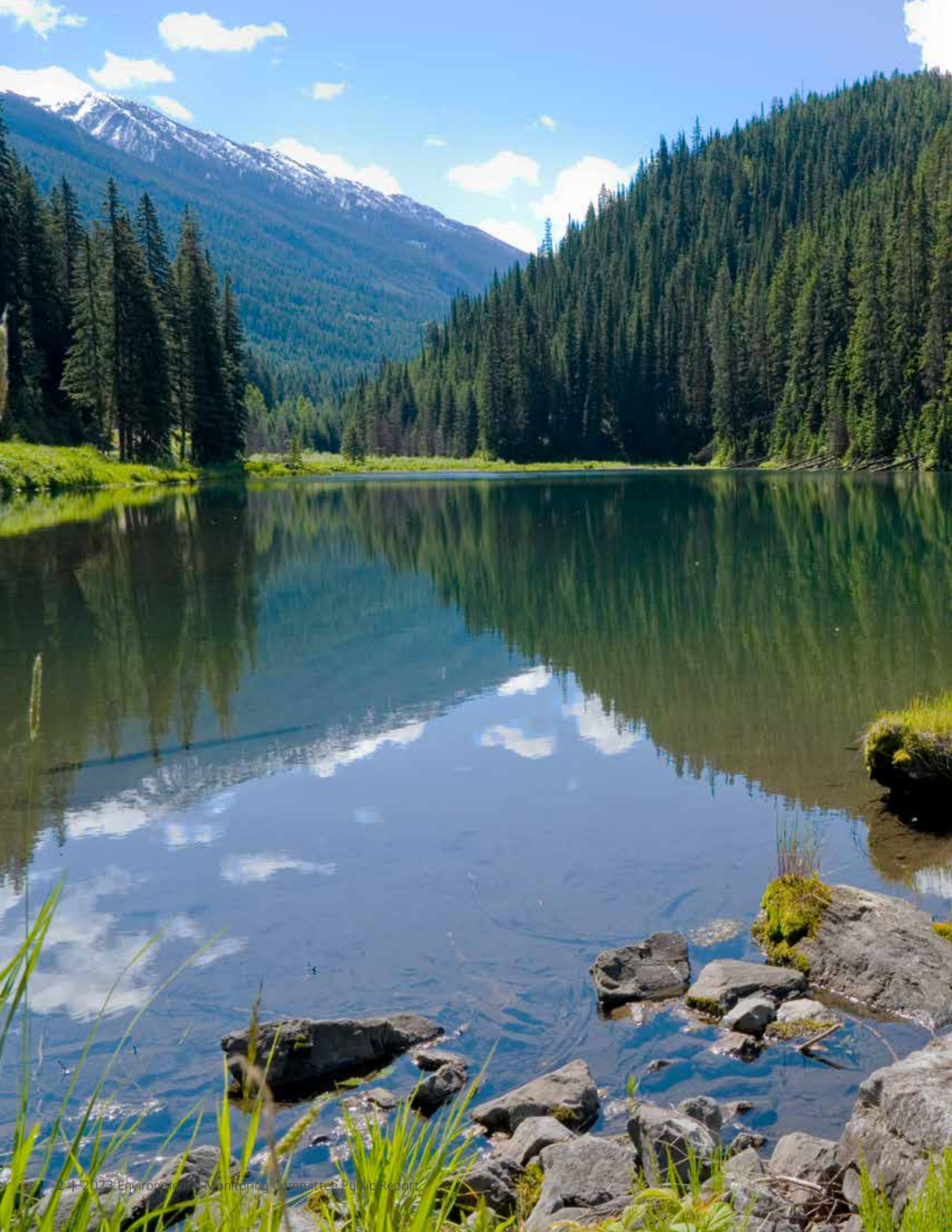
PERMIT 107517

ENVIRONMENTAL MONITORING COMMITTEE

2023 Public Report



Contents

About this Report

This report is prepared by the members of the Environmental Monitoring Committee (EMC). For more about the EMC and what it does, see page 5.

This report summarizes the 2022 monitoring results presented in the technical reports that Teck submitted to the British Columbia Ministry of Environment and Climate Change Strategy (ENV), as required by Permit 107517 under the Environmental Management Act (EMA). These technical reports are available at: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Managing Water Quality in the Elk Valley

The Elk Valley Water Quality Plan

Extracting coal from underground layers, or seams, causes certain substances to be released into nearby creeks and streams that can then flow into rivers and lakes. At the time, monitoring results indicated that the concentrations of these substances were increasing in some areas influenced by mining in the Elk Valley.

In April 2013, the British Columbia Ministry of Environment and Climate Change Strategy (ENV) issued Ministerial Order No. M113 requiring Teck to develop an Area-Based Management Plan (ABMP) which identified actions Teck will take to manage water quality downstream of Teck's steelmaking coal mines. The mine-related substances of concern in the Order are selenium, nitrate, sulphate, cadmium and calcite.

To meet the ABMP requirement, Teck developed the Elk Valley Water Quality Plan (EVWQP) between 2013 and 2014, with feedback from the public, Indigenous governments, provincial and federal governments, US governments, technical experts, and other stakeholders.

Teck submitted the EVWQP to the Minister in July 2014 and it was approved in November of that same year. The EVWQP guides water quality management in the Elk Valley and has four environmental objectives:

- protect aquatic ecosystem health
- manage bioaccumulation of mine-related substances in the environment
- protect human health
- protect groundwater

For more information, visit the Elk Valley Water Quality Hub: https://elkvalleywaterquality.gov.bc.ca/pages/area-based-management

For more information on how Teck plans to meet the EVWQP objectives, visit: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/news-and-publications/

The Elk Valley Permit

Following the approval of the EVWQP, ENV issued Permit 107517 (the Permit). Many of the actions and commitments described in the EVWQP were made legal requirements by this Permit, including the target concentrations for water quality.

Establishment of the Permit:

- set requirements that Teck must meet, including target concentrations for water quality, and
- required Teck to form an Environmental Monitoring Committee (EMC), an independent review body formed to strengthen Teck's aquatic environmental monitoring programs.

Third-Party Audit

Monitoring data for the Permit and its analysis is subject to review and audit by a third-party qualified professional on a three-year cycle. The audit must include a review of monitoring data and data analysis for reports submitted under the Permit relevant to at least three subject areas of Teck's environmental monitoring programs and must address at least one of the following topics:

- Data quality and completeness
- Compliance with Permit requirements
- Protocols and procedures from the quality assurance/ quality control plan for the monitoring program
- Current water quality guidance documents established by ENV and/or
- Standard operating procedures and data-handling protocols in place for Teck

The EMC selected three monitoring subject areas for the 2023 audit cycle:

- Selenium tissue sampling in fish
- Selenium tissue sampling in benthic invertebrates
- Aqueous surface water selenium speciation

The audit will be submitted to the EMC and ENV by October 31, 2023. The EMC will provide an update as part of the 2024 EMC Public Report.

The Environmental Monitoring Committee

The Environmental Monitoring Committee, or the EMC, was formed in 2015 following the issue of the Permit. Advice and input from the EMC is considered when making statutory decisions and Permit amendments.

Today the EMC includes the following core members:

- one independent aquatic scientist
- two representatives from ENV
- two representatives from the Ktunaxa Nation Council (KNC)
- two representatives from Teck

The following additional members attend meetings that relate to their work:

- one representative from the BC Interior Health (IH)
- two representatives from the BC Ministry of Energy, Mines & Low Carbon Innovation (EMLI)

The EMC is coordinated and facilitated by a neutral third-party Facilitation Team that includes:

- a Facilitator
- an Administrator
- a Note-taker

The EMC provides technical advice and Indigenous Knowledge to Teck's ongoing monitoring submissions, associated supporting studies and reports required under the Permit. The EMC does this by reviewing monitoring reports, identifying unexpected signals in data and providing recommendations to decision makers to support continual improvement of the aquatic environment. The EMC hosts an annual public meeting to inform the public and the scientific community of key monitoring results, learnings and advancements from the previous monitoring year.

To view EMC public reports and publicly available Teck reports, visit: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Statement provided by the

KTUNAXA NATION

We, as Ktunaxa ʔaqƚsmaknik̓ (people) have occupied Qukin ʔamakʔis (commonly referred to as the Elk Valley) for over 10,000 years. There have been significant impacts to ʔa'kxam̓is q̓api qapsin (All Living Things) in this area due to industrial activities such as coal mining and forestry. The Ktunaxa Nation Council is actively engaged in holding government and industry accountable in addressing the significant and ongoing impacts to our wuʔu ¢ ʔamakʔis (water and lands) in Qukin ʔamakʔis which for decades were authorized by the province without our free, prior and informed consent.

The value and significance of ʔa'kxam̓is q̓api qapsin to Ktunaxa, and in Qukin ʔamakʔis, must not be understated. As Ktunaxa, we will continue to be a voice for those who cannot speak for themselves – the four legged, the winged, the ones who crawl on the ground and swim in the waters – in upholding the responsibility given to us by the Creator and to safeguard for future generations. This is our part of our role and responsibility in Qukin ʔamakʔis (and throughout all of ʔamakʔis Ktunaxa). We remain the stewards of these lands and will continue to honor our relationships in the ways that we've been taught generation upon generation. We were created in interdependence with the land and water, and were given covenants by the Creator to protect, honor and celebrate what the Creator has given us. The land (including water) gives us the resources to survive, and in return, it is our responsibility to protect and not overuse the land.

The participation of the Ktunaxa Nation Council in the Environmental Monitoring Committee is to honor the responsibility Ktunaxa have to ʔa'kxam̓is q̓api qapsin, with the recognition that when the population of one living thing is impacted, so is everything else.

Figure 1. Ktunaxa "lifeways" within Qukin ʔamakʔis.
This image is a product of Ktunaxa community participatory research drawn by two Ktunaxa artists, Darcy Luke and Marisa Phillips. It is meant to symbolize "Ktunaxa being Ktunaxa on the land" and the tangible and intangible connection between ʔamak ɛ wuʔu (the land and water) and ʔaʼkxaṁ is q̓ api qapsin.

The Ktunaxa Nation Council's objective in this committee is to understand current conditions and to highlight to Teck Coal Ltd and the Province of British Columbia the serious need to protect and heal wuʔu ɛ ʔamakʔis for ʔaʼkxaṁ is q̓ api qapsin and future generations of Ktunaxa ʔaqłsmakniḵ. The Ktunaxa Nation Council includes the illustration above (Figure X) to visually represent the Ktunaxa lifeways of "Ktunaxa being Ktunaxa" within Qukin ʔamakʔis. We are deeply saddened by the current situation in Qukin ʔamakʔis and extremely frustrated with the bureaucratic and regulatory processes intended to protect it. Ktunaxa's concerns for ʔaʼkxaṁis q̓api qapsin, wuʔu ɛ ʔamakʔis remain outstanding in Qukin ʔamakʔis.

Monitoring Water Quality in the Elk Valley

The Permit sets water quality targets for concentrations of selenium, sulphate, nitrate and cadmium at specific locations within the Elk Valley. Long-term targets are set to protect aquatic life. Teck is required to monitor water quality at 165 locations in the Elk Valley and Koocanusa Reservoir. Monitoring evaluates water quality and allows for the early detection of emerging constituents of concern as mining operations proceed. Results inform management decisions for the protection of aquatic health.

There are two types of water quality targets in the Permit: compliance limits and site performance objectives.

Compliance limits are set for compliance points (Figure 1). Compliance points are water monitoring stations located immediately downstream of each of Teck's mine operations. These points correspond to stream locations where all or most of the mine-influenced water accumulates from an operation. There are seven compliance points.

Site performance objectives, or SPOs, are set for order stations (Figure 1). Order stations are water monitoring stations that are further downstream from Teck's mining operations where water that is mine-influenced is mixed with water that is not. Because of this mixing, concentrations at order stations are expected to be lower than at compliance points. There are seven order stations.

The EVWQP was designed for the Elk River watershed and the Canadian portion of the Koocanusa Reservoir, which represents the designated area as defined in 2013 by ENV. The EVWQP further divided the designated area into six management units (MUs) based on geographic features, major tributaries and hydrodynamic characteristics (Figure 2). These MUs are central to the area-based nature of the EVWQP to support monitoring and management activities.

Learn more about the EVWQP targets here: https://elkvalleywaterquality.gov.bc.ca/pages/water-quality-targets

Monitoring Programs and Management Plans reviewed by the EMC:

- Surface Water Monitoring
- Groundwater Monitoring
- Local Aquatic Effects Monitoring Programs (LAEMPs)
- Regional Aquatic Effects Monitoring Program (RAEMP)
- Koocanusa Reservoir Monitoring
- Calcite Monitoring
- Selenium Speciation Monitoring
- Chronic Toxicity Testing Program
- Human Health Risk Assessment
- Adaptive Management
- Tributary Management

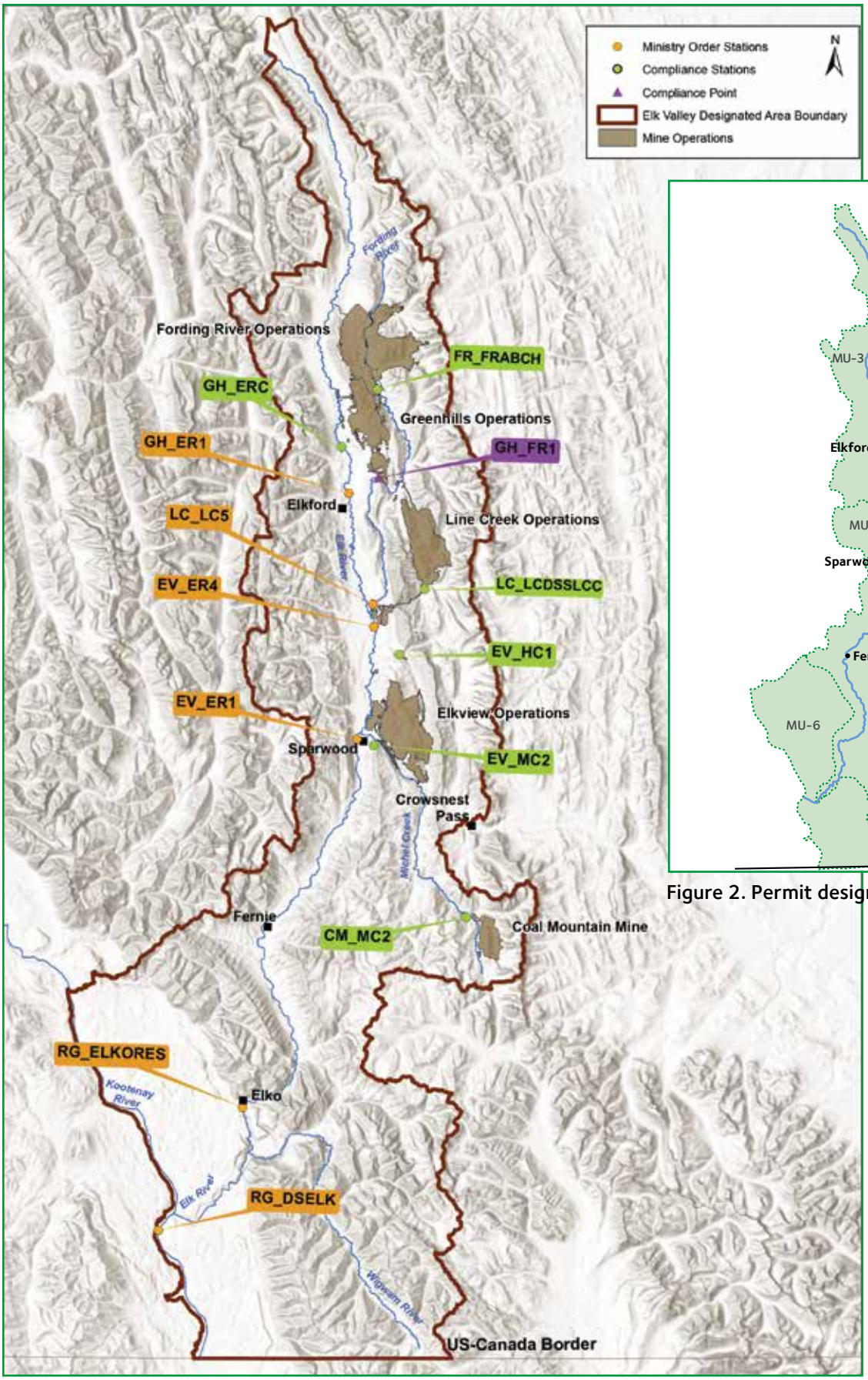


Figure 1. Permit designated area, mine operations, compliance points and order stations.

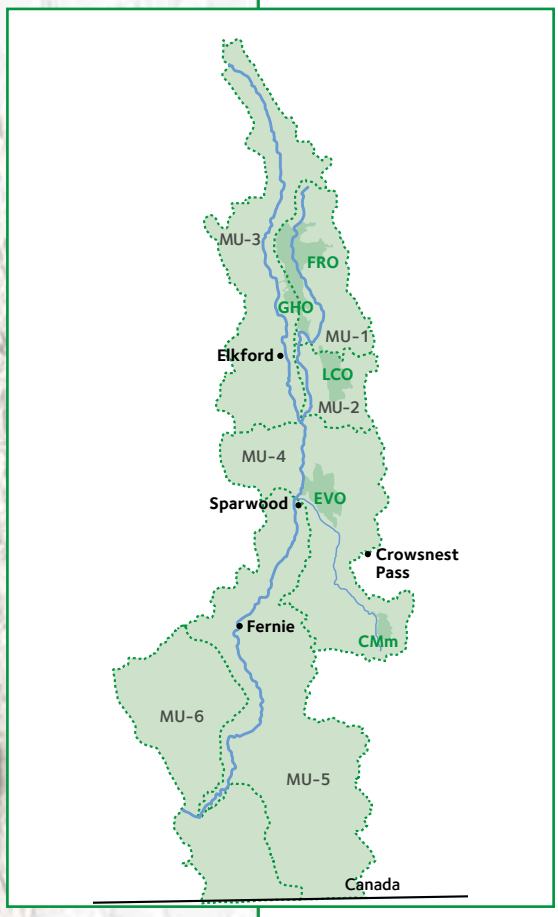


Figure 2. Permit designated area and MUs.

EMC 2022 Monitoring Highlights

Monitoring programs completed under the Permit are comprehensive and extend through the Elk Valley. During EMC engagements, EMC members, Teck Study Teams and Consultants discuss and review Teck's monitoring program results, study designs, reports and findings. Together the EMC's collaborative efforts guide monitoring in the Elk Valley.

Every three years, the data collected through the regional monitoring programs are compiled to evaluate the effects of mining on the entire Elk River watershed. The 2017 – 2019 analysis concluded that there were some changes in conditions observed throughout the Elk River watershed since previous monitoring cycles; however, effects related to these changes were most often seen in localized areas (i.e., mine-influenced tributaries) except for the Upper Fording River (see glossary, UFR). When considering all MUs together, effects on the aquatic environment were not widespread.

For this report, EMC members from ENV, Teck, IH and the Independent Scientist reviewed 2022 monitoring data collected throughout the designated area. Key monitoring results from six focus topics of interest were selected for this year's report:

1. Selenium Speciation Monitoring (regional, not illustrated on Figure 1)
2. Greenhills Operations (GHO) Calcite Monitoring
3. Line Creek Operations (LCO) Dry Creek Monitoring
4. Elkview Operations Saturated Rock Fill (EVO SRF)
5. Koocanusa Reservoir Monitoring
6. Westslope Cutthroat Trout (WCT) Populations, UFR and Grave-Harmer

For an in-depth look at 2022 Monitoring Reports visit Teck's Monitoring Water Quality in the Elk Valley: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-report

Figure 1. 2022 EMC monitoring areas of interest.

By the numbers

It takes a tremendous effort by the EMC and Teck Study Teams to maintain monitoring programs in the Elk Valley:

40 reports
totalling **40,068 pages**

47 supporting documents
totalling **1,992 pages**

37 presentations
totalling **1,246 pages**

To better understand and share insight into the Monitoring Programs, the EMC:

Participated in
54 engagements
(virtual and in-person)

Comprising of
136 hours of meetings
Including EMC virtual meetings, Public Report development, Adaptive Management Open Dialogue (AMOD) sessions and conferences.

Contributed
403 items of advice → in **34 advice tables**

Collaborated to develop this EMC Public Report

Selenium Speciation Monitoring

Corbin Sedimentation Ponds at Coal Mountain Mine.

What is Selenium Speciation?

Selenium can occur in many forms (species) and occurs naturally as selenate, selenite, organoselenium (organoSe) and elemental selenium (Figure 1).

OrganoSe (e.g., dimethylselenoxide [DMSeO], methyl seleninic acid [MeSeIV]) can be generated in some natural lentic (slow-flowing) waters as well as constructed mine water management structures such as sedimentation ponds and buffer ponds downstream of treatment facilities (Figure 2). Algal productivity and/or microbial activity in sedimentation and buffer ponds are likely the main source of organoSe. DMSeO and MeSeIV are much more bioavailable compared to selenate and selenite and can result in higher selenium bioaccumulation in aquatic biota.

The selenium bioaccumulation tool is a model developed to predict bioaccumulation of selenium in benthic invertebrates as a function of the concentration of different aqueous selenium species. It helps the EMC understand whether selenium bioaccumulation detected in benthic invertebrates is what would be predicted based on aqueous concentrations of specific species of selenium.

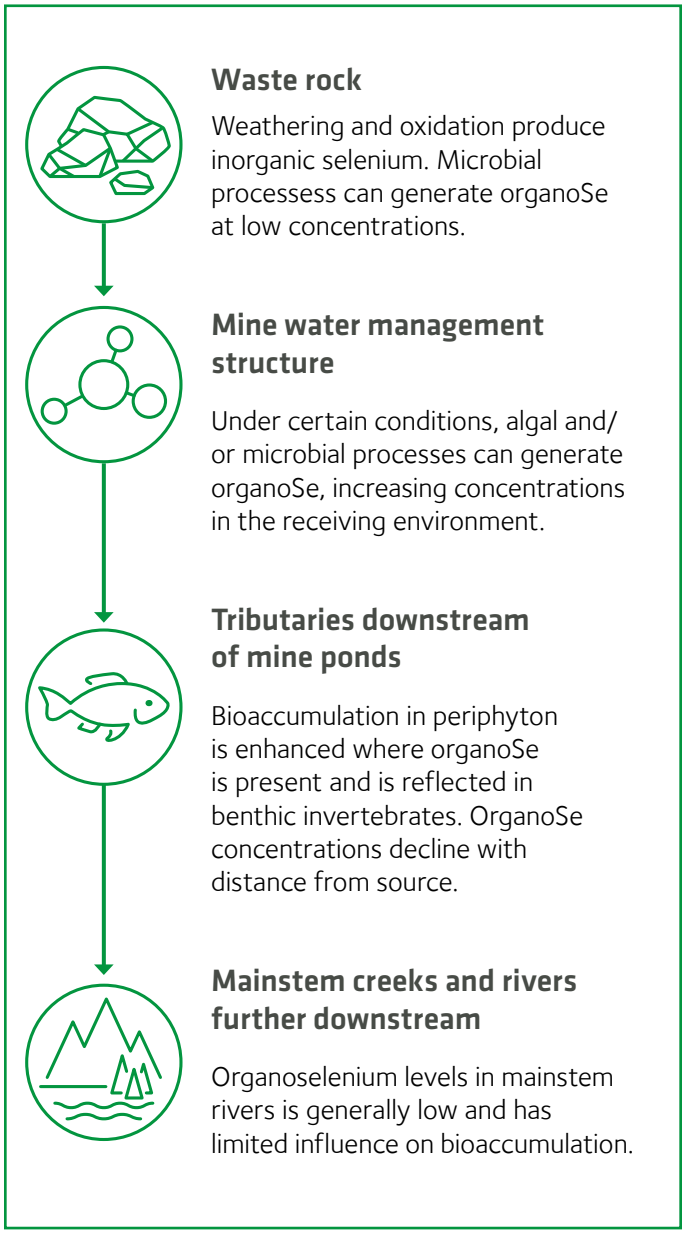


Figure 2. Conceptual model for changes to selenium speciation at Teck's Elk Valley Operations.

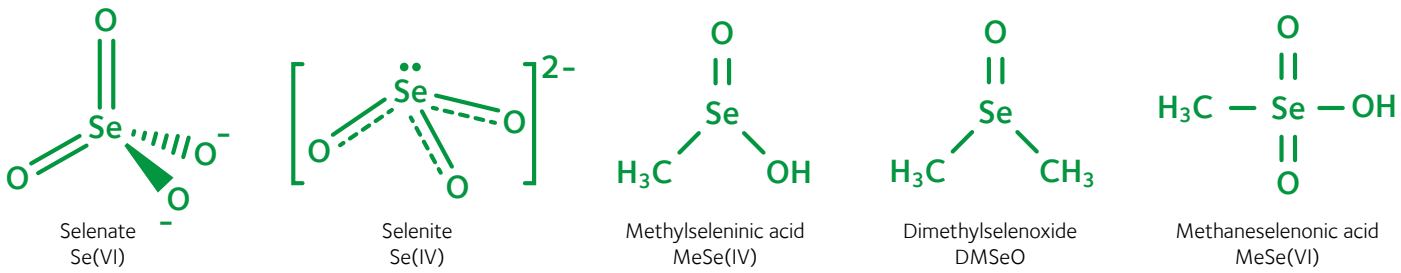


Figure 1. Selenium speciation and organoselenium.

Selenium Bioaccumulation

Enhanced selenium bioaccumulation can be observed in benthic invertebrate communities and fish downstream of sedimentation ponds (e.g., Harmer Creek, Line Creek, Greenhills Creek, LCO Dry Creek, Milligan Creek, Upper Thompson Creek). Figure 3 shows observed patterns of bioaccumulation in benthic invertebrates relative to concentration ranges of aqueous organoSe in lotic (i.e., fast moving) areas in the Elk Valley. Enhanced selenium bioaccumulation in benthic invertebrates was also observed in a localized area downstream of the EVO SRF; results of the causal investigation are discussed on page 24, Elkview Operations Saturated Rock Fill.

In 2021, the Permit required Teck to implement the Selenium Speciation Monitoring Program (SeSMP), which is a regional monitoring program designed to identify sites that generate organoSe, assess selenium bioaccumulation in aquatic biota and identify factors that may cause organoSe to form. The SeSMP will help Teck understand selenium speciation, bioaccumulation and will support Teck's adaptive management planning to attain area-based environmental management objectives.

Results of the SeSMP show detectable organoSe most often present immediately downstream of sedimentation ponds and in tributaries strongly influenced by mine-related sources of organoSe. Mainstem rivers rarely had detectable organoSe except in the Fording River immediately downstream of the FRO-S AWTF and Greenhills Creek. Strong seasonal cycles of selenite and organoSe concentrations have been identified, with maximum concentrations occurring between July and October. A detailed exploration of potential mechanisms behind organoSe generation is anticipated in the 2023

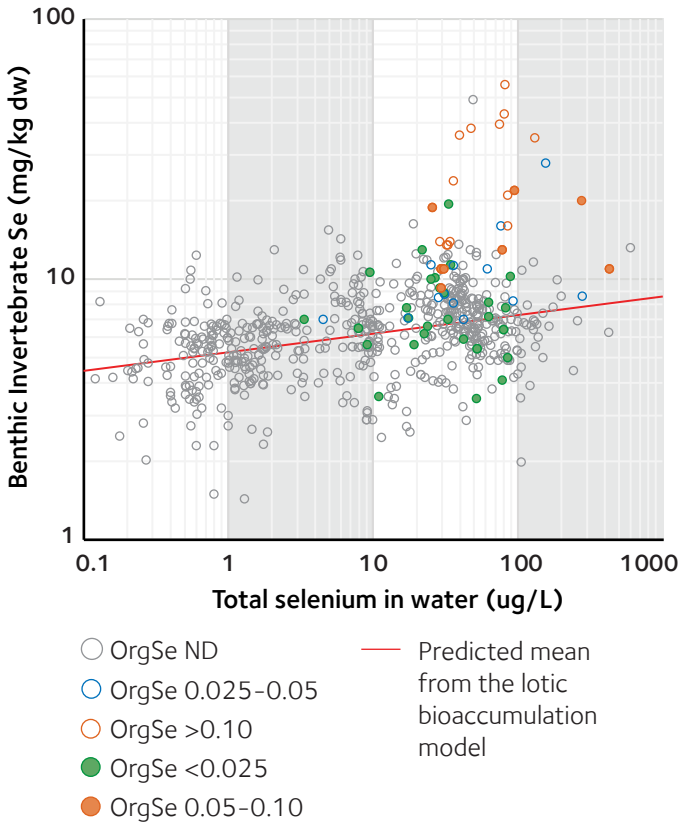


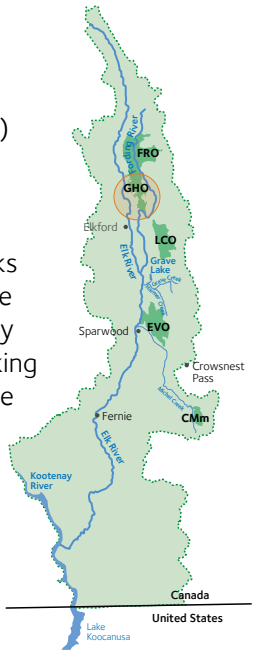
Figure 3. Observed patterns of bioaccumulation in benthic invertebrates relative to ranges of organoSe concentrations in lotic areas in the Elk Valley.

report; preliminary evaluation suggests an important role of aquatic vegetation as well as other factors. The SeSMP identified a need to better characterize vegetation and sediment characteristics as well as pond engineering details and management activities (e.g., dimensions, use of flocculant, pumping, aeration) to better identify predictors of organoSe concentrations.

Greenhills Operations Calcite Monitoring

Background

Calcite (calcium carbonate precipitate) has been observed in several creeks within the Elk River watershed downstream of Teck's mines and, to a much lesser extent, in reference creeks unaffected by mining. In parts of some creeks, calcite precipitation completely covers portions of the creek bed, making the substrate largely immovable. There are several metrics used to describe calcite precipitation and concretion (Figures 1 and 2).



The EVWQP identified four priority creeks for calcite management: Greenhills Creek (Greenhills Operations [GHO]), Corbin Creek (Coal Mountain Mine [CMm]), Dry Creek (Elkview Operations [EVO]), and Erickson Creek (EVO).

GHO is an active mining area north of Elkford, between the Fording River and the Elk River. It has been a focus for calcite remediation due to the long stretches of calcified habitat in both Greenhills Creek and the west side tributaries.

Calcite in the Mainstem

The calcite index (Figure 2) is generally very low in the mainstem systems, including the Elk River, the Fording River and Michel Creek. However, observations of calcite concretion have been documented in some reaches since 2019. Ongoing monitoring is evaluating the trends in calcite presence, concretion and indices.

Calcite presence score for each rock is based on:
absence (Cp = 0) or presence (Cp = 1)

Calcite index is a summed score of Cp and Cc.
(CI = 0-3)

Cp + Cc = CI

Calcite concretion score for each rock is based on how "stuck" the rock is to the stream bed.
0 = easily dislodged
1 = partially stuck
2 = unmoveable

Figure 1. Metrics used to describe calcite in streams.

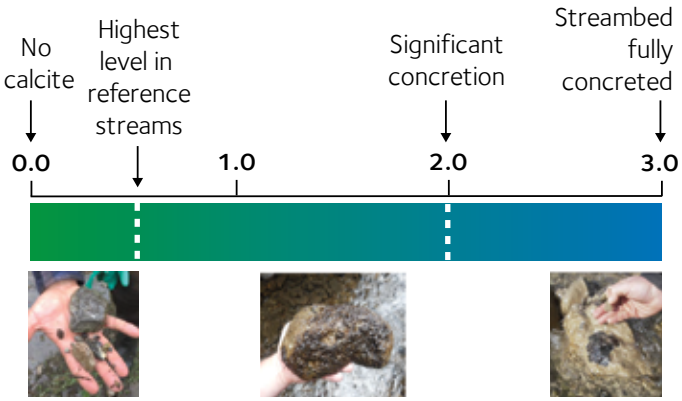


Figure 2. Examples of rocks at different calcite indices.

EVO Dry Creek showing calcite cascades.

Calcite Trends

Due to an increase in concretion, the calcite index at upper Greenhills Creek and most of the west side tributaries is increasing (Figure 3). Several monitoring locations show complete concretion of the streambed (CI=3). Greenhills Creek and Thompson Creek are the two streams with year-round flow that are fish-bearing or flowing into fish-bearing waters.

Calcite index across the Elk Valley has generally increased since 2013 with a potential decline observed only in the last few years (2020-2022) (Figure 4). Calcite mitigation efforts have only recently been implemented at select locations (Figure 5, page 17).

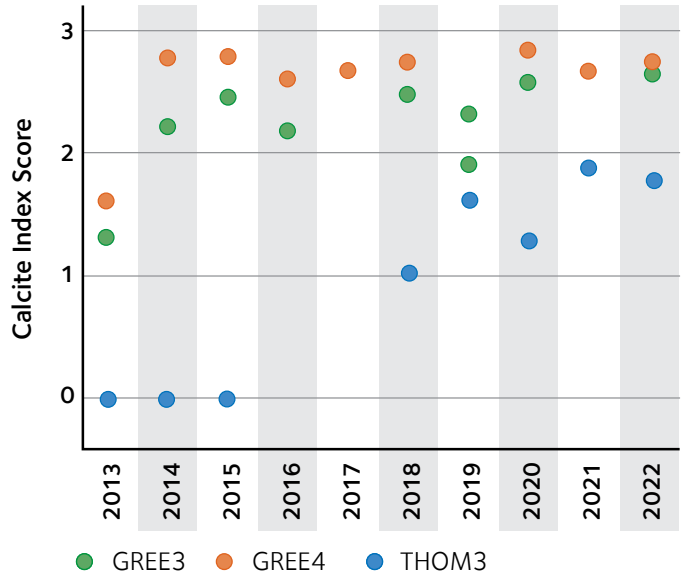


Figure 3. Calcite index from 2013 to 2022 at Greenhills Creek and Thompson Creek.

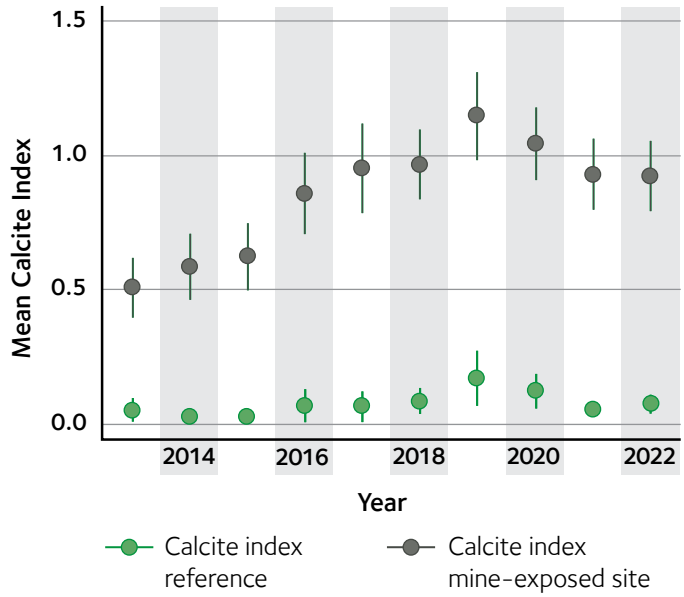


Figure 4. Mean calcite index from 2013 to 2022 for all reference and exposed sites in the Elk Valley. Error bars represent 95% confidence intervals.

Greenhills Operations Calcite Monitoring

Impacts to Aquatic Life

Calcite impacts aquatic health by reducing available streambed habitat. Concretion reduces the spacing between rocks that provides habitat for benthic communities and makes it more challenging for the fish to move the substrate and create nests (redds). Changes in benthic invertebrate communities provide information on the potential effect of calcite and can inform calcite management priorities.

Fish Habitat

Greenhills Creek and its tributary, Gardine Creek, are home to an isolated population of WCT. The WCT population in Greenhills/Gardine is not well documented. Ongoing monitoring evaluates trends in calcification and spawning habitat use. Redd counts vary year to year. In 2022, there were fewer redds observed in lower Greenhills Creek compared to 2021, but the number of redds were similar in upper Greenhills and Gardine Creeks in 2022 compared to 2021.

To learn more visit: *2022 Upper Fording River WCT Population Monitoring Report* https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Benthic Invertebrates

Calcite can impact benthic invertebrates by impairing access to food sources and, in highly concreted reaches, immobilizing larvae. In addition to impacts from calcite, both benthic invertebrate tissue selenium and water quality at Thompson Creek and lower Greenhills Creek were observed at concentrations that can impair the health of the benthic community. Teck has met with the EMC and is developing a predictive model for benthic invertebrates to better understand the impacts of calcite and water quality constituents.

To learn more visit: *2022 Greenhills Creek LAEMP* https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Caddisfly larvae in case and calcified rock at EVO Dry Creek.

Calcite Management

Teck has identified two management responses to increasing calcite trends in the Elk Valley: antiscalant dosing and physical excavation stream restoration.

Antiscalant dosing has been effective in mitigating calcite concretion in lower Greenhills Creek. In October 2017, an antiscalant facility (calcite prevention) was constructed and dosing began in Greenhills Creek upstream of the Greenhills Pond. In 2022, the GHO Antiscalant Addition System (AAS) was moved from lower to upper Greenhills Creek (directly above the confluence with Gardine Creek) to address calcite concretion closer to mine spoils (Figure 6). A 20 m area in upper Greenhills Creek was remediated during the relocation and the antiscalant facility started operating in November 2022. The new location provides an additional 2400 m of calcite protection in Greenhills Creek. An AAS is also planned for Thompson Creek in 2024. Locations of existing AAS facilities are shown in Figure 5.

Remediation trials started in 2022 with more planned over the next 10 years (Table 1). ENV is reviewing physical excavation stream restoration applications on a case-by-case basis.

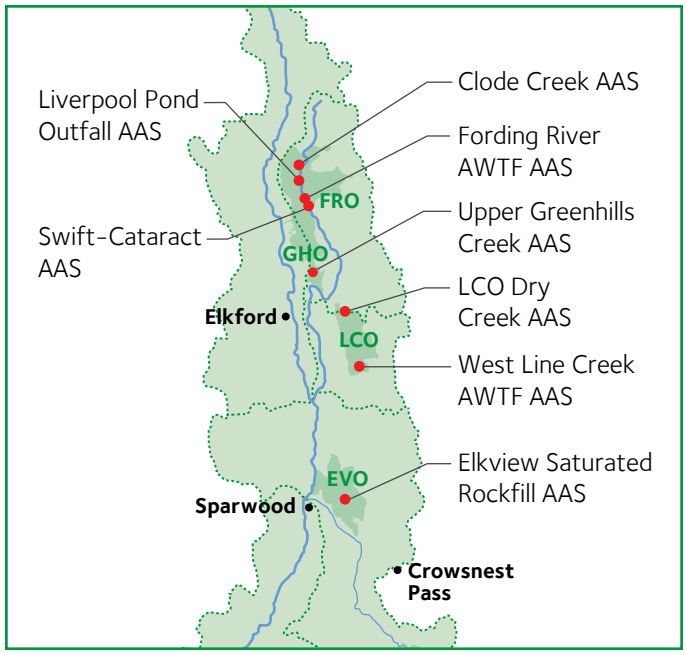


Figure 5. 2022 AAS locations.

Table 1. List of streams planned for calcite remediation within the next 10 years.

Stream	Start Year
Clode Creek	2022
Erickson Creek	2023/2024
Liverpool Pond Outfall	2023
Smith Pond Outfall	2023
Corbin Creek	2025
EVO Dry Creek	2025
Greenhills Creek	2029
South Pit Outfall	2029
Thompson Creek	2030

Regulatory Requirement

The Permit requires Teck to meet medium and long-term SPOs.

Medium-term SPO:

- Calcite concretion ≤ 0.50 by December 31, 2024.

Long-term SPO:

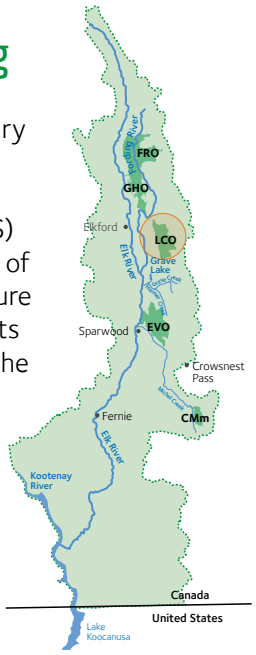
- Calcite index ≤ 0.50 by December 31, 2029.

Figure 6. Previous and current locations of the AAS on Greenhills Creek.

AAS on upper Greenhills Creek.

LCO Dry Creek Monitoring Results

Environmental Setting



LCO Dry Creek is a cold-water tributary to the UFR. Mining began in LCO Dry Creek in 2014 and the Dry Creek Water Management System (DCWMS) was constructed in the upper reaches of Dry Creek at the onset of mining (Figure 1). The DCWMS collects and re-directs mine-influenced surface water from the head pond (LC_DC3) through the two sedimentation ponds prior to discharging back to Dry Creek (near station LC_DCDS).

There is 5.5 km of fish accessible habitat in LCO Dry Creek, extending from the confluence of the Fording River to the spillway barrier at the head pond. Upstream of the spillway barrier is considered non-fish bearing. Culverts 1 km upstream of the Dry Creek/Fording River confluence act as partial barriers to upstream fish passage during some flow conditions.

As water flows from LC_DCDS to LC_DC1 concentrations of most mine-related constituents decrease. This is due to increasing distance from mine operations and a groundwater input between stations LC_DC2 and LC_DC4. In the lower 900 m of LCO Dry Creek a high proportion of WCT redds have been observed.

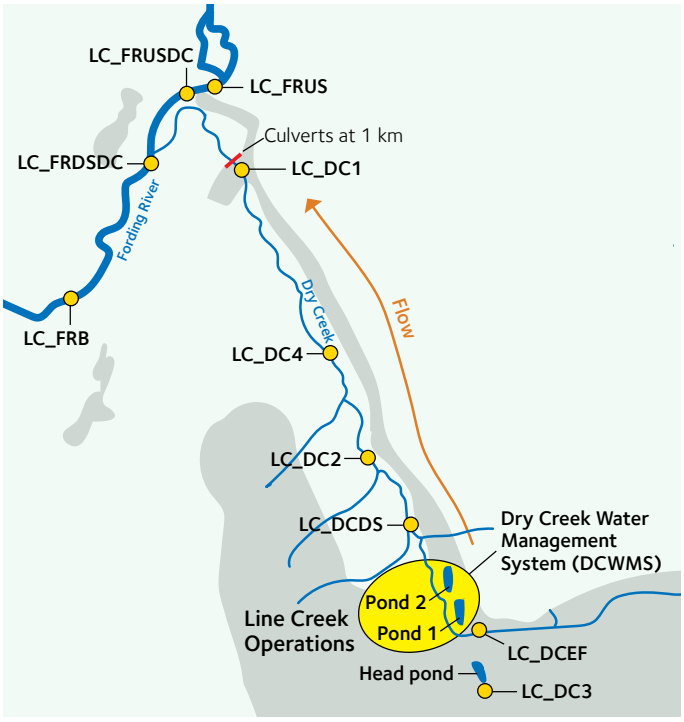


Figure 1. LCO Dry Creek LAEMP monitoring stations.

The LCO Dry Creek LAEMP assesses potential effects of the LCO Phase II mine development on water quality and aquatic life in Dry Creek.

Fording River Water Quality

Nitrate and nickel concentrations in the Fording River downstream of Dry Creek remain below effect concentrations. However, selenium concentrations in the Fording River were periodically higher than the level 1 benchmark (see Glossary) for WCT juvenile growth and the level 1 benchmark for WCT reproduction.

Selenium and nitrate concentrations in the Fording River upstream of Dry Creek are higher than those reported downstream. This is a result of upstream mining inputs from FRO.

Toxicity Testing

Details of chronic and acute toxicity testing are reported in the LAEMP and the annual chronic toxicity report. No acute toxicity test failures have been reported. Quarterly chronic toxicity tests collected at LC_DCDS indicate no effects for fish endpoints (including Rainbow Trout and Fathead Minnow tests). Conversely, adverse effects to chronic toxicity endpoints for invertebrates (*C. dubia* reproduction, *H. azteca* dry weight) and algae (*P. subcapitata* cell yield) have been observed at LC_DCDS, with nickel and nitrate identified as potential contributors.

Water Quality Constituents of Concern

Most constituents are below water quality guidelines; however, concentrations of mine-related constituents (selenium, nitrate, nickel) have increased since 2017. An increasing trend for sulphate has also been observed; however, concentrations remain below the BCWQG. Notable water quality results for Dry Creek in 2022 are discussed in the next section.

In 2022, peak nitrate concentrations at LC_DCDS were above the acute BCWQG for aquatic life during low flow and concentrations were above the level 2 benchmark for benthic invertebrates during high flow (Figure 2). Peak nitrate concentrations at LC_DC1 remained above the level 2 benchmark for benthic invertebrates during low flow and below effect concentrations during high flow. Fish benchmarks were also exceeded in LCO Dry Creek but to a lesser extent (not shown on graph).

Dissolved nickel concentrations were above the level 2 benchmark for benthic invertebrates at LC_DCDS and below effect concentrations at LC_DC1 (Figure 3).

Mean total selenium concentrations were significantly higher in 2022 than 2021 (Figure 4). Concentrations in Dry Creek were highest at LC_DC3 followed by the stations immediately downstream of the DCWMS. Selenium concentrations in Dry Creek were lowest at LC_DC4 and LC_DC1 in 2022.

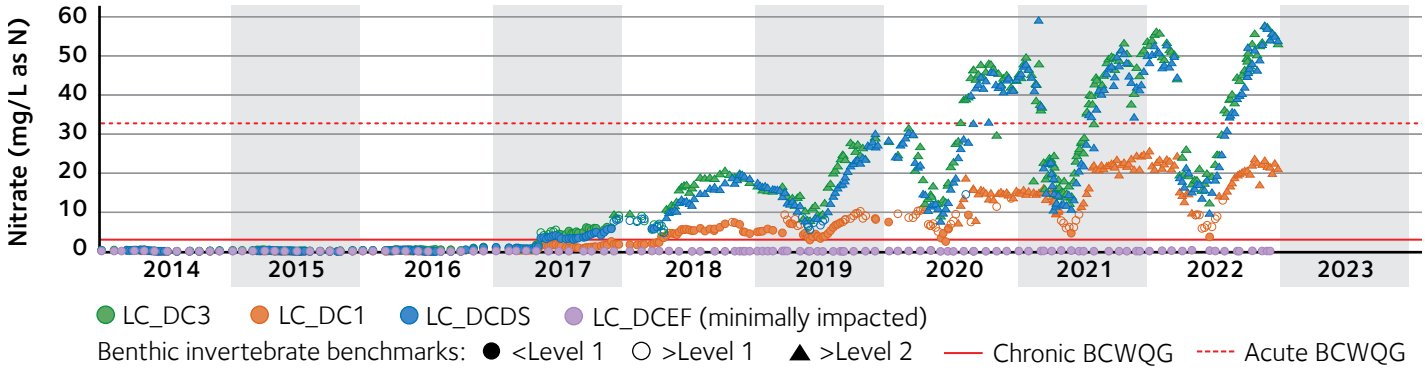


Figure 2. Nitrate concentrations in LCO Dry Creek, 2014 – 2022.

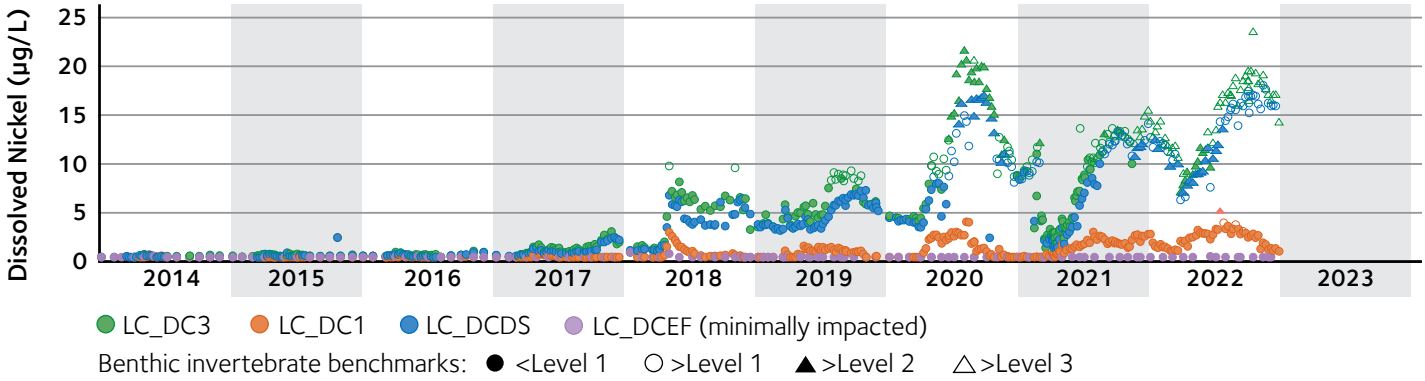


Figure 3. Dissolved nickel concentrations in LCO Dry Creek, 2014 – 2022.

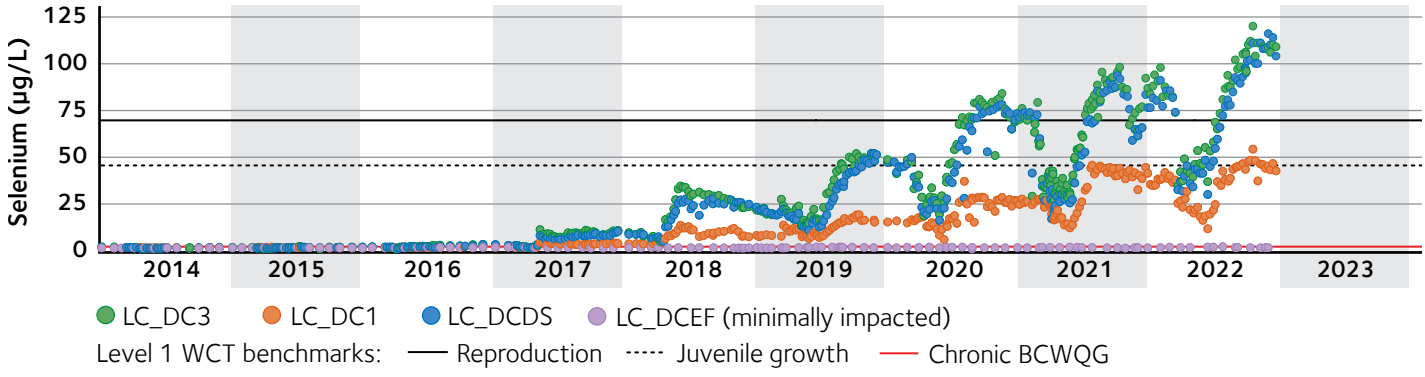


Figure 4. Selenium concentrations in LCO Dry Creek, 2014 – 2022.

LCO Dry Creek Monitoring Results

Benthic Invertebrate Tissue

Localized and elevated benthic tissue selenium (BIT Se) concentrations in the DCWMS and immediately downstream were identified in 2018 (> level 3 juvenile fish and benthic invertebrate benchmarks). These concentrations were attributed to increased production of organoselenium (organoSe) species in the sedimentation ponds during the growing season (i.e., selenate was being converted to more bioavailable forms of selenium).

In response, operation of the DCWMS was modified in 2020 to bypass the sedimentation ponds during the growing season. This operational change has reduced organoSe generation and subsequently BIT Se concentrations in Dry Creek.

In 2022 no samples from the Dry Creek LAEMP monitoring areas were above the level 2 benchmarks for effects to aquatic receptors. The 2022 results show BIT Se concentrations generally decreased relative to previous years in areas directly downstream of the DCWMS, while concentrations remained unchanged upstream of the DCWMS and further downstream (Figure 5).

BIT Se concentrations in the Fording River were consistent with previous years (2021 and 2020) and mean concentrations remained below the level 1 EVWQP benthic invertebrate benchmark of 13 mg/kg dw (not shown on graph).

To ensure continuous management of organoSe production, ENV issued a benthic invertebrate tissue selenium limit of 11 mg/kg dry weight (average limit from 5 replicate samples) at the monitoring station LC_DCDS. This limit came into effect on April 1, 2023.

Fish Habitat

Bypass of the DCWMS has reduced water temperatures in Dry Creek, resembling more natural conditions. Colder temperatures have resulted in a shorter, cooler growing season, which could influence WCT growth and recruitment. Prior to pond bypass, Growing Season Degree Days (GSDD) exceeded 1000 downstream of the sedimentation ponds and 800 near the confluence with the Fording River. In 2022, the GSDD in Dry Creek was less than 800, which is the recommended minimum requirement for WCT recruitment.

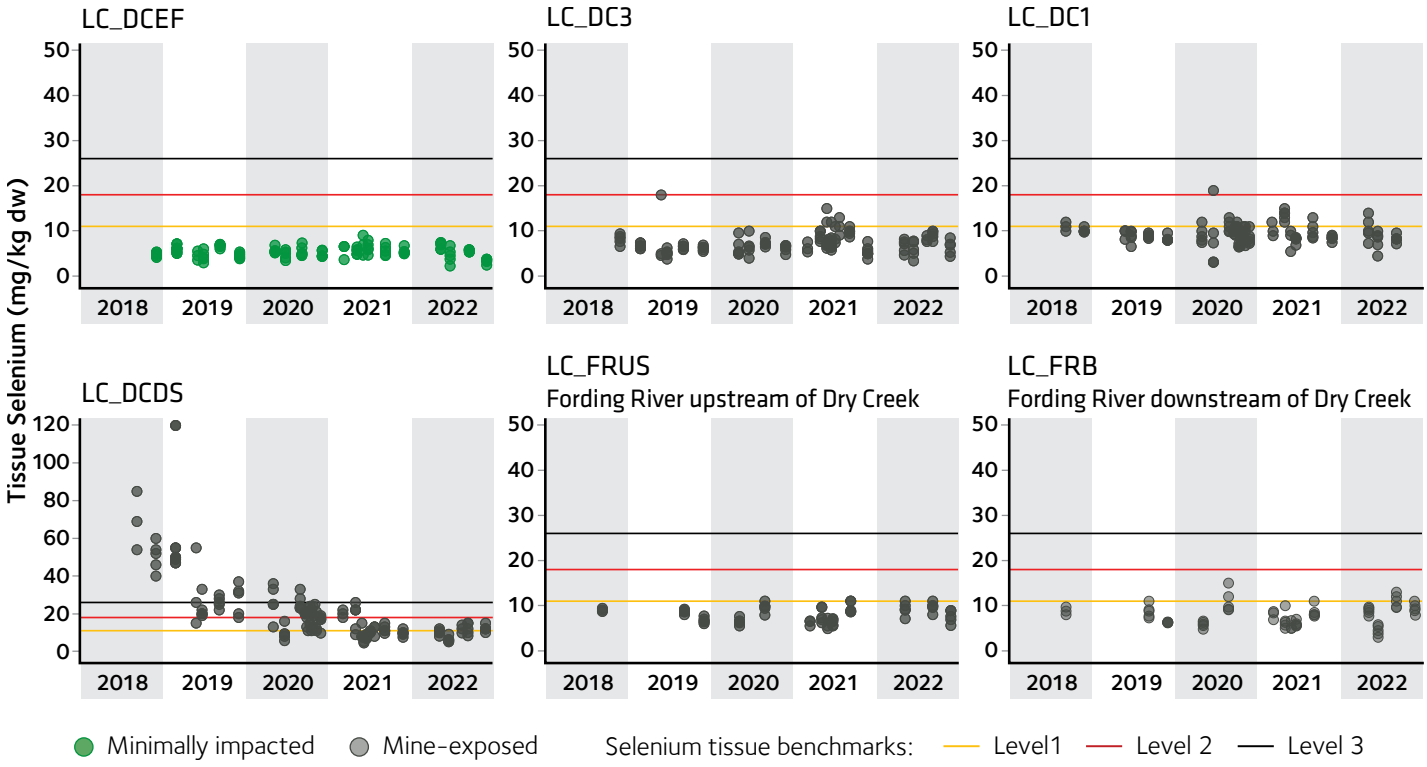


Figure 5. Selenium concentrations (mg/kg dw) in composite-taxa benthic invertebrate samples from Dry Creek sampling areas, 2018 to 2022. Horizontal lines: Level 1 (11 mg/kg dw), level 2 (18 mg/kg dw), level 3 (26 mg/kg dw) tissue benchmarks for juvenile fish growth.

Spawning activity is measured by the number of redds observed. In 2022, fewer redds were observed in Dry Creek compared to 2021. This decrease in redd counts was also observed throughout the UFR and may be associated with extended cold spring water temperatures.

Benthic Invertebrate Community

In general, benthic invertebrate communites in Dry Creek upstream of the DCWMS and closest to active mining (LC_DC3) were most likely to have endpoints outside of normal ranges. Areas located closest to the outlet of the ponds (LC_DCDS and LC_DC2) also tended to have lower %E (mayflies) than other areas and compared to regional and site-specific normal ranges.

More specifically, in 2022, %EPT (Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies]) decreased in most sites in Dry Creek when compared to 2021 results (Figure 6). Changes in benthic invertebrate community structure, namely decreases in mayflies, were also observed. This is likely a result of increasing concentrations of nitrate, selenium, and nickel. In the Fording River, benthic invertebrate community endpoints fell below normal ranges in at least one replicate from both LC_FRUS and LC_FRB for %EPT and in at least one replicate at LC_FRB for %E (Figure 6).

LCO Dry Creek Water Management System Sedimentation Ponds.

Next Steps

To improve water quality in LCO Dry Creek, Teck is planning the construction of a selenium, nitrate and sulphate treatment facility with an initial treatment capacity of 10,000 cubic metres per day (m³/d). The planned construction completion date is December 31, 2025.

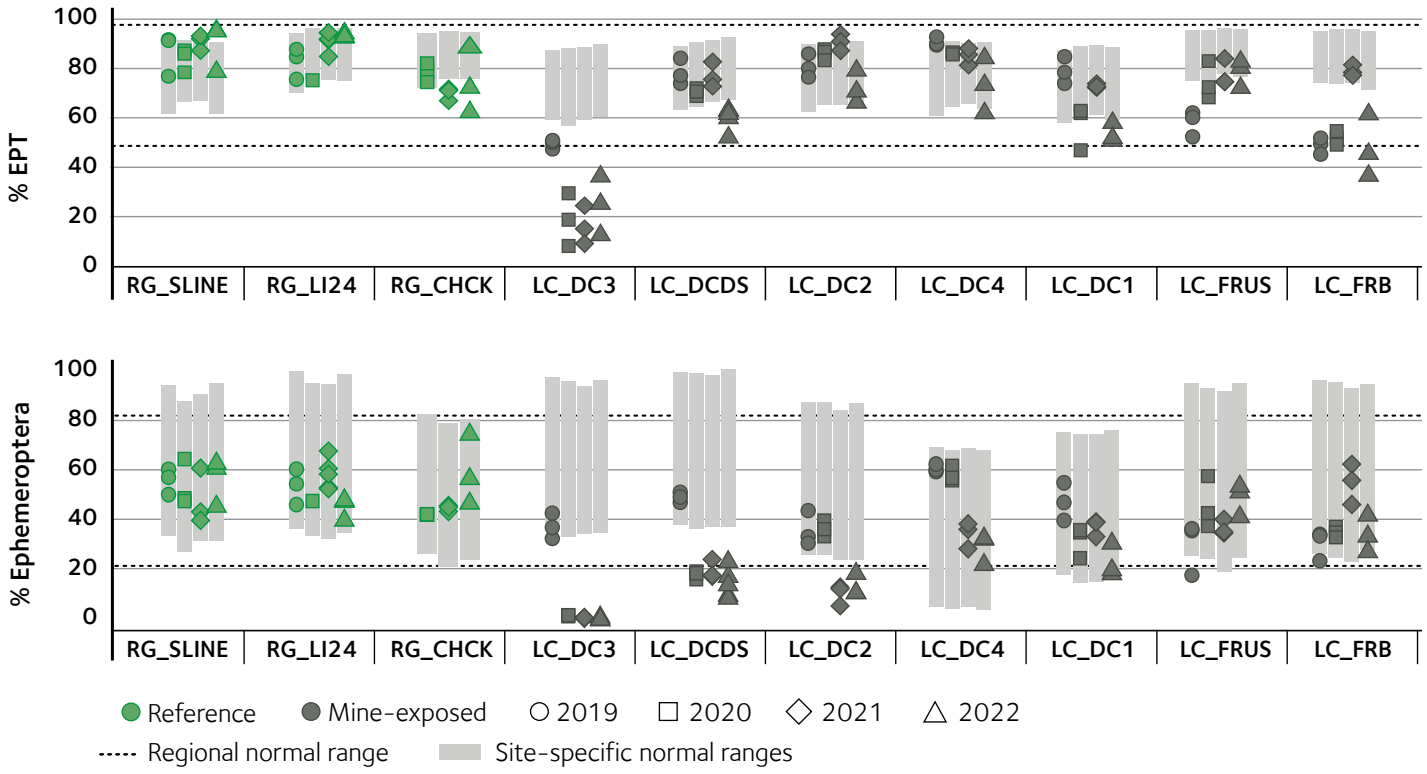
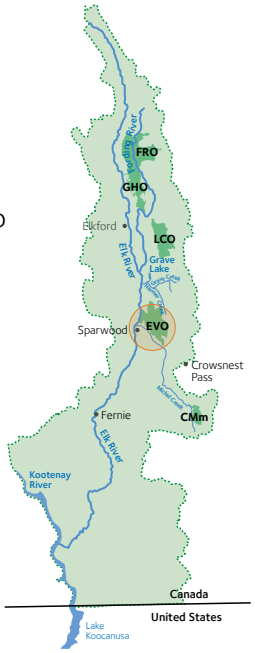


Figure 6. Benthic invertebrate community endpoints for Dry Creek and Fording River.

Elkview Operations Saturated Rock Fill

What is a Saturated Rock Fill?



Saturated Rock Fill (SRF) technology is one method used in the Elk Valley to treat mine-affected water. SRFs are created by backfilling mined out pits with rock, which are then saturated with water. Biological processes work to naturally remove selenium and nitrate. The SRFs operate following a three-step process (Figure 1):

1. Water for treatment is injected into the SRF.
2. Natural bacteria convert dissolved forms of selenium into a solid form, which remains securely stored in the SRF and nitrate to inert nitrogen gas, which is safely released.
3. Treated water is pumped out of the SRF and discharged to the receiving environment.

Teck is currently operating the EVO SRF (up to 20,000 m^3/day, Figure 2) and FRO North SRF has started commissioning and is planned to be fully operational by the end of 2023 (with a capacity of 30,000 m^3/day).

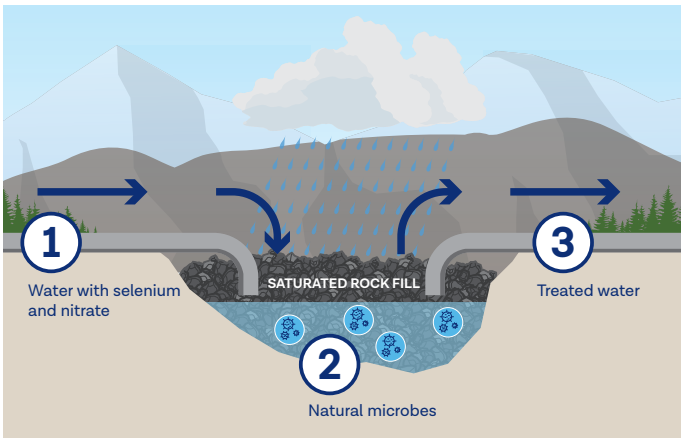


Figure 1. SRF water treatment process.

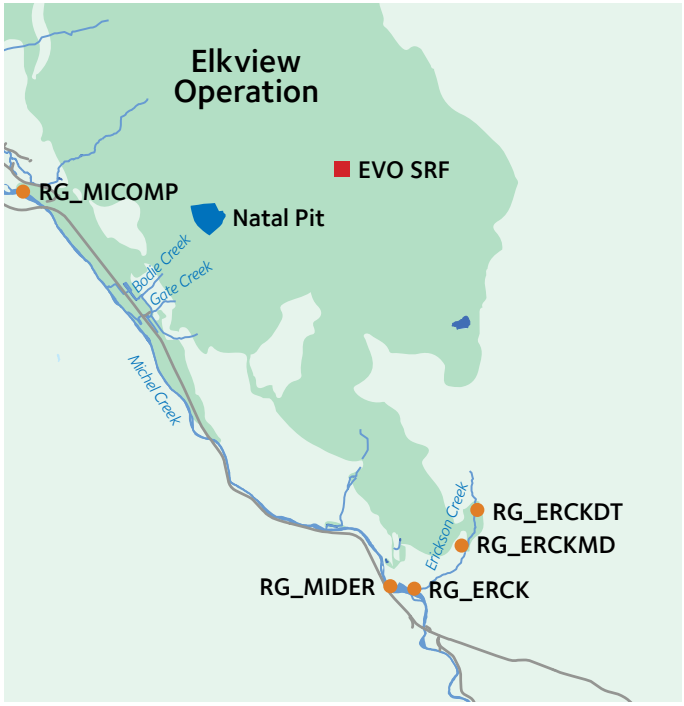


Figure 2. Location of the EVO SRF (red square) and associated water quality and biological monitoring locations (orange circles).

EVO SRF Background

In January 2018, EVO commenced Phase 1 of the EVO SRF with the intent of removing aqueous nitrate and selenium from mine contact water sourced from Natal Pit.

SRF trials showed the removal of over 90% selenium and nitrate, allowing Teck to proceed to Phase 2 in December 2020. Phase 2 constructed a conveyance system to allow for treatment of Erickson Creek. Currently, the SRF has the capacity to treat water from Natal Pit and/or Erickson Creek.

The discharge of treated effluent can flow into Erickson Creek and/or Gate and Bodie Creeks via the Bodie Rock Drain. Both pathways ultimately report to Michel Creek and subsequently the Elk River (Figure 2).

To monitor any changes to the environment from the EVO SRF, Teck is required under the Permit to conduct a LAEMP. The EVO LAEMP was designed to evaluate changes in water quality, calcite and temperature downstream of the EVO SRF in Gate, Bodie, Erickson and Michel Creeks. The LAEMP interprets how these changes may have potential effects to the biota.

Water Quality

Consistent with previous years, the 2022 water quality results indicate nitrate and total selenium decreased during operation of the EVO SRF (Figure 3).

Water treatment of Erickson Creek was paused in early April 2022 for planned maintenance and extended as an adaptive management response to mitigate an observed increase in benthic invertebrate tissue selenium. The SRF was restarted on October 4, 2022.

Despite the pause in operation the SRF removed 89,292 kg of nitrate and 672 kg of selenium in 2022, substantially decreasing the loads entering Michel Creek from EVO.

Erickson Creek water is occasionally mixed with Natal Pit water to increase water treatment capacity through the SRF and as a result nickel concentrations have increased in Erickson Creek (Figure 3).

EVO Erickson Creek.

These elevated concentrations are spatially constrained to Erickson Creek with nickel concentrations remaining below effects concentrations in Michel Creek (RG_MIDER).

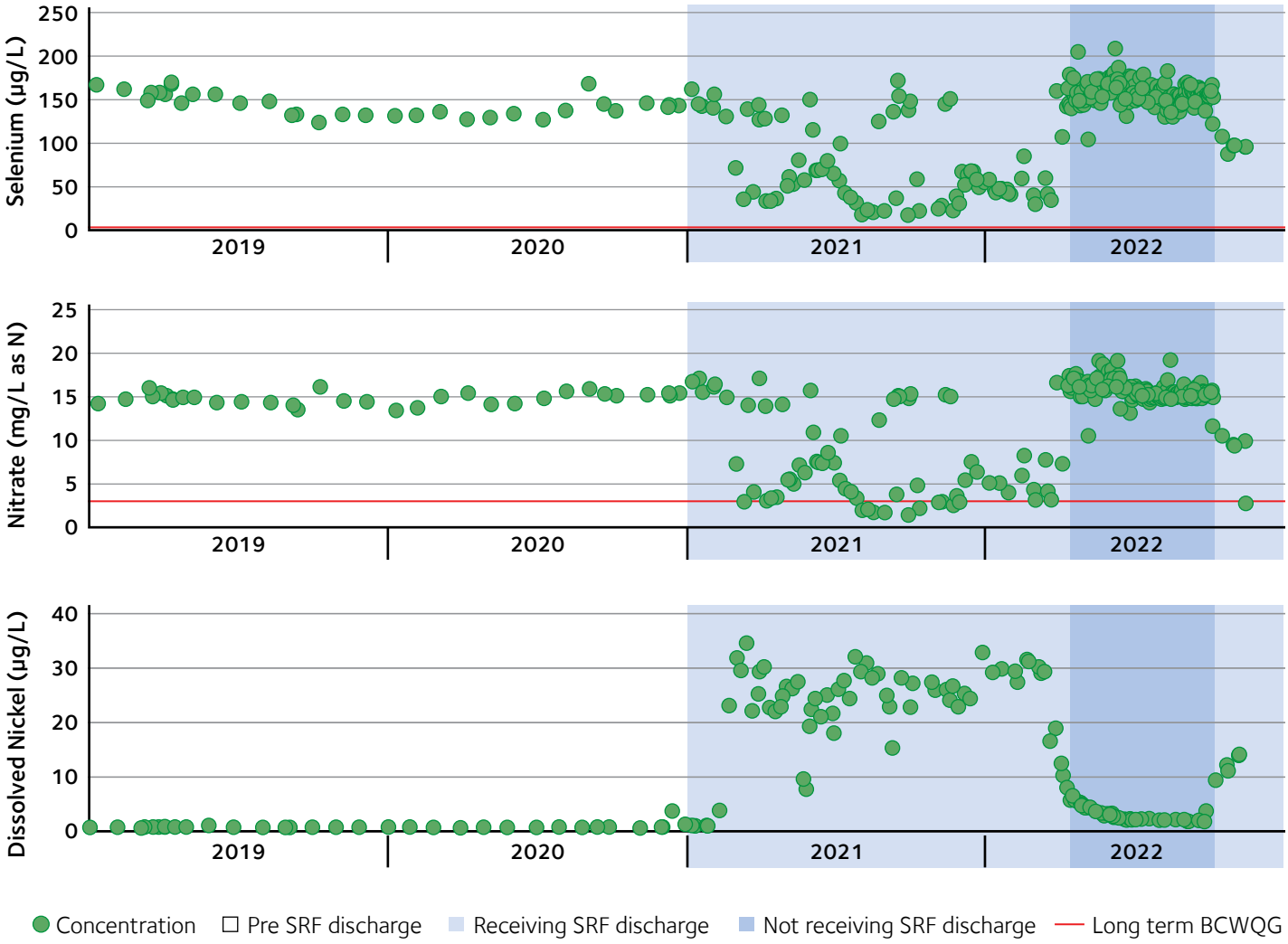


Figure 3. Selenium, nitrate, and dissolved nickel trends at RG_ERCK, downstream of the EVO SRF.

Elkview Operations Saturated Rock Fill

Unexpected Results

Monitoring in 2021 identified increasing BIT Se concentrations in upper Erickson Creek (RG_ERCKDT) with concentrations reaching the level 3 benthic invertebrate benchmark (Figure 4). To understand the risk and spatial extent, increased sampling was initiated. This increase remained localized to upper Erickson Creek, with BIT Se concentrations remaining below effect concentrations in lower Erickson (RG_ERCK) and Michel Creeks. Due to a natural fish barrier at RG_ERCK, the impacted section of stream is non-fish bearing habitat.

The SRF was taken offline from April to October 2022 to investigate these unexpected results. During this time, BIT Se concentrations returned to baseline.

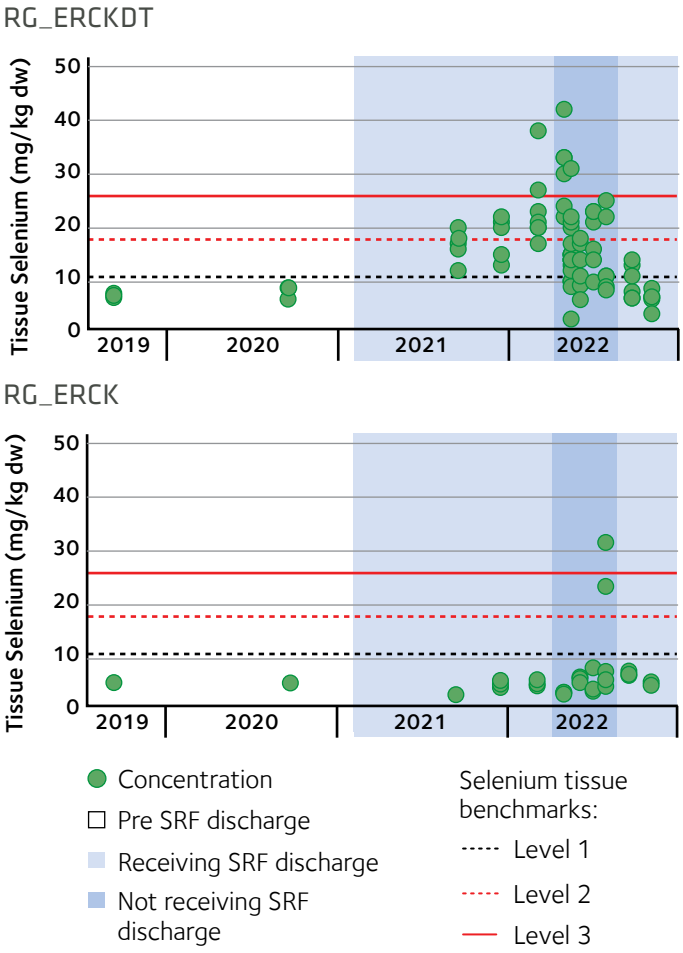


Figure 4. Selenium concentrations in benthic invertebrate tissue samples from Erickson Creek, 2019 to 2022. Horizontal lines: Level 1 (11 mg/kg dw), level 2 (18 mg/kg dw), level 3 (26 mg/kg dw) tissue benchmarks for juvenile fish growth.

Investigation

Reduced forms of selenium are more bioavailable and have the potential to increase BIT Se concentrations. Neither Teck's selenium bioaccumulation models, nor a review of selenium speciation data could explain the increase in BIT Se.

Teck established a team of external subject matter experts (SMEs) to investigate the cause of elevated BIT Se and provide recommendations for management actions. The SMEs provided the EMC with *The Investigation Into Enhanced Selenium Bioaccumulation in Benthic Invertebrate Tissue in Erickson Creek Summary Report* detailing causal pathways.

Outcome

Data indicate that fine grained particulates (manganese and iron oxides), derived from SRF operation, accumulate in bryophyte mats in upper Erickson Creek, which are acting as "hot spots" for selenium bioaccumulation.

It is hypothesized that direct consumption of particles by invertebrates or entrapment of particulates in the mats are changing the bioavailability of selenium.

The SRF was restarted on October 4, 2022, with a Trigger Response Plan in place that included enhanced monitoring and five trigger action responses dependent on monitoring results. The actions include confirmatory sampling, reduced treatment rates, and temporary SRF bypass. Teck met with the EMC and SMEs and is currently trialling a filtration system to remove particulates in water treated by SRF technology.

Bryophyte mats in upper Erickson Creek.

Aquatic Health

In 2022, the total abundance of EPT were within the regional (dashed lines) and habitat-adjusted (grey box) normal ranges at areas downstream of the SRF outfall in Erickson Creek. However, the proportion (%) fell below both normal ranges at areas downstream of the SRF (Figure 5). The proportion of these key benthic invertebrates remained within normal ranges in Michel Creek in 2022 (Figure 5). While effects to the benthic invertebrate community in relation to reference normal ranges were apparent in Erickson Creek these results were present prior to SRF commissioning and have not changed substantially over time. Having the SRF shutdown for most of the 2022 growing season makes interpretation of the relationship between SRF discharge and benthic invertebrate community structure challenging. Ongoing aquatic health monitoring under the RAEMP and EVO LAEMP will clarify this relationship.

Fish Tissue

There is no fish access in the upper reaches of Erickson Creek where the elevated BIT Se was observed. To date, a risk to fish in the downstream receiving environment has not been observed.

WCT tissue data is collected under the RAEMP, with the nearest collection station located at RG_MICOMP (Michel Creek). The 2021 results show muscle tissue Se concentrations in WCT below the level 1 benchmarks for reproduction (15.5 mg/kg dw). Monitoring is ongoing with the next fish tissue collection scheduled for 2024 under the RAEMP.

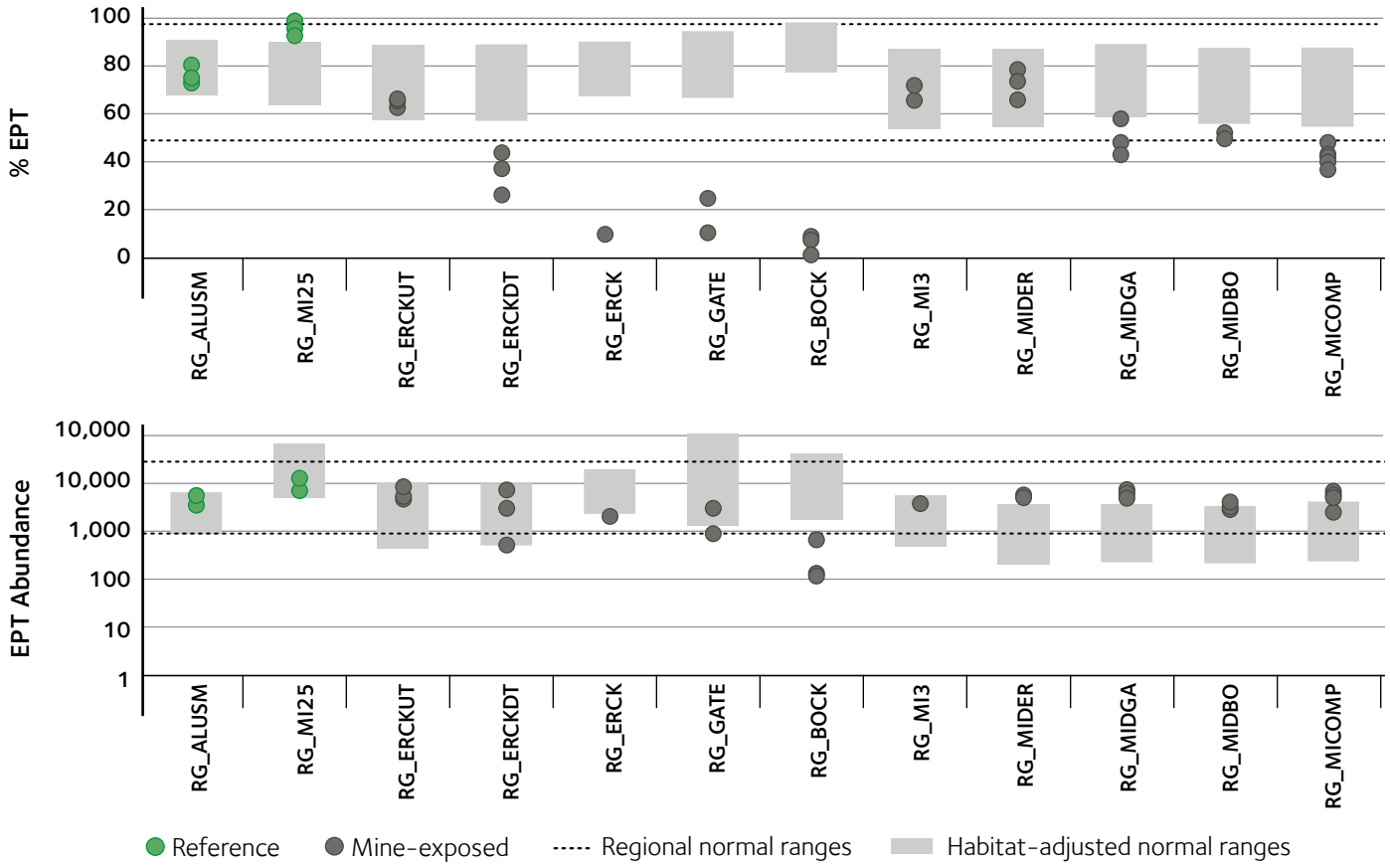


Figure 5. Benthic invertebrate community endpoints at Erickson Creek, Gate Creek, Bodie Creek and Michel Creek.

Koocanusa Reservoir Monitoring

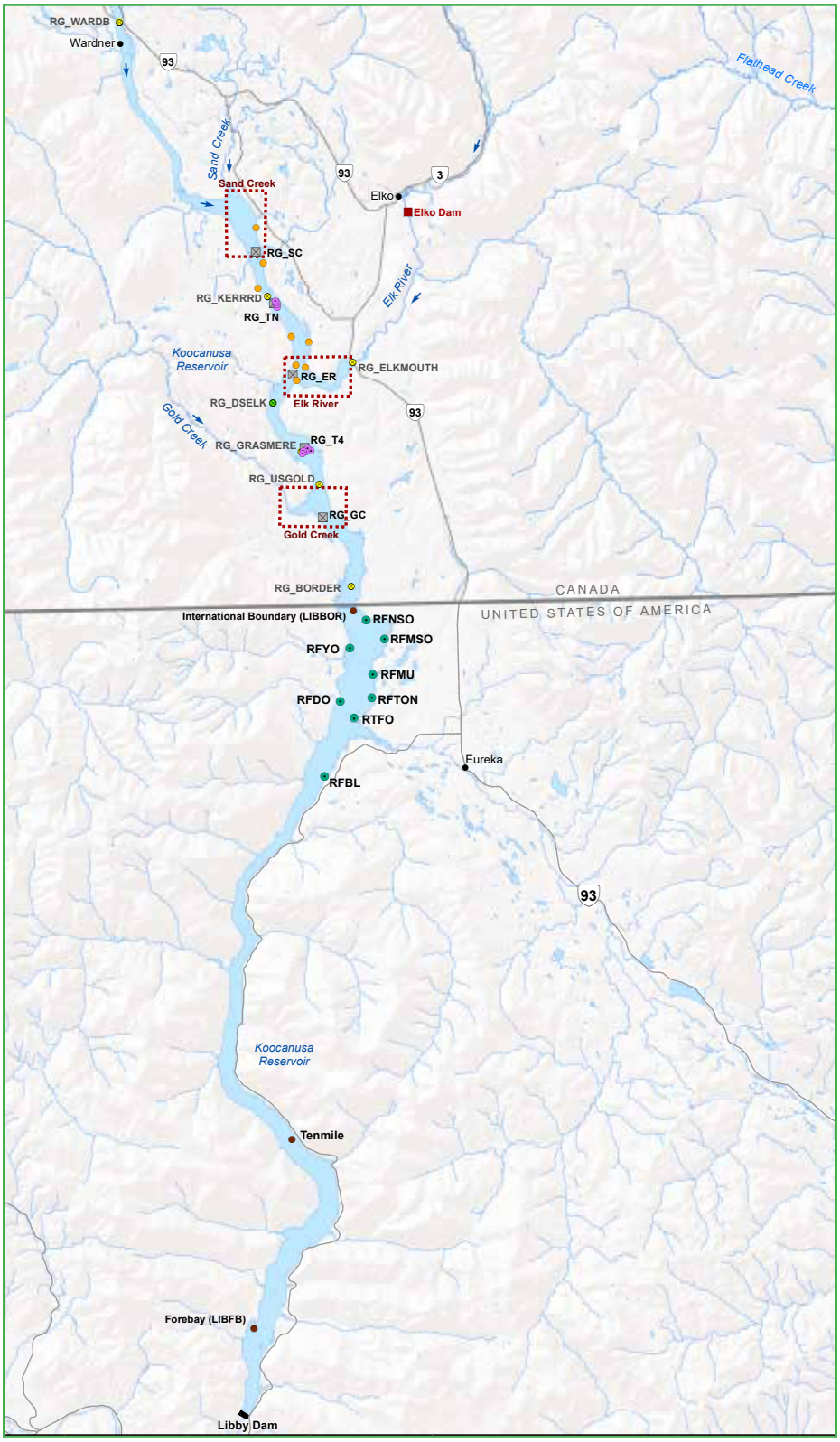
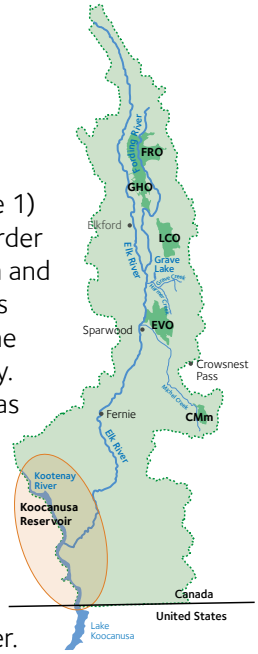


Figure 1. Koocanusa Reservoir monitoring stations.



The Koocanusa Reservoir (Figure 1) straddles the border between Canada and the United States and lies within the Ktunaxa Territory. The Reservoir was created in the 1970s by the Libby Dam, located on the Kootenay River on the American side of the border. The reservoir is a dynamic system that is strongly influenced by seasonal water levels which are controlled by the US Army Corps of Engineers.

The Koocanusa Monitoring Program is an ongoing program to assess spatial differences in physico-chemical and biological conditions in portions of the Canadian side of the Koocanusa Reservoir, downstream and upstream of the Elk River Mouth. Water quality, sediment quality and aquatic biota are regularly sampled as part of the monitoring program.

To view the full report, visit: *Koocanusa Reservoir Monitoring Program Annual Data Summary Report – 2022* https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Water Quality

In 2022 water levels were low in the spring (some samples were unable to be taken in April) and June water levels were the lowest since the start of the monitoring program in 2014.

Monitoring in 2022 indicated that some constituents were significantly higher downstream of the Elk River compared to upstream (e.g., nitrate, nitrite, selenium and total dissolved solids). However, consistent with past years, constituents (other than selenium) generally have concentrations that were below, or equal to, applicable BCWQG Guidelines and SPOs at the permitted Order station in the Koocanusa Reservoir downstream of the Elk River.

Monthly average selenium exceeded the SPO in April 2022 downstream of where the Elk River enters the Reservoir (Figure 2). The monthly average selenium concentration in February 2022 was not considered an exceedance because the Ministry rounds the monthly measurement to the nearest whole number when determining compliance with the selenium limit.

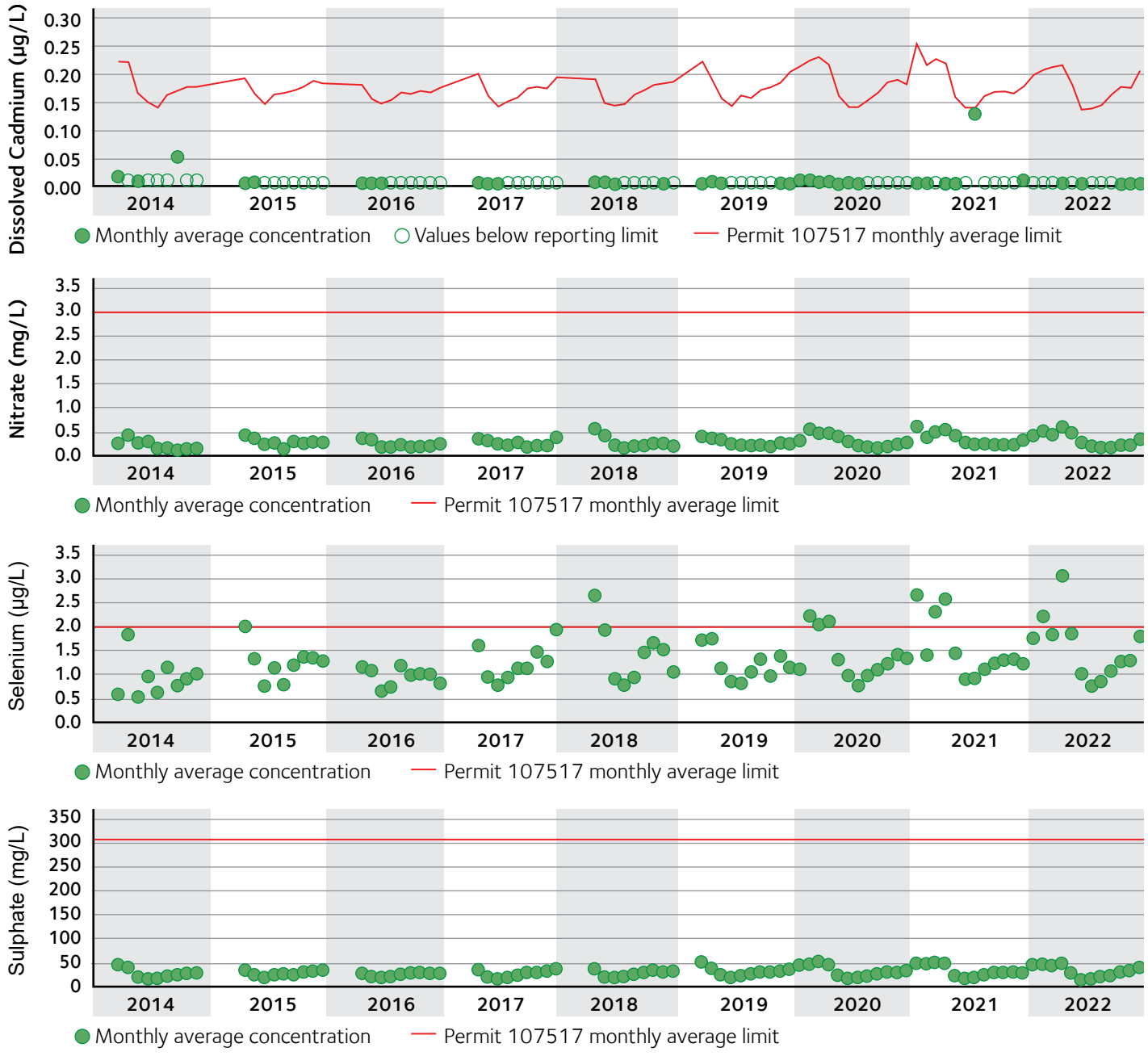


Figure 2. Monthly average concentrations of order constituents measured at the permitted order station, RG_DSELK.

Koocanusa Reservoir Monitoring

Fish Selenium Tissue Concentrations

Several fish species are monitored for concentrations of selenium in muscle tissue in the Koocanusa Reservoir (Figure 3).

Mean selenium concentration in all muscle tissue samples in 2022, except Redside Shiner at RG_ER, were below the BC guidelines (4 mg/kg dw) and the US EPA criterion (11.3 mg/kg dw) (Figure 3). Mean muscle tissue selenium concentration in Redside Shiner was 4.3 mg/kg dw at RG_ER.

A peer-reviewed study to characterize the effects of maternally transferred selenium on early life stages of Redside Shiner was completed. There was no adverse effect of selenium on embryo survival, deformity, or larval length up to the highest tested egg selenium concentration, indicating that the reproductive effects threshold for this species is >28 mg/kg dry weight. The study also demonstrated that sampling residual ovaries (i.e., the ovary tissue remaining after the ripe eggs were expressed) can overestimate selenium concentrations in ripe eggs, highlighting the importance of sampling eggs. Read the full study here: https://setac.onlinelibrary.wiley.com/doi/abs/10.1002/etc.5712.

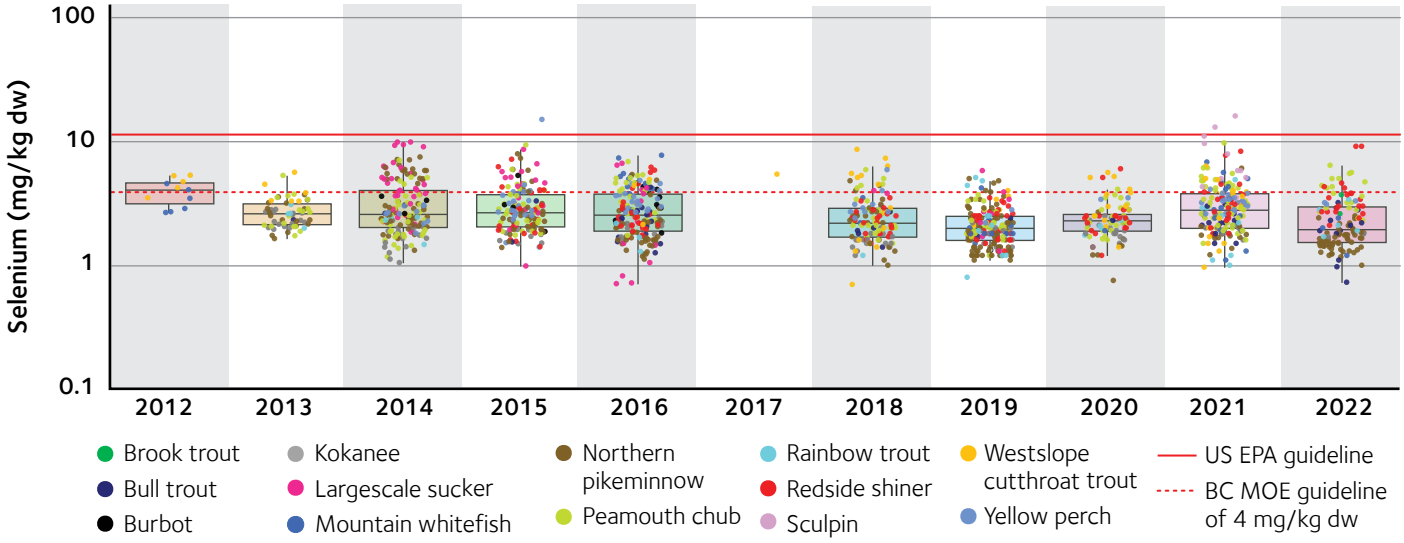
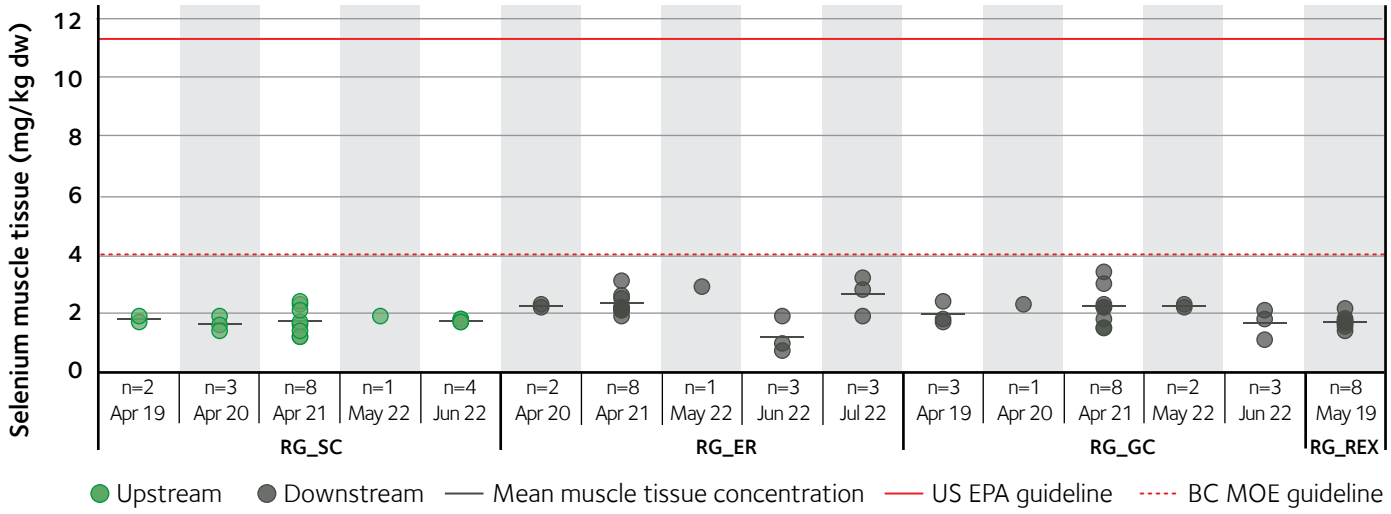


Figure 3. Fish muscle selenium concentrations for all locations within Koocanusa Reservoir.

Hoop net set downstream of bridge, Koocanusa Reservoir, near RG_SC in May 2023.

Bull Trout



Westslope Cutthroat Trout

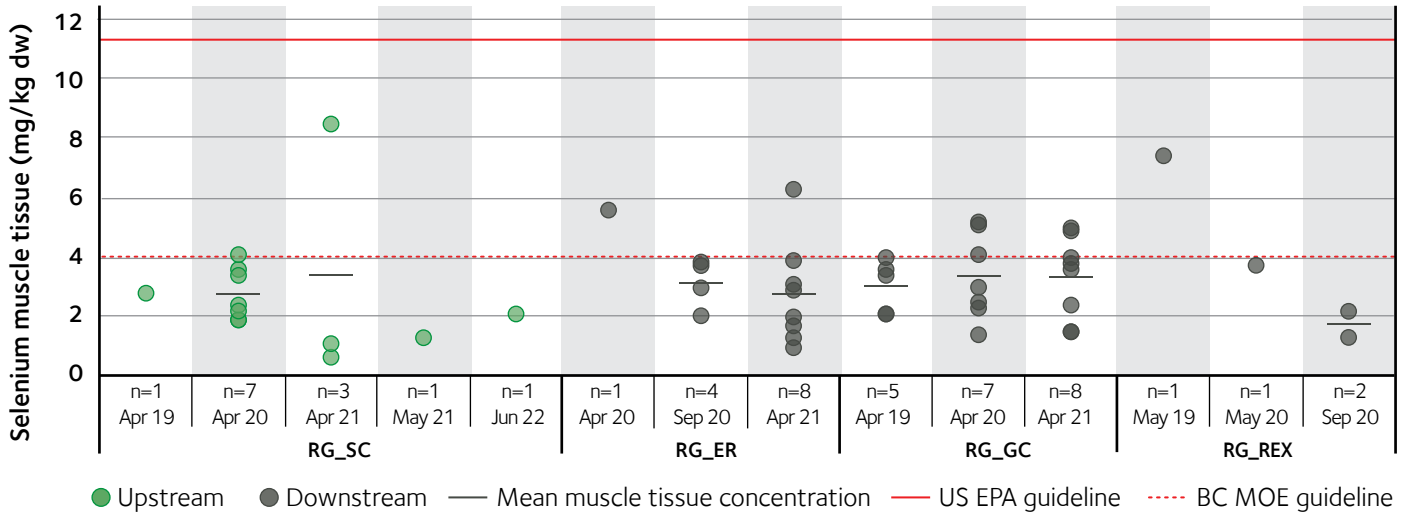


Figure 4. Concentrations of selenium (mg/kg dw) in fish muscle tissue, Koocanusa Reservoir Monitoring Program, 2019 to 2022.

Sport fish monitoring from 2019 to 2022 showed only Bull Trout had higher mean muscle selenium concentrations downstream of the Elk River compared to upstream, but concentrations remained below the BC guideline (Figure 4).

Westslope Cutthroat Trout mean selenium tissue concentrations were below BC guidelines for all years sampled (Figure 4).

Koocanusa Reservoir near RG_TN in June 2023.

Westslope Cutthroat Trout Populations

Upper Fording River

The Issue

Westslope Cutthroat Trout are the only fish species in the Fording River upstream of Josephine Falls. The British Columbia population is listed federally and provincially as Special Concern. Monitoring in fall of 2019 found that abundance of adults and sub-adults had declined significantly from previous sampling in 2017 (Figure 1).

Evaluation of Cause

An Evaluation of Cause (EOC) was developed to investigate, evaluate, and report on the reasons for the WCT population decline. Teck established a team of external SMEs who have had input from regulatory agencies, the KNC, and an independent scientist through various committees. The SMEs developed individual reports on each of the potential stressors and impact hypotheses.

The results of the individual stressor reports were used to support an integrated assessment of the causes for the decline in the fish population.

A final EOC report was produced in November 2021. Technical reviewers independent of the process provided 183 comments that Teck responded to in January 2022.

Constructed fish habitat in FRO Clode Creek.

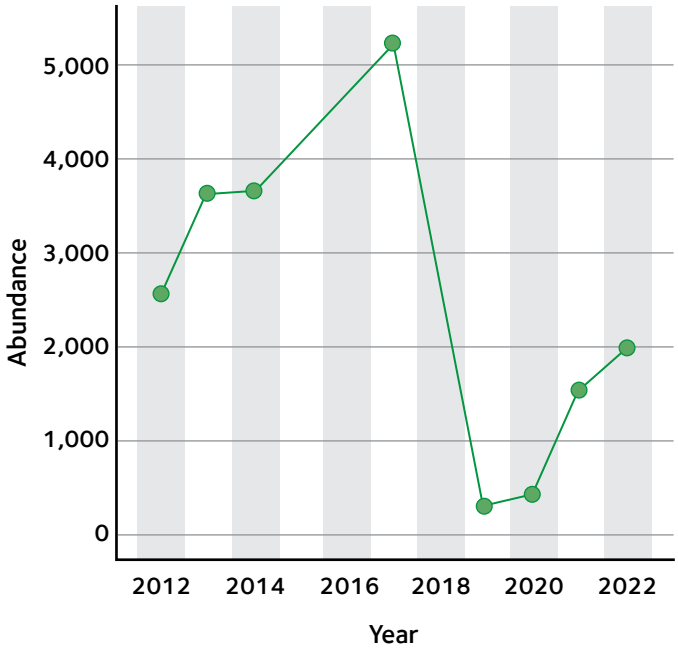


Figure 1. Estimated number of adult and sub-adult WCT in the UFR mainstem.

Outcome

The decline in abundance of WCT in the UFR is attributed to the interaction of extreme ice conditions (due to extreme, prolonged, cold air temperatures; seasonal, winter low flows; and low winter snowpack), sparse overwintering habitats and restrictive fish passage conditions during the preceding migration period in fall 2018.

Some of these stressors are natural, but mining development has altered the availability of overwintering habitats in portions of the UFR and exacerbated the challenges to fish passage through water use, channel widening and aggradation.

Read the full report: *Evaluation of Cause: Decline in Upper Fording River Westslope Cutthroat Trout Population, December 2021* https://www.teck.com/media/Upper-Fording-River-Evaluation-of-Cause-Report-December-2021.pdf

Underwater antenna array used to detect movements of tagged fish in the UFR.

Follow Up

Monitoring and research activities continued in 2022 including two new programs (indicated by *), all of which focused on understanding distributions of various life stages of WCT:

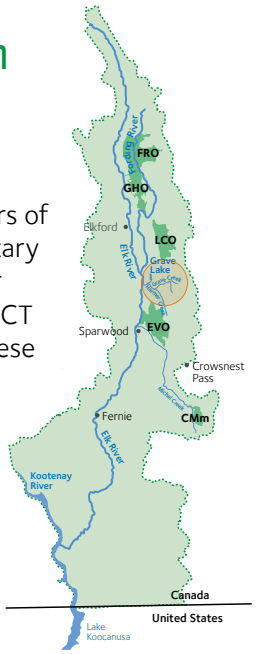
- Electrofishing surveys
- Tagging studies
- Spawning surveys
- Snorkel surveys of adult and sub-adult fish
- Angling surveys
- Night-time dip net surveys of fry*
- eDNA surveys*

Numbers of adult and sub-adult fish increased over the past three years (Figure 1), consistent with the conclusion that the decline occurred primarily as a result of short-term conditions.

Biologist conducting a snorkel survey in LCO Line Creek.

Westslope Cutthroat Trout Populations

Grave-Harmer Population



The Issue

Active mining occurs in the headwaters of EVO Dry Creek, which is a small tributary that flows into Harmer Creek. Harmer Creek then flows into Grave Creek. WCT are the only fish species residing in these three creeks. Both Harmer and Grave Creeks have comparable habitat characteristics except Harmer Creek is impacted by mining. Conversely, Grave Creek has no mine influence above the confluence with Harmer Creek.

Monitoring in 2017-2019 found that the abundance of juveniles (fish < 150 mm) had declined significantly in 2018 and 2019 in Harmer Creek (Figure 2). A similar reduction in juveniles was not observed in Grave Creek; therefore, these two creeks were studied under the EOC. Results of the EOC confirmed a recruitment failure of juvenile fish occurred.

Evaluation of Cause Process

An EOC process was established for the Harmer Creek population, similar to the UFR EOC, with a focus on the following potential causes:

- Water temperature and ice
- Instream flows
- Calcite
- Suspended solids
- Water quality, sediment quality
- Food availability
- Groundwater
- Small population size

A final EOC report was produced in March 2023. Read the full report: *Evaluation of Cause — Reduced Recruitment in the Harmer Creek Westslope Cutthroat Trout Population, March 2023* https://www.teck.com/media/Harmer-Creek-Evaluation-of-Cause%20-Report-March-2023.pdf

Abundance of fish

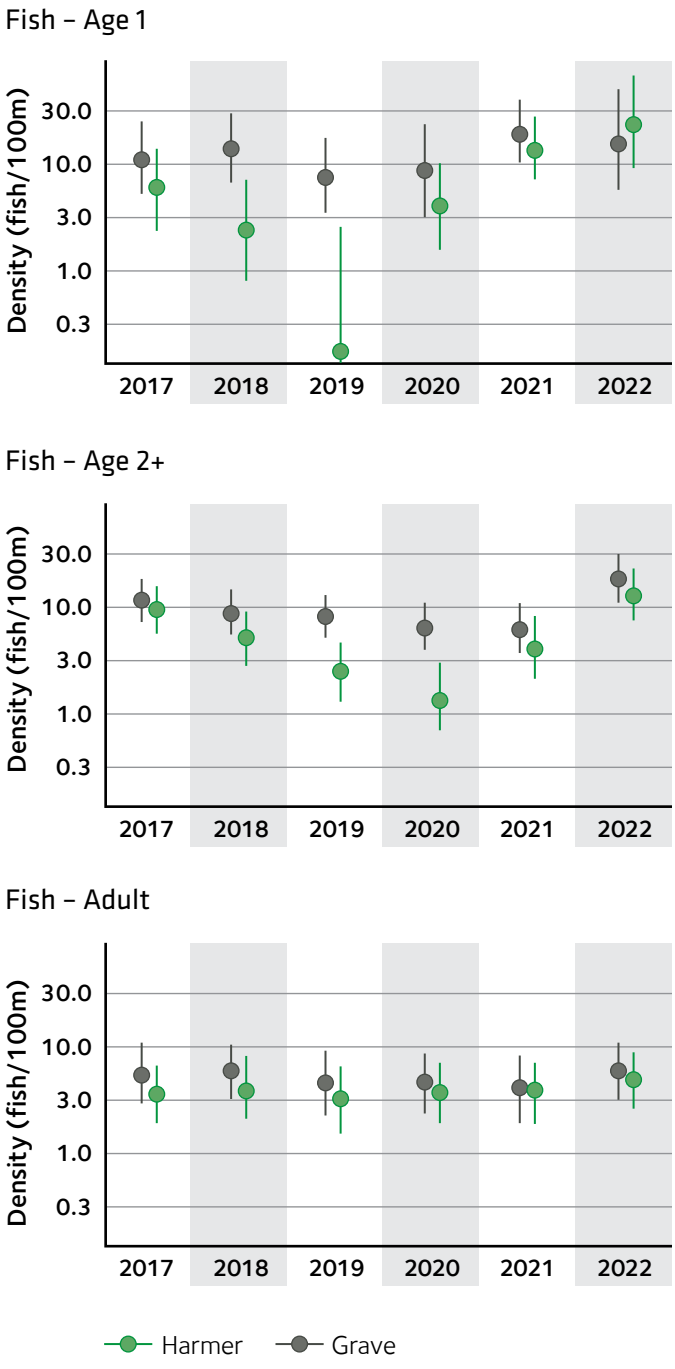


Figure 2. Estimated fish density by year, life stage and creek. Whiskers are 95% confidence intervals, indicating possible range of estimates.

Outcome

The EOC report concluded that the primary stressors contributing to reduced recruitment in 2018 to 2019 were naturally cool water temperatures, exposure to dietary selenium and habitat conditions in EVO Dry Creek. Cool water temperatures resulted in smaller young-of-year trout that are more prone to overwintering mortality. Selenium levels in Harmer were also high enough to modestly reduce growth of young-of-year fish (with implications for overwintering mortality). Habitat in EVO Dry Creek is highly calcified, impeding spawning, which may also be contributing to reduced recruitment in the Harmer system.

Westslope Cutthroat Trout.

Follow Up

Monitoring and research activities continued in 2022 including one new program (indicated by *), all of which focused on understanding distributions of various life stages of WCT:

- Electrofishing surveys
- Tagging studies
- Spawning surveys
- Night-time dip net surveys of fry*

Biologists electrofishing in EVO Harmer Creek.

Frequently Asked Questions

Frequently asked questions on this page were gathered from a survey to attendees at the 2021 EMC Public Meeting. The EMC answered only the questions within EMC scope.

Where can I learn more about water quality data in the Elk Valley?

The Elk Valley Water Quality Hub, produced by ENV, provides information, resources and tools on water quality within the designated area: elkvalleywaterquality.gov.bc.ca

Teck's monitoring reports are available at: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

What is Teck doing to improve water quality in the Elk Valley and when will water quality begin to improve?

Teck has constructed four treatment facilities to date (as of end of 2022), with a total treatment capacity of 77.5 million litres of water per day. The fourth treatment facility will be fully operational by the end of 2023. This is 5 million litres of water per day greater than the original treatment capacity anticipated for 2023 and a fourfold increase from 2020. The facilities are effectively removing 95% of selenium from treated water. More recently, Saturated Rock Fill (SRF) treatment at Elkview Operations (EVO) is removing up to 99%.

As a result, water quality monitoring shows that selenium levels are decreasing at points downstream of treatment in the Fording River. Selenium levels are also stabilizing in the Elk River and we expect further reductions in the Fording River, Elk River and the Koocanusa Reservoir as the fourth treatment facility becomes fully operational. Additional treatment is under development and coming online over the next five years, which is expected to result in an eightfold increase in treatment capacity over 2020 levels. In 2022, Teck published a progress update to the EVWQP, including its treatment schedule, entitled *Elk Valley Water Quality Plan and Implementation Plan Adjustments*. https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/news-and-publications/9318299e23a31b9c

The Permit requires that Teck meet progressively protective water quality limits over the next decade to meet expectations outlined in the EVWQP. Visualizations of how water quality has changed in the Elk Valley can be found on the Elk Valley Water Quality Hub website, which provides quarterly updates on water quality results and water treatment facility status and performance: https://elkvalleywaterquality.gov.bc.ca/pages/water-quality-dashboard.

Are Teck's monitoring programs robust?

The BC government oversees Teck's monitoring programs and sets requirements through the Permit, which requires Teck to:

- Collect samples according to approved scientific methods which are analyzed by accredited laboratories.
- Prepare study plans and reports that are signed off by qualified professionals (e.g., Registered Professional Biologists). These professionals are experts in their field of study and must follow their profession's code of ethics.
- Submit study plans, data and reports to the EMC for review.

Monitoring programs and study plans must be reviewed and approved by ENV. Ministry compliance staff audit water quality sampling, including lab testing. As required under the Permit, the EMC selects monitoring programs for an intensive third-party audit every three years.

Are Teck's treatment strategies showing an improvement to aquatic health?

Overall, water treatment facilities are reducing concentrations of selenium and nitrate below effect concentrations for sensitive aquatic life in most

locations. However, in some areas, treatment processes are introducing (e.g., organoselenium) or transporting existing (e.g., nickel) non-order constituents into the environment. These emerging issues are the focus of intensive monitoring and investigation to support improvements in aquatic health.

In addition to current water treatment technologies (e.g., SRF, Active Water Treatment Facility (AWTF), antiscalant), Teck is implementing other water quality management strategies in response to these emerging issues, including:

- Development of a nickel management strategy
- Bypassing sedimentation ponds to reduce organoselenium production (see LCO Dry, page 20)
- Adding particle filtration systems to SRFs and an Advanced Oxidative Process (AOP) to AWTF

Does monitoring indicate that Teck's water treatment is meeting the water quality targets of the EVWQP?

Monitoring results indicate that water quality limits are not always met in certain areas (Table 1 and 2). For example, selenium limits are regularly met in the Elk River and Michel Creek and are occasionally (seasonally) exceeded in the Fording River, Line Creek and Koocanusa Reservoir.

For compliance status see: https://elkvalleywaterquality.gov.bc.ca/pages/compliance-status

The Fording River and Line Creek are priority areas for water treatment to support meeting the EVWQP targets.

Table 1. Compliance record for order stations in 2022.

Location Code	Selenium	Nitrate	Sulphate	Cadmium
GH_FR1[1]	67%	67%	100%	100%
LC_LC5	83%	100%	100%	100%
GH_ER1	100%	100%	100%	100%
EV_ER4	100%	75%	100%	100%
EV_ER1	100%	92%	100%	100%
RG_ELKORES	100%	100%	100%	100%
RG_DSELK/LK2[2]	92%	100%	100%	100%

[1] GH_FR1 is both an order station and a compliance point.
[2] Until May 31, 2022, compliance with the SPOs was determined using results from RG_DSELK (E300230) only. As per an amendment letter dated June 1, 2022, LK2 includes five sampling locations along the cross-channel transect: RG_DSELK (EMS 300230), RG_DSELK_L2 (E327371), RG_DSELK_L1 (E327372), RG_DSELK_R1 (E327373), and RG_DSELK_R2 (E327374). Monthly average concentrations are calculated from daily transect averages.
Note. 100% means that Teck met the compliance limit at all times in 2022.

Table 2. Compliance record for compliance points in 2022.

Location Code	Selenium Daily Max	Selenium Monthly Average	Nitrate Daily Max	Nitrate Monthly Average	Sulphate Monthly Average	Cadmium Monthly Average
FR_FRABCH	78%	50%	42%	25%	100%	100%
GH_FR1[1]	97%	67%	92%	67%	100%	100%
GH_ERC	--	100%	--	100%	100%	100%
LC_LCDSSLCC	98%	83%	65%	25%	100%	100%
EV_HC1	--	100%	--	100%	100%	100%
EV_MC2	--	100%	--	100%	100%	100%
CM_MC2	--	100%	--	100%	100%	100%

[1] GH_FR1 is both an order station and a compliance point.
"--" indicates there is no limit in effect under the Permit.
Note. 100% means that Teck met the compliance limit at all times in 2022.

Frequently Asked Questions

What is selenium?

Selenium is a naturally occurring element found predominantly in the ground. Mining can expose selenium to air and water, allowing it to mobilize into waterways. Selenium can be found in different forms that vary in bioaccumulation potential and toxicity.

How does selenium impact fish?

Selenium is an essential nutrient for fish; however, excess selenium can impair growth and survival. A high concentration of bioaccumulated selenium in fish can alter enzyme function and metabolism, resulting in oxidative stress, tissue damage, and reduced growth. High selenium exposure can result in embryo-larval mortality and developmental defects.

Under the EVWQP, selenium tissue benchmarks have been developed for fish, invertebrates and birds to assess and characterize the risk of selenium bioaccumulation to aquatic dependent receptors and inform management decisions.

Why is nickel a concern?

Nickel is a naturally occurring element that is released into surface waters by weathering and erosion of geological materials (i.e., bedrock). In the Elk Valley, nickel is also released from mining waste rock through weathering processes similar to the release of the order constituents cadmium, nitrate, selenium and sulphate. Nickel was identified as a constituent of concern in Elk Valley mine-influenced waters through an investigation into unexpected chronic toxicity monitoring results in 2017 at Coal Mountain Operations (CMO).

Some local scale effects to mayflies have been attributed to nickel; however, current monitored nickel concentrations are not expected to have a direct impact on fish. Following Teck's Adaptive Management Process, investigations were initiated into nickel including derivation of Elk Valley-specific benchmarks.

ENV required Teck to consult with the EMC and develop science-based benchmarks considerate of sensitive benthic invertebrates and aqueous conditions in the Elk Valley. The new effects benchmarks are significantly lower than the BC Water Quality Guideline (BCWQG) and are being used in environmental impact assessments in the Elk Valley. The province is updating the BCWQG for nickel to recognize current research.

What is the state of non-municipal water sources in the Elk Valley?

BC Ministry of Health recommends testing and treating surface water (from rivers, streams or lakes) and groundwater at risk before drinking it anywhere in the province because of microbiological contaminants (bacteria, viruses and parasites) and industry-related substances. In the Elk Valley, industry-related substances are largely mine related. Untreated surface water should be boiled to address microbiological contaminants, but this will not address risks associated with mine-related substances.

In the Elk Valley, the surface water at many locations has selenium concentrations above the BC drinking water guideline of 10 µg/L (Figure 1). Some of these locations see these levels only during winter months, but some locations (such as tributaries close to mine operations) see these levels year round. Short-term exposure (skin contact or ingestion) from time to time is not a health risk; however, long-term frequent exposure increases the health risk.

Nitrate is another mine-related substance that has concentrations in river waters above drinking water quality guidelines in some areas of the Elk Valley. Consumption of river waters with elevated nitrate concentrations poses a health risk to infants when untreated surface water is regularly used to reconstitute infant formula.

Most people in the Elk Valley depend on groundwater wells for their drinking water, but some still rely on surface water. The results of the 2022 Teck's Regional Drinking Water Monitoring Program (RDWMP) indicated that 11 wells were above the drinking water guidelines for selenium and three of these 11 wells also had sulphate concentrations above the provincial aesthetic objective. No other mine-related constituents were above drinking water guidelines during this period. Seasonally elevated concentrations of mine-related constituents in these wells typically occurred during low-flow periods (October to April) when surface water concentrations can interact with groundwater aquifers. More information on potable water use in the Elk Valley is provided in a public notification issued in March each year (https://www.teck.com/media/ADV-016.2023_public_notification_01.pdf). We encourage private well and surface-intake owners in the Elk Valley to have their water tested regularly either through Teck's Regional Drinking Water Monitoring Program or independently through an accredited lab approved by the Provincial Health Officer.

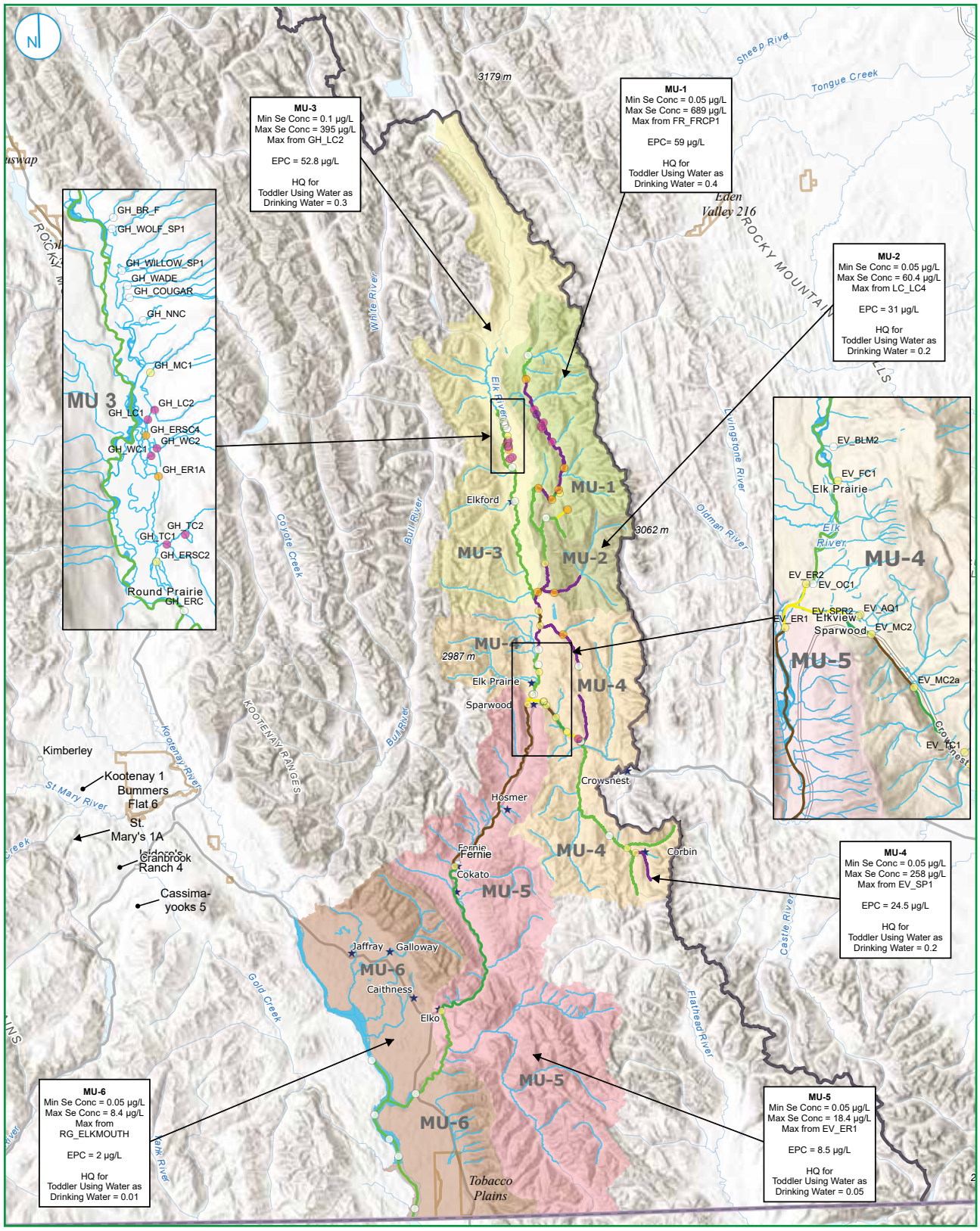


Figure 1. Total selenium concentrations in surface water (µg/l) and exposure point concentrations (epcs) of selenium in surface water

Are the fish safe to eat?

ENV and the BC Ministry of Health recommend the following screening values for selenium in fish tissue to protect human health: (see page 156 in: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg_companion_document.pdf)

- high fish intake: 7.3 µg/g dw
- moderate fish intake: 14.5 µg/g dw
- low fish intake 75 µg/g dw

In the Elk Valley (MUs 1 to 5 shown in Figure 1 on page 37), selenium in fish tissue in many areas is above the 7.3 µg/g screening value. However, exceeding a screening value only means that a detailed evaluation of human health risk should be conducted. To adequately assess human health risk in an area, all exposure pathways must be evaluated. This is what the Elk Valley HHRA will do. There are no fish consumption advisories for the Elk Valley at this time.

What is a Human Health Risk Assessment?

If contaminants of potential concern exceed water quality guidelines or screening values, a Human Health Risk Assessment (HHRA) can be conducted to more specifically assess the potential risk of health effects to human consumers. The risk assessment calculates the dose of contaminants ingested using measured concentrations of contaminants in different media (e.g., fish) and compares to daily intakes that have been documented to be safe. Teck is required to conduct an HHRA to assess potential risk to humans from mine-affected food and drinking water in the Elk Valley.

What is the status of the Elk Valley Human Health Risk Assessment?

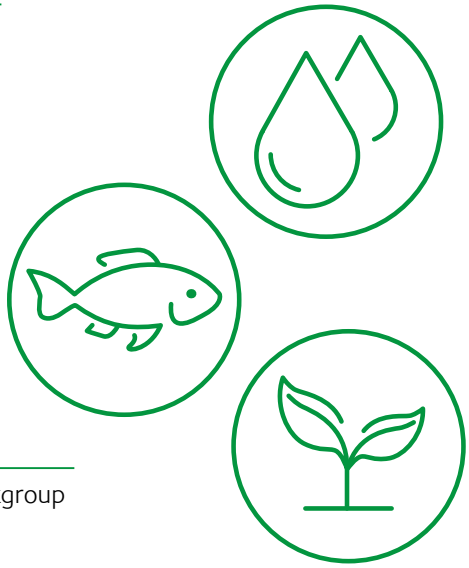
The Human Health Working Group has been collaborating on the Elk Valley HHRA since 2018. The assessment incorporates Ktunaxa interests and perspectives more comprehensively than previous Elk Valley HHRAs. Assessment methods and draft versions have been reviewed extensively by the working group, resulting in additions, refinements, and updates. The working group is reviewing the revised final HHRA report submitted in June 2023 to ensure reviewer input has been addressed and that the assessment meets the needs of their agencies. A second revised final report was submitted in October 2023.

2015

- A work plan for a human health risk assessment was reviewed by the EMC and approved by ENV.

2016

- Wild food samples donated by KNC for analysis.
- A human health risk assessment was completed and the final report was submitted to ENV and the EMC.
- EMC members concerned that potential health risks to Ktunaxa citizens were not adequately addressed.



2017

- Wild food samples donated by KNC for analysis.

2018

- Teck, KNC, IH and ENV established a dedicated workgroup committed to resolving concerns.

2019

- KNC launched an expanded diet study to understand preferred consumption rates of Ktunaxa citizens.
- Teck launched a wild game sample donation program for local hunters.
- Wild foods samples donated by KNC and local hunters for analysis.

2020

- Workgroup members collaborated on the various inputs to the risk assessment by sharing knowledge, expertise, and resources.
- KNC worked with Ktunaxa citizens to develop a conceptual site model that reflects Ktunaxa lifeways.
- KNC completed the Ktunaxa Diet Study Expansion.
- Wild foods samples donated by KNC for analysis.
- Teck re-launched its wild game sample donation program for local hunters.

2021

- The workgroup continued to collaborate on all decisions regarding inputs and assumptions for the risk assessment.
- The workgroup reviewed and discussed preliminary results.
- A draft report was provided to the workgroup for review.

2022

- The workgroup discussed comments and suggestions for the final report.
- A final report was submitted to ENV, the workgroup and the EMC.

2023

- The workgroup provided additional comments on the final report.
- A revised final report was submitted to ENV, the workgroup and the EMC.
- The workgroup provided additional comments on the revised final report.
- The workgroup continues to work through recent comments and suggestions on the revised final report. A second revised final report is expected to be submitted to ENV, the workgroup and the EMC in October 2023.

Glossary

acute toxicity
the adverse effects of a substance on an organism that result from either a single exposure or from multiple exposures in a short period of time.

adaptive management
a systematic, rigorous approach to environmental management that focuses on learning about important uncertainties, while at the same time implementing management actions based on the current understanding.

aquatic biota/aquatic life/aquatic organisms
animals (invertebrates, amphibians, fish, birds, etc.) that live in or depend on an aquatic environment.

area-based management plan
an environmental management plan for a designated area under the Environmental Management Act.

benchmark
a standard or point of reference against which things may be compared or evaluated.

- Level 1 benchmarks are derived to be concentrations below which no effects are expected on populations or communities of sensitive aquatic species.
- Level 2 benchmarks are derived to be concentrations at which low-level effects on populations of sensitive aquatic species are not expected but may be possible.
- Level 3 benchmarks are derived to be concentrations at which effects on populations of sensitive aquatic species would be expected and community-level changes may occur.

benthic
of, relating to, or occurring at the bottom of a body of water (e.g., lakes, rivers and streams).

benthic invertebrates
invertebrate organisms living at, in or in association with the bottom (benthic) substrate of lakes, ponds and streams. Examples of benthic invertebrates include some aquatic insect species (such as caddisfly larvae) that spend at least part of their lifestages dwelling on bottom sediments in the waterbody.

bioaccumulation
the buildup of substances, both toxic and benign, within the body tissues of an organism.

calcite
a mineral made up of calcium, carbon, and oxygen.

calcite concretion
a measure of the degree to which a particle (i.e., parts of the stream bed) is fused to adjacent particles by calcite: 0 = no concretion; 1 = concreted but movable by hand; 2 = concreted and immobile by hand.

calcite index
a numeric expression of the extent and degree of calcite formation; typically given as a range from 0 to 3.

chronic toxicity
the adverse effects of a substance on an organism that result from long-term exposure.

compliance point
a water monitoring station that is immediately downstream from one of Teck's mine operations in the Elk Valley.

confluence
occurs where two or more flowing bodies of water join together to form a single channel.

constituent
an element, substance, or ionic compound.

effluent
outflow or waste from human activities that is introduced into water or onto land.

Elk River watershed
the area that includes the Elk River and all of its tributaries.

Environmental Management Act
a British Columbia legislation that regulates release of effluent to water, land, and air.

ephemeroptera
a group of aquatic insects commonly called "Mayflies", occurring in aquatic environments as larvae, and often expressed as a percentage of the total numbers of benthos.

groundwater
water that flows beneath the water table, in soils and geologic formations.

human health risk assessment
an assessment to determine the potential risks to human health posed by the presence of contaminants within a defined area.

lentic
still water environments such as ponds and lakes.

local aquatic effects monitoring program
programs designed to answer specific questions about aquatic effects that arise because of the unique circumstances of a particular mine operation.

lotic
moving water environments such as creeks, streams and rivers.

metrics
a quantifiable measure that is used to track and assess the status of a specific process.

order station
a location specified by Ministerial Order No. 113 to monitor water quality.

organoselenium
refers to the forms of selenium that are created when selenium is taken up by algae and microbes and incorporated into biological compounds. Most or all of the selenium in

plants and animals is organoselenium. In surface waters, organoselenium is usually less than 0.1% of total selenium.

plecoptera
a group of aquatic invertebrates commonly called "Stoneflies", occuring in aquatic environments as larvae, and often expressed as a percentage of the total numbers of benthos.

reach
a section of a stream that is typically 100 metres long or more.

reference (stream, area, tributary)
a watercourse that has not been affected by mining activity; typically located upstream of mine operations.

regional aquatic effects monitoring program
a long-term monitoring program to assess potential regional scale effects in the aquatic environment downstream of mining operations within the Elk River watershed.

selenate
the most abundant and stable form of selenium in natural surface waters. It is the most oxidized form, similar in structure to sulphate. Selenium in Elk Valley waters is usually about 99% selenate.

selenite
is a more reactive form of selenium and is much less abundant than selenate in natural surface waters. Selenium in the Elk Valley is usually about 1% selenite.

selenium
is a naturally occurring element that is essential in low amounts for all life but can cause toxicity at high concentrations. Selenium is present in some mineral formations in the Elk Valley and is released by weathering of waste rock. It enters the food web in creeks and rivers when it is accumulated as a micronutrient by plants and algae.

site performance objective
an authorized target defined in the Permit for order stations.

tributary
a river, stream, or creek flowing into a larger river or lake.

trichoptera
a group of aquatic invertebrates commonly called "Caddisflies", occurring in aquatic environments as larvae, and often expressed as a percentage of the total numbers of benthos.

Upper Fording River (UFR)
consists of the Fording River and tributaries upstream of Josephine Falls, a natural barrier to fish passage. The UFR is mine-influenced and provides 57 km of mainstem habitat and 45 km of tributary habitat for WCT. Within the UFR, Teck operates three coal mines: Fording River Operations (FRO), Greenhills Operations (GHO), and Line Creek Operations (LCO).

water quality guideline
the recommended limit for the concentration of a substance in the water to protect ecological or human health; may be federal or provincial.

Abbreviations

AAS	Antiscalant Addition System
ABMP	Area-Based Management Plan
AMOD	Adaptive Management Open Dialogue
AOP	Advanced Oxidative Process
AWTF	Active Water Treatment Facility
BC MOE	BC Ministry of Environment
BCWQG	BC Water Quality Guidelines
BIT Se	benthic invertebrate tissue selenium
Cc	calcite concretion
CI	calcite index
CMm	Coal Mountain Mine
CMO	Coal Mountain Operations
Cp	calcite presence
DCWMS	Dry Creek Water Management System
DMSeo	dimethylselenoxide
EMA	Environmental Management Act
EMC	Environmental Monitoring Committee
EMLI	BC Ministry of Energy, Mines & Low Carbon Innovation
ENV	BC Ministry of Environment and Climate Change Strategy
EOC	Evaluation of Cause
EPT	ephemeroptera, plecoptera, tricoptera
EVO	Elk Valley Operations
EVWQP	Elk Valley Water Quality Plan
FRO	Fording River Operations
GHO	Greenhills Operations
HHRA	Human Health Risk Assessment
IH	Interior Health
KNC	Ktunaxa Nation Council
LAEMP	Local Aquatic Effects Monitoring Program
LCO	Line Creek Operations
MeSe(IV)	methylseleninic acid
mg/kg dw	milligram per kilogram of dry weight
MU	management unit
OrganoSe	organoselenium
Permit	Permit 107517
RAEMP	Regional Aquatic Effects Monitoring Program
RDWMP	Regional Drinking Water Monitoring Program
Se	selenium
SeSMP	Selenium Speciation Monitoring Program
SME	subject matter expert
SPO	site performance objectives
SRF	saturated rock fill
Teck	Teck Coal Ltd.
UFR	Upper Fording River
US EPA	United States Environmental Protection Agency
WCT	Westslope Cutthroat Trout