PERMIT 107517

ENVIRONMENTAL MONITORING COMMITTEE

2021 Public Meeting Posters

Contents

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 then flow into rivers and lakes. Monitoring results indicate that the concentrations of these substances are increasing in areas impacted by mining in the Elk Valley.

In April 2013, the British Columbia Minister of Environment issued Ministerial Order No. M113 that required Teck to develop an Area-based Management Plan (ABMP) and to identify the actions it will take to manage water quality downstream of its five steelmaking coal mines. The mine-related substances of concern in the Order are selenium (Se), nitrate (NO_3), sulphate (SO_4), cadmium (Cd), and calcite ($CaCO_3$). Between 2013 and 2014 Teck developed the Elk Valley Water Quality Plan (EVWQP) with feedback from the public, Indigenous governments, provincial and federal governments, technical experts, and other stakeholders. Teck submitted the EVWQP to the Minister in July 2014 and it was approved in November 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/media/2015-Water-elk_valley_water_quality_plan_T3.2.3.2.pdf

The Elk Valley Permit

Following the approval of the Elk Valley Water Quality Plan, the Ministry of Environment 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 this permit. Permit 107517 does not replace any of the permits previously issued to each of the mine operations. It is regionally focused and adds another layer of legal requirements for Teck.

Permit 107517 requires Teck to form an Environmental Monitoring Committee (EMC). The purpose of the EMC is to strengthen Teck's aquatic environmental monitoring and management 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 (ENV)
- two representatives from the BC Ministry of Energy, Mines & Low Carbon Innovation (EMLI)
- one representative from the BC Interior Health Authority (IHA)
- 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/Document Control Manager

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 in an effort 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.

Learn more information about EMC public reports and publicly available Teck reports:

https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Monitoring Water Quality in the Elk Valley

Permit 107517 requires water quality targets for concentrations of selenium, sulphate, nitrate, and cadmium in the water. These targets are meant to protect aquatic life based on available data. Teck is required to monitor water quality at 131 locations in the Elk Valley and Koocanusa Reservoir (see Figure 1). 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 (see 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 are set for order stations (see 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 Elk Valley Water Quality Plan (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 the BC Minister of Environment. The EVWQP further divided the Designated Area into six Management Units (MUs) based on geographic features, major tributaries and hydrodynamic characteristics (see Figure 2). These management units are central to the area-based nature of the EVWQP to support monitoring and management activities.

Monitoring and Management Programs

Samples from the compliance points and order stations provide data for the following ongoing programs:

- Surface Water Monitoring
- Groundwater Monitoring
- Local Aquatic Effects Monitoring Program (LAEMP)
- 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

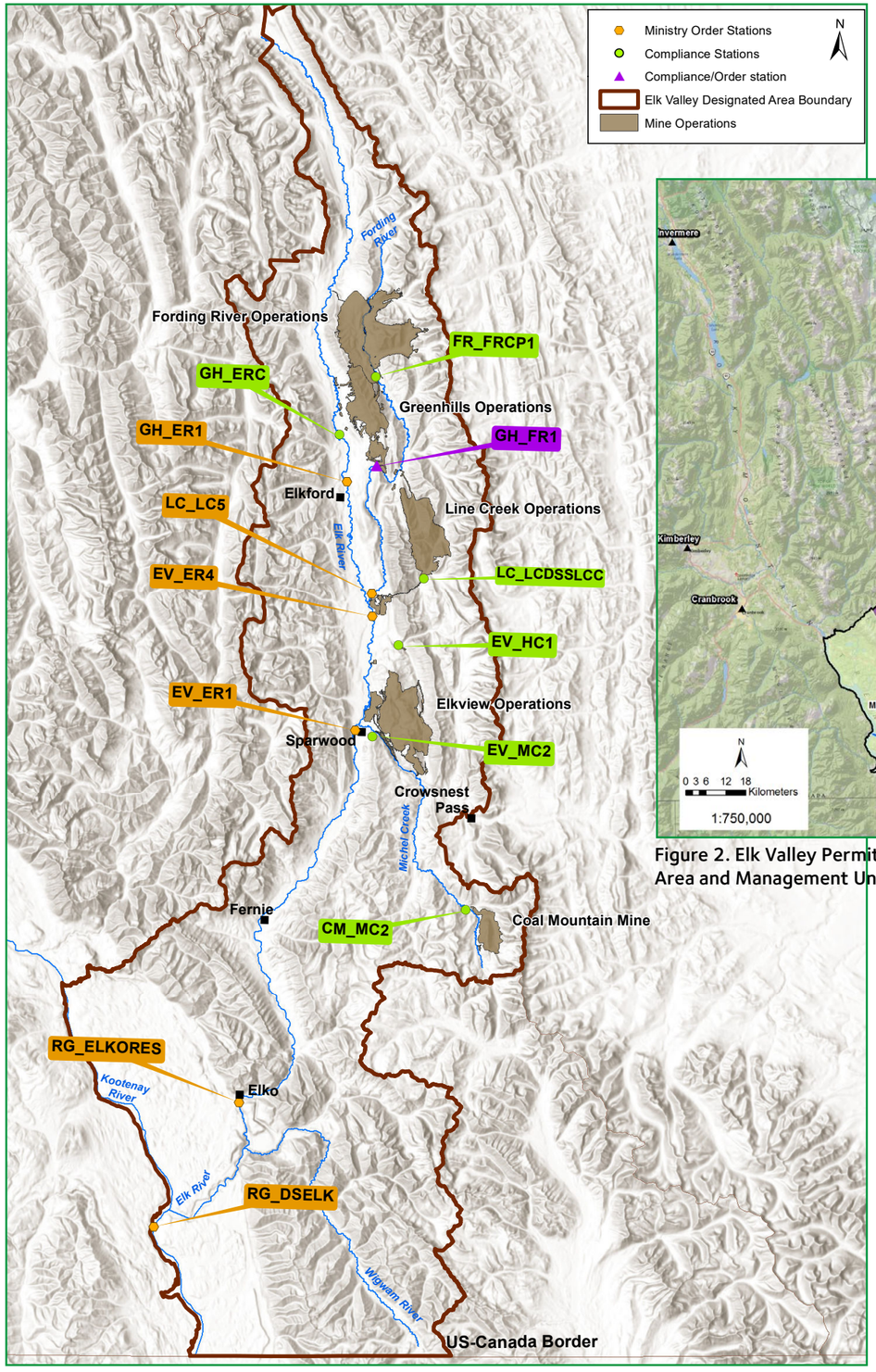


Figure 1. Elk Valley Permit 107517 Designated Area, Mine Operations, Compliance and Order Stations.

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

Key Insights and Monitoring Results from 2020

Adaptive Management

- Teck's Adaptive Management Plan (AMP) and related annual reports outline what has been learned, the activities and next steps to reduce key uncertainties (KUs) and evaluate the management questions (MQs).
- The most recent AMP was published in December of 2018 and is updated every three years.
- The AMP Response Framework outlines the process for notification, confirmation, investigation, and adjustments to monitoring and management when triggers or unexpected conditions are identified.
- Current and long-term continuous improvement goals were collaboratively developed by Teck and the Ktunaxa Nation Council (KNC).

Surface Water Quality Monitoring

- The chemistry of mine-influenced surface waters in the Elk Valley is generally well understood through evolving regional and local water quality sampling and modelling.
- Selenium and nitrate non-compliances continue to be observed at some compliance and order stations.
- Mine effluent discharges are evaluated for acute toxicity to understand the potential effects to aquatic health.

Groundwater Monitoring

- The 2017 - 2020 Regional Groundwater Monitoring Program (RGMP) was completed and the 2018 – 2021 Site-Specific Groundwater Monitoring Program (SSGMP) Work Plan progressed including flow accretion studies, aquifer testing, and installation of 22 monitoring wells at relevant locations in the Elk Valley.
- Teck completed the Sparwood Area Groundwater Supporting Study to reduce uncertainty related to transport of mine-influenced groundwater in the Michel Creek valley-bottom aquifer and assess potential impact on current drinking water sources in the Sparwood area.
- Teck continued monitoring potable wells under the Regional Drinking Water Monitoring Program (RDWMP). In 2020, 28 wells were sampled, and seven wells exceed BC Water Quality Guidelines (BCWQG) for mining related constituents. Teck facilitated the enrolment of the City of Fernie into the program and installed two monitoring wells to better understand surface water/groundwater interaction near multi-user drinking water wells.

Regional Aquatic Effects Monitoring Program (RAEMP)

- The RAEMP evaluates aquatic trends and patterns throughout the Elk Valley. Results indicate there are localized mine-related influences on biota and habitat, most of which are within the range of what is expected.
- Benthic invertebrate tissue selenium concentrations were largely within the expected range throughout the Elk Valley. In 2020, increasing tissue selenium concentrations were observed in the Upper Fording River as well as Harmer Creek.
- Supplemental research, such as the regional studies on lentic areas, selenium speciation and bioaccumulation, fish and amphibian selenium toxicity, and nutrient concentrations, further inform adaptive management and address trends identified in the RAEMP.

Figure 1. Columbia Spotted Frog

Local Aquatic Effects Monitoring Program (LAEMP)

- In 2020 there were five LAEMPs that continued to address uncertainties, or assess potential effects of changes in water management, or to generally assess aquatic environmental quality.
- Data collected under the LAEMPs have highlighted the need for better understanding of the factors (both natural and mine-related) that influence aquatic biota, in particular the benthic invertebrate community that is used as an indicator of aquatic ecosystem condition.
- Monitoring results from the LCO Line Creek LAEMP in 2020 indicated that the recommissioned AWTF (Active Water Treatment Facility) with AOP (Advanced Oxidation Process) continued to decrease aqueous concentrations of non-selenate species in AWTF effluent and reduce selenium bioaccumulation in benthic invertebrate tissue in Line Creek.
- Monitoring results from the FRO LAEMP indicated that both habitat variables and water quality are important contributors to variations in the benthic community within the FRO LAEMP study area, but the individual contributions of each are difficult to separate due to high levels of covariation among variables.

Key Insights and Monitoring Results from 2020

Koocanusa Reservoir Monitoring

- The Koocanusa Reservoir Monitoring Program assesses the physiochemical and biological conditions in the reservoir downstream of the Elk River confluence compared to upstream, and whether conditions are changing over time.
- All mean fish tissue samples, had selenium concentrations below the British Columbia guideline for fish tissue selenium.
- The order station in Koocanusa Reservoir was 100% compliant with site performance objectives (SPOs) in 2020, and concentrations of selenium were within the range projected by the Regional Water Quality Model.

Fish Supporting Studies

- The Redside Shiner recruitment study began in 2018 to assess potential for adverse effects on populations.
- Different species of fish vary in their sensitivity to selenium and work is underway to develop species-specific toxicity benchmarks for Redside Shiner, Northern Pikeminnow, and Mountain Whitefish.
- Additional supporting selenium ecotoxicity studies for Northern Pikeminnow and Mountain Whitefish are under way to increase our understanding of effects

Westslope Cutthroat Trout Populations

- Initial indications in an ongoing evaluation of cause study show extreme winter conditions, sparse overwintering habitats, restrictive fish passage and associated ice formation as the most likely primary causes of the decline of Westslope Cutthroat Trout in the Upper Fording River.
- Data suggest recruitment failure of Westslope Cutthroat Trout occurred in Harmer Creek in 2019 and 2020, with the underlying cause currently being investigated.
- Various studies and assessments are improving our understanding of the factors that influence population numbers of Westslope Cutthroat Trout to support recovery and conservation of WCT.

Figure 1. Redside Shiner

Figure 2. Westslope Cutthroat Trout

Figure 3. Typical spring conditions at Koocanusa Reservoir at monitoring station RG_DSELK. See map on Koocanusa Monitoring.

Calcite Monitoring

- Calcite remains a contaminant of concern in the Elk Valley.
- Antiscalant is an effective preventative technology against calcite concretion.
- Replacement of calcite-concreted stream bed with clean substrate will be trialed as a remediation strategy, pending further review of benefits and risks.

Nickel Monitoring

- Under certain conditions, nickel is toxic to benthic communities at concentrations lower than the current British Columbia Water Quality Guideline, which is undergoing revision.
- Understanding nickel toxicity is highly challenging because nickel toxicity is affected by other water quality factors such as hardness, alkalinity, and pH.
- Teck is completing work to develop site-specific nickel benchmarks to better understand the potential for adverse effects from nickel on the aquatic receiving environment.

Selenium Speciation Monitoring

- Selenium (Se) can occur as different forms (species).
- The presence of organic forms of selenium may result in increased selenium bioaccumulation in aquatic receptors, including benthic communities and fish, such that concentrations may be above effects benchmarks; these forms of selenium can occur in some mine water management structures such as sedimentation ponds.
- It is important to identify what conditions may favour generation of highly bioavailable forms of selenium and where and when this may be occurring to understand the potential for effects on the aquatic receiving environment and to inform the need for potential management

Human Health Risk Assessment

- It is required by Permit 107517.
- It is a collaborative effort between Ktunaxa Nation Council, BC Interior Health Authority, BC Ministry of Environment, and Teck.
- The work is inclusive, grounded, and reciprocal.

Adaptive Management

Adaptive management is a systematic, rigorous approach to environmental management that investigates key uncertainties while striving to meet multiple management objectives to adapt management actions from what is learned (Figure 1).

The Adaptive Management Plan (AMP) was developed to support the implementation of the Elk Valley Water Quality Plan (EVWQP) to achieve water quality and calcite targets; to ensure that human health and the environment are protected (and where necessary, restored); and to facilitate the continuous improvement of water quality in the Elk Valley. Current and long-term continuous improvement goals were collaboratively developed by Teck and Ktunaxa Nation Council (KNC). Teck is required to update the AMP every three years. The next update is December 2021.

Teck's water quality AMP is guided by six management questions (MQs) to collectively address Teck's regulatory requirements and the environmental management objectives of the EVWQP. The stages of the adaptive management cycle are reflected (by colour) in the process flow diagram used to evaluate each management question or MQ (see Figure 1 and Figure 2).

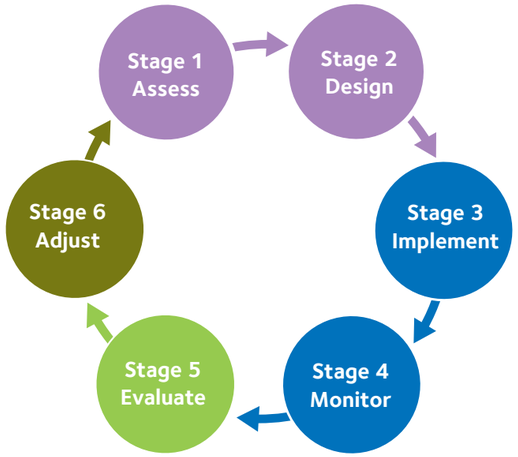


Figure 1. Adaptive Management Cycle.

MQ1: Will water quality limits and site performance objectives be met for selenium, nitrate, sulphate and cadmium?

MQ2: Will the aquatic ecosystem be protected by meeting the long-term site performance objectives?

MQ3: Are the combinations of methods for controlling selenium, nitrate, sulphate and cadmium included in the implementation plan the most effective for meeting limits and site performance objectives?

MQ4: Is calcite being managed effectively to meet site performance objectives and to protect the aquatic ecosystem?

MQ5: Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?

MQ6: Is water quality being managed to be protective of human health?

Monitoring Across Management Units

Figure 3 shows an example of monitoring results across management units (MUs) (see MU map on the Monitoring Water Quality in the Elk Valley poster). The Aquatic Data Integration Tool (ADIT) provides a structured framework for multiple types of environmental monitoring data to assess current conditions in the aquatic environment at local and regional scales, characterize types of observed effects, and identify potential causes. Each potential stressor and biological response has an associated set of criteria used to assign ADIT scores ranging from zero (no effect / same as reference) to three (strong evidence for effect). Figure 3 illustrates the richness of benthic communities in flowing (lotic) aquatic habitats. This figure has been developed into a data-driven metric to support tracking of progress towards Teck continuous improvement goals.

Evaluating Management Questions

Figure 2 shows the adaptive management process flow diagram used to re-evaluate MQs. The AMP Response Framework lies within the process flow diagram (see Figure 2, right column). It outlines Teck's process when triggers or unexpected conditions are identified to notify, confirm, investigate, and adjust monitoring and management.

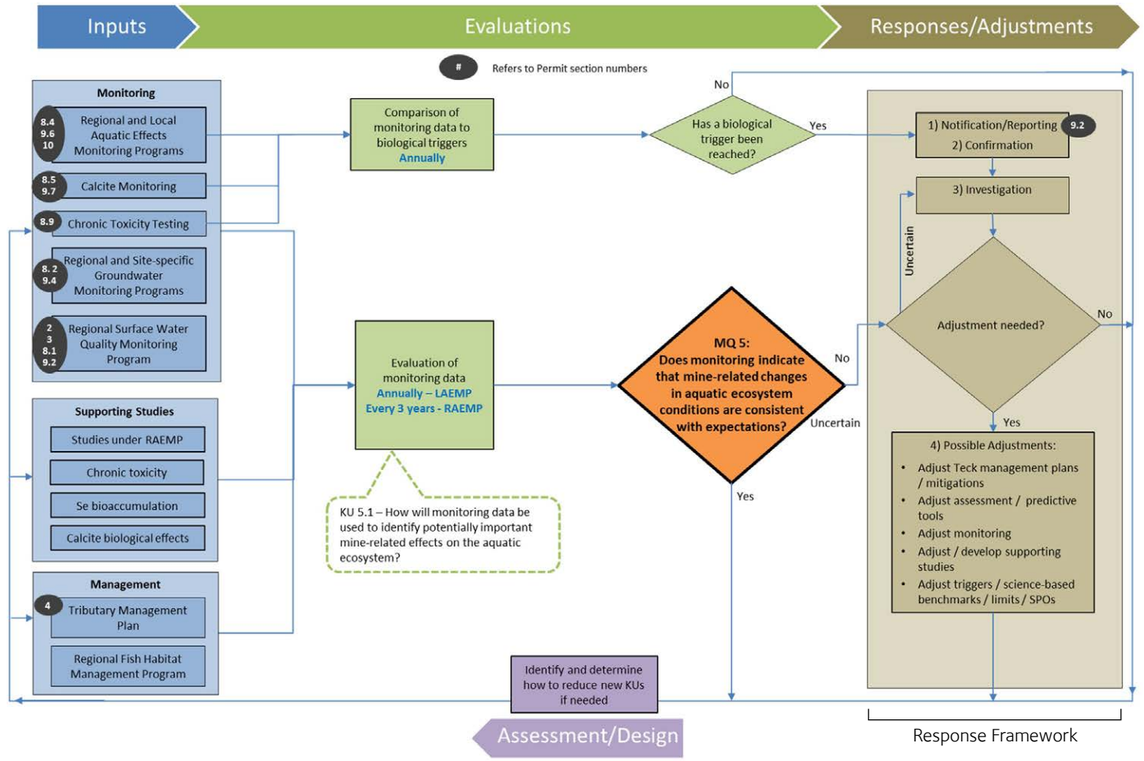


Figure 2. Example process flow diagram for re-evaluating Management Question 5 (MQ5).

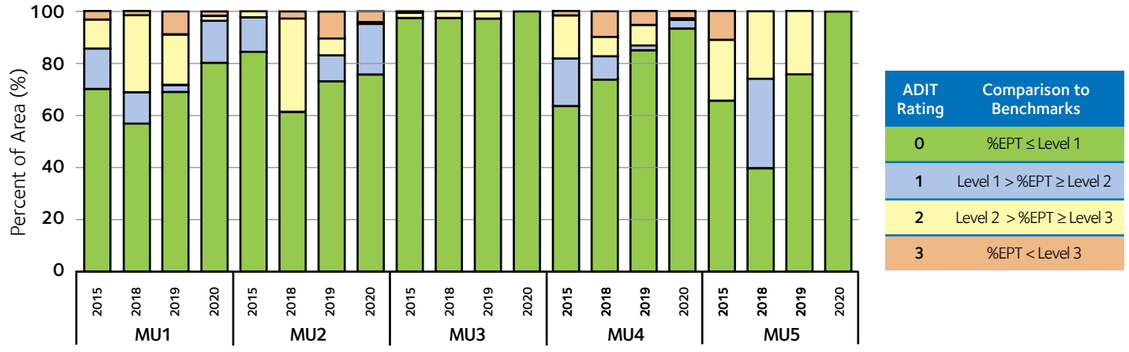


Figure 3. MQ 2/5 continuous improvement metric: percent of Ephemeroptera / Plecoptera / Trichoptera (Mayflies / Stoneflies / Caddisflies = %EPT) samples collected in each management unit compared to EVWQP Level 1, 2, and 3 effects benchmarks.

Surface Water Quality

Acute Toxicity Results for 2020

Rainbow Trout

- 476 tests completed at permitted locations with zero test failures (100% compliance).
- Results show an improvement from last year where 3 rainbow trout toxicity tests failed at Goddard Creek. This change has been attributed to the resolution of the flocculant dosing problems previously observed in Goddard Creek.

Water Flea

- 488 tests completed at permitted location with 4 test failures (99% compliance).
- The failures occurred at the Goddard Creek sedimentation pond decant.
- Failures linked to calcite precipitation on test organisms.

Figure 1. A rainbow trout fry *(Oncorhynchus mykiss)*.

Figure 2. Water flea *(Daphnia magna)*.

Water Quality Trends Over Time

Figure 3 summarizes order constituent trends over time. Between 2015-2020, cadmium was 100% compliant at all monitoring locations while sulphate was 100% compliant at all order stations (not presented). GH_FR1, at the Greenhills Operations, is both an order station and compliance point. Blank columns indicate no data was collected as there were no site performance objectives (SPOs) in effect that year. For more information about compliance points and order stations, refer to the Monitoring Water Quality in the Elk Valley poster.

- Line Creek Operation's compliance point (LC_LCDSSLCC) continues to have nitrate permit exceedances. In 2020, it was 25% compliant.
- The West Line Creek Active Water Treatment Facility has been successfully removing nitrate, but not enough to maintain compliance throughout the year.
- The Fording River (FR_FRCP1) compliance point continues to have the most selenium exceedances over time. In 2020, FR_FRCP1 was 42% compliant for selenium.
- The chemistry of the Fording River at this location is complicated by the proximity of mine influenced Cataract Creek and a seasonal lack of mixing with the mainstem.

Constituents of concern are addressed through several initiatives in the Elk Valley, including:

- Tributary Management Plans
- Calcite prevention through antiscalant addition systems
- Saturated Rock Fill (SRF). The Elkview SRF has achieved near complete removal of selenium and nitrate, treating up to 20 million litres of water per day in 2020.
- Active Water Treatment Facilities (AWTF) with Advanced Oxidation Process (AOP). West Line Creek AWTF is active, Fording River is under construction.

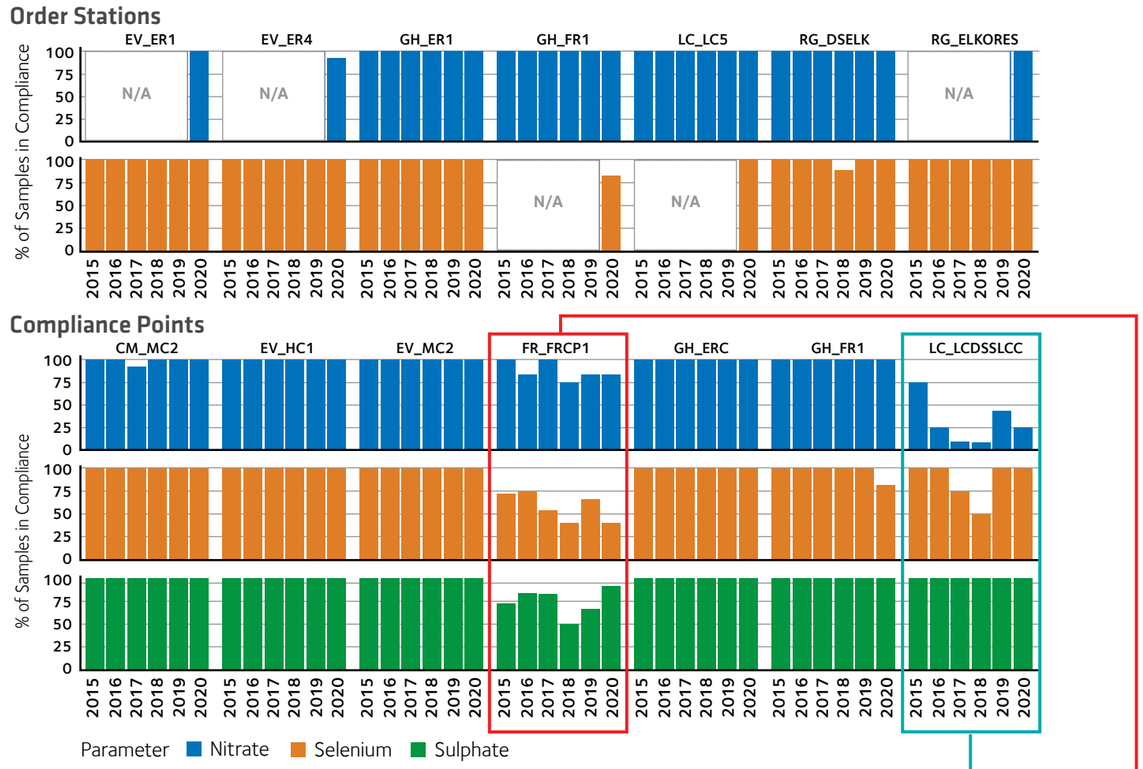


Figure 3. Annual compliance of order constituents from 2015 - 2020. Refer to corresponding red and blue boxes in Figures 4 and 5.

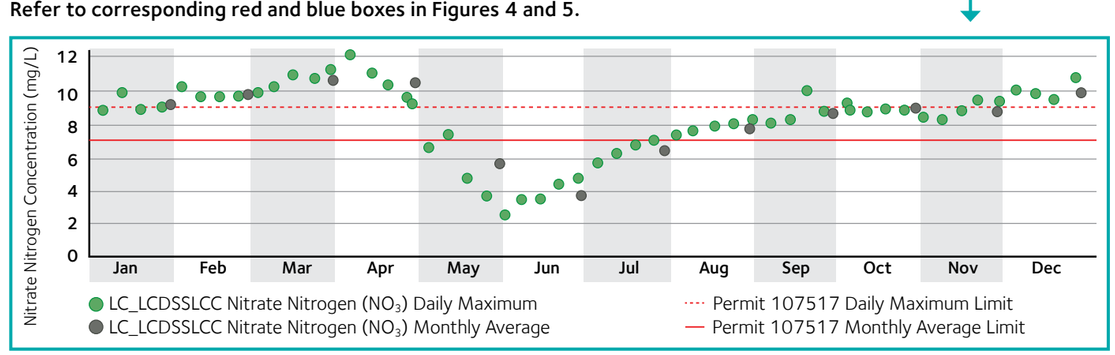


Figure 4. Nitrate concentrations at Line Creek Operations compliance point in 2020.

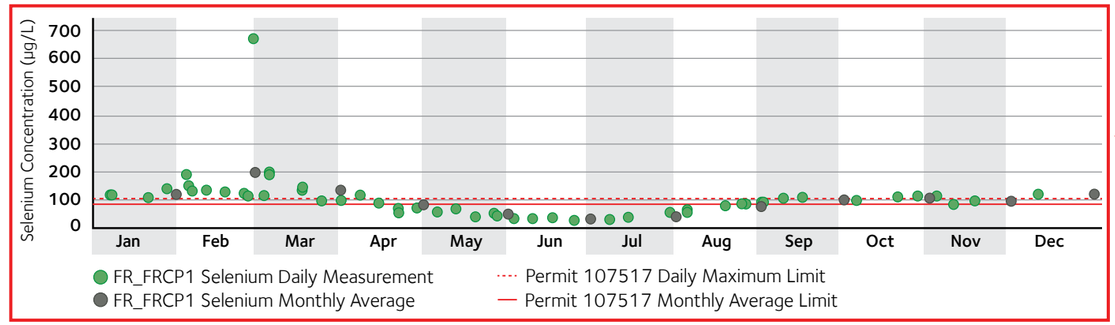


Figure 5. Selenium concentrations at Fording River Operations compliance point in 2020.

Groundwater Monitoring Program

Annual Compliance Monitoring

Teck completed the 2017 - 2020 RGMP Work Plan and continued progress on the 2018 – 2021 SSGMP Work Plan. Work executed included flow accretion studies, aquifer testing, and the installation of 22 additional monitoring wells at relevant locations in the Elk Valley. Data collected will be used to improve the regional and site-specific conceptual site models, the RWQM, and inform management actions to better serve current and future drinking water users. The 2020 – 2023 RGMP Update assessed remaining program gaps. The 2020 annual results were generally consistent with historical concentrations.

Drinking Water Monitoring Program

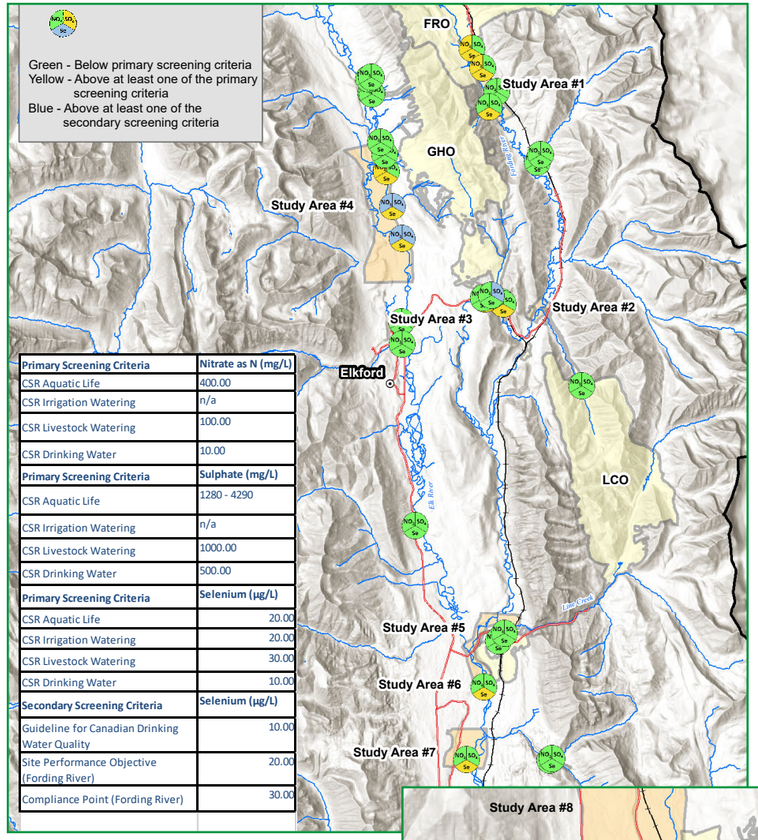
In 2020, Teck continued monitoring private and municipal potable wells under the Regional Drinking Water Monitoring Program (RDWMP). Teck encourages landowners and well operators to join the program through a variety of outreach initiatives, however participation in the program is voluntary. Twenty-eight wells were sampled. Selenium and/or sulphate concentrations were above the BC Source Drinking Water Quality Guidelines (BCSDWQGs) at seven wells, a decrease from 10 wells in 2019. Teck facilitated the enrolment of the City of Fernie into the program and installed two monitoring wells to reduce uncertainty relating to surface water–groundwater interaction near multi-user drinking water wells in the Sparwood Area. A variety of mitigations were provided to well users where selenium and/or sulphate concentrations were above the BCSDWQGs.

To request your well be sampled, call 1-855-806-6854.

Groundwater monitoring programs are conducted to understand how mine-related substances influence aquifers downgradient of mining operations. The Site-Specific Groundwater Monitoring Programs (SSGMPs) and Regional Groundwater Monitoring Programs (RGMPs) primarily compare groundwater quality to screening criteria focused on known mine-related substances (nitrate, sulphate, and dissolved selenium). In 2020, results were generally consistent with previous years. A map of locations show water quality status on Figure 1.

Teck completed the Sparwood Area Groundwater Supporting Study. The goal of the program was to reduce uncertainty related to transport pathways of mine-influenced groundwater in the Michel Creek valley-bottom aquifer and assess potential impact on current drinking water sources in the Sparwood area. The program involved the installation and sampling of 15 monitoring wells and evaluation of data collected at pre-existing wells and surface water monitoring stations. Collection of this data gives insight to better understand how surface water influences groundwater in the Sparwood area. The data may be used to support future improvement of the Regional Water Quality Model (RWQM) and inform water quality-related management decisions.

View Teck's 2020 annual reports: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/



Primary Screening Criteria	Nitrate as N (mg/L)
CSR Aquatic Life	400.00
CSR Irrigation Watering	n/a
CSR Livestock Watering	100.00
CSR Drinking Water	10.00
Primary Screening Criteria	**Sulphate (mg/L)**
CSR Aquatic Life	1280 - 4290
CSR Irrigation Watering	n/a
CSR Livestock Watering	1000.00
CSR Drinking Water	500.00
Primary Screening Criteria	**Selenium (µg/L)**
CSR Aquatic Life	20.00
CSR Irrigation Watering	20.00
CSR Livestock Watering	30.00
CSR Drinking Water	10.00
Secondary Screening Criteria	**Selenium (µg/L)**
Guideline for Canadian Drinking Water Quality	10.00
Site Performance Objective (Fording River)	20.00
Compliance Point (Fording River)	30.00

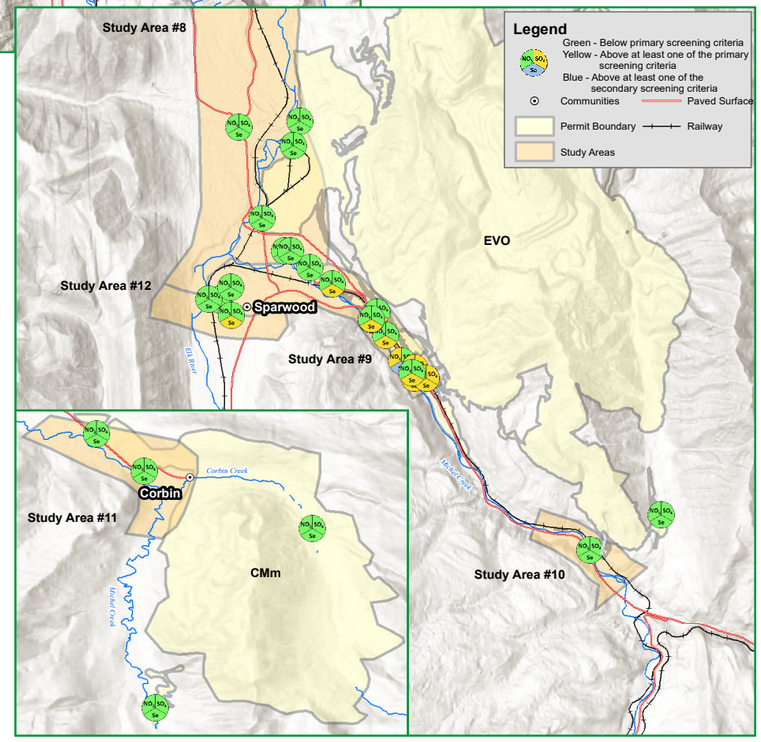


Figure 1. Pathways for mining influences on groundwater.

Key findings/ recommendations:

- There is further evidence of a thick and continuous fine-grained confining unit extending from Spring Creek to the Mountain View Trailer Park.
- This confining unit is not inferred to be fully continuous in the proximity Sparwood Well #3. Water quality at this location appears to reflect Elk River and Michel Creek influence.
- Monitoring of the new wells will continue under the RGMP/ SSGMP programs.

Groundwater Working Group (GWG)

The GWG supports the EMC with hydrogeology expertise. Membership of GWG group includes representatives from Teck Coal Limited, the Ktunaxa Nation Council, Ministry of Environment and Climate Change Strategy, Interior Health, and external consultants (qualified professionals). The GWG helps steer the continued development of Teck's groundwater monitoring programs.

Regional Aquatic Effects Monitoring Program (RAEMP)

RAEMP Purpose and Requirements

The RAEMP monitors, assesses, and interprets indicators of aquatic ecosystem condition related to mine operations to inform adaptive management.

Under Permit 107517, Teck is required to submit a RAEMP Report every three years. The most recent report covers monitoring data from 2017-2019. Teck provided the EMC with an update on RAEMP monitoring in 2020.

RAEMP Supporting Studies

The following studies support the RAEMP:

- Sediment Toxicity Study
- Nutrient Study
- Columbia Spotted Frog Toxicity Study
- Lentic Area Supporting Study
- Selenium Bioaccumulation Model

Figure 1. Columbia Spotted Frog

RAEMP Summary

RAEMP objectives are framed as questions to guide data analysis and interpretation. The objectives were developed collaboratively with the EMC.

Has there been a change in condition since previous monitoring cycles with respect to fish and benthic invertebrate population/ community indicators, water quality, sediment quality, calcite, and/or tissue selenium concentrations?

Changes in condition since previous monitoring cycles were observed throughout the Elk River watershed in all endpoints for which data were available; however, most unexpected changes related primarily to benthic invertebrate metrics. Most effects to the benthic invertebrate community (BIC) were observed in metrics that reflected the proportion of one group of organisms (e.g., EPT) relative to the overall community abundance, rather than the abundance of the organisms themselves. The absolute abundance of these organisms has remained similar over time and compared to reference areas, but the community structure has shifted leading to lower than expected (based on habitat conditions in a given area) relative, or percent, abundance. Total abundance and richness (number of different types of organisms) metrics tended to be within expected values based on habitat in most areas except the more highly mine-influenced tributaries.

Does the weight of evidence indicate the unexpected changes are mine-related?

In most cases, yes. However, there are challenges in separating mine-related impacts from habitat related effects. A lot of work continues to better understand habitat effects.

View Teck's 2020 annual reports: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

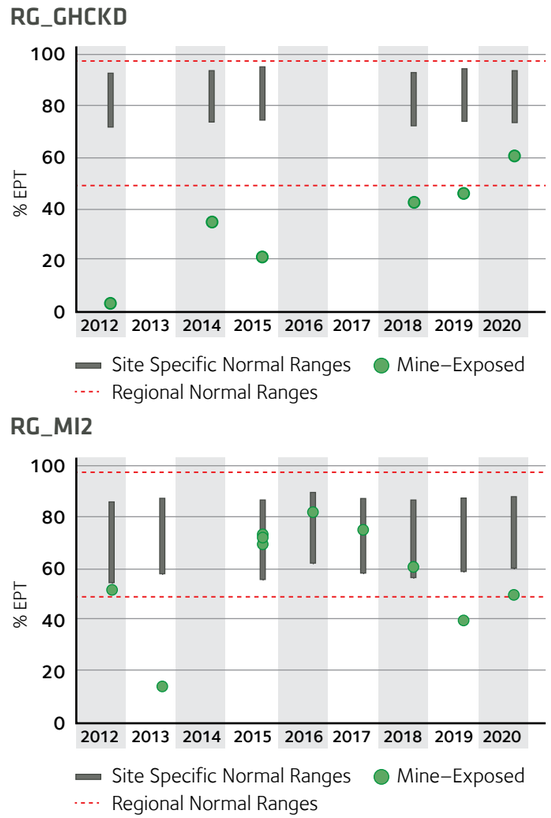


Figure 2. Benthic invertebrate community % EPT.

Were any identified changes unexpected (i.e., inconsistent with model predictions or general expectations)?

Yes, increasing tissue selenium concentrations were observed in the Upper Fording River (RG_FC1, RG_CLODE, RG_KICK, and RG_GHCKD) as well as Harmer Creek (RG_HACKUS).

What does the weight of evidence indicate about current or future ecosystem conditions in each management unit (MU) and regionally, considering the observed type, magnitude, spatial extent, and/or rate of change?

At a regional scale, the Upper Fording River (MU1) shows the greatest magnitude and spatial extent of change due to declines in Westslope Cutthroat Trout (WCT) populations and changes in the BIC. There are localized changes in some MUs and changes in BIC in MU4 (Michel Creek downstream of Coal Mountain Mine) which are thought to be related to nickel.

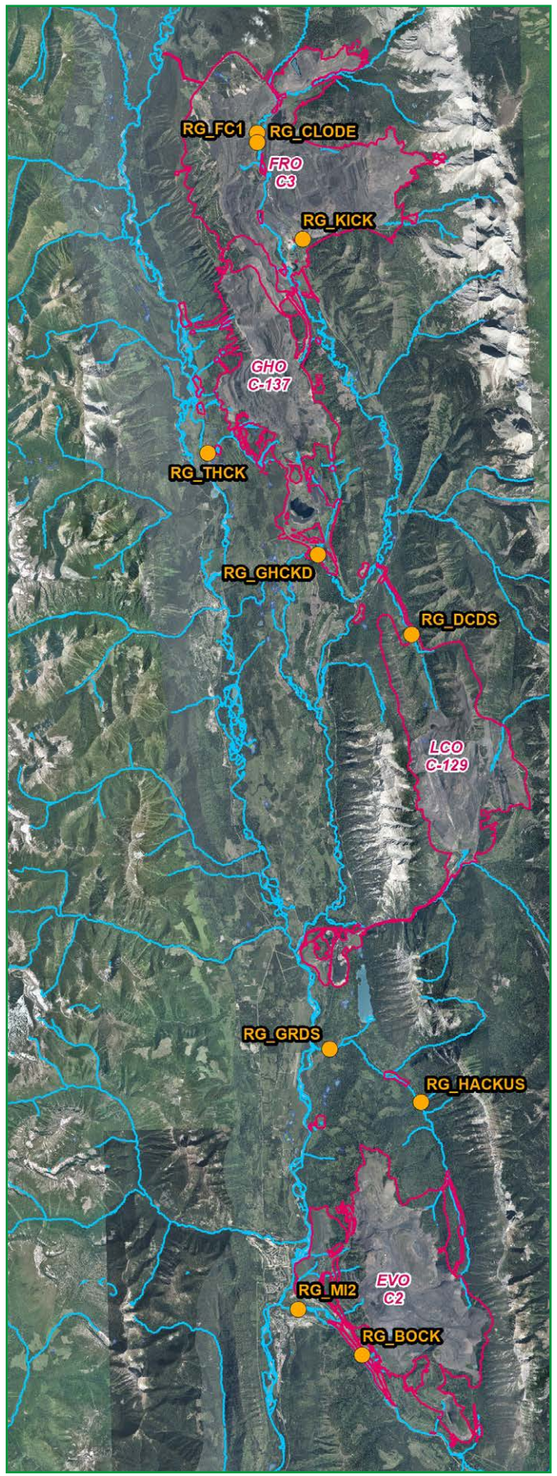


Figure 3. RAEMP sampling locations.

Regional Aquatic Effects Monitoring Program (RAEMP)

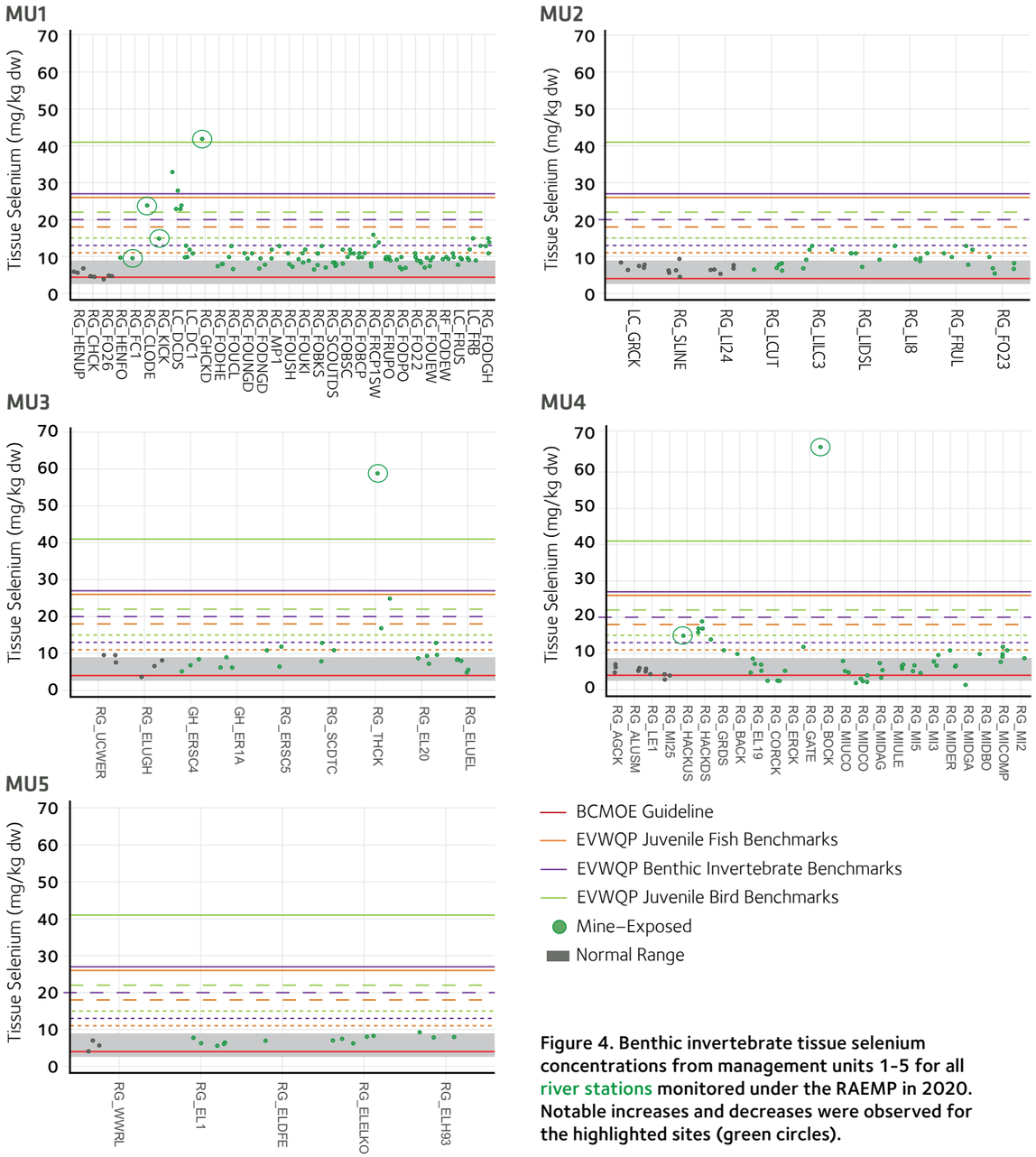


Figure 4. Benthic invertebrate tissue selenium concentrations from management units 1-5 for all river stations monitored under the RAEMP in 2020. Notable increases and decreases were observed for the highlighted sites (green circles).

2020 RAEMP Findings

Figure 4 shows benthic tissue selenium concentrations for all stations monitored under the 2020 RAEMP (covering 2017-2019), with 87% of these stations showing no change or effects to benthic invertebrate tissue selenium concentration. Stations showing increasing or decreasing trends (green circles in Figure 4) and annual trends are provided in more detail below in Figure 5.

The 2020 RAEMP key findings are summarized below. Management unit areas are on the MU map shown on Monitoring Water Quality in the Elk Valley.

- Slight decrease in benthic tissue selenium concentration at RG_GRDS (see Figure 3 for location).
- Decreases in calcite at RG_KICK, RG_GRDS, and RG_MI2 (see Figure 3 for locations).
- Increases in benthic tissue selenium concentrations in MU 1. These were observed at RG_FC1, RG_CLODE, RG_GHCKD and RG_KICK, RG_HACKUS (see Figure 3).
- Benthic tissue selenium at RG_THCK decreased from 2019 to 2020 but continues to exceed benchmarks established for the protection of benthic invertebrates, juvenile fish, and juvenile birds (see Figure 5).
- Increases in %EPT at RG_GHCKD, RG_MI2, and all biological areas in MU5 (see Figure 2 and Figure 3 for locations).
- Increases in most analyzed PAHs (polycyclic aromatic hydrocarbon) at RG_HACKDS (see Figure 3 for location).

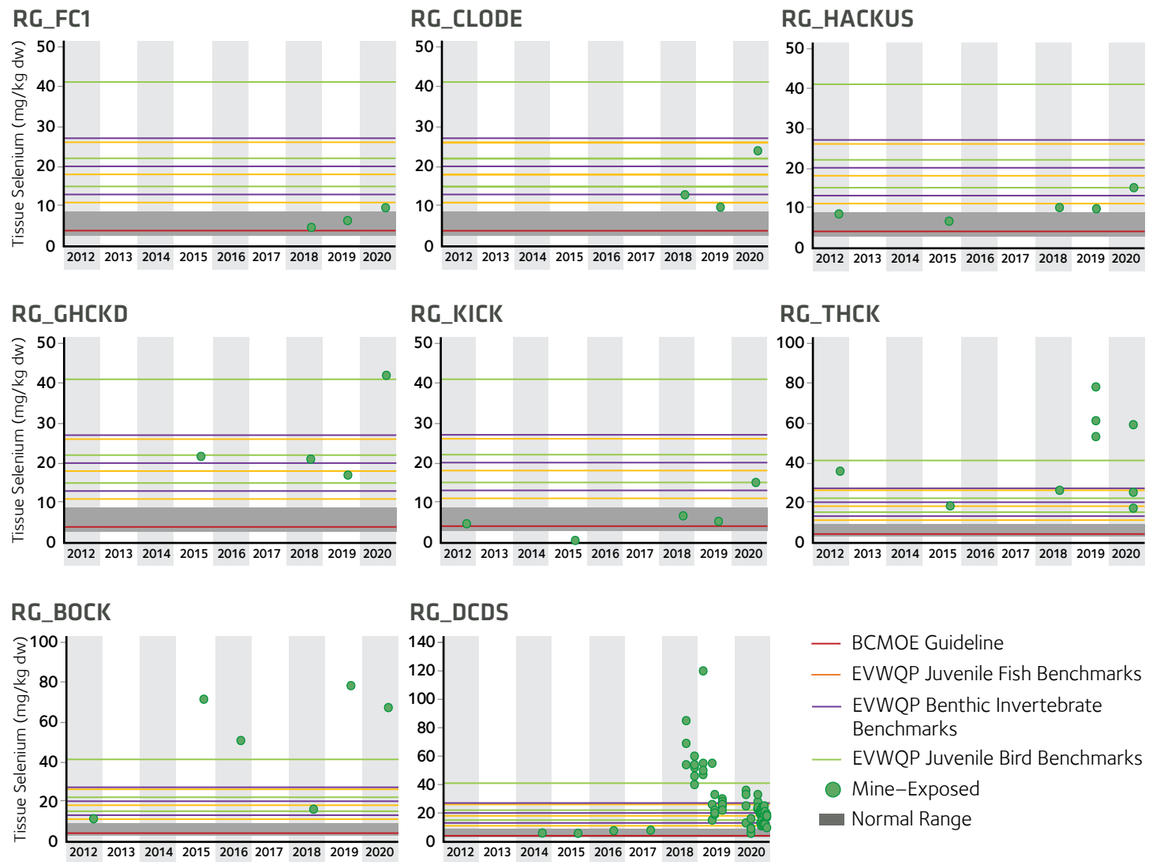


Figure 5. 2012-2020 Annual trends of benthic tissue selenium concentrations for locations highlighted in Figure 4.

Local Aquatic Effects Monitoring Programs (LAEMPs)

Fording River

Objective: Assess effect of active water treatment on the Fording River.

- Active Water Treatment Facility operational in 2021. Monitoring is ongoing to assess water quality and biological changes below the facility.
- LAEMP boundary continues to expand to broader areas in the Fording River.
- Water quality variables (related to mining), calcite, substrate size and flow volumes are considered contributing causes for the variations in the benthic community over a 4 km reach.

Figure 1. A dry section of the upper Fording River (near FR_FR1). Dry sections are a potential contributor to changes in benthic communities.

Greenhills

Objective: Assess conditions downstream of west side tributaries of Greenhills Operation.

- LAEMP commitments completed in 2020.
- Teck proposing to undertake routine monitoring of water quality variations under other programs (e.g., RAEMP, groundwater).

Figure 2. Elk River side-channel downstream of Thompson Creek, part of the Greenhills Operation.

View Teck's 2020 annual reports: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Line Creek

Objective: Assess effects of Active Water Treatment Facility (AWTF).

- Addition of advanced oxidative process (AOP) to the AWTF continued to reduce selenium in benthic communities and fish tissue to pre-treatment levels (or better).
- No measurable effects on benthic community, composition, or productivity.
- Monitoring is ongoing.

Coal Mountain

Objective: Assess magnitude and extent of influence of CMm on water quality and benthic communities.

- Spatial patterns in benthic communities corresponded most closely with water quality variables.
- Nickel concentrations, below British Columbia Water Quality Guideline (BCWQG), considered the most likely cause of changes in benthic communities.

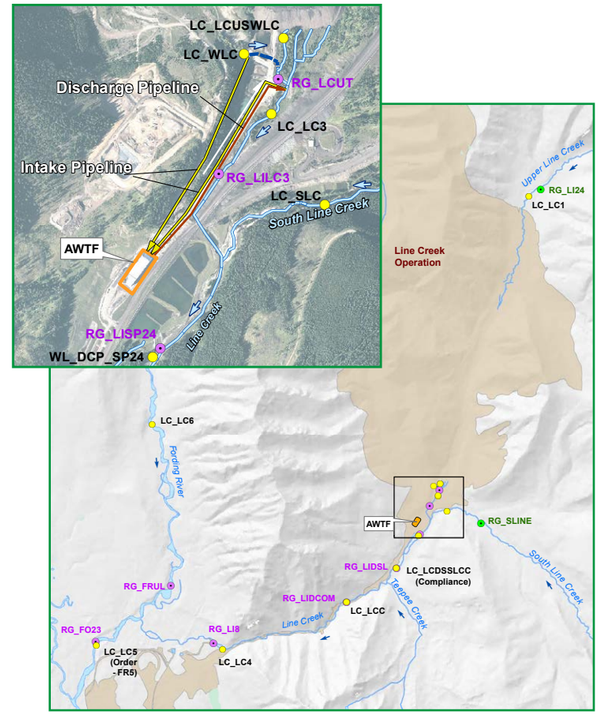


Figure 3. Map showing sampling locations for the Line Creek LAEMP.

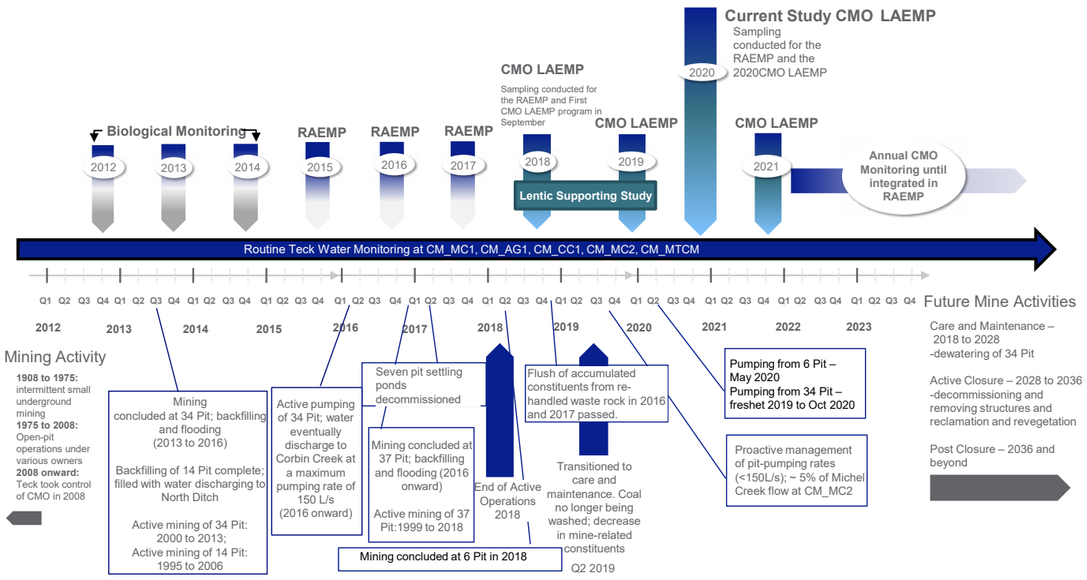


Figure 4. Flow chart of activities associated with Coal Mountain Mine LAEMP.

Local Aquatic Effects Monitoring Programs (LAEMPs)

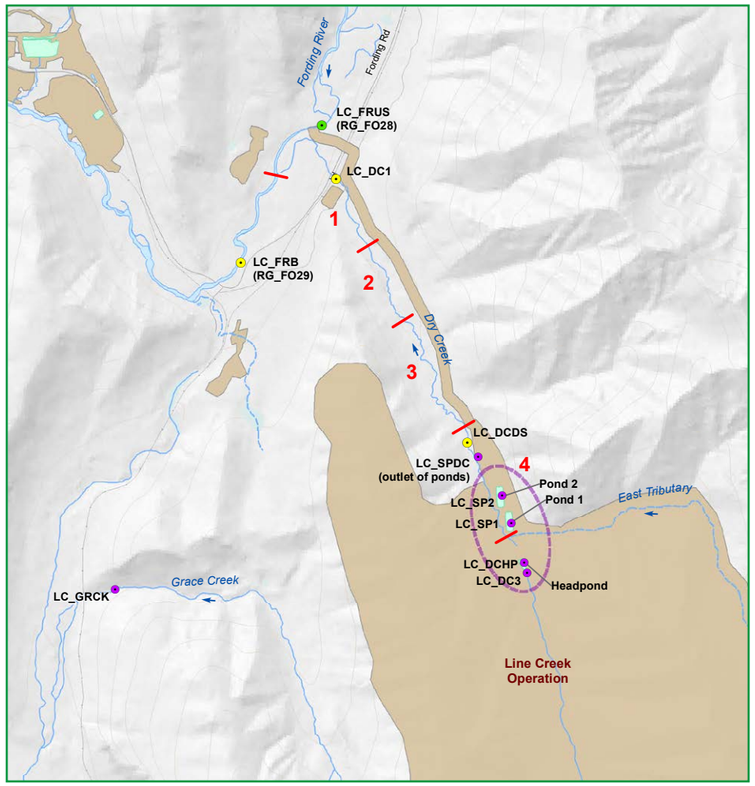


Figure 5. LCO Dry Creek sampling locations.

LCO – Dry Creek

Objective: Assess effects of Phase 2 Line Creek Operations on Dry Creek, Grace Creek, Unnamed Creek.

- To manage increased selenium bioaccumulation, a water management system bypass was initiated in July 2020.
- Benthic tissue selenium decreased in 2020.
- % Mayflies (Ephemeroptera) below normal ranges in 6 of 9 sample areas in 2020.
- Significant increases in multiple mine-related water quality variables (selenium, nickel, nitrate, sulphate, total dissolved solids, uranium) increased in 2020 relative to prior years.

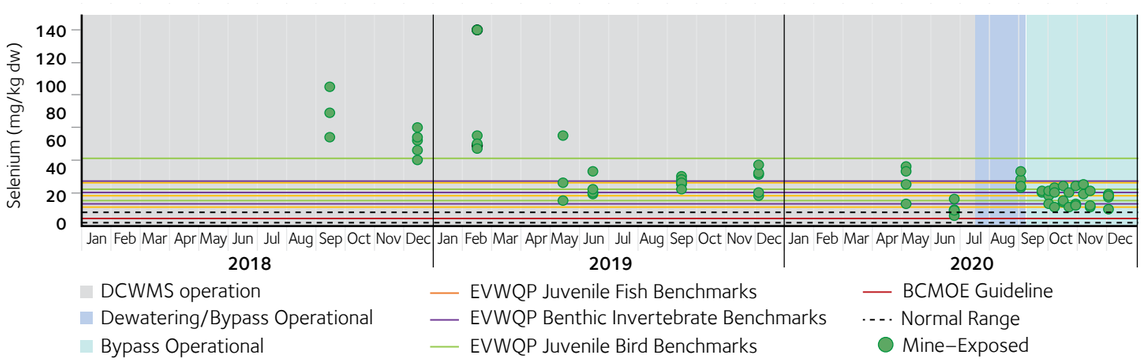


Figure 6. Variations in benthic tissue selenium over time.

Elkview

Objective: Assess effects of Saturated Rock Fill (SRF).

- Phase 2 of Elk Valley Operations SRF commenced in December 2020.
- Monitoring focus is on nickel, phosphorus, selenite, organoselenium, temperature, benthic communities, benthic tissue selenium.
- Current program runs 2021 to 2023.
- Monitoring to continue until effects of SRF is sufficiently understood.

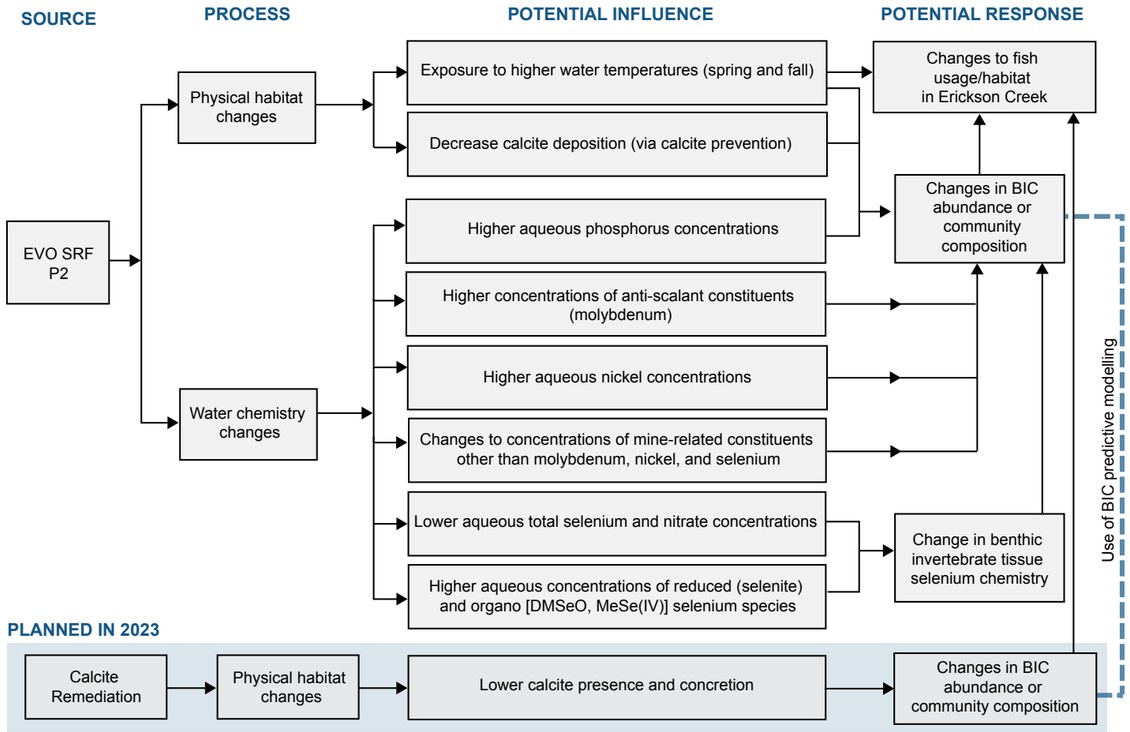


Figure 7. Conceptual model of potential changes in aquatic health to the SRF.

Koocanusa Reservoir Monitoring

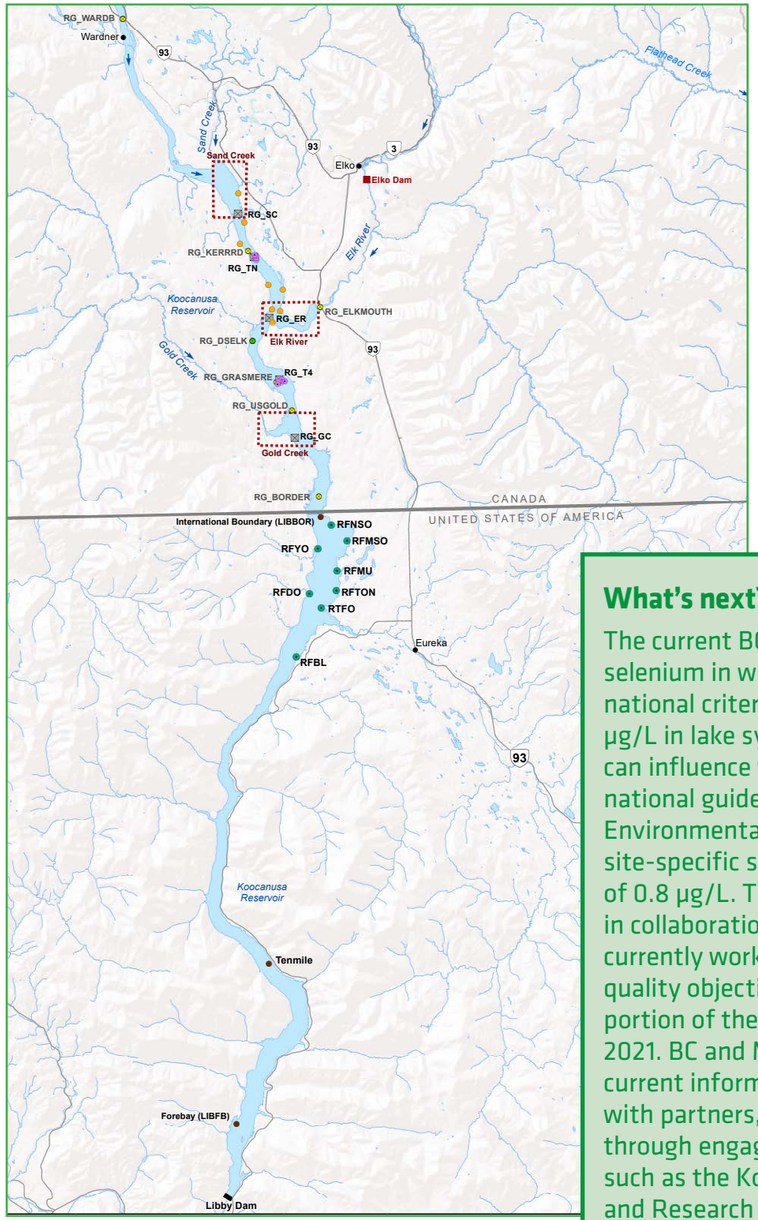


Figure 1. Koocanusa Reservoir monitoring stations.

The Koocanusa Reservoir, created in the 1970s by the Libby Dam in Montana on the Kootenay River (Figure 1), lies within the Ktunaxa Territory and straddles the border between Canada and the United States. It is a dynamic system that is strongly influenced by seasonal reservoir levels. Variations in physiochemical and biological conditions on the Reservoir can be attributed to reservoir conditions. Water quality, sediment quality and fish (aquatic biota) are regularly monitored as part of the Koocanusa Reservoir Monitoring Program.

What's next?

The current BC provincial guideline for selenium in water is 2 µg/L, while the US national criteria for selenium in water is 1.5 µg/L in lake systems. Site-specific factors can influence the applicability of provincial or national guidelines. Montana Department of Environmental Quality (DEQ) has adopted a site-specific selenium objective for Koocanusa of 0.8 µg/L. The BC Ministry of Environment, in collaboration with the Ktunaxa Nation is currently working on a site-specific water quality objective for selenium in the BC portion of the Reservoir which is expected in 2021. BC and Montana will continue to share current information and results, and meet with partners, stakeholders, and the public through engagement and consultation forums such as the Koocanusa Reservoir Monitoring and Research Working Group.

Water Quality

The monthly average concentration of order constituents (cadmium, nitrate, selenium, and sulphate) at the order station in Koocanusa Reservoir (RG_DSELK; EMS ID E300230) met the permitted limits in 2020 (Figure 2). Concentrations of other parameters of potential concern were all below provincial water quality guidelines, except for two instances of iron during freshet.

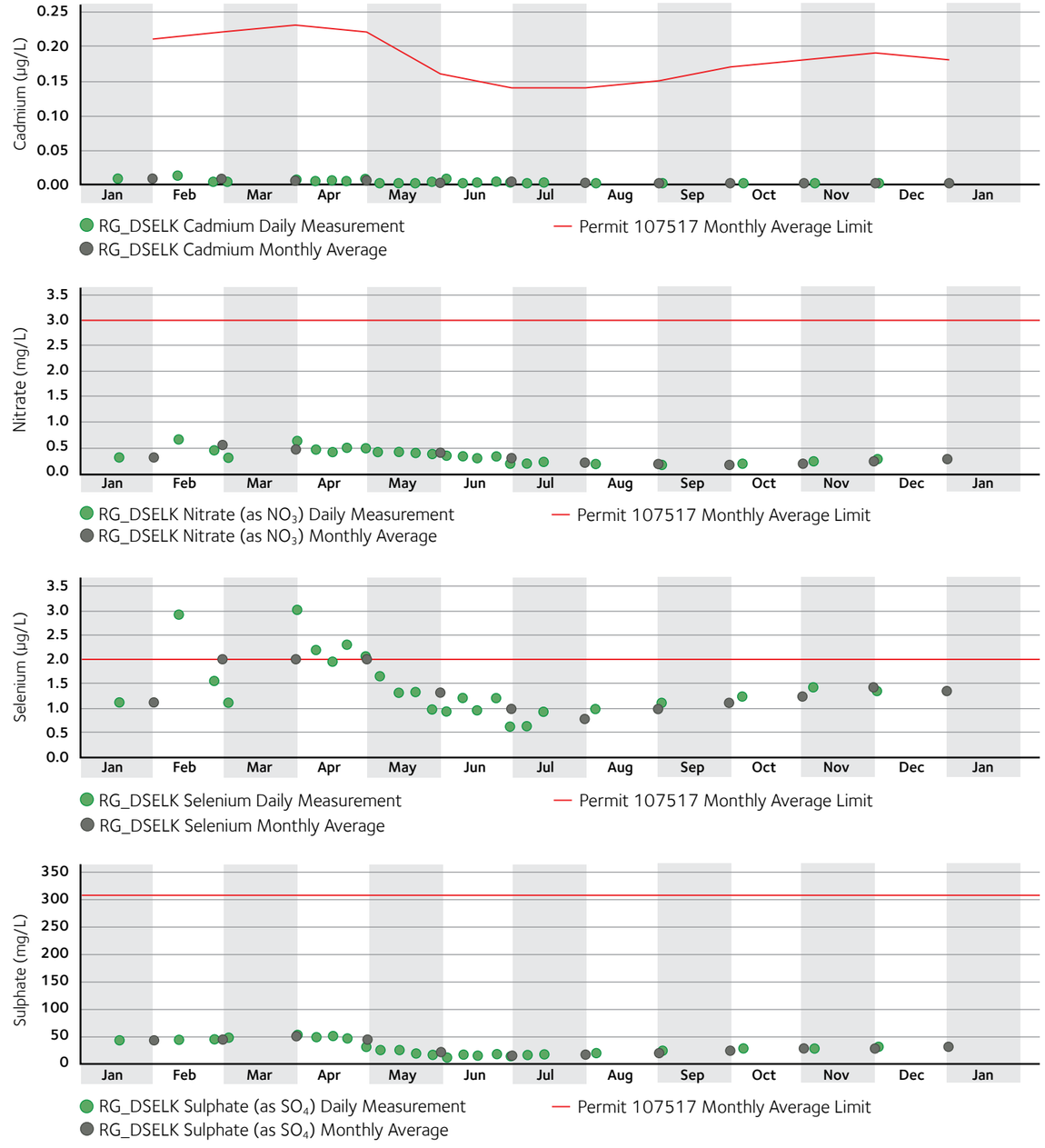


Figure 2. 2020 Monthly average concentration of order constituents.

Fish Supporting Studies

Redside Shiner Recruitment Study

The Redside Shiner (Figure 1) recruitment study began in 2018 to assess potential for adverse effects on populations. There are abundant young fish upstream and downstream of the Elk River (see Koocanusa Reservoir Monitoring, red boxes showing approximate fish sampling areas). However, high proportions of young of year were found in both areas, indicating recruitment (i.e., successful reproduction).

Different species of fish vary in their sensitivity to selenium and work is underway to develop species-specific toxicity benchmark for Redside Shiner, Northern Pikeminnow (see Figure 3), and Mountain Whitefish (see Figure 4).

Results of the Redside Shiner study indicate these fish are relatively tolerant to selenium. The final 2020 findings confirmed that unripe ovary/egg data is not reliable in evaluating exposure of developing embryos and that it is critical to assess ovary egg selenium concentrations at the time of spawning to evaluate selenium toxicity. There was no evidence of selenium effects on survival, growth, or deformity of Redside Shiner embryos and larvae up to the highest egg concentration.

Figure 1. Redside Shiner.

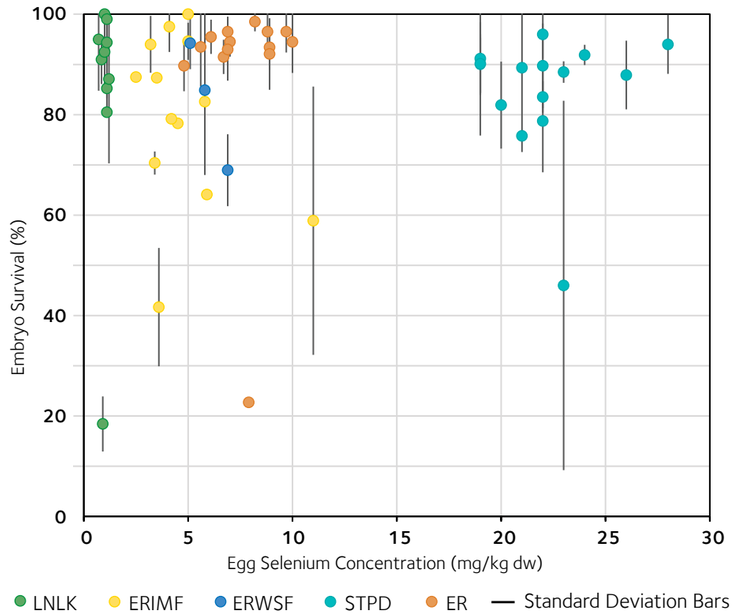


Figure 2. Survival of Redside Shiner larvae versus egg selenium concentrations.

Figure 2 plot shows no effect of egg selenium concentration on survival of embryos from fish collected in Loon Lake (LNLK, a reference location), the Elk River Impoundment at Fernie (ERIMF), the Elk River Wetland south of Fernie (ERWSF), Koocanusa Reservoir near the Elk River (ER), and Stanford Pond (STPD). Low survival and high variability in survival (standard deviation bars) observed in some clutches of eggs were related to factors such as fungal infection or incomplete fertilization.

Figure 3. Northern Pikeminnow.

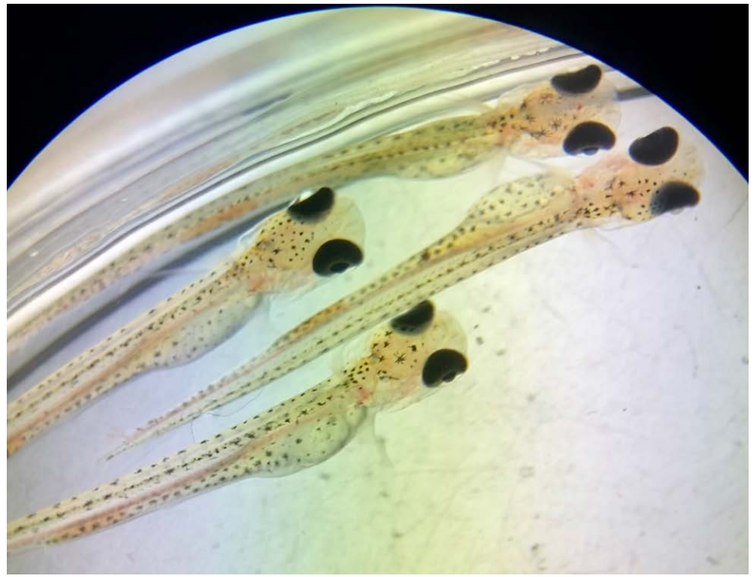


Figure 4. Lab samples of Mountain Whitefish larvae.

Ecotoxicity Studies

Additional supporting selenium ecotoxicity studies for Northern Pikeminnow (Figure 3) and Mountain Whitefish (Figure 5) are under way to increase our understanding of effects. Initial findings in these studies support the understanding that observed concentrations in ovaries decline as eggs mature—emphasizing the importance of understanding the concentrations in mature eggs for assessing their sensitivity. Additional reporting on these studies will be provided in 2021 and 2022, respectively.

Figure 5: Mountain Whitefish toxicity study.

View Teck's 2020 annual reports: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

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 (Figure 1) found that abundance of adults and sub-adults had declined significantly from previous sampling in 2017. Teck immediately implemented an Evaluation of Cause (EOC) process to determine likely causes. Follow-up monitoring in 2020 has confirmed the low counts.

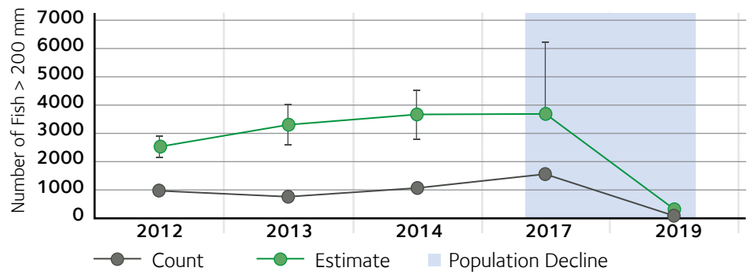


Figure 1. Variations in numbers of WCT in the Upper Fording River.
Cope, S. (2020a). Upper Fording River Westslope Cutthroat Trout Population Monitoring Project: 2019. Report Prepared for Teck Coal Limited, Sparwood, BC. Report Prepared by Westslope Fisheries Ltd., Cranbrook, BC. (40 p + 1 appendix).

Evaluation of Cause Process

The EOC is the process used to investigate, evaluate, and report on the reasons for the WCT population decline. Teck established a team of external subject matter experts who have had input from regulatory agencies, the Ktunaxa Nation Council (KNC), and an independent scientist through various committees. The subject matter experts developed individual reports on each of the potential stressors and impact hypotheses (Figure 2). The results of the individual stressor reports are used to support an integrated assessment of the causes of the decline in the fish population.

Outcomes

The Upper Fording River EOC process has not yet concluded, but preliminary findings indicate that the fish population decline happened due to combination of factors. The final report is currently expected to be complete by the end of the year and will be subsequently made publicly available.

Monitoring of the population is ongoing and recent fish survey results indicate a positive trend in the WCT population. Building on recovery actions already underway, WCT recovery plans are being prepared in 2021 by regulatory agencies, the KNC and Teck.

Abundances of Westslope Cutthroat Trout declined significantly in winter 2018/2019. The Evaluation of Cause process is underway and preliminary results indicate that the Upper Fording River fish population decline happened due to a combination of factors including extreme winter conditions (prolonged, low temperatures and ice conditions), low flows, and restrictive fish passage to overwintering habitats. In a separate watershed, results of WCT population monitoring in 2019 and 2020 indicate a recruitment failure in Harmer Creek. An Evaluation of Cause Team is working through available information to determine potential stressors that may have contributed to the recruitment failure.

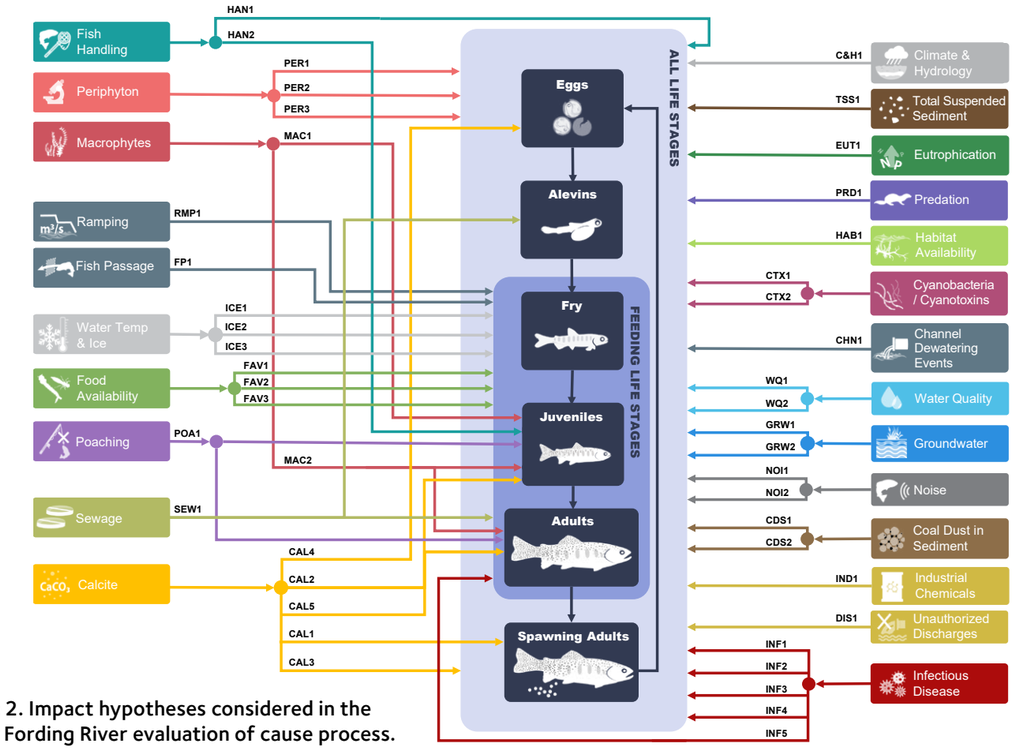


Figure 2. Impact hypotheses considered in the Upper Fording River evaluation of cause process.

Harmer Creek

The Issue

WCT is the only fish species in Harmer Creek. Monitoring in 2017-2019 (Figure 3) found that abundance of juveniles had declined significantly in 2018 and 2019 (Figure 4). Subsequent analysis has confirmed a recruitment failure of juvenile fish occurred.

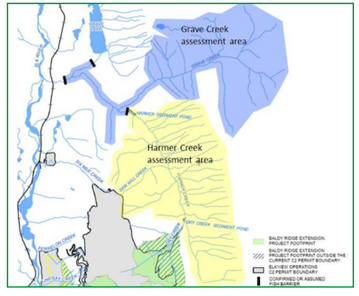


Figure 3. Map illustrating the location of Harmer Creek relative to Grave Creek and the Fording River.

Evaluation of Cause (EOC) Process

Like for 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.

Outcomes

Individual reports are currently being developed by subject matter experts. The EOC process is anticipated to be completed by early 2022. Monitoring of the population is ongoing.

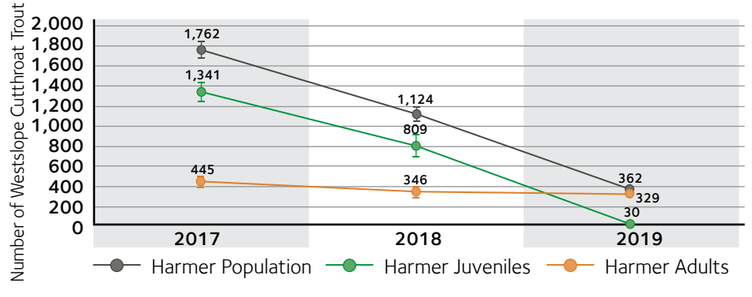


Figure 4. Variations in numbers of juvenile Westslope Cutthroat Trout in Harmer Creek. Cope, S. and A. Cope. 2020. Harmer and Grave Creek Westslope Cutthroat Trout Habitat and Population Assessment: Final Report. Report Prepared for Teck Coal Limited, Sparwood, B.C. Report Prepared by Westslope Fisheries Ltd., Cranbrook, B.C. 121 p. + 2 app.

Calcite Monitoring

Figure 1. Calcite index surveys in the Fording River.

Regulatory Requirement

- Permit 107517 requires Teck to meet a medium-term and a long-term

Medium-term SPO:

- Calcite Concretion ≤ 0.50 by December 31, 2024

Long-term SPO:

- Calcite Index ≤ 0.50 by December 31, 2029

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 2. Different metrics used to describe calcite in streams.

Calcite Sampling

Annual monitoring of calcite is completed throughout the Elk Valley mainstem and tributaries. 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 2). Calcite index scores range from 0 (no calcite) to 3 (fully concreted streambed) (Figure 3).

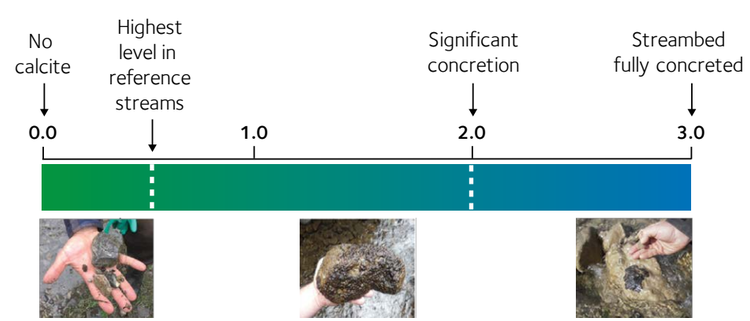


Figure 3. Examples of rocks at different calcite indices.

2020 Monitoring Results

In 2020, 27 reaches within 18 streams were identified as currently above the 2024 SPO for calcite concretion, which represents one additional reach from the 2019 total.

Of these 27 reaches, 14 reaches are prioritized for management within the Calcite Management Plan (CMP), an additional 4 reaches will/have been treated through saturated rock fills and active water treatment facilities and the remaining 9 reaches will be re-assessed for management within the 2022 CMP.

Similar to the previous year, an increasing trend of calcite indices within both mine exposed and reference reaches was observed (Figure 4). The increase in reference reaches, and some of the increase in mine exposed reaches, is hypothesized to be in response to the gradual return of calcite formation after the scouring and sediment/bedload recruitment associated with the floods of 2013.

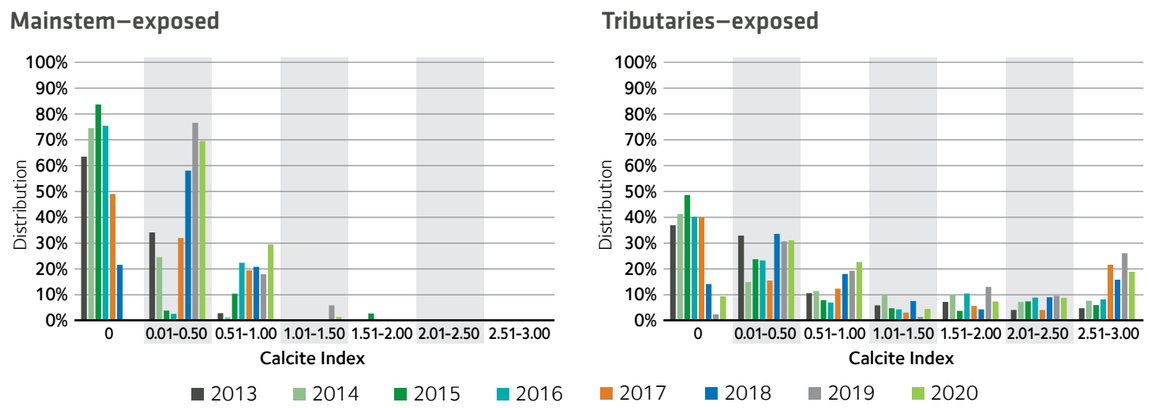


Figure 4. The distribution of calcite index by reach kilometers in both mining-exposed mainstems (left) and tributaries (right).

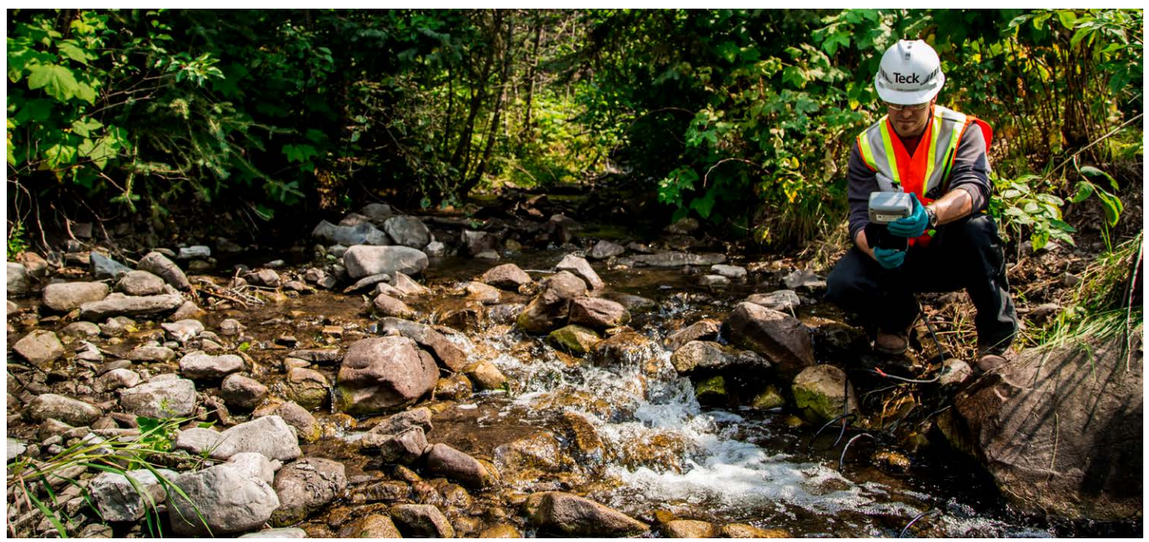


Figure 5. Water Quality Sampling along a calcified stream within the Elk Valley.

Access Teck's 2020 annual reports here: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Calcite Monitoring

Figure 6. Swift and Cataract Creek Outfall Structure. This water is dosed with antiscalant to neutralize Swift and Cataract Creeks as a source of calcite to the Fording River.

Environmental Impacts

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 to create nests (redds).

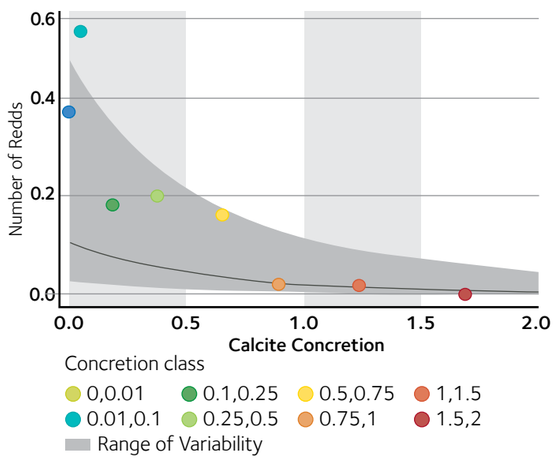


Figure 7. Predictive model of the relationship between redd counts and calcite concretion.

Spawning Habitat Suitability

Current models show that a calcite concretion score of 0.50 is predicted to reduce the number of Westslope Cutthroat Trout redd counts by approximately 50% (Figure 7). There is uncertainty in this model and refinement is underway.

Benthic Community

Increasing calcite concretion is correlated with a decline in sensitive benthic invertebrate taxa such as Ephemeroptera (Figure 8), although this observed impact may be due to poor water quality as well as concretion.

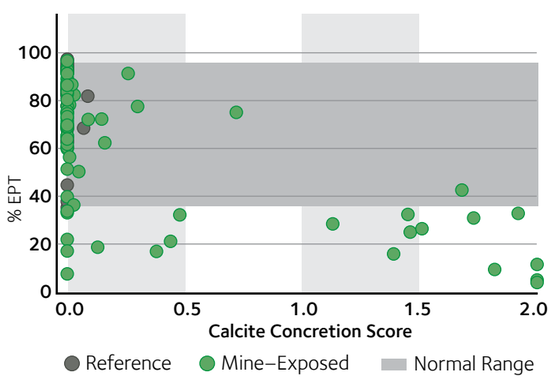


Figure 8. Plot of %EPT at various locations throughout the Elk Valley and the respective calcite concretion scores.

Management

Teck is developing and testing both preventative and remediation technologies to meet the SPOs established under Permit 107517.

Prevention

By the end of 2020, Teck implemented antiscalant addition facilities at three locations: Lower Greenhills Creek (Figure 10), West Line/Line Creek, and Swift-Cataract Creeks. Antiscalant has been effective in reducing calcite concretion rates at Lower Greenhills Creek and potentially Swift-Cataract Creek (Figure 9).

By the end of 2021, Teck will have three more antiscalant additional locations in operation at the EVO Saturated Rock Fill (Gate, Bodie and Erickson Creeks), LCO Dry Creek, and at the FRO active water treatment facility.

Remediation

A pilot test is planned for 2022 in which a short segment of concreted streambed will be excavated (Figure 11) and replaced with fresh substrate. Remediation is a critical component of calcite management.

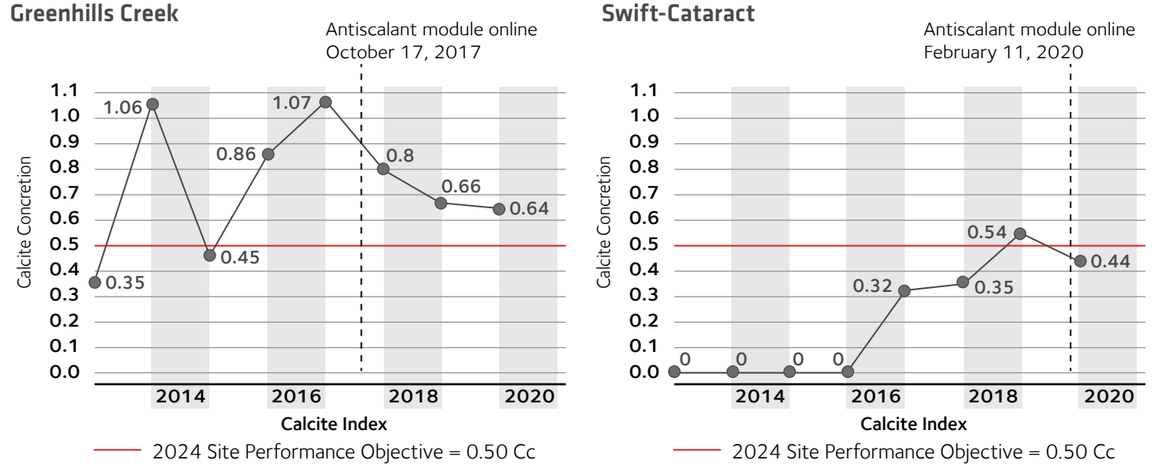


Figure 9. Plot of calcite concretion at Greenhills Creek (left) and Swift-Cataract Creek (right) since mid-2013.

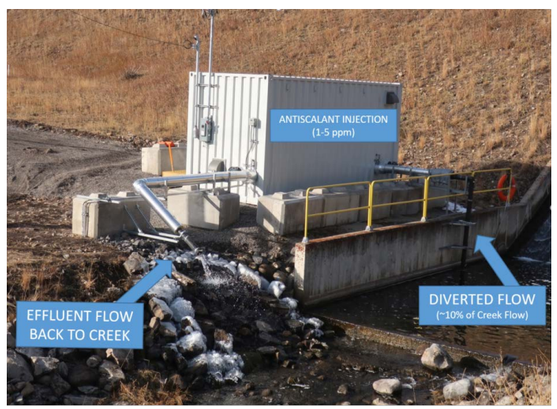


Figure 10. Antiscalant Addition Module at Lower Greenhills Creek.

Figure 11. Calcite excavation at Cataract Creek.

Nickel Monitoring

Nickel Toxicity

Understanding nickel toxicity is highly challenging because nickel toxicity can be affected by exposure and toxicity factors such as hardness, dissolved organic carbon (DOC), alkalinity, and pH. For example, nickel toxicity generally decreases with increasing hardness or DOC and increases with increasing pH or alkalinity.

Effects of Nickel

Nickel was identified as a potential constituent of concern through chronic toxicity testing completed at the Coal Mountain Mine (CMm) compliance location in 2017. Specialized investigations, including a toxicity identification evaluation, and a review of published data indicated toxicity to invertebrate species used in chronic toxicity testing was likely due to nickel. Invertebrates are more sensitive to nickel compared to fish and amphibians.

Nickel may potentially be affecting benthic invertebrate communities at some locations at CMm (and potentially at other locations) at concentrations lower than the current British Columbia Water Quality Guidelines for the Protection of Aquatic Life (BCWQG-PAL). Figure 2 shows results of chronic toxicity testing in the benthic community at the CMm compliance location. Toxicity has potentially been attributed to nickel exposure.

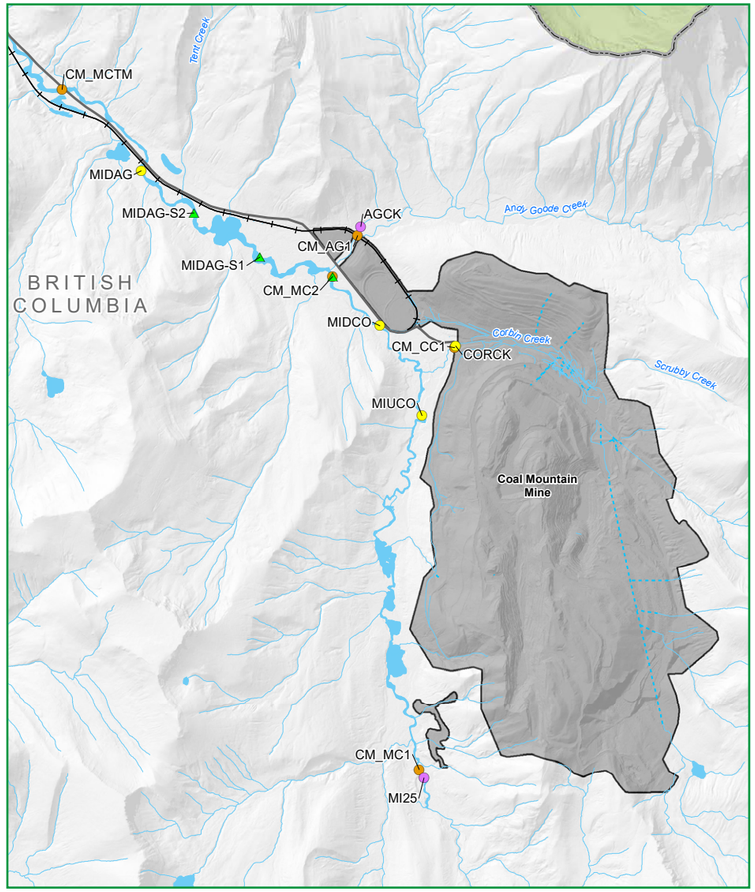


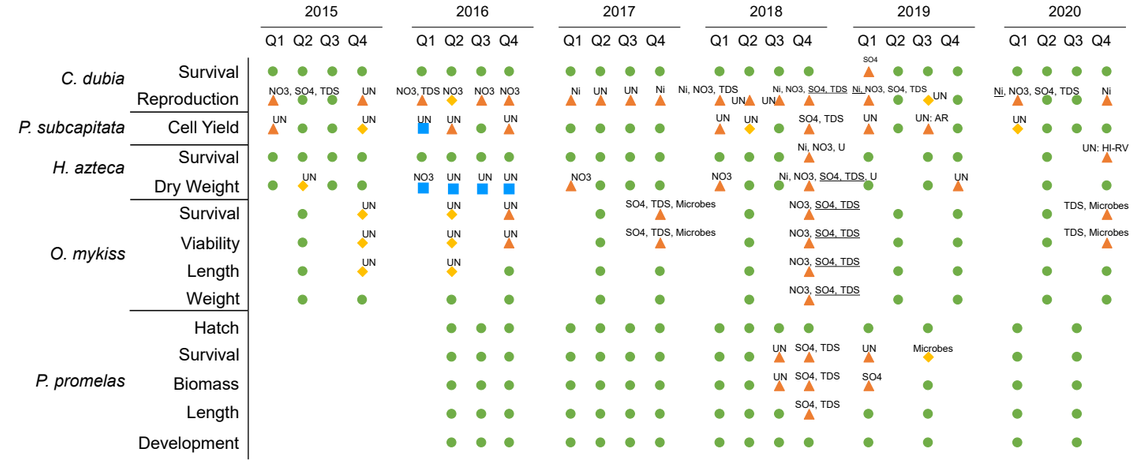
Figure 1. Coal Mountain mine sampling locations.

Response

The current BCWQG-PAL is being updated by BC Ministry of Environment.

Teck developed interim nickel screening values based on a literature review to screen for potential nickel toxicity in Elk Valley waters; the development of site-specific benchmarks for nickel is ongoing.

A Local Aquatic Effects Monitoring Program (LAEMP) was established at CMm and a series of investigations completed to refine Teck's understanding of nickel toxicity and evaluate potential nickel mitigation technologies (see Figure 1).



Certainty of significant toxic effect: ● No ■ Significant but not large ◆ Possible ▲ Likely

Constituents Identified as Potentially Contributing to Observed Responses: AR = anomalous results; HI-RV = high inter-replicate variability; Ni = Nickel; NO_3 = nitrate; SO_4 = sulphate; TDS = Total Disolved Solids; U = uranium; UN = unknown (no water quality constituent was identified); Underlined = primary expanatory variable identified if multiple constituents were identified as potentially causing observed response

Figure 2. Summary of test results at Coal Mountain mine Compliance Location CM_MC2.

Nickel Monitoring Results

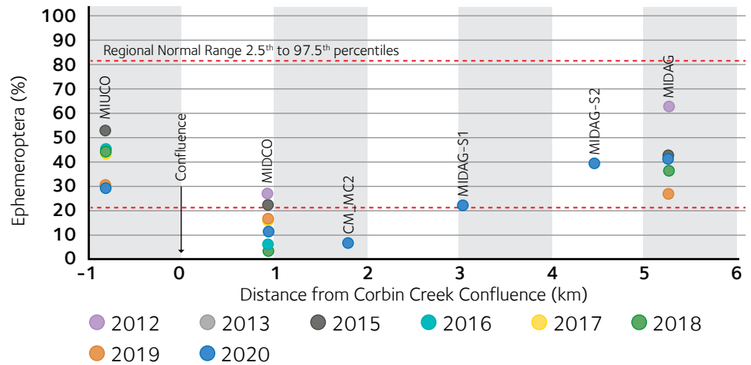


Figure 3. % Ephemeroptera results for Coal Mountain mine.

Figure 3 shows the % Ephemeroptera returning within regional normal range ~3 km downstream of Corbin Creek.

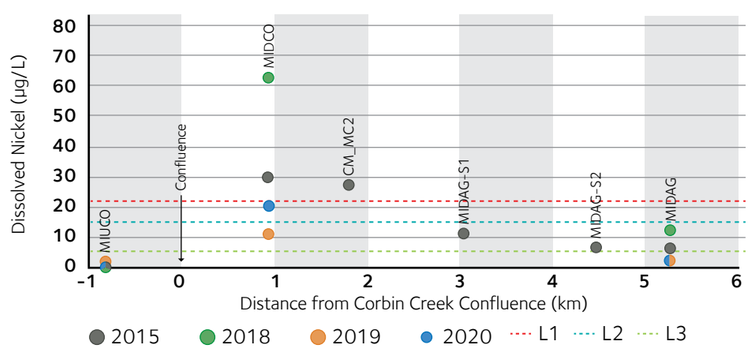


Figure 4. Dissolved Nickel results for Coal Mountain mine.

Figure 4 shows aqueous nickel near level 1 screening value 4.5 km downstream of Corbin Creek.

Selenium Speciation

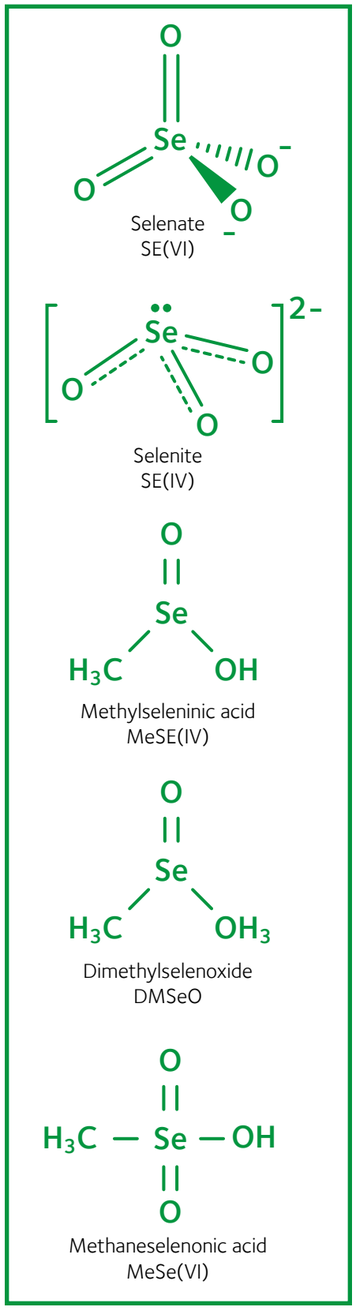


Figure 1. Selenium speciation and organoselenium.

What is Selenium Speciation?

Selenium (Se) speciation can vary and occurs naturally as selenate, selenite, organic selenium, elemental selenium, and other forms (see Figure 1).

Organoselenium (e.g., dimethylselenoxide [DMSeO], methylseleninic acid [MeSeIV]) can be generated in some mine water management structures such as sedimentation and buffer ponds and in the West Line Creek Active Water Treatment Facility (WLC AWTF). Algal productivity and/or microbial activity in sedimentation and buffer ponds are likely the main source of organoselenium.

DMSeO and MeSeIV are much more bioavailable compared to selenate or selenite and can result in higher selenium bioaccumulation in aquatic biota.

Selenium Bioaccumulation

Enhanced selenium bioaccumulation can be observed to some extent in benthic communities and fish downstream of sediment ponds. The Advanced Oxidation Process (AOP) was added to the WLC AWTF to successfully change organoselenium back to selenate (see LAEMP).

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

The selenium bioaccumulation tool is a model developed to predict bioaccumulation of selenium as a function of the concentration of selenium in different forms (species). It helps to understand if the selenium bioaccumulation is what we would predict based on the aqueous concentrations of specific species of selenium. Figure 2 shows the patterns of bioaccumulation in benthic invertebrates. The diagonal line in Figure 2 represents the lotic bioaccumulation model that calculates the predicted mean composite benthic invertebrate selenium concentration from aqueous total selenium concentration.

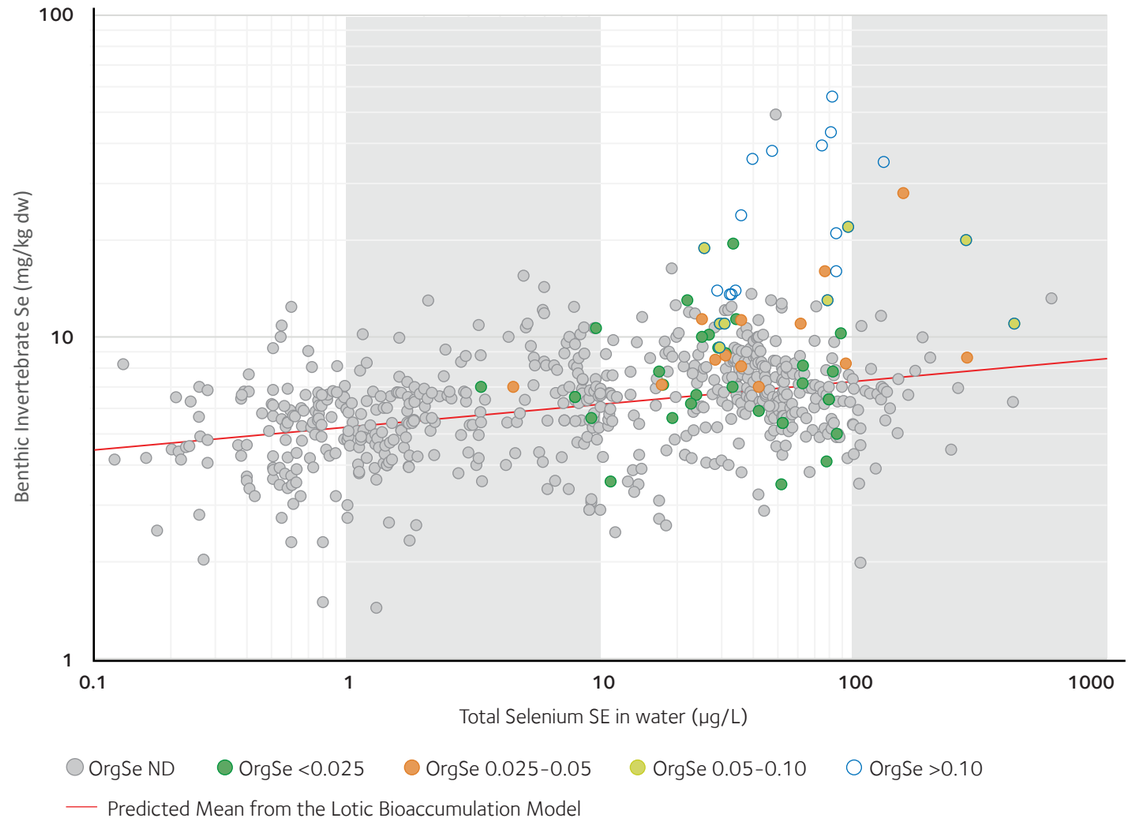


Figure 2. Patterns of bioaccumulation in benthic invertebrates.

Human Health Risk Assessment

An HHRA is required by Permit 107517

It is a collaborative effort between Ktunaxa Nation Council, BC Interior Health Authority, BC Ministry of Environment, Teck.

The work underway for this HHRA is inclusive, grounded, and reciprocal.

A human health risk assessment (HHRA) determines the potential risks to human health posed by certain substances. It considers how toxic the substance is, how much of the substance humans are exposed to, and how often.

This risk assessment will focus on mining-related substances found in the water, sediment, fish, wild plants, and wild game in the Elk Valley.

This risk assessment will evaluate the risk to human health based on the diet of valley residents and the Ktunaxa practice of **sukiɬ ik naɬsa** (eating well).

This risk assessment will tell us which mining-related substances in the Elk Valley could be a concern for human health and should be investigated more deeply.

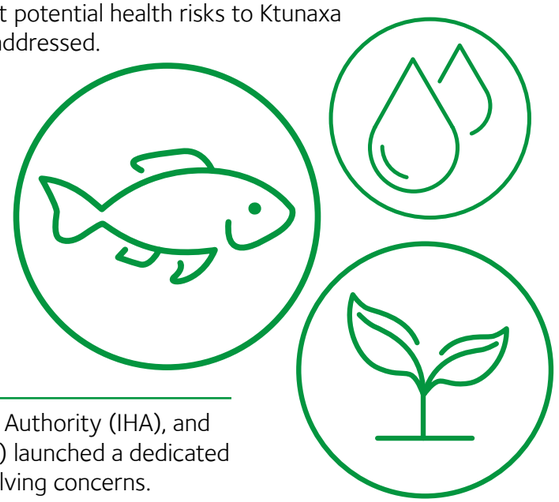
With respect to fish consumption, the BC Ministry of Environment and the BC Ministry of Health recommend the following screening values to protect human health: (see page 156 in https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg.pdf)

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

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 in place for the Elk Valley at this time.

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 Ktunaxa Nation Council (KNC) for analysis.
- A human health risk assessment was completed and reviewed by the Environmental Monitoring Committee (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, the KNC, Interior Health Authority (IHA), and Ministry of Environment (ENV) launched a dedicated workgroup committed to resolving concerns.

2019
- Workgroup members worked to increase their collective understanding of the technical aspects of human health risk assessments in general, and the unique challenges of this risk assessment in particular.
- 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 collaborate 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 relaunched the wild game sample donation program for local hunters.

2021
- An updated human health risk assessment is advancing with workgroup input and is expected to be completed and submitted to ENV by year end.

Glossary

active water treatment
a method of removing substances from water that requires regular human intervention and management. For example, the active water treatment facility at Line Creek Operations uses a system of tanks that use bacteria and other micro-organisms to remove mine-related substances from the water.

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.

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.

downgradient
a location that receives groundwater from another location.

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.

flow accretion
the increase in flow along a reach of a river.

flocculant
used to treat the water used in mineral extraction by aggregating fine suspended particles to form larger solids that can more easily be separated from the water.

freshet
spring thaw resulting from snow and ice melt in rivers.

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

hardness, hard water
water with a high content of calcium and magnesium or other dissolved metals.

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

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.

taxa
plural form of taxon, a taxonomic group of any rank, such as a species, family or class.

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.

Abbreviations

AMP	Adaptive Management Plan
AOP	Advanced Oxidation Process
AWFT	Active Water Treatment Facility
BCWQG	BC Water Quality Guidelines
BCSDWQG	BC Source Drinking Water Quality Guidelines
BIC	benthic invertebrate community
$CaCO_3$	calcite
Cd	cadmium
CI	calcite index / concretion index
CMm	Coal Mountain Mine
DEQ	Montana Department of Environmental Quality
DOC	dissolved organic carbon
EMC	Environmental Monitoring Committee
EMLI	BC Ministry of Energy, Mines & Low Carbon Innovation
EOC	Evaluation of Cause
EPT	ephemeroptera, plecoptera, tricoptera
EWT	early warning trigger
EVWQP	Elk Valley Water Quality Plan
GWG	Groundwater Working Group
IHA	Interior Health Authority
KNC	Ktunaxa Nation Council
LAEMP	Local Aquatic Effects Monitoring Program
MQ	management question
MU	management unit
NO_3	nitrate
NPM	Northern Pike Minnow
RAEMP	Regional Aquatic Effects Monitoring Program
RDWAP	Regional Groundwater Monitoring Program
RSC	Redside Shiner Community
Se	selenium
SO_4	sulphate
SPO	site performance objectives
SSGMP	Site-Specific Groundwater Monitoring Program
WCT	Westslope Cutthroat Trout