ELK RIVER ALLIANCE

COMMUNITY-BASED WATER MONITORING

2022 CABIN REPORT

2022

PREPARED BY:

ELK RIVER ALLIANCE,
FERNIE, BC

WITH FINANCIAL SUPPORT FROM:

THE PROVINCE OF BRITISH COLUMBIA'S BC COMMUNITY GAMING GRANT & HEALTHY WATERSHED INITIATIVE

THE REAL ESTATE FOUNDATION OF BRITISH COLUMBIA

THE ERA COMMUNITY

Land Acknowledgment

ERA operates within the ʔamak̓ʔis Ktunaxa, the Traditional Territory of the Ktunaxa Nation.

For more than 10,000 years, the Ktunaxa people have occupied their traditional territory, the ʔamak̓ʔis Ktunaxa, which spans from southwestern Canada into parts of the United States. (Ktunaxa Nation Council 2022). The Elk River flows through part of this traditional territory, the Qukin ʔamak̓ʔis, or the land of the raven. Prior to European settlement, the Ktunaxa people moved throughout this land, following vegetation and hunting cycles. The introduction of European settlers in the late 1800s and the creation of Indian reservations marked the beginning of large land-use changes and a long history of resource development.

Executive Summary

The Elk River Alliance's (ERA) Community-based Monitoring program (CBWM) was established in 2012 as a response to rising community concern over the health of the Elk River Watershed. The primary purpose of the program is to fill in gaps in currently available watershed data and to make these data accessible to the wider community. In 2020, ERA's CBWM program transitioned into a fully CABIN (Canadian Aquatic Biomonitoring Network) based program, adopting these nationally recognized protocols to assess 10 sites across 5 tributaries of the Elk River, all affected by different types of land-use and development.

The Elk Valley has a long history of resource development following European arrival more than 100 years ago. Currently, the valley is home to 4 active steelmaking coal mines, with two additional mines and a mine extension either currently submitted or pending submission for regulatory review. Following a long period of moderate timber extraction over the past century, the valley is experiencing a rapid increase in the rate and volume of clearcut timber harvesting by a private logging operation. Growing urban centers and linear development such as road, rail, power, and natural gas also have their impacts on the Elk River and its tributaries. Since there are extensive government and industry water monitoring programs examining the effects of mining operations, the Elk River Alliance's CBWM program focuses on streams impacted by other land uses, which are not directly affected by current mining operations.

Analysis of 2022 sampling data indicated that sites on Alexander Creek (ALX001, ALX003) and Boivin Creek (BOI001, BOI002) are in similar condition to their associated reference sites, based on their benthic macroinvertebrate communities, meaning that these streams likely contain healthy aquatic habitats. Conversely, sites on lower Coal Creek (COL001), lower Morrissey Creek (MOR001), and both Lizard Creek locations (LIZ001, LIZ003) deviated significantly from "reference condition" indicating potentially degraded aquatic systems. 2022 sampling also indicated that the upper Coal Creek (COL003) and upper Morrissey Creek (MOR002) sites may be moving away from "reference condition" with COL003 assessed at "divergent" and MOR002 becoming "mildly divergent". Initial investigations have not identified a clear cause. Further in-depth research is needed to determine the accuracy of these results and potential stressors affecting these tributaries.

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Acknowledgements - 2022

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- Ashlee Jollymore, ERA Board of Directors (Program Advisor)
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The **Healthy Watersheds Initiative** is a $27-million program, supported by the Province of BC, to stimulate British Columbia's economic recovery through investments in community-driven watershed conservation and restoration projects. Through this program, the Real Estate Foundation of BC, in partnership with Watersheds BC, is administering grants for more than 60 watershed security projects in communities across the province.

https://refbc.com/healthy-watersheds-initiative

The **Real Estate Foundation of BC** is a philanthropic organization that works to advance sustainable land use and real estate practices in British Columbia. Since 1988, the REFBC has granted more than $90 million for research, education, and policy projects that strengthen BC communities and protect our land and water.

https://refbc.com

Watersheds BC was launched in 2020 to support water leaders to improve decision-making for their home waters by equipping them with the knowledge, skills, and connections they need to engage effectively in their watershed. WBC supports water leaders across many organizations including First Nation communities and governments, local government staff, watershed boards and roundtables, provincial government staff, and other community champions.

https://www.watershedsbc.ca

The **Province of BC** has invested $37 million (including $27 million through the Healthy Watersheds Initiative) for projects that support healthy watersheds, species, and ecosystems, and create new jobs in areas that are critical to help communities adapt to the effects of climate change. This funding is part of the Province's $10-billion COVID-19 response to help people in hard-hit industries.

https://strongerbc.gov.bc.ca

Introduction

The Elk River Alliance

Operating since 2010, the Elk River Alliance (ERA) is a community-based water charity that connects people to the Elk River using science, education and community collaboration to ensure sustainable stewardship of the Elk River watershed. ERA aims to improve and preserve watershed health through projects that raise watershed literacy, inform sustainable water decision-making, collect scientific data to prioritize restoration opportunities, and promote safe and sustainable river recreation. ERA is a registered charity that is governed by a volunteer board consisting of board members from various backgrounds.

ERA has four guiding principles: (1) Stimulate conversation, share information, and facilitate community input to encourage sustainable water decision-making in the Elk Valley; (2) Promote a new era in watershed thinking by coordinating a community voice to contribute to watershed planning and management activities, regulatory processes, and other regional water initiatives; (3) Bring together diverse points of view and offer a safe place to dialogue about the Elk River, and; (4) Unite, not divide.

Advisor Credentials

Stella Swanson, Ph.D. Limnology (ERA Director)

Stella is an aquatic biologist whose 42 year-career has included management of the Aquatic Biology Group at the Saskatchewan Research Council and consulting with SENTAR Consultants and Golder Associates, Ltd. She has owned and operated Swanson Environmental Strategies since 2007, where she focuses on environmental risk management, Indigenous and community engagement, and sustainability. Stella has contributed to dozens of environmental impact assessments, ecological risk assessments and human health risk assessments. She provides strategic advice regarding the regulatory requirements for resource development projects and facilitates multidisciplinary teams working on a wide range of environmental issues. She led the development of a new generation of monitoring design approaches for Terrestrial Biological Monitoring, focused on monitoring for cumulative effects within the Oil Sands Monitoring Program and in 2020 was appointed to the Nuclear Waste Management Advisory Council to provide advice on siting a high-level nuclear waste facility in Canada. More locally, she led the original development of the Elk Valley Cumulative Effects Management Framework and was the chair of the Strategic Advisory Panel for Selenium Management.

Ashlee Jollymore, Ph.D. Resource Management Studies (ERA Director)

Ashlee is a senior hydrologist for MacDonald Hydrology Consultants Ltd., was previously a hydrologist for the provincial government in the River Forecast Centre, and has experience in forestry, land management and sustainable development.

Staff and Volunteer Credentials

Chad Hughes, Executive Director, B.Sc. Environmental Science

Kaileigh McCallum, Ecologist, M.Sc. Biodiversity & Conservation

Anne-Caroline Kroeger, Program Manager, M.Sc. Bioresource Engineering

Chris Bush, ERA Volunteer

Alana Block, ERA Volunteer

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Meagan Malone, ERA Volunteer

Staff and Volunteers were trained and received CABIN Field technician (Chris Bush, Alana Block, Chandra Buchanan, Meagan Malone, and Anne-Caroline Kroeger) and Project Manager level certification (Chad Hughes and Kaileigh McCallum), through the Canadian Rivers Institute and Living Lakes Canada (LLC). LLC also provided training on the new STREAM e-DNA program.

Community-based Water Monitoring (CBWM)

The Elk River Alliance's Community Based Water Monitoring (CBWM) program collects baseline data on aquatic habitat health and increases community water literacy in the Elk River Watershed, located in the East Kootenay Region of the Province. The program was created to fill gaps in watershed data, with findings creating an opportunity for community and industry discussion on watershed health and providing contextual information to decision makers. Trained staff and volunteers conduct monitoring and research on targeted Elk River tributaries and sharing relevant findings with the community.

The Elk Valley's long-standing relationship with coal mining has resulted in the formation of extensive government and industry water monitoring programs covering a large extent of mine-affected areas. However, aquatic health of non-mine-affected tributaries is not monitored despite impacts from other forms of land use. The Elk River Alliance's Community Based Water Monitoring program began monitoring the effects of land use on non-mine-affected Elk River tributaries to allow for a more well-rounded assessment of the state of the watershed. This program has expanded to now include five Elk River tributaries.

Study Area

ERA's CBWM program is located in the Elk River watershed, within the East Kootenay region of British Columbia (Figure 1). This watershed begins at the Elk Lakes near the Continental Divide and extends to Lake Koocanusa, which continues across the Canada-US border. The communities of Elkford, Sparwood, Hosmer, Fernie and Elko are located along the river as well as rural properties in the Regional District of East Kootenay.

In 2022, the CBWM program assessed ten sites across five major tributaries – Lizard Creek, Alexander Creek, Coal Creek, Boivin Creek and Morrissey Creek (Figure 1). These sites were chosen as they are areas of community interest and/or contain good aquatic habitat that ERA identified as important to monitor, preserve, or restore.

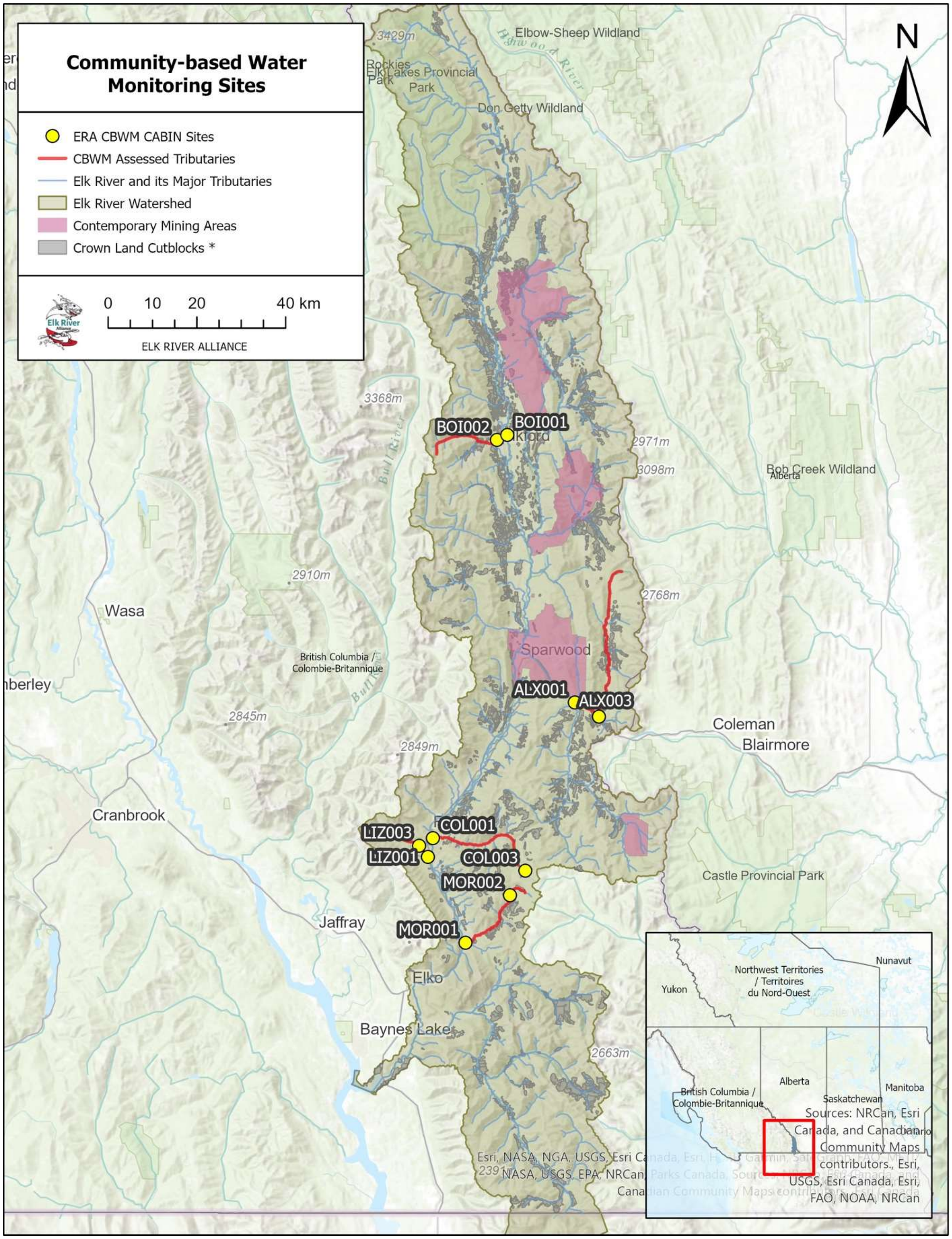


Figure 1. Elk River watershed (British Columbia) and CBWM site locations. ERA sites are chosen based on community input and focus largely on non-mine-affected tributaries. 2022 study locations include Boivin Creek, Alexander Creek, Lizard Creek, Coal Creek and Morrissey Creek.

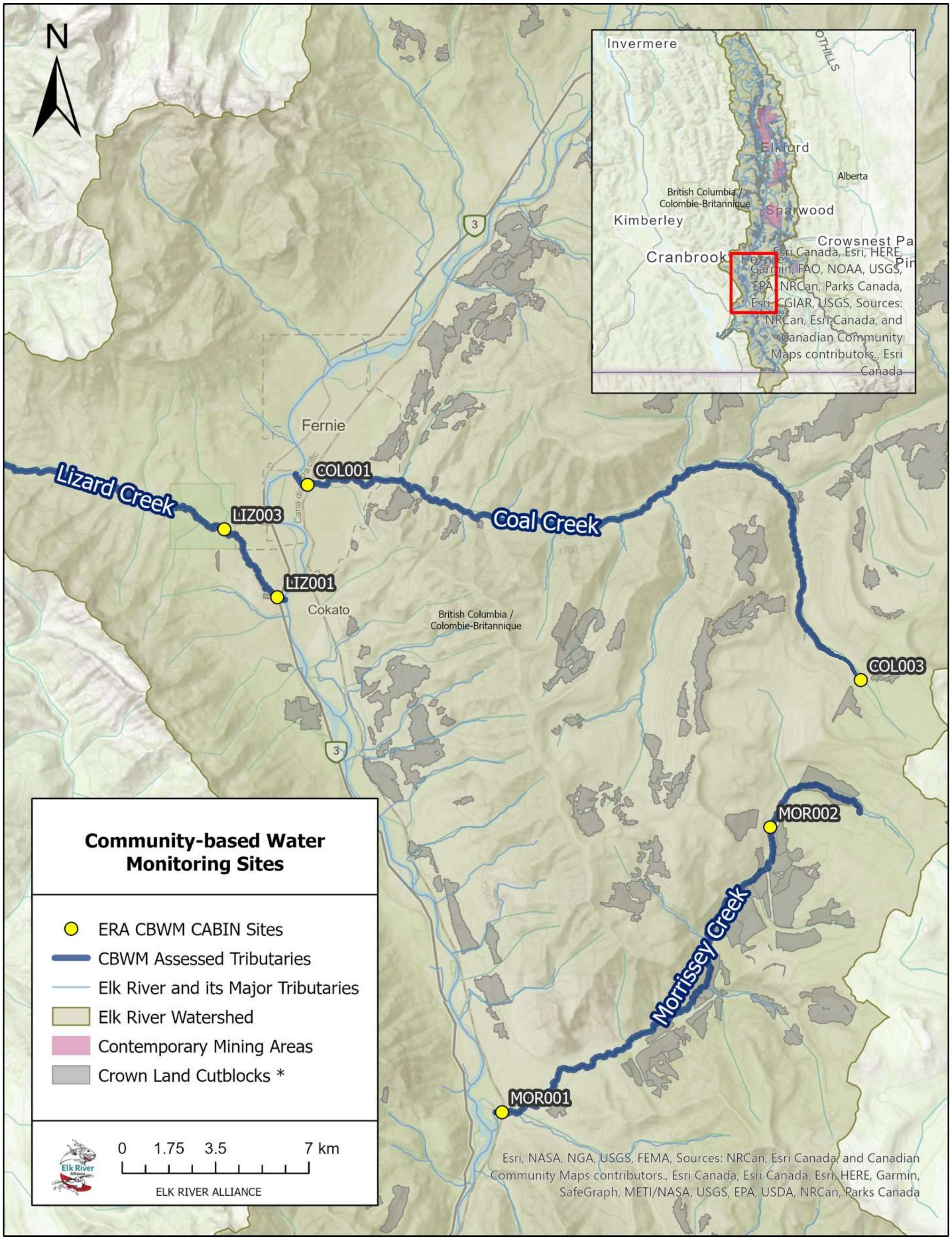


Figure 2. Close-up of Lizard Creek (LIZ001, LIZ003), Coal Creek (COL001, COL003) and Morrissey Creek (MOR001, MOR002), the southern-most study sites in the CBWM program.

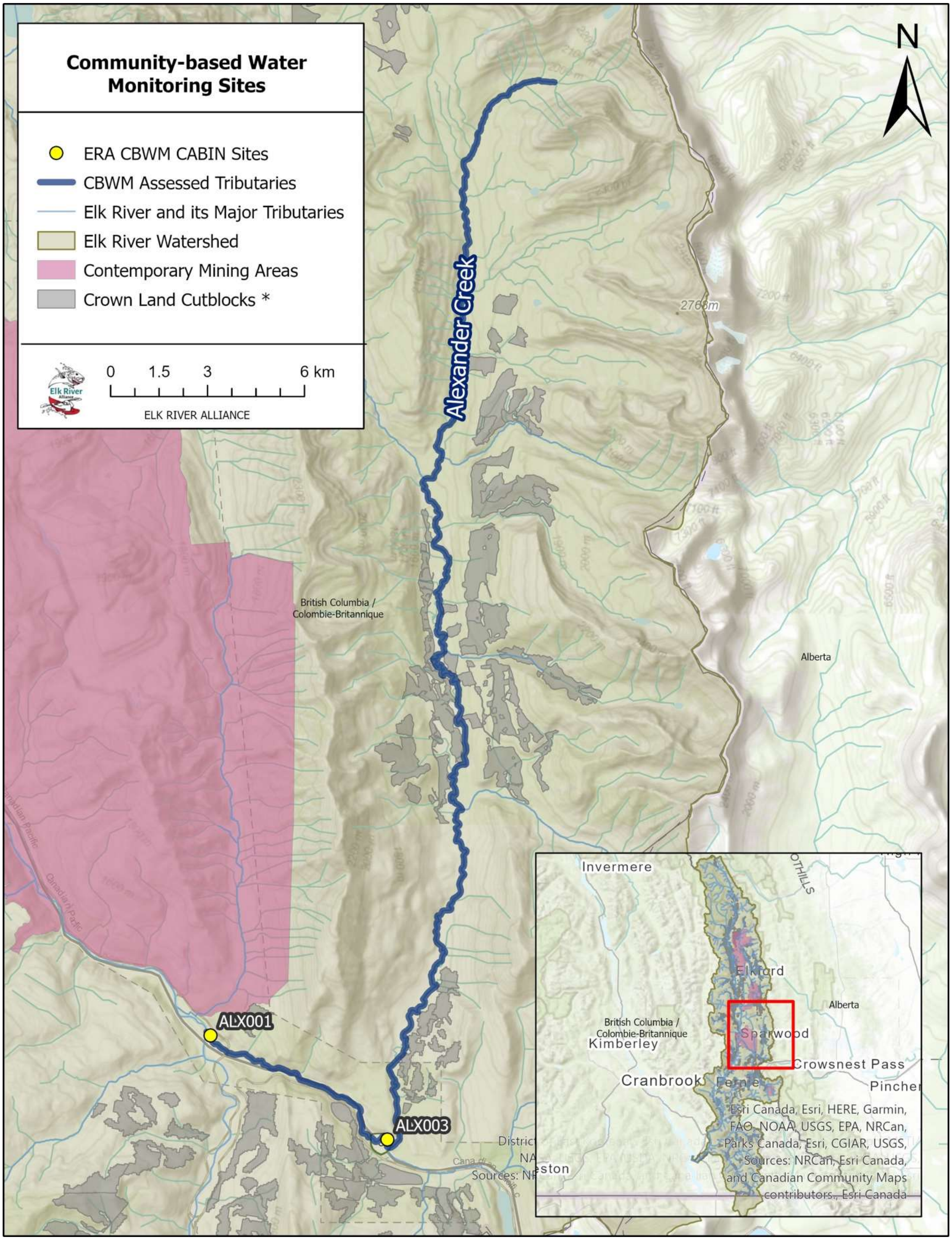


Figure 3. Alexander Creek site locations (ALX001, ALX003), just East of Sparwood, BC.

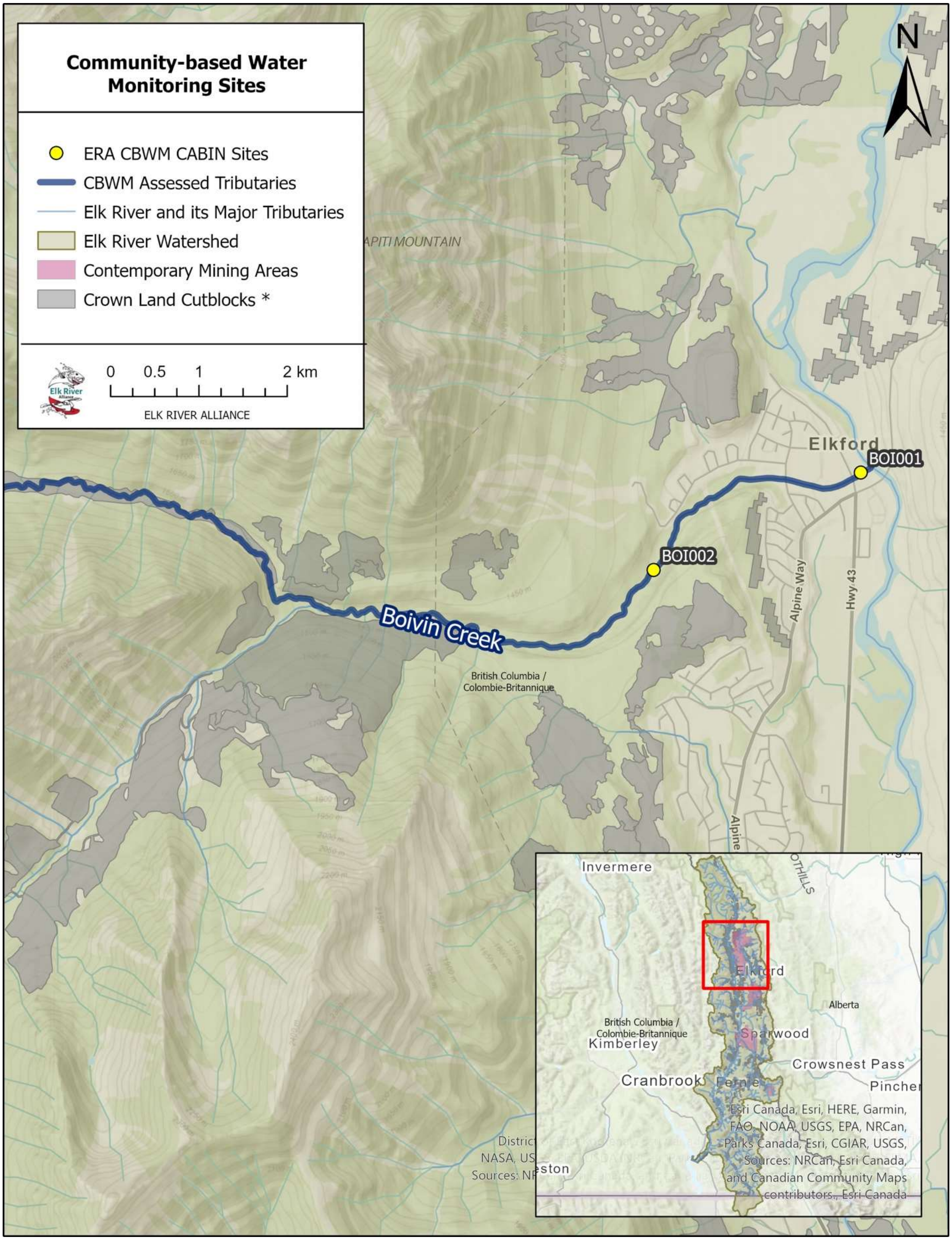


Figure 4. CBWM sites (BOI001, BOI002) on Boivin Creek in Elkford.

Lizard Creek

Lizard Creek, located approximately 5km south of Fernie, was the first Elk River tributary for ERA's CBWM program. It was initially assessed as a 'reference site' in 2011 since at the time, the creek and its catchment had relatively little residential development and no active industrial activity (although logging had occurred historically). A large amount of the lower portion of this creek falls within Mount Fernie Provincial Park and is protected. Upstream of the Provincial Park is Island Lake, a hotel and cat skiing area with access roads. Residential development near the creek began in 2018. Lizard Creek has continued to be monitored as it contains important spawning grounds for Westslope Cutthroat Trout (Elk River Alliance 2020).

Since 2018, the Lizard Creek catchment downstream of the provincial park has seen increasing urban, road and trail development. ERA will continue to pay special attention to these sites as the surrounding land-use changes.

LIZ001

Figure 5. Images of LIZ001: upstream across the stream and downstream. Note the clay visible on the side of the bank. The major flooding event in November 2021 left sections of Lizard Creek scoured down to the clay bed.

LIZ003

Figure 6. Images of LIZ003: upstream, across the stream and downstream.

Alexander Creek

In 2012, sites were established along Alexander Creek. This creek was identified as important due to its role as a significant tributary into Michel Creek, as well as the absence of effects from mining and urban development. The placement of sites along Alexander Creek allowed ERA to expand monitoring efforts into the Sparwood area. Sites along the creek were established to monitor effects related to stream proximity to the Crowsnest Highway, local logging and cattle grazing leases in the area.

The proposed Crown Mountain coal mine in the upper reaches of Alexander Creek poses an additional source of stressors, and continued monitoring here will provide baseline data for pre-mining conditions (NWP Coal Canada Ltd. 2014).

ALX001

Figure 7. Images of ALX001: upstream, across the stream and downstream.

ALX003

Figure 8. Images of ALX003: upstream, across the stream and downstream.

Boivin Creek

In 2018, Boivin Creek was selected to include Elkford in CBWM activities, and to contribute to a greater understanding of tributaries further upstream in the watershed. Boivin Creek was chosen for its undeveloped upstream catchment and to understand the effects of urban development and extensive riprap in its lower reaches.

BOI001

Figure 9. BOI001: upstream, across the stream and downstream.

BOI002

Figure 10. BOI002: upstream, across the stream and downstream.

Coal Creek

Coal Creek was added to the CBWM program in 2019. According to community discussions, this creek purportedly contained good quality habitat for Westslope Cutthroat Trout; however, few spawning sites were identified by ERA in a 2019 redd survey (Elk River Alliance 2020). Historical mining, logging, forestry, access roads, recreational trails/activities, and the old Fernie landfill are all likely stressors on this catchment. In recent years, increased clearcut logging activity and associated road development along Coal Creek continues to alter the waterways in this catchment area.

COL001

Figure 11. COL001: upstream, across the stream and downstream.

COL003

Figure 12. COL003: upstream, across the stream and downstream.

Morrissey Creek

The Morrissey Creek sites are the newest additions to ERA's CBWM monitoring locations, added in 2020 due to the presence of good quality trout spawning habitat coupled with logging, resource road use and cattle grazing activities in the catchment. Monitoring this creek is essential in understanding and potentially mitigating the effects of logging, linear development (forestry roads, gas lines), recreational use (vehicle and ATV access), agriculture, and natural erosion that may degrade Morrissey Creek.

These Morrissey Creek locations may also allow ERA to monitor the effects of short-term developments. In 2022, TC Energy began pipeline work in the Morrissey area - this included the expansion and increased use of roadways that run alongside Morrissey Creek. It is estimated that pipeline development in this area will be completed by 2024.

MOR001



Figure 13. MOR001: upstream, across the stream and downstream.

MOR002



Figure 14. MOR002: upstream, across the stream and downstream.

Background Information

CABIN

2020 marked the completion of ERA's CBWM program transition from Streamkeepers-based protocols to CABIN (Canadian Aquatic Biomonitoring Network) protocols for the assessment of aquatic health. CABIN is a nationally recognized program that uses a "reference system approach" to assess aquatic ecosystem condition and was designed with community-based water monitoring in mind. ERA staff and volunteers have been trained by certified CABIN trainers.

The reference system approach to assessment means study sites or "test sites" are compared to sites in pristine condition, without the presence of human impact, called "reference sites". CABIN uses a combination of physical, chemical and biological parameters, to statistically categorize a test site and analyze it based on benthic macroinvertebrate (aquatic insects, worms, etc. – see "Benthic Invertebrates" section below for more details) assemblages, in comparison to reference sites with similar hydrologic (amounts and quality of water), geomorphic (stream bed, channel features and bank forms) and geographic (topography, geology, climate, vegetation, and human setting) characteristics. The assumption is that a test site in good condition will have similarly assessed values to the associated reference sites, and the more polluted or poor quality the site is, the farther it will diverge from reference site conditions.

The use of CABIN protocols has greatly improved ERA's ability to produce data comparable to monitoring data collected by other organizations, government, and industry, increasing the validity of ERA's work, and facilitating better data sharing.

In 2020, a new statistical CABIN model for the Columbia Basin was released. Beginning in 2021, ERA's CBWM program upgraded from using the older Okanagan-Columbia 2010 model to the Columbia Basin 2020 model, which is tailored to a smaller, more specific region in BC, and includes the use of different criteria for site organization and assessment.

Habitat Variables

Geology, topography, stream morphology, climate and vegetation cover all play a critical role in stream health. The CABIN approach uses these characteristics to categorize and then assess test sites for similarities with reference sites. The physical characteristics of a test site are used to assign the site to a reference group for comparison.

These characteristics are important because the natural "pristine" state of a site is dependant upon these traits. If the CABIN test site was not compared to a suitable group of reference sites with similar physical variables, results would not accurately assess the health of an area. For example, a creek with limestone as the primary underlying rock will naturally have a higher pH than a stream dominated by sandstone, resulting in assemblages of benthic macroinvertebrates reflective of these respective natural conditions. If a limestone-based creek was compared to a sandstone-based "reference site", the different benthic macroinvertebrate community may be misinterpreted as a sign of an unhealthy aquatic system due to a pollutant causing a higher pH, rather than a natural occurrence.

Physical Properties of Water

The physical properties of water – colour, temperature, turbidity, taste and odour - are useful indicators of what is occurring within a stream. The CBWM program assesses both temperature and turbidity to better understand the condition of studied sites.

The *temperature* of a stream needs to remain within certain limits for healthy aquatic life, and many species take their life stage cues from temperature changes in the water. For example, Westslope Cutthroat Trout (WCT) begin migration to spawning grounds when the temperature is between 7-10 degrees Celsius (Bear, McMahon, and Zale 2007). Figure 15 includes a visual representation of temperature limits for the survival of adult WCT. In green is the optimal temperature range for this species, with the orange-red showing the sub-optimal, or increased stress range. The bright red colour signifies the range at which the temperature increase becomes lethal for WCT. Outside of these temperatures, WCT do not survive.

Temperature is closely correlated with dissolved oxygen levels. Colder water contains higher oxygen levels, which are critical for most of the stream life in the Rockies. Elevated water temperatures during WCT life stages such as embryo development (when oxygen requirements are particularly high) may result in embryo death or high mortality of alevins (a very young life stage, just after emergence from the egg). For example, if an early spring heat wave occurs and water temperature rises above 12°C, oxygen levels will fall below the guideline for protection of embryos and alevins (British Columbia Ministry of Environment and Climate Change Strategy 2021).

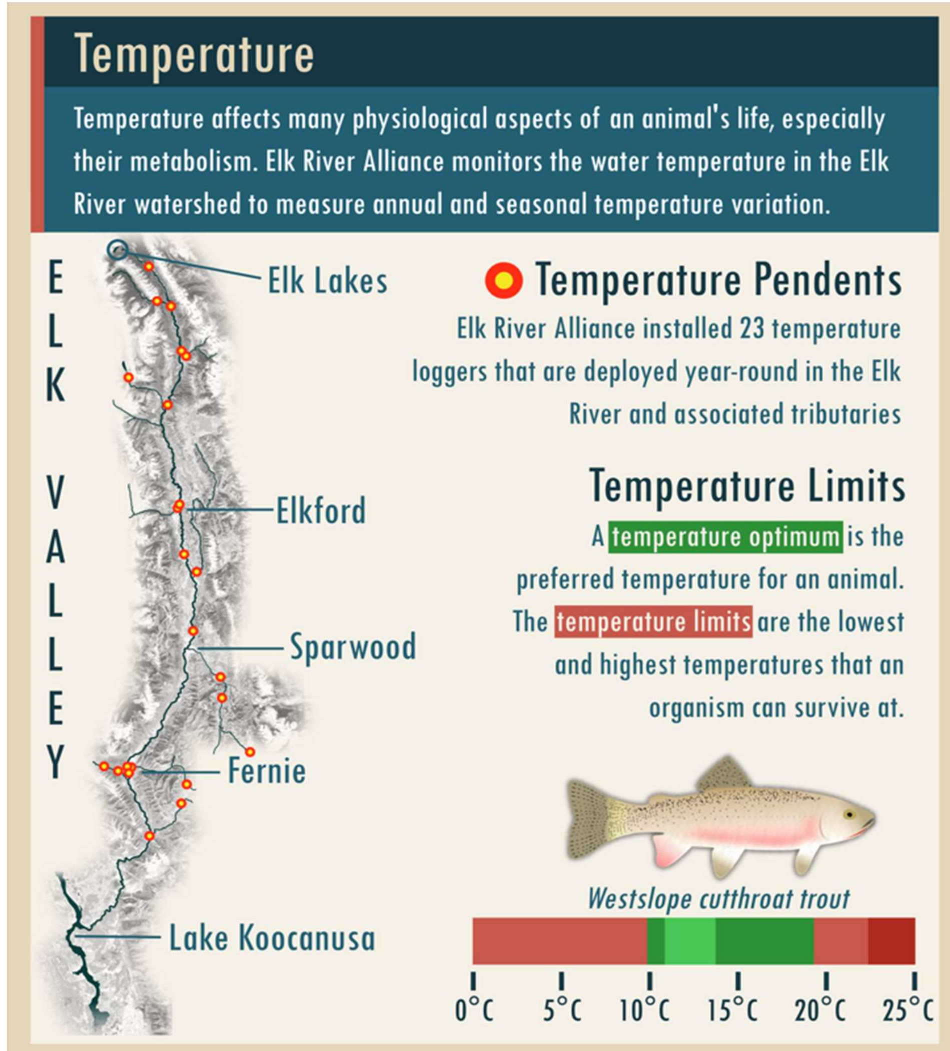


Figure 15. ERA Infographic outlining the importance of temperature to aquatic systems.

Turbidity is a measure of the ability of light to pass through water and is usually a reflection of the amount of sediment (B.C. Ministry of Environment and Climate Change Strategy 2021b). Excess sediment can negatively affect aquatic life - reduces the amount of sunlight reaching aquatic plants and organisms, settles on the bottom of the stream reducing habitat for benthic invertebrates and smothering fish eggs (Figure 16)

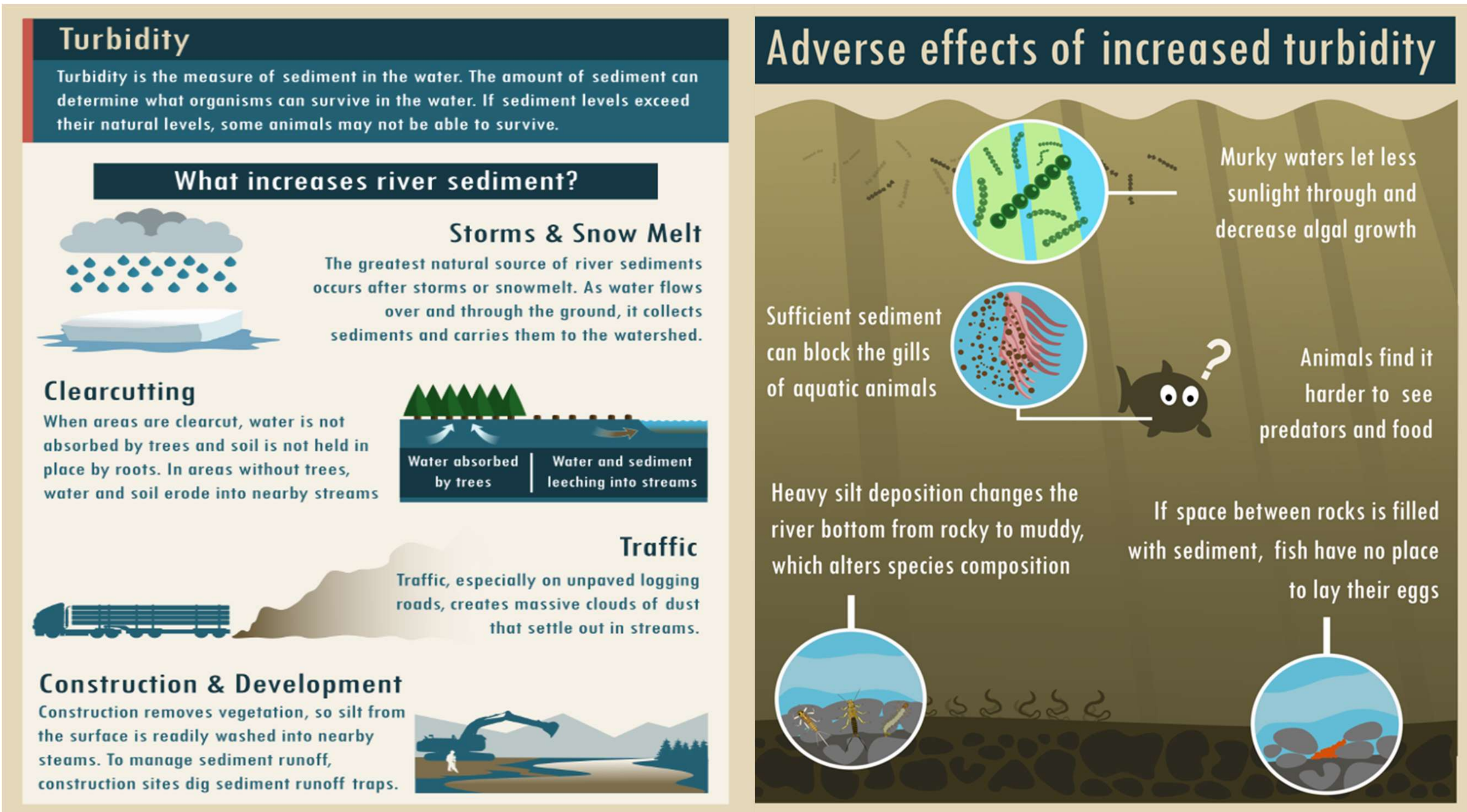


Figure 16. ERA CBWM infographic explaining turbidity and its importance.

Water Chemistry

Water chemistry parameters are important indicators of water quality. These parameters provide insight into the processes happening within a stream and the health of aquatic systems. Changes in water chemistry variables can signify landscape level changes or the introduction of new pollutants.

Dissolved oxygen, pH and conductivity are fundamental parameters measured as part of CABIN protocols. Aquatic life can only survive in water that falls within a specific range of water quality parameters. Unusually high or low measurements for any of these variables may suggest a problem in the stream.

Aquatic animals require enough dissolved oxygen for them to breathe easily. Oxygen levels depend on whether water is flowing or still, whether there are rocks or other obstacles for water to flow over, how many plants are growing in the water, and water temperature. Common causes of low dissolved oxygen are increases in temperature, decaying organic matter and weather (i.e. cloudy days reduce oxygen production from aquatic plants and algae). Excess nutrients added to the water via sewage or stormwater discharges, agricultural runoff or mine water discharges can cause excessive algae growth which then decompose, using up oxygen. The amount of dissolved oxygen in water affects the types

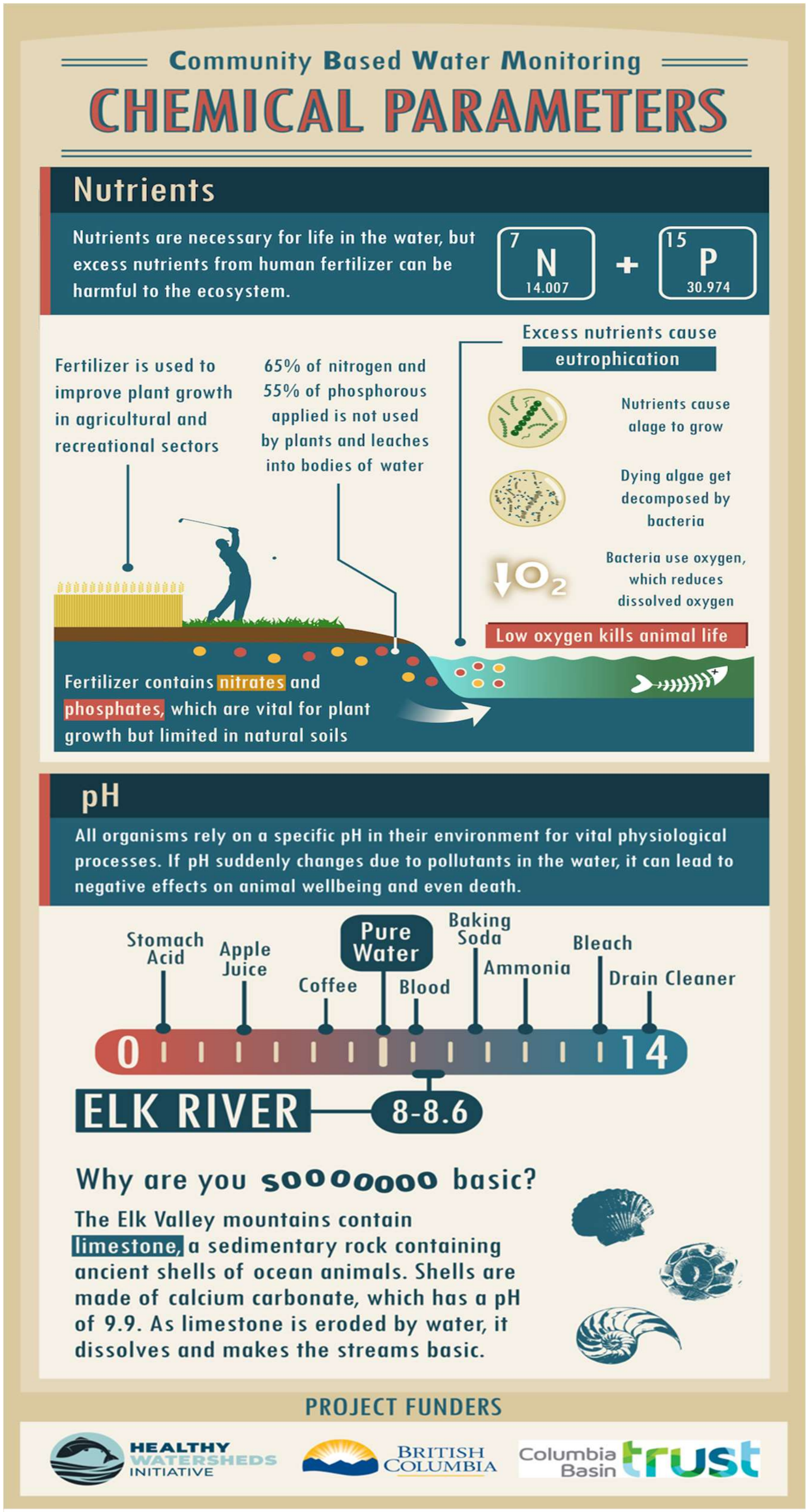


Figure 17. ERA infographic on chemical parameters associated with the CBWM program.

and health of aquatic life present. The lower the oxygen content, the less life that can persist in the water.

The pH range for freshwater aquatic life set by BC water quality guidelines is 6.5-9.0. Pure distilled water has a neutral pH of 7. The local geology of an area can result in water that is alkaline or acidic. In the Elk River watershed, streams are more alkaline due to a limestone-based geology, and aquatic organisms have adapted to these conditions. When pH levels deviate from natural ambient conditions, there may be direct or indirect effects on the health of aquatic organisms and partial or complete changes in species composition. The pH of water affects the solubility (amount that can be dissolved in water) and bioavailability (amount that can be used by aquatic life) of chemicals in water such as metals or nutrients (Government of British Columbia 2023). Low pH increases the solubility of metals, meaning that a decrease in the pH of a stream causes an increase in the amount of dissolved metals in that water. These high amounts of dissolved metal can attach to the surface of fish gills, damaging the gills and reducing oxygen uptake. Increases in pH can also increase the concentration of the more toxic forms of chemicals, like ammonia, in the water, killing fish quickly (B.C. Ministry of Environment and Climate Change Strategy 2021a). Significant changes in pH can be caused by historic mine wastes, landfill leachate, runoff from cattle feedlots, recent draining of wetlands, asphalt production or disposal, and limestone gravel roads (US EPA 2003).

Conductivity is another measure that can indicate changes in aquatic health. It is a measure of the ability of water to pass an electrical current. Conductivity increases when there are more dissolved mineral salts such as sodium, potassium, magnesium, chloride and sulphate (Chapman 1996). Significant changes in conductivity can be indicative of increased or decreased mineral salts dissolved in the water. In the Elk Valley, high conductivity in stream water is often associated with groundwater influence (because groundwater naturally has higher concentrations of salts); however, an increase in conductivity may point to increased human disturbance. Mining commonly causes increased sulphate concentrations in surface waters. Sodium, calcium, or potassium chloride runoff due to road salting is another common source of increased conductivity.

In addition to measurement of dissolved oxygen, pH and conductivity, the CBWM program includes water samples collected for laboratory analysis of nutrients, total and dissolved metals, and major ions (salts).

Changes in physical and chemical parameters which fall outside of the range of natural variability can cause a cascade of effects on the diversity and productivity of aquatic life. If such changes are observed, further monitoring should be initiated to explore different local stressors as potential causes. From here, additional required mitigation and management measures can be identified. For example, if elevated water temperatures in areas known to be important for WCT spawning are shown to be connected to less vegetation along the streambanks providing shade, mitigation may include planting of fast-growing riparian species such as willow.

If CABIN analyses show a test site in poor condition, water chemistry results can provide vital insight into what is occurring in the system. Often, consistent, long-term monitoring is needed to detect unusual changes to a specific water chemistry parameter and identify the underlying reasons for the change.

Benthic Invertebrates

A "biological indicator" is an organism that can be used to monitor the health of an ecosystem. CABIN uses benthic macroinvertebrates (small aquatic insects and other species such as aquatic worms) as biological indicators of stream health. While water chemistry variables can provide a "snapshot" of what is happening at a distinct moment in time within an aquatic system, benthic organisms experience the cumulative effects of all the physical and chemical stressors interacting within this system over time. Benthic organisms tend to remain in one general location and can be an indicator of the effects of activities associated with land uses in that area. Changes in the health of an aquatic systems are reflected in the structure of the communities of these organisms within it.

In general, aquatic communities consist of groups (taxa) that are tolerant to pollution and those that are sensitive to it. By comparing the amount of tolerant versus intolerant groups in a community, assumptions can be made about the overall health of a system. For example, mayflies (*Ephemeroptera*), stoneflies (*Plectoptera*) and caddisflies (*Trichoptera*) are all, generally, considered to be sensitive to pollution, while groups like midges (*Chironomidae*), leeches (*Hirudin*ea) and worms (*Naididae*) are more tolerant to pollutants. A high number of midges, leeches and worms and little of anything else is a likely indication of a stream in poor condition (Figure 18).

CABIN assessments use the composition of the benthic macroinvertebrate community (at the taxonomic level of family) within the stream, and their sensitivities, to make assumptions about the health of the system.

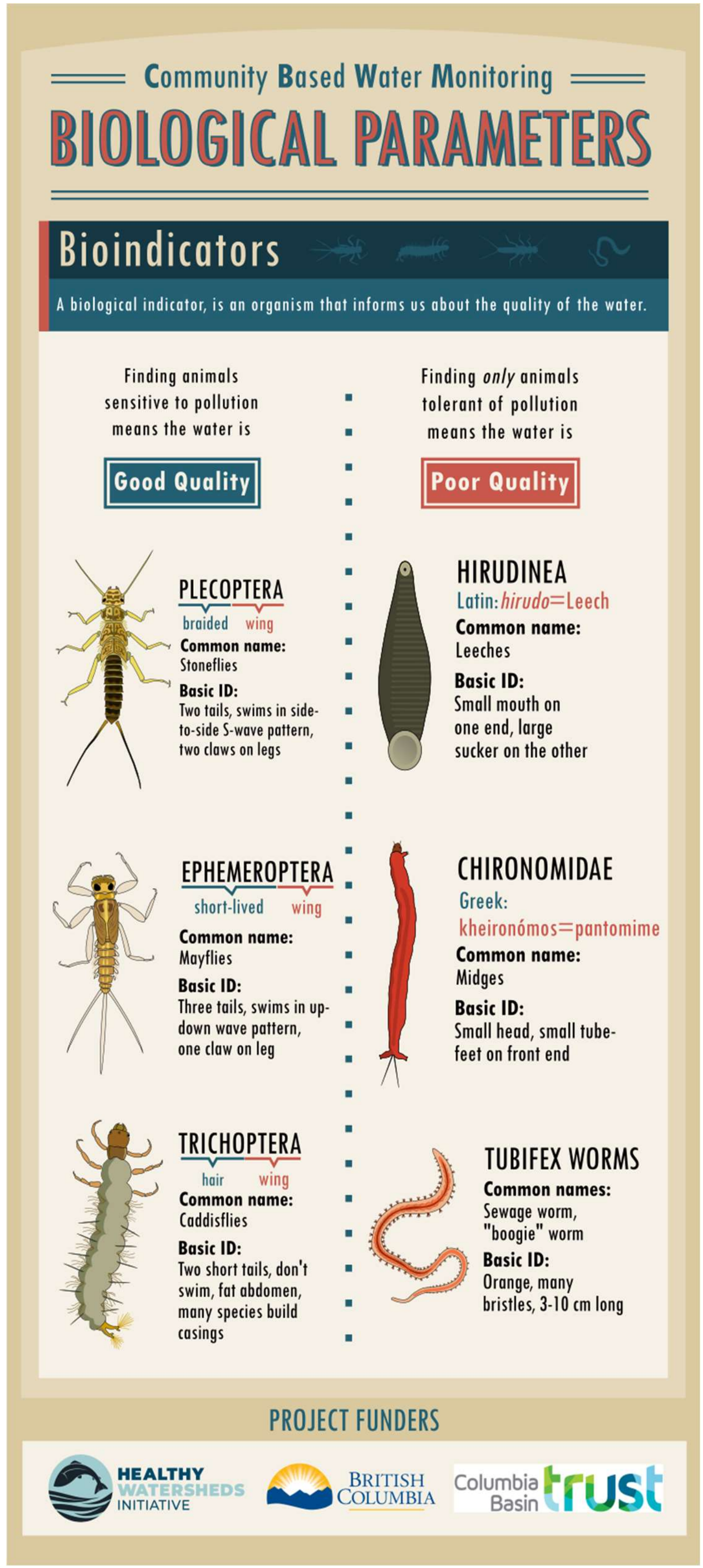


Figure 18. ERA infographic outlining the biological parameters associated with the CBWM program.

STREAM e-DNA

In 2020, the CBWM program was further expanded to include participating in STREAM e-DNA sampling; a trial for a future phase of CABIN monitoring, where additional benthic invertebrate samples are collected and analyzed to a finer taxonomic resolution using DNA analysis (Wright, Robinson, and Hajibabaei 2020). This means benthic organisms can be identified to the species level. STREAM e-DNA is not currently part of the CABIN analysis process, and the aim of these trials is to potentially incorporate this feature in future monitoring efforts.

Although DNA analysis only produces data on presence versus absence of benthic species, it allows for the examination of benthic communities at a finer taxonomic resolution and may prove helpful for the early identification of pathogenic species. For example, the *Tubifex tubifex* species of worm can host whirling disease (*Myxobolus cerebralis*), and the presence of *T. tubifex* may indicate a reach is vulnerable to whirling disease infection.

Methods

Site Selection

The Elk River Alliance's CBWM sites are chosen based on community input and/or the presence of important habitat that warrants monitoring. Areas of interest are identified using a combination of GIS (Geographic Information System) and in-person assessments. Representative sites along a creek are chosen to capture the effects of different types of land-use or disturbance. Typically, sites are placed upstream and downstream of suspected impacts or stressor source point. Sites may also be placed just above the confluence of tributaries to gain an overall idea of water quality and stream habitat health within a catchment.

Aquatic Habitat Assessment

Test sites were assessed using the techniques outlined in the Canadian Aquatic Biomonitoring Network (CABIN) Field Manual for Wadeable Streams (Carter 2012).

At each site, a detailed site description, including GPS location, surrounding land-use, site drawing, photographs, and reach[1] characteristics are recorded. This includes information on habitat types, canopy coverage, streamside vegetation and the amount of macrophyte (aquatic plants) and periphyton (organisms growing on submerged surfaces – i.e. algae, cyanobacteria, etc.) coverage.

Water chemistry measurements and water samples are taken at the lower end of the reach to avoid disturbing benthic macroinvertebrate communities. This includes the collection of on-site water quality parameters (temperature, dissolved oxygen, pH, conductivity, ORP, turbidity), and any samples that need to be taken for laboratory analysis of metals, nutrients, and major ions.

Next, the benthic macroinvertebrates are collected using the "kick-net" method, which includes 3 minutes of travelling backwards upstream, with a large net placed on the bottom of the stream, and aggressively kicking rocks to send any insects hanging on into the kick-net. Organisms and material collected in the net during these 3 minutes are moved into a sample jar and preserved with the appropriate chemicals.

When STREAM protocols are included, 3 additional "kick-net" samples are collected, prior to the standard CABIN "kick-net" sampling, using the same protocol but with full decontaminations of the equipment and sampler before each round (Wright, Robinson, and Hajibabaei 2020). Since STREAM focuses on taxonomic identification through DNA, proper decontamination is necessary to avoid tainting the samples. Benthic invertebrate sampling is always performed beginning downstream and moving upstream. STREAM samples are collected in sampling jars and preserved according to STREAM protocols. Only the lower site on each creek (near the mouth) were included in the STREAM program (i.e., COL001, MOR001 etc.).

CABIN requires the sampler to collect information on substrate characteristics. This includes following the kick-net path while counting and measuring 100 pebbles from the bottom of the stream and assessing every 10th pebble for embeddedness. The surrounding substrate, or streambed, material is also assessed based on size and consistency.

Finally, the study site channel characteristics are measured. The width of the stream during high flow (estimated based on bank structure and changes in vegetation) and current flow are measured, as well as

[1] Reach is the length of the stream included in the test site – usually 6 times the stream width.

the slope, depth, velocity, and overall discharge of the stream.

For more details on CABIN and STREAM protocols, please see the *Canadian Aquatic Biomonitoring Network (CABIN) Field Manual for Wadeable Streams*, and *STREAM: Procedure for collecting benthic macroinvertebrate DNA samples in wadeable streams* (Carter 2012; Wright, Robinson, and Hajibabaei 2020)

Laboratory Analysis

Basic water quality parameters – temperature, pH, conductivity, dissolved oxygen, and turbidity – were tested on site by trained ERA staff and volunteers. Samples acquired during site assessments were preserved appropriately and shipped to independent laboratories for further analysis.

Water Chemistry

CARO Analytical Services in Kelowna, BC was responsible for water chemistry analyses. Typically, ERA CABIN sites are assessed for total and dissolved metals, nutrients, cations and anions (e.g. chloride, sulphate, carbonate) (Appendix C: CARO Reports).

Benthic Invertebrate Taxonomy

ERA contracted Surrey-based, CABIN-approved, aquatic invertebrate taxonomist, Pina Viola (B.Sc. Biology, SFS, SAFIT) to assess benthic macroinvertebrate samples for the CBWM program. She sorted, identified, and performed data entry for benthic invertebrate samples, following CABIN laboratory protocols (Environment and Climate Change Canada 2020).

Data Analysis

As per CABIN Wadable Streams Protocols, all data collected was entered into the Environment and Climate Change Canada (ECCC) national CABIN database, under "CBWQ – Elk study".

In 2021, ERA shifted from using the older Okanagan-Columbia 2010 preliminary model to the new Columbia Basin 2020 model, to perform CABIN assessments. The new model includes 156 reference sites across the Columbia Basin, with 11 of these falling within the Elk River Watershed, an additional 4 in the neighbouring Flathead area, and 1 within the Bull River basin (Stephanie Strachan 2020).

To prepare site data for CABIN analysis, characteristics based on GIS data were assembled. Catchments for each site were delineated using GIS software and analysed for model requirements: drainage area (km2); % grassland; % low shrubland; % water; mean precipitation for October; minimum temperature for December; % sedimentary rock; and maximum slope.

From here the CABIN database sorts sites into smaller groups based on similarities in characteristics to designated groups of reference sites, then performs a BEAST (Benthic Assessment of Sediment) analysis to assess the health of a site, in comparison to similar reference sites, based on the benthic community structure, the functional responses of these invertebrates, and selected habitat variables. These analyses produce "community ellipses" for each site, which is an ordination plot that visually represents how similar reference sites are to each other and where a test site fits into the comparison among sites. The center ellipse represents reference condition. The further out from the center ellipse a test site appears, the more it has diverged from the reference condition and the more likely it is to be in poor condition.

Where sites appeared to be diverging from reference condition, data were further explored to investigate patterns associated with these sites. Water chemistry parameters were assessed for any notable results. RIVPACS, Bray-Curtis dissimilarities, and metrics related to the presence and abundance of specific invertebrates (i.e. EPT, *Diptera* and non-insects) were used to explore potential issues with benthic community structure.

RIVPACS (River Invertebrate Prediction and Classification System) is an aquatic biomonitoring system used to assess water quality. It measures taxa richness (presence/absence but not abundance), based on expected taxa according to reference sites versus what is observed at a test site. A value of 1, indicates the test site is similar to the reference sites, while values above 1 indicate increasing differences from the reference sites (and more taxa), and values below 1 indicate increasing differences but less taxa, and likely poorer conditions.

Bray-Curtis dissimilarity is a statistical assessment to measure the dissimilarity between sites based on numbers within groups at each site. In CABIN, the Bray-Curtis dissimilarity is used to measure both richness and abundance of test sites compared to the mean values of the reference sites. A value of 0 means that the sites are in good condition, similar to the mean values of the reference sites, while a value of 1 indicates complete dissimilarity.

Results & Discussion

In 2022, 10 sites were assessed across 5 tributaries – Lizard Creek, Alexander Creek, Boivin Creek, Coal Creek and Morrissey Creek. CABIN analyses tools yielded similar results to the previous year (see ERA's 2021 Report for details), with sites along Alexander Creek (ALX001, ALX003) and Boivin Creek (BOI001, BOI002) having similar benthic community structures to their associated reference sites, while lower Coal Creek (COL001), lower Morrissey Creek (MOR001), and both Lizard Creek sites (LIZ001, LIZ003) diverge significantly from the designated 'reference condition'. However, this year, both the upper Morrissey (MOR002) and upper Coal (COL003) sites appear to have continued to diverge farther from "reference condition", with MOR002 assessed as mildly divergent and COL003 moving to divergent.

ERA is concerned about these results and what they could mean for the health of these streams. However, the reason for these results is still uncertain. In 2020, CABIN introduced a new statistical model for aquatic habitat assessments in the Columbia Basin – Columbia 2020 model. The use of this model saw unexpected shifts in assessment results for ERA's test sites. This new model is generally considered more accurate and more sensitive to potential stressors – it is tailored more specifically to the region, focusing on the Columbia Basin rather than the previous model's focus on both the Columbia and Okanagan Basins, and features double the amount of reference sites than the previous model (Gaber 2012; Stephanie Strachan 2020). Due to these unexpected shifts in assessment results, ERA is recommending further investigations on "divergent" streams to examine potential unknown stressors on these systems and eliminate the possibility of inaccurate or exaggerated results related to the model's ability to represent ERA's test sites.

The composition of the benthic macroinvertebrate communities at many of these sites appears to align with these new assessment results, but water chemistry sampling results at all sites consistently remain below BC Water Quality Guideline limits for aquatic life and there are no obvious trends to lend support to any specific cause. ERA will continue the long-term monitoring of these sites into 2023, and is recommending further investigation, outside of CABIN assessments, to explore potential reasons for these results.

Lizard Creek

In 2022, Lizard Creek sites – LIZ001, LIZ003 – were assessed as "highly divergent" from reference condition based on the Columbia 2020 CABIN model (Figure 19). Year to year changes using the new model indicate a steady shift at LIZ001 from reference condition to highly divergent from 2014 to 2017, then remaining highly divergent from 2017-2022.

Although this appears to suggest a potential trend of site degradation over time, it is worth noting that this CABIN model sorted the LIZ001 site for comparison with a different set reference groups for 2012, 2014 and 2015, compared to the rest of the assessment years. Generally, sites are expected to be compared with the same reference group from year to year (based on the assumption that the fundamental geological, topographic, climate, stream morphological and vegetation cover characteristics remain the same). Capturing the full range of ecological variation of reference sites using an adequate number of sites sampled with sufficient frequency is critical for confident interpretation of CABIN data (Strachan and Reynolds 2014). The changing assignment of the reference group for the LIZ001 site may indicate a technician error or model issue rather than a truly changing site condition. Looking at the variables used to sort test sites into model reference site, only four changed between years – latitude, altitude, channel slope and % canopy cover. Of these predictor variables, only % canopy coverage had an obvious pattern between years sorted into the model's Reference Group 3 (2012, 2014 and 2015) which were all assessed as having 26-50% canopy coverage and Reference Group 2 (2013, 2016-2022), which were assessed as having 1-25% canopy coverage. Changing the canopy coverage in the data for the years sorted into Group 3 results in new assessments for these monitoring events, with 2012 changing to "Mildly Divergent", while 2014 and 2015 both become "Divergent". Essentially, by changing a single variable, and having all the LIZ001 site visits compared to the same set of reference sites, the pattern of increasing divergence that can be seen from 2014 to 2017 changes significantly. This may point to an issue with this CABIN model's ability to sort LIZ001 into a group with appropriate reference sites.

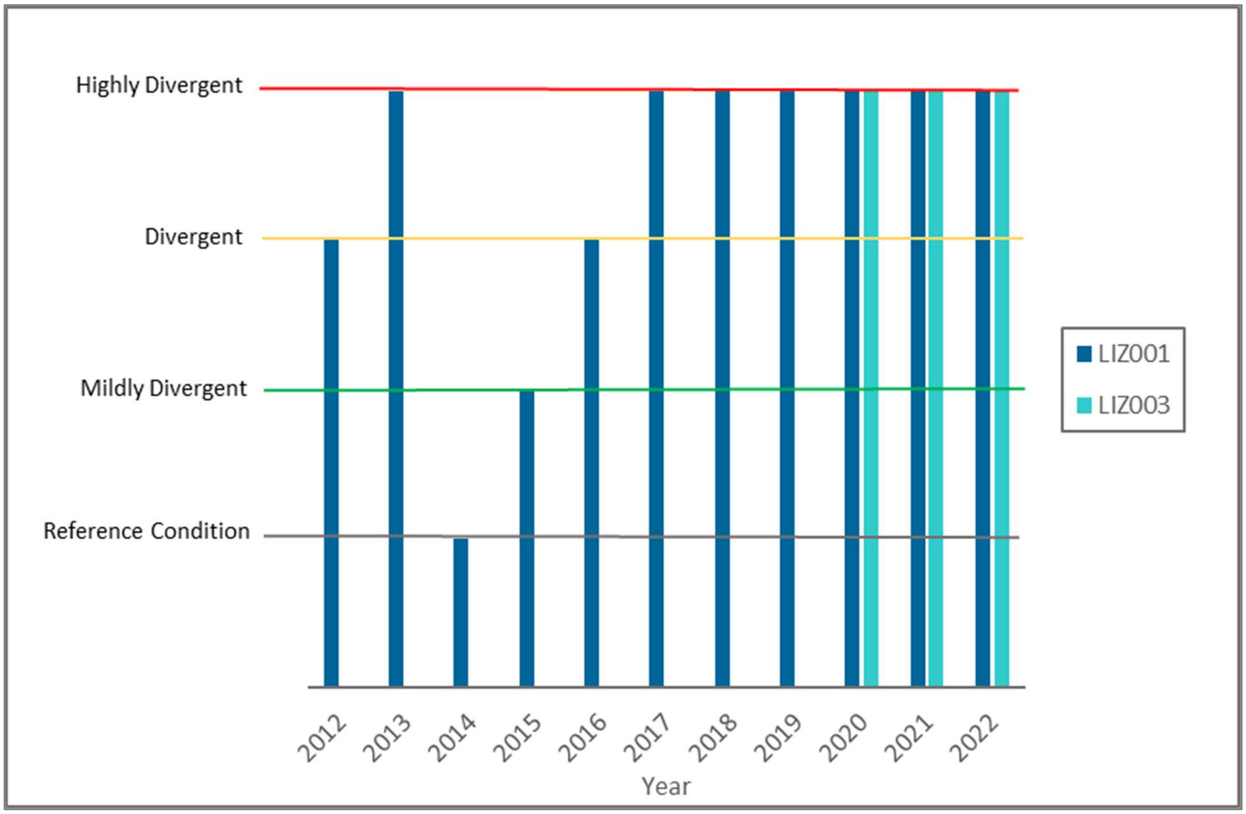


Figure 19.CABIN analysis results for Lizard Creek sites from 2012 – 2022 using the Columbia 2020 CABIN model.

Further examination into 2022 data, suggests that both Lizard Creek sites differ from reference sites according to the Bray-Curtis dissimilarity, which uses taxa richness and abundance for comparison (LIZ001: 0.97, LIZ003: 0.91); however, RIVPACS analysis, which take an exclusive presence/absence approach to assessment (LIZ001: 0.97, LIZ003: 0.97) suggests that these sites still have relatively good taxa richness. This difference may be in part due to the larger number of taxa present at Lizard Creek sites, compared to reference sites (Table 1).

Taking a closer look at the benthic macroinvertebrate community composition, the percentage of EPT individuals (*Ephemeroptera, Plecoptera, Trichoptera* - typically pollutant-sensitive taxa) for LIZ001 and LIZ003 (40.02% and 76.27%, respectively) is lower than what would be expected based on the reference site means (88.13% ±9.27; 91.94% ±7.30), but LIZ003's value is similar to the values seen at Alexander Creek and Boivin Creek, which are both in near "reference condition". Total abundance of benthic macroinvertebrates was significantly higher than expected according to mean reference site values which may contribute to the unexpected significant divergence from reference condition (i.e. LIZ003, the upper Lizard Creek site's abundance for 2022 was almost 24,000 higher than that of associated reference sites' mean)(Table 1). Although ERA is currently unsure of the cause, total abundance of benthic macroinvertebrates at Lizard Creek has been increasing over time - the data available for LIZ001 show a distinct pattern of increasing abundance since 2012 (LIZ003 has not been monitored long enough to begin confidently assessing any trends within this data)(Figure 20). Unfortunately, decreasing EPT appears to be accompanying this increase in abundance (Figure 20). There has also been a noticeable increase in the amount of *Tubifida,* a pollution-tolerant taxonomic order of worms, at LIZ001, which further suggests the introduction of a pollutant or disturbance affecting this site.

The high abundance with lower diversity (and low EPT) within the populations at LIZ001 likely suggests the introduction of a pollutant to the system and may signify the declining health of this site; however, further investigation of this area is needed to confirm and explore potential causation.

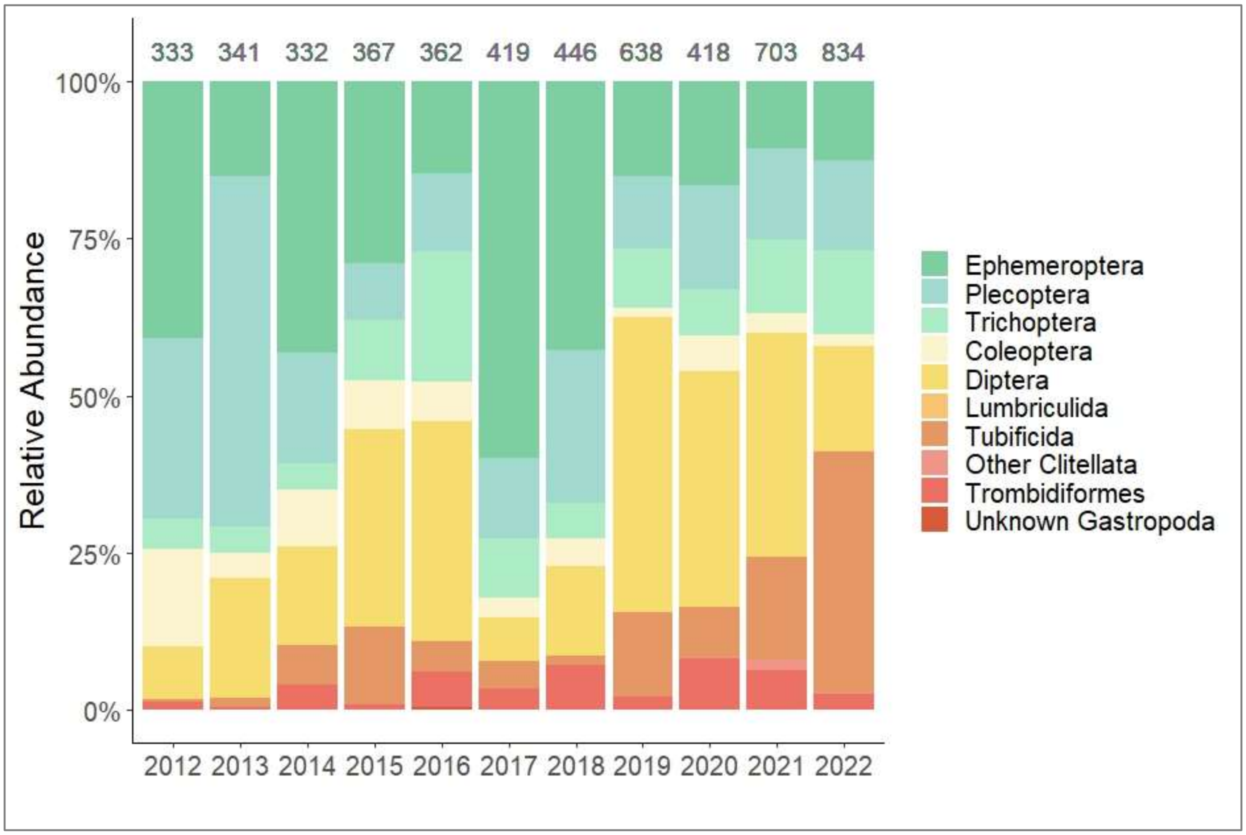


Figure 20. Plot of benthic macroinvertebrate community composition based on taxonomic order of samples collected at LIZ001 during CABIN sampling over time. The cool colours (blues, greens) represent orders that are generally sensitive to pollution (Ephemeroptera, Plecoptera, Tricoptera), while the orders in warm colours (yellow, orange, red) are more tolerant to pollutants. The numbers along the top of the graph are the raw individual counts of all benthic macroinvertebrates found at this site in each year.

Based on ERA's understanding of Lizard Creek, poor aquatic health at LIZ003 is unexpected. The LIZ003 site is within Mount Fernie provincial park and Island Lake Lodge is located near the headwaters of the creek (cat skiing, hotel, and restaurant operations). There is a resource road that runs alongside Lizard Creek for approximately 9.5 kilometers from Highway 3 to Island Lake Lodge and comes within 300 meters of the creek at different points along the way (See

Figure 21 for more details on land use within the Lizard Creek catchment). There are also several tributaries that cross over this road and eventually feed into Lizard Creek. Recreational use is moderate-to-high depending on the time of year, with many formal and informal trails used for skiing, biking, hiking, and horseback riding. Anecdotal observations indicate the presence of fish in good condition in Lizard Creek as well as spawning redd and fry and fingerling rearing area. However, regular visitors to the creek have noted increasing algae growth (particularly filamentous algae). Increased algae growth may indicate increased nutrient inputs to the creek.

LIZ001 is closer to the Lizard Creek confluence into the Elk River (**Error! Reference source not found.**). This site is downstream from the provincial park and has greater potential to be affected by human disturbance from residential development adjacent to the stream as well as recreational uses in the provincial park and adjacent private lands. Proposed future residential development adjacent to Lizard Creek, with associated access roads, water withdrawals from aquifers (which contribute to baseflow in the creek), and increased access for recreational uses may contribute additional impacts to those which may already be occurring. ERA is committed to continued monitoring of Lizard Creek as human activities in the catchment increase.

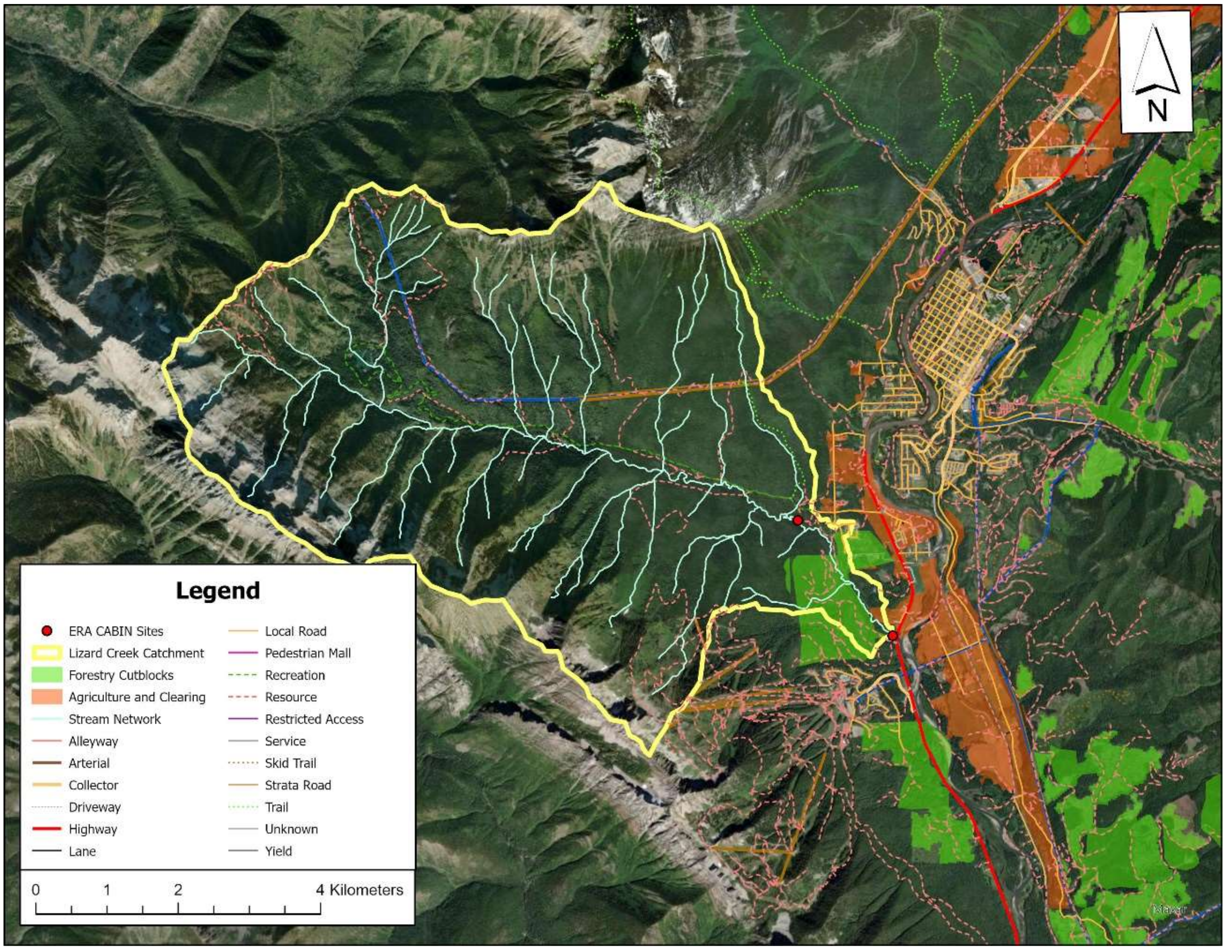


Figure 21. Land use in the Lizard Creek Catchment

Preliminary investigations into water quality parameters have not identified a clear cause - all measured water quality variables met BC guidelines for the protection of aquatic life and there have been no notable trends in water quality parameters (See Water Quality Trends section). However, trends cannot reliably be determined by “snapshot” sampling.

Initial examinations of water quality parameters in 2021 allowed ERA to begin flagging specific water quality parameters for continued monitoring. Although there were no exceedances of BC Water Quality Guidelines, LIZ001 and LIZ001 have consistently higher amounts of total phosphorus, sulfate, hardness (as CaCO3), conductivity, total calcium, and total magnesium than other CABIN monitored creeks (Figure 22;Figure 24; Figure 39).

Although high amounts of some of these parameters, namely, hardness, calcium, magnesium and conductivity, can, in the right conditions, result in the precipitation of calcite on rocks within a stream, naturally elevated levels are not a concern. In this case, these elevated levels can likely be attributed to the limestone-based geology of the area and increased groundwater influence (more interaction with the limestone) at Lizard Creek – as water erodes the limestone, minerals like calcium and magnesium are deposited into the stream, thereby also increasing the conductivity and hardness, but further investigation is needed to confirm this. If these levels are natural, further assessment of the ability of this CABIN model to accurately assess these sites is recommended, with associated reference samples containing significantly lower levels of many of these parameters – hardness (≅100 ± 77.36 mg/L), magnesium (≅9 ± 7.544 mg/L), and conductivity (≅120 ± 104.00 uS/cm).

Anecdotal observations of algal growth, led to an exploration of nutrient levels within Lizard Creek – both phosphorus and sulfate levels were flagged in 2021, and noted to be regularly higher than the other CABIN monitored creeks. Although there is currently no Water Quality Guideline for phosphorus in streams in BC, the long-term chronic limit within lakes is 0.015mg/L, which Lizard Creek sites regularly meet and/or exceed. Initial data investigations in 2021, also flagged sulfate as another parameter to watch. Although sulfate measurements at Lizard Creek sites are higher than ERA's other CABIN sites, they are all well below limits outlined in the BC Water Quality Guidelines (429 mg/L). Unfortunately, in 2022 the lab analyzing samples was unable to perform the test necessary to quantify total phosphorus (as P) or sulfate, so ERA is unable to complete a 2022 assessment. It may be worth noting that ERA's Coal Creek sites (COL001, COL003), which have also been diverging significantly from reference condition, are the only other ERA test sites that reach similar phosphorus levels. ERA will continue to monitor these parameters and recommend that it be considered for future examinations.

During these initial investigations, a potential pattern of increasing alkalinity was noted at Lizard Creek sites. Upon further investigation, this pattern seems to be shared amongst all of ERA's CABIN test sites. Similar to hardness, calcium and magnesium, elevated alkalinity is usually a result of the limestone-based geology of the local area. ERA will continue to monitor this parameter over time to continue to assess emerging trends (Figure 23).

In-depth investigations outside of CABIN assessments are needed to better understand what is occurring at Lizard Creek.

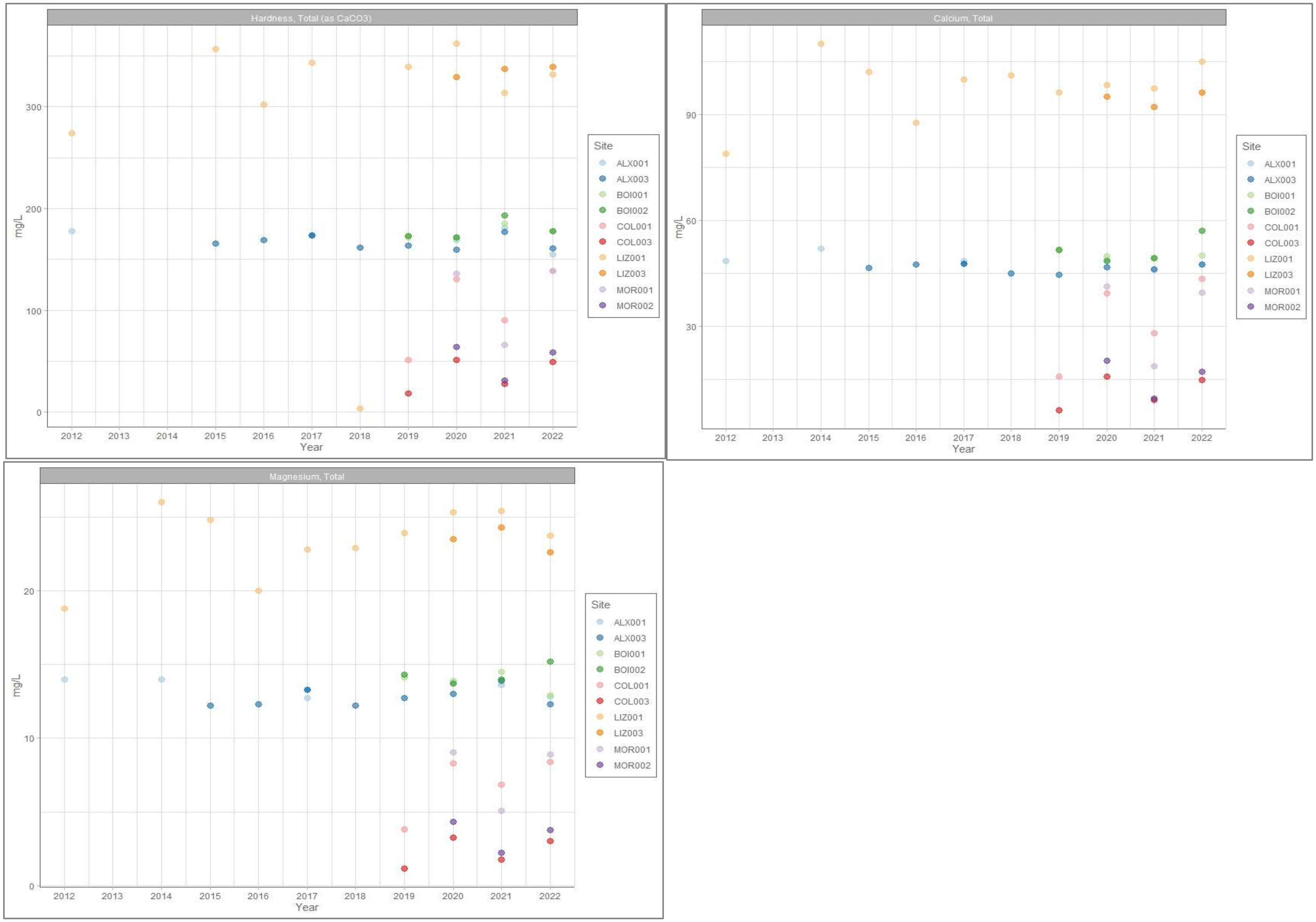
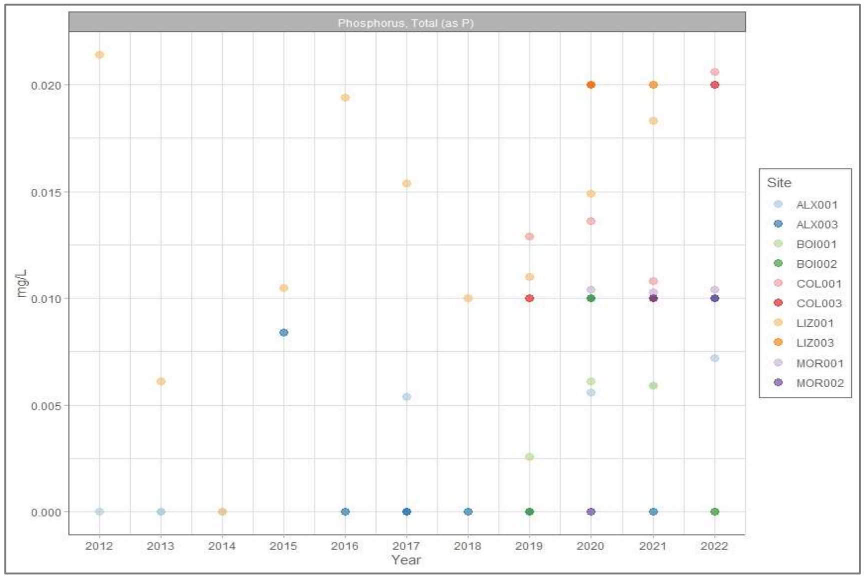


Figure 22. Total hardness (as CaCO3), total calcium, and total magnesium in samples at ERA CABIN sites between 2012 and 2022. Note that Lizard Creek sites have levels higher than the other monitored sites. All these parameters are likely a reflection of the limestone-based geology in the region and an increased groundwater influence at Lizard Creek.



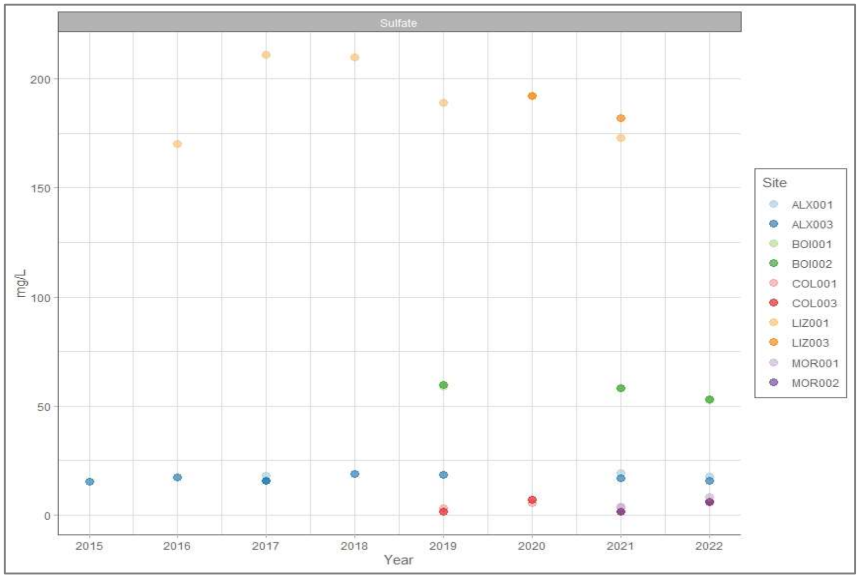
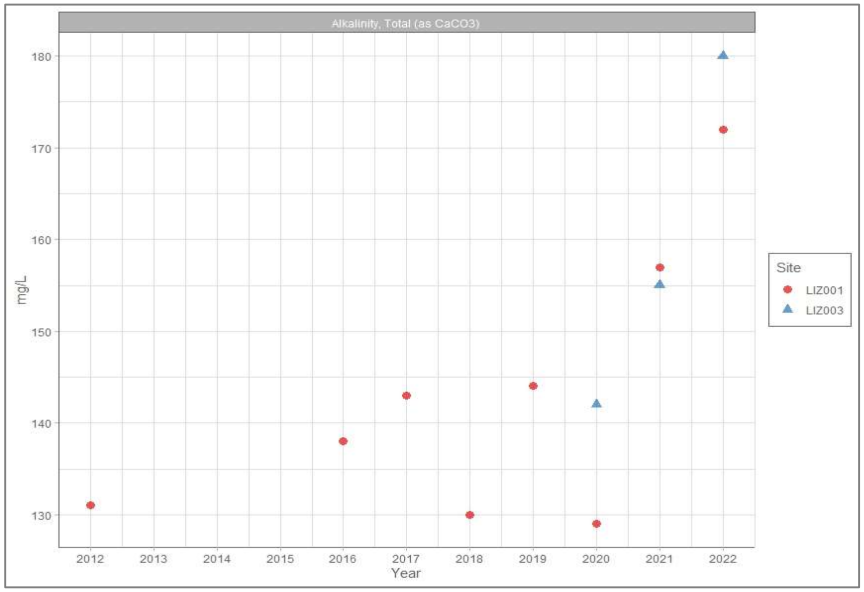


Figure 24. Total phosphorus and total sulfate at ERA CABIN sites between 2012 and 2022. Lizard Creek consistently has higher values within these parameters across years.



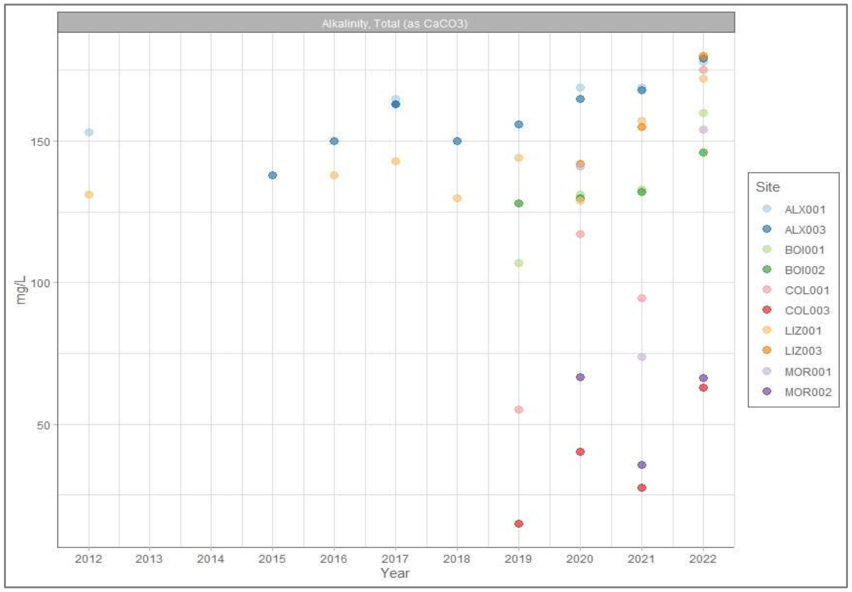


Figure 23. Total alkalinity (as CaCO3) over time. The plot on the left focuses on the Lizard Creek sites, while the graph on the right allows for comparison across sites. Although alkalinity is usually a result of the local geology, this analyte appears to be increasing over time.

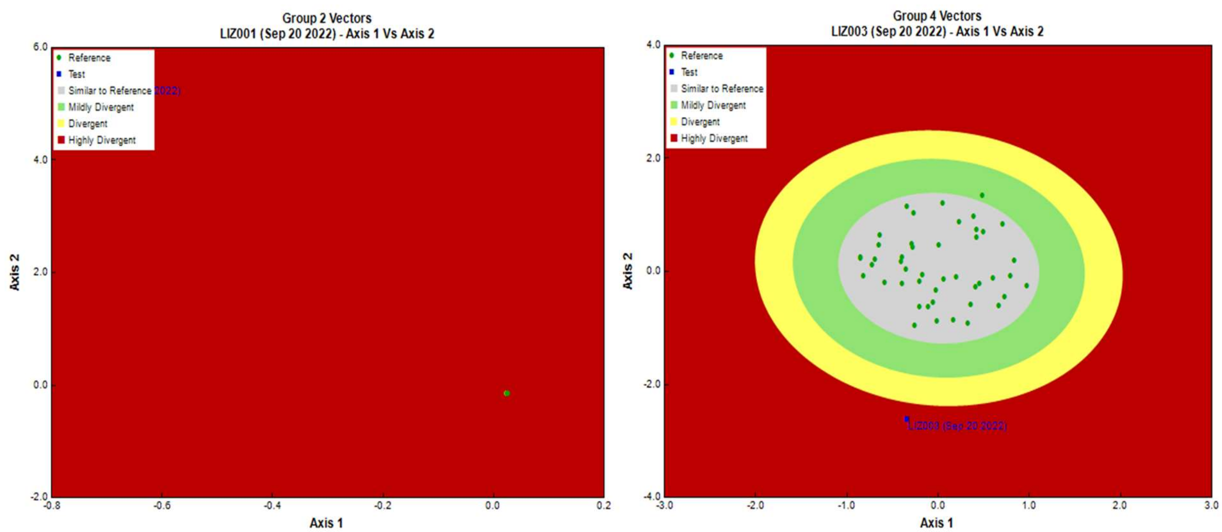


Figure 25. CABIN community ellipses for LIZ001 and LIZ003, respectively, in 2022. Note that in the LIZ001 diagram, the ellipses is the green dot in the bottom right of the diagram, while the point representing LIZ001 is to the top left, partially covered by the diagram's legend.

Alexander Creek

In 2022, both the upstream (ALX003) and downstream (ALX001) sites were in good condition, according to CABIN analysis (Figure 26). Water chemistry variables were also consistent with good health, with all measurements for both sites meeting the BC guidelines for the protection of aquatic life. There have been no consistent trends in dissolved oxygen, pH, conductivity, turbidity, or temperature (see the Water Quality Trends section below). However, trends cannot reliably be determined by "snapshot" sampling. ERA is currently implementing a network of real-time discharge and temperature monitoring in CBWM streams, which will allow for better monitoring.

CABIN results from Alexander Creek sites have been relatively consistent over time, generally remaining in reference condition, however ALX001 was found to be highly divergent in 2012 and divergent in 2017. Further statistical testing (Bray-Curtis, RIVPACS) indicates that sites on Alexander Creek were similar to reference sites in taxa diversity and %EPT.

Alexander Creek runs alongside the Crowsnest highway for about 4 kilometers, is crossed by the CP Rail mainline, and passes a gun range and local logging roads. Fluctuations in CABIN assessment may result from intermittent disturbances caused by the use of these areas, combined with events such as runoff from heavy or prolonged rain causing erosion of disturbed areas. Proposed mining development in the upper catchment may increase stressors on Alexander Creek. If mining development goes forward, ongoing monitoring of Alexander Creek will become increasingly important to track changes in stream health.

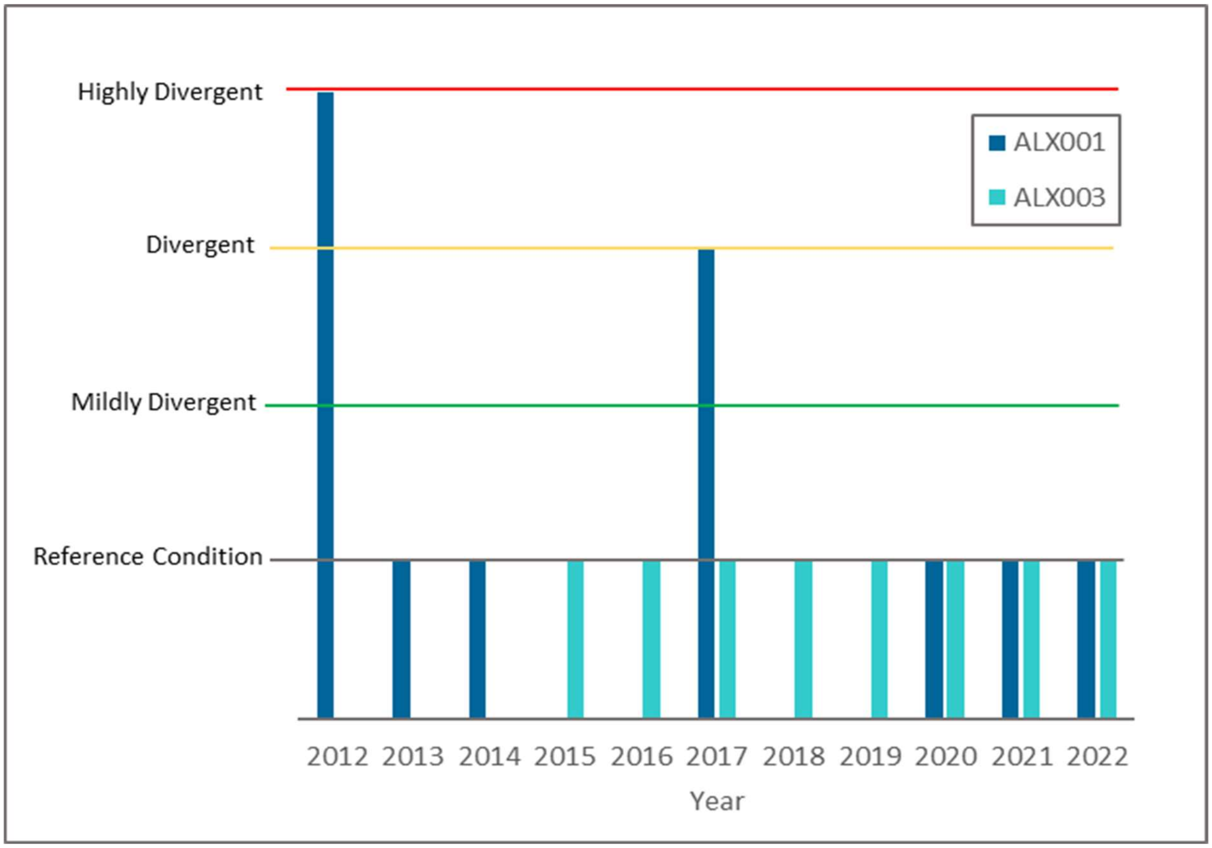


Figure 26. CABIN analysis results for Alexander Creek sites from 2012 - 2022.

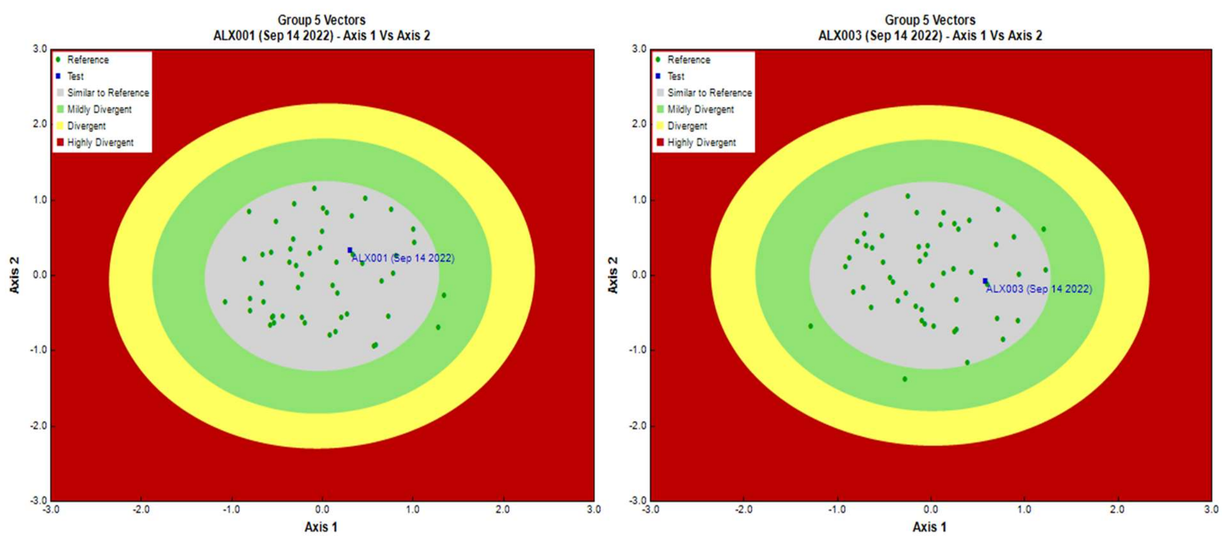


Figure 27. CABIN community ellipses for Alexander Creek sites (ALX001 & ALX003) in 2022.

Boivin Creek

In the four years (2019 to 2022) of monitoring on Boivin Creek, sites have remained in relatively good, stable condition (Figure 28). 2022 CABIN analysis showed that both Boivin Creek sites were in similar condition to their associated reference sites. The shift to a "mildly divergent" condition seen in 2021 at the lower Boivin Creek site (BOI001) was likely a result of the natural variability of benthic invertebrate communities, or a smaller disturbance. Further analysis of metrics associated with benthic invertebrate community structure suggested that in 2021, BOI001 may have been experiencing a slightly lower species richness (RIVPACS) which could have contributed to this assessment. Based on 2022 monitoring results, species richness (RIVPACS) at BOI001 has increased again, but %EPT has decreased which, if it continues, may affect future results (Table 1).

ERA began monitoring this site to assess the impacts of artificial riprap that stretches along large sections of the creek as it passes through Elkford. However, CABIN results to date show that the creek is similar to comparable reference sites. Continued monitoring efforts, including implementation of real-time monitoring of discharge and temperature will allow for more long-term assessments of the creek and potential impacts of local urban developments. All measured water quality variables met BC guidelines for the protection of aquatic life.

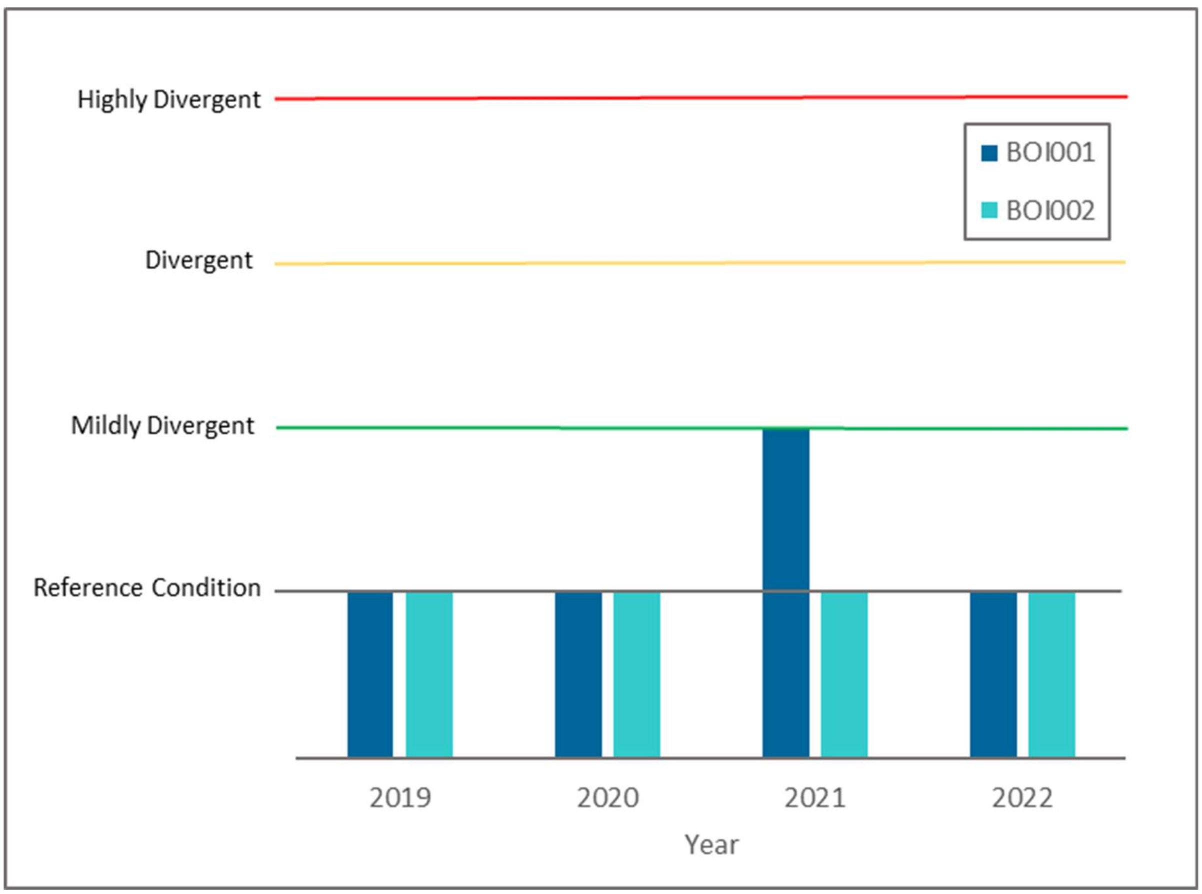


Figure 28. CABIN results for Boivin Creek sites in 2019 - 2022. The upstream (BOI002) site has remained in a similar state to reference condition, while the downstream site (BOI001) has experienced some fluctuation in state. Continued monitoring will allow for ERA to assess any developing patterns.

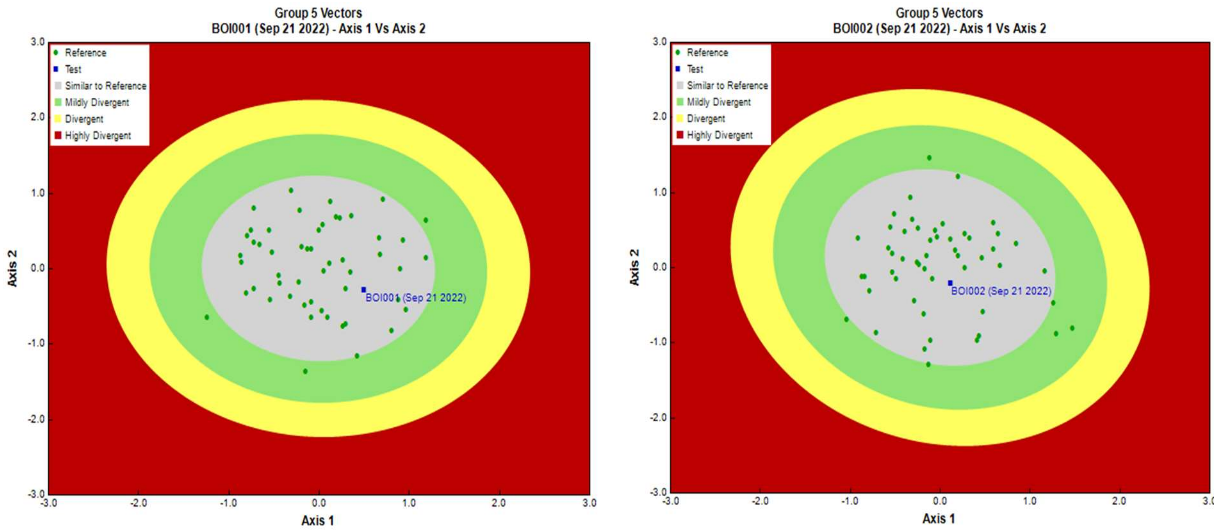


Figure 29. CABIN community ellipses for Boivin Creek sites (BOI001, BOI002) in 2022, showing both sites to be "similar to reference".

Coal Creek

Coal Creek was added to the CBWM CABIN assessments in 2019. Results indicate the creek is divergent from reference condition, with more dramatic results seen at the site near the mouth (COL001)(Figure 30). According to additional analyses, both sites along Coal Creek exhibited species diversity (Bray-Curtis), diverging from reference sites but both had high taxa richness when compared with reference sites (RIVPACS)(Table 1). Total abundance of individuals was much higher than expected for the lower site (more than 10,000 above what would be expected based on CABIN reference sites) which may push results to a more divergent classification.

Further analyses revealed low numbers of EPT individuals (generally sensitive to pollutants and their abundance is considered an indicator of good health) compared with Diptera and non-insects (generally pollutant-tolerant) - 37% of the benthic invertebrates sampled at COL001 were EPT individuals while 62% belonged to Diptera or non-insect groups, and COL003 having 66% EPT and 39% Diptera and non-insects.

All measured water quality variables met BC guidelines for the protection of aquatic life. The Coal Creek sites were established too recently to enable comparison of water quality results over time. Furthermore, as noted for the other creeks in the CBWM program, one-time sampling for water quality is not sufficient for indicating true trends.

The COL001 site is downstream of historic mining sites, a decommissioned landfill, cattle grazing, recreational ATV trails, and current clear-cut logging practices. The final kilometer stretch flows through a portion of Fernie before arriving at the sampling site. This urban portion of Coal Creek is confined by riprap and concrete armoring along the sides of the channel. Recreational use of the lower portion of the creek sometimes includes the construction of weirs in the streambed with large rocks and cobble to create swimming or wading areas.

The highly divergent results for the COL001 site are not unexpected, given the multiple historic and current stressors in the catchment. Benthic invertebrates integrate the effects of these multiple stressors, particularly flow, turbidity, and temperature, but may also be responding to short and long-term changes in water quality parameters such as nutrients. The consistent categorization of COL001 as "highly divergent" from reference condition over the four years it has been monitored, along with the list of known stressors effecting this stream, give ERA confidence in these results.

ERA will continue to monitor COL001 and COL003 to confirm CABIN results and acquire sufficient data to begin to evaluate trends. If the COL003 site continues to diverge from reference sites, ERA will seek to investigate further, as this site is within the headwaters, and poor conditions are not expected at this location.

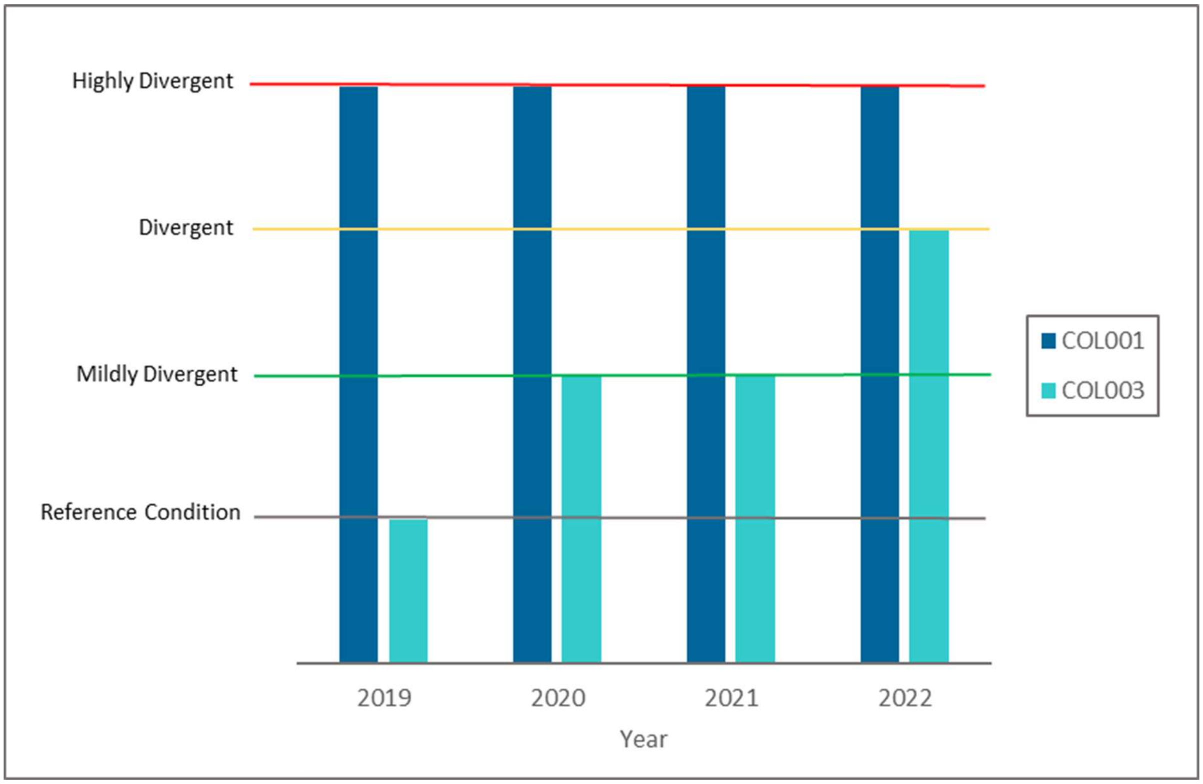


Figure 30. CABIN results for Coal Creek sites in 2019 – 2022.

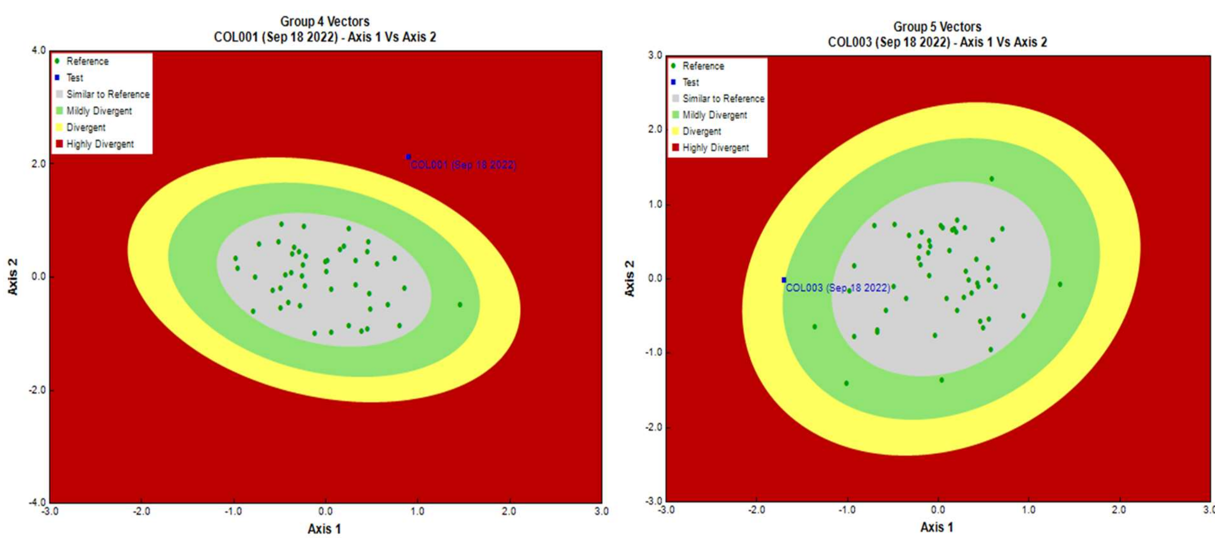


Figure 31. 2022 CABIN analysis community ellipses for Coal Creek sites, showing COL001 significantly divergent from reference condition (left) and COL003.

Morrissey Creek

2022 was the third year of CBWM assessments for Morrissey Creek. The upstream site, MOR002, shifted from a state like that of the associated reference sites to “mildly divergent”, while the downstream site, MOR001, remained highly divergent (Figure 32). Although the RIVPACS ratio suggests that MOR001 had a higher-than-expected taxa richness, the Bray-Curtis score (0.87) indicates the taxa diversity at the site was low. EPT values were significantly lower this year than in 2021 (42% compared to 86%) (Table 1). Like COL001, MOR001 also has very high total individual abundance numbers (10,780, compared to a mean reference site abundance of 1449.58 ± 859.69).

There were no exceedances of BC Water Quality Guidelines. The Morrissey Creek sites were established too recently to enable any valuable comparison of water quality results over time. Furthermore, as noted for the other creeks in the CBWM program, one-time sampling for water quality is not sufficient for indicating trends. Morrissey Creek is part of ERA’s continuous temperature and discharge monitoring network, which is currently being implemented.

Morrissey Creek originates from a geographically similar location to Coal Creek, with similar historical logging in the upstream reaches. MOR001 is downstream of active logging roads, ATV trails, cattle grazing, and an active farming area. Previously, MOR002 was above most potential disturbance, but is now being exposed to significant disturbance through the construction of the TC Energy pipeline – significant traffic and construction on roadways and bridges directly upstream of its location. 2022 results do not show significant changes to the benthic invertebrate community at MOR002 (other than a decrease in *Trichoptera,* leaving *Ephemeroptera* and *Plecoptera* to dominate the EPT portion of individuals in the stream), but the total abundance of individuals sampled doubled between years (although still within the range of associated reference locations).

The downstream sites in both Coal and Morrissey Creeks have multiple land use-related stressors in their catchments. Therefore, divergence from reference condition is not unexpected in either. Continued monitoring over time should begin to reveal patterns in site characteristics that may help identify the cause of these results. Further investigation, outside of CABIN monitoring, will be needed in future to fully understand the dynamics of this stream and the stressors effecting it.

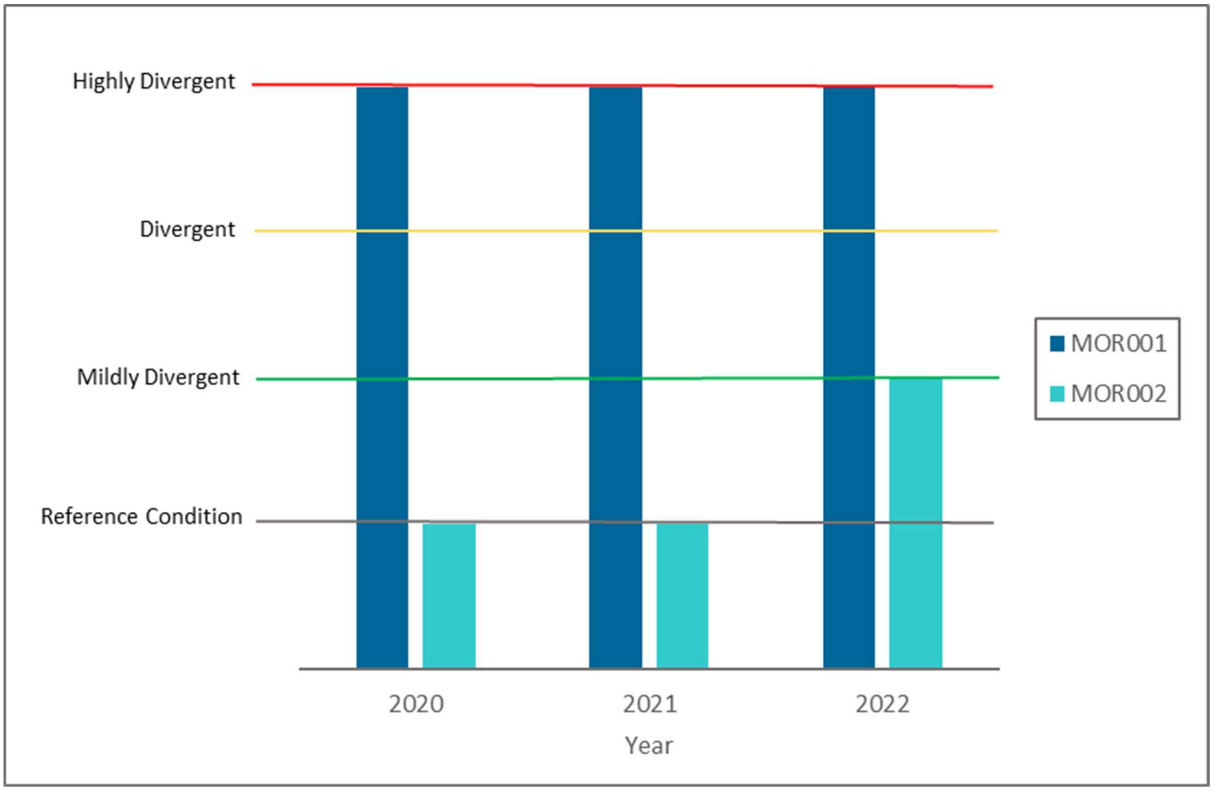


Figure 32. Results of CABIN assessment for Morrissey Creek sites in 2020-2022. This year, MOR001 was again classified as "highly divergent" while MOR002 appears to be experiencing a shift away from "reference condition" to "mildly divergent".

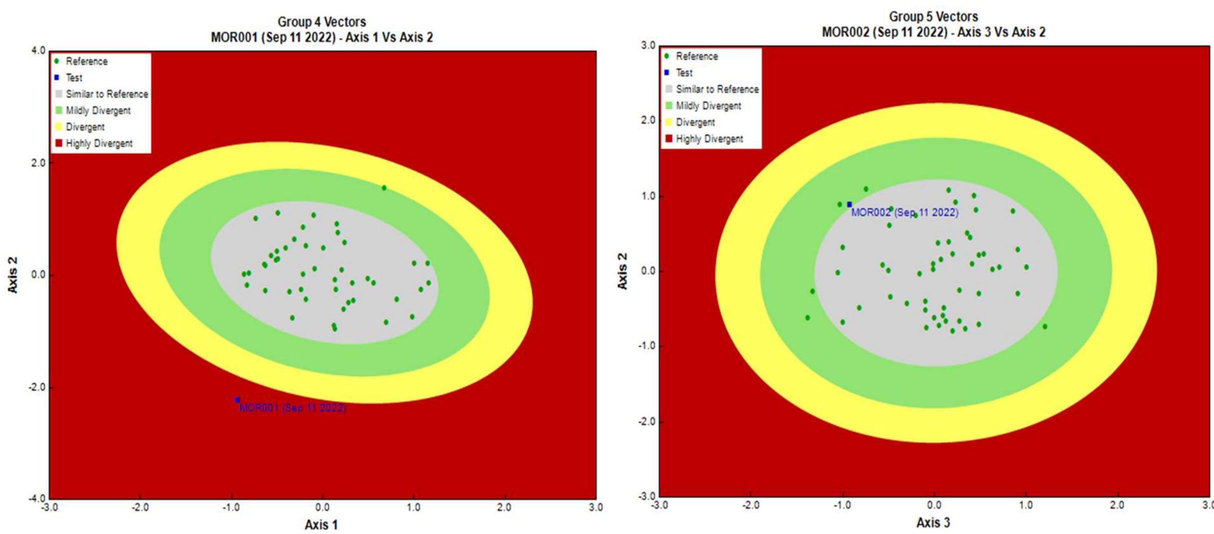


Figure 33. CABIN analysis community ellipses for the Morrissey Creek sites, showing MOR001 significantly diverging from reference condition and MOR002 beginning to diverge from reference condition.

Benthic Macroinvertebrate Communities

CABIN assessments assign test sites a condition based on the structure of the benthic macroinvertebrate community. Figure 34 shows the general diversity in each CBWM test stream, based on the proportion of individuals belonging to each taxonomic order. Sites with a higher proportion of EPT (pollution sensitive taxa) coincide with those deemed less divergent from reference condition through CABIN assessments, and sites with the lowest proportion of EPT are those that have been assessed as the most divergent. The sites assessed as most divergent, LIZ001, COL001, and MOR001, all have significantly smaller proportions of pollution-sensitive individuals, as well as higher numbers Tubifida (an order of pollution-tolerant worms).

The exception to this is the upper Lizard Creek site (LIZ003), which was assessed as "Highly Divergent", yet a majority of the taxa present are part of the pollution sensitive group (EPT). Different levels of species-specific sensitivity are seen within these EPT groups, with some exhibiting higher tolerances and even thriving in certain disturbed environments (Houghtona 2004). Further exploration of the conditions at Lizard Creek is needed to fully understand these results.

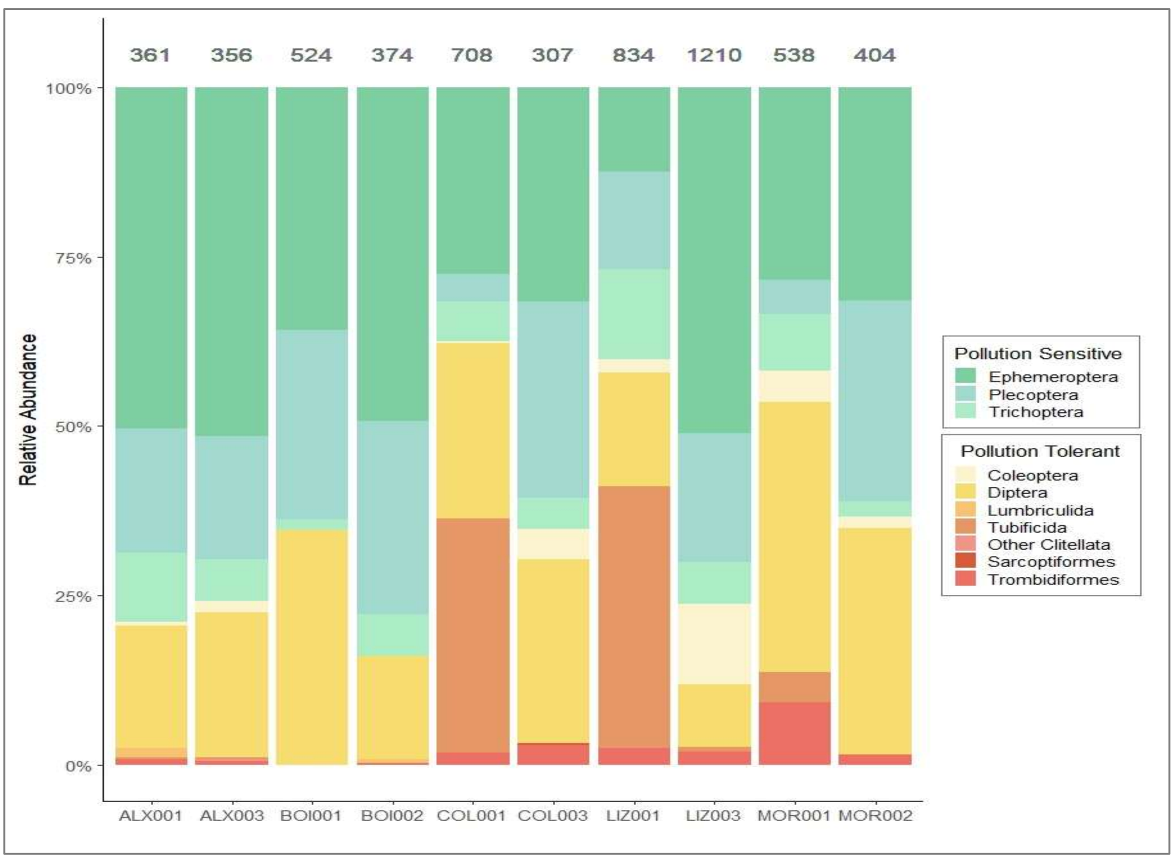


Figure 34. Graph representing the proportions of different taxonomic orders of benthic macroinvertebrates at each CBWM site. Raw counts of all benthic macroinvertebrate individuals found at each site are displayed along the top.

Table 1 takes a closer look at these results within benthic communities at each CBWM site using RIVPACS, Bray-Curtis Dissimilarity, %EPT and total abundance. The highlighted cells indicate values that differ significantly (i.e. 2 x standard deviation from the mean) from what is expected from a site in “reference condition”.

Table 1. A comparison of CBWM sites, their classification according to 2022 CABIN assessments, and additional statistical measures that address the classification – RIVPACS, Bray-Curtis dissimilarity, and the percent EPT (Ephemeroptera, Plecoptera, Trichoptera). Highlighted cells indicate values that differ from what is expected for a reference site in good condition.

Stream Name	Site ID	CABIN Analysis	RIVPACS O:E (P>0.5)	Bray-Curtis Dissimilarity*	% EPT	Total Abundance
Alexander Creek	ALX001	Reference	1.13	0.38[a]	78.95[a]	7,220.00[a]
	ALX003	Reference	1.12	0.38[a]	75.92[a]	7,140.00[a]
Boivin Creek	BOI001	Reference	0.98	0.45[a]	65.27[a]	8,733.00[a]
	BOI002	Reference	1.10	0.24[a]	83.96[a]	4,675.00[a]
Coal Creek	COL001	Highly Divergent	0.93	0.90[b]	37.43[b]	11,800.00[b]
	COL003	Divergent	0.79	0.69[a]	66.00[a]	1,565.00[a]
Lizard Creek	LIZ001	Highly Divergent	0.97	0.97[c]	40.02[c]	16,720.00[c]
	LIZ003	Highly Divergent	0.97	0.91[b]	76.27[b]	24,200.00[b]
Morrissey Creek	MOR001	Highly Divergent	1.13	0.87[b]	42.21[b]	10,780.00[b]
	MOR002	Mildly Divergent	0.80	0.59[a]	63.28[a]	6,766.67[a]
	Reference Mean			(a) 0.40 ±0.14 (b) 0.34 ±0.10 (c) 0.34 ±0.10	(a) 89.20 ±10.03 (b) 91.94 ±7.30 (c) 88.13 ±9.27	(a) 4,661.00 ±3,118.98 (b) 1449.58 ±859.69 (c) 1083.09 ±932.35

* The average dissimilarity value between individual reference sites and the “Reference Mean” that all test sites were measured against.

STREAM e-DNA

STREAM e-DNA analysis presents a list of species present at each sampled site, including general information on the species’ ability to tolerate stressors and information regarding species richness at each site.

ERA's inclusion of STREAM e-DNA monitoring allowed for the identification of *Tubifex tubifex,* one of the two host species necessary for the presence of whirling disease, caused by the *Myxobolus cerebralis* parasite at ERA CABIN monitoring sites, leading to the creation of ERA's Whirling Disease Education and Monitoring program. *Tubifex tubifex* was not identified in any CABIN monitoring streams in 2022, but was identified in previous years at Morrissey, Lizard and Boivin Creeks. As of the end of 2022, there are no known cases of whirling disease in British Columbia to date, but it is widespread in the neighbouring parts of Alberta, including the Oldman watershed bordering the Elk River watershed (Veillard and James 2020). If whirling disease were to enter BC, these creeks could be a high-risk area for an outbreak. The initial discovery of this species at Boivin Creek led the creation of a new ERA program, the 'Elk Valley Whirling Disease Project', an outreach and monitoring initiative within the Elk Valley to identify other potentially high-risk locations and educate to prevent the introduction of this disease.

The detailed STREAM report is available in (Appendix E: Stream Report).

Water Quality Trends

ERA's CBWM program monitors water quality parameters over time to assess long-term trends. Data on pH, temperature, turbidity, dissolved oxygen concentration, conductivity and discharge are available as far back as 2012.

pH

PH levels at all sites have been relatively consistent over time (Figure 35). All areas assessed remained within the 6.5 to 9 pH BC Water Quality Guideline limits for freshwater aquatic life (British Columbia Ministry of Environment and Climate Change Strategy 2021). Stream pH is primarily a function of surrounding geology, so the Elk Valley's predominantly limestone formations result in high pH values. Aquatic life in these areas has adapted to high pH conditions. If values deviate outside of these limits, damage to current aquatic communities and changes to the species composition of the stream can occur (B.C. Ministry of Environment and Climate Change Strategy 2021a).

In 2022, Boivin Creek (BOI001, BOI002) sites had a noticeably lower pH value than the other CABIN monitoring locations. This drop in pH at these sites is exclusive to 2022 results, and further years of monitoring are necessary begin to decipher between natural variation and patterns indicative of disturbance or permanent changes to aquatic habitats. Similarly, although **Error! Reference source not found.** appears to suggest a pattern of increasing pH over time at the upper Coal Creek site (COL003), there is not yet enough year-to-year data to draw any concrete conclusions.

ERA will continue to monitor for any potential patterns through yearly CABIN sampling.

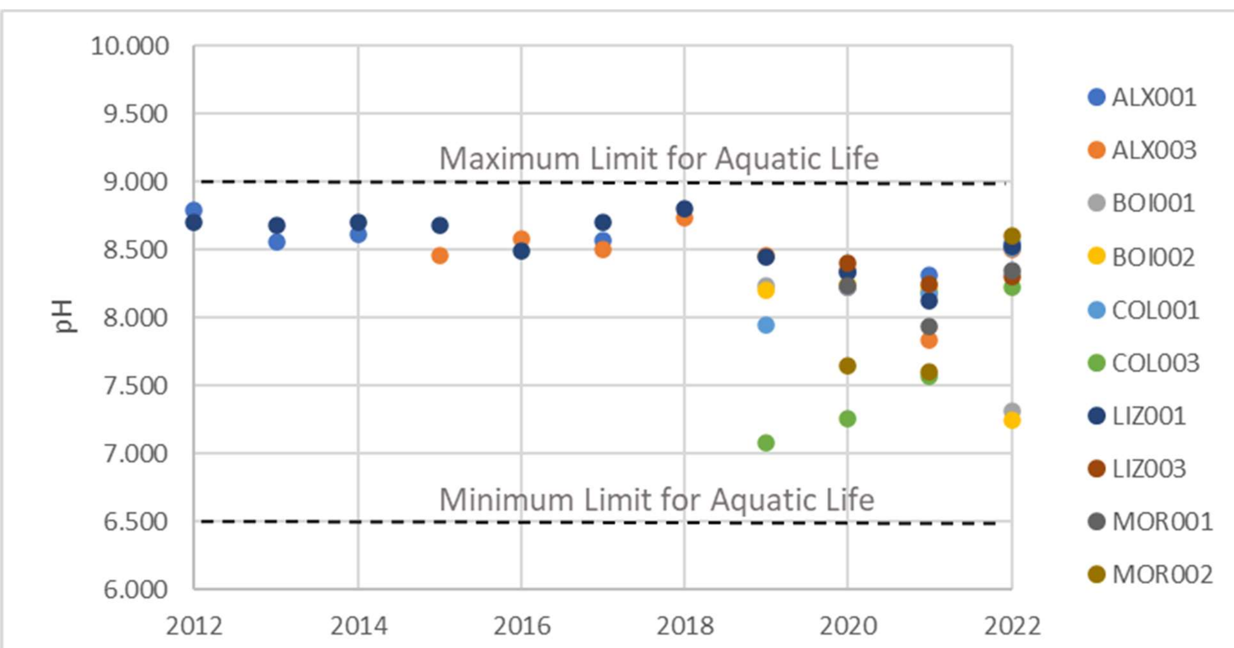


Figure 35. pH values for CBWM sites from 2012-2022. All sites remain within the range of limits outlined within the BC Water Quality Guidelines.

Temperature

In light of the potential effects of climate change on the Elk River system, understanding long-term temperature trends is a priority for ERA. Typically, aquatic life can only survive within specific ranges of temperatures. For example, WCT can only survive in waters between 0 – 25°C (Bear, McMahon, and Zale 2007).

Temperatures measured during CABIN monitoring varied considerably between sampling years at all sites (Figure 36). However, this can be attributed to natural climatic variability and different sampling dates. Although all sites in CABIN are monitored during low flow conditions between the end of August and the beginning of November, relatively large fluctuations are expected during this period, and a single annual measurement is insufficient to understand long term trends. Temperatures remained within the critical limit for important local species like the WCT and bull trout (DFO 2017).

In depth analysis of temperature is only possible with ongoing, frequent monitoring using instream logging equipment. To this end, as part of its broader monitoring program, ERA has developed a separate hydrometric monitoring program to examine stream temperature throughout the Elk Valley in more detail.

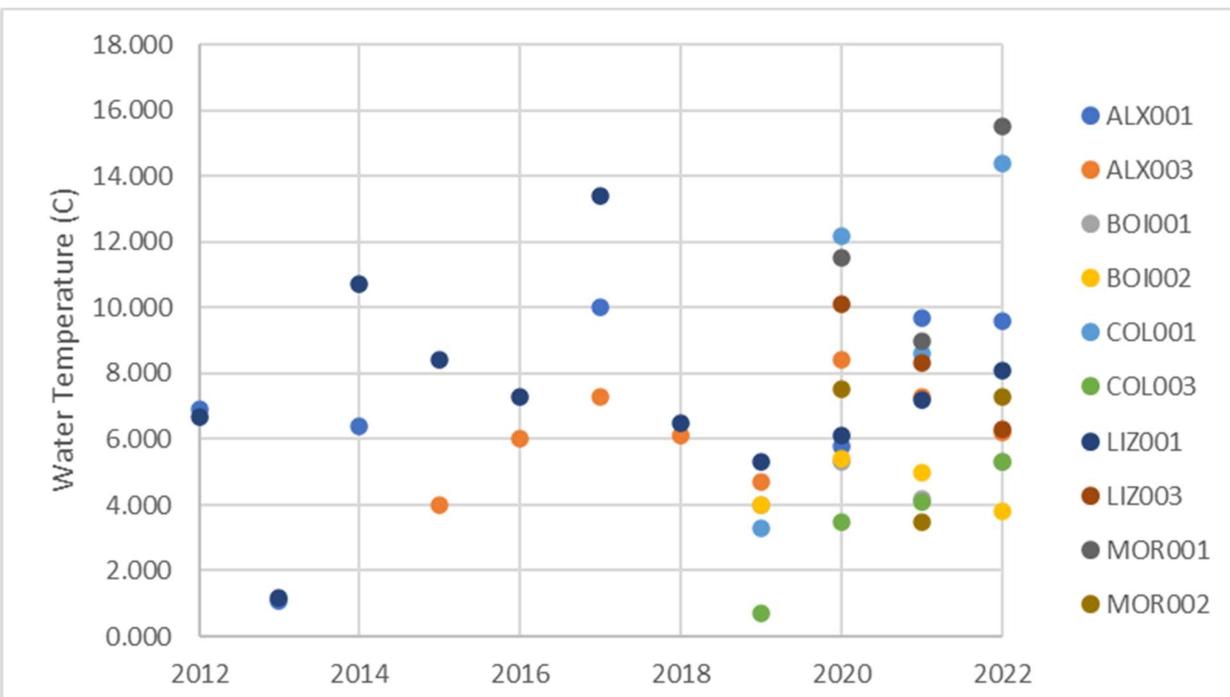


Figure 36. Temperature values for CBWM sites from 2012-2022.

Dissolved Oxygen

The concentration of dissolved oxygen (DO) at all CBWM sites has remained stable over time and is consistently above the BC Water Quality Guideline long-term minimum level of 8mg/L (Figure 37)(British Columbia Ministry of Environment and Climate Change Strategy 2021). Dissolved oxygen measurements are more consistent across sites since 2021, this is likely due to the use of new, more accurate equipment (YSI ProDSS). This consistency amongst these measurements is expected to be observed in future.

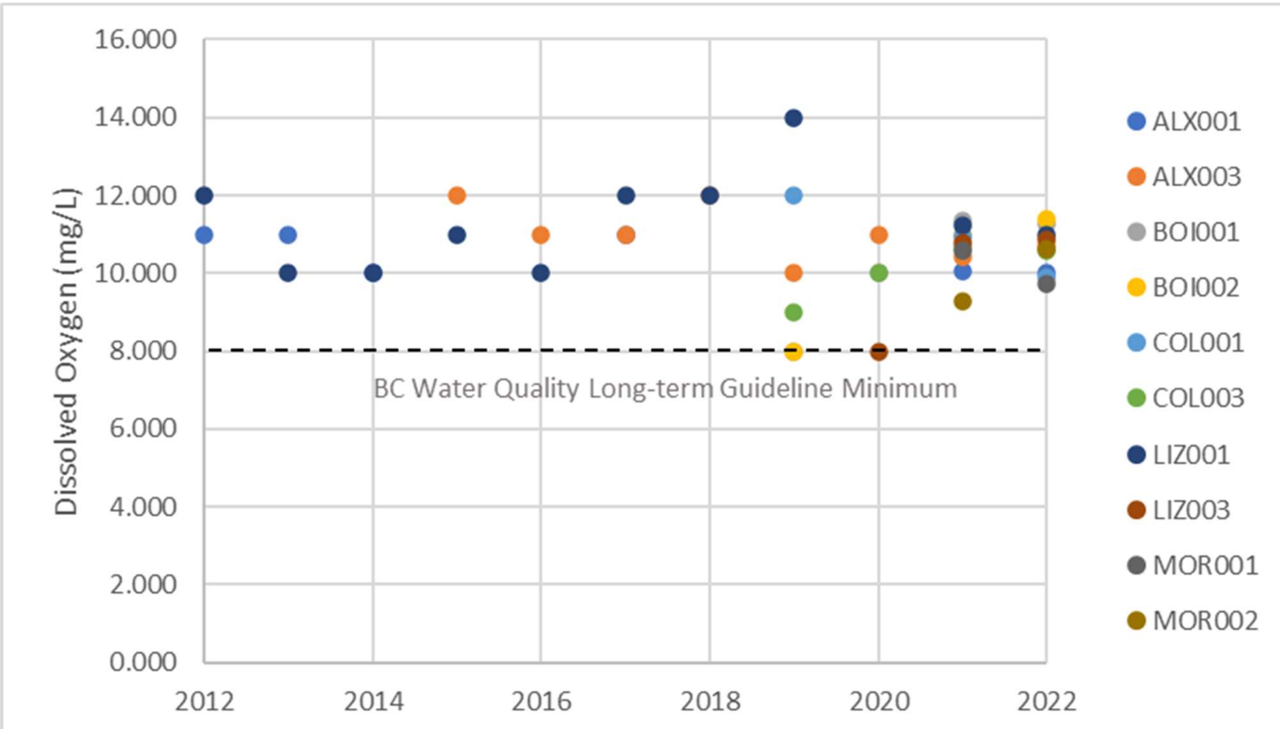


Figure 37. The amount of dissolved oxygen at CBWM sites in mg/L from 2012-2022. Site values do not fall below the BC water Quality Long-term Guideline minimum for Freshwater Aquatic Life (8mg/L).

Turbidity

Canadian Water Quality guidelines suggest that environmental samples vary within the normal range of 1 to 1000 NTU but that turbidity as low as 25 NTU can begin to have a negative effect on fish growth (Canadian Council of Ministers of the Environment 1999). Since 2012, CBWM site turbidity readings have remained below 4 NTU, with most readings below 2 NTU.

ERA staff and community observations indicate all tributaries in the Elk River watershed experience significant turbidity spikes during rainfall events and spring freshet. However, all monitored creeks tend to have low turbidity readings during low-flow conditions, with turbidity spikes generally being indicative of upstream disturbance coupled with high rainfall/snowmelt events, particularly during the May-July freshet.

According to the BC Water Quality Guidelines, turbidity is only a concern when the value changes by 8 or more NTU for 24 hours from the ambient turbidity level, or 2 NTU for 30 days (British Columbia Ministry of Environment and Climate Change Strategy 2021). Annual single occurrence sampling is not sufficient to detect these changes. In 2023, ERA will begin phase 2 of it’s Sedimentation program, working with Ed Clayton, a PhD candidate from the University of Auckland, to a explore the use of a low-cost sensor that hopes to enable continuous turbidity measurements throughout the year.

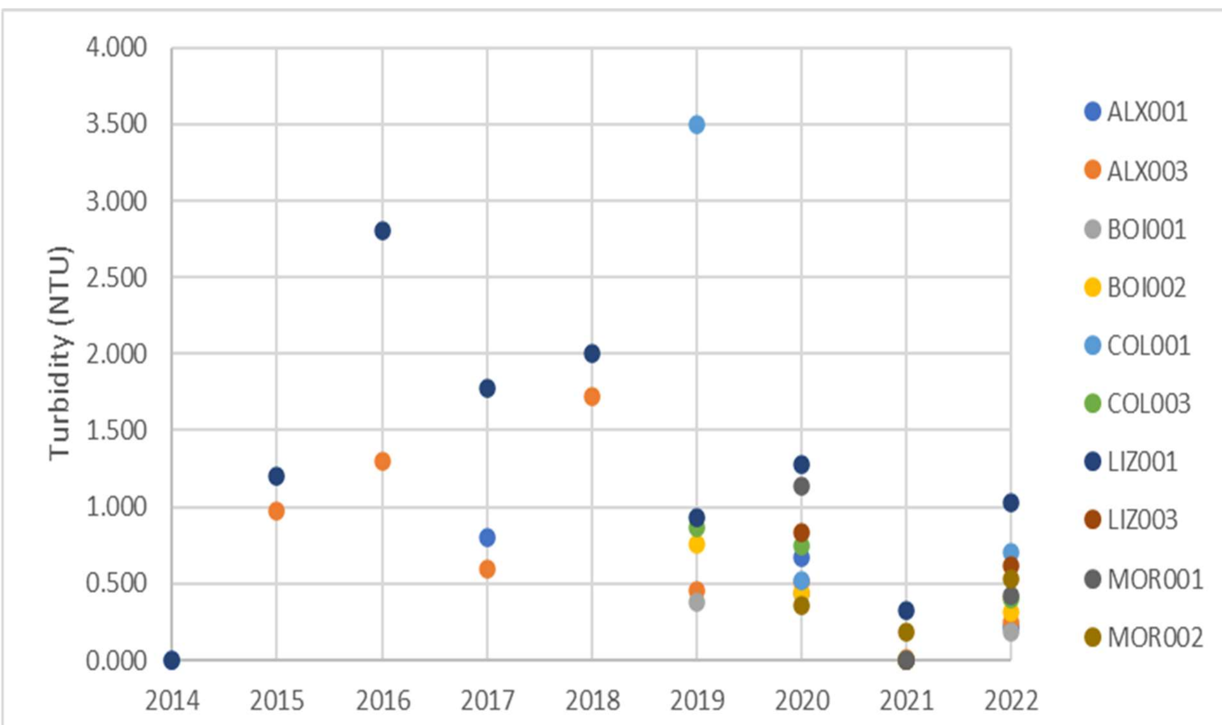


Figure 38. The turbidity (NTU) measured at CBWM sites from 2014-2022.

Conductivity

In general, conductivity levels for a freshwater river system range between 0 and 1000 uS/cm – conductivity levels above this are usually indicative of a saltwater system. Although all monitored sites fall within this range, the Lizard Creek sites have significantly higher conductivity levels than the other sites, likely due to high groundwater influence at this stream. This plot also shows a steep decrease in conductivity levels at LIZ001 between 2012 and 2013, followed by levels more than doubling in 2015. Although conductivity levels can fluctuate, the large change may have been a result of some added stressor.

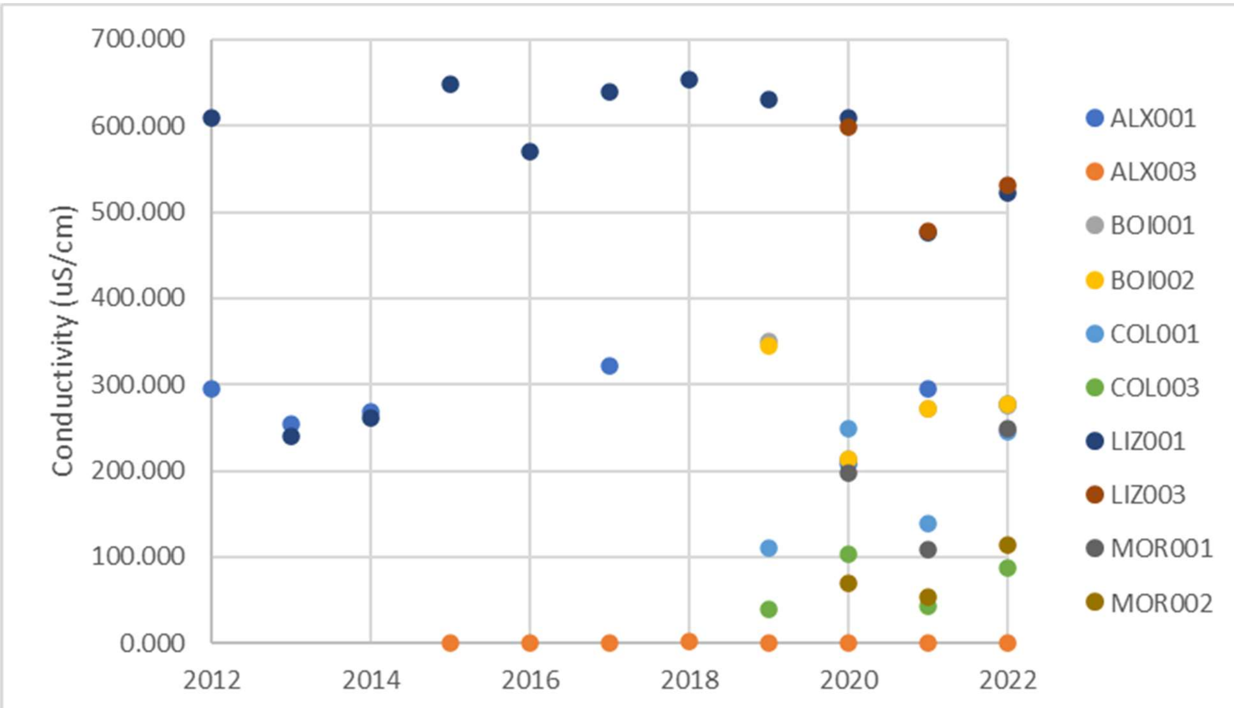


Figure 39. Conductivity levels measured at CBWM sites from 2012-2022.

Discharge

Discharge, referring to the volume of water flowing through a section of stream at a given time, was assessed during low flow conditions for each site (Figure 40). Discharge measurements at all sites remained relatively stable, fluctuating within site-specific ranges between years.

Like other measured parameters, discharge can fluctuate from day to day (and within the day). A single annual measurement is not sufficient to detect long term trends. In depth analysis of discharge is only possible with ongoing, frequent monitoring (e.g. hourly logging). To address this, ERA has begun implementing a hydrometric monitoring program to examine discharge in more detail.

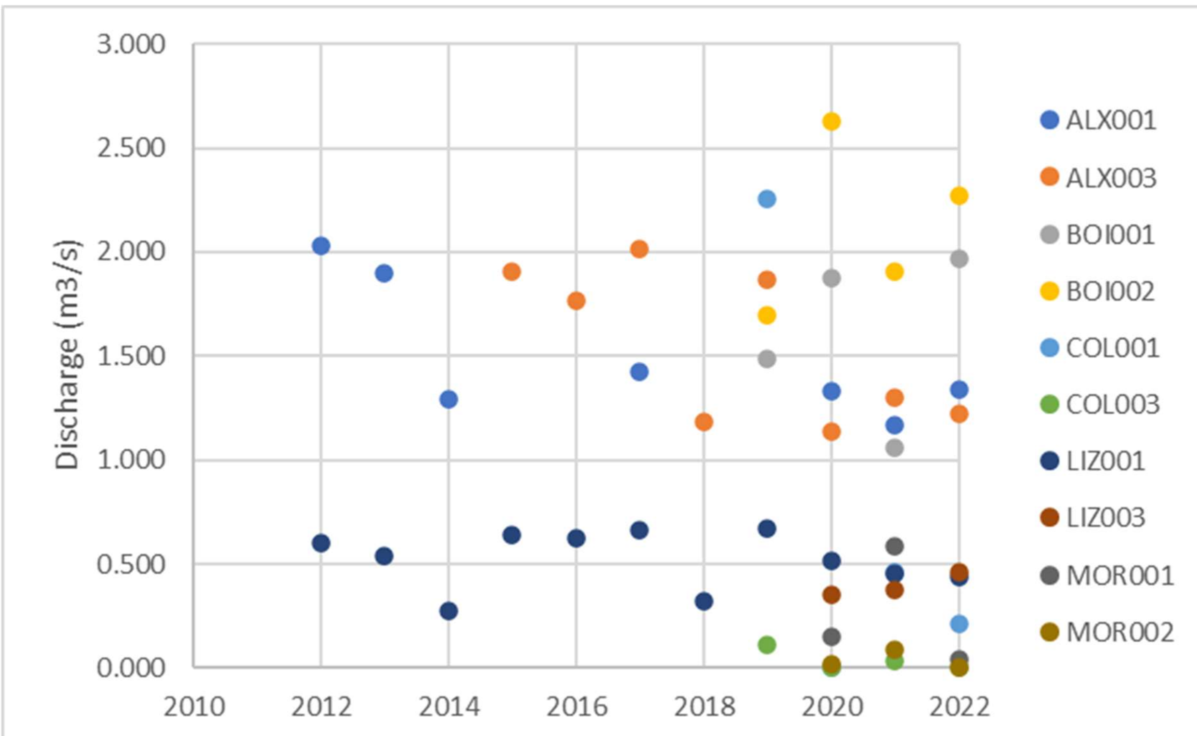


Figure 40. Discharge measurements calculated for CBWM sites from 2012- 2022.

Metals & Nutrients

Water chemistry data collected during the 2022 sampling period indicates there were no exceedances in metals or nutrients based on BC Water Quality Guidelines and no notable overall trends were observed.

Selenium and Calcite

The Elk Valley has a long history of mining, and its residents are very aware of the associated environmental issues with this industry. Selenium and calcite are two constituents of serious concern in this region.

Selenium (Se) is a naturally occurring element and low levels are essential for the health of both humans and animals (Janz et al. 2010). Unfortunately, selenium actively bioaccumulates in tissues, and in higher concentrations, begins to become toxic, eventually causing reproductive issues and deformities (Teck Resources Ltd. 2015). Waste rock, resulting from coal mining operations, contains selenium. During the mining process, this rock is broken into smaller pieces, creating more opportunity for air and water to interact with the rock. This results in the conversion of selenium into its soluble form, which is then released in water seeping through these waste rock piles into local waterways (Teck Resources Ltd. 2015). The BC water quality guideline for the protection of aquatic life is 2 µg/L (micrograms/litre). The BC human drinking water consumption guideline is 10 µg/L (British Columbia Ministry of Environment and Climate Change Strategy 2021).

Calcite ($CaCO_3$) is also naturally occurring and is formed when calcium (Ca) and carbonate (CO_3) ions react under saturated conditions (Janz et al. 2010). Calcite concretion in streambeds, specifically downstream of local coal mining operations, has become an increasing concern in the Elk Valley. Although calcite precipitates occur naturally, the waste rock produced from mining has high concentrations of both calcium and carbonate which can solidify on large stretches of stream. Supersaturated conditions cause concretion of the streambed which can negatively affect aquatic life by actively eliminating benthic invertebrate habitat (Barrett, Weech, and Orr 2016). High amounts of calcite precipitate correlate with decreased %EPT and %*Ephemeroptera* (Golder Associates Ltd. 2014). There are no water quality guidelines associated with calcite in rivers, and as the Elk River watershed is primarily calcite-rich limestone, local rivers are naturally high in this substance (Golder Associates Ltd. 2014). Assessments of calcite usually measure the amount of solidified deposits within a stream through pebble counts (Barrett, Weech, and Orr 2016). CBWM monitoring includes a pebble count which should allow ERA to see any major deposits, if present. To date, no major calcite deposits have been seen during monitoring. ERA may begin to explore options for more robust calcite monitoring, at the request of advisors on the Elk River Watershed Monitoring Collaborative.

Tributary catchments assessed with ERA's CBWM program are not affected by contemporary mining activities and are not expected to experience related contaminant issues. Selenium concentrations at the CBWM sites do not exceed reference levels and remain below the water quality guideline for freshwater aquatic life (Figure 41) (British Columbia Ministry of Environment and Climate Change Strategy 2021). For comparison, Figure 42 displays selenium concentrations in the Elk River mainstem near the outflow to Lake Koocanusa, (the Elk receives selenium loadings from upstream mines), and compares the levels found in ERA's CBWM assessed tributaries in 2020. The concentrations at these tributaries are well below what is now observed in the Elk River mainstem and are similar to those in the Elk River in the 1990s.

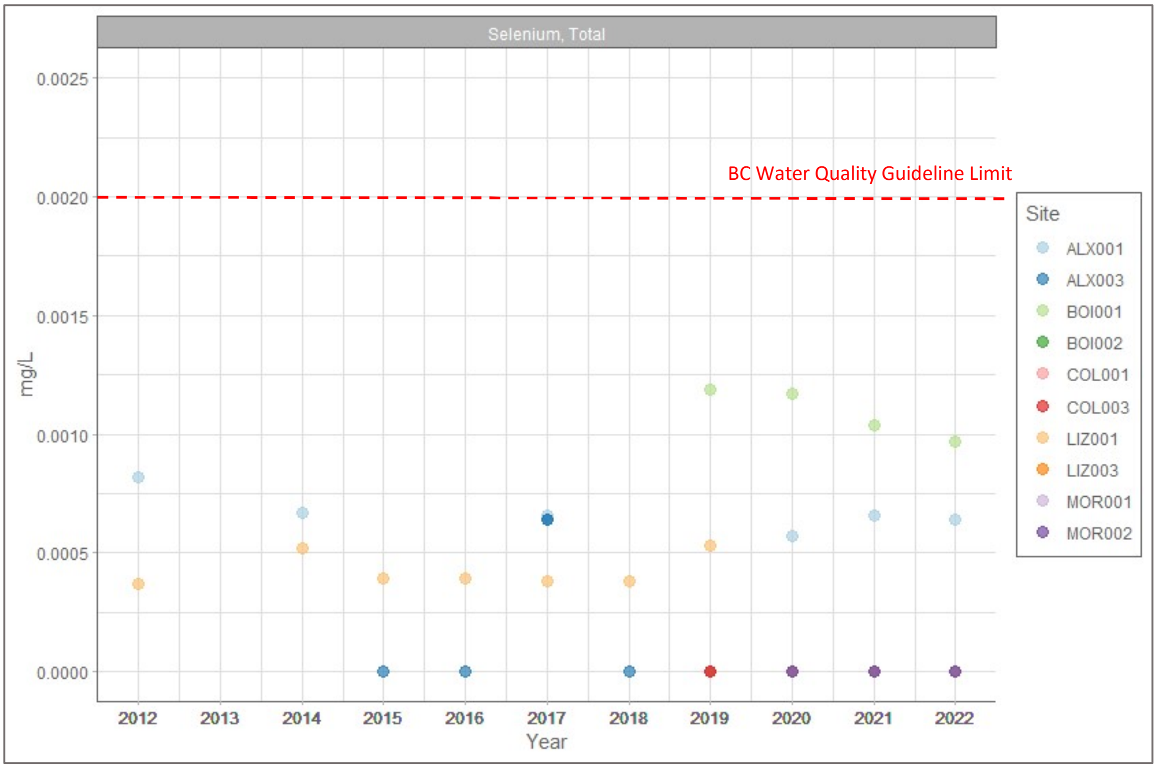


Figure 41. Total selenium concentrations at CBWM sites from 2012 to 2022. All concentrations are well below the BC water quality guideline of 0.002 mg/L (2µg/L).

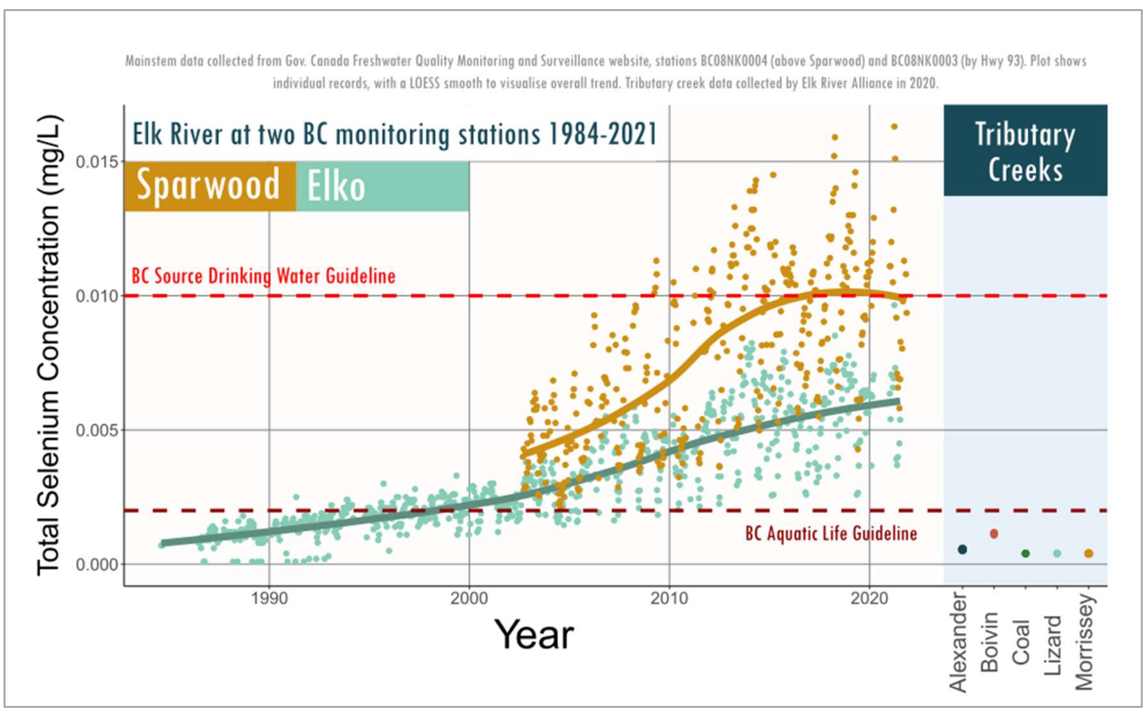


Figure 42. Total selenium in the Elk River mainstem at the outflow to Lake Koocanusa. Approximate concentrations at CBWM tributaries are included to the right and coincides with Elk River concentrations in the 1990s.

Study Limitations

A breakdown of some of the potential limitations for the 2022 CBWM sampling season.

Table 2. Outline of the potential limitations of ERA's Community-based Water Monitoring program

Aspect	Constraint	Comments on Limitations
Team competency/ experience	No	Teams performing site assessments are trained in CABIN protocols through the Canadian Rivers Institute, ECCC and/or Living Lakes Canada. Individuals in these teams have varying levels of experience practicing CABIN protocols but are always led by a more experienced ERA staff member.
Timing / weather / seasonality	No	All monitoring is completed during low flow conditions, typically between August and November. Site visits are rescheduled if weather is not conducive to CABIN sampling (i.e. heavy rains that may change benthic invertebrate communities).
CABIN Model	Maybe	In 2020 a new CABIN model was produced for the Columbia Basin which when applied to ERA sites, yielded substantially different results than with the previous model. ERA is currently investigating these issues to explore whether they are a result of unknown stressors on the aquatic systems, issues with the new model's ability to sort and assess ERA's sites, GIS, or field technician error.
Scope	No	The scope was clearly defined and realistically achievable within the designated timeframe.
Proportion of task achieved, and further work which might be needed	Maybe	All sites were successfully sampled and assessed, but there is room for improvement and expansion. The CBWM program aims to create a better understanding of watershed health. Increasing the number of sites across different watershed areas and incorporating a greater variety of habitats may be necessary to better understand overall ecosystem health.
Resources	No	Through the ERA board of directors and local partnerships, ERA staff have access to a diverse group of experts in various scientific fields. With the development of the Elk River Watershed Monitoring Collaborative, ERA's CBWM program focus will aim to align with the initiatives of this group and will gain further expertise in several different fields through its involvement in this program. In the past, ERA has had limited access to industry-standard equipment. In 2021, ERA was able to begin upgrading equipment. Physical water quality parameters are being assessed using the YSI ProDSS which increases the accuracy of measurements.
Access	No	All sites were accessible. Initial CBWM site selection includes evaluating the accessibility of a site prior to inclusion in the program.

Conclusion & Recommended Actions

ERA's CBWM program is an ongoing program used to assess streams of concern identified through research and community input. 2022 methodology continued to center around CABIN-based assessments and included STREAM e-DNA sampling.

While study sites on Alexander Creek and Boivin Creek appear to be in healthy condition, the lower Coal Creek site (COL001), the lower Morrisey Creek site (MOR001), and both Lizard Creek sites (LIZ001 and LIZ003), are being assessed as "highly divergent" from reference condition, which suggests that these sites may not be in good health. According to CABIN assessments, the upper test sites at both Coal and Morrissey are also experiencing a potential decline in health, with COL003 assessed as "divergent" and MOR002 as "mildly divergent".

Both Coal Creek and Morrissey Creek have large amounts of current and historical upstream development, which is why the poor assessment results at the lower sites (COL001, MOR001) were not entirely unexpected. Analysis of water quality parameters associated with these sites does not indicate any obvious red flags due to exceedances of water quality guidelines that would point to causes for divergence, but the diversity of the benthic communities at these locations appears abnormal compared to reference condition sites. Continuing to monitor these sites and watching for patterns in water quality parameters over time, is a priority going forward.

The unexpected results for the Lizard Creek sites are a concern given the creek's importance in Westslope Cutthroat Trout population recruitment (Elk River Alliance 2020). Although there are no specific exceedances of any water quality parameters based on BC guidelines, the benthic communities differ from what is expected from a typical healthy aquatic habitat, with numbers of pollutant-tolerant families becoming more prominent.

For each of these sites that have been assessed as "highly divergent", the total abundance of benthic invertebrates has been significantly higher than at associated reference sites. Furthermore, based on several measured water quality parameters, Lizard Creek may have unique conditions that are not captured by assigned reference sites (elevated alkalinity, hardness, calcium, magnesium, etc.). Due to the nature of CABIN models, which match a test site with a collection of specific reference sites and then compare the benthic communities, its possible that these high abundances have exaggerated how different the sites are, and produced these more extreme results, or that the differences in the natural state of this creek and reference creeks is too great to compare, yielding inaccurate results.

Understanding why these shifts in state have occurred, whether it is a data error, CABIN model issue, or a sign of a quickly degrading important aquatic habitat, is a high priority. ERA is recommending further investigations into potential stressors affecting these "highly divergent" CABIN monitoring sites. Lizard Creek has been flagged as a high priority creek for more in-depth monitoring in future.

ERA has established and continues to engage with the Elk River Watershed Collaborative Monitoring Program (ERWCMP). With the growth of new partnerships, the development of new research questions and access to previously inaccessible data, ERA hopes to continue to expand the CBWM program in the coming years and integrate ERA CABIN sites with ERWCMP's recommendations to improve our understanding of watershed health. The primary focus will continue to be filling in current data gaps and finding answers to the local community's environmental concerns. ERA will seek to engage the ERWCMP on the potential issues with Lizard Creek and hopes to enlist this group to take a leading role in new monitoring efforts on this Creek.

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Appendix A: CABIN Reports

ELK River Alliance			**Site**	**ALX001**	**ALX003**	**BOI001**	**BOI002**	**COL001**	**COL003**	**LIZ001**	**LIZ003**	**MOR001**	**MOR002**
2022 CABIN Benthos			**Stream**	**Alexander Creek**	**Alexander Creek**	**Boivin Creek**	**Boivin Creek**	**Coal Creek**	**Coal Creek**	**Lizard Creek**	**Lizard Creek**	**Morrissey Creek**	**Morrissey Creek**
Taxonomist: Pina Viola			**CABIN study**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**	**CBWQ-Elk**
Date: September 25, 2023			**Sampling date**	**09/14/2022**	**09/14/2022**	**09/21/2022**	**09/21/2022**	**09/18/2022**	**09/18/2022**	**09/20/2022**	**09/20/2022**	**09/11/2022**	**09/11/2022**
			Device	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**	**kicknet**
			Habitat	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**	**riffle**
			% sorted	**5/100**	**5/100**	**6/100**	**8/100**	**6/100**	**20/100**	**5/100**	**5/100**	**5/100**	**6/100**
Order	**Family**	**Genus**	**Species**										
Anellida-Oligochaeta				0	1	0	0	0	0	0	0	0	0
	Enchytraeidae			0	0	0	0	0	0	1	0	0	0
	Lumbriculidae			5	0	0	2	0	0	0	0	0	0
	Naididae (Tubificidae)			1	1	0	0	244	0	321	9	24	0
Acari-Sarcoptiformes (Oribatea)				0	0	0	0	0	1	0	0	0	0
Acari-Trombidiformes				0	0	0	0	0	4	0	1	5	0
	Aturidae	Aturus		0	0	0	0	1	0	1	0	3	2
	Hydryphantidae			0	0	0	1	0	0	0	0	0	0
		Protzia		0	0	0	0	0	0	0	0	0	1
	Hygrobatidae	Hygrobates		0	0	0	0	1	0	0	1	0	0
	Lebertiidae	Lebertia		2	1	0	0	3	0	12	9	2	2
	Sperchontidae	Sperchon		0	0	0	0	3	4	0	0	2	0
	Torrenticolidae	Testudacarus		0	1	0	0	0	0	4	13	1	0
		Torrenticola		1	0	0	0	5	1	4	0	37	1
Coleoptera	**Elmidae**			0	2	0	0	0	4	2	33	12	2
		Heterlimnius		2	4	0	0	1	10	14	110	3	5
		Narpus		0	0	0	0	0	0	0	1	0	0
		Zaitzevia		0	0	0	0	1	0	0	0	10	0
Diptera				0	0	0	0	0	0	0	1	0	0
	Ceratopogonidae			6	2	0	0	0	1	0	0	2	0
	Chironomidae			39	22	178	53	174	82	97	57	199	135
	Empididae			1	0	0	0	1	0	0	0	1	0
		Chelifera		0	3	0	0	0	0	0	0	1	0
		Oreogeton		0	0	0	1	0	0	0	0	0	0
		Wiedemannia		0	0	0	0	0	0	9	0	0	0
	Pelecorhynchidae	Glutops		0	0	0	0	0	0	0	2	0	0
	Psychodidae	Pericoma/Telmatoscopus		17	47	1	3	0	0	18	39	1	0
	Simuliidae			0	0	3	0	0	0	5	1	0	0
		Simulium		2	2	0	0	0	0	10	2	0	0
	Tipulidae			0	0	0	0	8	0	1	0	6	0
		Antocha		0	0	0	0	0	0	0	9	1	0
		Hexatoma		0	0	0	0	0	0	0	0	3	0
		Tipula (Arctotipula)		0	0	0	0	1	0	0	0	0	0
Ephemeroptera				0	0	0	0	0	0	0	1	0	0
	Ameletidae	Ameletus		1	1	1	5	1	64	1	0	4	27
	Baetidae			0	0	0	0	1	1	0	2	5	1
		Acentrella		0	0	0	0	1	0	0	0	4	0
		Baetis		55	22	33	36	21	6	54	209	5	15
		Diphetor		0	0	0	0	0	0	1	4	4	23
	Ephemerellidae			25	38	1	4	148	22	20	268	18	7
		Caudatella		2	18	0	0	0	0	0	0	0	0
		Drunella	Drunella coloradensis	1	2	1	1	0	0	0	0	0	0
			Drunella doddsi	16	8	17	61	1	0	17	62	0	0
			Drunella grandis	0	0	0	0	1	0	5	2	0	0
			Drunella spinifera	0	5	0	0	0	0	1	0	0	0
	Heptageniidae			22	24	38	9	3	0	3	28	38	3
		Cinygmula		23	38	28	23	15	4	2	35	58	42
		Epeorus		25	15	13	12	0	0	0	2	2	0
		Rhithrogena		12	12	56	33	1	0	0	5	3	4
	Leptophlebiidae			0	0	0	0	1	0	0	0	7	5
		Neoleptophlebia		0	0	0	0	1	0	0	0	5	0
Plecoptera				0	2	0	0	0	2	2	2	0	1
	Capniidae			1	5	1	2	22	24	7	29	17	37
	Chloroperlidae			2	1	1	9	0	12	0	7	0	16
		Sweltza		2	5	2	0	0	17	0	7	1	46
	Leuctridae			0	0	4	0	1	0	1	0	0	0

	Nemouridae			0	2	0	1	0	3	0	3	0	0
		Visoka		0	0	5	2	0	3	0	0	1	1
		Zapada		12	8	1	0	1	6	11	26	0	5
			Zapada cinctipes	17	14	0	0	3	0	64	78	6	1
			Zapada columbiana	0	2	18	14	0	3	7	4	0	1
			Zapada oregonensis/haisi	6	2	1	0	0	0	9	7	0	1
	Peltoperlidae			0	0	0	0	0	1	0	0	0	0
		Yoraperla		0	0	0	0	0	0	0	0	0	2
	Perlidae			0	0	0	0	0	6	4	9	0	2
		Doroneuria		0	0	0	0	0	**5**	**8**	**5**	**0**	**3**
	Perlodidae			1	6	0	1	0	7	0	0	0	1
		Megarcys		0	0	1	11	0	0	0	5	0	3
		Skwala		0	0	0	0	2	0	0	0	2	0
	Taeniopterygidae			25	18	112	67	0	0	7	48	0	0
Trichoptera				0	1	0	0	0	6	2	0	1	2
	Apatanidae	Apatania		0	0	0	0	0	0	1	1	0	0
	Brachycentridae	Brachycentrus		1	0	0	0	0	0	2	0	0	0
		Micrasema		1	3	0	0	0	8	6	5	7	2
	Glossosomatidae	Glossosoma		21	4	3	8	0	0	2	3	0	0
	Hydropsychidae			1	5	0	1	1	0	35	4	4	0
		Artopsyche		0	0	0	0	0	0	3	0	0	0
		Hydropsyche		0	0	0	0	1	0	49	1	10	0
		Parapsyche		1	1	0	0	0	0	0	1	0	0
	Hydroptilidae	Hydroptila		0	0	0	0	1	0	2	0	0	0
	Lepidostomatidae	Lepidostoma		0	0	0	0	38	0	0	0	23	0
	Rhyacophilidae	Rhyacophila		8	1	2	12	0	2	3	19	1	6
			Rhyacophila betteni gr.A	0	0	0	0	0	1	0	2	0	0
			Rhyacophila hyalinata gr.	1	0	0	0	0	0	0	0	0	0
			Rhyacophila narvae	0	1	0	0	0	0	0	0	0	0
			Rhyacophila sibirica gr., atr	0	2	0	0	0	0	0	0	0	0
			Rhyacophila vemna/brunn	3	3	3	1	0	2	2	3	0	0
	Uenoidae			0	0	0	0	0	0	0	0	0	1
		Neothremma		0	0	0	1	0	1	0	0	0	0
		Oligophlebodes		0	2	0	0	0	0	6	35	0	0
TOTAL				**361**	**357**	**524**	**374**	**708**	**313**	**836**	**1210**	**539**	**406**

Appendix B: Raw CABIN Datasheets

Field Crew: K. McCallum, A. Kroeger, A. Block Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 14/09/2022

☒ Occupational Health & Safety: Site Inspection Sheet completed

PRIMARY SITE DATA

CABIN Study Name: CBWM - Elk Local Basin Name: Elk River

River/Stream Name: Alexander Creek Stream Order: (map scale 1:50,000) 4

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Take left turnoff from highway before Michel Creek bridge (Spar→A
follow dirt road through forest - stay right. Park @ river,
walk up Michel to ALX confluence. Site is ~70m u/s of confluen

Surrounding Land Use: (check those present) Information Source: ______

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☒ Mining ☒ Commercial/Industrial ☒ Other train

Dominant Surrounding Land Use: (check one) Information Source: ______

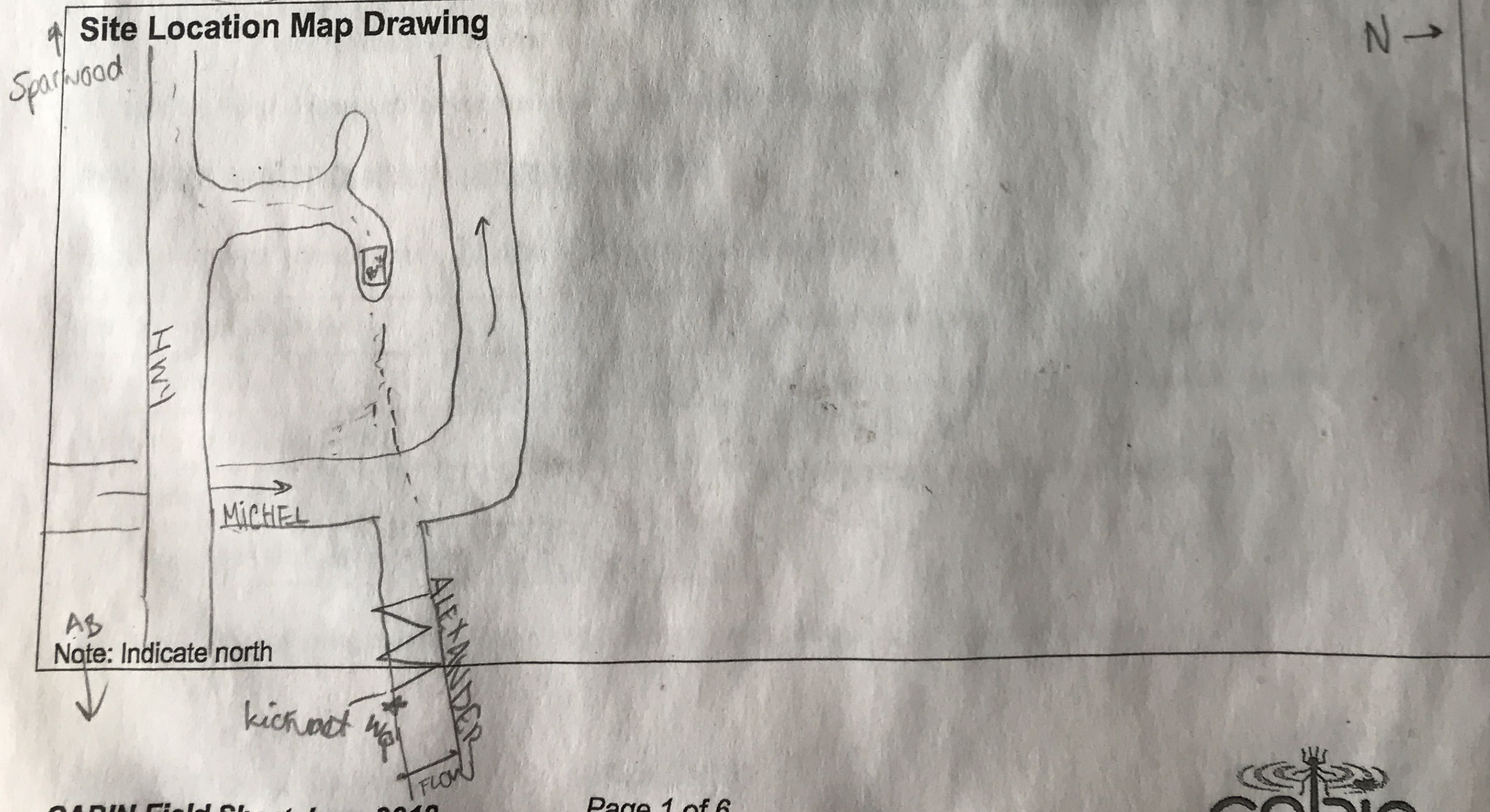
☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Location Data

Latitude: 49.674237 N Longitude: -114.780191 W (DMS or DD)

Elevation: 1219.0 (fasl or masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

CABIN

Field Crew: KM, AB, AK
Site Code: ALX001
Sampling Date: (DD/MM/YYYY) 14/09/2022

Photos

- [x] Field Sheet
- [x] Upstream
- [x] Downstream
- [x] Across Site
- [ ] Aerial View
- [x] Substrate (exposed)
- [x] Substrate (aquatic)
- [ ] Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   - [x] Riffle
   - [ ] Rapids
   - [x] Straight run
   - [ ] Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   - [ ] 0 %
   - [x] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   - [x] 0 %
   - [ ] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %

4. Streamside Vegetation: *(check those present)*
   - [x] ferns/grasses
   - [x] shrubs
   - [x] deciduous trees
   - [x] coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   - [x] ferns/grasses
   - [x] shrubs
   - [ ] deciduous trees
   - [ ] coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*
   - [ ] 1 - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   - [ ] 2 - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   - [x] 3 - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   - [ ] 4 - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   - [ ] 5 - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) [x] riffle [ ] rapids [ ] straight run

400 μm mesh Kick Net	
Person sampling	K.McCallum
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	1
Typical depth in kick area (cm)	20cm

Preservative used: 99% ISO

Sampled sieved on site using "Bucket Swirling Method":
[ ] YES [x] NO

If YES, debris collected for QAQC [ ]

Note: Indicate if a sampling method other than the recommended 400 μm mesh kick net is used.

CABIN
CANADIAN AQUATIC BIOMONITORING NETWORK

Field Crew: KM, AK, AB,

Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 14/09/2022

WATER CHEMISTRY DATA Time: 15:20 (24 hr clock) Time zone: MST

Air Temp: 17.0 (°C) Water Temp: 9.6 (°C) pH: 8.55

Specific Conductance: 276.8 (µs/cm) DO: 10.01 (mg/L) Turbidity: 0.22 (NTU)

195.3 µs/cm

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☒ Other check water sampling field sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **~~Calculated from map~~**

Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) ______ (m),

distance between contour intervals (horizontal distance) ______ (m)

slope = vertical distance/horizontal distance = ______

OR

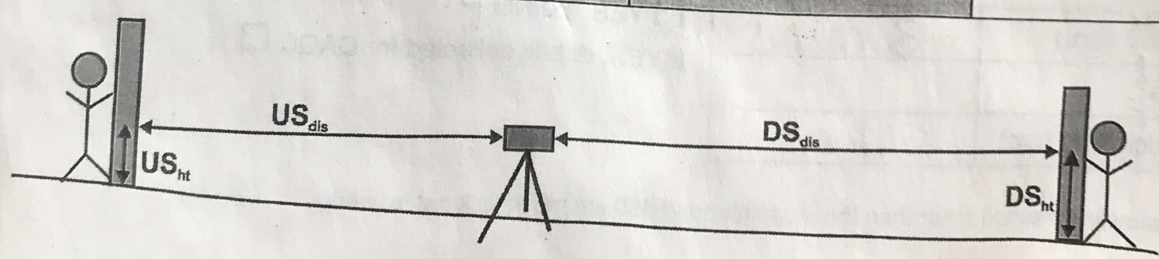
☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

0.703

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR [b]Height of rod	0.703	1.610	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR [a]T-B x 100	30 m [a]US_{dis}=T-B	30 m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60 m
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



CABIN

Field Crew: KM, AK, AB

Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 14/09/2022

RWB = 0.7

LWB = 10.5

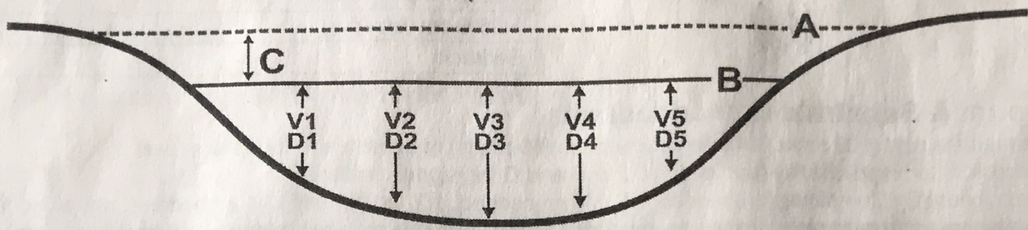
Widths and Depth

Location at site: d/s of kick net (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 14.3 (m)

B - Wetted Stream Width: 9.8 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 24 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

Q=1.338 m^3/s

See attached flow sheet.

☐ ~~**Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]~~

☐ ~~**Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)~~

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☒ Sontek (Flowtracker) or ☐ Other

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (D) (cm)							0.209
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)							0.653

Disch 1.3382

Site Code: ALX001

Field Crew: KM, AK, AB

Sampling Date: (DD/MM/YYYY) 14/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

6

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	5		26	9.0		51	25.0		76	3.0	
2	2.5		27	5.5		52	10.0		77	11.0	
3	3.5		28	5.0		53	4.0		78	27.0	
4	6		29	16		54	10.0		79	16.0	
5	1.8		30	2.2	0	55	7.0		80	9.5	0
6	6.0		31	16.0		56	4.0		81	4.7	
7	3.6		32	3.0		57	5.5		82	23	
8	8.2		33	8.5		58	7.5		83	5.8	
9	7.2		34	4.5		59	6.0		84	11	
10	3.5	1/4	35	17.0		60	5.5	0	85	5.8	
11	20.0		36	5.5		61	4.5		86	7.5	
12	11.6		37	3.1		62	5.5		87	14.0	
13	10.0		38	24.0		63	7.5		88	2.6	
14	3.0		39	38.0		64	8.0		89	8.0	
15	8.0		40	7.0	1/4	65	5.0		90	5.9	1/4
16	18.0		41	5.5		66	4.0		91	8.9	
17	16.0		42	45.0		67	3.5		92	6.5	
18	50.0		43	15.0		68	8.0		93	8.5	
19	7.2		44	25.0		69	2.5		94	11.5	
20	14.8	0	45	18.0		70	15.5	1/4	95	7.4	
21	7.0		46	17.0		71	6.5		96	12.0	
22	4.2		47	24.5		72	14.5		97	2.0	
23	2.4		48	17.0		73	6.5		98	5.4	
24	4.4		49	21.0		74	10.0		99	12.4	
25	10.5		50	21.0	3/4	75	3.0		100	5.5	3/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

CABIN

Field Crew: KM, AK, AB Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 14/09/2022

SITE INSPECTION

Site Inspected by: K McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: C Hughes Time checked-in: 12:00

Form of communication: ☐ radio ☒ cell ☒ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes: low flow

CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Elk River Alliance

Velocimeter Measurement Field Sheet

Q=1.338

Site: ALX001

Date: 22/09/14

Time: 17:01

Staff: KM

~~LWE:~~ ~~RWE:~~

Staff Gauge:

Wetted Width: 9.8

Bankful Width: 14.3

Instrument ID: Flowtracker 2

Photos:
- [x] 1. Completed Field Sheet
- [x] 2. Upstream
- [x] 3. Downstream
- [x] 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0.7	0	0	
2	0.9	0.28	0.224	
3	1.3	0.27	-0.089	
4	1.6	0.28	0.957	
5	1.7	0.32	0.814	
6	1.9	0.20	1.377	
7	2.1	0.26	1.244	
8	2.4	0.26	1.123	
9	2.8	0.32	0.921	
10	3.2	0.32	0.785	
11	3.6	0.30	0.935	
12	4	0.22	1.329	
13	4.4	0.12	1.271	
14	4.8	0.26	0.87	
15	5.2	0.26	0.472	

Continued from other side

16	5.6	0.28	0.225	
17	6.0	0.26	0.108	
18	6.4	0.12	0.477	
19	6.8	0.26	0.776	
20	7.2	0.28	0.684	
21	7.6	0.19	0.503	
22	8	0.18	0.233	
23	8.5	0.18	0.478	
24	9	0.15	0.437	
25	9.5	0.09	0.146	
26	10.5	0	0	
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

Anne-Caroline Kroeger

Field Crew: Kaileigh McCallum

Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 14/09/2022

Alane Block

☒ Occupational Health & Safety: Site Inspection Sheet completed

PRIMARY SITE DATA

CABIN Study Name: CBWM- ELK

Local Basin Name: Elk River Watershed

River/Stream Name: Alexander Creek

Stream Order: (map scale 1:50,000) 4

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: From highway #3 from Sparwood to AB, take left turn-off unto dirt road (past campground) keep your left to park. Walk up into forest for 30 meters up to Alexander Creek. Sampling site is on other side of Sparwood Rifle Range.

Surrounding Land Use: (check those present)

Information Source: visual

☒ Forest ☒ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☒ Logging ☒ Mining ☐ Commercial/Industrial ☒ Other rifle range + informal campground

exploration & EIA for future NWP mine

Dominant Surrounding Land Use: (check one)

Information Source: visual

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

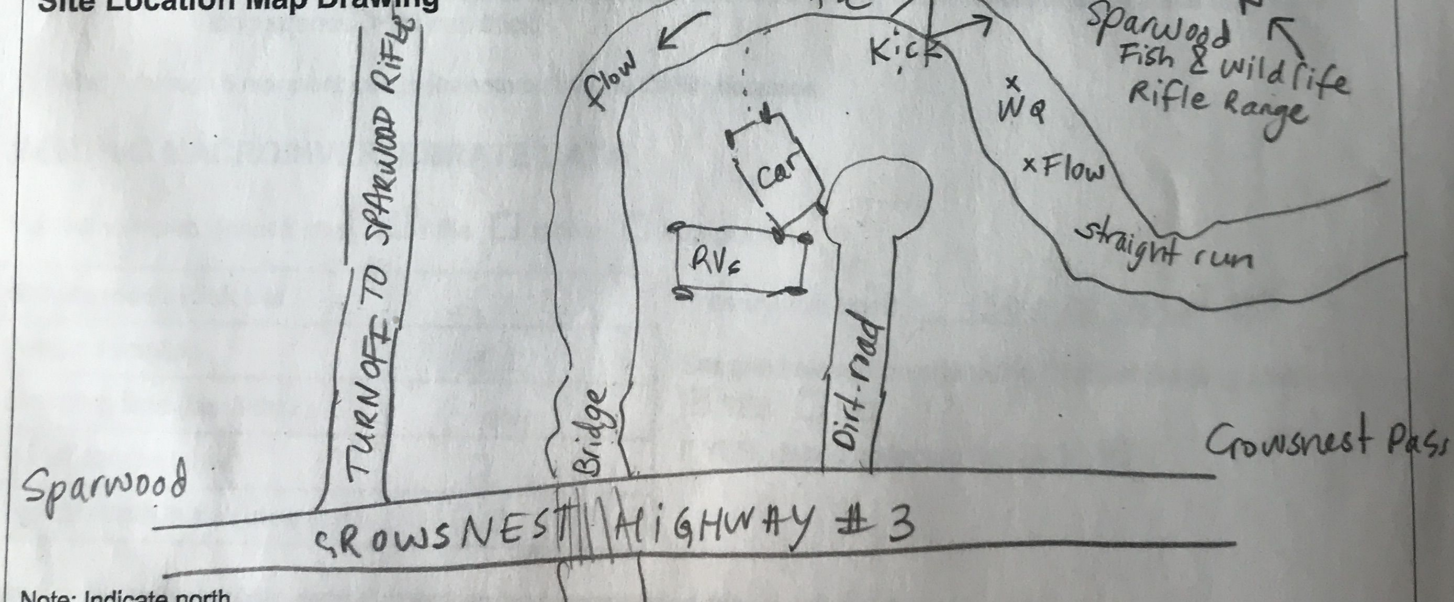
Location Data

Latitude: 49.655630 N Longitude: -114.730781 W (DMS or DD)

Elevation: 1311.0 (fasl or masl)

GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

Field Crew: K.M A.B A.C.K Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 14092022

Photos

☒ Field Sheet ☒ Upstream ☒ Downstream ☒ Across Site ☐ Aerial View

☒ Substrate (exposed) ☒ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

   ☒ Riffle ☐ Rapids ☒ Straight run ☒ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

   ☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

   ☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*

   ☒ ferns/grasses ☒ shrubs ☒ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

   ☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☐ 1 - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

   ☐ 2 - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

   ☒ 3 - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

   ☐ 4 - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

   ☐ 5 - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one)* ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	✓
Person sampling	ACK
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	2
Typical depth in kick area (cm)	20

Preservative used: isopropanol 99%

Sampled sieved on site using "Bucket Swirling Method":

☒ YES ☐ NO

If YES, debris collected for QAQC ☒

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: A. B K-M A.G.K.

Site Code: ALY003

Sampling Date: (DD/MM/YYYY) 14092022

WATER CHEMISTRY DATA Time: 9:24 (24 hr clock) **Time zone:** MST

Air Temp: 12.5 (°C) Water Temp: 6.2 (°C) pH: 8.5

Specific Conductance: 276.5 (µs/cm) DO: 10.7 (mg/L) Turbidity: 0.25 (NTU)

Check if water samples were collected for the following analyses:

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other See water sampling fieldsheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

- [ ] **Calculated from map**

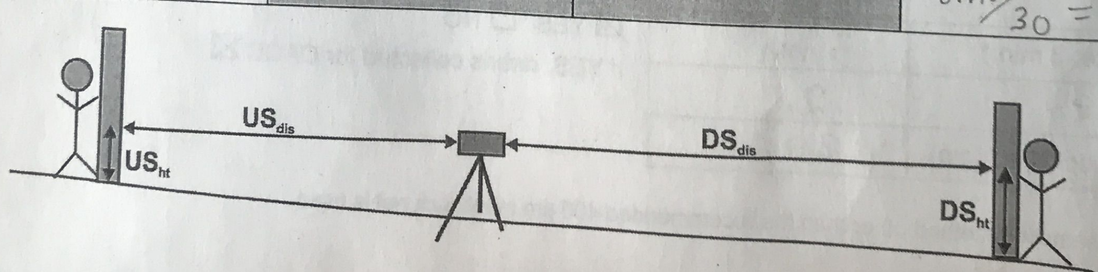
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance = ______

OR

- [x] **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
~~[a]Top Hairline (T)~~	—	—	
~~[a]Mid Hairline (ht)~~ OR [b]Height of rod	1.205	1.921	
~~[a]Bottom Hairline (B)~~	—	—	
[b]Distance (dis) OR [a]T-B x 100	30 m [a]US_{dis}=T-B	30.0 m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60.0m
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1.921 - 1.205 = 0.716
Slope (Δht/total dis)			0.716/30 = 0.02386667 (2.39%)



CABIN

Field Crew: A.B AC.K. K.M Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 14092022

LWB: 0.13m

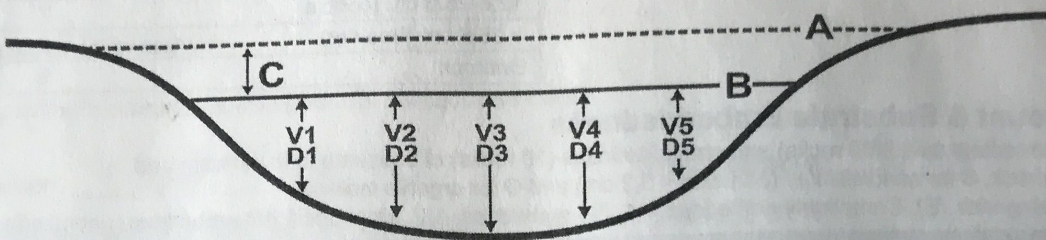
RWB: 10.1m

Widths and Depth

Location at site: u/s kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 10.90 (m) B - Wetted Stream Width: 9.97 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 19.1 cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

Q= 1.224m³/s

☐ **Velocity Head Rod (or ruler):** Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters:** Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☒ Sontek or ☐ Other Flowtracker 2

See attache Flow da shee

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (D) (cm)							0.263
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)							0.468

See attached flow sheet

Field Crew: K.M. ACK AB

Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 14092022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embedeedness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	5		26	6.5		51	3.0		76	6.1	
2	9		27	5.0		52	12.0		77	3.1	
3	2.5		28	13.0		53	10.5		78	6.5	
4	11		29	13		54	3		79	11.1	
5	7		30	9	1/4	55	8		80	6.2	1/4
6	7		31	12		56	16		81	4.1	
7	9		32	13		57	11		82	7	
8	11		33	12.2		58	8.6		83	4.5	
9	13	0	34	4.2		59	0.7		84	7	
10	12		35	11.1		60	8	1/4	85	6	
11	11		36	10.9		61	20		86	12.4	
12	10		37	14.5		62	9		87	11.5	
13	9		38	7.2		63	13.5		88	4.5	
14	21		39	11.9		64	11.5		89	19	
15	11		40	4.5	1/2	65	7.3		90	13	0
16	1		41	10.0		66	4.2		91	9.5	
17	8		42	10.1		67	8.3		92	19	
18	20		43	15.5		68	2.1		93	17	
19	10		44	14.0		69	10.7		94	9.5	
20	12	1/2	45	2.8		70	3.9	0	95	21	
21	11		46	7.5		71	10.2		96	0.6	
22	4		47	7.8		72	13		97	3.5	
23	8		48	4.5		73	3		98	11	
24	13		49	8.5		74	14.4		99	21.5	
25	10		50	47	1/2	75	10.1		100	9.4	1/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM AB ACK

Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 14/09/2022

SITE INSPECTION

Site Inspected by: Anne-Caroline Kroeger

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes

Time checked-in: 8:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

~~☐ PFD worn~~ N/A low flow (trickle)

☒ Appropriate footwear, waders, wading belt

~~☐ Belay used~~ N/A

Notes:

Q=0.468

iver Alliance

elocimeter Measurement Field Sheet

Elk River Alliance

LWE: RWE:

Site: ALX003

Date: 2022/09/14

Time: 11:11

Staff: AB, KM

Staff Gauge: ___

Wetted Width: 9.97

Bankful Width: 10.90

Instrument ID: Flowtracker

Photos: ☑ 1. Completed Field Sheet ☑ 2. Upstream ☑ 3. Downstream ☑ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0.13	0	0	Left Bank
2	0.25	0.12	0.031	
3	0.65	0.2	0.0259	
4	1.05	0.18	0.2718	
5	1.45	0.20	0.1153	rocks large u/s d/s
6	1.85	0.2	0.5359	
7	2.25	0.08	0.0746	
8	2.65	0.36	0.0158	
9	3.05	0.20	0.6308	
☆ 10	3.45	0.5 0.2 0.5	0.2178	
11	3.85	0.32	0.5428	
12	4.25	0.44	0.6371	
13	4.65	0.48	0.6465	
14	5.05	0.44	0.7231	
15	6.45	0.43	0.4947	

Continued from other side

16	5.85	0.38	0.7291	
17	6.25	0.44	0.5786	
18	6.65	0.28	0.5893	
19	7.05	0.34	0.6288	
20	7.45	0.31	0.4822	
21	7.85	0.18	0.4856	
22	8.25	0.22	0.3887	lg rock US
23	8.65	0.11	0.4041	
24	9.05	0.08	0.2834	
25	9.45	0.15	.1283	
26	10.10	0	0	RIGHT BANK
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: K.McCallum C.Hughes Site Code: BO1001

Sampling Date: (DD/MM/YYYY) 21/09/2022

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River

River/Stream Name: Boivin Creek Stream Order: (map scale 1:50,000) ______

Select one: ☒ ~~Test Site~~ ☐ Potential Reference Site

Geographical Description/Notes:
Boivin Creek above confluence into Elk River, below in-town bridge.

Surrounding Land Use: (check those present) Information Source: Visual, local know

☐ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban
☐ Logging ☐ Mining ☒ Commercial/Industrial ☐ Other ______

Dominant Surrounding Land Use: (check one) Information Source: vis, local

☐ Forest ☐ Field/Pasture ☐ Agriculture (in Elkford town) ☐ Residential/Urban
☐ Logging ☐ Mining ☒ Commercial/Industrial ☐ Other ______

Location Data

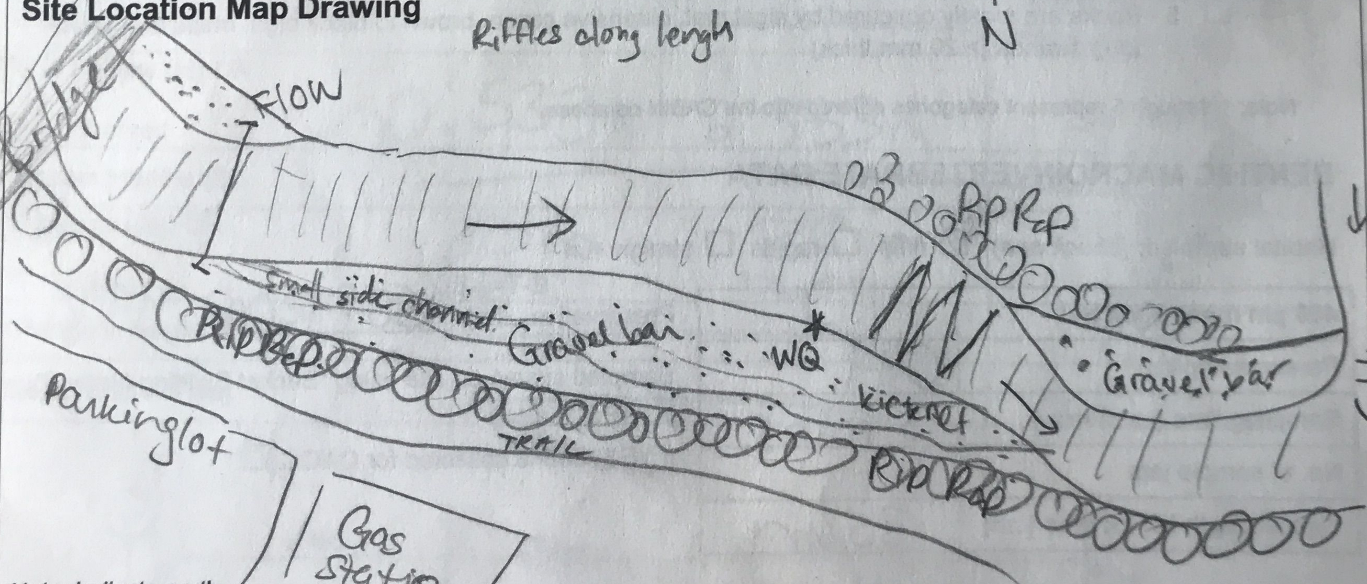
Latitude: 50.016926 N Longitude: - 114.936996 W (DMS or DD)

Elevation: 1248.5 (fasl or masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ______

DS=30
23.33

US=
0.533

Site Location Map Drawing



Note: Indicate north

CABIN

Site Code: B01001

Field Crew: KM, CH,

Sampling Date: (DD/MM/YYYY) 21/09/2022

Photos
☒ Field Sheet ☒ Upstream ☒ Downstream ☒ Across Site ☐ Aerial View
☒ Substrate (exposed) ☒ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☒ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*
☒ ferns/grasses ☒ shrubs ☐ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☒ ferns/grasses ☐ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☒ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: *(check one)* ☒ riffle ☐ rapids ☐ straight run

400 μm mesh Kick Net	
Person sampling	C.H.
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	1
Typical depth in kick area (cm)	35cm

Preservative used: ISOPROP 99%

Sampled sieved on site using "Bucket Swirling Method": ☒ YES ☐ NO

If YES, debris collected for QAQC ☒

Note: Indicate if a sampling method other than the recommended 400 μm mesh kick net is used.

Field Crew: KM, CH

Site Code: BO1001

Sampling Date: (DD/MM/YYYY) 21/09/2022

WATER CHEMISTRY DATA Time: 13:36 (24 hr clock) Time zone: MT

Air Temp: 17.5 (°C) Water Temp: 5.3 (°C) pH: 7.31

Specific Conductance: 276.3 (µs/cm) DO: 11.28 (mg/L) 89.1% Turbidity: 0.18 (NTU)

Check if water samples were collected for the following analyses:

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other See WQ field sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

- [ ] **Calculated from map**

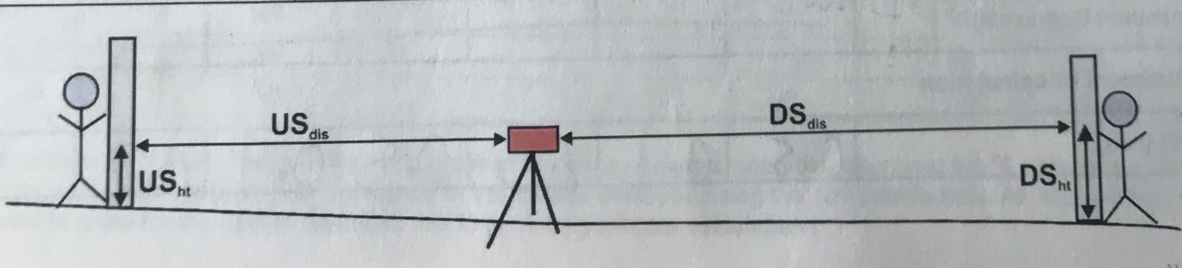
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance = ______

OR

- [x] **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	0.533 m	2.333 m	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	30m [a]US_{dis}=T-B	30m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}=$ 60
Change in height (Δht)			$DS_{ht}-US_{ht}=$ 1.8
Slope (Δht/total dis)			0.03



Site Code: B01001

Field Crew: KM, CH

Sampling Date: (DD/MM/YYYY) 21/09/2022

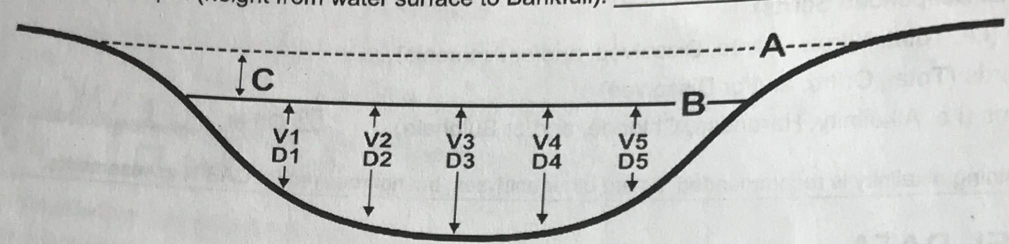
Widths and Depth

Location at site: u/s of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 8.95 (m) B - Wetted Stream Width: 8.35 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 20cm (cm)

	W	B
L	1.65	1.1
R	10	10.05



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☒ Other Global Flow probe

2.84 4.03 5.22 6.41 7.60 8.79

	1	2	3	4	5	6	AVG
Distance from Shore (m)	1.19	2.38	3.57	4.76	5.95	7.14	—
Depth (D) (cm)	13.0	39.0	44.0	36.0	32.0	12.5	
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)	0.5	0.9	1.5	0.5	0.7	0.7	

CABIN

Field Crew: KM, CH

Site Code: B01001

Sampling Date: (DD/MM/YYYY) 21/09/2022

SUBSTRATE DATA

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	5.5		26	10.1		51	9.1		76	35.4	
2	5.9		27	6.2		52	4.2		77	18.2	
3	3.5		28	7.9		53	15.1		78	17.0	
4	2.8		29	6.7		54	8.8		79	15.4	
5	18.5		30	3.4	1/4	55	11.0		80	7.2	
6	18.9		31	10.5		56	28.6		81	3.7	1/4
7	10.5		32	12.0		57	8.7		82	15.0	
8	19.2		33	15.0		58	10.4		83	10.0	
9	10.2		34	4.4		59	10.2		84	2.0	
10	11.0	0	35	3.0		60	17.4	1/4	85	5.2	
11	1.6		36	8.8		61	8.2		86	3.5	
12	21.0		37	23.3		62	6.5		87	4.6	
13	0.3		38	4.7		63	7.1		88	3.9	
14	5.7		39	5.5		64	4.4		89	0.8	
15	14.3		40	5.5	1/2	65	20.5		90	2.9	1/2
16	14.2		41	19.3		66	17.0		91	.7	
17	4.1		42	6.8		67	8.2		92	4.1	
18	4.1		43	3.9		68	15.0		93	3.5	
19	3.0		44	6.0		69	18.0		94	0.4	
20	28.6		45	10.1		70	8.5	1/2	95	7.5	
21	11.2	0	46	4.9		71	45.0		96	6.2	
22	10.5		47	12.1		72	17.0		97	1.2	
23	7.2		48	10.2		73	10.5		98	21.0	
24	23.2		49	9.9		74	15.0		99	11.6	
25	19.0		50	9.2	0	75	11.0		100	Fourteen cm	1/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Site Code: B01001

Field Crew: KM, CH

Sampling Date: (DD/MM/YYYY) 21/09/2022

SITE INSPECTION

Site Inspected by: K.McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: ACK

Time checked-in: 12:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☒ SPOT

Phone number: (514) 664-6815

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: K. McCallum, C. Hughes Site Code: BO1002

Sampling Date: (DD/MM/YYYY) 21/09/2020

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River

River/Stream Name: Boivin Ck. Stream Order: (map scale 1:50,000) ______

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Park @ x-country ski trails (on Natal Rd), follow path to bridge, stay on LWB, head u/s until "nightmare before x-mas" tree

Surrounding Land Use: (check those present) Information Source: visual, maps, local

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☒ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other recreational trails

Dominant Surrounding Land Use: (check one) Information Source: ______

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

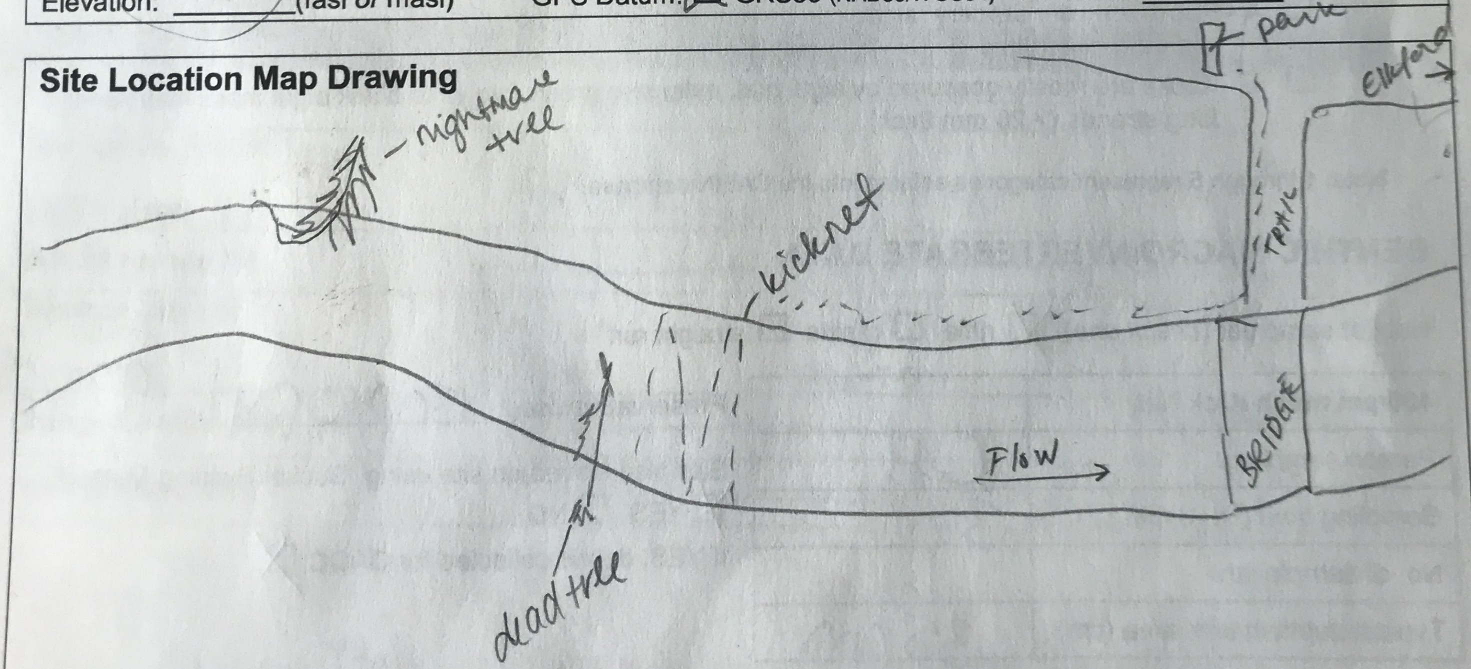
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Location Data

Latitude: 50.016927 N Longitude: - 114.936979 W (DMS or DD)

Elevation: ______ (fasl *or* masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

CABIN

Site Code: B01002

Field Crew: KM, CH

Sampling Date: (DD/MM/YYYY) 21/09/2022

Photos

- [x] Field Sheet
- [x] Upstream
- [x] Downstream
- [x] Across Site
- [ ] Aerial View
- [x] Substrate (exposed)
- [x] Substrate (aquatic)
- [x] Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   - [x] Riffle
   - [ ] Rapids
   - [ ] Straight run
   - [x] Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   - [x] 0 %
   - [ ] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   - [x] 0 %
   - [ ] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %

4. Streamside Vegetation: *(check those present)*
   - [x] ferns/grasses
   - [x] shrubs
   - [x] deciduous trees
   - [x] coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   - [ ] ferns/grasses
   - [x] shrubs
   - [ ] deciduous trees
   - [ ] coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*
   - [ ] 1 - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   - [x] 2 - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   - [ ] 3 - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   - [ ] 4 - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   - [ ] 5 - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) [x] riffle [ ] rapids [ ] straight run

400 μm mesh Kick Net	
Person sampling	CH
Sampling time (i.e. 3 min.)	3
No. of sample jars	
Typical depth in kick area (cm)	35cm

Preservative used: Isopropyl 99%

Sampled sieved on site using "Bucket Swirling Method": [x] YES [ ] NO

If YES, debris collected for QAQC [x]

Note: Indicate if a sampling method other than the recommended 400 μm mesh kick net is used.

Field Crew: KM, CH Site Code: BO1002

Sampling Date: (DD/MM/YYYY) 21/09/2022

WATER CHEMISTRY DATA Time: 11:30 (24 hr clock) Time zone: MT

Air Temp: 3.0 °C (°C) Water Temp: 3.8 (°C) pH: 7.24

Specific Conductance: 277.6 (µs/cm) DO: 11.40 (mg/L) 86.6% Turbidity: 0.31 (NTU)

Check if water samples were collected for the following analyses:

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other See water chem sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

- [ ] **Calculated from map**

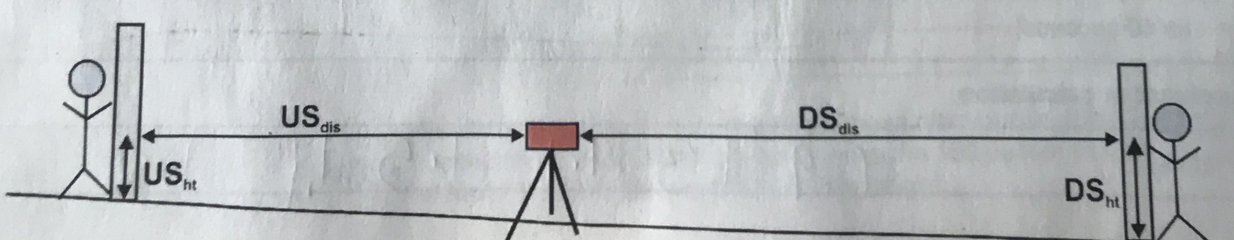
Scale: ________ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ________ (m),
distance between contour intervals (horizontal distance) ________ (m)
slope = vertical distance/horizontal distance = ________

OR

- [x] **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	—
[a]Mid Hairline (ht) OR [b]Height of rod	0.449 m	2.344 m	
[a]Bottom Hairline (B)	—	—	—
[b]Distance (dis) OR [a]T-B x 100	30 m [a]US_{dis}=T-B	30m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60
Change in height (Δht)	—	—	$DS_{ht}-US_{ht}$= 1.895
Slope (Δht/total dis)	—	—	0.031583



CABIN

Site Code: B01002

Field Crew: KM, CH,

Sampling Date: (DD/MM/YYYY) 21/09/2022

W B
L-4.38 0.90
R-9.82 10.10

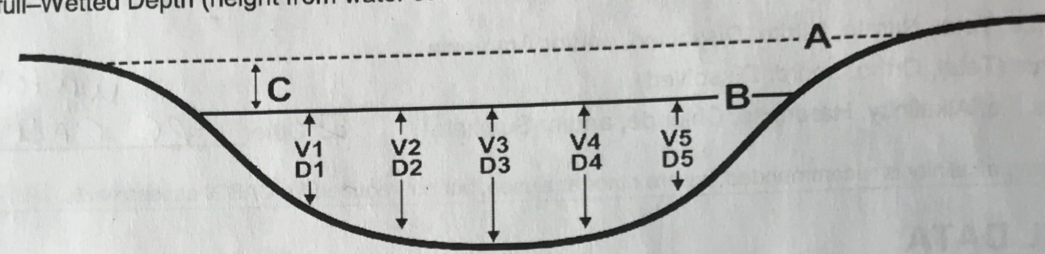
Widths and Depth

Location at site: u/s kicknet area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 9.2 (m)

B - Wetted Stream Width: 5.44 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 29.0 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √[2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☑ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☑ Other Global Flowprobe

	1	2	3	4	5	6	AVG
	5.16	5.94	6.72	7.5	8.28	9.06	
Distance from Shore (m)	0.78	1.55	2.34	3.12	3.90	4.68	—
Depth (D) (cm)	27.0	41.0	36.0	37.0	36.5	34.0	
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)	0.9	1.3	1.1	1.5	1.1	1.2	

CABIN

Field Crew: KM, CH. Site Code: BG1002

Sampling Date: (DD/MM/YYYY) 21/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	15.3		26	24.2		51	7.5		76	0.4	
2	5.3		27	11.0		52	22.0		77	0.2	
3	10.4		28	9.5		53	30.0		78	3.6	
4	4.0		29	6.6		54	25.0		79	21.8	
5	4.3		30	4.3	0	55	40.0		80	16.5	0
6	4.1		31	S		56	40.0		81	8.5	
7	2.9		32	5.2		57	10.6		82	15.0	
8	3.1		33	12.0		58	20.0		83	3.5	
9	1.5		34	6.0		59	14.0		84	2.0	
10	5.6	.25	35	4.8		60	30	.25	85	16.0	
11	5.1		36	8.6		61	9.5		86	4.8	
12	1.2		37	3.0		62	1.2		87	9.5	
13	8.1		38	7.0		63	11.5		88	4.2	
14	6.0		39	9.7		64	3.2		89	1.5	
15	14.0		40	7.5		65	5.1		90	3.0	.25
16	25.0		41	15.0		66	9.5		91	1.5	
17	25.0		42	26.0	.75	67	0.9		92	1.2	
18	16.0		43	28.0		68	0.5		93	5.5	
19	31.6		44	3.8		69	9.2		94	4.3	
20	80.0	.75	45	5.0		70	1.1	0	95	5.5	
21	11		46	7.2		71	22.4		96	7.2	
22	4.2		47	8.5		72	8.2		97	8.5	
23	S		48	4.2		73	7.5		98	15.0	
24	5.5		49	5.0		74	1.2		99	14.5	
25	10.5		50	12.9	.25	75	81		100	85	.50

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM, CH

Site Code: B01001

Sampling Date: (DD/MM/YYYY) 21/09/2022

SITE INSPECTION

Site Inspected by: KM.

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: ACK

Time checked-in: 9:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☒ SPOT

Phone number: (514) 664-6815

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: K. McCallum, C. Buchanan, M. Malone Site Code: COL001

Sampling Date: (DD/MM/YYYY) 18/09/2022

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk

River/Stream Name: Coal Creek Stream Order: (map scale 1:50,000) 3

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Site between Park Ave & train bridge, d/s of Sombrowskis giant house.

Surrounding Land Use: (check those present) Information Source:

☑ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

☑ Logging ☐ Mining ☐ Commercial/Industrial ☑ Other Recreation/train trail

Dominant Surrounding Land Use: (check one) Information Source:

☐ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

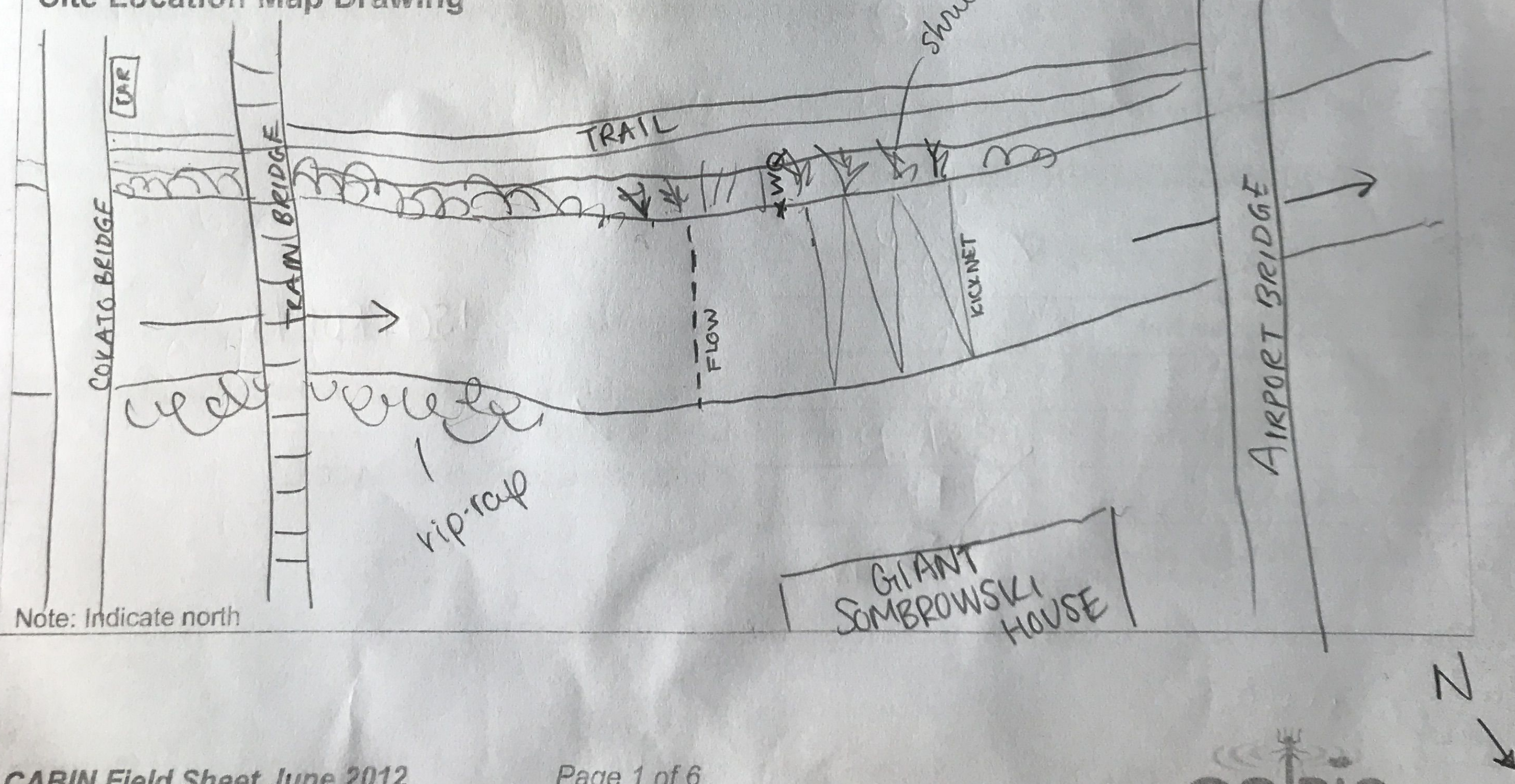
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other

Location Data

Latitude: 49.495744N Longitude: -115.066434 W (DMS or DD)

Elevation: 999 (fasl or masl) GPS Datum: ☑ GRS80 (NAD83/WGS84) ☐ Other:

Site Location Map Drawing



Note: Indicate north

CABIN

Field Crew: KM, CB, MM

Site Code: COL001

Sampling Date: (DD/MM/YYYY) 18/09/2022

Photos

- ☐ Field Sheet
- ☑ Upstream
- ☑ Downstream
- ☑ Across Site
- ☐ Aerial View
- ☑ Substrate (exposed)
- ☑ Substrate (aquatic)
- ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☑ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☐ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 % 2 or 3 horsetail

4. Streamside Vegetation: *(check those present)*
   ☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☐ shrubs ☑ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☐ 1 - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☐ 2 - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   ☑ 3 - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☐ 4 - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ 5 - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: *(check one)* ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	CB
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	15cm

Some deeper areas.

Preservative used: ISO PROPYL

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☑ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: K.M, C.B, M.M Site Code: COL001

Sampling Date: (DD/MM/YYYY) 18/09/2022

WATER CHEMISTRY DATA Time: 15:45 (24 hr clock) Time zone: MST

Air Temp: 21.0 (°C) Water Temp: 14.4 (°C) pH: 8.51

Specific Conductance: 245 (µs/cm) DO: 9.89 (mg/L) Turbidity: 0.70 (NTU)

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☒ Other See WQ sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000)

contour interval (vertical distance) ______ (m),

distance between contour intervals (horizontal distance) ______ (m)

slope = vertical distance/horizontal distance = ______

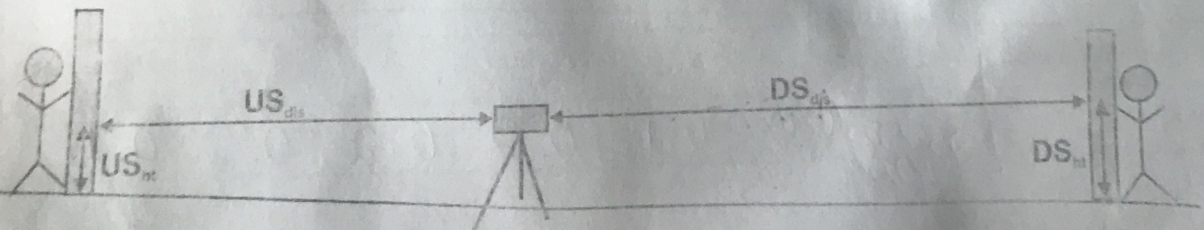
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
ᵃTop Hairline (T)	—	—	
ᵃMid Hairline (ht) OR ᵇHeight of rod	1.366m	1.775m	
ᵃBottom Hairline (B)	—	—	
ᵇDistance (dis) OR ᵃT-B x 100	30m ᵃUS_{dis}=T-B	30 m ᵃDS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60m
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.409m
Slope (Δht/total dis)			0.00681667



Field Crew: K.McCallum

Field Crew: KM, CB, MM

Site Code: COL001

Sampling Date: (DD/MM/YYYY) 18/09/2022

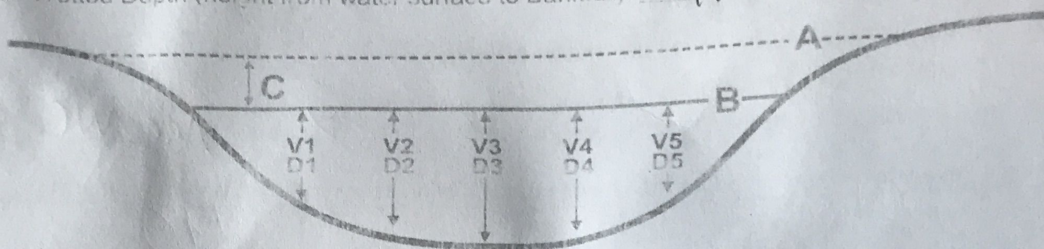
Widths and Depth

Location at site: upstream of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 19.8 (m)

B - Wetted Stream Width: 10.95 (m) L:3.7 R:14.65

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 1.50 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ Velocity Head Rod (or ruler): Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters:** Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☒ Other Global Flow probe

Velocity Head Rod (ruler) D (cm)	1	2	3	4	5	6	AVG
1.5 Distance from Shore (m)	4.5	6.0	7.5	9.0	10.5	12	
Depth (D) (cm)	9.8	15.8	20.0	19.6	6.0	18.2	
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)	0.0	0.1	0.2	0.2	0.2	0.1	

Field Crew: KM, CB, MM

Site Code: CO1001

Sampling Date: (DD/MM/YYYY) 18/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

* Right bank scoured + underneath clay is exposed

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	3.2		26	1.9		51	0.2		76	24.5	
2	9.6		27	15.4		52	13.5		77	4.1	
3	8.0		28	9.7		53	8.1		78	S	
4	8.5		29	5.2		54	4.8		79	4.8	
5	12.7		30	37.6	1/2	55	7.6		80	[illegible]	3/4
6	11.6		31	2.0		56	7.2		81	7.5	
7	1.0		32	6.3		57	9.7		82	1.2	
8	19.2		33	8.5		58	9.2		83	35.4	
9	4.0		34	8.2		59	11.5		84	2.7	
10	35.4	1/4	35	5.8		60	6.6	0	85	3.1	
11	13.1		36	6.6		61	11.2		86	8.0	
12	9.0		37	39.0		62	0.5		87	S	
13	16.3		38	12.7		63	S		88	16.1	
14	10.9		39	7.4		64	7.5		89	7.1	
15	3.1		40	20.9	1/2	65	4.7		90	6.9	0
16	10.4		41	2.8		66	3.2		91	12.8	
17	23.5		42	11.4		67	2.8		92	0.75	
18	20.6		43	4.2		68	4.2		93	2.1	
19	3.5		44	5.0		69	1.0		94	7.6	
20	6.5		45	27.6		70	4.7	1/4	95	2.5	
21	0.4	0	46	11.1		71	3.3		96	3.4	
22	0.9		47	28.4		72	8.0		97	4.1	
23	8.9		48	2.5		73	9.1		98	4.5	
24	3.4		49	8.2		74	4.7		99	4.2	
25	10.0		50	8.2	0	75	2.3		100	3.2	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

CABIN

Field Crew: KM, CB, MM Site Code: COL001

Sampling Date: (DD/MM/YYYY) 18/09/2022

SITE INSPECTION

Site Inspected by: K.M.

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: E.M Time checked-in: 12

Form of communication: ☒ radio ☒ cell ☒ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (709) 743-9678

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: K.McCallum, Site Code: COL003

Sampling Date: (DD/MM/YYYY) 18/09/2022

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River

River/Stream Name: Coal Creek Stream Order: (map scale 1:50,000) 1

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Coming from lower Coal: Take Coal Cr Rd to paiges Draw, park @ pullouts on left before switchback. Follow flagging tape to sites out right after site
Coming from Morrissey: Head up Morrissey past FWA towards MOE-082, continue until the fork in road + follow left directing towards coal creek

Surrounding Land Use: (check those present) Information Source: ______

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☒ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other hunting

Dominant Surrounding Land Use: (check one) Information Source: ______

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

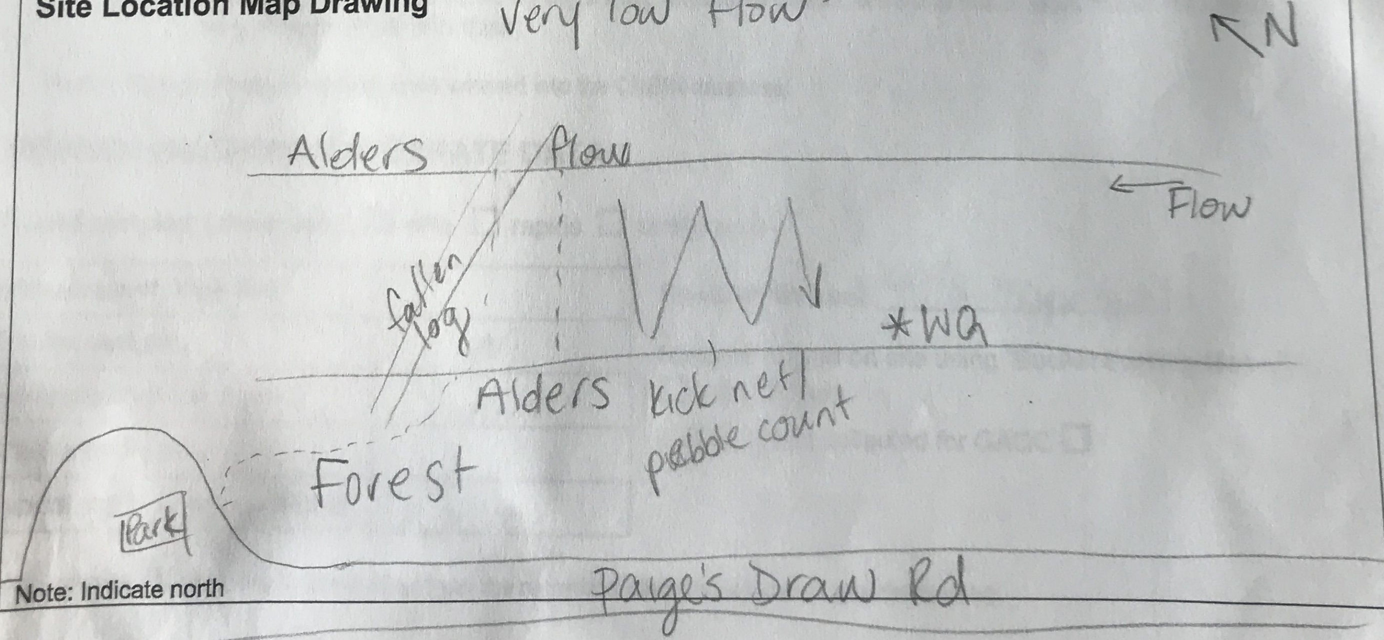
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Location Data

Latitude: 49.452853 N Longitude: - 114.87999 W (DMS or DD)

Elevation: 1737.0 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

CABIN CANADIAN AQUATIC

Field Crew: KM, CB, MM Site Code: COL003

Sampling Date: (DD/MM/YYYY) 18/09/2022

Photos

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View

☑ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☑ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☐ 1-25 % ☑ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*
   ☑ ferns/grasses ☑ shrubs ☐ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☑ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   ☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	K.M.
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	6cm

Preservative used: 99% Isopropyl

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☑ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Field Crew: KM, CB, MM Site Code: COL003

Sampling Date: (DD/MM/YYYY) 18/09/2022

WATER CHEMISTRY DATA Time: 11:20 (24 hr clock) Time zone: MDT

Air Temp: 10.0 (°C) Water Temp: 5.3 (°C) pH: 8.22

Specific Conductance: 86.9 (µs/cm) DO: 10.58 (mg/L) Turbidity: 0.40 (NTU)

C 54.3 µs/cm

Check if water samples were collected for the following analyses:

- ☑ TSS (Total Suspended Solids)
- ☑ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☑ Phosphorus (Total, Ortho, and/or Dissolved)
- ☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☑ Other See WQ analysis sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: ________ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) ________ (m),

distance between contour intervals (horizontal distance) ________ (m)

slope = vertical distance/horizontal distance = ________

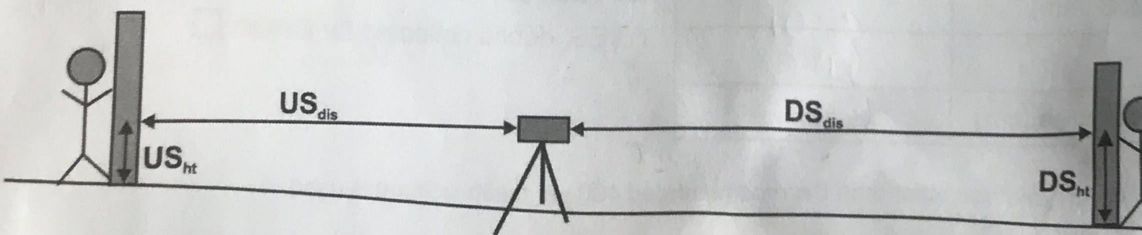
OR

☑ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR [b]Height of rod	1.231	1.725	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR [a]T-B x 100	13.7m [a]US_{dis}=T-B	13.6m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 27.3
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.494
Slope (Δht/total dis)			0.018095238



CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Field Crew: KM, CB, MM

Site Code: COL063

Sampling Date: (DD/MM/YYYY) 18/09/2022

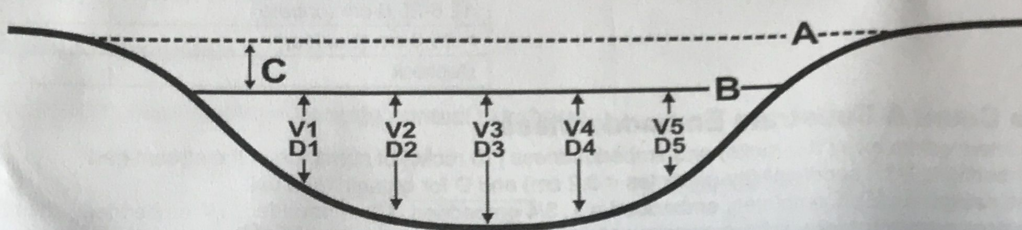
Widths and Depth

Location at site: D/S of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 3.46 (m)

B - Wetted Stream Width: 2.1 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 4.6cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

RWB 3.7 LWB 1.6

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☒ Other Globe Flowprobe.

	1	2	3	4	5	6	AVG
Distance from Shore (m)	1.9	2.2	2.5	2.8			
Depth (D) (cm)	6.9	10.8	8.1	4.2			7.5
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth (**$\Delta D=D_2-D_1$**) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)	0.1	0.0	0.0	0.0			0.025

Rock upstream

CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Field Crew: KM, CB, MM Site Code: COL003

Sampling Date: (DD/MM/YYYY) 18/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	3.2		26	9.2		51	1.2		76	3.1	
2	8.4		27	10.4		52	6.0		77	8.6	
3	2.1		28	5.4		53	3.1		78	26.0	
4	4.7		29	13.8		54	7.3		79	11.5	
5	15.4		30	4.9	0	55	3.2		80	3.8	1/4
6	4.9		31	14.0		56	7.6		81	2.7	
7	5.7		32	2.6		57	3.9		82	8.5	
8	1.2		33	5.6		58	1.5		83	5.7	
9	12.8		34	17.5		59	3.0		84	4.9	
10	9.6	0	35	2.2		60	22.8	3/4	85	6.8	
11	4.0		36	4.4		61	23		86	0.2	
12	11.8		37	4.5		62	17.1		87	8.8	
13	4.9		38	20.8		63	3.2		88	3.3	
14	1.5		39	13.9		64	11.0		89	1.0	
15	6.0		40	5.1	1/4	65	8.1		90	1.4	0
16	5.5		41	5.1		66	9.9		91	2.6	
17	5.8		42	7.7		67	4.0		92	11.4	
18	1.7		43	0.8		68	6.1		93	5.2	
19	11.4		44	2.0		69	6.0		94	2.5	
20	4.4		45	5.2		70	3.1	0	95	2.5	
21	6.7	1/4	46	13.7		71	16.8		96	18.6	
22	5.0		47	13.5		72	8.4		97	4.4	
23	4.0		48	1.0		73	4.3		98	3.6	
24	6.2		49	17.0		74	10.2		99	4.7	
25	1.7		50	6.4	0	75	4.0		100	6.9	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM, CB, MM

Site Code: COL003

Sampling Date: (DD/MM/YYYY) 18/09/2022

SITE INSPECTION

Site Inspected by: K.M.

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: E. Matveev

Time checked-in: 12

Form of communication: ☐ radio ☒ cell ☒ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: ~~Kaileigh McCallum~~, Chad Hughes, Anne-Caroline Kroeger Site Code: LIZ001

Sampling Date: (DD/MM/YYYY) 20/09/2022

[x] **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWG-Elk Local Basin Name: Elk River

River/Stream Name: Lizard Crk Stream Order: (map scale 1:50,000) 3

Select one: [x] Test Site [ ] Potential Reference Site

Geographical Description/Notes:
≐100m u/s from hwy 3 Liz. Ck. bridge, above scoured portion of river.

Surrounding Land Use: (check those present) Information Source: visual, local

[x] Forest [x] Field/Pasture [ ] Agriculture [x] Residential/Urban
[ ] Logging [ ] Mining [ ] Commercial/Industrial [x] Other recreational (prov. park)

Dominant Surrounding Land Use: (check one) Information Source: visual

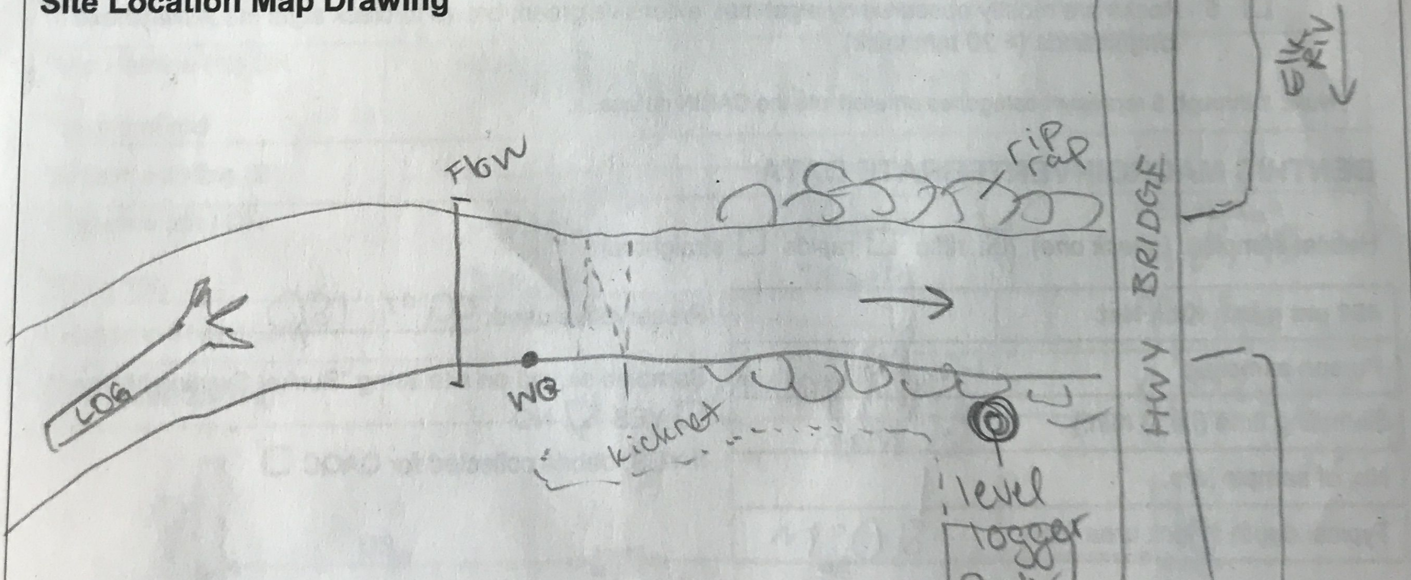
[x] Forest [ ] Field/Pasture [ ] Agriculture [ ] Residential/Urban
[ ] Logging [ ] Mining [ ] Commercial/Industrial [ ] Other ______

Location Data

Latitude: 49.47164 N Longitude: - 115.07759 W (DMS or DD)

Elevation: 940 (fasl or masl) GPS Datum: [x] GRS80 (NAD83/WGS84) [ ] Other: ______

Site Location Map Drawing



Note: Indicate north

CABIN

Field Crew: KM, CH, ACK Site Code: LIZ001

Sampling Date: (DD/MM/YYYY) 20/09/2022

Photos

- [x] Field Sheet
- [x] Upstream
- [x] Downstream
- [x] Across Site
- [ ] Aerial View
- [ ] Substrate (exposed)
- [x] Substrate (aquatic)
- [ ] Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   - [x] Riffle
   - [ ] Rapids
   - [x] Straight run
   - [ ] Pool/Back Eddy
2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   - [ ] 0 %
   - [x] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %
3. Macrophyte Coverage: *(not algae or moss, check one)*
   - [x] 0 %
   - [ ] 1-25 %
   - [ ] 26-50 %
   - [ ] 51-75 %
   - [ ] 76-100 %
4. Streamside Vegetation: *(check those present)*
   - [x] ferns/grasses
   - [x] shrubs
   - [x] deciduous trees
   - [x] coniferous trees
5. Dominant Streamside Vegetation: *(check one)*
   - [x] ferns/grasses
   - [ ] shrubs
   - [ ] deciduous trees
   - [ ] coniferous trees
6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*
   - [ ] **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   - [ ] **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   - [ ] **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   - [x] **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   - [ ] **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: *(check one)* [x] riffle [ ] rapids [ ] straight run

400 µm mesh Kick Net	
Person sampling	K. McCallum
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	20cm

Preservative used: 99% ISO

Sampled sieved on site using "Bucket Swirling Method": [ ] YES [x] NO

If YES, debris collected for QAQC [ ]

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

CABIN

Site Code: MOL007

Field Crew: KM, CB, MM

Sampling Date: (DD/MM/YYYY) 11/09/2022

WATER CHEMISTRY DATA Time: 10:27 (24 hr clock) **Time zone:** MDT

Air Temp: 8.6 (°C) Water Temp: 7.3 (°C) pH: 8.60

Specific Conductance: 113.8 (µs/cm) DO: 10.63 (mg/L) Turbidity: 0.53 (NTU)

Check if water samples were collected for the following analyses:

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

- [ ] **Calculated from map**

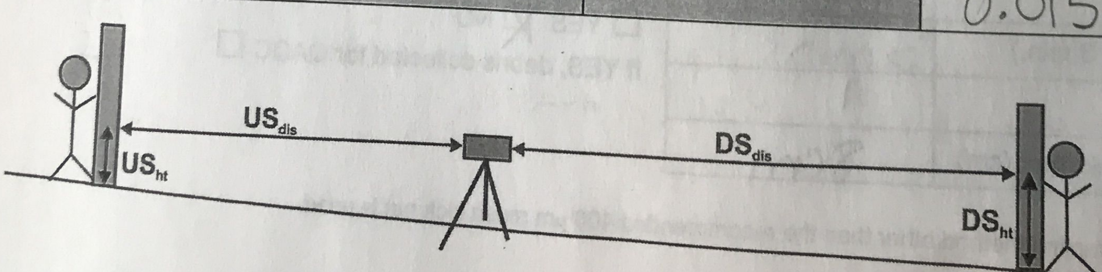
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance = ______

OR

- [x] **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR [b]Height of rod	1.288	1.590	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR [a]T-B x 100	10 [a]US_{dis}=T-B	10 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 20
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.302
Slope (Δht/total dis)			0.0151



Field Crew: KM, CH, ACK Site Code: LIZ001

Sampling Date: (DD/MM/YYYY) 20/09/2022

WATER CHEMISTRY DATA

Time: 12:28 (24 hr clock) Time zone: MT

Air Temp: 12.0 (°C) Water Temp: 8.1 (°C) pH: 8.52

Specific Conductance: 523 (µs/cm) DO: 10.97 (mg/L) Turbidity: 1.03 (NTU)

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other see water sampling sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: ________________ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ____________ (m),
distance between contour intervals (horizontal distance) ____________ (m)
slope = vertical distance/horizontal distance = ____________

OR

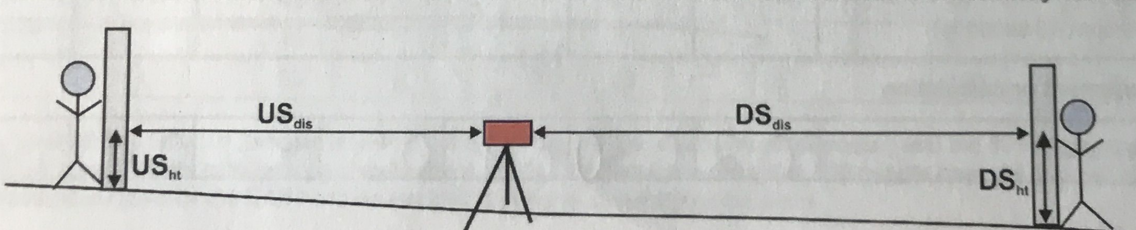
☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	0,93 m	2,245 m	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	24.85 m [a]US_{dis}=T-B	24.1m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 48.95
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1,315 m
Slope (Δht/total dis)			0,02686

(2.7%)



Field Crew: KM, CH, ACK

Site Code: LI2001

Sampling Date: (DD/MM/YYYY) 20/09/2022

Widths and Depth

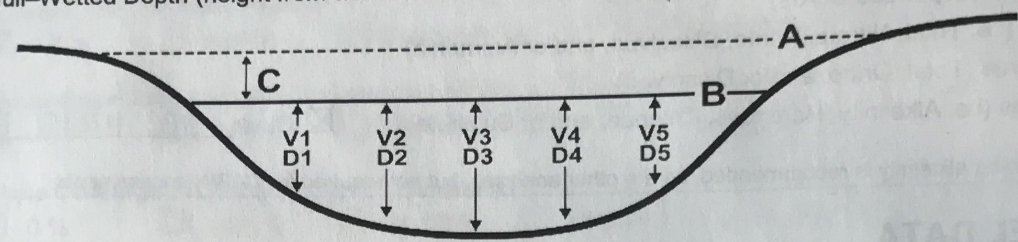
B W
0.84 1.76
9.35 6.45

Location at site: u/s of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 8.51 (m)

B - Wetted Stream Width: 4.69 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 17.0 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☒ Other Global Flowprobe

0.67

	1	2	3	4	5	6	AVG
Distance from Shore (m)	2.43	3.1	3.77	4.44	5.11	5.78	
Depth (**D**) (cm)	22.5	8.8	15.8	39.8	3.15	27.0	19.50
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)	0.2	0.30 rock	0.4	0.5	0.5	0.4	0.383

Field Crew: KM, CH, ACK Site Code: LI2001

Sampling Date: (DD/MM/YYYY) 20/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

Note:
~~River~~ Cre
has
been
scoured
clay
now
undercovere
and visibl
on bottom
of strea

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	3.2		26	8.2		51	19.4		76	7.9	
2	10.5		27	0.7		52	16.0		77	10.1	
3	0.5		28	11.9		53	24.4		78	6.9	
4	4.6		29	17.4		54	5.5		79	~~6.2~~	
5	25.2		30	18.4	1/2	55	4.5		80	23.2 ~~[illegible]~~	1/2
6	8.1		31	6.9		56	13.0		81	1.9	
7	19.2		32	22.2		57	11.2		82	1.5	
8	10.5		33	12.4		58	16.0		83	73.3	
9	5.9		34	4.2		59	13.7		84	4.7	
10	5.8	0	35	9.1		60	7.3	0	85	13.3	
11	6.3		36	12.2		61	12.1		86	10.5	
12	12.7		37	3.6		62	6.1		87	9.5	
13	49.8		38	S		63	8.9		88	18.5	
14	10.3		39	18.9		64	5.4		89	15.2	
15	0.3		40	18.9	1/2	65	10.3		90	13.8	0
16	18.8		41	1.5		66	0.9		91	11.3	
17	24.6		42	6.6		67	15.4		92	12.4	
18	14.3		43	9.8		68	17.5		93	20.2	
19	18.4		44	4.7		69	S		94	7.6	
20	17.3	3/4	45	3.6		70	~~15.8~~	1/4	95	9.8	
21	7.4		46	37.6		71	6.0		96	23.1	
22	7.8		47	5.7		72	43.1		97	5.4	
23	15.4		48	24.5		73	8.4		98	6.3	
24	18.4		49	7.3		74	12.3		99	13.3	
25	19.3		50	25.5	1	75	8.8		100	9.6	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

CABIN

Field Crew: KM, CM, ACK Site Code: LIZ001

Sampling Date: (DD/MM/YYYY) 20/09/2022

SITE INSPECTION

Site Inspected by: K. McCallum

Communication Information

☑ Itinerary left with contact person (include contact numbers)

Contact Person: E. Matveev Time checked-in: 12:00

Form of communication: ☐ radio ☑ cell ☐ satellite ☐ hotel/pay phone ☑ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☑ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: K.McCallum, C.Hughes, A.C.Kroeger Site Code: LIZ003

Sampling Date: (DD/MM/YYYY) 20/09/2022

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River

River/Stream Name: Lizard Ck. Stream Order: (map scale 1:50,000) 3

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Mt. Fernie Park @ far end of Visitor Parking, take trail upstream, site on left of trail (trail hits river just u/s of site), site is d/s of Bank restoration

Surrounding Land Use: (check those present) Information Source: local, visual

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other recreation (Island lake lodge, prov. park).

Dominant Surrounding Land Use: (check one) Information Source: ____

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

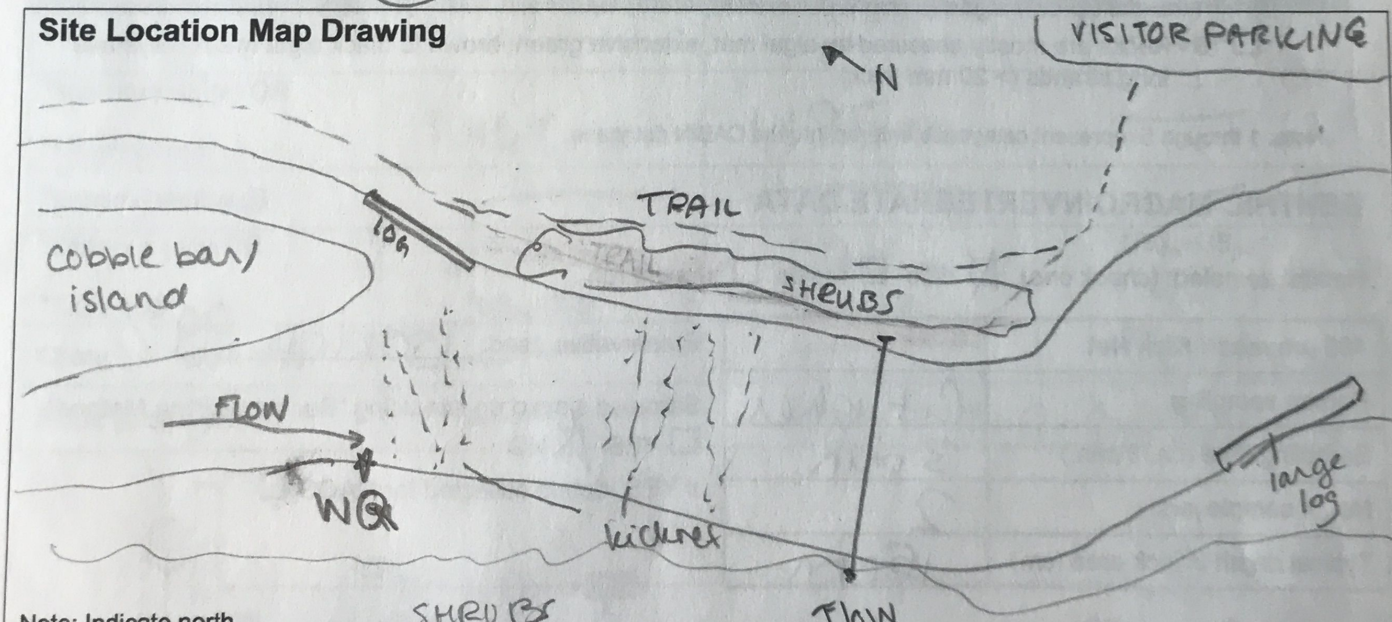
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ____

Location Data

Latitude: 49.485690 N Longitude: - 115.094321 W (DMS or DD)

Elevation: 1022.0 (fasl or masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ____

Site Location Map Drawing



Note: Indicate north

CABIN

Field Crew: KM, CH, ACK Site Code: LI2003

Sampling Date: (DD/MM/YYYY) 20/09/22

Photos

- [x] Field Sheet - [x] Upstream - [x] Downstream - [x] Across Site - [ ] Aerial View
- [x] Substrate (exposed) - [x] Substrate (aquatic) - [ ] Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   - [x] Riffle - [ ] Rapids - [x] Straight run - [ ] Pool/Back Eddy
2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   - [ ] 0 % - [x] 1-25 % - [ ] 26-50 % - [ ] 51-75 % - [ ] 76-100 %
3. Macrophyte Coverage: *(not algae or moss, check one)*
   - [x] 0 % - [ ] 1-25 % - [ ] 26-50 % - [ ] 51-75 % - [ ] 76-100 %
4. Streamside Vegetation: *(check those present)*
   - [x] ferns/grasses - [x] shrubs - [x] deciduous trees - [x] coniferous trees
5. Dominant Streamside Vegetation: *(check one)*
   - [ ] ferns/grasses - [x] shrubs - [ ] deciduous trees - [ ] coniferous trees
6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*
   - [ ] **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   - [x] **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   - [ ] **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   - [ ] **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   - [ ] **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: *(check one)* [x] riffle [ ] rapids [ ] straight run

400 µm mesh Kick Net	
Person sampling	C. Hughes
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	2
Typical depth in kick area (cm)	15cm

Preservative used: Isoprop. 99%

Sampled sieved on site using "Bucket Swirling Method": [ ] YES [x] NO

If YES, debris collected for QAQC [ ]

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: KM, CH, ACK Site Code: LIZ003

Sampling Date: (DD/MM/YYYY) 20/09/2022

WATER CHEMISTRY DATA Time: 09:30 (24 hr clock) Time zone: MT

Air Temp: 9.8 (°C) Water Temp: 6.3 (°C) pH: 8.30

Specific Conductance: 531 (µs/cm) DO: 10.88 (mg/L) Turbidity: 0.62 (NTU)

Check if water samples were collected for the following analyses:

- ☑ TSS (Total Suspended Solids)
- ☑ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☑ Phosphorus (Total, Ortho, and/or Dissolved)
- ☑ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☑ Other See WC. sheet

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

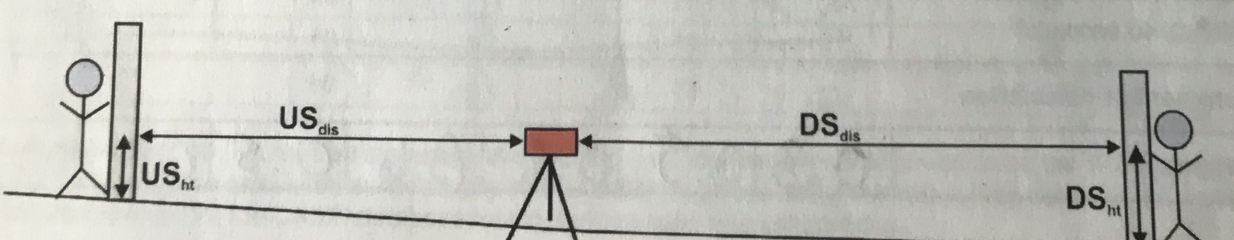
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance = ______

OR

☑ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	—
[a]Mid Hairline (ht) OR [b]Height of rod	1.468m.	1.185m	—
[a]Bottom Hairline (B)	—	—	—
[b]Distance (dis) OR [a]T-B x 100	22m [a]US_{dis}=T-B	22m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 44m
Change in height (Δht)	—	—	$DS_{ht}-US_{ht}$= 0.283m
Slope (Δht/total dis)	—	—	0.00643182



CABIN

Field Crew: KM, CH, ACk   Site Code: 42003

Sampling Date: (DD/MM/YYYY) 20/09/2022

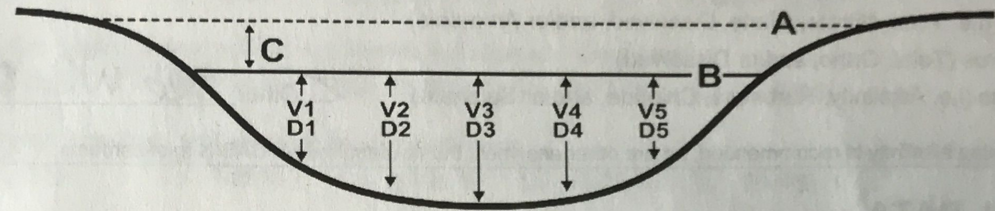
L R
0.51 8.39
0.78 4.8

Widths and Depth

Location at site: d/s of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 7.89 (m)   B - Wetted Stream Width: 4.02 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 30.0 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☒ Other Global Flowprobe

9.5

	1	2	3	4	5	6	AVG
Distance from Shore (m)	1.35	1.92	2.49	3.06	3.63	4.2	
Depth (D) (cm)	18.8	20.9	26.1	32.5	23.0	12.2	22.25
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)	0.3	0.5	0.8	0.6	0.5	0.4	0.5167

Field Crew: Lem, CH, ACK Site Code: L12003

Sampling Date: (DD/MM/YYYY) 20/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	7.1		26	4.8		51	3.0		76	5.5	
2	7.2		27	10.0		52	4.5		77	3.6	
3	5.5		28	10.0		53	1.6		78	3.5	
4	3.5		29	5.0		54	7.1		79	2.6	
5	6.7		30	4.0		55	4.5		80	1.6	0
6	6.6		31	6.0		56	9.0		81	6.6	
7	9.4		32	11.0	1/4	57	10.0		82	2.0	
8	9.0		33	3.5		58	4.5		83	7.6	
9	8.0		34	4.5		59	6.0		84	8.0	
10	8.2	0	35	9.0		60	9.0		85	8.5	
11	6.0		36	1.5		61	7.1	1/4	86	11.0	
12	3.0		37	2.5		62	5.4		87	7.0	
13	7.5		38	6.8		63	3.5		88	2.2	
14	4.0		39	6.0		64	3.0		89	0.7	
15	2.6		40	7.5	0	65	5.0		90	0.8	0
16	3.0		41	7.0		66	1.5		91	6.5	
17	6.1		42	7.0		67	1.5		92	1.5	
18	3.0		43	2.0		68	1.7		93	7.2	
19	12.0		44	4.6		69	5.0		94	3.0	
20	6.0	1/2	45	4.5		70	8.5	3/4	95	4.8	
21	13.5		46	5.5		71	4.0		96	1.4	
22	4.5		47	3.0		72	8.0		97	2.4	
23	5.5		48	3.0		73	5.0		98	10.0	
24	4.1		49	1.4		74	7.6		99	1.5	
25	6.5		50	9.0	1/4	75	7.2		100	1.6	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

CABIN

1.448

Field Crew: KM, CH, ACK

Site Code: L12003

Sampling Date: (DD/MM/YYYY) 20/09/2022

SITE INSPECTION

Site Inspected by: K. McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: E. Matveev

Time checked-in: 8:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☒ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: K. McCallum, C. Bush, M. Malone Site Code: MOR001

Sampling Date: (DD/MM/YYYY) 11/09/2021

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM-Elk Local Basin Name: Elk River

River/Stream Name: Morrissey Stream Order: (map scale 1:50,000) 4

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Morrissey FSR to Lodgepole. Turn right near Snowmobile Association sign (on left). Drive to railway park + walk d/s 50 m to site

Surrounding Land Use: (check those present) Information Source: visual, maps

☒ Forest ☐ Field/Pasture ☒ Agriculture ☐ Residential/Urban

☒ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other hunting, pipeline construction

☒ railway u/s

Dominant Surrounding Land Use: (check one) Information Source: visual

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

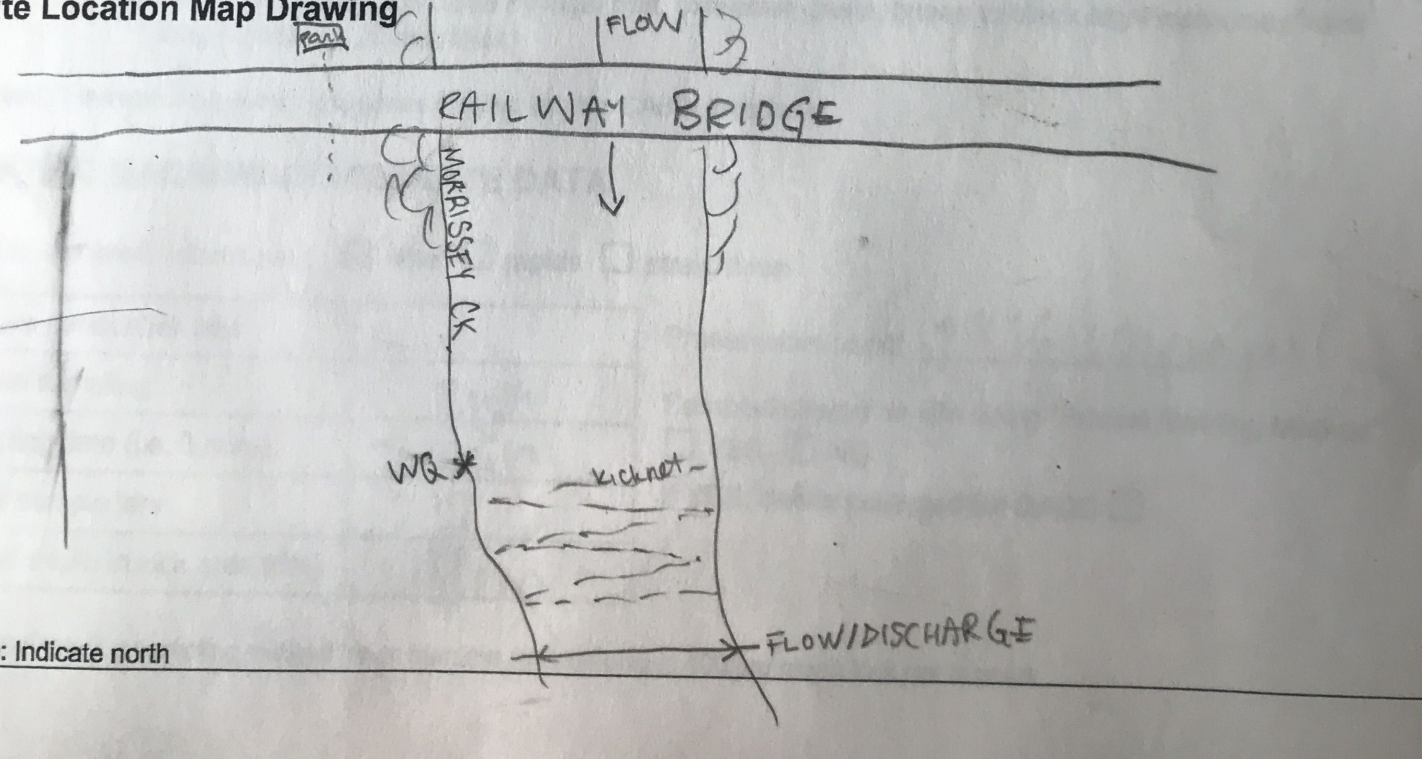
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ____

Location Data

Latitude: 49.358327 N Longitude: -115.000669 W (DMS or DD)

Elevation: 948.0 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: ____

Site Location Map Drawing



Note: Indicate north

Field Crew: KM, CB, MM Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 11/09/2022

Photos

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View

☑ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

☑ Riffle ☐ Rapids ☑ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*

☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

☐ ferns/grasses ☐ shrubs ☑ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

☑ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	C. Bush
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	2
Typical depth in kick area (cm)	13cm

Preservative used: 99% isopropyl

Sampled sieved on site using "Bucket Swirling Method":

☐ YES ☑ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

CABIN

Site Code: MOR001

Field Crew: KM, CB, MM

Sampling Date: (DD/MM/YYYY) 1/09/2022

WATER CHEMISTRY DATA

Time: 15:36 (24 hr clock) Time zone: ____

Air Temp: 17.9 (°C) Water Temp: 15.5 (°C) pH: 8.35

Specific Conductance: 248.8 (µs/cm) DO: 9.72 (mg/L) Turbidity: 0.42 (NTU)

Check if water samples were collected for the following analyses:

- ☑ TSS (Total Suspended Solids)
- ☑ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☑ Phosphorus (Total, Ortho, and/or Dissolved)
- ☑ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☐ Other ____

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

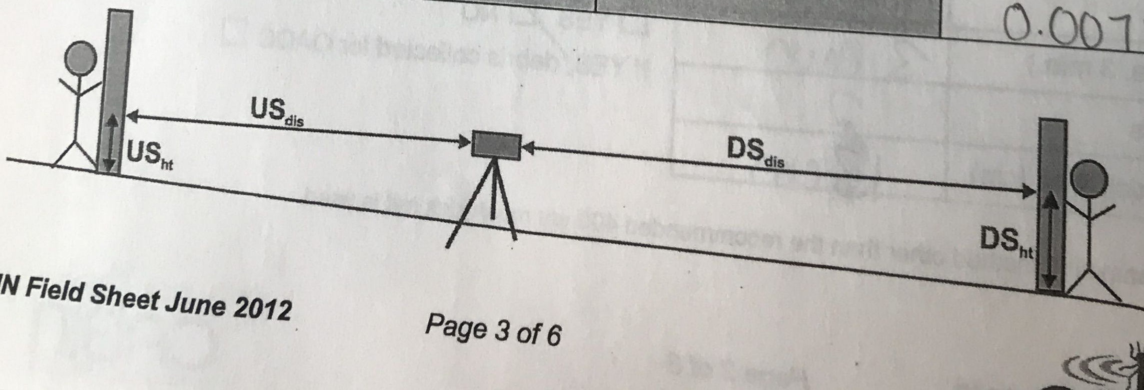
Scale: ____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ____ (m),
distance between contour intervals (horizontal distance) ____ (m)
slope = vertical distance/horizontal distance = ____

OR

☑ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR			
[b]Height of rod	1.355	1.557	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR			
[a]T-B x 100	14.22 [a]US_{dis}=T-B	14.22 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 28.44
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.202
Slope (Δht/total dis)			0.0071



Field Crew: KM, CB, MM Site Code: MOR002

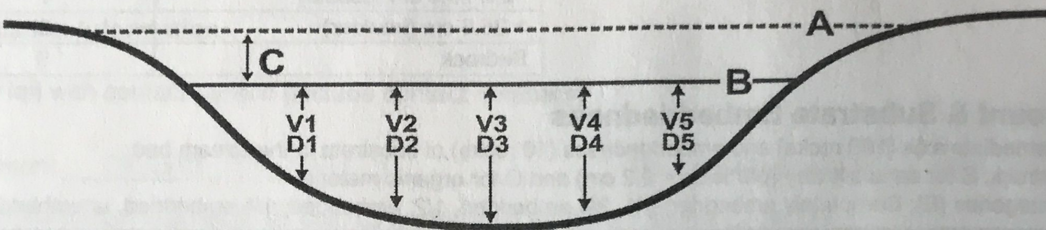
Sampling Date: (DD/MM/YYYY) 09/11/2022

Widths and Depth

Location at site: d/s of kick area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 20.50 (m) B - Wetted Stream Width: 5.8 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 1.45 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

→ See hydro field sheet

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

$Q = 0.046\ m^3/s$

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☒ Sontek or ☐ Other________

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (D) (cm)							0.197
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)							0.04

CABIN

Field Crew: KM, CB, MM.

Site Code: MOR001

Sampling Date: (DD/MM/YYYY) 11/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	19.0		26	5.1		51	19.0		76	6.1	
2	10.8		27	2.9		52	17.5		77	8.9	
3	15.6		28	5.8		53	3.0		78	6.4	
4	24.9		29	11.9		54	16.6		79	20.2	
5	4.3		30	3.9	0	55	14.9		80	13.1	1/4
6	8.9		31	11.4		56	6.6		81	5.2	
7	10.1		32	10.5		57	2.5		82	4.4	
8	12.2		33	11.2		58	2.4		83	22.1	
9	2.6		34	7.1		59	3.9		84	9.3	
10	5.4	0	35	18.5		60	8.5	1/4	85	18.2	
11	3.2		36	13.5		61	13.2		86	32.1	
12	8.5		37	1.5		62	5.8		87	15.4	
13	16.1		38	15.6		63	8.7		88	18.5	
14	14.3		39	9.1		64	5.8		89	18.1	
15	3.7		40	1.4		65	3.8		90	16.6	75%
16	2.8		41	1.8		66	24.0		91	2.9	
17	2.1		42	14.6	50%	67	12.0		92	17.5	
18	3.9		43	7.5		68	3.0		93	21.7	
19	6.4		44	6.9		69	6.4		94	6.2	
20	11.2	0	45	12.1		70	5.6		95	13.4	
21	10.1		46	5.2		71	9.0		96	1.9	
22	12.2		47	4.3		72	3.6		97	3.8	
23	S		48	20.0		73	8.8		98	3.9	
24	9.7		49	3.4		74	5.8	0	99	37.5	
25	4.2		50	17.6	1/4	75	23.0		100	9.2	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM, CB, MM Site Code: MOR001

Sampling Date: (DD/MM/YYYY) 11/09/2022

SITE INSPECTION

Site Inspected by: meagan malone

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: chad hughes Time checked-in: 16:11

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☑ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Elk River Alliance

Velocimeter Measurement Field Sheet

Q=0.046m³/s

LWE: RWE:

Site: MOR001

Date: 22/09/11

Time: 15:52

Staff: KM, CB

Staff Gauge: ______

Wetted Width: 5.8

Bankful Width: 20.5

Instrument ID: Flowtracker2

Photos:
- ☑ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☑ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	1.55	0	0	
2	1.75	0.09	-0.001	
3	1.95	0.15	0.016	
4	2.15	0.2	0.007	
5	2.35	0.12	0.081	
6	2.55	0.145	0.049	
7	2.75	0.22	0.035	
8	2.95	0.21	0.059	
9	3.15	0.227	0.023	
10	3.35	0.23	0.014	
11	3.55	0.217	0.036	
12	3.75	0.275	0.052	
13	3.95	0.225	0.076	
14	4.15	0.23	0.082	
15	4.35	0.22	0.065	

Continued from other side

16	4.55	0.265	0.062	
17	4.75	0.28	0.048	
18	4.8	0.28	0.065	
19	4.95	0.265	0.087	
20	5.15	0.23	0.039	
21	5.35	0.22	0.048	
22	5.55	0.27	-0.003	
23	5.75	0.25	0.025	
24	5.95	0.26	0.024	
25	6.15	0.23	0.028	
26	6.35	0.23	0.019	
27	6.55	0.22	0.037	
28	6.75	0.12	0.022	
29	7.35	0	0	
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: K. McCallum, C. Bush, M. Malone   Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 1/09/2022

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CRWM-Elk   Local Basin Name: Elk River

River/Stream Name: Morrissey   Stream Order: (map scale 1:50,000) 3

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Drive Morrissey FSR until 3rd bridge. Walk d/s ≃ 50 m to site

Surrounding Land Use: (check those present)   Information Source: visual, maps

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☒ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other construction-pipeline

Dominant Surrounding Land Use: (check one)   Information Source: ______

☐ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

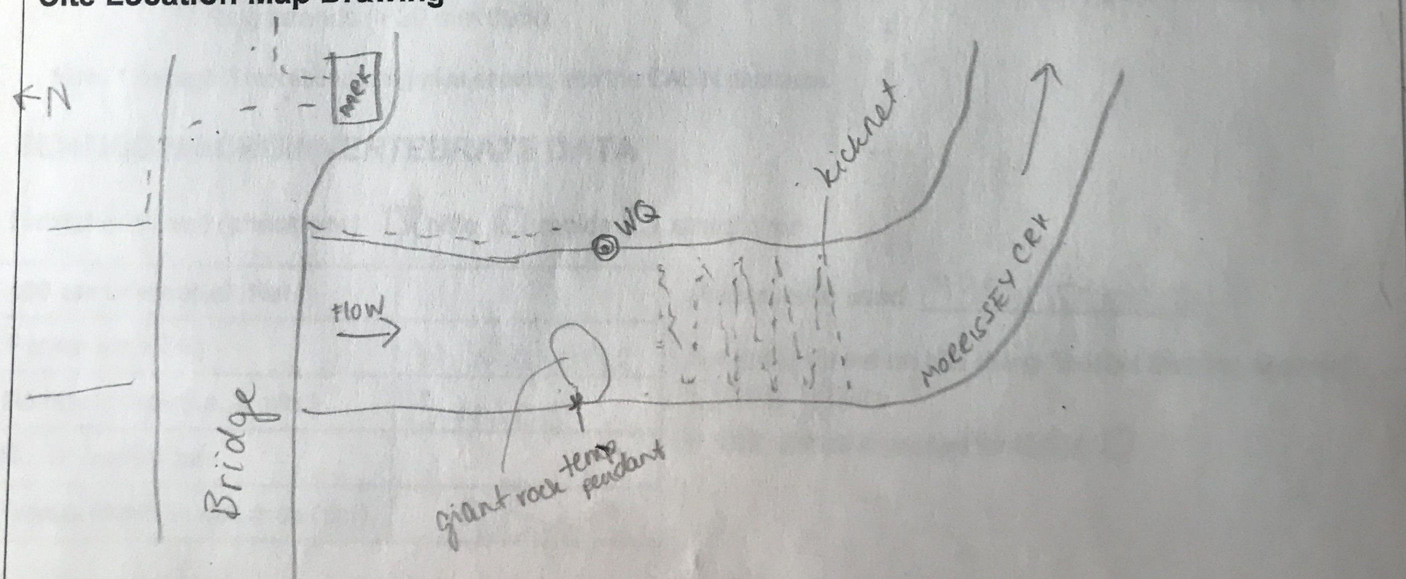
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Location Data

Latitude: 49.420558 N Longitude: - 114.910687 W (DMS or DD)

Elevation: 1544.0 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

Field Crew: KM, CB, MM

Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 11/09/2022

Photos

☒ Field Sheet ☒ Upstream ☒ Downstream ☒ Across Site ☐ Aerial View

☒ Substrate (exposed) ☒ Substrate (aquatic) ☐ Other ________

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☒ Riffle ☐ Rapids ☐ Straight run ☒ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☐ 1-25 % ☒ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
   ☒ ferns/grasses ☒ shrubs ☐ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   → ☒ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run

400 μm mesh Kick Net	
Person sampling	M. Malone
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	1
Typical depth in kick area (cm)	8cm

Preservative used: 99% isopropyl

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☒ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 μm mesh kick net is used.

Site Code: MC002

Field Crew: KM, CB, MM

Sampling Date: (DD/MM/YYYY) 11/09/2022

WATER CHEMISTRY DATA Time: 10:27 (24 hr clock) Time zone: MDT

Air Temp: 8.6 (ºC) Water Temp: 7.3 (ºC) pH: 8.60

Specific Conductance: 113.8 (μs/cm) DO: 10.63 (mg/L) Turbidity: 0.53 (NTU)

Check if water samples were collected for the following analyses:

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other ____

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

- [ ] **Calculated from map**

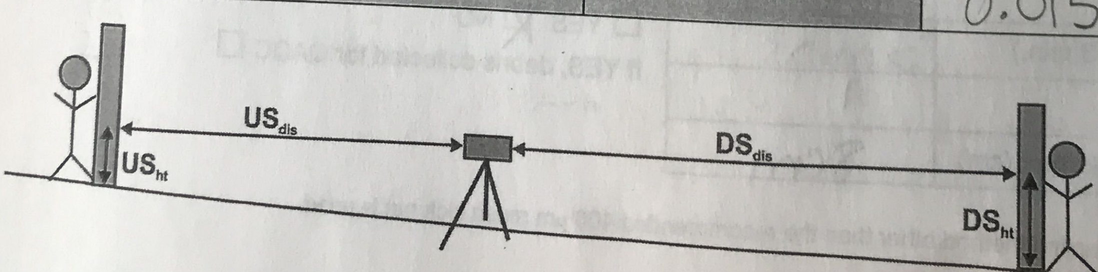
Scale: ____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ____ (m),
distance between contour intervals (horizontal distance) ____ (m)
slope = vertical distance/horizontal distance = ____

OR

- [x] **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR [b]Height of rod	1.288	1.590	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR [a]T-B x 100	10 [a]US_{dis}=T-B	10 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 20
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.302
Slope (Δht/total dis)			0.0151



CABIN

Field Crew: km, CB, MM

Site Code: MORC002

Sampling Date: (DD/MM/YYYY) 11/09/2022

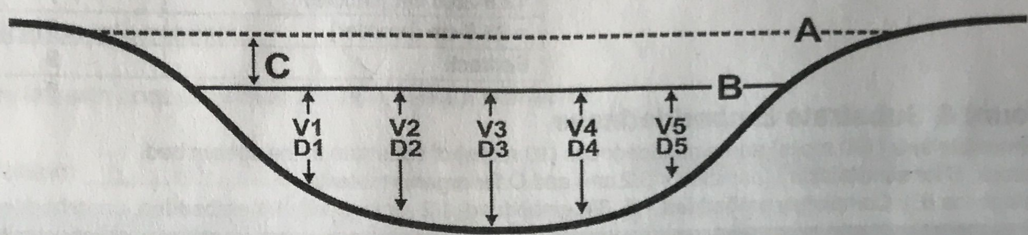
Widths and Depth

Location at site: up stream 20m of kick (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 12.76 (m)

B - Wetted Stream Width: 1.4m (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 78.5 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

* see hydro metric ~~data sheet~~

☐ **Velocity Head Rod (or ruler):** Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters:** Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☑ **Direct velocity measurements:** ☐ Marsh-McBirney ☑ Sontek Flowtracker 2 or ☐ Other

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (D) (cm)							0.088
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)							0.06

$Q = 0.007 m^3/s$

CABIN

Note: Indicate ...

Field Crew: KM, CB, MM

Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 11/09/2022

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	8.1		26	5.7		51	4.3		76	4.4	
2	11.2		27	2.7		52	6.4		77	5	
3	4.9		28	1.4		53	7.5		78	33.4	
4	0.8		29	5.6		54	3.7		79	5.7	
5	7.4		30	9	50%	55	8.7		80	3.1	0
6	35.6		31	5.5		56	1		81	13.3	
7	7.6		32	10		57	14.2		82	5.2	
8	1.7		33	17.5		58	6.3		83	6.7	
9	11.3		34	4.3		59	2.8		84	1.8	
10	2.8	0%	35	6.1		60	4.8	25%	85	6	
11	1.8		36	3.2		61	4.8		86	7.1	
12	3.2		37	4.8		62	8.3		87	3.3	
13	2.9		38	4.5		63	12.5		88	10.6	
14	10		39	14.3		64	1.2		89	4.8	
15	19.8		40	6.9	0%	65	3.4		90	8.2	0
16	4.3		41	1.8		66	11.5		91	10.4	
17	6		42	7.8		67	0.9		92	0.9	
18	1.4		43	8.4		68	[illegible]5		93	1.4	
19	7.9		44	10.6		69	1.5		94	0.6	
20	7.5	50%	45	1.7		70	6	0	95	4.6	
21	14.3		46	7.2		71	1.1		96	3.1	
22	6.9		47	3.2		72	11.2		97	21	
23	19		48	1.7		73	7.9		98	5.4	
24	2		49	25.8		74	3.3		99	8.9	
25	7.6		50	8.9	25%	75	1.8		100	6	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: K. McCallum, C. Bush, M. Malone Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 11/09/2022

SITE INSPECTION

Site Inspected by: K. McCallum

Communication Information

☑ Itinerary left with contact person (include contact numbers)

Contact Person: E. Matveev Time checked-in: 9:00

Form of communication: ☐ radio ☒ cell ☑ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☑ PFD worn

☑ Appropriate footwear, waders, wading belt

☑ Belay used

Notes:

Q = 0.007 m^3/s

Elk River Alliance

Velocimeter Measurement Field Sheet

Site: MOR002

Date: 2022/09/11

Time: 11:52

Staff: KM, CB

Photos: ☑ 1. Completed Field Sheet ☑ 2. Upstream ☑ 3. Downstream ☑ 4. Across (from left bank if possible)

LWE: RWE:

Staff Gauge: —

Wetted Width: 1.40

Bankful Width: —

Instrument ID: Flowtracker2

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0.8	0	0	
2	0.9	0.05	-0.009	
3	1.0	0.08	0.009	
4	1.1	0.06	0.102	
5	1.2	0.07	0.095	
6	1.3	0.06	0.123	
7	1.4	0.07	0.06	
8	1.5	0.07	0.077	
9	1.55	0.08	0.108	
10	1.6	0.12	0.085	
11	1.65	0.15	0.084	
12	1.7	0.15	0.078	
13	1.75	0.15	0.071	
14	1.8	0.15	0.072	
15	1.85	0.12	0.083	

Continued from other side

16	1.9	0.14	0.042	
17	2.0	0.12	0.039	
18	2.1	0.1	0.032	
19	2.2	0	0	
20				
21				
22				
23				
24				
25				
26				
27				
28				
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31				
32				
33				
34				
35				

Comments:

Appendix C: CARO Reports

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0		
ATTENTION	Kaileigh McCallum	**WORK ORDER**	22I2256
PO NUMBER		**RECEIVED / TEMP**	2022-09-16 14:00 / 9.9°C
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52
PROJECT INFO	[info]	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here:
https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX001_20220914_1520 (22I2256-01) | Matrix: Water | Sampled: 2022-09-14 15:20						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-21	
Chloride	**0.97**	AO ≤ 250	0.10	mg/L	2022-09-21	
Fluoride	**0.17**	MAC = 1.5	0.10	mg/L	2022-09-21	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-21	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-21	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-21	HT1
Sulfate	**17.7**	AO ≤ 500	1.0	mg/L	2022-09-21	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-22	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-22	
Surrogate: 2-Methylnonane (EPH/F2-4)	*90*		*60-140*	%	*2022-09-22*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**155**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Barium, dissolved	**0.0681**	N/A	0.0050	mg/L	2022-09-22	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-22	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-22	
Calcium, dissolved	**41.6**	N/A	0.20	mg/L	2022-09-22	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-22	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-22	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Lithium, dissolved	**0.00341**	N/A	0.00010	mg/L	2022-09-22	
Magnesium, dissolved	**12.4**	N/A	0.010	mg/L	2022-09-22	
Manganese, dissolved	**0.00057**	N/A	0.00020	mg/L	2022-09-22	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-22	
Molybdenum, dissolved	**0.00072**	N/A	0.00010	mg/L	2022-09-22	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-22	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-22	
Potassium, dissolved	**0.40**	N/A	0.10	mg/L	2022-09-22	
Selenium, dissolved	**0.00063**	N/A	0.00050	mg/L	2022-09-22	
Silicon, dissolved	**2.1**	N/A	1.0	mg/L	2022-09-22	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-22	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX001_20220914_1520 (22I2256-01) | Matrix: Water | Sampled: 2022-09-14 15:20, Continued						
Dissolved Metals, Continued						
Sodium, dissolved	**1.77**	N/A	0.10	mg/L	2022-09-22	
Strontium, dissolved	**0.114**	N/A	0.0010	mg/L	2022-09-22	
Sulfur, dissolved	**5.4**	N/A	3.0	mg/L	2022-09-22	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-22	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-22	
Uranium, dissolved	**0.000576**	N/A	0.000020	mg/L	2022-09-22	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-22	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
General Parameters						
Alkalinity, Total (as CaCO3)	**178**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Phenolphthalein (as CaCO3)	**1.9**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Bicarbonate (as CaCO3)	**174**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Carbonate (as CaCO3)	**3.8**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-22	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-20	
BOD, 5-day	< 6.2	N/A	2.0	mg/L	2022-09-22	
Carbon, Total Organic	**0.87**	N/A	0.50	mg/L	2022-09-21	
Carbon, Dissolved Organic	**0.66**	N/A	0.50	mg/L	2022-09-21	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-18	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2022-09-23	
Phosphorus, Total (as P)	**0.0072**	N/A	0.0050	mg/L	2022-09-21	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-23	HT1
Total Metals						
Aluminum, total	**0.0061**	OG < 0.1	0.0050	mg/L	2022-09-20	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-20	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-20	
Barium, total	**0.0674**	MAC = 2	0.0050	mg/L	2022-09-20	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-20	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2022-09-20	
Calcium, total	**47.5**	None Required	0.20	mg/L	2022-09-20	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-20	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-20	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-09-20	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-20	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier

ALX001_20220914_1520 (22I2256-01) | Matrix: Water | Sampled: 2022-09-14 15:20, Continued

Total Metals, Continued

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Lithium, total	**0.00389**	N/A	0.00010	mg/L	2022-09-20	
Magnesium, total	**12.8**	None Required	0.010	mg/L	2022-09-20	
Manganese, total	**0.00092**	MAC = 0.12	0.00020	mg/L	2022-09-20	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-22	
Molybdenum, total	**0.00073**	N/A	0.00010	mg/L	2022-09-20	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-20	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-20	
Potassium, total	**0.38**	N/A	0.10	mg/L	2022-09-20	
Selenium, total	**0.00064**	MAC = 0.05	0.00050	mg/L	2022-09-20	
Silicon, total	**2.0**	N/A	1.0	mg/L	2022-09-20	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-20	
Sodium, total	**1.80**	AO ≤ 200	0.10	mg/L	2022-09-20	
Strontium, total	**0.114**	MAC = 7	0.0010	mg/L	2022-09-20	
Sulfur, total	**5.4**	N/A	3.0	mg/L	2022-09-20	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-20	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-20	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-20	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-20	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-20	
Uranium, total	**0.000576**	MAC = 0.02	0.000020	mg/L	2022-09-20	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-20	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-20	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	

ALX003_20220914_0924 (22I2256-02) | Matrix: Water | Sampled: 2022-09-14 09:24

Anions

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-21	
Chloride	**0.80**	AO ≤ 250	0.10	mg/L	2022-09-21	
Fluoride	**0.15**	MAC = 1.5	0.10	mg/L	2022-09-21	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-21	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-21	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-21	HT1
Sulfate	**15.7**	AO ≤ 500	1.0	mg/L	2022-09-21	

BCMOE Aggregate Hydrocarbons

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
EPHw10-19	< 250	N/A	250	µg/L	2022-09-22	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-22	
Surrogate: 2-Methylnonane (EPH/F2-4)	*93*		*60-140*	*%*	*2022-09-22*	

Calculated Parameters

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Hardness, Total (as CaCO3)	**161**	None Required	0.500	mg/L	N/A	

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
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Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX003_20220914_0924 (22I2256-02) | Matrix: Water | Sampled: 2022-09-14 09:24, Continued						
Calculated Parameters, Continued						
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0780**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Barium, dissolved	**0.0679**	N/A	0.0050	mg/L	2022-09-22	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-22	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-22	
Calcium, dissolved	**44.3**	N/A	0.20	mg/L	2022-09-22	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-22	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-22	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Lithium, dissolved	**0.00338**	N/A	0.00010	mg/L	2022-09-22	
Magnesium, dissolved	**12.2**	N/A	0.010	mg/L	2022-09-22	
Manganese, dissolved	**0.00100**	N/A	0.00020	mg/L	2022-09-22	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-22	
Molybdenum, dissolved	**0.00063**	N/A	0.00010	mg/L	2022-09-22	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-22	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-22	
Potassium, dissolved	**0.37**	N/A	0.10	mg/L	2022-09-22	
Selenium, dissolved	**0.00052**	N/A	0.00050	mg/L	2022-09-22	
Silicon, dissolved	**2.1**	N/A	1.0	mg/L	2022-09-22	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-22	
Sodium, dissolved	**1.57**	N/A	0.10	mg/L	2022-09-22	
Strontium, dissolved	**0.110**	N/A	0.0010	mg/L	2022-09-22	
Sulfur, dissolved	**5.0**	N/A	3.0	mg/L	2022-09-22	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-22	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-22	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-22	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-22	
Uranium, dissolved	**0.000531**	N/A	0.000020	mg/L	2022-09-22	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-22	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-22	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-22	
General Parameters						

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX003_20220914_0924 (22I2256-02) | Matrix: Water | Sampled: 2022-09-14 09:24, Continued						
General Parameters, Continued						
Alkalinity, Total (as CaCO3)	**179**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Bicarbonate (as CaCO3)	**179**	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-22	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-22	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-20	
BOD, 5-day	< 6.2	N/A	2.0	mg/L	2022-09-22	
Carbon, Total Organic	**0.59**	N/A	0.50	mg/L	2022-09-21	
Carbon, Dissolved Organic	**0.56**	N/A	0.50	mg/L	2022-09-21	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-18	
Nitrogen, Total Kjeldahl	**0.078**	N/A	0.050	mg/L	2022-09-23	
Phosphorus, Total (as P)	**0.0081**	N/A	0.0050	mg/L	2022-09-21	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-23	HT1
Total Metals						
Aluminum, total	**0.0087**	OG < 0.1	0.0050	mg/L	2022-09-20	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-20	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-20	
Barium, total	**0.0650**	MAC = 2	0.0050	mg/L	2022-09-20	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-20	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2022-09-20	
Calcium, total	**47.5**	None Required	0.20	mg/L	2022-09-20	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-20	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-20	
Iron, total	**0.014**	AO ≤ 0.3	0.010	mg/L	2022-09-20	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-20	
Lithium, total	**0.00361**	N/A	0.00010	mg/L	2022-09-20	
Magnesium, total	**12.3**	None Required	0.010	mg/L	2022-09-20	
Manganese, total	**0.00155**	MAC = 0.12	0.00020	mg/L	2022-09-20	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-22	
Molybdenum, total	**0.00065**	N/A	0.00010	mg/L	2022-09-20	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-20	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-20	
Potassium, total	**0.35**	N/A	0.10	mg/L	2022-09-20	
Selenium, total	**0.00052**	MAC = 0.05	0.00050	mg/L	2022-09-20	
Silicon, total	**2.0**	N/A	1.0	mg/L	2022-09-20	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-20	
Sodium, total	**1.57**	AO ≤ 200	0.10	mg/L	2022-09-20	
Strontium, total	**0.109**	MAC = 7	0.0010	mg/L	2022-09-20	
Sulfur, total	**5.0**	N/A	3.0	mg/L	2022-09-20	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

ALX003_20220914_0924 (22I2256-02) | Matrix: Water | Sampled: 2022-09-14 09:24, Continued

Total Metals, Continued

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-20	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-20	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-20	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-20	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-20	
Uranium, total	**0.000522**	MAC = 0.02	0.000020	mg/L	2022-09-20	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-20	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-20	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-20	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2017)	Closed Reflux, Colorimetry	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in “batches” and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I1978										
Blank (B2I1978-BLK1)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.05	0.05	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 0.5	0.5	mg/L							
Blank (B2I1978-BLK2)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.05	0.05	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 0.5	0.5	mg/L							
Blank (B2I1978-BLK3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.05	0.05	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 0.5	0.5	mg/L							
LCS (B2I1978-BS1)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Bromide	3.85	0.10	mg/L	4.00		96	85-115			
Chloride	16.3	0.05	mg/L	16.0		102	90-110			
Fluoride	4.07	0.10	mg/L	4.00		102	88-108			
Nitrate (as N)	4.17	0.010	mg/L	4.00		104	90-110			
Nitrite (as N)	1.96	0.010	mg/L	2.00		98	85-115			
Phosphate (as P)	1.07	0.0050	mg/L	1.00		107	80-120			
Sulfate	16.3	0.5	mg/L	16.0		102	90-110			
LCS (B2I1978-BS2)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Bromide	3.92	0.10	mg/L	4.00		98	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I1978, Continued										
LCS (B2I1978-BS2), Continued				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Chloride	15.6	0.05	mg/L	16.0		97	90-110			
Fluoride	4.02	0.10	mg/L	4.00		101	88-108			
Nitrate (as N)	4.03	0.010	mg/L	4.00		101	90-110			
Nitrite (as N)	1.98	0.010	mg/L	2.00		99	85-115			
Phosphate (as P)	1.05	0.0050	mg/L	1.00		105	80-120			
Sulfate	15.9	0.5	mg/L	16.0		99	90-110			
LCS (B2I1978-BS3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Bromide	3.65	0.10	mg/L	4.00		91	85-115			
Chloride	15.6	0.05	mg/L	16.0		97	90-110			
Fluoride	4.08	0.10	mg/L	4.00		102	88-108			
Nitrate (as N)	4.01	0.010	mg/L	4.00		100	90-110			
Nitrite (as N)	1.98	0.010	mg/L	2.00		99	85-115			
Phosphate (as P)	1.06	0.0050	mg/L	1.00		106	80-120			
Sulfate	15.4	0.5	mg/L	16.0		96	90-110			
BCMOE Aggregate Hydrocarbons, Batch B2I2496										
Blank (B2I2496-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*4360*		*µg/L*	4400		*99*	*60-140*			
LCS (B2I2496-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
EPHw10-19	17900	250	µg/L	15400		116	70-130			
EPHw19-32	25900	250	µg/L	22100		117	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*4440*		*µg/L*	4400		*101*	*60-140*			
LCS Dup (B2I2496-BSD2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
EPHw10-19	16000	250	µg/L	15400		104	70-130	11	20	
EPHw19-32	23000	250	µg/L	22100		104	70-130	12	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*4330*		*µg/L*	4400		*98*	*60-140*			
Dissolved Metals, Batch B2I2476										
Blank (B2I2476-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Dissolved Metals, Batch B2I2476, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I2476-BLK1), Continued				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B2I2476-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Aluminum, dissolved	3.97	0.0050	mg/L	4.00		99	80-120			
Antimony, dissolved	0.0392	0.00020	mg/L	0.0400		98	80-120			
Arsenic, dissolved	0.0408	0.00050	mg/L	0.0400		102	80-120			
Barium, dissolved	0.0393	0.0050	mg/L	0.0400		98	80-120			
Beryllium, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Bismuth, dissolved	0.0406	0.00010	mg/L	0.0400		101	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		99	80-120			
Cadmium, dissolved	0.0395	0.000010	mg/L	0.0400		99	80-120			
Calcium, dissolved, dissolved	3.87	0.20	mg/L	4.00		97	80-120			
Chromium, dissolved	0.0398	0.00050	mg/L	0.0400		100	80-120			
Cobalt, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Copper, dissolved	0.0398	0.00040	mg/L	0.0400		100	80-120			
Iron, dissolved	3.92	0.010	mg/L	4.00		98	80-120			
Lead, dissolved	0.0408	0.00020	mg/L	0.0400		102	80-120			
Lithium, dissolved	0.0393	0.00010	mg/L	0.0400		98	80-120			
Magnesium, dissolved, dissolved	3.96	0.010	mg/L	4.00		99	80-120			
Manganese, dissolved	0.0399	0.00020	mg/L	0.0400		100	80-120			
Molybdenum, dissolved	0.0387	0.00010	mg/L	0.0400		97	80-120			
Nickel, dissolved	0.0395	0.00040	mg/L	0.0400		99	80-120			
Phosphorus, dissolved	4.02	0.050	mg/L	4.00		101	80-120			
Potassium, dissolved	4.05	0.10	mg/L	4.00		101	80-120			
Selenium, dissolved	0.0416	0.00050	mg/L	0.0400		104	80-120			
Silicon, dissolved	4.1	1.0	mg/L	4.00		102	80-120			
Silver, dissolved	0.0395	0.000050	mg/L	0.0400		99	80-120			
Sodium, dissolved	4.12	0.10	mg/L	4.00		103	80-120			
Strontium, dissolved	0.0405	0.0010	mg/L	0.0400		101	80-120			
Sulfur, dissolved	41.2	3.0	mg/L	40.0		103	80-120			
Tellurium, dissolved	0.0392	0.00050	mg/L	0.0400		98	80-120			
Thallium, dissolved	0.0414	0.000020	mg/L	0.0400		103	80-120			
Thorium, dissolved	0.0406	0.00010	mg/L	0.0400		102	80-120			
Tin, dissolved	0.0394	0.00020	mg/L	0.0400		99	80-120			
Titanium, dissolved	0.0392	0.0050	mg/L	0.0400		98	80-120			
Tungsten, dissolved	0.0406	0.0010	mg/L	0.0400		102	80-120			
Uranium, dissolved	0.0427	0.000020	mg/L	0.0400		107	80-120			
Vanadium, dissolved	0.0399	0.0050	mg/L	0.0400		100	80-120			
Zinc, dissolved	0.0402	0.0040	mg/L	0.0400		100	80-120			
Zirconium, dissolved	0.0394	0.00010	mg/L	0.0400		98	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	2212256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I2586										
Blank (B2I2586-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I2586-BLK2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
LCS (B2I2586-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, dissolved	0.000522	0.000010	mg/L	0.000500		104	80-120			
LCS (B2I2586-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, dissolved	0.000524	0.000010	mg/L	0.000500		105	80-120			
General Parameters, Batch B2I1971										
Blank (B2I1971-BLK1)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1971-BLK2)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1971-BLK3)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1971-BLK4)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B2I1971-BS1)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.4	0.50	mg/L	10.0		104	78-116			
Carbon, Dissolved Organic	10.6	0.50	mg/L	10.0		106	78-116			
LCS (B2I1971-BS2)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.6	0.50	mg/L	10.0		106	78-116			
Carbon, Dissolved Organic	10.6	0.50	mg/L	10.0		106	78-116			
LCS (B2I1971-BS3)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.6	0.50	mg/L	10.0		106	78-116			
Carbon, Dissolved Organic	10.6	0.50	mg/L	10.0		106	78-116			
LCS (B2I1971-BS4)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.5	0.50	mg/L	10.0		105	78-116			
Carbon, Dissolved Organic	10.5	0.50	mg/L	10.0		105	78-116			
LCS (B2I1971-BS5)				Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.4	0.50	mg/L	10.0		104	78-116			
Carbon, Dissolved Organic	10.5	0.50	mg/L	10.0		105	78-116			
Duplicate (B2I1971-DUP4)		**Source: 2212256-02**		Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	0.62	0.50	mg/L		0.59				16	
Carbon, Dissolved Organic	0.61	0.50	mg/L		0.56				15	
Matrix Spike (B2I1971-MS4)		**Source: 2212256-02**		Prepared: 2022-09-21, Analyzed: 2022-09-21						
Carbon, Total Organic	10.9	0.50	mg/L	10.0	0.59	103	70-130			
Carbon, Dissolved Organic	10.7	0.50	mg/L	10.0	0.56	101	70-130			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	2212256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I1974										
Blank (B2I1974-BLK1)				Prepared: 2022-09-17, Analyzed: 2022-09-22						
BOD, 5-day	< 2.0	2.0	mg/L							
LCS (B2I1974-BS1)				Prepared: 2022-09-17, Analyzed: 2022-09-22						
BOD, 5-day	183	51.6	mg/L	198		92	85-115			
General Parameters, Batch B2I1997										
Blank (B2I1997-BLK1)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Chemical Oxygen Demand	< 20	20	mg/L							
LCS (B2I1997-BS1)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Chemical Oxygen Demand	548	20	mg/L	500		110	89-115			
General Parameters, Batch B2I2208										
Blank (B2I2208-BLK1)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2208-BLK2)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2208-BLK3)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2208-BLK4)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2208-BLK5)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
LCS (B2I2208-BS1)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	0.956	0.050	mg/L	1.00		96	90-115			
LCS (B2I2208-BS2)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	0.943	0.050	mg/L	1.00		94	90-115			
LCS (B2I2208-BS3)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	0.944	0.050	mg/L	1.00		94	90-115			
LCS (B2I2208-BS4)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	0.913	0.050	mg/L	1.00		91	90-115			
LCS (B2I2208-BS5)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Ammonia, Total (as N)	0.919	0.050	mg/L	1.00		92	90-115			
General Parameters, Batch B2I2304										
Blank (B2I2304-BLK1)				Prepared: 2022-09-20, Analyzed: 2022-09-21						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B2I2304-BLK2)				Prepared: 2022-09-20, Analyzed: 2022-09-21						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
LCS (B2I2304-BS1)				Prepared: 2022-09-20, Analyzed: 2022-09-21						
Phosphorus, Total (as P)	0.102	0.0050	mg/L	0.100		102	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2304, Continued										
LCS (B2I2304-BS2)				Prepared: 2022-09-20, Analyzed: 2022-09-21						
Phosphorus, Total (as P)	0.102	0.0050	mg/L	0.100		102	85-115			
General Parameters, Batch B2I2448										
Blank (B2I2448-BLK1)				Prepared: 2022-09-21, Analyzed: 2022-09-23						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B2I2448-BLK2)				Prepared: 2022-09-21, Analyzed: 2022-09-23						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B2I2448-BS1)				Prepared: 2022-09-21, Analyzed: 2022-09-23						
Nitrogen, Total Kjeldahl	1.05	0.050	mg/L	1.00		105	85-115			
LCS (B2I2448-BS2)				Prepared: 2022-09-21, Analyzed: 2022-09-23						
Nitrogen, Total Kjeldahl	1.05	0.050	mg/L	1.00		105	85-115			
General Parameters, Batch B2I2545										
Blank (B2I2545-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I2545-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Solids, Total Suspended	87.0	10.0	mg/L	100		87	85-115			
General Parameters, Batch B2I2627										
Blank (B2I2627-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I2627-BLK2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B2I2627-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Alkalinity, Total (as CaCO3)	114	1.0	mg/L	100		114	80-120			
LCS (B2I2627-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Alkalinity, Total (as CaCO3)	114	1.0	mg/L	100		114	80-120			
Total Metals, Batch B2I2226										
Blank (B2I2226-BLK1)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Total Metals, Batch B2I2226, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I2226-BLK1), Continued				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B2I2226-BS1)				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Aluminum, total	4.00	0.0050	mg/L	4.00		100	80-120			
Antimony, total	0.0398	0.00020	mg/L	0.0400		100	80-120			
Arsenic, total	0.0407	0.00050	mg/L	0.0400		102	80-120			
Barium, total	0.0390	0.0050	mg/L	0.0400		98	80-120			
Beryllium, total	0.0395	0.00010	mg/L	0.0400		99	80-120			
Bismuth, total	0.0409	0.00010	mg/L	0.0400		102	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		105	80-120			
Cadmium, total	0.0398	0.000010	mg/L	0.0400		99	80-120			
Calcium, total	4.07	0.20	mg/L	4.00		102	80-120			
Chromium, total	0.0403	0.00050	mg/L	0.0400		101	80-120			
Cobalt, total	0.0401	0.00010	mg/L	0.0400		100	80-120			
Copper, total	0.0399	0.00040	mg/L	0.0400		100	80-120			
Iron, total	4.11	0.010	mg/L	4.00		103	80-120			
Lead, total	0.0411	0.00020	mg/L	0.0400		103	80-120			
Lithium, total	0.0402	0.00010	mg/L	0.0400		100	80-120			
Magnesium, total	4.08	0.010	mg/L	4.00		102	80-120			
Manganese, total	0.0405	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, total	0.0396	0.00010	mg/L	0.0400		99	80-120			
Nickel, total	0.0404	0.00040	mg/L	0.0400		101	80-120			
Phosphorus, total	4.09	0.050	mg/L	4.00		102	80-120			
Potassium, total	4.05	0.10	mg/L	4.00		101	80-120			
Selenium, total	0.0394	0.00050	mg/L	0.0400		98	80-120			
Silicon, total	4.0	1.0	mg/L	4.00		100	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2256
PROJECT	CBWM-2022	**REPORTED**	2022-09-23 12:52

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B2I2226, Continued										
LCS (B2I2226-BS1), Continued				Prepared: 2022-09-20, Analyzed: 2022-09-20						
Silver, total	0.0403	0.000050	mg/L	0.0400		101	80-120			
Sodium, total	3.94	0.10	mg/L	4.00		99	80-120			
Strontium, total	0.0403	0.0010	mg/L	0.0400		101	80-120			
Sulfur, total	39.6	3.0	mg/L	40.0		99	80-120			
Tellurium, total	0.0380	0.00050	mg/L	0.0400		95	80-120			
Thallium, total	0.0395	0.000020	mg/L	0.0400		99	80-120			
Thorium, total	0.0398	0.00010	mg/L	0.0400		100	80-120			
Tin, total	0.0400	0.00020	mg/L	0.0400		100	80-120			
Titanium, total	0.0396	0.0050	mg/L	0.0400		99	80-120			
Tungsten, total	0.0413	0.0002	mg/L	0.0400		103	80-120			
Uranium, total	0.0414	0.000020	mg/L	0.0400		103	80-120			
Vanadium, total	0.0404	0.0050	mg/L	0.0400		101	80-120			
Zinc, total	0.0397	0.0040	mg/L	0.0400		99	80-120			
Zirconium, total	0.0402	0.00010	mg/L	0.0400		100	80-120			
Total Metals, Batch B2I2587										
Blank (B2I2587-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2587-BLK2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2587-BLK3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	< 0.000010	0.000010	mg/L							
LCS (B2I2587-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	0.000482	0.000010	mg/L	0.000500		96	80-120			
LCS (B2I2587-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	0.000474	0.000010	mg/L	0.000500		95	80-120			
LCS (B2I2587-BS3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Mercury, total	0.000506	0.000010	mg/L	0.000500		101	80-120			

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0		
ATTENTION	Kaileigh McCallum	**WORK ORDER**	2213237
PO NUMBER		**RECEIVED / TEMP**	2022-09-23 16:30 / NA
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39
PROJECT INFO	[info]	**COC NUMBER**	B90467

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Work Order Comments: Custody Seals Intact: N/A

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

BO1001_20220921_1336 (22I3237-01) | Matrix: Water | Sampled: 2022-09-21 13:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-30	
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2022-09-30	
Fluoride	**0.23**	MAC = 1.5	0.10	mg/L	2022-09-30	
Nitrate (as N)	**0.039**	MAC = 10	0.010	mg/L	2022-09-30	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-30	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-30	HT1
Sulfate	**52.8**	AO ≤ 500	1.0	mg/L	2022-09-30	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-29	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-29	
Surrogate: 2-Methylnonane (EPH/F2-4)	*82*		*60-140*	%	*2022-09-29*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**178**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0389**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Barium, dissolved	**0.0268**	N/A	0.0050	mg/L	2022-09-29	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-29	
Cadmium, dissolved	**0.000020**	N/A	0.000010	mg/L	2022-09-29	
Calcium, dissolved	**50.2**	N/A	0.20	mg/L	2022-09-29	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-29	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-29	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Lithium, dissolved	**0.00133**	N/A	0.00010	mg/L	2022-09-29	
Magnesium, dissolved	**12.8**	N/A	0.010	mg/L	2022-09-29	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-29	
Molybdenum, dissolved	**0.00135**	N/A	0.00010	mg/L	2022-09-29	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-29	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-29	
Potassium, dissolved	**0.27**	N/A	0.10	mg/L	2022-09-29	
Selenium, dissolved	**0.00097**	N/A	0.00050	mg/L	2022-09-29	
Silicon, dissolved	**2.0**	N/A	1.0	mg/L	2022-09-29	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-29	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
BO1001_20220921_1336 (22I3237-01) | Matrix: Water | Sampled: 2022-09-21 13:36, Continued						
Dissolved Metals, Continued						
Sodium, dissolved	**0.62**	N/A	0.10	mg/L	2022-09-29	
Strontium, dissolved	**0.492**	N/A	0.0010	mg/L	2022-09-29	
Sulfur, dissolved	**15.7**	N/A	3.0	mg/L	2022-09-29	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-29	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-29	
Uranium, dissolved	**0.000914**	N/A	0.000020	mg/L	2022-09-29	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-29	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
General Parameters						
Alkalinity, Total (as CaCO3)	**160**	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Bicarbonate (as CaCO3)	**160**	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-27	
BOD, 5-day	< 6.7	N/A	2.0	mg/L	2022-09-29	
Carbon, Total Organic	< 0.50	N/A	0.50	mg/L	2022-09-28	
Carbon, Dissolved Organic	< 0.50	N/A	0.50	mg/L	2022-09-28	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-26	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2022-10-02	
Phosphorus, Total (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-28	
Total Metals						
Aluminum, total	< 0.0050	OG < 0.1	0.0050	mg/L	2022-10-02	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-10-01	
Arsenic, total	**0.00053**	MAC = 0.01	0.00050	mg/L	2022-10-01	
Barium, total	**0.0274**	MAC = 2	0.0050	mg/L	2022-10-01	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-10-01	
Cadmium, total	**0.000026**	MAC = 0.005	0.000010	mg/L	2022-10-01	
Calcium, total	**50.0**	None Required	0.20	mg/L	2022-10-01	
Chromium, total	**0.00052**	MAC = 0.05	0.00050	mg/L	2022-10-01	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-10-01	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-10-01	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-10-01	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
BO1001_20220921_1336 (22I3237-01) | Matrix: Water | Sampled: 2022-09-21 13:36, Continued						
Total Metals, Continued						
Lithium, total	**0.00131**	N/A	0.00010	mg/L	2022-10-01	
Magnesium, total	**12.9**	None Required	0.010	mg/L	2022-10-01	
Manganese, total	< 0.00020	MAC = 0.12	0.00020	mg/L	2022-10-01	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-30	
Molybdenum, total	**0.00140**	N/A	0.00010	mg/L	2022-10-01	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-10-01	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-10-01	
Potassium, total	**0.28**	N/A	0.10	mg/L	2022-10-01	
Selenium, total	**0.00097**	MAC = 0.05	0.00050	mg/L	2022-10-01	
Silicon, total	**2.1**	N/A	1.0	mg/L	2022-10-01	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-10-01	
Sodium, total	**0.57**	AO ≤ 200	0.10	mg/L	2022-10-01	
Strontium, total	**0.490**	MAC = 7	0.0010	mg/L	2022-10-01	
Sulfur, total	**16.9**	N/A	3.0	mg/L	2022-10-01	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-10-01	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-10-01	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-10-01	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-01	
Tungsten, total	**0.0002**	N/A	0.0002	mg/L	2022-10-01	
Uranium, total	**0.000916**	MAC = 0.02	0.000020	mg/L	2022-10-01	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-01	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-10-01	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
BO1002_20220921_1130 (22I3237-02) | Matrix: Water | Sampled: 2022-09-21 11:30						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-30	
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2022-09-30	
Fluoride	**0.24**	MAC = 1.5	0.10	mg/L	2022-09-30	
Nitrate (as N)	**0.066**	MAC = 10	0.010	mg/L	2022-09-30	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-30	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-30	HT1
Sulfate	**53.0**	AO ≤ 500	1.0	mg/L	2022-09-30	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-29	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-29	
Surrogate: 2-Methylnonane (EPH/F2-4)	*87*		*60-140*	%	*2022-09-29*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**178**	None Required	0.500	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
BO1002_20220921_1130 (22I3237-02) | Matrix: Water | Sampled: 2022-09-21 11:30, Continued						
Calculated Parameters, Continued						
Nitrate+Nitrite (as N)	**0.0657**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0657**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Barium, dissolved	**0.0260**	N/A	0.0050	mg/L	2022-09-29	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-29	
Cadmium, dissolved	**0.000027**	N/A	0.000010	mg/L	2022-09-29	
Calcium, dissolved	**50.1**	N/A	0.20	mg/L	2022-09-29	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-29	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-29	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Lithium, dissolved	**0.00132**	N/A	0.00010	mg/L	2022-09-29	
Magnesium, dissolved	**12.8**	N/A	0.010	mg/L	2022-09-29	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-29	
Molybdenum, dissolved	**0.00136**	N/A	0.00010	mg/L	2022-09-29	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-29	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-29	
Potassium, dissolved	**0.28**	N/A	0.10	mg/L	2022-09-29	
Selenium, dissolved	**0.00100**	N/A	0.00050	mg/L	2022-09-29	
Silicon, dissolved	**2.0**	N/A	1.0	mg/L	2022-09-29	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-29	
Sodium, dissolved	**0.63**	N/A	0.10	mg/L	2022-09-29	
Strontium, dissolved	**0.490**	N/A	0.0010	mg/L	2022-09-29	
Sulfur, dissolved	**15.7**	N/A	3.0	mg/L	2022-09-29	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-29	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-29	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-29	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-29	
Uranium, dissolved	**0.000916**	N/A	0.000020	mg/L	2022-09-29	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-29	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-29	

General Parameters

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
BO1002_20220921_1130 (22I3237-02) | Matrix: Water | Sampled: 2022-09-21 11:30, Continued						
General Parameters, Continued						
Alkalinity, Total (as CaCO3)	**146**	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Bicarbonate (as CaCO3)	**146**	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-28	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-27	
BOD, 5-day	< 6.7	N/A	2.0	mg/L	2022-09-29	
Carbon, Total Organic	< 0.50	N/A	0.50	mg/L	2022-09-28	
Carbon, Dissolved Organic	< 0.50	N/A	0.50	mg/L	2022-09-28	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-26	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2022-10-02	
Phosphorus, Total (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-29	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-28	
Total Metals						
Aluminum, total	< 0.0050	OG < 0.1	0.0050	mg/L	2022-10-02	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-10-01	
Arsenic, total	**0.00058**	MAC = 0.01	0.00050	mg/L	2022-10-01	
Barium, total	**0.0307**	MAC = 2	0.0050	mg/L	2022-10-01	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-10-01	
Cadmium, total	**0.000028**	MAC = 0.005	0.000010	mg/L	2022-10-01	
Calcium, total	**57.0**	None Required	0.20	mg/L	2022-10-01	
Chromium, total	**0.00062**	MAC = 0.05	0.00050	mg/L	2022-10-01	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-10-01	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-10-01	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-10-01	
Lithium, total	**0.00152**	N/A	0.00010	mg/L	2022-10-01	
Magnesium, total	**15.2**	None Required	0.010	mg/L	2022-10-01	
Manganese, total	< 0.00020	MAC = 0.12	0.00020	mg/L	2022-10-01	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-30	
Molybdenum, total	**0.00156**	N/A	0.00010	mg/L	2022-10-01	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-10-01	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-10-01	
Potassium, total	**0.33**	N/A	0.10	mg/L	2022-10-01	
Selenium, total	**0.00110**	MAC = 0.05	0.00050	mg/L	2022-10-01	
Silicon, total	**2.4**	N/A	1.0	mg/L	2022-10-01	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-10-01	
Sodium, total	**0.66**	AO ≤ 200	0.10	mg/L	2022-10-01	
Strontium, total	**0.561**	MAC = 7	0.0010	mg/L	2022-10-01	
Sulfur, total	**19.2**	N/A	3.0	mg/L	2022-10-01	

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
BO1002_20220921_1130 (22I3237-02) | Matrix: Water | Sampled: 2022-09-21 11:30, Continued						
Total Metals, Continued						
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-10-01	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-10-01	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	
Tin, total	**0.00045**	N/A	0.00020	mg/L	2022-10-01	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-01	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-10-01	
Uranium, total	**0.00107**	MAC = 0.02	0.000020	mg/L	2022-10-01	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-01	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-10-01	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-01	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
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Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2017)	Closed Reflux, Colorimetry	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in “batches” and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I2828										
Blank (B2I2828-BLK1)				Prepared: 2022-09-30, Analyzed: 2022-09-30						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B2I2828-BLK2)				Prepared: 2022-10-01, Analyzed: 2022-10-01						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
LCS (B2I2828-BS1)				Prepared: 2022-09-30, Analyzed: 2022-09-30						
Bromide	3.72	0.10	mg/L	4.00		93	85-115			
Chloride	15.7	0.10	mg/L	16.0		98	90-110			
Fluoride	4.08	0.10	mg/L	4.00		102	88-108			
Nitrate (as N)	4.09	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.04	0.010	mg/L	2.00		102	85-115			
Phosphate (as P)	0.911	0.0050	mg/L	1.00		91	80-120			
Sulfate	15.7	1.0	mg/L	16.0		98	90-110			
LCS (B2I2828-BS2)				Prepared: 2022-10-01, Analyzed: 2022-10-01						
Bromide	3.70	0.10	mg/L	4.00		93	85-115			
Chloride	16.1	0.10	mg/L	16.0		101	90-110			
Fluoride	4.13	0.10	mg/L	4.00		103	88-108			
Nitrate (as N)	4.05	0.010	mg/L	4.00		101	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	1.09	0.0050	mg/L	1.00		109	80-120			
Sulfate	15.6	1.0	mg/L	16.0		98	90-110			

BCMOE Aggregate Hydrocarbons, Batch B2I3443

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
BCMOE Aggregate Hydrocarbons, Batch B2I3443, Continued										
Blank (B2I3443-BLK1)				Prepared: 2022-09-29, Analyzed: 2022-09-29						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*2950*		*µg/L*	4400		*67*	*60-140*			
LCS (B2I3443-BS2)				Prepared: 2022-09-29, Analyzed: 2022-09-29						
EPHw10-19	17100	250	µg/L	15400		111	70-130			
EPHw19-32	25100	250	µg/L	22100		113	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*3120*		*µg/L*	4400		*71*	*60-140*			
LCS Dup (B2I3443-BSD2)				Prepared: 2022-09-29, Analyzed: 2022-09-29						
EPHw10-19	17800	250	µg/L	15400		115	70-130	4	20	
EPHw19-32	26200	250	µg/L	22100		118	70-130	5	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*3350*		*µg/L*	4400		*76*	*60-140*			
Dissolved Metals, Batch B2I3391										
Blank (B2I3391-BLK1)				Prepared: 2022-09-29, Analyzed: 2022-09-29						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I3391, Continued										
LCS (B2I3391-BS1)				Prepared: 2022-09-29, Analyzed: 2022-09-29						
Aluminum, dissolved	3.99	0.0050	mg/L	4.00		100	80-120			
Antimony, dissolved	0.0397	0.00020	mg/L	0.0400		99	80-120			
Arsenic, dissolved	0.0411	0.00050	mg/L	0.0400		103	80-120			
Barium, dissolved	0.0389	0.0050	mg/L	0.0400		97	80-120			
Beryllium, dissolved	0.0406	0.00010	mg/L	0.0400		102	80-120			
Bismuth, dissolved	0.0406	0.00010	mg/L	0.0400		101	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		102	80-120			
Cadmium, dissolved	0.0399	0.000010	mg/L	0.0400		100	80-120			
Calcium, dissolved, dissolved	4.05	0.20	mg/L	4.00		101	80-120			
Chromium, dissolved	0.0402	0.00050	mg/L	0.0400		100	80-120			
Cobalt, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Copper, dissolved	0.0402	0.00040	mg/L	0.0400		100	80-120			
Iron, dissolved	3.98	0.010	mg/L	4.00		100	80-120			
Lead, dissolved	0.0403	0.00020	mg/L	0.0400		101	80-120			
Lithium, dissolved	0.0409	0.00010	mg/L	0.0400		102	80-120			
Magnesium, dissolved, dissolved	4.09	0.010	mg/L	4.00		102	80-120			
Manganese, dissolved	0.0403	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Nickel, dissolved	0.0398	0.00040	mg/L	0.0400		99	80-120			
Phosphorus, dissolved	3.98	0.050	mg/L	4.00		99	80-120			
Potassium, dissolved	3.98	0.10	mg/L	4.00		100	80-120			
Selenium, dissolved	0.0400	0.00050	mg/L	0.0400		100	80-120			
Silicon, dissolved	4.2	1.0	mg/L	4.00		104	80-120			
Silver, dissolved	0.0403	0.000050	mg/L	0.0400		101	80-120			
Sodium, dissolved	3.99	0.10	mg/L	4.00		100	80-120			
Strontium, dissolved	0.0404	0.0010	mg/L	0.0400		101	80-120			
Sulfur, dissolved	39.5	3.0	mg/L	40.0		99	80-120			
Tellurium, dissolved	0.0409	0.00050	mg/L	0.0400		102	80-120			
Thallium, dissolved	0.0400	0.000020	mg/L	0.0400		100	80-120			
Thorium, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Tin, dissolved	0.0410	0.00020	mg/L	0.0400		103	80-120			
Titanium, dissolved	0.0405	0.0050	mg/L	0.0400		101	80-120			
Tungsten, dissolved	0.0402	0.0010	mg/L	0.0400		101	80-120			
Uranium, dissolved	0.0403	0.000020	mg/L	0.0400		101	80-120			
Vanadium, dissolved	0.0400	0.0050	mg/L	0.0400		100	80-120			
Zinc, dissolved	0.0385	0.0040	mg/L	0.0400		96	80-120			
Zirconium, dissolved	0.0410	0.00010	mg/L	0.0400		102	80-120			
Duplicate (B2I3391-DUP1)		**Source: 22I3237-01**		Prepared: 2022-09-29, Analyzed: 2022-09-29						
Aluminum, dissolved	< 0.0050	0.0050	mg/L		< 0.0050				20	
Antimony, dissolved	< 0.00020	0.00020	mg/L		< 0.00020				20	
Arsenic, dissolved	< 0.00050	0.00050	mg/L		< 0.00050				20	
Barium, dissolved	0.0261	0.0050	mg/L		0.0268			3	20	
Beryllium, dissolved	< 0.00010	0.00010	mg/L		< 0.00010				20	
Bismuth, dissolved	< 0.00010	0.00010	mg/L		< 0.00010				20	
Boron, dissolved	< 0.0500	0.0500	mg/L		< 0.0500				20	
Cadmium, dissolved	0.000024	0.000010	mg/L		0.000020				20	
Calcium, dissolved, dissolved	49.3	0.20	mg/L		50.2			2	20	
Chromium, dissolved	< 0.00050	0.00050	mg/L		< 0.00050				20	
Cobalt, dissolved	< 0.00010	0.00010	mg/L		< 0.00010				20	
Copper, dissolved	< 0.00040	0.00040	mg/L		< 0.00040				20	
Iron, dissolved	< 0.010	0.010	mg/L		< 0.010				20	
Lead, dissolved	< 0.00020	0.00020	mg/L		< 0.00020				20	
Lithium, dissolved	0.00131	0.00010	mg/L		0.00133			1	20	
Magnesium, dissolved, dissolved	12.7	0.010	mg/L		12.8			< 1	20	
Manganese, dissolved	< 0.00020	0.00020	mg/L		< 0.00020				20	

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I3391, Continued										
Duplicate (B2I3391-DUP1), Continued		**Source: 22I3237-01**		Prepared: 2022-09-29, Analyzed: 2022-09-29						
Molybdenum, dissolved	0.00135	0.00010	mg/L		0.00135			< 1	20	
Nickel, dissolved	< 0.00040	0.00040	mg/L		< 0.00040				20	
Phosphorus, dissolved	< 0.050	0.050	mg/L		< 0.050				20	
Potassium, dissolved	0.28	0.10	mg/L		0.27				20	
Selenium, dissolved	0.00099	0.00050	mg/L		0.00097				20	
Silicon, dissolved	2.0	1.0	mg/L		2.0				20	
Silver, dissolved	< 0.000050	0.000050	mg/L		< 0.000050				20	
Sodium, dissolved	0.63	0.10	mg/L		0.62			< 1	20	
Strontium, dissolved	0.491	0.0010	mg/L		0.492			< 1	20	
Sulfur, dissolved	15.8	3.0	mg/L		15.7			< 1	20	
Tellurium, dissolved	< 0.00050	0.00050	mg/L		< 0.00050				20	
Thallium, dissolved	< 0.000020	0.000020	mg/L		< 0.000020				20	
Thorium, dissolved	< 0.00010	0.00010	mg/L		< 0.00010				20	
Tin, dissolved	< 0.00020	0.00020	mg/L		< 0.00020				20	
Titanium, dissolved	< 0.0050	0.0050	mg/L		< 0.0050				20	
Tungsten, dissolved	< 0.0010	0.0010	mg/L		< 0.0010				20	
Uranium, dissolved	0.000927	0.000020	mg/L		0.000914			1	20	
Vanadium, dissolved	< 0.0050	0.0050	mg/L		< 0.0050				20	
Zinc, dissolved	< 0.0040	0.0040	mg/L		< 0.0040				20	
Zirconium, dissolved	< 0.00010	0.00010	mg/L		< 0.00010				20	
Matrix Spike (B2I3391-MS1)		**Source: 22I3237-02**		Prepared: 2022-09-29, Analyzed: 2022-09-29						
Aluminum, dissolved	3.95	0.0050	mg/L	4.00	< 0.0050	99	70-130			
Antimony, dissolved	0.0379	0.00020	mg/L	0.0400	< 0.00020	95	70-130			
Arsenic, dissolved	0.0420	0.00050	mg/L	0.0400	< 0.00050	104	70-130			
Barium, dissolved	0.0645	0.0050	mg/L	0.0400	0.0260	96	70-130			
Beryllium, dissolved	0.0408	0.00010	mg/L	0.0400	< 0.00010	102	70-130			
Bismuth, dissolved	0.0348	0.00010	mg/L	0.0400	< 0.00010	87	70-130			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400	< 0.0500	94	70-130			
Cadmium, dissolved	0.0403	0.000010	mg/L	0.0400	0.000027	101	70-130			
Calcium, dissolved, dissolved	52.3	0.20	mg/L	4.00	50.1	55	70-130			MS2
Chromium, dissolved	0.0398	0.00050	mg/L	0.0400	< 0.00050	98	70-130			
Cobalt, dissolved	0.0386	0.00010	mg/L	0.0400	< 0.00010	97	70-130			
Copper, dissolved	0.0387	0.00040	mg/L	0.0400	< 0.00040	97	70-130			
Iron, dissolved	3.89	0.010	mg/L	4.00	< 0.010	97	70-130			
Lead, dissolved	0.0397	0.00020	mg/L	0.0400	< 0.00020	99	70-130			
Lithium, dissolved	0.0414	0.00010	mg/L	0.0400	0.00132	100	70-130			
Magnesium, dissolved, dissolved	17.9	0.010	mg/L	4.00	12.8	127	70-130			
Manganese, dissolved	0.0398	0.00020	mg/L	0.0400	< 0.00020	99	70-130			
Molybdenum, dissolved	0.0414	0.00010	mg/L	0.0400	0.00136	100	70-130			
Nickel, dissolved	0.0388	0.00040	mg/L	0.0400	< 0.00040	97	70-130			
Phosphorus, dissolved	4.06	0.050	mg/L	4.00	< 0.050	101	70-130			
Potassium, dissolved	4.12	0.10	mg/L	4.00	0.28	96	70-130			
Selenium, dissolved	0.0415	0.00050	mg/L	0.0400	0.00100	101	70-130			
Silicon, dissolved	6.0	1.0	mg/L	4.00	2.0	101	70-130			
Silver, dissolved	0.0374	0.000050	mg/L	0.0400	< 0.000050	93	70-130			
Sodium, dissolved	4.53	0.10	mg/L	4.00	0.63	98	70-130			
Strontium, dissolved	0.528	0.0010	mg/L	0.0400	0.490	95	70-130			
Sulfur, dissolved	54.7	3.0	mg/L	40.0	15.7	97	70-130			
Tellurium, dissolved	0.0422	0.00050	mg/L	0.0400	< 0.00050	106	70-130			
Thallium, dissolved	0.0393	0.000020	mg/L	0.0400	< 0.000020	98	70-130			
Thorium, dissolved	0.0394	0.00010	mg/L	0.0400	< 0.00010	99	70-130			
Tin, dissolved	0.0407	0.00020	mg/L	0.0400	< 0.00020	102	70-130			
Titanium, dissolved	0.0404	0.0050	mg/L	0.0400	< 0.0050	101	70-130			
Tungsten, dissolved	0.0400	0.0010	mg/L	0.0400	< 0.0010	100	70-130			
Uranium, dissolved	0.0410	0.000020	mg/L	0.0400	0.000916	100	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	2213237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I3391, Continued										
Matrix Spike (B2I3391-MS1), Continued		**Source: 2213237-02**		Prepared: 2022-09-29, Analyzed: 2022-09-29						
Vanadium, dissolved	0.0408	0.0050	mg/L	0.0400	< 0.0050	101	70-130			
Zinc, dissolved	0.0410	0.0040	mg/L	0.0400	< 0.0040	99	70-130			
Zirconium, dissolved	0.0409	0.00010	mg/L	0.0400	< 0.00010	102	70-130			
Dissolved Metals, Batch B2I3408										
Blank (B2I3408-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I3408-BLK2)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I3408-BLK3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
LCS (B2I3408-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	0.000535	0.000010	mg/L	0.000500		107	80-120			
LCS (B2I3408-BS2)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	0.000518	0.000010	mg/L	0.000500		104	80-120			
LCS (B2I3408-BS3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	0.000534	0.000010	mg/L	0.000500		107	80-120			
Duplicate (B2I3408-DUP2)		**Source: 2213237-01**		Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	< 0.000010	0.000010	mg/L		< 0.000010				20	
Matrix Spike (B2I3408-MS2)		**Source: 2213237-02**		Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, dissolved	0.000243	0.000010	mg/L	0.000250	< 0.000010	97	70-130			
General Parameters, Batch B2I2761										
Blank (B2I2761-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2761-BLK2)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2761-BLK3)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2761-BLK4)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B2I2761-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	10.4	0.50	mg/L	10.0		104	78-116			
Carbon, Dissolved Organic	10.4	0.50	mg/L	10.0		104	78-116			
LCS (B2I2761-BS2)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	10.5	0.50	mg/L	10.0		105	78-116			
Carbon, Dissolved Organic	11.0	0.50	mg/L	10.0		110	78-116			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2761, Continued										
LCS (B2I2761-BS3)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	9.53	0.50	mg/L	10.0		95	78-116			
Carbon, Dissolved Organic	9.37	0.50	mg/L	10.0		94	78-116			
LCS (B2I2761-BS4)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Carbon, Total Organic	9.32	0.50	mg/L	10.0		93	78-116			
Carbon, Dissolved Organic	10.4	0.50	mg/L	10.0		104	78-116			
General Parameters, Batch B2I2823										
Blank (B2I2823-BLK1)				Prepared: 2022-09-24, Analyzed: 2022-09-29						
BOD, 5-day	< 2.0	2.0	mg/L							
LCS (B2I2823-BS1)				Prepared: 2022-09-24, Analyzed: 2022-09-29						
BOD, 5-day	203	55.5	mg/L	198		103	85-115			
Duplicate (B2I2823-DUP1)		**Source: 22I3237-02**		Prepared: 2022-09-24, Analyzed: 2022-09-29						
BOD, 5-day	< 6.7	2.0	mg/L		< 6.7				22	
General Parameters, Batch B2I2911										
Blank (B2I2911-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Chemical Oxygen Demand	< 20	20	mg/L							
LCS (B2I2911-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Chemical Oxygen Demand	534	20	mg/L	500		107	89-115			
General Parameters, Batch B2I3086										
Blank (B2I3086-BLK1)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B2I3086-BLK2)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B2I3086-BLK3)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B2I3086-BLK4)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B2I3086-BLK5)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
LCS (B2I3086-BS1)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	0.944	0.020	mg/L	1.00		94	90-115			
LCS (B2I3086-BS2)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	0.907	0.020	mg/L	1.00		91	90-115			
LCS (B2I3086-BS3)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	0.916	0.020	mg/L	1.00		92	90-115			
LCS (B2I3086-BS4)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	0.928	0.020	mg/L	1.00		93	90-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I3086, Continued										
LCS (B2I3086-BS5)				Prepared: 2022-09-27, Analyzed: 2022-09-27						
Ammonia, Total (as N)	0.980	0.020	mg/L	1.00		98	90-115			
General Parameters, Batch B2I3242										
Blank (B2I3242-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I3242-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Solids, Total Suspended	88.5	5.0	mg/L	100		88	85-115			
General Parameters, Batch B2I3359										
Blank (B2I3359-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I3359-BLK2)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I3359-BLK3)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B2I3359-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	111	1.0	mg/L	100		111	80-120			
LCS (B2I3359-BS2)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	120	1.0	mg/L	100		120	80-120			
LCS (B2I3359-BS3)				Prepared: 2022-09-28, Analyzed: 2022-09-28						
Alkalinity, Total (as CaCO3)	114	1.0	mg/L	100		114	80-120			
General Parameters, Batch B2I3367										
Blank (B2I3367-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B2I3367-BLK3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
LCS (B2I3367-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Phosphorus, Total (as P)	0.106	0.0050	mg/L	0.100		106	85-115			
LCS (B2I3367-BS3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Phosphorus, Total (as P)	0.105	0.0050	mg/L	0.100		105	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I3639										
Blank (B2I3639-BLK1)				Prepared: 2022-09-30, Analyzed: 2022-10-02						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B2I3639-BLK2)				Prepared: 2022-09-30, Analyzed: 2022-10-02						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B2I3639-BS1)				Prepared: 2022-09-30, Analyzed: 2022-10-02						
Nitrogen, Total Kjeldahl	0.931	0.050	mg/L	1.00		93	85-115			
LCS (B2I3639-BS2)				Prepared: 2022-09-30, Analyzed: 2022-10-02						
Nitrogen, Total Kjeldahl	0.921	0.050	mg/L	1.00		92	85-115			
Total Metals, Batch B2I3409										
Blank (B2I3409-BLK1)				Prepared: 2022-09-28, Analyzed: 2022-09-30						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I3409-BLK2)				Prepared: 2022-09-28, Analyzed: 2022-09-30						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I3409-BLK3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, total	< 0.000010	0.000010	mg/L							
LCS (B2I3409-BS1)				Prepared: 2022-09-28, Analyzed: 2022-09-30						
Mercury, total	0.000548	0.000010	mg/L	0.000500		110	80-120			
LCS (B2I3409-BS2)				Prepared: 2022-09-28, Analyzed: 2022-09-30						
Mercury, total	0.000563	0.000010	mg/L	0.000500		113	80-120			
LCS (B2I3409-BS3)				Prepared: 2022-09-28, Analyzed: 2022-09-29						
Mercury, total	0.000539	0.000010	mg/L	0.000500		108	80-120			
Matrix Spike (B2I3409-MS2)		**Source: 22I3237-02**		Prepared: 2022-09-28, Analyzed: 2022-09-30						
Mercury, total	0.000270	0.000010	mg/L	0.000250	< 0.000010	108	70-130			
Total Metals, Batch B2I3636										
Blank (B2I3636-BLK1)				Prepared: 2022-09-30, Analyzed: 2022-10-02						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I3237
PROJECT	CBWM-2022	**REPORTED**	2022-10-03 13:39

Total Metals, Batch B2I3636, Continued

Blank (B2I3636-BLK1), Continued — Prepared: 2022-09-30, Analyzed: 2022-09-30

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							

LCS (B2I3636-BS1) — Prepared: 2022-09-30, Analyzed: 2022-10-02

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Aluminum, total	3.87	0.0050	mg/L	4.00		97	80-120			
Antimony, total	0.0450	0.00020	mg/L	0.0400		113	80-120			
Arsenic, total	0.0447	0.00050	mg/L	0.0400		112	80-120			
Barium, total	0.0451	0.0050	mg/L	0.0400		113	80-120			
Beryllium, total	0.0456	0.00010	mg/L	0.0400		114	80-120			
Bismuth, total	0.0440	0.00010	mg/L	0.0400		110	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		120	80-120			
Cadmium, total	0.0445	0.000010	mg/L	0.0400		111	80-120			
Calcium, total	4.75	0.20	mg/L	4.00		119	80-120			
Chromium, total	0.0448	0.00050	mg/L	0.0400		112	80-120			
Cobalt, total	0.0444	0.00010	mg/L	0.0400		111	80-120			
Copper, total	0.0436	0.00040	mg/L	0.0400		109	80-120			
Iron, total	4.35	0.010	mg/L	4.00		109	80-120			
Lead, total	0.0450	0.00020	mg/L	0.0400		112	80-120			
Lithium, total	0.0452	0.00010	mg/L	0.0400		113	80-120			
Magnesium, total	4.55	0.010	mg/L	4.00		114	80-120			
Manganese, total	0.0453	0.00020	mg/L	0.0400		113	80-120			
Molybdenum, total	0.0447	0.00010	mg/L	0.0400		112	80-120			
Nickel, total	0.0446	0.00040	mg/L	0.0400		111	80-120			
Phosphorus, total	4.42	0.050	mg/L	4.00		110	80-120			
Potassium, total	4.45	0.10	mg/L	4.00		111	80-120			
Selenium, total	0.0440	0.00050	mg/L	0.0400		110	80-120			
Silicon, total	4.6	1.0	mg/L	4.00		116	80-120			
Silver, total	0.0437	0.000050	mg/L	0.0400		109	80-120			
Sodium, total	4.53	0.10	mg/L	4.00		113	80-120			
Strontium, total	0.0449	0.0010	mg/L	0.0400		112	80-120			
Sulfur, total	44.1	3.0	mg/L	40.0		110	80-120			
Tellurium, total	0.0418	0.00050	mg/L	0.0400		105	80-120			
Thallium, total	0.0431	0.000020	mg/L	0.0400		108	80-120			
Thorium, total	0.0451	0.00010	mg/L	0.0400		113	80-120			
Tin, total	0.0458	0.00020	mg/L	0.0400		115	80-120			
Titanium, total	0.0497	0.0050	mg/L	0.0400		124	80-120			MES
Tungsten, total	0.0458	0.0002	mg/L	0.0400		115	80-120			
Uranium, total	0.0456	0.000020	mg/L	0.0400		114	80-120			
Vanadium, total	0.0451	0.0050	mg/L	0.0400		113	80-120			
Zinc, total	0.0446	0.0040	mg/L	0.0400		112	80-120			

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B2I3636, Continued										
LCS (B2I3636-BS1), Continued				Prepared: 2022-09-30, Analyzed: 2022-10-01						
Zirconium, total	0.0448	0.00010	mg/L	0.0400		112	80-120			

QC Qualifiers:

MES	A number up to 10% (rounded down) of the analytes in a Multi-Element Scan may exceed control limits by up to 10% (absolute).
MS2	The native sample concentration is greater than the spike concentration hence the matrix spike limits do not apply.

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0		
ATTENTION	Kaileigh McCallum	**WORK ORDER**	22I2558
PO NUMBER		**RECEIVED / TEMP**	2022-09-20 14:00 / 11.2°C
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24
PROJECT INFO	[info]	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Work Order Comments: Custody Seals Intact: N/A

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL001_20220918_1545 (22I2558-01) | Matrix: Water | Sampled: 2022-09-18 15:45						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-23	
Chloride	**0.61**	AO ≤ 250	0.10	mg/L	2022-09-23	
Fluoride	< 0.10	MAC = 1.5	0.10	mg/L	2022-09-23	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-23	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-23	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-23	HT1
Sulfate	**6.4**	AO ≤ 500	1.0	mg/L	2022-09-23	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-23	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-23	
Surrogate: 2-Methylnonane (EPH/F2-4)	*77*		*60-140*	%	*2022-09-23*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**139**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0530**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Barium, dissolved	**0.287**	N/A	0.0050	mg/L	2022-09-23	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-23	
Cadmium, dissolved	**0.000031**	N/A	0.000010	mg/L	2022-09-23	
Calcium, dissolved	**42.5**	N/A	0.20	mg/L	2022-09-23	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Iron, dissolved	**0.010**	N/A	0.010	mg/L	2022-09-23	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Lithium, dissolved	**0.00710**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, dissolved	**8.03**	N/A	0.010	mg/L	2022-09-23	
Manganese, dissolved	**0.00305**	N/A	0.00020	mg/L	2022-09-27	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-26	
Molybdenum, dissolved	**0.00085**	N/A	0.00010	mg/L	2022-09-23	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, dissolved	**0.81**	N/A	0.10	mg/L	2022-09-23	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Silicon, dissolved	**1.8**	N/A	1.0	mg/L	2022-09-23	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-23	

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL001_20220918_1545 (22I2558-01) | Matrix: Water | Sampled: 2022-09-18 15:45, Continued						
Dissolved Metals, Continued						
Sodium, dissolved	**2.73**	N/A	0.10	mg/L	2022-09-23	
Strontium, dissolved	**0.143**	N/A	0.0010	mg/L	2022-09-23	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-23	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-23	
Uranium, dissolved	**0.000543**	N/A	0.000020	mg/L	2022-09-23	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-23	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
General Parameters						
Alkalinity, Total (as CaCO3)	**175**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Bicarbonate (as CaCO3)	**175**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-22	
BOD, 5-day	< 7.3	N/A	2.0	mg/L	2022-09-26	
Carbon, Total Organic	**2.31**	N/A	0.50	mg/L	2022-09-26	
Carbon, Dissolved Organic	**1.85**	N/A	0.50	mg/L	2022-09-26	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-22	
Nitrogen, Total Kjeldahl	**0.053**	N/A	0.050	mg/L	2022-09-27	
Phosphorus, Total (as P)	**0.0206**	N/A	0.0050	mg/L	2022-09-23	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-23	
Total Metals						
Aluminum, total	**0.0078**	OG < 0.1	0.0050	mg/L	2022-09-23	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-23	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-23	
Barium, total	**0.279**	MAC = 2	0.0050	mg/L	2022-09-23	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-23	
Cadmium, total	**0.000037**	MAC = 0.005	0.000010	mg/L	2022-09-23	
Calcium, total	**43.5**	None Required	0.20	mg/L	2022-09-23	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Copper, total	**0.00050**	MAC = 2	0.00040	mg/L	2022-09-23	
Iron, total	**0.017**	AO ≤ 0.3	0.010	mg/L	2022-09-23	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-23	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL001_20220918_1545 (22I2558-01) | Matrix: Water | Sampled: 2022-09-18 15:45, Continued						
Total Metals, Continued						
Lithium, total	**0.00736**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, total	**8.38**	None Required	0.010	mg/L	2022-09-23	
Manganese, total	**0.00411**	MAC = 0.12	0.00020	mg/L	2022-09-23	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-26	
Molybdenum, total	**0.00085**	N/A	0.00010	mg/L	2022-09-23	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, total	**0.85**	N/A	0.10	mg/L	2022-09-23	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Silicon, total	**2.0**	N/A	1.0	mg/L	2022-09-23	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-23	
Sodium, total	**2.77**	AO ≤ 200	0.10	mg/L	2022-09-23	
Strontium, total	**0.146**	MAC = 7	0.0010	mg/L	2022-09-23	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-23	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-23	
Uranium, total	**0.000528**	MAC = 0.02	0.000020	mg/L	2022-09-23	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-23	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
COL003_20220918_1120 (22I2558-02) | Matrix: Water | Sampled: 2022-09-18 11:20						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-22	
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2022-09-22	
Fluoride	< 0.10	MAC = 1.5	0.10	mg/L	2022-09-22	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-22	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-22	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-22	HT1
Sulfate	**6.3**	AO ≤ 500	1.0	mg/L	2022-09-22	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-23	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-23	
Surrogate: 2-Methylnonane (EPH/F2-4)	*97*		*60-140*	*%*	*2022-09-23*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**49.1**	None Required	0.500	mg/L	N/A	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL003_20220918_1120 (22I2558-02) | Matrix: Water | Sampled: 2022-09-18 11:20, Continued						
Calculated Parameters, Continued						
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0158**	N/A	0.0050	mg/L	2022-09-23	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Barium, dissolved	**0.0817**	N/A	0.0050	mg/L	2022-09-23	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-23	
Cadmium, dissolved	**0.000059**	N/A	0.000010	mg/L	2022-09-23	
Calcium, dissolved	**14.9**	N/A	0.20	mg/L	2022-09-23	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-23	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Lithium, dissolved	**0.00012**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, dissolved	**2.90**	N/A	0.010	mg/L	2022-09-23	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-27	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-26	
Molybdenum, dissolved	**0.00043**	N/A	0.00010	mg/L	2022-09-23	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, dissolved	**0.24**	N/A	0.10	mg/L	2022-09-23	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Silicon, dissolved	**1.1**	N/A	1.0	mg/L	2022-09-23	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-23	
Sodium, dissolved	**0.17**	N/A	0.10	mg/L	2022-09-23	
Strontium, dissolved	**0.0191**	N/A	0.0010	mg/L	2022-09-23	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-23	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-23	
Uranium, dissolved	**0.000093**	N/A	0.000020	mg/L	2022-09-23	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-23	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	

General Parameters

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL003_20220918_1120 (22I2558-02) | Matrix: Water | Sampled: 2022-09-18 11:20, Continued						
General Parameters, Continued						
Alkalinity, Total (as CaCO3)	**62.8**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Bicarbonate (as CaCO3)	**62.8**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-22	
BOD, 5-day	< 7.3	N/A	2.0	mg/L	2022-09-26	
Carbon, Total Organic	**2.08**	N/A	0.50	mg/L	2022-09-26	
Carbon, Dissolved Organic	**1.96**	N/A	0.50	mg/L	2022-09-26	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-22	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2022-09-27	
Phosphorus, Total (as P)	**0.0168**	N/A	0.0050	mg/L	2022-09-23	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-23	
Total Metals						
Aluminum, total	**0.0253**	OG < 0.1	0.0050	mg/L	2022-09-23	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-23	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-23	
Barium, total	**0.0768**	MAC = 2	0.0050	mg/L	2022-09-23	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-23	
Cadmium, total	**0.000060**	MAC = 0.005	0.000010	mg/L	2022-09-23	
Calcium, total	**14.8**	None Required	0.20	mg/L	2022-09-23	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-23	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-09-23	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-23	
Lithium, total	**0.00015**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, total	**3.03**	None Required	0.010	mg/L	2022-09-23	
Manganese, total	**0.00062**	MAC = 0.12	0.00020	mg/L	2022-09-23	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-26	
Molybdenum, total	**0.00042**	N/A	0.00010	mg/L	2022-09-23	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, total	**0.25**	N/A	0.10	mg/L	2022-09-23	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Silicon, total	**1.1**	N/A	1.0	mg/L	2022-09-23	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-23	
Sodium, total	**0.17**	AO ≤ 200	0.10	mg/L	2022-09-23	
Strontium, total	**0.0197**	MAC = 7	0.0010	mg/L	2022-09-23	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-23	

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
COL003_20220918_1120 (22I2558-02) | Matrix: Water | Sampled: 2022-09-18 11:20, Continued						
Total Metals, Continued						
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-23	
Uranium, total	**0.000091**	MAC = 0.02	0.000020	mg/L	2022-09-23	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-23	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
DUP001_20220918_1120 (22I2558-03) | Matrix: Water | Sampled: 2022-09-18 11:20						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-22	
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2022-09-22	
Fluoride	< 0.10	MAC = 1.5	0.10	mg/L	2022-09-22	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-22	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-22	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-22	HT1
Sulfate	**6.3**	AO ≤ 500	1.0	mg/L	2022-09-22	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-23	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-23	
Surrogate: 2-Methylnonane (EPH/F2-4)	*97*		*60-140*	%	*2022-09-23*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**48.5**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0172**	N/A	0.0050	mg/L	2022-09-23	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Barium, dissolved	**0.0816**	N/A	0.0050	mg/L	2022-09-23	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-23	
Cadmium, dissolved	**0.000054**	N/A	0.000010	mg/L	2022-09-23	
Calcium, dissolved	**14.7**	N/A	0.20	mg/L	2022-09-23	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DUP001_20220918_1120 (22I2558-03) | Matrix: Water | Sampled: 2022-09-18 11:20, Continued						
Dissolved Metals, Continued						
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-23	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Lithium, dissolved	**0.00013**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, dissolved	**2.83**	N/A	0.010	mg/L	2022-09-23	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-26	
Molybdenum, dissolved	**0.00043**	N/A	0.00010	mg/L	2022-09-23	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, dissolved	**0.24**	N/A	0.10	mg/L	2022-09-23	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Silicon, dissolved	**1.1**	N/A	1.0	mg/L	2022-09-23	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-23	
Sodium, dissolved	**0.16**	N/A	0.10	mg/L	2022-09-23	
Strontium, dissolved	**0.0192**	N/A	0.0010	mg/L	2022-09-23	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-23	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-23	
Uranium, dissolved	**0.000092**	N/A	0.000020	mg/L	2022-09-23	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-23	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
General Parameters						
Alkalinity, Total (as CaCO3)	**61.4**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Bicarbonate (as CaCO3)	**61.4**	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-24	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-22	
BOD, 5-day	< 7.3	N/A	2.0	mg/L	2022-09-26	
Carbon, Total Organic	**2.11**	N/A	0.50	mg/L	2022-09-26	
Carbon, Dissolved Organic	**1.80**	N/A	0.50	mg/L	2022-09-26	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-22	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2022-09-27	
Phosphorus, Total (as P)	**0.0153**	N/A	0.0050	mg/L	2022-09-23	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-23	
Total Metals						

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DUP001_20220918_1120 (22I2558-03) | Matrix: Water | Sampled: 2022-09-18 11:20, Continued						
Total Metals, Continued						
Aluminum, total	**0.0188**	OG < 0.1	0.0050	mg/L	2022-09-23	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-23	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-23	
Barium, total	**0.0772**	MAC = 2	0.0050	mg/L	2022-09-23	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-23	
Cadmium, total	**0.000051**	MAC = 0.005	0.000010	mg/L	2022-09-23	
Calcium, total	**14.9**	None Required	0.20	mg/L	2022-09-23	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-23	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-09-23	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-23	
Lithium, total	**0.00014**	N/A	0.00010	mg/L	2022-09-23	
Magnesium, total	**3.06**	None Required	0.010	mg/L	2022-09-23	
Manganese, total	**0.00023**	MAC = 0.12	0.00020	mg/L	2022-09-23	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-26	
Molybdenum, total	**0.00042**	N/A	0.00010	mg/L	2022-09-23	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-23	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-23	
Potassium, total	**0.25**	N/A	0.10	mg/L	2022-09-23	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-23	
Silicon, total	**1.1**	N/A	1.0	mg/L	2022-09-23	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-23	
Sodium, total	**0.16**	AO ≤ 200	0.10	mg/L	2022-09-23	
Strontium, total	**0.0195**	MAC = 7	0.0010	mg/L	2022-09-23	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-23	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-23	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-23	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-23	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-23	
Uranium, total	**0.000088**	MAC = 0.02	0.000020	mg/L	2022-09-23	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-23	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-23	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-23	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2017)	Closed Reflux, Colorimetry	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

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ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

![CARO Analytical Services]

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I2233										
Blank (B2I2233-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 0.5	0.5	mg/L							
Blank (B2I2233-BLK2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 0.5	0.5	mg/L							
LCS (B2I2233-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.86	0.10	mg/L	4.00		97	85-115			
Chloride	15.6	0.10	mg/L	16.0		97	90-110			
Fluoride	4.07	0.10	mg/L	4.00		102	88-108			
Nitrate (as N)	4.08	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	1.96	0.010	mg/L	2.00		98	85-115			
Phosphate (as P)	1.10	0.0050	mg/L	1.00		110	80-120			
Sulfate	15.8	0.5	mg/L	16.0		98	90-110			
LCS (B2I2233-BS2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.70	0.10	mg/L	4.00		92	85-115			
Chloride	15.6	0.10	mg/L	16.0		98	90-110			
Fluoride	4.12	0.10	mg/L	4.00		103	88-108			
Nitrate (as N)	4.09	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.03	0.010	mg/L	2.00		101	85-115			
Phosphate (as P)	1.04	0.0050	mg/L	1.00		104	80-120			
Sulfate	15.6	0.5	mg/L	16.0		98	90-110			
Duplicate (B2I2233-DUP2)	**Source: 22I2558-01**			Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L		< 0.10				10	

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I2233, Continued										
Duplicate (B2I2233-DUP2), Continued	**Source: 2212558-01**			Prepared: 2022-09-23, Analyzed: 2022-09-23						
Chloride	0.61	0.10	mg/L		0.61			< 1	10	
Fluoride	< 0.10	0.10	mg/L		< 0.10				10	
Nitrate (as N)	< 0.010	0.010	mg/L		< 0.010				10	
Nitrite (as N)	< 0.010	0.010	mg/L		< 0.010				15	
Phosphate (as P)	< 0.0050	0.0050	mg/L		< 0.0050				20	
Sulfate	6.4	1.0	mg/L		6.4			< 1	10	
Matrix Spike (B2I2233-MS2)	**Source: 2212558-01**			Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.62	0.10	mg/L	4.00	< 0.10	91	80-120			
Chloride	16.8	0.10	mg/L	16.0	0.61	101	75-125			
Fluoride	3.90	0.10	mg/L	4.00	< 0.10	96	75-125			
Nitrate (as N)	3.80	0.010	mg/L	4.00	< 0.010	95	75-125			
Nitrite (as N)	2.04	0.010	mg/L	2.00	< 0.010	102	80-120			
Phosphate (as P)	0.798	0.0050	mg/L	1.00	< 0.0050	80	70-130			
Sulfate	22.3	0.5	mg/L	16.0	6.4	100	75-125			
BCMOE Aggregate Hydrocarbons, Batch B2I2678										
Blank (B2I2678-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*4200*		*µg/L*	4400		*95*	*60-140*			
LCS (B2I2678-BS2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
EPHw10-19	15500	250	µg/L	15400		100	70-130			
EPHw19-32	22800	250	µg/L	22100		103	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*3370*		*µg/L*	4400		*77*	*60-140*			
LCS Dup (B2I2678-BSD2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
EPHw10-19	15700	250	µg/L	15400		102	70-130	1	20	
EPHw19-32	23000	250	µg/L	22100		104	70-130	1	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*3540*		*µg/L*	4400		*80*	*60-140*			
Dissolved Metals, Batch B2I2636										
Blank (B2I2636-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Dissolved Metals, Batch B2I2636, Continued

Blank (B2I2636-BLK1), Continued — Prepared: 2022-09-23, Analyzed: 2022-09-23

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							

LCS (B2I2636-BS1) — Prepared: 2022-09-23, Analyzed: 2022-09-23

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Aluminum, dissolved	4.06	0.0050	mg/L	4.00		102	80-120			
Antimony, dissolved	0.0410	0.00020	mg/L	0.0400		102	80-120			
Arsenic, dissolved	0.0416	0.00050	mg/L	0.0400		104	80-120			
Barium, dissolved	0.0410	0.0050	mg/L	0.0400		103	80-120			
Beryllium, dissolved	0.0396	0.00010	mg/L	0.0400		99	80-120			
Bismuth, dissolved	0.0416	0.00010	mg/L	0.0400		104	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		101	80-120			
Cadmium, dissolved	0.0411	0.000010	mg/L	0.0400		103	80-120			
Calcium, dissolved, dissolved	3.88	0.20	mg/L	4.00		97	80-120			
Chromium, dissolved	0.0403	0.00050	mg/L	0.0400		101	80-120			
Cobalt, dissolved	0.0400	0.00010	mg/L	0.0400		100	80-120			
Copper, dissolved	0.0399	0.00040	mg/L	0.0400		100	80-120			
Iron, dissolved	4.03	0.010	mg/L	4.00		101	80-120			
Lead, dissolved	0.0416	0.00020	mg/L	0.0400		104	80-120			
Lithium, dissolved	0.0391	0.00010	mg/L	0.0400		98	80-120			
Magnesium, dissolved, dissolved	4.06	0.010	mg/L	4.00		102	80-120			
Manganese, dissolved	0.0405	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, dissolved	0.0400	0.00010	mg/L	0.0400		100	80-120			
Nickel, dissolved	0.0401	0.00040	mg/L	0.0400		100	80-120			
Phosphorus, dissolved	4.11	0.050	mg/L	4.00		103	80-120			
Potassium, dissolved	3.96	0.10	mg/L	4.00		99	80-120			
Selenium, dissolved	0.0412	0.00050	mg/L	0.0400		103	80-120			
Silicon, dissolved	4.0	1.0	mg/L	4.00		101	80-120			
Silver, dissolved	0.0410	0.000050	mg/L	0.0400		102	80-120			
Sodium, dissolved	4.12	0.10	mg/L	4.00		103	80-120			
Strontium, dissolved	0.0409	0.0010	mg/L	0.0400		102	80-120			
Sulfur, dissolved	42.1	3.0	mg/L	40.0		105	80-120			
Tellurium, dissolved	0.0412	0.00050	mg/L	0.0400		103	80-120			
Thallium, dissolved	0.0421	0.000020	mg/L	0.0400		105	80-120			
Thorium, dissolved	0.0420	0.00010	mg/L	0.0400		105	80-120			
Tin, dissolved	0.0413	0.00020	mg/L	0.0400		103	80-120			
Titanium, dissolved	0.0402	0.0050	mg/L	0.0400		100	80-120			
Tungsten, dissolved	0.0418	0.0010	mg/L	0.0400		105	80-120			
Uranium, dissolved	0.0424	0.000020	mg/L	0.0400		106	80-120			
Vanadium, dissolved	0.0405	0.0050	mg/L	0.0400		101	80-120			
Zinc, dissolved	0.0415	0.0040	mg/L	0.0400		104	80-120			
Zirconium, dissolved	0.0414	0.00010	mg/L	0.0400		103	80-120			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	2212558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I2908										
Blank (B2I2908-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I2908-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
LCS (B2I2908-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000553	0.000010	mg/L	0.000500		111	80-120			
LCS (B2I2908-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000523	0.000010	mg/L	0.000500		105	80-120			
General Parameters, Batch B2I2377										
Blank (B2I2377-BLK1)				Prepared: 2022-09-21, Analyzed: 2022-09-26						
BOD, 5-day	< 2.0	2.0	mg/L							
LCS (B2I2377-BS1)				Prepared: 2022-09-21, Analyzed: 2022-09-26						
BOD, 5-day	204	60.9	mg/L	198		103	85-115			
Duplicate (B2I2377-DUP1)		**Source: 2212558-03**		Prepared: 2022-09-21, Analyzed: 2022-09-26						
BOD, 5-day	< 7.3	2.0	mg/L		< 7.3				22	
General Parameters, Batch B2I2456										
Blank (B2I2456-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Chemical Oxygen Demand	< 20	20	mg/L							
LCS (B2I2456-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Chemical Oxygen Demand	515	20	mg/L	500		103	89-115			
General Parameters, Batch B2I2506										
Blank (B2I2506-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK3)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK4)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK5)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B2I2506-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.4	0.50	mg/L	10.0		104	78-116			
Carbon, Dissolved Organic	10.4	0.50	mg/L	10.0		104	78-116			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2506, Continued										
LCS (B2I2506-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.1	0.50	mg/L	10.0		101	78-116			
Carbon, Dissolved Organic	9.97	0.50	mg/L	10.0		100	78-116			
LCS (B2I2506-BS3)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.1	0.50	mg/L	10.0		101	78-116			
Carbon, Dissolved Organic	9.98	0.50	mg/L	10.0		100	78-116			
LCS (B2I2506-BS4)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	9.85	0.50	mg/L	10.0		98	78-116			
Carbon, Dissolved Organic	9.85	0.50	mg/L	10.0		98	78-116			
LCS (B2I2506-BS5)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.5	0.50	mg/L	10.0		105	78-116			
Carbon, Dissolved Organic	10.5	0.50	mg/L	10.0		105	78-116			
Duplicate (B2I2506-DUP2)		**Source: 22I2558-01**		Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	2.31	0.50	mg/L		2.31				16	
Carbon, Dissolved Organic	1.91	0.50	mg/L		1.85				15	
Matrix Spike (B2I2506-MS2)		**Source: 22I2558-01**		Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	12.1	0.50	mg/L	10.0	2.31	98	70-130			
Carbon, Dissolved Organic	12.0	0.50	mg/L	10.0	1.85	102	70-130			
General Parameters, Batch B2I2543										
Blank (B2I2543-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2543-BLK2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2543-BLK3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2543-BLK4)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2543-BLK5)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
LCS (B2I2543-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	1.02	0.050	mg/L	1.00		102	90-115			
LCS (B2I2543-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	1.02	0.050	mg/L	1.00		102	90-115			
LCS (B2I2543-BS3)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	0.973	0.050	mg/L	1.00		97	90-115			
LCS (B2I2543-BS4)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	0.995	0.050	mg/L	1.00		100	90-115			
LCS (B2I2543-BS5)				Prepared: 2022-09-22, Analyzed: 2022-09-22						
Ammonia, Total (as N)	1.01	0.050	mg/L	1.00		101	90-115			

General Parameters, Batch B2I2645

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2645, Continued										
Blank (B2I2645-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-23						
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L							BLK
Blank (B2I2645-BLK2)				Prepared: 2022-09-22, Analyzed: 2022-09-23						
Phosphorus, Total (as P)	0.0026	0.0020	mg/L							BLK
LCS (B2I2645-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-23						
Phosphorus, Total (as P)	0.112	0.0020	mg/L	0.100		112	85-115			
LCS (B2I2645-BS2)				Prepared: 2022-09-22, Analyzed: 2022-09-23						
Phosphorus, Total (as P)	0.113	0.0020	mg/L	0.100		113	85-115			
General Parameters, Batch B2I2722										
Blank (B2I2722-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I2722-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Solids, Total Suspended	95.0	10.0	mg/L	100		95	85-115			
General Parameters, Batch B2I2817										
Blank (B2I2817-BLK1)				Prepared: 2022-09-24, Analyzed: 2022-09-24						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B2I2817-BS1)				Prepared: 2022-09-24, Analyzed: 2022-09-24						
Alkalinity, Total (as CaCO3)	114	1.0	mg/L	100		114	80-120			
General Parameters, Batch B2I2871										
Blank (B2I2871-BLK1)				Prepared: 2022-09-25, Analyzed: 2022-09-27						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B2I2871-BLK2)				Prepared: 2022-09-25, Analyzed: 2022-09-27						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B2I2871-BS1)				Prepared: 2022-09-25, Analyzed: 2022-09-27						
Nitrogen, Total Kjeldahl	0.931	0.050	mg/L	1.00		93	85-115			
LCS (B2I2871-BS2)				Prepared: 2022-09-25, Analyzed: 2022-09-27						
Nitrogen, Total Kjeldahl	0.939	0.050	mg/L	1.00		94	85-115			
Total Metals, Batch B2I2681										
Blank (B2I2681-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Total Metals, Batch B2I2681, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I2681-BLK1), Continued				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B2I2681-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Aluminum, total	4.13	0.0050	mg/L	4.00		103	80-120			
Antimony, total	0.0394	0.00020	mg/L	0.0400		99	80-120			
Arsenic, total	0.0428	0.00050	mg/L	0.0400		107	80-120			
Barium, total	0.0387	0.0050	mg/L	0.0400		97	80-120			
Beryllium, total	0.0388	0.00010	mg/L	0.0400		97	80-120			
Bismuth, total	0.0401	0.00010	mg/L	0.0400		100	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		100	80-120			
Cadmium, total	0.0399	0.000010	mg/L	0.0400		100	80-120			
Calcium, total	3.94	0.20	mg/L	4.00		98	80-120			
Chromium, total	0.0411	0.00050	mg/L	0.0400		103	80-120			
Cobalt, total	0.0412	0.00010	mg/L	0.0400		103	80-120			
Copper, total	0.0411	0.00040	mg/L	0.0400		103	80-120			
Iron, total	4.07	0.010	mg/L	4.00		102	80-120			
Lead, total	0.0397	0.00020	mg/L	0.0400		99	80-120			
Lithium, total	0.0390	0.00010	mg/L	0.0400		98	80-120			
Magnesium, total	4.28	0.010	mg/L	4.00		107	80-120			
Manganese, total	0.0412	0.00020	mg/L	0.0400		103	80-120			
Molybdenum, total	0.0392	0.00010	mg/L	0.0400		98	80-120			
Nickel, total	0.0409	0.00040	mg/L	0.0400		102	80-120			
Phosphorus, total	4.08	0.050	mg/L	4.00		102	80-120			
Potassium, total	4.21	0.10	mg/L	4.00		105	80-120			
Selenium, total	0.0402	0.00050	mg/L	0.0400		101	80-120			
Silicon, total	4.1	1.0	mg/L	4.00		104	80-120			
Silver, total	0.0401	0.000050	mg/L	0.0400		100	80-120			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2558
PROJECT	CBWM-2022	**REPORTED**	2022-09-27 15:24

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B2I2681, Continued										
LCS (B2I2681-BS1), Continued				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Sodium, total	4.07	0.10	mg/L	4.00		102	80-120			
Strontium, total	0.0419	0.0010	mg/L	0.0400		105	80-120			
Sulfur, total	40.7	3.0	mg/L	40.0		102	80-120			
Tellurium, total	0.0384	0.00050	mg/L	0.0400		96	80-120			
Thallium, total	0.0391	0.000020	mg/L	0.0400		98	80-120			
Thorium, total	0.0404	0.00010	mg/L	0.0400		101	80-120			
Tin, total	0.0398	0.00020	mg/L	0.0400		99	80-120			
Titanium, total	0.0415	0.0050	mg/L	0.0400		104	80-120			
Tungsten, total	0.0396	0.0002	mg/L	0.0400		99	80-120			
Uranium, total	0.0398	0.000020	mg/L	0.0400		100	80-120			
Vanadium, total	0.0405	0.0050	mg/L	0.0400		101	80-120			
Zinc, total	0.0404	0.0040	mg/L	0.0400		101	80-120			
Zirconium, total	0.0396	0.00010	mg/L	0.0400		99	80-120			
Total Metals, Batch B2I2909										
Blank (B2I2909-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2909-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Mercury, total	< 0.000010	0.000010	mg/L							
LCS (B2I2909-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	0.000530	0.000010	mg/L	0.000500		106	80-120			
LCS (B2I2909-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Mercury, total	0.000428	0.000010	mg/L	0.000500		86	80-120			

QC Qualifiers:

BLK Analyte concentration in the Method Blank is above the Reporting Limit (RL).

CARO ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0		
ATTENTION	Kaileigh McCallum	**WORK ORDER**	22I2857
PO NUMBER		**RECEIVED / TEMP**	2022-09-21 14:30 / 12.8°C
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20
PROJECT INFO	[info]	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20220920_1228 (22I2857-01) | Matrix: Water | Sampled: 2022-09-20 12:28						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-23	
Chloride	**0.23**	AO ≤ 250	0.10	mg/L	2022-09-23	
Fluoride	**0.11**	MAC = 1.5	0.10	mg/L	2022-09-23	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-23	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-23	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-25	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-25	
Surrogate: 2-Methylnonane (EPH/F2-4)	*95*		*60-140*	%	*2022-09-25*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**332**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0630**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Barium, dissolved	**0.0706**	N/A	0.0050	mg/L	2022-09-25	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-25	
Cadmium, dissolved	**0.000012**	N/A	0.000010	mg/L	2022-09-25	
Calcium, dissolved	**94.9**	N/A	0.20	mg/L	2022-09-25	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-25	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-25	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	
Lithium, dissolved	**0.00381**	N/A	0.00010	mg/L	2022-09-25	
Magnesium, dissolved	**23.0**	N/A	0.010	mg/L	2022-09-25	
Manganese, dissolved	**0.00144**	N/A	0.00020	mg/L	2022-09-25	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-27	
Molybdenum, dissolved	**0.00183**	N/A	0.00010	mg/L	2022-09-25	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-25	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-25	
Potassium, dissolved	**0.43**	N/A	0.10	mg/L	2022-09-25	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Silicon, dissolved	**2.2**	N/A	1.0	mg/L	2022-09-25	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-25	
Sodium, dissolved	**1.67**	N/A	0.10	mg/L	2022-09-25	
Strontium, dissolved	**1.57**	N/A	0.0010	mg/L	2022-09-25	

CARO
ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20220920_1228 (22I2857-01) | Matrix: Water | Sampled: 2022-09-20 12:28, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	**66.4**	N/A	3.0	mg/L	2022-09-25	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-25	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-25	
Uranium, dissolved	**0.000357**	N/A	0.000020	mg/L	2022-09-25	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-25	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
General Parameters						
Alkalinity, Total (as CaCO3)	**172**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Phenolphthalein (as CaCO3)	**1.4**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Bicarbonate (as CaCO3)	**169**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Carbonate (as CaCO3)	**2.8**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-25	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-23	
BOD, 5-day	< 6.8	N/A	2.0	mg/L	2022-09-27	
Carbon, Total Organic	**1.00**	N/A	0.50	mg/L	2022-09-26	
Carbon, Dissolved Organic	**0.93**	N/A	0.50	mg/L	2022-09-26	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-25	
Nitrogen, Total Kjeldahl	**0.063**	N/A	0.050	mg/L	2022-09-28	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-26	
Total Metals						
Aluminum, total	**0.0238**	OG < 0.1	0.0050	mg/L	2022-09-24	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-24	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-24	
Barium, total	**0.0751**	MAC = 2	0.0050	mg/L	2022-09-24	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-24	
Cadmium, total	**0.000016**	MAC = 0.005	0.000010	mg/L	2022-09-24	
Calcium, total	**105**	None Required	0.20	mg/L	2022-09-24	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-24	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-24	
Iron, total	**0.023**	AO ≤ 0.3	0.010	mg/L	2022-09-24	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-24	
Lithium, total	**0.00403**	N/A	0.00010	mg/L	2022-09-24	
Magnesium, total	**23.7**	None Required	0.010	mg/L	2022-09-24	
Manganese, total	**0.00286**	MAC = 0.12	0.00020	mg/L	2022-09-24	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20220920_1228 (22I2857-01) | Matrix: Water | Sampled: 2022-09-20 12:28, Continued						
Total Metals, Continued						
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-28	
Molybdenum, total	**0.00199**	N/A	0.00010	mg/L	2022-09-24	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-24	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-24	
Potassium, total	**0.43**	N/A	0.10	mg/L	2022-09-24	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-24	
Silicon, total	**2.6**	N/A	1.0	mg/L	2022-09-24	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-24	
Sodium, total	**1.73**	AO ≤ 200	0.10	mg/L	2022-09-24	
Strontium, total	**1.73**	MAC = 7	0.0010	mg/L	2022-09-24	
Sulfur, total	**73.0**	N/A	3.0	mg/L	2022-09-24	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-24	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-24	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-24	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-24	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-24	
Uranium, total	**0.000397**	MAC = 0.02	0.000020	mg/L	2022-09-24	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-24	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-24	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
LIZ003_20220920_0930 (22I2857-02) | Matrix: Water | Sampled: 2022-09-20 09:30						
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-09-23	
Chloride	**0.23**	AO ≤ 250	0.10	mg/L	2022-09-23	
Fluoride	< 0.10	MAC = 1.5	0.10	mg/L	2022-09-23	
Nitrate (as N)	**0.046**	MAC = 10	0.010	mg/L	2022-09-23	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-23	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-25	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-25	
Surrogate: 2-Methylnonane (EPH/F2-4)	*94*		*60-140*	*%*	*2022-09-25*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**339**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0464**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.136**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ003_20220920_0930 (22I2857-02) | Matrix: Water | Sampled: 2022-09-20 09:30, Continued						
Dissolved Metals, Continued						
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Barium, dissolved	**0.0653**	N/A	0.0050	mg/L	2022-09-25	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-25	
Cadmium, dissolved	**0.000012**	N/A	0.000010	mg/L	2022-09-25	
Calcium, dissolved	**97.3**	N/A	0.20	mg/L	2022-09-25	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-25	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-25	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	
Lithium, dissolved	**0.00396**	N/A	0.00010	mg/L	2022-09-25	
Magnesium, dissolved	**23.2**	N/A	0.010	mg/L	2022-09-25	
Manganese, dissolved	**0.00251**	N/A	0.00020	mg/L	2022-09-25	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-27	
Molybdenum, dissolved	**0.00185**	N/A	0.00010	mg/L	2022-09-25	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-25	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-25	
Potassium, dissolved	**0.43**	N/A	0.10	mg/L	2022-09-25	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Silicon, dissolved	**2.4**	N/A	1.0	mg/L	2022-09-25	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-25	
Sodium, dissolved	**1.67**	N/A	0.10	mg/L	2022-09-25	
Strontium, dissolved	**1.64**	N/A	0.0010	mg/L	2022-09-25	
Sulfur, dissolved	**67.9**	N/A	3.0	mg/L	2022-09-25	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-25	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-25	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-25	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-25	
Uranium, dissolved	**0.000354**	N/A	0.000020	mg/L	2022-09-25	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-25	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-25	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-25	
General Parameters						
Alkalinity, Total (as CaCO3)	**180**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Bicarbonate (as CaCO3)	**180**	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-25	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-25	

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ003_20220920_0930 (22I2857-02) | Matrix: Water | Sampled: 2022-09-20 09:30, Continued						
General Parameters, Continued						
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-09-23	
BOD, 5-day	< 6.8	N/A	2.0	mg/L	2022-09-27	
Carbon, Total Organic	**1.07**	N/A	0.50	mg/L	2022-09-26	
Carbon, Dissolved Organic	**0.80**	N/A	0.50	mg/L	2022-09-26	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-25	
Nitrogen, Total Kjeldahl	**0.090**	N/A	0.050	mg/L	2022-09-28	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-26	
Total Metals						
Aluminum, total	**0.0151**	OG < 0.1	0.0050	mg/L	2022-09-24	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-24	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-24	
Barium, total	**0.0653**	MAC = 2	0.0050	mg/L	2022-09-24	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-24	
Cadmium, total	**0.000014**	MAC = 0.005	0.000010	mg/L	2022-09-24	
Calcium, total	**96.2**	None Required	0.20	mg/L	2022-09-24	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-24	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-24	
Iron, total	**0.016**	AO ≤ 0.3	0.010	mg/L	2022-09-24	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-24	
Lithium, total	**0.00378**	N/A	0.00010	mg/L	2022-09-24	
Magnesium, total	**22.6**	None Required	0.010	mg/L	2022-09-24	
Manganese, total	**0.00337**	MAC = 0.12	0.00020	mg/L	2022-09-24	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-28	
Molybdenum, total	**0.00188**	N/A	0.00010	mg/L	2022-09-24	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-24	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-24	
Potassium, total	**0.41**	N/A	0.10	mg/L	2022-09-24	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-24	
Silicon, total	**2.6**	N/A	1.0	mg/L	2022-09-24	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-24	
Sodium, total	**1.66**	AO ≤ 200	0.10	mg/L	2022-09-24	
Strontium, total	**1.70**	MAC = 7	0.0010	mg/L	2022-09-24	
Sulfur, total	**67.8**	N/A	3.0	mg/L	2022-09-24	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-24	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-24	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-24	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-24	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-24	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ003_20220920_0930 (22I2857-02) | Matrix: Water | Sampled: 2022-09-20 09:30, Continued						
Total Metals, Continued						
Uranium, total	**0.000366**	MAC = 0.02	0.000020	mg/L	2022-09-24	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-24	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-24	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-24	

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
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Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2017)	Closed Reflux, Colorimetry	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I2664										
Blank (B2I2664-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Blank (B2I2664-BLK2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Blank (B2I2664-BLK3)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	< 0.10	0.10	mg/L							
Chloride	< 0.10	0.10	mg/L							
Fluoride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
LCS (B2I2664-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.93	0.10	mg/L	4.00		98	85-115			
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Fluoride	4.08	0.10	mg/L	4.00		102	88-108			
Nitrate (as N)	4.09	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	1.96	0.010	mg/L	2.00		98	85-115			
LCS (B2I2664-BS2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.86	0.10	mg/L	4.00		96	85-115			
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Fluoride	3.97	0.10	mg/L	4.00		99	88-108			
Nitrate (as N)	3.93	0.010	mg/L	4.00		98	90-110			
Nitrite (as N)	1.95	0.010	mg/L	2.00		97	85-115			
LCS (B2I2664-BS3)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Bromide	3.93	0.10	mg/L	4.00		98	85-115			
Chloride	16.2	0.10	mg/L	16.0		101	90-110			

APPENDIX 2: QUALITY CONTROL RESULTS

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I2664, Continued										
LCS (B2I2664-BS3), Continued				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Fluoride	4.16	0.10	mg/L	4.00		104	88-108			
Nitrate (as N)	4.13	0.010	mg/L	4.00		103	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
BCMOE Aggregate Hydrocarbons, Batch B2I2865										
Blank (B2I2865-BLK1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*4230*		*µg/L*	4400		*96*	*60-140*			
LCS (B2I2865-BS2)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
EPHw10-19	16900	250	µg/L	15400		110	70-130			
EPHw19-32	24500	250	µg/L	22100		111	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*4150*		*µg/L*	4400		*94*	*60-140*			
LCS Dup (B2I2865-BSD2)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
EPHw10-19	17400	250	µg/L	15400		113	70-130	3	20	
EPHw19-32	25300	250	µg/L	22100		114	70-130	3	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*4310*		*µg/L*	4400		*98*	*60-140*			
Dissolved Metals, Batch B2I2801										
Blank (B2I2801-BLK1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I2801, Continued										
Blank (B2I2801-BLK1), Continued				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B2I2801-BS1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Aluminum, dissolved	4.03	0.0050	mg/L	4.00		101	80-120			
Antimony, dissolved	0.0408	0.00020	mg/L	0.0400		102	80-120			
Arsenic, dissolved	0.0422	0.00050	mg/L	0.0400		105	80-120			
Barium, dissolved	0.0398	0.0050	mg/L	0.0400		100	80-120			
Beryllium, dissolved	0.0399	0.00010	mg/L	0.0400		100	80-120			
Bismuth, dissolved	0.0397	0.00010	mg/L	0.0400		99	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		102	80-120			
Cadmium, dissolved	0.0405	0.000010	mg/L	0.0400		101	80-120			
Calcium, dissolved, dissolved	4.02	0.20	mg/L	4.00		101	80-120			
Chromium, dissolved	0.0412	0.00050	mg/L	0.0400		103	80-120			
Cobalt, dissolved	0.0407	0.00010	mg/L	0.0400		102	80-120			
Copper, dissolved	0.0405	0.00040	mg/L	0.0400		101	80-120			
Iron, dissolved	4.08	0.010	mg/L	4.00		102	80-120			
Lead, dissolved	0.0403	0.00020	mg/L	0.0400		101	80-120			
Lithium, dissolved	0.0400	0.00010	mg/L	0.0400		100	80-120			
Magnesium, dissolved, dissolved	4.17	0.010	mg/L	4.00		104	80-120			
Manganese, dissolved	0.0407	0.00020	mg/L	0.0400		102	80-120			
Molybdenum, dissolved	0.0395	0.00010	mg/L	0.0400		99	80-120			
Nickel, dissolved	0.0407	0.00040	mg/L	0.0400		102	80-120			
Phosphorus, dissolved	4.05	0.050	mg/L	4.00		101	80-120			
Potassium, dissolved	4.08	0.10	mg/L	4.00		102	80-120			
Selenium, dissolved	0.0409	0.00050	mg/L	0.0400		102	80-120			
Silicon, dissolved	4.2	1.0	mg/L	4.00		104	80-120			
Silver, dissolved	0.0409	0.000050	mg/L	0.0400		102	80-120			
Sodium, dissolved	4.00	0.10	mg/L	4.00		100	80-120			
Strontium, dissolved	0.0417	0.0010	mg/L	0.0400		104	80-120			
Sulfur, dissolved	41.0	3.0	mg/L	40.0		103	80-120			
Tellurium, dissolved	0.0398	0.00050	mg/L	0.0400		99	80-120			
Thallium, dissolved	0.0398	0.000020	mg/L	0.0400		99	80-120			
Thorium, dissolved	0.0408	0.00010	mg/L	0.0400		102	80-120			
Tin, dissolved	0.0410	0.00020	mg/L	0.0400		103	80-120			
Titanium, dissolved	0.0392	0.0050	mg/L	0.0400		98	80-120			
Tungsten, dissolved	0.0399	0.0010	mg/L	0.0400		100	80-120			
Uranium, dissolved	0.0401	0.000020	mg/L	0.0400		100	80-120			
Vanadium, dissolved	0.0410	0.0050	mg/L	0.0400		102	80-120			
Zinc, dissolved	0.0396	0.0040	mg/L	0.0400		99	80-120			
Zirconium, dissolved	0.0408	0.00010	mg/L	0.0400		102	80-120			
Dissolved Metals, Batch B2I2968										
Blank (B2I2968-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I2968-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I2968-BLK3)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	< 0.000010	0.000010	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I2968, Continued										
Blank (B2I2968-BLK4)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
LCS (B2I2968-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000487	0.000010	mg/L	0.000500		97	80-120			
LCS (B2I2968-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000492	0.000010	mg/L	0.000500		98	80-120			
LCS (B2I2968-BS3)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000490	0.000010	mg/L	0.000500		98	80-120			
LCS (B2I2968-BS4)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000490	0.000010	mg/L	0.000500		98	80-120			
Duplicate (B2I2968-DUP3)		**Source: 22I2857-02**		Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	< 0.000010	0.000010	mg/L		< 0.000010				20	
Matrix Spike (B2I2968-MS3)		**Source: 22I2857-01**		Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, dissolved	0.000238	0.000010	mg/L	0.000250	< 0.000010	95	70-130			
General Parameters, Batch B2I2506										
Blank (B2I2506-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK3)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK4)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I2506-BLK5)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B2I2506-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.4	0.50	mg/L	10.0		104	78-116			
Carbon, Dissolved Organic	10.4	0.50	mg/L	10.0		104	78-116			
LCS (B2I2506-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.1	0.50	mg/L	10.0		101	78-116			
Carbon, Dissolved Organic	9.97	0.50	mg/L	10.0		100	78-116			
LCS (B2I2506-BS3)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.1	0.50	mg/L	10.0		101	78-116			
Carbon, Dissolved Organic	9.98	0.50	mg/L	10.0		100	78-116			
LCS (B2I2506-BS4)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	9.85	0.50	mg/L	10.0		98	78-116			
Carbon, Dissolved Organic	9.85	0.50	mg/L	10.0		98	78-116			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2506, Continued										
LCS (B2I2506-BS5)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Carbon, Total Organic	10.5	0.50	mg/L	10.0		105	78-116			
Carbon, Dissolved Organic	10.5	0.50	mg/L	10.0		105	78-116			
General Parameters, Batch B2I2570										
Blank (B2I2570-BLK1)				Prepared: 2022-09-22, Analyzed: 2022-09-27						
BOD, 5-day	< 2.0	2.0	mg/L							
LCS (B2I2570-BS1)				Prepared: 2022-09-22, Analyzed: 2022-09-27						
BOD, 5-day	185	56.4	mg/L	198		93	85-115			
General Parameters, Batch B2I2705										
Blank (B2I2705-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2705-BLK2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2705-BLK3)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B2I2705-BLK4)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
LCS (B2I2705-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	0.984	0.050	mg/L	1.00		98	90-115			
LCS (B2I2705-BS2)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	0.996	0.050	mg/L	1.00		100	90-115			
LCS (B2I2705-BS3)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	0.985	0.050	mg/L	1.00		98	90-115			
LCS (B2I2705-BS4)				Prepared: 2022-09-23, Analyzed: 2022-09-23						
Ammonia, Total (as N)	0.978	0.050	mg/L	1.00		98	90-115			
General Parameters, Batch B2I2861										
Blank (B2I2861-BLK1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Chemical Oxygen Demand	< 20	20	mg/L							
LCS (B2I2861-BS1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Chemical Oxygen Demand	517	20	mg/L	500		103	89-115			
General Parameters, Batch B2I2873										
Blank (B2I2873-BLK1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I2873-BLK2)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I2873, Continued										
Blank (B2I2873-BLK2), Continued				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I2873-BLK3)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B2I2873-BS1)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	114	1.0	mg/L	100		114	80-120			
LCS (B2I2873-BS2)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	116	1.0	mg/L	100		116	80-120			
LCS (B2I2873-BS3)				Prepared: 2022-09-25, Analyzed: 2022-09-25						
Alkalinity, Total (as CaCO3)	117	1.0	mg/L	100		117	80-120			
General Parameters, Batch B2I2923										
Blank (B2I2923-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I2923-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-26						
Solids, Total Suspended	100	10.0	mg/L	100		100	85-115			
General Parameters, Batch B2I2999										
Blank (B2I2999-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-28						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B2I2999-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-28						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B2I2999-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-28						
Nitrogen, Total Kjeldahl	0.978	0.050	mg/L	1.00		98	85-115			
LCS (B2I2999-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-28						
Nitrogen, Total Kjeldahl	0.969	0.050	mg/L	1.00		97	85-115			
Total Metals, Batch B2I2797										
Blank (B2I2797-BLK1)				Prepared: 2022-09-23, Analyzed: 2022-09-24						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Total Metals, Batch B2I2797, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I2797-BLK1), Continued				Prepared: 2022-09-23, Analyzed: 2022-09-24						
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B2I2797-BS1)				Prepared: 2022-09-23, Analyzed: 2022-09-24						
Aluminum, total	4.02	0.0050	mg/L	4.00		101	80-120			
Antimony, total	0.0403	0.00020	mg/L	0.0400		101	80-120			
Arsenic, total	0.0420	0.00050	mg/L	0.0400		105	80-120			
Barium, total	0.0388	0.0050	mg/L	0.0400		97	80-120			
Beryllium, total	0.0388	0.00010	mg/L	0.0400		97	80-120			
Bismuth, total	0.0390	0.00010	mg/L	0.0400		98	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		99	80-120			
Cadmium, total	0.0403	0.000010	mg/L	0.0400		101	80-120			
Calcium, total	3.97	0.20	mg/L	4.00		99	80-120			
Chromium, total	0.0409	0.00050	mg/L	0.0400		102	80-120			
Cobalt, total	0.0405	0.00010	mg/L	0.0400		101	80-120			
Copper, total	0.0399	0.00040	mg/L	0.0400		100	80-120			
Iron, total	4.05	0.010	mg/L	4.00		101	80-120			
Lead, total	0.0394	0.00020	mg/L	0.0400		99	80-120			
Lithium, total	0.0382	0.00010	mg/L	0.0400		96	80-120			
Magnesium, total	4.12	0.010	mg/L	4.00		103	80-120			
Manganese, total	0.0405	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, total	0.0397	0.00010	mg/L	0.0400		99	80-120			
Nickel, total	0.0398	0.00040	mg/L	0.0400		99	80-120			
Phosphorus, total	4.00	0.050	mg/L	4.00		100	80-120			
Potassium, total	4.07	0.10	mg/L	4.00		102	80-120			
Selenium, total	0.0398	0.00050	mg/L	0.0400		100	80-120			
Silicon, total	4.1	1.0	mg/L	4.00		102	80-120			
Silver, total	0.0406	0.000050	mg/L	0.0400		101	80-120			
Sodium, total	4.02	0.10	mg/L	4.00		100	80-120			
Strontium, total	0.0416	0.0010	mg/L	0.0400		104	80-120			
Sulfur, total	40.1	3.0	mg/L	40.0		100	80-120			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I2857
PROJECT	CBWM-2022	**REPORTED**	2022-10-31 14:20

Total Metals, Batch B2I2797, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
LCS (B2I2797-BS1), Continued				Prepared: 2022-09-23, Analyzed: 2022-09-24						
Tellurium, total	0.0384	0.00050	mg/L	0.0400		96	80-120			
Thallium, total	0.0393	0.000020	mg/L	0.0400		98	80-120			
Thorium, total	0.0392	0.00010	mg/L	0.0400		98	80-120			
Tin, total	0.0403	0.00020	mg/L	0.0400		101	80-120			
Titanium, total	0.0402	0.0050	mg/L	0.0400		100	80-120			
Tungsten, total	0.0402	0.0002	mg/L	0.0400		100	80-120			
Uranium, total	0.0404	0.000020	mg/L	0.0400		101	80-120			
Vanadium, total	0.0397	0.0050	mg/L	0.0400		99	80-120			
Zinc, total	0.0401	0.0040	mg/L	0.0400		100	80-120			
Zirconium, total	0.0405	0.00010	mg/L	0.0400		101	80-120			

Total Metals, Batch B2I2969

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I2969-BLK1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2969-BLK2)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2969-BLK3)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I2969-BLK4)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	< 0.000010	0.000010	mg/L							
LCS (B2I2969-BS1)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	0.000481	0.000010	mg/L	0.000500		96	80-120			
LCS (B2I2969-BS2)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	0.000473	0.000010	mg/L	0.000500		95	80-120			
LCS (B2I2969-BS3)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	0.000464	0.000010	mg/L	0.000500		93	80-120			
LCS (B2I2969-BS4)				Prepared: 2022-09-26, Analyzed: 2022-09-27						
Mercury, total	0.000463	0.000010	mg/L	0.000500		93	80-120			

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ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0		
ATTENTION	Kaileigh McCallum	**WORK ORDER**	22I1636
PO NUMBER		**RECEIVED / TEMP**	2022-09-13 14:00 / 6.4°C
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57
PROJECT INFO	[info]	**COC NUMBER**	B122576

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here:
https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001-20220911-1536 (22I1636-01) | Matrix: Water | Sampled: 2022-09-11 15:36						
Anions						
Chloride	**3.39**	AO ≤ 250	0.10	mg/L	2022-09-17	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-17	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-17	HT1
Phosphate (as P)	**0.0097**	N/A	0.0050	mg/L	2022-09-17	HT1
Sulfate	**8.2**	AO ≤ 500	1.0	mg/L	2022-09-17	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-16	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-16	
Surrogate: 2-Methylnonane (EPH/F2-4)	*91*		*60-140*	%	*2022-09-16*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**139**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0670**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-17	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-17	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-17	
Barium, dissolved	**0.170**	N/A	0.0050	mg/L	2022-09-17	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-17	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-17	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-17	
Cadmium, dissolved	**0.000022**	N/A	0.000010	mg/L	2022-09-17	
Calcium, dissolved	**40.3**	N/A	0.20	mg/L	2022-09-17	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-17	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-17	
Copper, dissolved	**0.00042**	N/A	0.00040	mg/L	2022-09-17	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-17	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-17	
Lithium, dissolved	**0.00381**	N/A	0.00010	mg/L	2022-09-17	
Magnesium, dissolved	**9.27**	N/A	0.010	mg/L	2022-09-17	
Manganese, dissolved	**0.00591**	N/A	0.00020	mg/L	2022-09-17	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-16	
Molybdenum, dissolved	**0.00079**	N/A	0.00010	mg/L	2022-09-17	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-17	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-17	
Potassium, dissolved	**0.68**	N/A	0.10	mg/L	2022-09-17	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-17	
Silicon, dissolved	**2.0**	N/A	1.0	mg/L	2022-09-17	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-17	
Sodium, dissolved	**2.06**	N/A	0.10	mg/L	2022-09-17	
Strontium, dissolved	**0.157**	N/A	0.0010	mg/L	2022-09-17	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001-20220911-1536 (22I1636-01) | Matrix: Water | Sampled: 2022-09-11 15:36, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-17	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-17	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-17	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-17	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-17	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-17	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-17	
Uranium, dissolved	**0.000424**	N/A	0.000020	mg/L	2022-09-17	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-17	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-17	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-17	
General Parameters						
Alkalinity, Total (as CaCO3)	**154**	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Bicarbonate (as CaCO3)	**154**	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
BOD, 5-day	< 5.6	N/A	2.0	mg/L	2022-09-19	
Carbon, Total Organic	**1.68**	N/A	0.50	mg/L	2022-09-19	
Carbon, Dissolved Organic	**1.59**	N/A	0.50	mg/L	2022-09-16	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-14	
Nitrogen, Total Kjeldahl	**0.067**	N/A	0.050	mg/L	2022-09-16	
Phosphorus, Total (as P)	**0.0104**	N/A	0.0050	mg/L	2022-09-16	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-14	
Total Metals						
Aluminum, total	**0.0175**	OG < 0.1	0.0050	mg/L	2022-09-18	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-18	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-18	
Barium, total	**0.166**	MAC = 2	0.0050	mg/L	2022-09-18	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-18	
Cadmium, total	**0.000022**	MAC = 0.005	0.000010	mg/L	2022-09-18	
Calcium, total	**39.5**	None Required	0.20	mg/L	2022-09-18	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-18	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Copper, total	**0.00046**	MAC = 2	0.00040	mg/L	2022-09-18	
Iron, total	**0.018**	AO ≤ 0.3	0.010	mg/L	2022-09-18	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-18	
Lithium, total	**0.00348**	N/A	0.00010	mg/L	2022-09-18	
Magnesium, total	**8.90**	None Required	0.010	mg/L	2022-09-18	
Manganese, total	**0.00694**	MAC = 0.12	0.00020	mg/L	2022-09-18	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001-20220911-1536 (22I1636-01) | Matrix: Water | Sampled: 2022-09-11 15:36, Continued						
Total Metals, Continued						
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-17	
Molybdenum, total	**0.00077**	N/A	0.00010	mg/L	2022-09-18	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-18	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-18	
Potassium, total	**0.66**	N/A	0.10	mg/L	2022-09-18	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-18	
Silicon, total	**1.9**	N/A	1.0	mg/L	2022-09-18	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-18	
Sodium, total	**2.00**	AO ≤ 200	0.10	mg/L	2022-09-18	
Strontium, total	**0.152**	MAC = 7	0.0010	mg/L	2022-09-18	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-18	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-18	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-18	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-18	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-18	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-18	
Uranium, total	**0.000414**	MAC = 0.02	0.000020	mg/L	2022-09-18	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-18	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-18	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
MOR002-20220911-1027 (22I1636-02) | Matrix: Water | Sampled: 2022-09-11 10:27						
Anions						
Chloride	**2.65**	AO ≤ 250	0.10	mg/L	2022-09-17	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-09-17	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-17	HT1
Sulfate	**5.8**	AO ≤ 500	1.0	mg/L	2022-09-17	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-16	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-16	
Surrogate: 2-Methylnonane (EPH/F2-4)	*91*		*60-140*	%	*2022-09-16*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**58.5**	None Required	0.500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0112**	N/A	0.0050	mg/L	2022-09-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Barium, dissolved	**0.164**	N/A	0.0050	mg/L	2022-09-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR002-20220911-1027 (22I1636-02) | Matrix: Water | Sampled: 2022-09-11 10:27, Continued						
Dissolved Metals, Continued						
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-16	
Cadmium, dissolved	**0.000027**	N/A	0.000010	mg/L	2022-09-16	
Calcium, dissolved	**16.8**	N/A	0.20	mg/L	2022-09-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Lithium, dissolved	**0.00103**	N/A	0.00010	mg/L	2022-09-16	
Magnesium, dissolved	**3.99**	N/A	0.010	mg/L	2022-09-16	
Manganese, dissolved	**0.00129**	N/A	0.00020	mg/L	2022-09-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-16	
Molybdenum, dissolved	**0.00060**	N/A	0.00010	mg/L	2022-09-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-16	
Potassium, dissolved	**0.46**	N/A	0.10	mg/L	2022-09-16	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Silicon, dissolved	< 1.0	N/A	1.0	mg/L	2022-09-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-16	
Sodium, dissolved	**1.62**	N/A	0.10	mg/L	2022-09-16	
Strontium, dissolved	**0.112**	N/A	0.0010	mg/L	2022-09-16	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-16	
Uranium, dissolved	**0.000182**	N/A	0.000020	mg/L	2022-09-16	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**66.3**	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Bicarbonate (as CaCO3)	**66.3**	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
BOD, 5-day	< 5.6	N/A	2.0	mg/L	2022-09-19	
Carbon, Total Organic	**1.75**	N/A	0.50	mg/L	2022-09-16	
Carbon, Dissolved Organic	**1.70**	N/A	0.50	mg/L	2022-09-16	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR002-20220911-1027 (22I1636-02) | Matrix: Water | Sampled: 2022-09-11 10:27, Continued						
General Parameters, Continued						
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-14	
Nitrogen, Total Kjeldahl	**0.132**	N/A	0.050	mg/L	2022-09-16	
Phosphorus, Total (as P)	**0.0102**	N/A	0.0050	mg/L	2022-09-16	
Solids, Total Suspended	**5.4**	N/A	2.0	mg/L	2022-09-14	
Total Metals						
Aluminum, total	**0.0401**	OG < 0.1	0.0050	mg/L	2022-09-18	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-18	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-18	
Barium, total	**0.160**	MAC = 2	0.0050	mg/L	2022-09-18	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-18	
Cadmium, total	**0.000024**	MAC = 0.005	0.000010	mg/L	2022-09-18	
Calcium, total	**17.2**	None Required	0.20	mg/L	2022-09-18	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-18	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-18	
Iron, total	**0.020**	AO ≤ 0.3	0.010	mg/L	2022-09-18	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-18	
Lithium, total	**0.00108**	N/A	0.00010	mg/L	2022-09-18	
Magnesium, total	**3.75**	None Required	0.010	mg/L	2022-09-18	
Manganese, total	**0.00164**	MAC = 0.12	0.00020	mg/L	2022-09-18	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-17	
Molybdenum, total	**0.00058**	N/A	0.00010	mg/L	2022-09-18	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-18	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-18	
Potassium, total	**0.45**	N/A	0.10	mg/L	2022-09-18	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-18	
Silicon, total	< 1.0	N/A	1.0	mg/L	2022-09-18	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-18	
Sodium, total	**1.56**	AO ≤ 200	0.10	mg/L	2022-09-18	
Strontium, total	**0.108**	MAC = 7	0.0010	mg/L	2022-09-18	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-18	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-18	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-18	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-18	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-18	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-18	
Uranium, total	**0.000183**	MAC = 0.02	0.000020	mg/L	2022-09-18	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-18	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-18	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR002-20220911-1027 (22I1636-02) | Matrix: Water | Sampled: 2022-09-11 10:27, Continued						
Total Metals, Continued						
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-18	
FLD001-20220911-1536 (22I1636-03) | Matrix: Water | Sampled: 2022-09-11 15:36						
Anions						
Chloride	**0.93**	AO ≤ 250	0.10	mg/L	2022-09-16	
Nitrate (as N)	**0.012**	MAC = 10	0.010	mg/L	2022-09-16	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-09-16	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-09-16	HT1
Sulfate	**13.8**	AO ≤ 500	1.0	mg/L	2022-09-16	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2022-09-16	
EPHw19-32	< 250	N/A	250	µg/L	2022-09-16	
Surrogate: 2-Methylnonane (EPH/F2-4)	*89*		*60-140*	%	*2022-09-16*	
Calculated Parameters						
Hardness, Total (as CaCO3)	< 0.500	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0117**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0917**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Barium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-09-16	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-16	
Calcium, dissolved	< 0.20	N/A	0.20	mg/L	2022-09-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Lithium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Magnesium, dissolved	< 0.010	N/A	0.010	mg/L	2022-09-16	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-09-16	
Molybdenum, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-09-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-09-16	
Potassium, dissolved	< 0.10	N/A	0.10	mg/L	2022-09-16	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
FLD001-20220911-1536 (22I1636-03) | Matrix: Water | Sampled: 2022-09-11 15:36, Continued						
Dissolved Metals, Continued						
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Silicon, dissolved	< 1.0	N/A	1.0	mg/L	2022-09-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-09-16	
Sodium, dissolved	< 0.10	N/A	0.10	mg/L	2022-09-16	
Strontium, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-16	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2022-09-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-09-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-09-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-09-16	
Uranium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-09-16	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-09-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-09-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-09-16	
General Parameters						
Alkalinity, Total (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-09-18	
BOD, 5-day	< 5.6	N/A	2.0	mg/L	2022-09-19	
Carbon, Total Organic	**0.81**	N/A	0.50	mg/L	2022-09-16	
Carbon, Dissolved Organic	< 0.50	N/A	0.50	mg/L	2022-09-16	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2022-09-14	
Nitrogen, Total Kjeldahl	**0.080**	N/A	0.050	mg/L	2022-09-16	
Phosphorus, Total (as P)	**0.0067**	N/A	0.0050	mg/L	2022-09-16	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2022-09-16	
Total Metals						
Aluminum, total	**0.0080**	OG < 0.1	0.0050	mg/L	2022-09-15	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-09-15	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-09-15	
Barium, total	< 0.0050	MAC = 2	0.0050	mg/L	2022-09-15	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-09-15	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2022-09-15	
Calcium, total	< 0.20	None Required	0.20	mg/L	2022-09-15	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-15	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-09-15	

TEST RESULTS

REPORTED TO	Elk River Alliance	WORK ORDER	22I1636
PROJECT	CBWM-2022	REPORTED	2022-09-20 12:57

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
FLD001-20220911-1536 (22I1636-03) | Matrix: Water | Sampled: 2022-09-11 15:36, Continued						
Total Metals, Continued						
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-09-15	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-09-15	
Lithium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Magnesium, total	< 0.010	None Required	0.010	mg/L	2022-09-15	
Manganese, total	< 0.00020	MAC = 0.12	0.00020	mg/L	2022-09-15	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2022-09-17	
Molybdenum, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-09-15	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-09-15	
Potassium, total	< 0.10	N/A	0.10	mg/L	2022-09-15	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-09-15	
Silicon, total	< 1.0	N/A	1.0	mg/L	2022-09-15	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-09-15	
Sodium, total	< 0.10	AO ≤ 200	0.10	mg/L	2022-09-15	
Strontium, total	< 0.0010	MAC = 7	0.0010	mg/L	2022-09-15	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-09-15	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-09-15	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-09-15	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-09-15	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-15	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-09-15	
Uranium, total	< 0.000020	MAC = 0.02	0.000020	mg/L	2022-09-15	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-09-15	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-09-15	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-09-15	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
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Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2017)	Closed Reflux, Colorimetry	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
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General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in “batches” and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2I1570										
Blank (B2I1570-BLK1)				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B2I1570-BLK2)				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
LCS (B2I1570-BS1)				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Chloride	15.8	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.04	0.010	mg/L	4.00		101	90-110			
Nitrite (as N)	1.94	0.010	mg/L	2.00		97	85-115			
Phosphate (as P)	1.05	0.0050	mg/L	1.00		105	80-120			
Sulfate	15.6	1.0	mg/L	16.0		97	90-110			
LCS (B2I1570-BS2)				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Chloride	15.8	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.05	0.010	mg/L	4.00		101	90-110			
Nitrite (as N)	1.94	0.010	mg/L	2.00		97	85-115			
Phosphate (as P)	1.05	0.0050	mg/L	1.00		105	80-120			
Sulfate	15.6	1.0	mg/L	16.0		97	90-110			
BCMOE Aggregate Hydrocarbons, Batch B2I1802										
Blank (B2I1802-BLK1)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*4360*		*µg/L*	*4400*		*99*	*60-140*			
LCS (B2I1802-BS2)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
EPHw10-19	17600	250	µg/L	15400		114	70-130			

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
BCMOE Aggregate Hydrocarbons, Batch B2I1802, Continued										
LCS (B2I1802-BS2), Continued				Prepared: 2022-09-15, Analyzed: 2022-09-16						
EPHw19-32	25100	250	µg/L	22100		113	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*4350*		*µg/L*	4400		*99*	*60-140*			
LCS Dup (B2I1802-BSD2)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
EPHw10-19	17300	250	µg/L	15400		112	70-130	1	20	
EPHw19-32	24800	250	µg/L	22100		112	70-130	1	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*4380*		*µg/L*	4400		*99*	*60-140*			
Dissolved Metals, Batch B2I1705										
Blank (B2I1705-BLK1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B2I1705-BS1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Aluminum, dissolved	4.14	0.0050	mg/L	4.00		104	80-120			
Antimony, dissolved	0.0408	0.00020	mg/L	0.0400		102	80-120			
Arsenic, dissolved	0.0428	0.00050	mg/L	0.0400		107	80-120			
Barium, dissolved	0.0405	0.0050	mg/L	0.0400		101	80-120			
Beryllium, dissolved	0.0414	0.00010	mg/L	0.0400		104	80-120			
Bismuth, dissolved	0.0402	0.00010	mg/L	0.0400		100	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Dissolved Metals, Batch B2I1705, Continued

LCS (B2I1705-BS1), Continued — Prepared: 2022-09-16, Analyzed: 2022-09-16

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		103	80-120			
Cadmium, dissolved	0.0406	0.000010	mg/L	0.0400		101	80-120			
Calcium, dissolved, dissolved	3.99	0.20	mg/L	4.00		100	80-120			
Chromium, dissolved	0.0420	0.00050	mg/L	0.0400		105	80-120			
Cobalt, dissolved	0.0409	0.00010	mg/L	0.0400		102	80-120			
Copper, dissolved	0.0410	0.00040	mg/L	0.0400		102	80-120			
Iron, dissolved	4.04	0.010	mg/L	4.00		101	80-120			
Lead, dissolved	0.0401	0.00020	mg/L	0.0400		100	80-120			
Lithium, dissolved	0.0413	0.00010	mg/L	0.0400		103	80-120			
Magnesium, dissolved, dissolved	4.14	0.010	mg/L	4.00		103	80-120			
Manganese, dissolved	0.0409	0.00020	mg/L	0.0400		102	80-120			
Molybdenum, dissolved	0.0397	0.00010	mg/L	0.0400		99	80-120			
Nickel, dissolved	0.0402	0.00040	mg/L	0.0400		101	80-120			
Phosphorus, dissolved	4.23	0.050	mg/L	4.00		106	80-120			
Potassium, dissolved	4.07	0.10	mg/L	4.00		102	80-120			
Selenium, dissolved	0.0405	0.00050	mg/L	0.0400		101	80-120			
Silicon, dissolved	4.1	1.0	mg/L	4.00		103	80-120			
Silver, dissolved	0.0404	0.000050	mg/L	0.0400		101	80-120			
Sodium, dissolved	4.08	0.10	mg/L	4.00		102	80-120			
Strontium, dissolved	0.0422	0.0010	mg/L	0.0400		105	80-120			
Sulfur, dissolved	40.4	3.0	mg/L	40.0		101	80-120			
Tellurium, dissolved	0.0417	0.00050	mg/L	0.0400		104	80-120			
Thallium, dissolved	0.0402	0.000020	mg/L	0.0400		100	80-120			
Thorium, dissolved	0.0405	0.00010	mg/L	0.0400		101	80-120			
Tin, dissolved	0.0410	0.00020	mg/L	0.0400		102	80-120			
Titanium, dissolved	0.0417	0.0050	mg/L	0.0400		104	80-120			
Tungsten, dissolved	0.0413	0.0010	mg/L	0.0400		103	80-120			
Uranium, dissolved	0.0406	0.000020	mg/L	0.0400		102	80-120			
Vanadium, dissolved	0.0407	0.0050	mg/L	0.0400		102	80-120			
Zinc, dissolved	0.0408	0.0040	mg/L	0.0400		102	80-120			
Zirconium, dissolved	0.0404	0.00010	mg/L	0.0400		101	80-120			

Dissolved Metals, Batch B2I1798

Blank (B2I1798-BLK1) — Prepared: 2022-09-17, Analyzed: 2022-09-17

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I1798, Continued										
Blank (B2I1798-BLK1), Continued				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0050	0.0050	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B2I1798-BS1)				Prepared: 2022-09-17, Analyzed: 2022-09-17						
Aluminum, dissolved	3.93	0.0050	mg/L	4.00		98	80-120			
Antimony, dissolved	0.0400	0.00020	mg/L	0.0400		100	80-120			
Arsenic, dissolved	0.0418	0.00050	mg/L	0.0400		104	80-120			
Barium, dissolved	0.0395	0.0050	mg/L	0.0400		99	80-120			
Beryllium, dissolved	0.0407	0.00010	mg/L	0.0400		102	80-120			
Bismuth, dissolved	0.0401	0.00010	mg/L	0.0400		100	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0400		100	80-120			
Cadmium, dissolved	0.0398	0.000010	mg/L	0.0400		100	80-120			
Calcium, dissolved, dissolved	3.98	0.20	mg/L	4.00		100	80-120			
Chromium, dissolved	0.0405	0.00050	mg/L	0.0400		101	80-120			
Cobalt, dissolved	0.0407	0.00010	mg/L	0.0400		102	80-120			
Copper, dissolved	0.0411	0.00040	mg/L	0.0400		103	80-120			
Iron, dissolved	4.10	0.010	mg/L	4.00		103	80-120			
Lead, dissolved	0.0401	0.00020	mg/L	0.0400		100	80-120			
Lithium, dissolved	0.0373	0.00010	mg/L	0.0400		93	80-120			
Magnesium, dissolved, dissolved	3.88	0.010	mg/L	4.00		97	80-120			
Manganese, dissolved	0.0403	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, dissolved	0.0393	0.00010	mg/L	0.0400		98	80-120			
Nickel, dissolved	0.0406	0.00040	mg/L	0.0400		102	80-120			
Phosphorus, dissolved	3.99	0.050	mg/L	4.00		100	80-120			
Potassium, dissolved	4.03	0.10	mg/L	4.00		101	80-120			
Selenium, dissolved	0.0416	0.00050	mg/L	0.0400		104	80-120			
Silicon, dissolved	4.1	1.0	mg/L	4.00		102	80-120			
Silver, dissolved	0.0401	0.000050	mg/L	0.0400		100	80-120			
Sodium, dissolved	3.94	0.10	mg/L	4.00		98	80-120			
Strontium, dissolved	0.0411	0.0010	mg/L	0.0400		103	80-120			
Sulfur, dissolved	40.9	3.0	mg/L	40.0		102	80-120			
Tellurium, dissolved	0.0401	0.00050	mg/L	0.0400		100	80-120			
Thallium, dissolved	0.0400	0.000020	mg/L	0.0400		100	80-120			
Thorium, dissolved	0.0405	0.00010	mg/L	0.0400		101	80-120			
Tin, dissolved	0.0395	0.00020	mg/L	0.0400		99	80-120			
Titanium, dissolved	0.0396	0.0050	mg/L	0.0400		99	80-120			
Tungsten, dissolved	0.0409	0.0010	mg/L	0.0400		102	80-120			
Uranium, dissolved	0.0403	0.000020	mg/L	0.0400		101	80-120			
Vanadium, dissolved	0.0407	0.0050	mg/L	0.0400		102	80-120			
Zinc, dissolved	0.0405	0.0040	mg/L	0.0400		101	80-120			
Zirconium, dissolved	0.0397	0.00010	mg/L	0.0400		99	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Dissolved Metals, Batch B2I1798, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Matrix Spike (B2I1798-MS1)	**Source: 22I1636-01**			Prepared: 2022-09-17, Analyzed: 2022-09-17						
Aluminum, dissolved	3.97	0.0050	mg/L	4.00	< 0.0050	99	70-130			
Antimony, dissolved	0.0392	0.00020	mg/L	0.0400	< 0.00020	98	70-130			
Arsenic, dissolved	0.0430	0.00050	mg/L	0.0400	< 0.00050	107	70-130			
Barium, dissolved	0.211	0.0050	mg/L	0.0400	0.170	102	70-130			
Beryllium, dissolved	0.0416	0.00010	mg/L	0.0400	< 0.00010	104	70-130			
Bismuth, dissolved	0.0325	0.00010	mg/L	0.0400	< 0.00010	81	70-130			
Boron, dissolved	0.0519	0.0500	mg/L	0.0400	< 0.0500	106	70-130			
Cadmium, dissolved	0.0414	0.000010	mg/L	0.0400	0.000022	103	70-130			
Calcium, dissolved, dissolved	42.7	0.20	mg/L	4.00	40.3	59	70-130			MS2
Chromium, dissolved	0.0401	0.00050	mg/L	0.0400	< 0.00050	100	70-130			
Cobalt, dissolved	0.0397	0.00010	mg/L	0.0400	< 0.00010	99	70-130			
Copper, dissolved	0.0399	0.00040	mg/L	0.0400	0.00042	99	70-130			
Iron, dissolved	4.10	0.010	mg/L	4.00	< 0.010	102	70-130			
Lead, dissolved	0.0393	0.00020	mg/L	0.0400	< 0.00020	98	70-130			
Lithium, dissolved	0.0469	0.00010	mg/L	0.0400	0.00381	108	70-130			
Magnesium, dissolved, dissolved	13.1	0.010	mg/L	4.00	9.27	96	70-130			
Manganese, dissolved	0.0457	0.00020	mg/L	0.0400	0.00591	99	70-130			
Molybdenum, dissolved	0.0413	0.00010	mg/L	0.0400	0.00079	101	70-130			
Nickel, dissolved	0.0396	0.00040	mg/L	0.0400	< 0.00040	98	70-130			
Phosphorus, dissolved	4.16	0.050	mg/L	4.00	< 0.050	104	70-130			
Potassium, dissolved	4.63	0.10	mg/L	4.00	0.68	99	70-130			
Selenium, dissolved	0.0425	0.00050	mg/L	0.0400	< 0.00050	106	70-130			
Silicon, dissolved	5.9	1.0	mg/L	4.00	2.0	97	70-130			
Silver, dissolved	0.0403	0.000050	mg/L	0.0400	< 0.000050	101	70-130			
Sodium, dissolved	6.22	0.10	mg/L	4.00	2.06	104	70-130			
Strontium, dissolved	0.193	0.0010	mg/L	0.0400	0.157	92	70-130			
Sulfur, dissolved	42.1	3.0	mg/L	40.0	< 3.0	100	70-130			
Tellurium, dissolved	0.0430	0.00050	mg/L	0.0400	< 0.00050	107	70-130			
Thallium, dissolved	0.0400	0.000020	mg/L	0.0400	< 0.000020	100	70-130			
Thorium, dissolved	0.0407	0.00010	mg/L	0.0400	< 0.00010	102	70-130			
Tin, dissolved	0.0412	0.00020	mg/L	0.0400	< 0.00020	103	70-130			
Titanium, dissolved	0.0372	0.0050	mg/L	0.0400	< 0.0050	93	70-130			
Tungsten, dissolved	0.0412	0.0010	mg/L	0.0400	< 0.0010	103	70-130			
Uranium, dissolved	0.0404	0.000020	mg/L	0.0400	0.000424	100	70-130			
Vanadium, dissolved	0.0415	0.0050	mg/L	0.0400	< 0.0050	103	70-130			
Zinc, dissolved	0.0413	0.0040	mg/L	0.0400	< 0.0040	102	70-130			
Zirconium, dissolved	0.0415	0.00010	mg/L	0.0400	< 0.00010	104	70-130			

Dissolved Metals, Batch B2I1892

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I1892-BLK1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I1892-BLK2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I1892-BLK3)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B2I1892-BLK4)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
LCS (B2I1892-BS1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	0.000472	0.000010	mg/L	0.000500		94	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2I1892, Continued										
LCS (B2I1892-BS2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	0.000475	0.000010	mg/L	0.000500		95	80-120			
LCS (B2I1892-BS3)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	0.000477	0.000010	mg/L	0.000500		95	80-120			
LCS (B2I1892-BS4)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, dissolved	0.000482	0.000010	mg/L	0.000500		96	80-120			
General Parameters, Batch B2I1477										
Blank (B2I1477-BLK1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1477-BLK2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1477-BLK3)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1477-BLK4)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1477-BLK5)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B2I1477-BLK6)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B2I1477-BS1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	10.1	0.50	mg/L	10.0		101	78-116			
Carbon, Dissolved Organic	9.87	0.50	mg/L	10.0		99	78-116			
LCS (B2I1477-BS2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	9.75	0.50	mg/L	10.0		98	78-116			
Carbon, Dissolved Organic	9.79	0.50	mg/L	10.0		98	78-116			
LCS (B2I1477-BS3)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	10.2	0.50	mg/L	10.0		102	78-116			
Carbon, Dissolved Organic	10.1	0.50	mg/L	10.0		101	78-116			
LCS (B2I1477-BS4)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	10.0	0.50	mg/L	10.0		100	78-116			
Carbon, Dissolved Organic	10.2	0.50	mg/L	10.0		102	78-116			
LCS (B2I1477-BS5)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	10.3	0.50	mg/L	10.0		103	78-116			
Carbon, Dissolved Organic	10.4	0.50	mg/L	10.0		104	78-116			
LCS (B2I1477-BS6)				Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	9.93	0.50	mg/L	10.0		99	78-116			
Carbon, Dissolved Organic	10.1	0.50	mg/L	10.0		101	78-116			

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I1477, Continued										
Duplicate (B2I1477-DUP2)		**Source: 22I1636-03**		Prepared: 2022-09-19, Analyzed: 2022-09-19						
Carbon, Total Organic	0.84	0.50	mg/L		0.81				16	
Carbon, Dissolved Organic	< 0.50	0.50	mg/L		< 0.50				15	
Matrix Spike (B2I1477-MS2)		**Source: 22I1636-03**		Prepared: 2022-09-16, Analyzed: 2022-09-16						
Carbon, Total Organic	10.2	0.50	mg/L	10.0	0.81	94	70-130			
Carbon, Dissolved Organic	10.0	0.50	mg/L	10.0	< 0.50	95	70-130			
General Parameters, Batch B2I1515										
Blank (B2I1515-BLK1)				Prepared: 2022-09-14, Analyzed: 2022-09-14						
Chemical Oxygen Demand	< 20	20	mg/L							
LCS (B2I1515-BS1)				Prepared: 2022-09-14, Analyzed: 2022-09-14						
Chemical Oxygen Demand	506	20	mg/L	500		101	89-115			
General Parameters, Batch B2I1543										
Blank (B2I1543-BLK1)				Prepared: 2022-09-14, Analyzed: 2022-09-19						
BOD, 5-day	< 2.0	2.0	mg/L							
LCS (B2I1543-BS1)				Prepared: 2022-09-14, Analyzed: 2022-09-19						
BOD, 5-day	214	46.7	mg/L	198		108	85-115			
General Parameters, Batch B2I1562										
Blank (B2I1562-BLK1)				Prepared: 2022-09-14, Analyzed: 2022-09-14						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I1562-BS1)				Prepared: 2022-09-14, Analyzed: 2022-09-14						
Solids, Total Suspended	90.0	10.0	mg/L	100		90	85-115			
General Parameters, Batch B2I1675										
Blank (B2I1675-BLK1)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B2I1675-BS1)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Solids, Total Suspended	96.5	5.0	mg/L	100		96	85-115			
General Parameters, Batch B2I1765										
Blank (B2I1765-BLK1)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B2I1765-BLK2)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B2I1765-BLK3)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
LCS (B2I1765-BS1)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	0.107	0.0050	mg/L	0.100		107	85-115			
LCS (B2I1765-BS2)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	0.108	0.0050	mg/L	0.100		108	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2I1765, Continued										
LCS (B2I1765-BS3)				Prepared: 2022-09-15, Analyzed: 2022-09-16						
Phosphorus, Total (as P)	0.108	0.0050	mg/L	0.100		108	85-115			
General Parameters, Batch B2I1877										
Blank (B2I1877-BLK1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B2I1877-BS1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Nitrogen, Total Kjeldahl	0.976	0.050	mg/L	1.00		98	85-115			
General Parameters, Batch B2I2027										
Blank (B2I2027-BLK1)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I2027-BLK2)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B2I2027-BLK3)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B2I2027-BS1)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	110	1.0	mg/L	100		110	80-120			
LCS (B2I2027-BS2)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	110	1.0	mg/L	100		110	80-120			
LCS (B2I2027-BS3)				Prepared: 2022-09-18, Analyzed: 2022-09-18						
Alkalinity, Total (as CaCO3)	110	1.0	mg/L	100		110	80-120			
Total Metals, Batch B2I1701										
Blank (B2I1701-BLK1)				Prepared: 2022-09-15, Analyzed: 2022-09-15						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							

CARO ANALYTICAL SERVICES

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Total Metals, Batch B2I1701, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I1701-BLK1), Continued				Prepared: 2022-09-15, Analyzed: 2022-09-15						
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B2I1701-BS1)				Prepared: 2022-09-15, Analyzed: 2022-09-15						
Aluminum, total	4.14	0.0050	mg/L	4.00		103	80-120			
Antimony, total	0.0393	0.00020	mg/L	0.0400		98	80-120			
Arsenic, total	0.0402	0.00050	mg/L	0.0400		101	80-120			
Barium, total	0.0390	0.0050	mg/L	0.0400		98	80-120			
Beryllium, total	0.0388	0.00010	mg/L	0.0400		97	80-120			
Bismuth, total	0.0393	0.00010	mg/L	0.0400		98	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		104	80-120			
Cadmium, total	0.0387	0.000010	mg/L	0.0400		97	80-120			
Calcium, total	4.12	0.20	mg/L	4.00		103	80-120			
Chromium, total	0.0399	0.00050	mg/L	0.0400		100	80-120			
Cobalt, total	0.0403	0.00010	mg/L	0.0400		101	80-120			
Copper, total	0.0395	0.00040	mg/L	0.0400		99	80-120			
Iron, total	4.09	0.010	mg/L	4.00		102	80-120			
Lead, total	0.0397	0.00020	mg/L	0.0400		99	80-120			
Lithium, total	0.0406	0.00010	mg/L	0.0400		101	80-120			
Magnesium, total	4.05	0.010	mg/L	4.00		101	80-120			
Manganese, total	0.0404	0.00020	mg/L	0.0400		101	80-120			
Molybdenum, total	0.0393	0.00010	mg/L	0.0400		98	80-120			
Nickel, total	0.0400	0.00040	mg/L	0.0400		100	80-120			
Phosphorus, total	4.06	0.050	mg/L	4.00		102	80-120			
Potassium, total	4.03	0.10	mg/L	4.00		101	80-120			
Selenium, total	0.0394	0.00050	mg/L	0.0400		98	80-120			
Silicon, total	4.3	1.0	mg/L	4.00		107	80-120			
Silver, total	0.0390	0.000050	mg/L	0.0400		98	80-120			
Sodium, total	4.03	0.10	mg/L	4.00		101	80-120			
Strontium, total	0.0394	0.0010	mg/L	0.0400		98	80-120			
Sulfur, total	41.0	3.0	mg/L	40.0		103	80-120			
Tellurium, total	0.0389	0.00050	mg/L	0.0400		97	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Total Metals, Batch B2I1701, Continued

LCS (B2I1701-BS1), Continued — Prepared: 2022-09-15, Analyzed: 2022-09-15

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Thallium, total	0.0394	0.000020	mg/L	0.0400		99	80-120			
Thorium, total	0.0398	0.00010	mg/L	0.0400		99	80-120			
Tin, total	0.0396	0.00020	mg/L	0.0400		99	80-120			
Titanium, total	0.0409	0.0050	mg/L	0.0400		102	80-120			
Tungsten, total	0.0408	0.0002	mg/L	0.0400		102	80-120			
Uranium, total	0.0398	0.000020	mg/L	0.0400		99	80-120			
Vanadium, total	0.0403	0.0050	mg/L	0.0400		101	80-120			
Zinc, total	0.0396	0.0040	mg/L	0.0400		99	80-120			
Zirconium, total	0.0392	0.00010	mg/L	0.0400		98	80-120			

Total Metals, Batch B2I1800

Blank (B2I1800-BLK1) — Prepared: 2022-09-15, Analyzed: 2022-09-18

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0002	0.0002	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0050	0.0050	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							

LCS (B2I1800-BS1) — Prepared: 2022-09-15, Analyzed: 2022-09-18

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Aluminum, total	4.10	0.0050	mg/L	4.00		103	80-120			
Antimony, total	0.0397	0.00020	mg/L	0.0400		99	80-120			
Arsenic, total	0.0416	0.00050	mg/L	0.0400		104	80-120			
Barium, total	0.0414	0.0050	mg/L	0.0400		104	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	22I1636
PROJECT	CBWM-2022	**REPORTED**	2022-09-20 12:57

Total Metals, Batch B2I1800, Continued

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
LCS (B2I1800-BS1), Continued				Prepared: 2022-09-15, Analyzed: 2022-09-18						
Beryllium, total	0.0393	0.00010	mg/L	0.0400		98	80-120			
Bismuth, total	0.0393	0.00010	mg/L	0.0400		98	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0400		94	80-120			
Cadmium, total	0.0398	0.000010	mg/L	0.0400		99	80-120			
Calcium, total	4.05	0.20	mg/L	4.00		101	80-120			
Chromium, total	0.0402	0.00050	mg/L	0.0400		100	80-120			
Cobalt, total	0.0411	0.00010	mg/L	0.0400		103	80-120			
Copper, total	0.0405	0.00040	mg/L	0.0400		101	80-120			
Iron, total	4.11	0.010	mg/L	4.00		103	80-120			
Lead, total	0.0401	0.00020	mg/L	0.0400		100	80-120			
Lithium, total	0.0358	0.00010	mg/L	0.0400		90	80-120			
Magnesium, total	3.95	0.010	mg/L	4.00		99	80-120			
Manganese, total	0.0406	0.00020	mg/L	0.0400		102	80-120			
Molybdenum, total	0.0394	0.00010	mg/L	0.0400		98	80-120			
Nickel, total	0.0407	0.00040	mg/L	0.0400		102	80-120			
Phosphorus, total	4.10	0.050	mg/L	4.00		102	80-120			
Potassium, total	4.08	0.10	mg/L	4.00		102	80-120			
Selenium, total	0.0410	0.00050	mg/L	0.0400		102	80-120			
Silicon, total	4.2	1.0	mg/L	4.00		105	80-120			
Silver, total	0.0403	0.000050	mg/L	0.0400		101	80-120			
Sodium, total	4.00	0.10	mg/L	4.00		100	80-120			
Strontium, total	0.0411	0.0010	mg/L	0.0400		103	80-120			
Sulfur, total	40.9	3.0	mg/L	40.0		102	80-120			
Tellurium, total	0.0388	0.00050	mg/L	0.0400		97	80-120			
Thallium, total	0.0398	0.000020	mg/L	0.0400		99	80-120			
Thorium, total	0.0405	0.00010	mg/L	0.0400		101	80-120			
Tin, total	0.0399	0.00020	mg/L	0.0400		100	80-120			
Titanium, total	0.0406	0.0050	mg/L	0.0400		102	80-120			
Tungsten, total	0.0402	0.0002	mg/L	0.0400		101	80-120			
Uranium, total	0.0407	0.000020	mg/L	0.0400		102	80-120			
Vanadium, total	0.0406	0.0050	mg/L	0.0400		101	80-120			
Zinc, total	0.0410	0.0040	mg/L	0.0400		102	80-120			
Zirconium, total	0.0402	0.00010	mg/L	0.0400		101	80-120			

Total Metals, Batch B2I1893

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Blank (B2I1893-BLK1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B2I1893-BLK2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, total	< 0.000010	0.000010	mg/L							
LCS (B2I1893-BS1)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, total	0.000562	0.000010	mg/L	0.000500		112	80-120			
LCS (B2I1893-BS2)				Prepared: 2022-09-16, Analyzed: 2022-09-16						
Mercury, total	0.000521	0.000010	mg/L	0.000500		104	80-120			

QC Qualifiers:

MS2 The native sample concentration is greater than the spike concentration hence the matrix spike limits do not apply.

Appendix D: Benthic Macroinvertebrate Taxonomy Report

Site Description

Study Name	CBWQ-Elk
Site	ALX001
Sampling Date	Sep 14 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.67424 N, 114.78019 W
Altitude	1219
Local Basin Name	Alexander Creek
	Elk River
Stream Order	4

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.3%	3.3%	3.9%	8.0%	82.0%	1.6%
CABIN Assessment of ALX001 on Sep 14, 2022	Similar to Reference					

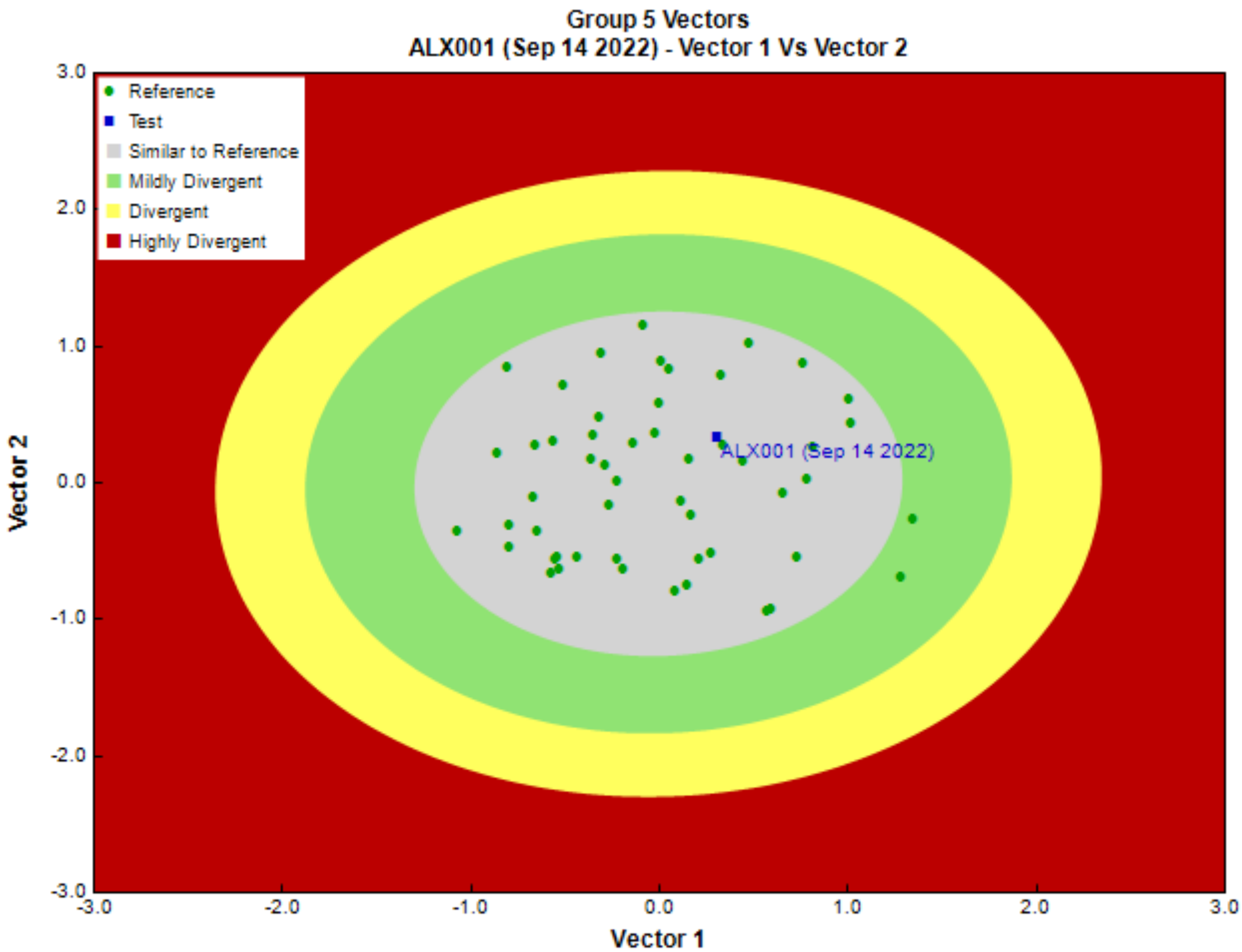

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	5	100.0
		Tubificida	Naididae	1	20.0
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	2	40.0
			Torrenticolidae	1	20.0
	Insecta	Coleoptera	Elmidae	2	40.0
		Diptera	Ceratopogonidae	6	120.0
			Chironomidae	39	780.0
			Empididae	1	20.0
			Psychodidae	17	340.0
			Simuliidae	2	40.0
		Ephemeroptera	Ameletidae	1	20.0
			Baetidae	55	1,100.0
			Ephemerellidae	44	880.0
			Heptageniidae	82	1,640.0
		Plecoptera	Capniidae	1	20.0
			Chloroperlidae	4	80.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	35	700.0
			Perlodidae	1	20.0
			Taeniopterygidae	25	500.0
		Trichoptera	Brachycentridae	2	40.0
			Glossosomatidae	21	420.0
			Hydropsychidae	2	40.0
			Rhyacophilidae	12	240.0
			Total	361	7,220.0

Metrics

Name	ALX001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.38	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.9	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	1.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	48.8	45.8 ± 14.9
% Predatores	17.2	14.8 ± 9.8
% Scrapers	52.4	59.4 ± 19.6
% Shredder	18.0	30.7 ± 17.4
No. Clinger Taxa	25.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	10.8	7.5 ± 8.6
% Coleoptera	0.6	0.1 ± 0.3
% Diptera + Non-insects	20.5	10.7 ± 9.9
% Ephemeroptera	50.4	47.2 ± 15.8
% Ephemeroptera that are Baetidae	30.2	25.4 ± 20.8
% EPT Individuals	78.9	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	38.0	58.3 ± 10.6
% of 5 dominant taxa	70.6	83.6 ± 6.3
% of dominant taxa	22.7	37.8 ± 11.1
% Plecoptera	18.3	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	5.4	25.4 ± 24.6
% Tricoptera	10.2	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	7220.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	5.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	5700.0	4035.4 ± 2618.4
EPT taxa (no)	13.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	5.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.4	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	23.0	17.0 ± 3.1
Trichoptera taxa	4.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at ALX001
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.44
RIVPACS : Observed taxa P>0.50	14.00
RIVPACS : O:E (p > 0.5)	1.13
RIVPACS : Expected taxa P>0.70	9.53
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	ALX001	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	20.9	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	24.00	46.71 ± 35.00
Depth-Max (cm)	38.0	28.8 ± 13.7
Discharge (m^3/s)	1.338	0.682
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.04 ± 0.95
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	0	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0151167	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.65	0.58 ± 0.20
Velocity-Max (m/s)	1.38	0.85 ± 0.27
Width-Bankfull (m)	14.3	16.1 ± 13.1
Width-Wetted (m)	9.8	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	2	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	44.44840	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-14.37000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	179.83405	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	4.13231	7.47766 ± 6.29880
Natl-ShrubLow (%)	0.08024	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 6
%Cobble (%)	55	57 ± 15
%Gravel (%)	0	2 ± 3
%Pebble (%)	41	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	7.45	24.05 ± 35.66
Dg (cm)	7.9	23.0 ± 33.8
Dominant-1st (Category(0-9))	6	6 ± 1

Habitat Description

Variable	ALX001	Predicted Group Reference Mean ±SD
Dominant-2nd (Category(0-9))	5	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	39.74502	20.01334 ± 7.41149
SlopeMax (%)	353.26163	488.94077 ± 542.32910
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0061000	0.0078031 ± 0.0090962
As (mg/L)	0.0002500	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.0674000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	47.5000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000050	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	0.9700000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0002500	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.1700000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0050000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	178.0000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	0.6600000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	0.8700000	0.5586957 ± 0.6229060
General-Conductivity (μS/cm)	195.3000000	173.5150000 ± 86.2502071
General-DO (mg/L)	10.0100000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	155.0000000	109.1853659 ± 48.3470504
General-pH (pH)	8.6	8.0 ± 0.6
General-SolidsTSS (mg/L)	1.0000000	5.2717002 ± 27.1908288
General-SpCond (μS/cm)	276.8000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	17.0	7.2 ± 5.7
General-TempWater (Degrees Celsius)	9.6000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.2200000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.3800000	0.3312424 ± 0.1572675
Li (mg/L)	0.0038900	0.0009183 ± 0.0003795
Mg (mg/L)	12.8000000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0009200	0.0007721 ± 0.0008518
Mo (mg/L)	0.0007300	0.0012835 ± 0.0042333
Na (mg/L)	1.8000000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2 (mg/L)	0.0050000	0.0049953 ± 0.0199967
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0050000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.0250000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.0250000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0072000	0.0031912 ± 0.0087929
S (mg/L)	5.4000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0006400	0.0002782 ± 0.0002859
Si (mg/L)	2.0000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0001000	0.0000300 ± 0.0000407
SO4 (mg/L)	17.7000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.1140000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205

Habitat Description

Variable	ALX001	Predicted Group Reference Mean ±SD
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0005760	0.0003872 ± 0.0002299
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	ALX003
Sampling Date	Sep 14 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.65563 N, 114.73078 W
Altitude	1311
Local Basin Name	Alexander Creek
	Elk River Watershed
Stream Order	4

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.5%	2.1%	3.6%	6.3%	85.6%	0.9%
CABIN Assessment of ALX003 on Sep 14, 2022	Similar to Reference					

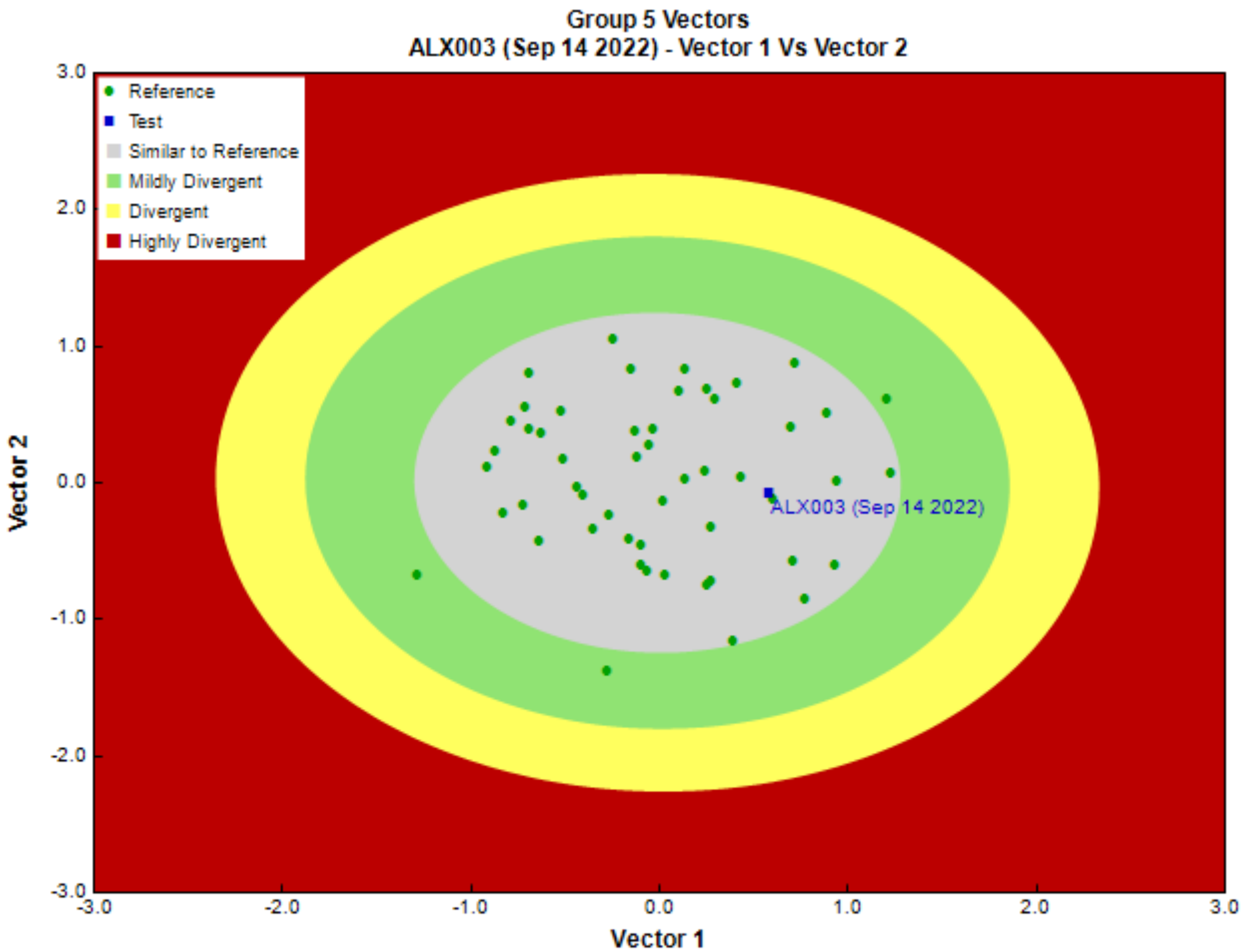

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata			1	20.0
		Tubificida	Naididae	1	20.0
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	20.0
			Torrenticolidae	1	20.0
	Insecta	Coleoptera	Elmidae	6	120.0
		Diptera	Ceratopogonidae	2	40.0
			Chironomidae	22	440.0
			Empididae	3	60.0
			Psychodidae	47	940.0
			Simuliidae	2	40.0
		Ephemeroptera	Ameletidae	1	20.0
			Baetidae	22	440.0
			Ephemerellidae	71	1,420.0
			Heptageniidae	89	1,780.0
		Plecoptera		2	40.0
			Capniidae	5	100.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Chloroperlidae	6	120.0
			Nemouridae	28	560.0
			Perlodidae	6	120.0
			Taeniopterygidae	18	360.0
		Trichoptera		1	20.0
			Brachycentridae	3	60.0
			Glossosomatidae	4	80.0
			Hydropsychidae	6	120.0
			Rhyacophilidae	7	140.0
			Uenoidae	2	40.0
			Total	357	7,140.0

Metrics

Name	ALX003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.38	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.8	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.8	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	2.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	58.3	45.8 ± 14.9
% Predatores	14.3	14.8 ± 9.8
% Scrapers	41.7	59.4 ± 19.6
% Shredder	16.8	30.7 ± 17.4
No. Clinger Taxa	30.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	6.2	7.5 ± 8.6
% Coleoptera	1.7	0.1 ± 0.3
% Diptera + Non-insects	22.4	10.7 ± 9.9
% Ephemeroptera	51.8	47.2 ± 15.8
% Ephemeroptera that are Baetidae	12.0	25.4 ± 20.8
% EPT Individuals	75.9	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	45.3	58.3 ± 10.6
% of 5 dominant taxa	72.8	83.6 ± 6.3
% of dominant taxa	25.2	37.8 ± 11.1
% Plecoptera	17.8	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	27.3	25.4 ± 24.6
% Tricoptera	6.2	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	7140.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	5.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	5360.0	4035.4 ± 2618.4
EPT taxa (no)	14.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.3	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	23.0	17.0 ± 3.1
Trichoptera taxa	5.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at ALX003
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.47
RIVPACS : Observed taxa P>0.50	14.00
RIVPACS : O:E (p > 0.5)	1.12
RIVPACS : Expected taxa P>0.70	9.54
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	ALX003	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	26.3	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	19.10	46.71 ± 35.00
Depth-Max (cm)	50.0	28.8 ± 13.7
Discharge (m^3/s)	1.224	0.682
Macrophyte (PercentRange)	1	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.04 ± 0.95
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0238667	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.47	0.58 ± 0.20
Velocity-Max (m/s)	0.73	0.85 ± 0.27
Width-Bankfull (m)	10.9	16.1 ± 13.1
Width-Wetted (m)	10.0	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	2	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	43.56508	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-14.37000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	145.66791	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	2.54675	7.47766 ± 6.29880
Natl-ShrubLow (%)	0.09901	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	1	6 ± 6
%Cobble (%)	74	57 ± 15
%Gravel (%)	3	2 ± 3
%Pebble (%)	22	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	9.75	24.05 ± 35.66
Dg (cm)	8.2	23.0 ± 33.8
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 1

Habitat Description

Variable	ALX003	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	37.52888	20.01334 ± 7.41149
SlopeMax (%)	353.26163	488.94077 ± 542.32910
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0087000	0.0078031 ± 0.0090962
As (mg/L)	0.0002500	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.0650000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	47.5000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000050	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	0.8000000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0002500	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.1500000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0140000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	179.0000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	0.5600000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	0.5900000	0.5586957 ± 0.6229060
General-DO (mg/L)	10.7000000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	161.0000000	109.1853659 ± 48.3470504
General-pH (pH)	8.5	8.0 ± 0.6
General-SolidsTSS (mg/L)	1.0000000	5.2717002 ± 27.1908288
General-SpCond (µS/cm)	246.5000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	12.5	7.2 ± 5.7
General-TempWater (Degrees Celsius)	6.2000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.2500000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.3500000	0.3312424 ± 0.1572675
Li (mg/L)	0.0036100	0.0009183 ± 0.0003795
Mg (mg/L)	12.3000000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0015500	0.0007721 ± 0.0008518
Mo (mg/L)	0.0006500	0.0012835 ± 0.0042333
Na (mg/L)	1.5700000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2 (mg/L)	0.0050000	0.0049953 ± 0.0199967
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0050000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.0780000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.0780000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0081000	0.0031912 ± 0.0087929
S (mg/L)	5.0000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0005200	0.0002782 ± 0.0002859
Si (mg/L)	2.0000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0001000	0.0000300 ± 0.0000407
SO4 (mg/L)	15.7000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.1090000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0005220	0.0003872 ± 0.0002299

Habitat Description

Variable	ALX003	Predicted Group Reference Mean ±SD
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	BOI001
Sampling Date	Sep 21 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	50.02314 N, 114.91614 W
Altitude	1261
Local Basin Name	Elk River
	Boivin Creek
Stream Order	4

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	6.4%	9.5%	4.6%	17.3%	58.2%	4.0%
CABIN Assessment of BOI001 on Sep 21, 2022	Similar to Reference					

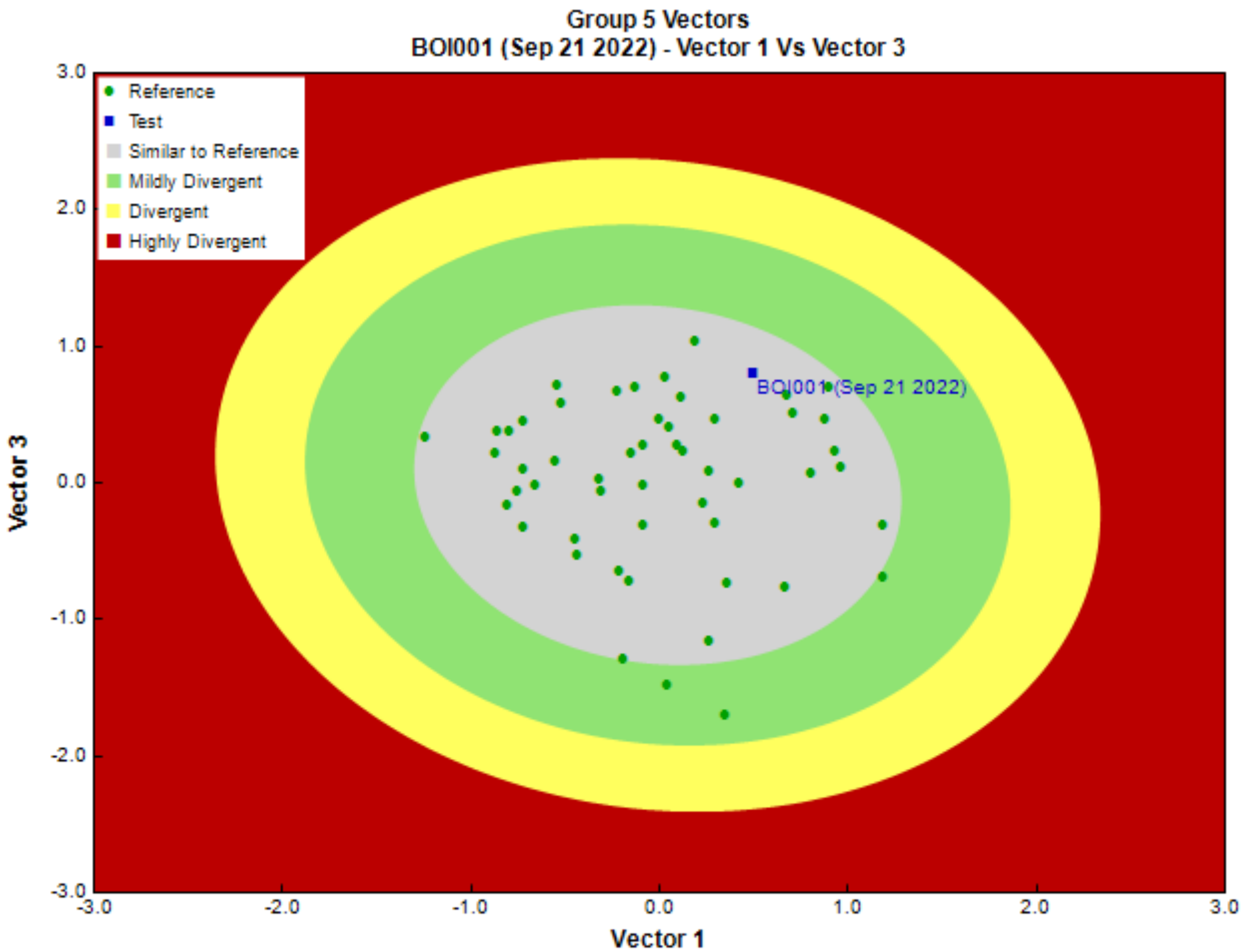

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Diptera	Chironomidae	178	2,966.7
			Psychodidae	1	16.7
			Simuliidae	3	50.0
		Ephemeroptera	Ameletidae	1	16.7
			Baetidae	33	550.0
			Ephemerellidae	19	316.7
			Heptageniidae	135	2,250.0
		Plecoptera	Capniidae	1	16.7
			Chloroperlidae	3	50.0
			Leuctridae	4	66.7
			Nemouridae	25	416.7
			Perlodidae	1	16.7
			Taeniopterygidae	112	1,866.7
		Trichoptera	Glossosomatidae	3	50.0
			Rhyacophilidae	5	83.3
			Total	524	8,733.6

Metrics

Name	BOI001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.45	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.2	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.2	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	64.7	45.8 ± 14.9
% Predatores	35.7	14.8 ± 9.8
% Scrapers	54.6	59.4 ± 19.6
% Shredder	27.1	30.7 ± 17.4
No. Clinger Taxa	21.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	34.0	7.5 ± 8.6
% Coleoptera	0.0	0.1 ± 0.3
% Diptera + Non-insects	34.7	10.7 ± 9.9
% Ephemeroptera	35.9	47.2 ± 15.8
% Ephemeroptera that are Baetidae	17.6	25.4 ± 20.8
% EPT Individuals	65.3	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	59.7	58.3 ± 10.6
% of 5 dominant taxa	92.2	83.6 ± 6.3
% of dominant taxa	34.0	37.8 ± 11.1
% Plecoptera	27.9	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	1.5	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.7	0.9 ± 0.1
Total Abundance	8733.3	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	5700.0	4035.4 ± 2618.4
EPT taxa (no)	12.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	6.0	5.5 ± 1.1
Shannon-Wiener Diversity	1.7	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	15.0	17.0 ± 3.1
Trichoptera taxa	2.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at BOI001
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	11.28
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	9.41
RIVPACS : Observed taxa P>0.70	9.00
RIVPACS : O:E (p > 0.7)	0.96

Habitat Description

Variable	BOI001	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	29.4	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	20.00	46.71 ± 35.00
Depth-Max (cm)	44.0	28.8 ± 13.7
Discharge (m^3/s)	1.965	0.682
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	0.00	1.04 ± 0.95
Reach-%Logging (PercentRange)	0	0 ± 0
Reach-DomStreamsideVeg (Category(1-4))	1	3 ± 1
Reach-Pools (Binary)	0	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0300000	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	0	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.80	0.58 ± 0.20
Velocity-Max (m/s)	1.50	0.85 ± 0.27
Width-Bankfull (m)	9.0	16.1 ± 13.1
Width-Wetted (m)	8.4	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	3	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	45.44750	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-14.85000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	63.55090	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	0.92278	7.47766 ± 6.29880
Natl-ShrubLow (%)	0.38854	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 6
%Cobble (%)	60	57 ± 15
%Gravel (%)	5	2 ± 3
%Pebble (%)	31	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	8.95	24.05 ± 35.66
Dg (cm)	7.7	23.0 ± 33.8
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	18.45671	20.01334 ± 7.41149
SlopeMax (%)	317.63962	488.94077 ± 542.32910
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0025000	0.0078031 ± 0.0090962
As (mg/L)	0.0005300	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.0274000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013

Habitat Description

Variable	BOI001	Predicted Group Reference Mean ±SD
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	50.0000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000260	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	0.0500000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0005200	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.2300000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0050000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	160.0000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	0.2500000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	0.2500000	0.5586957 ± 0.6229060
General-DO (mg/L)	11.2800000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	178.0000000	109.1853659 ± 48.3470504
General-pH (pH)	7.3	8.0 ± 0.6
General-SolidsTSS (mg/L)	1.0000000	5.2717002 ± 27.1908288
General-SpCond (µS/cm)	276.3000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	17.5	7.2 ± 5.7
General-TempWater (Degrees Celsius)	5.3000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.1800000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.2800000	0.3312424 ± 0.1572675
Li (mg/L)	0.0013100	0.0009183 ± 0.0003795
Mg (mg/L)	12.9000000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0001000	0.0007721 ± 0.0008518
Mo (mg/L)	0.0014000	0.0012835 ± 0.0042333
Na (mg/L)	0.5700000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2 (mg/L)	0.0050000	0.0049953 ± 0.0199967
Nitrogen-NO2+NO3 (mg/L)	0.0389000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0390000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.0250000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.0250000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0025000	0.0031912 ± 0.0087929
S (mg/L)	16.9000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0009700	0.0002782 ± 0.0002859
Si (mg/L)	2.1000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0001000	0.0000300 ± 0.0000407
SO4 (mg/L)	52.8000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.4900000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0009160	0.0003872 ± 0.0002299
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	BOI002
Sampling Date	Sep 21 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	50.01693 N, 114.93698 W
Altitude	1316
Local Basin Name	Elk River
	Boivin Creek
Stream Order	4

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	6.6%	7.2%	4.4%	14.8%	63.7%	3.2%
CABIN Assessment of BOI002 on Sep 21, 2022	Similar to Reference					

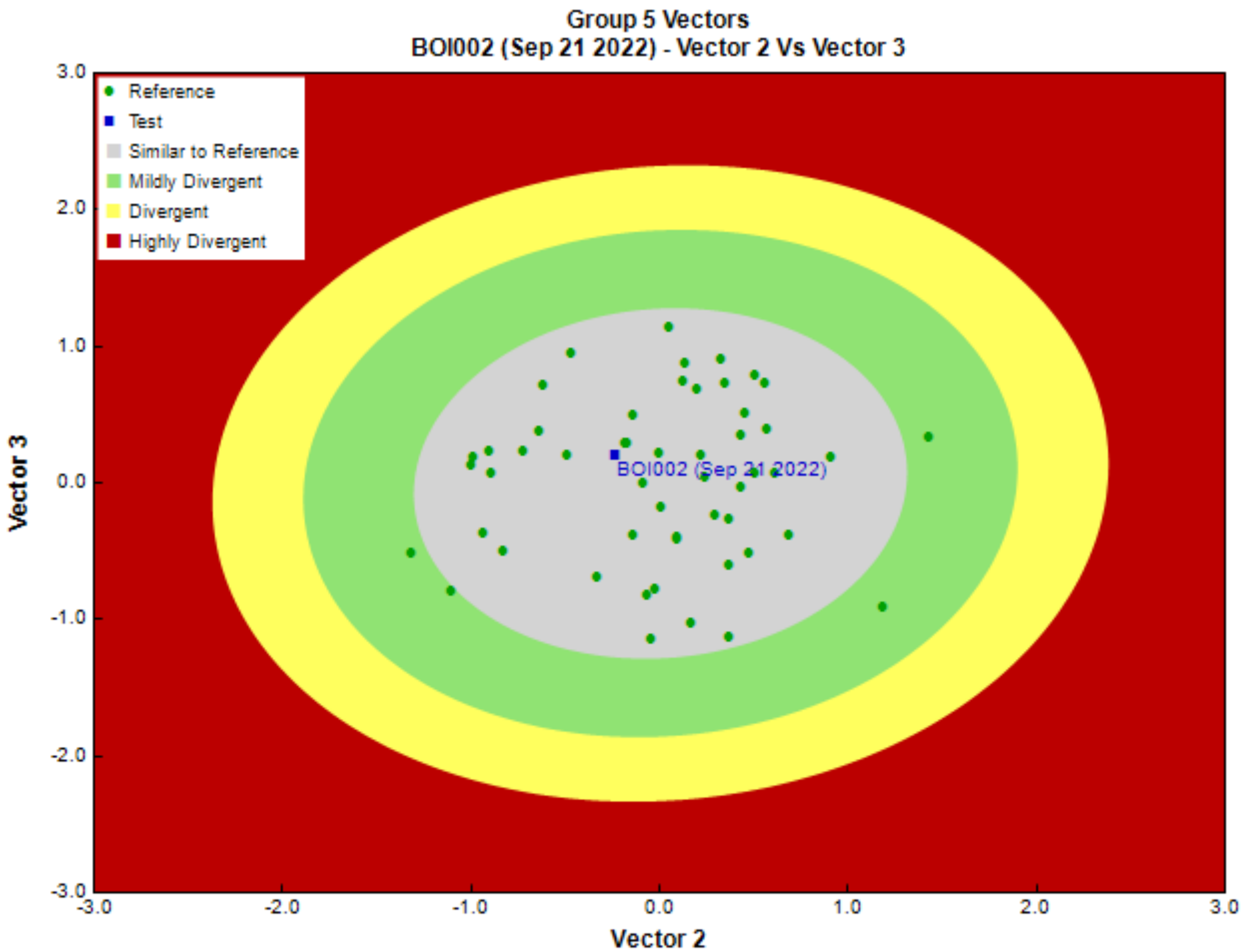

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	8/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	2	25.0
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	1	12.5
	Insecta	Diptera	Chironomidae	53	662.5
			Empididae	1	12.5
			Psychodidae	3	37.5
		Ephemeroptera	Ameletidae	5	62.5
			Baetidae	36	450.0
			Ephemerellidae	66	825.0
			Heptageniidae	77	962.5
		Plecoptera	Capniidae	2	25.0
			Chloroperlidae	9	112.5
			Nemouridae	17	212.5
			Perlodidae	12	150.0
			Taeniopterygidae	67	837.5
		Trichoptera	Glossosomatidae	8	100.0
			Hydropsychidae	1	12.5

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Rhyacophilidae	13	162.5
			Uenoidae	1	12.5
			Total	374	4,675.0

Metrics

Name	BOI002	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.24	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.3	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.3	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	57.5	45.8 ± 14.9
% Predatores	21.7	14.8 ± 9.8
% Scrapers	50.8	59.4 ± 19.6
% Shredder	23.0	30.7 ± 17.4
No. Clinger Taxa	20.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	14.2	7.5 ± 8.6
% Coleoptera	0.0	0.1 ± 0.3
% Diptera + Non-insects	16.0	10.7 ± 9.9
% Ephemeroptera	49.2	47.2 ± 15.8
% Ephemeroptera that are Baetidae	19.6	25.4 ± 20.8
% EPT Individuals	84.0	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	38.5	58.3 ± 10.6
% of 5 dominant taxa	79.9	83.6 ± 6.3
% of dominant taxa	20.6	37.8 ± 11.1
% Plecoptera	28.6	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	4.3	25.4 ± 24.6
% Tricoptera	6.1	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	4675.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	3925.0	4035.4 ± 2618.4
EPT taxa (no)	13.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	5.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.2	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	18.0	17.0 ± 3.1
Trichoptera taxa	4.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at BOI002
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	11.78
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	1.10
RIVPACS : Expected taxa P>0.70	9.42
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	1.06

Habitat Description

Variable	BOI002	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	35.3	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	29.00	46.71 ± 35.00
Depth-Max (cm)	41.0	28.8 ± 13.7
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	0.00	1.04 ± 0.95
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0315830	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	1.18	0.58 ± 0.20
Velocity-Max (m/s)	1.50	0.85 ± 0.27
Width-Bankfull (m)	9.2	16.1 ± 13.1
Width-Wetted (m)	5.4	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	3	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	45.58192	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-14.85000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	59.44235	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	0.67640	7.47766 ± 6.29880
Natl-ShrubLow (%)	0.28480	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	11	6 ± 6
%Cobble (%)	44	57 ± 15
%Gravel (%)	12	2 ± 3
%Pebble (%)	31	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	0 ± 1
D50 (cm)	7.35	24.05 ± 35.66
Dg (cm)	6.5	23.0 ± 33.8
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	16.55265	20.01334 ± 7.41149
SlopeMax (%)	317.63962	488.94077 ± 542.32910
Water Chemistry		

Habitat Description

Variable	BOI002	Predicted Group Reference Mean ±SD
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0025000	0.0078031 ± 0.0090962
As (mg/L)	0.0005800	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.0307000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	57.0000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000280	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	0.0500000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0006200	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.2400000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0050000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	146.0000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	0.2500000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	0.2500000	0.5586957 ± 0.6229060
General-DO (mg/L)	11.4000000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	178.0000000	109.1853659 ± 48.3470504
General-pH (pH)	7.2	8.0 ± 0.6
General-SolidsTSS (mg/L)	1.0000000	5.2717002 ± 27.1908288
General-SpCond (µS/cm)	277.6000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	3.0	7.2 ± 5.7
General-TempWater (Degrees Celsius)	3.8000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.3100000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.3300000	0.3312424 ± 0.1572675
Li (mg/L)	0.0015200	0.0009183 ± 0.0003795
Mg (mg/L)	15.2000000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0001000	0.0007721 ± 0.0008518
Mo (mg/L)	0.0015600	0.0012835 ± 0.0042333
Na (mg/L)	0.6600000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2 (mg/L)	0.0050000	0.0049953 ± 0.0199967
Nitrogen-NO2+NO3 (mg/L)	0.0657000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0660000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.0250000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.0657000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0025000	0.0031912 ± 0.0087929
S (mg/L)	19.2000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0011000	0.0002782 ± 0.0002859
Si (mg/L)	2.4000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0004500	0.0000300 ± 0.0000407
SO4 (mg/L)	53.0000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.5610000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0010700	0.0003872 ± 0.0002299
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	COL001
Sampling Date	Sep 18 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.49574 N, 115.06643 W
Altitude	999
Local Basin Name	Elk River
	Coal Creek
Stream Order	3

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	2.7%	13.6%	11.8%	47.7%	21.9%	2.2%
CABIN Assessment of COL001 on Sep 18, 2022	Highly Divergent					

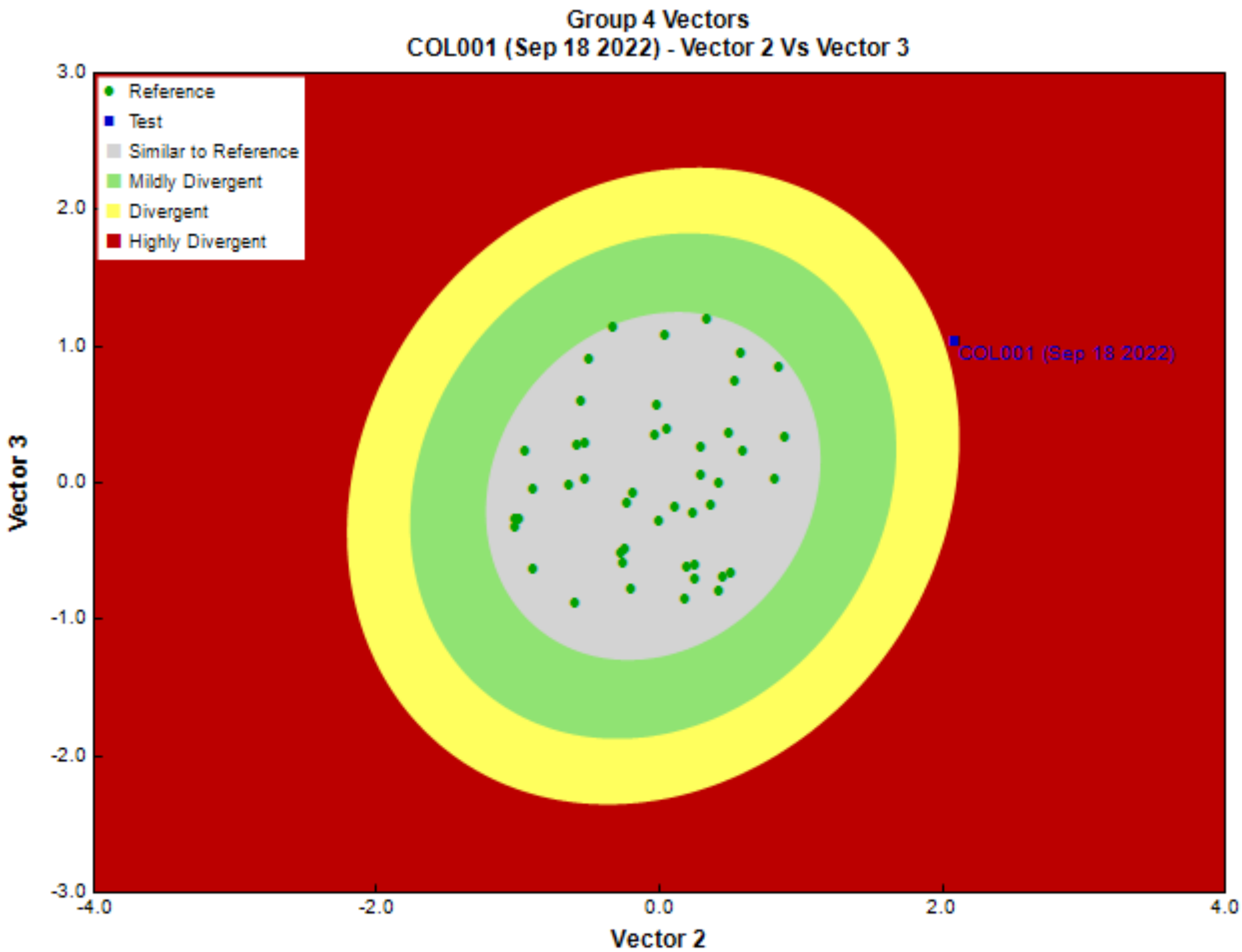

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	244	4,066.7
Arthropoda	Arachnida	Trombidiformes	Aturidae	1	16.7
			Hygrobatidae	1	16.7
			Lebertiidae	3	50.0
			Sperchontidae	3	50.0
			Torrenticolidae	5	83.3
	Insecta	Coleoptera	Elmidae	2	33.4
		Diptera	Chironomidae	174	2,900.0
			Empididae	1	16.7
			Tipulidae	9	150.0
		Ephemeroptera	Ameletidae	1	16.7
			Baetidae	23	383.4
			Ephemerellidae	150	2,500.1
			Heptageniidae	19	316.7
			Leptophlebiidae	2	33.3
		Plecoptera	Capniidae	22	366.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Leuctridae	1	16.7
			Nemouridae	4	66.7
			Perlodidae	2	33.3
		Trichoptera	Hydropsychidae	2	33.4
			Hydroptilidae	1	16.7
			Lepidostomatidae	38	633.3
			Total	708	11,800.5

Metrics

Name	COL001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.9	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	8.6	3.2 ± 0.4
Hilsenhoff Family index (North-West)	8.6	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	2.0	1.9 ± 1.0
Tolerant individuals (%)	--	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	117.7	47.1 ± 15.4
% Predatores	27.1	12.9 ± 7.3
% Scrapers	6.6	68.3 ± 16.1
% Shredder	10.7	36.7 ± 14.6
No. Clinger Taxa	21.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	24.6	5.2 ± 5.7
% Coleoptera	0.3	0.6 ± 2.2
% Diptera + Non-insects	62.3	7.4 ± 7.0
% Ephemeroptera	27.5	45.8 ± 15.1
% Ephemeroptera that are Baetidae	11.8	28.9 ± 20.8
% EPT Individuals	37.4	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	59.0	59.5 ± 11.3
% of 5 dominant taxa	88.8	85.1 ± 6.5
% of dominant taxa	34.5	37.7 ± 10.4
% Plecoptera	4.1	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	4.9	23.9 ± 23.6
% Tricoptera	5.8	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.9 ± 0.1
Total Abundance	11800.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.5
Diptera taxa	3.0	2.6 ± 1.1
Ephemeroptera taxa	5.0	3.7 ± 0.6
EPT Individuals (Sum)	4416.7	1353.0 ± 804.6
EPT taxa (no)	12.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	4.0	5.4 ± 1.2
Shannon-Wiener Diversity	1.8	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	22.0	16.5 ± 3.6
Trichoptera taxa	3.0	3.2 ± 1.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at COL001
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	11.85
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.93
RIVPACS : Expected taxa P>0.70	10.13
RIVPACS : Observed taxa P>0.70	8.00
RIVPACS : O:E (p > 0.7)	0.79

Habitat Description

Variable	COL001	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	90.78003 ± 16.48787
Channel		
Depth-Avg (cm)	14.9	27.7 ± 12.1
Depth-BankfullMinusWetted (cm)	15.00	48.41 ± 32.00
Depth-Max (cm)	20.0	41.6 ± 18.0
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.20 ± 0.86
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Pools (Binary)	1	1 ± 1
Reach-Rapids (Binary)	0	1 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0068167	0.0302442 ± 0.0225320
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.13	0.65 ± 0.30
Velocity-Max (m/s)	0.20	1.02 ± 0.40
Width-Bankfull (m)	19.8	22.0 ± 20.4
Width-Wetted (m)	11.0	14.4 ± 14.2
XSEC-VelInstrumentDirect (Category(1-3))	3	2 ± 1
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	52.84964	101.93711 ± 37.08464
Temp12_DECmin (Degrees Celsius)	-13.25000	-12.60285 ± 1.55807
Hydrology		
Drainage-Area (km^2)	117.65190	153.19859 ± 249.47160
Landcover		
Natl-Grassland (%)	0.08905	4.14423 ± 3.51761
Natl-ShrubLow (%)	2.06878	4.00461 ± 2.77104
Natl-Water (%)	0.00000	0.26551 ± 0.58793
Reg-Ice (%)	0.00000	2.39543 ± 4.09623
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	5	8 ± 8
%Cobble (%)	49	53 ± 15
%Gravel (%)	8	4 ± 6
%Pebble (%)	36	33 ± 14
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	0 ± 0
D50 (cm)	7.00	14.48 ± 20.33
Dg (cm)	5.5	13.1 ± 19.3
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 1

Habitat Description

Variable	COL001	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 2
Topography		
Reg-SlopeLT30% (%)	44.43454	17.11832 ± 8.21512
SlopeMax (%)	161.32619	386.22536 ± 140.72382
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000028 ± 0.0000036
Al (mg/L)	0.0078000	0.0136410 ± 0.0145846
As (mg/L)	0.0002500	0.0001754 ± 0.0001818
B (mg/L)	0.0250000	0.0305833 ± 0.0370084
Ba (mg/L)	0.2790000	0.0435560 ± 0.0571949
Be (mg/L)	0.0000500	0.0000056 ± 0.0000072
Bi (mg/L)	0.0000500	0.0000028 ± 0.0000036
Br (mg/L)	0.0500000	0.0268750 ± 0.0585132
Ca (mg/L)	43.5000000	20.8384848 ± 13.6841012
Cd (mg/L)	0.0000370	0.0000115 ± 0.0000149
Chloride-Total (mg/L)	0.6100000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000298 ± 0.0000226
Cr (mg/L)	0.0002500	0.0000900 ± 0.0000889
Cu (mg/L)	0.0005000	0.0003212 ± 0.0001572
F (mg/L)	0.5500000	0.0484615 ± 0.0355181
Fe (mg/L)	0.0170000	0.0442667 ± 0.0348579
General-Alkalinity (mg/L)	175.0000000	59.4800000 ± 43.9851975
General-CarbonDOC (mg/L)	1.8500000	0.6500000 ± 0.3535534
General-CarbonTOC (mg/L)	2.3100000	0.3944444 ± 0.3157179
General-DO (mg/L)	9.8900000	12.6802381 ± 11.2165934
General-Hardness (mg/L)	139.0000000	76.7342857 ± 54.3511564
General-pH (pH)	8.5	7.9 ± 0.4
General-SolidsTSS (mg/L)	1.0000000	1.9034611 ± 3.0161707
General-SpCond (µS/cm)	245.0000000	153.2777778 ± 120.2707781
General-TempAir (Degrees Celsius)	21.0	10.6 ± 5.4
General-TempWater (Degrees Celsius)	14.4000000	6.4219048 ± 2.3475813
General-Turbidity (NTU)	0.7000000	2.7965000 ± 4.1415171
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.8500000	0.4511613 ± 0.2901093
Li (mg/L)	0.0073600	0.0016910 ± 0.0023918
Mg (mg/L)	8.3800000	5.1886364 ± 5.0072212
Mn (mg/L)	0.0041100	0.0028572 ± 0.0019872
Mo (mg/L)	0.0008500	0.0006660 ± 0.0004339
Na (mg/L)	2.7700000	0.9945806 ± 0.9373003
Ni (mg/L)	0.0002000	0.0002298 ± 0.0001811
Nitrogen-NO2 (mg/L)	0.0050000	0.0042917 ± 0.0108893
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0732400 ± 0.0567225
Nitrogen-NO3 (mg/L)	0.0050000	0.0865111 ± 0.0538993
Nitrogen-TKN (mg/L)	0.0530000	97.0987778 ± 290.9629753
Nitrogen-TN (mg/L)	0.0530000	24.3739167 ± 145.4787822
Pb (mg/L)	0.0001000	0.0000559 ± 0.0000496
Phosphorus-OrthoP (mg/L)	0.0025000	0.0008667 ± 0.0013292
Phosphorus-TP (mg/L)	0.0206000	0.0031194 ± 0.0039854
S (mg/L)	1.5000000	362.2600000 ± 803.7224104
Sb (mg/L)	0.0001000	0.0000288 ± 0.0000136
Se (mg/L)	0.0002500	0.0002422 ± 0.0003912
Si (mg/L)	2.0000000	1.9070000 ± 0.6500353
Sn (mg/L)	0.0001000	0.0000988 ± 0.0001602
SO4 (mg/L)	6.4000000	18.1942857 ± 18.0693910
Sr (mg/L)	0.1460000	0.1493500 ± 0.1276611
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0008433 ± 0.0009290
Tl (mg/L)	0.0000100	0.0000031 ± 0.0000048
U (mg/L)	0.0005280	0.0005805 ± 0.0003382

Habitat Description

Variable	COL001	Predicted Group Reference Mean ±SD
V (mg/L)	0.0005000	0.0001220 ± 0.0001369
Zn (mg/L)	0.0020000	0.0009430 ± 0.0009518
Zr (mg/L)	0.0000500	0.0000900 ± 0.0000894

Site Description

Study Name	CBWQ-Elk
Site	COL003
Sampling Date	Sep 18 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.45285 N, 114.87999 W
Altitude	1737
Local Basin Name	Elk River
	Coal Creek
Stream Order	1

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	0.3%	0.0%	1.7%	1.1%	96.8%	0.0%
CABIN Assessment of COL003 on Sep 18, 2022	Divergent					

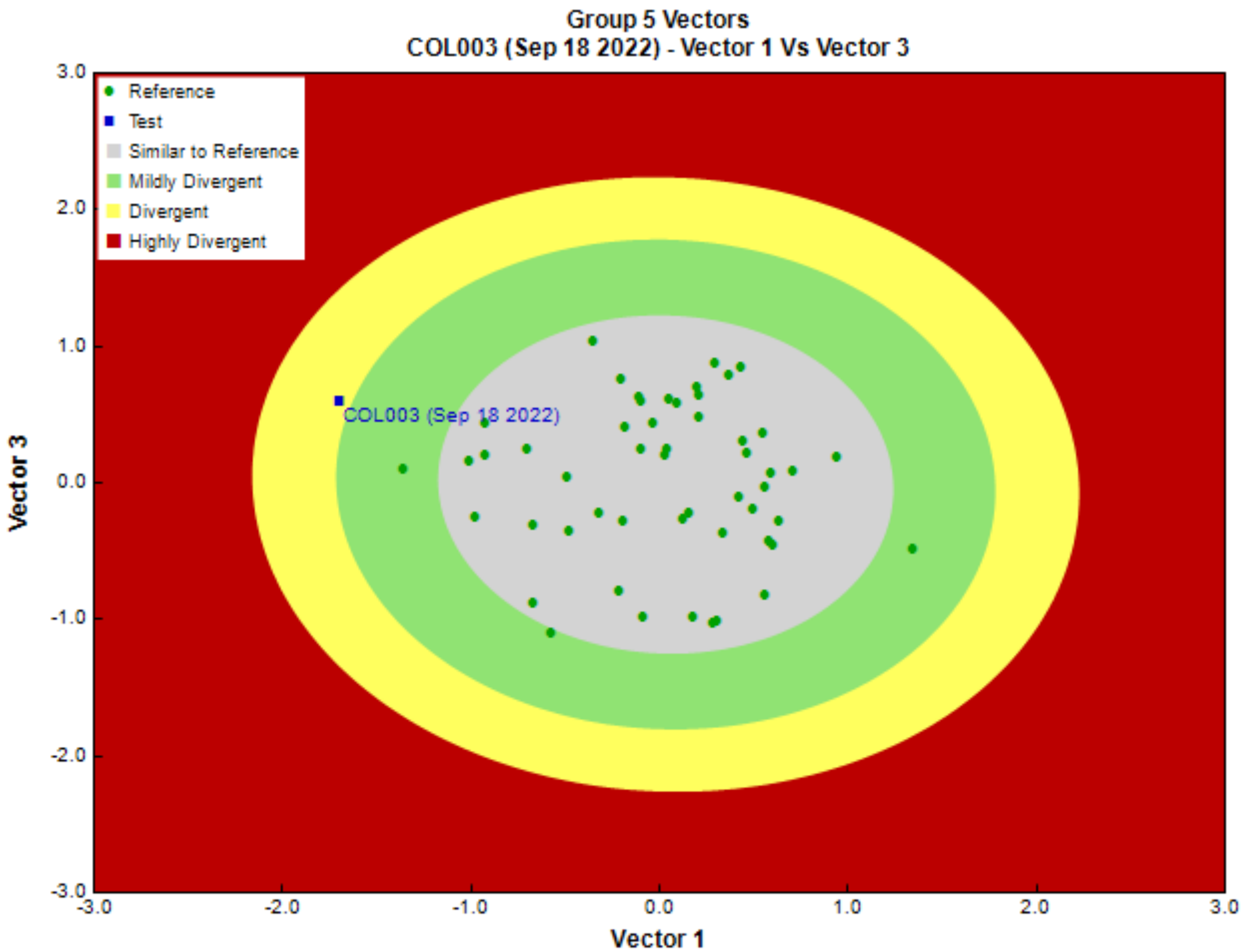

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	20/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Sarcoptiformes		1	5.0
		Trombidiformes		4	20.0
			Sperchontidae	4	20.0
			Torrenticolidae	1	5.0
	Insecta	Coleoptera	Elmidae	14	70.0
		Diptera	Ceratopogonidae	1	5.0
			Chironomidae	82	410.0
		Ephemeroptera	Ameletidae	64	320.0
			Baetidae	7	35.0
			Ephemerellidae	22	110.0
			Heptageniidae	4	20.0
		Plecoptera		2	10.0
			Capniidae	24	120.0
			Chloroperlidae	29	145.0
			Nemouridae	15	75.0
			Peltoperlidae	1	5.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlidae	11	55.0
			Perlodidae	7	35.0
		Trichoptera		6	30.0
			Brachycentridae	8	40.0
			Rhyacophilidae	5	25.0
			Uenoidae	1	5.0
			Total	313	1,565.0

Metrics

Name	COL003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.69	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	1.8	3.4 ± 0.4
Hilsenhoff Family index (North-West)	1.8	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	65.8	45.8 ± 14.9
% Predatores	37.7	14.8 ± 9.8
% Scrapers	8.3	59.4 ± 19.6
% Shredder	19.8	30.7 ± 17.4
No. Clinger Taxa	20.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	27.3	7.5 ± 8.6
% Coleoptera	4.7	0.1 ± 0.3
% Diptera + Non-insects	29.3	10.7 ± 9.9
% Ephemeroptera	32.3	47.2 ± 15.8
% Ephemeroptera that are Baetidae	7.2	25.4 ± 20.8
% EPT Individuals	66.0	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	48.7	58.3 ± 10.6
% of 5 dominant taxa	73.7	83.6 ± 6.3
% of dominant taxa	27.3	37.8 ± 11.1
% Plecoptera	29.0	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	4.7	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.7	0.9 ± 0.1
Total Abundance	1565.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	2.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	990.0	4035.4 ± 2618.4
EPT taxa (no)	13.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	6.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.2	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	18.0	17.0 ± 3.1
Trichoptera taxa	3.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at COL003
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.58
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	0.79
RIVPACS : Expected taxa P>0.70	9.58
RIVPACS : Observed taxa P>0.70	8.00
RIVPACS : O:E (p > 0.7)	0.83

Habitat Description

Variable	COL003	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	7.5	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	4.60	46.71 ± 35.00
Depth-Max (cm)	10.8	28.8 ± 13.7
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	2.00	1.04 ± 0.95
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0180952	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	0	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.03	0.58 ± 0.20
Velocity-Max (m/s)	0.10	0.85 ± 0.27
Width-Bankfull (m)	3.5	16.1 ± 13.1
Width-Wetted (m)	2.1	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	3	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	52.73000	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-13.00000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	5.65737	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	0.00000	7.47766 ± 6.29880
Natl-ShrubLow (%)	0.14265	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	1	6 ± 6
%Cobble (%)	38	57 ± 15
%Gravel (%)	9	2 ± 3
%Pebble (%)	52	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	5.35	24.05 ± 35.66
Dg (cm)	5.2	23.0 ± 33.8
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1

Habitat Description

Variable	COL003	Predicted Group Reference Mean ±SD
Topography		
Reg-SlopeLT30% (%)	73.39946	20.01334 ± 7.41149
SlopeMax (%)	101.76495	488.94077 ± 542.32910
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0253000	0.0078031 ± 0.0090962
As (mg/L)	0.0002500	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.0768000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	14.8000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000600	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	0.0500000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0002500	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.5500000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0050000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	62.8000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	1.9600000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	2.0800000	0.5586957 ± 0.6229060
General-Conductivity (µS/cm)	54.3000000	173.5150000 ± 86.2502071
General-DO (mg/L)	10.5800000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	49.1000000	109.1853659 ± 48.3470504
General-pH (pH)	8.2	8.0 ± 0.6
General-SolidsTSS (mg/L)	1.0000000	5.2717002 ± 27.1908288
General-SpCond (µS/cm)	86.9000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	10.0	7.2 ± 5.7
General-TempWater (Degrees Celsius)	5.3000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.4000000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.2500000	0.3312424 ± 0.1572675
Li (mg/L)	0.0001500	0.0009183 ± 0.0003795
Mg (mg/L)	3.0300000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0006200	0.0007721 ± 0.0008518
Mo (mg/L)	0.0004200	0.0012835 ± 0.0042333
Na (mg/L)	0.1700000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2 (mg/L)	0.0050000	0.0049953 ± 0.0199967
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0050000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.0250000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.0250000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0168000	0.0031912 ± 0.0087929
S (mg/L)	1.5000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0002500	0.0002782 ± 0.0002859
Si (mg/L)	1.1000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0001000	0.0000300 ± 0.0000407
SO4 (mg/L)	6.3000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.0197000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0000910	0.0003872 ± 0.0002299
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377

Habitat Description

Variable	COL003	Predicted Group Reference Mean ±SD
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	LIZ001
Sampling Date	Sep 20 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.47164 N, 115.07716 W
Altitude	994
Local Basin Name	Lizard Creek
	Elk River
Stream Order	3

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	5.6%	36.1%	17.1%	26.9%	8.6%	5.6%
CABIN Assessment of LIZ001 on Sep 20, 2022	Highly Divergent					

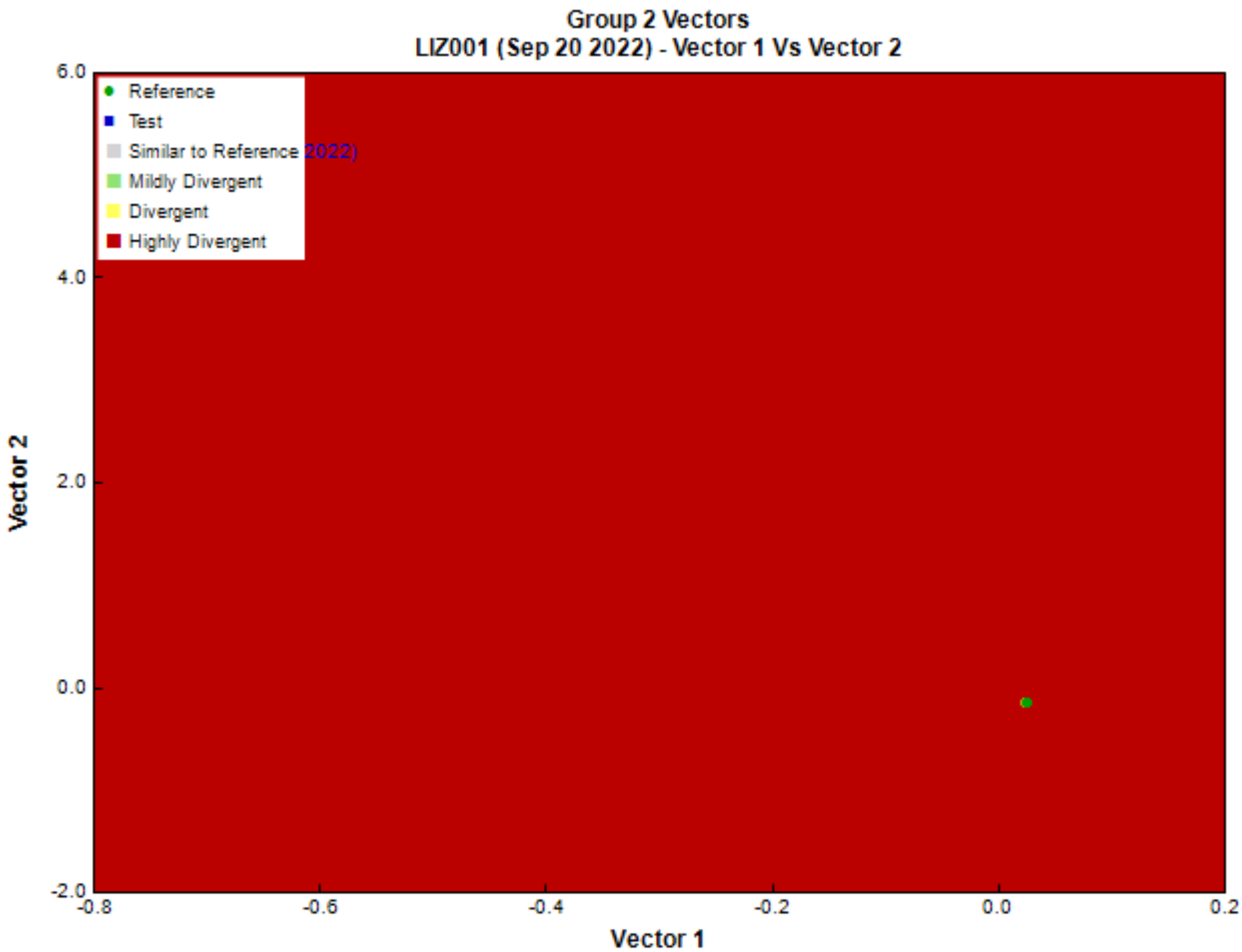

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata		Enchytraeidae	1	20.0
		Tubificida	Naididae	321	6,420.0
Arthropoda	Arachnida	Trombidiformes	Aturidae	1	20.0
			Lebertiidae	12	240.0
			Torrenticolidae	8	160.0
	Insecta	Coleoptera	Elmidae	16	320.0
		Diptera	Chironomidae	97	1,940.0
			Empididae	9	180.0
			Psychodidae	18	360.0
			Simuliidae	15	300.0
			Tipulidae	1	20.0
		Ephemeroptera	Ameletidae	1	20.0
			Baetidae	55	1,100.0
			Ephemerellidae	43	860.0
			Heptageniidae	5	100.0
		Plecoptera		2	40.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Capniidae	7	140.0
			Leuctridae	1	20.0
			Nemouridae	91	1,820.0
			Perlidae	12	240.0
			Taeniopterygidae	7	140.0
		Trichoptera		2	40.0
			Apataniidae	1	20.0
			Brachycentridae	8	160.0
			Glossosomatidae	2	40.0
			Hydropsychidae	87	1,740.0
			Hydroptilidae	2	40.0
			Rhyacophilidae	5	100.0
			Uenoidae	6	120.0
			Total	836	16,720.0

Metrics

Name	LIZ001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.97	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	8.4	3.6 ± 0.4
Hilsenhoff Family index (North-West)	8.4	3.2 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	2.7 ± 1.5
Tolerant individuals (%)	--	0.9 ± 0.2
Functional Measures		
% Filterers	--	0.6 ± 0.3
% Gatherers	123.8	38.1 ± 14.1
% Predatores	30.4	15.8 ± 9.1
% Scrapers	23.4	60.8 ± 14.6
% Shredder	15.8	23.9 ± 11.1
No. Clinger Taxa	30.0	22.0 ± 5.6
Number Of Individuals		
% Chironomidae	11.7	6.0 ± 5.6
% Coleoptera	1.9	1.7 ± 4.1
% Diptera + Non-insects	57.9	10.1 ± 7.7
% Ephemeroptera	12.5	53.4 ± 13.8
% Ephemeroptera that are Baetidae	52.9	29.5 ± 17.8
% EPT Individuals	40.0	88.1 ± 9.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	50.2	54.4 ± 11.4
% of 5 dominant taxa	78.2	81.6 ± 8.1
% of dominant taxa	38.6	35.2 ± 11.4
% Plecoptera	14.2	28.8 ± 11.6
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	78.4	28.7 ± 28.3
% Tricoptera	13.3	6.0 ± 5.0
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.9 ± 0.1
Total Abundance	16720.0	1083.1 ± 932.3
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.3 ± 0.5
Diptera taxa	5.0	3.1 ± 1.3
Ephemeroptera taxa	4.0	3.8 ± 0.6
EPT Individuals (Sum)	6660.0	941.8 ± 766.3
EPT taxa (no)	16.0	12.4 ± 2.4
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	5.3 ± 1.3
Shannon-Wiener Diversity	2.2	2.0 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1

Metrics

Name	LIZ001	Predicted Group Reference Mean ±SD
Total No. of Taxa	27.0	18.2 ± 4.7
Trichoptera taxa	7.0	3.3 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at LIZ001
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.35
RIVPACS : Observed taxa P>0.50	12.00
RIVPACS : O:E (p > 0.5)	0.97
RIVPACS : Expected taxa P>0.70	10.06
RIVPACS : Observed taxa P>0.70	9.00
RIVPACS : O:E (p > 0.7)	0.89

Habitat Description

Variable	LIZ001	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	91.25558 ± 24.81348
Channel		
Depth-Avg (cm)	24.2	31.4 ± 15.4
Depth-BankfullMinusWetted (cm)	17.00	54.15 ± 36.59
Depth-Max (cm)	39.8	46.8 ± 23.7
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.00 ± 0.96
Reach-DomStreamsideVeg (Category(1-4))	1	3 ± 1
Reach-Pools (Binary)	0	1 ± 1
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 1
Slope (m/m)	0.0268600	0.0435622 ± 0.0544263
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.38	0.63 ± 0.23
Velocity-Max (m/s)	0.50	0.95 ± 0.33
Width-Bankfull (m)	8.5	23.6 ± 18.9
Width-Wetted (m)	4.7	14.0 ± 9.6
XSEC-VelInstrumentDirect (Category(1-3))	3	2 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	48.29762	93.78954 ± 37.73803
Temp12_DECmin (Degrees Celsius)	-13.15000	-12.77499 ± 1.90440
Hydrology		
Drainage-Area (km^2)	45.25148	267.49128 ± 347.95771
Landcover		
Natl-Grassland (%)	3.20456	4.84000 ± 3.39798
Natl-ShrubLow (%)	6.94321	4.94988 ± 4.53147
Natl-Water (%)	0.16023	0.22026 ± 0.32058
Reg-Ice (%)	0.00000	4.18114 ± 6.57069
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	4	6 ± 7
%Cobble (%)	68	51 ± 23
%Gravel (%)	6	4 ± 6

Habitat Description

Variable	LIZ001	Predicted Group Reference Mean ±SD
%Pebble (%)	20	39 ± 23
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	0 ± 0
D50 (cm)	10.40	8.79 ± 6.32
Dg (cm)	8.5	7.7 ± 3.1
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	35.05430	22.23150 ± 8.61518
SlopeMax (%)	223.55025	475.68167 ± 413.51912
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000038 ± 0.0000018
Al (mg/L)	0.0238000	0.0064450 ± 0.0021850
As (mg/L)	0.0002500	0.0002615 ± 0.0000120
B (mg/L)	0.0250000	0.0262500 ± 0.0335876
Ba (mg/L)	0.0751000	0.0683500 ± 0.0002121
Be (mg/L)	0.0000500	0.0000075 ± 0.0000035
Bi (mg/L)	0.0000500	0.0000038 ± 0.0000018
Br (mg/L)	0.0500000	0.0140909 ± 0.0253375
Ca (mg/L)	105.0000000	24.6363636 ± 20.0629852
Cd (mg/L)	0.0000160	0.0000038 ± 0.0000018
Chloride-Total (mg/L)	0.2300000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000114 ± 0.0000019
Cr (mg/L)	0.0002500	0.0000750 ± 0.0000354
Cu (mg/L)	0.0002000	0.0001155 ± 0.0000219
F (mg/L)	0.1100000	0.0633810 ± 0.0630004
Fe (mg/L)	0.0230000	0.0105500 ± 0.0036062
General-Alkalinity (mg/L)	172.0000000	74.2125000 ± 53.9915558
General-CarbonDOC (mg/L)	0.9300000	0.0000000 ± 0.0000000
General-CarbonTOC (mg/L)	1.0000000	0.9750000 ± 0.4596194
General-DO (mg/L)	10.9700000	11.0129630 ± 0.8955266
General-Hardness (mg/L)	332.0000000	95.8956522 ± 77.3576081
General-pH (pH)	8.5	7.7 ± 0.8
General-SolidsTSS (mg/L)	1.0000000	5.9463636 ± 8.6422279
General-SpCond (µS/cm)	523.0000000	165.1777778 ± 128.4575336
General-TempAir (Degrees Celsius)	12.0	11.5 ± 5.9
General-TempWater (Degrees Celsius)	8.1000000	6.4451852 ± 2.2997548
General-Turbidity (NTU)	1.0300000	5.7154545 ± 6.9690564
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.4300000	0.4604091 ± 0.2737828
Li (mg/L)	0.0040300	0.0011000 ± 0.0000000
Mg (mg/L)	23.7000000	8.6045455 ± 7.5439965
Mn (mg/L)	0.0028600	0.0007470 ± 0.0001937
Mo (mg/L)	0.0019900	0.0006780 ± 0.0000170
Na (mg/L)	1.7300000	1.0881818 ± 0.7163042
Ni (mg/L)	0.0002000	0.0001625 ± 0.0001945
Nitrogen-NO2 (mg/L)	0.0050000	0.0034091 ± 0.0048394
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0789333 ± 0.0140433
Nitrogen-NO3 (mg/L)	0.0050000	0.0719000 ± 0.0408583
Nitrogen-TKN (mg/L)	0.0630000	0.0200000
Nitrogen-TN (mg/L)	0.0630000	0.0929091 ± 0.0373336
Pb (mg/L)	0.0001000	0.0000337 ± 0.0000259
Phosphorus-TP (mg/L)	0.0250000	0.0049864 ± 0.0043795
S (mg/L)	73.0000000	5.0000000
Sb (mg/L)	0.0001000	0.0000635 ± 0.0000092
Se (mg/L)	0.0002500	0.0001105 ± 0.0000134
Si (mg/L)	2.6000000	2.5681818 ± 1.4562562
Sn (mg/L)	0.0001000	0.0000075 ± 0.0000035
Sr (mg/L)	1.7300000	0.0445000 ± 0.0002828

Habitat Description

Variable	LIZ001	Predicted Group Reference Mean ±SD
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0005000
Tl (mg/L)	0.0000100	0.0000015 ± 0.0000007
U (mg/L)	0.0003970	0.0012050 ± 0.0000495
V (mg/L)	0.0005000	0.0001500 ± 0.0000707
Zn (mg/L)	0.0020000	0.0006400 ± 0.0005091
Zr (mg/L)	0.0000500	0.0000000 ± 0.0000000

Site Description

Study Name	CBWQ-Elk
Site	LIZ003
Sampling Date	Sep 20 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.48569 N, 115.09432 W
Altitude	1022
Local Basin Name	Lizard Creek
	Central Kootenay
Stream Order	3

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	3.9%	27.7%	18.0%	33.4%	11.3%	5.7%
CABIN Assessment of LIZ003 on Sep 20, 2022	Highly Divergent					

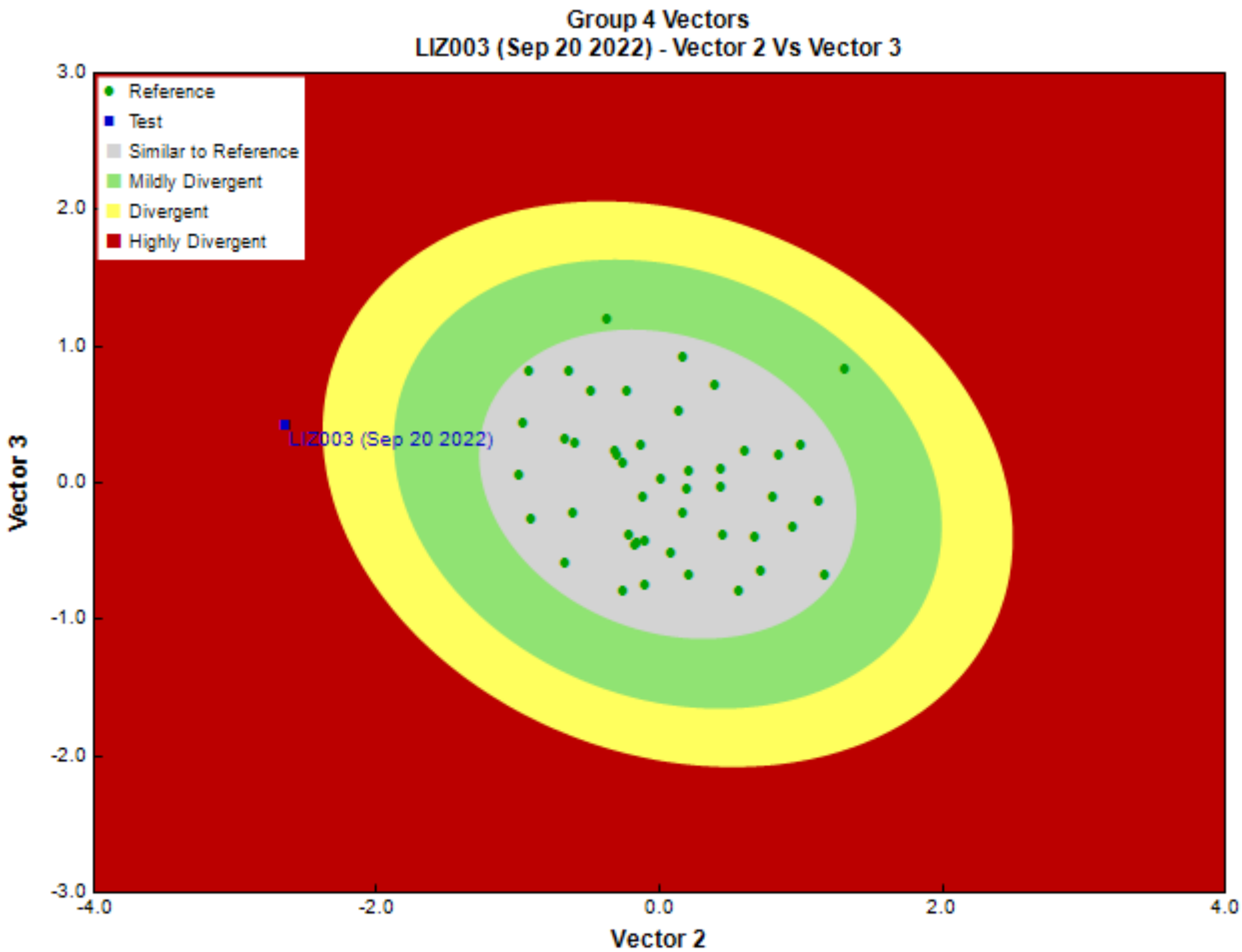

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	9	180.0
Arthropoda	Arachnida	Trombidiformes		1	20.0
			Hygrobatidae	1	20.0
			Lebertiidae	9	180.0
			Torrenticolidae	13	260.0
	Insecta	Coleoptera	Elmidae	144	2,880.0
		Diptera		1	20.0
			Chironomidae	57	1,140.0
			Pelecorhynchidae	2	40.0
			Psychodidae	39	780.0
			Simuliidae	3	60.0
			Tipulidae	9	180.0
		Ephemeroptera		1	20.0
			Baetidae	215	4,300.0
			Ephemerellidae	332	6,640.0
			Heptageniidae	70	1,400.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera		2	40.0
			Capniidae	29	580.0
			Chloroperlidae	14	280.0
			Nemouridae	118	2,360.0
			Perlidae	14	280.0
			Perlodidae	5	100.0
			Taeniopterygidae	48	960.0
		Trichoptera	Apataniidae	1	20.0
			Brachycentridae	5	100.0
			Glossosomatidae	3	60.0
			Hydropsychidae	6	120.0
			Rhyacophilidae	24	480.0
			Uenoidae	35	700.0
			Total	1,210	24,200.0

Metrics

Name	LIZ003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.91	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.7	3.2 ± 0.4
Hilsenhoff Family index (North-West)	3.7	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	5.0	1.9 ± 1.0
Tolerant individuals (%)	--	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	67.3	47.1 ± 15.4
% Predatores	11.5	12.9 ± 7.3
% Scrapers	43.4	68.3 ± 16.1
% Shredder	29.3	36.7 ± 14.6
No. Clinger Taxa	34.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	4.7	5.2 ± 5.7
% Coleoptera	12.0	0.6 ± 2.2
% Diptera + Non-insects	11.8	7.4 ± 7.0
% Ephemeroptera	51.2	45.8 ± 15.1
% Ephemeroptera that are Baetidae	34.8	28.9 ± 20.8
% EPT Individuals	76.3	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	45.4	59.5 ± 11.3
% of 5 dominant taxa	72.9	85.1 ± 6.5
% of dominant taxa	27.6	37.7 ± 10.4
% Plecoptera	18.9	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	8.1	23.9 ± 23.6
% Tricoptera	6.1	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	24200.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.5
Diptera taxa	5.0	2.6 ± 1.1
Ephemeroptera taxa	3.0	3.7 ± 0.6
EPT Individuals (Sum)	18380.0	1353.0 ± 804.6
EPT taxa (no)	15.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	6.0	5.4 ± 1.2
Shannon-Wiener Diversity	2.3	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1

Metrics

Name	LIZ003	Predicted Group Reference Mean ±SD
Total No. of Taxa	25.0	16.5 ± 3.6
Trichoptera taxa	6.0	3.2 ± 1.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at LIZ003
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.34
RIVPACS : Observed taxa P>0.50	12.00
RIVPACS : O:E (p > 0.5)	0.97
RIVPACS : Expected taxa P>0.70	10.07
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.09

Habitat Description

Variable	LIZ003	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	90.78003 ± 16.48787
Channel		
Depth-Avg (cm)	22.3	27.7 ± 12.1
Depth-BankfullMinusWetted (cm)	30.00	48.41 ± 32.00
Depth-Max (cm)	32.5	41.6 ± 18.0
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.20 ± 0.86
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	0	1 ± 1
Reach-Rapids (Binary)	0	1 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0064318	0.0302442 ± 0.0225320
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.52	0.65 ± 0.30
Velocity-Max (m/s)	0.80	1.02 ± 0.40
Width-Bankfull (m)	7.9	22.0 ± 20.4
Width-Wetted (m)	4.0	14.4 ± 14.2
XSEC-VelInstrumentDirect (Category(1-3))	3	2 ± 1
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	50.00611	101.93711 ± 37.08464
Temp12_DECmin (Degrees Celsius)	-13.15000	-12.60285 ± 1.55807
Hydrology		
Drainage-Area (km^2)	41.13000	153.19859 ± 249.47160
Landcover		
Natl-Grassland (%)	3.33072	4.14423 ± 3.51761
Natl-ShrubLow (%)	6.54389	4.00461 ± 2.77104
Natl-Water (%)	0.17633	0.26551 ± 0.58793
Reg-Ice (%)	0.00000	2.39543 ± 4.09623
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	8 ± 8
%Cobble (%)	39	53 ± 15
%Gravel (%)	9	4 ± 6
%Pebble (%)	52	33 ± 14

Habitat Description

Variable	LIZ003	Predicted Group Reference Mean ±SD
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	5.20	14.48 ± 20.33
Dg (cm)	4.6	13.1 ± 19.3
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 2
Topography		
Reg-SlopeLT30% (%)	30.96964	17.11832 ± 8.21512
SlopeMax (%)	223.55025	386.22536 ± 140.72382
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000028 ± 0.0000036
Al (mg/L)	0.0151000	0.0136410 ± 0.0145846
As (mg/L)	0.0002500	0.0001754 ± 0.0001818
B (mg/L)	0.0250000	0.0305833 ± 0.0370084
Ba (mg/L)	0.0653000	0.0435560 ± 0.0571949
Be (mg/L)	0.0000500	0.0000056 ± 0.0000072
Bi (mg/L)	0.0000500	0.0000028 ± 0.0000036
Br (mg/L)	0.0500000	0.0268750 ± 0.0585132
Ca (mg/L)	96.2000000	20.8384848 ± 13.6841012
Cd (mg/L)	0.0000140	0.0000115 ± 0.0000149
Chloride-Total (mg/L)	0.2300000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000298 ± 0.0000226
Cr (mg/L)	0.0002500	0.0000900 ± 0.0000889
Cu (mg/L)	0.0002000	0.0003212 ± 0.0001572
F (mg/L)	0.5500000	0.0484615 ± 0.0355181
Fe (mg/L)	0.0160000	0.0442667 ± 0.0348579
General-Alkalinity (mg/L)	180.0000000	59.4800000 ± 43.9851975
General-CarbonDOC (mg/L)	0.8000000	0.6500000 ± 0.3535534
General-CarbonTOC (mg/L)	1.0700000	0.3944444 ± 0.3157179
General-DO (mg/L)	10.8800000	12.6802381 ± 11.2165934
General-Hardness (mg/L)	339.0000000	76.7342857 ± 54.3511564
General-pH (pH)	8.3	7.9 ± 0.4
General-SolidsTSS (mg/L)	1.0000000	1.9034611 ± 3.0161707
General-SpCond (µS/cm)	531.0000000	153.2777778 ± 120.2707781
General-TempAir (Degrees Celsius)	9.8	10.6 ± 5.4
General-TempWater (Degrees Celsius)	6.3000000	6.4219048 ± 2.3475813
General-Turbidity (NTU)	0.6200000	2.7965000 ± 4.1415171
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.4100000	0.4511613 ± 0.2901093
Li (mg/L)	0.0037800	0.0016910 ± 0.0023918
Mg (mg/L)	22.6000000	5.1886364 ± 5.0072212
Mn (mg/L)	0.0033700	0.0028572 ± 0.0019872
Mo (mg/L)	0.0018800	0.0006660 ± 0.0004339
Na (mg/L)	1.6600000	0.9945806 ± 0.9373003
Ni (mg/L)	0.0002000	0.0002298 ± 0.0001811
Nitrogen-NO2 (mg/L)	0.0050000	0.0042917 ± 0.0108893
Nitrogen-NO2+NO3 (mg/L)	0.0464000	0.0732400 ± 0.0567225
Nitrogen-NO3 (mg/L)	0.0460000	0.0865111 ± 0.0538993
Nitrogen-TKN (mg/L)	0.0900000	97.0987778 ± 290.9629753
Nitrogen-TN (mg/L)	0.1360000	24.3739167 ± 145.4787822
Pb (mg/L)	0.0001000	0.0000559 ± 0.0000496
Phosphorus-TP (mg/L)	0.0250000	0.0031194 ± 0.0039854
S (mg/L)	67.8000000	362.2600000 ± 803.7224104
Sb (mg/L)	0.0001000	0.0000288 ± 0.0000136
Se (mg/L)	0.0002500	0.0002422 ± 0.0003912
Si (mg/L)	2.6000000	1.9070000 ± 0.6500353
Sn (mg/L)	0.0001000	0.0000988 ± 0.0001602
Sr (mg/L)	1.7000000	0.1493500 ± 0.1276611
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000

Habitat Description

Variable	LIZ003	Predicted Group Reference Mean ±SD
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0008433 ± 0.0009290
Tl (mg/L)	0.0000100	0.0000031 ± 0.0000048
U (mg/L)	0.0003660	0.0005805 ± 0.0003382
V (mg/L)	0.0005000	0.0001220 ± 0.0001369
Zn (mg/L)	0.0020000	0.0009430 ± 0.0009518
Zr (mg/L)	0.0000500	0.0000900 ± 0.0000894

Site Description

Study Name	CBWQ-Elk
Site	MOR001
Sampling Date	Sep 11 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.35833 N, 115.00067 W
Altitude	948
Local Basin Name	Morrissey Creek
	Central Kootenay
Stream Order	4

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	2.9%	22.4%	14.6%	48.1%	9.6%	2.5%
CABIN Assessment of MOR001 on Sep 11, 2022	Highly Divergent					

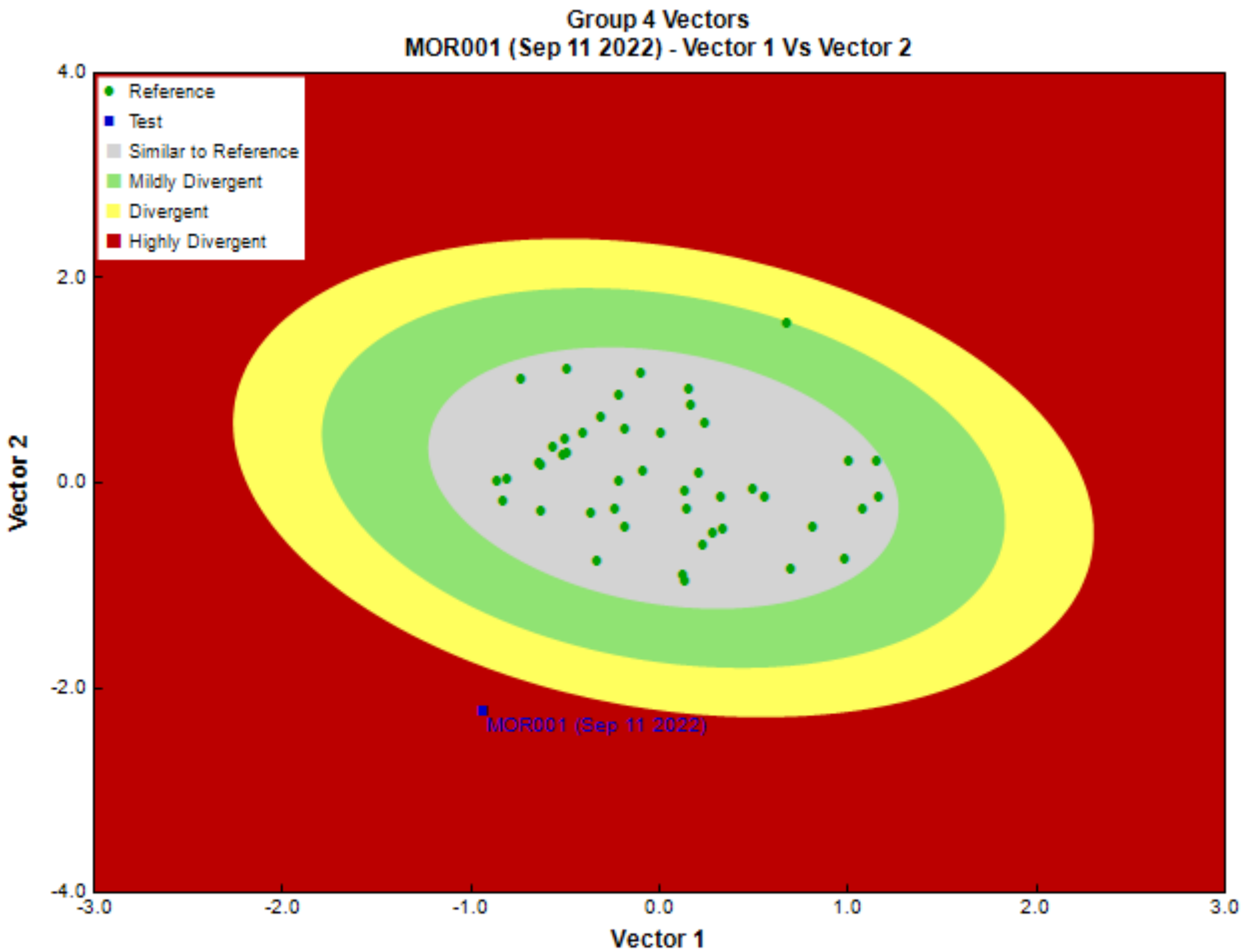

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	24	480.0
Arthropoda	Arachnida	Trombidiformes		5	100.0
			Aturidae	3	60.0
			Lebertiidae	2	40.0
			Sperchontidae	2	40.0
			Torrenticolidae	38	760.0
	Insecta	Coleoptera	Elmidae	25	500.0
		Diptera	Ceratopogonidae	2	40.0
			Chironomidae	199	3,980.0
			Empididae	2	40.0
			Psychodidae	1	20.0
			Tipulidae	10	200.0
		Ephemeroptera	Ameletidae	4	80.0
			Baetidae	18	360.0
			Ephemerellidae	18	360.0
			Heptageniidae	101	2,020.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Leptophlebiidae	12	240.0
		Plecoptera	Capniidae	17	340.0
			Chloroperlidae	1	20.0
			Nemouridae	7	140.0
			Perlodidae	2	40.0
		Trichoptera		1	20.0
			Brachycentridae	7	140.0
			Hydropsychidae	14	280.0
			Lepidostomatidae	23	460.0
			Rhyacophilidae	1	20.0
			Total	539	10,780.0

Metrics

Name	MOR001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.87	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.5	3.2 ± 0.4
Hilsenhoff Family index (North-West)	4.5	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	3.0	1.9 ± 1.0
Tolerant individuals (%)	--	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	64.0	47.1 ± 15.4
% Predatores	50.1	12.9 ± 7.3
% Scrapers	29.3	68.3 ± 16.1
% Shredder	16.5	36.7 ± 14.6
No. Clinger Taxa	23.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	37.3	5.2 ± 5.7
% Coleoptera	4.7	0.6 ± 2.2
% Diptera + Non-insects	53.1	7.4 ± 7.0
% Ephemeroptera	28.7	45.8 ± 15.1
% Ephemeroptera that are Baetidae	11.8	28.9 ± 20.8
% EPT Individuals	42.2	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	56.3	59.5 ± 11.3
% of 5 dominant taxa	72.6	85.1 ± 6.5
% of dominant taxa	37.3	37.7 ± 10.4
% Plecoptera	5.1	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	31.1	23.9 ± 23.6
% Tricoptera	8.4	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.5	0.9 ± 0.1
Total Abundance	10780.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.5
Diptera taxa	5.0	2.6 ± 1.1
Ephemeroptera taxa	5.0	3.7 ± 0.6
EPT Individuals (Sum)	4500.0	1353.0 ± 804.6
EPT taxa (no)	13.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	4.0	5.4 ± 1.2
Shannon-Wiener Diversity	2.2	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	24.0	16.5 ± 3.6
Trichoptera taxa	4.0	3.2 ± 1.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at MOR001
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.37
RIVPACS : Observed taxa P>0.50	14.00
RIVPACS : O:E (p > 0.5)	1.13
RIVPACS : Expected taxa P>0.70	10.12
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	0.99

Habitat Description

Variable	MOR001	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	90.78003 ± 16.48787
Channel		
Depth-Avg (cm)	19.7	27.7 ± 12.1
Depth-BankfullMinusWetted (cm)	1.15	48.41 ± 32.00
Depth-Max (cm)	28.0	41.6 ± 18.0
Discharge (m^3/s)	0.046	4.100
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	1.20 ± 0.86
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Pools (Binary)	0	1 ± 1
Reach-Rapids (Binary)	0	1 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0071000	0.0302442 ± 0.0225320
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.04	0.65 ± 0.30
Velocity-Max (m/s)	0.09	1.02 ± 0.40
Width-Bankfull (m)	20.5	22.0 ± 20.4
Width-Wetted (m)	5.8	14.4 ± 14.2
Climate		
Precip10_OCT (mm)	51.55424	101.93711 ± 37.08464
Temp12_DECmin (Degrees Celsius)	-13.00000	-12.60285 ± 1.55807
Hydrology		
Drainage-Area (km^2)	81.94000	153.19859 ± 249.47160
Landcover		
Natl-Grassland (%)	0.00000	4.14423 ± 3.51761
Natl-ShrubLow (%)	4.53336	4.00461 ± 2.77104
Natl-Water (%)	0.00000	0.26551 ± 0.58793
Reg-Ice (%)	0.00000	2.39543 ± 4.09623
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	2	8 ± 8
%Cobble (%)	59	53 ± 15
%Gravel (%)	2	4 ± 6
%Pebble (%)	36	33 ± 14
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 0
D50 (cm)	8.85	14.48 ± 20.33
Dg (cm)	7.5	13.1 ± 19.3
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1

Habitat Description

Variable	MOR001	Predicted Group Reference Mean ±SD
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 2
Topography		
Reg-SlopeLT30% (%)	50.32512	17.11832 ± 8.21512
SlopeMax (%)	209.87454	386.22536 ± 140.72382
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000028 ± 0.0000036
Al (mg/L)	0.0175000	0.0136410 ± 0.0145846
As (mg/L)	0.0002500	0.0001754 ± 0.0001818
B (mg/L)	0.0250000	0.0305833 ± 0.0370084
Ba (mg/L)	0.1660000	0.0435560 ± 0.0571949
Be (mg/L)	0.0000500	0.0000056 ± 0.0000072
Bi (mg/L)	0.0000500	0.0000028 ± 0.0000036
Br (mg/L)	0.0500000	0.0268750 ± 0.0585132
Ca (mg/L)	39.5000000	20.8384848 ± 13.6841012
Cd (mg/L)	0.0000220	0.0000115 ± 0.0000149
Chloride-Total (mg/L)	3.3900000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000298 ± 0.0000226
Cr (mg/L)	0.0002500	0.0000900 ± 0.0000889
Cu (mg/L)	0.0004600	0.0003212 ± 0.0001572
F (mg/L)	0.5500000	0.0484615 ± 0.0355181
Fe (mg/L)	0.0180000	0.0442667 ± 0.0348579
General-Alkalinity (mg/L)	154.0000000	59.4800000 ± 43.9851975
General-CarbonDOC (mg/L)	1.5900000	0.6500000 ± 0.3535534
General-CarbonTOC (mg/L)	1.6800000	0.3944444 ± 0.3157179
General-DO (mg/L)	9.7200000	12.6802381 ± 11.2165934
General-Hardness (mg/L)	139.0000000	76.7342857 ± 54.3511564
General-pH (pH)	8.4	7.9 ± 0.4
General-SolidsTSS (mg/L)	1.0000000	1.9034611 ± 3.0161707
General-SpCond (µS/cm)	248.8000000	153.2777778 ± 120.2707781
General-TempAir (Degrees Celsius)	17.9	10.6 ± 5.4
General-TempWater (Degrees Celsius)	15.5000000	6.4219048 ± 2.3475813
General-Turbidity (NTU)	0.4200000	2.7965000 ± 4.1415171
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.6600000	0.4511613 ± 0.2901093
Li (mg/L)	0.0034800	0.0016910 ± 0.0023918
Mg (mg/L)	8.9000000	5.1886364 ± 5.0072212
Mn (mg/L)	0.0069400	0.0028572 ± 0.0019872
Mo (mg/L)	0.0007700	0.0006660 ± 0.0004339
Na (mg/L)	2.0000000	0.9945806 ± 0.9373003
Ni (mg/L)	0.0002000	0.0002298 ± 0.0001811
Nitrogen-NO2 (mg/L)	0.0050000	0.0042917 ± 0.0108893
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0732400 ± 0.0567225
Nitrogen-NO3 (mg/L)	0.0050000	0.0865111 ± 0.0538993
Nitrogen-TKN (mg/L)	0.0670000	97.0987778 ± 290.9629753
Nitrogen-TN (mg/L)	0.0670000	24.3739167 ± 145.4787822
Pb (mg/L)	0.0001000	0.0000559 ± 0.0000496
Phosphorus-OrthoP (mg/L)	0.0097000	0.0008667 ± 0.0013292
Phosphorus-TP (mg/L)	0.0104000	0.0031194 ± 0.0039854
S (mg/L)	1.5000000	362.2600000 ± 803.7224104
Sb (mg/L)	0.0001000	0.0000288 ± 0.0000136
Se (mg/L)	0.0002500	0.0002422 ± 0.0003912
Si (mg/L)	1.9000000	1.9070000 ± 0.6500353
Sn (mg/L)	0.0001000	0.0000988 ± 0.0001602
SO4 (mg/L)	8.2000000	18.1942857 ± 18.0693910
Sr (mg/L)	0.1520000	0.1493500 ± 0.1276611
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0008433 ± 0.0009290
Tl (mg/L)	0.0000100	0.0000031 ± 0.0000048
U (mg/L)	0.0004140	0.0005805 ± 0.0003382
V (mg/L)	0.0005000	0.0001220 ± 0.0001369

Habitat Description

Variable	MOR001	Predicted Group Reference Mean ±SD
Zn (mg/L)	0.0020000	0.0009430 ± 0.0009518
Zr (mg/L)	0.0000500	0.0000900 ± 0.0000894

Site Description

Study Name	CBWQ-Elk
Site	MOR002
Sampling Date	Sep 11 2022
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.42056 N, 114.91069 W
Altitude	1544
Local Basin Name	Morrissey Creek
	Central Kootenay
Stream Order	3

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 04, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.1%	0.5%	9.3%	6.8%	82.2%	0.1%
CABIN Assessment of MOR002 on Sep 11, 2022	Mildly Divergent					

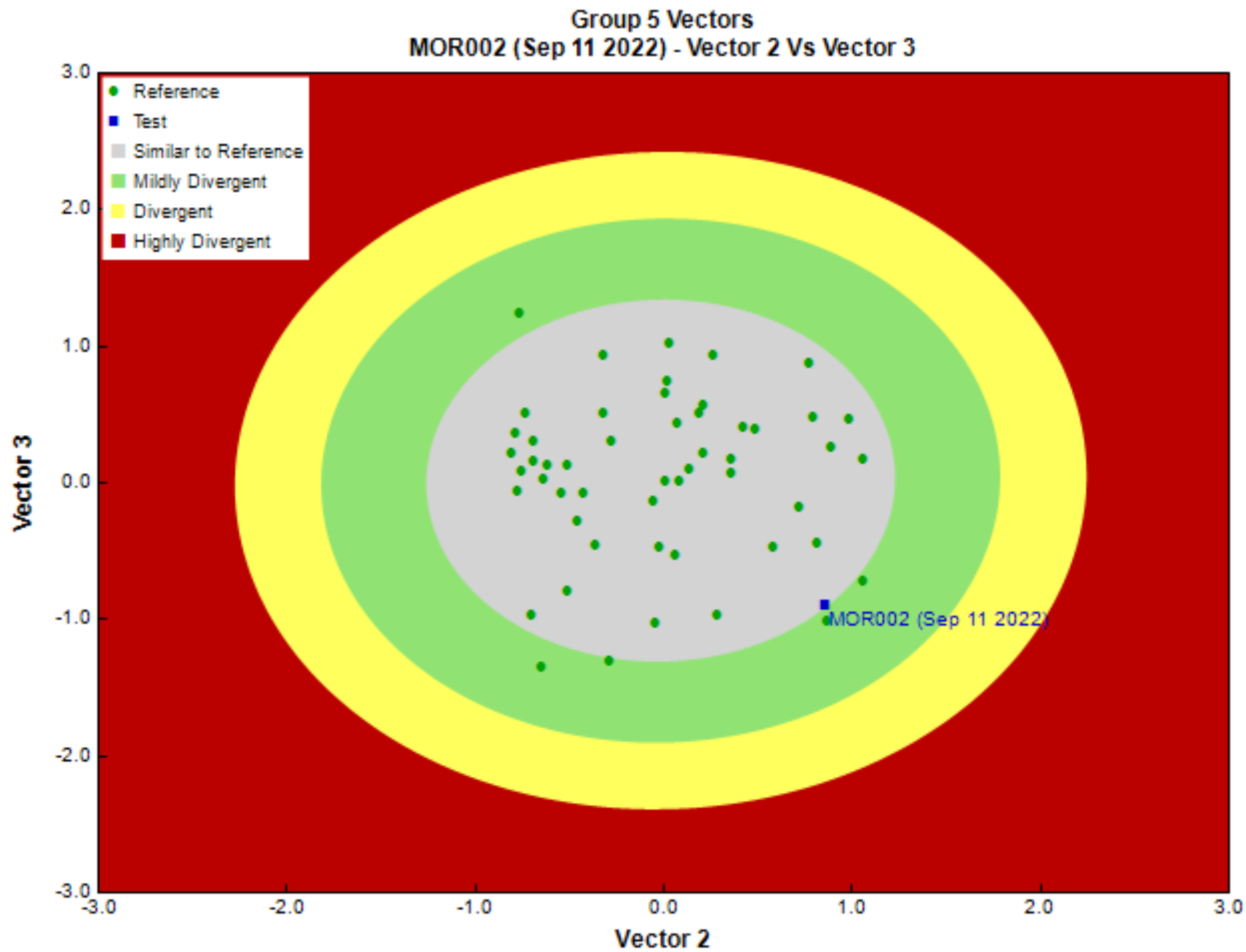

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Aturidae	2	33.3
			Hydryphantidae	1	16.7
			Lebertiidae	2	33.3
			Torrenticolidae	1	16.7
	Insecta	Coleoptera	Elmidae	7	116.6
		Diptera	Chironomidae	135	2,250.0
		Ephemeroptera	Ameletidae	27	450.0
			Baetidae	39	650.0
			Ephemerellidae	7	116.7
			Heptageniidae	49	816.7
			Leptophlebiidae	5	83.3
		Plecoptera		1	16.7
			Capniidae	37	616.7
			Chloroperlidae	62	1,033.4
			Nemouridae	9	150.1
			Peltoperlidae	2	33.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlidae	5	83.3
			Perlodidae	4	66.7
		Trichoptera		2	33.3
			Brachycentridae	2	33.3
			Rhyacophilidae	6	100.0
			Uenoidae	1	16.7
			Total	406	6,766.8

Metrics

Name	MOR002	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.59	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	2.9	3.4 ± 0.4
Hilsenhoff Family index (North-West)	2.9	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	47.5	45.8 ± 14.9
% Predatores	38.9	14.8 ± 9.8
% Scrapers	23.6	59.4 ± 19.6
% Shredder	14.0	30.7 ± 17.4
No. Clinger Taxa	26.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	33.5	7.5 ± 8.6
% Coleoptera	1.7	0.1 ± 0.3
% Diptera + Non-insects	35.0	10.7 ± 9.9
% Ephemeroptera	31.5	47.2 ± 15.8
% Ephemeroptera that are Baetidae	30.7	25.4 ± 20.8
% EPT Individuals	63.3	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	48.9	58.3 ± 10.6
% of 5 dominant taxa	79.9	83.6 ± 6.3
% of dominant taxa	33.5	37.8 ± 11.1
% Plecoptera	29.5	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	2.2	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.7	0.9 ± 0.1
Total Abundance	6766.7	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	1.0	2.8 ± 1.0
Ephemeroptera taxa	5.0	3.7 ± 0.5
EPT Individuals (Sum)	4250.0	4035.4 ± 2618.4
EPT taxa (no)	14.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	6.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.1	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	20.0	17.0 ± 3.1
Trichoptera taxa	3.0	3.1 ± 1.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at MOR002
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.45
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	0.80
RIVPACS : Expected taxa P>0.70	9.52
RIVPACS : Observed taxa P>0.70	8.00
RIVPACS : O:E (p > 0.7)	0.84

Habitat Description

Variable	MOR002	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	100.00000	98.46051 ± 8.10999
Channel		
Depth-Avg (cm)	8.8	20.0 ± 8.6
Depth-BankfullMinusWetted (cm)	78.50	46.71 ± 35.00
Depth-Max (cm)	15.0	28.8 ± 13.7
Discharge (m^3/s)	0.007	0.682
Macrophyte (PercentRange)	1	0 ± 0
Reach-%CanopyCoverage (PercentRange)	2.00	1.04 ± 0.95
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	1 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0151000	0.0270638 ± 0.0257534
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	0	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.06	0.58 ± 0.20
Velocity-Max (m/s)	0.12	0.85 ± 0.27
Width-Bankfull (m)	12.8	16.1 ± 13.1
Width-Wetted (m)	1.4	9.8 ± 7.7
XSEC-VelInstrumentDirect (Category(1-3))	3	3 ± 0
XSEC-VelMethod (Category(1-3))	3	2 ± 1
Climate		
Precip10_OCT (mm)	54.52875	64.42223 ± 33.96544
Temp12_DECmin (Degrees Celsius)	-13.00000	-12.74810 ± 1.73767
Hydrology		
Drainage-Area (km^2)	17.89000	100.09787 ± 132.80561
Landcover		
Natl-Grassland (%)	0.00000	7.47766 ± 6.29880
Natl-ShrubLow (%)	2.38954	1.80492 ± 1.50412
Natl-Water (%)	0.00000	0.32077 ± 0.59001
Reg-Ice (%)	0.00000	1.28005 ± 3.54484
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	3	6 ± 6
%Cobble (%)	40	57 ± 15
%Gravel (%)	11	2 ± 3
%Pebble (%)	45	34 ± 16
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	5.65	24.05 ± 35.66
Dg (cm)	5.0	23.0 ± 33.8
Dominant-1st (Category(0-9))	6	6 ± 1

Habitat Description

Variable	MOR002	Predicted Group Reference Mean ±SD
Dominant-2nd (Category(0-9))	5	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	73.39946	20.01334 ± 7.41149
SlopeMax (%)	97.94038	488.94077 ± 542.32910
Water Chemistry		
Ag (mg/L)	0.0000250	0.0000018 ± 0.0000013
Al (mg/L)	0.0401000	0.0078031 ± 0.0090962
As (mg/L)	0.0002500	0.0002735 ± 0.0001787
B (mg/L)	0.0250000	0.0127286 ± 0.0135802
Ba (mg/L)	0.1600000	0.0677069 ± 0.0514113
Be (mg/L)	0.0000500	0.0000043 ± 0.0000039
Bi (mg/L)	0.0000500	0.0000018 ± 0.0000013
Br (mg/L)	0.0500000	0.0303333 ± 0.0788597
Ca (mg/L)	17.2000000	28.2142857 ± 13.7707094
Cd (mg/L)	0.0000240	0.0000100 ± 0.0000293
Chloride-Total (mg/L)	2.6500000	0.0000000 ± 0.0000000
Co (mg/L)	0.0000500	0.0000075 ± 0.0000060
Cr (mg/L)	0.0002500	0.0001514 ± 0.0001361
Cu (mg/L)	0.0002000	0.0001604 ± 0.0001447
F (mg/L)	0.5500000	0.0876667 ± 0.0847823
Fe (mg/L)	0.0200000	0.0101789 ± 0.0111495
General-Alkalinity (mg/L)	66.3000000	98.9704545 ± 43.8308301
General-CarbonDOC (mg/L)	1.7000000	0.8383333 ± 0.4040008
General-CarbonTOC (mg/L)	1.7500000	0.5586957 ± 0.6229060
General-DO (mg/L)	10.6300000	10.7243478 ± 0.8596502
General-Hardness (mg/L)	58.5000000	109.1853659 ± 48.3470504
General-pH (pH)	8.6	8.0 ± 0.6
General-SolidsTSS (mg/L)	5.4000000	5.2717002 ± 27.1908288
General-SpCond (µS/cm)	113.8000000	196.0710526 ± 116.3908975
General-TempAir (Degrees Celsius)	8.6	7.2 ± 5.7
General-TempWater (Degrees Celsius)	7.3000000	6.2042553 ± 2.0993816
General-Turbidity (NTU)	0.5300000	0.4347619 ± 0.5563328
Hg (ng/L)	0.0000200	0.0000000 ± 0.0000000
K (mg/L)	0.4500000	0.3312424 ± 0.1572675
Li (mg/L)	0.0010800	0.0009183 ± 0.0003795
Mg (mg/L)	3.7500000	7.8748571 ± 3.9958945
Mn (mg/L)	0.0016400	0.0007721 ± 0.0008518
Mo (mg/L)	0.0005800	0.0012835 ± 0.0042333
Na (mg/L)	1.5600000	0.7930303 ± 0.4756164
Ni (mg/L)	0.0002000	0.0001266 ± 0.0001131
Nitrogen-NO2+NO3 (mg/L)	0.0050000	0.0287300 ± 0.0357249
Nitrogen-NO3 (mg/L)	0.0050000	0.0336397 ± 0.0328125
Nitrogen-TKN (mg/L)	0.1320000	0.0352941 ± 0.0299453
Nitrogen-TN (mg/L)	0.1320000	0.0675581 ± 0.0509763
Pb (mg/L)	0.0001000	0.0000179 ± 0.0000156
Phosphorus-OrthoP (mg/L)	0.0025000	0.1105304 ± 0.5208890
Phosphorus-TP (mg/L)	0.0102000	0.0031912 ± 0.0087929
S (mg/L)	1.5000000	3.6625000 ± 1.5619928
Sb (mg/L)	0.0001000	0.0000337 ± 0.0000157
Se (mg/L)	0.0002500	0.0002782 ± 0.0002859
Si (mg/L)	0.5000000	2.0400303 ± 0.8510321
Sn (mg/L)	0.0001000	0.0000300 ± 0.0000407
SO4 (mg/L)	5.8000000	13.3070732 ± 13.0883468
Sr (mg/L)	0.1080000	0.0893414 ± 0.0805860
Te (mg/L)	0.0002500	0.0000000 ± 0.0000000
Th (mg/L)	0.0000500	0.0000000 ± 0.0000000
Ti (mg/L)	0.0025000	0.0003150 ± 0.0001205
Tl (mg/L)	0.0000100	0.0000040 ± 0.0000067
U (mg/L)	0.0001830	0.0003872 ± 0.0002299

Habitat Description

Variable	MOR002	Predicted Group Reference Mean ±SD
V (mg/L)	0.0005000	0.0001617 ± 0.0001537
Zn (mg/L)	0.0020000	0.0003724 ± 0.0003377
Zr (mg/L)	0.0000500	0.0000500 ± 0.0000000

Appendix E: Stream Report

Preliminary DNA Data

Elk River watershed, BC

Elk River Alliance – Community Based Water Monitoring

April 2023

Photo: Alexander Creek, Credit: Elk River Alliance

STREAM

www.STREAM-DNA.com

Hajibabaei Lab, Centre for Biodiversity Genomics, University of Guelph

Environment and Climate Change Canada

Living Lakes Canada

Table of Contents

DISCLAIMER: This report is a preliminary report based on the samples and information provided by the corresponding organisation. Identifications of taxa are based on best available information at time of analysis and reporting.

1. INTRODUCTION
    1.1. Benthic Macroinvertebrates

Freshwater benthic macroinvertebrates are typically insect orders, as well as crustaceans (e.g. crayfish), gastropods (e.g. snails), bivalves (e.g. freshwater mussels) and oligochaetes (e.g. worms), which are located on or within the benthic substrate of freshwater systems (i.e. streams, rivers, lakes; (Covich et al., 1999; Schmera et al., 2017). Benthic macroinvertebrates occupy important roles in the functioning of freshwater ecosystems, namely nutrient cycling within aquatic food webs and also influence numerous processes including microbial production and release of greenhouse gases (Covich et al., 1999; Schmera et al., 2017).

Biological monitoring (biomonitoring), referring to the collection and identification of particular aquatic species is an effective method for measuring the health status of freshwater systems. Currently, macroinvertebrates are routinely used for biomonitoring studies in freshwater habitats because they are relatively sedentary, have high species richness and a range of responses to different environmental stressors and contaminants, including temperature (Curry et al., 2018; Geest et al., 2010; Rosenberg and Resh, 1993; Sidney et al., 2016). Some groups of macroinvertebrates (mayflies, Ephemeroptera; stoneflies, Plecoptera and caddisflies, Trichoptera), commonly referred to as EPT groups, are more sensitive to change in the aquatic environment and are deemed important bioindicator taxa for assessing freshwater quality (Curry et al., 2018; Hajibabaei et al., 2012, 2011).

Traditionally, macroinvertebrates are identified to family level (**Figure 1**) through morphological identification using microscopy, however there has been a shift from this labour-intensive methodology to a DNA-based approach (Curry et al., 2018; Hajibabaei et al., 2012, 2011). 'Biomonitoring 2.0' combines bulk-tissue DNA collection (i.e. benthos) with next-generation sequencing (NGS), to produce high-quality data in large quantities and allows identification to a finer resolution than traditional methods (Baird and Hajibabaei, 2012; Hajibabaei et al., 2012).

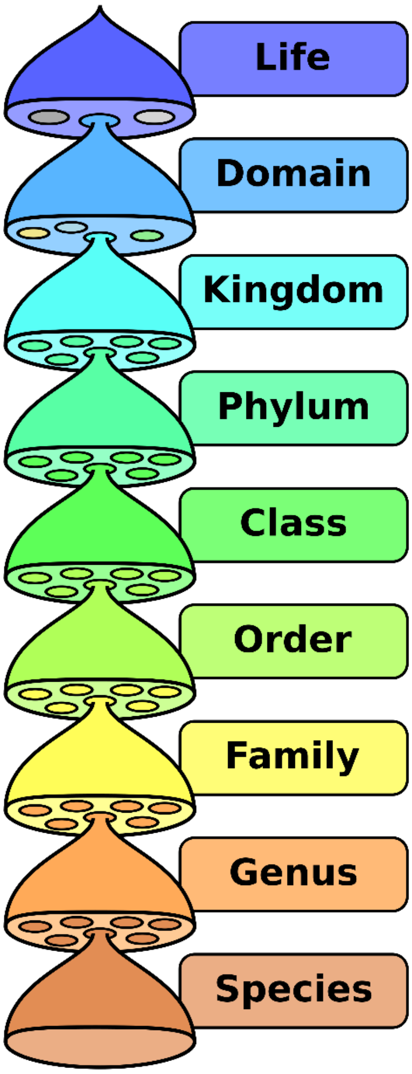

Figure 1. Graphical representation the classification of organisms.

1.2. Background of STREAM

STREAM (Sequencing The Rivers for Environmental Assessment and Monitoring), is a biomonitoring project, which involves the combination of community based monitoring and DNA metabarcoding technologies to assess the benthic macroinvertebrate communities in watersheds across Canada (**Figure 2**). STREAM is a collaboration between Living Lakes Canada (LLC) and Environmental and Climate Change Canada (ECCC), led by the Hajibabaei Lab at Centre for Biodiversity

Genomics (University of Guelph, Canada) with World Wildlife Fund Canada as a founding member organization. STREAM employs a standard sampling protocol modified from the Canadian Aquatic Biomonitoring Network (CABIN) programme. Where possible, the aquatic biodiversity data generated in STREAM will be added to the existing CABIN database, to improve our understanding of the health of Canadian watersheds.

The main objective of STREAM is to generate baseline benthic macroinvertebrate DNA data from across Canada. To understand the health status of freshwater systems, we first need to understand the natural fluctuations and trends of benthic macroinvertebrates, especially in locations which are data deficient. By building this baseline, in years to come we can investigate the longer-term trends and begin to understand the impact of issues, such as climate change, on freshwater systems. STREAM was established with the main premise of fast-tracking the generation of benthic macroinvertebrate data from 12-18 months to ~2 months, while increasing the taxonomic resolution of the data produced. To date this timeline has not been regularly met, but steps are being taken to further optimize lab processing and reporting to more regularly meet this timeline for the 2023 sampling season.

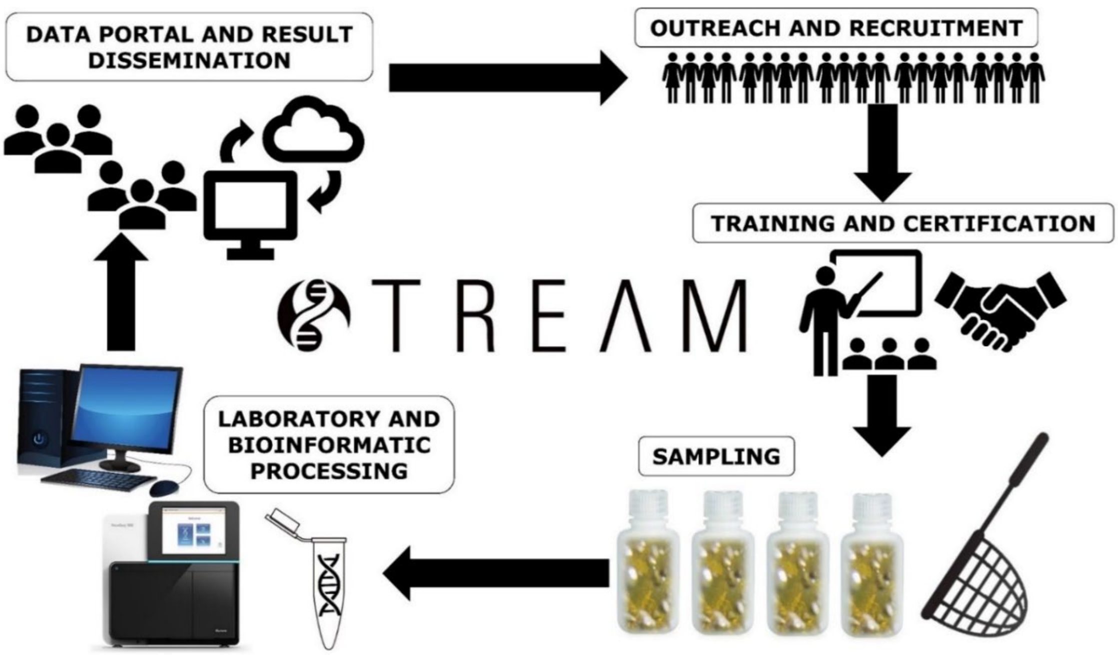

Figure 2. Graphical representation of the STREAM collaborative workflow for DNA biomonitoring of benthic invertebrates.

1.3. Objective of Report

Data and information included in this report is a preliminary examination of results from the Elk River watershed, within the Columbia Basin (BC), which consists of a list of the macroinvertebrate taxa detected within the samples submitted. This report aims to highlight the different macroinvertebrate EPT taxa and provide basic richness metrics as a useful contribution for community groups to assess river health. This report also includes data from 2020 and 2021 sampling seasons.

1.4. Study Objective

Community-based water monitoring (CBWM) groups collected baseline Elk River tributary habitat data to increase community water literacy and understanding of the Elk River Watershed. Monitoring and research is conducted by trained staff and volunteers and presented in easily understood terminology to the community, including updates on the current status of aquatic health and concerns regarding future trends. Community members are educated through the sharing of data to the public at annual workshops, summer markets, direct participation with the program, and mixed media reporting. This increases water literacy and opens a two-way dialogue with residents to discuss community concerns regarding watershed health.

2. METHODOLOGY

2.1. Study Area

In September 2022 sampling was conducted at four locations within the Elk River watershed (BC; Figure 3). Sampling was conducted by the Elk River Alliance for benthic macroinvertebrate monitoring with STREAM.

Additional site information, including coordinates is provided in Appendix A

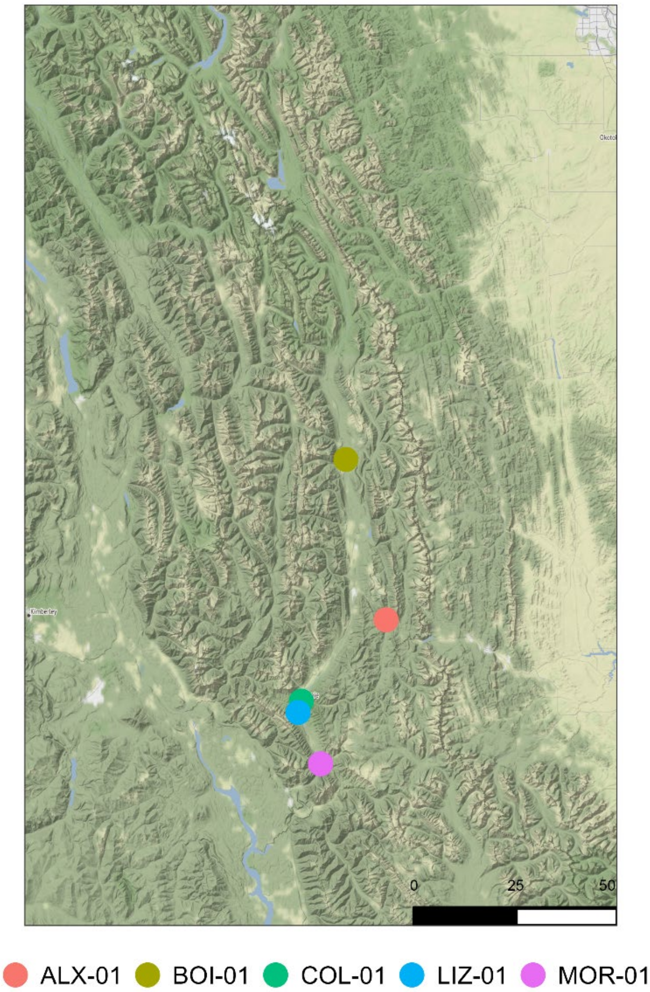

Figure 3. Map of sampling locations within the Elk River watershed (BC). Scale bar shown in kilometres.

2.2. DNA Sampling and Processing Methods

2.2.1. Measures to Avoid DNA Contamination

Prior to sampling, kick-nets were sanitized in bleach for 5 minutes and kept in clean garbage bags until they were used in the field. Gloves were used when handling all sampling materials to avoid contamination. During the kick-netting, the surveyor in the water wore two pairs of gloves while handling the kick-net. The outer pair of gloves was removed prior to transferring the contents into sampling containers so that the gloves used when contacting the sample were guaranteed to be clean. Each sampling container was individually sealed in a Ziploc bag prior to placing them in the cooler.

2.2.2. Benthic Macroinvertebrate Field Sampling Protocol

Benthic macroinvertebrate DNA samples were collected following the STREAM Procedure for collecting benthic macroinvertebrate DNA samples in wadeable streams (v1.0 June 2019) and the CABIN Field Manual for Wadeable Streams (2012). The STREAM procedure outlines steps to minimize DNA contamination and preserve DNA samples and was employed in conjunction with sampling steps outlined in the CABIN manual. All samples collected were transported to the University of Guelph Centre for Biodiversity Genomics.

2.2.3. Laboratory Methods

Benthic samples were preserved in antifreeze and stored at -20°C until processing. Benthic samples were coarsely homogenized in a sterile blender and DNA was extracted using a DNeasy® PowerSoil® Pro kit (Qiagen, CA) kit. Extracted DNA was then processed following the standard Hajibabaei Lab protocol for Next-Generation Sequencing (NGS). Sequences were then processed through the MetaWorks (v1.11.3) pipeline: https://github.com/terrimporter/MetaWorks.

3. RESULTS

3.1. Overview

The raw data output from NGS produced sequences for a range of taxa. This taxa list was reduced to only sequences that identified macroinvertebrates associated with freshwater and riparian ecosystems, and that were of high enough quality to match reference sequences. These results consisted of **46 Orders, 151 Families, 197 Genera, and 174 Species of invertebrates**. After normalizing, species richness (number of species present) ranged from 13 in ALX-1C (2020) to 40 in LIZ-1C (2022) (**Figure 4**). A full taxonomic list of macroinvertebrates identified to the raw genus and species level is included as a separate Excel spreadsheet (STREAM_RP89_Taxonomy).

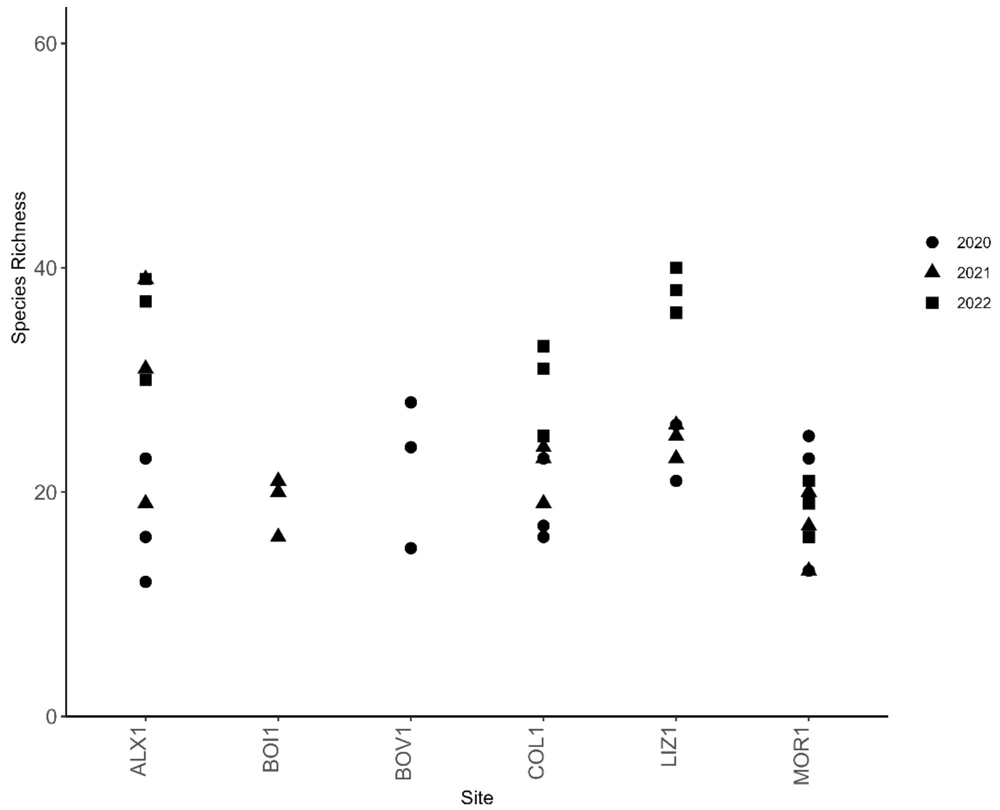

Figure 4. Species richness of each site sampled. Only species taxonomically assigned with high confidence (bootstrap support >= 0.70) are included. Based on normalized data.

3.2. Taxonomic Coverage

A range of macroinvertebrate species were detected from the 2022 samples. Traditional bioindicator EPT species were detected across the sampling sites, including 26 species of Ephemeroptera (mayflies), 27 species of Plecoptera (stoneflies) and 24 Trichoptera (caddisflies; **Table 2**). Some families of these EPT groups are typically sensitive to many pollutants in the stream environment and are therefore associated with clean water (Gresens et al., 2009; Laini et al., 2019; Loeb and Spacie, 1994).

Please refer to the '**Macroinvertebrate Bioindicator Families Guide v1.2**' attached with your data or visit the corresponding website here for more information on approximate tolerances for the species detected in your sites.

Note: The benthic macroinvertebrate kick-net sample procedure often results in collection of both aquatic and terrestrial taxa, however terrestrial taxa are not identified using the traditional taxonomic identification methods. Due to the nature of DNA metabarcoding, both terrestrial and aquatic macroinvertebrates are identified and described using the DNA approach in this report.

Table 1. List of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa identified to the species level. P = present. Grey cells indicate absence. Site names for each column refer to site code (see Appendix A). Only species taxonomically assigned with high confidence (bootstrap support >= 0.70) are included.

Order	Family	Common Name	Species	2022			
				ALX_1	COL_1	LIZ_1	MOR_1
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus bellulus*	P	P		
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus celer*	P		P	
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus subnotatus*				P
Ephemeroptera	Baetidae	Small minnow mayflies	*Acentrella insignificans*		P		
Ephemeroptera	Baetidae	Small minnow mayflies	*Acentrella turbida*		P	P	P
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis bicaudatus*	P		P	
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis phoebus*	P	P		
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis tricaudatus*	P	P	P	P
Ephemeroptera	Baetidae	Small minnow mayflies	*Callibaetis ferrugineus*				
Ephemeroptera	Baetidae	Small minnow mayflies	*Diphetor hageni*		P		P
Ephemeroptera	Caenidae	Small square-gilled mayflies	*Caenis amica*		P		
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella coloradensis*	P	P	P	P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella doddsii*	P	P	P	P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella flavilinea*	P	P		P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella grandis*	P	P	P	P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella spinifera*	P		P	
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Ephemerella tibialis*	P	P	P	
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Cinygmula spJMW3*	P	P	P	
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus albertae*		P		
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus deceptivus*	P	P	P	
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus grandis*	P			
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus longimanus*	P	P		
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Maccaffertium smithae*				P
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Rhithrogena robusta*	P			
Ephemeroptera	Leptophlebiidae	Prong-gilled mayflies	*Paraleptophlebia heteronea*	P	P		P
Ephemeroptera	Leptophlebiidae	Prong-gilled mayflies	*Paraleptophlebia memorialis*				P

Table 1 cont.

Order	Family	Common Name	Species	2022			
				ALX_1	COL_1	LIZ_1	MOR_1
Plecoptera	Capniidae	Small winter stoneflies	*Capnia coloradensis*		P	P	
Plecoptera	Capniidae	Small winter stoneflies	*Capnia confusa*		P		P
Plecoptera	Capniidae	Small winter stoneflies	*Capnia gracilaria*			P	
Plecoptera	Capniidae	Small winter stoneflies	*Capnia petila*			P	
Plecoptera	Capniidae	Small winter stoneflies	*Eucapnopsis brevicauda*	P	P	P	P
Plecoptera	Capniidae	Small winter stoneflies	*Utacapnia columbiana*	P	P	P	
Plecoptera	Capniidae	Small winter stoneflies	*Utacapnia logana*	P	P	P	
Plecoptera	Capniidae	Small winter stoneflies	*Utacapnia trava*		P		
Plecoptera	Chloroperlidae	Green stoneflies	*Paraperla frontalis*	P			
Plecoptera	Chloroperlidae	Green stoneflies	*Plumiperla diversa*	P			
Plecoptera	Chloroperlidae	Green stoneflies	*Sweltsa borealis*	P			
Plecoptera	Chloroperlidae	Green stoneflies	*Sweltsa coloradensis*	P	P		
Plecoptera	Leuctridae	Rolled-winged stoneflies	*Paraleuctra occidentalis*	P			
Plecoptera	Nemouridae	Spring stoneflies	*Podmosta delicatula*				
Plecoptera	Nemouridae	Spring stoneflies	*Prostoia besametsa*	P	P	P	
Plecoptera	Nemouridae	Spring stoneflies	*Visoka cataractae*	P	P	P	
Plecoptera	Perlidae	Common stoneflies	*Doroneuria theodora*	P	P	P	P
Plecoptera	Perlidae	Common stoneflies	*Hesperoperla pacifica*	P		P	
Plecoptera	Perlodidae	Springflies	*Isoperla petersoni*		P		
Plecoptera	Perlodidae	Springflies	*Isoperla sobria*				
Plecoptera	Perlodidae	Springflies	*Kogotus modestus*	P			
Plecoptera	Perlodidae	Springflies	*Megarcys watertoni*	P	P	P	
Plecoptera	Perlodidae	Springflies	*Setvena bradleyi*	P			
Plecoptera	Pteronarcyidae	Giant stoneflies	*Pteronarcella badia*		P		
Plecoptera	Pteronarcyidae	Giant stoneflies	*Pteronarcys princeps*			P	
Plecoptera	Taeniopterygidae	Winter stoneflies	*Doddsia occidentalis*	P		P	
Plecoptera	Taeniopterygidae	Winter stoneflies	*Taenionema pallidum*			P	
Trichoptera	Apataniidae	Early smoky wing sedges	*Apatania comosa*	P	P		
Trichoptera	Brachycentridae	Humpless casemaker caddisflies	*Brachycentrus americanus*	P			
Trichoptera	Brachycentridae	Humpless casemaker caddisflies	*Micrasema bactro*			P	P
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Anagapetus debilis*				
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Glossosoma pyroxum*	P			
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Glossosoma verdonum*			P	
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Arctopsyche grandis*	P		P	P
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Ceratopsyche oslari*		P	P	P
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Parapsyche elsis*	P		P	
Trichoptera	Hydroptilidae	Microcaddisflies	*Hydroptila consimilis*				
Trichoptera	Hydroptilidae	Microcaddisflies	*Metrichia patagonica*			P	
Trichoptera	Lepidostomatidae	Bizarre caddisflies	*Lepidostoma cascadense*	P			
Trichoptera	Lepidostomatidae	Bizarre caddisflies	*Lepidostoma pluviale*		P	P	P
Trichoptera	Lepidostomatidae	Bizarre caddisflies	*Lepidostoma rayneri*		P		
Trichoptera	Limnephilidae	Northern caddisflies	*Onocosmoecus unicolor*		P		
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila angelita*	P			
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila bifila*	P			
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila brunnea*	P		P	
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila coloradensis*	P			
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila vaccua*	P			
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila vagrita*	P			
Trichoptera	Uenoidae	Stonecase caddisfly	*Neophylax rickeri*			P	
Trichoptera	Uenoidae	Stonecase caddisfly	*Neophylax splendens*			P	
Trichoptera	Uenoidae	Stonecase caddisfly	*Oligophlebodes sierra*	P		P	

3.2. Whirling Disease Host Detection

Whirling Disease is a disease caused by *Myxobolus cerebralis*, a microscopic parasite that affects salmonid fish such as trout, salmon and whitefish (Gilbert and Granath, 2003). *M. cerebralis* requires a specific aquatic oligochaete (worm) intermediate host, *Tubifex tubifex* (sludge worm). This species is most commonly associated with poor-quality, eutrophic conditions (Gilbert and Granath, 2003).

While there are still no documented cases of Whirling disease in BC, it has been confirmed in several locations in Alberta near the BC border. No *T. tubifex* were detected in the 2022 STREAM samples. Additional samples were collected at 5 locations that were more suitable habitat for *T. tubifex* than the riffle habitat sampled through CABIN. Of these five sites, three sites had positive *Tubifex* identifications, COLA, ELKA, and MCL. The complete taxonomic results for these samples can also be found in the STREAM taxonomy report attached.

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5. APPENDICES

Appendix A. Summary table of sample sites, including site name, year of collection and site coordinates. Pool samples were collected due to the better suitability of habitat they provide for *Tubifex* (Annelida).

Site	River	Latitude	Longitude	Year
ALX-01	Alexander Creek	49.67394	-114.78	2020, 2021, **2022**
BOI-01	Boivin Creek	50.02315	-114.916	2020, 2021
COL-01	Coal Creek	49.49556	-115.066	2020, 2021, **2022**
LIZ-01	Lizard Creek	49.47094	-115.077	2020, 2021, **2022**
MOR-01	Morrissey Creek	49.35806	-115.001	2020, 2021, **2022**
ALX-01	Alexander Creek	49.67394	-114.7799	Pool
MCL-04	Michel Creek	49.606725	-114.791884	Pool
FOR-01	Forsyth Creek	50.231674	-114.968607	Pool
COLA-01	Coal Creek	49.508273	-115.056515	Pool
ELKA-01	Elk River	49.496074	-115.068808	Pool

6. GLOSSARY

Term	Meaning
Benthic/benthos	The ecological region at the lowest level of a body of water such as an ocean, lake, or stream, including the sediment surface and some sub-surface layers.
Biomonitoring	The science of inferring the ecological condition of an ecosystem (i.e. rivers, lakes, streams, and wetlands) by examining the organisms that live there.
Bootstrap support	Statistical methods used to evaluate and distinguish the confidence of results produced.
Bulk-tissue DNA sample	This refers to the collection and removal of a reasonable quantity of representative material (including organisms such as river bugs) from a location (i.e. river bed).
DNA extraction	Isolation of DNA from either the target organism (i.e. DNA from an insect leg) or from an environmental sample (i.e. DNA from a water or benthos sample).
DNA Metabarcoding	Amplification of DNA using universal barcode primers (e.g. universal for invertebrates) to allow sequencing of DNA from target organisms (e.g. invertebrates) from environmental samples (e.g. river water or benthos).
Environmental DNA (eDNA)	The DNA released into the environment through faeces, urine, gametes, mucus, etc. eDNA can result from the decomposition of dead organisms. eDNA is characterized by a complex mixture of nuclear, mitochondrial or chloroplast DNA, and can be intracellular (from living cells) or extracellular. Environmental DNA: DNA that can be extracted from environmental samples (such as soil, water, or air), without first isolating any target organisms.
EPT groups	The three orders of aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).
Macroinvertebrate	Organisms that lack a spine and are large enough to be seen with the naked eye. Examples of macro-invertebrates include flatworms, crayfish, snails, clams and insects, such as dragonflies.
Metrics	The method of measuring something, or the results obtained from this.
Next-generation sequencing (NGS)	Use of next-generation sequencers (i.e. Illumina) to millions or billions of DNA strands in parallel.
Normalizing	The process of rarefying samples down to the smallest library size – a common practice in DNA metabarcoding methods.
Richness	The number of species represented in an ecological community, landscape or region. Species richness is simply a count of species, and it does not take into

	account the abundances of the species or their relative abundance distributions.
Riparian	Relating to or situated on the banks of a river.
Sample homogenization	The process of making an environmental sample (i.e. benthos) uniform. For liquid/benthos samples, this often involves mixing using a blender so that DNA is evenly distributed within the sample.
Taxa	Unit used in the science of biological classification, or taxonomy.