PERMIT 107517

ENVIRONMENTAL MONITORING COMMITTEE

2022 Public Report

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About this Report

This report is prepared by the members of the Environmental Monitoring Committee and is produced and distributed with the support of the British Columbia Ministry of Environment and Climate Change Strategy (ENV) and Teck Coal Ltd. (Teck).

For information about the Environmental Monitoring Committee and what it does, see page 5.

This report summarizes the 2021 monitoring results presented in the technical reports that Teck submitted to ENV. These technical reports are available to the public and 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

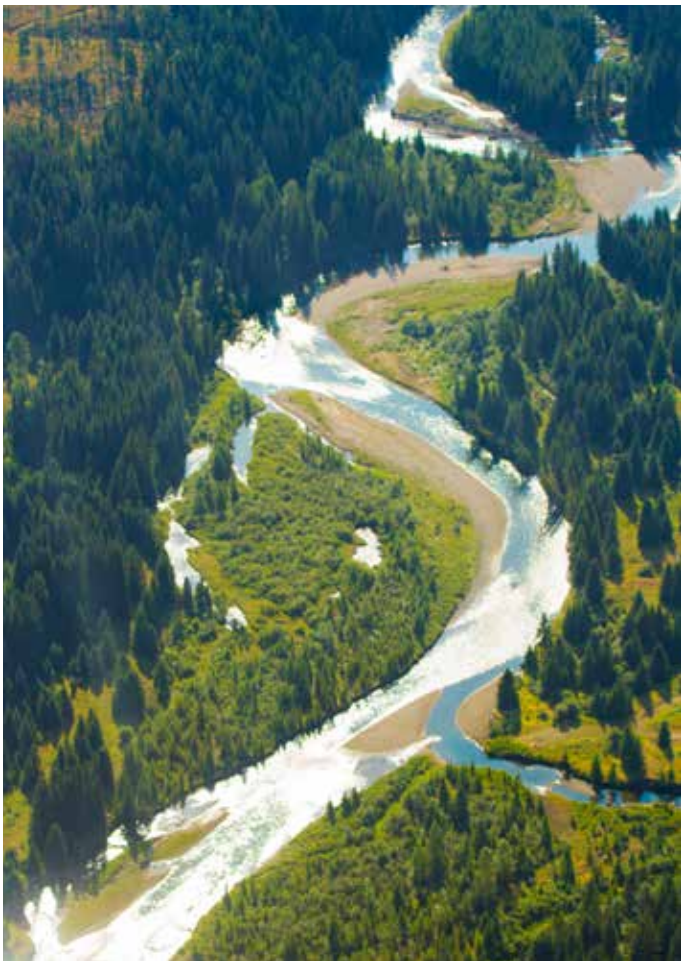
The Elk Valley Water Quality Plan

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. Monitoring results indicate that the concentrations of these substances are 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) and to identify 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

Learn more about the EVWQP here: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/news-and-publications/9318299e23a31b9c



The Elk Valley Permit

Following the approval of the EVWQP, ENV issued Permit 107517—often called the Elk Valley 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.

Teck must meet all the requirements in the Permit. Permit 107517 is regional and does not replace any previously issued permits.

Permit 107517 requires Teck to form an Environmental Monitoring Committee (EMC).

The purpose of the EMC is to strengthen Teck's aquatic environmental monitoring programs required under Permit 107517.

The Environmental Monitoring Committee

The Environmental Monitoring Committee, or the EMC, was formed in 2015 following the issue of Permit 107517.

Today the EMC includes 10 members

- one independent aquatic scientist
- two representatives from the BC Ministry of Environment and Climate Change Strategy (ENV)
- two representatives from the BC Ministry of Energy, Mines & Low Carbon Innovation (EMLI)
- one representative from the BC Interior Health (IH)
- two representatives from the Ktunaxa Nation Council (KNC)
- two representatives from Teck

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

- a Facilitator
- an Administrator
- a meeting note-taker

The EMC provides technical advice and Indigenous Knowledge to Teck's ongoing monitoring submissions, associated supporting studies and reports required under Permit 107517. The EMC does this by reviewing submissions, sharing open dialogue and documenting advice and input as part of the review process to support continual improvement in monitoring activities under the EVWQP and the Permit.

The EMC hosts an annual public meeting to inform the public and the scientific community of activities and findings for the year.

Read EMC public reports and publicly available Teck reports: 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 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 wuʔu ɛ ʔamakʔis (water and lands) 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 (Figure 1) 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

Permit 107517 requires water quality targets for concentrations of selenium, sulphate, nitrate, and cadmium in the water. Long-term targets are meant to protect aquatic life. Teck is required to monitor water quality at 155 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 Permit 107517: compliance limits and site performance objectives.

Compliance limits are set for compliance points (Figure 1). Compliance points are water monitoring stations that are downstream from each of Teck's mine operations in the Elk Valley. 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 (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 by Ministerial Order. 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.

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

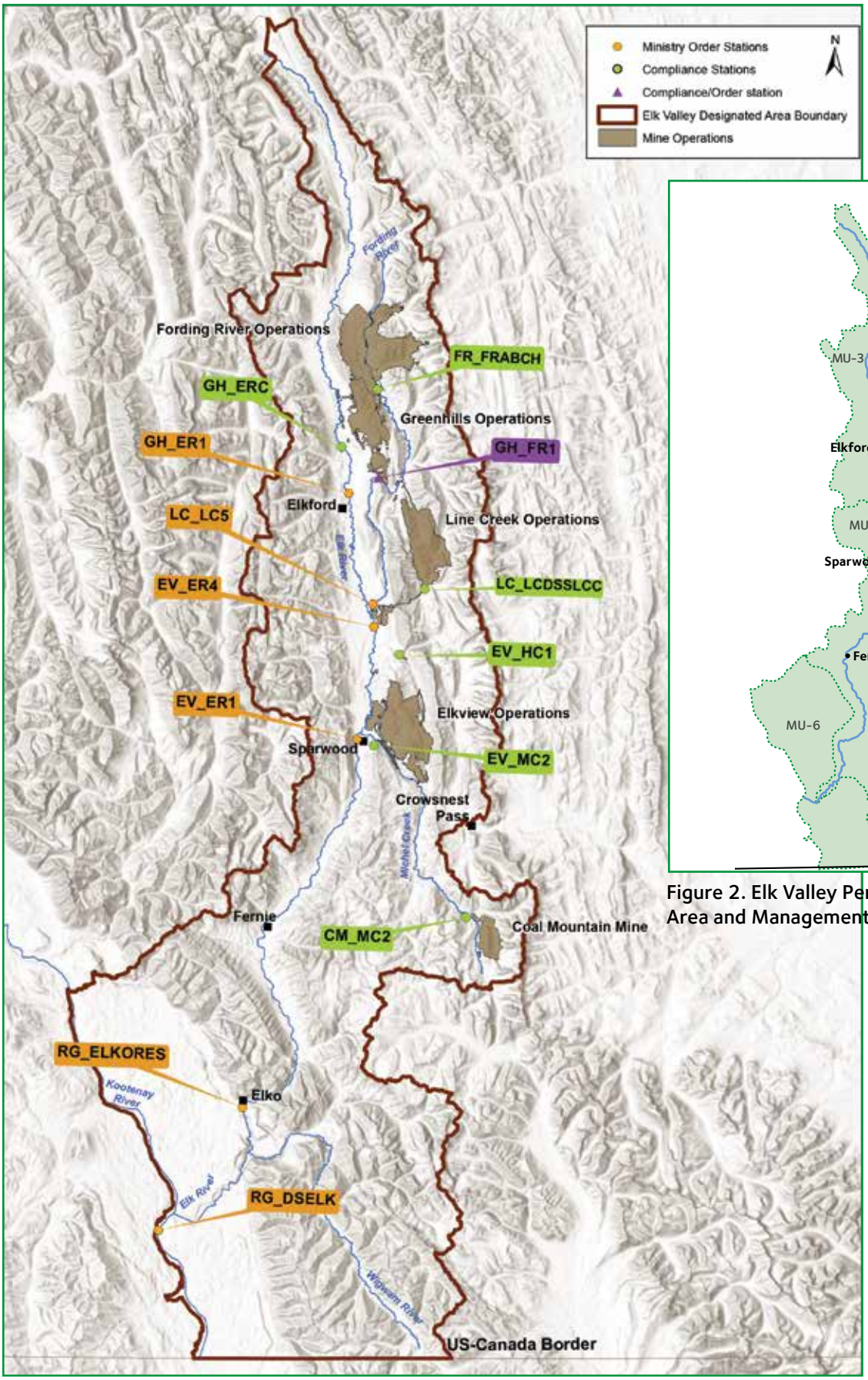


Figure 1. Elk Valley Permit 107517 Designated Area, Mine Operations, Compliance and Order Stations.

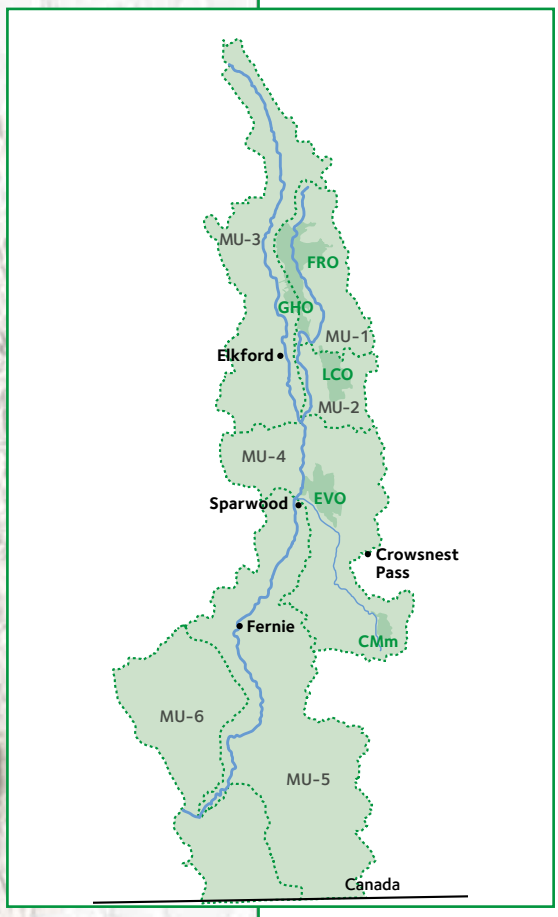


Figure 2. Elk Valley Permit 107517 Designated Area and Management Units.

Frequently Asked Questions

What is selenium?

Selenium is a naturally occurring element found predominantly in the ground. Mining activity 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 human health?

Although selenium is an essential micronutrient for humans, it can be toxic when ingested at high concentrations. Selenium is known to bioaccumulate, and prolonged exposures to a high-selenium diet can result in increasing levels of selenium in the body. In humans, symptoms of chronic overexposure to selenium, called selenosis, include fatigue, hair and nail damage or loss.

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 birth defects.

Are the fish coming back?

Preliminary results indicate Westslope Cutthroat Trout (WCT) population is growing in the upper Fording River after a severe cold weather event in 2019. The upper Fording River will remain closed to fishing, but Teck is supporting the WCT through instream habitat restoration, reducing water use and water treatment facilities. Teck has intensified fish monitoring to track success to these mitigation activities as well as the potential influence of climate change.

What is Teck doing to improve water quality in the Elk Valley?

As per the EVWQP, Teck is focused on stabilizing and reducing the concentrations of selenium and other constituents to reach the long-term targets. Teck has three water treatment facilities that are effectively removing 95% of selenium from water. A fourth is being commissioned and additional facilities are under development. By the end of 2022, Teck will have the capacity to treat up to 77.5 million litres of water per day — a fourfold increase from the treatment capacity in 2020.

With this capacity, it is expected that one of the primary objectives of the EVWQP will be achieved: stabilizing and reducing the selenium trend in the Elk Valley. Significant additional treatment is under construction and coming online over the next five years which will result in a further eight fold increase in treatment capacity over 2020 levels. Teck recently published a progress update to the EVWQP, including its treatment schedule: https://www.teck.com/sustainability/sustainability-topics/water/water-quality-in-the-elk-valley/news-and-publications/9318299e23a31b9c

How can calcite concretion be a problem in waterways?

Calcite (as calcium carbonate) is a naturally occurring compound and is further mobilized into waterways by the weathering of mining spoils near headwaters. There are some mine impacted tributaries throughout the Elk Valley where calcite concretion has been observed.

Calcite concretion reduces the spacing between rocks that provides habitat for benthic communities and overwintering areas for fish. Calcite accumulation on a streambed may influence the suitability of spawning habitat by making it more challenging for the fish to move the substrate and create nests (redds).

For more information about the 2021 Regional Calcite Monitoring Program visit: https://www.teck.com/media/Calcite-Monitoring-Program-2021.pdf

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 waste rock through weathering processes similar to the release of the Order Constituents cadmium, 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 observed although 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 nickel interim screening values and benchmarks.

Benthic invertebrates (aquatic insects) are the most sensitive organisms to nickel and are the primary environmental concern related to nickel in the Elk Valley (fish and amphibians are much less sensitive to nickel). BC has a working water quality guideline of 150 µg/L but this guideline is out of date. Current literature and field observations indicate that benthic invertebrates, are sensitive to nickel concentrations as low as 5.3 – 15 µg/L.

The EMC are working to better understand the local risks associated with nickel. Teck submitted the Nickel Benchmark Report on August 31, 2022 and it is currently under review by the EMC.

EMC 2021 Monitoring Highlights

Monitoring programs completed under Permit 107517 are comprehensive and extend through the Elk Valley. During EMC conference calls, EMC members, Teck Study Teams and Consultants engage in scientific discussion and peer review of Teck's monitoring 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 Elk River watershed as a whole. The 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) with the exception of the upper Fording River. When considering management units as a whole, effects on the aquatic environment were not wide-spread.

For this Report, the EMC members from Teck, ENV, IH and the Independent Scientist reviewed 2021 monitoring work geographically. From this high-level view the EMC identified five focus topics of interest from 2021 to highlight in this report:

1. Westslope Cutthroat Trout Populations
2. Greenhills Operations Calcite Monitoring
3. Line Creek Operations Dry Creek Monitoring Results
4. Elkview Operations Saturated Rock Fill
5. Koocanusa Monitoring

For an in-depth look at 2021 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-reports/

Figure 1. 2021 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:

30,836 **pages of reports**

21 **data packages**

totalling
1,082 **tabs filled with data**

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

Participated in
51 **conference calls**

totalling **102** **hours**

with over **685** **attendees**

Contributed
475 **pieces of advice and input** → in **53** **advice and input tables**

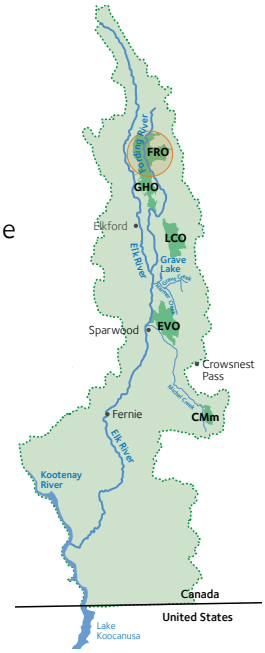
Collaborated to develop this EMC Public Report

Westslope Cutthroat Trout Populations

Upper Fording River

The Issue

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



Evaluation of Cause Process

An Evaluation of Cause Process (EOC) was developed to investigate, evaluate, and report on the reasons for the WCT population decline. Teck established a team of external subject matter experts who had input from regulatory agencies and the KNC. The subject matter experts developed individual reports on each of the potential stressors and impact hypotheses.

Upper Fording River Westslope Cutthroat Trout.

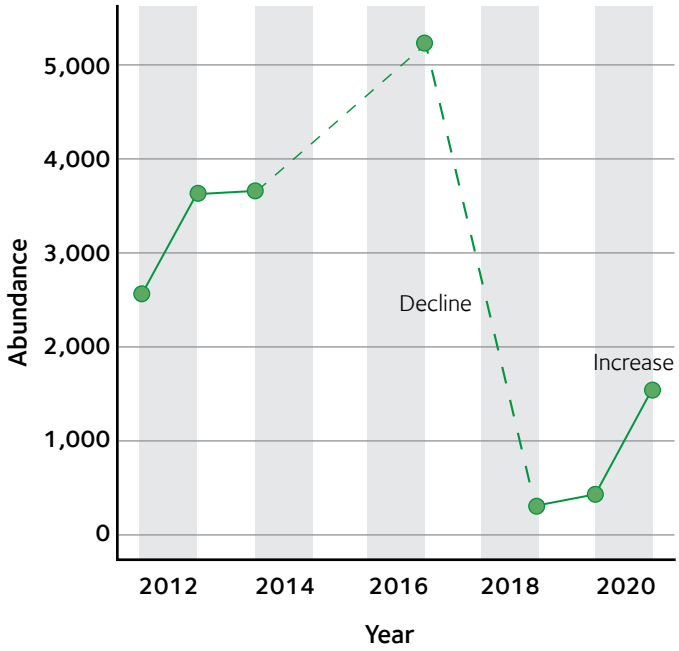


Figure 1. Westslope Cutthroat Trout abundance over time, for adults and subadults (>200 mm).

The results of the individual stressor reports were used to support an integrated assessment of the causes of 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.

Outcome

The decline in abundance of WCT in the upper Fording River 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 the fall of 2018.

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

Read the Upper Fording River Evaluation of Cause Report: https://www.teck.com/media/Upper-Fording-River-Evaluation-of-Cause-Report-December-2021.pdf

Upper Fording River Westslope Cutthroat Trout.

Follow Up

The Upper Fording River WCT population was monitored in 2020 and 2021. Numbers of adult and subadult fish (greater than 200 mm) increased in 2020 and 2021 (Figure 1). Fish populations vary naturally over time as they respond to environmental pressures. Teck is committed to studying this fish population with an annual program that includes estimating numbers of WCT for multiple life stages to understand high-elevation population dynamics.

In 2021 Teck commenced a WCT recovery action plan with input from KNC, the Province, DFO and External Subject Matter Experts. The Plan includes habitat and water quantity improvements over the next 5 years.

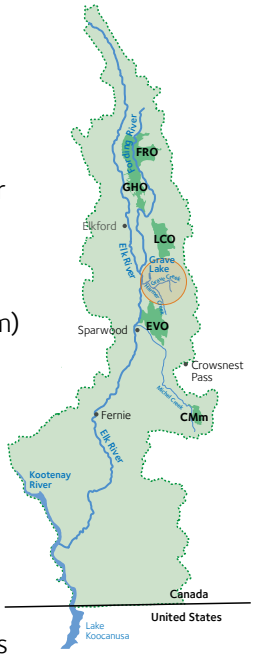
Upstream portion of Ewin Creek that was backpack electrofished, September 2021.

Westslope Cutthroat Trout Populations

Harmer Creek

The Issue

WCT is the only fish species in Harmer Creek and is listed as Special Concern in British Columbia. Monitoring in 2017-2019 (Figure 2) found that abundance of juveniles (fish < 150 mm) had declined significantly in 2018 and 2019 (Figure 3). Subsequent analysis confirmed a recruitment failure of juvenile fish occurred.



Evaluation of Cause Process

Similar to the Upper Fording River, an EOC process was established for the Harmer Creek population, with a focus on the following potential causes:

- water temperature and ice,
- instream flows,
- calcite,
- suspended solids,
- water quality, sediment quality,
- food availability,
- groundwater, and,
- small population size.

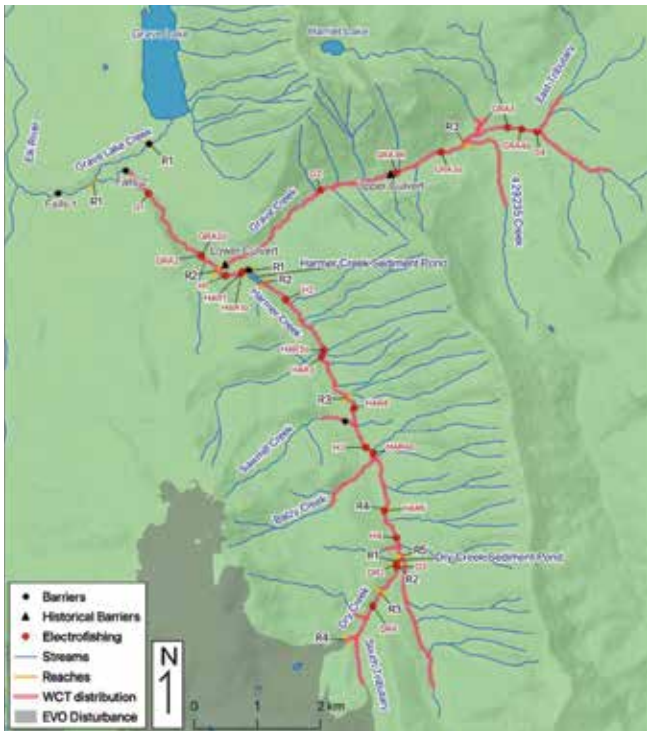
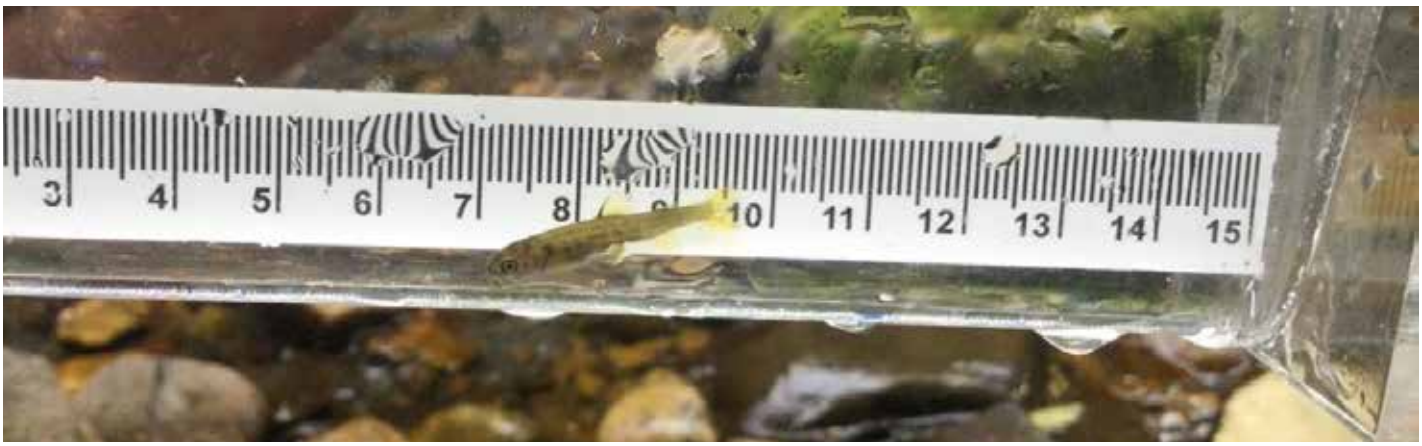


Figure 2. Grave and Harmer Creek study area with upstream historical and current barriers, electrofishing locations, reach breaks and the potential fish distribution.

Outcome

Individual reports are still being developed by subject matter experts. The EOC process will be completed by the end of 2022. Harmer Creek is cool, with summer temperatures below the WCT optimum for growth. Overwintering age 0+ fry in Harmer Creek have been ~ 6 mm shorter than fry in Grave Creek, with the



Westslope Cutthroat Trout in Grave Creek by backpack electrofishing, September 2021.

difference considered to be sufficient to reduce overwintering survival compared to Grave Creek. Indications to date suggest that temperatures are one potential cause of shorter fry. Water quality, particularly selenium concentrations, is another potential cause of shorter fry. Historical temperature and water quality monitoring were insufficient to resolve the relative influences on WCT fry size and mortality, and more studies are being conducted to understand the magnitude of those potential influences.

Follow Up

The Harmer WCT population was monitored in 2020 and 2021. Harmer Creek data are compared to support understanding of the cause of the decline. Numbers of adult fish did not decline (in 2018/2019) and have been stable since then. Numbers of 1+ and 2+ fish increased in 2020 and 2021 (Figure 3). 2021 was a warmer year including the BC heat dome event and good Age-0 recruitment was observed. Teck is committed to learning about this population and has initiated a recovery program to support the population.

Beaver dam complex upstream of Harmer Dam.

Abundance of fish

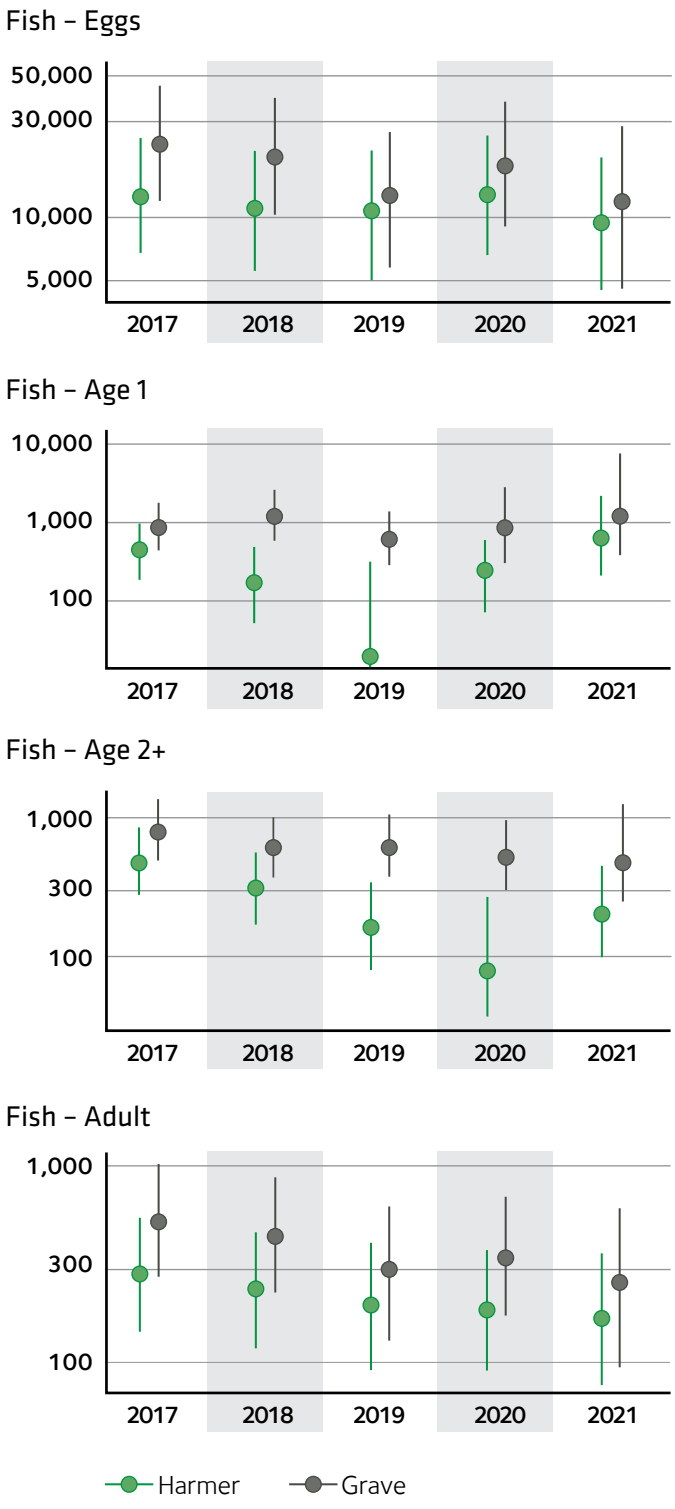
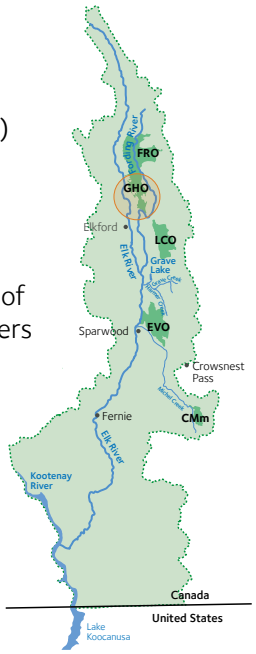


Figure 3. Estimated number of WCT by age class in Harmer Creek and Grave Creek.

Greenhills Operation Calcite Monitoring

Background

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



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.

Water Quality

GHO mining activities such as discharges from pit pumping continue to impact the water quality at the west side tributaries and Greenhills Creek. As of 2021, there remain elevated concentrations of selenium, nickel, sulphate, nitrate, and total dissolved solids (TDS) in most of the west side tributaries. Thompson Creek provides the largest loading of mining constituents, notably selenium, to the Elk River. However, the selenium concentration in the Elk River remains below the EVWQP level 1 benchmark.

Greenhills Creek shows decreasing concentrations of nickel, but selenium concentrations are consistent with previous years.

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.

$$Cp + Cc = CI$$

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. Different metrics used to describe calcite in streams.

Why care about calcite?

Within each stream reach, rocks are randomly inspected for both calcite presence (Cp) as well as the degree of calcite concretion (Cc). These scores are summed to yield a calcite index (CI) (Figure 1).

Calcite index scores range from 0 (no calcite) to 3 (fully concreted streambed) (Figure 2). Figure 2 shows, an increase in calcite index is associated with increased calcite concretion of the streambed.

Calcite concretion reduces the spacing between rocks that provides habitat for benthic communities and overwintering areas for fish. Calcite accumulation on a streambed may influence the suitability of spawning habitat by making it more challenging for the fish to move the substrate and create nests (redds).

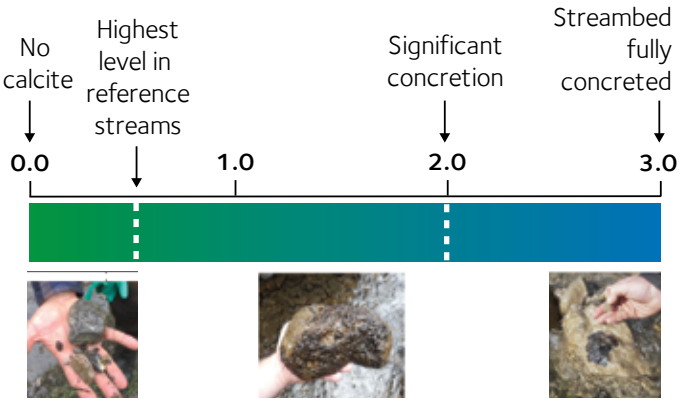


Figure 2. Examples of rocks at different calcite indices.

Calcite Extent

The map (Figure 3) shows the calcite index for the west side tributaries and Greenhills Creek. A high degree of calcite concretion has been observed at Greenhills, Thompson, Wolfram South, and upper Mickelson Creeks.

Calcite concretion continues to increase at the GHO west tributaries and remains a concern to aquatic biota (notably benthic invertebrates and Westslope Cutthroat Trout) in Greenhills Creek.

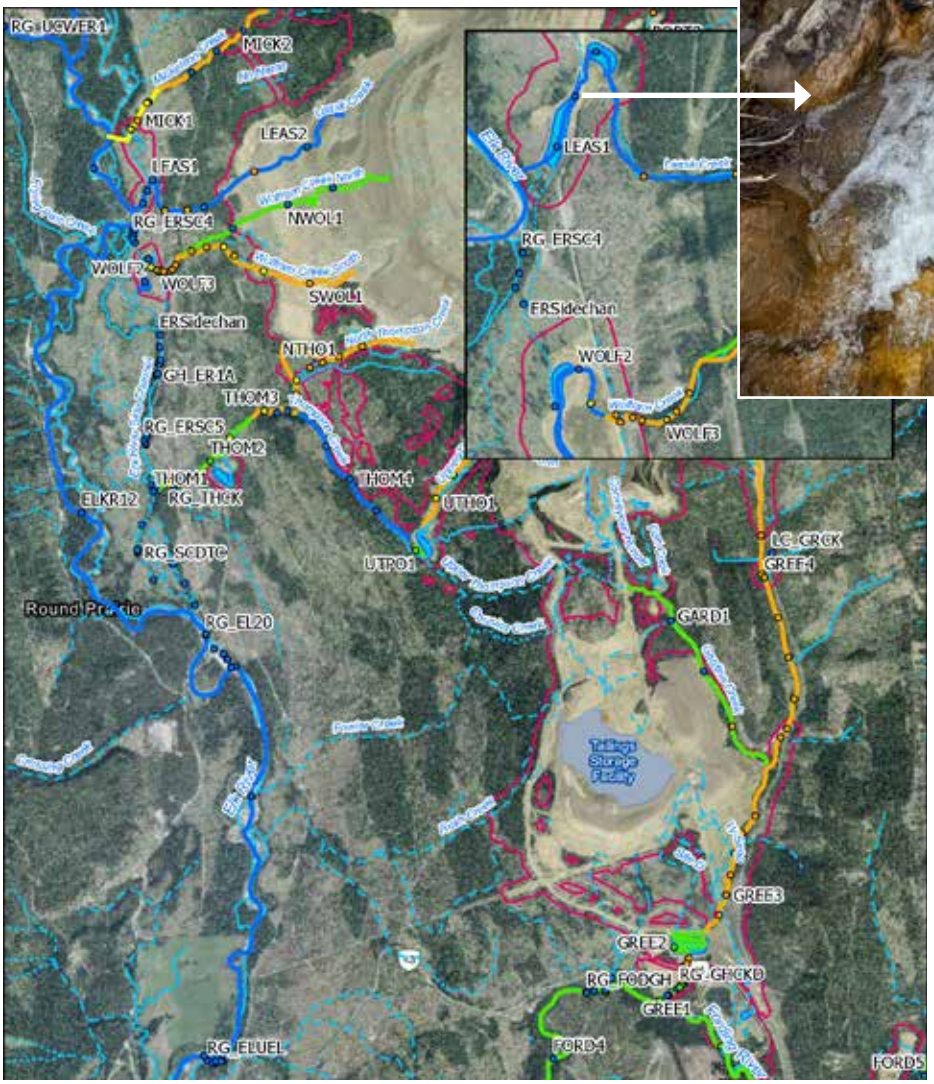


Figure 3. Map showing calcite index for GHO west side tributaries and Greenhills Creek.

Fully concreted section of streambed at Leask Creek which is not fish bearing and does not connect to the Elk River.

Regulatory Requirement

Permit 107517 requires Teck to meet a medium-term 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.

Greenhills Operation Calcite Monitoring

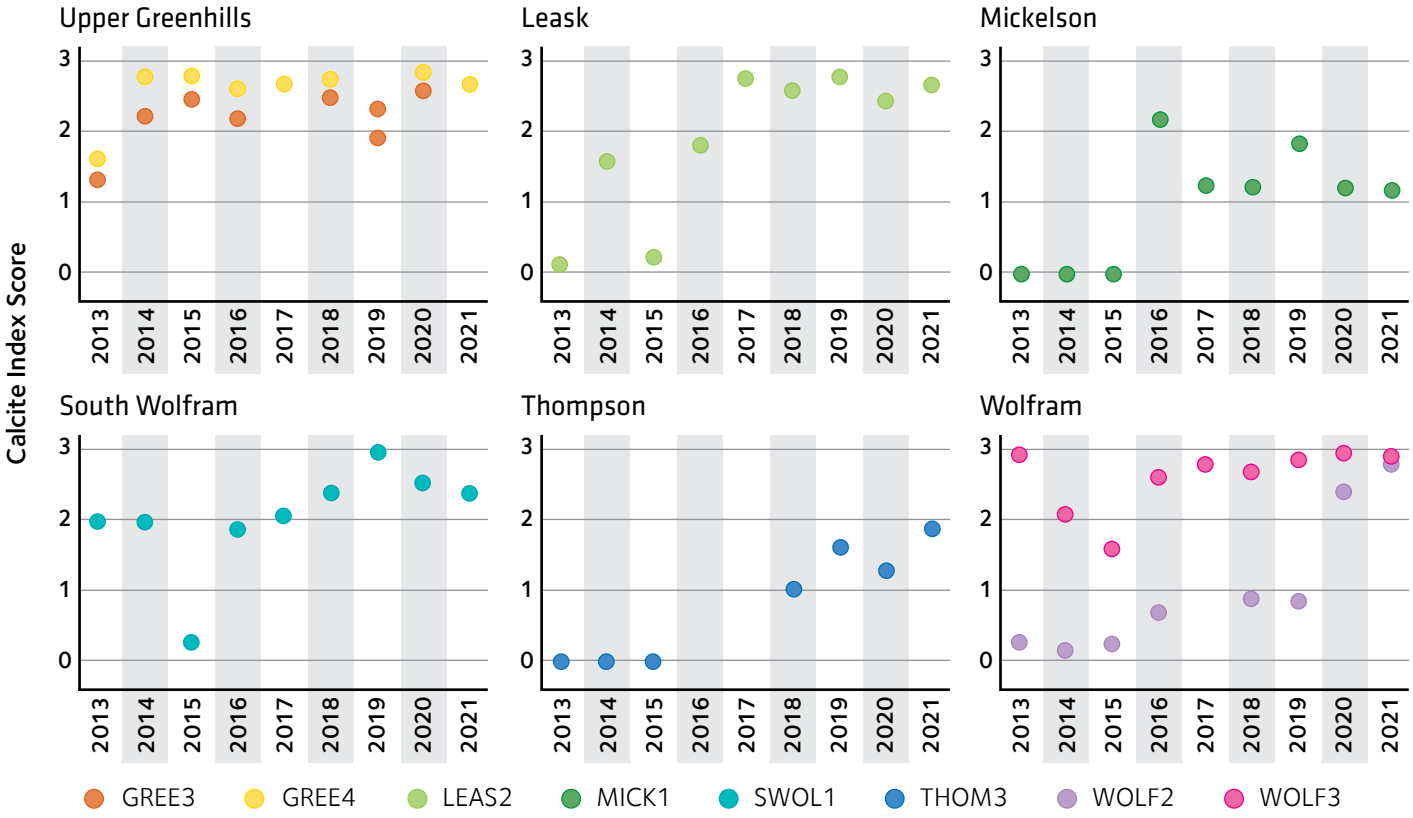


Figure 4. Calcite index scores from 2013 to 2021 for GHO west side tributaries and Greenhills Creek.

GHO Calcite Trends

There is an increasing trend in calcite index scores at upper Greenhills Creek and in most of the west side tributaries due to an increase in concretion (Figure 4). Several monitoring locations show complete concretion of the streambed.

Calcite Management

Antiscalant dosing has been effective in mitigating calcite concretion at lower Greenhills Creek (Figure 5). Plans are underway to install an antiscalant addition facility in upper Greenhills (directly above the confluence with Gardine Creek) by the end of 2022 to address calcite concretion closer to the mine spoils. An antiscalant addition facility is also planned for Thompson Creek by the end of 2023.

Deployment of antiscalant addition facilities is complicated by the observation that calcite co-precipitates some metals.

Calcite prevention strategies, therefore, need to consider the potential increase in other metals in the absence of calcite formation.

Antiscalant facility at lower Greenhills Creek.

Stream rehabilitation (by calcite excavation and substrate replacement) was originally planned for 2022 in upper Greenhills Creek but was delayed due to concerns about potential impacts on WCT populations. Teck has submitted permit applications to trial calcite remediation at other locations with reduced risk to aquatic life.

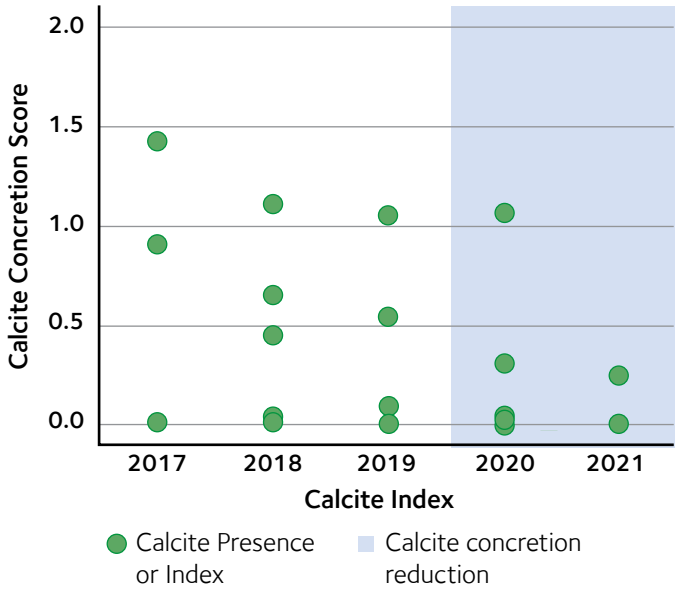


Figure 5. Reduction in calcite concretion at lower Greenhills Ck (RG_GHBP) coinciding with antiscalant addition (shaded box).

Impacts to Aquatic Life

Calcite impacts aquatic health by reducing available streambed habitat. Trends in fish and benthic invertebrate populations provide information on the severity of this impact and inform calcite management priorities.

Fish Habitat

Greenhills and Gardine Creeks are home to an isolated population of WCT. The WCT population in Greenhills/Gardine is not well documented. Heavy calcification may be impairing the sustained recovery of the population. Fish condition in 2021 decreased slightly at upper Greenhills Creek and Gardine Creek compared to 2017-2019, but it is unclear whether this observation is linked to water quality, calcite or other factors. There is a growing understanding that calcite concretion impairs the ability of fish to dig spawning nests (redds).

Benthic Invertebrates

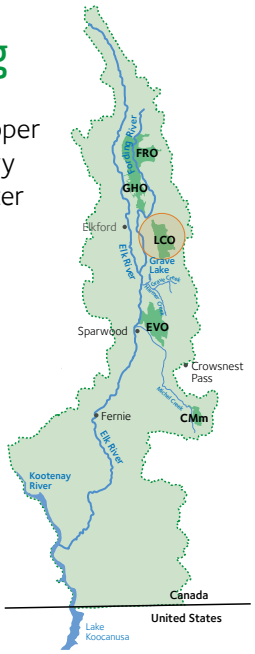
Calcite can impact benthic invertebrates by impairing access to food sources and, in highly concreted reaches, immobilizing larvae. In addition to impacts from calcite, benthic invertebrate tissue selenium at Thompson Creek and Lower Greenhills Creek was observed at concentrations that can impair the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

Caddisfly larvae in its casing at Corbin Creek. Calcite is present at the top of the rock.

Caddisfly.

LCO Dry Creek Monitoring Results

Environmental Setting



LCO Dry Creek is a tributary to the upper Fording River. 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.

Approximately 5.5 km of habitat is considered accessible to Westslope Cutthroat Trout from the Upper Fording River population. It is limited by a complete barrier at the spillway (downstream of the head pond of the DCWMS). Intermittent barriers at the Fording Road and railway culverts at river km 1 in the lower reach of Dry Creek act as a barrier to passage in some years. A portion of the flow from the east tributary (LC_DCEF) naturally flows subsurface in the area of the sedimentation ponds (LC_DCDS) and returns to the surface further downstream (LC_DC4) (Figure 1).

The LCO Dry Creek Local Aquatic Effects Monitoring Program (LAEMP) assesses potential effects on water quality and aquatic life in Dry Creek from LCO Phase II mine development.

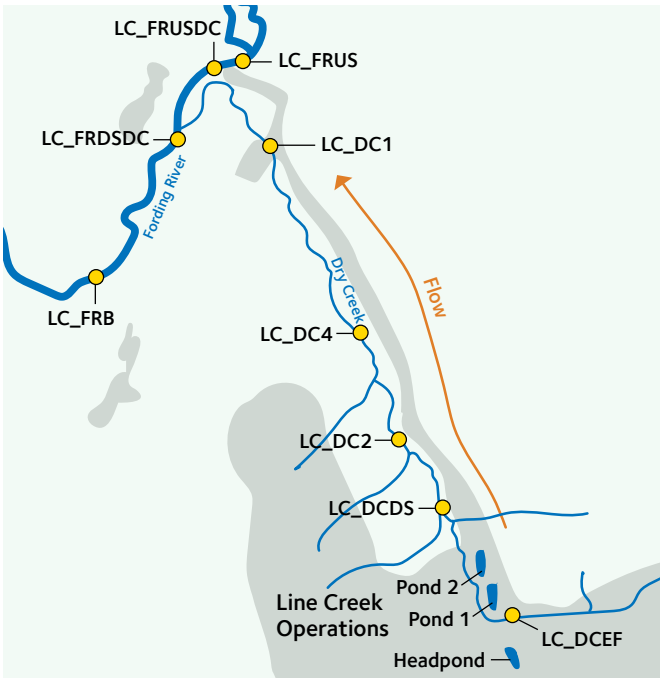
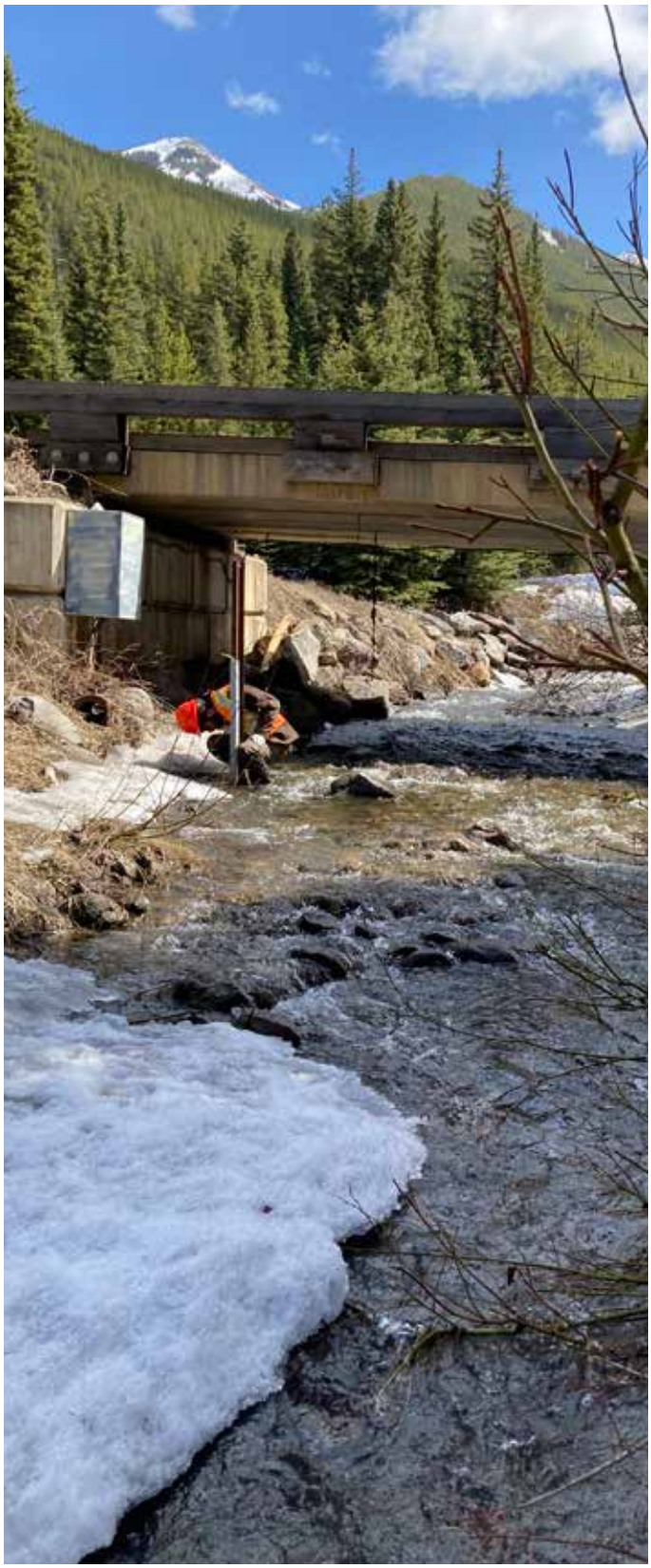


Figure 1. LCO Dry Creek monitoring area.



Ewen Creek road bridge at Dry Creek.

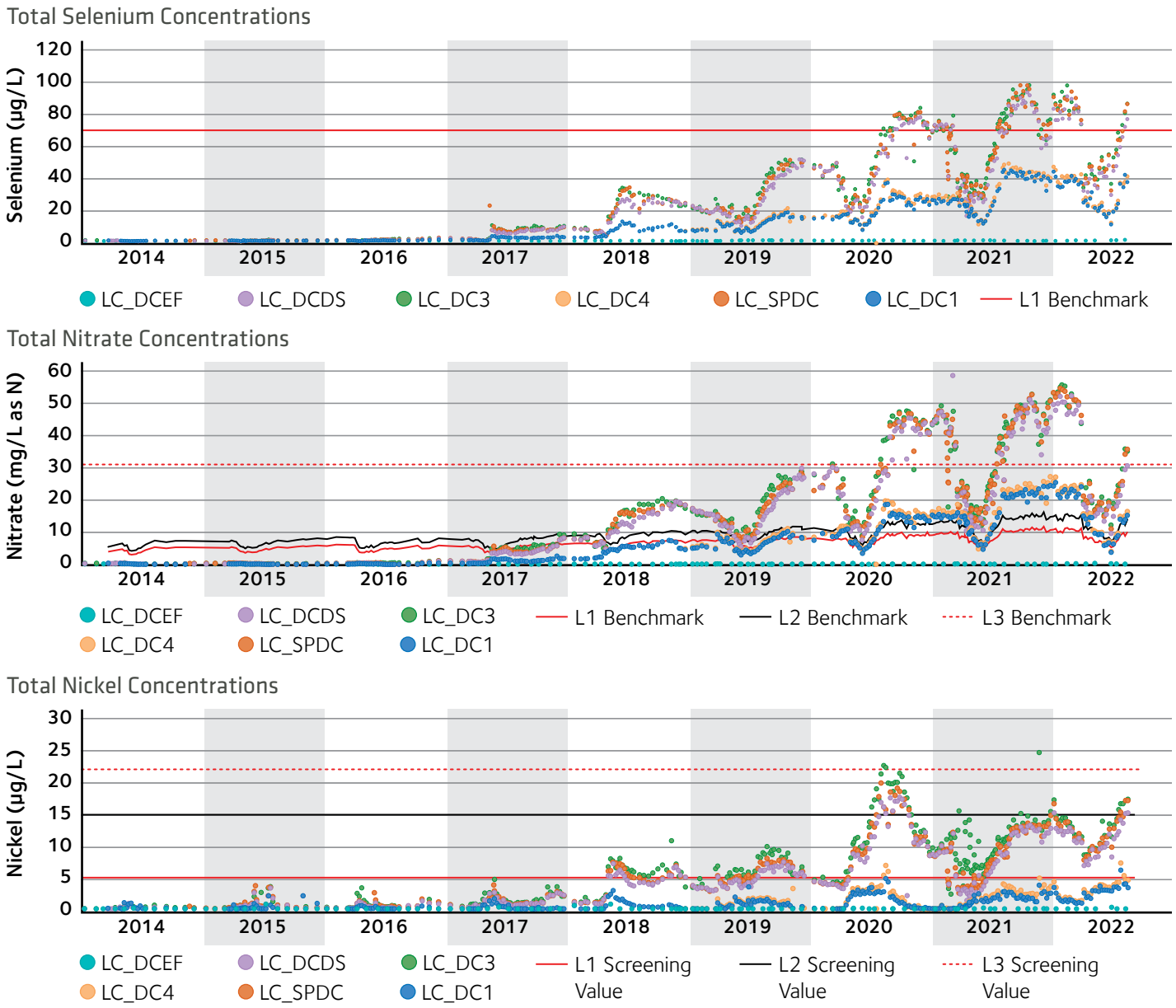


Figure 2. Total selenium, nitrate and nickel concentrations in LCO Dry Creek from 2014 to 2022, with effects benchmarks.

Water Quality

Following are the key 2021 water quality results for Dry Creek as shown in Figure 2 above:

- Concentrations of mine-related constituents (selenium, nitrate, sulphate, nickel) have increased since 2017. Mining in the watershed started in 2014.
- Most constituents are below water quality guidelines.
- Total selenium is above the Level 1 EVWQP benchmark downstream of the sediment pond (LC_DCDS).
- Nitrate is above the Level 2 EVWQP Benchmark at all stations in Dry Creek and above the Level 3 downstream of the sediment pond (LC_DCDS).
- Nitrite and cadmium have also exceeded water quality guidelines periodically downstream of the sediment pond (LC_DCDS).
- Nickel is above the Level 1 interim screening value at all stations in Dry Creek and above the Level 2 screening value downstream of the sediment pond (LC_DCDS).

Toxicity Testing

Details of chronic and acute toxicity testing are reported in the LAEMP. There have been no test failures for acute toxicity sampling at the discharge of the DCWMS. Quarterly chronic toxicity results in 2021 downstream of the sediment pond (LC_DCDS) indicate no effects for fish endpoints (including rainbow trout and fathead minnow tests). Chronic effects to *C.dubia* reproduction and *H. azteca* dry weight have been observed at LC_DCDS, with nickel and nitrate identified as potential causes.

LCO Dry Creek Monitoring Results

Benthic Invertebrate Tissue

Localized elevated benthic tissue selenium concentrations in the DCWMS and immediately downstream were identified in 2018. These concentrations were attributed to increased production of organoselenium species in the sedimentation ponds during the growing season.

Seasonal bypass of the ponds during the growing season since 2020 has reduced organoselenium downstream of the ponds and benthic invertebrate tissue selenium concentrations in Dry Creek have decreased.

Selenium tissue concentrations at downstream locations in Dry Creek and in the Fording River have remained stable since 2018 and are less than Level 1 and/or Level 2 benchmarks.

Average benthic tissue concentrations from the reference area are above the BC interim invertebrate tissue guideline (4 mg/kg dw) but are below Elk Valley specific benchmarks designed to protect juvenile fish growth:

- Level 1 = 11 mg/kg dw
- Level 2 = 18 mg/kg dw

Despite waterborne selenium concentrations approaching 100 µg/L downstream of the waste rock pile (i.e., LC_DC3), average benthic tissue concentrations are similar to reference conditions and consistently below Level 1 and 2 benchmarks (Figure 3 below).

Benthic Invertebrate Community

Total abundance and species richness of benthic invertebrate communities were generally within regional and site-specific ranges. Benthic invertebrate communities in Dry Creek upstream of the DCWMS had endpoints outside of normal ranges (e.g., mayflies, stoneflies, caddisflies).

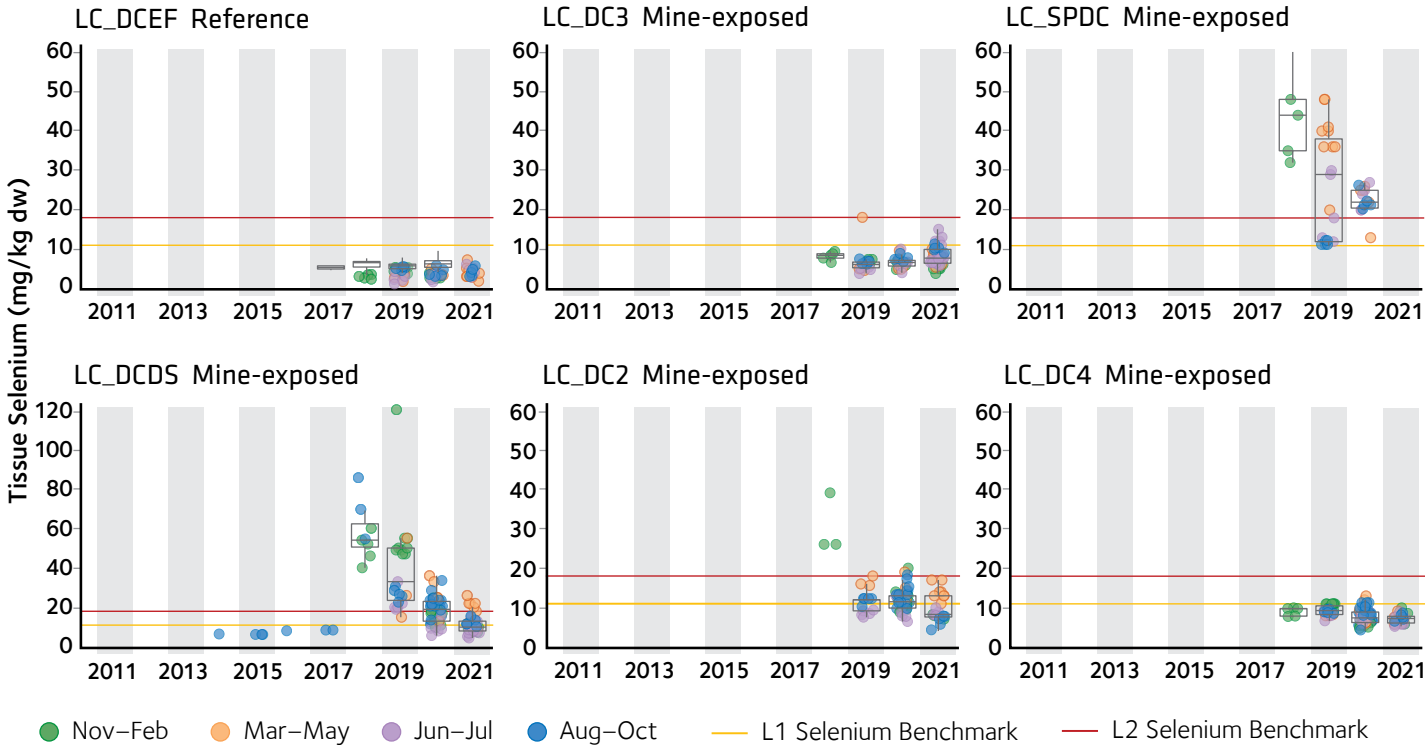


Figure 3. Box-and-Whisker:
Box reflects annual summary statistics (e.g., median, 25th, and 75th percentiles). Whiskers reflect 1.5 times the interquartile range. Horizontal Lines: Level 1 (11 mg/kg dw) and Level 2 (18 mg/kg dw) tissue benchmarks for juvenile fish growth.

Areas located closest to the pond discharge (LC_DCDS and LC_DC2) also had a lower proportion of mayflies than other areas in Dry Creek and regional sites. Benthic invertebrate communities located upstream and downstream of the mouth of Dry Creek in the Fording River were similar to each other, and community endpoints were within regional normal ranges.

Fish Tissue Selenium Concentrations

Westslope Cutthroat Trout muscle concentrations in Dry Creek have generally remained below generic and specific-specific muscle tissue guidelines:

- USEPA muscle criterion (11.3 mg/kg dw)
- Specific-specific threshold (15.5 mg/kg dw)

The two fish tissue samples collected from LCO Dry Creek in 2019 represent samples prior to the DCWMS bypass, which was initiated to reduce the export of organoselenium (Figure 4).

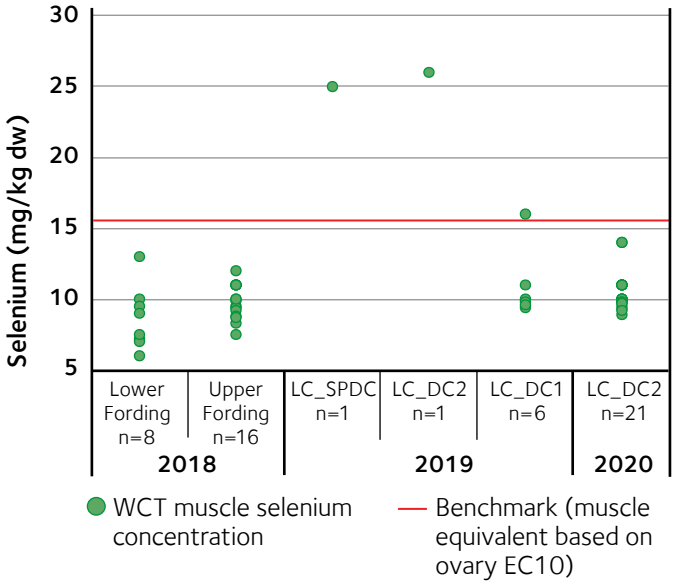


Figure 4. Westslope Cutthroat Trout muscle selenium concentrations compared between Dry Creek sampling areas and Fording River areas, 2018 and 2020.

Next Steps

Teck has proposed a conveyance and supplementation system to improve water quality in Dry Creek, which is currently under regulatory review. Teck continues to evaluate the feasibility of additional or alternative water quality mitigation in the LCO Dry Creek watershed.

LCO Dry Creek, March 2021.

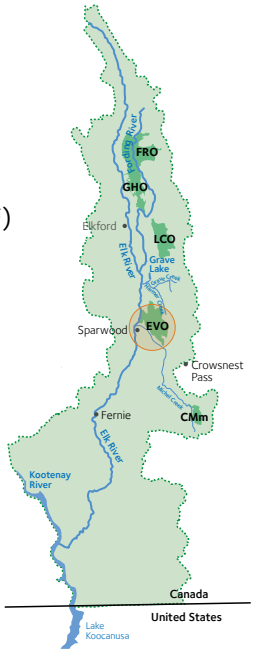
BRN Spoil Failure

On February 11, 2021, a portion of waste rock spoil in the Burnt Ridge North (BRN) mining area experienced a failure resulting in material runout, a portion of which was deposited over approximately 435 m of Dry Creek. The impacted section of Dry Creek is not fish-bearing.

Following the incident, Teck engaged third-party QPs (Qualified Professionals) to conduct environmental impact assessments including studies for geochemistry, water quality modeling, hydrogeology, hydrology, aquatic health, fish and fish habitat, and wildlife. On January 13, 2022, Teck and supporting QPs presented findings and updates to regulators (EMLI, ENV, Department of Fisheries and Oceans, Ministry of Forests, Lands, Natural Resource Operations and Rural Development) and KNC. Surface water upstream of the DCWMS was impacted for a short period following the spoil failure but returned to expected conditions by the end of the snowmelt. Water quality downstream of the DCWMS, toxicity testing and benthic tissue selenium concertation showed no response to the spoil failure.

Elkview Operations Saturated Rock Fill

What is a Saturated Rock Fill?



After extensive research and development, 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 SRF operates 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 currently is operating one SRF and another is being brought online. The Elkview Operation (EVO) SRF (see Figure 2) is in Phase 2 and treats up to 20,000 m^3/day. Fording River Operation SRF (FRO North) once operational will treat up to 9,500 m^3/day.

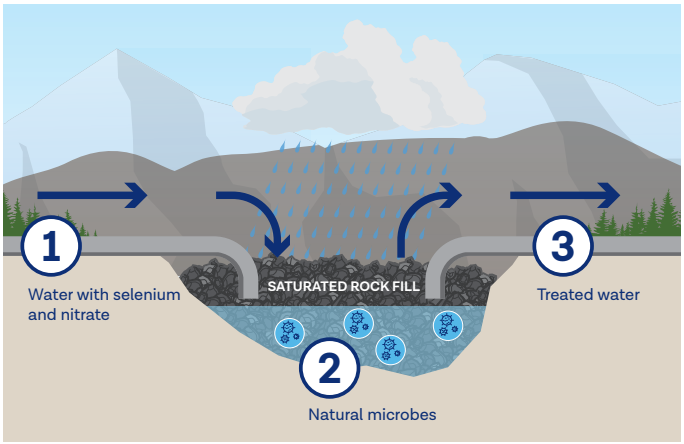


Figure 1. SRF Water Treatment Process.

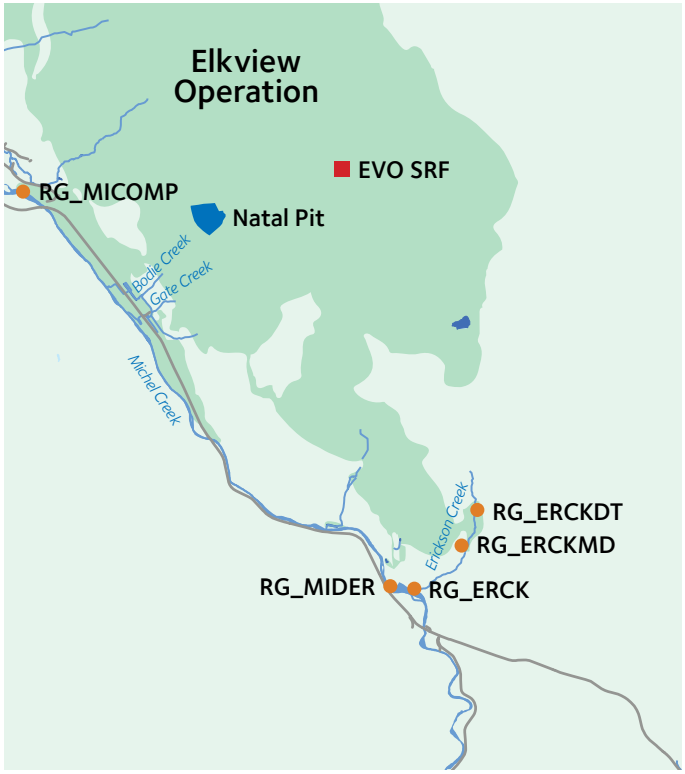


Figure 2. Location of the EVO SRF treatment facility (red square) and water quality and biological monitoring locations (orange dots).

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-influenced 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).

Under Permit 107517, the EVO Local Aquatic Effects Monitoring Program (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.

Water Quality

The 2021 water quality results indicate several constituents decreased during Phase 2 of the EVO SRF including nitrate and total selenium.

In 2021 the SRF removed 55,574 kg of nitrate and 548 kg of selenium, decreasing concentrations entering Erickson Creek and Michel Creek (Figure 3).

By mixing Erickson Creek water with Natal pit water to increase water treatment capacity through the SRF, total nickel concentrations increased above benthic invertebrate interim screening values downstream of the SRF outfall in Erickson Creek.

Monitoring changes in water quality from SRF treatment continues under the EVO LAEMP.

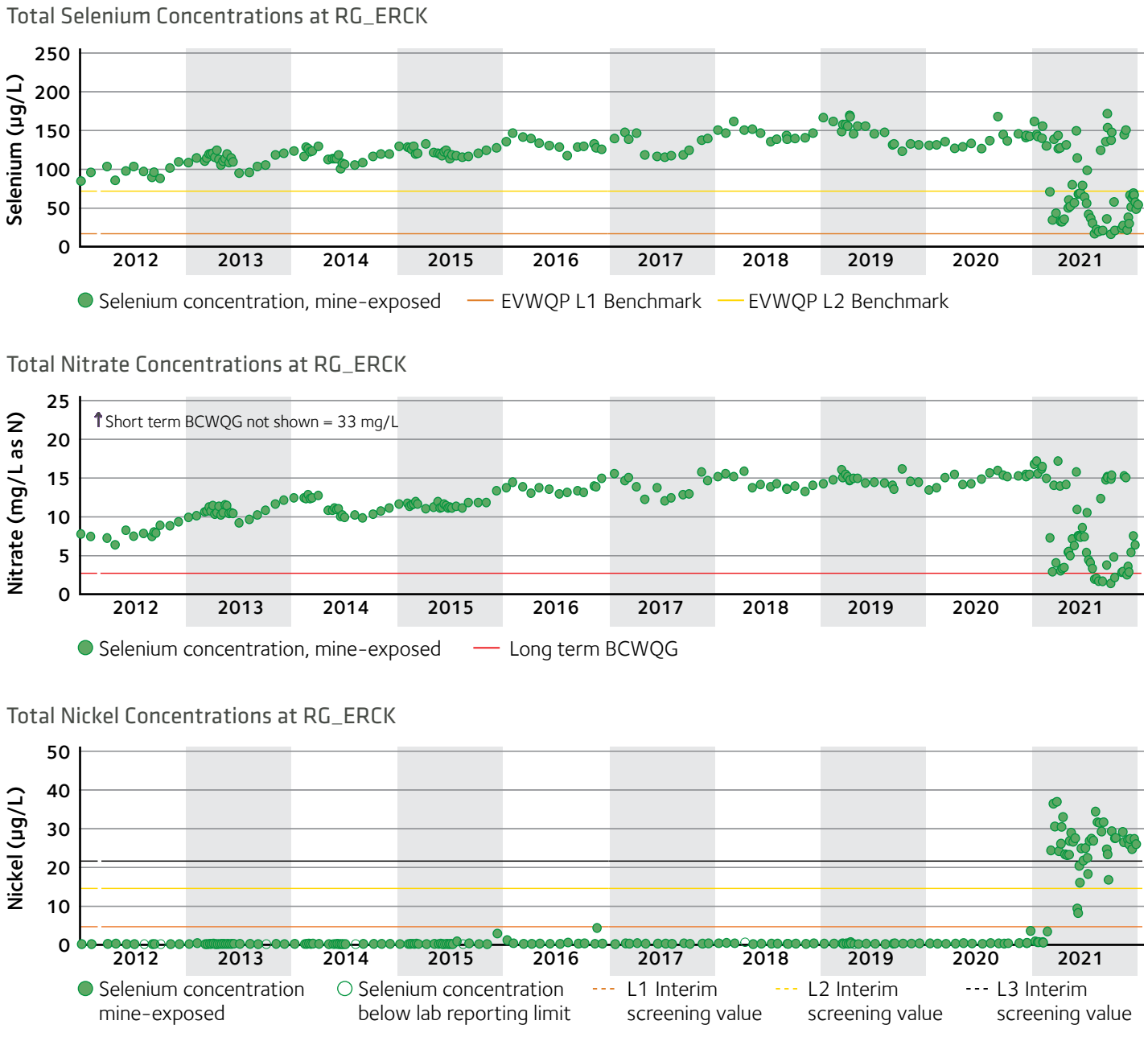


Figure 3. Time series plots of selenium, nitrate, and nickel concentrations from RAEMP sampling areas, 2012 to 2021.

Elkview Operations Saturated Rock Fill

Selenium Bioaccumulation

Routine monitoring in September 2021 identified benthic invertebrate tissue selenium (BIT Se) had increased above the Level 1 benchmark for growth, reproduction, and survival within the upper portions of Erickson Creek (RG_ERCKDT) (Figure 4).

Confirmatory sampling in December 2021 identified BIT Se above the Level 2 benchmark at RG_ERCKDT and above the Level 1 benchmark mid-way down Erickson Creek (RG_ERCKMD).

BIT Se concentrations in the lower portions of Erickson Creek (RG_ERCK) and Michel Creek remained below Level 1 benchmark, indicating a localized effect occurring in upper Erickson Creek.

The impacted section of Erickson Creek is non-fish bearing due to a natural barrier downstream at RG_ERCK.

Reduced forms of selenium are the most bioavailable and have the potential to increase Se tissue concentrations in benthic invertebrates and fish.

A review of Se speciation data showed a marginal increase in the concentration of organoselenium species in Erickson Creek; however, this contribution alone cannot explain the elevated selenium observed in BIT.

Areas with elevated tissue concentrations could not be explained using regional bioaccumulation models, suggesting that aqueous total selenium and/or selenium speciation cannot fully explain the elevated BIT Se results (i.e., there is another biological process occurring downstream of the SRF).

The cause of elevated BIT Se in upper Erickson Creek is currently uncertain and causal investigations with a team of subject matter experts (SMEs) are ongoing. The SMEs are starting to narrow in on causal factors and Teck is investigating potential mitigation options.

Aquatic Health

In 2021, the total percentage of mayflies, caddisflies and stoneflies fell below the regional and habitat-adjusted normal ranges at areas upstream and downstream of the SRF outfall in Erickson Creek but remained within normal ranges in Michel Creek (Figure 5). The lower percentages in Erickson Creek appears to be driven by low total and relative abundance of mayfly (Ephemeroptera) and high total and relative abundance of midges (Chironomidae) (Figure 6). Results suggest that a shift in benthic invertebrate community (BIC) structure may be occurring; however, this shift does not appear to be directly related to SRF discharge as BIC changes are observed both upstream and downstream of the SRF outfall. Aquatic health continues to be monitored under the RAEMP and EVO LAEMP.

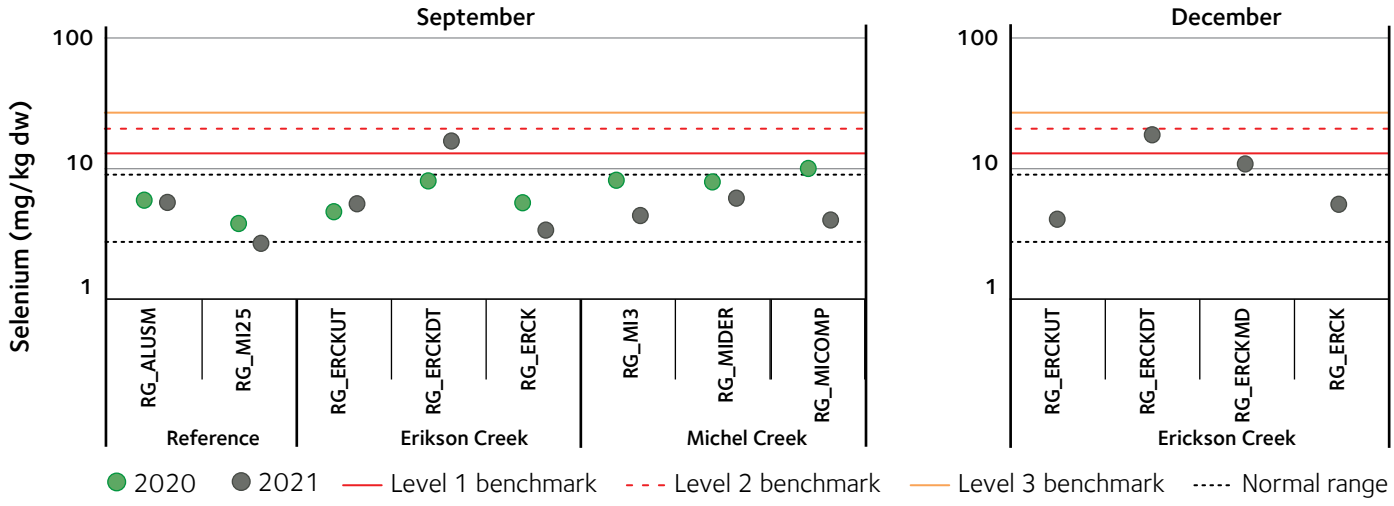


Figure 4. Mean selenium concentrations in composite-taxa benthic invertebrate samples collected in 2020 (green) and 2021 (grey) at Erickson and Michel Creeks.

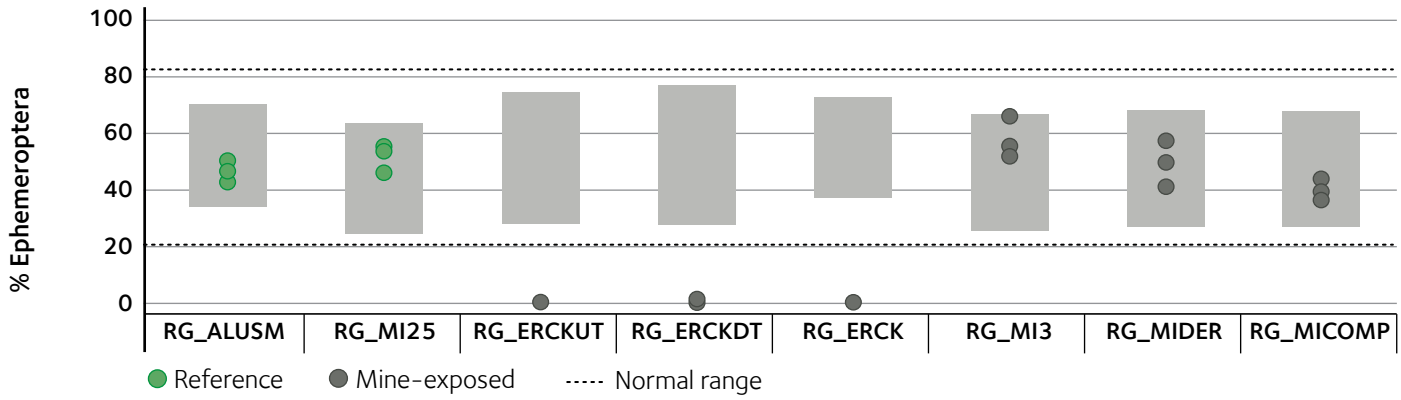


Figure 5. Percent ephemeroptera, EVO LAEMP, September 2021.

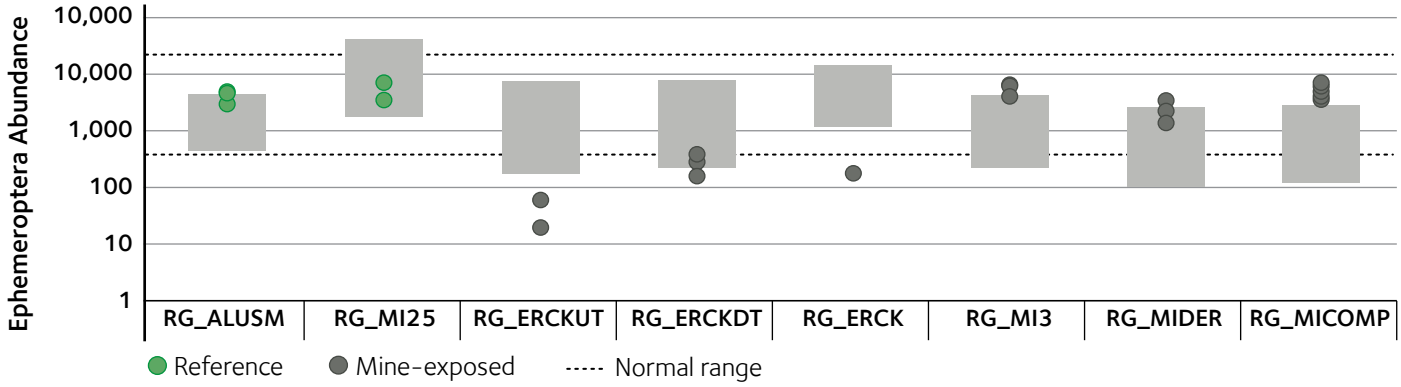


Figure 6. Benthic invertebrate ephemeroptera abundance (no. of organisms/3 m kick, EVO LAEMP, September 2021).

Fish Tissue

Fish access is limited to the lower 300 m reach of Erickson Creek (i.e. RG_ERCK); therefore, there is no fish use in the upper reaches where the elevated BIT Se is observed.

The 2021 BIT Se monitoring results indicate a localized effect that is not expected to represent an increased risk to fish.

WCT tissue data is collected under the RAEMP, with the nearest collection station located at RG_MICOMP (Michel Creek near lower compliance point). The 2021 results show muscle tissue selenium concentrations below the EVWQP effects benchmark of 15.5 mg/kg dw (Figure 7).

Monitoring is ongoing under the EVO LAEMP and the RAEMP.

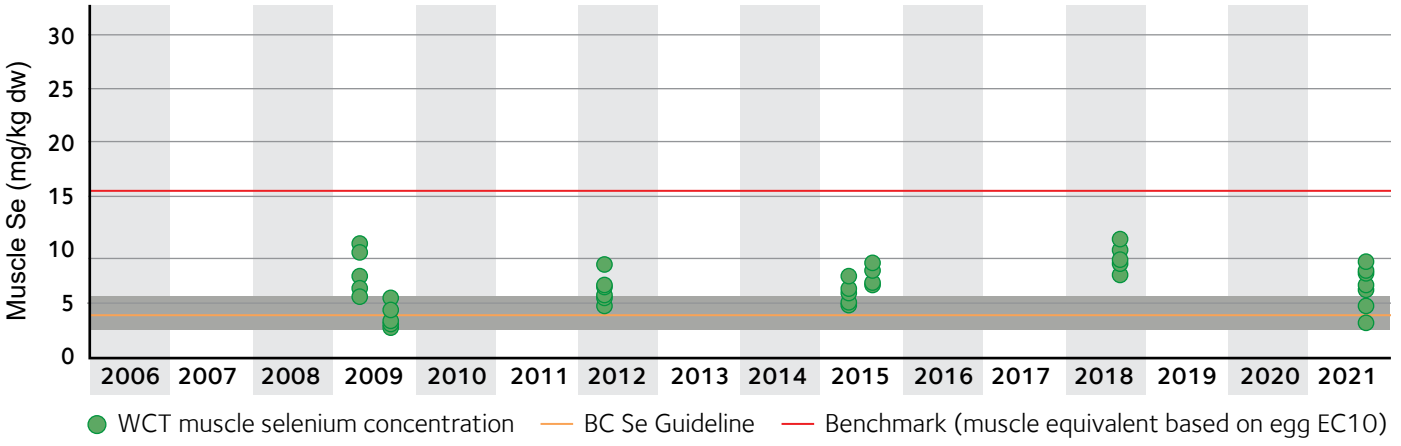


Figure 7. Selenium concentrations in Westslope Cutthroat Trout muscle tissue at Lower Michel Creek (RG_MICOMP), 2006 to 2021.

Koocanusa Reservoir Monitoring

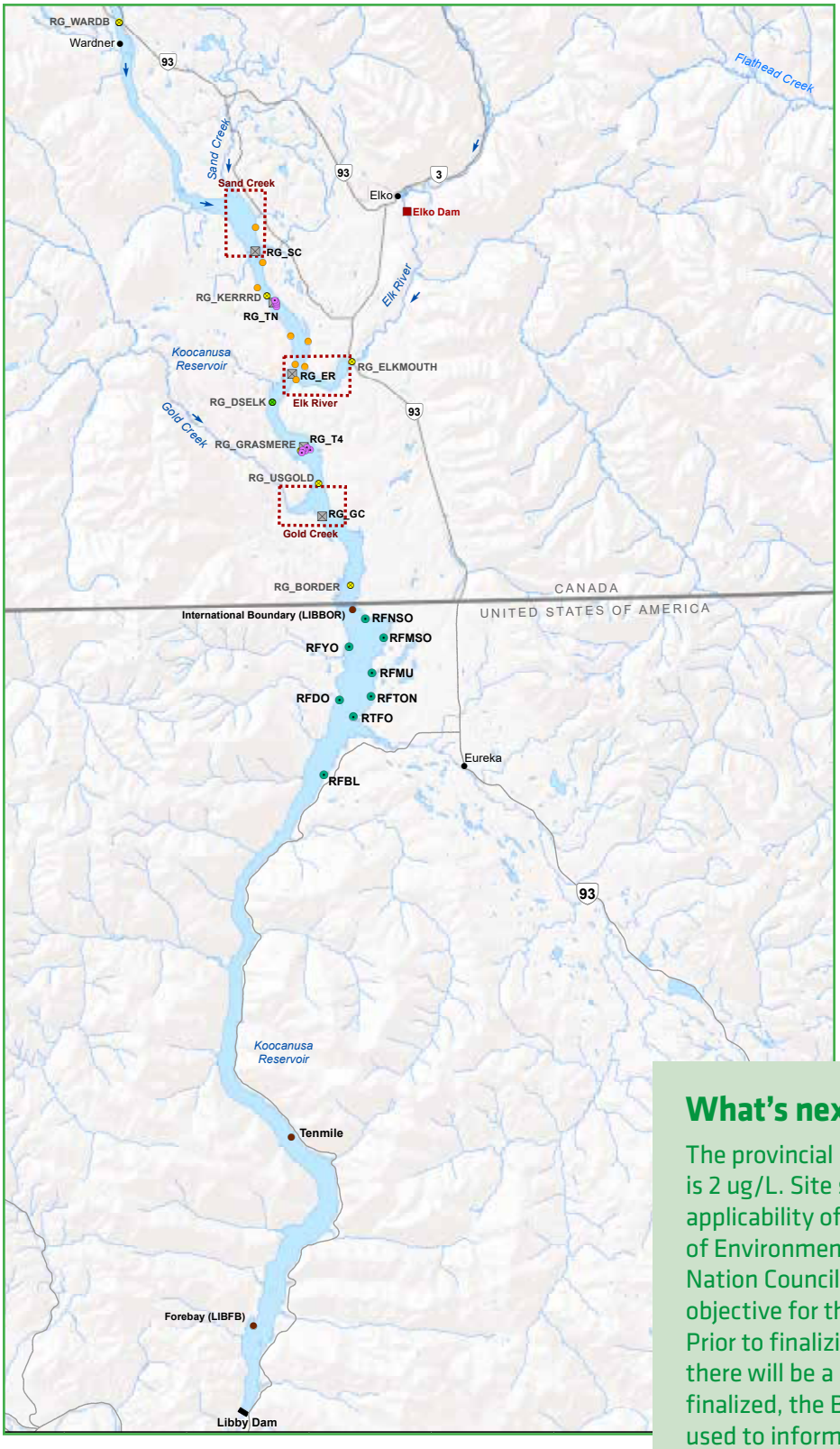
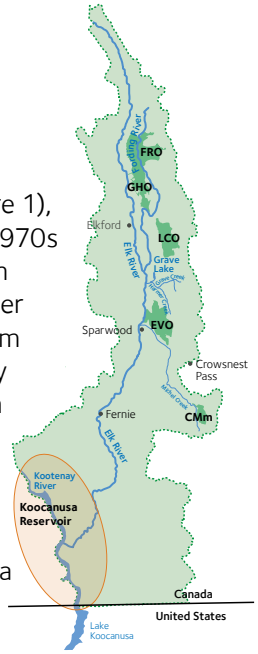


Figure 1. Koocanusa Reservoir monitoring stations.



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

The Koocanusa Monitoring Program is an ongoing monitoring 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 2021 Koocanusa Reservoir Monitoring Report visit: https://www.teck.com/media/Koocanusa-Reservoir-Monitoring-Report-2021.pdf

What's next?

The provincial BC guideline for selenium in water is 2 ug/L. Site specific factors can influence the applicability of provincial guidelines. The BC Ministry of Environment, in collaboration with the Ktunaxa Nation Council, has developed a draft water quality objective for the Canadian portion of the Reservoir. Prior to finalizing the draft water quality objective, there will be a 30-day public review period. Once finalized, the BC water quality objective will be used to inform updates to selenium targets in the Reservoir.

Water Quality

Monitoring in 2021 indicated that constituents (other than selenium) have monthly average concentrations that were below, or equal to, applicable BC WQ Guidelines and SPOs at permitted water quality stations downstream (RG-DSELK) of where the Elk River enters the Reservoir (Figure 2).

Mean monthly selenium was elevated relative to guidelines and exceeded the SPO on occasion downstream of where the Elk River enters the Reservoir.

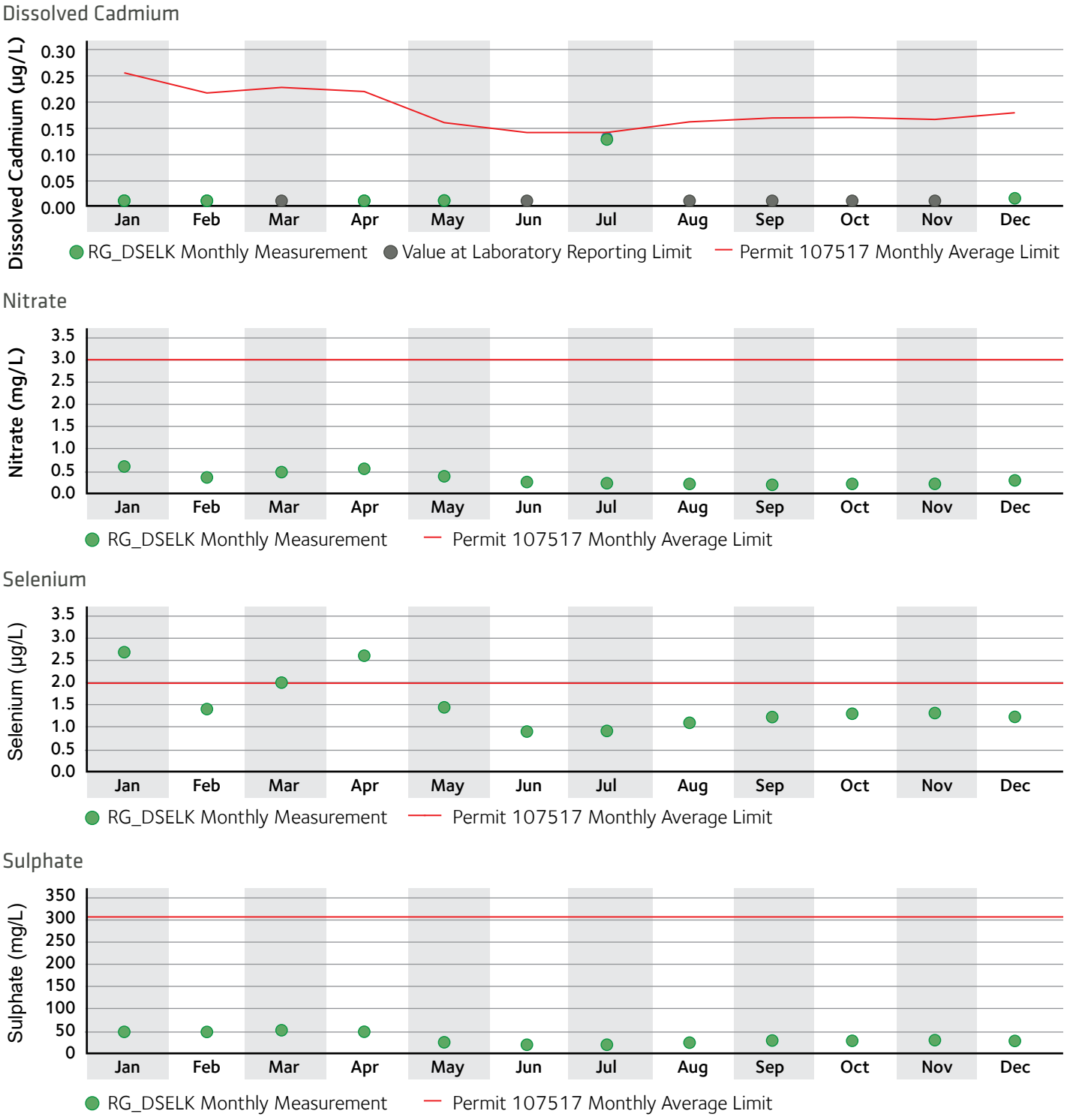


Figure 2. 2021 Monthly average concentrations of order constituents.

Koocanusa Reservoir Monitoring

Fish Selenium Tissue Concentrations

Several fish species are monitored for concentrations of selenium in muscle tissue in the Koocanusa reservoir including Peamouth Chub, Redside Shiner, Bull Trout, Kokanee Salmon, Mountain Whitefish, Rainbow Trout, Westslope Cutthroat Trout, Largescale Sucker, Slimy Sculpin and Yellow Perch (Figure 3).

Mean selenium concentrations in the muscle of all fish species sampled were below the BCWQG (4 ug/g dw) and the US EPA criterion (11.3 ug/g dw) for selenium, except Slimy Sculpin, which were elevated above the BCWQG, but below the US EPA criterion.

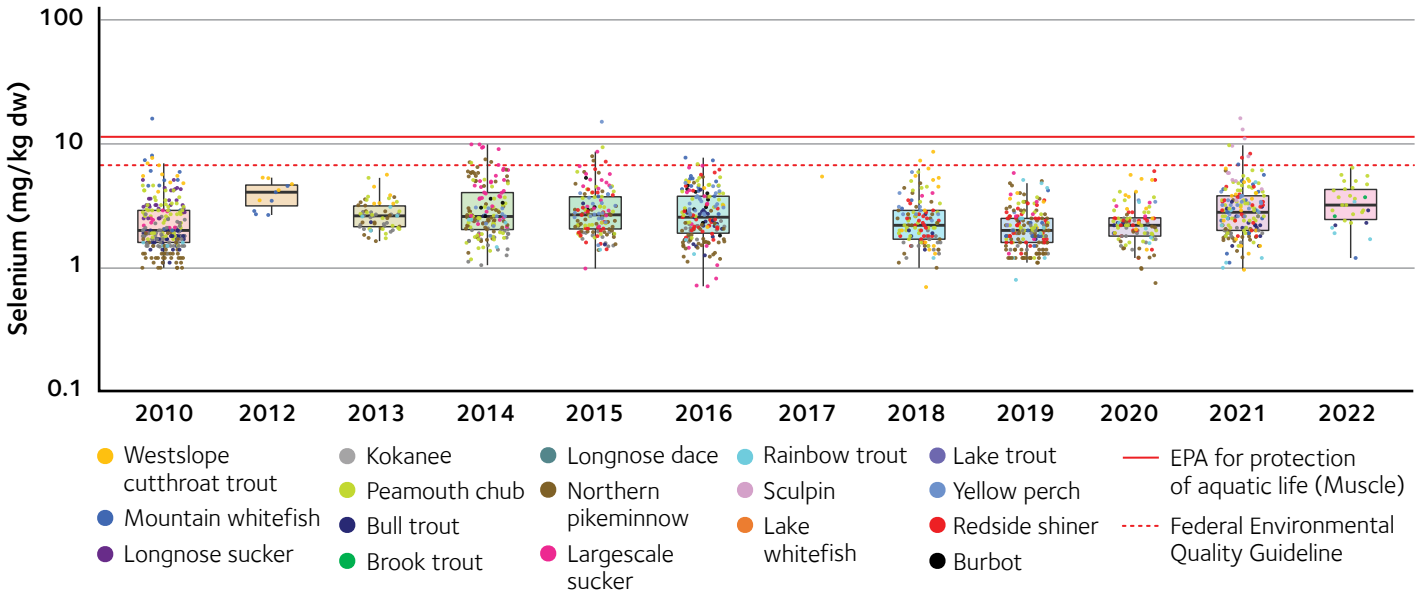
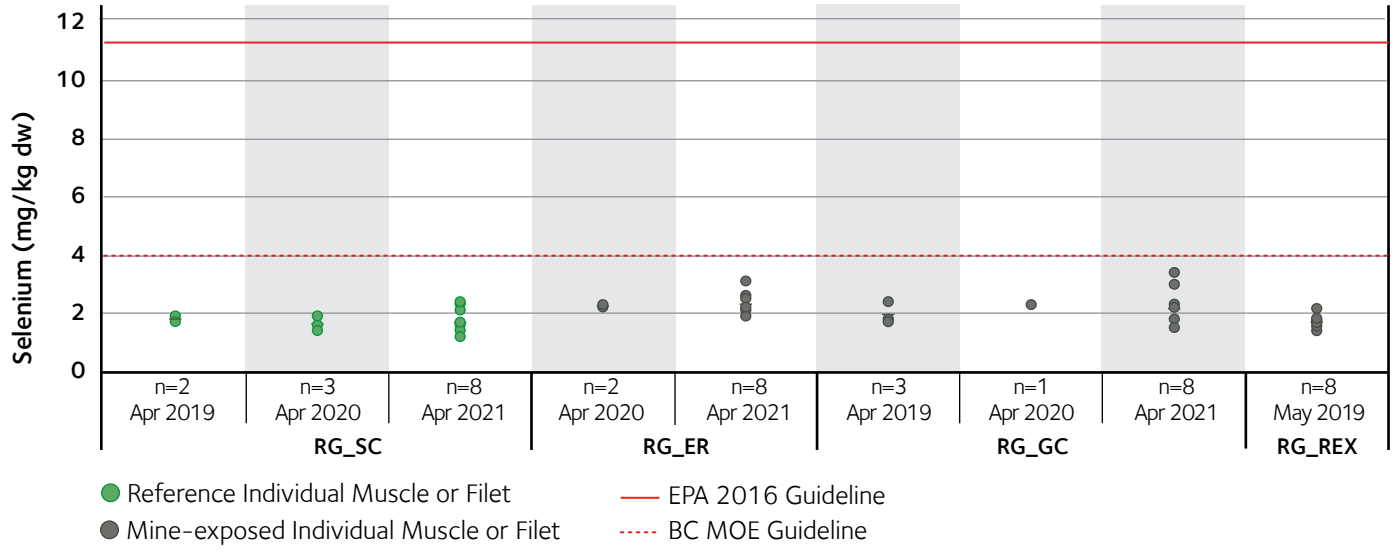


Figure 3. Fish muscle selenium concentrations within Koocanusa Reservoir.

Hoop net set in Gold Creek arm of the Koocanusa Reservoir in April 2019.

Bull Trout



Westslope Cutthroat Trout

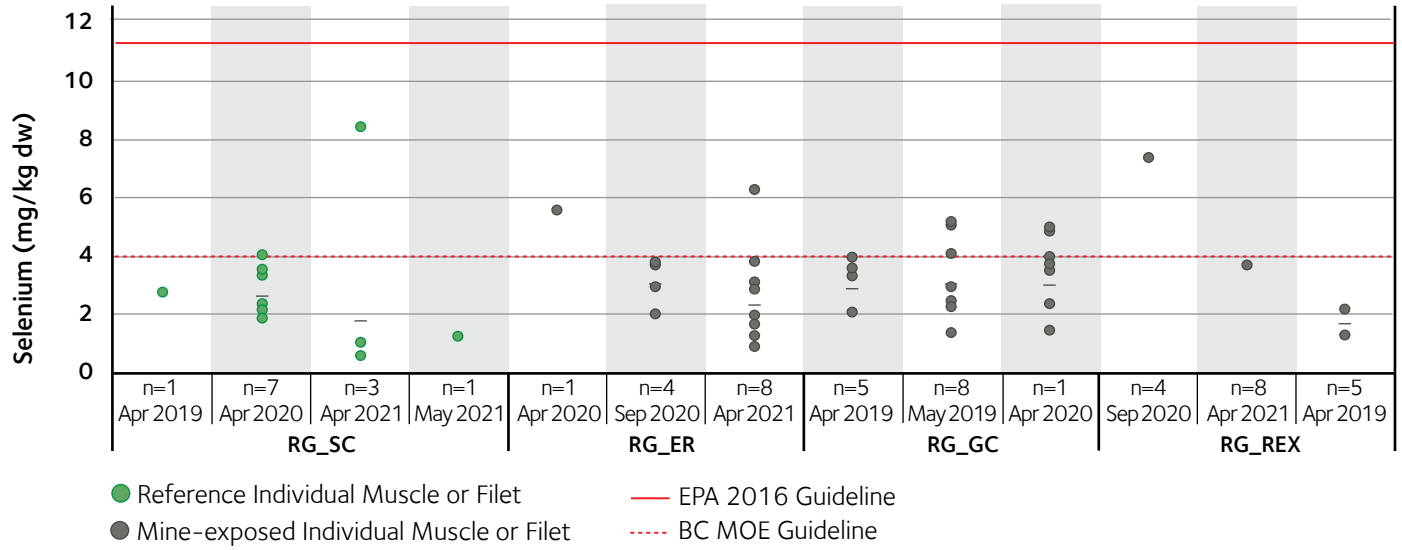


Figure 4. Concentrations of selenium (mg/kg dw) in fish muscle tissue, Koocanusa Reservoir Monitoring Program, 2019 to 2021.

Among sport fish, only Bull Trout had higher mean muscle selenium concentrations downstream of the Elk River compared to upstream, but concentrations remained below the BCWQG (Figure 4).

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

Westslope Cutthroat Trout being netted for non-lethal sample collection.

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 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.

hydrogeology
the area of geology concerned with the distribution and movement of groundwater in the soil and rocks occurring underground or on the surface of the earth.

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.

Abbreviations

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 limit or standard set by the Director for specific location.

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.

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.

ABMP	Area-Based Management Plan
BCWQG	BC Water Quality Guidelines
BIC	benthic invertebrate community
BIT	benthic invertebrate tissue
BRN	Burnt Ridge North
Cc	calcite concretion
CI	calcite index
CMm	Coal Mountain Mine
Cp	calcite presence
DCWMS	Dry Creek Water Management System
DEQ	Montana Department of Environmental Quality
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
IH	Interior Health
KNC	Ktunaxa Nation Council
LAEMP	Local Aquatic Effects Monitoring Program
LCO	Line Creek Operations
mg/kg dw	milligram per kilogram of dry weight
MU	management unit
NO3	nitrate
NPM	Northern Pikeminnow
QP	qualified professional
RAEMP	Regional Aquatic Effects Monitoring Program
Se	selenium
SME	subject matter expert
SPO	site performance objectives
SRF	saturated rock fill
TDS	total dissolved solids
Teck	Teck Coal Mines Ltd.
WCT	Westslope Cutthroat Trout
WQ	water quality