Elk Valley Water Quality Plan
2019 Implementation Plan Adjustment - Summary

February 2019

In April 2013, the British Columbia (B.C.) Minister of Environment issued Ministerial Order No. M113 (Order), which required Teck to prepare an area-based management plan for the Elk River watershed and the Canadian portion of the Koocanusa Reservoir. In this plan, Teck was required to identify the water quality mitigation, for existing plus planned (to end of 2037) waste rock, that is required to stabilize and reduce concentrations of nitrate, selenium, sulphate, and cadmium and the formation of calcite downstream, its five mines.

From 2013 to 2014, Teck developed an area-based management plan, called the Elk Valley Water Quality Plan. Teck had input from the public, First Nations, provincial and federal governments, technical experts, and other Communities of Interest. Teck submitted the Elk Valley Water Quality Plan to the Minister in July 2014 and it was approved in November that same year. The Elk Valley Water Quality Plan, or EVWQP, includes an Initial Implementation Plan (IIP) that outlines the mitigation planned to achieve targets for the concentration of selenium, sulphate, nitrate, and cadmium in surface water at specific locations throughout the Elk Valley and in the Koocanusa Reservoir. These targets, both short-term and long-term, are meant to stabilize and reverse increasing concentrations of the four constituents named in the Order. Active Water Treatment Facilities (AWTFs) and clean water diversions were identified in the EVWQP as mitigation tools to achieve this.

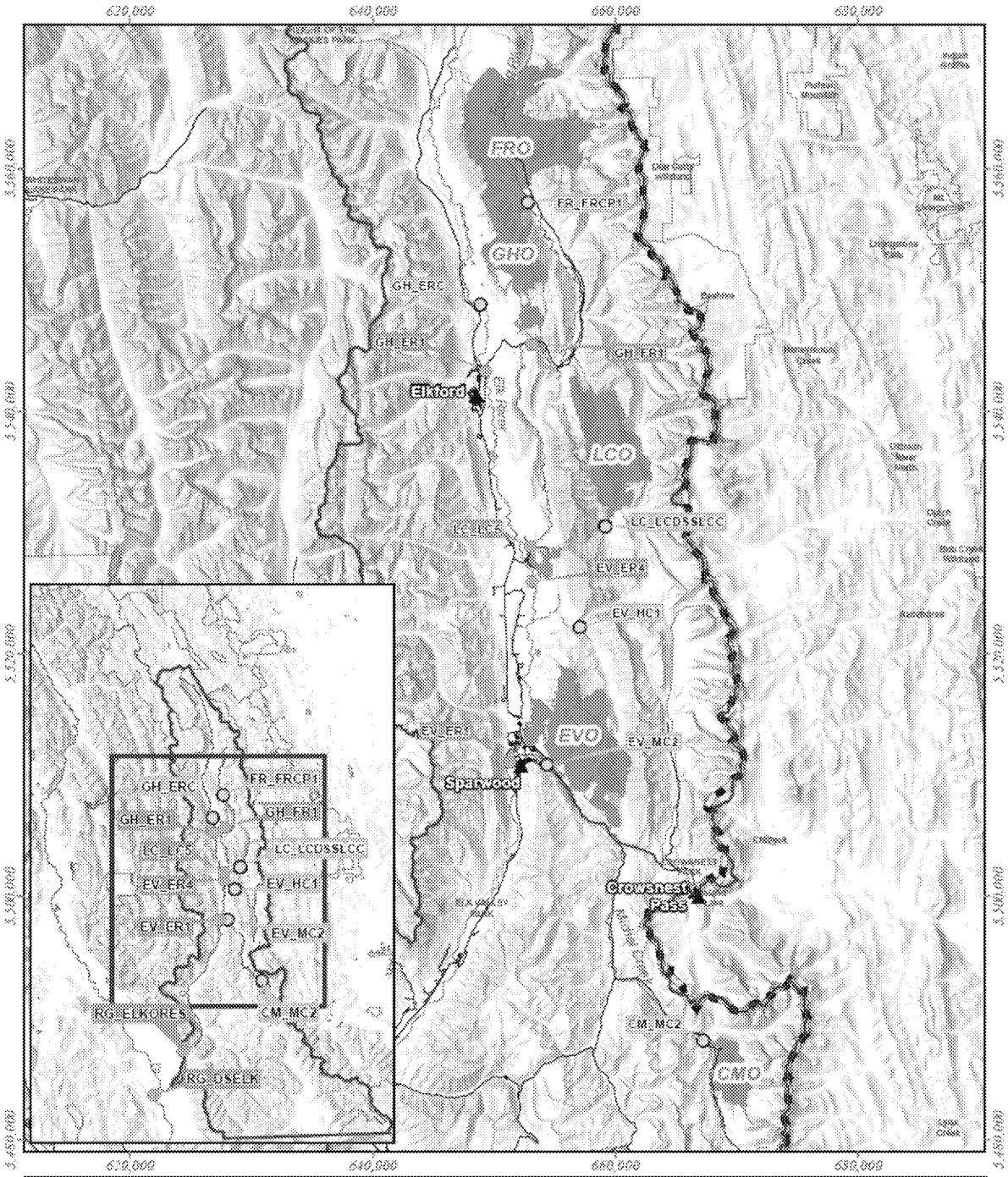
In November 2014, the B.C. Ministry of Environment issued Permit 107517 to Teck under the *Environmental Management Act*. Many of the actions and commitments that Teck made in the EVWQP IIP were incorporated into the permit requirements. To maintain compliance, Teck must meet the requirements in the Permit, including the construction and operation of AWTFs on the timelines specified and achievement of water quality targets.

Compliance Limits and Site Performance Objectives under Permit 107517 are collectively referred to as water quality targets in this document. Compliance Limits are set for compliance points. Compliance points are water monitoring stations that are downstream from each of Teck's mine operations in the Elk Valley. These points are intended to be at the point where all or most of the point and non-point discharges from a mine site or portions of a mine site are expected to report. There are eight compliance points that have limits for selenium, sulphate, nitrate, and cadmium (Figure 1; the compliance point shown as LC_WTF_OUT is for the West Line Creek AWTF effluent discharge point).

Site Performance Objectives, or SPOs are set for Order Stations. These stations are also water monitoring stations, but these are further downstream from Teck's mining operations. They are intended to reflect fully mixed conditions, taking into account water from all upstream sources. There are seven Order Stations which have SPOs for selenium, sulphate, nitrate, and cadmium. SPOs are based on the targets from the integrated effects assessment completed for the EVWQP, whereas the Compliance Limits listed in Permit 107517 were based on the 2014 Regional Water Quality Model (RWQM) projected water quality conditions under the IIP. The locations of the Order Stations and compliance points are illustrated on Figure 1.

Mines Act C-Permits require adjustments to the IIP, based on an adaptive management approach, by July 31, 2019 and every three years thereafter. Permit 107517 and Mines Act C-Permits required the RWQM be updated by October 31, 2017.The October 2017 RWQM update showed that the projected concentrations were above limits and SPOs, resulting in the need to update the mitigation plan (IIP).

ED_013890_00000724-00002



ED_013890_00000724-00003

Key Adjustments to the IIP Reflected in the 2019 IPA

The 2019 Implementation Plan Adjustment (2019 IPA) is a revised implementation plan developed to achieve the SPOs and Compliance Limits included in the EVWQP and Permit 107517.

Teck completed the 2019 IPA and provided opportunity for the B.C. Ministry of Energy, Mines and Petroleum Resources (EMPR), B.C. Ministry of Environment and Climate Change Strategy (ENV), and representatives of the Ktunaxa Nation Council (KNC) to provide input. Seven review meetings were held with EMPR, ENV and the KNC to review information and gather feedback for integration into the plan. Outreach to other Communities of Interest also occurred.

On August 31, 2018, Teck submitted the 2019 IPA to the provincial government and the KNC for their technical review. Teck will revise the 2019 IPA to incorporate feedback received through the technical review as well as through further outreach with other Communities of Interest. Once final, the 2019 IPA will be posted at www.teck.com/elkvalley.

The primary differences between the IIP and the 2019 IPA are summarized as follows:

- the timing of treatment
- total treatment capacity, and
- the period over which treatment was assessed (extended from a 20-year planning window to mitigate the estimated water quality effects of Teck's permitted development).

Timing of Water Treatment in the Valley and Locations

The IIP included the construction and operation of six AWTFs by 2032, with a total treatment capacity of 130,000 cubic metres per day (m^3/d). The 2019 IPA, informed by the 2017 RWQM[1], includes the construction of the original six AWTFs included in the IIP plus seven additional facilities and associated water management with a total treatment capacity of 204,600 m^3/d over the extended timeframe (see Table 1). Clean water diversions included in the 2019 IPA are shown in Table 2. Mitigation in the 2019 IPA is intended to stabilize and reduce concentrations of nitrate, selenium, and sulphate for Teck's permitted development as well as for planned development over the next 20 years. Removal of cadmium is not currently required to meet long-term water quality limits. The sequence of water treatment is also shown on Figure 2 for the Koocanusa Reservoir at the Order Station (RG_DSELK). In parallel to executing active water treatment, Teck continues to advance alternative water treatment technologies (including Saturated Rock Fills) which could replace AWTFs in future adjustments to the implementation plan.

[1] Following submission of the 2017 RWQM, changes were made to the model based on regulatory feedback, to improve model performance, and to some mining related inputs. These changes are documented in the IPA.

ED_013890_00000724-00004

Table 1 Treatment Capacity and Timing Comparison between the 2019 Implementation Plan Adjustment and the Initial Implementation Plan

Modelled Active Water Treatment Facility (1)	2019 Implementation Plan Adjustment		Initial Implementation Plan	
	Date Fully Effective (2)	Hydraulic Capacity (m^3/d)	Date Fully Effective	Hydraulic Capacity (m^3/d)
West Line Creek (WLC) Phase I	December 31, 2018	6,000	June 30, 2014	7,500
WLC Phase II	December 31, 2019	1,100	-	-
Fording River Operation (FRO) AWTF-S Phase I	December 31, 2021	20,000	December 31, 2019	20,000
Elkview Operation (EVO) Phase I	September 30, 2022	20,000	December 31, 2021	30,000
FRO-N Phase I	December 31, 2023	30,000	December 31, 2023	15,000
WLC Phase III	December 31, 2025	12,500	-	-
EVO Phase II	December 31, 2027	20,000	December 31, 2025	20,000
FRO-S Phase II	December 31, 2029	5,000	-	-
Greenhills Operation (GHO) Phase I	December 31, 2031	2,500	December 31, 2027	7,500
WLC Phase IV	December 31, 2033	32,500	January 1, 2032	7,500
FRO-S Phase III	December 31, 2035	20,000	-	-
Line Creek Operation (LCO) Dry Creek Phase I	December 31, 2037	2,500	January 1, 2028	7,500
FRO-N Phase II	December 31, 2039	20,000	December 31, 2031	15,000
EVO Phase III	December 31, 2043	5,000	-	-
LCO Dry Creek Phase II	December 31, 2049	2,500	-	-
GHO Phase II	2100+	5,000	-	-
Total Hydraulic Capacity (m^3/d)		204,600		130,000

(1) Clean water diversions associated with the 2019 IPA include the diversion of Upper Kilmarnock watershed at FRO and diversion of Upper Line Creek, Horseshoe Creek and No Name Creek at LCO.

(2) The fully effective date is the date when the treatment facility has been built, seeded, commissioned and is effective at the hydraulic capacity listed above

ED_013890_00000724-00005

Table 2 Clean Water Diversion Capacity and Timing Comparison between the 2019 Implementation Plan Adjustment and the Initial Implementation Plan

Clean-Water Diversion	Associated Active Water Treatment Facility	Initial Implementation Plan		2019 IPA	
		Streams and Volume Diverted	Date Operational	Streams and Volume Diverted	Date Operational
Kilmarnock Creek	FRO AWTF-S	Upper Brownie and Kilmarnock watersheds, estimated at 45,000 m^3/d	December 31, 2018	Upper Kilmarnock Watershed, estimated up to 45,000 m^3/d[a]	December 31, 2020[a]
Erickson Creek	EVO AWTF 1	Upper Erickson Watershed, estimated at 14,000 m^3/d	December 31, 2020	Not included	
South Gate Creek	EVO AWTF 1	South Gate Creek, estimated at 3,500 m^3/d	December 31, 2020	South Gate Creek, estimated at 3,500 m^3/d	In place and operating.
Upper Line Creek, Horseshoe and No Name Creeks	WLC AWTF 2	Upper Line Creek and Horseshoe Creek, estimated at 35,000 m^3/d and No Name Creek, estimated at 7,000 m^3/d	2032	Upper Line Creek and Horseshoe Creek estimated at 35,000 m^3/d.No Name Creek estimated at 7,000 m^3/d. Total of 42,000 m^3/d	December 31, 2025

Notes:

a) Scoping stage of project is underway which includes a more detailed assessment of the sizing and timing of the diversion, and of constructability and operability considerations. This more detailed assessment may result in changes to the sizing, timing or operational approach of the diversion.

Site Performance Objectives and 2019 IPA

The 2019 IPA works towards stabilization and reduction of selenium and nitrate concentrations in the Elk Valley at Order Stations. The Plan projects that selenium and nitrate concentrations will be at or below SPOs at all seven Order Stations following the commissioning of the Fording River Operations South AWTF and the Elkview Operations AWTF (i.e., from 2023 onward). Prior to the commissioning of these AWTFs, selenium and nitrate concentrations are predicted to be seasonally (under winter low flow conditions) above SPOs at the following Order Stations: Fording River downstream of Greenhills Creek (GH_FR1; 0200378), Fording River downstream of Line Creek (LC_LC5; 020028), Elk River upstream of Grave Creek (EV_ER4; 0200027), and the Koocanusa Reservoir (RG_DSELK; E300230). Studies are underway to evaluate the effects of these short-term projected seasonal exceedances of the SPOs on the aquatic ecosystem.

Projected selenium concentrations for the Koocanusa Reservoir with the 2019 IPA are shown on Figure 2. The information on the plot represents monthly average selenium concentrations over time. The solid orange, blue and gray lines correspond to the projected monthly average concentrations under 1-in-10-year low, average and 1-in-10-year high flows, respectively. The green dots represent the monthly average historical concentrations from the monitoring dataset for the RG_DSELK Order Station. The vertical blue lines represent the fully effective dates for the AWTFs in the 2019 IPA (Table 1).

Teck's current selenium and nitrate treatment technology (biological active water treatment) does not treat sulphate. Based on water quality modelling, sulphate treatment may be required as early as 2026 at Line Creek Operations. Teck continues to advance and evaluate different sulphate treatment technologies to support the implementation of sulphate treatment by 2026. This includes planning, which is underway, for a sulphate treatment technology pilot program which will be conducted in 2019 and 2020.

ED_013890_00000724-00006

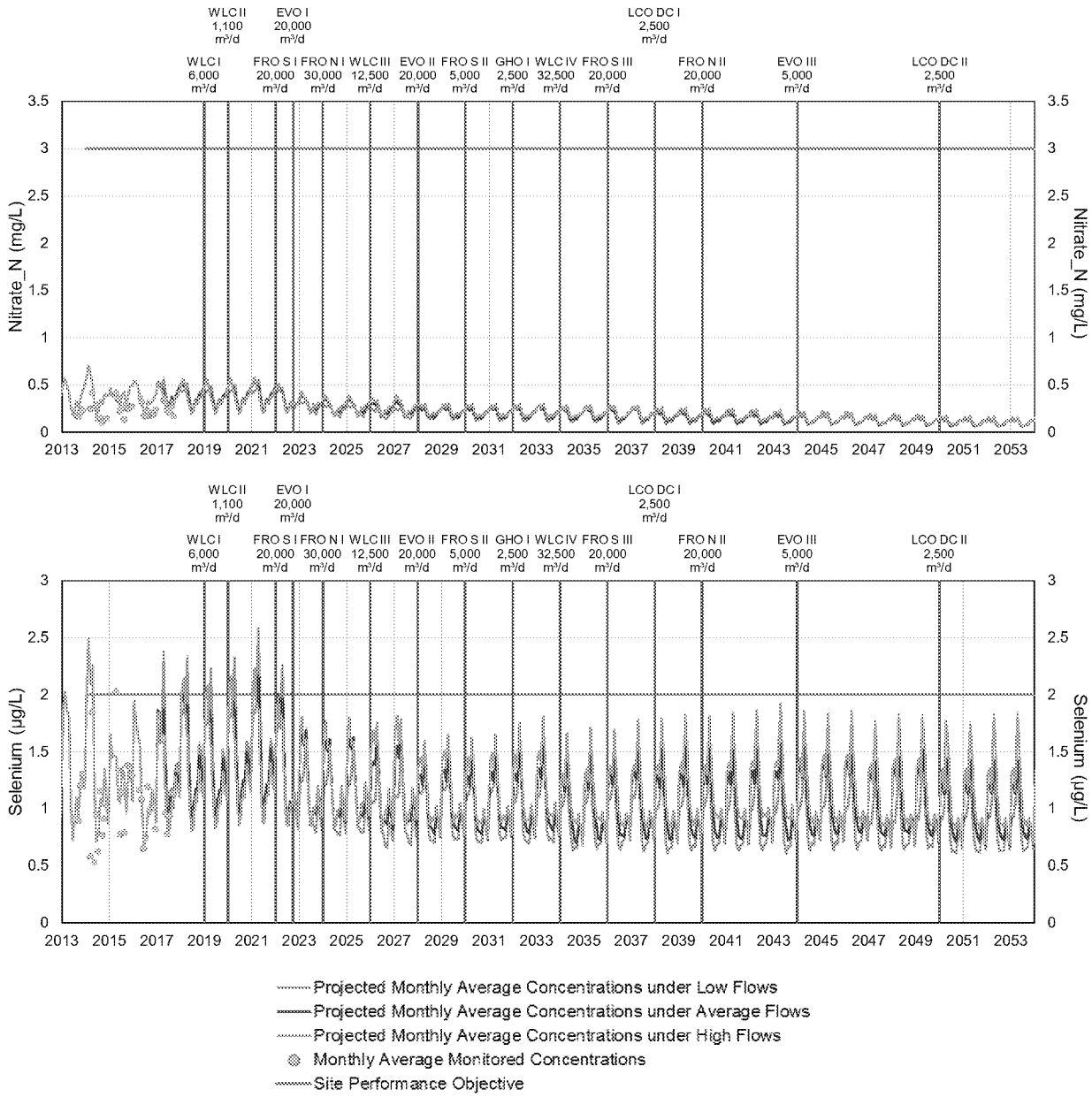


Figure 2 Projected Monthly Average Nitrate and Selenium Concentrations in the Koocanusa Reservoir Order Station RG_DSELK

Research and Development

Teck currently has more than 20 research and development projects underway related to water quality in the Elk Valley, including projects to better control the release of water quality constituents at the source and to develop new water treatment methods. This includes the application and advancement of alternative treatment technologies, nitrate source control, sulphate treatment and calcite management.

ED_013890_00000724-00007

Teck will continue to undertake studies to evaluate the effects on the aquatic ecosystem, including studying the ecological relevance of short-term and seasonal nitrate, selenium and sulphate concentrations above SPOs. This will inform future adjustments to the implementation plan.

Closing

If you have any comments or questions on this 2019 IPA Summary, please contact Teck c/o:

Nic Milligan
Manager, Social Responsibility
250.425.3335
nic.milligan@teck.com

ED_013890_00000724-00008