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Technical Report Overview

Report: 2020 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

Overview: This report presents the 2020 results of the local aquatic effects monitoring program developed for Teck's Greenhill Operations. The 2020 program was designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension.

This report was prepared for Teck by Minnow Environmental Inc.

For More Information

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Future studies will be made available at **teck.com/elkvalley**

2020 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

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2020 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

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EXECUTIVE SUMMARY

The 2020 Greenhills Operations (GHO) Local Aquatic Effects Monitoring Program (LAEMP) is designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension at GHO. The GHO LAEMP focused on the Elk River (upstream and downstream of GHO), Elk River tributaries on the west side of Greenhills Ridge, as well as a side channel of the Elk River that receives flows, via surface water and/or groundwater, from the mine-influenced west-side tributaries (e.g., Thompson, Wolfram, and Leask creeks). The Elk River side channel is located between the Elk River and the west side of Greenhills Ridge. It branches off from the Elk River just south of Leask Creek, flows south over the Elk River floodplain, and converges back with the Elk River roughly 1.2 km downstream of Thompson Creek. The Elk River side channel receives overland flows from Thompson Creek at Reach 2. Four main study questions (discussed in detail in the paragraphs that follow) address concerns related to the local study area. The study questions focused on amphibian habitat quality/availability, surface water quality, the interaction between surface water and groundwater, and benthic invertebrate community structure and tissue chemistry.

Over thirty multi-day field visits were completed within the side channel and its floodplain complex in all seasons from 2017 to 2019 to identify and document habitat and occurrences of aquatic dependent biota. In 2020, three additional amphibian surveys were conducted in May, June, and July. These data were used to answer study question #2 (What is the seasonal habitat availability for amphibians in Reach 2[1] of the Elk River side channel?). The results were generally consistent over the four study years. Seasonal changes in flow affected habitat availability (e.g., lentic habitat was only observed in fall and winter in Reach 2). From freshet to late summer (three to four months of each study year), Reach 2 received flow from both the Elk River (via the upper side channel) and from Thompson Creek. Flows were relatively swift during this time, and not suitable for amphibian breeding. Although Reach 2 was swiftly flowing in the spring and early summer, breeding habitat may be present elsewhere in the area. From fall to early spring, Reach 2 remained wetted due to surface flows from Thompson Creek; during this time, the upper side channel is dry and disconnected from the main stem Elk River. Three amphibian species (Columbia spotted frog, western toad, long-toed salamander) were observed throughout the side channel in late spring and summer. Study question #2 has been answered through four years of investigation, and therefore it is recommended that no more work be done to address this study question.

[1] Reach 2 is located at the Elk River side channel at the confluence of Thompson Creek.

Water quality data were assessed for stations in the west-side tributaries, Elk River side channel, and the main stem Elk River to address study question #3 (What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?). Water quality at side channel stations GH_ER1A and GH_ERSC2 was influenced by Wolfram and Thompson creeks. Concentrations of most constituents were lower at the side channel station GH_ERSC4, located upstream of Wolfram and Thompson creeks, compared to the two downstream stations. Within the side channel and main stem Elk River, the highest concentrations of constituents generally occurred in Reach 2 (RG_GH-SCW3), which receives flow directly from Thompson Creek. Discharges from the west-side tributaries contributed to higher concentrations of some mine-related constituents in the main stem Elk River downstream of GHO (GH_ERC) relative to the upstream reference station (GH_ER2); however, with the exception of total selenium, concentrations measured at GH_ERC were typically below benchmarks, screening values, and/or British Columbia Water Quality Guidelines (BCWQG), or were comparable to the upstream reference station. For the west-side tributaries, total selenium, sulphate, and TDS have been increasing in Leask and Wolfram creeks, while total nickel has been increasing in Leask Creek. In Thompson Creek, sulphate has increased in recent years, whereas total nickel has decreased. At the Reach 2 outlet, total nickel was higher in 2019 and 2020 compared to 2018. At the downstream main stem Elk River station (GH_ERC), total selenium concentrations were higher in 2018, 2019, and 2020 relative to previous years, and nitrate concentrations were higher in 2019 and 2020 relative to previous years.

To answer study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?), a hydrogeological review and analysis of available groundwater and surface water data from the west side of GHO along the Elk River side channel. Side channel surface water predominantly infiltrated to ground and recharged groundwater. Localized areas of groundwater discharge occurred near the confluence with Wolfram Creek as well as downstream of Thompson Creek, but these discharge areas did not result in sustained flows within the side channel. Gaps and uncertainties were previously identified in the 2018 GHO LAEMP Report and have been partly addressed through work conducted in 2019 and 2020. Some uncertainties remain related to study question #4 remain. Additional work is planned for 2021 as part of the MBI to address remaining gaps, including installing new monitoring wells, collecting additional groundwater data, seep reconnaissance and sampling in the Elk River Side Channel, conducting flow and load accretion studies, and conducting geophysical surveys to determine depth to bedrock.

Benthic invertebrate community data collected annually in September from 2017 to 2020 contributed to the understanding of study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk

River upstream and downstream of the side channel, and are they changing over time?). Benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem Elk River stations (GH_ER2 and GH_ERC) and Elk River side channel stations (GH_ERSC4, GH_ER1A, and RG_ERSC5). In 2020 at main stem Elk River and Elk River side channel areas, total abundance, richness, % EPT (relative abundance of Ephemeroptera, Plecoptera, and Trichoptera), % Ephemeroptera, % Plecoptera, and % Trichoptera were within or above the regional normal range, except for % Trichoptera at GH_ER1A, RG_ERSC5, and GH_ERC in one sample each. The relative proportion of Trichoptera has been similarly low at the upstream reference area (GH_ER2); therefore, samples with % Trichoptera less than the regional normal range are likely related to local habitat characteristics rather than mine influence. At all main stem Elk River and Elk River side channel stations, % Chironomidae, % Diptera, and % Oligochaeta were within or below the regional normal range, except for % Oligochaeta at RG_ERSC5 in one of three samples. Overall, benthic invertebrate communities in the main stem Elk River and the Elk River side channel did not appear to be adversely affected by mine discharges.

Benthic invertebrate tissue chemistry data (selenium concentrations) were also collected annually in September of 2017 to 2020, and further addressed study question #5. Selenium concentrations in benthic invertebrate tissue were highest in Thompson Creek. Selenium concentrations in benthic invertebrate tissue from side channel stations were higher than main stem stations. Concentrations in the side channel increased from upstream to downstream, from area GH_ERSC4 (upstream of Wolfram Creek) to GH_ER1A and GH_ERSC5 (both downstream of Wolfram Creek) to Reach 2 (RG_GH-SCW2 and RG_GH-SCW3), which is downstream of Thompson Creek. Although areas GH_ERSC2 and RG_SCDTC are both downstream of Thompson Creek and had similar aqueous concentrations of selenium, GH_ERSC2 had higher concentrations of selenium in benthic invertebrate tissue relative to Reach 2 and RG_SCDTC, likely due to the more depositional nature of the area. Higher concentrations of selenium in benthic invertebrate tissue samples collected from Thompson Creek and downstream likely resulted from the presence of aqueous selenium in more bioavailable forms.

Benthic invertebrate community structure and tissue chemistry were similar at the downstream main stem station (GH_ERC) and the upstream main stem reference station (GH_ER2), suggesting minimal influence of GHO and the west-side tributaries on benthic invertebrate community endpoints and tissue chemistry in the main stem Elk River.

In further support of study question #5 to better understand potential mine-related effects on benthic invertebrate communities and tissue chemistry, sediment quality was assessed in the main stem Elk River upstream and downstream of the side channel, and in Reach 2 of the side channel. Except for chrysene in one of five samples, 2−methylnaphthalene in two of five samples, phenanthrene in three of five samples, and pyrene in two of five samples collected at Reach 2, concentrations of constituents were within the normal range in sediment samples collected in 2020. Concentrations of constituents were below the upper sediment quality guideline (SQG; or only SQG only in the case of selenium) in all samples from 2020, except for selenium, 2−methylnaphthalene, and phenanthrene in Reach 2. In general, sediment quality data indicated limited influence of mine-related discharges on sediment chemistry in the main stem Elk River downstream of the side channel.

Teck has fulfilled the Permit 107517 Section 8.3.4 requirement for a LAEMP to be conducted from 2017 to 2020, focussing on the local area of the upper Elk River, the Elk River side channel, and tributaries located on the west side of Greenhills Ridge. Where concerns remain, the GHO LAEMP monitoring is incorporated into existing monitoring programs, such that these residual concerns continue to be addressed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ADIT – Aquatic Data Integration Tool

ANOVA – Analysis of Variance

AMP – Adaptive Management Plan

BCMOE – Ministry of Environment

BCWQG – British Columbia Water Guideline

CABIN - Canadian Aquatic Biomonitoring Network

CI – Calcite Index

CMO – Coal Mountain Operation

CPP – Cougar Pit Phase 5 and 7-2 Project

CSM – Conceptual Site Model

DO – Dissolved Oxygen

DQR – Data Quality Review

dw – Dry Weight

EMC – Environmental Monitoring Committee

ENV – British Columbia Ministry of Environment and Climate Change Strategy (formerly BCMOE)

EPT – Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)

EVO – Elkview Operation

EVWQP – Elk Valley Water Quality Plan

EWT – Early Warning Trigger

FRO – Fording River Operation

GHO – Greenhills Operation

HSD – Honestly Significant Difference

K-M – Kaplan-Meier

KNC – Ktunaxa Nation Council

LA-ICP-MS – Laser Ablation Inductively Coupled Plasma Mass Spectrometry

LAEMP – Local Aquatic Effects Monitoring Program

LPL – Lowest Practical Level

LRL – Laboratory Reporting Limit

LCO – Line Creek Operation

MBI – Mass Balance Investigation

MCT – Measure of Central Tendency

MOD – Magnitude of Difference

PAH – Polycyclic Aromatic Hydrocarbon

PEL – Probable Effect Level

QA/QC – Quality Assurance and Quality Control

RAEMP – Regional Aquatic Effects Monitoring Program

RGMP – Regional Groundwater Monitoring Program

RWQM – Regional Water Quality Model

SEL – Severe Effect Level

SEV – Scale of the Severity

SQG – Sediment Quality Guideline

SSGMP – Site-Specific GHO Groundwater Monitoring Program

TDS – Total Dissolved Solids

TOC – Total Organic Carbon

TrichAnalytics Inc. - Trich

TSS – Total Suspended Solids

1 INTRODUCTION

1.1 Background

Teck Coal Limited (Teck) operates four steelmaking coal mines in the Elk River watershed, which are the Fording River Operation (FRO), Greenhills Operation (GHO), Line Creek Operation (LCO), and Elkview Operation (EVO; Figure 1.1). A fifth mine, Coal Mountain Mine (CMm), is also owned by Teck and located in the Elk River watershed; however, it is no longer in operation and has been moved into the care and maintenance designation. Discharges from the mines to the Elk River watershed are authorized by the British Columbia Ministry of Environment and Climate Change Strategy (ENV; formerly Ministry of Environment [BCMOE]) through permits that are issued under provisions of the *Environmental Management Act*. Permit 107517, issued November 19, 2014, and amended as required, specifies the terms and conditions associated with discharges from the five mine operations.

Through issuance of Permit 107517, ENV required that Teck develop a Local Aquatic Effects Monitoring Program (LAEMP) related to GHO (Figure 1.2) for 2017 to 2020. Section 8.3.4 of Permit 107517 outlines the LAEMP requirements as follows:

> *"The permittee must complete to the satisfaction of the director a study design for a LAEMP which will focus on the upper Elk River and the Elk River side channel and tributaries located on the west side of Greenhills Operation between EMS sites 0200389 [GH_ER2] and E3000090 [GH_ERC][2] for 2017-2020 by June 1, 2017[3]. The study design must be reviewed by the EMC[4] and be designed to an appropriate temporal scale to capture short term, local effects to the immediate receiving environment. Any changes to the approved study design must be reported in the annual LAEMP report."*

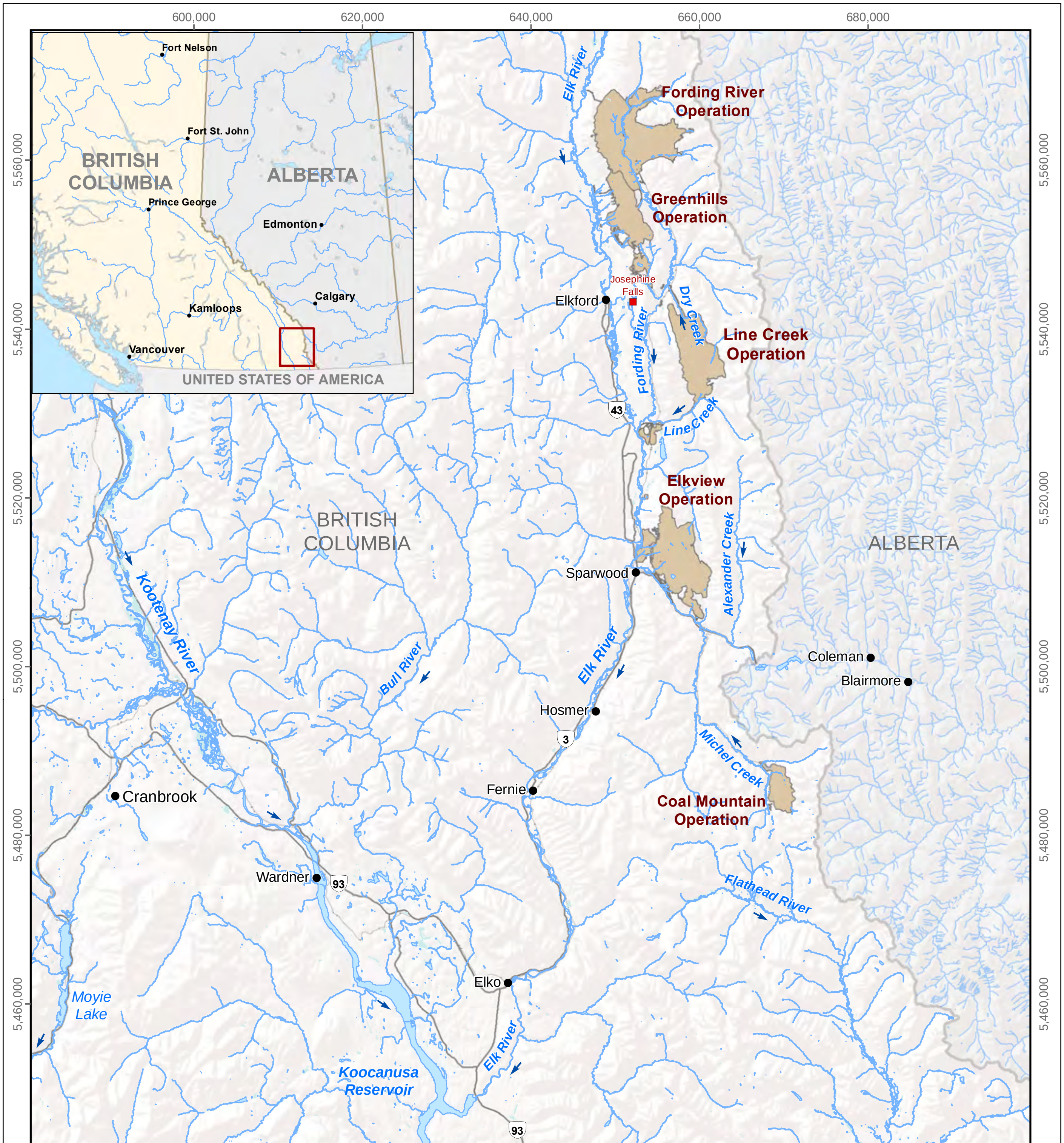
Also, Section 9.5 of Permit 107517 states:

> *"The LAEMP Annual Reports must be reported on in accordance with generally accepted standards of good scientific practice in a written report and submitted to*

[2] Herein referred to as the west-side tributaries.

[3] A study design for the 2017 LAEMP was submitted on May 31, 2017.

[4] EMC refers to the Environmental Monitoring Committee, which Teck was required to form under Permit 107517. The EMC consists of representatives from Teck, ENV, the Ministry of Energy and Mines, the Ktunaxa Nation Council (KNC), Interior Health Authority, and an Independent Scientist. Environment and Climate Change Canada (ECCC) has also agreed to provide its perspectives on matters related to Permit 107517 and the Committee's activities, on a case-by-case basis when requested by the Committee. To date, the Committee has not called on ECCC to participate. The EMC reviews submissions and provides technical advice to Teck and the ENV Director regarding monitoring programs as stipulated in Section 12.2 of Permit 107517.



LEGEND

Teck Coal Mine Operation

Teck's Coal Mine Operations within the Elk River Watershed, Southeast British Columbia

0 10 20 40 km

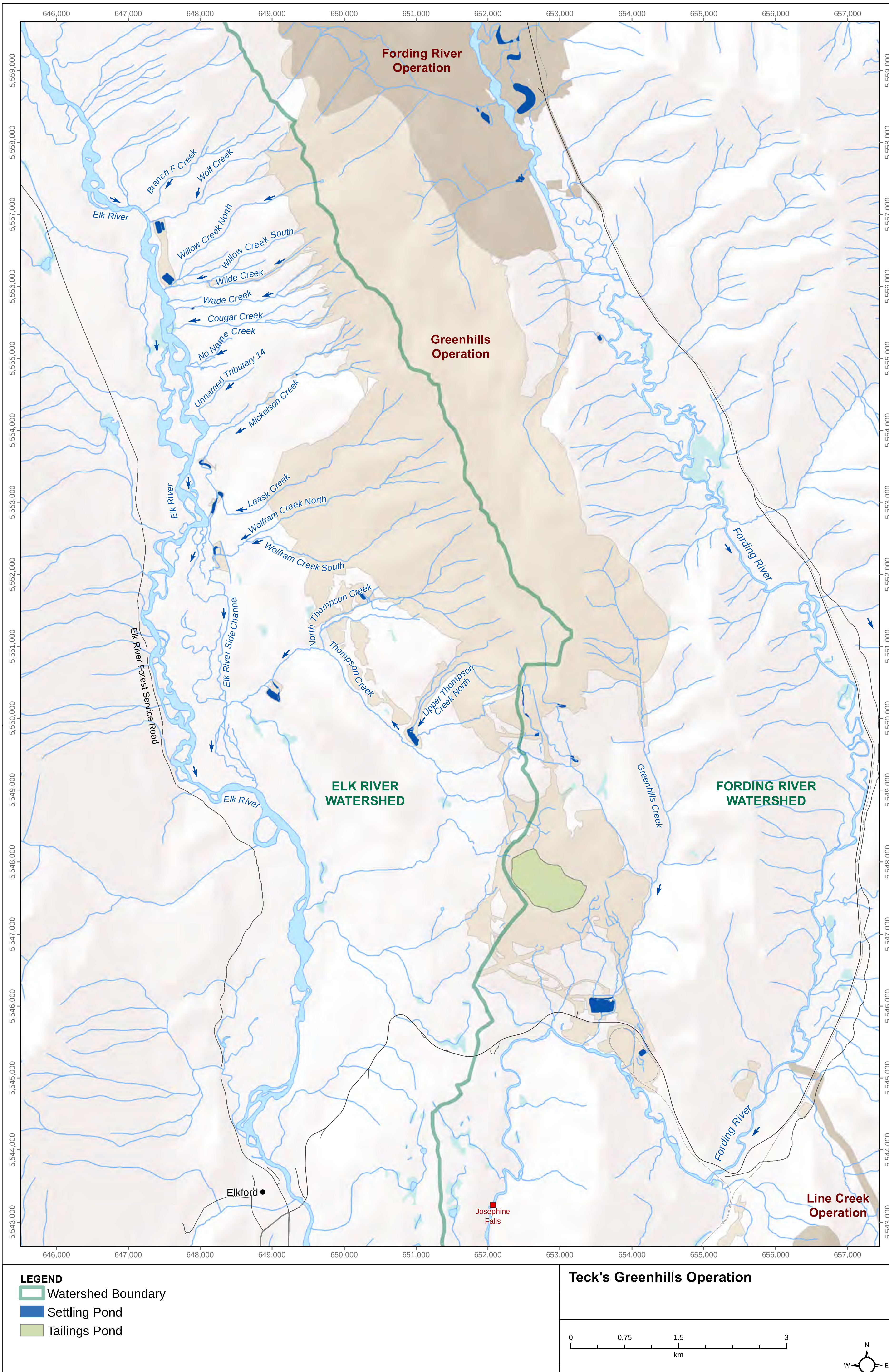
Projection: North American Datum 1983 UTM Zone 11

Date: May 2021
Project 207202.0022

minnow environmental inc.

Figure 1.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 1.1 Teck Coal Limited Operation.mxd



Teck's Greenhills Operation

0 0.75 1.5 3 km

Projection: North American Datum 1983 UTM Zone 11
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

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Figure 1.2

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 1.2 Teck GHO.mxd *the director of each year following the data collection calendar year on the following dates […] GHO LAEMP: May 31."*

In addition to monitoring under the LAEMP, Teck conducts the Regional Aquatic Effects Monitoring Program (RAEMP) under Permit 107517. The RAEMP provides comprehensive routine monitoring and assessment of potential mine-related effects on the aquatic environment downstream from Teck's mines in the Elk Valley. Annual sampling and more comprehensive monitoring every three years is completed under the RAEMP, with the most recent cycle of sampling completed in December 2019, and report submitted in November 2020 (Minnow 2020). The next cycle of RAEMP sampling is to be completed by December 2022. Teck conducts a variety of additional programs to monitor, evaluate, and/or manage the aquatic effects of mining operations within the Elk Valley at local and regional scales, including:

- water quality monitoring;
- calcite monitoring;
- chronic toxicity testing;
- fish and fish habitat management and monitoring;
- RAEMP;
- tributary management (through the Tributary Management Plan); and
- various supporting studies.

Following discussion with and advice from the Environmental Monitoring Committee (EMC), a phased approach to the GHO LAEMP study design was approved by ENV. A study design (Minnow and Lotic 2017) was submitted on May 31st, 2017, and preliminary reconnaissance work was conducted from May 2017 to April 2018. An updated study design was submitted on May 31st, 2018 that covered the 2018 to 2020 period (Minnow and Lotic 2018a). The 2018 to 2020 GHO LAEMP was designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension at GHO. The study questions focused on furthering the understanding of hydrology, habitat use by biota, water quality, surface water/groundwater interactions, benthic invertebrate communities, benthic invertebrate tissue chemistry, and investigating whether biota in Reach 2 (formerly referred to as the "side channel wetland") are influenced by mining activities. As with LAEMPs for other Teck Operations, the GHO LAEMP was designed to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into other existing monitoring programs. In consideration of potential existing and future mine-related influences at GHO, as well as data collected from 2017 to 2019 (Minnow and

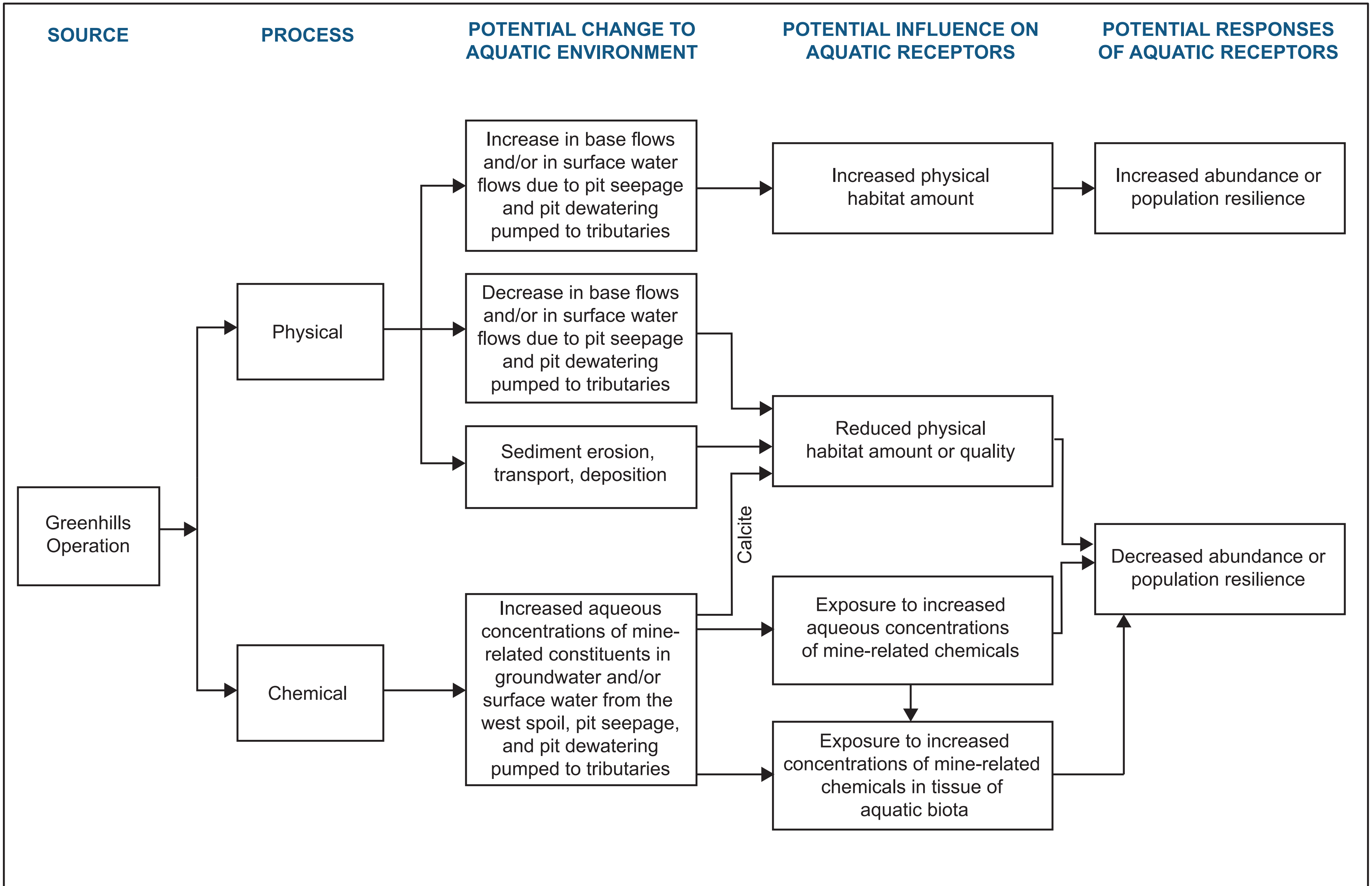
Lotic 2018b, 2019, 2020), a modified scope was recommended in an Updated Sampling Design for the 2020 GHO LAEMP (Minnow 2020a), which was submitted to ENV on June 1, 2020 (Appendix A). The updated study design was approved on July 28, 2020 (ENV 2020; Appendix A). The results of the data that were collected from January to December 2020 following the updated study design are described herein.

1.2 Conceptual Site Model

A conceptual site model (CSM) is a written and/or illustrative depiction of relationships between human activities that disturb the environment and the ways such disturbances can alter the ecosystem and affect biological receptors. Figure 1.3 presents a CSM for potential effects on aquatic receptors related to the Elk River, Elk River side channel, and the west-side tributaries associated with GHO. As illustrated by the CSM, mining may affect aquatic receptors through physical and/or chemical processes; these general processes are explained in-depth in the RAEMP Study Design (Minnow 2018). With respect to this LAEMP, mine-related physical and chemical stressors in the west-side tributaries, upper Elk River, and Elk River side channel arise from:

- landscape restructuring, potentially occurring due to re-location of soils and rock material (e.g., waste rock piles), re-sloping of the topography, and diversion of water;
- sediment transport in streams, potentially occurring as a combination of:
    - bedload (the coarsest transported material, moving along the bottom),
    - suspended load (materials lifted above the bed by the flow and transported in the water column), and
    - washload (the finest-grained fraction of the suspension; Polzin 1998);
- increases or decreases to base flow and surface water flows, potentially occurring due to pit seepage and pit water pumped to tributaries; and
- increased concentrations of mine-related constituents in water and sediment, potentially originating from the West spoil, pit seepage, and pit water pumped to tributaries.

The CSM identified potential influences of mining activities on aquatic receptors (Figure 1.3), which were used to develop study questions (Section 1.3) and assessment endpoints based on potential responses (Table 1.1). As illustrated in the CSM (Figure 1.3), potential mining effects on receptors may manifest as changes in abundance of sensitive receptors, which also results in changes to relative community structure. Therefore, the GHO LAEMP study questions focus on assessing potential mine-related effects on focal species or population groups (Table 1.1),



Conceptual Site Model for Potential Mine-Related Effects on the Aquatic Ecosystem, 2020 GHO LAEMP

Date: May 2021
Project 207202.0022

minnow environmental inc.
A Trinity Consultants Company

Figure 1.3

Trinity Consultants Inc/Teck/207202-0022-GHO LAEMP/GIS/Report/Graphics/20-22 Figure 1.3 Conceptual Site Model

Table 1.1: Summary of Receptors, Assessment Endpoints, Measurement Endpoints, and Evaluation Criteria for the GHO LAEMP, 2020

Receptor Group	Assessment Endpoint	Measurement Endpoint[a]	Evaluation Criteria[a,b]	Endpoint Type[c]
Fish	Population abundance or resilience	Surface water chemistry	Concentrations of constituents relative to effect benchmarks, guidelines, and past observations (SQ #1, #3, and #4)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and 6)	Indirect
	Fish population effects related to selenium	Benthic invertebrate tissue selenium concentrations	Concentrations relative to effect benchmarks (SQ #5)	Indirect
Benthic Invertebrates	Benthic invertebrate abundance and assemblage (lotic habitats)	Abundance	Comparison to reference areas and past observations (SQ #5)	Direct
		Richness		
		% EPT		
		% Ephemeroptera		
		Tissue selenium concentrations	Concentrations relative to effect benchmarks and past observations (SQ #5)	Indirect
		Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Calcite	Calcite index relative to known or suspected effect levels and past observations (SQ #5)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and #6)	Indirect
	Benthic invertebrate abundance and assemblage (lentic habitats)	Tissue selenium concentrations	Concentrations relative to effect benchmarks and past observations (SQ #5)	Direct
		Surface water chemistry	Concentrations of constituents relative to effect benchmarks, guidelines, and past observations (SQ #1, #3, and #4)	Indirect
		Calcite	Calcite index relative to known or suspected effect levels and past observations (SQ #5)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and #6)	Indirect
Amphibians	Amphibian population effects related to selenium	Surface water chemistry	Concentrations of constituents relative to effect benchmarks, guidelines, and past observations (SQ #1, #3, and #4)	Indirect
		Benthic invertebrate tissue selenium concentrations	Concentrations relative to effect benchmarks (SQ #5)	Indirect
Birds	Bird population effects related to selenium	Surface water chemistry	Concentrations of constituents relative to effect benchmarks, guidelines, and past observations (SQ #1, #3, and #4)	Indirect
		Benthic invertebrate tissue selenium concentrations	Concentrations relative to effect benchmarks (SQ #5)	Indirect

[a] Some endpoints/criteria apply to only selected habitats or sampling areas. See text for details.
[b] (SQ #) indicates the study question(s) that are addressed (directly or indirectly) by the listed evaluation criteria.
[c] Measurement endpoints are identified as either direct or indirect. Direct indicators are biological measurements that relate directly to the populations or communities. Indirect indicators are abiotic endpoints measuring mine-related physical and chemical stressors, and act as corroborating or explanatory evidence of observed effects or lack of effects on receptors. See the Study Design for the RAEMP 2018 to 2020 (Minnow 2018c) for further detail.

while also allowing for collection of relevant background information (i.e., aquatic-dependent biota distributions; Section 1.3).

1.3 Study Questions

To focus the scope of the 2018 to 2020 study design, six study questions were developed in consultation with the EMC. The 2020 work was conducted based on an updated study design (approved on July 28, 2020; Appendix A), in which two of these study questions (#1 and #6) and one sub-question (#3d) were discontinued, and one study question (#2) was narrowed in scope. The remaining study questions and associated sub-questions for the 2020 GHO LAEMP are:

2. What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?
3. What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?
    a. What is the water quality in the west-side tributaries, and how is it changing over time?
    b. What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?
    c. What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?
4. What is the interaction between surface water and groundwater in the Elk River side channel?
5. What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?

This report describes the approach, methods, and results used to address the study questions associated with the 2020 data collection.

1.4 Summary of the GHO LAEMPs from 2017 to 2019

A side channel of the Elk River and its adjacent floodplain complex were identified as the local study area because they receive flows, either via surface water or groundwater, from the mine-influenced west-side tributaries (e.g., Thompson Creek, Wolfram Creek, Leask Creek, and likely also Mickelson Creek; Figure 1.2). The study also addressed the west-side tributaries and the main stem Elk River upstream and downstream of the side channel. Located between the Elk River and the west side of the Greenhills Ridge, the Elk River side channel branches off from the Elk River just south of Leask Creek, flows south, and converges back with the Elk River roughly 1.2 km downstream from Thompson Creek. The Elk River side channel was observed to undergo seasonal flooding and braiding, with variable flow throughout the year. In addition to mine-related influences, the area has also been subject to logging and is used as rangeland for cattle.

The GHO LAEMP results from 2017 to 2019 indicated that the west-side tributaries had no effect on biota in the main stem Elk River, and minimal effects on biota within the Elk River side channel and isolated pools (Minnow and Lotic 2018b, 2019, 2020). The area most likely to experience mine-related effects was Reach 2 (the side channel area at the confluence with Thompson Creek), based on its lentic nature during part of the year[5]. Data collected to date indicate this area is perennially-wetted, and, relative to other reaches within the side channel, has elevated concentrations of one or more mine-related constituents in water, sediment, and benthic invertebrate tissue (Minnow and Lotic 2018b, 2019, 2020).

Based on the GHO LAEMP results from 2017 to 2019, recommendations were made and accepted to modify the study design for 2020. Based on the updated study design, work was discontinued for study question #1 (What is the relationship between flows in the main stem Elk River and flows in the Elk River side channel?) and study question #3d (What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates?). Study question #6 (Is the mine-related influence on Reach 2 having an effect on aquatic dependent biota?) was removed to reduce redundancy in reporting, while for the 2020 GHO LAEMP the data that previously fell under study question #6 is reported under study questions #2, #3, #4 and #5. Study question #2 (What is the seasonal habitat availability for aquatic dependent biota in the Elk River side channel?) was reworded. The new study question #2 (What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?) narrowed the focus to habitat availability for amphibians in Reach 2.

[5] Reach 2 displays characteristics of both lotic and lentic systems, depending on the season. Lotic ecosystems are flowing freshwater systems with unidirectional water movement along a slope in response to gravity. In contrast, lentic ecosystems are differentiated by still water. In 2018 to 2020, Reach 2 was documented as swiftly flowing from freshet until early summer (i.e., lotic), had moderate channelization with slow flow from late summer until fall, and, once the area became isolated in late fall through winter, water pooled at the mouth of Thompson Creek (i.e., lentic).

1.5 Linkages to the Adaptive Management Plan for Teck Coal in the Elk Valley

As required in Permit 107517 Section 10, Teck has developed an Adaptive Management Plan (AMP). The purpose of the AMP is to support implementation of the Elk Valley Water Quality Plan (EVWQP) to achieve water quality and calcite targets, to be protective of human health and the environment, and where necessary, restorative, and to facilitate continuous improvement of water quality in the Elk Valley (Teck 2018). Following an adaptive management framework, the AMP identifies six Management Questions that will be re-evaluated at regular intervals as part of AMP updates throughout EVWQP implementation. Data from the RAEMP (Minnow 2020) and the various LAEMPs (including the present monitoring program) will feed into the adaptive management process to address these Management Questions that collectively address the environmental management objectives of the AMP (Teck 2018) and the EVWQP (Teck 2014).

Monitoring data from the LAEMP has contributed to the broader data set assessed every three years within the RAEMP, in addition to having addressed questions specific to the GHO LAEMP on an annual basis. The RAEMP is designed to evaluate multiple management related questions, such as Management Question #5 (i.e., "Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?") and Management Question #2, (i.e., "Will aquatic ecosystem health be protected by meeting the long-term site performance objectives?). Additionally, for each Management Question a "Key Uncertainty" framework has been also developed to identify data gaps and direct future work (as described in annual AMP Reports). Information acquired from the GHO LAEMP will be used in conjunction with studies in the Elk Valley area (including other LAEMPs) to reduce these uncertainties and provide additional context to the ecological conditions of the Elk Valley area as a whole.

The evaluation of biological triggers for potential monitoring and/or management actions is incorporated as part of Management Question #5 of the AMP (Teck 2018). Generally, triggers are intended as a simple way to flag potential unexpected monitoring results that may require management action. In the 2020 GHO LAEMP (herein), percent EPT (Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies]) and selenium concentrations in composite-taxa benthic invertebrate tissue were assessed against their respective biological triggers (additional information and methods pertaining to this analysis can be found in Appendix I).

The second annual AMP report was submitted on July 31, 2020, and included data from 2019 (Teck 2020b). That report indicated that biological monitoring results collected downstream of sedimentation/buffer ponds were not as expected for Thompson Creek, which is monitored under the GHO LAEMP and the RAEMP. Specifically, concentrations of selenium in benthic invertebrate tissue were higher than expected (given the measured water quality concentrations) at Thompson Creek. In response to this, AMP response actions in 2019 focused on initiating further investigations, which are outlined in detail in the 2019 Annual AMP report (Teck 2020b). The investigations of cause have tested or will test the current hypothesis that suggests the elevated selenium in benthic invertebrate tissue may be caused by increased aqueous concentrations of reduced selenium species, which are more bioavailable than selenate (Teck 2020b). The reduced species of selenium may be produced in the upstream sedimentation ponds (water management structures), where the where conditions may be conducive to the reduction of selenate (least bioavailable) to selenite (more bioavailable) or to organoselenide (most bioavailable). Furthermore, the increased hydraulic residency of these sedimentation ponds creates lentic-like conditions, potentially leading to greater selenium accumulation in organic detritus and organic-rich sediments (Young et al. 2010). Several investigations have been conducted, including an interlaboratory tissue analysis validation study and updates to the selenium bioaccumulation model and tool. Under the GHO LAEMP, supplementary selenium speciation water quality sampling was conducted in September 2020 at the GHO LAEMP areas concurrent with benthic invertebrate tissue chemistry sampling, which is investigated herein (see Sections 2.3 and 6.3). In addition, a selenium speciation monitoring program is currently being designed to investigate selenium speciation in sedimentation ponds throughout the region. Concurrent with these investigations of cause, Teck is advancing several possible adjustments, which may include habitat management and/or pond management modifications (Teck 2020b). Teck plans to implement fish-relocation projects within the Thompson sedimentation pond systems to reduce the potential risk to fish (Teck 2020b).

The implementation of adaptive management actions is not constrained to the AMP or LAEMP annual reporting cycles, but may be (and has been) initiated at any time during the course of each annual LAEMP cycle (results are reported on May 31 of each year for the preceding calendar year) depending on the answers to site-specific LAEMP questions and on available data. Monitoring plans and schedules will continue to adapt to findings in the field and operational needs. For more information on the adaptive management framework, the Management Questions, the Key Uncertainties, the Response Framework, Continuous Improvement, linkages between the AMP and other EVWQP programs, and AMP reporting, refer to the AMP (Teck 2018) and the 2019 Annual AMP report (Teck 2020b).

2 METHODS

2.1 Overview

Monitoring of the upper Elk River, the Elk River side channel, and west-side tributaries is currently conducted at various frequencies and timing under several programs (Tables 2.1 to 2.3), including the GHO LAEMP, regional and site-specific groundwater monitoring programs, and the RAEMP. Amphibian surveys were conducted in May, June, and July 2020 by Vast Resource Solutions (Vast 2020; Sections 2.2 and 3). Routine water quality and flow data are also monitored weekly/monthly[6] by Teck in the west-side tributaries, Elk River side channel, and Elk River (water quality only) as required under Permit 107517 and Permit 6428 (Sections 2.3, 2.4, 4, and 5). Under the annual Site-Specific GHO Groundwater Monitoring Program (SSGMP) and the Regional Groundwater Monitoring Program (RGMP), groundwater quality and interactions with surface water continue to be monitored (Section 5). Under the RAEMP and the GHO LAEMP, in September 2020, benthic invertebrate community composition (Sections 2.5 and 6), benthic invertebrate tissue chemistry (Sections 2.6 and 6), and supporting data were collected (Sections 2.7 and 6.4). All relevant monitoring data collected in 2020 are compiled herein (Tables 2.1 to 2.3), and compared to previous data where appropriate, to address the study questions (Section 1.3).

2.2 Amphibians (Question #2)

2.2.1 Overview

In 2020, habitat characteristics and observations of amphibians in Reach 2 were documented to address study question #2 (What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?). Work was completed in 2020 by Vast Resource Solutions (Vast 2020, Appendix C) and results from previous GHO LAEMP reporting (Minnow and Lotic 2018b, 2019, 2020) were also incorporated to address study question #2.

2.2.2 Habitat Assessment

Spring and summer were selected to perform visual surveys in 2020 to provide additional information about presence of each amphibian life stage. Habitat parameters observed at target locations throughout the breeding period were recorded on field tablets (Apple™ iPad mini 4; Vast 2020; Appendix C). Two trained personnel surveyed each area by completing a walking assessment and documented specific habitat characteristics and habitat features, including

[6] Sampling is done on a monthly basis (August to March) and/or weekly/monthly basis (March 15 to July 15), as required by Permit 107517 and Permit 6428.

Table 2.1: Summary of Amphibian Surveys and Surface Water Quality, Groundwater Quality, Benthic Invertebrate, and Sediment Quality Sampling Conducted for the 2020 GHO LAEMP

Exposure Type	Stream Type [a]	Stream Name	Water Station Code	Biological Area Code or Staff Gauge Location Code	ENV EMS Number	Area Description	UTM for Biological Area Code (NAD83, 11U)		Status	Question #2	Question #3, also supporting #4 and #5	Question #4		Question #5			
										Amphibians	Surface Water [b]	Hydrology	Groundwater [c]	Benthic Invertebrates		Substrate	
							Easting	Northing		Survey	Chemistry	Water Level, Flow, and Temperature Monitoring	Chemistry	Community Endpoints	Tissue Chemistry (Composite Taxa)	Calcite Index	Sediment Physical-chemical Attributes
Reference	M	Elk River	GH_ER2	RG_ELUGH	200389	u/s Branch Cr. and GHO	646739	5557609	Core RAEMP Reference	-	monthly[e], concurrently[e]	-	-	3 Annually	3 Annually	3 Annually	3 Annually
	M	Elk River	-	ERUS	-	Elk River u/s side channel	648114	5552674	GHO LAEMP	-	-	monthly/ continuous	-	-	-	-	-
Mine-exposed	S	Elk River Side Channel	GH_ERSC4	GH_ERSC4	E305878	Elk River side channel u/s of Wolfram Creek	648111	5552522	GHO LAEMP / RAEMP	-	monthly[e], concurrently[e]	monthly/ continuous	-[d]	3 Annually	3 Annually	3 Annually	-
	S	Elk River Side Channel	GH_ER1A	GH_ER1A	E305876	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648379	5551653	GHO LAEMP / RAEMP	-	monthly[e], concurrently[e]	monthly/ continuous	-[d]	3 Annually	3 Annually	3 Annually	-
	S	Elk River Side Channel	RG_ERSC5	RG_ERSC5	-	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648275	5550608	GHO LAEMP	-	concurrently[e]	-	-[d]	3 Annually	3 Annually	3 Annually	-
	T	Mickelson Creek	GH_MC1	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862	GHO LAEMP	-	monthly[e]	-	-[d]	-	-	-	-
	T	Leask Creek	GH_LC1	GH_LC1	E257796	Leask Creek Sed. Pond Decant	648153	5552859	GHO LAEMP	-	monthly[e]	-	-[d]	-	-	-	-
	T	Wolfram Creek	GH_WC1	GH_WC1	E257795	Wolfram Creek Sed. Pond Decant	648222	5552086	GHO LAEMP	-	monthly[e]	-	-[d]	-	-	-	-
	T	Thompson Creek	GH_TC2	THCK	E207436	Lower Thompson Creek	648596	5550237	RAEMP	-	monthly[e], concurrently[e]	-	-[d]	1 (2018) 3 (2019, 2020) Annually	1 (2018) 3 (2019, 2020) Annually	1 (2018) 3 (2019, 2020) Annually	-
	Le	Elk River Side Channel Reach 2	RG_GH-SCW1	RG_GH-SCW1	-	Inlet of Reach 2 in the Elk River side channel upstream of Thompson Creek	648317	5550334	GHO LAEMP	-	monthly[f]	-	-[d]	-	-	-	-
	Le	Elk River Side Channel Reach 2	RG_GH-SCW3	RG_GH-SCW3	-	Outlet of Reach 2 in the Elk River side channel downstream of Thompson Creek	648332	5550166	GHO LAEMP / RAEMP	May, June, July 2020	monthly[f], concurrently[e]	-	-[d]	-	3 Annually	3 Annually	5 Annually
	S	Elk River Side Channel	GH_ERSC2	GH_ERSC2	E305877	Elk River side channel d/s of Thompson Creek	648341	5549812	GHO LAEMP	-	monthly[e], concurrently[e]	monthly/ continuous	-[d]	3 Annually[g,h]	3 Annually[g,h]	3 Annually[g]	-
	S	Elk River Side Channel	-	RG_SCDTC	-	Elk River side channel d/s of Thompson Creek	648226	5549603	GHO LAEMP / RAEMP	-	concurrently[e]	-	-[d]	3 Annually[h]	3 Annually[h]	3 Annually	-
	S	Elk River Side Channel	-	RG_ERSCDS	-	Elk River u/s side channel	648771	5549103	GHO LAEMP	-	-	monthly/ continuous	-[d]	-	-	-	-
	M	Elk River	GH_ERC (Compliance)	RG_EL20	E300090	d/s Thompson Cr. and GHO	649146	5548514	Core RAEMP Mine-exposed	-	monthly/weekly[e], concurrently[e]	monthly/ continuous	-[d]	5 Annually	5 Annually	5 Annually	5 Annually

Sampling conducted for, and reported under, the GHO LAEMP.
Sampling conducted for, and reported under, the RAEMP. Data also reported and interpreted under the GHO LAEMP.
Sampling conducted for, and reported under, the GHO Site-Specific Groundwater Monitoring Program. See Table 2.3 for groundwater monitoring wells.

Note: "-" indicates no work conducted, as per approved study design.
[a] M-main stem (lotic); S-side channel (lotic); Le - side channel (semi-lentic); T-tributary (lotic).
[b] See Table 2.2 for additional surface water stations for the west-side tributaries.
[c] See Table 2.3 for ground water quality stations from the GHO Site-Specific Groundwater Monitoring Program that were assessed for the 2020 GHO LAEMF
[d] The GHO Site-Specific Groundwater Monitoring Program will be updated to address GHO LAEMP data needs
[e] Concurrently - water chemistry sampling will be conducted concurrent with biological sampling. Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 642
[f] Collected monthly concurrent with monthly hydrology surveys
[g] Was not wetted during September 2018 and therefore could not be sampled. In September 2019, this station was depositional and therefore could be sampled for benthic invertebrate tissue chemistry, but not benthic invertebrate communit
[h] In September 2020, this station was depositional and therefore could be sampled for benthic invertebrate tissue chemistry, but not benthic invertebrate community

Table 2.2: West-side Tributary Water Quality Monitoring Stations in the GHO LAEMP, 2020

Exposure Type	Tributary Name	Water Station Code	ENV EMS Number	Area Description	UTM (NAD83, 11U)	
					Easting	Northing
Reference	Branch F Creek	GH_BR_F	E287437	Branch F at LRP Road	647423	5557155
Mine-exposed	Wolf Creek	GH_WOLF	-[a]	Wolf Creek	647490	5556959
		GH_WOLF_SP1	E305855	Wolf Creek Sediment Pond Decant	647392	5556916
	Willow Creek	GH_WILLOW	-[a]	Willow Creek at LRP Road	647654	5556061
		GH_WILLOW_S [b]	-[a]	Willow South Creek at LRP Road	647663	5556006
		GH_WILLOW_SP1	E305854	Willow Sediment Pond Decant	647604	5556029
	Wade Creek	GH_WADE	E287433	Wade Creek at LRP Road	647723	5555707
	Cougar Creek	GH_COUGAR	E287432	Cougar Creek at LRP Road	647765	5555457
	No Name Creek	GH_NNC	E305875	No Name Creek	648055	5554967
	Branch D	GH_BR_D	-[a]	Branch D Creek	648062	5554869
	Mickelson Creek	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862
	Leask Creek	GH_LC2	-[a]	Leask Creek upstream of Sediment Pond	648297	5553064
		GH_LC1	E257796	Leask Creek Sediment Pond Decant	648153	5552859
	Wolfram Creek	GH_WC2	-[a]	Wolfram Creek upstream of Sediment Pond	648347	5552251
		GH_WC1	E257795	Wolfram Creek Sediment Pond Decant	648222	5552086
	Thompson Creek	GH_TC2	E207436	Thompson Creek Sediment Pond Decant	648596	5550237
		GH_TC1	E102714	Thompson Creek at LRP Road	648550	5550221

Note: The west-side tributaries are listed from upstream to downstream. The side channel branches off from the main stem Elk River downstream of Leask Creek and upstream of Wolfram Creek (delineated in this table by the double line; see Figure 2.1).

[a] No ENV EMS number.

[b] Sampling has not occurred at GH_WILLOW_S since 2017. All flow reports to station GH_WILLOW then through ponds to station GH_WILLOW_SP1.

Table 2.3: Groundwater Monitoring Stations in the 2020 GHO LAEMP

Exposure Type	Nearest Surface Water	Groundwater Monitoring Station Code	Area Description	UTM (NAD83, 11U)	
				Easting	Northing
Mine-exposed or potentially mine-exposed	Leask Creek	GH_MW_LC3A/B/C	South of Leask Pond	648182	5552734
	Wolfram Creek	RG_MW_LCWC1	East of Wolfram Pond, north of Wolfram Creek	648362	5552403
	Side Channel	GH_MW_WC1-A/B/C	Side channel west of Wolfram Pond	647987	5552217
	Wolfram Creek	GH_GA-MW-2	East of Wolfram Pond	648283	5552107
	Wolfram Creek	RG_MW_WC2A/B	West of Wolfram Pond	648195	5552081
	Thompson Creek	GH_GA-MW-3	North of Thompson Creek	648580	5550305
	Side Channel	RG_MW_ER3A/B	Side channel near confluence with Thompson Creek	648290	5550075
	Side Channel	RG_MW_ER6A/B	Side channel south of confluence with Thompson Creek	648589	5549350
	Side Channel	RG_MW_ER4A/B	Side channel south of confluence with Thompson Creek	648304	5549323
	Side Channel	RG_MW_ER5A/B	Side channel near southern confluence with Elk River	648690	5549134

Note: The groundwater stations are listed from north to south.

substrate, shoreline vegetation, aquatic macrophytes (submergent and emergent), and other aquatic species present (Appendix Table C.1; Vast 2020). Surrounding land use, anthropogenic influence, and connectivity between other aquatic and terrestrial habitats were also recorded (Appendix Table C.1; Vast 2020). *In situ* water quality was measured using a YSI Professional Plus™ water quality meter during each assessment, including water temperature, dissolved oxygen (DO), specific conductivity, conductivity, and pH (Appendix Tables C.2 and C.3; Vast 2020). The probes were calibrated weekly for conductivity, daily for pH, and before each site visit for DO (Vast 2020; Appendix C).

2.2.3 Amphibian Surveys

In 2020, surveys were conducted on May 13, June 23, and July 24 to determine presence or absence of endemic amphibian species at their various life stages, targeting egg masses (early-late May), larval stage (mid-late June), and metamorph/sub-adult/adult stages (mid-late July; Vast 2020; Appendix C). Two experienced surveyors assessed the entire perimeter of the target area using the Double Independent Observer Method (Vast 2020; Appendix C). This method puts each observer on opposite sides of the waterbody, where they walk on the edge of the water around half of the area perimeter and meet in the middle (Vast 2020; Appendix C). Egg masses and larval stage amphibians were visually surveyed when walking through the riparian area, taking care to search through aquatic vegetation with little disturbance. Adults were scared to land by walking, as well as carefully searched for throughout vegetation (Vast 2020; Appendix C). Adults were identified and enumerated visually, by auditory observations, or by capture using a D-net (Vast 2020; Appendix C; Photos C.1 to C.11). Polarized sunglasses were used to enhance visibility through the water column. Data, including photos, incidental species or life stage detection, and general notes, were recorded using field tablets (Apple™ iPad mini 4; Vast 2020; Appendix C).

2.3 Water Quality (Questions #3 and #4)

2.3.1 Overview

In this 2020 GHO LAEMP report, water quality data were used to address two study questions (Section 1.3):

- What is the influence of GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel? (study question #3 and its sub-questions); and
- What is the interaction between surface water and groundwater in the Elk River side channel? (study question #4).

Data from Teck's surface water quality monitoring under Permit 107517 and Permit 6428 as well as supplementary sampling conducted concurrent with GHO LAEMP field sampling were evaluated (Tables 2.1 to 2.3).

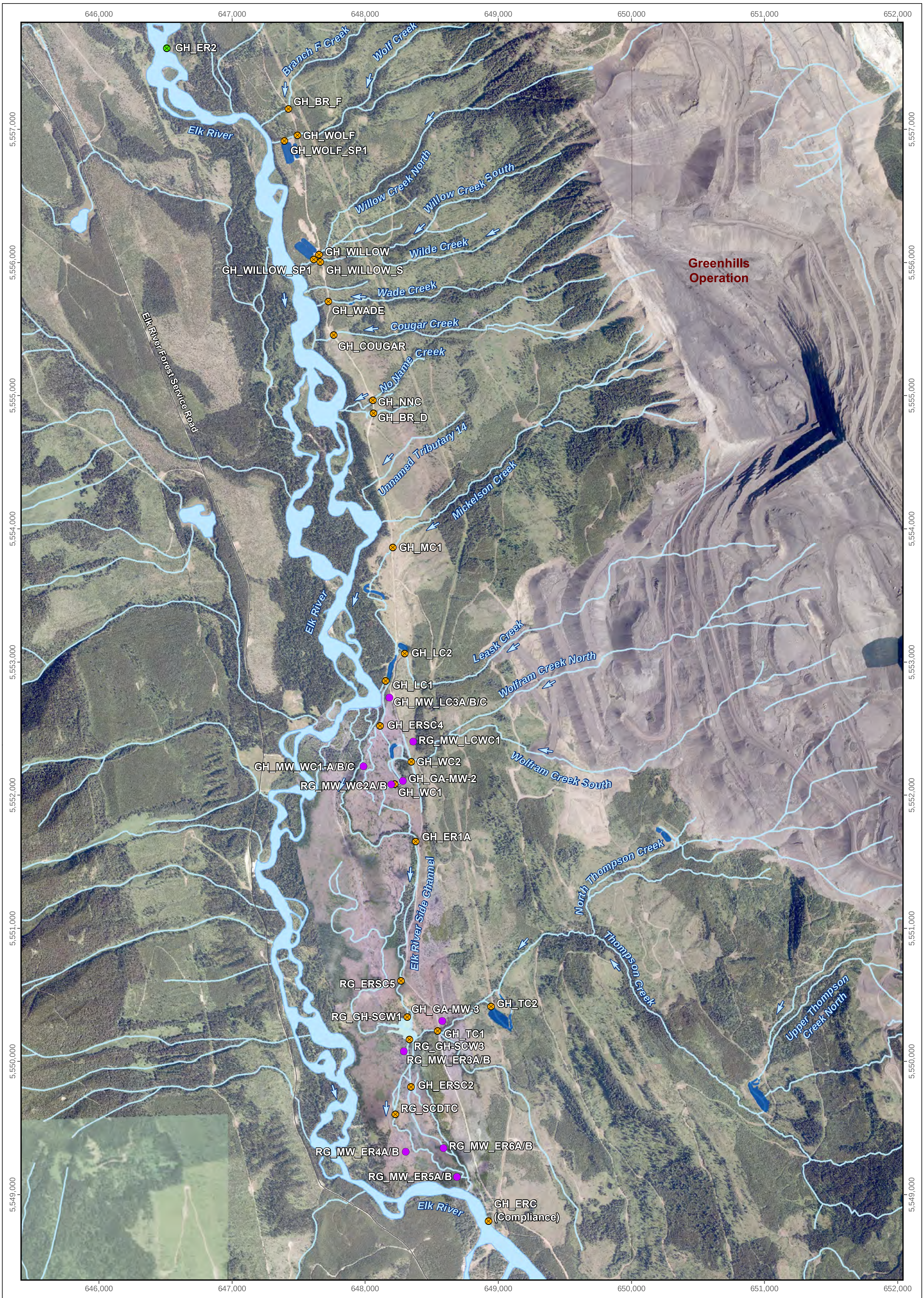
2.3.2 Sample and Data Collection

Water quality samples were collected weekly/monthly[7] by Teck as part of the permitted water quality sampling program. Water quality data were downloaded from Teck's EQuIS™ database for the water quality stations located in the west-side tributaries, the upper Elk River, and the Elk River side channel (Figure 2.1). Additional water quality samples were collected specifically for the GHO LAEMP. Between January 2020 and December 2020, grab samples were collected monthly at the inlet (RG-GHSCW1) and outlet (RG_GHSCW3) of Reach 2 to support the assessment of water quality in the side channel (study question #2.b). Water quality samples were also collected concurrent with benthic invertebrate community and tissue chemistry samples in September 2020 (Section 2.6 and 2.7).

Water samples were collected into clean, pre-labelled containers provided by the analytical laboratory. Samples were preserved immediately as required, and once re-capped, bottles were inverted two or three times to mix the preservative with the water sample. Water samples were kept cold and shipped to the analytical laboratory. Concurrent with water quality sampling, *in situ* measurements of temperature, DO, pH, and specific conductance were collected using a multi-probe water quality meter.

As open-pit mining progresses at GHO, water collects in the pits due to surface water runoff and groundwater infiltration as operations extend below the groundwater table. To dewater the GHO pits, water has been pumped and discharged into Mickelson, Leask, and Wolfram creeks. Pit pumping discharge data were reviewed with the GHO water management team. Mickelson Creek received pit pumping discharge in 2015 only, Leask Creek received discharge from 2016 to present, and Wolfram Creek received discharge from 2011 to present. The other west-side tributaries (including Thompson Creek) have not received pit pumping discharge (Teck 2020a). Prior to 2018, typical discharge rates were 3,000 to 5,000 m^3/day during most of the year and up to 15,000 m^3/day in peak freshet. Detailed documentation of discharge began in 2018 and will be ongoing (Appendix Table D.1; Minnow and Lotic 2020). These pit pumping discharge data were assessed to determine how water management may have influenced water quality.

[7] Sampling is conducted on a monthly basis (August to March) and/or weekly/monthly basis (March 15 to July 15), as required by Permit 107517 and Permit 6428.



LEGEND

- Groundwater Monitoring Station
- Routine Water Quality Monitoring Station (Permit 107517), Reference
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond

Surface Water and Groundwater Quality Monitoring Stations, 2020 GHO LAEMP

0 0.5 1 2
km

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W E
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Projection: North American Datum 1983 UTM Zone 11
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Date: May 2021
Project 207202.0022

minnow environmental inc.

Figure 2.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 2.1 Surface WQ.mxd

2.3.3 Laboratory Analysis

Water samples were analyzed by ALS Environmental (Calgary, Alberta) for parameters consistent with Permit 107517 (i.e., conventional parameters, major ions, nutrients, and total and dissolved metals, Table 2.4) using standard methods (Table 2.5). Water samples collected concurrent with biological monitoring were also analyzed by Brooks Applied Labs (Bothell, Washington) for selenium concentrations (i.e., total and dissolved selenium concentrations, and selenium speciation results including concentrations of selenate, selenite, dimethylselenoxide, methylseleninic acid, selenocyanate, selenomethionine, methaneselenonic acid, selenosulphate, and unknown selenium species).

Quality assurance and quality control (QA/QC) associated with routine water quality monitoring were discussed in the annual water quality report for Permit 107517 (Teck 2021). Quality control results are discussed in greater detail in the Data Quality Review (DQR) in Appendix B for water samples collected concurrent with biological samples (see Appendix H for applicable laboratory reports).

2.3.4 Screening and Plotting of Water Quality Constituents

Water quality assessment focused on constituents that were identified as mine-related in the Adaptive Management Plan and had early warning triggers (EWTs) defined (Azimuth 2018; i.e., dissolved cadmium, nitrate, total selenium, sulphate, total antimony, total barium, total boron, dissolved cobalt, total lithium, total manganese, total molybdenum, total nickel, nitrite, total dissolved solids [TDS], total uranium, and total zinc). For this 2020 GHO LAEMP report, dissolved nickel, phosphorus, orthophosphate, and total suspended solids (TSS) were also assessed based on EMC input. Dissolved nickel, which is more bioavailable than total nickel, was presented in the report to determine whether dissolved nickel is above interim screening values. Phosphorus and orthophosphate were presented because environmental assessments completed as part of the Cougar Pit extension predicted elevated concentrations of phosphorus in Wolf, Willow, and Wolfram creeks. Total suspended solids was added to assess the potential effects of total suspended solids on fish habitat and use.

These constituents were compared to British Columbia Water Guidelines (BCWQG) and/or EVWQP benchmarks, as well as interim screening values for nickel, as applicable, for the 2020 calendar year (Appendix Table D.2). Within the GHO LAEMP, the most conservative (i.e., lowest) EVWQP Level 1 and Level 2 benchmarks were used for screening. The Level 1 benchmark for cadmium is hardness-based and is based on reproductive toxicity to the water flea *Daphnia magna* (HDR 2014). For nitrate, the Level 1 and Level 2 benchmarks are based on reproductive toxicity to the water flea *Ceriodaphnia dubia* (Golder 2014a). For total selenium, the

Table 2.4: Water Sample Analyses

Category	Parameters (as per Permit 107517, Appendix 3, Table 24)
Field Parameters	temperature, specific conductance, dissolved oxygen (DO), pH
Conventional Parameters	specific conductance, total dissolved solids (TDS), total suspended solids (TSS), hardness, alkalinity, dissolved organic carbon (DOC), total organic carbon (TOC), turbidity
Major Ions	bromide, fluoride, calcium, chloride, magnesium, potassium, sodium, sulphate
Nutrients	ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), orthophosphate, total phosphorus
Total and Dissolved Metals	aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, zinc

Table 2.5: Analytical Methods for Water Samples

Analyte	Units	Method	Reference
Turbidity	NTU	Nephelometric	APHA 2130 Turbidity
Hardness (as $CaCO_3$)	mg/L	Calculation	APHA 2340B
Total Suspended Solids	mg/L	Gravimetric	APHA 2540 D
Total Dissolved Solids	mg/L	Gravimetric	APHA 2540 C
Alkalinity	mg/L	Potentiometric Titration	APHA 2320
Ammonia (as N)	mg/L	Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
Bromide (Br)	mg/L	Ion Chromatography	APHA 4110 B
Chloride (Cl)	mg/L	Ion Chromatography	APHA 4110 B
Fluoride (F)	mg/L	Ion Chromatography	APHA 4110 B
Total Kjeldahl Nitrogen	mg/L	Fluorescence	APHA 4500-NORG D.
Nitrate (as N)	mg/L	Ion Chromatography	EPA 300.0
Nitrite (as N)	mg/L	Ion Chromatography	EPA 300.0
Phosphorus (P)-Total	mg/L	Colourimetrically	APHA 4500-P Phosphorous
Orthophosphate	mg/L	Colourimetrically	APHA 4500-P Phosphorous (Filter through 0.45 um filter)
Sulphate (SO_4)	mg/L	Ion Chromatography	APHA 4110 B
Dissolved Organic Carbon	mg/L	Combustion	APHA 5310 TOTAL ORGANIC CARBON (Filter through 0.45 um membrane filter)
Total Organic Carbon	mg/L	Combustion	APHA 5310 TOC
Total & Dissolved Metals	mg/L	CRC ICPMS (collision cell inductively coupled plasma - mass spectrometry) ICPOES (inductively coupled plasma - optical emission spectrophotometry)	APHA 3030 B&E / EPA SW-846 6020A EPA 3005A/6010B Dissolved metals filtered through a 0.45 um filter

Level 1 and Level 2 benchmarks are based on reproductive toxicity to sensitive fish species (Golder 2014b). The Level 1 and Level 2 benchmarks for sulphate are hardness-based, and are based on toxicity to rainbow trout early life-stage survival and development (Golder 2014a). Per an EMC request in July 2019, concentrations of TSS were assessed using the Newcombe and Jensen 1996 model to determine the potential for effects on fish habitat availability and use in the Elk River side channel (Appendix Table D.3). The model uses a severity scale produced from a dose-response relationship based on TSS concentrations and exposure time. Concentrations of TSS were compared to the model Scale of the Severity (SEV) 7, which is the level where moderate habitat degradation and impaired homing are predicted (Appendix Table D.3; Newcombe and Jensen 1996). The TSS concentration for each SEV level (including SEV 7) was calculated using the model assuming one week of exposure to juvenile and adult salmonids, with TSS particle sizes 0.5 to 250 µm (i.e., Group 1 from Newcombe and Jensen 1996). Expose duration was selected to be conservative, based on water sampling weekly/monthly frequency (Section 2.3.2). Salmonids fish species type (as opposed to non-salmonids species type) was selected due to the presence of salmonids in the side channel (Minnow and Lotic 2020). It is assumed that all life stages could be present in the side channel, and both fry and adults have been observed in the side channel (Minnow and Lotic 2020). Particle size selection was conservative by assuming presence of both fine and coarse sediments, which, respectively can impact fish via passing through gill membranes into interlamellar spaces of gill tissues and via mechanical abrasion of gills. The following model was used:

$$z = a + b(\log_e x) + c(\log_e y)$$

Where z is the severity of ill effect, x is duration of exposure (hours), and y is concentration of suspended sediment (mg SS/L). In this model, the intercept (a) and slope coefficients (b and c) were determined by the model group, which was for Group 1 for this project, where a = 1.0642, b = 0.6068, and c = 0.7384 (Newcombe and Jensen 1996).

Plots of constituent concentrations from 2012 to 2020 (for the west-side tributaries and the main stem Elk River stations) or from 2014 to 2020 (for the Elk River side channel stations) were prepared individually for each monitoring station relative to BCWQG, EVWQP benchmarks, and/or interim screening values (where applicable), and also as combined plots to allow for visual comparison among stations. Plots were qualitatively assessed for seasonal and temporal patterns. Water quality data were assessed for:

- the west-side tributaries (study question #3a);
- the Elk River side channel stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Reach 2 (RG_GH-SW1, RG_GH-SCW3) (study question #3b); and

- the main stem Elk River downstream (GH_ERC) and upstream (GH_ER2) of the west-side tributaries (study question #3c).

2.3.5 Statistical Analyses

2.3.5.1 Monthly Means

Statistical analyses of water quality constituents were conducted using monthly means. Monthly mean concentrations were calculated using the Kaplan-Meier (K-M) method. The method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the K-M estimator (used to estimate the mean survival time in survival analysis) to calculate the mean. The calculation was conducted using the survfit() function in the survival package (Therneau 2017) in R (R Core Team 2020) and involves calculating the area under the K-M survival curve. The K-M method is non-parametric and can accommodate multiple laboratory reporting limits (LRLs). The method of calculating the mean is equivalent to using the distribution of detectable values below the LRL to represent values that are < LRL. For example, the mean of the data set {1, 2, <4, 5} is estimated as the mean of 1, 2, [½×1 + ½×2], and 5 which is 2.375. The value <4 is replaced by the distribution of values below 4 (i.e., 1 and 2 with equal weight of ½). Similarly, the mean of the data set {1, 1.6, 2, 2.1, <4, 5} is estimated as the mean of 1, 1.6, 2, 2.1, [¼×1 + ¼×1.6 + ¼×2 + ¼×2.1], and 5 which is 2.229. Again, the value <4 is replaced by the distribution of values below 4 (i.e., 1, 1.6, 2, and 2.1 with equal weight of ¼). If there is only one LRL and no detected values below the LRL, then the K-M estimate of the mean is equivalent to replacing the value below the LRL with the LRL (i.e., the best estimate for the values < LRL is the LRL).

2.3.5.2 Temporal Trends

Temporal changes in monthly mean water concentrations were evaluated for each station (reference and mine-exposed) from 2012 to 2020 (west-side tributaries and the main stem Elk River stations) or from 2015 to 2020 (Elk River side channel stations). Data analysis included only years with at least six months of data and included only stations with at least three years of data. Due to the presence of LRLs for most parameters, a censored regression Analysis of Variance (ANOVA) model with factors *Year* and *Month* and assuming a log-normal distribution of the response variable was fit with maximum likelihood estimation for each station. The significance of each term in the model was assessed using likelihood-ratio tests to determine if there was a significant change in log-likelihood with the addition of the term in the model. This tested for an overall difference among years and including the *Month* term in the model controlled for seasonal effects within a year. If the year term was significant (α = 0.05), post-hoc contrasts were conducted to test for all pairwise differences among years with an

$\alpha = 0.05$ in a Tukey's Honestly Significant Difference test (HSD) which corrects for the number of comparisons.

For each year, for statistically significant differences, a percent magnitude of difference (MOD) from the base year (i.e., first year with minimum number of months) was calculated as:

$$\frac{Year_i - Base\ Year}{Base\ Year} \times 100\ \%$$

and the significant difference between 2020 and all other years and between 2020 and 2019 was assessed. All statistics were conducted in R (R Core Team 2020).

2.3.5.3 Main Stem Elk River versus the Side Channel (Question #3b)

Statistical comparisons of water quality between the lotic side channel stations (GH_ERSC2, GH_ER1A, GH_ERSC4) and the Elk River upstream (GH_ER2) and downstream (GH_ERC) stations were conducted to assess differences among years (from 2016 to 2020) and among stations. Statistical analysis of water quality data focussed on monthly mean concentrations of constituents with EWTs and total suspended solids. The statistical comparisons were conducted on the mathematical differences (side channel – downstream, and side channel –-upstream) in $\log_{10}$ monthly mean concentrations to remove the influence of season. The differences in $\log_{10}$ monthly mean concentrations between areas were tested using a two-way ANOVA with factors Year, Area (the three side channel stations), and the Area x Year interaction.

The side channel versus upstream and side channel versus downstream comparisons were conducted by testing whether differences in $\log_{10}$ monthly mean concentrations between stations were different from zero using a one-sample t-test by testing the hypothesis (H_{01}):

$$H_{01}: \mu d = 0$$

where μd represented the difference in monthly means between side channel stations and upstream or downstream stations. The tests for H_{01} were conducted by: (1) pooling five years of data and stations when the Area x Year interaction and Area factors were not significant (P-value > 0.05); (2) pooling five years of data, but separately by side channel station when the Area x Year interaction was not significant, but Area was significant; or (3) separately by station and year when the Area x Year interaction term was significant.

When the differences in monthly mean concentrations between the side channel and upstream or downstream stations were significant, the MOD was calculated as:

$$MOD = \frac{(MCT_{SC} - MCT_{US})}{MCT_{US}} \times 100\%$$

or

$$MOD = \frac{(MCT_{SC} - MCT_{DS})}{MCT_{DS}} \times 100\%$$

where MCT_{SC}, $MCT_{US,}$ and MCT_{DS} were the geometric mean measure of central tendency (MCT) for the side channel, downstream, and upstream stations, respectfully.

2.3.5.4 Main Stem Elk River Downstream versus Upstream of the West-Side Tributaries (Question #3c)

Concentrations at the Elk River downstream station (GH_ERC) were compared to upstream (GH_ER2) using the difference in $\log_{10}$ monthly mean concentrations between stations. Potential changes over time at the downstream station compared to upstream were tested using an ANOVA on the differences in $\log_{10}$ monthly mean concentrations between stations, with Year as a co-variate. When the Year term was not significant, the difference between the upstream and downstream stations was tested using a using a one sample t-test (see section 2.4.5.3). When Year was significant, it suggested that the difference between the upstream and downstream stations varied by year, and a t-test was run separately for each year. When the difference in monthly mean concentrations between the upstream and downstream stations was significant overall, or for an individual year, the MOD was calculated as:

$$MOD = \frac{(MCT_{DS} - MCT_{US})}{MCT_{US}} \times 100\%$$

where MCT_{DS}, and MCT_{US} were the geometric means for the downstream and upstream stations, respectively.

2.4 Surface Water and Groundwater Interaction (Question #4)

SNC-Lavalin (2021) completed a report describing the updated understanding of groundwater-surface water interaction along the Elk River side channel to support study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?).

To assess this, available groundwater data and surface water data were compiled. Groundwater data were collected in 2020 as part of other on-going programs such as the GHO Site-Specific Groundwater Monitoring Program (SSGMP), the Regional Groundwater Monitoring Program (RGMP), the Cougar Pit Phase 5 and 7-2 Project (CPP), and the Mass Balance Investigation (MBI). Instantaneous flow and water quality data were collected by Teck as part of on-going surface water monitoring programs at GHO (Section 2.3.2). Specifically, for the GHO LAEMP, surface water level data were collected by water level and temperature loggers

(Onset Hobo U 20 Level loggers) that were installed at RG_ERUS, GH_ERSC4, GH_ER1A, RG_ERSCDS and (Figure 2.2). Water level and temperature data were used to confirm dry periods. A barometric logger was at GH_ER1A was used to correct submerged water level loggers for changes in atmospheric pressure. Data were downloaded routinely from the loggers to avoid data loss. A detailed description of data collected in support of study question #4 is provided in Appendix E.

The assessment included:

- spatial and temporal comparison of groundwater elevations in monitoring wells to surface water levels in the adjacent side channel and tributaries (including sedimentation ponds) and the Elk River; and,
- spatial and temporal comparison of groundwater chemistry (including mine-related constituents and major ions) from monitoring wells to surface water chemistry data from tributaries, the Elk River side channel, and the main stem Elk River.

2.5 Benthic Invertebrate Community (Question #5)

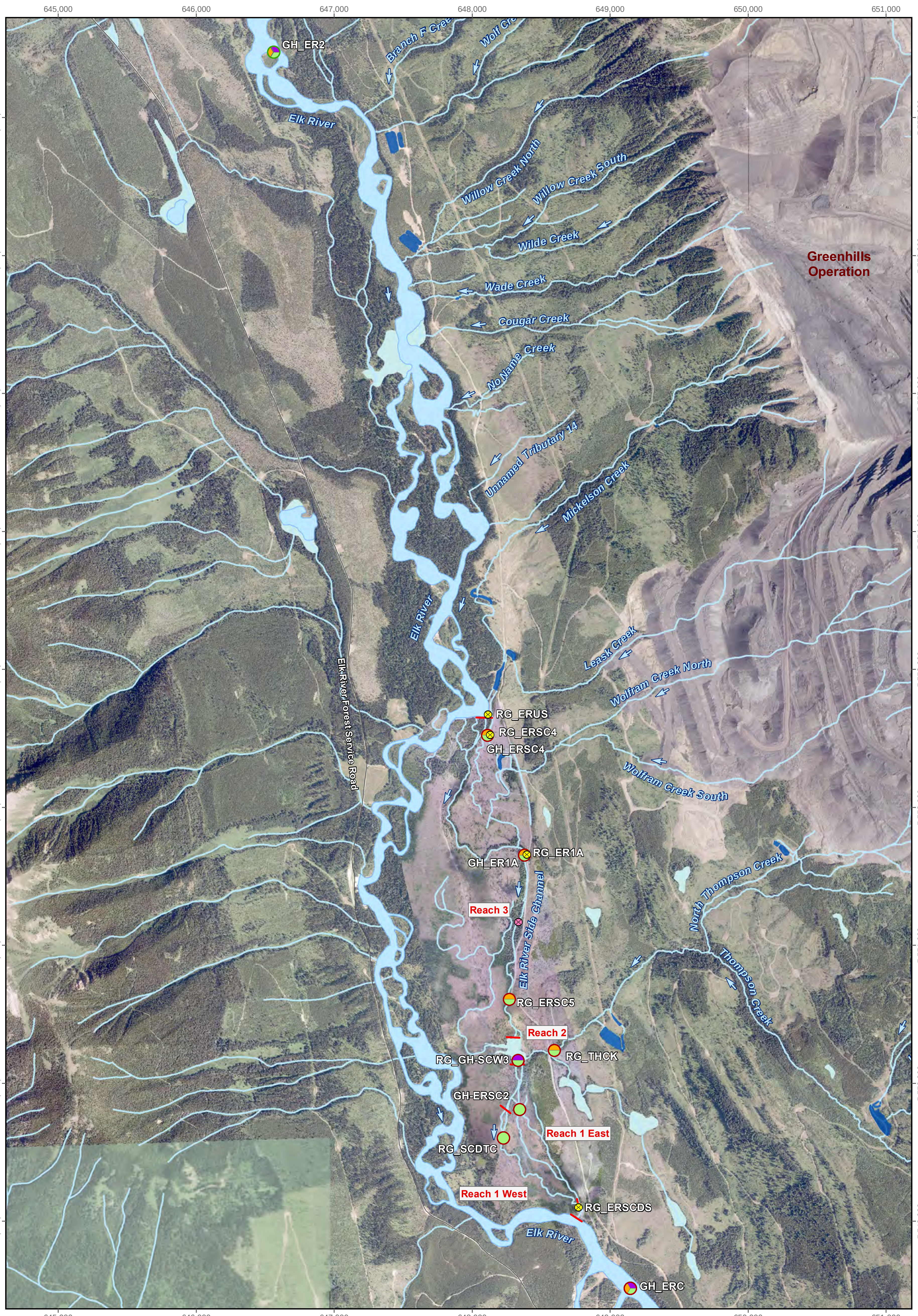
2.5.1 Overview

Benthic invertebrate community structure data were assessed to address study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

2.5.2 Sample Collection

Benthic invertebrate community samples were collected from three areas in the side channel connected to the Elk River (GH_ERSC4, GH_ER1A, and RG_ERSC5[8]; Figure 2.2). Samples were also collected from two stations in the main stem Elk River: downstream of the west-side tributaries (GH_ERC) and upstream of mine influence (GH_ER2; Figure 2.2). Based on power analysis in the RAEMP study design (Minnow 2018), it was determined that five samples would be collected at core RAEMP monitoring areas (i.e., Compliance and Order stations; GH_ERC) and three samples would be collected at core RAEMP reference areas

[8] The study design proposed benthic invertebrate tissue chemistry sampling areas at GH_ERSC4, GH_ER1A, RG_ERSC5, and GH_ERSC2; however, GH_ERSC2 was dry at the time of sampling in 2018 and depositional (all fines) in 2019 and 2020, and therefore a new station downstream of the confluence with Thompson Creek (RG_SCDTC) was sampled in 2018 and 2019. In 2020, water levels at station RG_SCDTC were too low to conduct benthic invertebrate community sampling.



LEGEND

Sampling Type

- Mine-exposed
- Reference
- Sediment Quality
- Benthic Invertebrate Community
- Benthic Invertebrate Tissue Chemistry
- Water Level and Temperature Logger
- Barometric Logger
- Reach Break
- Settling Pond

Data Logger, Benthic Invertebrate Community, and Benthic Invertebrate Tissue Chemistry, and Sediment Quality Sampling Stations, 2020 GHO LAEMP

0 0.5 1 2
km

Projection: North American Datum 1983 UTM Zone 11

Date: May 2021
Project 207202.0022

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Figure 2.2

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 2.2 Biological Locations.mxd (i.e., GH_ER2). At some GHO LAEMP stations in 2017 and/or 2018, a single sample was collected based on the RAEMP study design. To provide greater power to detect changes over time, additional replicates (three samples rather than one) were added to support the GHO LAEMP at side channel stations GH_ERSC4, GH_ER1A, and RG_ERSC5 in 2018, 2019, and 2020, as well as in 2019 at side channel station RG_SCDTC, and in 2019 and 2020 at tributary station RG_THCK. Samples were collected using the Canadian Aquatic Biomonitoring Network (CABIN) protocol for the kick and sweep method (Environment Canada 2012a, 2014). The field technician conducted a 3-minute travelling kick into a kick net with a triangular aperture measuring 36 cm per side and mesh having 400 µm openings. During sampling, the technician moved across the stream channel (from bank to bank, depending on stream depth and width) in an upstream direction. With the kick net held immediately downstream of the technician's feet, the detritus and invertebrates disturbed from the substrate were passively collected in the kick-net by the stream current. After three minutes of sampling time, the sampler returned to the stream bank with the sample.

Organisms collected into the kick net were carefully rinsed into a labelled wide-mouth plastic jar. Internal labels were used to confirm the correct identity of each sample. Samples were preserved to a level of 10% buffered formalin in ambient water within approximately six hours of collection to ensure that organisms were not lost through predation or decomposition.

Supporting information was collected concurrent with, and at the same locations as, benthic invertebrate community samples, including habitat characteristics (Section 2.7.1), calcite coverage (Section 2.7.2), water quality samples (Section 2.3.2), and sediment quality samples (Section 2.7.3).

2.5.3 Laboratory Analysis

Benthic invertebrate community samples were sent to Cordillera Consulting (lead taxonomist Scott Finlayson), in Summerland BC, for sorting and taxonomic identification to the lowest practical level (LPL; typically genus or species). At the beginning of the sorting process, the total number of preserved organisms in each sample was estimated. If the total number was estimated to be greater than 300, then the sample was sub-sampled for sorting and enumeration. A minimum of 5% of each sample was sorted, consistent with requirements specified by Environment Canada (2012b, 2014). Sorting efficiency and sub-sampling accuracy and precision were quantified using methods outlined by Environment Canada (2012b, 2014). Total organism abundance was reported for each sample (see Appendix F for laboratory reports). Based on the results provided for QA/QC samples, the benthic invertebrate community data collected for the GHO LAEMP were judged to be of acceptable quality (Appendix B).

2.5.4 Data Analysis

For benthic invertebrate community samples, total abundance, LPL richness, % EPT, % Ephemeroptera, % Plecoptera, % Trichoptera, and relative abundance of major taxonomic groups were determined and compared within and among areas. Community endpoints were also compared to normal ranges[9] defined in the RAEMP based on samples collected from regional reference areas from 2012 to 2019 (Minnow 2020b; Appendix Table F.1), as well as to the upstream main stem Elk River reference station (GH_ER2). Site-specific normal ranges were calculated as prediction intervals from the final habitat model for main stem Elk River stations (GH_ER2, GH_ERC) and Thompson Creek (RG_THCK; Appendix Table F.2). Ninety-fifth percentile prediction intervals were calculated from linear mixed-effects models using simulations (n = 100,000) to generate residual variation in random-effects terms. For Ephemeroptera and EPT abundance endpoints, the prediction intervals from the % Ephemeroptera and % EPT models were multiplied by the prediction intervals from the abundance model to generate the taxa-specific endpoint abundance predictions. Prediction intervals were calculated using the predictInterval() function in the merTools R package (Knowles and Frederick, 2019). To evaluate changes over time, benthic invertebrate community endpoints from 2012 to 2020 were visually compared, where data were available.

The % EPT endpoint was also assessed against biological triggers as part of Teck's AMP (Teck 2018) for GHO LAEMP monitoring areas with available water quality projections (i.e., mine-exposed areas RG_THCK and GH_ERC; see Appendix I for details).

2.6 Benthic Invertebrate Tissue Chemistry (Question #5)

2.6.1 Overview

In 2020, benthic invertebrate tissue chemistry data were assessed to address study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

2.6.2 Sample Collection

Benthic invertebrate tissue samples were collected in September 2020 from four riffle areas in the side channel (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC), from two depositional areas in the side channel (i.e., substrate was predominantly fines-sized particles rather than a habitat of riffle and cobble; GH_ERSC2 and Reach 2 at RG_GH-SCW3), and from the main stem

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[9] The reference area normal range was defined as the 2.5th to 97.5th percentiles of the distribution of reference area data (pooled 2012 to 2019 data) reported in the RAEMP (Minnow 2020).

Elk River stations (GH_ERC and GH_ER2; Figure 2.2). Samples were taxa-composites (representative of the benthic invertebrate taxa present in each sampling area) collected in triplicate at each area using the kick and sweep method. The taxa present in the samples were documented. Benthic invertebrates were picked free of debris in the field, placed into a sterile labelled cryovial, and stored in a cooler with ice packs until transfer to a freezer later in the day.

Data collected previously has suggested that Annelids exhibit higher concentrations of selenium compared to other benthic organisms, even at reference areas (Minnow 2016; Minnow and Lotic 2020; Luoma 2021). Therefore, the benthic invertebrate tissue chemistry sampling protocol for Annelids in 2020 was to either a) collect them into the composite sample at a proportion that was representative of the community, or b) if there was one or two Annelids that would have made up a much greater proportion of the tissue sample by biomass than what was representative of the community present, then the annelids were to be excluded from the composite taxa sample and instead be collected for a separate tissue sample. In 2020, Annelids were not observed in the field when picking organisms for the composite benthic invertebrate tissue chemistry samples, so this protocol was not applied.

Supporting information was collected concurrent with, and at the same locations as, benthic invertebrate tissue samples, including habitat characteristics (Section 2.7.1), calcite coverage (Section 2.7.2), water quality samples (Section 2.3.2), and sediment quality samples (Section 2.7.3).

2.6.3 Laboratory Analysis

Benthic invertebrate tissue samples were kept in a freezer until they were shipped in coolers to the TrichAnalytics Inc. (Trich) laboratory in Saanichton, British Columbia. At the laboratory, the samples were freeze-dried, homogenized, and then analyzed for metals using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). Results were reported on a dry weight (dw) basis, along with moisture content (based on the difference between wet and freeze-dried sample weights).

The QA/QC procedures for benthic invertebrate tissue samples included the assessment of laboratory duplicates, and quality control reference materials and standards. Based on the results provided for QA/QC samples, the benthic invertebrate tissue data collected for the GHO LAEMP were judged to be of acceptable quality (Appendix G).

2.6.4 Data Analysis

Benthic invertebrate tissue selenium concentrations were compared to EVWQP Level 1, Level 2, and Level 3 benchmarks as well as normal ranges[10] defined in the RAEMP (Minnow 2020b; Appendix Table G.1). Tissue selenium concentrations were also plotted and spatially compared within and among areas and were compared to predictions made by the selenium bioaccumulation model (Golder 2018, 2020) and the selenium speciation bioaccumulation tool (b-tool; de Bruyn and Luoma 2021).

The endpoint of selenium concentrations in benthic invertebrate tissue was also assessed against biological triggers that were established as part of Teck's AMP (Teck 2018) for GHO LAEMP monitoring areas with available water quality projections (i.e., mine-exposed areas RG_THCK and GH_ERC; see Appendix I for details).

2.7 Supporting Information

2.7.1 Habitat

Habitat characteristics were documented (notes and photo-documentation), and included channel depth and velocity (measured using a Hach FH950 flow meter, 15 cm above the substrate), substrate characteristics (i.e., 100 pebble count, consistent with CABIN protocol), surrounding land use, anthropogenic activity, bank stability, bankfull width, and wetted width.

2.7.2 Calcite

Calcite coverage was assessed as part of the pebble counts at the two main stem stations (GH_ER2 and GH_ERC), the four side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC), and Thompson Creek (RG_THCK) in September 2020. Pebble counts were not conducted at the side channel stations GH_ERSC2 and RG_GH-SCW3, as the substrates at these areas were predominantly fines and sand, with no calcification or concretion. Field measurements were consistent with calcite monitoring conducted for the RAEMP (Minnow 2020b) and followed a modified 100-particle pebble count method developed for Teck's Calcite Monitoring Program (Robinson and Atherton 2016, Teck 2016). For this modified approach, calcite was measured only in riffle habitats on undisturbed substrate in the immediate vicinity of where benthic invertebrate community samples were collected (e.g., no more than roughly 10 m distance). One hundred streambed particles were randomly selected over the study area and were measured for calcite presence/absence and concretion. The presence (score = 1) or absence (score = 0) of calcite was recorded for each of the 100 particles. The degree of

[10] The reference area normal range for composite benthic invertebrate tissue samples is defined as the 2.5th to 97.5th percentiles of the distribution of reference area data (pooled 1996 to 2019 data) reported in the RAEMP (Minnow 2020).

concretion was also assessed by determining if the particle was removed with negligible resistance (not concreted; score = 0), noticeable resistance but removable (partially concreted; score = 1), or immovable (fully concreted; score = 2). 100-particles were measured for each Calcite Index (CI) determination. Consistent with the RAEMP, CI was determined for each benthic invertebrate community sampling location, and therefore was collected in triplicate for most GHO LAEMP stations, except GH_ERC, where five CI counts were conducted.

The results for the 100 particles surveyed for calcite were expressed as a CI based on the following equation:

$$CI = C_p + C_c$$

Where:

$$CI = Calcite\ Index$$

$$C_p = Calcite\ Presence\ Score = \frac{Number\ of\ particles\ with\ calcite}{Number\ of\ particles\ counted}$$

$$C_c = Calcite\ Concretion\ Score = \frac{Sum\ of\ particle\ concretion\ scores}{Number\ of\ particles\ counted}$$

2.7.3 Sediment Quality

2.7.3.1 Sample Collection

Sediment quality samples were collected concurrent with benthic invertebrate samples at the two main stem Elk River areas (GH_ER2 and GH_ERC) and at Reach 2 (RG_GH-SCW3), the depositional area of the side channel at the confluence with Thompson Creek (Figure 2.1). Five samples were collected at each of the mine-exposed areas (RG_GH-SCW3 and GH_ERC), while three samples were collected at the GH_ER2 reference area. Sediment samples were collected using a stainless-steel spoon and were transferred into glass jars for analysis of polycyclic aromatic hydrocarbons (PAHs), and into polyethylene bags for all other analyses (see Section 2.7.3.2). Samplers took care to only remove the top 1 to 2 cm of sediment and continued to collect sediment until sufficient sample volume was retrieved. For QA/QC purposes, duplicate (split) samples were collected at a frequency of approximately 10% of the total number of samples to assess field precision (i.e., two sets of field duplicate samples). Following collection, samples were placed in a refrigerator at approximately 4°C until submission to the analytical laboratory.

2.7.3.2 Laboratory Analysis

Sediment samples for chemical analysis were sent to ALS Environmental (Calgary, Alberta). The laboratory was instructed to thoroughly homogenize each sediment sample (according to standard laboratory protocols) to ensure that aliquots taken for analysis were representative and comparable. Sediment samples were analyzed for metals, mercury, total organic carbon (TOC), PAHs, particle size distribution, and moisture content using standard methods (Table 2.6). In addition to collection of field duplicate samples, QA/QC included assessment of laboratory duplicates, spike recoveries, and certified reference materials (Appendices B and H). Based on the QA/QC results provided, the sediment data were judged to be of acceptable quality (Appendices B and H).

2.7.3.3 Data Analysis

Sediment quality data were evaluated relative to BC working sediment quality guidelines (SQG) and, where applicable, the reference area normal range (i.e., the 2.5th to 97.5th percentiles of 2013 and 2019 reference area data reported in the LAEMP for lentic stations; Minnow 2020b). Two levels of guideline are typically defined: a lower SQG and an upper SQG. The lower SQG represents concentrations below which adverse biological effects would not be expected to occur. In contrast, the upper SQGs (i.e., probable effect level [PEL] or severe effect level [SEL]) represent concentrations above which effects may be frequently observed. The SQGs are not based on cause-effect studies, but rather on levels of toxic substances found in the sediment where biological effects have been measured (ENV 2021), such that the exceedance of individual SQGs cannot be interpreted as strong evidence for biological response.

Sediment normal ranges were calculated using 76 data points collected from nine reference areas over four years (2017 to 2020; Appendix Table H.8). Because values reported for a few parameters were <LRL, normal range percentiles were calculated using Kaplan-Meier (K-M) percentiles, based on the methods described by Helsel (2012), as described in Section 2.3.5.1.

Table 2.6: Analytical Methods for Sediment Samples

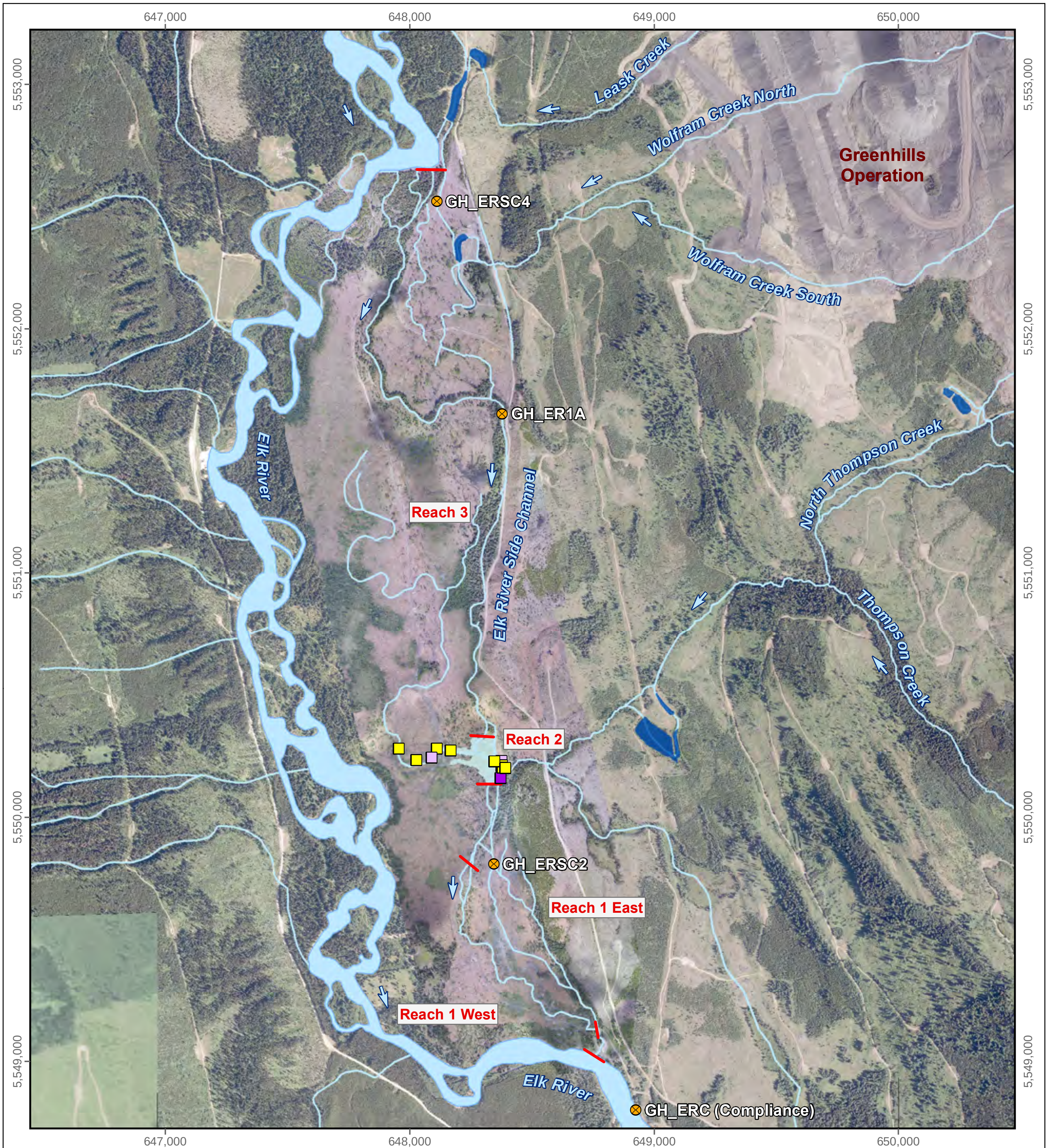
Analyte	Units	Method	Reference
Metals	mg/kg	Collision Reaction Cell Inductively Coupled Plasma Mass Spectrometry (CRC ICP-MS)	EPA 200.2/6020A (mod)
Mercury	mg/kg	Cold Vapor-Atomic Absorption (CVAAS)	EPA 200.2/1631E (mod)
Total Organic Carbon (TOC)	%	TOC is calculated by the difference between total carbon and total inorganic carbon	CSSS (2008) 21.2
Polycyclic Aromatic Hydrocarbons (PAHs)	mg/kg %	Rotary extraction using hexane/acetone followed by capillary column gas chromatography with mass spectrometric detection (GC/MS)	EPA 3570/8270
Particle Size Distribution	%	Dry sieving (coarse particles), wet sieving (sand), and the pipette sedimentation method (fine particles)	SSIR-51 METHOD 3.2.1
Moisture Content	%	Determined gravimetrically by drying the sample at 105 °C	CCME for PHC in Soil - Tier 1 (mod)

3 RESULTS: STUDY QUESTION #2

Habitat characterization and amphibian presence data were evaluated to address study question #2 (What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?). These data provide information about seasonal habitat availability for amphibians in the side channel, which gives context for understanding potential exposure pathways. Habitat surveys and aquatic-dependent biota surveys were conducted monthly from May 2017 to July 2020 (Minnow and Lotic 2018a, 2020), as well as additional amphibian-targeted surveys conducted in May, June, and July 2020 (Appendix C; Vast 2020).

Habitat characterization of Reach 2 was consistent from 2017 to 2020, with the availability and attributes of wetted habitat varying greatly throughout each year (Minnow and Lotic 2020; Appendix Photos C.1 to C.11). Reach 2 remained wetted throughout four years of the study. From freshet to fall (three to four months of each study year), Reach 2 received flow from both the Elk River (via the upper side channel) and Thompson Creek. Flows were relatively swift during this time and therefore the Reach 2 habitat was not suitable for amphibian breeding and use by early life stages, although breeding habitat may be present elsewhere in the area. From fall to early spring, Reach 2 remained wetted due to surface flows from Thompson Creek, but during this time the upper side channel disconnected from the main stem Elk River and was dry. Sparse emergent macrophytes were present in May 2020 when the channel overflowed its banks and braided through the side channel complex, however vegetation was absent during subsequent visits when stream wetted width was narrower (Appendix Table C.1; Appendix Photos C.6 to C.10). As in previous years, fish were observed in the side channel (Appendix Table C.1; Minnow and Lotic 2020); due to the risk of predation on amphibian eggs and larvae, the presence of fish can be a major deterrent for breeding habitat and may further explain the absence of evidence of amphibian breeding (Monello and Wright 1999; Vast 2020). Both the inlet and outlet of Reach 2 remined well oxygenated (i.e., DO > 5 mg/L), pH remained within the BCWQG acceptable range (6.5 < pH < 9.0), and temperature remained below the BCWQG maximum (19 °C; Appendix Tables C.2 and C.3). Ultimately, there are no barriers to the use of Reach 2 by amphibians, and therefore, despite habitat being unsuitable for amphibian breeding, it is expected that the area is used by a variety of amphibians.

During surveys conducted from 2017 to 2020, three amphibians species (adult and subadult Columbia spotted frog, adult western toads, and subadult/larval long-toed salamanders) were observed in Reach 2 from June to September (Figure 3.1; Appendix Table C.4). Western toads were the most common amphibian species, with adults observed on ten occasions during the four years of the GHO LAEMP study (Appendix Table C.4). Most amphibians observed



LEGEND

- Long-toed Salamander
- Columbia Spotted Frog
- Western Toad
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Reach Break
- Settling Pond

Amphibian Observations in Reach 2, GHO LAEMP, May 2017 to July 2020

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11
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Date: May 2021
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Figure 3.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 3.1 Amphibian Observations.mxd were adults, except for one subadult Columbia spotted frog and all the long-toed salamanders (Appendix Table C.4)

The surveys from 2017 to 2020 confirmed the seasonal availability of amphibian habitat in Reach 2 and confirmed the use of Reach 2 by three species of amphibians of larval to adult life stages, which answered study question #2 (What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?).

4 RESULTS: STUDY QUESTION #3

4.1 Overview

Data evaluated in this section are related to study question #3:

What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?

a. What is the water quality in the west-side tributaries, and how is it changing over time?

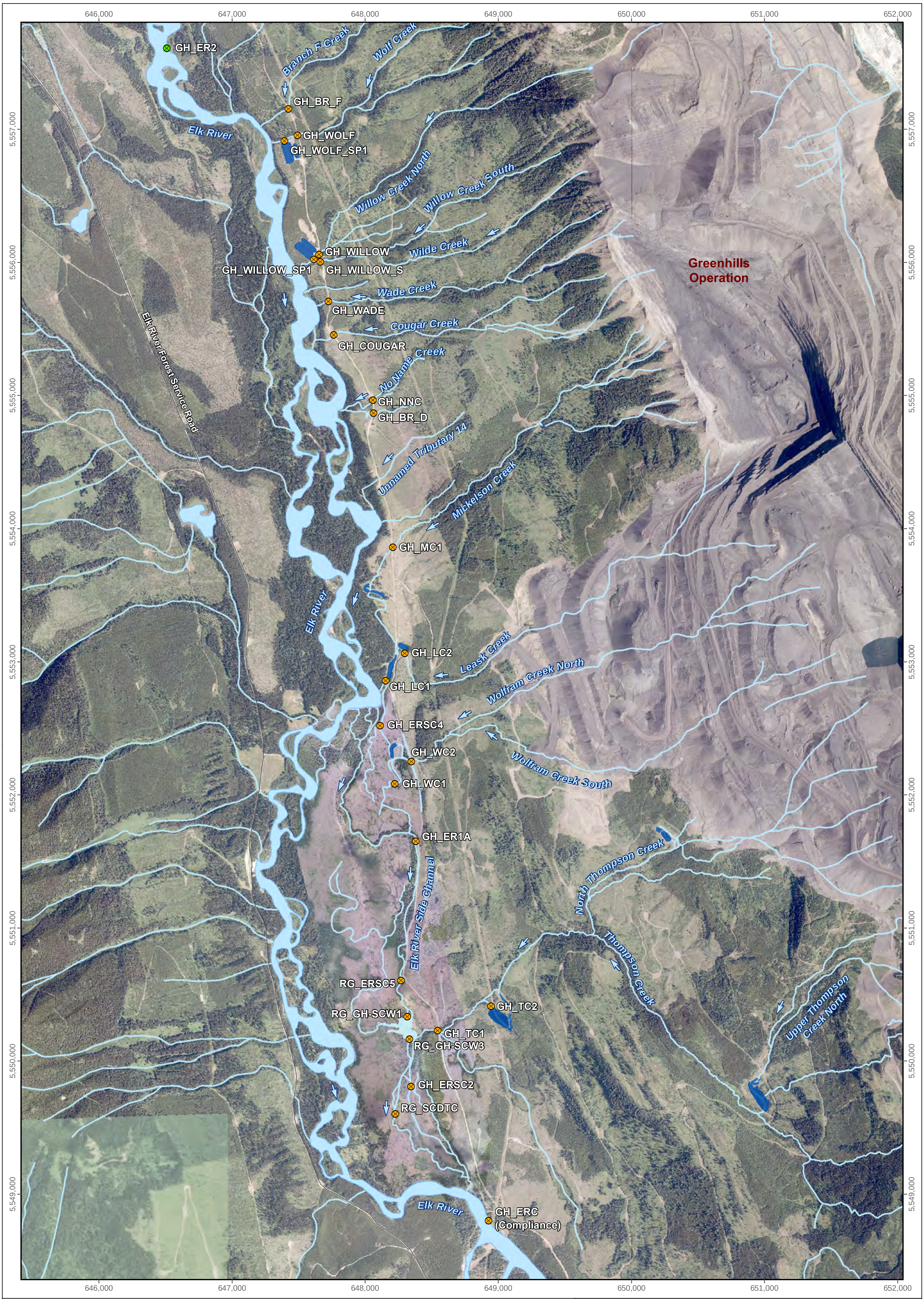
b. What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?

c. What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?

Evaluation of water quality included assessment of constituents with EWTs (i.e., dissolved cadmium, nitrate, total selenium, sulphate, total antimony, total barium, total boron, dissolved cobalt, total lithium, total manganese, total molybdenum, total nickel, nitrite, TDS, total uranium, and total zinc), as well as dissolved nickel, phosphorus, orthophosphate, and TSS.

4.2 West-side Tributaries

When flowing, Branch F, Wolf, Willow, Wade, Cougar, and No Name creeks (northern west-side tributaries) enter the Elk River upstream from the Elk River side channel (Figure 4.1, Table 2.2). The downstream ends of Mickelson and Leask creeks are sedimentation ponds, which have overflow channels that may connect to the Elk River when water levels are high (Figure 4.1) and may also influence water quality in the main stem Elk River and/or side channel via groundwater flow paths. Wolfram Creek (downstream of the sedimentation pond) connected to the side channel via surface flows during May 2018, June to July 2019, and June to July 2020 only (Minnow and Lotic 2019, 2020), and likely also influenced water quality through groundwater flow paths (SNC-Lavalin 2020, 2021). Mickelson Creek received pit pumping discharge in 2015 only, Leask Creek received discharge from 2016 to present, and Wolfram Creek received discharge from 2011 to present (Minnow and Lotic 2020, Appendix Table D.1). Consistently throughout all study years, Thompson Creek flowed into Reach 2 of the Elk River side channel, which is downstream of side channel station GH_ER1A and upstream of GH_ERSC2 (Figure 4.1, Table 2.2). Pit pumping discharge may have impacted water quality in Mickelson, Leask, and Wolfram creeks.



LEGEND

- Routine Water Quality Monitoring Station (Permit 107517), Reference
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond

Surface Water Quality Monitoring Stations, 2020 GHO LAEMP

0 0.5 1 2 km

N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: May 2021
Project 207202.0022

minnow environmental inc.

Figure 4.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 4.1 Surface WQ.mxd

Water quality data collected in 2020 from the west-side tributaries were compared to applicable BCWQG, EVWQP benchmarks, and/or interim screening values (Appendix Table D.2; Appendix Figures D.1 to D.19 and D.39 to D.57). In more northern west-side tributaries (Branch F, Wolf, Willow, Wade, Cougar, No Name, Branch D, and Mickelson creeks), concentrations were typically below applicable BCWQG and EVWQP benchmarks for most constituents (Appendix Table D.5). Water quality in the three southern-most west-side tributaries, Leask (GH_LC1, GH_LC2), Wolfram (GH_WC1, GH_WC2), and Thompson (GH_TC1, GH_TC2) creeks, indicated mine influence based on concentrations of nitrate, sulphate, TDS, total nickel, total selenium, and/or total uranium, which were frequently (greater than 50% of samples) above BCWQG, applicable EVWQP benchmarks, and/or interim screening values (Appendix Table D.5; Appendix Figures D.1 to D.19). In 2020, total nickel concentrations were above the Level 3 interim screening value and total uranium concentrations were above the BCWQG in Leask and Wolfram creeks, but not Thompson Creek (Appendix Table D.5, Appendix Figures D.16 and D.18). Nitrate concentrations were also frequently or always above the BCWQG and equivalent EVWQP Level 1 benchmark, sulphate and TDS were frequently or always above the Level 1 EVWQP benchmarks, and total selenium concentrations were frequently above the Level 2 EVWQP benchmark in Leask, Wolfram, and Thompson creeks in 2020 (Appendix Table D.5, Appendix Figures D.1, D.5, D.6, and D.17). Ammonia concentrations were occasionally above BCWQG in Thompson Creek (19% of samples; Appendix Table D.5). Selenium speciation data for Thompson Creek indicated detectable concentrations of organoselenium species that could affect localized patterns of bioaccumulation (Appendix Table D.4; Section 6.3).

In Mickelson Creek, the influence of pit pumping was evident in 2015 and 2016, when the concentrations of nitrate, sulphate, TDS, total selenium, and total uranium were significantly higher than other years, including 2020 (Appendix Table D.6, Appendix Figures D.1, D.6, D.6, D.17, and D.18). In Leask Creek, concentrations of total selenium were higher in 2018, 2019, and 2020 compared to previous years, whereas nitrate concentrations were higher in 2018 compared to other years (Appendix Table D.6, Appendix Figures D.1 and D.17). Also in Leask Creek, sulphate, TDS, total nickel, and total uranium concentrations increased from 2012 to 2015, and then remained elevated into 2020 (Appendix Table D.6, Appendix Figures D.5, D.6, D.16, and D.18). In Wolfram Creek, nitrate and total selenium concentrations were significantly higher in 2017, 2018, 2019, and 2020 compared to previous years (Appendix Table D.6, Appendix Figures D.1 and D.17). Concentrations of sulphate, TDS, and uranium were elevated in Wolfram Creek in 2015, 2016, and 2017 compared to previous years, and were further elevated in 2018 to 2020 compared to previous years (Appendix Table D.6, Appendix Figures D.5, D.6, and D.18). Total nickel concentrations were relatively stable from 2012 to 2017, and then increased in 2018 and remained elevated (Appendix Table D.6, Appendix Figure D.16). In Thompson Creek, sulphate increased in 2018, 2019, and 2020 compared to previous years, whereas total nickel increased in 2013 and 2014 compared to 2012, then decreased from 2014 to 2016 and decreased further from 2017 to 2020 (Appendix Table D.6, Appendix Figures D.5 and D.16). In the west-side tributaries overall, total selenium, sulphate, and TDS appear to be increasing in Leask and Wolfram creeks, while total nickel is also increasing in Leask Creek (Appendix Table D.6). In Thompson Creek, sulphate has increased in recent years, whereas total nickel has decreased.

4.3 Side Channel Monitoring Stations

In 2020, water quality constituents at the side channel monitoring stations (i.e., GH_ERSC4, GH_ER1A, GH_ERSC2, and the Reach 2 stations RG_GH-SCW1 and RG_GH-SCW3; Figure 4.1) were typically lower than BCWQG, EVWQP benchmarks, and/or interim screening values, except for total selenium at GH_ERSC2, and for nitrate, sulphate, and total selenium, at the outlet of Reach 2 (RG_GH-SCW3; Appendix Table D.7, Appendix Figures D.20 to D.57). Concentrations of nitrate, sulphate, TDS, dissolved cadmium, total lithium, and total selenium generally increased from GH_ERSC4 to GH_ER1A to RG_GH-SCW3 (i.e., from upstream to downstream), likely associated with the influence of Wolfram and Thompson creeks (Appendix Table D.7, Appendix Figures D.20 to D.38). Further downstream, concentrations of mine-related constituents at GH_ERSC2 were typically higher than at GH_ER1A, but lower than RG_GH-SCW3. Total nickel concentrations were higher in Reach 2 in 2019 and 2020 compared to 2018, but otherwise there were no apparent temporal trends in water quality at these stations (Appendix Table D.8, Appendix Figures D.20 to D.38). Selenium speciation data for the Elk River side channel stations indicated detectable concentrations of organoselenium species in stations downstream of Thompson Creek (RG_GH-SCW3, GH_ERSC2, RG_SCDTC) that could affect localized patterns of bioaccumulation (Appendix Table D.4; Section 6.3).

Input from the EMC indicated a desire to understand how land-use activities are influencing habitat availability, specifically how TSS concentrations in the Elk River side channel influence fish habitat and use. The EMC discussion also indicated that the high turbidity events were likely a result of logging operations that occurred in the winter 2017/2018 and spring 2018, as documented by the study team. Concentrations of TSS were compared to the Newcombe and Jensen 1996 model SEV 7, which is the level where moderate habitat degradation and impaired homing are predicted (Appendix Table D.3). Concentrations of TSS in the side channel were typically below SEV 7, except during spring (Appendix Figure D.26), suggesting that fish use may be affected at that time. Concentrations of TSS also peaked above SEV 7 during freshet at the upstream main stem Elk River reference station (GH_ER2; Appendix Figure D.58), suggesting that these increases are in part natural. Concentrations of TSS in the side channel were higher than at the reference station (MOD of 56%; Appendix Table D.9) but were not different from concentrations in the downstream main stem Elk River station (GH_ERC; Appendix Table D.10). Elevated concentrations of TSS in the side channel and downstream Elk River relative to reference were likely due to runoff travelling through cutblocks in the riparian areas. Cutblocks in the riparian areas have resulted in reduced vegetative buffer (see satellite imagery around the side channel in Figure 4.1; Minnow and Lotic 2020), likely causing reduced bank stability and soil retention, as well as increased amounts of soil carried into the streams by runoff, which would result in increased TSS.

Water quality at the side channel stations was compared to the main stem stations upstream (GH_ER2) and downstream (GH_ERC) of the side channel, using data from 2016 to 2020 (Appendix Tables D.9 and D.10, Appendix Figures D.39 to D.57). Constituent concentrations were typically higher in the side channel compared to the upstream main stem reference station (GH_ER2), with nitrate, sulphate, total lithium, and total selenium having the greatest magnitude of difference (Appendix Table D.9). At the most upstream side channel station (GH_ERSC4, which is upstream of the influence of Wolfram and Thompson creeks), nitrate, sulphate, dissolved cadmium, total barium, total lithium, and total selenium were significantly lower than concentrations at the downstream main stem station (GH_ERC; Appendix Table D.10). Water quality at station GH_ER1A was not significantly different from GH_ERC for most constituents, except for higher concentrations of nitrite, total molybdenum, and total uranium (Appendix Table D.10). At the most downstream side channel station (GH_ERSC2), nitrate, nitrite, sulphate, TDS, dissolved cadmium, total lithium, total manganese, total molybdenum, total nickel, total selenium, and total uranium were significantly greater than GH_ERC (Appendix Table D.10). This is likely a result of GH_ERSC2 being more directly influenced by surface water flows from Thompson Creek, as well as possibly through groundwater flow paths (Section 5; SNC-Lavalin 2021).

4.4 Main Stem Elk River Downstream versus Upstream of the West-Side Tributaries

Data from 2012 to 2020 for the monitoring stations in the main stem Elk River downstream of the west side tributaries (GH_ERC) was compared to the Elk River station upstream of mine influence (GH_ER2) to assess the overall influence of GHO on water quality in the upper Elk River (Figure 4.1, Appendix Figure D.58). In 2020, constituent concentrations were typically below applicable BCWQG, EVWQP benchmarks, and/or interim screening values except for ammonia, total chromium, total iron, and total selenium (Appendix Table D.11, Appendix Figure D.58). Total chromium, and total iron concentrations were greater than BCWQG at both the downstream and upstream stations, and ammonia concentrations were greater than BCWQG at the upstream station only, suggesting these parameters are naturally elevated (Appendix Table D.11, Appendix Figure D.58). In 2020, total selenium concentrations at the downstream station (GH_ERC) exceeded the BCWQG in 43% of samples, but all were below the EVWQP Benchmarks (Appendix Table D.11). Both selenate (oxidized selenium species) and selenite (reduced selenium species) were present at the downstream station, and organoselenium species methylseleninic acid and dimethylselenoxide were not detected (Appendix Table D.4; Section 6.3). Conversely, aqueous selenium at the Elk River reference station (GH_ER2) was entirely in the oxidized form (selenate), with no detectable organoselenium (Appendix Table D.4; Section 6.3). This suggested that selenite in the downstream Elk River (GH_ERC) may be from Thompson Creek inputs (Section 4.3), but that the most bioavailable forms are consumed within Thompson Creek and the side channel, which are upstream from the Elk River. However, selenite is more bioavailable than selenate, and therefore could affect localized patterns of bioaccumulation at station GH_ERC. Total selenium concentrations were higher in 2018, 2019, and 2020 compared to previous years at the downstream main stem station (GH_ERC), whereas at the main stem reference station (GH_ER2) total selenium increased in 2016 compared to previous years, and then remained elevated into 2020 (Appendix Table D.12, Appendix Figure D.58). Similarly, nitrate concentrations were higher in 2019 and 2020 compared to previous years at GH_ERC, whereas at the reference station nitrate concentrations increased in 2014 compared to previous years and then remained elevated into 2020 (Appendix Table D.12, Appendix Figure D.58).

Concentrations of nitrate, sulphate, TDS, TSS, total barium, total lithium, total molybdenum, total nickel, total selenium, and total uranium at the downstream station (GH_ERC) were significantly greater than at the reference station (GH_ER2; Appendix Table D.13), due to the influence of GHO via the west-side tributaries. The greatest difference between the mine-exposed (downstream) and reference (upstream) main stem Elk River stations was for nitrate (i.e., MOD 566%; Appendix Table D.13). Concentrations of total manganese were lower at the downstream station compared to reference (Appendix Table D.13).

4.5 Summary

Water quality in the more northern west-side tributaries (i.e., Branch F, Wolf Creek, Willow Creek, Wade Creek, Cougar Creek, No Name Creek, and Mickelson Creek) was typically below BCWQG, EVWQP benchmarks, and/or interim screening values. Water quality in Leask, Wolfram, and Thompson creeks showed evidence of mine influence based on concentrations of total nickel, nitrate, total selenium, sulphate, TDS, and total uranium, which were frequently above applicable BCWQG, EVWQP benchmarks, and/or interim screening values. Total selenium, sulphate, and TDS appear to be increasing in Leask and Wolfram creeks, while total nickel is increasing in Leask Creek. In Thompson Creek, sulphate has increased in recent years, whereas total nickel has decreased.

Water quality at side channel stations GH_ER1A and GH_ERSC2 was influenced by Wolfram and Thompson creeks, showing occasional concentrations of nitrate, ammonia, total chromium, and total selenium that were greater than BCWQG and/or applicable EVWQP benchmarks (Level 2 for total selenium, Level 1 for other constituents). The highest concentrations of mine-related constituents occurred in Reach 2 at the confluence of Thompson Creek and the Elk River side channel. At the Reach 2 outlet, total nickel was higher in 2019 and 2020 compared to 2018. Water quality at side channel station GH_ER1A was comparable to the downstream main stem Elk River station, whereas at the furthest downstream side channel station (GH_ERSC2), concentrations of nitrate, nitrite, sulphate, TDS, dissolved cadmium, total lithium, total manganese, total molybdenum, total nickel, total selenium, and total uranium were higher than the downstream main stem Elk River station (due to the influence of Thompson Creek).

Water quality at the main stem Elk River station downstream of the side channel (GH_ERC) had higher concentrations of nitrate, sulphate, TDS, TSS, total barium, total lithium, total molybdenum, total nickel, total selenium, and total uranium relative to the main stem upstream reference station (GH_ER2). However, concentrations of constituents in the downstream main stem Elk River station (GH_ERC) were typically below applicable BCWQG, EVWQP benchmarks, and/or interim screening values, except for total chromium and total iron (which were also elevated in the reference station), and total selenium. At the downstream main stem station (GH_ERC), total selenium concentrations were higher in 2018 to 2020 compared to previous years, and nitrate concentrations were higher in 2019 and 2020 as compared to previous years.

5 RESULTS: STUDY QUESTION #4

Data evaluated in this section address study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?). A hydrogeological review and analysis of available groundwater and surface water data for the west side of GHO was conducted for data collected in 2020 (SNC-Lavalin 2021). Detailed interpretation and conclusions are provided in a report in Appendix E (SNC-Lavalin 2021), and a summary is provided herein. This summary was authored by Emma Canham, M.Sc., and reviewed by Stefan Humphries, M.Sc., P.Geo., who takes professional responsibility for the report.

Like in 2018 and 2019, hydrographs, vertical gradients, and water quality data from 2020 continued to support the conceptual model that the side channel predominantly infiltrated to ground and recharges groundwater. Seasonal flow in the side channel infiltrated to ground across most of the channel, with receding flows leading to the development of isolated pools in fall, winter, and early spring (SNC-Lavalin 2020; Minnow and Lotic 2020). Four isolated pools were identified as likely being groundwater-fed; however, these pools did not appear to produce sustained flows in the side channel (SNC-Lavalin 2020; Minnow and Lotic 2020). A review of seeps from the Regional Seep Monitoring Program indicated no relevant seeps in the GHO LAEMP study area (SNC-Lavalin 2021, SRK 2021).

Like previous years, in 2020 concentrations of surface water order constituents (i.e., nitrate, sulphate, and dissolved selenium) generally increased along the side channel flow path, likely due to loading of surface water order constituents from mine-influenced tributaries on the west side of GHO (Section 4.2). In the side channel upstream of the confluence with Wolfram Creek (GH_ERSC4), surface water quality was generally similar to the upstream Elk River (GH_ER2) and groundwater did not appear to influence water quality or quantity, except for the water quality of one sample which indicated the influence of Leask Creek. Downstream of the confluence with Wolfram Creek but upstream of Reach 2, water quality in the side channel varied seasonally, with highest concentrations of order constituents at station GH_ER1A occurring from April to June. Higher concentrations likely occurred due to increased flows from snow melt in spring that infiltrated to a shallow groundwater flow path, as well as due to the surface flow connection from Wolfram Pond to the side channel during June and July 2020. At Reach 2 of the side channel, Thompson Creek appeared to be the main influence on water quality, particularly in late fall through early spring when Thompson Creek was the only surface water source and the upstream Elk River side channel was not wetted. In Reach 2, groundwater did not appear to be influencing water quality or quantity. In the side channel downstream of Reach 2, an area between Reach 2 and downstream station GH_ERSC2 appeared to receive groundwater flow in spring and summer, whereas side channel flows infiltrated to ground during the fall. This area of the side channel was predominantly dry during the winter.

Gaps and uncertainties were previously identified in the 2018 GHO LAEMP Report and have been partly addressed through work conducted in 2019 and 2020. Some uncertainties remain related to study question #4 remain. Additional work is planned for 2021 as part of the MBI to address remaining gaps, including installing new monitoring wells, collecting additional groundwater data, seep reconnaissance and sampling in the Elk River Side Channel, conducting flow and load accretion studies, and conducting geophysical surveys to determine depth to bedrock. See Section 7.2 and Appendix E for detailed recommendations to address these remaining uncertainties.

6 RESULTS: STUDY QUESTION #5

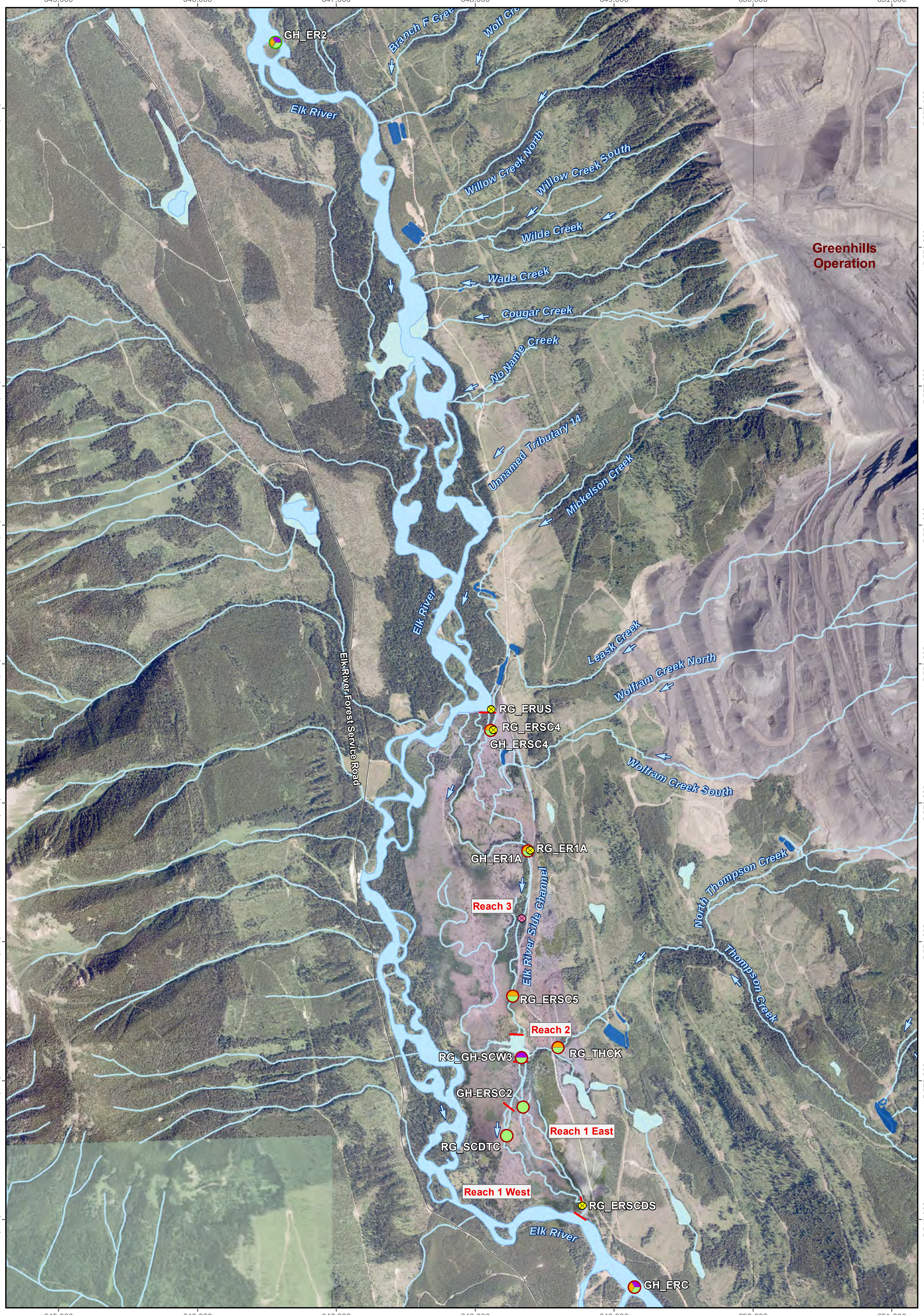
6.1 Overview

Data evaluated in this section for Elk River side channel and main stem Elk River stations pertain to study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?). Thompson Creek was also evaluated, per EMC discussions.

6.2 Benthic Invertebrate Community Composition

Benthic invertebrate community samples collected in September were compared among and within stations in the main stem Elk and Elk River side channel (Figure 6.1; Appendix Tables E.1 to E.4 and H.1). Consistent with previous years, community endpoints generally did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC) and side channel stations (GH_ERSC4, GH_ER1A, and RG_ERSC5), except for Coleoptera, which were present in the side channel, but largely absent from the main stem stations (Figure 6.2). Compared to the main stem and side channel stations, the samples collected from Thompson Creek (RG_THCK) had greater proportions of Coleoptera and Diptera, and a lower proportion of Ephemeroptera (Figure 6.2); differences between main stem Elk River samples and samples from a mine-exposed tributary are expected due to habitat differences (e.g., Thompson Creek is narrower, steeper, and calcified). Water quality differences, such as differences in selenium speciation (Section 4.2) may also play a role.

Site-specific normal ranges were calculated for total abundance, LPL richness, % EPT, and % Ephemeroptera endpoints for the main stem Elk River areas. These endpoints were within or above the site-specific normal ranges, except for LPL richness at GH_ERC in one of five samples. At all main stem Elk River and all Elk River side channel stations, total abundance, LPL richness, % EPT, % Ephemeroptera, % Plecoptera, and % Trichoptera were within or above the regional normal range, except for % Trichoptera at GH_ER1A, RG_ERSC5, and GH_ERC in one sample each (Figures 6.3 to 6.5). The relative proportion of Trichoptera has been similarly low at the upstream reference aera (GH_ER2), with the single 2016 sample also being below the regional normal range. Therefore, samples with % Trichoptera less than the regional normal range are likely related to habitat rather than to mine influence (Appendix Figure F.6). At all main stem Elk River and Elk River side channel stations, % Chironomidae, % Diptera, and % Oligochaeta were within or below the regional normal range, except for % Oligochaeta at RG_ERSC5, which was above the regional normal range in one of three samples (Figures 6.6 and 6.7).



LEGEND

Sampling Type

Mine-exposed

Reference

Sediment Quality

Benthic Invertebrate Community

Benthic Invertebrate Tissue Chemistry

Water Level and Temperature Logger

Barometric Logger

Reach Break

Settling Pond

Data Logger, Benthic Invertebrate Community, and Benthic Invertebrate Tissue Chemistry, and Sediment Quality Sampling Stations, 2020 GHO LAEMP

0 0.5 1 2
km

N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: May 2021
Project 207202.0022

minnow environmental inc.

Figure 6.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Teck - 207202.0022 - GHO LAEMP\4 - GIS\Report\20-22 Figure 6.1 Biological Locations.mxd

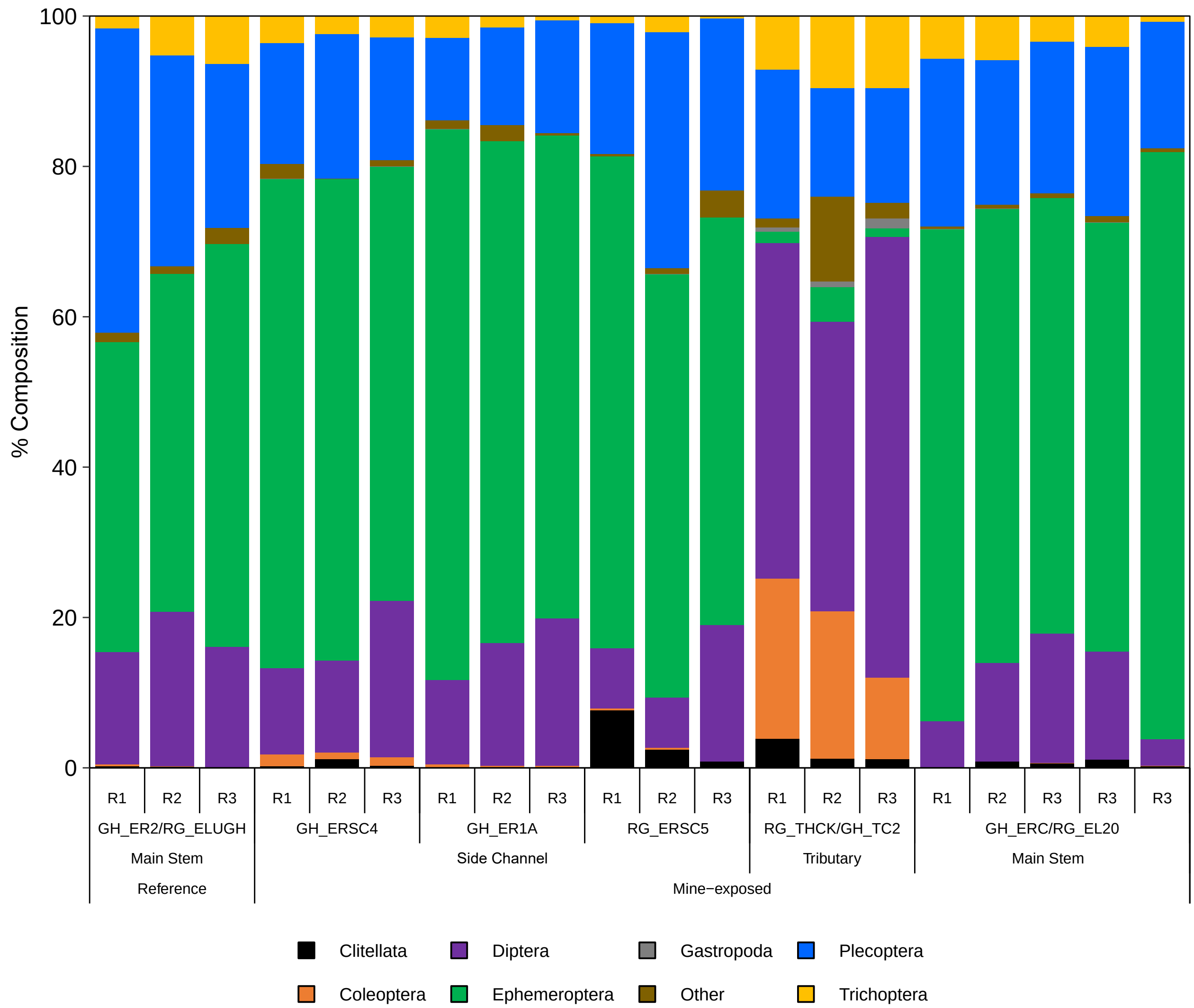


Figure 6.2: Benthic Invertebrate Community Composition, GHO LAEMP, September 2020

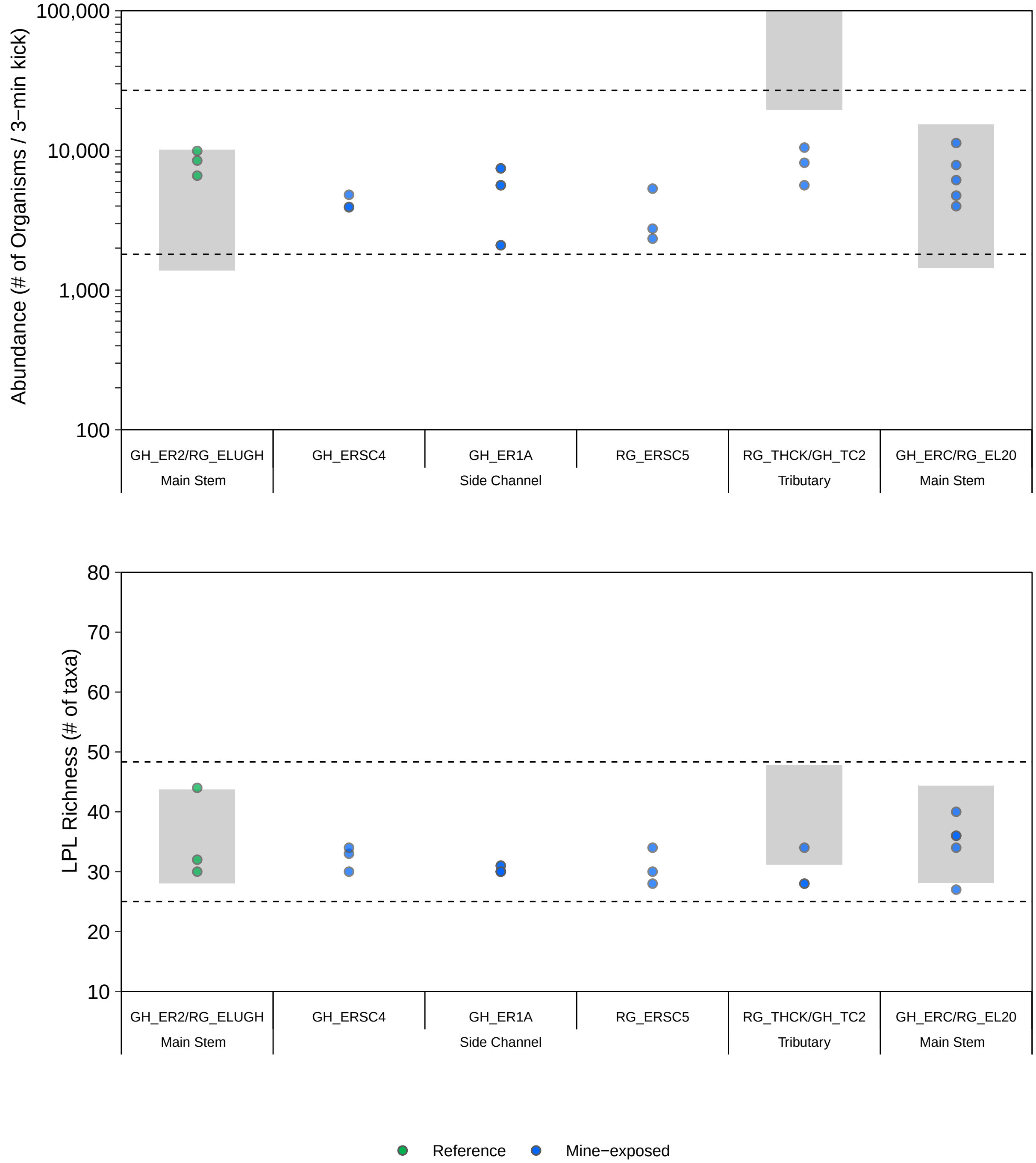


Figure 6.3: Benthic Invertebrate Community Abundance and LPL Richness, GHO LAEMP, September 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines. LPL = taxa identified to the lowest practical level.

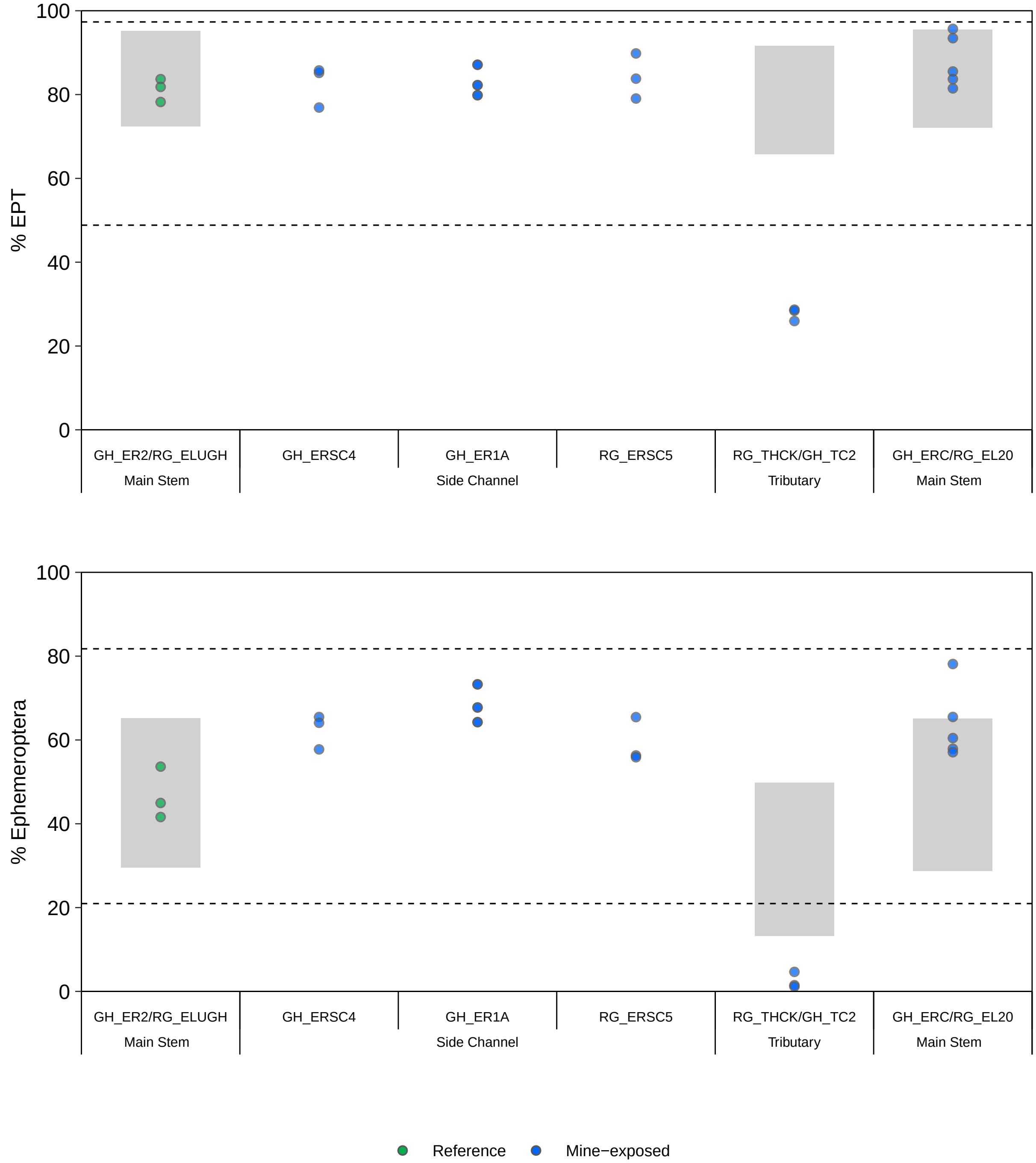


Figure 6.4: Benthic Invertebrate Community % EPT and % Ephemeroptera, GHO LAEMP, September 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines. ETP = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

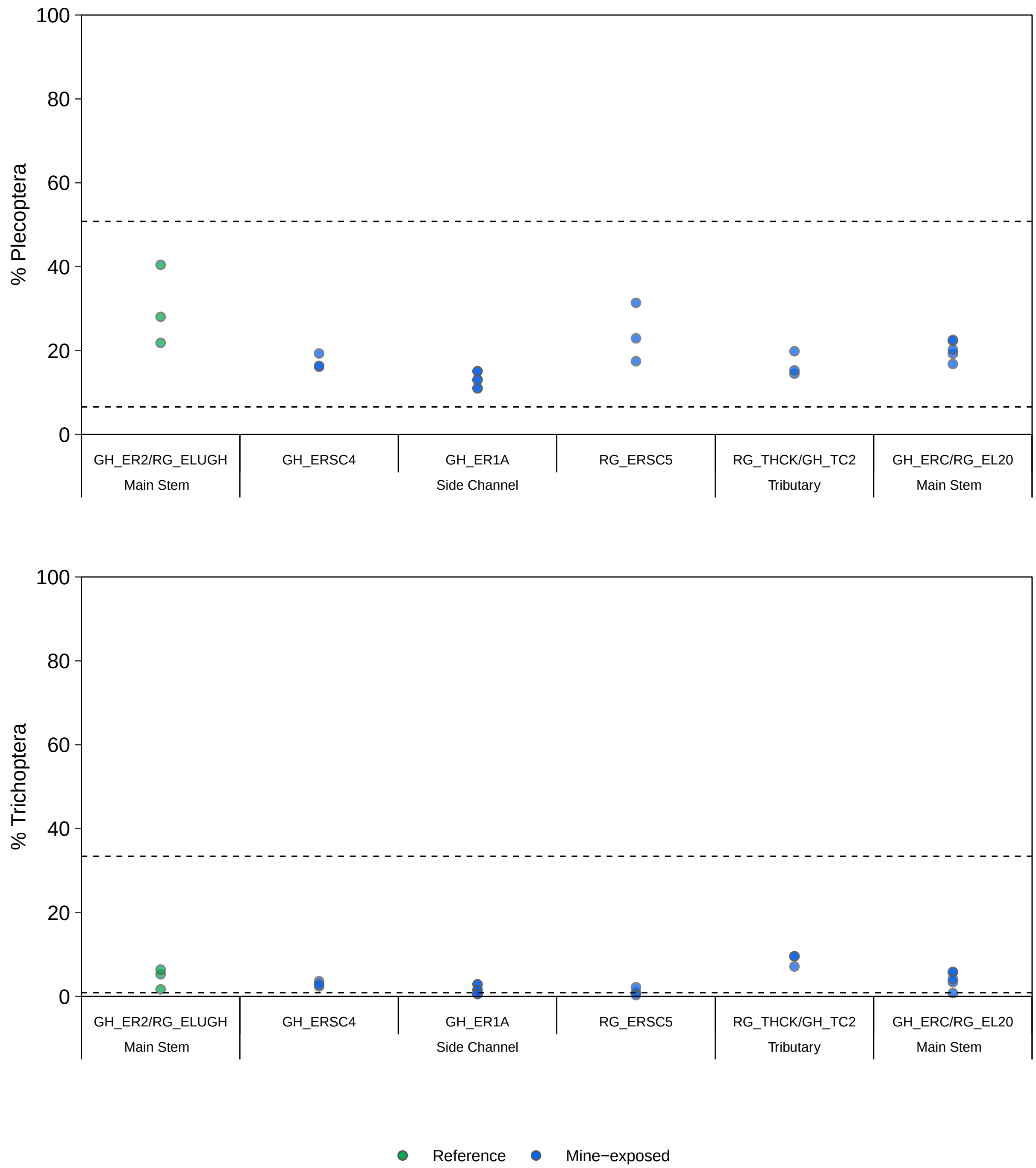


Figure 6.5: Benthic Invertebrate Community % Plecoptera and % Trichoptera, GHO LAEMP, September 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

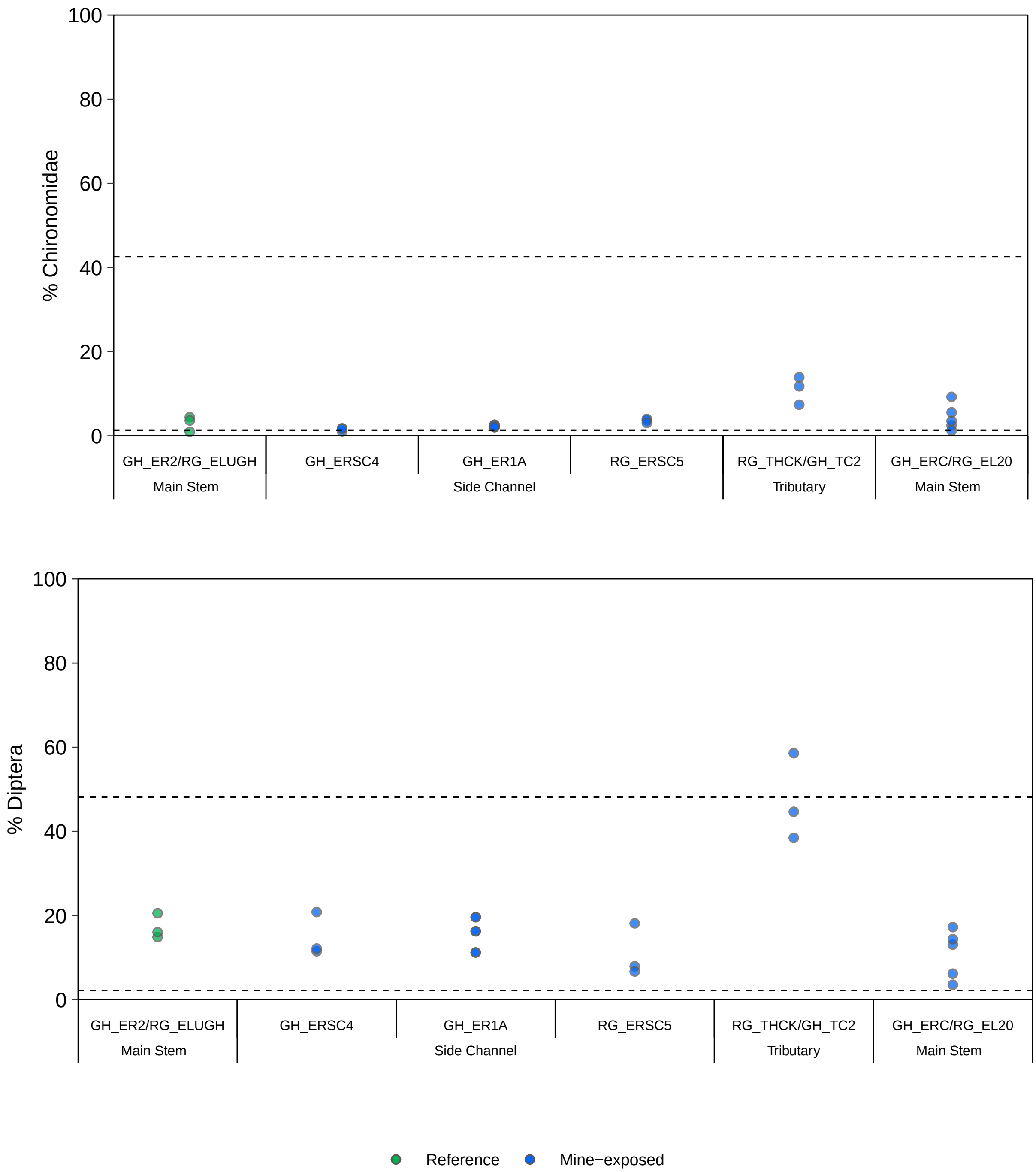


Figure 6.6: Benthic Invertebrate % Chironomidae and % Diptera Abundance, GHO LAEMP, September 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

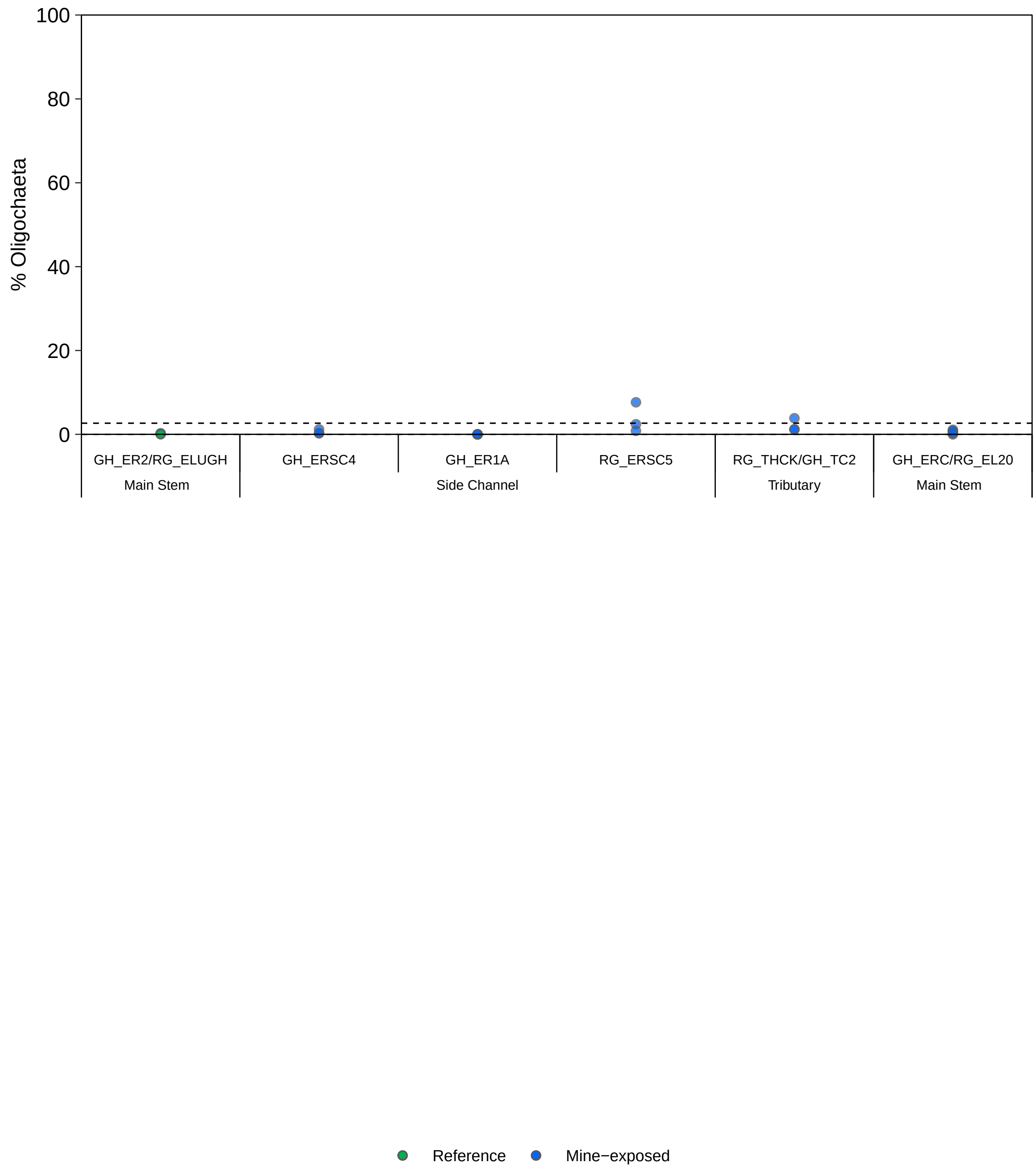


Figure 6.7: Benthic Invertebrate % Oligochaeta Abundance, GHO LAEMP, September 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lineses, with the minimum value = 0%.

At Thompson Creek (RG_THCK), abundance, LPL richness, % Plecoptera, % Trichoptera, and % Chironomidae were within the regional normal range, whereas % EPT and % Ephemeroptera were below the regional normal range in all samples and % Diptera and % Oligochaeta were each above the regional normal range in one of three samples (Figures 6.3 to 6.7). In addition to regional normal ranges, site-specific normal ranges were calculated for total abundance, LPL richness, % EPT, and % Ephemeroptera endpoints for RG_THCK (Figures 6.3 and 6.4). Abundance, % EPT, and % Ephemeroptera were below the site-specific normal ranges for three of three samples, and LPL richness was below the site-specific normal range for two of three samples (Figures 6.3 and 6.4).

There were no apparent temporal patterns in benthic invertebrate community endpoints from 2012 to 2020, except at the downstream main stem station GH_ERC, where there was an apparent decrease in % Plecoptera from 2015 to 2019, but then an increase in 2020 (Appendix Figures F.1 to F.9). Single samples were collected each year from 2015 to 2017, so the apparent trend may simply be natural variation (as demonstrated by the within station variability measured in 2018, 2019, and 2020 at reference station GH_ER2). Despite the possible downward trend from 2015 to 2019, % Plecoptera at GH_ERC remained within the regional normal range as well as within the range observed at the upstream main stem reference station (GH_ER2), except for one of three samples collected in 2019.

Percent EPT was also assessed against the biological trigger established for this endpoint (information pertaining to the determination of the biological trigger value can be found in Appendix I). This was completed for GHO LAEMP monitoring areas with available water quality predictions (i.e., the two mine-exposed areas RG_THCK and GH_ERC; see Appendix I for details). Neither mine-exposed area (RG_THCK with three replicates and GH_ERC with five replicates) had replicates that reached the biological trigger (i.e., % EPT was always above the biological trigger), and therefore no action is required. Further information regarding the % EPT biological trigger as it pertains to the GHO LAEMP can be found in Appendix I.

Overall, benthic invertebrate communities in the side channel and at the main stem location downstream of the side channel are not adversely affected by mine-related discharges.

6.3 Concentrations of Selenium in Benthic Invertebrate Tissue

Selenium concentrations in benthic invertebrate tissue samples collected annually in September from 2017 to 2020 from the main stem Elk River (upstream reference station GH_ER2 and mine-exposed station GH_ERC) and from the two most-upstream side channel stations (GH_ERSC4 and GH_ER1A) were below all EVWQP benchmarks, except for one of three samples in 2020 at GH_ERC and one of three samples in 2018 at GH_ER1A (Figure 6.8;

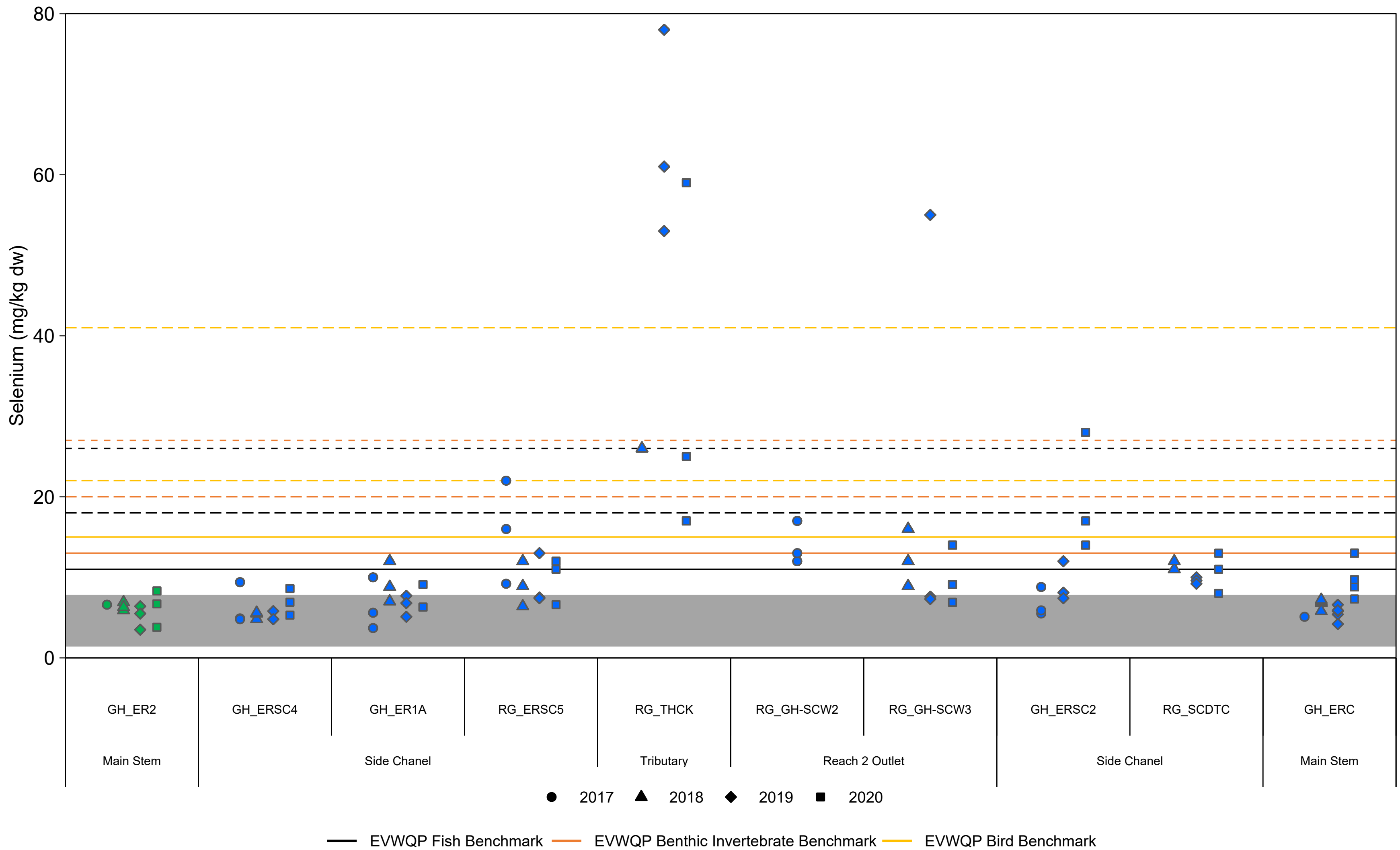


Figure 6.8: Selenium Concentrations in Benthic Invertebrate Composite Tissue Samples, GHO LAEMP, 2017 to 2020

Notes: Gray shading represents the reference area normal range defined as the 2.5th and 97.5th percentiles of the distribution of reference area data (pooled 1996 to 2019 data) reported in the RAEMP (Minnow 2020). Reference areas are shown in green and mine-exposed areas are shown in blue. Solid line = Level 1 Benchmark. Long hashed line = Level 2 benchmark. Short hashed line = Level 3 benchmark. All samples collected in September.

Appendix Tables G1 and G.2). In 2020, the highest selenium concentrations were measured in samples collected from Thompson Creek (RG_THCK; Figure 6.8). Of the three samples collected from Thompson Creek, one was higher than EVWQP Level 3 benchmarks for benthic invertebrates and dietary effects to fish and birds; one was higher than EVWQP Level 2 benchmarks for benthic invertebrates and dietary effects to fish and birds; and one was higher than EVWQP Level 1 benchmarks for benthic invertebrates and dietary effects to fish and birds (Figure 6.8; Appendix Table G.2). However, average selenium concentrations in samples from Thompson Creek were lower in 2020 than in 2019, possibly due to the presence of Annelids in 2019 (see below; Figure 6.8). Downstream of Thompson Creek, selenium concentrations in benthic invertebrate tissue samples collected in the side channel (areas RG_GH-SCW3, GH_ERSC2, and RG_SCDTC) were higher compared to side channel areas upstream of Thompson Creek (Figure 6.8). In 2020, mine-exposed main stem Elk River area GH_ERC had concentrations of selenium in benthic invertebrate tissues that were higher than the upstream reference area (GH_ER2) and the regional normal range in four of five samples, and higher than the EVWQP Level 1 fish benchmark in one of five samples (Figure 6.8).

Selenium concentrations in benthic invertebrate tissue was also assessed against the biological trigger established for this endpoint (information pertaining to the determination of the biological trigger value can be found in Appendix I). Similar to the biological trigger evaluation for % EPT, this was completed for each replicate from GHO LAEMP monitoring areas with available water quality predictions (i.e., the two mine-exposed areas RG_THCK and GH_ERC; see Appendix I for details). In Thompson Creek (RG_THCK), all three replicates exceeded the biological trigger, with concentrations of selenium in tissue ranging from 17 to 59 mg/kg dw. This is consistent with previous findings that biological monitoring results collected downstream of the Thompson Creek sedimentation/buffer ponds were not as expected (Teck 2020b). This issue is currently being tracked through the AMP response framework (Section 1.5; Teck 2020b). In the main stem Elk River station downstream of GHO (GH_ERC), one of five replicates exceeded the biological trigger, with concentrations of selenium in tissue of 13 mg/kg dw. Given that only one of the four replicates marginally exceed the biological trigger (exceeded the upper 95% prediction limit of the biological trigger by only 10.8%), this result likely does not warrant further investigation for GH_ERC at this time. If replicates exceed this biological trigger again in 2021, benthic invertebrate tissue at this area should be considered for tracking under the AMP. Further information regarding the selenium concentrations in benthic invertebrate tissue biological trigger as it pertains to the GHO LAEMP are provided in Appendix I.

Concentrations of selenium in benthic invertebrate tissues were variable within stations; however, they were generally similar between years for most stations, although greater variability was shown for RG_THCK, RG_GH-SCW3, GH_ERSC2, and GH_ERC (Figure 6.8). There were no apparent increases or decreases in concentrations from 2017 to 2020, except for higher concentrations in 2020 compared to previous years at areas GH_ERSC2 and GH_ERC (Figure 6.8). Aqueous total selenium was higher in 2019 and 2020 at GH_ERC compared to previous years (Section 4.4), which may have caused the increase in concentrations of selenium in benthic invertebrate tissue in 2020. This water quality trend was not observed at GH_ERSC2 (Section 4.3).

Higher concentrations of selenium in benthic invertebrate tissue samples likely result from the presence of aqueous selenium in more bioavailable forms (e.g., organoselenium species methylseleninic acid [MeSe(IV)] and dimethylselenoxide [DMSeO] at Thompson Creek and side channel stations, as well as selenite at Thompson Creek and all stations downstream of Thompson Creek). Within the GHO LAEMP study areas in 2020, concentrations of organoselenium species were highest in Thompson Creek (RG_THCK; Figure 6.9, Appendix Table D.4). Concentrations of organoselenium species decreased downstream in the side channel (Reach 2, RG_ERSC2, RG_SCDTC)) and further decreased in the downstream main stem Elk River (area GH_ERC; Figure 6.9). Selenium species selenite, methylseleninic acid, and dimethylselenoxide were not detectable at the LRL at the Elk River reference area (GH_ER2) and upstream side channel areas (GH_ERSC4, GH_ER1A, RG_ERSC5; Figure 6.9), indicating Thompson Creek as a source of these selenium species. Aqueous selenium speciation data collected concurrent with biological monitoring began in 2020, therefore temporal assessments could not be made. These concentrations of organoselenium species could affect localized patterns of bioaccumulation within Thompson Creek and downstream (Figure 6.9).

For some samples collected in previous study years, higher concentrations of selenium in benthic invertebrate tissues may have also been due to the presence of Annelids (segmented worms) in the sample (i.e., two of three samples from RG_ERSC5 in 2017, all three samples from RG_THCK in 2019, and one out of three samples from RG_GH-SCW3 in 2019; Minnow and Lotic 2020). In 2020, a study was conducted to investigate selenium bioaccumulation in Annelids from various locations in the Elk River watershed (Luoma 2021). This study indicated that Annelids had higher concentrations of selenium compared to other benthic organisms (i.e., Annelid tissue samples contained two- to nine-times higher concentrations of selenium than tissue samples from the same area that were benthic invertebrate community composites; Luoma 2021). When Annelids are collected in samples, they typically contribute a large amount of biomass relative to the overall number of organisms present in the sample (i.e., one or two worms often provides sufficient biomass for a tissue sample),

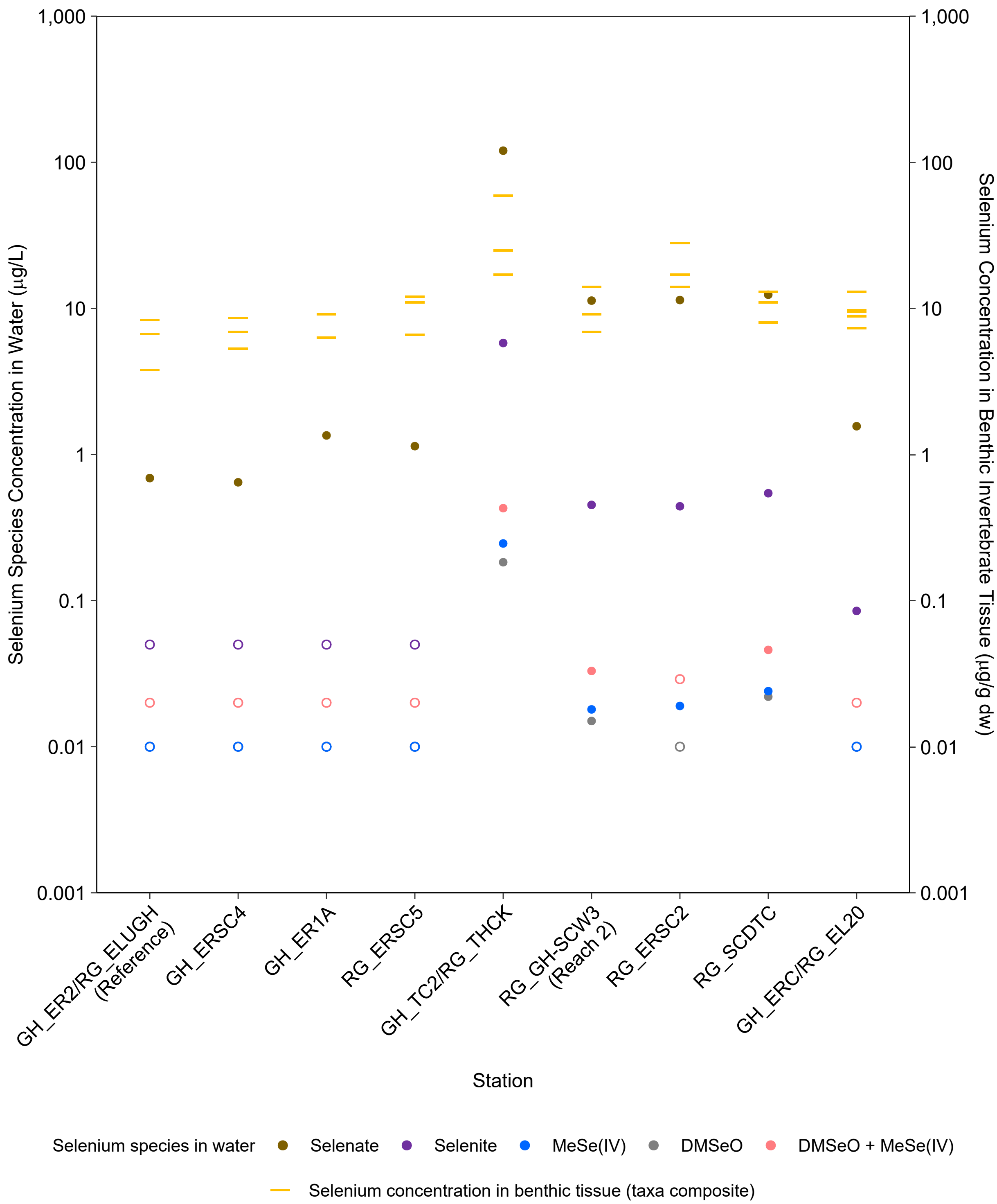


Figure 6.9: Concentrations of Selenium Species Measured in Water Samples Collected Concurrent with Benthic Invertebrate Tissue Samples, and Concentrations of Selenium Measured in Benthic Invertebrate Tissue, GHO LAEMP, September 2020

Notes: MeSe(IV) = methylseleninic acid. DMSeO = dimethylselenoxide. Samples at the laboratory reporting limit (LRL) are plotted with an open symbol.

and therefore could have a substantial influence on concentrations. This may have contributed to variability within areas and among years (Figure 6.8).

Selenium concentrations in 2020 were within the 95% prediction limits of the selenium bioaccumulation model for the Elk River reference area (GH_ER2) and two upper-most side channel areas (GH_ERSC4 and GH_ER1A; Figure 6.10; Teck 2014; Golder 2020). Most of data for all years were above (rather than around) the model line (Figure 6.10), indicating that the model underpredicts bioaccumulation for benthic invertebrates in the GHO LAEMP study areas. As stated in previous reports and above (Minnow and Lotic 2018b, 2019, 2020), the higher concentrations in tissue were likely due to the speciation of aqueous selenium at these stations and, possibly also due to the presence of Annelids (segmented worms) in the samples. Although annelids were present in some samples collected in previous years (Minnow and Lotic 2020), none were present in the 2020 samples. Underprediction may have occurred for stations in Reach 2 (RG_GH-SCW2 and RG_GH-SCW3) and area GH_ERSC2, as the selenium bioaccumulation model was created based on a data set from lotic stations, and these three stations are depositional, with lentic characteristics in the fall. Because the bioaccumulation model underpredicted bioaccumulation for most GHO LAEMP study areas and because organoselenium species have been measured in those areas, the selenium speciation bioaccumulation tool (referred to as the b-tool) was expected to provide more accurate predictions of bioaccumulation (Golder 2018; de Bruyn and Luoma 2021). The b-tool provided more accurate predictions than the selenium bioaccumulation model; however, the b-tool still underpredicted concentrations for areas GH_ER1A, RG_ERSC5, GH_ERSC2, and GH_ERC (Figure 6.11; Appendix Table G.3). This may have been resulted from several possible (but unconfirmed) factors, including seasonal variability in the speciation of aqueous selenium, higher discharge from Thompson Creek sedimentation ponds during freshet, seasonally variable groundwater seepage, the seasonal drying of most sections of the side channel, and/or the taxa composition of the benthic invertebrate tissue samples. The Selenium Speciation Monitoring Program, which is currently being designed, may address some of these uncertainties. Thompson Creek is being considered for inclusion into this program.

6.4 Supporting Information

6.4.1 Habitat

The mine-exposed and reference main stem Elk River stations were well matched, with similar sized channels and cobble-dominated substrates (Appendix Tables H.2 and H.3). Compared to the main stem stations, side channel stations had much narrower wetted widths and a greater proportion of sand and fines (Appendix Tables H.2 and H.3). Reach 2 and GH_ERSC2 were predominantly fines (Appendix Table H.2). Thompson Creek was steeper and narrower than

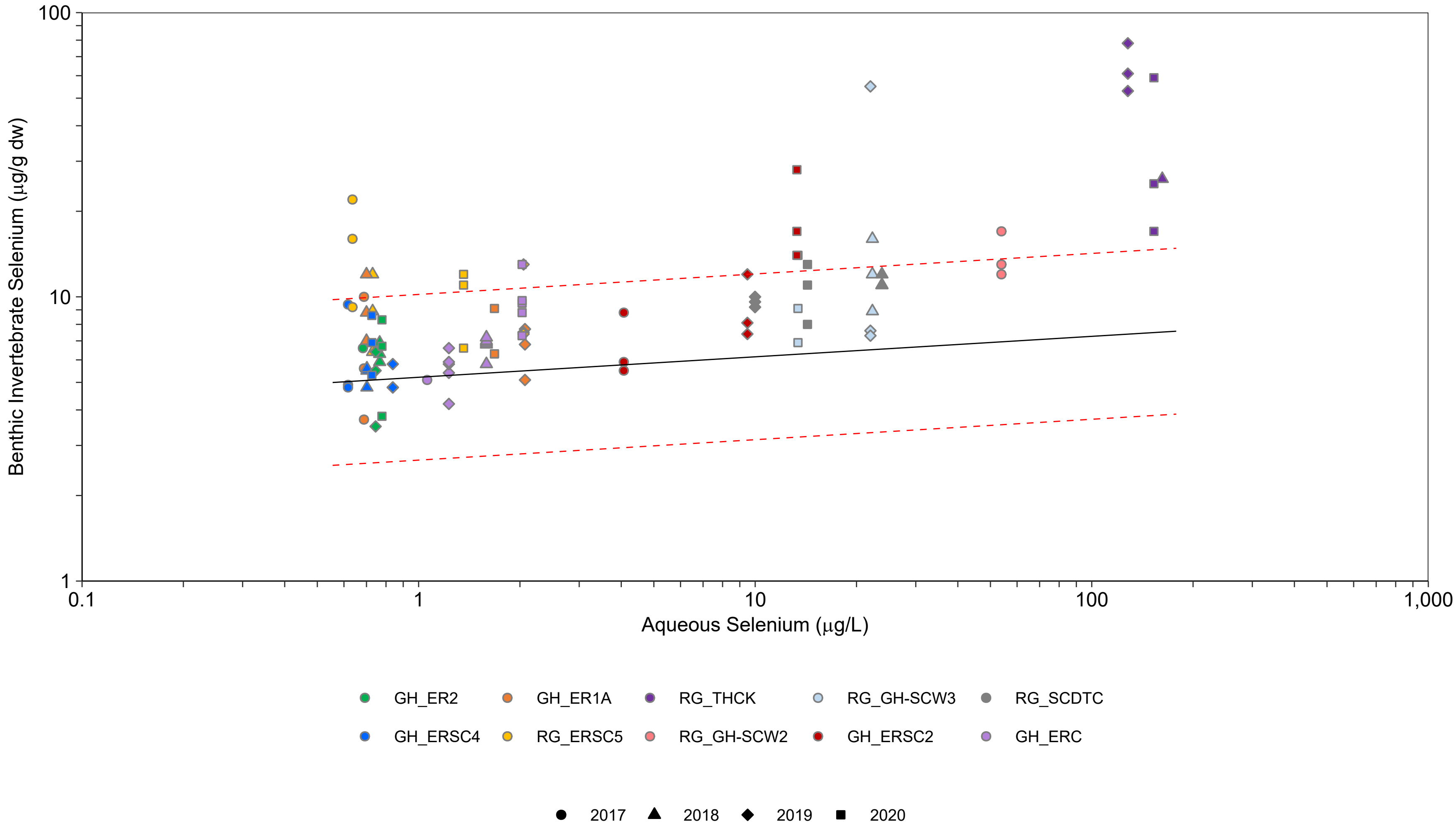


Figure 6.10: Observed (Markers) and Modelled (Lines) Selenium Concentrations in Benthic Invertebrate Composite Tissue Samples Relative to Aqueous Selenium Concentrations, GHO LAEMP, 2017 to 2020

Notes: Mean benthic invertebrate selenium concentrations (solid black line) were estimated using a one-step water to benthic invertebrate selenium bioaccumulation model: log10[Se]benthicinvertebrate=0.717+0.072xlog10[Se]$_{aq}$ (Golder 2020). The 95% prediction limits for a single value from the one-step water to benthic invertebrate selenium bioaccumulation model are plotted as dashed red lines. All samples collected in September.

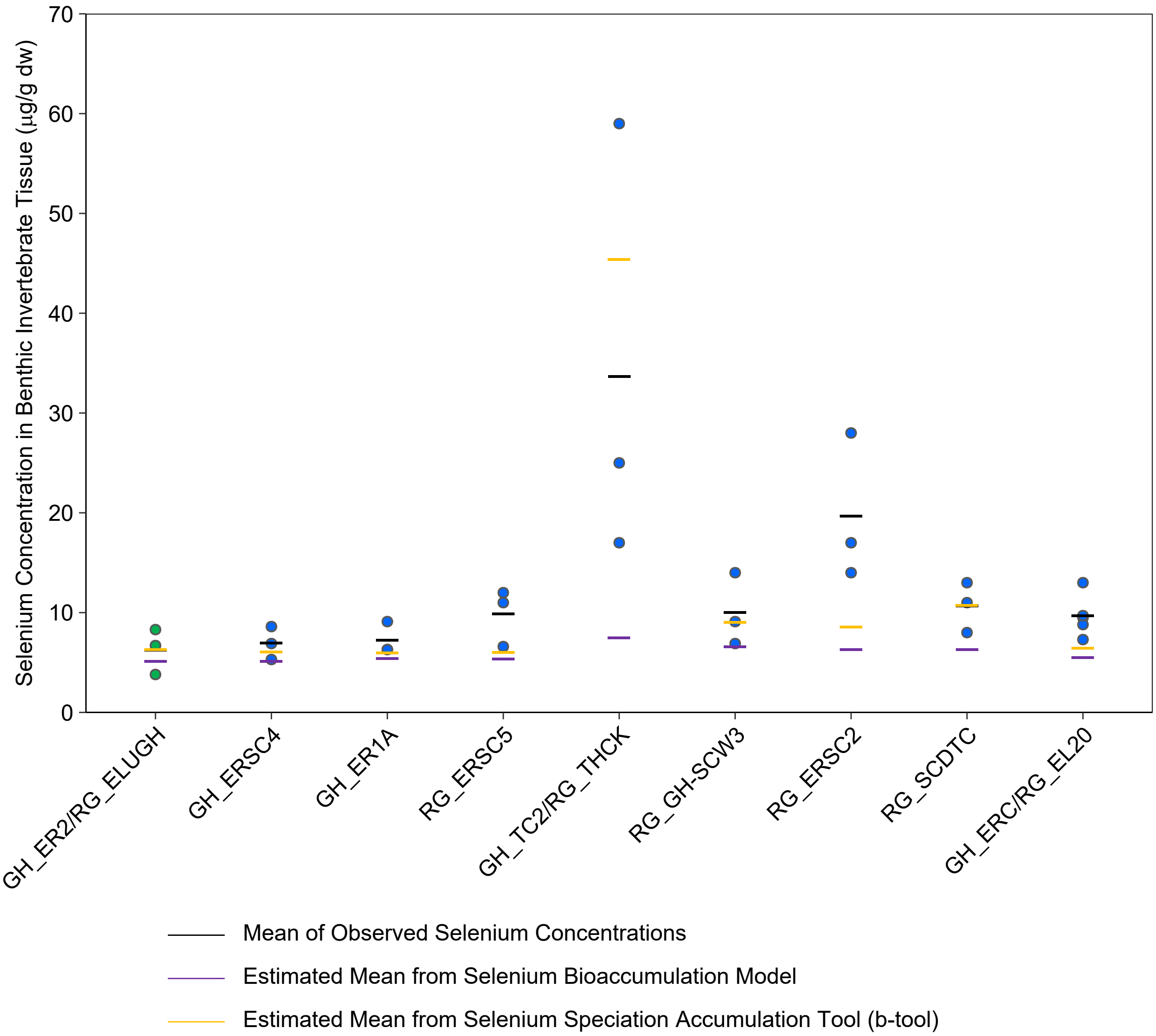


Figure 6.11: Observed (Markers) and Modelled (Lines) Selenium Concentrations in Benthic Invertebrate Composite Tissue Samples, GHO LAEMP, September 2020

Notes: Green represents reference stations and blue represents mine-exposed stations. The purple line shows the mean estimated from the selenium bioaccumulation model, which used a one-step water to benthic invertebrate selenium bioaccumulation model: log10[Se]benthicinvertebrate=0.717+0.072xlog10[Se]aq (Golder 2020). The yellow line shows the mean estimated from the selenium speciation bioaccumulation tool (b-tool; de Bruyn and Luoma 2021).

main stem and side channel stations, with cobble-dominated substrate. *In situ* water quality was similar among stations at the time of benthic invertebrate sampling (Appendix Table H.4), with all stations being well-oxygenated. Water in the side channel and main stem Elk River was cooler than water in Thompson Creek (Appendix Table H.4). Specific conductance was highest in Thompson Creek (Appendix Table H.4).

6.4.2 Calcite

Calcite indices measured in biological sampling areas at the downstream main stem Elk River station (GH_ERC) and Elk River side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, RG_SCDTC) annually in September of 2017 to 2020 ranged from 0 to 0.46 (Table 6.1; Appendix Table H.6), which was within the reference condition of less than 1.0 (97.5^{th} percentile upper limit of the reference normal range; Minnow 2020b). In 2020, the calcite index measured at the Thompson Creek tributary (RG_THCK; average CI = 0.8, ranging from 0.37 to 1.09) was higher than at the main stem Elk River and side channel stations; however, the substrate at RG_THCK was not fully concreted (C_c scores ranged from 0 to 0.29), and the average calcite index was within the reference condition of 0 to 1.0 (Minnow 2020b; Table 6.1; Appendix Table H.6).

6.4.3 Sediment Quality

Sediment quality samples were collected in the main stem Elk River upstream (GH_ER2) and downstream of the west side tributaries (GH_ERC), as well as Reach 2 (RG_GH-SCW3; Figures 6.1 and 6.12). Sediment TOC and particle size distributions were consistent with previous years (Figure 6.12). Sediment TOC and particle size were generally similar among Elk River stations (GH_ERC and GH_ER2). Reach 2 (RG_SCW3), which was depositional habitat, typically had higher concentration of TOC, a greater proportion of silt, and a smaller proportion of sand as compared to the lotic main stem Elk River stations (GH_ERC and GH_ER2; Figure 6.12).

In 2020, within Reach 2 (RG_GH-SCW3), concentrations of parameters with SQGs exceeded the lower SQG for cadmium (all five samples), nickel (all five samples), selenium (one of five samples exceeded the only SQG), benz(a)anthracene (two of five samples), chrysene (three of five samples, with two samples below the LRL but about the lower SQG), dibenz(a,h)anthracene (three of five samples), fluorene (four of five samples), 2−methylnaphthalene (all five samples), naphthalene (all five samples), phenanthrene (all five samples), and pyrene (two of five samples) (Figure 6.13, Appendix Table H.7). However, all concentrations were lower than the upper SQGs, except for 2−methylnaphthalene in all five samples from Reach 2 and phenanthrene in three of five samples from Reach 2 (Figure 6.13, Appendix Table H.7). Additionally, all concentrations

Table 6.1: Calcite Index Measured at Benthic Invertebrate Monitoring Areas in Riffles, GHO LAEMP, September 2017 to 2020

Area ID	2017				2018				2019				2020			
	Minimum	Maximum	n	Average Calcite Index	Minimum	Maximum	n	Average Calcite Index	Minimum	Maximum	n	Average Calcite Index	Minimum	Maximum	n	Average Calcite Index
GH_ER2 / RG_ELUGH	0	0	1	0	0	0	3	0	0	0	3	0	0	0	3	0
GH_ERSC4	0	0	1	0	0	0	3	0	0.10	0.63	3	0.34	0	0	3	0
GH_ER1A	0	0	1	0	0	0	3	0	0.33	0.48	3	0.43	0.01	0.06	3	0.04
RG_ERSC5	0	0	1	0	0	0	3	0	0	0	3	0	0	0.12	3	0.04
GH_TC2 / RG_THCK[a]	-	-	-	-	0.80	0.80	1	0.80	0.30	0.50	3	0.39	0.37	1.1	3	0.80
RG_SCDTC[b]	-	-	-	-	0	0	1	0	0.40	0.57	3	0.46	0	0	3	0
GH_ERC / RG_EL20	0	0	1	0	0	0.04	5	0.014	0.060	0.62	5	0.39	0	0	5	0

Note: "-" indicates area not sampled in 2017, as per study design (Minnow and Lotic 2017).
[a] THCK was not included in the 2017 GHO LAEMP study design.
[b] RG_SCDTC was dry in 2017.

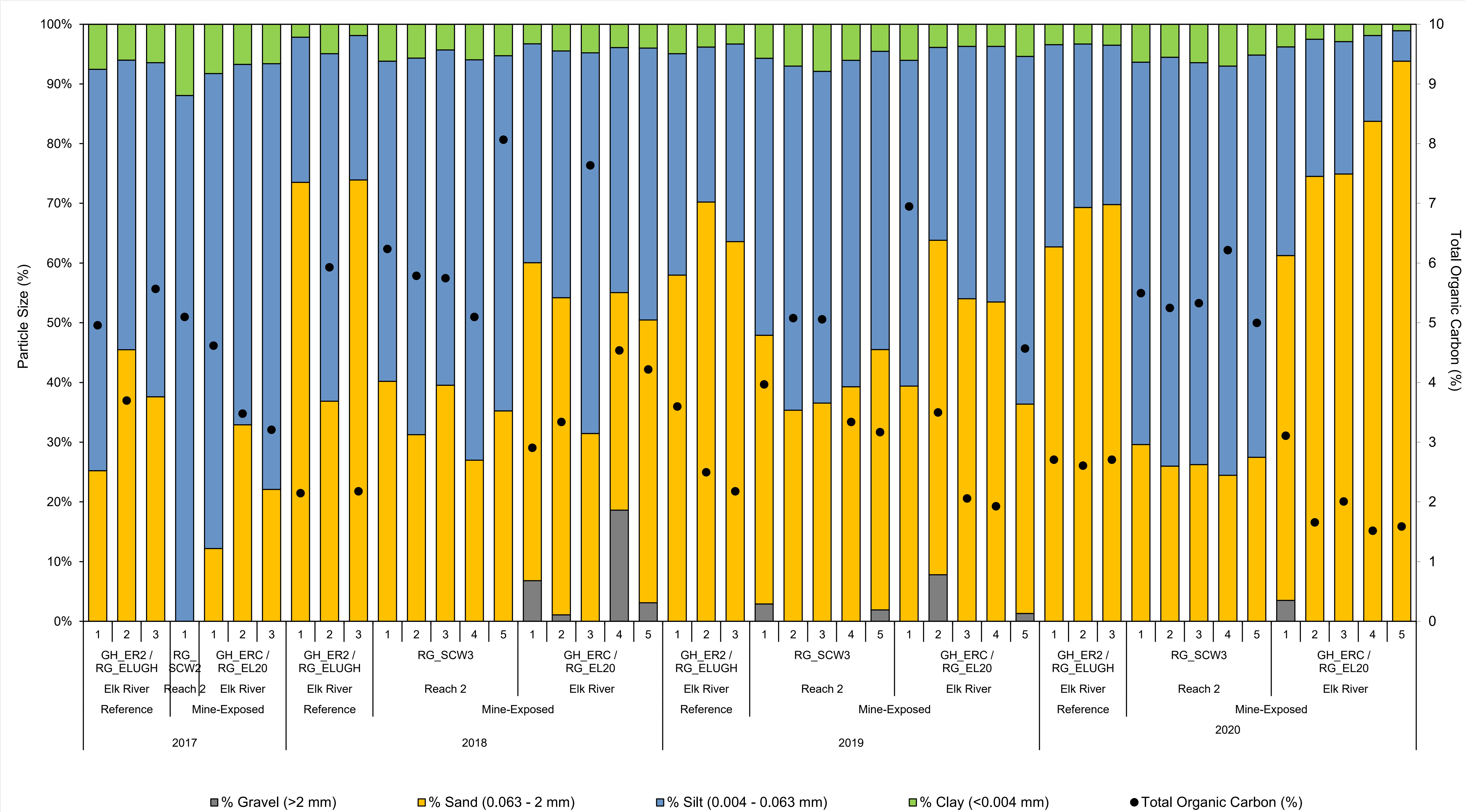


Figure 6.12: Mean Particle Size (%) and Total Organic Carbon Content (%) in Sediments, GHO LAEMP, September 2017, 2018, 2019, and 2020

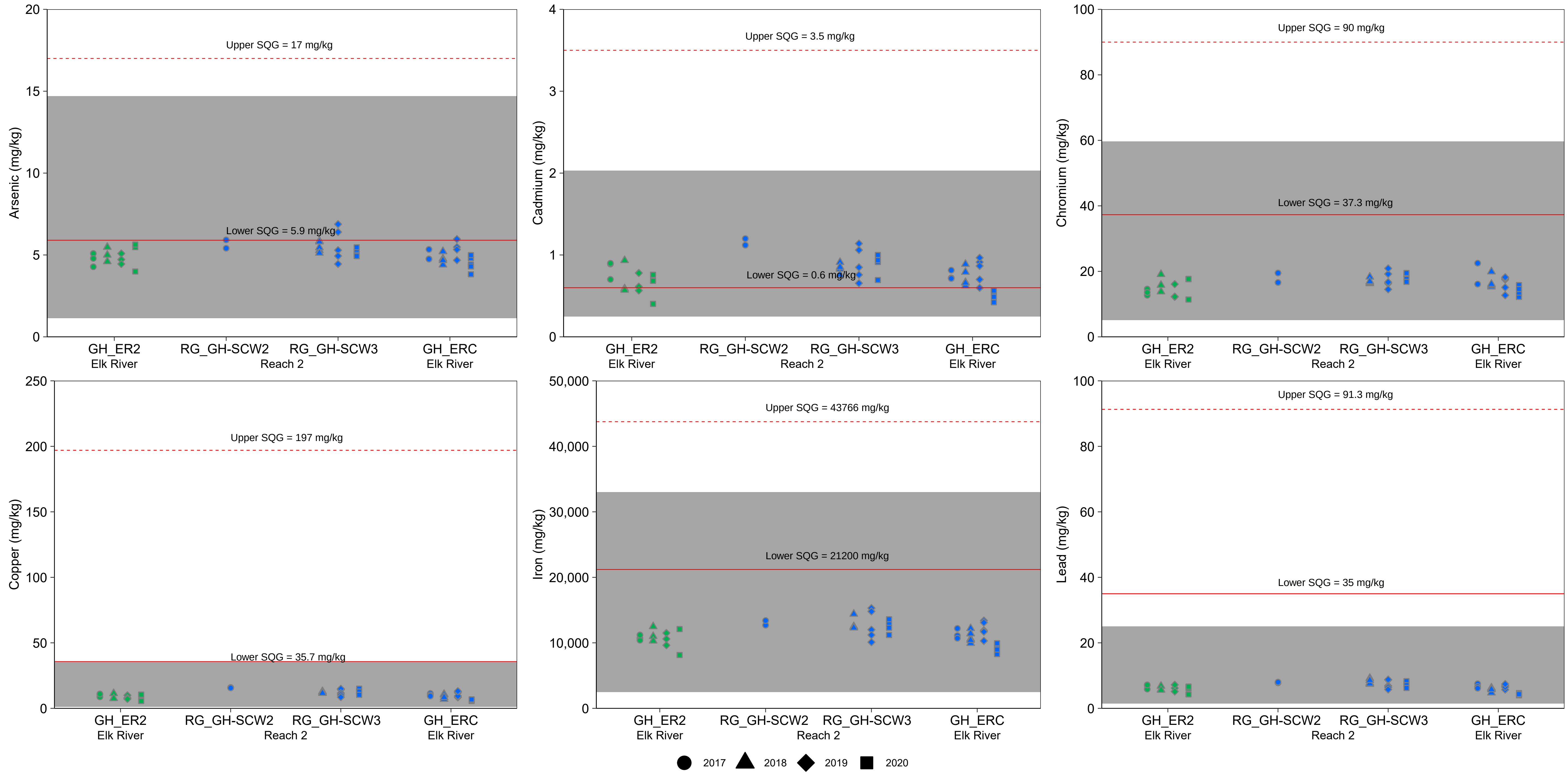


Figure 6.13: Sediment Metal and Polycyclic Aromatic Hydrocarbons (PAH) Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, GHO LAEMP, September 2017 to 2020

Notes: Blue markers = mine−exposed station. Green marker = reference station. Solid line = Lower SQG. Hashed line = Upper SQG. Selenium and silver have only one SQG. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2020).

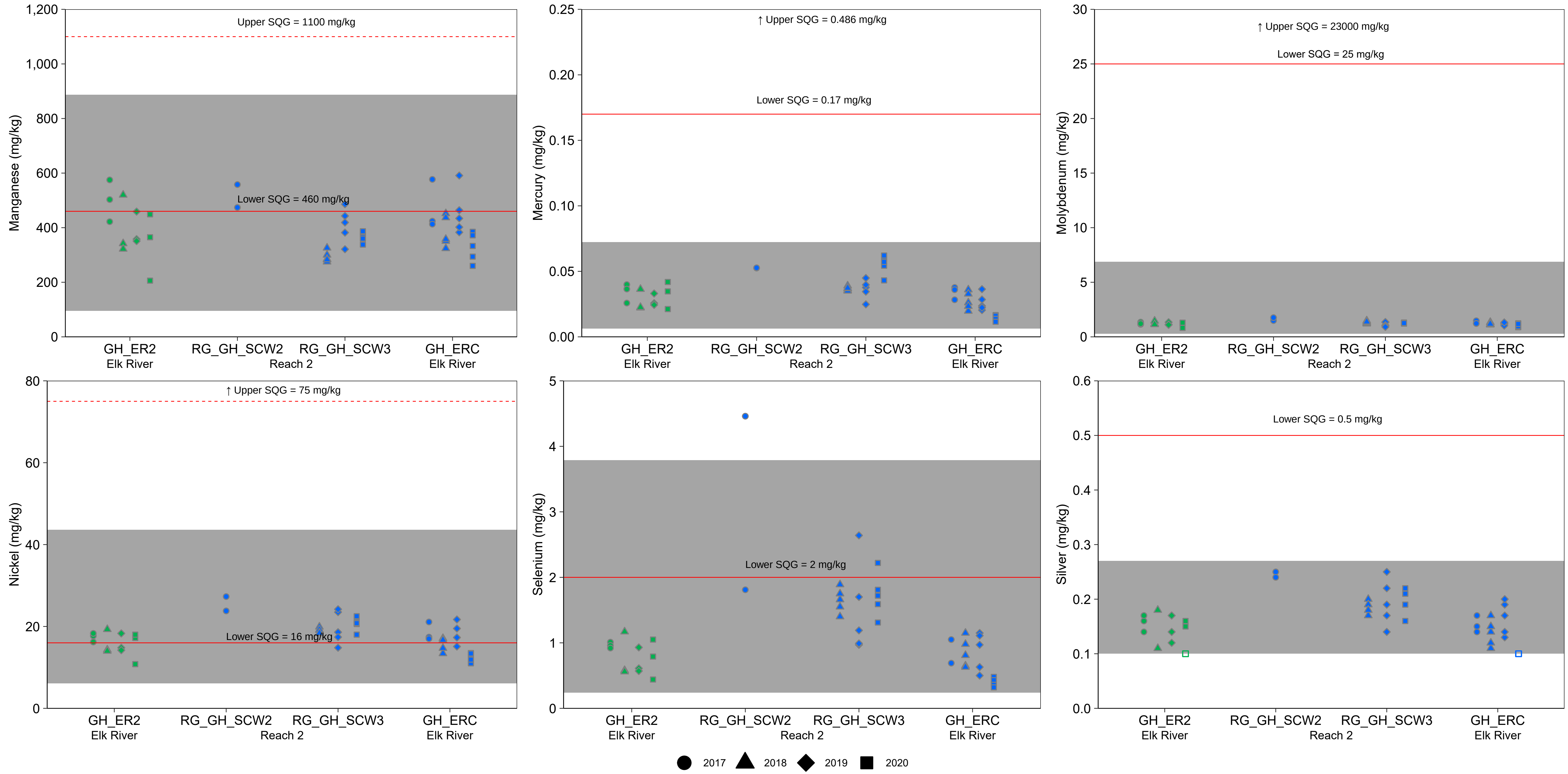


Figure 6.13: Sediment Metal and Polycyclic Aromatic Hydrocarbons (PAH) Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, GHO LAEMP, September 2017 to 2020

Notes: Blue markers = mine−exposed station. Green marker = reference station. Solid line = Lower SQG. Hashed line = Upper SQG. Selenium and silver have only one SQG. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2020).

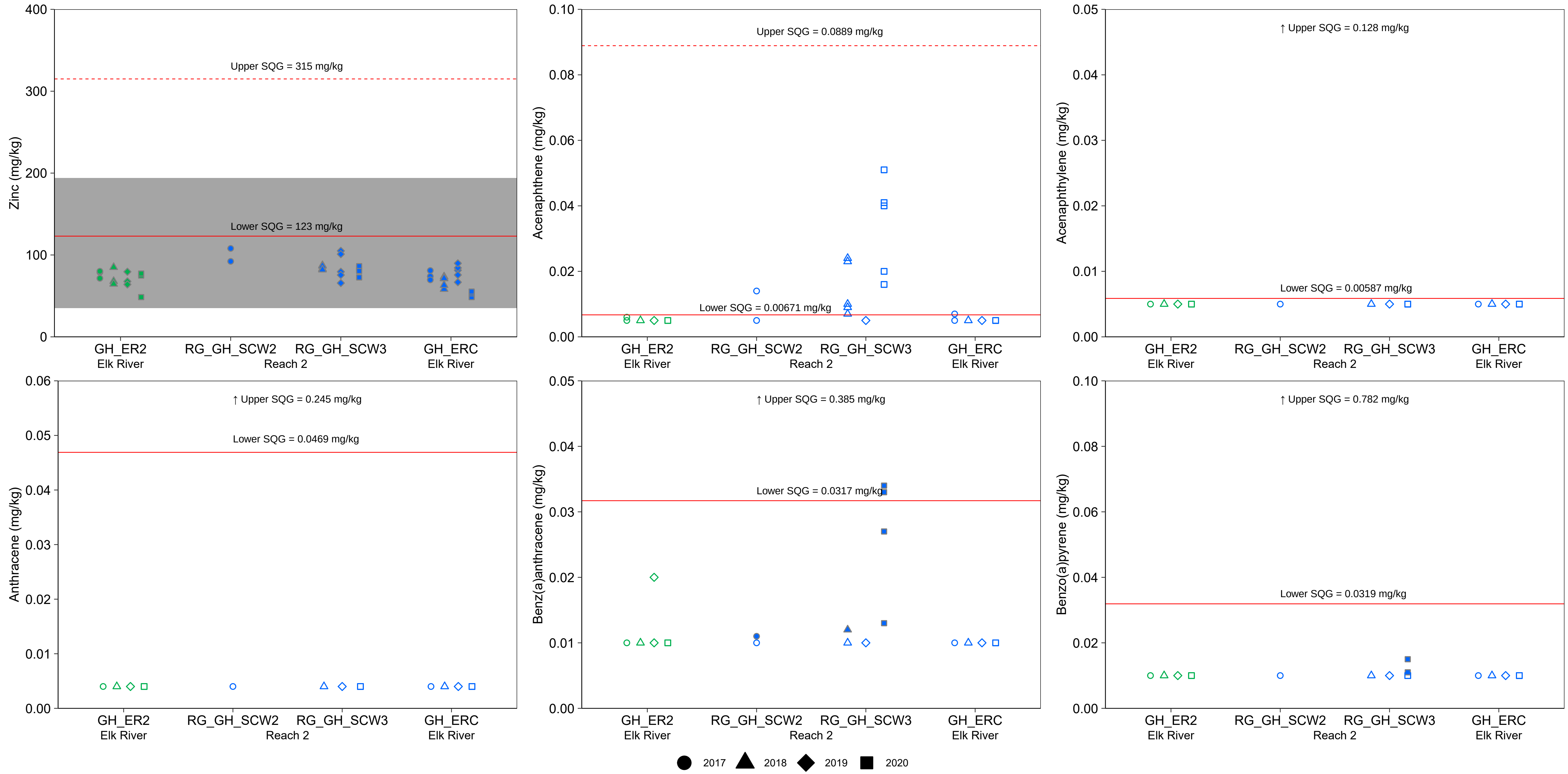


Figure 6.13: Sediment Metal and Polycyclic Aromatic Hydrocarbons (PAH) Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, GHO LAEMP, September 2017 to 2020

Notes: Blue markers = mine−exposed station. Green marker = reference station. Solid line = Lower SQG. Hashed line = Upper SQG. Selenium and silver have only one SQG. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2020).

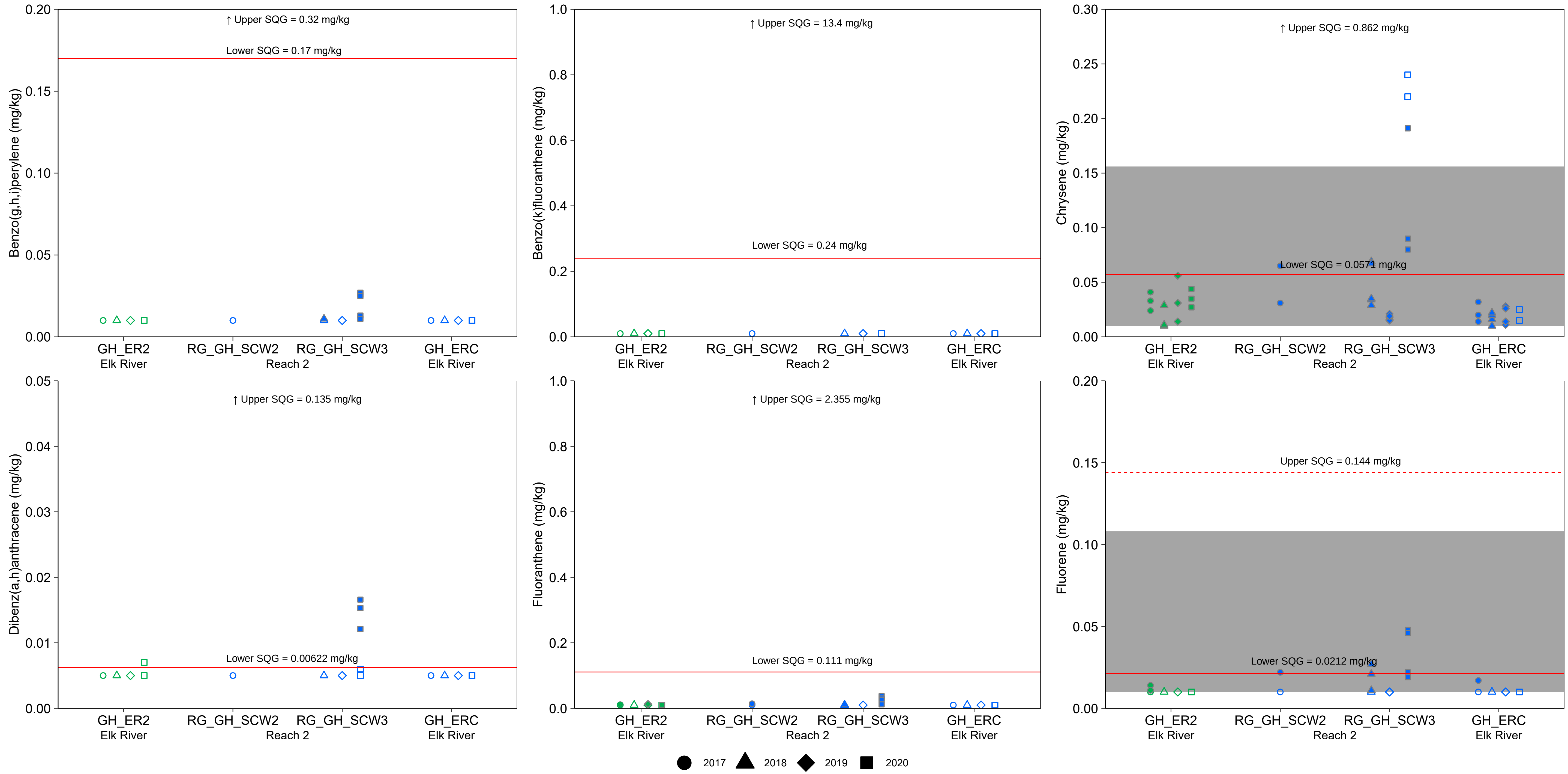


Figure 6.13: Sediment Metal and Polycyclic Aromatic Hydrocarbons (PAH) Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, GHO LAEMP, September 2017 to 2020

Notes: Blue markers = mine−exposed station. Green marker = reference station. Solid line = Lower SQG. Hashed line = Upper SQG. Selenium and silver have only one SQG. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2020).

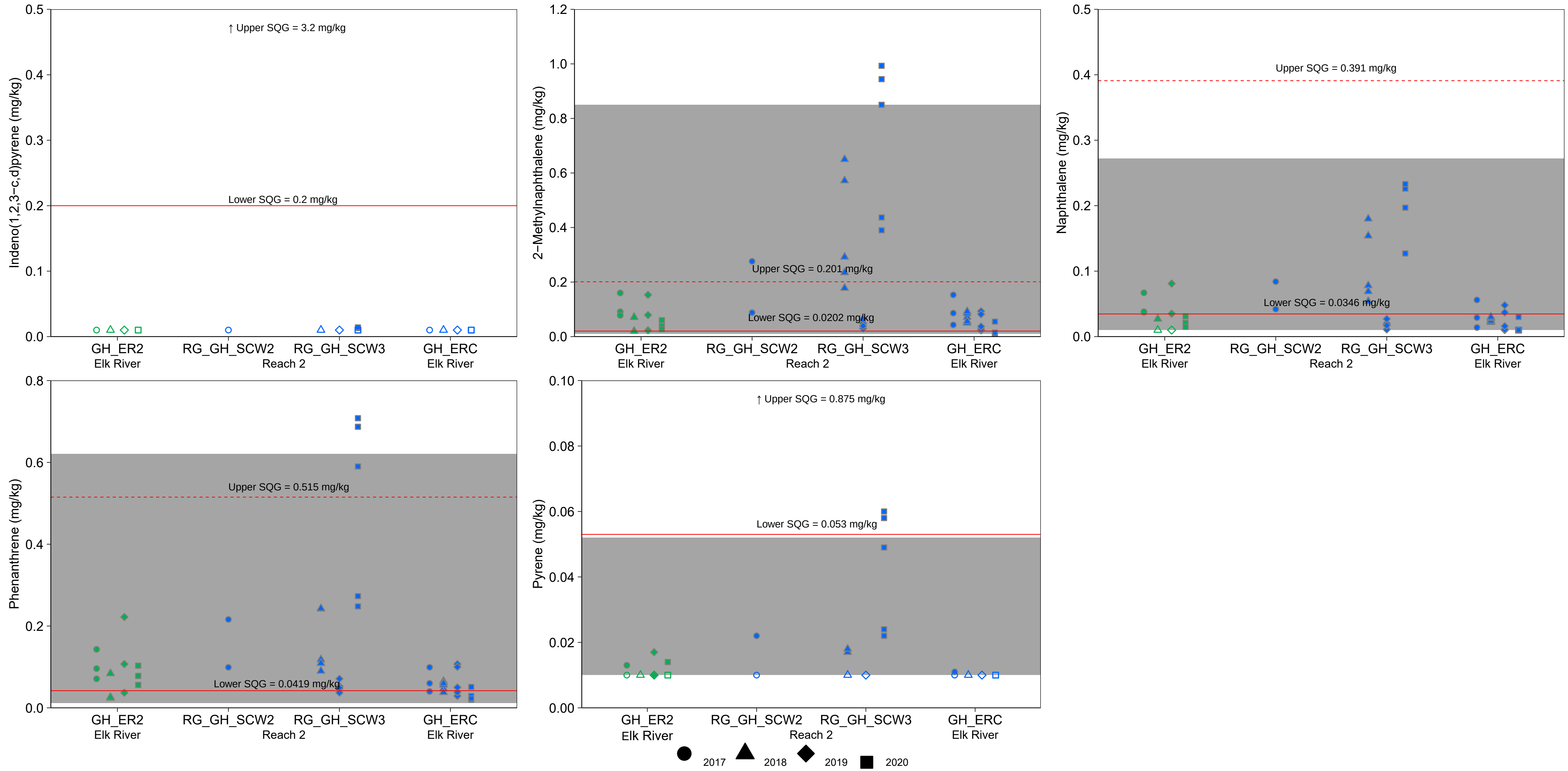


Figure 6.13: Sediment Metal and Polycyclic Aromatic Hydrocarbons (PAH) Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, GHO LAEMP, September 2017 to 2020

Notes: Blue markers = mine−exposed station. Green marker = reference station. Solid line = Lower SQG. Hashed line = Upper SQG. Selenium and silver have only one SQG. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2020).

were within the regional normal range, except for 2−methylnaphthalene, phenanthrene, and pyrene in two of five samples from Reach 2 (Figure 6.13, Appendix Table H.7).

Although sediment quality in Reach 2 exhibited influence from the west-side tributaries, sediment quality was similar in the main stem Elk River downstream (GH_ERC) and upstream (GH_ER2) of the west side tributaries (Figure 6.13). Within the Elk River stations (GH_ERC and GH_ER2), in 2020 the lower SQG was only exceeded for cadmium and nickel (two of three samples from GH_ER2 reference area), and for phenanthrene (all three GH_ER2 samples and one of five GH_ERC samples), indicating elevated concentrations in the Elk River were not mine-related. Data collected from 2017 to 2020 indicated no temporal patterns, except for a possible decrease in concentrations of chromium and 2-methylnaphthalene from 2017 to 2020 at the main stem Elk River downstream (GH_ERC; Figure 6.13).

Overall, sediment quality in the main stem Elk River downstream of the side channel (GH_ERC) was not adversely affected by mine-related discharges. However, sediment quality in Reach 2 exhibits influence from the west-side tributaries (particularly Thompson Creek), having higher concentrations of selenium and some PAHs relative to Elk River stations (though typically still within the normal range).

6.5 Summary

Data collected from 2017 to 2020 furthered the understanding of study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

Benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC), and side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC). Abundance, richness, % EPT, % Ephemeroptera, % Plecoptera, and % Trichoptera, % Chironomidae, and % Diptera were within or above the site-specific normal ranges (where applicable) and regional normal ranges for main stem Elk River and side channel stations, with few exceptions. The community of Thompson Creek was different than the main stem Elk River and Elk River side channel stations, likely due to a combination of habitat and water quality differences.

Selenium concentrations in benthic invertebrate tissue were highest in Thompson Creek. Selenium concentrations in benthic invertebrate tissue from side channel stations were higher than main stem stations. Concentrations in the side channel increased from upstream to downstream, from area GH_ERSC4 (upstream of Wolfram Creek) to GH_ER1A and GH_ERSC5 (both downstream of Wolfram Creek) to Reach 2 (RG_GH-SCW2 and RG_GH-SCW3) and RG_SCDTC, which are downstream of Thompson Creek. Area GH_ERSC2, which is also downstream of Thompson Creek, had higher concentrations relative to Reach 2 and RG_SCDTC, likely due to the more depositional nature of the area, although aqueous selenium speciation data collected in September 2020 had similar results for Reach 2, GH_ERSC2, and RG_SCDTC. Higher concentrations of selenium in in benthic invertebrate tissue samples collected from Thompson Creek and downstream likely result from the presence of aqueous selenium in more bioavailable forms.

Benthic invertebrate community structure and tissue chemistry were similar at the downstream main stem station (GH_ERC) and the upstream main stem reference station (GH_ER2), suggesting minimal influence of GHO and the west-side tributaries on benthic invertebrate community endpoints and tissue chemistry in the main stem Elk River.

7 INTEGRATED SUMMARY AND RECOMMENDATIONS

7.1 Summary

The 2020 GHO LAEMP investigated five study questions designed to address localized concerns downstream of the west spoil development and Cougar Pit extension at GHO. The GHO LAEMP targeted the Elk River (upstream and downstream of GHO), tributaries on the west-side of the Greenhills Ridge, as well as a side channel of the Elk River that receives flows, via surface water and/or groundwater, from the mine influenced west-side tributaries (e.g., Thompson, Wolfram, and Leask creeks). The study questions focused on characterization and understanding of habitat quality/availability, water quality, benthic invertebrate community structure, and benthic invertebrate tissue chemistry.

Within the side channel and its floodplain complex, over thirty multi-day field visits were completed in all seasons from 2017 to 2019 to identify and document habitat and occurrences of aquatic-dependent biota. In 2020, three additional amphibian surveys were conducted in May, June, and July. Data were used to answer study question #2 (What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?). The results were generally consistent over the four study years. Seasonal changes in flow affected habitat availability (e.g., lentic habitat was only observed in fall and winter in Reach 2). From freshet to late summer (three to four months of each study year), Reach 2 received flow from both the Elk River (via the upper side channel) and Thompson Creek. Flows were relatively swift during this time. From fall to early spring, Reach 2 remained wetted due to overland flows from Thompson Creek, but the upper side channel disconnected from the main stem Elk River and was dry. Reach 2 was swiftly flowing in the spring and early summer, and therefore was not suitable breeding habitat. Three amphibian species (Columbia spotted frog, western toad, long-toed salamander) were observed throughout the side channel in late spring and summer.

Water quality data were assessed for stations in the west-side tributaries, Elk River side channel and the main stem Elk River to address study question #3 (What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?) and its sub-questions. Water quality at side channel stations GH_ER1A and GH_ERSC2 was influenced by Wolfram and Thompson creeks, and concentrations at these stations were typically higher than at the upstream side channel station GH_ERSC4. Within the side channel and main stem Elk River, the highest concentrations of constituents generally occurred in Reach 2 (RG_GH-SCW3), which receives flow directly from Thompson Creek. Discharges from the west-side tributaries contributed to higher concentrations of some mine-related constituents in the main stem Elk River (GH_ERC) downstream of GHO relative to the upstream reference; however, concentrations measured at GH_ERC were typically below benchmarks, screening values, and/or BCWQG, or were comparable to the upstream reference, except for total selenium (frequently above the long term BCWQG, but below all EVWQP benchmarks) and total nickel (occasionally above the Level 1 Interim Screening Value). These general water quality results were consistent over the GHO LAEMP study (from 2017 to 2020). At the west-side tributaries, sulphate, TDS, and total selenium have been increasing in Leask and Wolfram creeks, while total nickel has been increasing in Leask Creek. In Leask and Wolfram creeks, sulphate and TDS concentrations typically exceed the EVWQP Level 1 benchmarks, total selenium typically exceeds the EVWQP Level 2 benchmark. In Leask Creek, total nickel concentrations exceeded the Level 3 Interim Screening Value since 2016. In Thompson Creek, sulphate has increased in recent years, with concentrations typically above the EVWQP Level 1 benchmark. Total nickel has decreased in recent years at Thompson Creek. At the Reach 2 outlet, total nickel was higher in 2019 and 2020 compared to 2018. At the downstream main stem Elk River station (GH_ERC), total selenium concentrations were higher in 2018 to 2020 compared to previous years, with concentrations frequently above the long term BCWQG, but well below all EVWQP benchmarks. Also, at station GH_ERC, nitrate concentrations were higher in 2019 to 2020, as compared to previous years, but remained well below the BCWQG.

To answer study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?), a hydrogeological review and analysis of available groundwater and surface water data from the west side of GHO along the Elk River side channel. The data review indicated that side channel surface water predominantly infiltrated to ground and recharged groundwater. Localized areas of groundwater discharge occurred near the confluence with Wolfram Creek as well as downstream of Thompson Creek, but these discharge areas did not result in sustained flows within the side channel. Gaps and uncertainties were identified.

Benthic invertebrate community data collected annually in September from 2017 to 2020 furthered the understanding of study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?). Benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC) and side channel stations (GH_ERSC4, GH_ER1A, and RG_ERSC5). In 2020 at main stem Elk River and Elk River side channel areas, total abundance, LPL richness, % EPT, % Ephemeroptera, % Plecoptera, and % Trichoptera were within or above the regional normal range, except for % Trichoptera at GH_ER1A, RG_ERSC5, and GH_ERC in one sample each. The relative proportion of Trichoptera has been similarly low at the upstream reference aera (GH_ER2); therefore, samples with % Trichoptera less than the regional normal range are likely related to habitat rather than mine influence. At all main stem Elk River and Elk River side channel stations, % Chironomidae, % Diptera, and % Oligochaeta were within or below the regional normal range, except for % Oligochaeta at RG_ERSC5 in one of three samples. Compared to the main stem and side channel stations, the samples collected from Thompson Creek (RG_THCK) had greater proportions of Coleoptera and Diptera, a lower proportion of Ephemeroptera, and more community endpoints that differed from the normal range, likely due to habitat differences (e.g., Thompson Creek is narrower, steeper, and calcified) or water quality differences. Overall, benthic invertebrate communities in the main stem Elk River and the Elk River side channel did not appear to be adversely affected by mine related discharges.

Benthic invertebrate tissue chemistry (selenium) data were also collected annually in September of 2017 to 2020, and furthered the understanding of study question #5. Selenium concentrations in benthic invertebrate tissue were highest in Thompson Creek. Selenium concentrations in benthic invertebrate tissue from side channel stations were higher than main stem stations. Concentrations in the side channel increased from upstream to downstream, from area GH_ERSC4 (upstream of Wolfram Creek) to GH_ER1A and GH_ERSC5 (both downstream of Wolfram Creek) to Reach 2 (RG_GH-SCW2 and RG_GH-SCW3), which is downstream of Thompson Creek. Although areas GH_ERSC2 and RG_SCDTC are both downstream of Thompson Creek, GH_ERSC2 had higher concentrations of selenium in tissue relative to Reach 2 and RG_SCDTC despite similar concentrations of aqueous selenite and organoselenium species, likely due to the more depositional nature of the area. Higher concentrations of selenium in benthic invertebrate tissue samples collected from Thompson Creek and downstream likely result from the presence of aqueous selenium in more bioavailable forms. At area GH_ERC, average concentrations were higher in 2020 compared to previous years, possibly due to higher aqueous total selenium at this area in 2019 and 2020 compared to previous years.

Benthic invertebrate community structure and tissue chemistry were similar at the downstream main stem station (GH_ERC) and the upstream main stem reference station (GH_ER2), suggesting minimal influence of GHO and the west-side tributaries on benthic invertebrate community endpoints and tissue chemistry in the main stem Elk River.

In support of study question #5 and to better understand potential mine-related effects on benthic invertebrate communities and tissue chemistry, sediment quality was assessed in the main stem Elk River upstream and downstream of the side channel, and in Reach 2 of the side channel. Except for chrysene in one of five samples, 2−methylnaphthalene in two of five samples, phenanthrene in three of five samples, and pyrene in two of five samples collected at Reach 2, concentrations of constituents were within the normal range in samples collected in 2020. Concentrations of constituents were below the upper (or only in the case of selenium) SQG in all samples from 2020, except for selenium, 2−methylnaphthalene, and phenanthrene in Reach 2. Data collected from 2017 to 2020 indicated no temporal patterns, except for a possible decrease in concentrations of chromium and 2−methylnaphthalene from 2017 to 2020 at the main stem Elk River downstream (GH_ERC). In general, sediment quality data indicated limited influence of mine-related discharges on sediment chemistry in the main stem Elk River downstream of the side channel.

The results from the 2020 GHO LAEMP provide information that supports Teck's Adaptive Management Program (Teck 2018). Table 7.1 summarizes material presented in this report that is relevant to the AMP. The results from this study also supported the evaluation of biological triggers, which are intended to identify unexpected monitoring results that may lead to responses under the AMP response framework. Biological trigger results indicated that neither of the two mine-exposed areas evaluated (RG_THCK and GH_ERC) reached the % EPT biological trigger (Table 7.2). This trigger will continue to be monitored as part of the RAEMP. Additionally, efforts are also currently underway (i.e., predictive modeling) to resolve uncertainty around effects of mine-related stressors on benthic invertebrate community endpoints (further information regarding the response for these biological triggers can be found in Appendix I). All replicates for RG_THCK (Thompson Creek) reached the biological trigger for the evaluation of selenium in benthic invertebrate tissues (Table 7.2), likely related to high concentrations of non-selenate species in water (Section 6.3). This issue is already being tracked through the AMP response framework (Section 1.5; Teck 2020b). One out of five replicates for GH_ERC also marginally reached the the biological trigger for the evaluation of selenium in benthic invertebrate tissues (Table 7.2). This biological trigger exceedance does not warrant further investigation at this time since this was an isolated event (one of five replicates) and showed a low magnitude of exceedance (Appendix I). If replicates exceed this biological trigger again in 2021, this issue should be considered for tracking under the AMP. Monitoring of the benthic invertebrate selenium biological trigger at RG_THCK and GH_ERC will continue under the RAEMP. Overall, results of the biological trigger evaluation were consistent with the findings of the integrated assessment conducted under the 2020 GHO LAEMP. Given that current biological triggers were sufficient to identify monitoring areas where biological responses are occurring, no additional triggers are recommended at this time.

7.2 Recommendations

Teck has fulfilled the Permit 107517 (Section 8.3.4) requirement of conducting a LAEMP from 2017 to 2020, focusing on the upper Elk River, the Elk River side channel, and tributaries located on the west side of GHO. Where concerns remain over specific components of the GHO LAEMP,

Table 7.1: Summary of Findings, Responses, and Adjustments Related to the GHO LAEMP in 2020

Key Question(s)	Data Evaluation Process	Outcome(s)	Responses & Adjustments in 2020	EMC Engagement
#2. What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?	Conducted amphibian surveys in May, June, and July 2020.	The seasonal habitat availability and use by amphibians has been demonstrated. Surveys of amphibians from 2017 to 2020 determined that the side channel was being used by three species of amphibians.	Additional years of surveys would not further the understanding of how mine related discharges might affect seasonal habitat availability for amphibians. Do no further work on this study question.	An updated sampling design for 2020 was submitted to ENV June 1, 2020. The updated study design was approved July 28, 2020. A meeting was held to discuss discontinuing GHO LAEMP after 2020 while continuing monitoring under other programs. The draft data package of 2020 results and outline of monitoring to be addressed in other programs in 2021 was submitted to EMC March 31, 2021 and discussed by tele-conference April 7, 2021. Written input from EMC on March draft data package received April 26, 2021.
#3. What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?	Assessed water quality at west-side tributary, side channel, and Elk River stations. Compared constituent concentrations to BCWQG, EVWQP benchmarks, and/or interim screening values. Assessed for temporal trends.	Mine influence indicated in the southern-most tributaries.	None. Monitoring to continue under Teck's Annual Water Quality Report and the MBI.	
#4. What is the interaction between surface water and groundwater in the Elk River side channel?	Conducted a hydrogeological review and analysis of available groundwater and surface water data for the west side of GHO.	Within the side channel, surface water predominantly infiltrated to ground, recharging groundwater. Localized areas of groundwater discharge occurred in the side channel near Wolfram Creek and downstream of Thompson Creek, but these did not result in sustained flows within the side channel.	Work is planned for 2021 under the GHO SSGMP, RGMP, MBI, and/or CPP: • seep reconnaissance and sampling; • installation of monitoring wells; • groundwater sampling; • flow and load accretion studies; and • geophysical surveys.	
#5. What are the BIC structures and BIT chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?	Assessed BIC structures relative to normal ranges and the upstream reference area. Assess BIT chemistry relative to EVWQP benchmarks and the upstream reference area. Assessed for temporal trends.	The BIC and BIT chemistry were similar among the Elk River stations downstream and upstream of mine influence. Percent EPT was low in Thompson Creek compared to the normal range. Selenium in BIT was elevated in Thompson Creek and in the side channel downstream of Thompson Creek compared to EVWQP benchmarks.	Selenium concentrations in BIT replicates at Thompson Creek reached an AMP biological trigger, and are being addressed through the AMP response framework (Section 1.5; Teck 2020b).	

Notes: GHO = Greenhills Operation; LAEMP = Local Aquatic Effects Monitoring Program; BCWQG = British Columbia Water Quality Guideline; EVWQP = Elk Valley Water Quality Plan; MBI = Mass Balance Investigation; GHO SSGMP = Greenhills Operation Site-Specific Groundwater Monitoring Program; RGMP = Regional Groundwater Monitoring Program; CPP = Cougar Pit Phase 5 and 7-2 Project; BIC = benthic invertebrate community; BIT = benthic invertebrate tissue; % EPT = Percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies); AMP = Adaptive Management Plan.

Table 7.2: Summary of Biological Trigger Analysis for Percent EPT and Concentration of Selenium in Benthic Invertebrate Tissue, Thopmson Creek and Elk River, 2020

Waterbody	Area		% EPT [a]		Selenium BIT [b]	
			Number Replicates Evaluated	Number of Replicates Reaching Biological Trigger [c]	Number Replicates Evaluated	Number of Replicates Reaching Biological Trigger [d]
Thompson Creek	RG_THCK	Mine-exposed	3	0	3	3
Elk River	GH_ERC	Mine-exposed	5	0	5	1

[a] % EPT = % EPT = Percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Biological Trigger analysis for % EPT was for the September 2020 sampling event.
[b] Selenium BIT = Selenium concentrations in benthic invertebrate tissue (mg/kg dw). Biological Trigger analysis for Selenium BIT was for the September 2020 sampling event.

[c] Number of Replicates Reaching Biological Trigger for % EPT refers to those replicates which were below both triggering steps (i.e., below the lower 2.5th percentile of the habitat-adjusted normal range and expectations, as based on predicted Aquatic Data Integration Tool [ADIT] Scores). See Appendix Section I.2.2 for more details.

[d] Number of Replicates Reaching Biological Trigger for Selenium BIT refers to those replicates which were above both triggering steps (i.e., above the upper 97.5th percentile prediction limit of the regional normal range and expectations, as based on the predicted 95% percentile from the water to benthic invertebrate selenium bioaccumulation model). See Appendix Section I.2.3 for more details.

monitoring that addresses those concerns is already conducted and reported under existing monitoring programs, or will be added to existing monitoring programs, such that these concerns continue to be addressed. In order to assure the continued evaluation of the potential effects of mine influence on the immediate receiving environment, the following recommendations are made for the 2020 GHO LAEMP study questions (Table 7.3).

Study question #2: What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?

Recommendation: Discontinue the investigation into habitat availability for amphibians in Reach 2 of the Elk River side channel.

Rationale: The habitat of the Elk River side channel and observations of biota in the side channel were documented over four years, during over 40 field visits that occurred in all seasons. The seasonal habitat availability and use by amphibians has been demonstrated. Amphibian breeding habitat was not present in Reach 2. Surveys of amphibians from 2017 to 2020 determined that the side channel was being used by three species of amphibians (Columbia spotted frog, western toad, and long-toed salamander). Additional surveys would not further the understanding of how mine-related discharges might affect seasonal habitat availability for amphibians.

Study question #3: What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?

Recommendation: Continue to monitor water quality in the west-side tributaries (stations GH_BR_F, GH_WOLF_SP1, GH_WILLOW_SP1, GH_WADE, GH_COUGAR, GH_NNC, GH_MC1, GH_LC2, GH_LC1, GH_WC2, GH_WC1, GH_TC2, and GH_TC1), Elk River side channel (stations GH_ERSC4, GH_ER1A, and GH_ERSC2) and the main stem Elk River (stations GH_ER2 and GH_ERC), and continue to report the water quality results under Teck's Annual Water Quality Report. West-side tributary stations GH_WOLF, GH_WILLOW, and GH_BR_D are not required under Permit 107517; instead, they are being monitored for baseline data for Phase 5 and Phase 7-2 mine extensions. Sampling at GH_WILLOW_S has not occurred since 2017 at this location; all flow reports to station GH_WILLOW then through ponds to station GH_WILLOW_SP1, and therefore this station will no longer be reported. These water quality data collected for Phase 5 and Phase 7-2 mine extensions will be included in project applications and reviews in the future. Reach 2 inlet (RG_GH-SW1) and outlet (RH_GH-SCW3) stations within the side channel will continue to be monitored monthly and reported in the MBI program.

Rationale: The Annual Water Quality Report evaluates compliance for order constituents, compares water quality to BCWQG, compares water quality to early warning triggers for

Table 7.3: Primary Monitoring Programs for 2021 and Onward Incorporating Data that have been Reported under the 2020 GHO LAEMP Report

Station Type	Stream Type[a]	Stream Name	Water Station Code	Biological Area Code or Staff Gauge Location Code	ENV EMS Number	Primary Monitoring Program	Question #2	Question #3 and #4, and supporting #5	Question #4	Question #5			
							Amphibians	Surface Water and Groundwater	Hydrology	Benthic Invertebrates		Substrate	
							Survey	Chemistry	Water Level and/or Flow Monitoring	Community Endpoints	Tissue Chemistry (Composite Taxa)	Calcite Index	Sediment Physical-chemical Attributes
Reference	M	Elk River	GH_ER2	RG_ELUGH	200389	Annual Water Quality Report, RAEMP	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP. Sample also collected concurrent[b] with biological monitoring for the RAEMP.	-	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	Three replicates collected annually for the RAEMP concurrent with biological monitoring.
Reference	T	Branch F Creek	GH_BR_F	-	E287437	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Wolf Creek	GH_WOLF	-	-	-	-	Baseline data collected for Phase 5 and/or Phase 7-2 mine extensions, to be included in future project applications and reviews. Sampling frequency will not change. GH_WOLF is upstream of GH_WOLF_SP1, therefore this station is not needed to understand constituent loadings to the Elk River.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Wolf Creek	GH_WOLF_SP1	-	E305855	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Willow Creek	GH_WILLOW	-	-	-	-	Baseline data collected for Phase 5 and/or Phase 7-2 mine extensions, to be included in future project applications and reviews. Sampling frequency will not change. GH_WILLOW and is upstream of GH_WILLOW_SP1, therefore this station is not needed to understand constituent loadings to the Elk River.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Willow Creek	GH_WILLOW_S	-	-	-	-	Sampling has not occurred at GH_WILLOW_S since 2017. All flow reports to station GH_WILLOW then through ponds to station GH_WILLOW_SP1.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Willow Creek	GH_WILLOW_SP1	-	E305854	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Wade Creek	GH_WADE	-	E287433	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Cougar Creek	GH_COUGAR	-	E287432	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	No Name Creek	GH_NNC	-	E305875	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Branch D	GH_BR_D	-	-	-	-	Baseline data collected for Phase 5 and/or Phase 7-2 mine extensions, to be included in future project application and review. Sampling frequency will not change.	-	-	-	-	-
Mine-exposed or Potentially Mine-exposed	T	Mickelson Creek	GH_MC1	GH_MC1	0200388	Annual Water Quality Report, RAEMP	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP.	-	-	-	-	-
	T	Leask Creek	GH_LC1	GH_LC1	E257796	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	-	-	-

(green) No change to monitoring frequency, but in 2021 and onward data will be reported and interpreted in a report other than the GHO LAEMP.
(blue) Sampling and/or reporting will be discontinued, or sampling frequency will be different than in the 2020 GHO LAEMP Study Design.

Notes: "-" indicates no work conducted, as per approved 2020 GHO LAEMP study design. RAEMP = Regional Aquatic Effects Monitoring Program. GHO SSGMP = Greenhills Operation Site Specific Groundwater Monitoring Program. MBI = Mass Balance Investigation. CPP = Cougar Pit Phase 5 and 7-2 Project.
[a] M - main stem (lotic); T - tributary (lotic); GW - groundwater; S - side channel (lotic); De - depositional side channel (semi-lentic).
[b] Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 6428. Concurrently - water chemistry sampling will be conducted concurrent with biological sampling.
[c] The monitoring of benthic invertebrate tissue chemistry area GH_ERSC2 will be discontinued, as the habitat does not meet the criteria for inclusion in to the RAEMP study design (i.e., depositional, semi lentic, and dry from late fall until late spring) and because this area is less than 350 m away from areas RG_GH-SCW3 and RG_SCDTC with no contributing tributaries between the areas (i.e., spatial coverage is adequate without area GH_ERSC2).

Table 7.3: Primary Monitoring Programs for 2021 and Onward Incorporating Data that have been Reported under the 2020 GHO LAEMP Report

Station Type	Stream Type[a]	Stream Name	Water Station Code	Biological Area Code or Staff Gauge Location Code	ENV EMS Number	Primary Monitoring Program	Question #2	Question #3 and #4, and supporting #5	Question #4	Question #5			
							Amphibians	Surface Water and Groundwater	Hydrology	Benthic Invertebrates		Substrate	
							Survey	Chemistry	Water Level and/or Flow Monitoring	Community Endpoints	Tissue Chemistry (Composite Taxa)	Calcite Index	Sediment Physical-chemical Attributes
Mine-exposed	GW	Near Leask Creek	GH_MW_LC3A/B/C	-	-	MBI	-	Currently monitored for the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
	M	Elk River	-	ERUS	-	GHO SSGMP	-	-	Water level logger data only. Currently reported in the MBI. Data are recommended for potential inclusion in the GHO SSGMP as appropriate.	-	-	-	-
	S	Elk River Side Channel	GH_ERSC4	GH_ERSC4	E305878	Annual Water Quality Report, RAEMP, GHO SSGMP	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP. Sample also collected concurrent[b] with biological monitoring for the RAEMP.	Currently reported in the MBI. Data are recommended for potential inclusion in the GHO SSGMP as appropriate.	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	-
	GW	Near Side Channel	GH_MW_WC1-A/B/C	-	-	MBI	-	Currently monitored for the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
	T	Wolfram Creek	GH_WC1	GH_WC1	E257795	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP.	-	-	-	-	-
	GW	Near Wolfram Creek	RG_MW_LCWC1	-	-	-	-	Currently monitored for the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
			GH_GA-MW-2	-	-	GHO SSGMP	-	Currently monitored in the GHO SSGMP.	-	-	-	-	-
			RG_MW_WC2A/B	-	-	MBI	-	Currently monitored for the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
	S	Elk River Side Channel Downstream of Wolfram	GH_ER1A	GH_ER1A	E305876	Annual Water Quality Report, RAEMP, GHO SSGMP	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP. Sample also collected concurrent[b] with biological monitoring for the RAEMP.	Currently reported in the MBI. Data are recommended for potential inclusion in the GHO SSGMP as appropriate.	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	-
			RG_ERSC5	RG_ERSC5	-	RAEMP	-	Sample collected concurrent[b] with biological monitoring for the RAEMP.	-	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	-
	De	Elk River Side Channel Reach 2 Inlet	RG_GH-SCW1	RG_GH-SCW1	-	MBI	-	Monthly[b] samples collected for the MBI.	-	-	-	-	-

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Sampling and/or reporting will be discontinued, or sampling frequency will be different than in the 2020 GHO LAEMP Study Design.

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[a] M - main stem (lotic); T - tributary (lotic); GW - groundwater; S - side channel (lotic); De - depositional side channel (semi-lentic).
[b] Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 6428. Concurrently - water chemistry sampling will be conducted concurrent with biological sampling.
[c] The monitoring of benthic invertebrate tissue chemistry area GH_ERSC2 will be discontinued, as the habitat does not meet the criteria for inclusion in to the RAEMP study design (i.e., depositional, semi lentic, and dry from late fall until late spring) and because this area is less than 350 m away from areas RG_GH-SCW3 and RG_SCDTC with no contributing tributaries between the areas (i.e., spatial coverage is adequate without area GH_ERSC2).

Table 7.3: Primary Monitoring Programs for 2021 and Onward Incorporating Data that have been Reported under the 2020 GHO LAEMP Report

Station Type	Stream Type[a]	Stream Name	Water Station Code	Biological Area Code or Staff Gauge Location Code	ENV EMS Number	Primary Monitoring Program	Question #2	Question #3 and #4, and supporting #5	Question #4	Question #5			
							Amphibians	Surface Water and Groundwater	Hydrology	Benthic Invertebrates		Substrate	
							Survey	Chemistry	Water Level and/or Flow Monitoring	Community Endpoints	Tissue Chemistry (Composite Taxa)	Calcite Index	Sediment Physical-chemical Attributes
Mine-exposed	T	Thompson Creek	GH_TC2	THCK	E207436	E207436	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP. Sample also collected concurrent[b] with biological monitoring.	-	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	-
	GW	Near Thompson Creek	GH_GA-MW-3	-	-	GHO SSGMP	-	Currently monitored in the GHO SSGMP.	-	-	-	-	-
	De	Elk River Side Channel Reach 2 Outlet	RG_GH-SCW3	RG_GH-SCW3	-	MBI, RAEMP	No further monitoring in 2021, as study question #2 has been answered.	Monthly[b] samples collected for the MBI. No change to monitoring frequency in 2021. Sample also collected concurrent[b] with biological monitoring for the lentic program of the RAEMP.	-	-	Sampling frequency reduced from annually to every three years, consistent with the study design for the lentic program of the RAEMP.	Determined for three reaches concurrent with biological monitoring, every three years for the lentic program of the RAEMP.	Five replicates collected concurrent with biological sampling, every three years for the lentic program of the RAEMP.
	S	Elk River Side Channel Downstream of Reach 2	GH_ERSC2	GH_ERSC2	E305877	Annual Water Quality Report	-	Monthly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report.	-	-	Sampling to be discontinued after 2020[c].	Sampling to be discontinued after 2020[c].	-
			-	RG_SCDTC	-	RAEMP	-	Sample collected concurrent[b] with biological monitoring.	-	Three replicates collected annually for the RAEMP.	Three replicates collected annually for the RAEMP.	Determined for three reaches concurrent with biological monitoring.	-
			-	RG_ERSCDS	-	-	-	-	Water level and flow data are currently reported in the MBI. Data are recommended for potential inclusion in the GHO SSGMP as appropriate.	-	-	-	-
	GW	Near Side Channel Downstream of Reach 2	RG_MW_ER3A/B	-	-	MBI	-	Currently monitored in the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
			RG_MW_ER6A/B	-	-	MBI	-	Currently monitored in the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
			RG_MW_ER4A/B	-	-	MBI	-	Currently monitored in the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
			RG_MW_ER5A/B	-	-	MBI	-	Currently monitored in the MBI and to be considered for potential inclusion into the SSGMP during the 2021 to 2024 SSGMP process.	-	-	-	-	-
	M	Elk River	GH_ERC (Compliance)	RG_EL20	E300090	Annual Water Quality Report, RAEMP, GHO SSGMP	-	Monthly/weekly[b] samples collected primarily for Permit 107517 and Teck's Annual Water Quality Report, and is also reported in the RAEMP. Sample also collected concurrent[b] with biological monitoring for the RAEMP.	Currently reported in the MBI. Data are recommended for potential inclusion in the GHO SSGMP as appropriate.	Five replicates collected annually for the RAEMP.	Five replicates collected annually for the RAEMP.	Determined for five reaches concurrent with biological monitoring.	Five replicates collected annually for the RAEMP concurrent with biological monitoring.

No change to monitoring frequency, but in 2021 and onward data will be reported and interpreted in a report other than the GHO LAEMP.
Sampling and/or reporting will be discontinued, or sampling frequency will be different than in the 2020 GHO LAEMP Study Design.

Notes: "-" indicates no work conducted, as per approved 2020 GHO LAEMP study design. RAEMP = Regional Aquatic Effects Monitoring Program. GHO SSGMP = Greenhills Operation Site Specific Groundwater Monitoring Program. MBI = Mass Balance Investigation. CPP = Cougar Pit Phase 5 and 7-2 Project.
[a] M - main stem (lotic); T - tributary (lotic); GW - groundwater; S - side channel (lotic); De - depositional side channel (semi-lentic).
[b] Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 6428. Concurrently - water chemistry sampling will be conducted concurrent with biological sampling.
[c] The monitoring of benthic invertebrate tissue chemistry area GH_ERSC2 will be discontinued, as the habitat does not meet the criteria for inclusion in to the RAEMP study design (i.e., depositional, semi-lentic, and often dry from late fall until late spring) and because this area is less than 350 m away from areas RG_GH-SCW3 and RG_SCDTC with no contributing tributaries between the areas (i.e., spatial coverage is adequate without area GH_ERSC2).

mine-related constituents, and evaluates general patterns and trends for order and non-order constituents. Ongoing monitoring of surface water quality will help to assess the potential for risks to the receiving environment. The MBI is designed support Teck's Regional Water Quality Model (RWQM) by assessing the nitrate and selenium load sinks in the Elk River, Fording River, and Michel Creek valleys, aiming to account for the discrepancy between measured and modelled concentrations of selenium and nitrate (parameters indicative of mine-influence) in the RWQM. The MBI will continue to collect flow and surface water data at stations relevant to the MBI investigation. When the MBI concludes, the MBI stations will be evaluated for inclusion in ongoing programs (SSGMP, RGMP, and/or surface water flow monitoring program), as appropriate and applicable. Station GH_WOLF is upstream of GH_WOLF_SP1, and station GH_WILLOW is upstream of GH_WILLOW_SP1, therefore these upstream stations are not needed to understand constituent loadings to the Elk River.

Recommendation: Continue to collect selenium speciation water quality samples concurrent with September benthic invertebrate tissue samples at Elk River, Elk River side channel, and Thompson Creek stations, and report the results in the RAEMP. Consider including Thompson Creek stations (upstream and downstream of the sedimentation ponds) in the Selenium Speciation Monitoring Program (study design to be determined).

Rationale: The concentrations of selenium in benthic invertebrate tissue were higher than EVWQP benchmarks at some stations (highest in Thompson Creek), and concentrations were typically above the concentrations predicted by the selenium bioaccumulation model based on total aqueous selenium concentrations. Sampling in September 2020 indicated the presence of organoselenium species in Thompson Creek and all downstream side channel stations. Selenium speciation water quality samples will continue to support the interpretation of selenium bioavailability and assist in understanding possible causes of these elevated concentrations.

Study question #4: What is the interaction between surface water and groundwater in the Elk River side channel?

Recommendation: To further the understand of surface water and groundwater interactions in the Elk River side channel, the following additional work is planned for 2021 under the GHO SSGMP, RGMP, MBI, and/or CPP:

- seep reconnaissance and sampling in the Elk River side channel;
- installation of additional monitoring wells;
- groundwater sampling;
- flow and load accretion studies; and

- geophysical surveys to determine depth to bedrock.

Monitor, report, and interpret these data under the GHO SSGMP, RGMP, MBI, and/or CPP. These data will be integrated into future iterations of the GHO SSGMP and the conceptual site model (CSM). New findings relating to surface water and groundwater interactions in the Elk River side channel area will also be presented in the Annual Elk Valley Combined Groundwater Report. Water level and flow at surface water quality stations ERUS, GH_ERSC4, GH_ER1A, RG_ERSCDS, RG_ERC, and GH_ERC have been monitored for the GHO LAEMP from 2018 to 2020, and are also incorporated into the MBI. The MBI will continue to collect flow and surface water data at stations relevant to the MBI investigation. When the MBI concludes, these stations will be evaluated for inclusion in ongoing programs (SSGMP, RGMP, and/or surface water flow monitoring program), as appropriate and applicable.

Rationale: The current data have provided a high-level characterization of the interaction between surface water and ground water in the side channel, indicating that the side channel surface water predominantly infiltrated to ground and recharged groundwater. Localized areas of groundwater discharge occurred near the confluence with Wolfram Creek as well as downstream of Thompson Creek, creating four of the isolated pools that persisted when the side channel was otherwise dry. The objective of study question #4 was to address data gaps and uncertainties associated with groundwater–surface water interaction along the Elk River side channel. The interaction has been generally characterized. Some gaps remain in understanding this relationship in greater detail. Preliminary investigation into the shallow groundwater conditions between Wolfram Pond and the side channel (GH_ER1A) were conducted after monitoring wells were installed in 2020, but further years of data will increase the understanding of groundwater quality in this area over time. The remaining gaps will be addressed in detail as part of other on-going programs: the GHO SSGMP, RGMP, MBI, and CPP.

Study question #5: What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?

Recommendation: Continue to monitor benthic invertebrate community (areas GH_ER2, GH_ERSC4, GH_ER1A, GH_ERSC5, RG_THCK, RG_SCDTC, and GH_ERC), benthic invertebrate tissue chemistry areas (areas GH_ER2, GH_ERSC4, GH_ER1A, GH_ERSC5, RG_THCK, RG_GH-SCW3, RG_SCDTC, and GH_ERC), and supporting data (i.e., habitat data and calcite index for all community and tissue areas, and sediment quality for GH_ER2, RG_GH-SCW3, and GH_ERC). Present these data to the EMC annually under the RAEMP data package, and report the results every three years under the RAEMP Report. Under this reporting system, benthic invertebrate communities will continue to be assessed using community metrics (i.e., abundance, richness, and proportion of major taxonomic groups), and continue to be compared to site-specific and/or regional normal ranges. Biological triggers (Appendix I) will be assessed annually as part of the RAEMP. Under this reporting system, concentrations of selenium in benthic invertebrate tissue will continue to be assessed relative to EVWQP benchmarks. This recommended approach will differ from monitoring under the 2020 GHO LAEMP study design in two ways: (1) monitoring of area RG_GH-SCW3 will be reduced from annually under the GHO LAEMP to every three years under the lentic area program of the RAEMP; and (2) monitoring of benthic invertebrate tissue chemistry area GH_ERSC2 will be discontinued.

Rationale: The evaluation of benthic invertebrate community characteristics and tissue chemistry are important components for assessing potential mine-related effects on the aquatic ecosystem. The frequency of benthic invertebrate tissue chemistry monitoring at area RG_GH-SCW3 (Reach 2) will be reduced from annually to every three years to be consistent with the lentic area program study design, as this area is depositional. Annual monitoring will still occur at lotic stations, including Thompson Creek (RG_THCK), which is upstream from Reach 2 and has higher concentrations of aqueous bioavailable selenium. The monitoring of benthic invertebrate tissue chemistry at area GH_ERSC2 will be discontinued, as the habitat does not meet the criteria for inclusion in to the RAEMP study design (i.e., depositional, semi-lentic, and dry from late fall until late spring) and because this area is less than 350 m away from areas RG_GH-SCW3 and RG_SCDTC with no contributing tributaries between the areas (i.e., spatial coverage is adequate without area GH_ERSC2).

7.3 Statement of Intent

As noted in the study design (Minnow and Lotic 2017, 2018a, Minnow 2020a) and previous reports (Minnow and Lotic 2018b, 2019, 2020), the GHO LAEMP will continue to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into the RAEMP, GHO SSGMP, and/or other existing monitoring programs, as appropriate. Teck has fulfilled the Permit 107517 Section 8.3.4 requirement for a LAEMP to be conducted from 2017 to 2020, focusing on the local area of the upper Elk River, the Elk River side channel, and tributaries located on the west side of Greenhills Ridge. Where concerns remain, the GHO LAEMP monitoring is incorporated into existing monitoring programs, such that these residual concerns continue to be addressed. In consideration of these factors, a statement of intent to discontinue the GHO LAEMP was provided to ENV on May 31, 2021. Field monitoring is currently being conducted in accordance with the Updated 2020 GHO LAEMP study design, and changes recommended above will not be implemented until written confirmation has been received from ENV.

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APPENDIX A
STUDY DESIGN AMENDMENT FOR THE 2020 GHO LAEMP

APPENDIX A
UPDATED SAMPLING DESIGN FOR
2020 GHO LAEMP
(MINNOW, JUNE 2020)

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June 1, 2020

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PO Box 1777
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Re: Updated Sampling Design for 2020 GHO LAEMP

Dear Carla,

This letter has been prepared in response to discussions with the Environmental Monitoring Committee (EMC) in March regarding updates to the 2020 Greenhills Operation (GHO) Local Aquatic Effects Monitoring Program (LAEMP) sampling design based on findings from the 2017, 2018, and 2019 programs. Annual GHO LAEMP reports have been submitted for 2017, 2018, and 2019; the 2019 annual report was submitted to the Director on May 29, 2020.

Following discussion with the Environmental Monitoring Committee (EMC) and the provision of advice by the EMC, a phased approach to the GHO LAEMP study design was approved by the British Columbia Ministry of Environment and Climate Change Strategy (ENV) on August 18, 2017. A study design (Minnow and Lotic 2017) was submitted on May 31, 2017 in accordance with the requirements of Permit 107517. The design was accepted by ENV on August 24, 2018 and preliminary reconnaissance work was conducted from May 2017 to April 2018. An updated study design was submitted on May 31, 2018 that covered the 2018 to 2020 period (Minnow and Lotic 2018). The 2018 to 2020 LAEMP was designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension at GHO. As with LAEMPs for other Teck Operations, the GHO LAEMP is also designed to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into other existing monitoring programs (e.g., Site-Specific Groundwater Monitoring Program [SSGMP] and Regional Groundwater Monitoring Program [RGMP], Mass Balance Investigations [MBI] and the Regional Aquatic Effects Monitoring Program [RAEMP]). In consideration of potential existing and future mine-related influences at GHO, the following key questions were developed in consultation with the EMC to guide study design development:

1. What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel?
2. What is the seasonal habitat availability for aquatic-dependent biota (i.e., fish, amphibians, and aquatic-feeding birds) in the Elk River side channel?
3. What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?
    a. What is the water quality in the west-side tributaries, and how is it changing over time?
    b. What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?
    c. What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?
    d. What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates (i.e., fish, amphibians, and aquatic-feeding birds)?
4. What is the interaction between surface water and groundwater in the Elk River side channel?
5. What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?
6. Is the mine-related influence on Reach 2[1] having an effect on aquatic-dependent biota (benthic invertebrates, fish, amphibians, and aquatic-feeding birds)?

The original study design was intended to cover the 2018 to 2020 time period; however, based on the results from the 2017, 2018, and 2019 programs, changes are being proposed for the 2018 to 2020 GHO LAEMP study design (to be implemented for the 2020 GHO LAEMP field season). A draft data package of 2019 GHO LAEMP results was submitted to the EMC on March 8, 2020. Results and proposed study design modifications were discussed during a

[1] The area that has previously been referred to as the “side channel wetland” is herein called Reach 2, as it is not a true wetland (Minnow and Lotic 2019).

teleconference on March 9, 2020. Based on the findings from previous GHO LAEMP reports and feedback from the EMC, the following study design changes are proposed:

Do no further work on study question #1 (What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel?).

To address study question #1, hydrology data were collected and assessed in 2017, 2018, and 2019, including: water levels (measured continuously in the side channel and main stem Elk River), monthly flow measurements in the side channel, and monthly characterization of side channel hydrology features (i.e., dry sections, braids, isolated pools, and tributary surface connectivity). The Elk River side channel was observed to undergo seasonal flooding and braiding, with variable flow throughout the year, which was generally consistent from 2017 to 2019. Flows in the main stem Elk River and flows in the Elk River side channel were strongly correlated. Water from the main stem Elk River flowed overland into the side channel from freshet until winter when stream flow decreased both in the main stem Elk River and at the three side channel stations. The side channel was fully wetted for three to four months of each study year. Stream flow was lowest in the main stem Elk River from winter until freshet; at this time, the side channel became disconnected from the main stem Elk River and Reaches 1 and 3 slowly dried. Isolated pools were documented as areas dried, but typically persisted for less than three months. Water quality data suggested that, while most pools were stagnant water resulting from dewatering of the side channel, a few pools likely received groundwater contributions. Reach 2 at the confluence of the side channel and Thompson Creek remained wetted throughout the year due to receiving flows from Thompson Creek. The recommendation was been made to do no further work on study question #1, as the relationship between flows in the main stem Elk River and flows in the Elk River side channel is now sufficiently understood - the side channel flow is predominantly influenced by the Elk River itself, rather than the tributaries, except for Reach 2 at the mouth of Thompson Creek.

Adjust study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel?) to focus on amphibian use in the Elk River side channel habitat. It is recommended that study question #2 is reworded to "What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?".

Within the side channel and its floodplain complex, over thirty field visits were completed in all seasons from 2017 to 2019 to identify and document habitat and occurrences of aquatic-dependent biota. Monthly surveys documented side channel morphology/hydrology, wetted areas, overwintering habitat, and *in situ* water quality of isolated pools and level logger stations. A Fish Habitat Assessment Procedure (FHAP) survey was completed in 2017 to categorize the quality of fish habitat, which remained consistent from 2017 to 2019. During monthly surveys, the side channel was traversed to document aquatic or aquatic-dependant species utilizing the side channel. This included observations of fish (including eggs, fry, young-of-the-year, juveniles, and adults, as well as spawning fish and redds during spring and fall surveys), visual and/or auditory detections of amphibians (including eggs, tadpoles, and adults), and visual and/or auditory detections of aquatic-dependent birds (including nests, eggs, chicks, and adults).

Abundant wetted area was available to aquatic-dependent biota from spring to summer when the side channel was flowing and connected to the main stem Elk River. In the fall, aquatic habitat became more limited as the side channel began to dry. Later in the fall, the side channel sections downstream and upstream of Reach 2 were dry and remained dry throughout the winter. Reach 2 remained wetted throughout the three years of the study and consistently received flows from Thompson Creek, providing some lentic habitat in the fall and winter. Additional sparse/patchy habitat was provided by ephemeral isolated pools that remained as the side channel dried. However, isolated pools typically persisted for less than a month, were shallow, and covered a relatively small surface area.

Reach 2 was generally not considered suitable breeding habitat for amphibians, as much of the side channel and floodplain complex were flooded and swiftly flowing in the spring and early summer. However, breeding habitat may be present elsewhere in the area, and several amphibians (Columbia spotted frog and western toad adults, and larval long-toed salamander) were observed throughout the side channel in late spring and summer. Suitable habitat was available for all life stages of fish and aquatic-dependent birds in the side channel and floodplain complex from spring through fall, as well as in Reach 2 during winter. Ultimately, there are no barriers to use of the side channel complex by aquatic biota (with the exception of dry reaches in late fall/winter, which are barriers to fish passage at that time of year), and therefore it is expected that the area is used by a variety of fish, amphibians, and aquatic-dependent birds. This was confirmed by observations of aquatic-biota throughout the three years of study.

Overall, the three years of study have well-documented the habitat availability and have therefore largely addressed study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel). Additional years of surveys would not further the understanding of how mine related discharges might affect aquatic-dependent biota. Based on discussions with the EMC, Teck is proposing to complete additional work under an adjusted study question #2 to reduce remaining uncertainties around the potential for amphibian use in Reach 2 of the side channel. Amphibian occurrence and critical habitats have been be documented on the west side of the Greenhills ridge through four studies:

(1) the CPX Baseline Wildlife surveys (Matrix Solutions 2015),

(2) the Lentic Area Supporting Study report and the accompanying Amphibian Occurrence and Distribution Study report (in draft),

(3) the Greenhills Operations (GHO) Cougar Pit Extension Phase 2 (CPX2) and Fording River Operations Castle: Terrestrial Wildlife Baseline Report (i.e., the GHO CPX2 Terrestrial Baseline; Hemmera 2020 in draft), and

(4) the GHO LAEMP work (Minnow and Lotic 2018, 2019, 2020).

These programs demonstrated that a variety of amphibians (Columbia spotted frog, long-toed salamander, western toad, and wood frog) were present on the west side of Greenhills ridge, despite waterbodies being predominantly high-gradient and lotic. Additional years of surveys would not appreciably further this understanding of which amphibian species occur in this region.

Based on data collected from 2017 to 2019, the GHO LAEMP identified Reach 2 as the area of the side channel with the greatest potential for localized adverse effects to biota based on water quality, sediment quality, and selenium concentrations in benthic invertebrate tissue. Uncertainties regarding amphibian use of Reach 2 have been identified, as larval long-toed salamanders were found in a dry ‘finger’ of the side channel in this area in 2018, suggesting the area may have amphibian breeding habitat that has been previously undiscovered, perhaps due to accessibility issues. To reflect these findings and uncertainties, it is recommended that study question #2 is reworded to: “What is the seasonal habitat availability for amphibians in Reach 2 of the Elk River side channel?”. Additional amphibian surveys will be conducted in 2020, consistent with the methods used in the amphibian distribution and occurrence study (VAST 2019), timed to target three life stages (egg, larval, and adult) from May through August and to target amphibians species found in the Elk Valley (Table 1, Figure 1).

Continue to monitor water quality in the west-side tributaries, Elk River side channel (including Reach 2), and the main stem Elk River, in support of study questions #3a (What is the water quality in the west-side tributaries, and how is it changing over time?), #3b (What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?), and #3c (What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?).

Surface water quality samples are collected weekly/monthly at lotic side channel stations. Additional water quality samples are collected concurrent with benthic invertebrate community and tissue sampling. Monitoring results from 2017 to 2019 have indicated that water quality in the Elk River side channel is influenced by Wolfram and Thompson creeks. Reach 2 of the Elk River side channel, which receives flow directly from Thompson Creek, typically showed the highest concentrations of constituents. Continued monitoring of water quality in the west-side tributaries, Elk River side channel (including Reach 2), and the main stem Elk River is recommended for 2020 (Tables 1 and 2, Figure 2).

Do no further work on study question #3d (What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates [i.e., fish, amphibians, and aquatic-feeding birds]?).

Water quality in isolated pools was highly dependent on location, with the highest concentrations of constituents generally occurring in pools downstream of Reach 2. Three years of study have determined that isolated pools provide relatively limited habitat, as pools typically persisted for less than a month, had small surface areas, and were shallow (please see Minnow 2020 for additional discussion of the pools and representative photos). The water quality of most isolated pools was influenced by side channel water quality because isolated pools were formed by water that persisted as the side channel dried. Pools located upstream of Reach 2 had water quality comparable to GH_ERSC4 and GH_ER1A, whereas pools downstream of Reach 2 exhibited influence from Thompson Creek. Side channel water quality will continue to be monitored under study question #3b. Water quality data indicated that a few of the isolated pools were localized areas of groundwater discharge, occurring near the confluence with Wolfram Creek (SC3-P13) and downstream of Thompson Creek (SC2-P3, SC2-P1 and SC2-P2). Groundwater quality will continue to be monitored under groundwater programs outside of the GHO LAEMP and evaluation of the groundwater-surface water interactions in the Elk River side channel will also continue under the GHO LAEMP in 2020 (see study question #4).

Continue evaluation of groundwater-surface water interactions in the Elk River side channel in 2020 to support study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?).

To answer study question #4, a hydrogeological review and analysis of available groundwater and surface water data was conducted by SNC-Lavalin in 2020 using data from the west side of GHO along the Elk River side channel. The data review indicated that side channel surface water predominantly infiltrated to ground and recharged groundwater. Localized areas of groundwater discharge appeared to occur near the mean the mouth of Wolfram Creek at the side channel as well as downstream of Thompson Creek, creating a few of the isolated pools that persisted when the side channel was otherwise dry (see Table D of SNC-Lavalin 2020).

These discharge areas did not result in sustained flows within the side channel. The isolated pools were shallow, and either had small surface areas or only persisted for two months.

Data gaps and uncertainties associated with groundwater–surface water interaction along the Elk River side channel were identified in the 2020 assessment (SNC-Lavalin 2020). Remaining gaps will be addressed by improving the monitoring well network with new well installations in 2020 and collection of additional groundwater data. This will occur as part of other on-going programs, including the SSGMP, RGMP, CPX2, and MBI Program. Data from these projects and the GHO LAEMP will be used to address study question #4 in an updated hydrogeological review and analysis of available groundwater and surface water data to be reported in the 2021 GHO LAEMP report (Table 1).

Continue monitoring to support study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

Benthic invertebrate community and tissue samples have been collected at Elk River main stem and side channel stations since 2017. Concurrent with benthic invertebrate sampling, the following supporting information was documented or collected: habitat, calcite index, water quality samples, and sediment quality samples. Benthic invertebrate community structure and tissue chemistry were similar at the downstream main stem station and the upstream main stem reference station, suggesting minimal influence of GHO and the west-side tributaries on benthic invertebrate community endpoints and tissue chemistry in the main stem Elk River and side channel. Evaluation of benthic invertebrate community characteristics and tissue chemistry are important components for assessing potential mine-related effects on the aquatic ecosystem, and assessment of these endpoints will continue in 2020 (Table 1, Figure 1).

Discontinue the evaluation of Reach 2 locations under study question #6 (Is the mine-related influence on the side channel wetland having an effect on aquatic dependent biota [benthic invertebrates, fish, amphibians, and aquatic-feeding birds]?). Instead, continue to monitor presence of amphibians, Reach 2 water quality (monthly), Reach 2 sediment quality (September), and Reach 2 benthic invertebrate tissue chemistry (September), under study questions #2, #3b, #4, and #5.

Data collected from 2017 to 2019 confirmed that Reach 2 of the side channel provides habitat for fish, amphibians, and aquatic-dependent birds, but is not expected to provide optimal habitat for breeding amphibians. In 2019, aqueous concentrations of TDS and sulphate were frequently above the BCWQG and/or EVWQP Level 1 benchmarks, while aqueous concentrations of nitrate and total selenium were frequently above the EVWQP Level 2 benchmarks. However, most other water constituents with EWT were typically below BCWQG and/or EVWQP Level 1 benchmarks. In 2019, concentrations of metals and PAHs in sediment were below the upper SQG except for selenium in one of three samples was above the only SQG. Selenium concentrations in sediment were either similar to the upstream reference or were within the normal range. In 2019, benthic invertebrate tissue selenium concentrations varied greatly, with two samples below Level 1 benchmarks and within the normal range, and one sample that was higher than EVWQP Level 3 benchmarks for benthic invertebrates and dietary effects to birds and juvenile fish. Based on comparison of selenium concentrations in benthic invertebrate tissue to the EVWQP benchmarks, there is potential for localized adverse effects to fish, benthic invertebrates, and aquatic-dependent birds due to the mine related influence on Reach 2.

Within the 2018 GHO LAEMP and this current 2019 GHO LAEMP, reporting of Reach 2 data has been repetitive, with results first presented under study questions #2, #3, and #5, and then the same results summarized again under study question #6 (Table 1, Figures 1 and 2). To reduce the redundancy, it is recommended that study question #6 is removed, with Reach 2 data assessed within the context of the rest of the side channel, as follows:

- Water quality of Reach 2 will continue to be assessed under study question #3b (What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?) and study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?).
- Sediment quality and benthic invertebrate tissue chemistry of Reach 2 will continue to be assessed under study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).
- An integrated summary of the results of all study questions that will continue to provide an understanding of the overall conditions in the GHO LAEMP study area, including Reach 2.

Summary

The GHO LAEMP is designed to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into other existing monitoring programs. Sufficient data have been collected to address study question #1 and #3d, and therefore it is recommended that no further work be conducted on these questions. Sufficient data have been collected to narrow the scope of study question #2, therefore it is recommended that the question be reworded to reflect this new focus (Table 1, Figure 1). Data collected for study question #6 have been summarized under study question #6, but also under study questions #2, #3, and #5 (Table 1, Figures 1 and 2). Therefore, to reduce redundancy in reporting, it is recommended that Reach 2 data are no longer assessed under study question #6. No study design changes are recommended for study questions #3a, #3b, #3c, #4, and #5 (Tables 1 and 2, Figures 1 and 2). An extensive review of the study questions and proposed changes are in the 2019 GHO LAEMP report, as requested by EMC. If you have any questions or comments, please do not hesitate to contact me.

Sincerely,

Minnow Environmental Inc.

Jess Tester, B.Sc., R.P.Bio.

Aquatic Scientist

cc: Pierre Stecko, M.Sc., EP, R.P. Bio., Senior Aquatic Scientist

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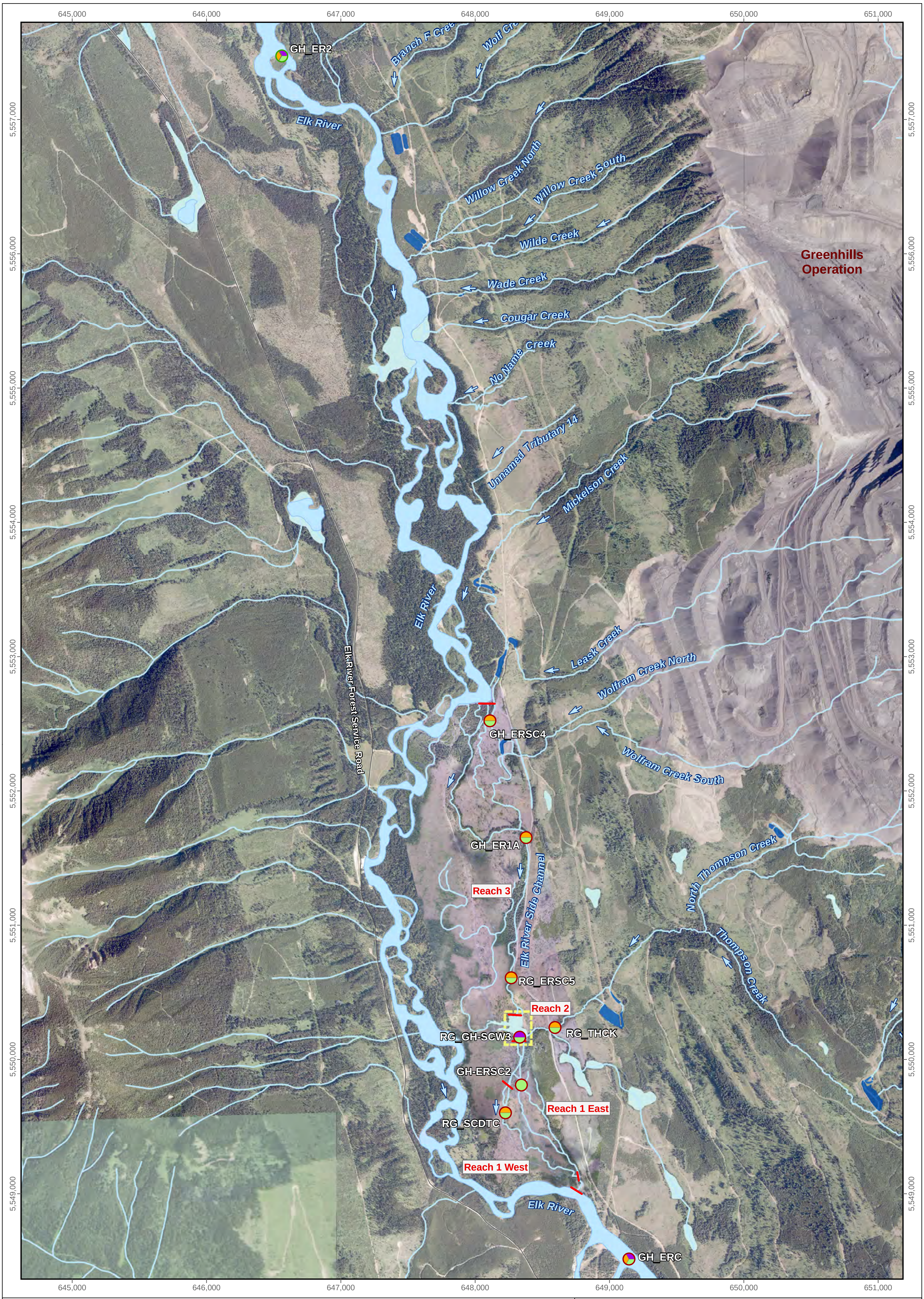

LEGEND

Sampling Type

Mine-exposed

Reference

Sediment Quality

Benthic Invertebrate Community

Benthic Invertebrate Tissue Chemistry

Amphibian Survey

Reach Break

Settling Pond

Proposed Benthic Invertebrate Community and Tissue Chemistry, and Sediment Quality Sampling Stations, and Amphibian Surveys, GHO LAEMP, 2020

0 0.5 1 2
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 11
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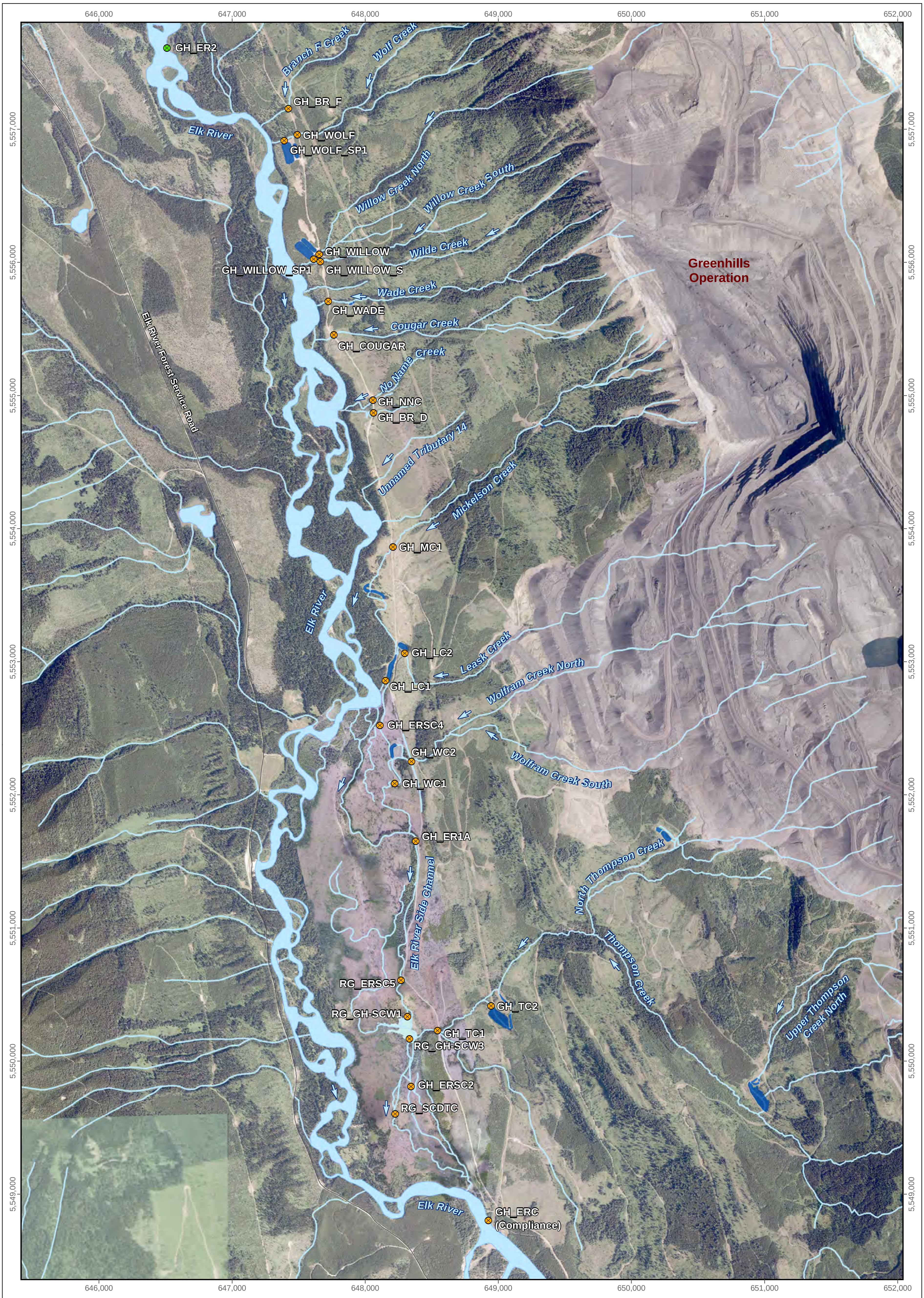
Date: June 2020
Project 197202.0011

minnow environmental inc.

Figure 1

Document Path: S:\Projects\197202\197202.0011 - Teck GHO LAEMP 2019\4 - GIS\Study Design Amendment\19-11 Figure 1 Proposed BI, Tissue, Sediment and Amphibian Locations.mxd



LEGEND

- Routine Water Quality Monitoring Station (Permit 107517), Reference
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond

Proposed Surface Water Quality Monitoring Stations, GHO LAEMP 2020

0 0.5 1 2
km

N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: June 2020
Project 197202.0011

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Figure 2

Table 1: Summary of Water and Sediment Quality Sampling, Biological Sampling, and Biota Surveys Proposed for the GHO LAEMP 2020

Exposure Type	Stream Type	Stream Name	Water Station Code	Biological Area Code or Staff Gauge Location Code	ENV EMS Number	Area Description	UTM for Biological Area Code (NAD83, 11U)		Status	Groundwater	Surface Water	Substrate		Benthic Invertebrates		Amphibians
							Easting	Northing		Chemistry	Chemistry	Calcite Index	Sediment Physical-chemical Attributes	Community Endpoints	Tissue Chemistry (Composite taxa)	Survey
Reference	Main stem	Elk River	GH_ER2	RG_ELUGH	200389	u/s Branch Cr. and GHO	646739	5557609	Core RAEMP Reference	regular monitoring	monthly[c], concurrently[c]	3	3	3	3	-
Mine-exposed	Tributary	Mickelson Creek	GH_MC1	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862	GHO LAEMP		monthly[c]	-	-	-	-	-
	Tributary	Leask Creek	GH_LC1	GH_LC1	E257796	Leask Creek Sed. Pond Decant	648153	5552859	GHO LAEMP		monthly[c]	-	-	-	-	-
	Side channel	Elk River Side Channel	GH_ERSC4	GH_ERSC4	E305878	Elk River side channel u/s of Wolfram Creek	648111	5552522	GHO LAEMP		monthly[c], concurrently[c]	3	-	3	3	-
	tributary	Wolfram Creek	GH_WC1	GH_WC1	E257795	Wolfram Creek Sed. Pond Decant	648222	5552086	GHO LAEMP		monthly[c]	-	-	-	-	-
	Side channel	Elk River Side Channel	GH_ER1A	GH_ER1A	E305876	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648379	5551653	GHO LAEMP		monthly[c], concurrently[c]	3	-	3	3	-
	Side channel	Elk River Side Channel	RG_ERSC5	RG_ERSC5	-	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648275	5550608	GHO LAEMP		concurrently[c]	3	-	3	3	-
	Tributary	Thompson Creek	GH_TC2	THCK	E207436	Lower Thompson Creek	648596	5550237	RAEMP		monthly[c], concurrently[c]	3	-	3	3	-
	Side channel	Elk River Side Channel Wetland	RG_GH-SCW1	RG_GH-SCW1	-	Inlet of Reach 2 in the Elk River side channel downstream of Thompson Creek	648317	5550334	GHO LAEMP		monthly[c]	-	-	-	-	-
	Side channel	Elk River Side Channel Wetland	RG_GH-SCW3	RG_GH-SCW3	-	Outlet of Reach 2 in the Elk River side channel downstream of Thompson Creek	648332	5550166	GHO LAEMP		monthly[c], concurrently[c]	3	5	-	3	May through August
	Side channel	Elk River Side Channel	GH_ERSC2	GH_ERSC2	E305877	Elk River side channel d/s of Thompson Creek	648341	5549812	GHO LAEMP		monthly[c], concurrently[c]	3	-	3	3	
	Side channel	Elk River Side Channel	-	RG_SCDTC	-	Elk River side channel d/s of Thompson Creek	648226	5549603	GHO LAEMP		concurrently[c]	3	-	3	3	
	Main stem	Elk River	GH_ERC (Compliance)	RG_EL20	E300090	d/s Thompson Cr. and GHO	649146	5548514	Core RAEMP Mine-exposed		monthly/weekly[c], concurrently[c]	5	5	5	5	-

Sampling conducted for, and reported under, the 2020 GHO LAEMP.

Sampling conducted for, and reported under, the Regional Aquatic Effects Monitoring Program (RAEMP). Data will also be reported and interpreted under the 2020 GHO LAEMP.

Sampling conducted for, and reported under, the Site-Specific Groundwater Monitoring Program [SSGMP], the Regional Groundwater Monitoring Program [RGMP], Mass Balance Investigations [MBI], and Cougar Pit Extension Phase 2 (CPX2) monitoring. Data will also be reported and interpreted under the 2020 GHO LAEMP. New groundwater monitoring wells will be added in 2020, with locations to be determined.

Notes: "-" indicates no work conducted.

[b] The site-specific GHO groundwater program will be updated to address GHO LAEMP data needs.

[c] Concurrently - water chemistry sampling will be conducted concurrent with sediment and biological sampling. Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 6428.

Table 2: West-side Tributary Monthly Water Quality Monitoring Stations in the GHO LAEMP, 2020 (No Changes Proposed)

Exposure Type	Tributary Name	Water Station Code	ENV EMS Number	Area Description	UTM (NAD83, 11U)	
					Easting	Northing
Reference	Branch F Creek	GH_BR_F	E287437	Branch F at LRP Road	647423	5557155
Mine-exposed	Wolf Creek	GH_WOLF	E305855	Wolf Creek Sed. Pond Decant	647490	5556959
	Willow Creek	GH_WILLOW	-[a]	Willow Creek at LRP Road	647654	5556061
		GH_WILLOW_SP1	E305854	Willow Sediment Pond Decant	647604	5556029
		GH_WILLOW_S	-[a]	Willow South Creek at LRP Road	647663	5556006
	Wade Creek	GH_WADE	E287433	Wade Creek at LRP Road	647723	5555707
	Cougar Creek	GH_COUGAR	E287432	Cougar Creek at LRP Road	647765	5555457
	No Name Creek	GH_NNC	E305875	No Name Creek	648055	5554967
	Branch D	GH_BR_D	-[a]	Branch D Creek	648062	5554869
	Mickelson Creek	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862
	Leask Creek	GH_LC2	-[a]	Leask Creek upstream of Sed. Pond	648297	5553064
		GH_LC1	E257796	Leask Creek Sed. Pond Decant	648153	5552859
	Wolfram Creek	GH_WC2	-[a]	Wolfram Creek upstream of Sed. Pond	648347	5552251
		GH_WC1	E257795	Wolfram Creek Sed. Pond Decant	648222	5552086
	Thompson Creek	GH_TC2	E207436	Thompson Creek Sed. Pond Decant	648596	5550237
		GH_TC1	E102714	Thompson Creek at LRP Road	648550	5550221

Note: The west-side tributaries are listed from upstream to downstream. The side channel branches off from the main stem Elk River downstream of Leask Creek and upstream of Wolfram Creek (delineated in this table by the double line; see Figure 1). Water chemistry sampling is conducted monthly through Permit 107517 and Permit 6428.

[a] No ENV EMS number.

APPENDIX A
ACCEPTANCE OF CHANGES TO THE 2018 TO 2020 STUDY DESIGN FOR THE GHO LAEMP (ENV, JULY 2020)

July 28, 2020 Authorization Number: 107517

VIA EMAIL: Carla.Fraser@teck.com

Dear Carla Fraser:

Re: Acceptance of changes to the 2018-2020 Study Design for the Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP)

The Ministry of Environment and Climate Change Strategy is in receipt of the "Updated Sampling Design for 2020 GHO LAEMP" letter dated June 1, 2020 prepared by Minnow Environmental Inc. and submitted by Teck Coal Ltd. The proposed changes to the study design were submitted for approval as required by Section 9.3.4 of Permit 107517.

In preparation of this letter the Ministry has reviewed advice made by the independent scientist and Ktunaxa Nation Council (KNC) to the Environmental Monitoring Committee (EMC), and has reviewed Teck's responses to this advice which were provided to the EMC on June 1, 2020.

The Updated Sampling Design for 2020 GHO LAEMP dated June 1, 2020 is accepted.

This amendment doesn't exclude additional LAEMP questions that may arise and be required to be addressed.

If you have any questions, please contact Kara Przeczek (kara.przeczek@gov.bc.ca).

Yours truly,

Lana Miller, PhD.
for Director, *Environmental Management Act*

Ec:
Kara Przeczek, Environmental Protection Regional Operations Branch
Heather McMahon, Ktunaxa Nation Council
EMPR Permitting and Reclamation

APPENDIX B

DATA QUALITY REVIEW

APPENDIX B DATA QUALITY REVIEW

B1 INTRODUCTION

B1.1 Background

A variety of factors can influence the physical, chemical, and biological measurements made in an environmental study, and thus affect the accuracy and/or precision of the data. The magnitude of inaccuracy and/or imprecision have the potential to affect the reliability of conclusions made from the data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize variability that does not reflect natural spatial and/or temporal variability in the environment).

Data quality, as a concept, is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted to establish a relevant basis for judging whether the data set is adequate. A Data Quality Review (DQR) involves comparisons of field and laboratory measurement performance to Data Quality Objectives (DQOs) established for a particular study, such as evaluation of Laboratory Reporting Limits (LRLs), blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials [CRMs]).

Samples for chemical analyses were sent to laboratories accredited by the Canadian Association of Laboratory Accreditation (CALA) or the National Environmental Laboratory Accreditation Program (NELAP). Data were reviewed to determine if DQOs set by the laboratory (Table B.1) were met. Programs involving many samples and analytes often yield some results that exceed DQOs. This is particularly so for multi-element scans because the analytical conditions are not necessarily optimal for every element included in the scan.

The following DQR was conducted on laboratory data reported in 2020 for samples collected in support of the GHO LAEMP. The objective of this DQR was to define the overall quality of the data, and, by extension, the confidence with which the data can be used to derive conclusions. The intent of a DQR is not to reject measurements that did not meet a laboratory's DQO, but to ensure that questionable data received more scrutiny to determine what effects, if any, were had on interpretation of results within the context of the project.

B1.2 Laboratory Reporting Limits

A Laboratory Reporting Limit (LRL) is the lowest concentration of an analyte that can be reported with a reasonable degree of accuracy and precision and is ideally synonymous with the lower limit of quantitation (LLOQ). The LLOQ is the lowest concentration of an analyte that can be reliably measured within specific limits of precision and accuracy during routine

Table B.1: Laboratory Data Quality Objectives (DQO) for the GHO LAEMP, 2020

Quality Control Measure	Quality Control Sample Type/Check	Study Component				
		Water Chemistry	Selenium Speciation	Sediment Chemistry	Benthic Invertebrate Community	Benthic Invertebrate Tissue Chemistry
		ALS	Brooks	ALS	Cordillera	TrichAnalytics
Analytical Laboratory LRLs	Comparison of actual LRL versus target LRL	LRL for each parameter should be at least as low as applicable guidelines, benchmarks, and screening values	LRL for each parameter should be at least as low as applicable guidelines, benchmarks, and screening values	LRL for each parameter should be at least as low as applicable guidelines, benchmarks, and screening values	-	LRL for each parameter should be at least as low as applicable guidelines and benchmarks
Blank Analysis	Field or Laboratory Blank	Concentrations measured in blank samples should be < LRL	Concentrations measured in blank samples should be < LRL	-	-	-
Field Precision	Field Duplicates	≤30% RPD	-	≤30% RPD	-	-
Laboratory Precision	Laboratory Duplicates	≤10% RPD (conductivity) ≤15% RPD (ORP, turbidity) ≤20% RPD (all remaining analytes)	≤20% RPD (total selenium) ≤25% RPD (selenium species)	≤5% RPD (particle size) ≤20% RPD (moisture) ≤30% RPD (all remaining analytes) ≤40% RPD (aluminum, barium, lead, mercury, molybdenum, potassium, silver, sodium, strontium, tin, titanium) ≤50% RPD (PAHs) Within 2-times the LRL (pH)	-	≤60% RPD (calcium and strontium) ≤40% RPD (all remaining analytes)
Laboratory Accuracy	Recovery of Blank Spike	6.9 to 7.1 (pH) 60 to 140% (total silicon) 75 to 125% (TKN) 80 to 120% (orthophosphate, phosphorus, TOC, DOC, total and dissolved metals) 85 to 115% (alkalinity, ammonia, bromide, TSS, TDS, turbidity) 90 to 110% (conductivity, chloride, fluoride, nitrate, nitrite, sulfate)	75 to 125% (methylseleninic acid, selenate, selenite, selenocyanate, selenomethionine, total selenium)	50 to 130% (naphthalene) 50 to 150% (Acridine, Benzo(e)pyrene, 1-Methylnaphthalene, Perylene, Quinoline) 60 to 130% (all remaining PAHs) 80 to 120% (inorganic carbon, metals) 90 to 110% (moisture, TOC)	-	-
	Recovery of Matrix Spike	70 to 130% (DOC, orthophosphate, total phosphorus, TKN, TOC, total and dissolved metals) 75 to 125% (ammonia, bromide, chloride, fluoride, nitrate, nitrite, sulfate)	75 to 125% (selenate, selenite, selenocyanate, selenomethionine, total selenium)	50 to 150% (PAHs)	-	-
	Matrix Spike Duplicate	-	75 to 125% (selenate, selenite, selenocyanate, selenomethionine, total selenium)	-	-	-
	Recovery of Certified Reference Material	80 to 120% (orthophosphate, total phosphorus) 85 to 115% (alkalinity, turbidity) 90 to 110% (conductivity) 210 to 230% (ORP) 6.9 to 7.1 (pH)	75 to 125% (total selenium)	70 to 130% (metals)	-	60 to 140% (antimony, barium, boron, silver, titanium, tin) 70 to 130% (all remaining analytes) 90 to 110% (selenium)
	Internal Reference Material	-	-	60 to 130% (PAHs) 80 to 120% (inorganic carbon, total carbon) 7.4 to 8 (pH 1:2 soil:water)	-	-
	Laboratory Control Sample	6.9 to 7.1 (pH) 75 to 125% (TKN) 80 to 120% (ORP, DOC, TOC, total phosphorus, all metals) 85 to 115% (all remaining analytes) 90 to 110% (conductivity, fluoride, nitrate, nitrite, sulfate)	-	60 to 130% (PAHs) 80 to 120% (metals) 90 to 110% (inorganic carbon, total carbon) 90 to 110% (moisture) 6.8 to 7.2 (pH 1:2 soil:water)	-	-
	Organism Recovery	-	-	-	≥90% recovery	-
	Organism Sub-Sampling Accuracy	-	-	-	≤20% difference between sub-samples; minimum of 5% of each sample must be analyzed; TIR < 5%	-

Notes: "-" indicates quality control method was not applied; ALS = ALS Environmental; Brooks = Brooks Applied Laboratory; SRC = Saskatchewan Research Council; LRL = Laboratory Reporting Limit; RPD = Relative Percent Difference; DQO = Data Quality Objectives; ORP = oxidation-reduction potential; PAHs = polycyclic aromatic hydrocarbons; TKN = Total Kjeldahl Nitrogen; TOC = total organic carbon; DOC = dissolved organic carbon; TSS = total suspended solids; TDS = total dissolved solids; TIR = total identification error rate.

operating conditions, which in most cases is the lowest concentration on the calibration curve. This differs from the lowest concentration that can be detected (i.e., reliably distinguished from a blank sample) which is known as the method detection limit (MDL). The LRL is typically three to ten times the method detection limit (MDL); however, some guidelines are so low the LRL is equal to the MDL to meet the guideline. Achieving satisfactory LRLs is important when comparing concentrations to guidelines for that medium. If the LRL is above the guideline, the data cannot be accurately interpreted. Consistency is also important for LRLs when taking consecutive samples. Changes in LRLs between laboratory reports can affect summary calculations and introduce confounding factors when assessing trends. For the present study, LRLs were screened against guidelines including British Columbia Water Quality Guidelines for the protection of Aquatic Life (BCWQG; ENV 2019, 2021), Elk Valley Water Quality Plan (EVWQP) benchmarks (Teck 2014), and site-specific screening values, as appropriate.

B1.3 Quality Control Samples

Typically, a DQR involves the examination of analytical results associated with several types of Quality Control (QC) samples collected (or prepared) in the field and laboratory. Quality control samples collected for this project, and a description of each QC sample type, are as follows:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed in the same way as regular samples. These samples reflect contamination of samples occurring in the field (in the case of field or travel blanks) or in the laboratory (in the case of laboratory or method blanks). Concentrations of analytes should be below the LRL.
- **Laboratory duplicates** are replicate sub-samples created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect variability introduced during laboratory sample handling and analysis, and thus provide a measure of laboratory precision.
- **Field duplicates** are samples collected from a randomly selected field station that are homogenized to the greatest extent possible in the field, split, and analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. These samples reflect variability introduced during the handling of samples (e.g., during collection and homogenization), both in the field and laboratory, and therefore provide a measure of field sampling and laboratory precision.

- **Spike recovery samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in the spiked sample minus the amount in the original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes, BS) are created using laboratory control materials whereas matrix spikes (MS) are created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.

- **CRM** or **IRM** are commercially or internally prepared or homogenized reference materials containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known concentration that was recovered in the analysis.

- **LCS** are laboratory control samples created in the laboratory to have a known analyte concentration in a matrix free of interferences, such as deionized water or reference sand. The sample results are compared to the target results to confirm that the analytical method is accurate in a purified reference sample. The results are reported as the percent of the known concentration that was recovered in the analysis.

- **Organism recovery checks** for benthic invertebrate community samples involve the reprocessing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved in the original processing to reduce bias. This check allows for the determination of accuracy through assessment of recovery efficiency.

- **Sub-sampling error** is assessed for studies in which benthic invertebrate community samples require sub-sampling (due to excessive sample volume and/or high invertebrate density). By comparing the numbers of benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample. Therefore, sub-sampling error provides a measure of analytical accuracy and precision. The processing of entire benthic invertebrate community samples in representative sample fractions also allows an evaluation of sub-sampling accuracy.

B2 WATER QUALITY

B2.1 Laboratory Reporting Limited

The analytical reports for water chemistry from ALS Environmental and Brooks Applied Labs (BAL; see Appendix H for laboratory reports L2499489, L2502324, L2503391, L2504022, and L2505298) were examined to assess LRLs relative to applicable guidelines (Tables B.2 and B.3). The LRLs for water quality analytes were assessed relative to British Columbia Water Quality Guidelines (BCWQG; ENV 2019, 2021) for the protection of freshwater aquatic life, EVWQP Level 1 Benchmarks for water quality (Teck 2014), and relevant site-specific benchmarks. Several analytes were entirely reported below the LRL (i.e., in 100% of samples; Table B.2 and B.3). For those analytes with one or more result(s) below the LRL, achieved LRLs were consistently lower than the BCWQG and EVWQP Level 1 Benchmarks for water quality (Teck 2014). Therefore, the achieved LRLs were appropriate for this study.

B2.2 Field and Laboratory Blanks

One field blank sample and three trip blank samples were submitted to ALS Environmental for water chemistry analyses to assess the potential for field sampling contamination (Table B.4). The same DQOs that were used for laboratory blanks were also used for field blanks (i.e., concentrations should be < LRL). Of the 292 analyte results for field and trip blanks, only 7 (2.40%) had concentrations greater than the LRL (Table B.4). For analytes with reported concentrations greater than the LRL, only two had concentrations greater than 5-times the LRL (ammonia and Total Kjeldahl Nitrogen; Appendix H).

A total of 105 method blank samples were assessed for water chemistry (not including those for selenium speciation) were analyzed by ALS Environmental (Appendix H). These blank samples consisted of 523 individual analyte results. All concentrations were below the LRL.

Overall, the number of detectable concentrations was relatively low among trip, field, and laboratory blank samples, and the majority of detectable concentrations were within 5-times the LRL. Therefore, these results are expected to have a negligible impact on data interpretability in this study.

B2.3 Data Accuracy and Precision

Data accuracy for water chemistry analyses completed by ALS Environmental (excluding selenium speciation) was evaluated based on results for 6 certified reference materials (CRM) samples, 129 laboratory control samples (LCS), and 19

Table B.2: Laboratory Reporting Limit (LRL) Evaluation for Water Chemistry Analyses

Parameter	Units	BC WQG [a]		EVWQP Level 1 Benchmarks/ Relevant Screening Values [b]	Range of LRLs	No. LRLs > Guideline [c]	No. Sample Results < LRL
		Short-term	Long-term				
Physical Tests							
Conductivity	µS/cm	-	-	-	2	-	0
Hardness (as $CaCO_3$)	mg/L	-	-	-	0.5	-	0
pH	pH	-	-	-	0.1	-	0
ORP	mV	-	-	-	-1000	-	0
Total Suspended Solids	mg/L	-	-	-	1	-	5 (62.5%)
Total Dissolved Solids	mg/L	-	-	1,000	20	0	0
Turbidity	NTU	-	-	-	0.1	-	0
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	-	-	-	1	-	8 (100%)
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	-	-	-	1	-	1 (12.5%)
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	-	-	-	1	-	3 (37.5%)
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	-	-	-	1	-	7 (87.5%)
Alkalinity, Total (as $CaCO_3$)	mg/L	-	-	-	1	-	0
Bromide (Br)	mg/L	-	-	-	0.05 to 0.25	-	8 (100%)
Chloride (Cl)	mg/L	600	150	-	0.1 to 0.5	0	0
Fluoride	mg/L	1.52	-	-	0.02 to 0.1	0	1 (12.5%)
Ammonia, Total (as N) [d]	mg/L	0.752	0.102	-	0.005	0	5 (62.5%)
Nitrate (as N)	mg/L	32.8	3.00	4.75	0.005 to 0.025	0	0
Nitrite (as N) [e]	mg/L	0.0600	0.0200	-	0.001 to 0.005	0	6 (75.0%)
Total Kjeldahl Nitrogen	mg/L	-	-	-	0.05 to 0.25	-	4 (50.0%)
Orthophosphate - Dissolved	mg/L	-	-	-	0.001	-	7 (87.5%)
Phosphorus (P) - Total	mg/L	-	-	-	0.002	-	5 (62.5%)
Sulfate [f]	mg/L	-	309	429	0.3 to 1.5	0	0
Anion Sum	meq/L	-	-	-	0	-	0
Cation Sum	meq/L	-	-	-	0	-	0
Organic / Inorganic Carbon							
Dissolved Organic Carbon	mg/L	-	-	-	0.5	-	5 (62.5%)
Total Organic Carbon	mg/L	-	-	-	0.5	-	5 (62.5%)
Total Metals							
Aluminum	mg/L	-	-	-	0.003	-	0
Antimony	mg/L	-	0.00900	-	0.0001	0	7 (87.5%)
Arsenic	mg/L	0.00500	-	-	0.0001	0	1 (12.5%)
Barium	mg/L	-	1.00	-	0.0001	0	0
Beryllium	µg/L	-	0.130	-	0.02	0	8 (100%)
Bismuth	mg/L	-	-	-	0.00005	-	8 (100%)
Boron	mg/L	-	1.20	-	0.01	0	7 (87.5%)
Cadmium	µg/L	-	-	-	0.005	-	0
Calcium	mg/L	-	-	-	0.05	-	0
Chromium [g]	mg/L	-	0.00100	-	0.0001	0	1 (12.5%)
Cobalt	µg/L	110	4.00	-	0.1	0	8 (100%)
Copper	mg/L	0.200	0.200	-	0.0005	0	8 (100%)
Iron	mg/L	1.00	-	-	0.01	0	2 (25.0%)
Lead [f]	mg/L	0.145	0.00897	-	0.00005	0	7 (87.5%)
Lithium	mg/L	-	-	-	0.001	-	0
Magnesium	mg/L	-	-	-	0.1	-	0
Manganese	mg/L	2.27	1.30	-	0.0001	-	0
Mercury [h]	µg/L	-	0.00125	-	0.0005	0	7 (87.5%)
Molybdenum	mg/L	2.00	1.00	-	0.00005	0	0
Nickel [f]	mg/L	-	0.135	0.00530	0.0005	0	3 (37.5%)
Potassium	mg/L	-	-	-	0.05	-	0
Selenium	µg/L	-	2.00	19.0	0.05	0	0
Silicon	mg/L	-	-	-	0.1	-	0
Silver [f]	mg/L	0.00300	0.00150	-	0.00001	0	8 (100%)
Sodium	mg/L	-	-	-	0.05	-	0
Strontium	mg/L	-	-	-	0.0002	-	0
Thallium	mg/L	-	0.000800	-	0.00001	0	7 (87.5%)
Tin	mg/L	-	-	-	0.0001	-	8 (100%)
Titanium	mg/L	-	-	-	0.01	-	8 (100%)
Uranium	mg/L	-	0.00850	-	0.00001	0	0
Vanadium	mg/L	-	-	-	0.0005	-	8 (100%)
Zinc [f]	mg/L	0.0832	0.0578	-	0.003	0	8 (100%)
Dissolved Metals							
Aluminum	mg/L	0.100	0.0500	-	0.003	0	8 (100%)
Antimony	mg/L	-	-	-	0.0001	-	7 (87.5%)
Arsenic	mg/L	-	-	-	0.0001	-	3 (37.5%)
Barium	mg/L	-	-	-	0.0001	-	0
Beryllium	µg/L	-	-	-	0.02	-	8 (100%)
Bismuth	mg/L	-	-	-	0.00005	-	8 (100%)
Boron	mg/L	-	-	-	0.01	-	7 (87.5%)
Cadmium [f]	µg/L	0.936	0.295	0.196	0.005	-	0
Calcium	mg/L	-	-	-	0.05	-	0
Chromium	mg/L	-	-	-	0.0001	-	1 (12.5%)
Cobalt	µg/L	-	-	-	0.1	-	8 (100%)
Copper	mg/L	0.200	0.200	-	0.0002	0	7 (87.5%)
Iron	mg/L	0.350	-	-	0.01	0	8 (100%)
Lead [f]	mg/L	-	-	-	0.00005	-	8 (100%)
Lithium	mg/L	-	-	-	0.001	-	0
Magnesium	mg/L	-	-	-	0.1	-	0
Manganese	mg/L	-	-	-	0.0001	-	0
Mercury [h]	µg/L	-	-	-	0.000005	-	8 (100%)
Molybdenum	mg/L	-	-	-	0.00005	-	0
Nickel [f]	mg/L	-	-	-	0.0005	-	3 (37.5%)
Potassium	mg/L	-	-	-	0.05	-	0
Selenium	µg/L	-	-	-	0.05	-	0
Silicon	mg/L	-	-	-	0.05	-	0
Silver [f]	mg/L	-	-	-	0.00001	-	8 (100%)
Sodium	mg/L	-	-	-	0.05	-	0
Strontium	mg/L	-	-	-	0.0002	-	0
Thallium	mg/L	-	-	-	0.00001	-	8 (100%)
Tin	mg/L	-	-	-	0.0001	-	8 (100%)
Titanium	mg/L	-	-	-	0.01	-	8 (100%)
Uranium	mg/L	-	-	-	0.00001	-	0
Vanadium	mg/L	-	-	-	0.0005	-	8 (100%)
Zinc [f]	mg/L	-	-	-	0.001	-	7 (87.5%)

Notes: The total number of samples (n) was 8. EVWQP = Elk Valley Water Quality Plan; LRL = Laboratory Reporting Limit, "-" indicates where no applicable guideline exists.

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (ENV 2019 and 2020).

[b] Where more than one EVWQP Level 1 Benchmark or screening value was applicable, the most conservative (lowest) value was used.

[c] The LRLs for all analytes were consistently less than the applicable EVWQP Level 1 benchmarks (Teck 2014) or screening values (Golder 2014; Teck 2020)

[d] Based on most conservative guideline using highest temperature (20) and pH (9).

[e] Minimum water quality guidelines for Nitrite (as N) reported in ENV (2020) for chloride concentrations < 2 mg/L.

[f] Hardness-based guidelines calculated using the minimum hardness observed for all samples (139 mg/L).

[g] Guideline for Chromium VI (0.001 mg/L) was selected, as this is the principal species found in surface waters.

[h] The most conservative guideline (0.00125 µg/L) was applied.

Table B.3: Laboratory Reporting Limit (LRL) Evaluation for Selenium Speciation Analyses

Parameter	Units	BC WQG [a]		EVWQP Level 1 Benchmarks/ Relevant Screening Values [b]	Range of LRLs	No. LRLs > Guideline	No. Sample Results < LRL
		Short-term	Long-term				
Selenium (Se)-Total	µg/L	-	2.00	19.0	0.192	0	0
Selenium (Se)-Dissolved	µg/L	-	-	-	0.192	-	0
Dimethylselenoxide-Dissolved	µg/L	-	-	-	0.01	-	6 (66.7%)
MeSe(IV) - methylseleninic acid CH_3SeO_2H-Dissolved	µg/L	-	-	-	0.01	-	5 (55.6%)
Selenium Unknown - Dissolved	µg/L	-	-	-	0.01	-	9 (100%)
Se(IV) - selenite $SeO_3^{(-2)}$-Dissolved	µg/L	-	-	-	0.05	-	4 (44.4%)
Se(VI) - selenate $SeO_4^{(-2)}$-Dissolved	µg/L	-	-	-	0.06	-	0
SeCN - selenocyanate $SeCN^{(-1)}$ - Dissolved	µg/L	-	-	-	0.04	-	9 (100%)
SeMe - selenomethionine $CH_3SeCH_2CH_2CH(NH_2)CO_2H$-Dissolved	µg/L	-	-	-	0.01	-	9 (100%)
Selenosulfate-Dissolved	µg/L	-	-	-	0.06	-	9 (100%)
Unknown Selenium Species-Dissolved	µg/L	-	-	-	0.06	-	9 (100%)

Notes: The total number of samples (n) was 9. EVWQP = Elk Valley Water Quality Plan; LRL = Laboratory Reporting Limit. "-" indicates that no applicable guideline exists for that analyte.

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (ENV 2019 and 2020)

[b] Where more than one EVWQP Level 1 Benchmark or screening value was applicable, the most conservative (lowest) value was used.

Table B.4: Field Blank and Trip Blank Evaluation for Water Chemistry Analyses

Parameter	Units	BC WQG [a]		EVWQP Level 1 Benchmarks/ Relevant Screening Values [b]	Range of LRLs	No. LRLs > Guideline [c]	No. Sample Results < LRL
		Short-term	Long-term				
Physical Tests							
Conductivity (@ 25°C)	µS/cm	-	-	-	2	-	4 (100%)
Hardness (as $CaCO_3$)	mg/L	-	-	-	0.5	-	2 (100%)
pH	pH	-	-	-	0.1	-	-
ORP	mV	-	-	-	-1000	-	-
Total Suspended Solids	mg/L	-	-	-	1	-	4 (100%)
Total Dissolved Solids	mg/L	-	-	1,000	10	0	4 (100%)
Turbidity	NTU	-	-	-	0.1	-	4 (100%)
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	-	-	-	1	-	1 (25.0%)
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	-	-	-	1	-	4 (100%)
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	-	-	-	1	-	4 (100%)
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	-	-	-	1	-	4 (100%)
Alkalinity, Total (as $CaCO_3$)	mg/L	-	-	-	1	-	4 (100%)
Bromide (Br)	mg/L	-	-	-	0.05	-	4 (100%)
Chloride (Cl)	mg/L	600	150	-	0.1	0	4 (100%)
Fluoride	mg/L	1.52	-	-	0.02	0	4 (100%)
Ammonia, Total (as N) [d]	mg/L	0.752	0.102	-	0.005	0	3 (75.0%)
Nitrate (as N)	mg/L	32.8	3.00	4.75	0.005	0	4 (100%)
Nitrite (as N) [e]	mg/L	0.0600	0.0200	-	0.001	0	4 (100%)
Total Kjeldahl Nitrogen	mg/L	-	-	-	0.05	-	4 (100%)
Orthophosphate - Dissolved	mg/L	-	-	-	0.001	-	4 (100%)
Phosphorus (P) - Total	mg/L	-	-	-	0.002	-	4 (100%)
Sulfate [f]	mg/L	-	309	429	0.3	0	4 (100%)
Anion Sum	meq/L	-	-	-	0.1	-	4 (100%)
Cation Sum	meq/L	-	-	-	0.1	-	4 (100%)
Organic / Inorganic Carbon							
Dissolved Organic Carbon	mg/L	-	-	-	0.5	-	2 (100%)
Total Organic Carbon	mg/L	-	-	-	0.5	-	4 (100%)
Total Metals							
Aluminum	mg/L	-	-	-	0.003	-	4 (100%)
Antimony	mg/L	-	0.00900	-	0.0001	0	4 (100%)
Arsenic	mg/L	0.00500	-	-	0.0001	0	4 (100%)
Barium	mg/L	-	1.00	-	0.0001	0	3 (75.0%)
Beryllium	µg/L	-	0.130	-	0.02	0	4 (100%)
Bismuth	mg/L	-	-	-	0.00005	-	4 (100%)
Boron	mg/L	-	1.20	-	0.01	0	4 (100%)
Cadmium	µg/L	-	-	-	0.005	-	4 (100%)
Calcium	mg/L	-	-	-	0.05	-	4 (100%)
Chromium [g]	mg/L	-	0.00100	-	0.0001	0	4 (100%)
Cobalt	µg/L	110	4.00	-	0.1	0	4 (100%)
Copper	mg/L	0.200	0.200	-	0.0005	0	4 (100%)
Iron	mg/L	1.00	-	-	0.01	0	4 (100%)
Lead [f]	mg/L	0.145	0.00897	-	0.00005	0	4 (100%)
Lithium	mg/L	-	-	-	0.001	-	4 (100%)
Magnesium	mg/L	-	-	-	0.1	-	4 (100%)
Manganese	mg/L	2.27	1.30	-	0.0001	0	4 (100%)
Mercury [h]	µg/L	-	0.00125	-	0.0005	0	4 (100%)
Molybdenum	mg/L	2.00	1.00	-	0.00005	0	4 (100%)
Nickel [f]	mg/L	-	0.135	0.00530	0.0005	0	4 (100%)
Potassium	mg/L	-	-	-	0.05	-	4 (100%)
Selenium	µg/L	-	2.00	19.0	0.05	0	4 (100%)
Silicon	mg/L	-	-	-	0.1	-	4 (100%)
Silver [f]	mg/L	0.00300	0.00150	-	0.00001	0	4 (100%)
Sodium	mg/L	-	-	-	0.05	-	3 (75.0%)
Strontium	mg/L	-	-	-	0.0002	-	4 (100%)
Thallium	mg/L	-	0.000800	-	0.00001	0	4 (100%)
Tin	mg/L	-	-	-	0.0001	-	3 (75.0%)
Titanium	mg/L	-	-	-	0.01	-	4 (100%)
Uranium	mg/L	-	0.00850	-	0.00001	0	4 (100%)
Vanadium	mg/L	-	-	-	0.0005	-	4 (100%)
Zinc [f]	mg/L	0.0832	0.0578	-	0.003	0	4 (100%)
Dissolved Metals							
Aluminum	mg/L	0.100	0.0500	-	0.003	0	2 (100%)
Antimony	mg/L	-	-	-	0.0001	-	2 (100%)
Arsenic	mg/L	-	-	-	0.0001	-	2 (100%)
Barium	mg/L	-	-	-	0.0001	-	2 (100%)
Beryllium	µg/L	-	-	-	0.02	-	2 (100%)
Bismuth	mg/L	-	-	-	0.00005	-	2 (100%)
Boron	mg/L	-	-	-	0.01	-	2 (100%)
Cadmium [f]	µg/L	0.936	0.295	0.196	0.005	0	2 (100%)
Calcium	mg/L	-	-	-	0.05	-	4 (100%)
Chromium	mg/L	-	-	-	0.0001	-	2 (100%)
Cobalt	µg/L	-	-	-	0.1	-	2 (100%)
Copper	mg/L	0.200	0.200	-	0.0002	0	2 (100%)
Iron	mg/L	0.350	-	-	0.01	0	2 (100%)
Lead [f]	mg/L	-	-	-	0.00005	-	2 (100%)
Lithium	mg/L	-	-	-	0.001	-	2 (100%)
Magnesium	mg/L	-	-	-	0.005 to 0.1	-	4 (100%)
Manganese	mg/L	-	-	-	0.0001	-	2 (100%)
Mercury [h]	µg/L	-	-	-	0.005	-	2 (100%)
Molybdenum	mg/L	-	-	-	0.00005	-	2 (100%)
Nickel [f]	mg/L	-	-	-	0.0005	-	2 (100%)
Potassium	mg/L	-	-	-	0.05	-	4 (100%)
Selenium	µg/L	-	-	-	0.05	-	2 (100%)
Silicon	mg/L	-	-	-	0.05	-	2 (100%)
Silver [f]	mg/L	-	-	-	0.00001	-	2 (100%)
Sodium	mg/L	-	-	-	0.05	-	4 (100%)
Strontium	mg/L	-	-	-	0.0002	-	2 (100%)
Thallium	mg/L	-	-	-	0.00001	-	2 (100%)
Tin	mg/L	-	-	-	0.0001	-	2 (100%)
Titanium	mg/L	-	-	-	0.01	-	2 (100%)
Uranium	mg/L	-	-	-	0.00001	-	2 (100%)
Vanadium	mg/L	-	-	-	0.0005	-	2 (100%)
Zinc [f]	mg/L	-	-	-	0.001	-	2 (100%)

Indicates at least one field or trip blank sample had a detectable concentration above the LRL.

Notes: One field blank and three trip blank samples were analyzed. In two trip blank samples, only Ca, Mg, K and Na were analyzed for dissolved metals. EVWQP = Elk Valley Water Quality Plan; LRL = Laboratory Reporting Limit, "-" indicates where no applicable guideline exists.

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (ENV 2019 and 2020)

[b] Where more than one EVWQP Level 1 Benchmark or screening value was applicable, the most conservative (lowest) value was used.

[c] The LRLs for all analytes were consistently less than the applicable EVWQP Level 1 benchmarks (Teck 2014) or screening values (Golder 2014; Teck 2020)

[d] Based on most conservative guideline using highest temperature (20) and pH (9).

[e] Minimum water quality guidelines for Nitrite (as N) reported in ENV (2020) for chloride concentrations < 2 mg/L.

[f] Hardness-based guidelines calculated using the minimum hardness observed for all samples (139 mg/L).

[g] Guideline for Chromium VI (0.001 mg/L) was selected, as this is the principal species found in surface waters.

[h] The most conservative guideline (0.00125 µg/L) was applied.

matrix spike (MS) samples (Appendix H). Results of CRM, LCS, and MS sample analyses generally met the laboratory DQO (Table B.1), with the following exceptions:

- total antimony in one LCS sample;
- total beryllium in one LCS sample;
- total lithium in one LCS sample;
- total barium in one MS sample;
- total calcium in one MS sample;
- magnesium in one MS sample;
- total sulphate in one MS sample;
- total strontium in two MS samples;

For the LCS samples that did not meet the laboratory DQO, the DQO was exceeded by less than 10%, which is considered acceptable as per CCME (see laboratory report L2504022 in Appendix H). For the MS results which did not meet the laboratory DQO, analyte concentrations were high in the background sample (i.e., the field sample used as the base for the MS sample) and the analytical laboratory was unable to accurately calculate the recovery of the spiked material (see laboratory reports L2499489 and L2503391 in Appendix H). Otherwise, accuracy for all analytes in CRM, LCS, and MS samples were within the laboratory DQO. Therefore, the overall accuracy achieved by the laboratory was considered good.

Data accuracy for selenium speciation analyses completed by BAL was evaluated based on the results for eight CRM samples, eight blank spike (BS) samples, three MS samples, and three matrix spike duplicate (MSD) samples (Appendix H). All CRM, BS, MS, and MSD samples met the laboratory DQO. Therefore, the overall accuracy achieved by the laboratory was considered excellent.

Two sets of field duplicate samples were collected to assess field sampling precision of water chemistry measured by ALS Environmental (excluding selenium speciation; Table B.5). Relative percent differences (RPDs) between field duplicate samples for most analytes (> 90% of detected analytes) were below 30%, with the exceptions of:

- oxidation-reduction potential (ORP) in one set of samples (RPD = 32.4%);
- acidity in one set of samples (RPD = 46.2%);

Table B.5: Field Duplicate Results for Water Chemistry Analyses

Parameter	Units	RG_EL20_WS_2020-09-15_1430	RG_RIVER_WS_2020-09-15_1430	RPD1	RG_ERSC5_WS_2020-09-10_1645	RG_RIVER1_WS_2020-09-10_1645	RPD2
Physical Tests							
Conductivity (@ 25°C)	µS/cm	298	297	0.336	295	296	0.338
Hardness (as $CaCO_3$)	mg/L	171	165	3.57	167	172	2.95
pH	pH	8.32	8.18	1.70	8.3	8.3	0
ORP	mV	419	329	24.1	375	520	32.4
Total Suspended Solids	mg/L	<1	<1	-	<1	<1	-
Total Dissolved Solids	mg/L	190	183	3.75	187	186	0.536
Turbidity	NTU	0.5	0.11	128	0.69	0.77	11.0
Anions and Nutrients							
Acidity (as $CaCO_3$)	mg/L	<1	1.6	46.2	<1	<1	-
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	<1	149	197	145	140	3.51
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	<1	<1	-	<1	<1	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	150	<1	197	<1	<1	-
Alkalinity, Total (as $CaCO_3$)	mg/L	150	149	0.669	145	140	3.51
Bromide (Br)	mg/L	<0.05	<0.05	-	<0.05	<0.05	-
Chloride (Cl)	mg/L	0.32	0.31	3.17	0.32	0.32	0
Fluoride	mg/L	0.15	0.146	2.70	0.164	0.162	1.23
Ammonia, Total (as N)	mg/L	0.0095	0.0056	51.7	0.0086	<0.005	52.9
Nitrate (as N)	mg/L	0.398	0.393	1.26	0.342	0.342	0
Nitrite (as N)	mg/L	<0.001	<0.001	-	<0.001	<0.001	-
Total Kjeldahl Nitrogen	mg/L	<0.05	<0.05	-	0.194	0.144	29.6
Orthophosphate-Dissolved	mg/L	0.0013	<0.001	26.1	<0.001	<0.001	-
Phosphorus (P)-Total	mg/L	<0.002	<0.002	-	<0.002	<0.002	-
Sulfate	mg/L	27.3	27	1.10	26.1	26.1	0
Anion Sum	meq/L	3.61	3.59	0.556	3.48	3.39	2.62
Cation Sum	meq/L	3.47	3.36	3.22	3.39	3.49	2.91
Organic / Inorganic Carbon							
Dissolved Organic Carbon	mg/L	<0.5	<0.5	-	<0.5	<0.5	-
Total Organic Carbon	mg/L	<0.5	<0.5	-	<0.5	<0.5	-
Total Metals							
Aluminum	mg/L	0.0056	0.0066	16.4	0.0082	0.0141	52.9
Antimony	mg/L	<0.0001	<0.0001	-	<0.0001	<0.0001	-
Arsenic	mg/L	<0.0001	0.00018	57.1	0.00012	0.00014	15.4
Barium	mg/L	0.057	0.0552	3.21	0.0475	0.0483	1.67
Beryllium	µg/L	<0.02	<0.02	-	<0.02	<0.02	-
Bismuth	mg/L	<0.00005	<0.00005	-	<0.00005	<0.00005	-
Boron	mg/L	<0.01	<0.01	-	<0.01	<0.01	-
Cadmium	µg/L	0.0087	0.0071	20.3	0.009	0.0099	9.52
Calcium	mg/L	50.1	47.4	5.54	46.8	46.8	0
Chromium	mg/L	0.00024	0.00023	4.26	0.00021	0.0002	4.88
Cobalt	µg/L	<0.1	<0.1	-	<0.1	<0.1	-
Copper	mg/L	<0.0005	<0.0005	-	<0.0005	<0.0005	-
Iron	mg/L	<0.01	<0.01	-	0.011	0.019	53.3
Lead	mg/L	<0.00005	<0.00005	-	<0.00005	<0.00005	-
Lithium	mg/L	0.003	0.0028	6.90	0.0029	0.003	3.39
Magnesium	mg/L	11.3	12.4	9.28	12.1	12.5	3.25
Manganese	mg/L	0.00115	0.00116	0.866	0.00169	0.00211	22.1
Mercury	µg/L	<0.0005	<0.0005	-	<0.0005	<0.0005	-
Molybdenum	mg/L	0.00124	0.0011	12.0	0.00122	0.00107	13.1
Nickel	mg/L	<0.0005	<0.0005	-	0.00107	0.00107	0
Potassium	mg/L	0.418	0.43	2.83	0.425	0.421	0.946
Selenium	µg/L	2.03	1.7	17.7	1.36	1.42	4.32
Silicon	mg/L	1.99	2.06	3.46	1.78	1.79	0.560
Silver	mg/L	<0.00001	<0.00001	-	<0.00001	<0.00001	-
Sodium	mg/L	0.948	0.928	2.13	0.827	0.846	2.27
Strontium	mg/L	0.209	0.216	3.29	0.213	0.213	0
Thallium	mg/L	<0.00001	<0.00001	-	<0.00001	<0.00001	-
Tin	mg/L	<0.0001	<0.0001	-	<0.0001	<0.0001	-
Titanium	mg/L	<0.01	<0.01	-	<0.01	<0.01	-
Uranium	mg/L	0.000711	0.000785	9.89	0.0008	0.000822	2.71
Vanadium	mg/L	<0.0005	0.00069	31.9	<0.0005	<0.0005	-
Zinc	mg/L	<0.003	<0.003	-	<0.003	<0.003	-
Dissolved Metals							
Aluminum	mg/L	<0.003	<0.003	-	<0.003	<0.003	-
Antimony	mg/L	<0.0001	<0.0001	-	<0.0001	<0.0001	-
Arsenic	mg/L	<0.0001	<0.0001	-	<0.0001	<0.0001	-
Barium	mg/L	0.0554	0.056	1.08	0.0468	0.048	2.53
Beryllium	µg/L	<0.02	<0.02	-	<0.02	<0.02	-
Bismuth	mg/L	<0.00005	<0.00005	-	<0.00005	<0.00005	-
Boron	mg/L	<0.01	<0.01	-	<0.01	<0.01	-
Cadmium	µg/L	0.0072	0.0069	4.26	0.0083	0.0082	1.21
Calcium	mg/L	48.9	46.5	5.03	48.3	49.6	2.66
Chromium	mg/L	0.00022	0.00022	0	0.00023	0.0002	14.0
Cobalt	µg/L	<0.1	<0.1	-	<0.1	<0.1	-
Copper	mg/L	<0.0002	<0.0002	-	<0.0002	<0.0002	-
Iron	mg/L	<0.01	<0.01	-	<0.01	<0.01	-
Lead	mg/L	<0.00005	<0.00005	-	<0.00005	<0.00005	-
Lithium	mg/L	0.0031	0.0027	13.8	0.0031	0.0031	0
Magnesium	mg/L	11.8	12	1.68	11.3	11.7	3.48
Manganese	mg/L	0.00069	0.0007	1.44	0.00085	0.00092	7.91
Mercury	µg/L	<0.005	<0.005	-	<0.005	<0.005	-
Molybdenum	mg/L	0.00118	0.00107	9.78	0.00101	0.001	0.995
Nickel	mg/L	<0.0005	<0.0005	-	0.00058	0.00057	1.74
Potassium	mg/L	0.432	0.421	2.58	0.422	0.446	5.53
Selenium	µg/L	1.8	1.72	4.55	1.4	1.38	1.44
Silicon	mg/L	1.93	1.92	0.519	1.75	1.76	0.570
Silver	mg/L	<0.00001	<0.00001	-	<0.00001	<0.00001	-
Sodium	mg/L	0.998	0.91	9.22	0.815	0.847	3.85
Strontium	mg/L	0.211	0.208	1.43	0.202	0.208	2.93
Thallium	mg/L	<0.00001	<0.00001	-	<0.00001	<0.00001	-
Tin	mg/L	<0.0001	<0.0001	-	<0.0001	<0.0001	-
Titanium	mg/L	<0.01	<0.01	-	<0.01	<0.01	-
Uranium	mg/L	0.000762	0.000775	1.69	0.000786	0.000807	2.64
Vanadium	mg/L	<0.0005	<0.0005	-	<0.0005	<0.0005	-
Zinc	mg/L	0.004	<0.001	120	<0.001	<0.001	-

RPD >30%.

Notes: The RPD was calculated using < LRL results at the LRL if one result in a duplicate pair was below the LRL. The RPD was not calculated if both results were <LRL. RPD = relative percent difference; "-"= no data/not calculated; LRL = Laboratory Reporting Limit.

- total ammonia in two sets of samples (RPD = 5.17 to 52.9%);
- total aluminum in one set of samples (RPD = 52.9%);
- total arsenic in one set of samples (RPD = 57.1%);
- total vanadium in one set of samples (RPD = 31.9%); and
- dissolved zinc in one set of samples (RPD = 120%).

For all results listed above, the higher RPDs between paired results is due to at least one of these concentrations being detected close to (within 3-times for aluminum and within 1.5-times for all other pairs) or below the LRL, where greater variability among paired results is anticipated. Overall, as few analytes in field duplicates (less than 5%) had RPDs exceeding 30%, field sampling precision for water chemistry was considered acceptable for the purposes of this study.

Recommended hold times for oxidation-reduction potential (ORP) and pH were exceeded for all water chemistry samples prior to receipt of samples by the laboratory (Appendix H). The hold times for these analyses is 0.25 h, which is not feasible to meet while working in the field. All other recommended hold times were met for all GHO LAEMP samples.

B2.4 Data Quality Statement

Water chemistry data collected for the present study were of acceptable quality as characterized by good detectability, concentrations below LRLs in all method blank samples, good laboratory precision and accuracy, and good field sampling precision. Therefore, the associated data are considered acceptable for this study.

B3 SEDIMENT QUALITY

B3.1 Laboratory Reporting Limits

The analytical reports for sediment chemistry from ALS (see Appendix H for laboratory report) were examined to assess LRLs relative to applicable guidelines (Table B.6). The LRLs for these analytes were assessed relative to existing British Columbia Working Sediment Quality Guidelines (SQG; ENV 2021). Several analytes were entirely reported below the LRL (i.e., in 100% of samples; Table B.6). For all metals and several polycyclic aromatic hydrocarbons (PAHs) with one or more result below the LRL, achieved LRLs were consistently lower than applicable guidelines for sediment quality (Teck 2014; ENV 2021). However, LRLs for acenaphthene, chrysene, and dibenz(a,h)anthracene exceeded the lower SQG (i.e., Interim Sediment Quality Guideline) in 53.8 to 100% of samples. The reason for these high LRLs was due to a combination of chromatographic interference due to PAH co-elution effects. Overall, the LRLs for most analytes, with the exception of a few PAHs as noted above, were considered appropriate for this study.

B3.2 Laboratory Blanks

A total of 8 method blank samples for sediment chemistry were analyzed by ALS (Appendix H), consisting of 126 individual analyte results. All reported method blank results were within the laboratory DQO (Table B.1). Thus, the method blank results for this study indicated no inadvertent contamination of sediment samples within the laboratory during analysis.

B3.3 Data Accuracy and Precision

Data accuracy for sediment chemistry analyses completed by ALS was evaluated based on the analysis of two CRM samples, 10 Internal Reference Material (IRM) samples, and 11 LCS samples. All CRM, IRM, and LCS results met the laboratory DQO (Table B.1). Therefore, the accuracy achieved by the laboratory was considered excellent.

One set of laboratory duplicate samples were assessed to determine the laboratory precision (Appendix H). All laboratory duplicate results met the laboratory DQO (Table B.1). Therefore, the accuracy achieved by the laboratory was considered excellent.

Two sets of field duplicate samples were collected to assess the precision of field sampling of sediment chemistry (Table B.7). Samples were collected as split samples (i.e., a larger sample was homogenized and then split into two duplicate sub-samples), and as such some variability was expected based on the inherent heterogeneity of sediments. The RPDs between field duplicate samples for most metals (> 90%) were below 30% with the exceptions of:

Table B.6: Laboratory Reporting Limit (LRL) Evaluation for Sediment Chemistry Samples Relative to Sediment Criteria

Parameter	Units	BC SQGs		Range of LRLs	No. LRLs > ISQG	No. LRLs > PEL	No. Sample Results < LRL
		ISQG	PEL				
Physical Tests							
% Moisture	%	-	-	0.25	-	-	0
pH (1:2 soil:water)	pH	-	-	0.1	-	-	0
Particle Size							
% Gravel (>2mm)	%	-	-	1	-	-	12 (92.3%)
% Sand (2.00mm - 1.00mm)	%	-	-	1	-	-	8 (61.5%)
% Sand (1.00mm - 0.50mm)	%	-	-	1	-	-	5 (38.5%)
% Sand (0.50mm - 0.25mm)	%	-	-	1	-	-	4 (30.8%)
% Sand (0.25mm - 0.125mm)	%	-	-	1	-	-	0
% Sand (0.125mm - 0.063mm)	%	-	-	1	-	-	0
% Silt (0.063mm - 0.0312mm)	%	-	-	1	-	-	0
% Silt (0.0312mm - 0.004mm)	%	-	-	1	-	-	0
% Clay (<4um)	%	-	-	1	-	-	0
Organic Carbon							
Total Organic Carbon	%	-	-	0.05 to 0.97	-	-	0
Metals							
Aluminum	mg/kg	-	-	50	-	-	0
Antimony	mg/kg	-	-	0.1	-	-	0
Arsenic	mg/kg	5.90	17.0	0.1	0	0	0
Barium	mg/kg	-	-	0.5	-	-	0
Beryllium	mg/kg	-	-	0.1	-	-	0
Bismuth	mg/kg	-	-	0.2	-	-	13 (100%)
Boron	mg/kg	-	-	5	-	-	0
Cadmium	mg/kg	0.600	3.50	0.02	0	0	0
Calcium	mg/kg	-	-	50	-	-	0
Chromium	mg/kg	37.3	90.0	0.5	0	0	0
Cobalt	mg/kg	-	-	0.1	-	-	0
Copper	mg/kg	35.7	197	0.5	-	-	0
Iron	mg/kg	21,200	43,766	50	0	0	0
Lead	mg/kg	35.0	91.3	0.5	0	0	0
Lithium	mg/kg	-	-	2	-	-	0
Magnesium	mg/kg	-	-	20	-	-	0
Manganese	mg/kg	460	1,100	1	0	0	0
Mercury	mg/kg	0.170	0.486	0.005	0	0	0
Molybdenum	mg/kg	-	-	0.1	-	-	0
Nickel	mg/kg	16.0	75.0	0.5	0	0	0
Phosphorus	mg/kg	-	-	50	-	-	0
Potassium	mg/kg	-	-	100	-	-	0
Selenium	mg/kg	2.00	-	0.2	0	-	0
Silver	mg/kg	0.500	-	0.1	0	-	6 (46.2%)
Sodium	mg/kg	-	-	50	-	-	0
Strontium	mg/kg	-	-	0.5	-	-	0
Sulfur	mg/kg	-	-	1000	-	-	13 (100%)
Thallium	mg/kg	-	-	0.05	-	-	0
Tin	mg/kg	-	-	2	-	-	13 (100%)
Titanium	mg/kg	-	-	1	-	-	0
Tungsten	mg/kg	-	-	0.5	-	-	13 (100%)
Uranium	mg/kg	-	-	0.05	-	-	0
Vanadium	mg/kg	-	-	0.2	-	-	0
Zinc	mg/kg	123	315	2	0	0	0
Zirconium	mg/kg	-	-	1	-	-	12 (92.3%)
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	0.00671	0.0889	0.005 to 0.051	5 (38.5%)	0	13 (100%)
Acenaphthylene	mg/kg	0.00587	0.128	0.005	0	0	13 (100%)
Acridine	mg/kg	-	-	0.01 to 0.05	-	-	11 (84.6%)
Anthracene	mg/kg	0.0469	0.245	0.004	0	0	13 (100%)
Benz(a)anthracene	mg/kg	0.0317	0.385	0.01	0	0	8 (61.5%)
Benzo(a)pyrene	mg/kg	0.0319	0.782	0.01	0	0	10 (76.9%)
Benzo(b&j)fluoranthene	mg/kg	-	-	0.01	-	-	5 (38.5%)
Benzo(b+j+k)fluoranthene	mg/kg	-	-	0.015	-	-	7 (53.8%)
Benzo(g,h,i)perylene	mg/kg	0.170	0.320	0.01	0	0	8 (61.5%)
Benzo(k)fluoranthene	mg/kg	0.240	13.4	0.01	0	0	13 (100%)
Benzo(e)pyrene	mg/kg	-	-	0.01	-	-	5 (38.5%)
Chrysene	mg/kg	0.0571	0.862	0.01 to 0.24	2 (28.6%)	0	7 (53.8%)
Dibenz(a,h)anthracene	mg/kg	0.00622	0.135	0.005 to 0.007	1 (10.0%)	0	10 (76.9%)
Fluoranthene	mg/kg	0.111	2.36	0.01	0	0	7 (53.8%)
Fluorene	mg/kg	0.0212	0.144	0.01	0	0	8 (61.5%)
Indeno(1,2,3-c,d)pyrene	mg/kg	0.200	3.20	0.01	0	0	11 (84.6%)
1-Methylnaphthalene	mg/kg	-	-	0.05	-	-	7 (53.8%)
2-Methylnaphthalene	mg/kg	0.0202	0.201	0.01	0	0	0
Naphthalene	mg/kg	0.0346	0.391	0.01	0	0	3 (23.1%)
Perylene	mg/kg	-	-	0.01	-	-	6 (46.2%)
Phenanthrene	mg/kg	0.0419	0.515	0.01	0	0	0
Pyrene	mg/kg	0.0530	0.875	0.01	0	0	7 (53.8%)
Quinoline	mg/kg	-	-	0.05	-	-	13 (100%)

Shading indicates an LRL greater than the lowest BC WSQG (i.e., the ISQG).

Notes: the total number of samples (n) was 13. BC SQGs = British Columbia Working Sediment Quality Guidelines; LRL = Laboratory Reporting Limit; ISQG = Interim Sediment Quality Guideline; PEL = Probable Effects Level; % = percent; > = greater than; mm = millimetres; < = less than; µm = micrometres; - = no data/not applicable; mg/kg = milligrams per kilogram; BCMOECCS = British Columbia Ministry of Environment and Climate Change Strategy.

Table B.7: Field Duplicate Results for Sediment Samples

Parameter	Unit	RG_EL20 / GH_ERC		RPD (%)	RG_ELUGH / GH_ER2		RPD (%)
		RG_EL20_SE-1_2020-09-15_1244	RG_RIVER_SE-5_2020-09-15_1244		RG_ELUGH_SE-2_2020-09-17_1040	RG_RIVER_SE-5_2020-09-17_1040	
Physical Tests							
% Moisture	%	26.3	35.5	29.8	43.8	39.7	9.82
pH (1:2 soil:water)	pH	8.42	8.25	2.04	8.24	8.29	0.605
Particle Size							
% Gravel (>2mm)	%	3.5	7.4	71.6	<1	1.6	46.2
% Sand (2.00mm - 1.00mm)	%	4	4.7	16.1	1.5	3.8	86.8
% Sand (1.00mm - 0.50mm)	%	7.2	7.4	2.74	6.2	6.3	1.60
% Sand (0.50mm - 0.25mm)	%	12.9	12.2	5.58	13.7	15.1	9.72
% Sand (0.25mm - 0.125mm)	%	17.3	15.9	8.43	28.1	17	49.2
% Sand (0.125mm - 0.063mm)	%	16.3	14.5	11.7	19.4	13.8	33.7
% Silt (0.063mm - 0.0312mm)	%	16.9	16.7	1.19	13.4	18.2	30.4
% Silt (0.0312mm - 0.004mm)	%	18	17.7	1.68	13.8	20.4	38.6
% Clay (<4um)	%	3.8	3.5	8.22	3.3	3.8	14.1
Organic Carbon							
Total Organic Carbon	%	3.11	2.85	8.72	2.61	3.12	17.8
Metals							
Aluminum	mg/kg	4,320	5,520	24.4	7,340	7,500	2.16
Antimony	mg/kg	0.35	0.38	8.22	0.54	0.51	5.71
Arsenic	mg/kg	4.41	4.93	11.1	5.64	5.67	0.531
Barium	mg/kg	81.1	108	28.5	146	151	3.37
Beryllium	mg/kg	0.36	0.44	20.0	0.56	0.53	5.50
Bismuth	mg/kg	<0.2	<0.2	-	<0.2	<0.2	-
Boron	mg/kg	6.3	8.1	25.0	7.8	10	24.7
Cadmium	mg/kg	0.559	0.644	14.1	0.758	0.727	4.18
Calcium	mg/kg	90,100	69,800	25.4	56,800	58,500	2.95
Chromium	mg/kg	13.9	14.6	4.91	17.7	18.2	2.79
Cobalt	mg/kg	2.74	3.26	17.3	4.26	4.23	0.707
Copper	mg/kg	6.58	9.12	32.4	10.5	10.8	2.82
Iron	mg/kg	8,920	10,400	15.3	12,100	12,100	0
Lead	mg/kg	3.96	4.97	22.6	6.64	6.9	3.84
Lithium	mg/kg	6.6	7.1	7.30	10	10.2	1.98
Magnesium	mg/kg	14,200	11,600	20.2	12,700	13,200	3.86
Manganese	mg/kg	385	370	3.97	449	399	11.8
Mercury	mg/kg	0.0166	0.0259	43.8	0.0419	0.0385	8.46
Molybdenum	mg/kg	1.24	1.2	3.28	1.3	1.29	0.772
Nickel	mg/kg	13.5	14.2	5.05	18	18	0
Phosphorus	mg/kg	1090	1100	0.913	1150	1230	6.72
Potassium	mg/kg	1120	1430	24.3	1930	1960	1.54
Selenium	mg/kg	0.48	0.64	28.6	1.05	0.74	34.6
Silver	mg/kg	<0.1	0.12	18.2	0.16	0.15	6.45
Sodium	mg/kg	106	92	14.1	102	110	7.55
Strontium	mg/kg	124	95.7	25.8	94.1	94.7	0.636
Sulfur	mg/kg	<1,000	<1,000	-	<1,000	<1,000	-
Thallium	mg/kg	0.153	0.177	14.5	0.194	0.194	0
Tin	mg/kg	<2	<2	-	<2	<2	-
Titanium	mg/kg	18.7	16.8	10.7	20.3	20	1.49
Tungsten	mg/kg	<0.5	<0.5	-	<0.5	<0.5	-
Uranium	mg/kg	1.02	1.03	0.976	1.01	0.985	2.51
Vanadium	mg/kg	21.7	26.3	19.2	34.8	35	0.573
Zinc	mg/kg	49.3	58.4	16.9	77.3	85.5	10.1
Zirconium	mg/kg	<1	<1	-	1	<1	0
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	<0.005	<0.005	-	<0.005	<0.005	-
Acenaphthylene	mg/kg	<0.005	<0.005	-	<0.005	<0.005	-
Acridine	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Anthracene	mg/kg	<0.004	<0.004	-	<0.004	<0.004	-
Benz(a)anthracene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Benzo(a)pyrene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Benzo(b&j)fluoranthene	mg/kg	<0.01	0.011	9.52	0.022	0.016	31.6
Benzo(b+j+k)fluoranthene	mg/kg	<0.015	<0.015	-	0.022	0.016	31.6
Benzo(g,h,i)perylene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Benzo(k)fluoranthene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Benzo(e)pyrene	mg/kg	<0.01	0.01	0	0.019	0.014	30.3
Chrysene	mg/kg	<0.025	<0.03	-	0.044	0.032	31.6
Dibenz(a,h)anthracene	mg/kg	<0.005	<0.005	-	<0.007	<0.005	-
Fluoranthene	mg/kg	<0.01	<0.01	-	0.011	<0.01	9.52
Fluorene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.01	<0.01	-	<0.01	<0.01	-
1-Methylnaphthalene	mg/kg	<0.05	0.071	34.7	0.054	<0.05	7.69
2-Methylnaphthalene	mg/kg	0.055	0.115	70.6	0.06	0.05	18.2
Naphthalene	mg/kg	0.03	0.054	57.1	0.031	0.026	17.5
Perylene	mg/kg	<0.01	<0.01	-	0.019	0.015	23.5
Phenanthrene	mg/kg	0.051	0.08	44.3	0.103	0.087	16.8
Pyrene	mg/kg	<0.01	<0.01	-	0.014	<0.01	33.3
Quinoline	mg/kg	<0.05	<0.05	-	<0.05	<0.05	-

RPD >30%.

Notes: The RPD was calculated using <LRL results at the LRL if one result in a duplicate pair was below the LRL. The RPD was not calculated if both results were <LRL. RPD = relative percent difference; LRL = Laboratory Reporting Limit.

- copper in one set of samples (RPD = 32.4%);
- selenium in one set of samples (RPD = 34.6%);

For the selenium result listed above, the higher RPD between paired results is due to at least one of these concentrations being within 2-times the LRL, where greater variability among paired results is anticipated.

Variability among paired results was greater for PAHs than for metals and, due several results below the LRL for PAHs, only 17 RPD values could be calculated out of 46 paired results. Of these, several PAHs had RPD values greater than 30% including:

- benzo(b&j)fluoranthene in one set of samples (RPD = 31.6%);
- benzo(b+j+k)fluoranthene in one set of samples (RPD = 31.6%);
- benzo(e)pyrene in one set of samples (RPD = 30.3%);
- chrysene in one set of samples (RPD = 31.6%);
- 1-methylnaphthalene in one set of samples (RPD = 34.7%);
- 2-methylnaphthalene in one set of samples (RPD = 70.6%);
- napthalene in one set of samples (RPD = 57.1%); and
- phenanthrene in one set of samples (RPD = 44.3%).

Of result listed above, the higher RPD between paired results is due to at least one of these concentrations being within 3-times (for five of the results listed) or 5-times (for two of the results listed) the LRL, where greater variability among paired results is anticipated.

Overall, as only 8.6% of RPDs for metals and PAHs exceeded 30%, field precision and reproducibility were considered adequate. The greater variability observed for PAHs is likely attributed to residual heterogeneity in the samples. Subtle differences in the distribution of fine particulate matter and associated PAHs amongst split samples may exist even after homogenization in the field. Additionally, the transfer of sample material from one container (i.e., the bin in which the samples were homogenized) to another (i.e., the sample jar or bag) may introduce variability (Weiner 2013).

B3.2 Data Quality Statement

Sediment chemistry data collected for the present study were of acceptable quality as characterized by good detectability (with the exception of a few PAHs), negligible analyte concentrations in method blanks, good laboratory precision and accuracy, and good field sampling precision. Overall, the associated data were considered acceptable for this study.

B4 BENTHIC INVERTEBRATE COMMUNITY

B4.1 Benthic Invertebrate Sub Sampling Accuracy

The analytical reports from Cordillera Consulting Inc. were examined to assess sub-sampling accuracy. For all samples, Canadian Aquatic Biomonitoring Network (CABIN) protocols were followed for sub-sampling (i.e., identification of a minimum 300 invertebrates), with a minimum of 5% of a sample being assessed Table B.8. All benthic invertebrate community structure samples (n = 20) were subject to sub-sampling (Table B.8). Sub-sampling efficiency was assessed by comparing the numbers of benthic invertebrates recovered between at least two sub-samples. Both the precision and accuracy of sub-sampling efficiency assessments in 2020 met the respective DQO in all cases (≤ 20%; Table B.9). Thus, the precision and accuracy for sub-sampling of benthic invertebrate community samples was considered acceptable for this study.

B4.2 Organism Sorting Efficiency

To measure the effectiveness of the sorters, at least 10% of samples were selected at random for resorting analysis by a different sorter; three samples were assessed for this project. Sorting efficiency (i.e., percent recovery) of benthic invertebrate samples was excellent, achieving an average of 98.7% for the three community structure samples (Table B.10). Recovery in quality control samples was above the laboratories' DQO (Cordillera: ≥ 95%), so organism sorting efficiency was considered excellent.

B4.3 Taxonomic Identification Accuracy

Cordillera Consulting Inc. performed an internal audit of taxonomic identification for at least 10% of all community structure samples (n = 2; Table B.11). The analysts reported a total identification error rate (TIR) of 0%, a percent difference in enumeration (PDE) of 0.101 to 0.148%, a percent taxonomic disagreement (PTD) of 0.590 to 0.806%, and Bray Curtis Dissimilarity Index (BCDI, a measure of the differences in identifications between different analysts) of 0.00443 to 0.00706). The laboratory DQO was based on TIR as per CABIN laboratory methods (< 5% TIR; Environment Canada 2014). As TIR was below 5% for all samples examined, the taxonomic accuracy of the analysis was considered good.

B4.4 Data Quality Statement

Benthic invertebrate community data collected for the present study were of excellent quality as characterized by good sorting efficiency, subsampling precision and accuracy, and excellent taxonomic identification accuracy. Therefore, the associated data can be used with a high level of confidence in the derivation.

Table B.8: Sub-Sampling Percentages, Benthic Invertebrate Community Samples

Sample ID	Date	Laboratory ID	% Sampled	# Invertebrates
RG_ELUGH_BIC-1_2020-09-17	17-Sep-20	CC210922	5%	423
RG_ELUGH_BIC-2_2020-09-17	17-Sep-20	CC210923	5%	496
RG_ELUGH_BIC-3_2020-09-17	17-Sep-20	CC210924	5%	330
GH_ERSC4_BIC-1_2020-09-12	12-Sep-20	CC210925	10%	391
GH_ERSC4_BIC-2_2020-09-12	12-Sep-20	CC210926	7%	337
GH_ERSC4_BIC-3_2020-09-12	12-Sep-20	CC210927	9%	355
GH_ER1A_BIC-1_2020-09-11	11-Sep-20	CC210928	20%	419
GH_ER1A_BIC-2_2020-09-11	11-Sep-20	CC210929	6%	338
GH_ER1A_BIC-3_2020-09-12	12-Sep-20	CC210930	5%	372
RG_ERSC5_BIC-1_2020-09-11	11-Sep-20	CC210931	14%	327
RG_ERSC5_BIC-2_2020-09-11	11-Sep-20	CC210932	7%	373
RG_ERSC5_BIC-3_2020-09-11	11-Sep-20	CC210933	13%	358
RG_THCK_BIC-1_2020-09-10	10-Sep-20	CC210934	6%	339
RG_THCK_BIC-2_2020-09-10	10-Sep-20	CC210935	5%	408
RG_THCK_BIC-3_2020-09-10	10-Sep-20	CC210936	5%	525
RG_EL20_BIC-1_2020-09-15	15-Sep-20	CC210937	5%	565
RG_EL20_BIC-2_2020-09-16	16-Sep-20	CC210938	9%	359
RG_EL20_BIC-3_2020-09-16	16-Sep-20	CC210939	10%	475
RG_EL20_BIC-4_2020-09-16	16-Sep-20	CC210940	6%	368
RG_EL20_BIC-5_2020-09-16	16-Sep-20	CC210941	5%	393

Table B.9: Summary of Subsampling Efficiency

Laboratory ID	Sample ID	# of Organisms in Subsample										Total # of Organisms	Precision		Accuracy	
	Subsample #	1	2	3	4	5	6	7	8	9	10	Total	Min (%)	Max (%)	Min (%)	Max (%)
CC210928	GH_ER1A_BIC-1_2020-09-11	418	452	402	479	446	-	-	-	-	-	2197	1.33	16.1	1.50	9.01
CC210939	RG_EL20_BIC-3_2020-09-16	468	393	409	411	433	456	427	413	448	422	4280	0.48	16.0	0.23	9.35

Table B.10: Summary of Sorting Efficiency for Benthic Invertebrate Community Samples

Sample ID	Laboratory ID	Taxon	Organisms Missed	Total Organisms Found	% Efficiency
GH_ER1A_BIC-3_2020-09-12	CC210930	No invertebrates found	0	372	100
RG_ERSC5_BIC-3_2020-09-11	CC210933	Diptera	1		
		Chironomidae	1		
		Trichoptera	1		
		Total	3	358	99
RG_EL20_BIC-4_2020-09-16	CC210940	Chironomidae	1		
		Baetidae	1		
		Ephemerellidae	2		
		Heptageniidae	5		
		Trichoptera	1		
		Total	10	368	97
Average Recovery					98.7

Notes: As sorting progressed, 10% of samples were randomly chosen by senior members of the sorting team for resorting. All sorters working on a project had at least one sample resorted by another sorter. An efficiency of 90% was expected. If 90/95% efficiency was not met, samples from that sorter were re-sorted. To calculate sorting efficiency the following formula was used: (# organisms missed / total organisms found) X 100.

Table B.11: Percent Benthic Invertebrate Community Organism Recovery

Sample ID	Laboratory ID	Taxa Identified	TIR	PDE	PTD	BCDI
RG_ELUGH_BIC-2_2020-09-17	CC210923	495	0.00	0.101	0.806	0.00706
RG_THCK_BIC-1_2020-09-10	CC210934	338	0.00	0.148	0.590	0.00443

Notes: TIR = Total Identification Error Rate, PDE = Percent Difference in Enumeration, PTD = Percent Taxonomic Disagreement, BCDI = Bray Curtis Dissimilarity Index to quantify differences in identifications.

B5 BENTHIC INVERTEBRATE TISSUE CHEMISTRY

B5.1 Laboratory Reporting Limits

Analytical report of benthic invertebrate tissue metal concentrations from TrichAnalytics (see Appendix G for laboratory report) was examined to provide an inventory of analyte results below the LRL and to compare the LRLs for these analytes to available benchmarks (Table B.12).

The sole focus of interpretation of benthic invertebrate tissue chemistry results for the GHO LAEMP was selenium. The achieved LRL was below the LRL. Selenium was detectable (i.e., > LRL) in all benthic invertebrate samples, therefore comparison of the selenium LRL to the applicable benchmark (i.e., Elk Valley Water Quality Plan Level 1 benchmark for effects to invertebrates [13 mg/kg dry weight]; Teck 2014) was not necessary to assess whether adequate detectability was achieved. Overall, the detectability of selenium in all samples (i.e., > LRL) indicates that the achieved LRLs were suitable for the study.

B5.2 Data Accuracy and Precision

Data accuracy was evaluated based on the analysis of 2 CRM samples consisting of 60 individual analyte results (Appendix G). The CRM analyses results met the laboratory DQO (Appendix G). Accuracy achieved by the laboratory in this study can therefore be considered excellent.

Laboratory precision was evaluated based on duplicate analysis of benthic invertebrate tissue samples. Laboratory duplicate results for benthic invertebrate tissue were within the DQO set by TrichAnalytics for all samples and analyses, including selenium (Appendix G). The laboratory analytical precision can be considered excellent for this study.

B5.3 Data Quality Statement

Benthic invertebrate tissue data collected for the present study were of good quality as characterized by good detectability, appropriate LRLs, and good laboratory precision and accuracy. Therefore, the associated data can be used with a good level of confidence in the derivation of conclusions for this study.

Table B.12: Laboratory Reporting Limit (LRL) Evaluation for Benthic Invertebrate Tissue Chemistry Analyses

Parameter	Units	EVWQP Level 1 Benchmarks/ Relevant Screening Values	Range of LRLs	No. LRLs > Guideline	No. Sample Results < LRL
Aluminum	ppm	-	0.004	-	0
Antimony	ppm	-	0.092	-	0
Arsenic	ppm	-	3.1	-	0
Barium	ppm	-	0.049	-	0
Beryllium	ppm	-	0.04	-	0
Boron	ppm	-	79	-	0
Cadmium	ppm	-	11	-	0
Calcium	ppm	-	20	-	0
Chromium	ppm	-	0.27	-	0
Cobalt	ppm	-	0.047	-	0
Copper	ppm	-	0.646	-	0
Iron	ppm	-	0.009	-	0
Lead	ppm	-	4.1	-	0
Lithium	ppm	-	0.004	-	0
Magnesium	ppm	-	0.015	-	0
Manganese	ppm	-	0.008	-	0
Mercury	ppm	-	0.783	-	0
Molybdenum	ppm	-	0.392	-	0
Nickel	ppm	-	0.348	-	0
Phosphorus	ppm	-	0.001	-	0
Potassium	ppm	-	0.026	-	0
Selenium	ppm	13	0.001	0	0
Silver	ppm	-	0.076	-	0
Sodium	ppm	-	0.021	-	0
Strontium	ppm	-	0.006	-	0
Thallium	ppm	-	0.001	-	0
Tin	ppm	-	0.028	-	1 (3.03%)
Titanium	ppm	-	0.001	-	0
Uranium	ppm	-	0.001	-	0
Vanadium	ppm	-	0.001	-	0
Zinc	ppm	-	0.358 to 5	-	0

Notes: The total number of samples analyzed (n) was 90. EVWQP = Elk Valley Water Quality Plan; LRL = Laboratory Reporting Limit. "-" indicates where no applicable guideline exists.

B6 DATA QUALITY SUMMARY

Overall, the quality of the data collected for this project was considered acceptable for the derivation of conclusions associated with the objectives of the 2020 GHO LAEMP.

B7 REFERENCES

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Weiner, E.R. 2013. Applications of Environmental Aquatic Chemistry: A Practical Guide, Third Edition. CRC Press, Boca Raton, FL.

APPENDIX C
REACH 2 AMPHIBIAN HABITAT

Photo C.1: **RG_GH-SCW3 (Reach 2), September 2017**

Photo C.2: **RG_GH-SCW3 (Reach 2), September 2018**

Photo C.3: **RG_GH-SCW3 (Reach 2), September 2018**

Photo C.4: **RG_GH-SCW3 (Reach 2), September 2018**

Photo C.5: **RG_GH-SCW3 (Reach 2), September 2019**

Photo C.6: **RG_GH-SCW3 (Reach 2), May 2020 (photo from Vast 2 2)**

Photo C.7: RG_GH-SCW3 (Reach 2) Flooded Grasslands, June 2020, (photo from   ast 2 2)

Photo C.8: RG_GH-SCW3 (Reach 2), May to July 2020 (left to right; photo from   ast 2 2)

Photo C.9: **RG_GH-SCW3 (Reach 2), September 2020**

Photo C.10: **RG_GH-SCW3 (Reach 2), September 2020**

Photo C.11: **Columbia spotted frog (left) and western toad (right), RG_GH-SCW3, June and July 2020 (photo from ast 2 2)**

Table C.1: Habitat Characteristics of Reach 2, May to July 2020 ast 2 2

Habitat Parameter		13-May-20	23-Jun-20	24-Jul-20
Aquatic Macrophytes	Emergent	S	A	A
	Submergent	A	A	A
Number of Fish Observed		0	5	12
Adjacent Land Use		forestry and recreation; forest service road adjacent		
Adjacent Terrestrial Habitat		undisturbed forest		
Habitat Connectivity		yes		
Water Level		shallow margin sections present		
Shoreline Aquatic Vegetation		grass and willow		
Other Comments		flowing creek with slower side channels and stagnant pools; no signs of beaver activity		

Notes: Data presented was collected by Vast Resource Solutions in 2020. S = sporadic. A = abundant.

Table C.2: ***In Situ*** **Water Quality Measurements for the Inlet of Reach 2 (Station SCW1), 2018 to 2020**

Year	Date	Temperature	Dissolved Oxygen		Specific Conductivity	pH
		(°C)	(% Sat.)	(mg/L)	(µs/cm)	pH Units
BC WQG Maximum		-	-	5	-	6.5
BC WQG Minimum		19	-	-	-	9.0
2018	24-May-18	6.5	100.0	12.37	301	8.08
	14-Jun-18	6.5	94.1	11.56	293	8.10
	18-Jul-18	10	94.6	10.68	277	8.18
	14-Aug-18	11.9	82.2	8.81	260	8.30
	12-Sep-18	7.5	96.7	11.56	310	8.07
	11-Oct-18	2.4	80.8	10.98	293	7.91
2019	12-Jun-19	7.4	90.7	10.91	263	8.10
	5-Jul-19	7.0	85.9	10.36	230	7.87
	7-Aug-19	10.9	86.8	9.58	270	8.18
	20-Sep-19	8.8	81.9	9.52	381	8.09
	9-Oct-19	0.7	90.7	12.97	375	7.54
2020	5-May-20	5.6	76.5	9.62	229	7.97
	12-Jun-20	6.5	86.6	10.25	658	8.47
	21-Jul-20	8.6	89.6	10.45	264	8.17
	17-Aug-20	13.5	79.1	8.23	254	8.25
	4-Sep-20	10.2	96.4	10.82	300	8.25
	19-Oct-20	0.8	80.1	11.45	237	7.41

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Notes: WQG = water quality guideline. " - " indicates no WQG. Station SCW1 was dry from January 2018 to April 2018, from November 2018 to May 2019, from November 2019 to April 2020, and from November 2020 to December 2020.

Table C.3: ***In Situ*** **Water Quality Measurements for the Outlet of Reach 2 (Station SCW3), 2018 to 2020**

Year	Date	Temperature	Dissolved Oxygen		Specific Conductivity	pH
		(°C)	(% Sat.)	(mg/L)	(µs/cm)	pH Units
BC WQG Maximum		-	-	5	-	6.5
BC WQG Minimum		19	-	-	-	9.0
2018	24-Jan-18	0.3	86.8	12.5	1,709	7.71
	15-Feb-18	-0.1	78.9	11.4	1,912	8.09
	15-Mar-18	0.4	61.9	8.75	1,636	8.32
	16-Apr-18	0.3	71.2	10.3	1,322	7.02
	24-May-18	7.5	98.6	11.8	400	8.20
	14-Jun-18	6.5	94.0	11.6	294	7.90
	18-Jul-18	10.3	92.6	10.4	315	8.20
	14-Aug-18	13	83.3	8.76	484	8.39
	12-Sep-18	7.9	96.5	11.4	561	8.18
	11-Oct-18	2.4	84.7	11.6	1,046	8.36
	21-Nov-18	-0.1	68.5	9.86	1,986	7.05
	4-Dec-18	-0.01	93.6	13.6	2,007	8.00
2019	15-Jan-19	0	96.2	13.96	1,936	8.11
	17-Apr-19	6.3	82.6	10.25	1,233	8.81
	8-May-19	8.4	83.2	9.72	1,130	8.40
	12-Jun-19	7.9	92.8	11	260	8.15
	5-Jul-19	7.2	86.1	10.4	230	7.93
	7-Aug-19	11.0	87.8	9.69	272	7.92
	20-Sep-19	9.1	84.5	9.72	558	8.17
	9-Oct-19	1.4	92.4	12.92	1,943	8
	6-Nov-19	0	92.7	13.45	1,468	7.52
	4-Dec-19	0.1	62.2	9.04	1,589	8.17
2020	17-Jan-20	-0.1	83.3	12.13	1,217	7.27
	12-Feb-20	0.4	72.4	10.49	1,289	7.52
	12-Mar-20	0.1	88.2	12.69	1,470	7.73
	07-Apr-20	0.6	82.8	11.83	1,354	7.66
	05-May-20	5.5	76.2	9.6	289	8.15
	12-Jun-20	6.2	85.1	10.54	259	7.97
	21-Jul-20	8.5	88.0	10.26	267	7.83
	17-Aug-20	13.6	79.8	8.27	310	8.09
	04-Sep-20	10.9	95.1	10.5	547	8.16
	19-Oct-20	1.6	81.2	11.31	1,050	7.72
	10-Nov-20	0.1	79.8	11.40	1,930	8.69
	10-Dec-20	0	79	11.42	2,087	7.53

Value less than the BC WQG minimum or greater than the BC WQG maximum.

Notes: WQG = water quality guideline. " - " indicates no WQG.

Table C.4: GHO LAEMP Amphibian Observations within Reach 2, May 2017 to July 2020

Species	Life Stage	Number	Year	Month	Location	Easting	Northing
western toad	adult	1	2017	July	Reach 2	-	-
Columbia spotted frog	adult	1	2017	August	Reach 3	-	-
Columbia spotted frog	adult	1	2018	June	Reach 2	648373	5550161
western toad	adult	1	2018	July	Reach 1/2 break	648257	5549933
western toad	adult	1	2018	July	Reach 2	648325	5550044
western toad	adult	1	2018	July	Reach 2 (2nd finger)	648112	5550281
western toad	adult	1	2018	July	Reach 2	648167	5550274
western toad	adult	1	2018	August	Reach 2 (2nd finger)	647955	5550282
long-toed salamander[a]	subadult / larva	10	2018	September	Reach 2 (2nd finger)	648090	5550244
Columbia spotted frog	adult	1	2020	June	Reach 2 (outlet)	648377	5550209
Columbia spotted frog	subadult	1	2020	June	Reach 2	648376	5550231
western toad[b]	adult	1	2020	June	Reach 2	648379	5550214
western toad	adult	1	2020	June	Reach 2	648380	5550204
western toad	adult	1	2020	July	Reach 2	648347	5550229
western toad	adult	1	2020	July	Reach 2	648391	5550201

Note: "-" indicates UTM not recorded.

[a] The 10 salamanders were found deceased in the naturally dewatering area off of Reach 2.

[b] Identified by call.

APPENDIX C
MEMO: AMPHIBIAN OCCURRENCE AND DISTRIBUTION STUDY IN THE ELK RIVER WATERSHED (VAST 2020)

August 30, 2020

Project/Reference Number: 20.0062

Teck Coal Limited
421 Pine Avenue
Sparwood, BC
V0B 2G0

Attention: Cait Good

Re: Amphibian Occurrence and Distribution Study in the Elk River Watershed

Teck Coal Limited (Teck) retained VAST Resource Solutions Inc. (VAST) in 2020 to complete amphibian surveys at several lentic areas as part of the Amphibian Occurrence and Distribution Study. The data will be used to inform Teck's Local Aquatic Effects Monitoring Programs (LAEMP) and toxicology study. This letter outlines the surveys that took place and the results.

1 Background

1.1 Introduction

The Amphibian Occurrence and Distribution Study (this study) is a component of the Lentic Area Supporting Study, a supporting study under the Regional Aquatic Effects Monitoring Program (RAEMP). Additional supporting studies being completed under the RAEMP include Local Aquatic Effects Monitoring Programs (LAEMP) and a Columbia spotted frog toxicity study. Together, these studies are expected to inform the implementation of the Elk Valley Water Quality Plan.

The objectives of this study were to document the occurrence of amphibian species at each life stage (i.e., egg, larval, metamorph/subadult/adult), determine the distribution of amphibians, and characterize the population structure of amphibians in MU's 1-6. To satisfy these objectives, surveys were completed during the breeding season (April to August) in 2018 and 2019 at reference and mine-exposed lentic areas within the Elk, Flathead, and Kootenay River watersheds. Surveys targeted the following species: Columbia spotted frog (*Rana lutieventris)*, western toad (*Anaxys boreas)*, long-toed salamander (*Ambysotma macrodactylum*), wood frog (*Lithobates sylvaticus)*, and Pacific chorus frog (*Pseudacris regilla*).

In 2020, additional amphibian surveys and habitat assessments were completed to satisfy two goals:

1. Provide amphibian occurrence and habitat data to Teck Greenhills Operations LAEMP;
2. Provide amphibian occurrence and distribution and habitat data at mine-exposed sites to inform Teck's Columbia spotted frog toxicity study.

1.2 Amphibian Ecology

Amphibians belong to the vertebrate class Amphibia and are characterized by a two-stage life cycle: an aquatic larval form that metamorphosize into a terrestrial adult form (Wells, 2010). Amphibians are ectothermic and rely on the environment to heat their body and complete physiological processes. As such, the timing of amphibian life history stages and the duration of development is largely dependent on ambient (i.e., air or water) temperatures. Generally, amphibians make use of and move between aquatic and terrestrial habitats (Pilliod et al., 2002; Regosin et al., 2003; Bull, 2006). In temperate environments, adult amphibians leave terrestrial or aquatic over-wintering sites in the spring (typically April-May) and move to aquatic breeding habitats. At this time, male frogs and toads call to attract females (Hammerson, 1999). Females lay eggs over the course of a few days to weeks (Waldman, 1981; Bull and Shepherd, 2003) and following this, adults either return to terrestrial habitats (e.g., western toad, long-toed salamander, wood frog, Pacific chorus frog) or remain close to aquatic habitats (e.g., Columbia spotted frog) (Kleeberger and Werner, 1983; Regosin et al., 2002; COSEWIC, 2012; BC CDC, 2016; Pilliod et al., 2002). Eggs develop into larvae (i.e., tadpoles) over the course of a few days to three weeks. Larvae absorb oxygen through gills (internal or external) in the water (Dodd, 2010). The duration of the larval form can vary considerably, but typically metamorphosis occurs by fall of the same year, at which time most larvae metamorphose into adults that can live on land and breathe air (Wilbur and Collins, 1973).

Aquatic breeding habitats typically include shallow areas of wetlands, lakes, and ponds where submergent and emergent vegetation occur (Stebbins, 2003). Western toad typically lay eggs in silty or sandy shallow margins (Bull, 2006; COSEWIC, 2012), while Columbia spotted frog, wood frog, and long-toed salamander depisit eggs on emerged or submerged vegetation (e.g., willow branches; sedges, grasses; Waldman, 1981; Hawkes and Tuttle, 2013). The aquatic life cycle depends on sufficient water levels at lentic areas to prevent egg masses and larvae from desiccation; therefore, ephemeral waterbodies typically don't make suitable long-term breeding habitat (Forester and Lykens, 1987; Graham and Powell, 1999; Bull, 2005). Additionally, the presence of fish can be a major deterrent for breeding habitat selection due to potential predation on eggs and larvae (Monello & Wright, 1999).

Terrestrial habitats may be used as movement corridors, foraging, and over-wintering and may include forests, streams, and grasslands that contain coarse woody debris and/or vegetation (e.g., horsetail, moss) for cover and moisture (Kleeberger and Werner, 1983; Regosin et al., 2002; COSEWIC, 2012; Bull, 2006; Schmetterling and Young, 2008). Moist conditions are essential for adult amphibians occupying terrestrial habitat to avoid desiccation. Movements among habitat types is typically not far (a few to several hundred meters); however, western toad in some regions (e.g., Montana) travel up to 13km (Schmetterling and Young, 2008; Bull, 2006). Rivers and roads can be a barrier to amphibian movement (Emel and Storfer, 2012), but possibly to a lesser extent for western toad that are capable swimmers and often use streams and roads as movement corridors (Schmetterling and Young, 2008; South Coast Conservation Program, 2017).

All native (i.e., endemic) amphibian species are protected in British Columbia (BC) under the *Wildlife Act*. Five species occur in the Elk River watershed: Columbia spotted frog, western toad, long-toed salamander, wood frog, and Pacific chorus frog. The Elk Valley is at the eastern extent of the range of Pacific chorus frog, therefore it is less likely to occur in this region (BC CDC, 2016e). Populations of amphibians in southeastern BC are considered stable and are yellow-listed: however, declines of western toad have been noted and an expert threat assessment is needed for all species (BC CDC, 2016a-e). Western toad is federally listed as a Species of Special Concern (*Species at Risk Act*, Schedule 1). Threats to local amphibian populations include habitat degradation, road mortality, and pollution/toxicity (COSEWIC, 2012; BC CDC, 2016a-e). Land use adjacent to lentic areas (e.g., forestry, roads, agriculture, mine works) can affect habitat quality and, therefore, survival of amphibians (COSEWIC, 2012; Pilliod and Scherer, 2015). Additionally, noise from surrounding land use can influence reproductive success, as it can prevent female conspecifics from hearing the breeding calls of males

(Nelson et al., 2016). Globally, the fungal disease chytridiomycosis has caused widespread declines in amphibian populations; however, to date this disease is not known to have caused mortality in BC (Govindarajulu et al. 2013). It is not known if climate change is affecting amphibians in the Elk River watershed; however, changes in precipitation and temperatures are linked to direct and indirect mortality in amphibians (review in Li et al., 2012).

1.3 Methods

1.3.1 Amphibian Surveys

The occurrence (i.e., presence/non-detection) of amphibians was determined at three survey stages: egg mass (early-late May), larval (mid-late June), and metamorph/subadult/adult (late July). Visual encounter surveys were used to determine occurrence during egg mass and metamorph/subadult/adult surveys, while aquatic funnel trapping was used during larval surveys. Visual encounter surveys involved two observers, each on the opposing sides of a lentic area, walking along the edge of the water. Each surveyor walked the entire perimeter (double independent observer method) for egg mass surveys, while each surveyor walked opposing halves of the perimeter (meeting in the middle) for metamorph/subadult/adult surveys, as surveyors are likely to flush amphibians on land. Observers were previously trained and had experience identifying amphibian species. Photographs and data were recorded on field tablets (Apple™ iPad mini 4). Incidental detections of species and life stages were recorded and included in overall observations.

Two sites surveyed in 2019 (RG_GHWC and RG_GLMS) in which amphibian egg masses and larvae were previously detected were visited on the same date to ensure surveying occurred during peak egg-laying and development. No egg masses were detected at RG_GHWC during the first egg mass survey (likely due to below average spring temperatures); therefore, a second survey was completed later in May. Wood frog tadpoles were captured in aquatic funnel traps at RG_GLMS, indicating larval surveys occurred during the appropriate larval development period.

1.3.2 Habitat Assessment

Habitat parameters recorded included features that generally remain constant and those that may fluctuate throughout the breeding period. Constant features included the presence of a pond liner, dominant sediment type, adjacent land use, presence of adjacent undisturbed terrestrial habitat, adjacent road type, and connectivity between the lentic area (aquatic habitat) and terrestrial habitat. Features that may fluctuate included presence of shallow margins, dominant shoreline vegetation, emergent and submergent vegetation amount, number of fish observed, and signs of beaver activity. Shallow margins were defined as depths up to 30 cm. Photographs and data were recorded on field tablets (Apple™ iPad mini 4).

In situ water quality measurements were collected at each site during each assessment. A water quality meter (YSI Professional Plus ™, YSI, Inc.) was used to measure water temperature (°C), dissolved oxygen (DO; mg/L and %), specific conductance (µS/cm), conductivity (µS/cm), pH, and the oxidation reduction potential (ORP; mV). The conductivity probes were calibrated weekly and pH probes were calibrated daily, prior to surveying (YSI, 2017). Dissolved oxygen was calibrated at the site to account for differences in oxygen levels due to changes in elevation.

2 Part 1: Amphibian Occurrence and Habitat Assessment for Greenhills Operations LAEMP

2.1 Objectives

The first goal was completed at one site, GH_SCW3 (648370 m E, 5550233 m N), within MU3 and on Greenhills Operations (GHO). Results of this survey will contribute to GHO's LAEMP. As such, the objectives for part 1 were:

- Determine amphibian presence/non-detection of each life stage (egg mass, larval, metamorph/subadult/adult); and,
- Evaluate habitat features and determine how it changes throughout the breeding period.

2.2 Results

Two species were observed at GH_SCW3: Columbia spotted frog and western toad (**Figure 1**). Only the subadult and adult life stages were observed. Observations were made during larval and metamorph surveys.

GH_SCW3 was a mixture of lotic and lentic areas as it was comprised of a flowing creek with adjacent stagnant pools (**Table 1**; **Figure 2**). Sediment was predominantly silt-clay. The site is adjacent to previously logged areas that are currently being used for recreation (e.g., camping, ATV's). Most of the lentic area was surrounded by forest with good connectivity between aquatic and terrestrial habitats. The nearest road was a forest service road approximately 280 m from the lotic portion of the site.

Shallow margins were present at GH_SCW3 throughout the breeding period (

Table *2*): however, water levels changed drastically between each survey visit (**Figure 3**). Water levels were highest during larval surveys, in which there were no slow-moving side channels, but stagnant water present in nearby grasslands (**Figure 4**). These grasslands had dried up by the timing of metamorph surveys when water levels were lowest. Dominant shoreline vegetation remained consistent and was comprised of willows and grasses. The amount of emergent vegetation increased over the breeding period, while submergent vegetation generally remained consistent. Groups of minnows were observed in slow-moving side channels. There were no signs of beaver activity detected throughout the breeding period.

Water quality parameters recorded at GH_SCW3 can be found in Appendix B.

Table 1. Habitat parameters of each site surveyed in 2020.

Habitat Parameter	Observation
Pond Liner Present	No
Dominant Sediment Type	Silt-clay
Adjacent Land Use	Forestry; Recreation
Adjacent Undisturbed Terrestrial Habitat	Forest
Adjacent Road	Forest Service Road
Habitat Connectivity (Aquatic to Terrestrial)	Intact
Comments	Flowing creek with slower side channels and stagnant pools

Table 2. Habitat parameters recorded at each site during egg mass, larval, and metamorph surveys in 2020.

Habitat Parameter	Date		
	13-May	23-Jun	24-Jul
Shallow Margins Present	Sections	Sections	Sections
Dominant Shoreline Vegetation	Grass; Willow	Grass; Willow	Grass; Willow
Emergent Vegetation Amount	Sporadic	Abundant	Abundant
Submergent Vegetation Amount	Abundant	Abundant	Abundant
Number of Fish Observed	0	5	12
Signs of Beaver Activity	None	None	None

Figure 1. Columbia spotted frog (left) and western toad (right) observed at GH_SCW3 during larval and metamorph surveys in 2020.

Figure 2. Flowing water (left) and stagnant pools (right) at GH_SCW3 in May 2020.

Figure 3. Water levels during egg mass, larval, and metamorph surveys (left to right) at GH_SCW3.


Figure 4. Flooded grassland at GH_SCW3 during larval surveys in June 2020.

2.3 Discussion

The presence of adult Columbia spotted frog and western toad during larval and metamorph surveys at GH_SCW3 suggests this is important habitat for amphibians; however, the absence of breeding evidence and ephemerality of stagnant water indicate this site is not likely suitable breeding habitat. The abundance of emergent vegetation, intact forest, and flooded terrestrial sections provide suitable habitat for amphibian movement corridors (Schmetterling and Young, 2008), likely explaining the occurrence of adults after the egg-laying period. Additionally, the presence of fish at GH_SCW3 may partially explain the absence of evidence of amphibian breeding, as fish can predate on eggs and larvae (Monello & Wright, 1999). Despite this, small fish pose no threat to adult amphibians.

2.4 Summary and Conclusion

- Columbia spotted frog and western toad were detected at GH_SCW3;
- No evidence of breeding (i.e., egg masses, tadpoles, or metamorphs) was observed;
- Water levels changed drastically throughout the breeding period, with the larval period having the highest levels and metamorph the lowest;
- The site had good connectivity between aquatic and terrestrial habitats;
- In conclusion, GH_SCW3 is likely not suitable amphibian breeding habitat but is suitable as a movement corridor and/or for foraging.

3 Part 2: Amphibian Occurrence and Distribution and Habitat Assessment for Toxicity Study

3.1 Objectives

The second goal was completed at seven sites within MUs 1-4. (**Table 3**). These results will inform Teck's toxicity study and future analyses identifying habitat features that best explain amphibian occurrence. As such, the objectives for part 2 were:

- Determine amphibian presence/non-detection at each life stage (egg mass, larval, metamorph/subadult/adult) at six of the seven sites (**Table 3**); and,
- Evaluate habitat features at each site.

Table 3. Sites surveyed in 2020.

Management Unit	Site ID	UTM	
		Easting	Northing
MU1	Clode	650927	5564396
	Greenhills Pond	653408	5546081
MU2	LCCPU	659883	5531526
MU3	THPD*	648953	5550417
MU4	Harmer Pond	657080	5522152
	Goddard Finger Ponds	653187	5514093
	Gate Pond	655856	5509074

*Site not surveyed for amphibians in 2020: only a habitat assessment and water quality parameters were recorded

3.2 Results

Observations of amphibians were recorded at three sites in MU's 1-3, in which two amphibian species were detected: Columbia spotted frog and western toad. Western toad was detected at Clode and LCCPU. LCCPU was the only site with breeding evidence where all life stages (i.e., egg mass, larval, metamorph, adult) of western toad were detected (**Figure 5**). Columbia spotted frog was also detected at LCCPU; however, only the adult life stage was observed (**Figure 6**). No incidental amphibians were observed at THPD while completing the habitat assessments.

Sites surveyed were lentic areas located either on mine sites (five sites) or nearby in previously-logged areas currently used for recreation (two sites; **Table 4**; **Figure 7**). Three of the sites adjacent to mine operations (Clode, Greenhills Pond, and Goddard Finger Ponds) did not have undisturbed terrestrial habitat adjacent to the lentic area or connectivity between aquatic and terrestrial habitats. Two other sites adjacent to mine operations (LCCPU and Gate Pond) had portions of the lentic area surrounded by forest and some degree of connectivity between aquatic and terrestrial habitats, but, the degree of connectivity was not ideal (i.e., a river divided the lentic area and adjacent terrestrial habitats). The two sites adjacent to previously logged areas (THPD and Harmer Pond) had portions or most of the lentic area surrounded by forest and sustained connectivity between aquatic and terrestrial habitats. All sites had a road immediately adjacent to the lentic area that were either mine works or forest service roads. The dominant sediment type at most sites was comprised of or included silt-clay suitable for western toad egg-laying, while one site (Gate Pond) was predominantly gravel. Considerable noise from mine works (e.g., vehicles, conveyor belts, explosives) was noted at four sites (Clode, Greenhills Pond, LCCPU, and Goddard Finger Ponds). None of the sites had pond liners.

The presence of shallow margins did not change throughout the breeding period for all sites except Gate Pond, which had none present in the spring but some shallow sections later in summer as water levels dropped (**Table 5**). LCCPU had the shallowest margins (about 5 cm) where silt-clay and emergent grass occurred (**Figure 8**). Shoreline vegetation at all sites predominantly included grass and remained consistent throughout the breeding period at all sites except Gate Pond, where grass was dominant in spring and was succeeded by a mixture of grass and weeds later in summer. The amount of emergent vegetation increased across the breeding period at three sites (Clode, THPD, and Harmer Pond) and remained consistent at all other sites. THPD and Harmer Pond had the most abundant emergent vegetation overall. The amount of submergent vegetation generally remained consistent at most sites; however, it increased over the breeding period at two sites (Harmer Pond and Gate Pond). Submergent vegetation was most abundant at Gate Pond; however, the majority of submergent vegetation at this site was algae which became very abundant in July. Fish were only observed at Goddard Finger Ponds in aquatic funnel traps during larval surveys. Signs of beaver were observed at one site, Harmer Pond, during egg mass and larval surveys.

Water quality parameters for all sites and all visits can be found in Appendix B.

Figure 5. Western toad egg masses, larvae, metamorphs, and adult (top to bottom; left to right) observed at LCCPU in 2020.

Figure 6. Columbia spotted frog adult observed at LCCPU in 2020.

Table 4. Habitat parameters of each site surveyed in 2020.

Habitat Parameter	Management Unit 1		Management Unit 2	Management Unit 3	Management Unit 4		
	Clode	Greenhills Pond	LCCPU	THPD	Harmer Pond	Goddard Finger Ponds	Gate Pond
Pond Liner Present	No	No	No	No	No	No	No
Dominant Sediment Type	Silt-clay; Cobbles; Riprap	Silt-clay; Cobbles	Silt-Clay; Cobbles; Riprap	Silt-clay	Silt-clay	Silt-clay	Gravel
Adjacent Land Use	Mining	Mining	Mining	Forestry; Recreation	Forestry; Recreation	Mining	Mining
Adjacent Undisturbed Terrestrial Habitat	None	None	Forest	Forest	Forest	None	Forest
Adjacent Road	Mine Works	Mine Works	Mine Works	Forest Service Road	Forest Service Road	Mine Works	Mine Works; Highway
Habitat Connectivity (Aquatic to Terrestrial)	None	None	River between pond and terrestrial habitat	Intact	Intact	None	River between pond and terrestrial habitat
Comments	Noise from mine operations	Noise from mine operations	Noise from mine operations; very shallow section comprised of silt and emergent grass	Campers and ATV's nearby	Campers and ATV's nearby	Murky water-poor visibility; Noise from mine operations	Abundant algae; grew exponentially in July

Table 5. Habitat parameters recorded at each site during egg mass, larval, and metamorph surveys in 2020.

Habitat Parameter	Management Unit 1					
	Clode			Greenhills Pond		
	13-May	23-Jun	24-Jul	13-May	22-Jun	24-Jul
Shallow Margins Present	Sections	Sections	Sections	Sections	Sections	Sections
Dominant Shoreline Vegetation	Grass	Grass	Grass	Grass; Shrubs-Willow	Grass; Shrubs-Willow	Grass; Shrubs-Willow
Emergent Vegetation Amount	Nil	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic
Submergent Vegetation Amount	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic
Number of Fish Observed	0	0	0	0	0	0
Signs of Beaver Activity	None	None	None	None	None	None
Habitat Parameter	**Management Unit 2**			**Management Unit 3**		
	LCCPU			**THPD**		
	05-May	**22-Jun**	**23-Jul**	**13-May**	**23-Jun**	**24-Jul**
Shallow Margins Present	Sections	Sections	Sections	Sections	Sections	Sections
Dominant Shoreline Vegetation	Grass	Grass	Grass	Grass	Grass	Grass

Emergent Vegetation Amount	Sporadic	Sporadic	Sporadic	Sporadic	Abundant	Abundant
Submergent Vegetation Amount	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic
Number of Fish Observed	0	0	0	0	0	0
Signs of Beaver Activity	None	None	None	None	None	None

Habitat Parameter	**Management Unit 4**								
	Harmer Pond			**Goddard Finger Ponds**			**Gate Pond**		
	05-May	**15-Jun**	**23-Jul**	**11-May**	**15-Jun**	**23-Jul**	**11-May**	**15-Jun**	**23-Jul**
Shallow Margins Present	Sections	Sections	Sections	Sections	Sections	Sections	None	None	Sections
Dominant Shoreline Vegetation	Grass; Trees	Grass; Trees	Grass; Trees	Grass	Grass	Grass	Grass	Grass	Grass; Weeds
Emergent Vegetation Amount	Sporadic	Sporadic	Abundant	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic
Submergent Vegetation Amount	Nil	Nil	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic	Sporadic	Abundant
Number of Fish Observed	0	0	0	0	4	0	0	0	0
Signs of Beaver Activity	Yes-chewed stumps	Yes-beaver in water	None	None	None	None	None	None	None

Figure 7. Habitat photos of Clode, Greenhills Pond, LCCPU, THPD, Harmer Pond, Goddard Finger Ponds, and Gate Pond (top to bottom; left to right) in July 2020.

Figure 8. Shallow margins with silt-clay and emergent grass at LCCPU.

3.3 Discussion

Overall, amphibian occurrence was low at these sites, with observations occurring at two of the six sites surveyed (33%). Only two species were observed: Columbia spotted frog and western toad, with breeding evidence observed only for western toad. LCCPU had the highest number of detections, including adults of both species and egg masses, larvae, and metamorphs of western toad.

Habitat at LCCPU included sections of shallow margins where silt-clay and emergent grass occur, which is ideal egg-laying habitat for western toad (Bull, 2006; COSEWIC, 2012); therefore, it is unsurprising that western toad was found breeding at this site. The observation of adult Columbia spotted frog at LCCPU suggests this species may use this lentic area as foraging grounds and/or as a movement corridor, although habitat features at this site may not be suitable for breeding for this species. The amount of emergent and submergent vegetation in shallow areas at LCCPU may not have been sufficient for breeding Columbia spotted frog. While the river on the eastern perimeter and road on the western perimeter at LCCPU may not inhibit western toad or Columbia spotted frog movement, it may prove problematic for other amphibian species.

Habitat at Clode is likely unsuitable for amphibian breeding. The observation of western toad at this site suggests it may be important as foraging grounds and/or as a movement corridor. Clode had one section of shallow margins with silt-clay and emergent grass, although it was small and the majority of the lentic area had steep banks with little to no emergent and submergent vegetation or connectivity to adjacent terrestrial habitat. Despite the presence of suitable habitat features, the scarcity of such habitats and the presence of steeply-eroded banks may explain why western toad were present but not breeding at this site.

Habitat quality was poor at Greenhills Pond, Goddard Finger Ponds, and Gate due to steep banks, gravel sediment, fish presence, lack of or poor connectivity between aquatic and terrestrial habitats, and little to no adjacent terrestrial habitats. These factors may explain (either individually or cumulatively) why amphibians were not detected at these sites.

Additional factors that may influence amphibian occurrence at lentic areas on mine sites include poor water quality and anthropogenic noise. Water at Goddard Finger Ponds was saturated with coal particles and appeared black and murky, the presence and abundance of algae at Gate Pond may affect amphibian reproductive success (Bold and Wynne, 1985; Lin and Bishop, 2015), and specific conductance was high (>1000 µS /cm; Appendix B) at Clode, Greenhills Pond, Goddard Finger Ponds, and Gate Pond. Anthropogenic noise at lentic areas on mine sites may additionally influence occurrence of some amphibian species by disrupting male calling during breeding in the spring, particularly for quiet calling species such as Columbia spotted frog (Government of BC, 2002). Western toad was found breeding at LCCPU despite the noise: however, it may be an additional explanation for why Columbia spotted frog, a quieter calling species, was not found breeding at this site or others with nearby noise. Further analysis examining the effect and extent to which water quality parameters and anthropogenic noise influence amphibian occurrence should be completed.

Harmer Pond had good breeding habitat for amphibians that included emergent vegetation, silt-clay sediment, and adjacent terrestrial habitat with connectivity: it is surprising that no amphibians were found at this location. One potential explanation may be the presence of fish which can predate amphibian eggs and larvae (Monello & Wright, 1999). While fish were not detected at this site, it likely does not reflect true absence given these surveys did not target fish. Additionally, amphibians may require more extensive portions of the lentic area to be comprised of shallow sections and most sections at Harmer Pond were deep.

THPD also had good habitat, but there were no incidental amphibians detected during habitat assessments. Western toad and long-toed salamander were observed at this site in 2019, with breeding evidence for long-toed salamander. Potential presence of fish, insufficient deep sections, and high specific conductance may be factors influencing the species present and breeding at this site.

It is likely the combination of habitat features, rather than the features independently, that make a lentic area suitable for breeding amphibians. Additionally, suitable habitat is different for each species (Waldman, 1981; Bull, 2006; Hawkes and Tuttle, 2013) and some may be less affected by anthropogenic disturbance and barriers to movement (Schmetterling and Young, 2008; Emel and Storfer, 2012; Nelson et al., 2016). This likely explains why western toad breed at LCCPU, but not other species and why amphibians occurred and breed at this site over other sites.

3.4 Summary and Conclusion

- Western toad adults were observed at Clode;
- Columbia spotted frog adults were observed at LCCPU;
- Western toad at all life stages (egg masses, larvae, and metamorphs/adults) were observed at LCCPU;
- Generally, a lack of connectivity between aquatic and terrestrial habitats, steep banks and deep water, fish presence, and gravel sediment coincided with the absence of amphibians and/or breeding evidence;
- Additional factors that may influence amphibian occurrence include anthropogenic noise and water quality;
- In conclusion, suitable habitats for breeding likely include a combination of features and may vary for each species; therefore, focused, species-specific research projects identifying and quantifying the effect of various factors on distribution and occurrence of each species would be necessary to determine what may influence occurrence and distribution.

4 Limitations and Closure

The Client and all readers of this report are hereby advised of the following:

- The work performed in this report was carried out in accordance with the terms and conditions specified in our signed Project Work Agreement (PWA) and/or Authorization to Proceed with the Client. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in this report and/or the PWA. Since site conditions may change over time, the report is intended for immediate use only.
- This report is intended to provide information to the Client to assist it in making business decisions. VAST is not a party to the various considerations underlying the business decisions and does not make recommendations regarding such. In providing this report, VAST accepts no liability or responsibility in respect of the site described in this report or for any business decisions relating to the site, including decisions in respect of the purchase, sale or investment in the site.
- The information presented in this report was acquired, compiled and interpreted exclusively for the Client for the purposes described in this report. VAST Resource Solutions does not accept any responsibility for the use of this report, in whole or in part, for any purpose other than intended or to any third-party for use whatsoever.
- Services provided by VAST Resource Solutions for this report have been conducted in a manner consistent with the level of skill, care and competence ordinarily exercised by members of the profession currently practicing under similar conditions and like circumstances in the same jurisdiction in which the services were provided. Professional judgment has been applied to developing the conclusions in this report. No warranties, expressed or implied, are made as to the professional services provided under the terms of the PWA and included in this report.
- The report is based on and limited by circumstances and conditions referred to throughout the report and on information available at the time of the site investigation. The conclusions of this report are based in part on information provided by others. Unless specifically indicated in this report, VAST has not independently verified the accuracy or completeness of the information provided by third-party sources. The accuracy of this report is therefore subject to any errors or omissions in the information provided.
- VAST is not responsible for the documentation of environmental conditions at the site that were not apparent from readily available sources. Future assessments may reveal conditions not apparent at the time of this report.
- The findings, conclusions and recommendations presented by VAST in this report reflect VAST's best judgment based on the site conditions at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. The findings cannot be extended to previous or future site conditions or to portions of the Site which were unavailable for direct observation.
- The conclusions and recommendations in this report do not relieve the Client, their agents or representatives of the responsibility to comply with applicable acts, regulations, bylaws and/or decisions of any authorities that have jurisdiction under an enactment.

- This report must be read and interpreted as a whole, as sections taken out of context may be misleading.
- If discrepancies occur between any preliminary (draft) version and the final, signed version of this report, it is the final, signed version that takes precedence. Digital copies of this report may be available upon request. If discrepancies occur between the paper version and the digital copy, the final, signed paper version takes precedence.
- Nothing in this report is intended to constitute or provide a legal opinion.
- The author reserves the right to amend this report if additional information becomes available.

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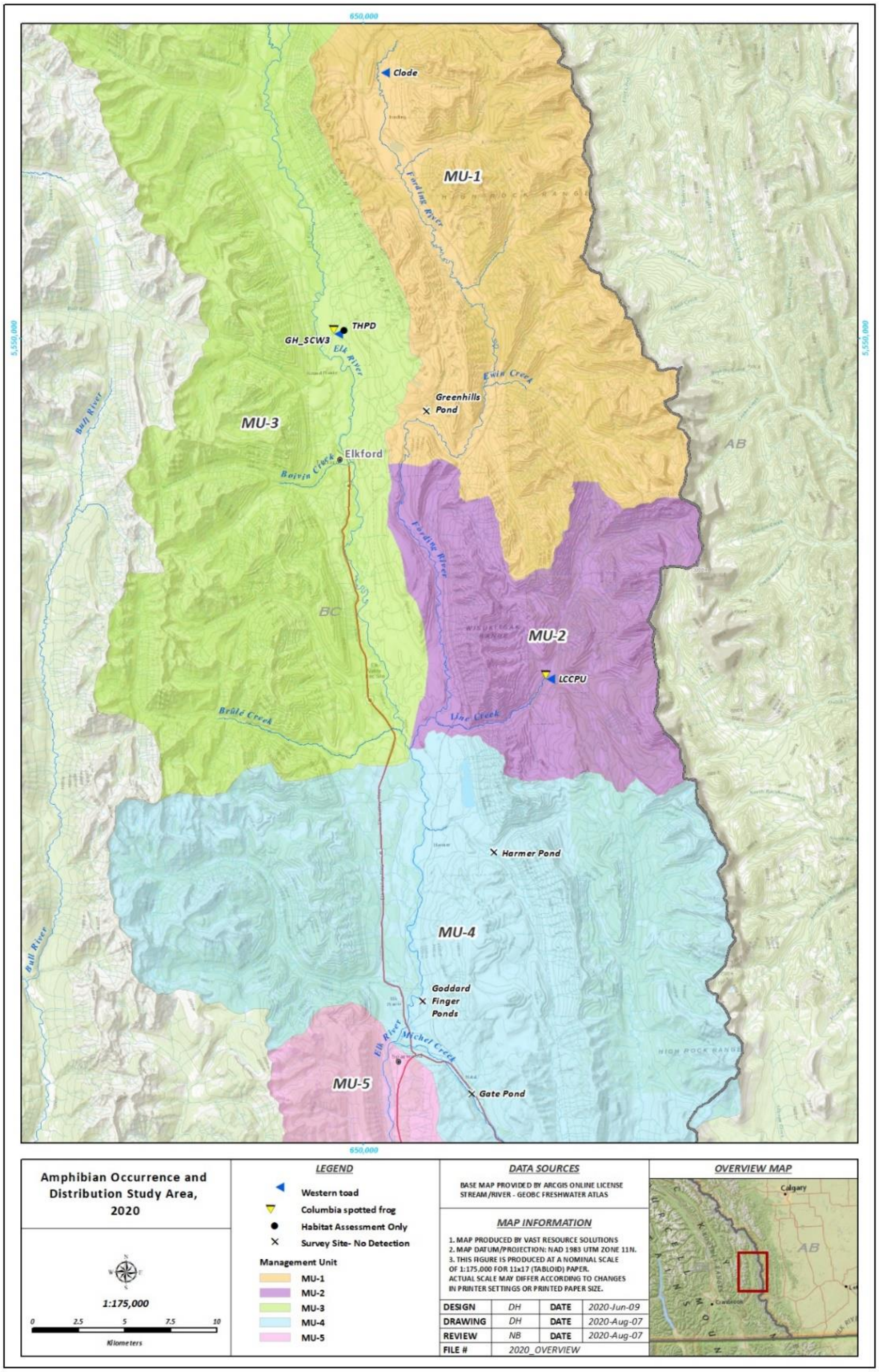
Appendix A

Overview map of sites surveyed and the location of amphibian species observed in 2020.



Appendix B

Water quality measurements recorded at each site during egg mass, larval, and metamorph surveys in 2020. ORP = oxidation reduction potential.

Field Parameter	Units	Management Unit 1							
		Clode				Greenhills Pond			
		13-May	29-May	23-Jun	24-Jul	13-May	29-May	22-Jun	24-Jul
Water Temperature	(°C)	11.7	11.2	12.2	14.7	7.7	12.4	14.8	17.7
Dissolved Oxygen	(%)	80.0	91.4	87.9	68.4	93.0	99.1	67.2	99.9
	(Mg/L)	8.6	9.9	9.4	6.9	11.0	10.5	6.8	9.4
Conductivity	(µS/cm)	1354.0	979.0	1219.0	1314.0	489.8	682.0	887.0	1269.0
Specific Conductance	(µS/cm)	1817.0	1341.0	1611.0	1634.0	728.4	896.0	1099.0	1474.0
pH	pH Units	8.1	8.1	.	8.0	8.0	8.5	.	8.4
ORP	(mV)	194.4	129.2	119.7	120.4	198.3	102.3	136.4	104.8

Field Parameter	Units	Management Unit 2				Management Unit 3					
		LCCPU				GH_SCW3				THPD	
		05-May	28-May	22-Jun	23-Jul	13-May	29-May	23-Jun	24-Jul	13-May	24-Jul
Water Temperature	(°C)	2.6	7.6	7.6	11.8	7.0	8.6	10.3	10.4	8.4	19.8
Dissolved Oxygen	(%)	71.4	116.0	78.2	104.1	87.0	72.7	87.4	72.8	94.0	129.9
	(Mg/L)	9.7	13.7	9.1	11.3	10.6	8.5	9.8	8.1	11.0	11.8
Conductivity	(µS/cm)	.	406.2	429.4	489.1	215.4	232.0	199.6	189.1	673.0	1462.0
Specific Conductance	(µS/cm)	.	599.3	644.6	656.7	327.8	337.3	277.8	262.1	1004.0	1631.0

pH	pH Units	8.2	7.6	.	7.7	8.3	8.0	.	8.4	8.5	8.3
ORP	(mV)	193.7	121.3	89.7	103.8	176.4	81.6	44.5	75.9	181.5	128.0

Field Parameter	**Units**	**Management Unit 4**											
		Harmer Pond				**Goddard Finger Ponds**				**Gate Pond**			
		05-May	**27-May**	**15-Jun**	**23-Jul**	**11-May**	**27-May**	**15-Jun**	**23-Jul**	**11-May**	**27-May**	**15-Jun**	**23-Jul**
Water Temperature	(°C)	4.9	7.3	6.4	12.1	6.2	12.9	11.4	19.2	7.6	8.9	9.3	16.0
Dissolved Oxygen	(%)	94.6	91.0	69.3	95.1	105.0	80.1	60.8	83.4	96.0	74.6	62.1	198.0
	(Mg/L)	11.8	11.0	8.5	10.1	13.2	8.7	6.6	7.72	11.2	8.7	7.1	19.1
Conductivity	(µS/cm)	.	301.0	271.5	4619.0	.	784.0	701.0	659.1	.	1201.0	1199.0	1860.0
Specific Conductance	(µS/cm)	.	456.7	419.2	622.1	.	1048.0	948.0	1071	.	1735.0	1711.0	2252.0
pH	pH Units	8.1	8.4	8.4	8.1	7.9	8.0	8.4	8.07	8.1	8.2	8.4	8.6
ORP	(mV)	201.1	110.2	88.3	105.5	265.9	109.7	127.2	113.3	286.5	131.6	146.5	137.2

Dissolved oxygen and pH were cross-checked with the BC surface water quality guidelines (WQG; BC MOE, 2019) for the short-term and long-term protection of aquatic life.
The short-term acute (i.e., maximum) WQG for dissolved oxygen is 5-9 mg/L, depending on life stage (i.e., embryo vs adult).
The long-term chronic (i.e., average) WQG for dissolved oxygen is 8-11 mg/L, depending on life stage (i.e., embryo vs adult).
The short-term maximum and long-term average were the same for pH (i.e., 6.5-9.0). Note, may change based on site specific ambient levels.

= Concentration exceeds the BC surface water quality guidelines for the long-term protection of aquatic life (BC MOE, 2019)

= Concentration exceeds the BC surface water quality guidelines for the short- and long-term protection of aquatic life (BC MOE, 2019)

Note:
"." = parameter not measured due to YSI dysfunction

Reference: BC Ministry of Environment (MOE). (2019). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Ministry of Environment & Climate Change Strategy.

304 Industrial Road G, CRANBROOK, BC V1C 7J4
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APPENDIX D
WATER QUALITY

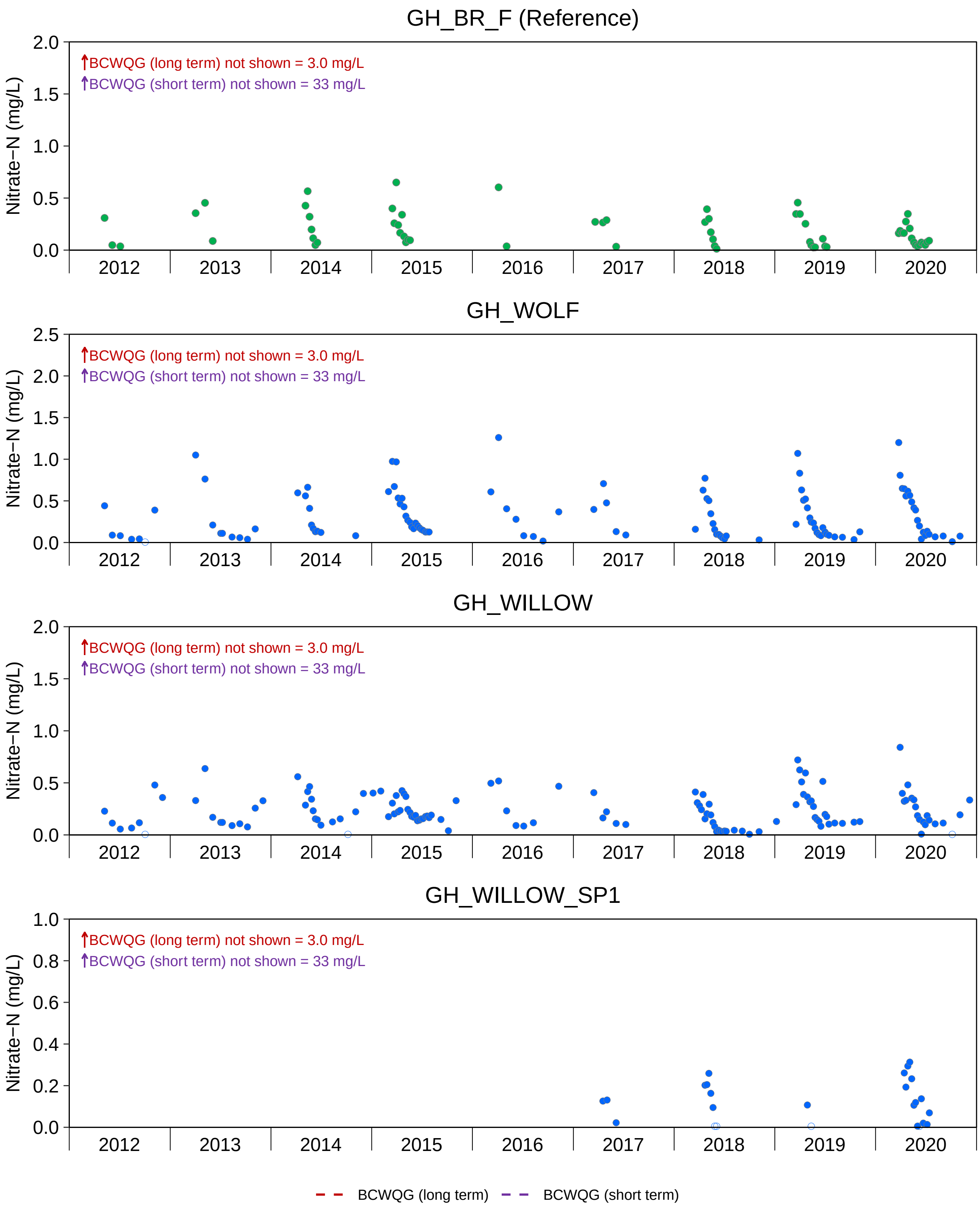


Figure D.1: Concentrations of Nitrate−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

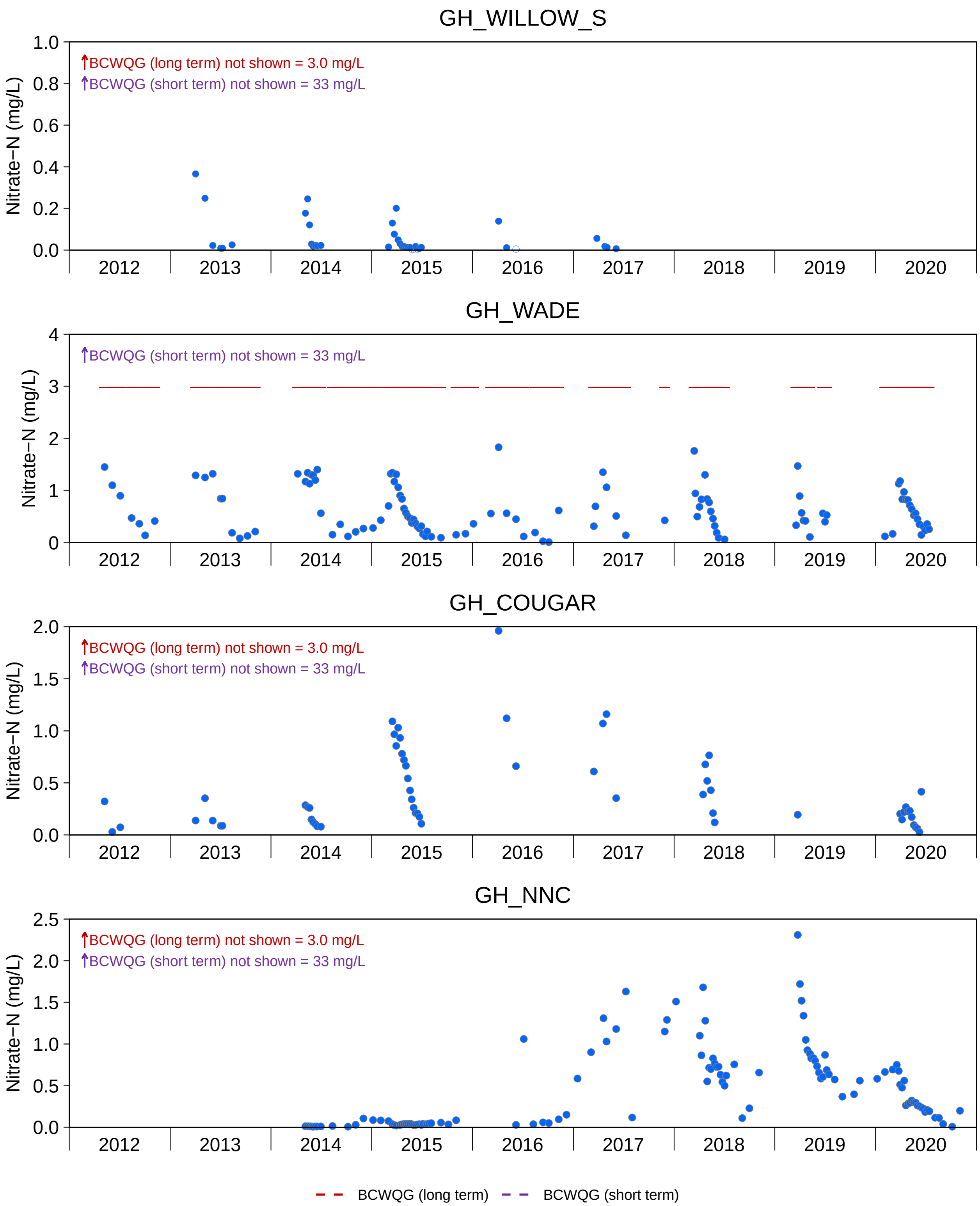


Figure D.1: Concentrations of Nitrate−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

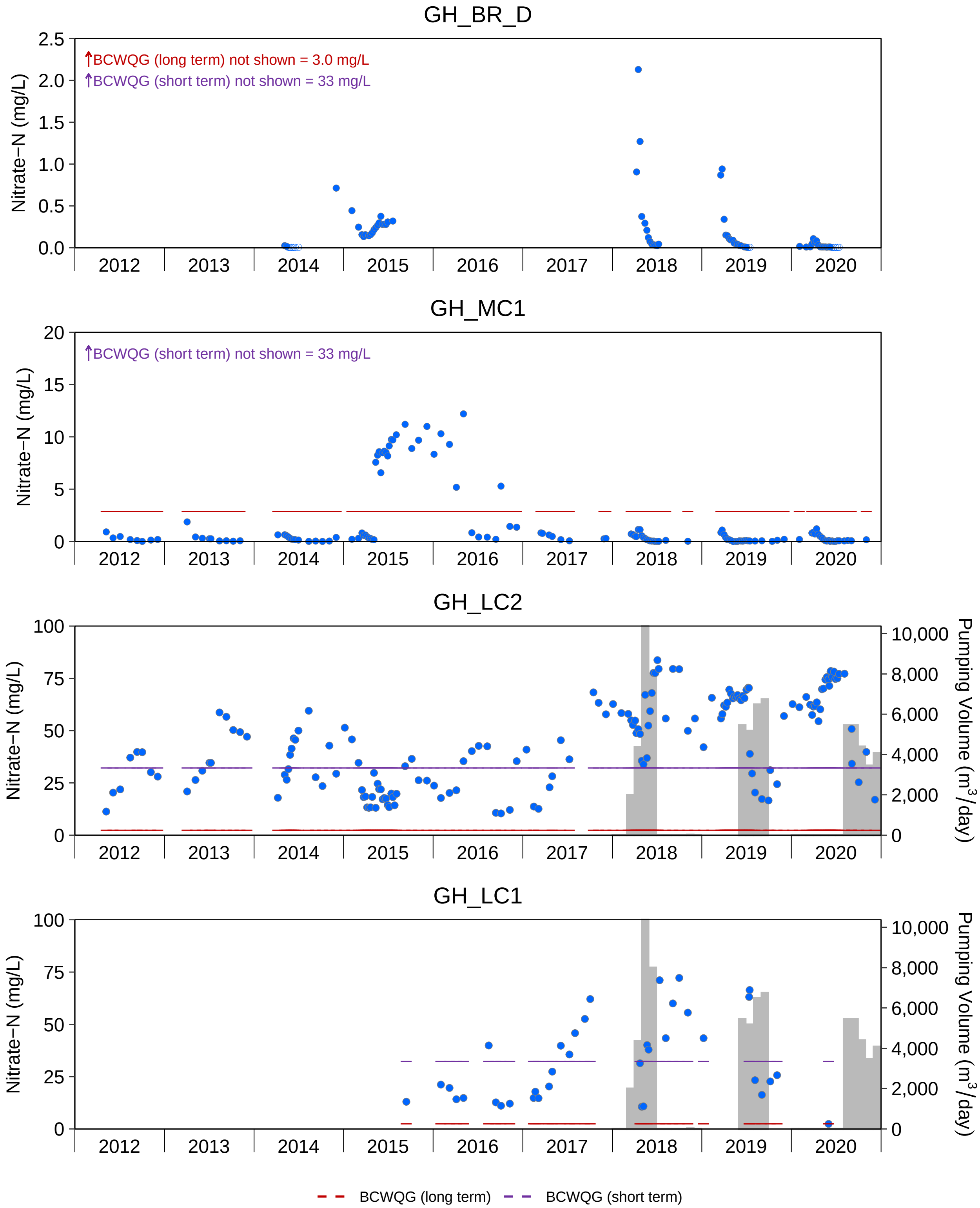


Figure D.1: Concentrations of Nitrate−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

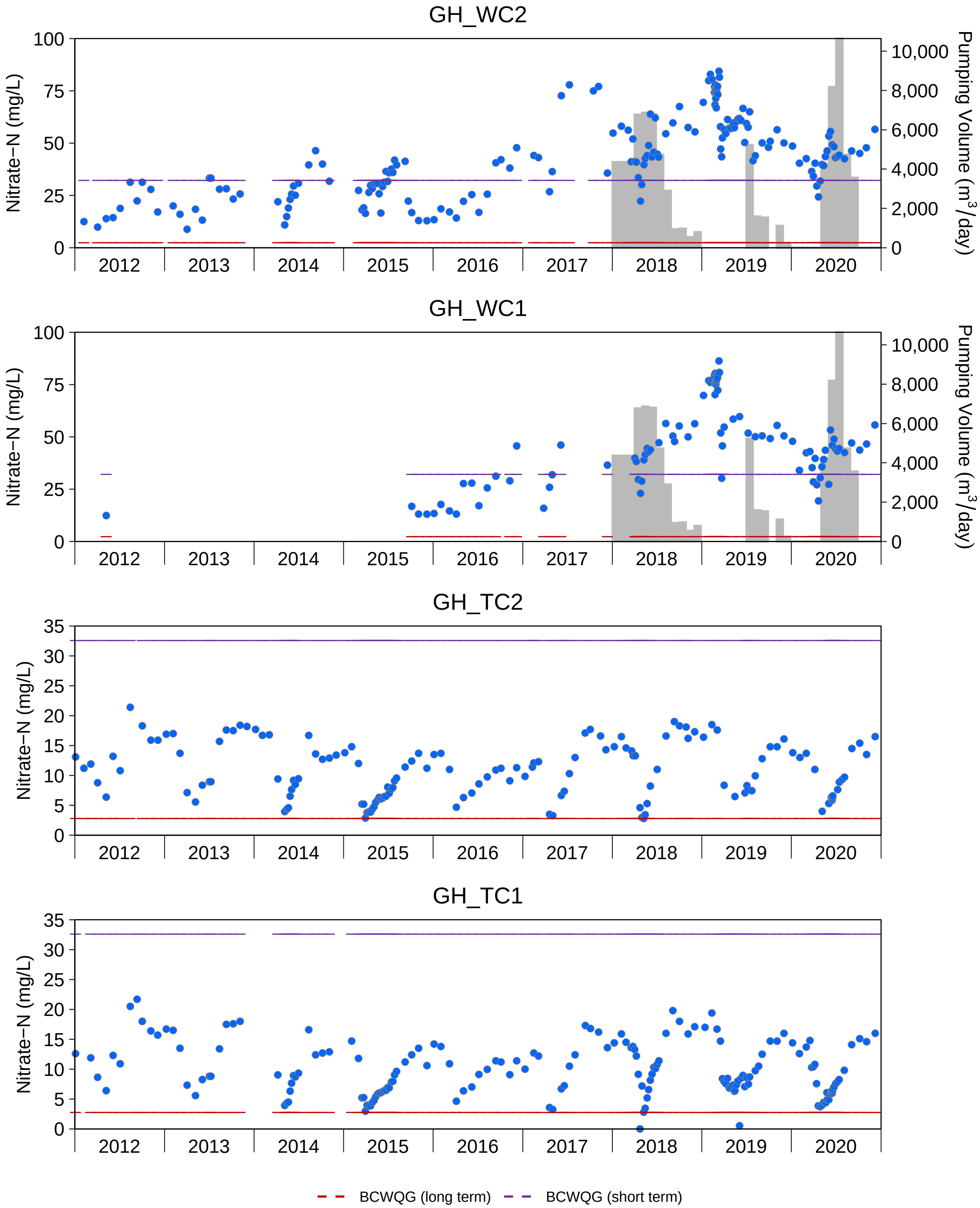


Figure D.1: Concentrations of Nitrate−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

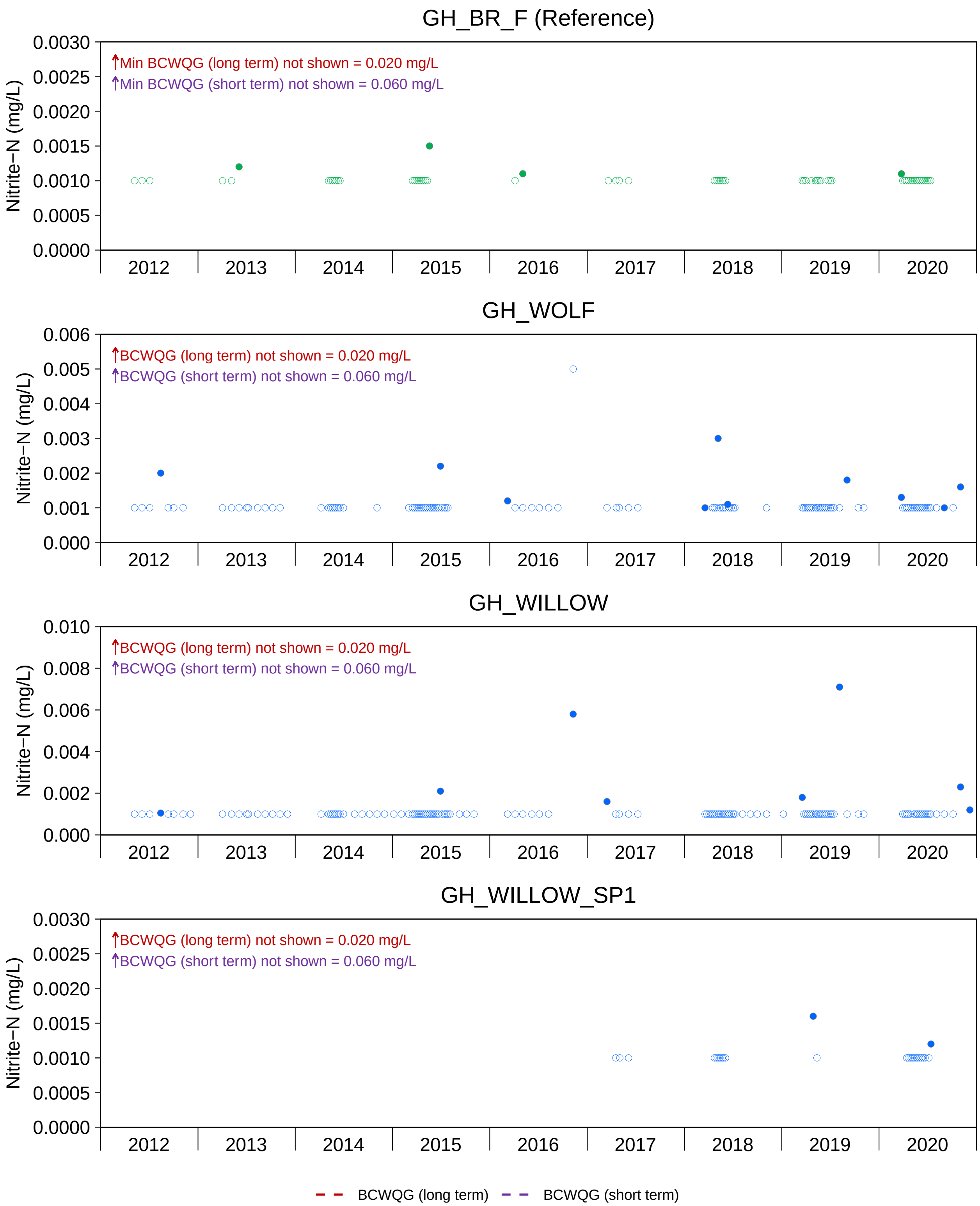


Figure D.2: Concentrations of Nitrite−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

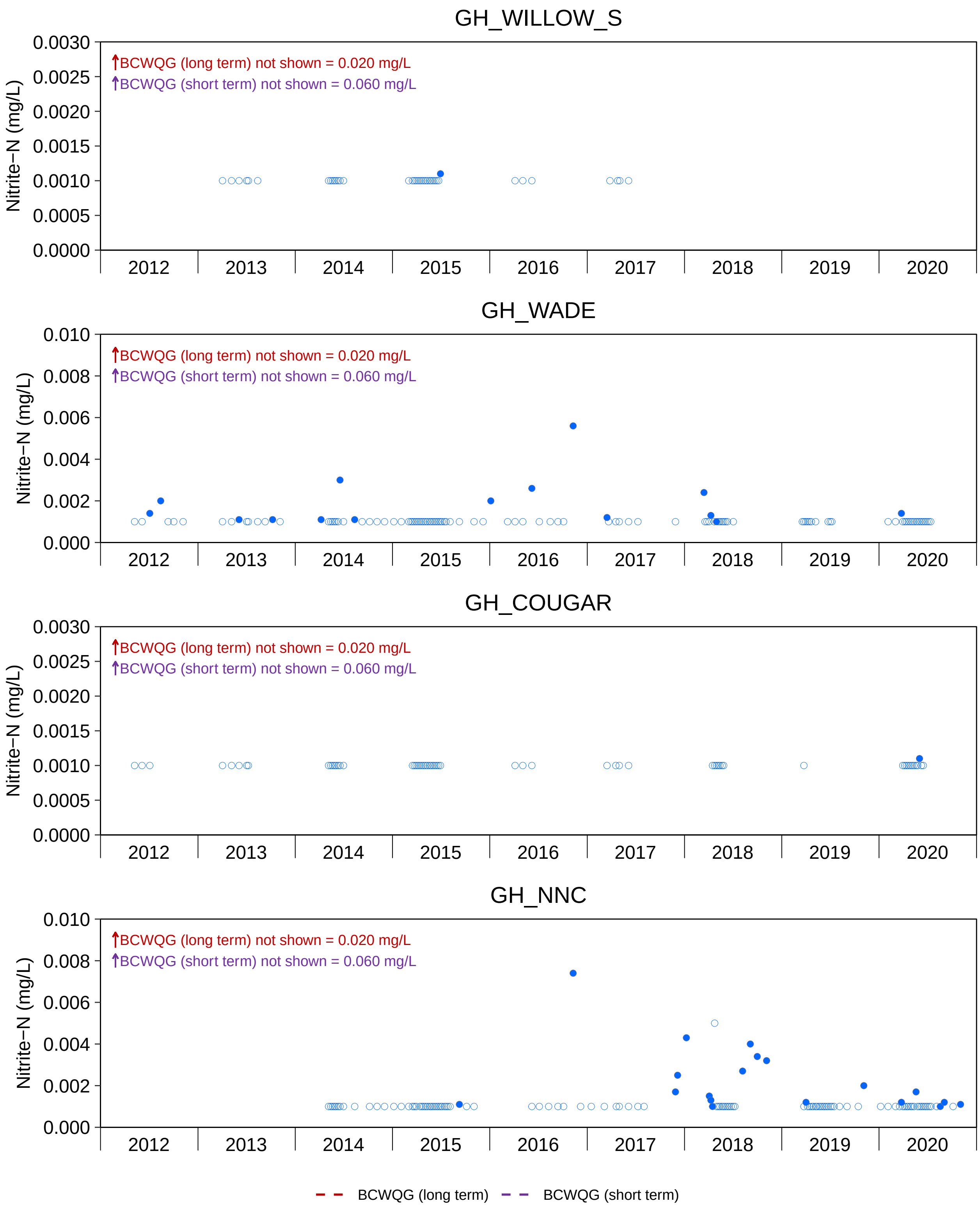


Figure D.2: Concentrations of Nitrite−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

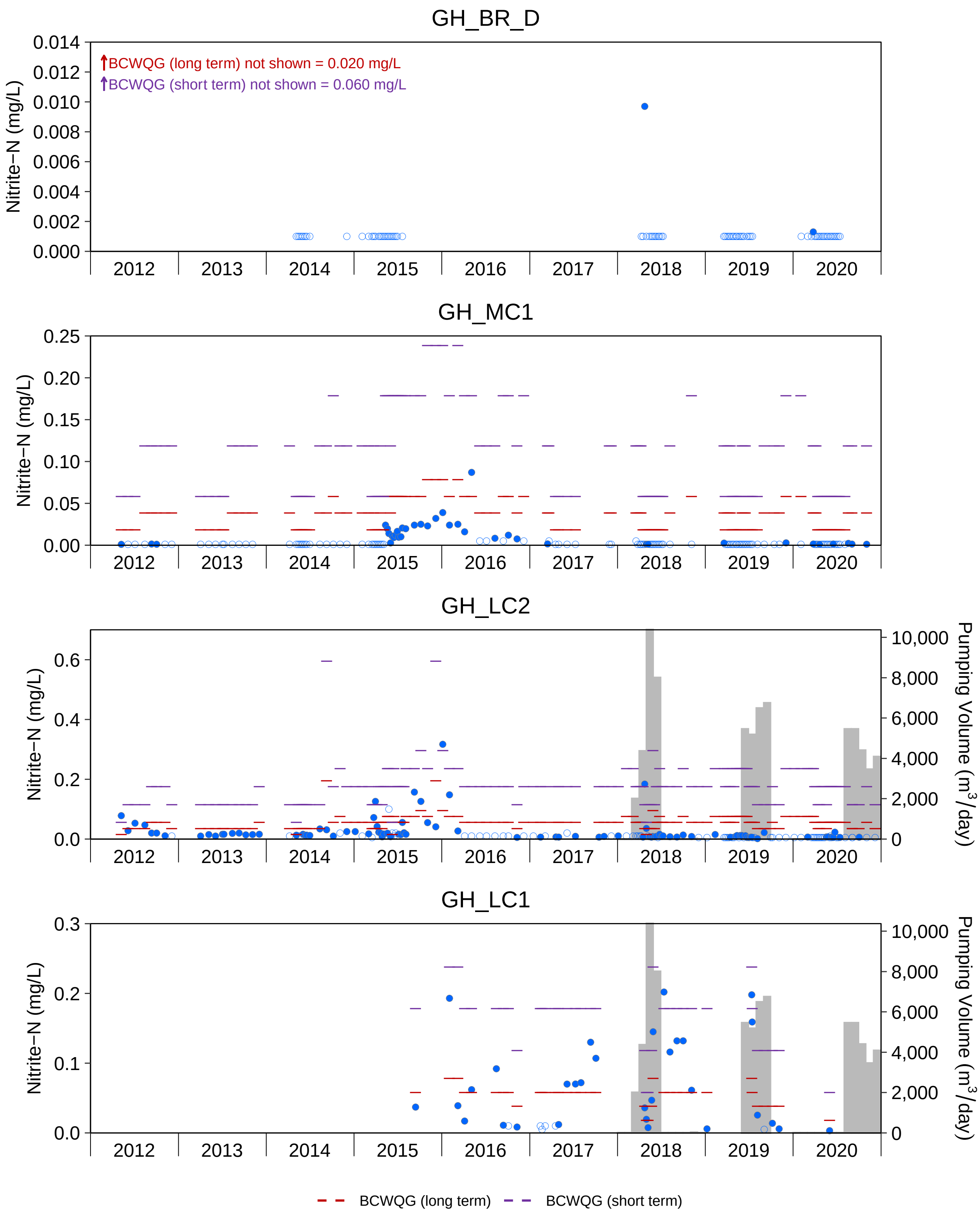


Figure D.2: Concentrations of Nitrite−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

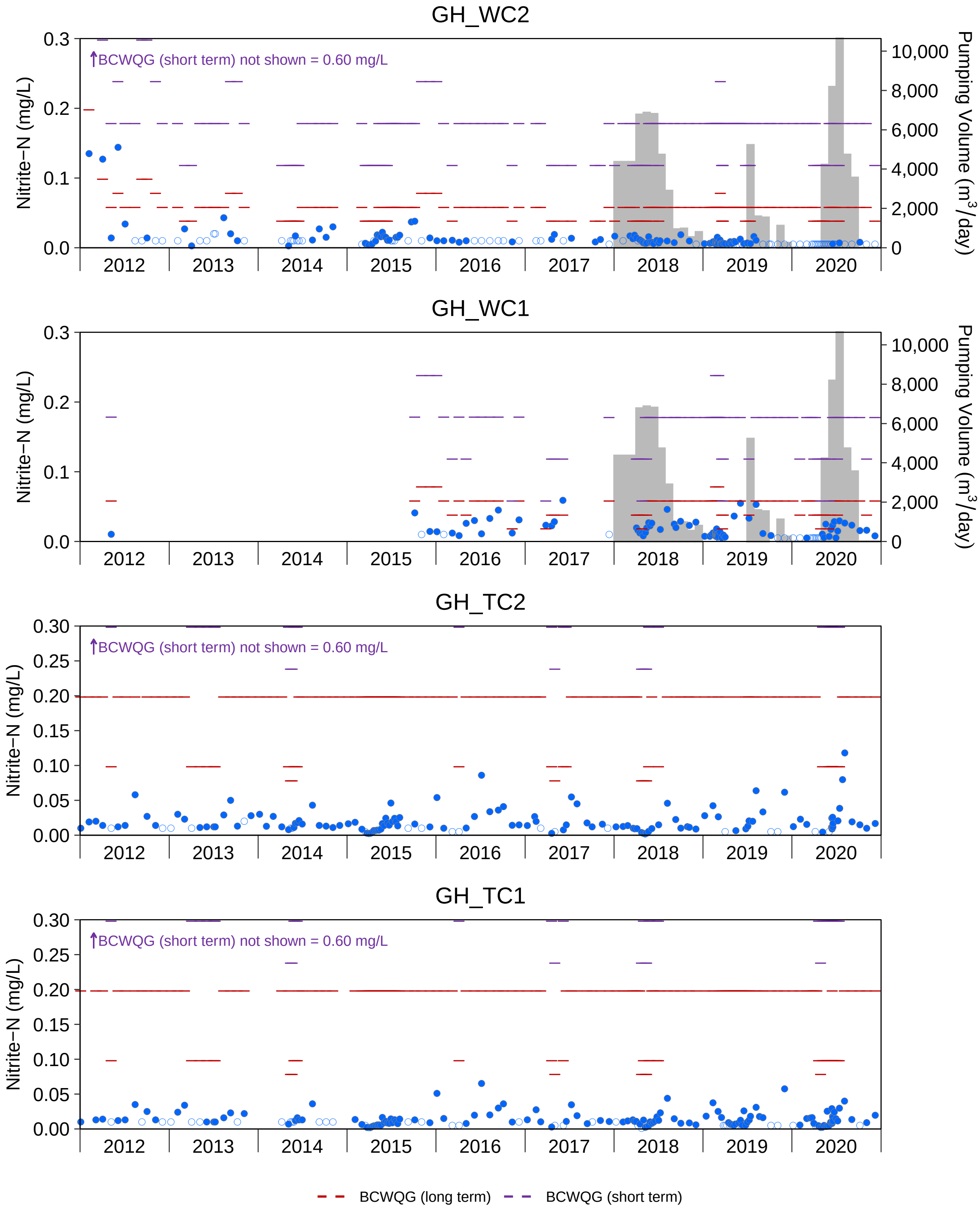


Figure D.2: Concentrations of Nitrite−N in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

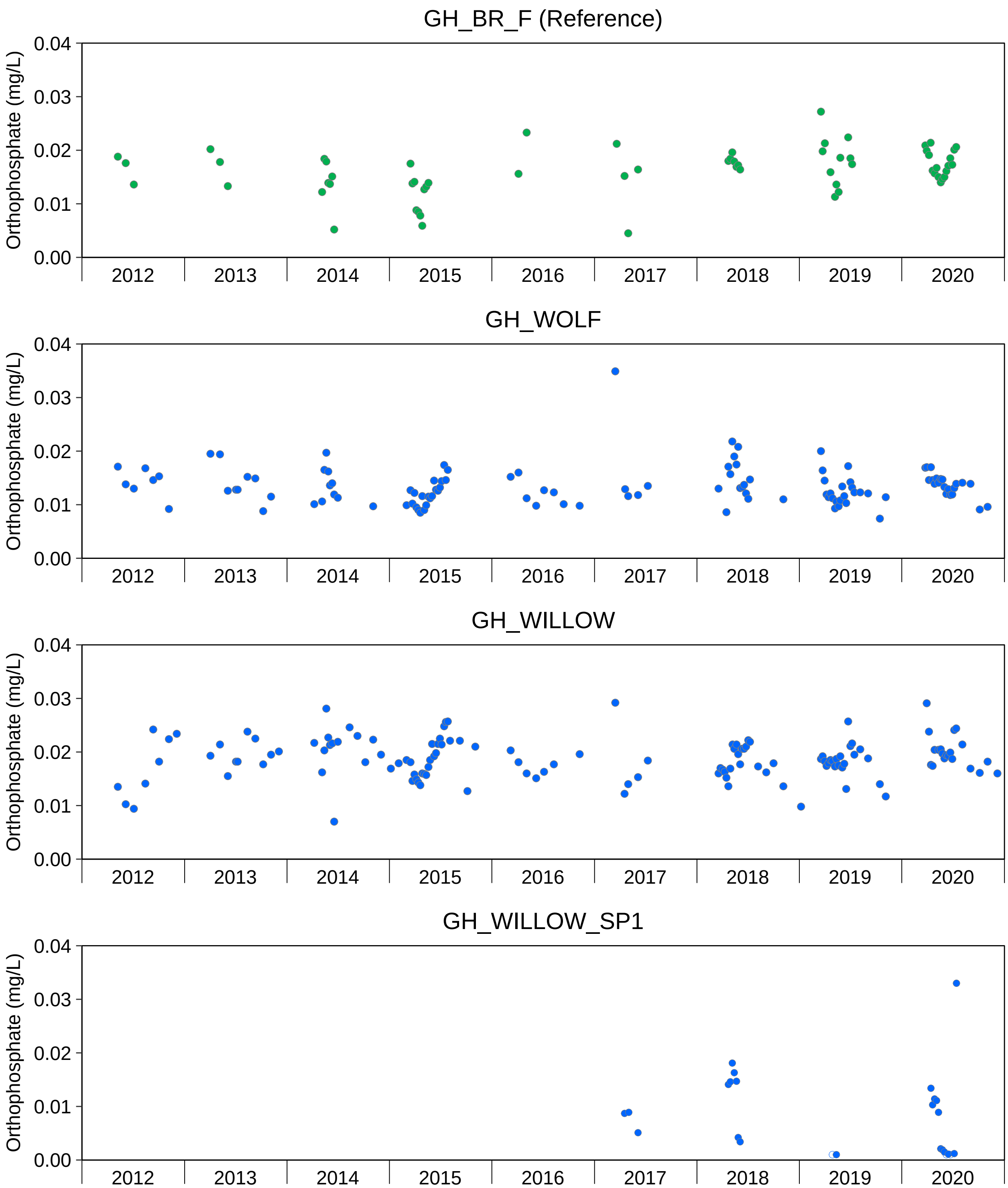


Figure D.3: Concentrations of Orthophosphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

Figure D.3: Concentrations of Orthophosphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

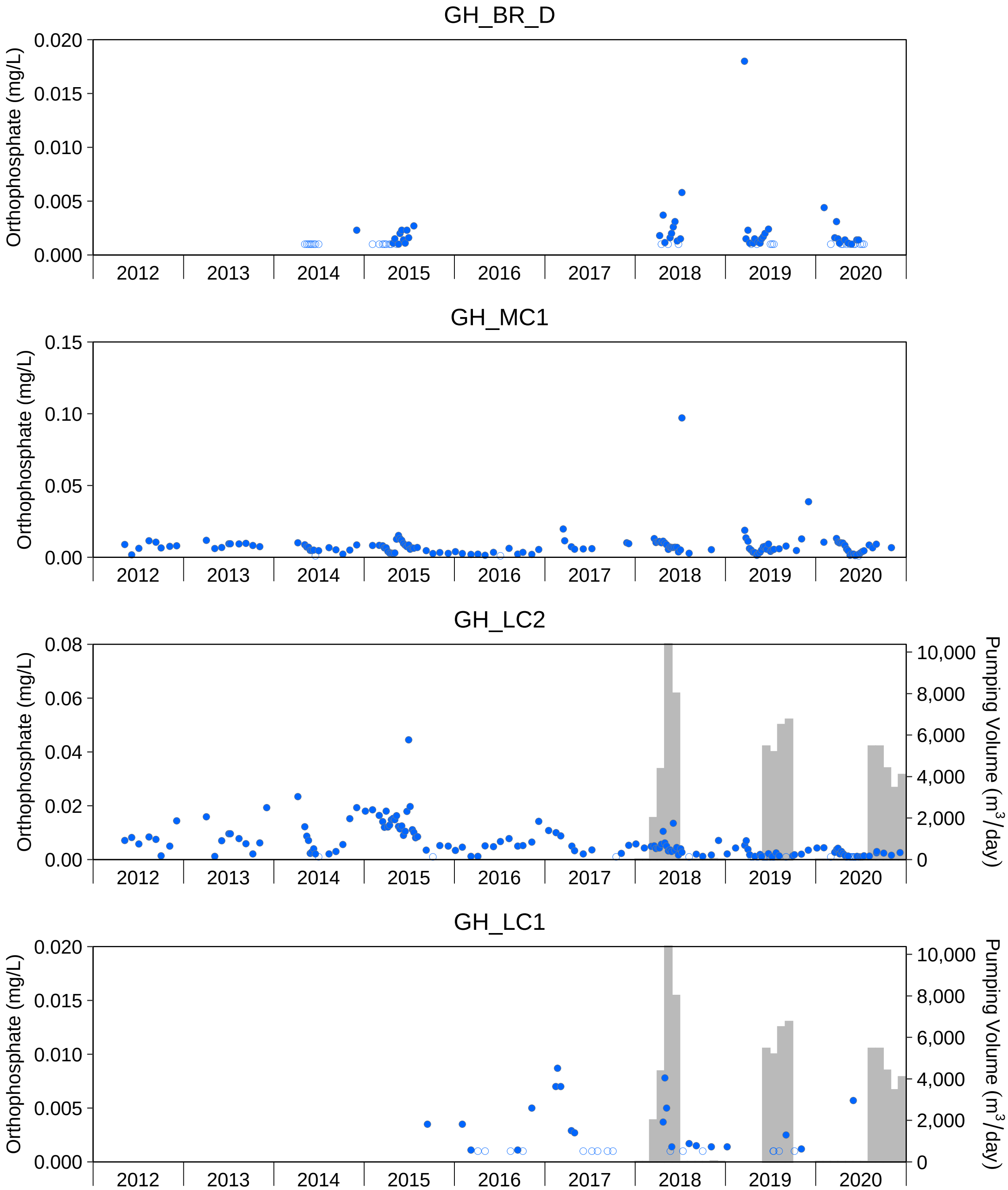


Figure D.3: Concentrations of Orthophosphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

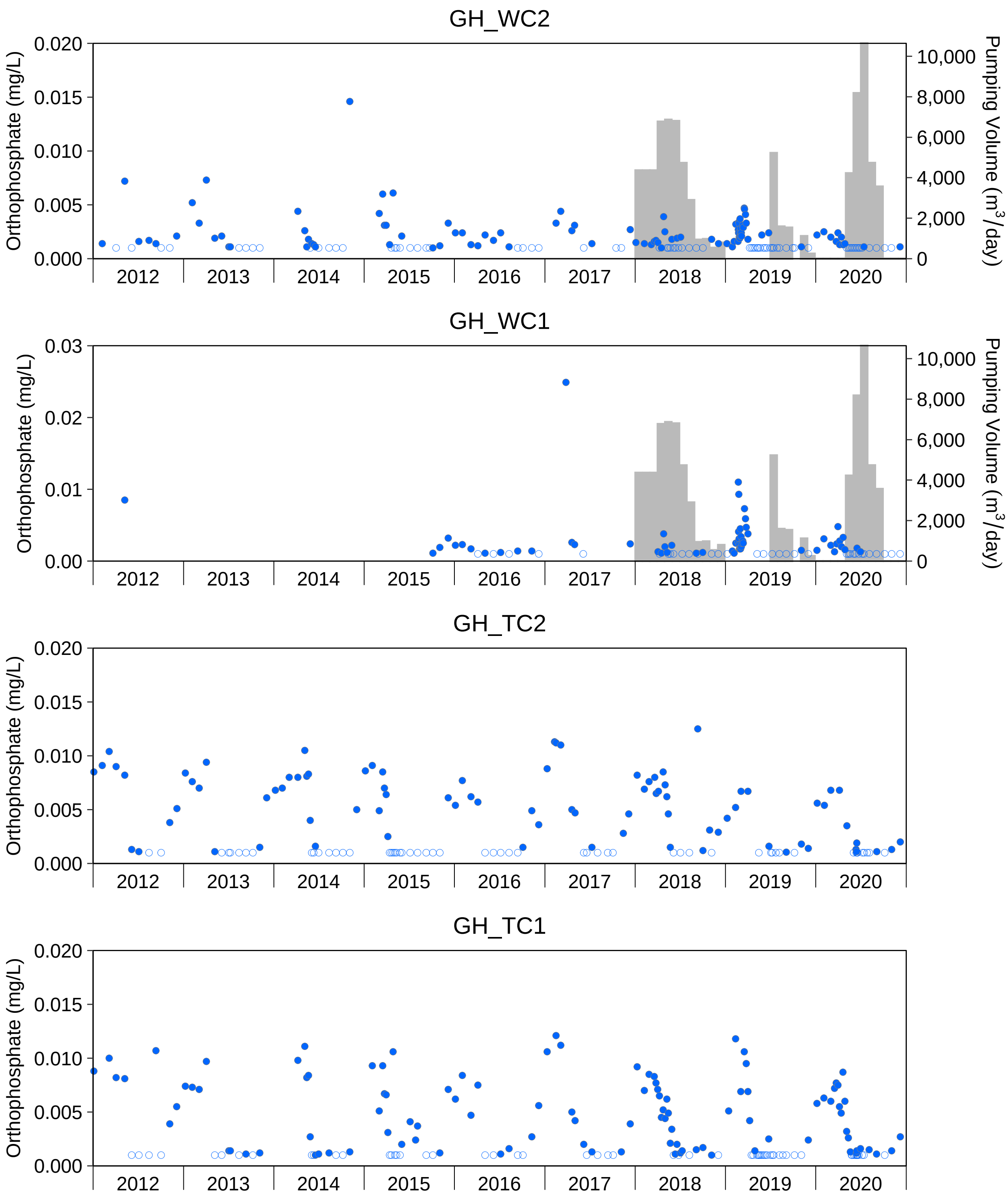


Figure D.3: Concentrations of Orthophosphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

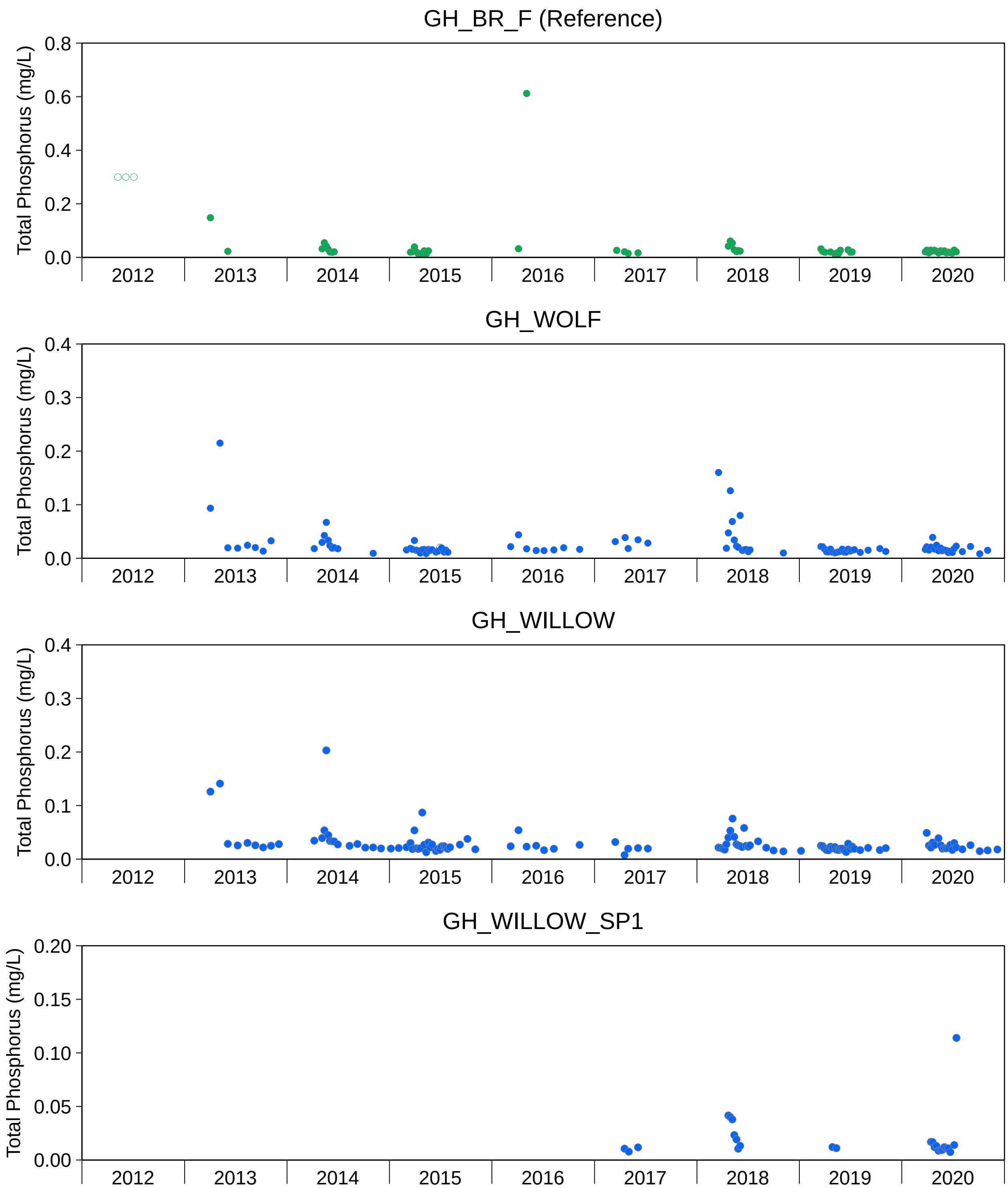


Figure D.4: Concentrations of Total Phosphorus in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Phosphorus was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

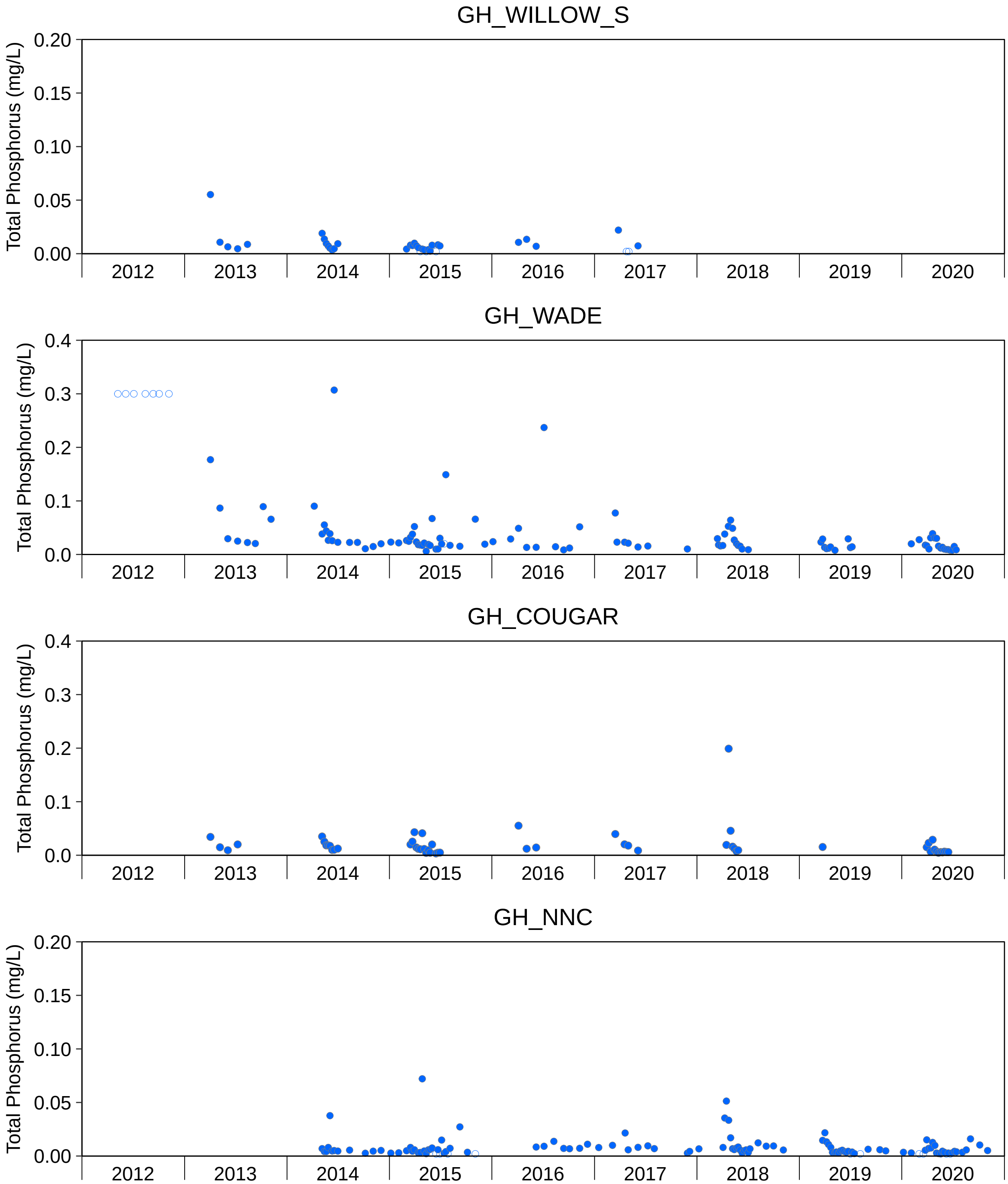


Figure D.4: Concentrations of Total Phosphorus in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Phosphorus was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

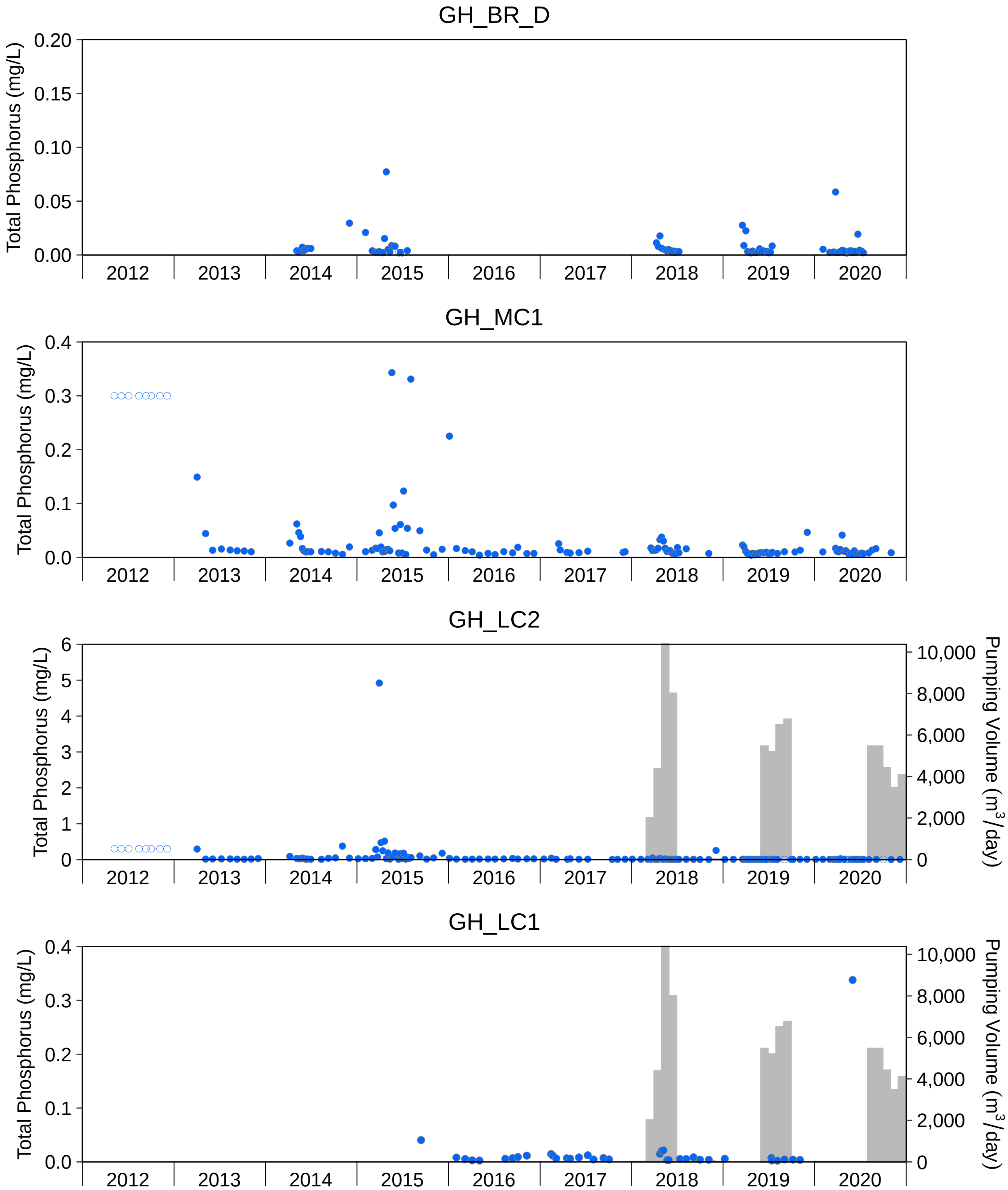


Figure D.4: Concentrations of Total Phosphorus in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Phosphorus was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

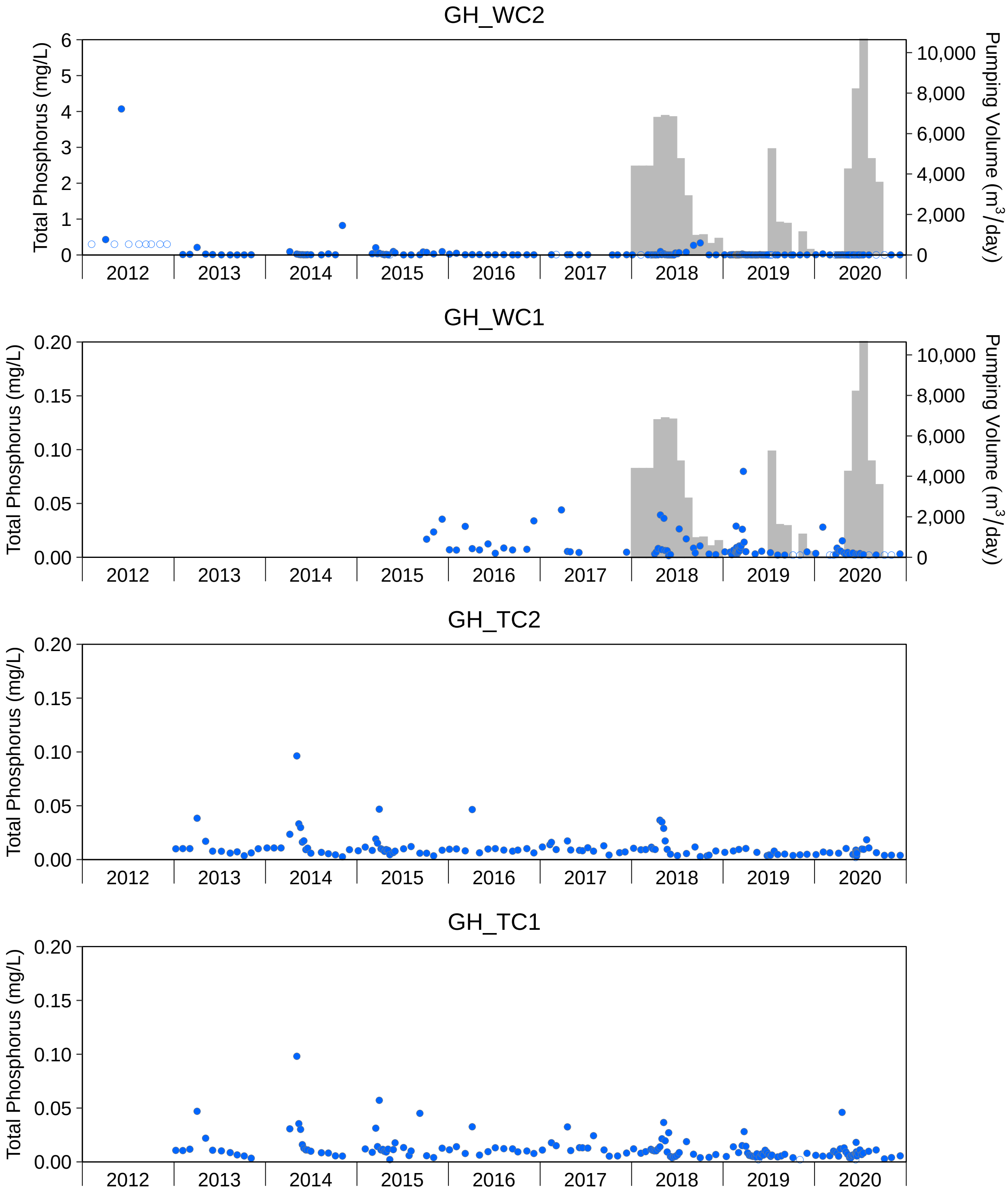


Figure D.4: Concentrations of Total Phosphorus in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Phosphorus was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

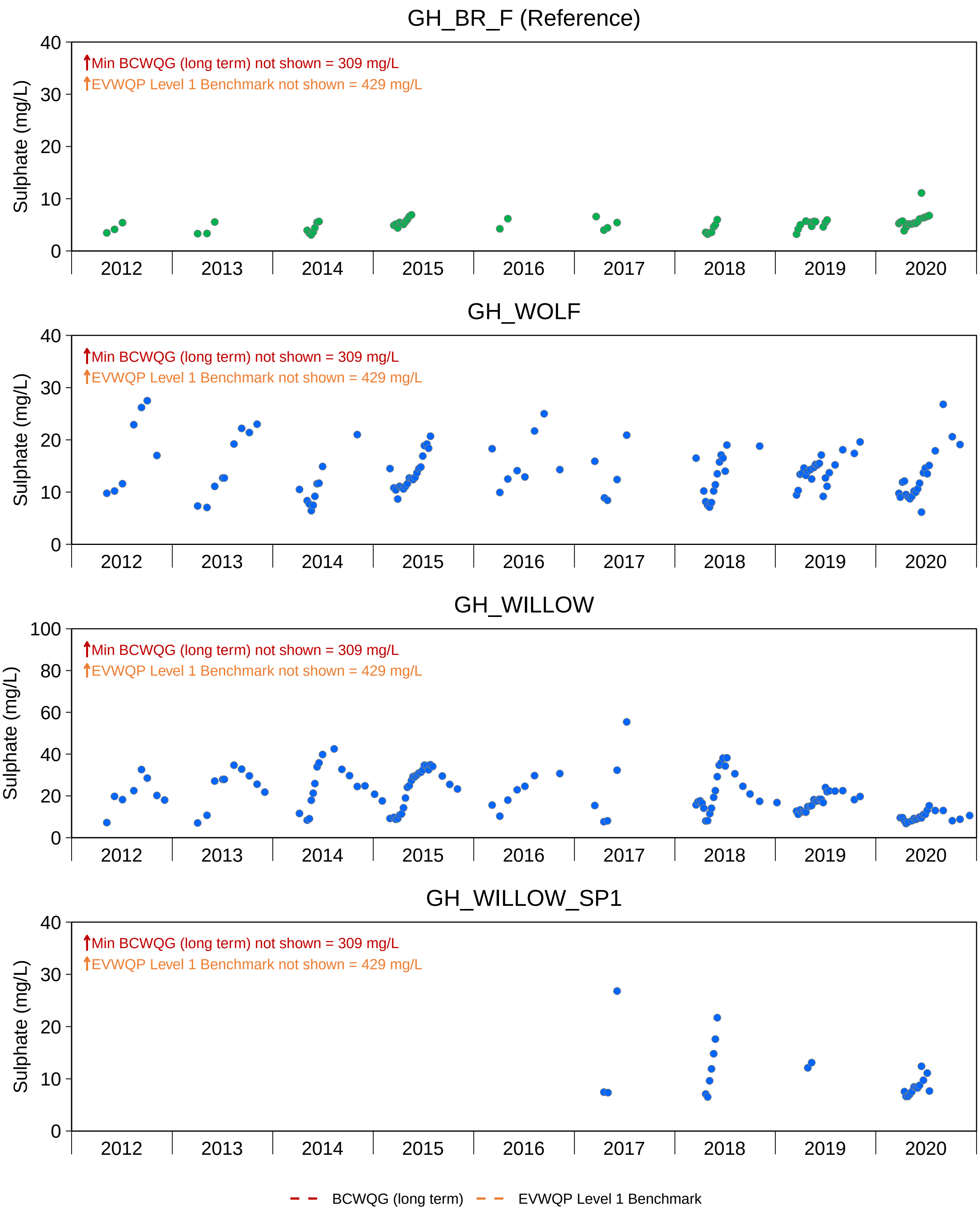


Figure D.5: Concentrations of Sulphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

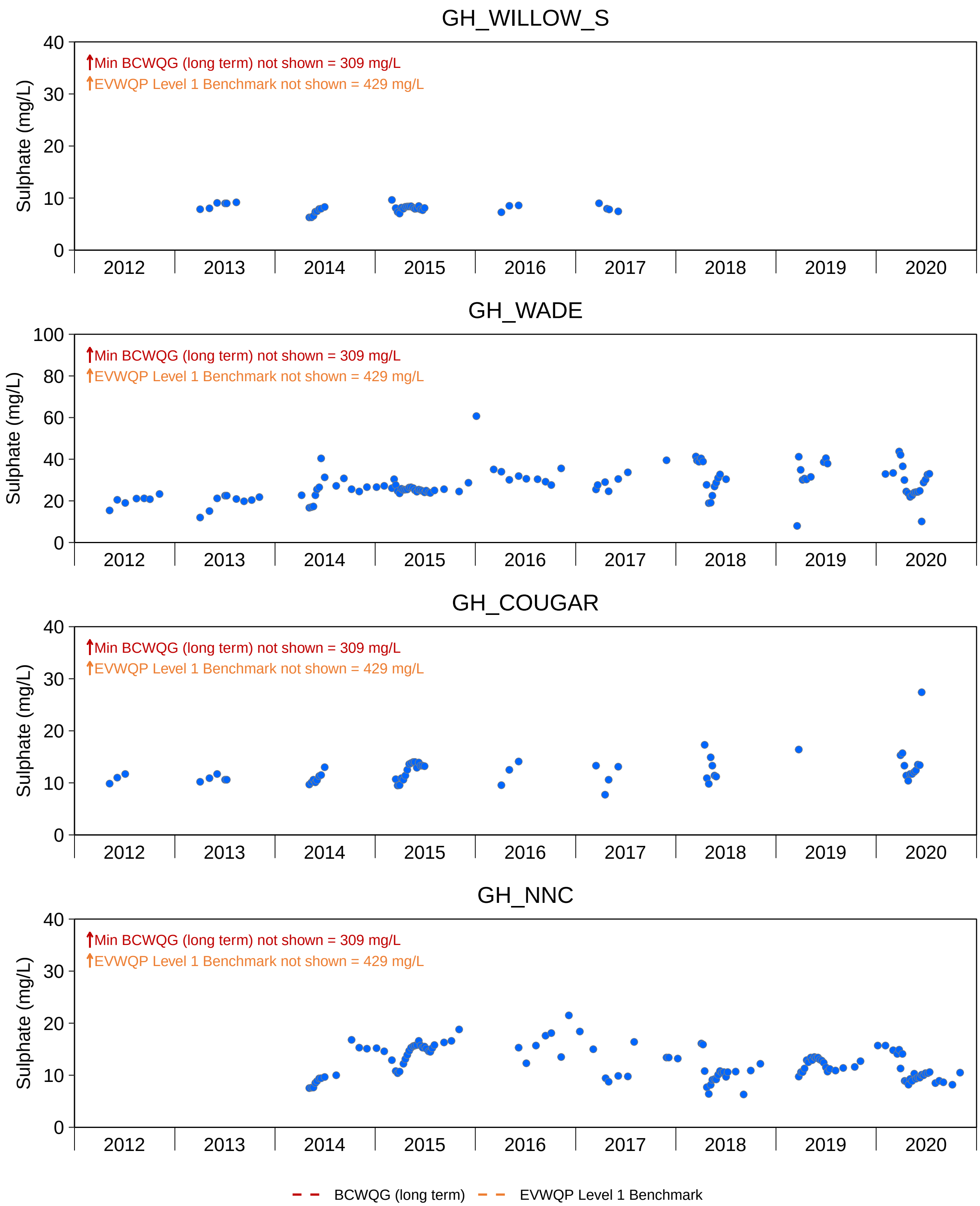


Figure D.5: Concentrations of Sulphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018)

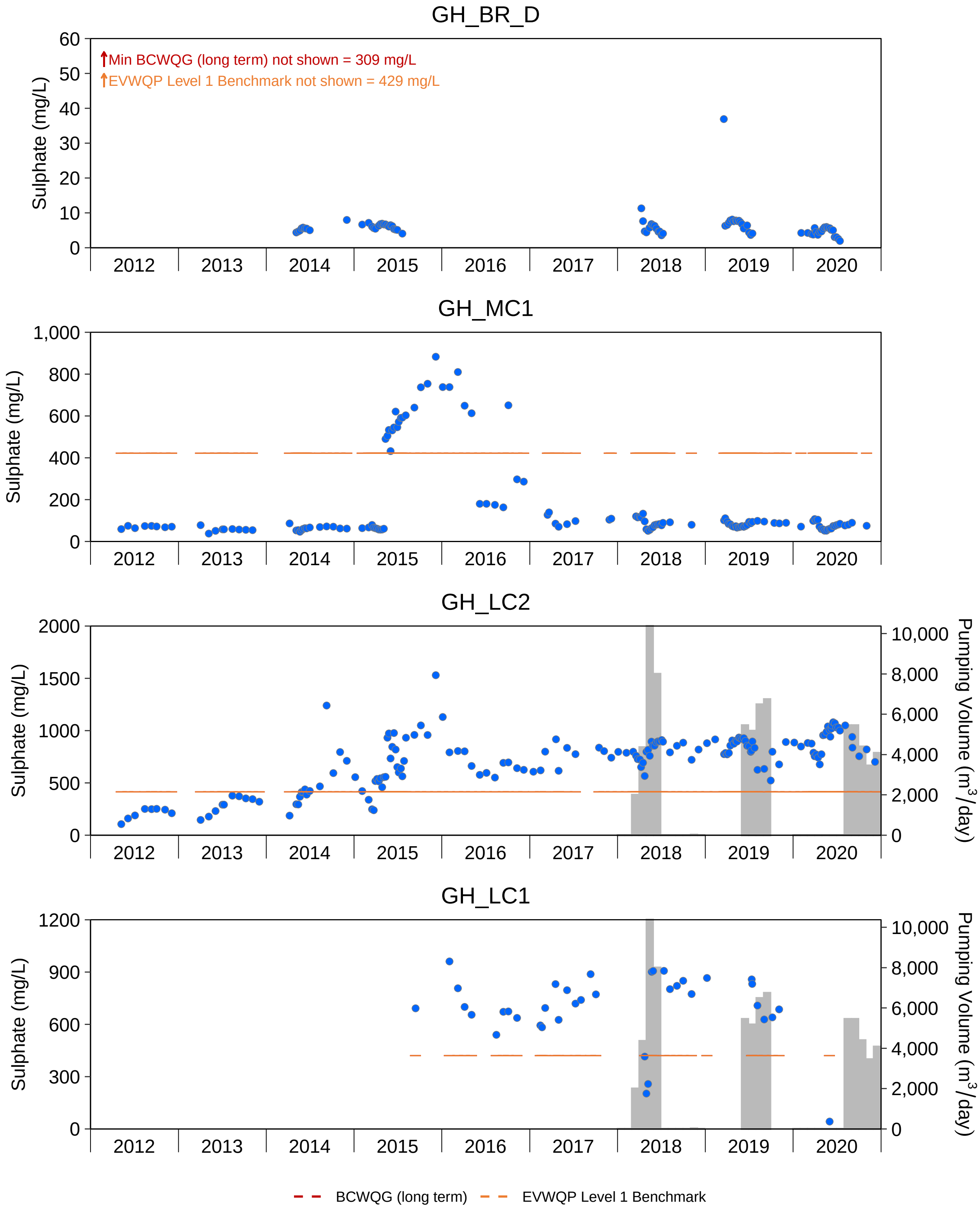


Figure D.5: Concentrations of Sulphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

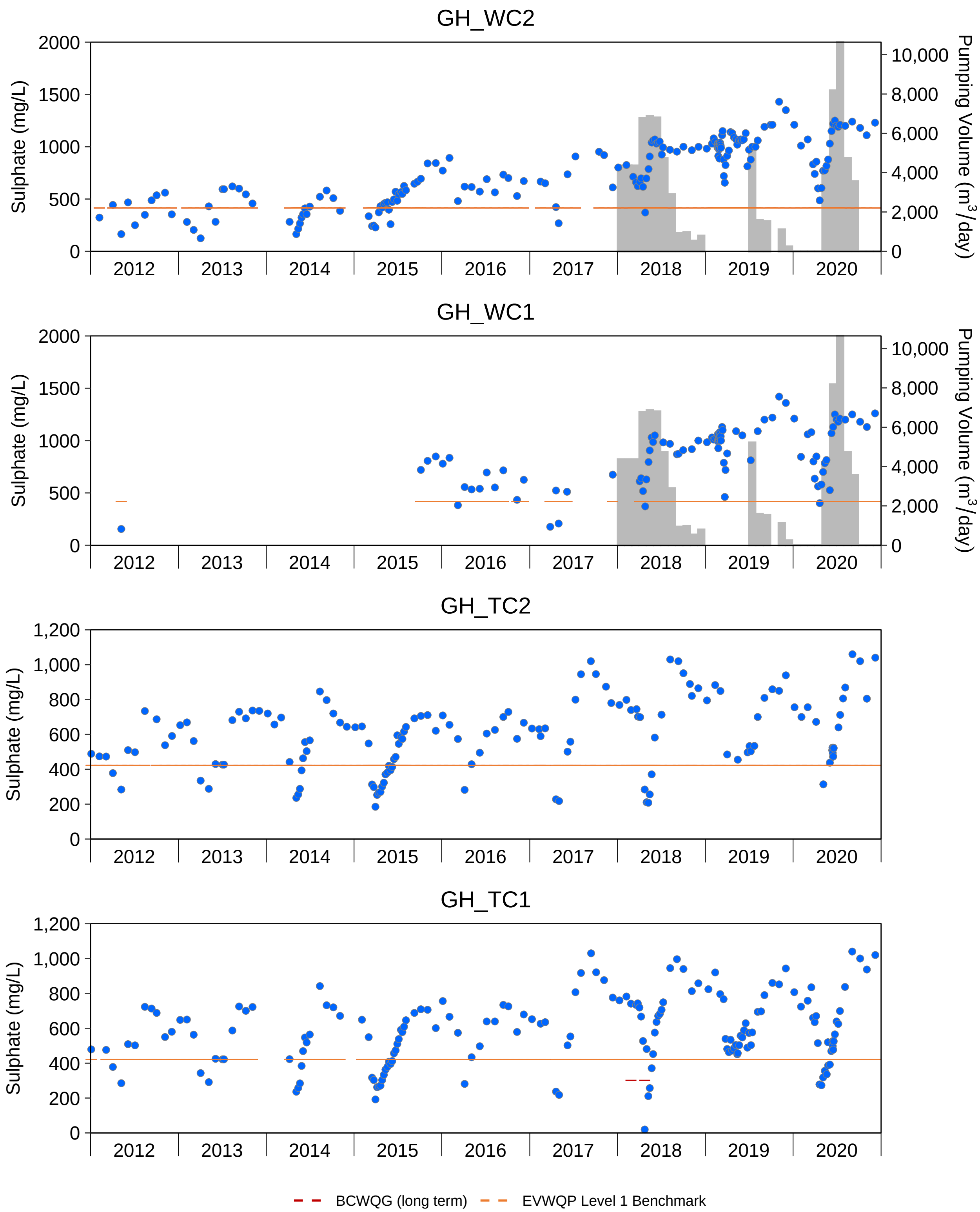


Figure D.5: Concentrations of Sulphate in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

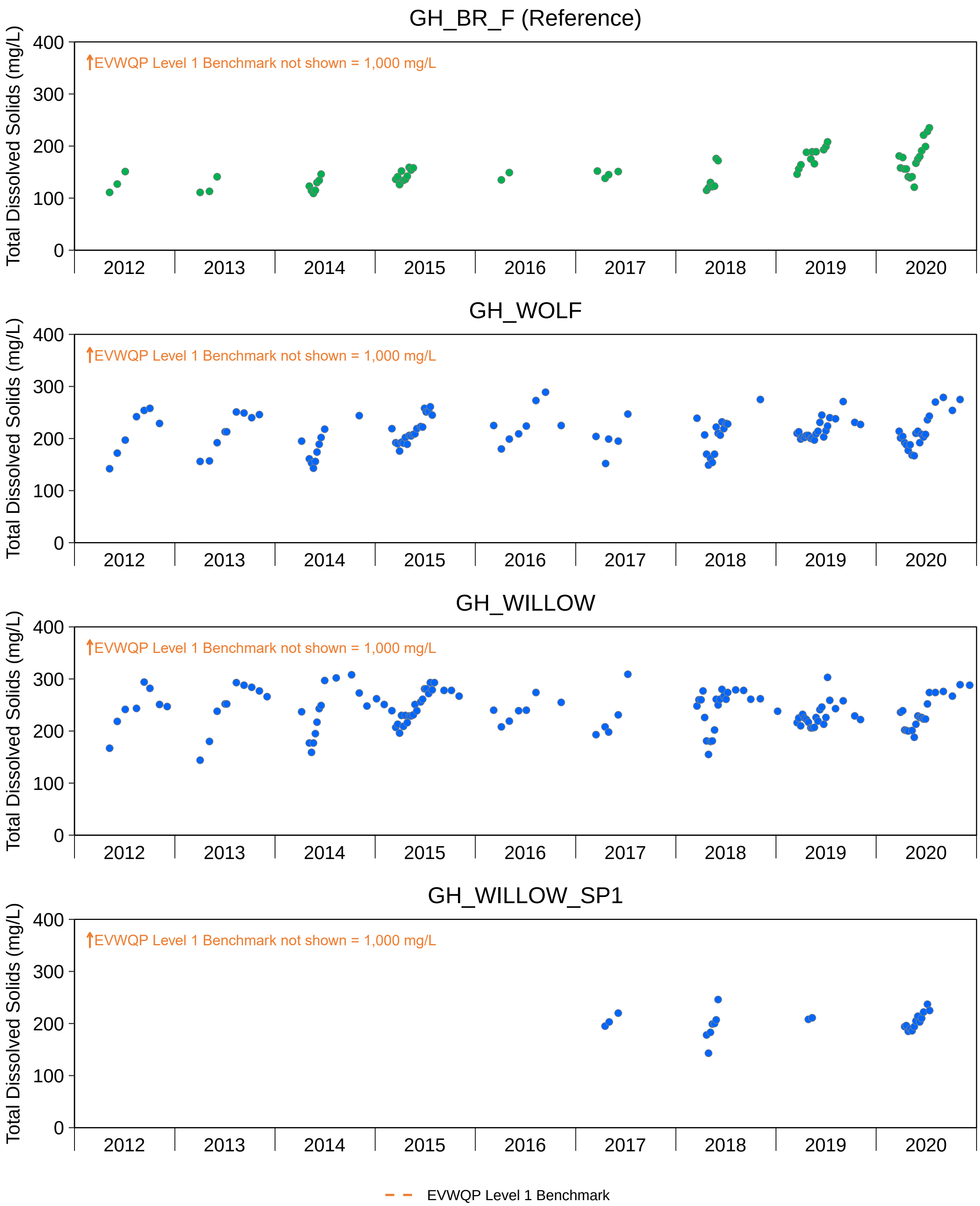


Figure D.6: Concentrations of Total Dissolved Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Dissolved Solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

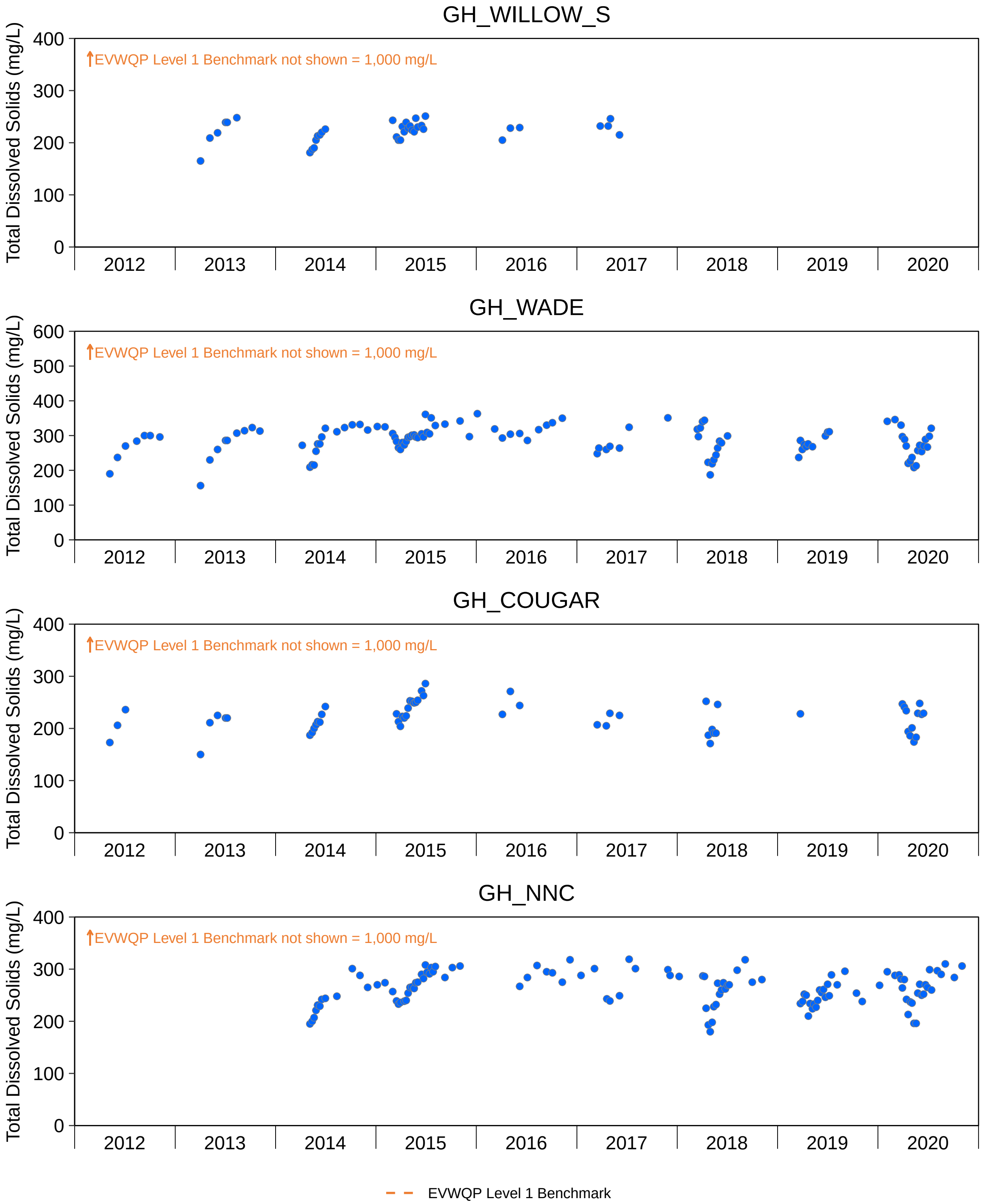


Figure D.6: Concentrations of Total Dissolved Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Dissolved Solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

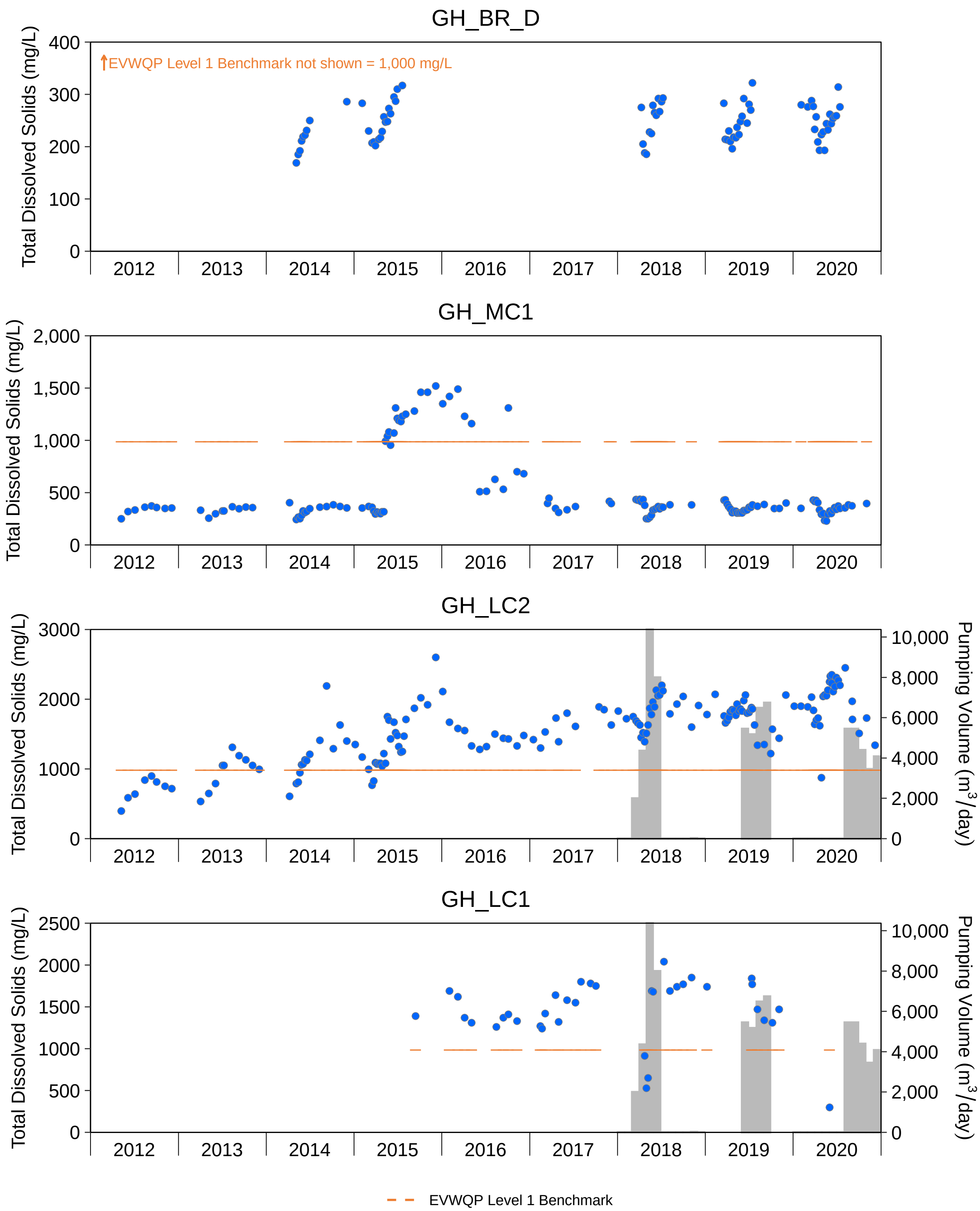


Figure D.6: Concentrations of Total Dissolved Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Dissolved Solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

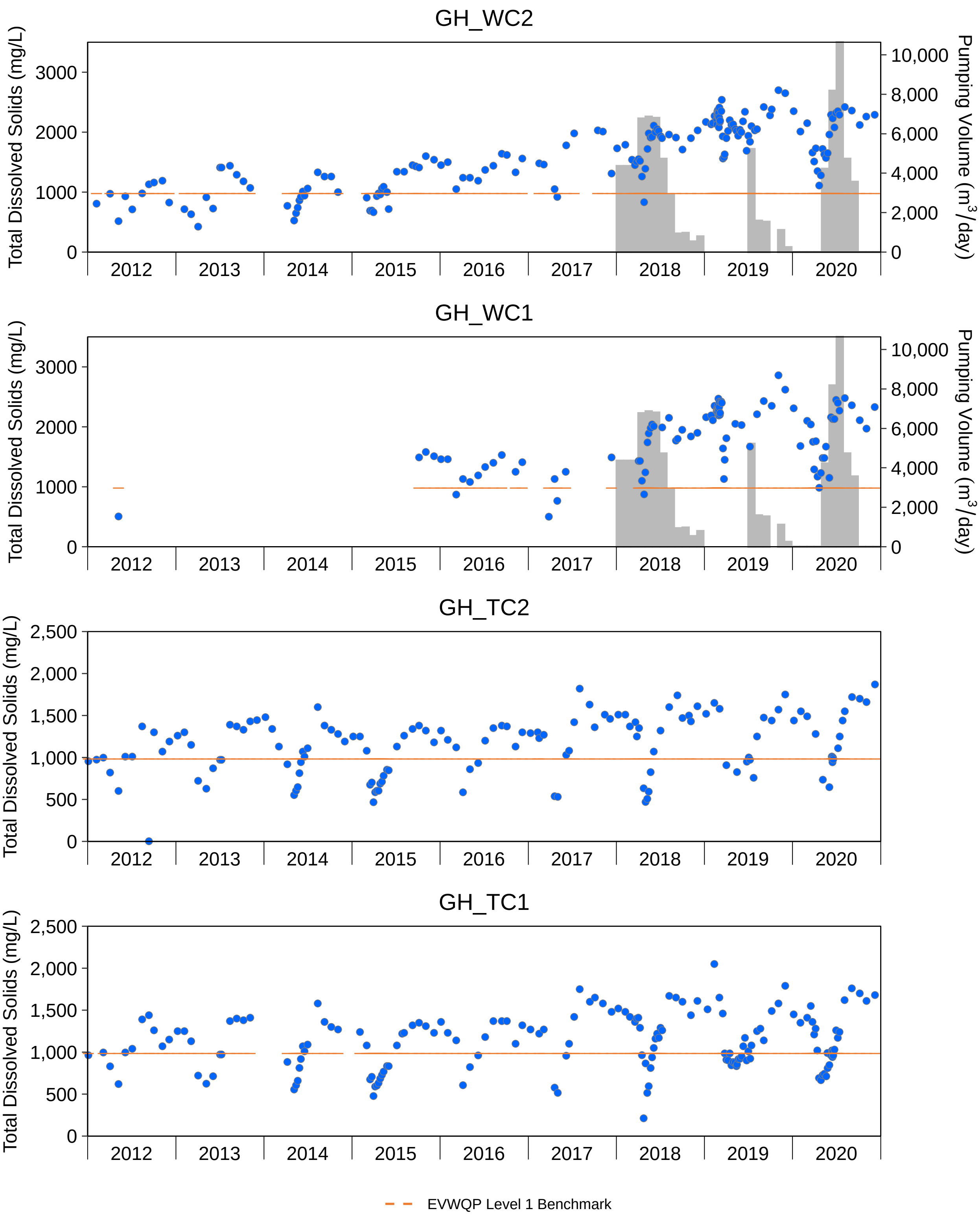


Figure D.6: Concentrations of Total Dissolved Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Dissolved Solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

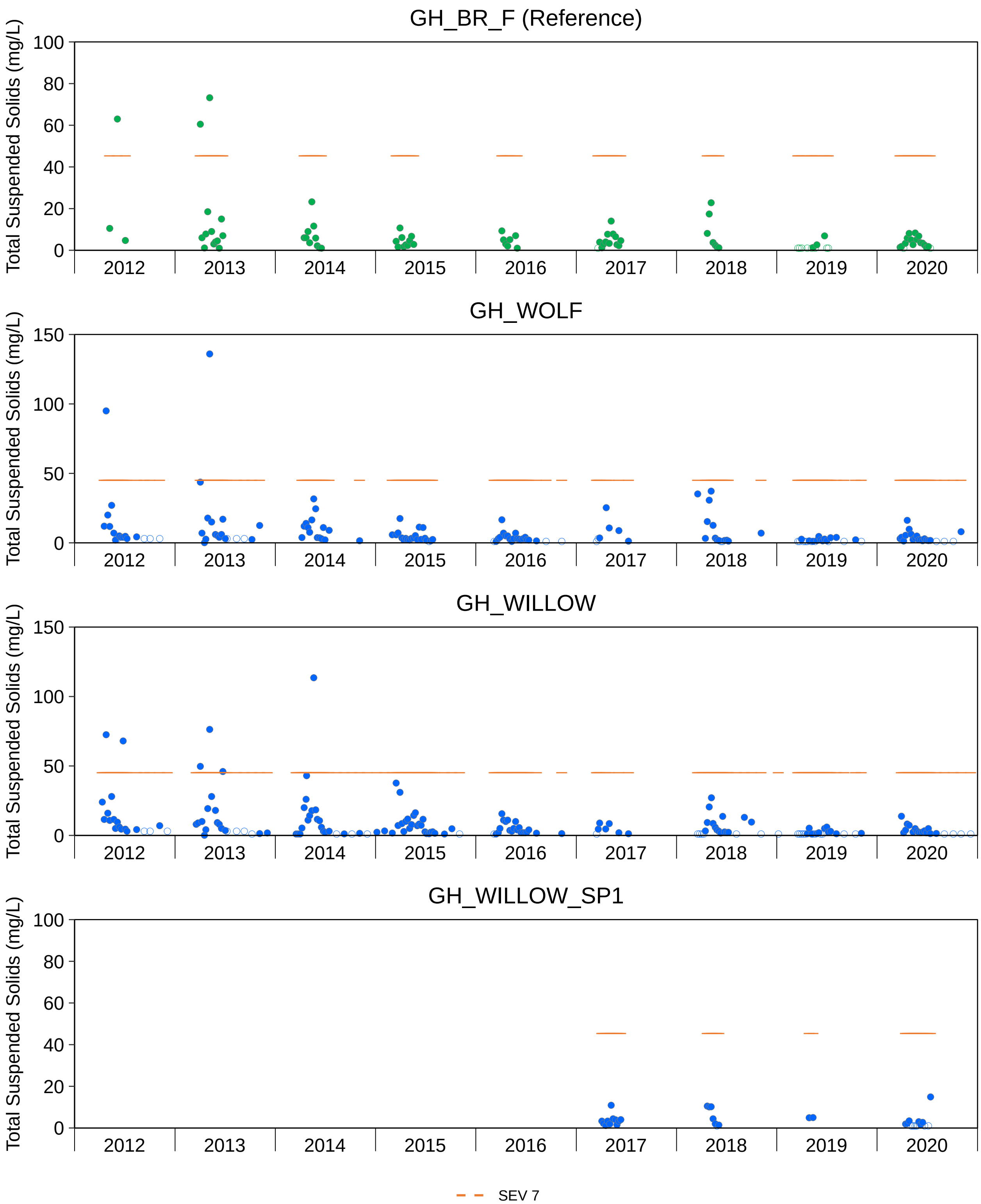


Figure D.7: Concentrations of Total Suspended Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. TSS was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

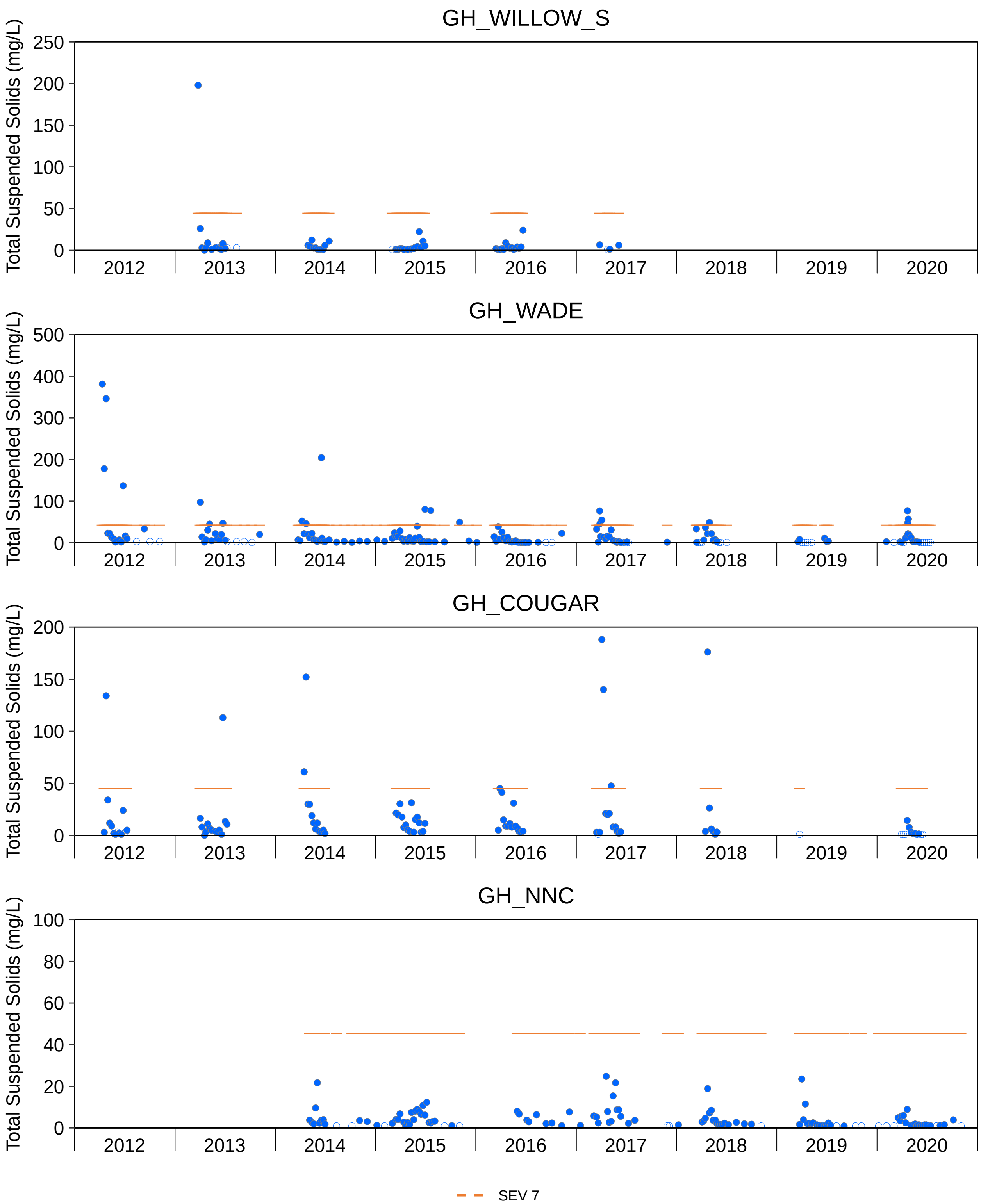


Figure D.7: Concentrations of Total Suspended Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. TSS was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

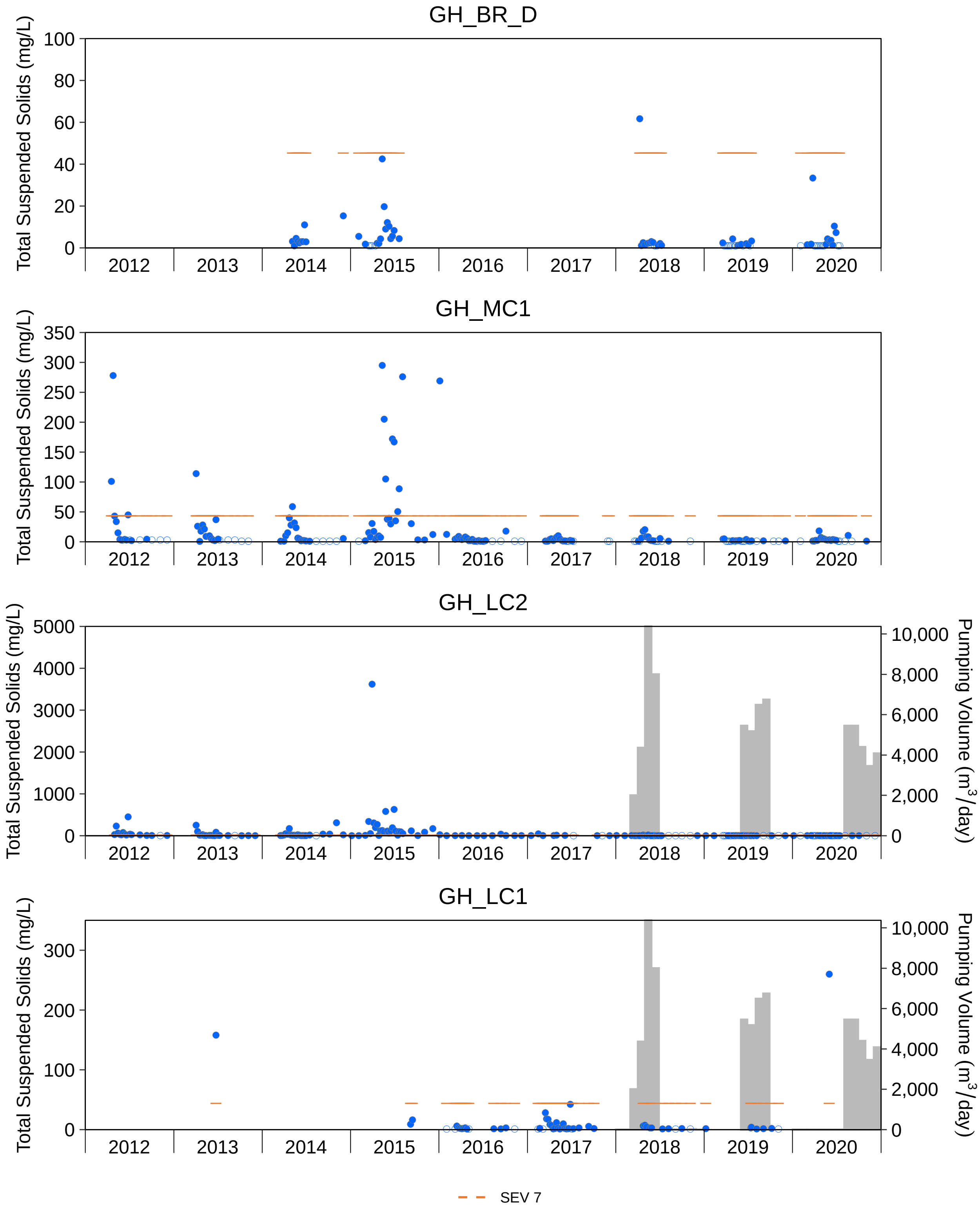


Figure D.7: Concentrations of Total Suspended Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. TSS was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

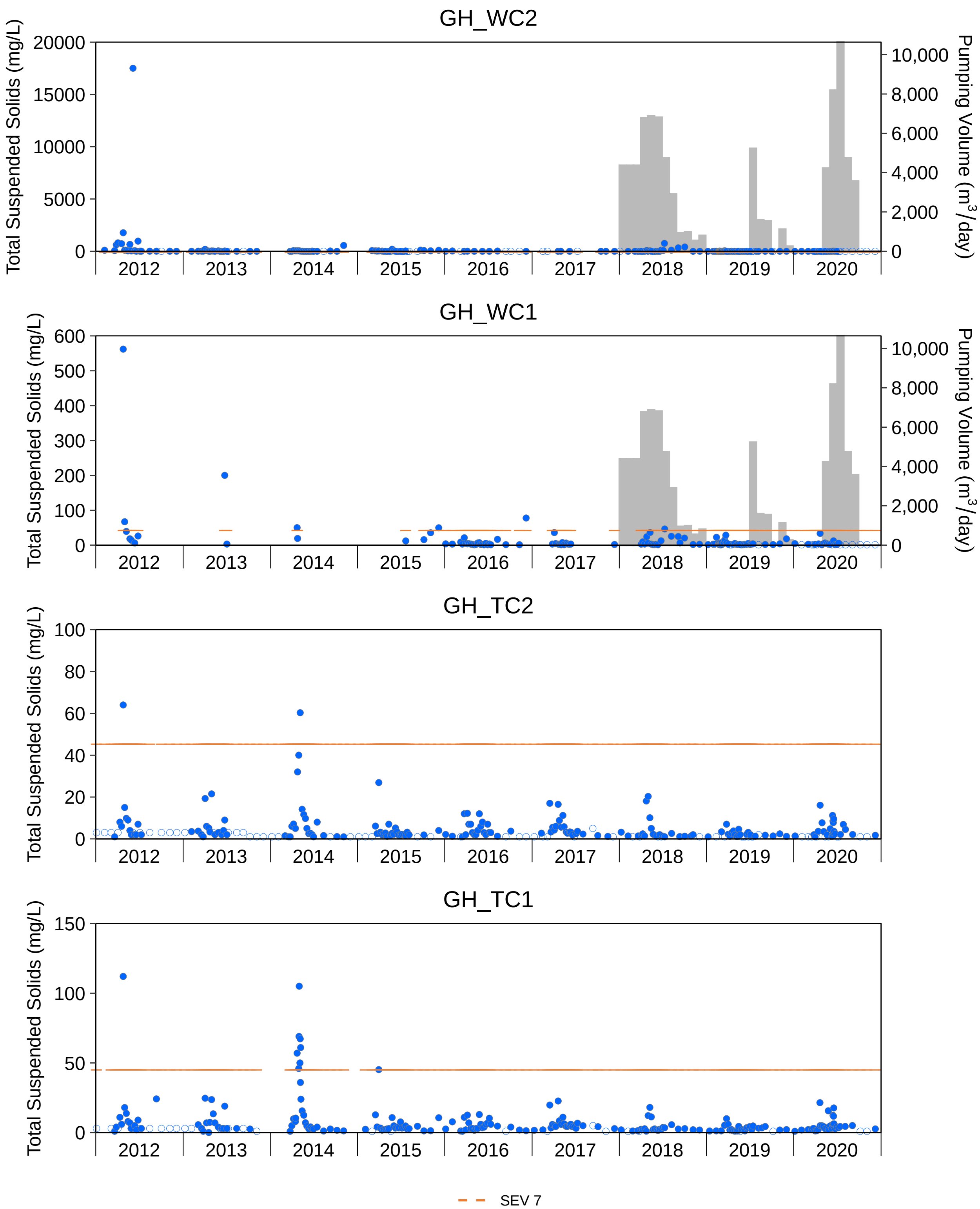


Figure D.7: Concentrations of Total Suspended Solids in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. TSS was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

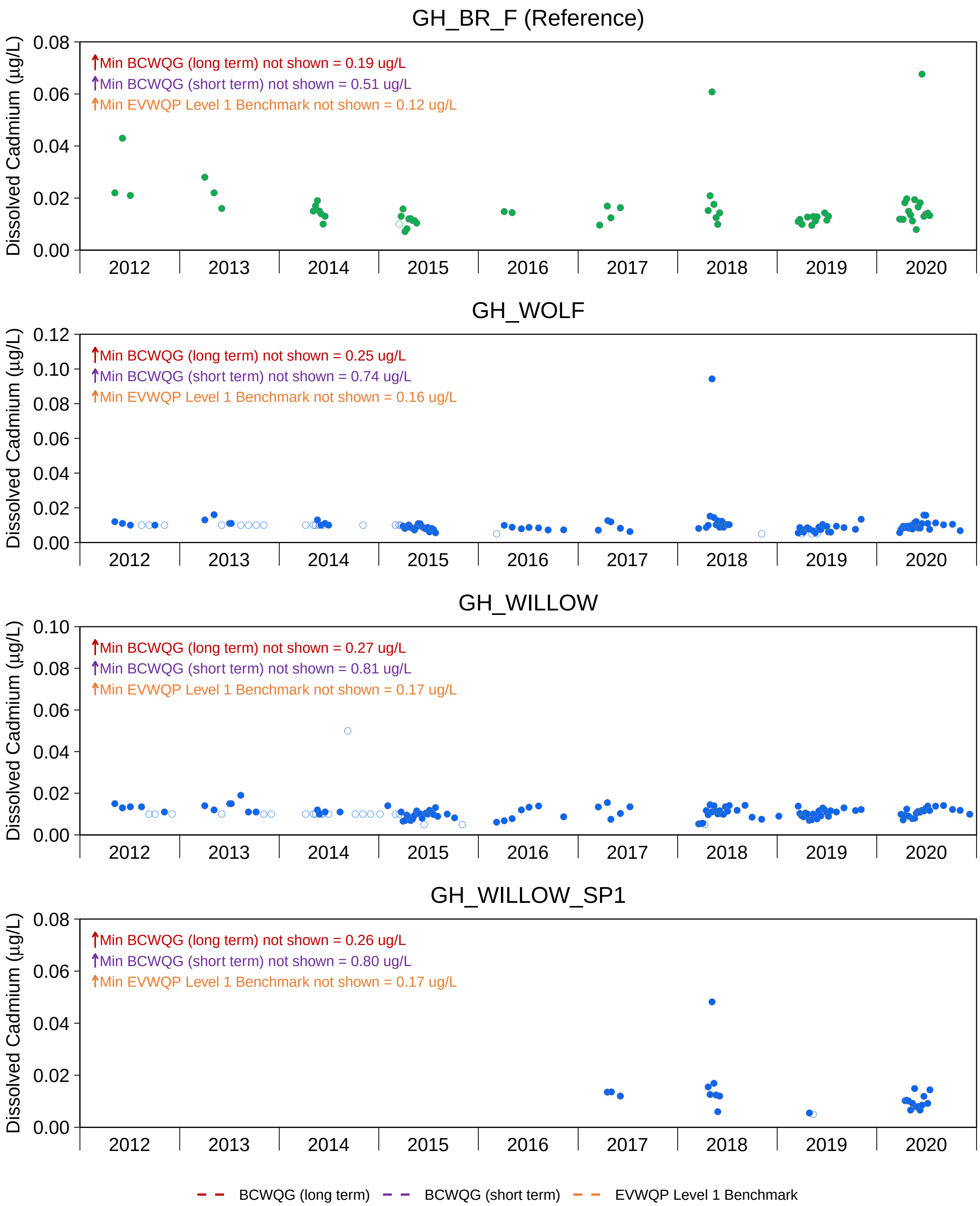


Figure D.8: Concentrations of Dissolved Cadmium in Samples Collected from the West Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved Cadmium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

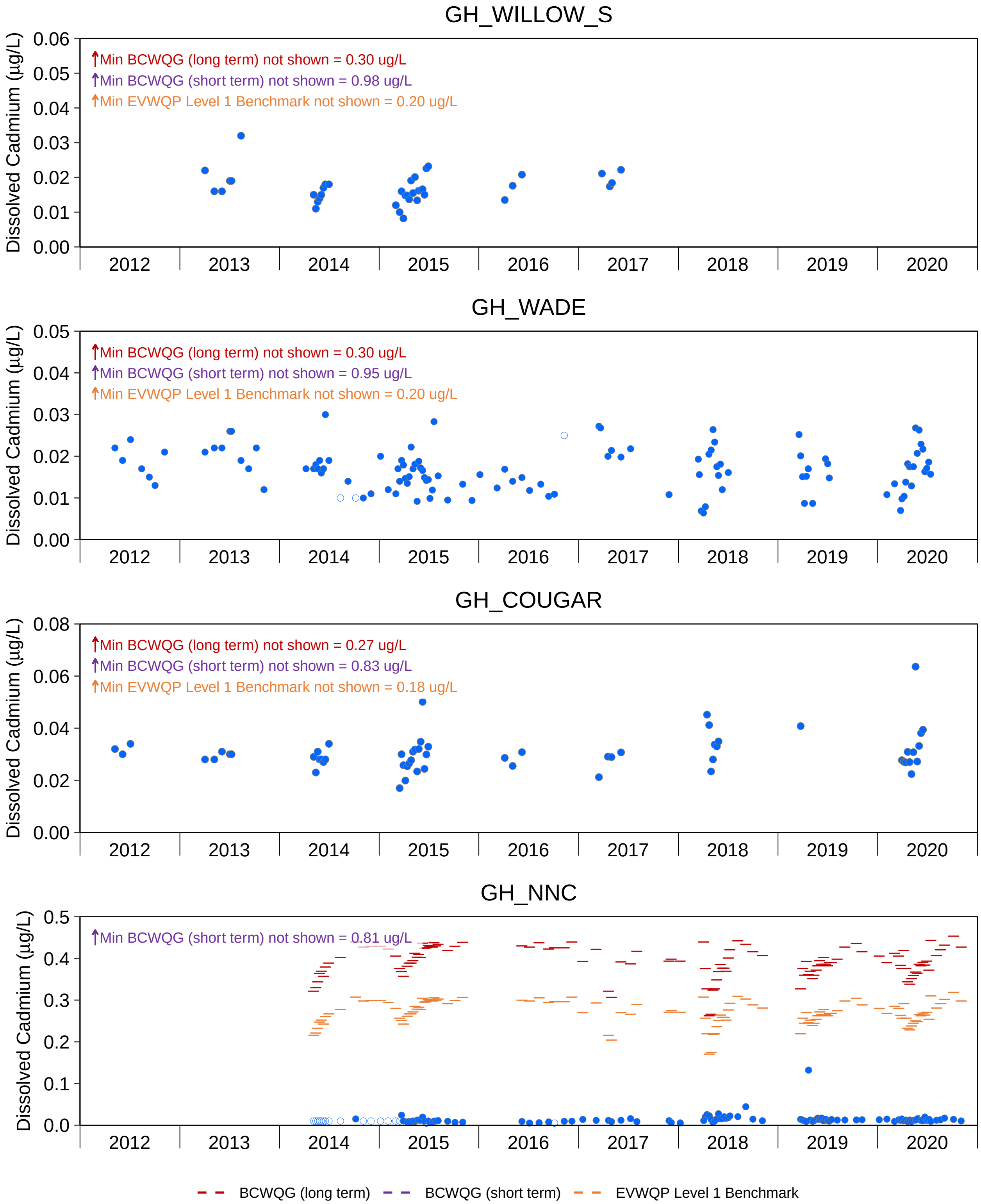


Figure D.8: Concentrations of Dissolved Cadmium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved Cadmium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

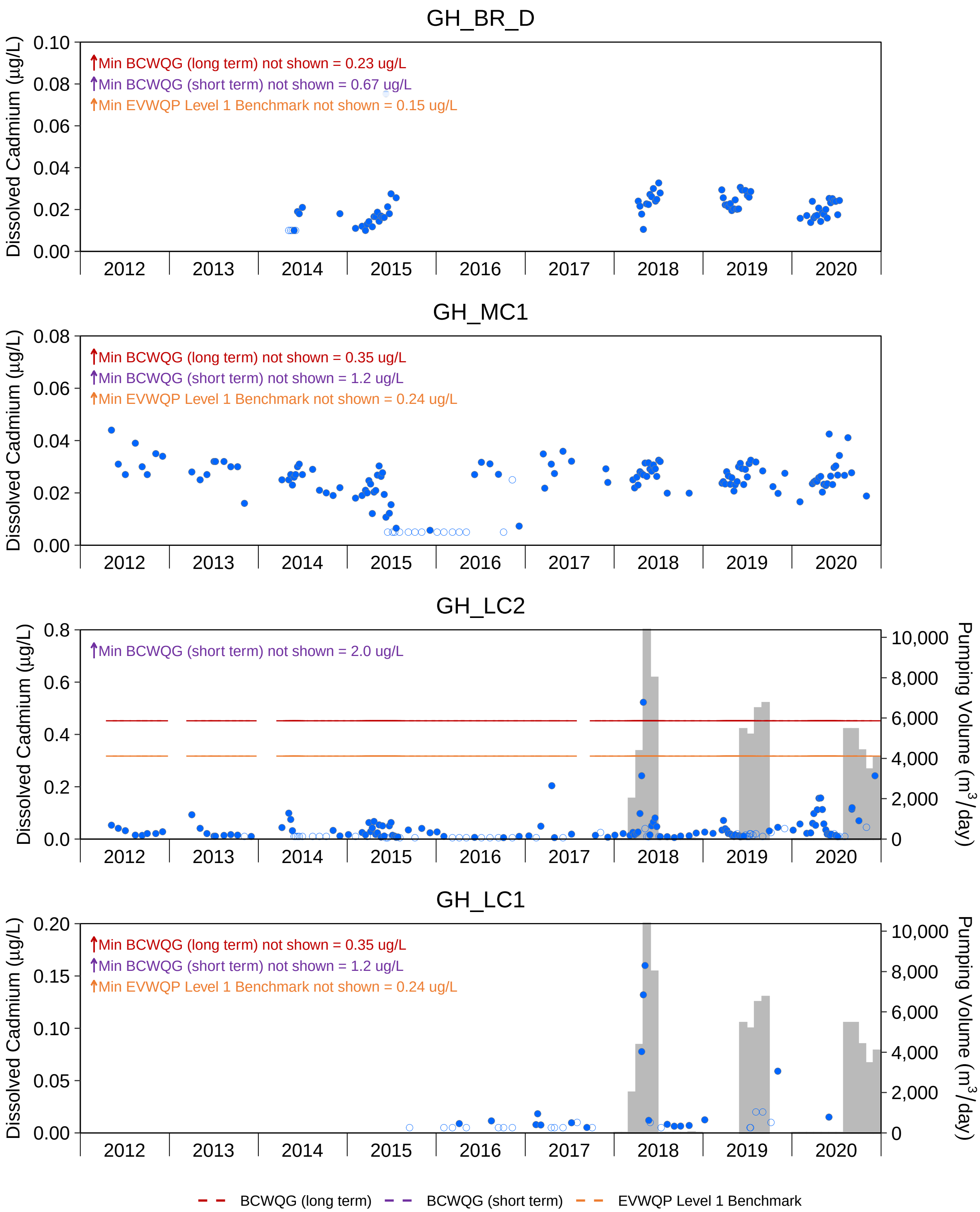


Figure D.8: Concentrations of Dissolved Cadmium in Samples Collected from the West Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved Cadmium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

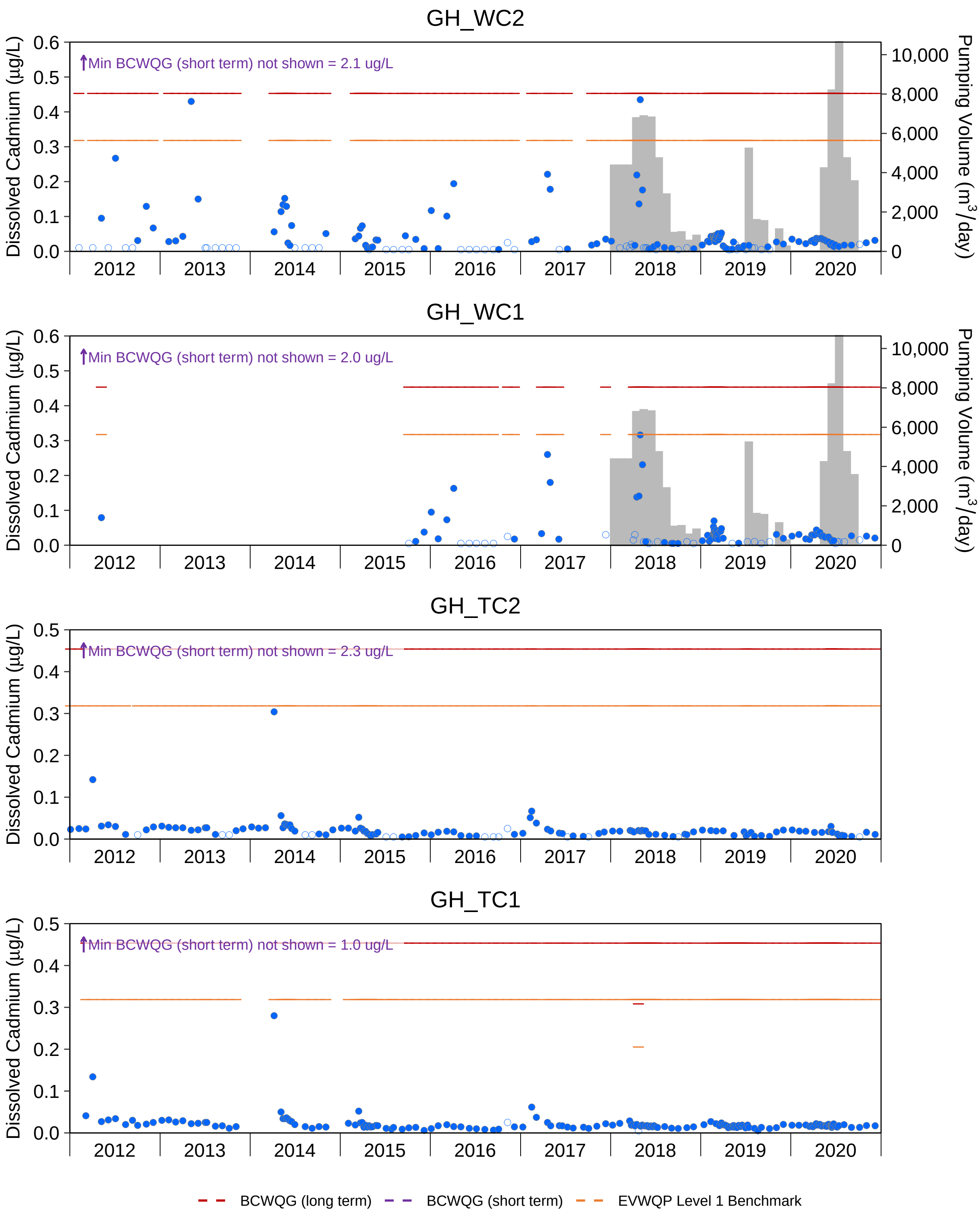


Figure D.8: Concentrations of Dissolved Cadmium in Samples Collected from the West Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved Cadmium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

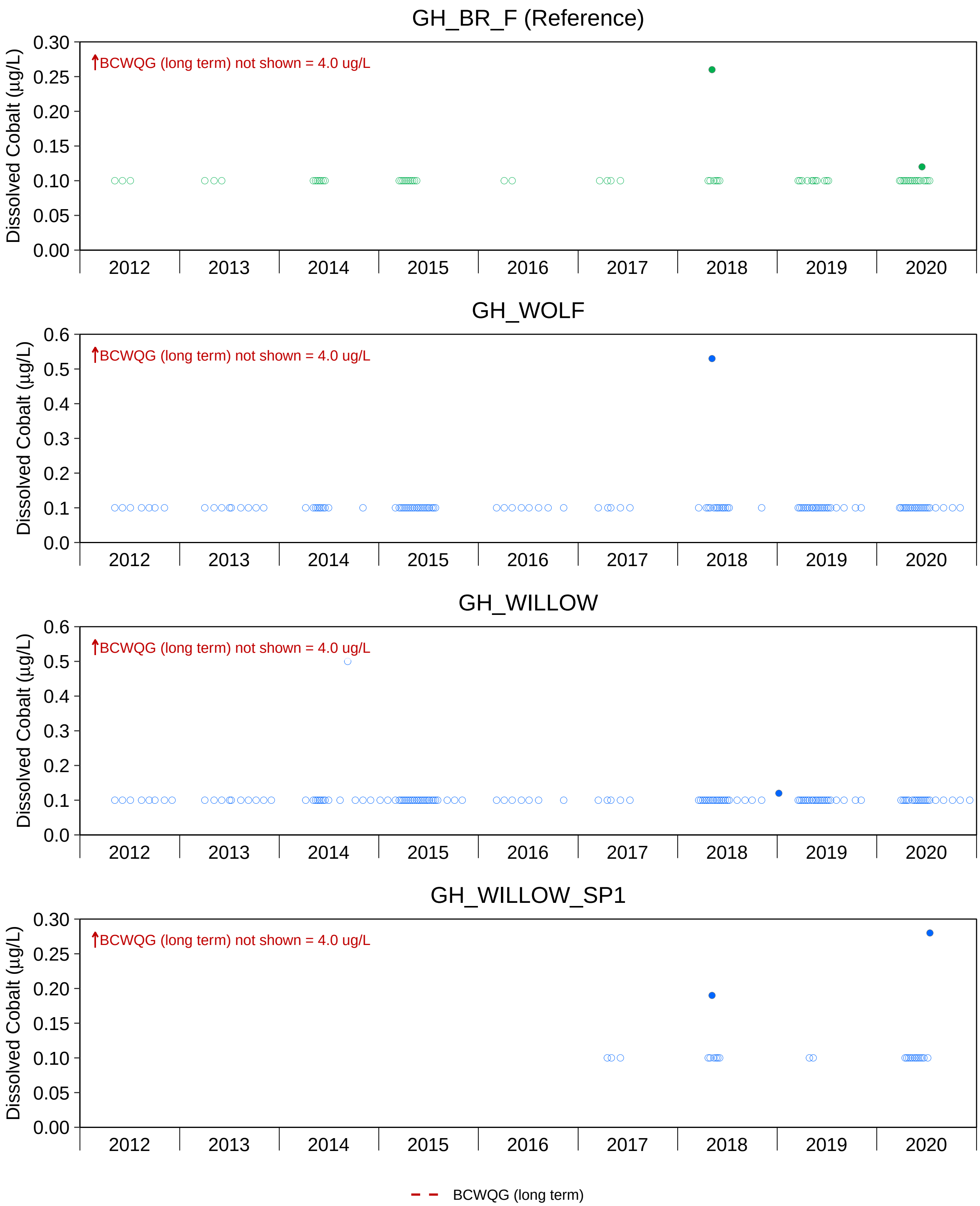


Figure D.9: Concentrations of Dissolved Cobalt in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved Cobalt was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

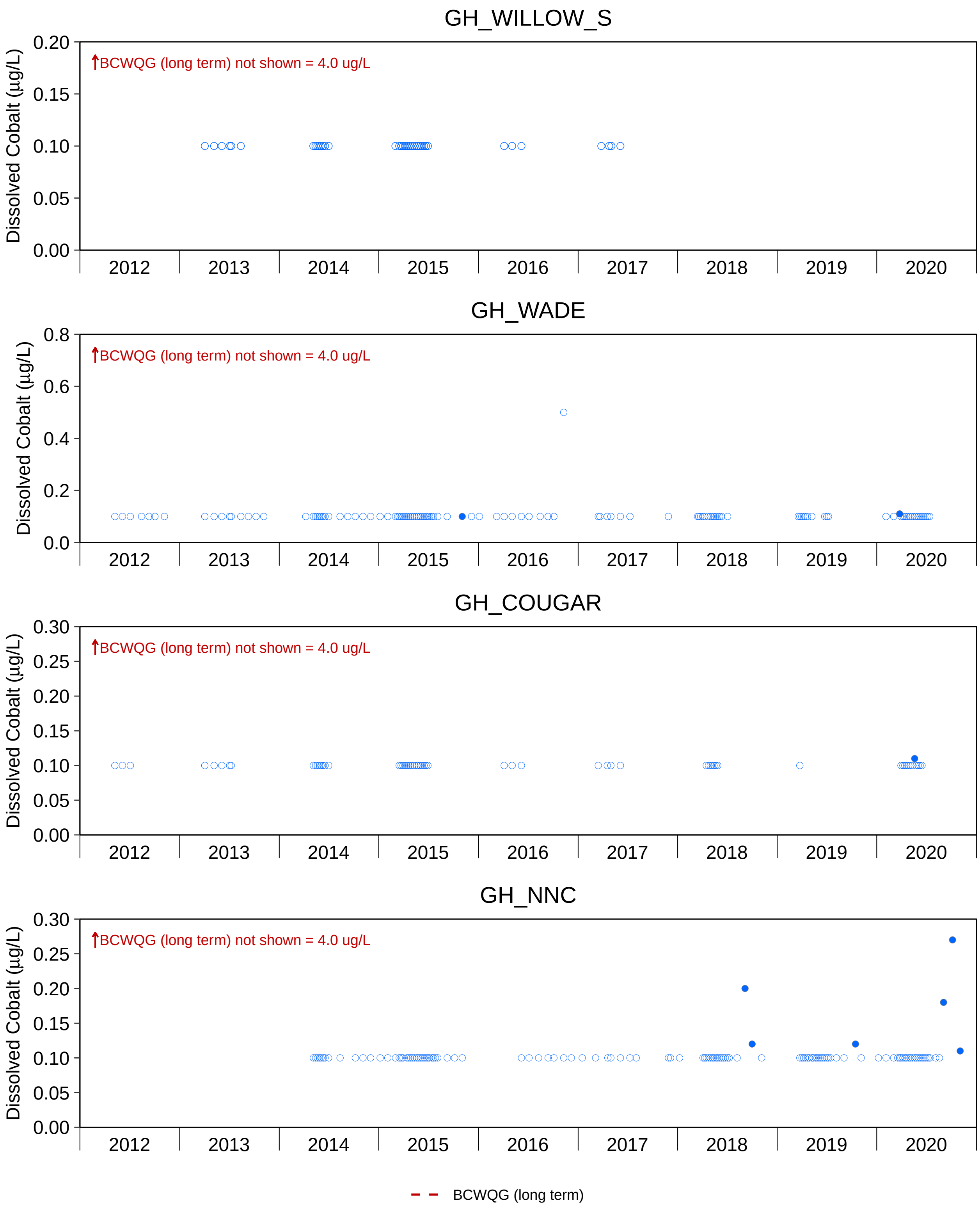


Figure D.9: Concentrations of Dissolved Cobalt in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved Cobalt was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

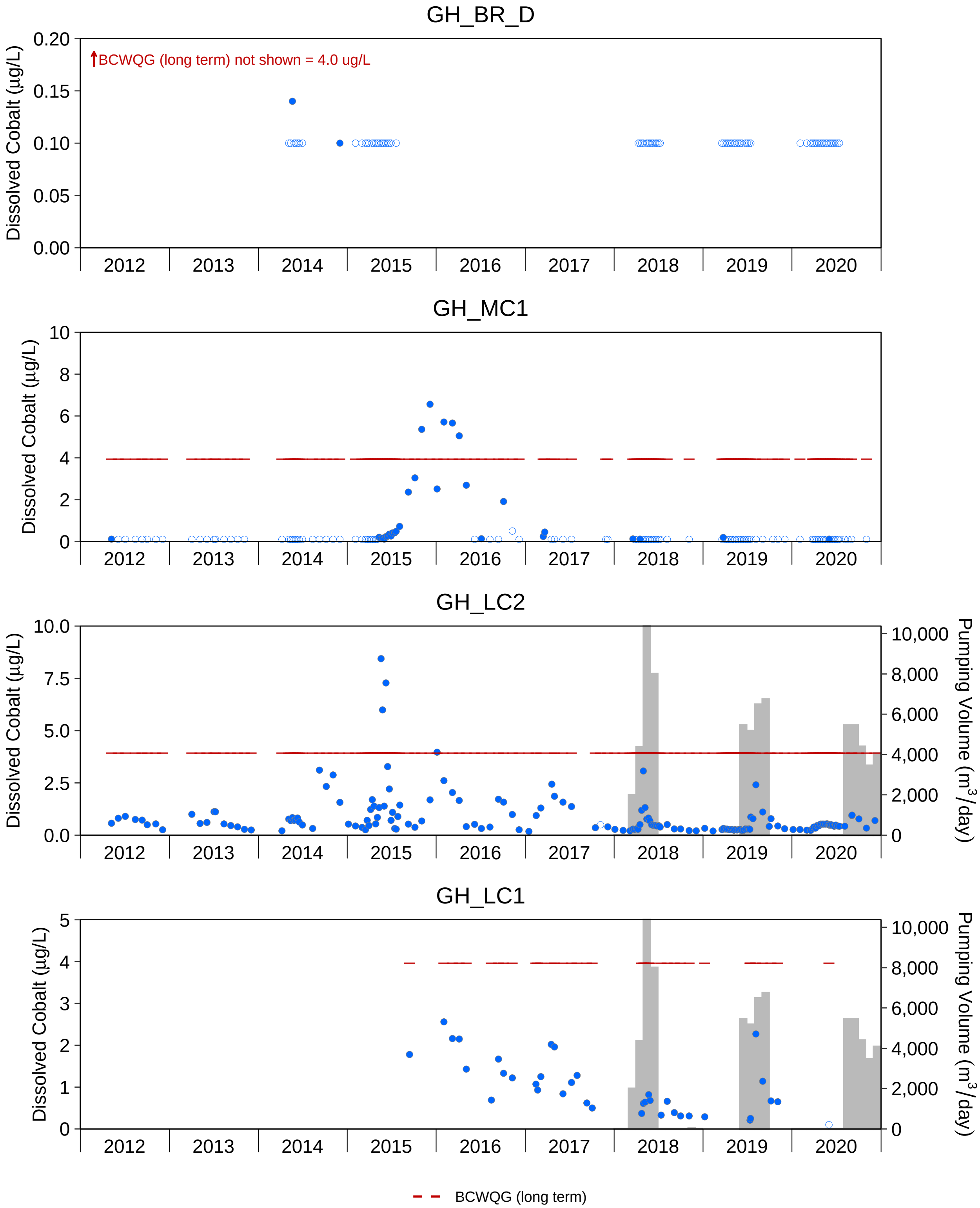


Figure D.9: Concentrations of Dissolved Cobalt in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved Cobalt was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

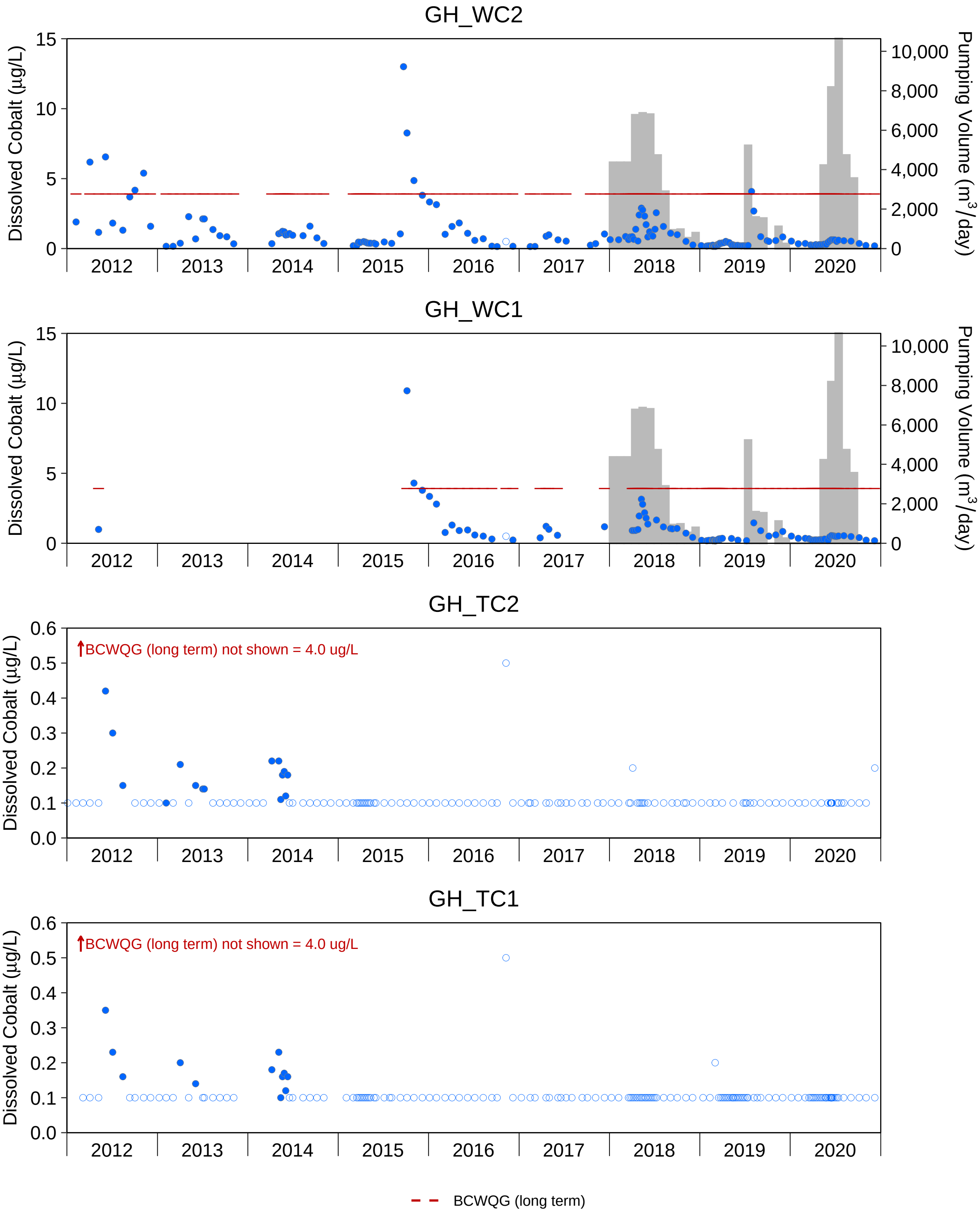


Figure D.9: Concentrations of Dissolved Cobalt in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved Cobalt was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

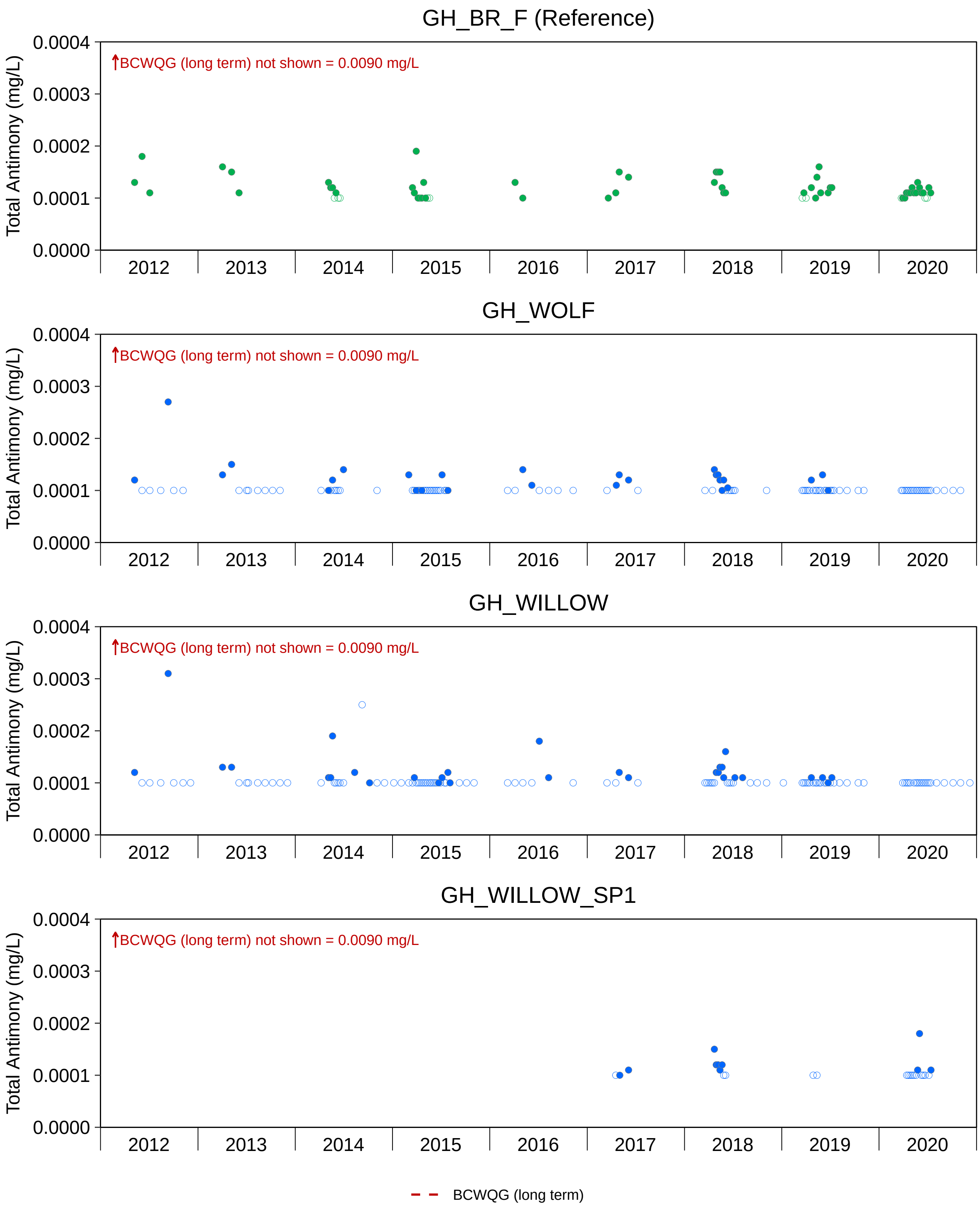


Figure D.10: Concentrations of Total Antimony in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

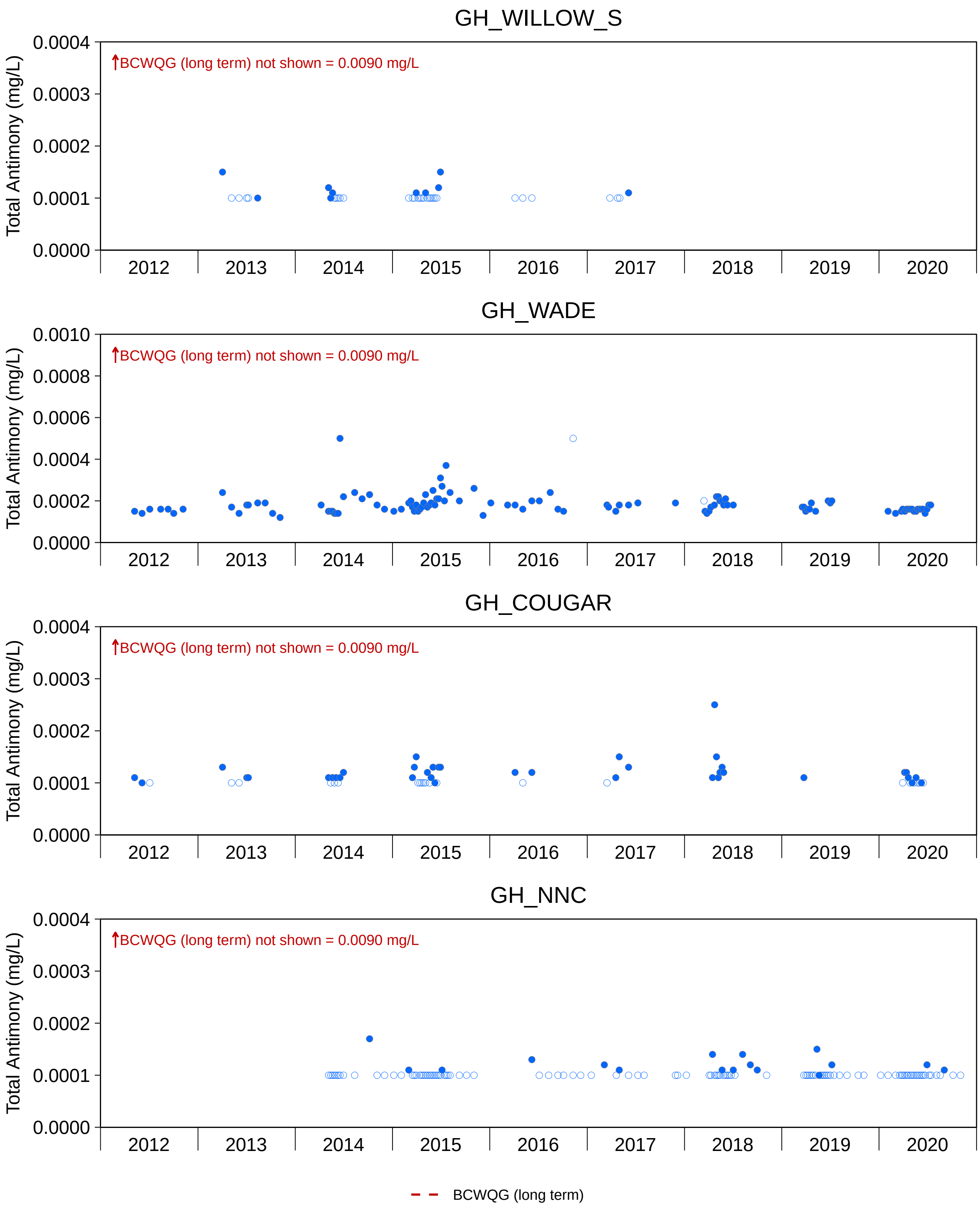


Figure D.10: Concentrations of Total Antimony in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

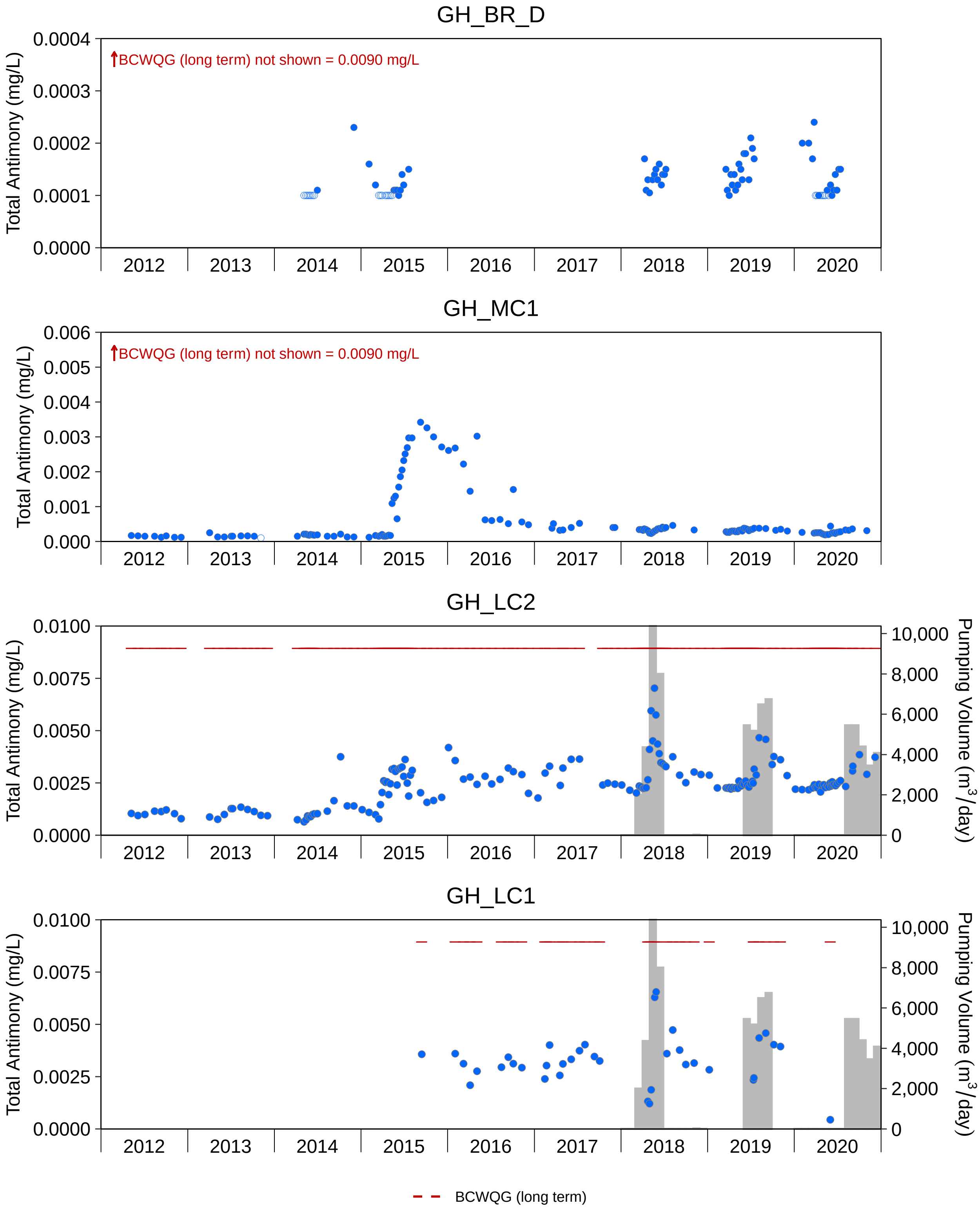


Figure D.10: Concentrations of Total Antimony in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

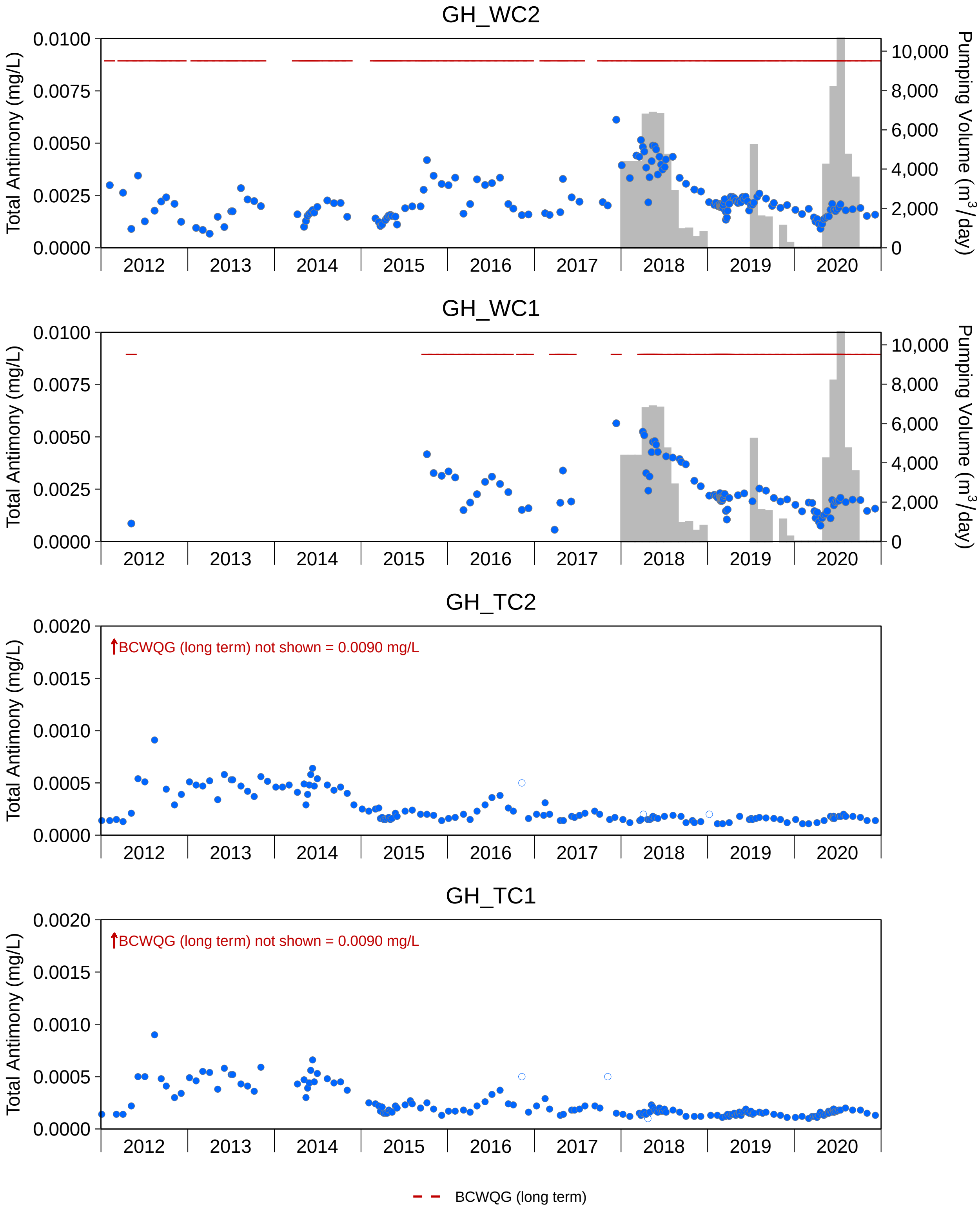


Figure D.10: Concentrations of Total Antimony in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

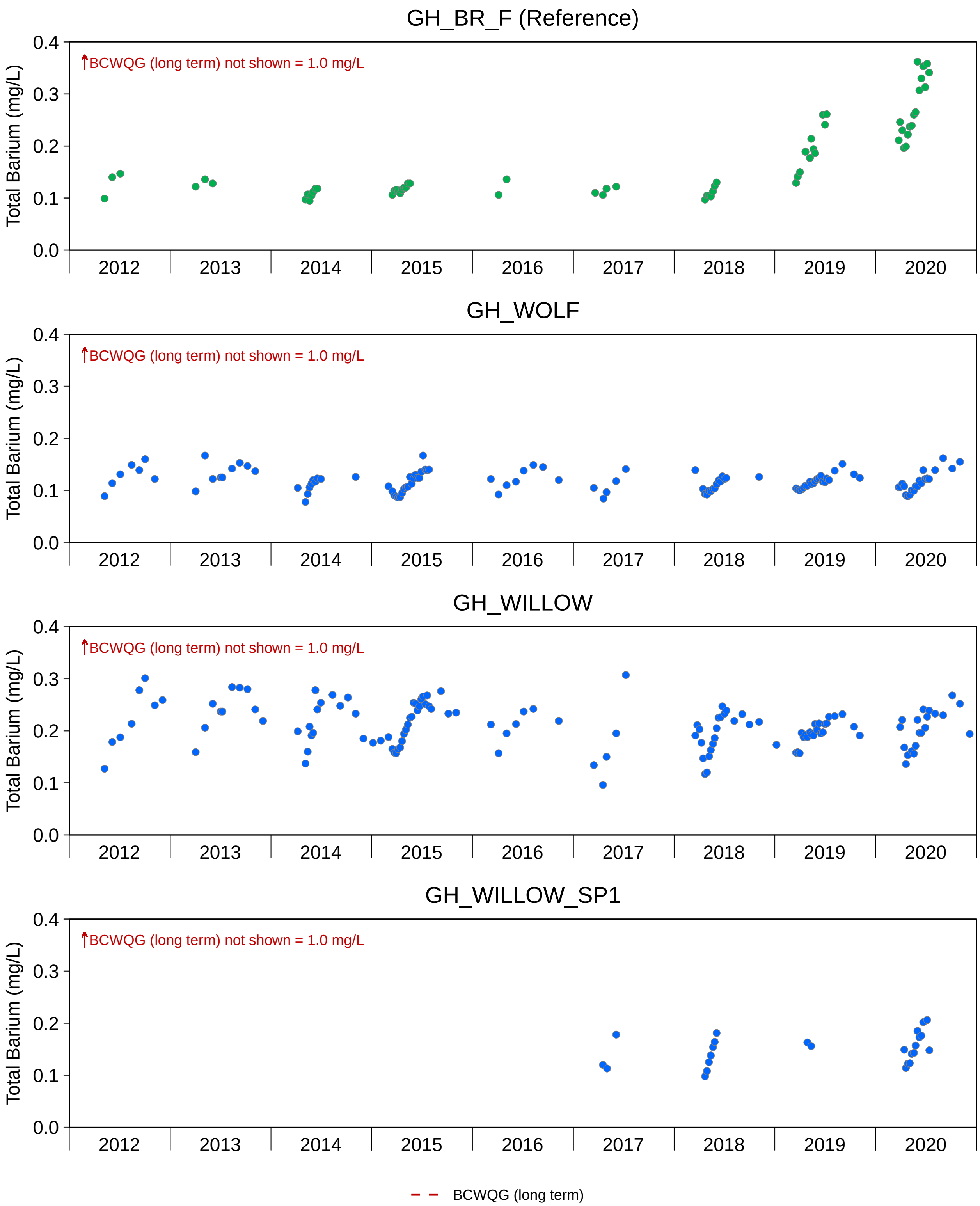


Figure D.11: Concentrations of Total Barium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

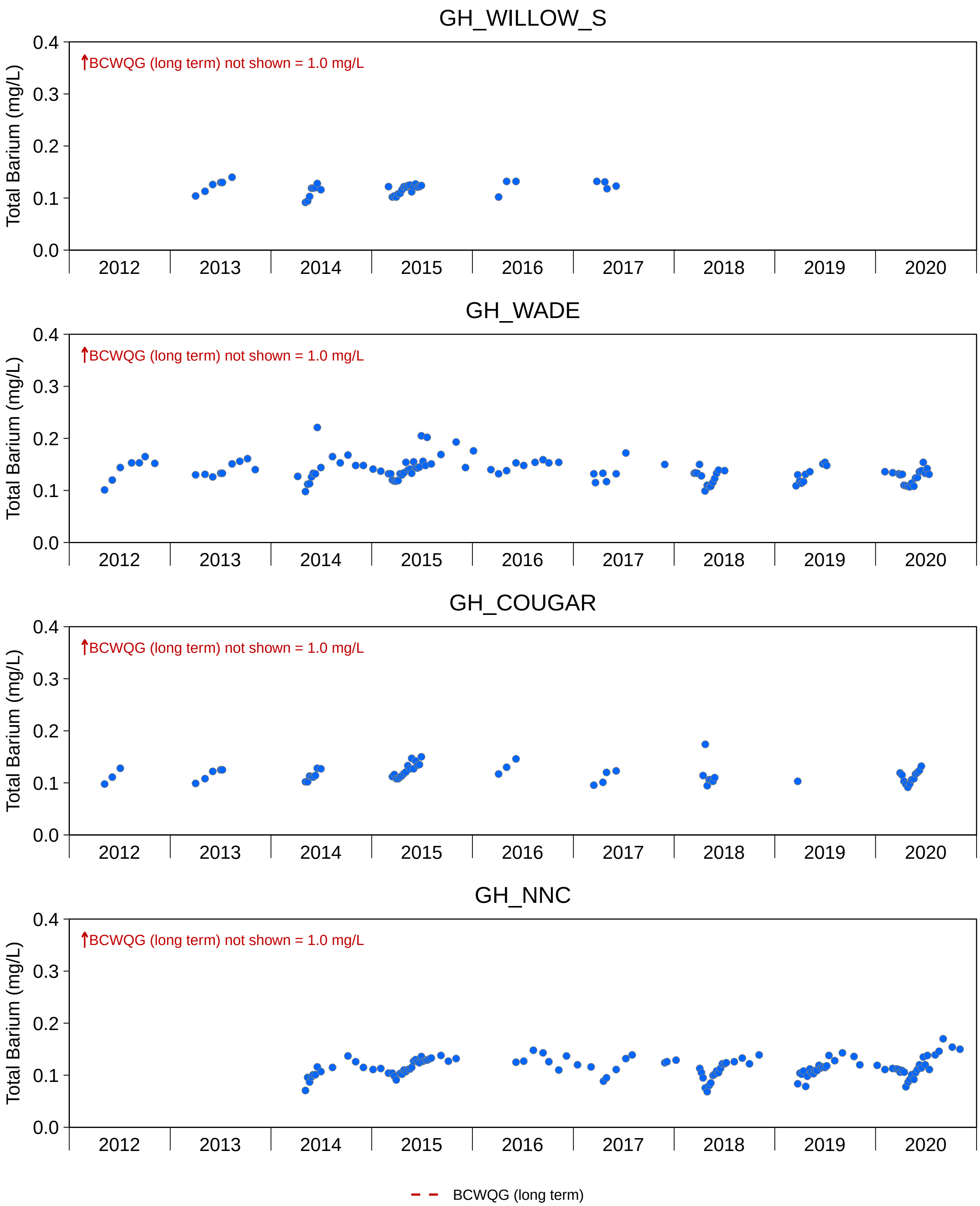


Figure D.11: Concentrations of Total Barium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

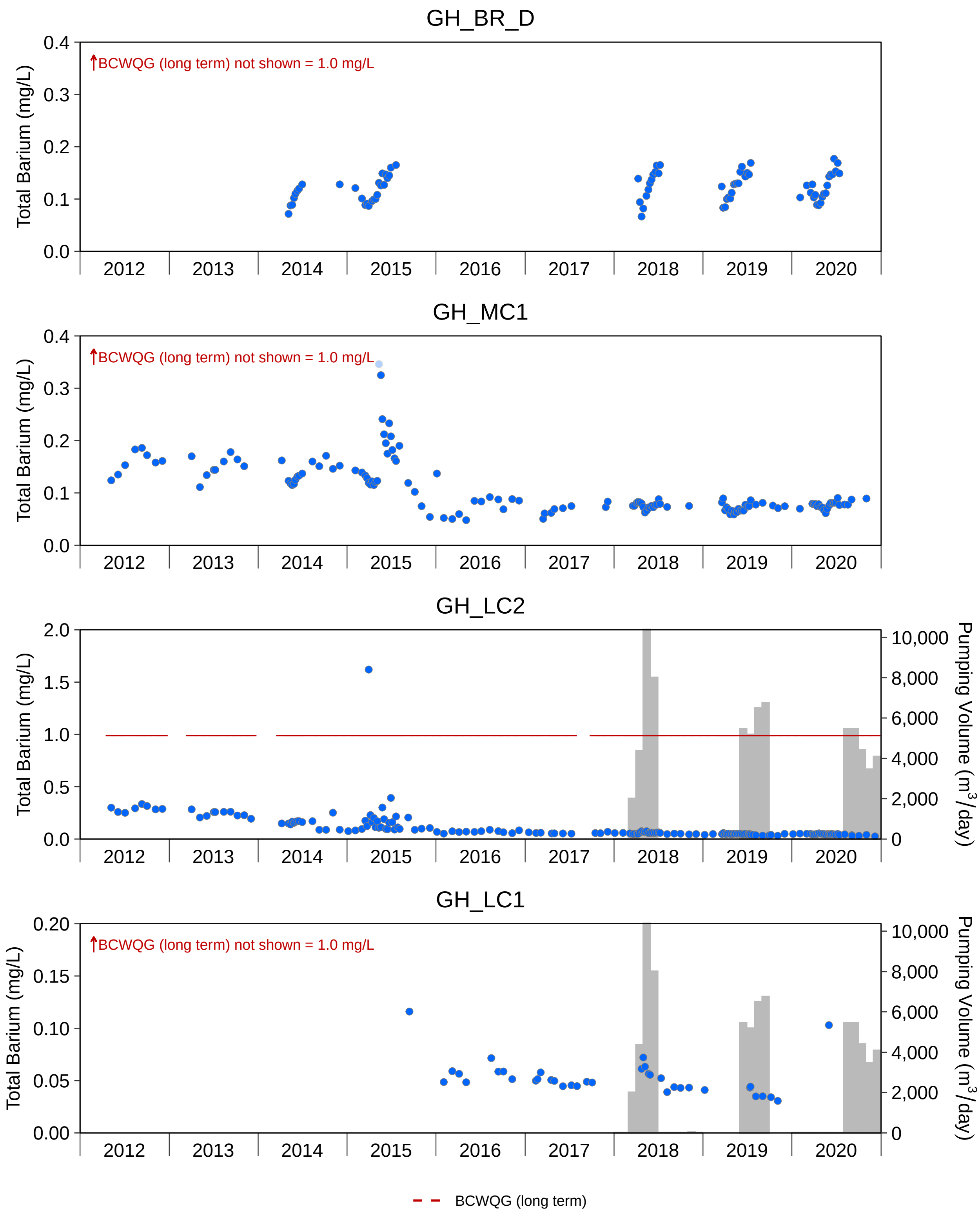


Figure D.11: Concentrations of Total Barium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

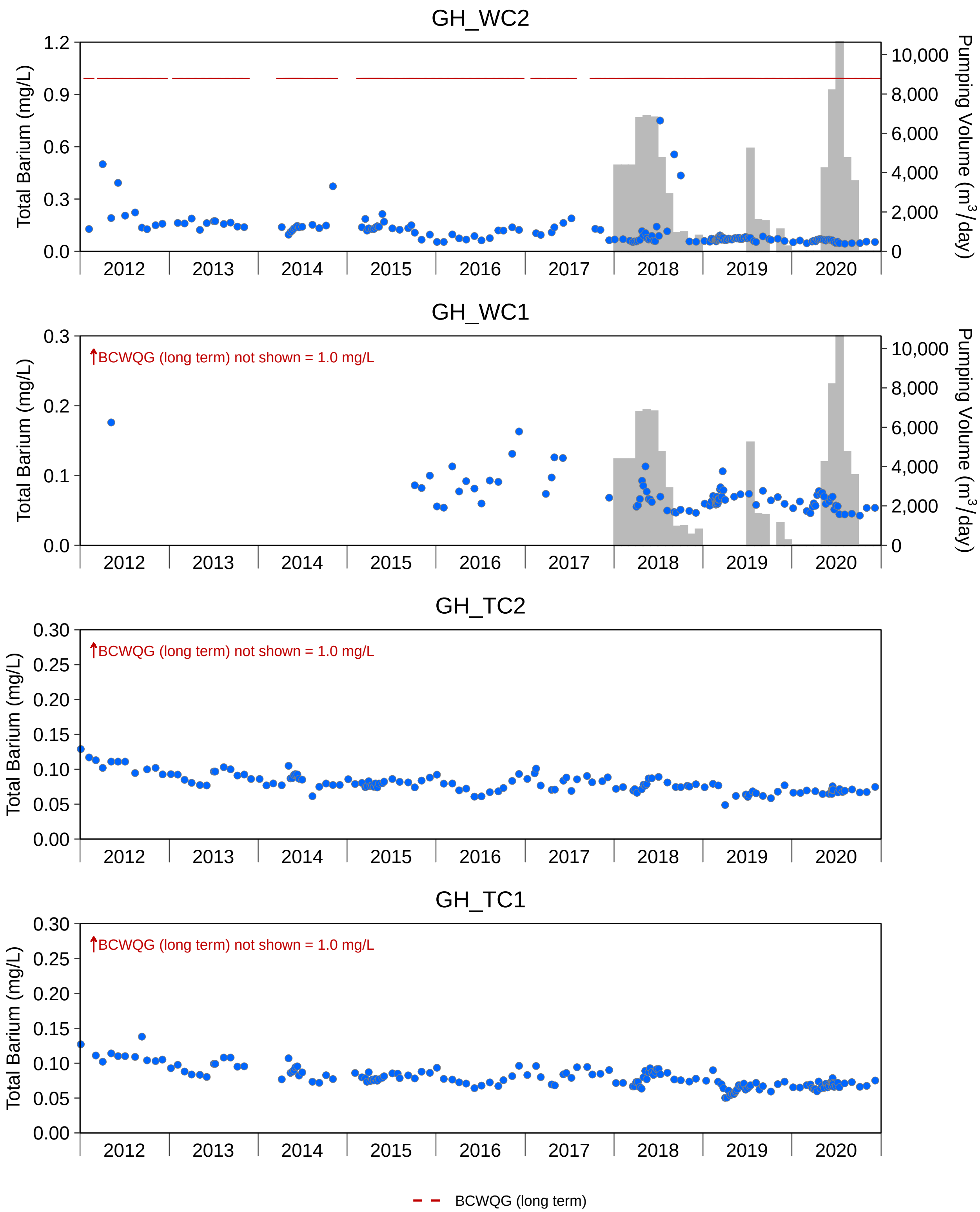


Figure D.11: Concentrations of Total Barium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

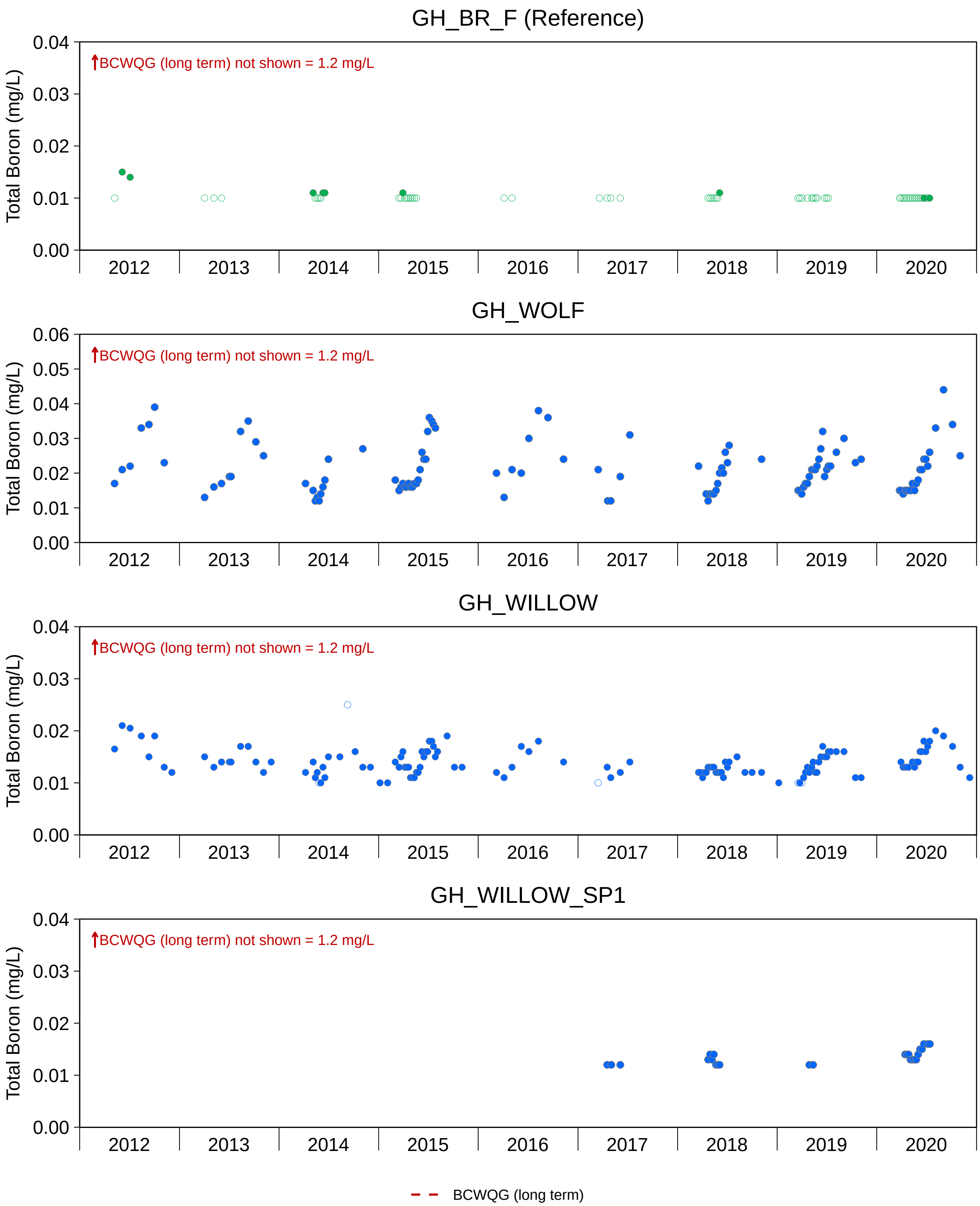


Figure D.12: Concentrations of Total Boron in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

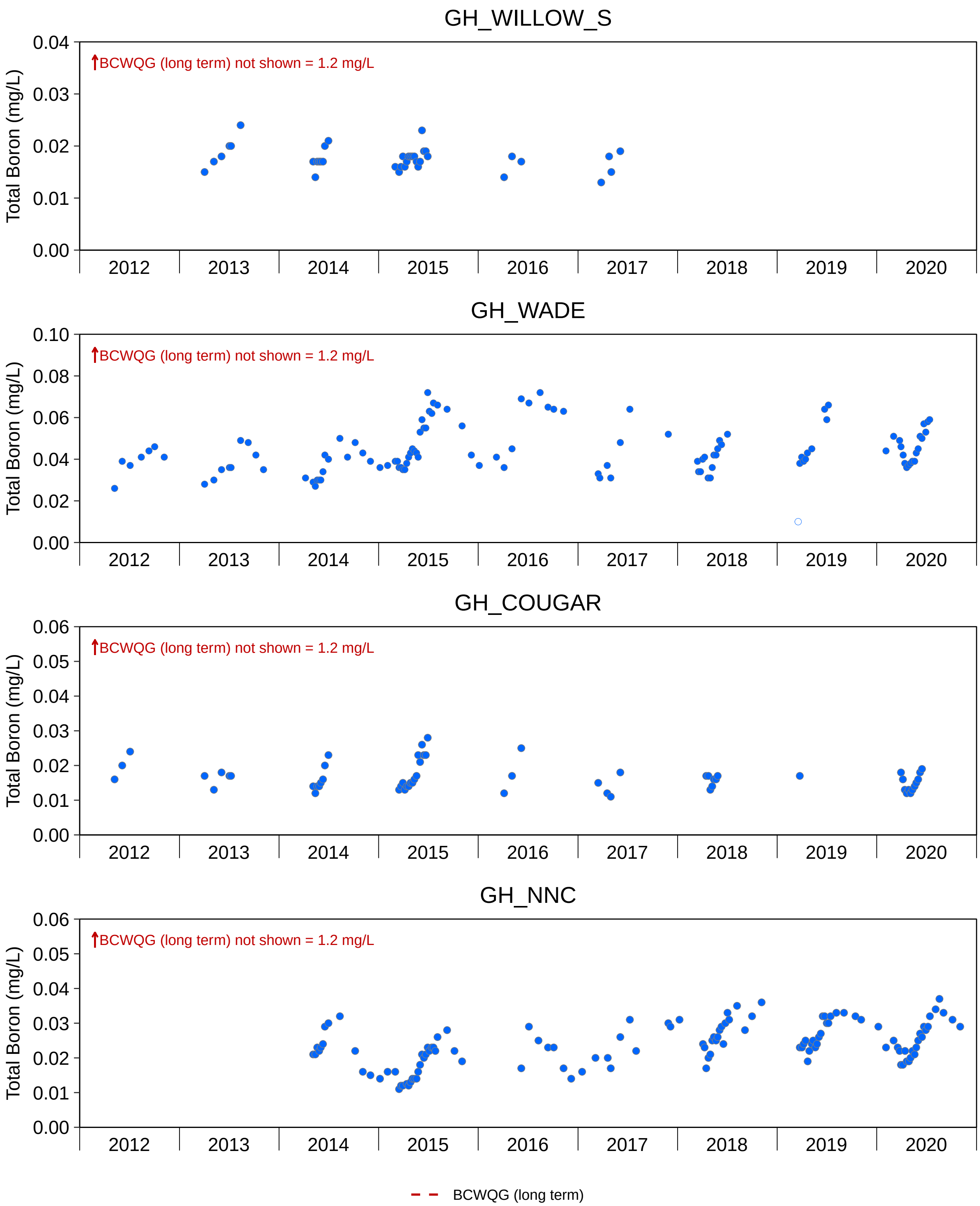


Figure D.12: Concentrations of Total Boron in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

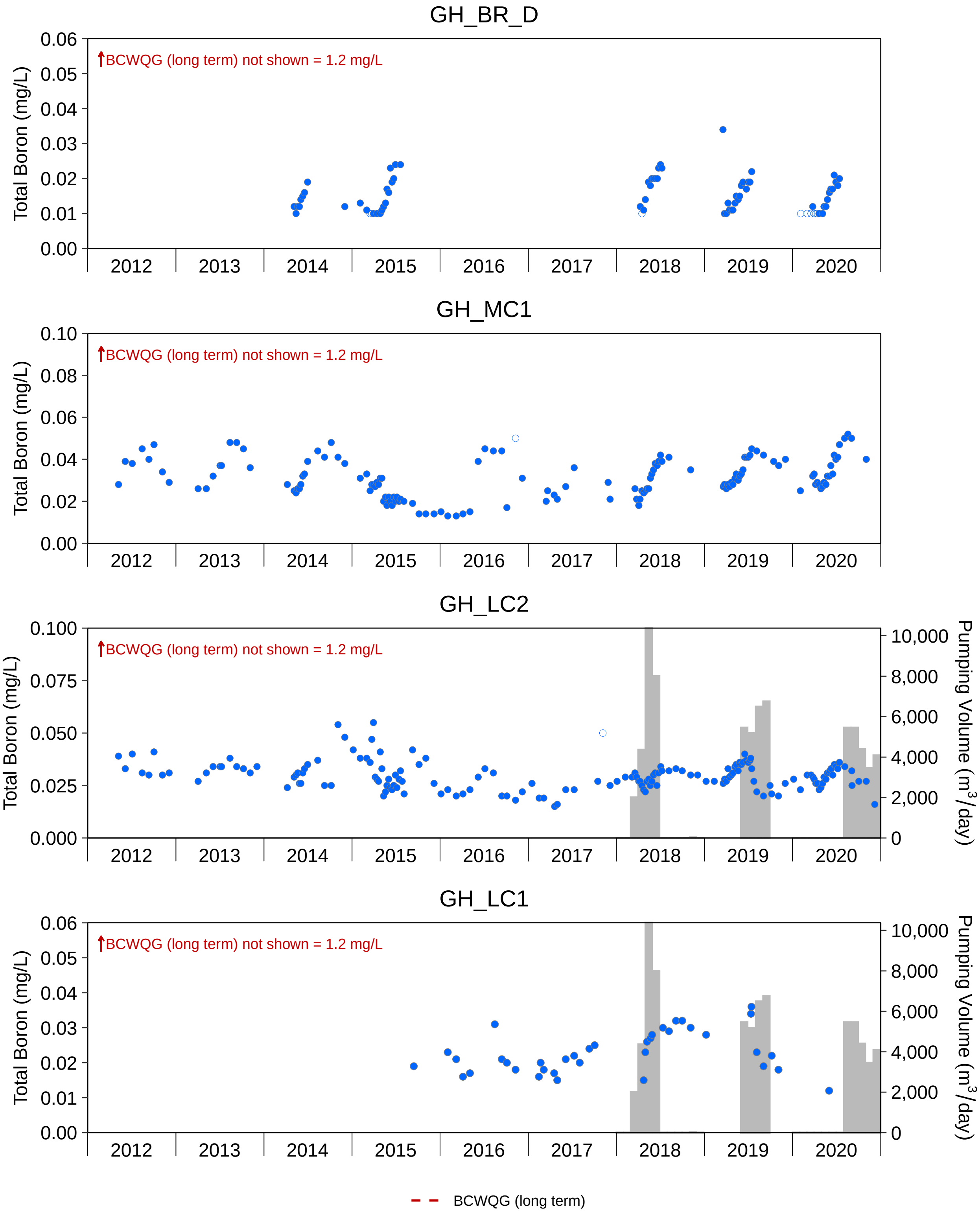


Figure D.12: Concentrations of Total Boron in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

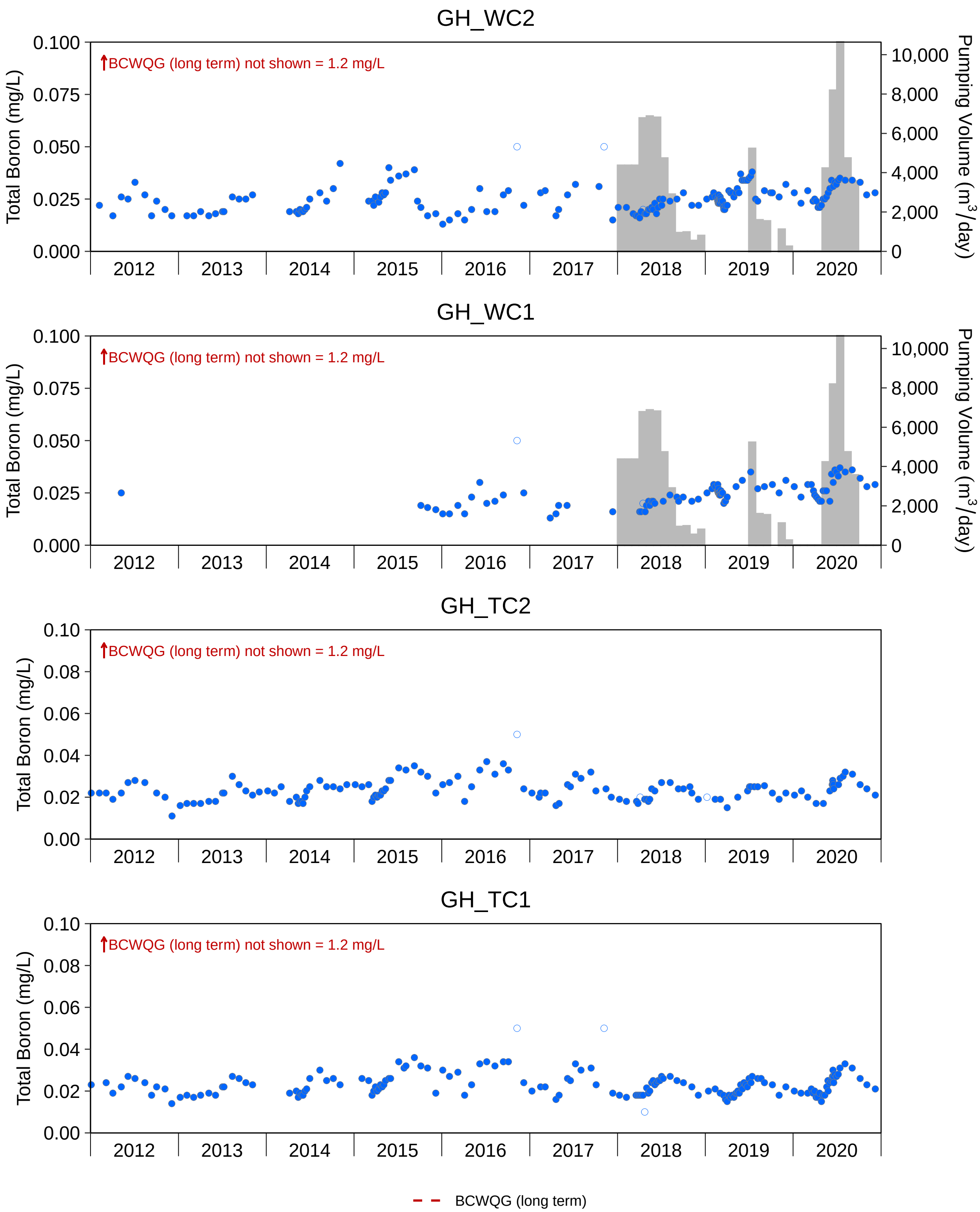


Figure D.12: Concentrations of Total Boron in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

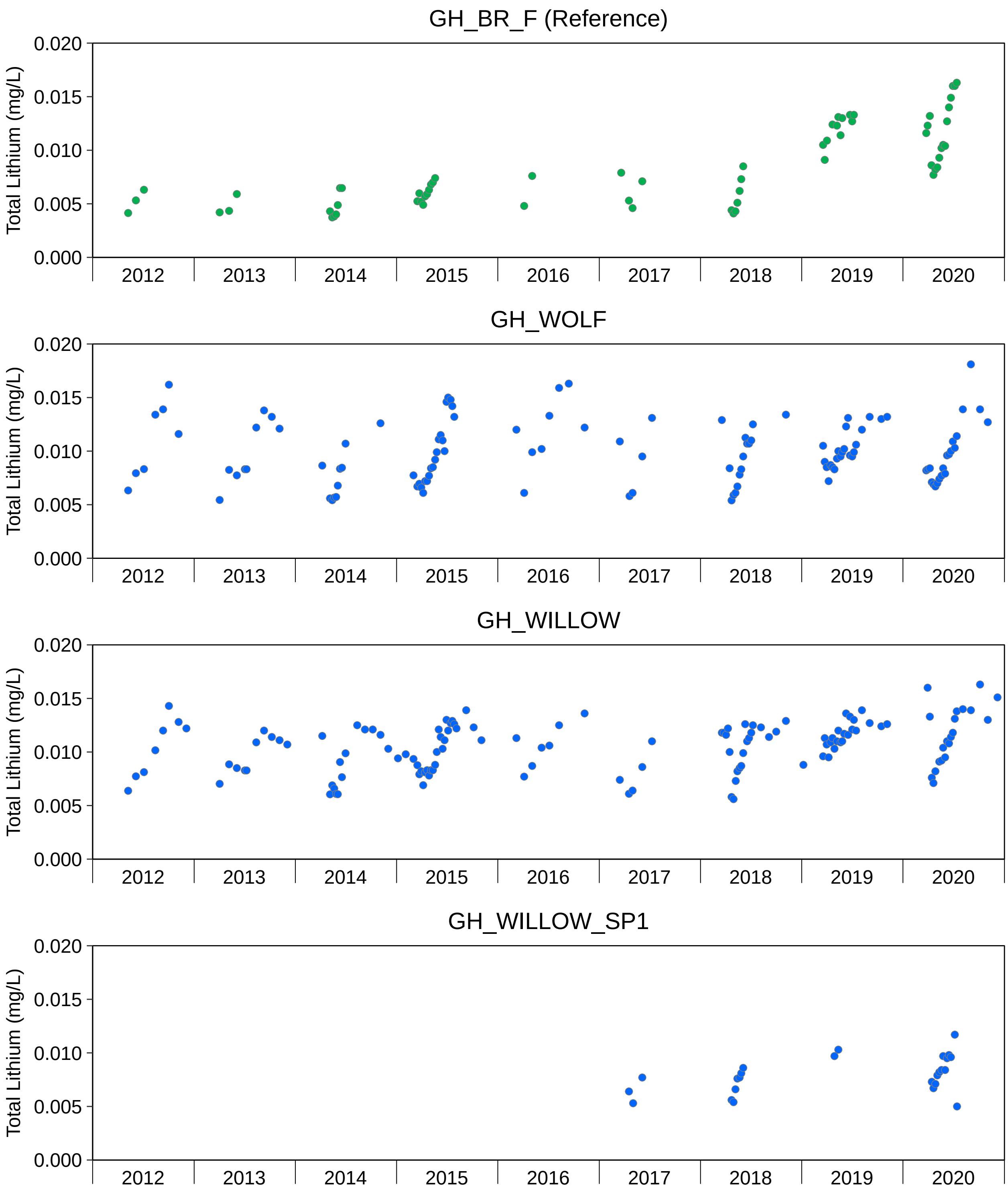


Figure D.13: Concentrations of Total Lithium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

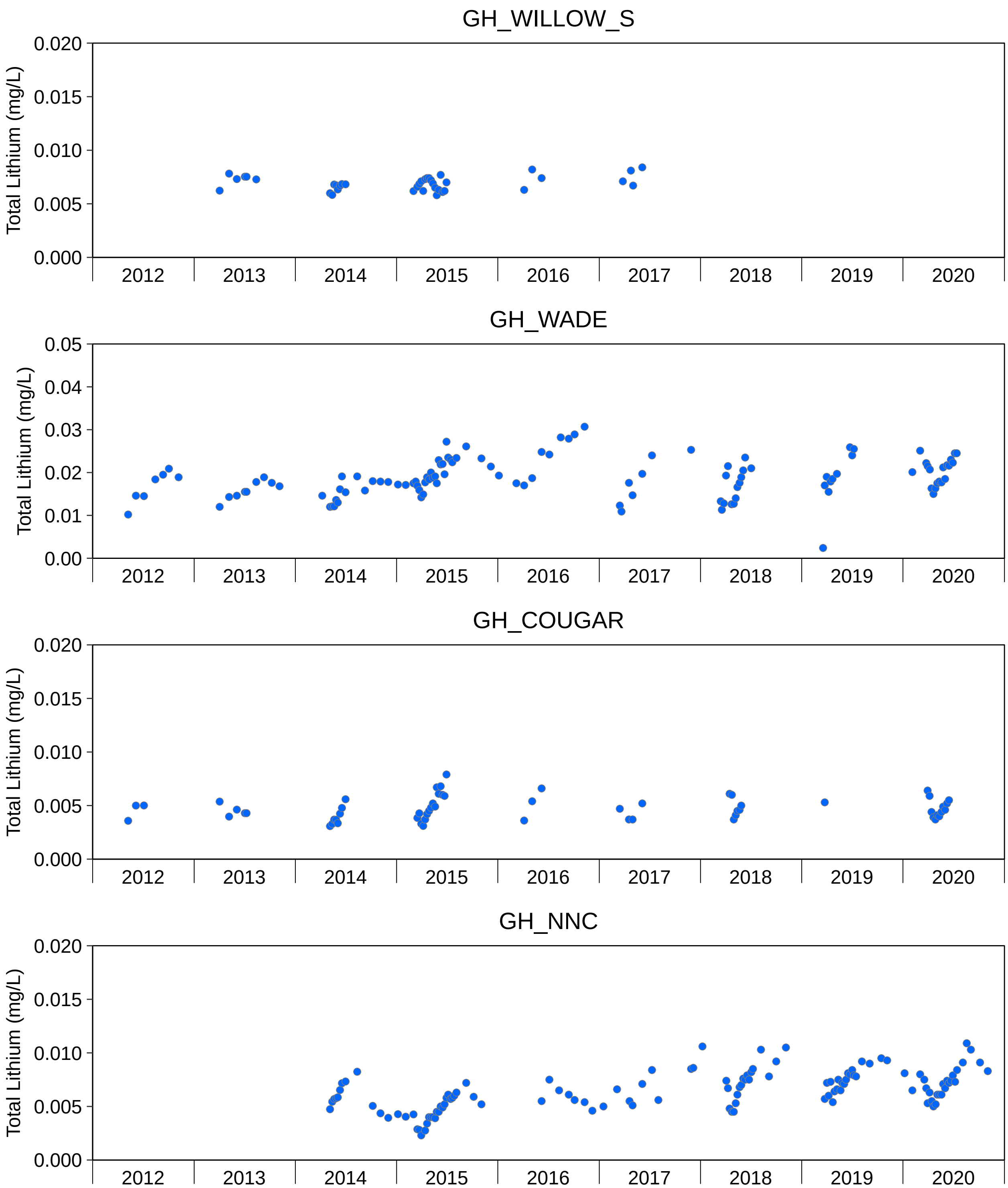


Figure D.13: Concentrations of Total Lithium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

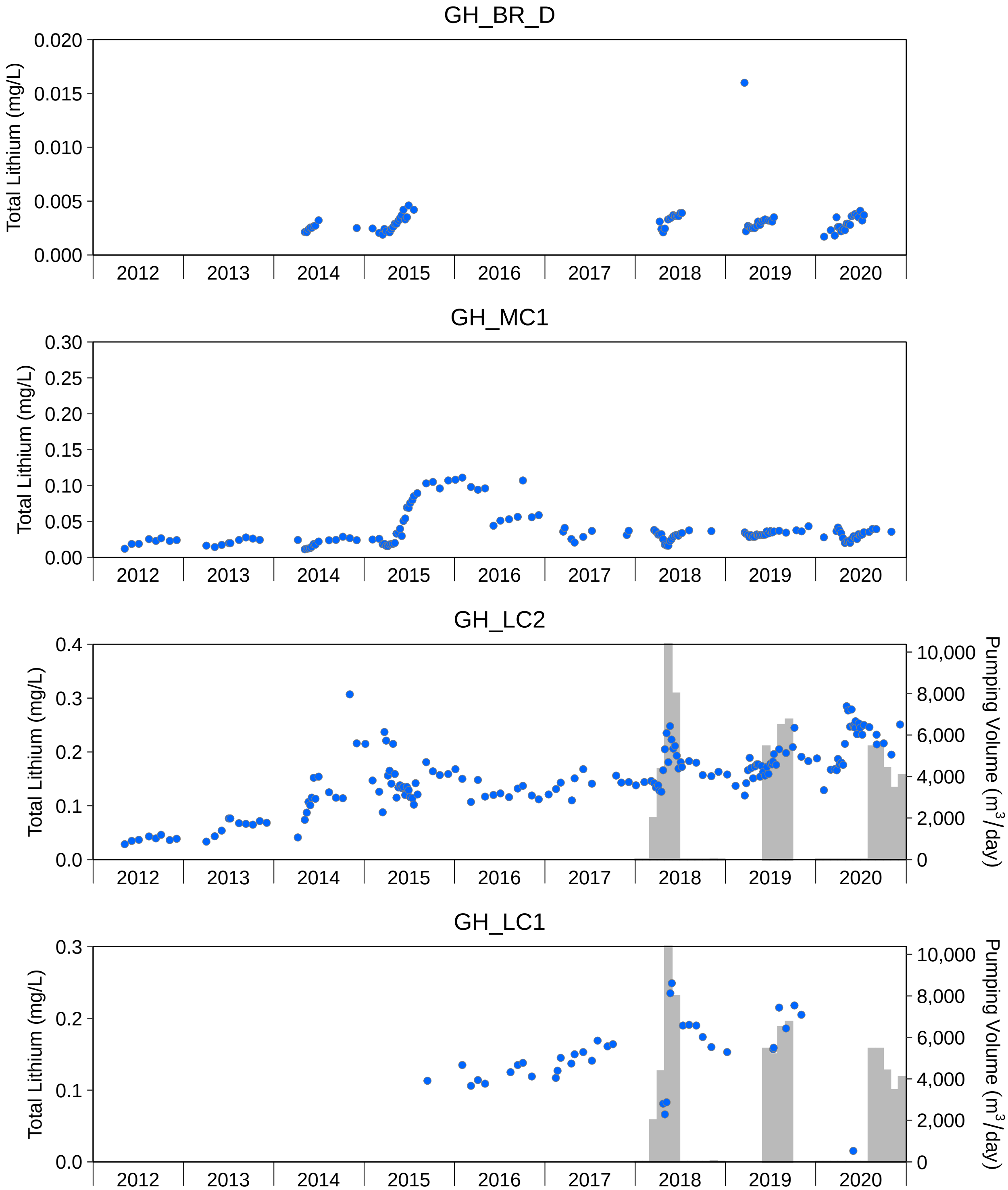


Figure D.13: Concentrations of Total Lithium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

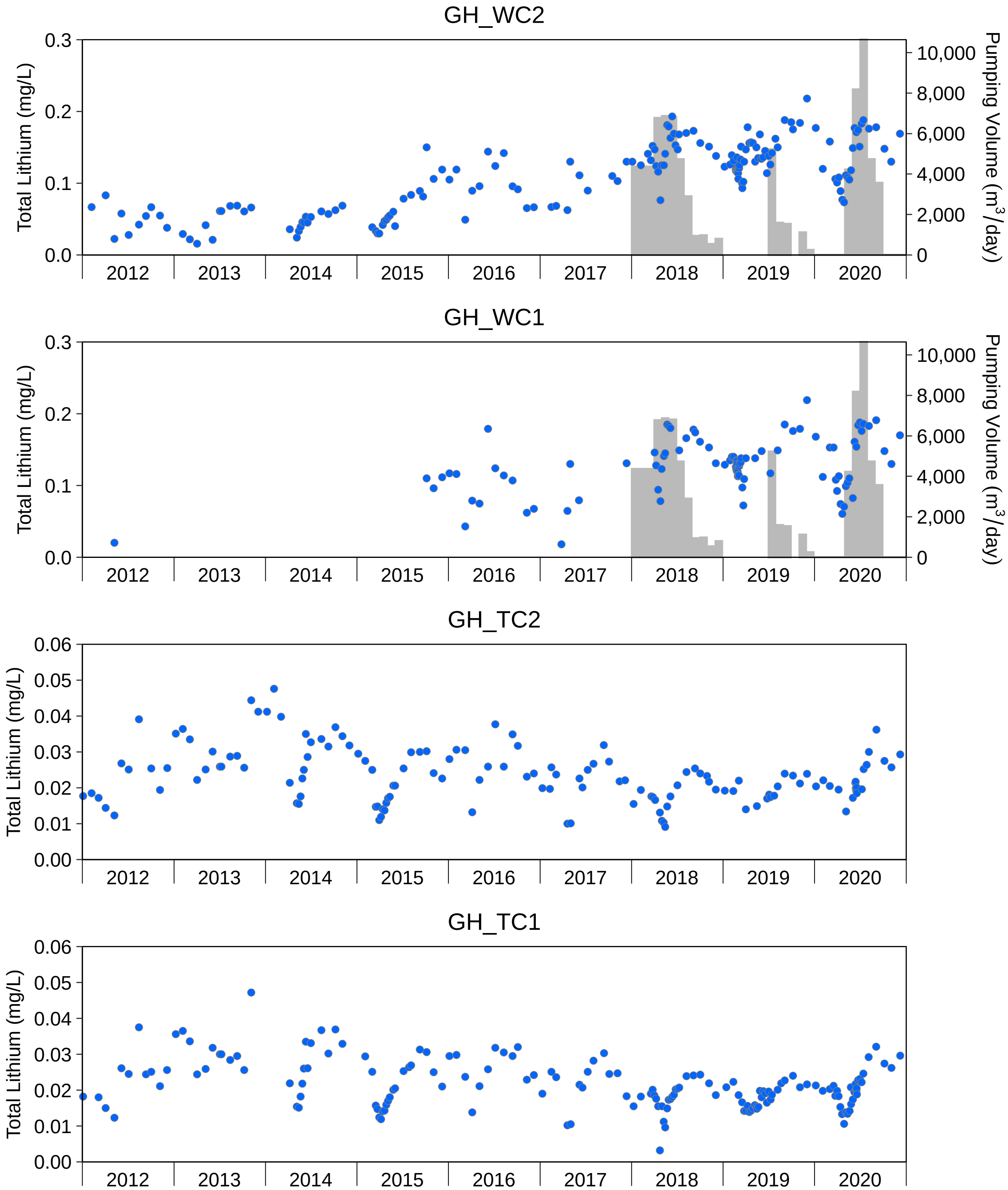


Figure D.13: Concentrations of Total Lithium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

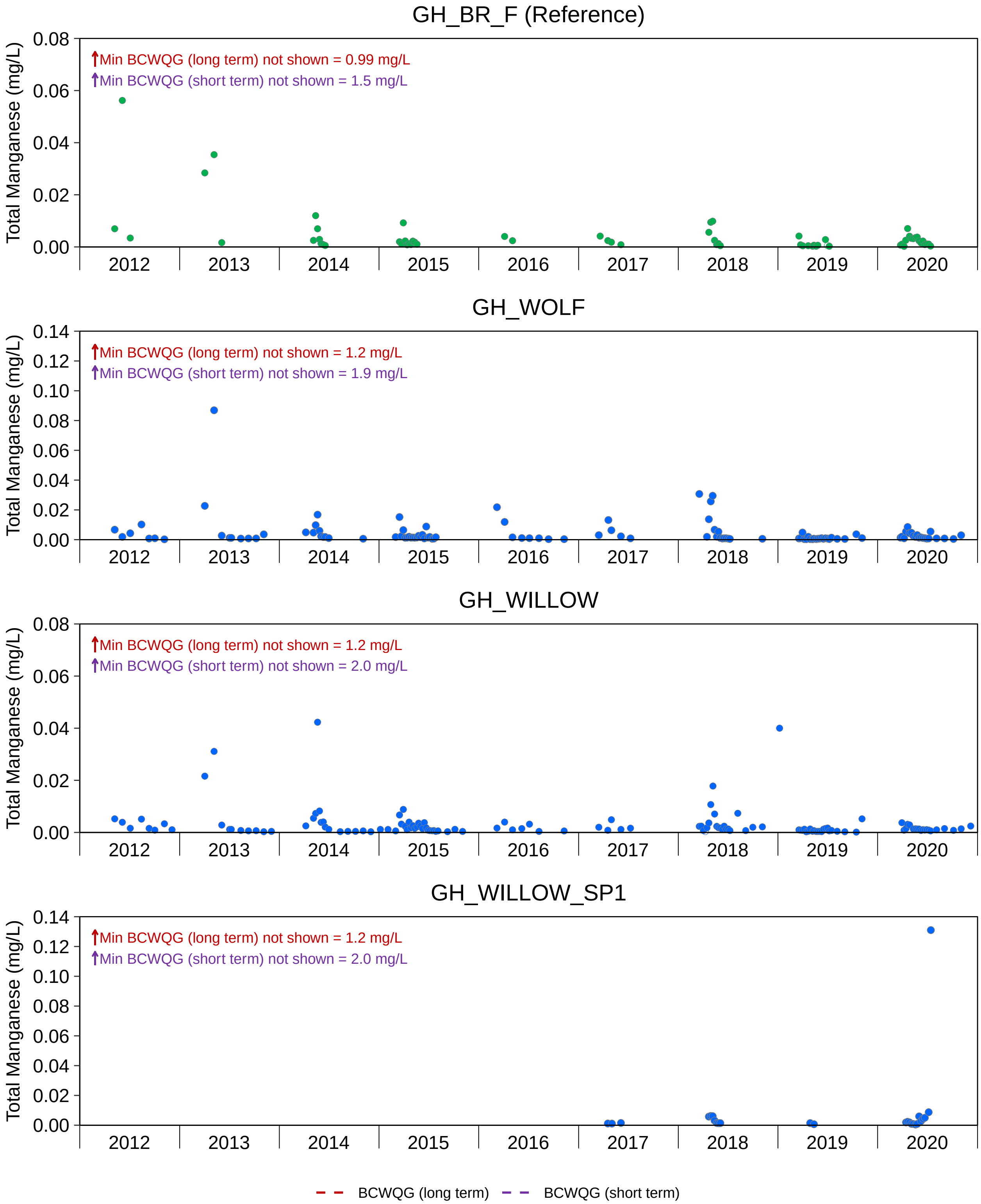


Figure D.14: Concentrations of Total Manganese in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Manganese was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

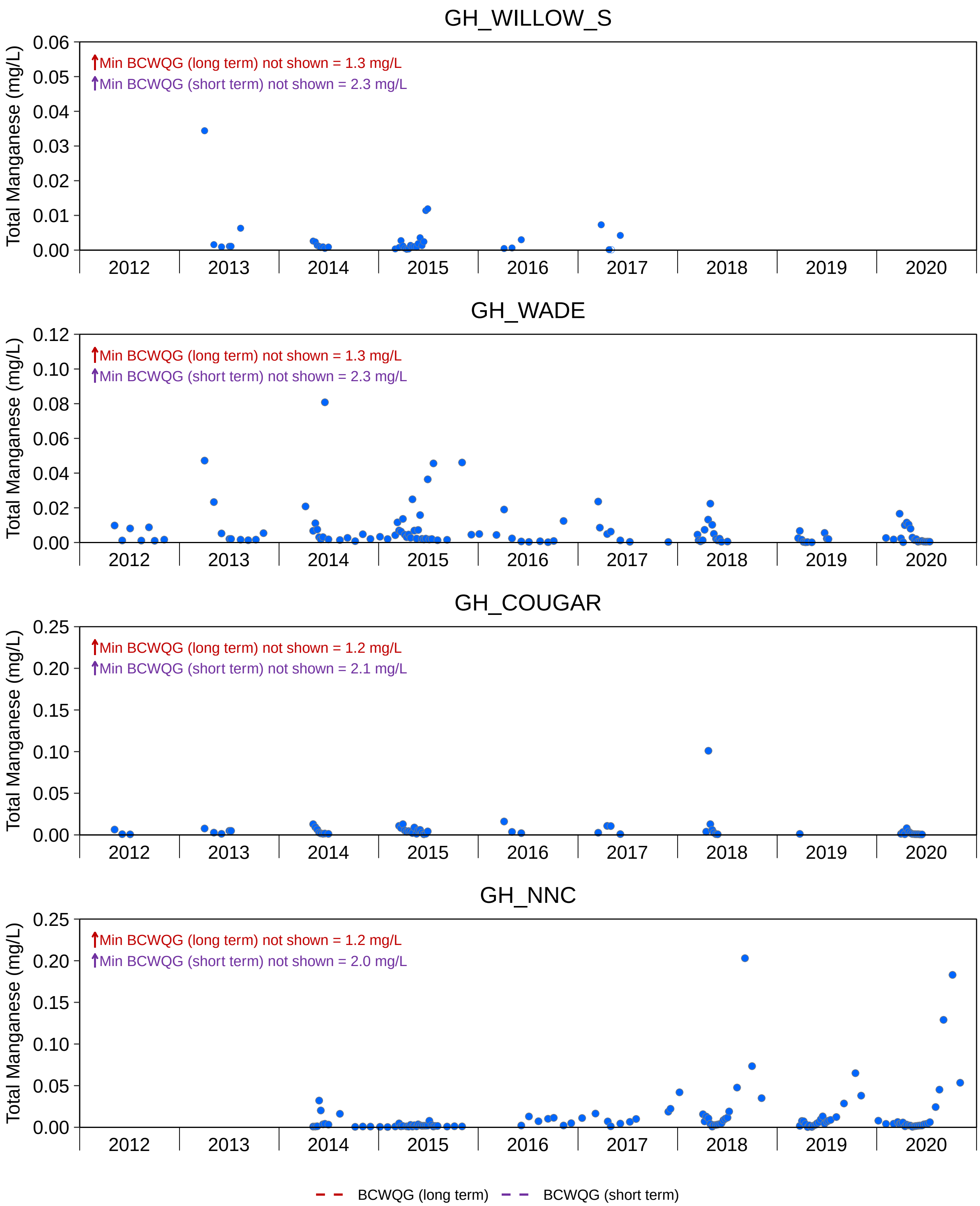


Figure D.14: Concentrations of Total Manganese in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Manganese was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

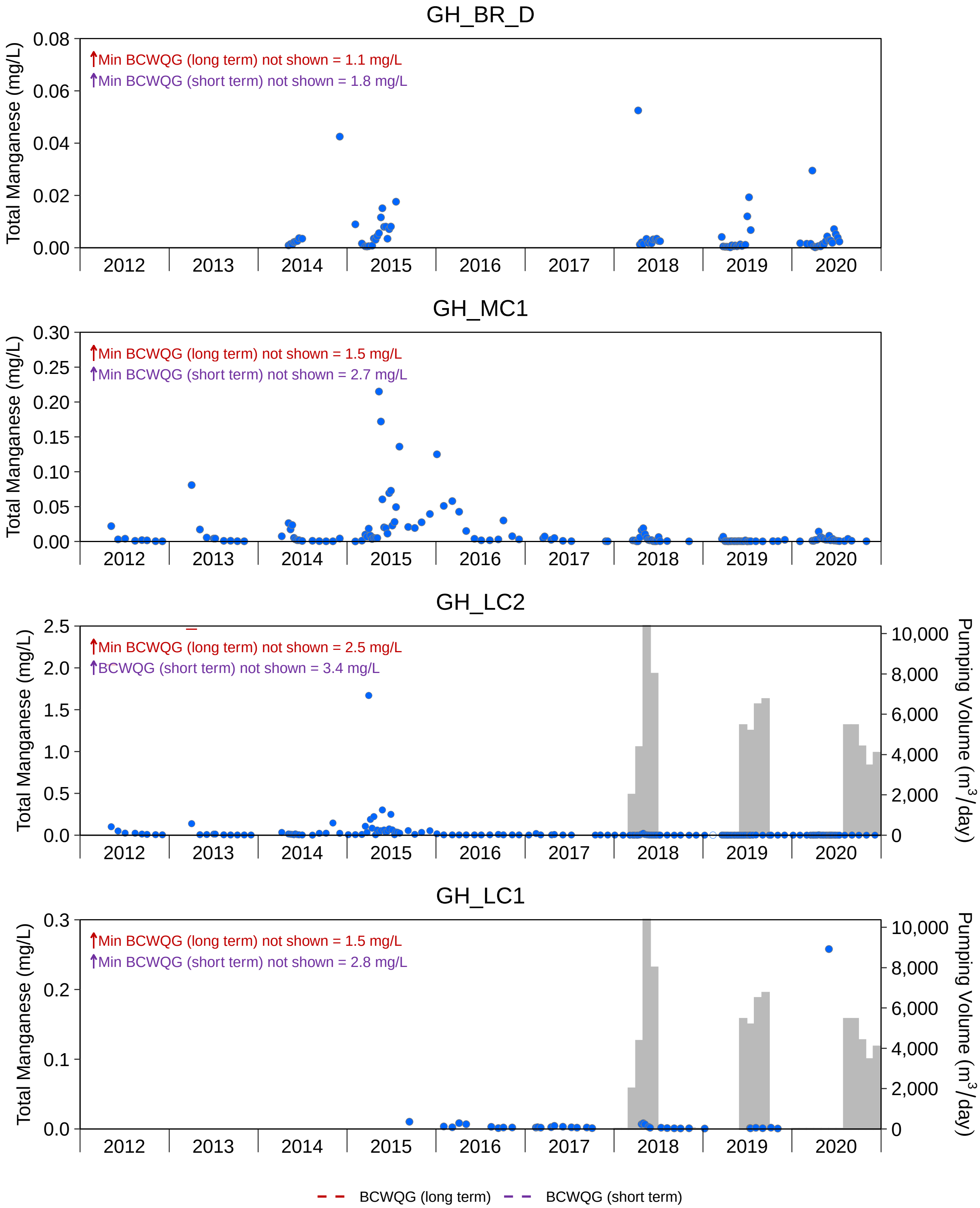


Figure D.14: Concentrations of Total Manganese in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Manganese was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

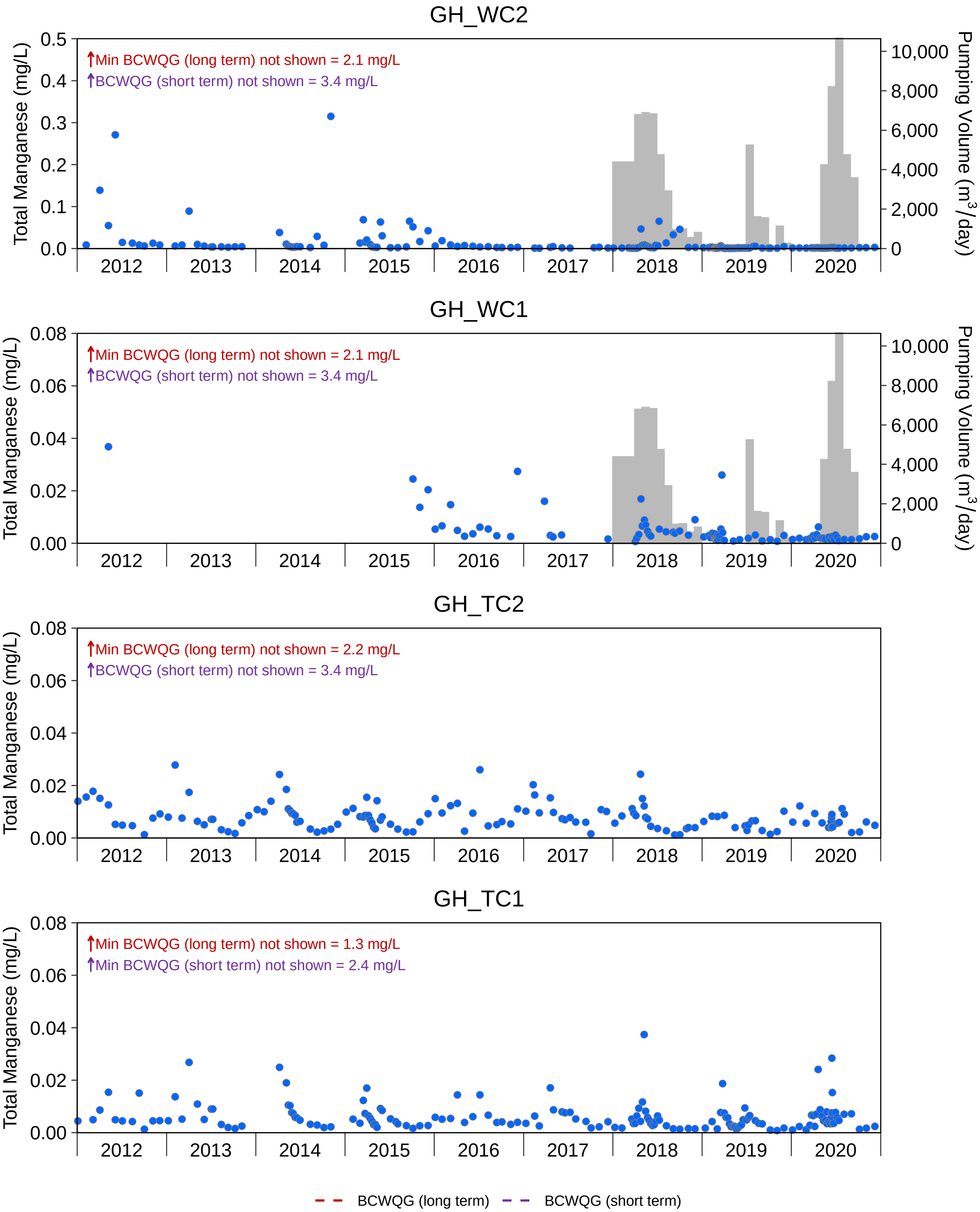


Figure D.14: Concentrations of Total Manganese in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Manganese was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

Figure D.15: Concentrations of Total Molybdenum in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

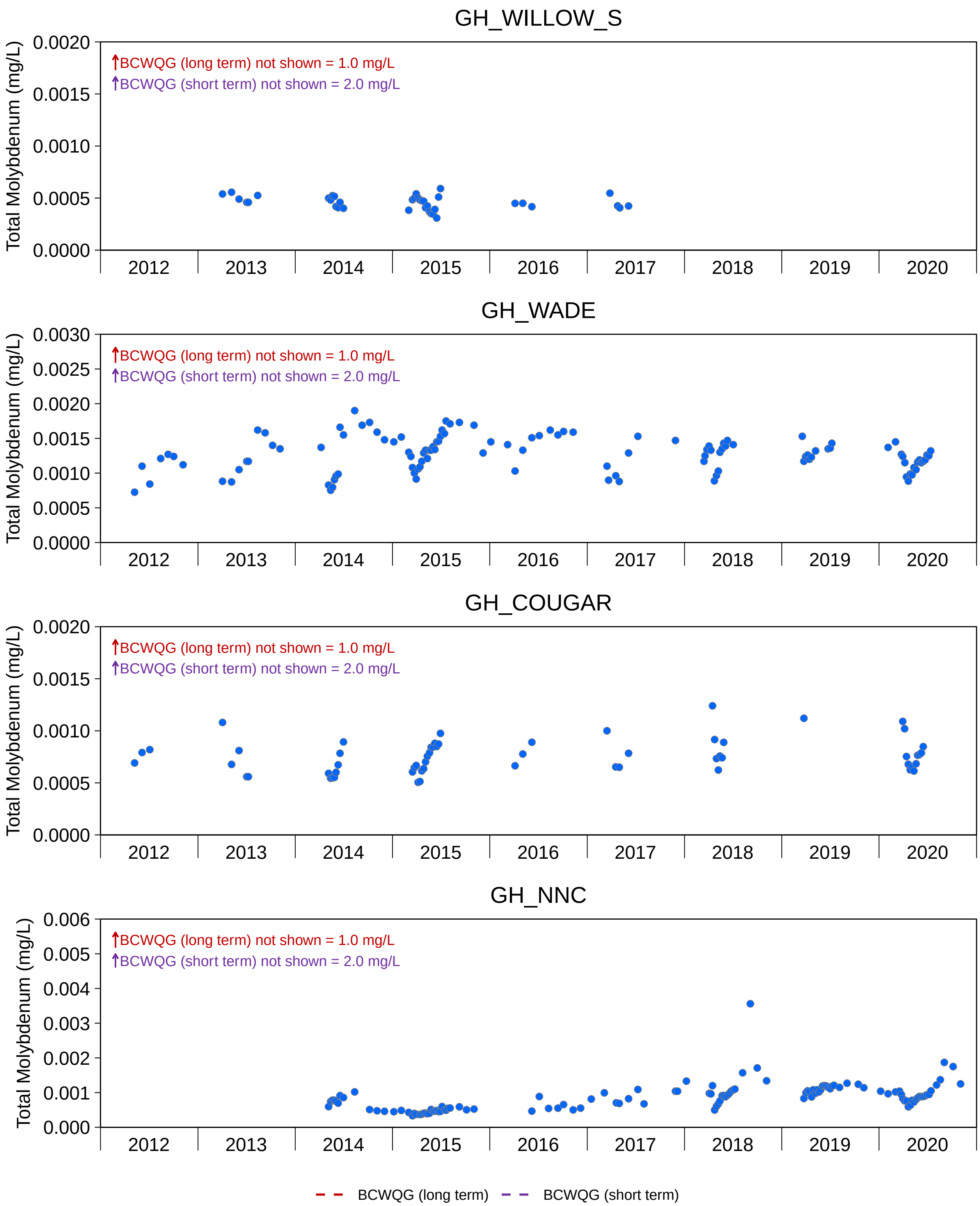


Figure D.15: Concentrations of Total Molybdenum in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

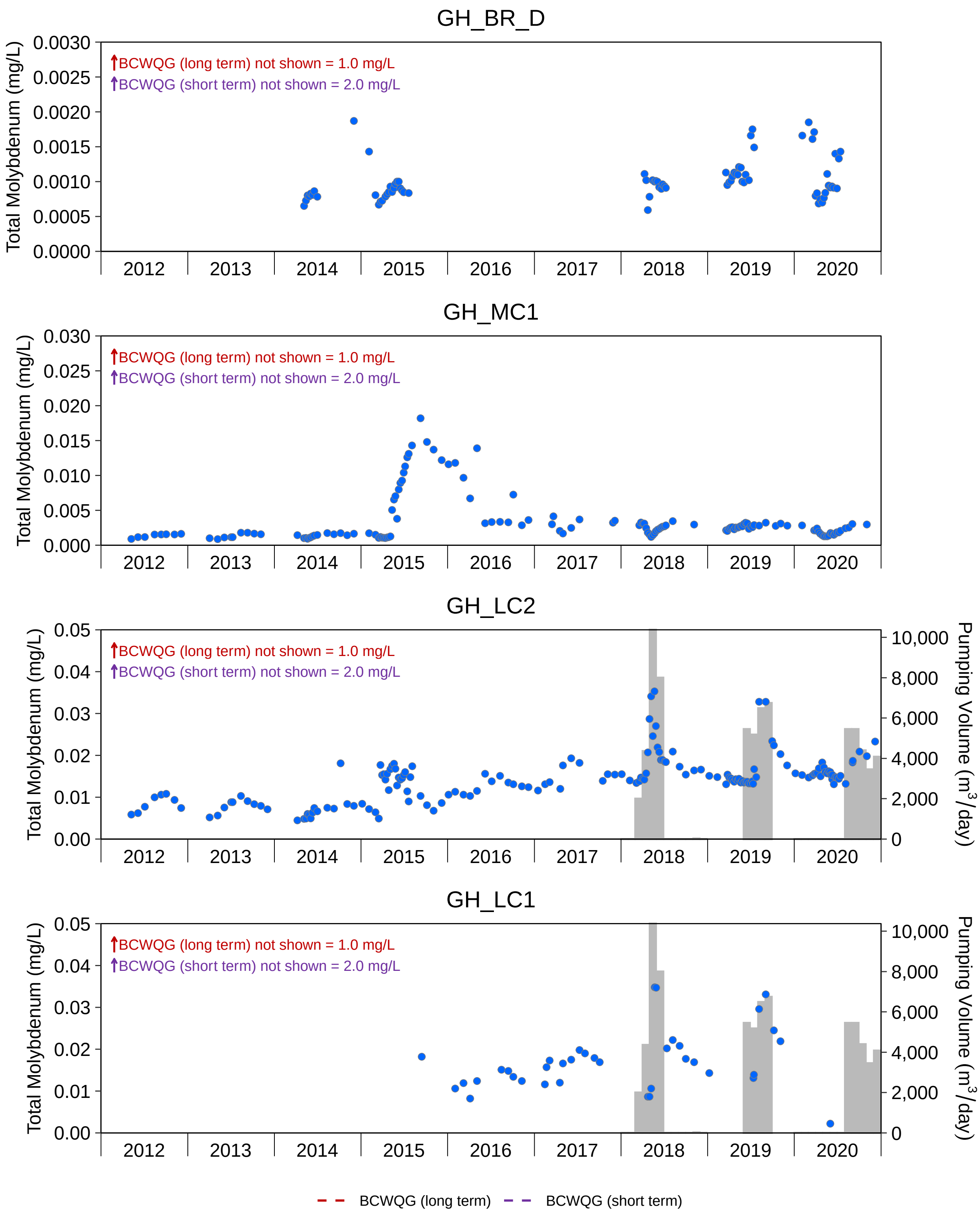


Figure D.15: Concentrations of Total Molybdenum in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

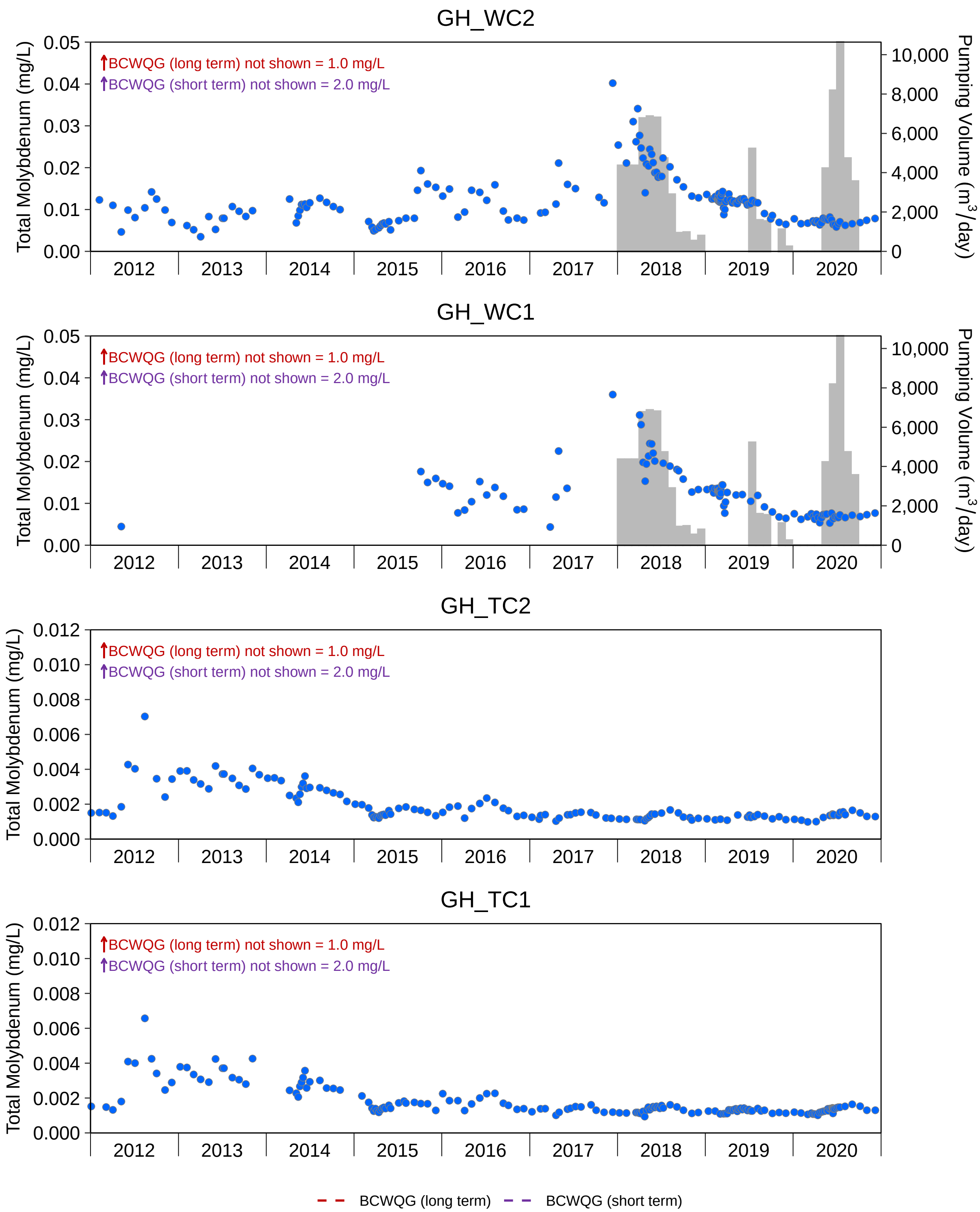


Figure D.15: Concentrations of Total Molybdenum in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

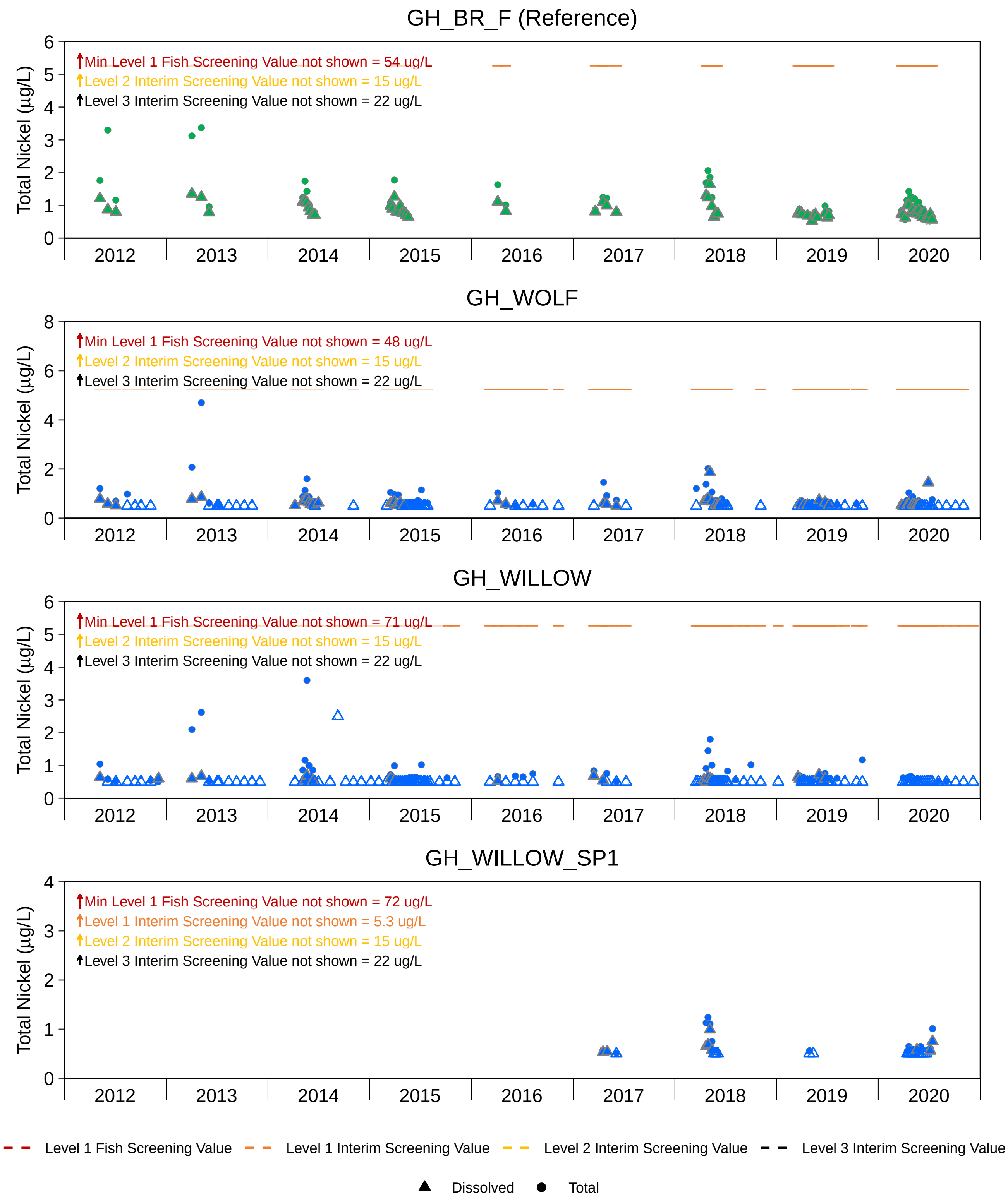


Figure D.16: Concentrations of Total Nickel in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only.

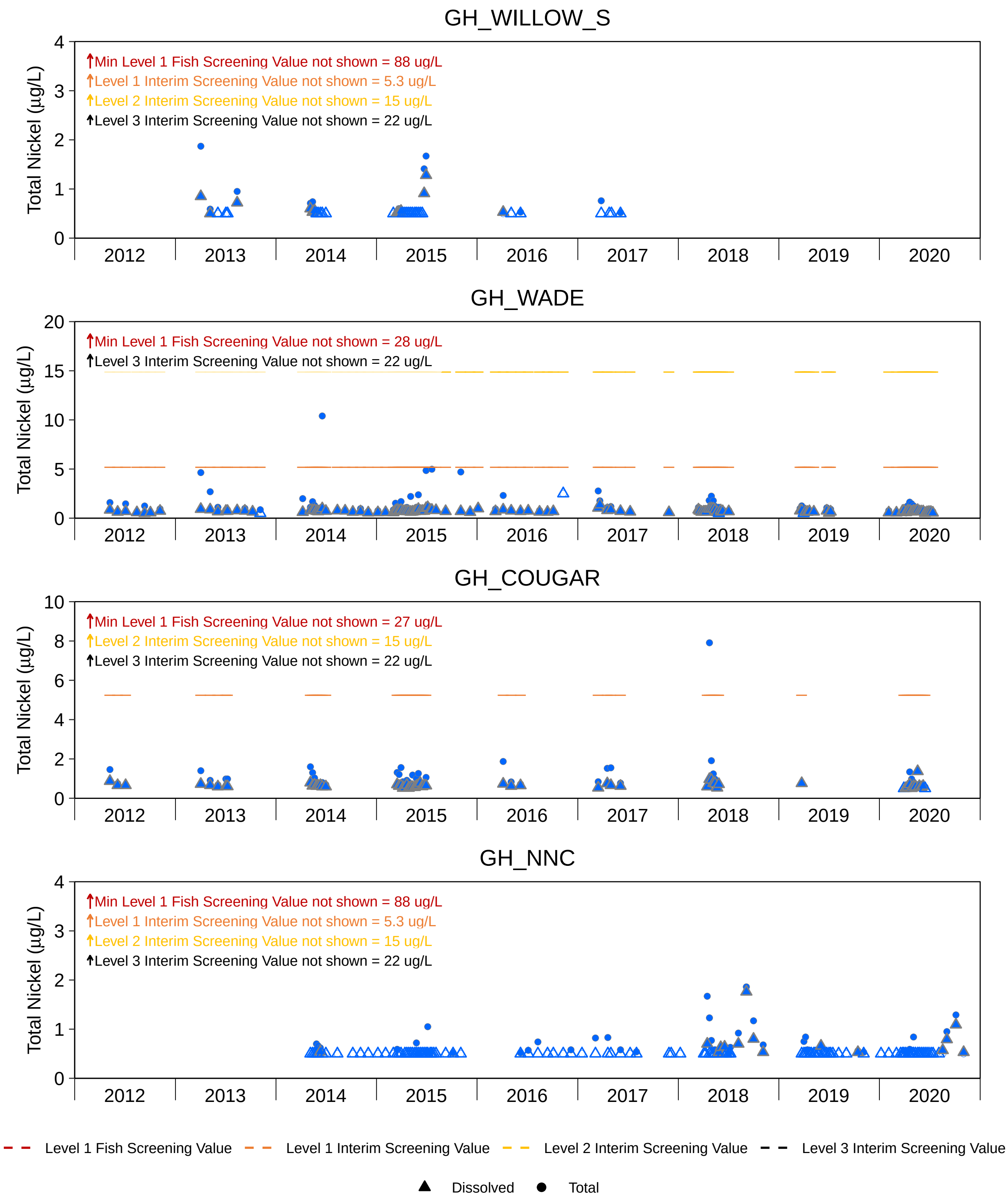


Figure D.16: Concentrations of Total Nickel in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only.

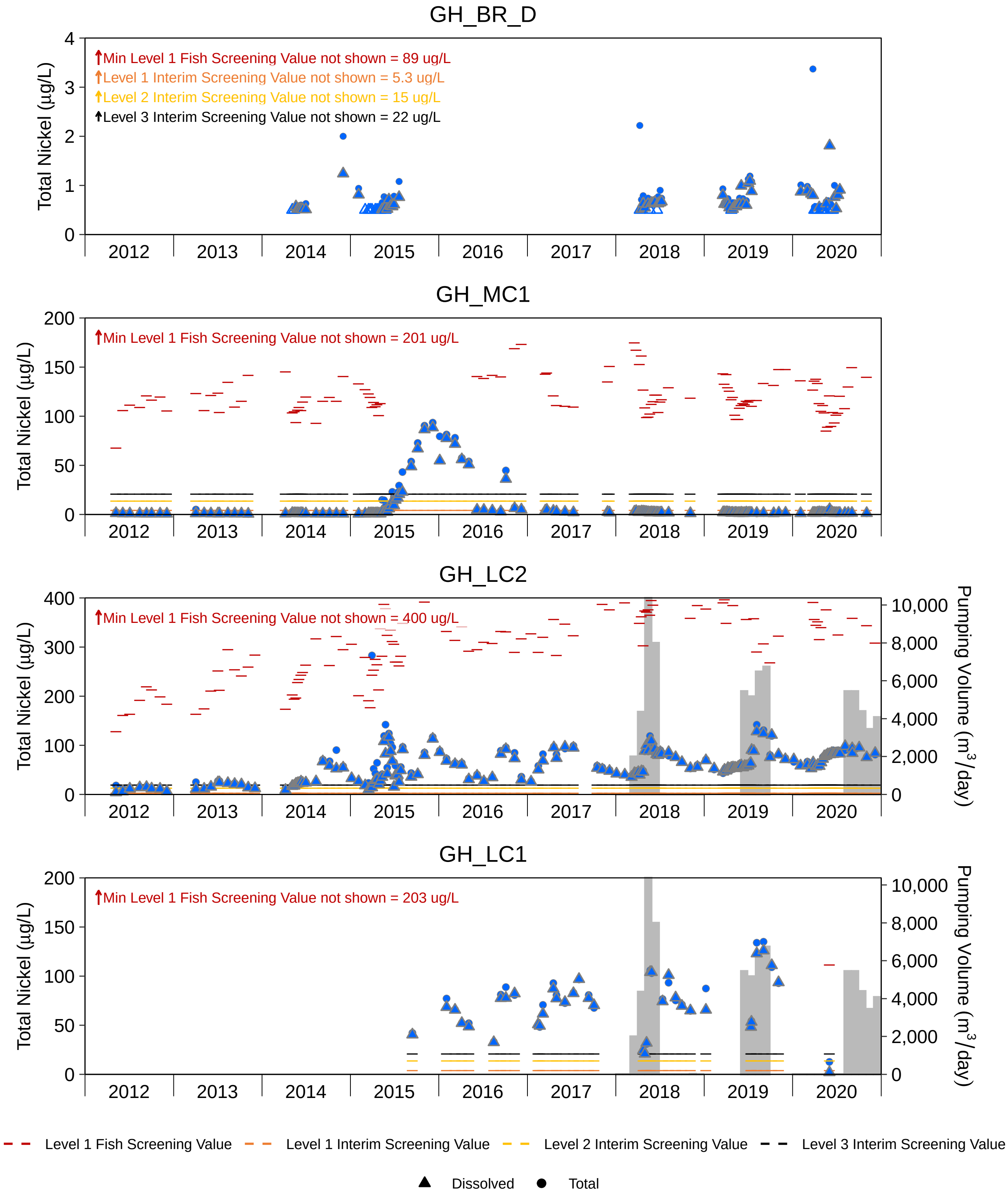


Figure D.16: Concentrations of Total Nickel in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only. Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

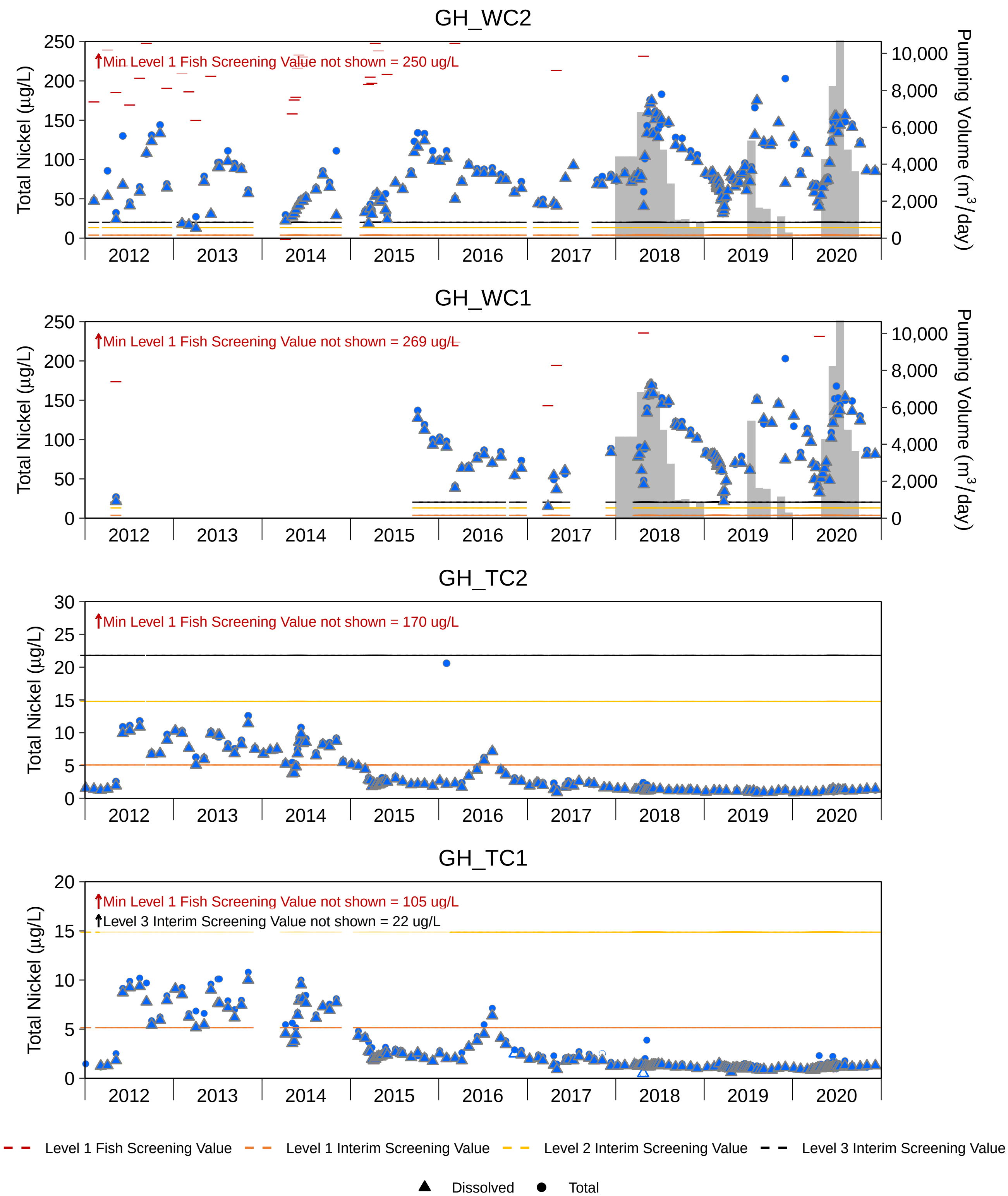


Figure D.16: Concentrations of Total Nickel in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only. Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

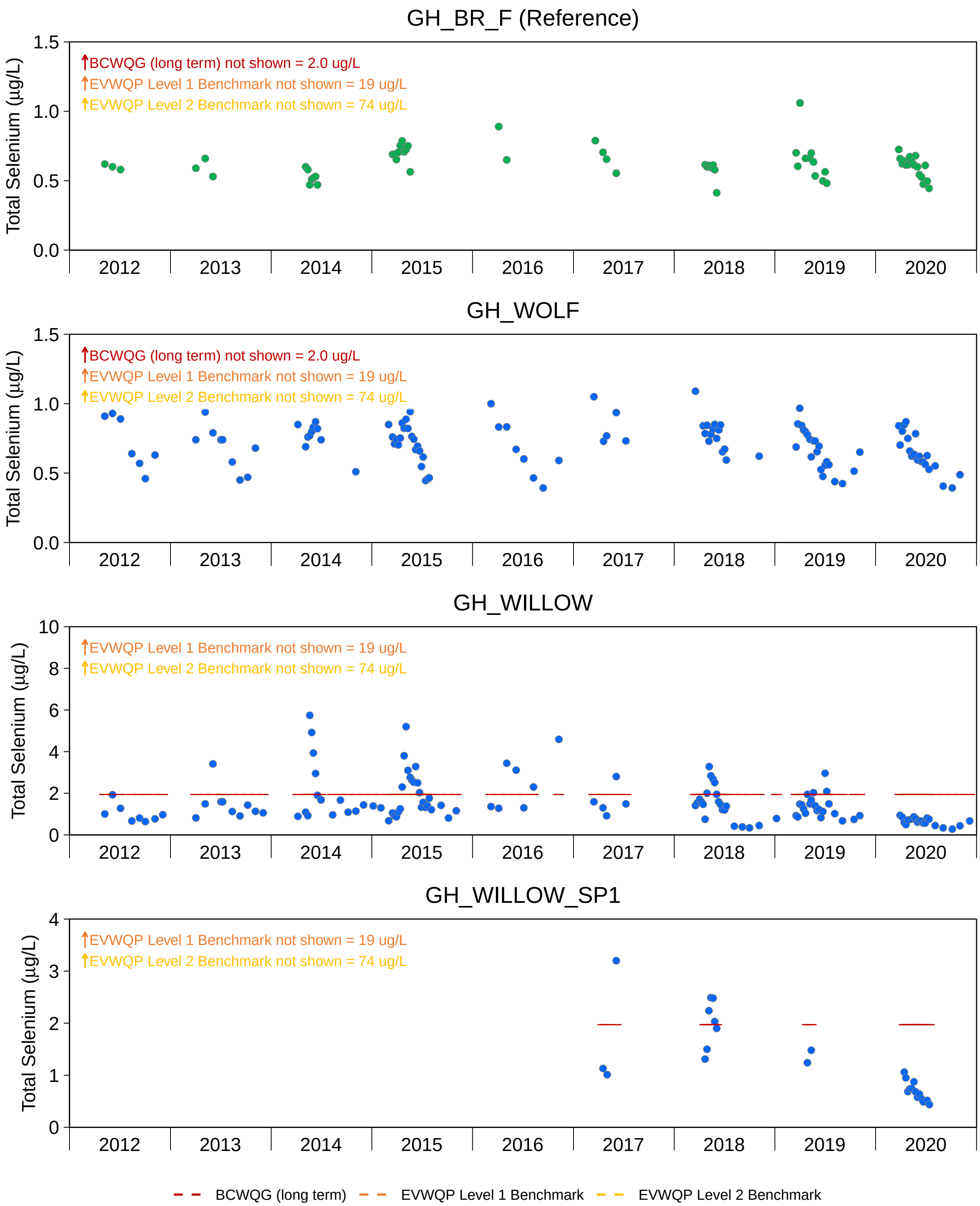


Figure D.17: Concentrations of Total Selenium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

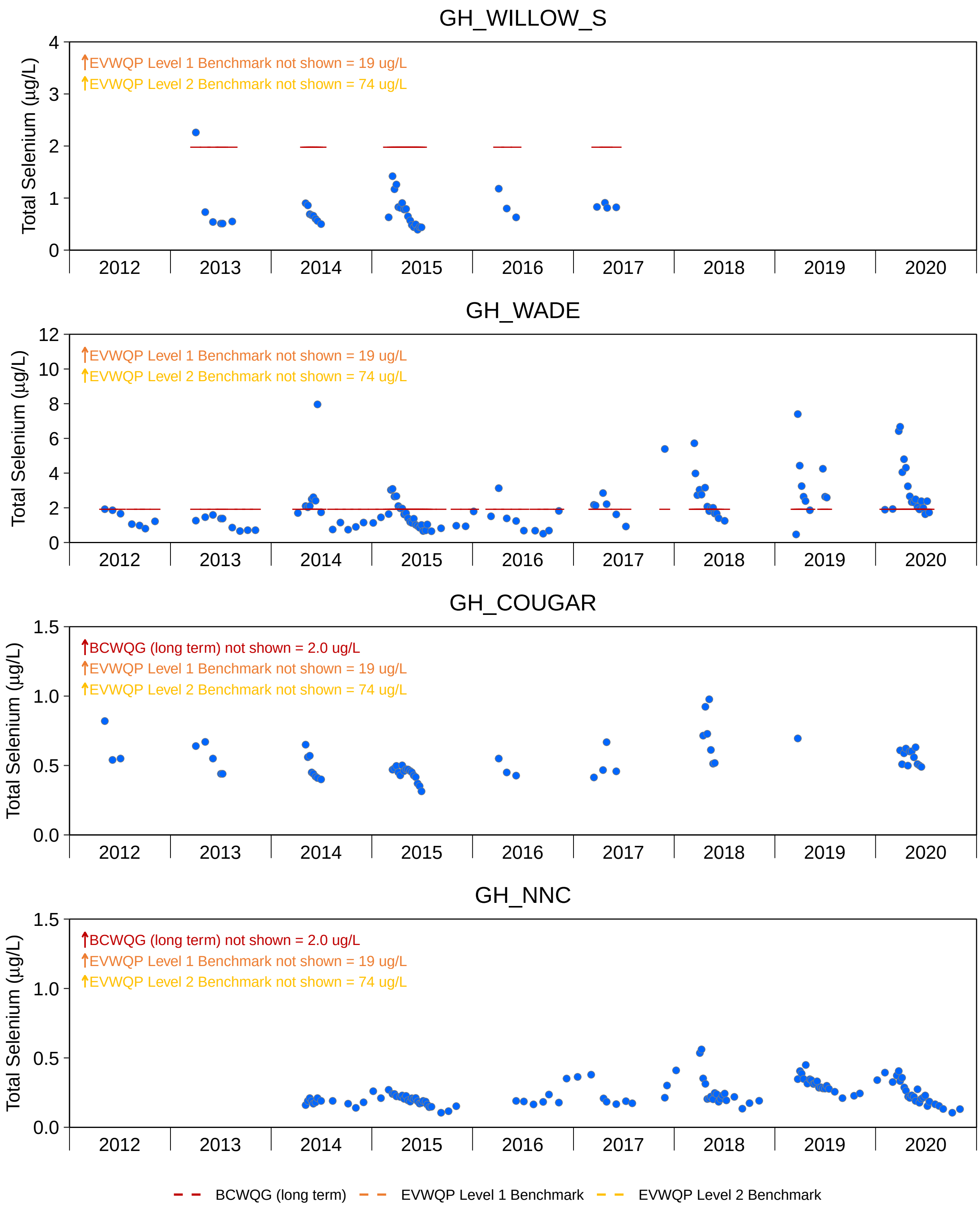


Figure D.17: Concentrations of Total Selenium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

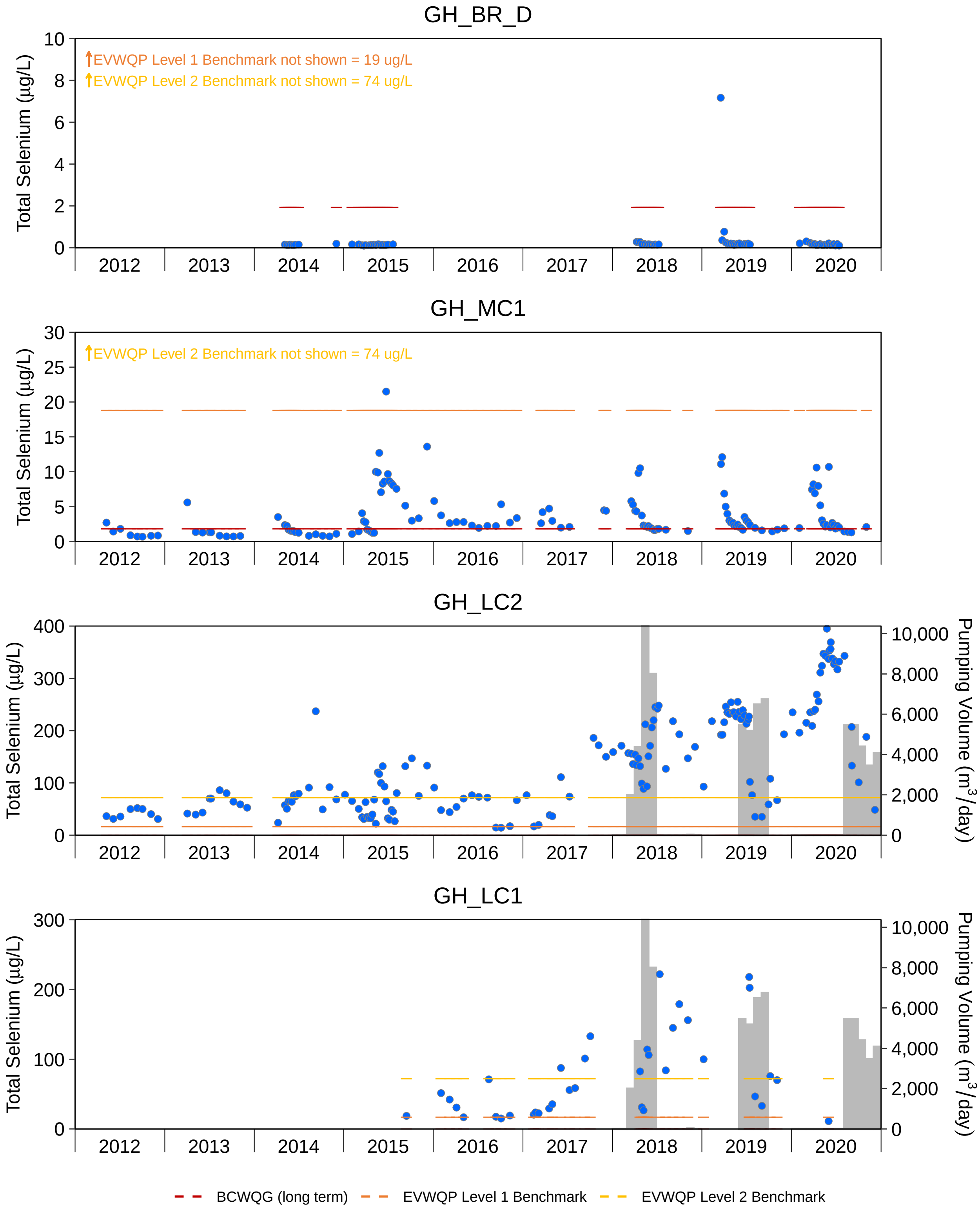


Figure D.17: Concentrations of Total Selenium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

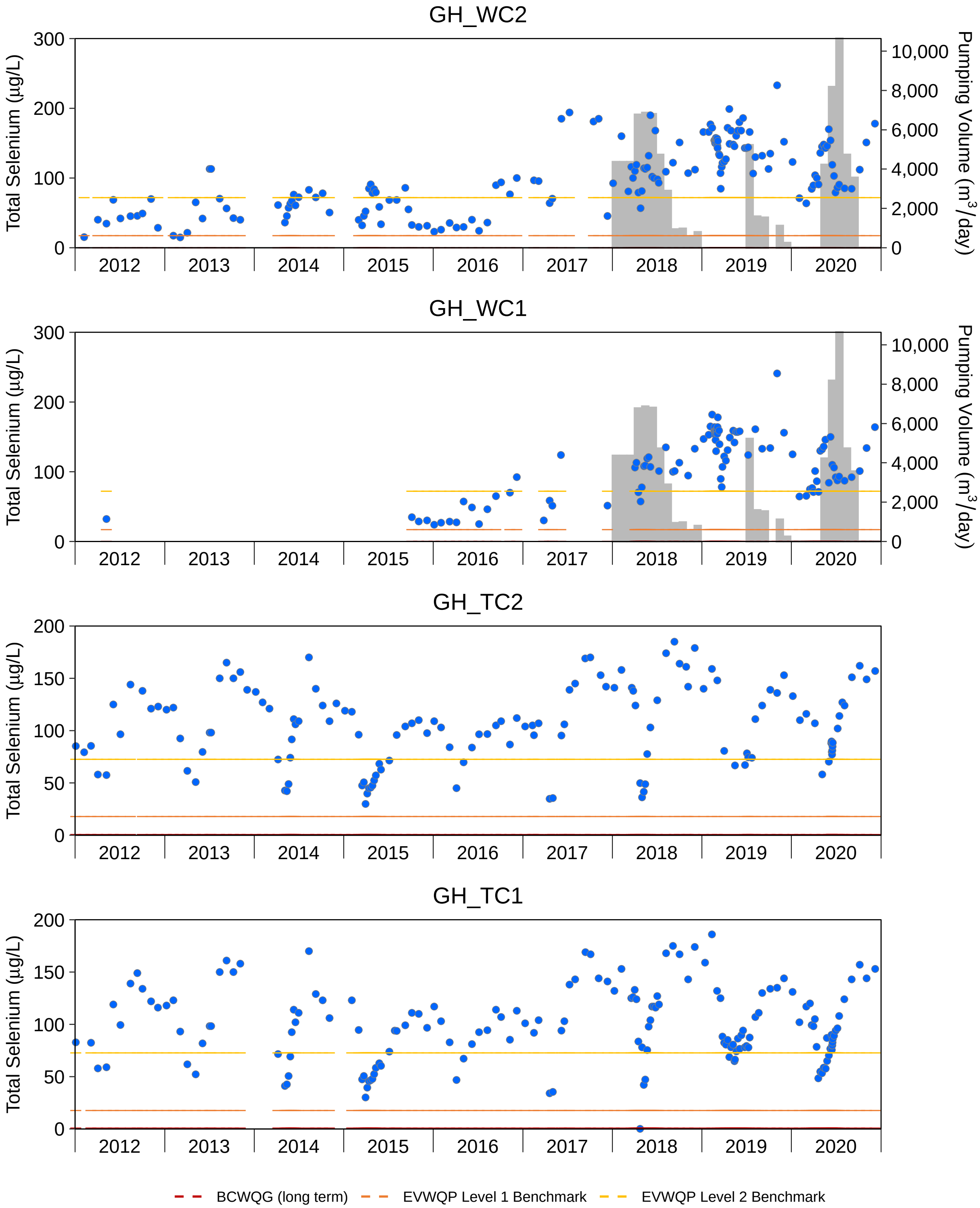


Figure D.17: Concentrations of Total Selenium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

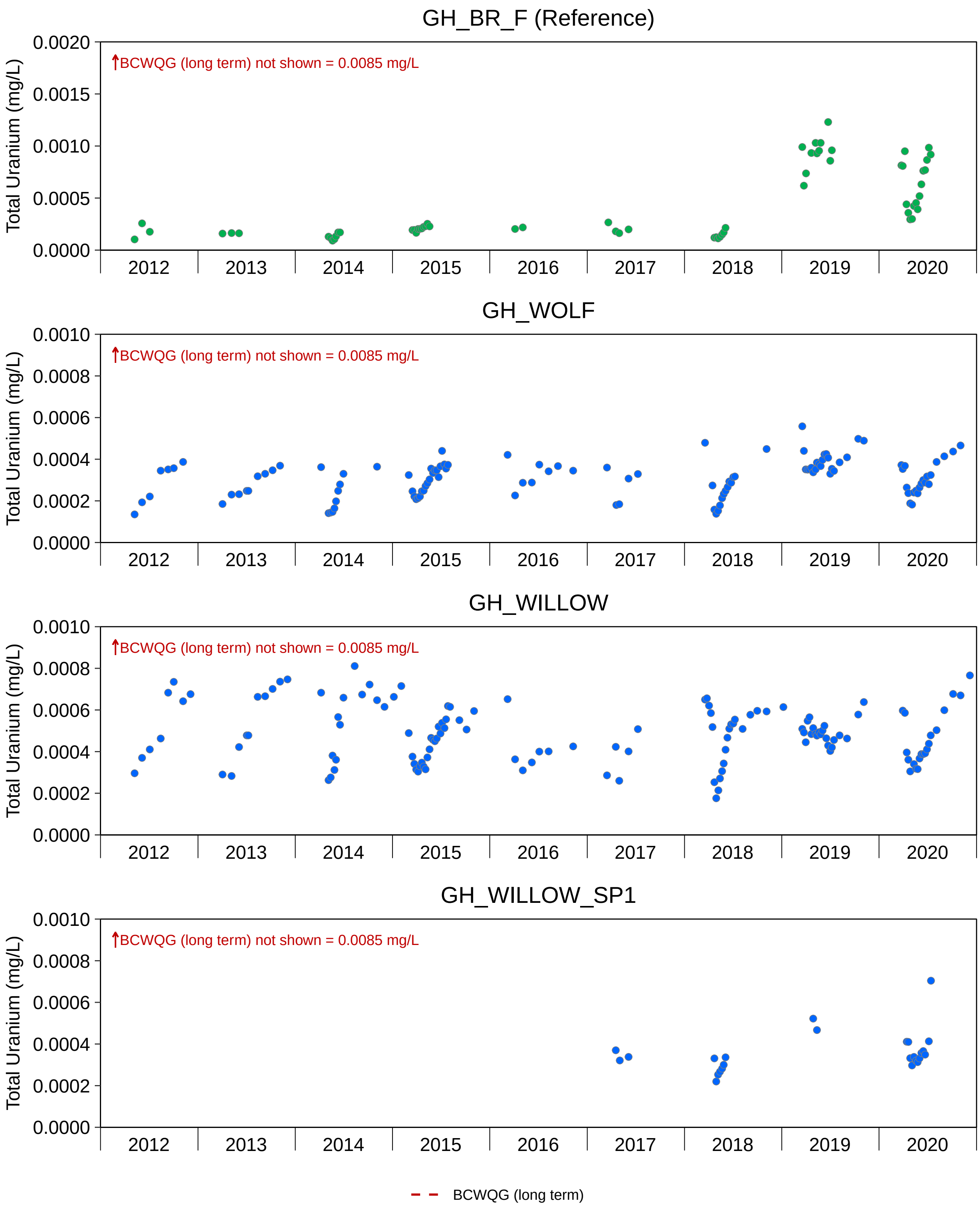


Figure D.18: Concentrations of Total Uranium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

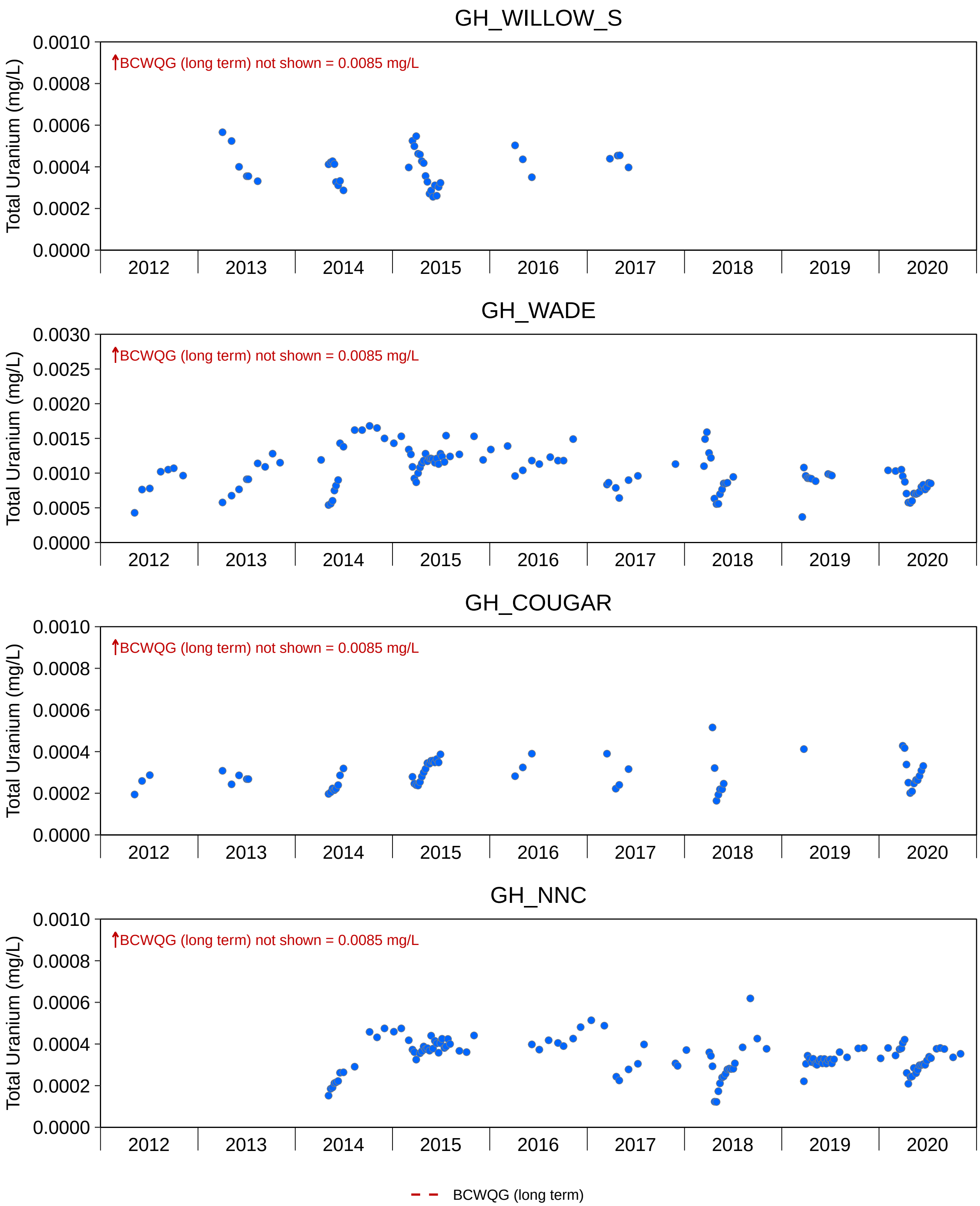


Figure D.18: Concentrations of Total Uranium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

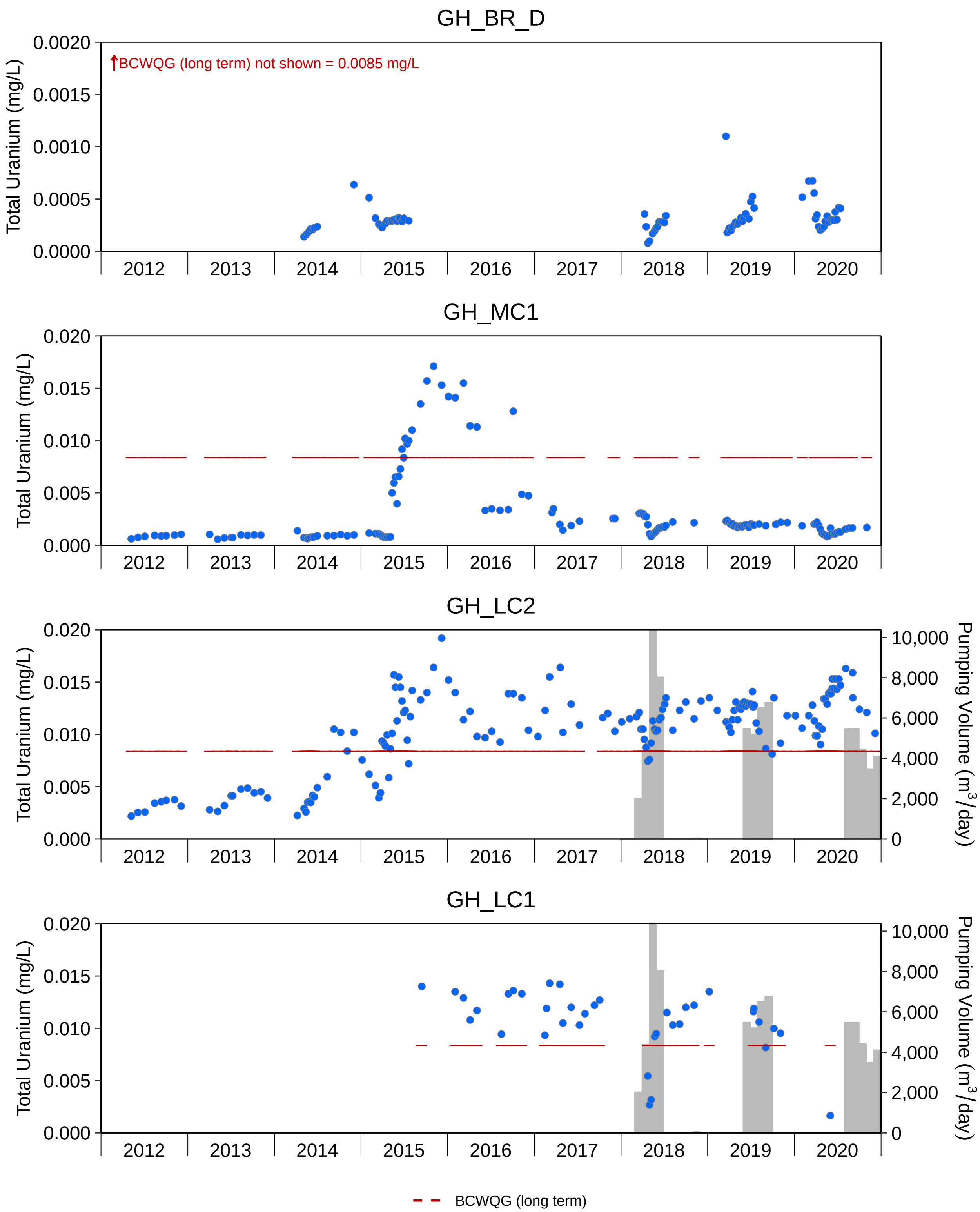


Figure D.18: Concentrations of Total Uranium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

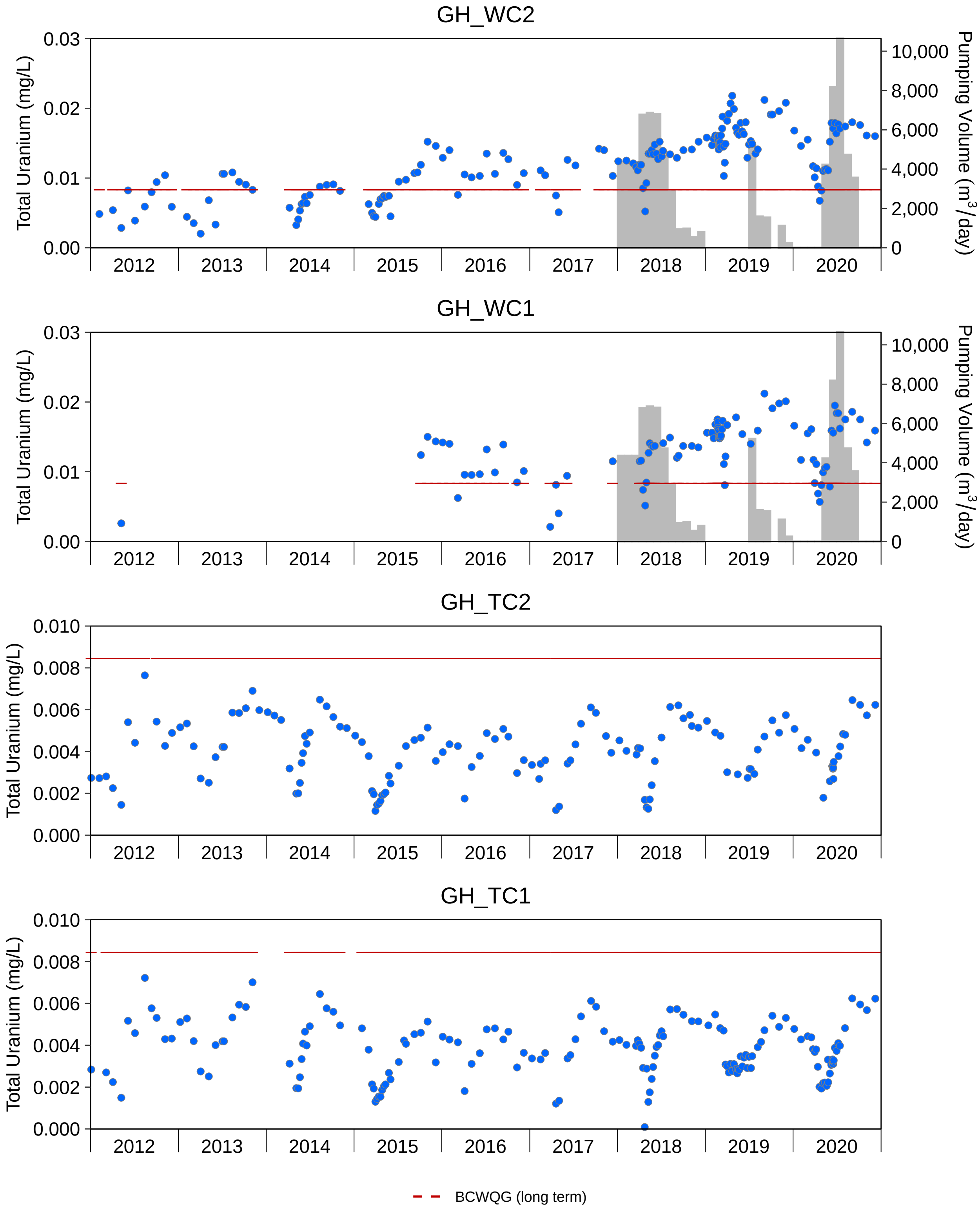


Figure D.18: Concentrations of Total Uranium in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

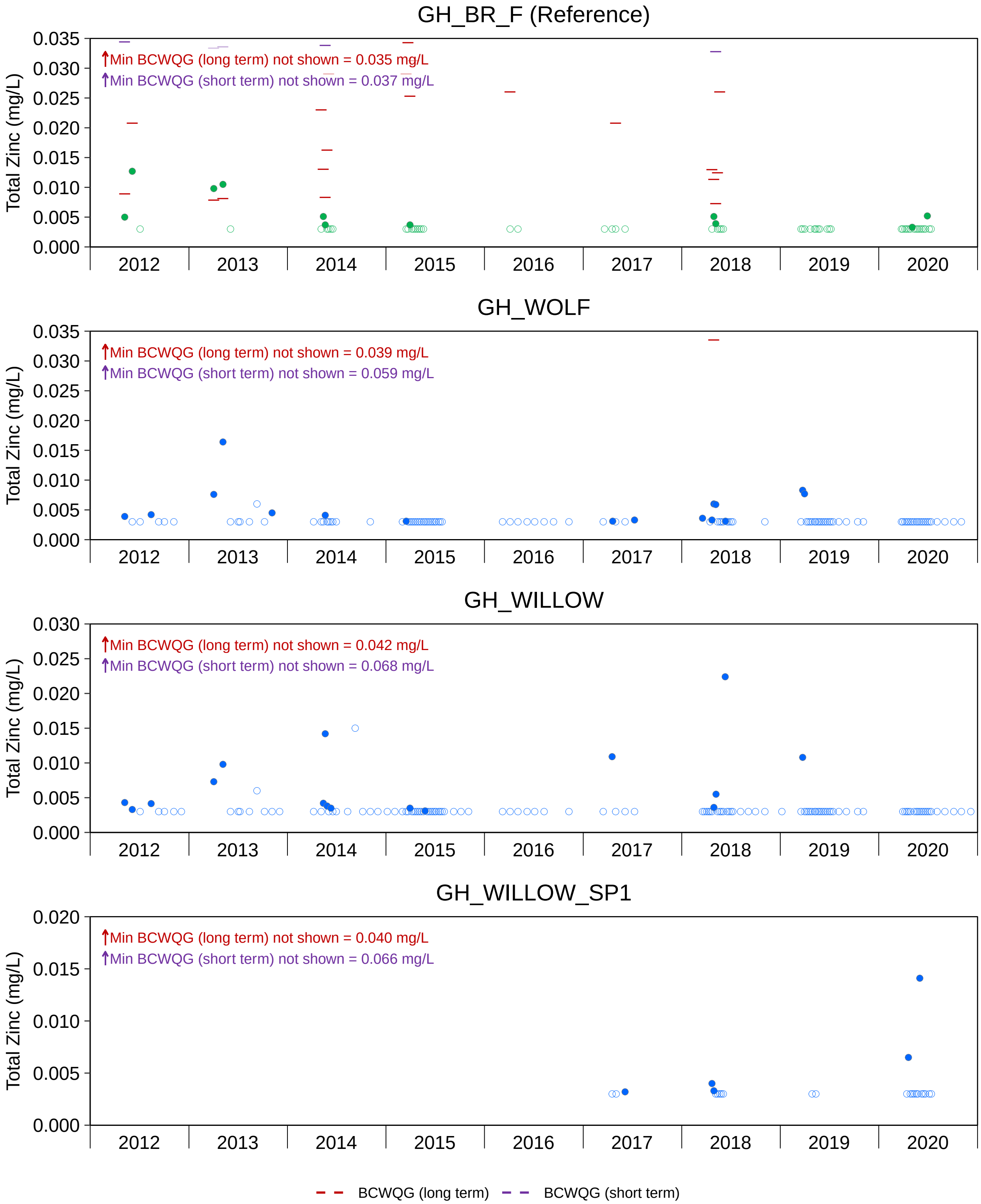


Figure D.19: Concentrations of Total Zinc in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Zinc was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

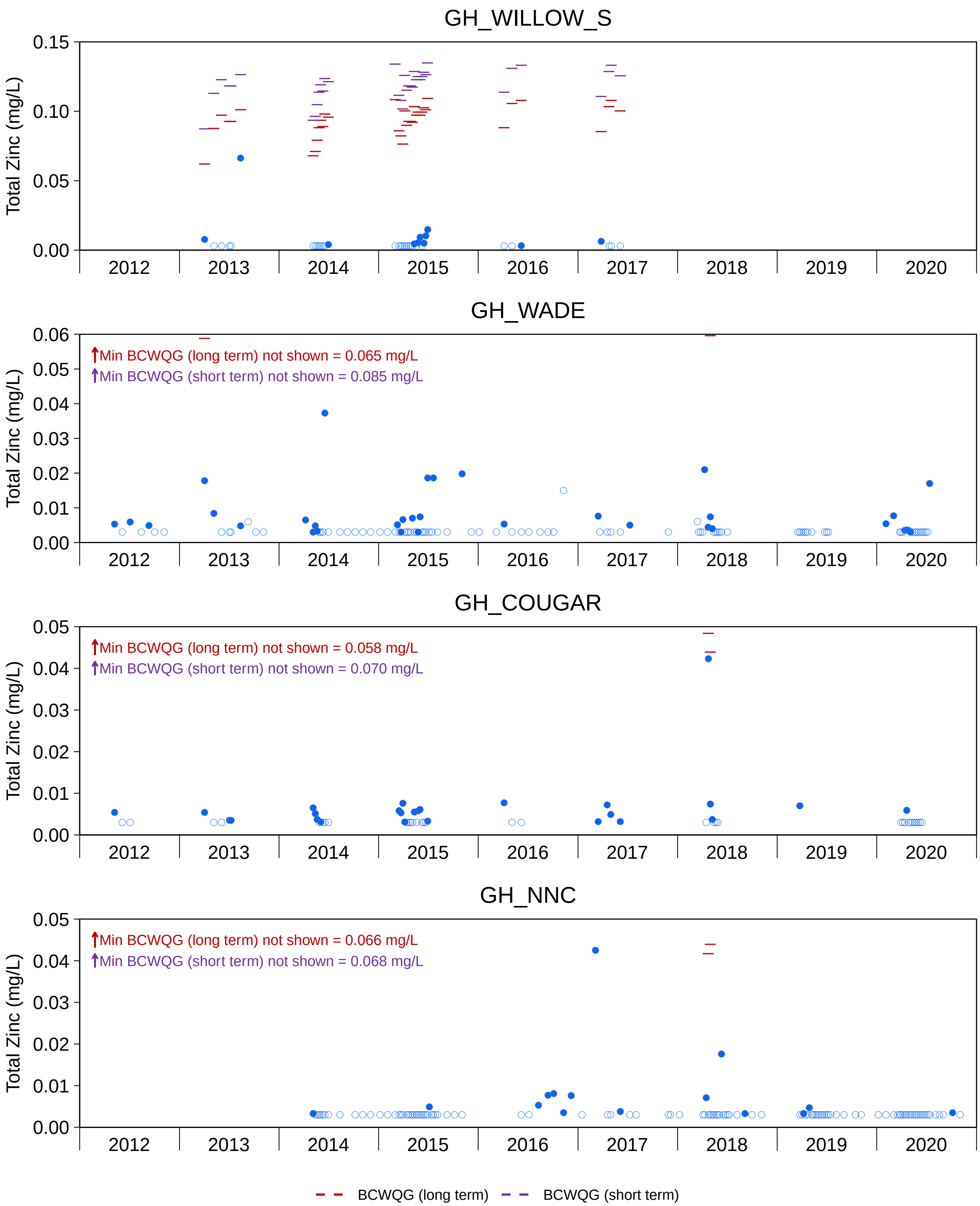


Figure D.19: Concentrations of Total Zinc in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Zinc was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

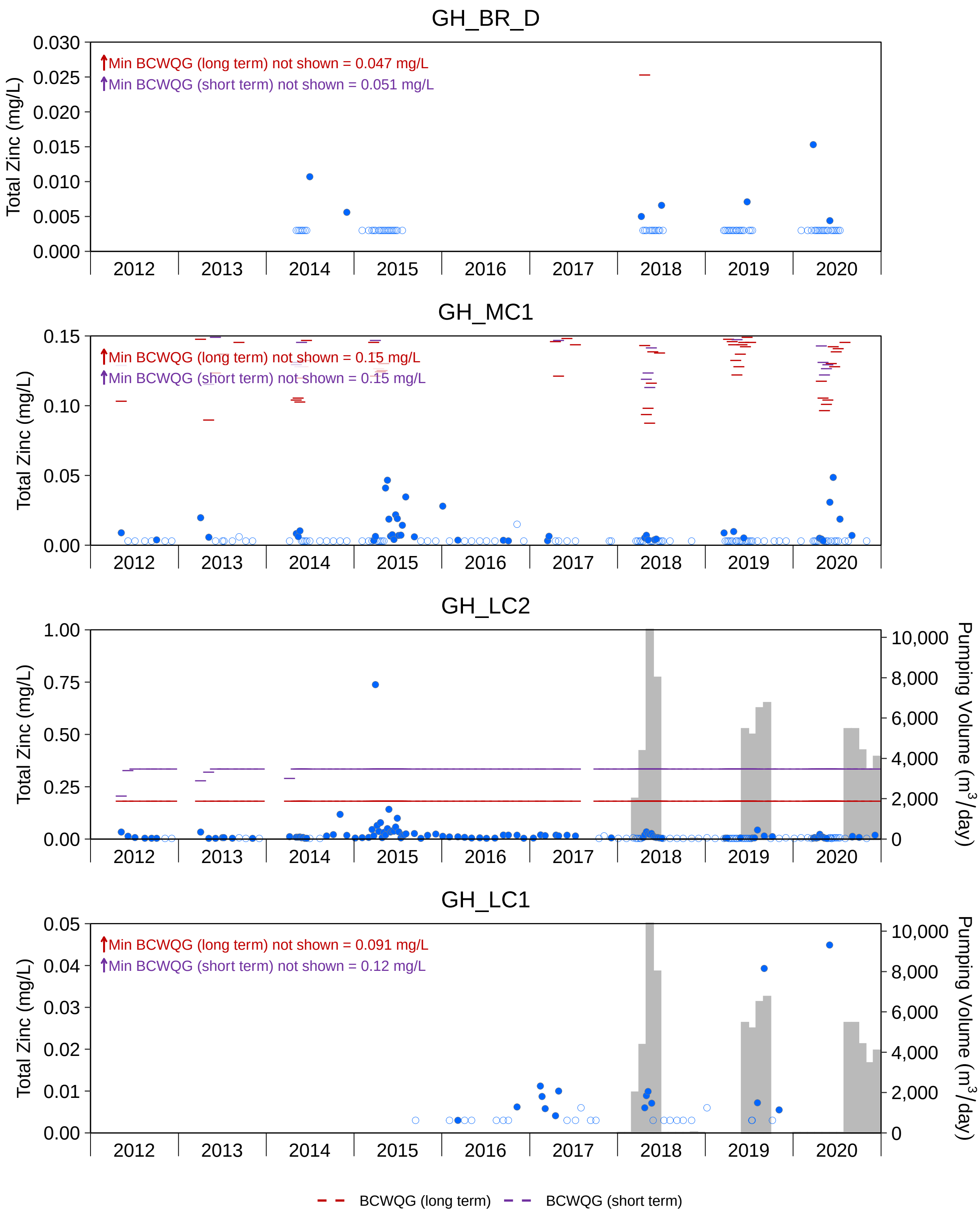


Figure D.19: Concentrations of Total Zinc in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Zinc was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

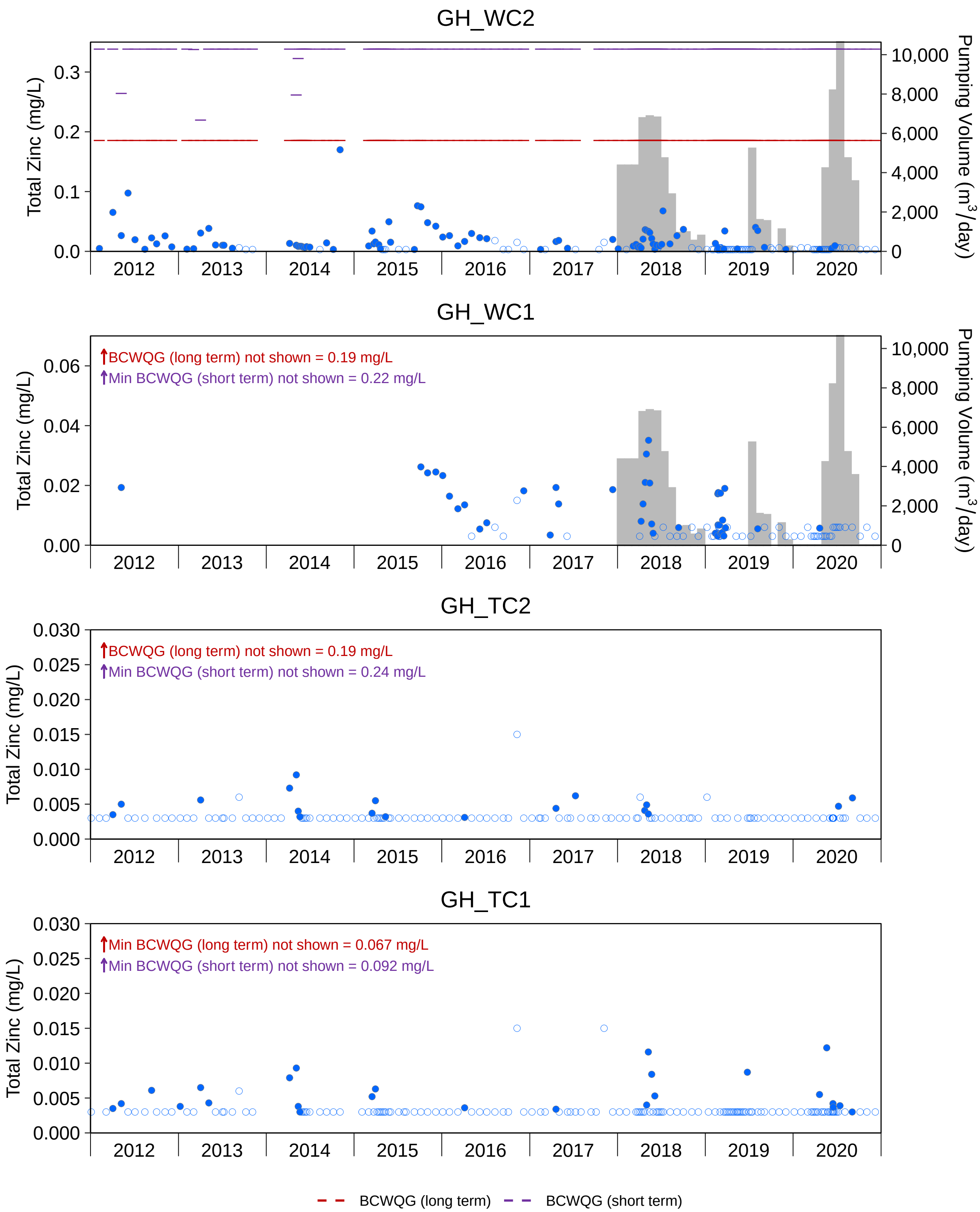


Figure D.19: Concentrations of Total Zinc in Samples Collected from the West-Side Tributaries (2012 to 2020) and Monthly Average Rate of Pit Pumping Discharged to Leask Creek and Wolfram Creek (2018 to 2020)

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Zinc was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Pit pumping volume shown as grey bars. See information regarding pit pumping discharge records in Section 2.3.2.

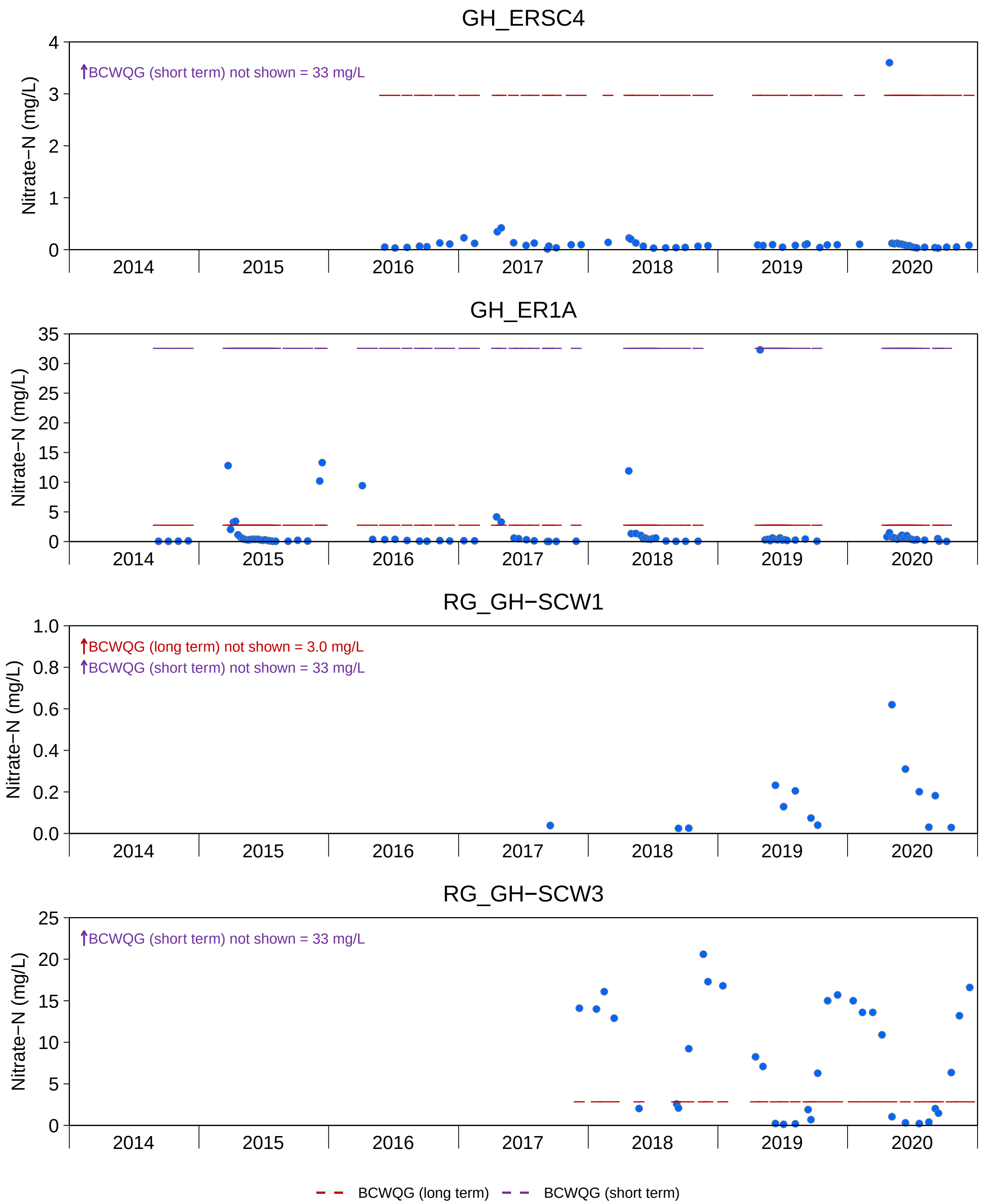


Figure 2 : Concentrations of Nitrate−N in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

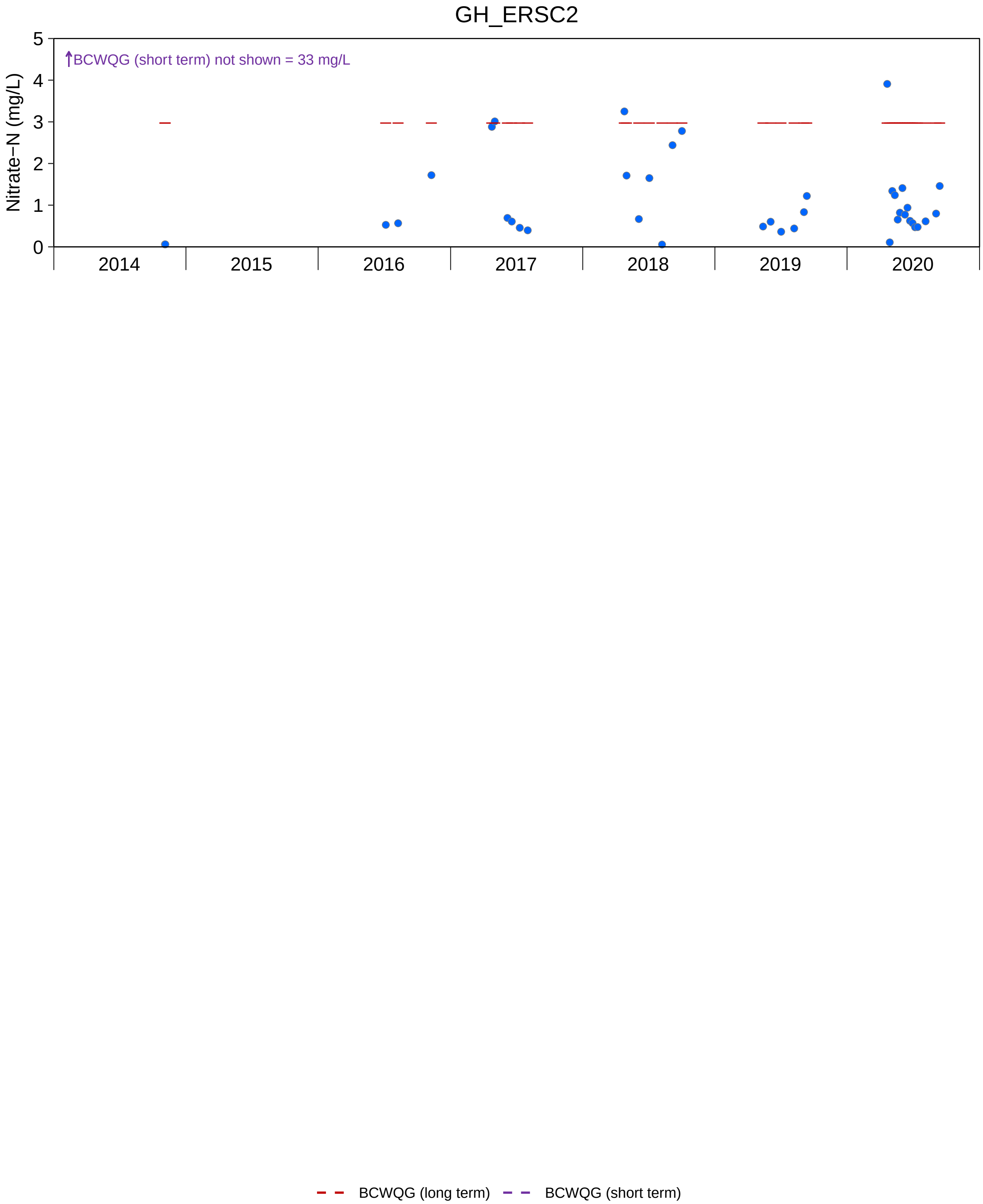


Figure 2 : Concentrations of Nitrate−N in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Nitrate−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

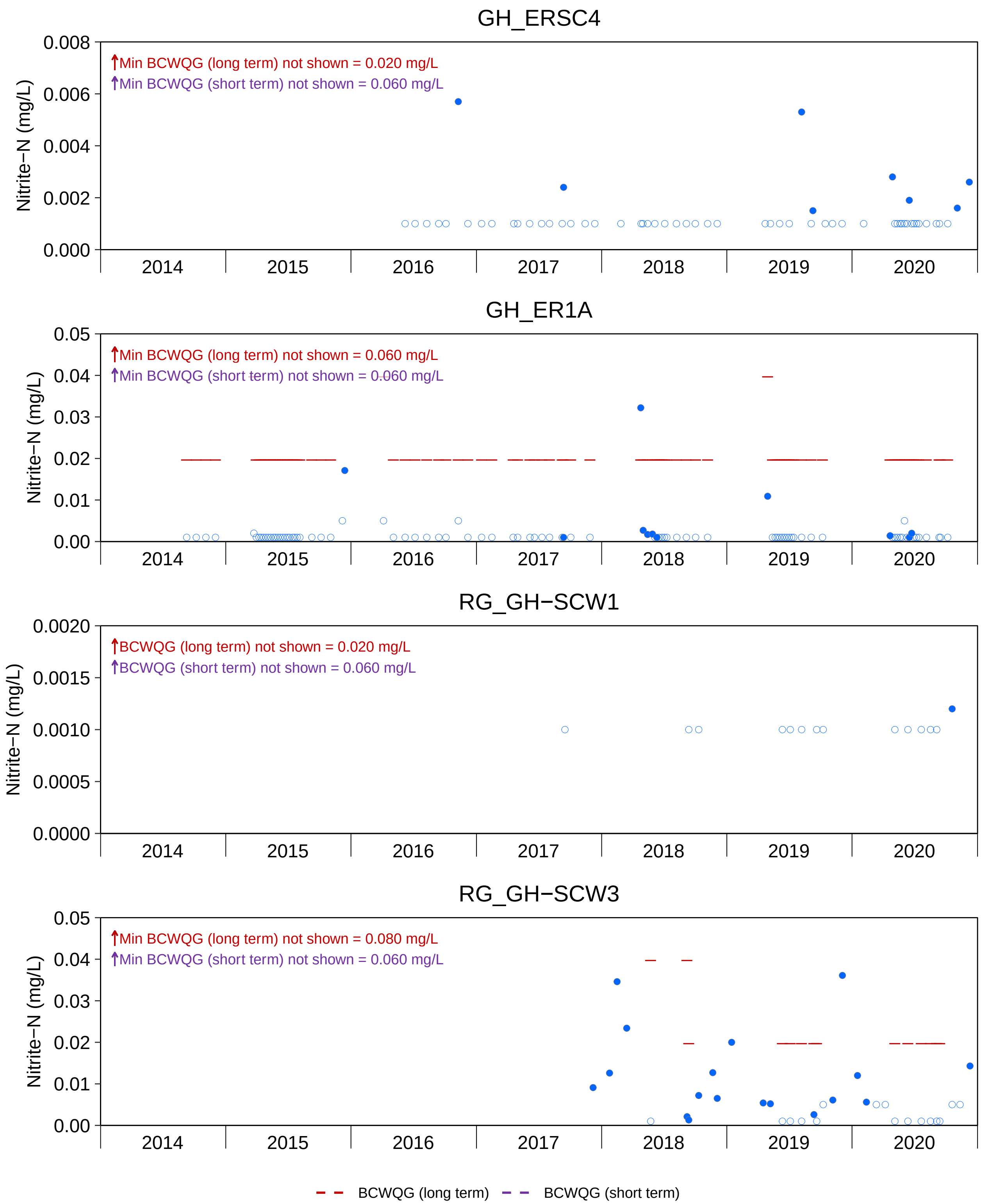
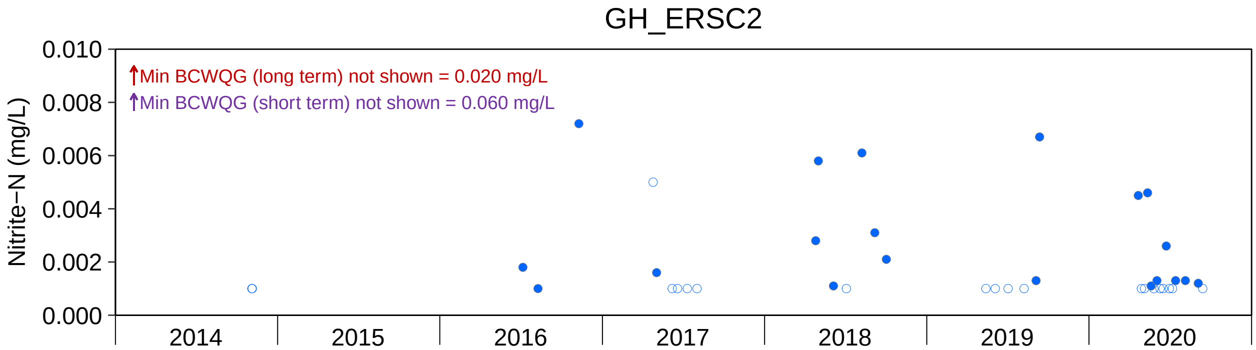


Figure 21: Concentrations of Nitrite−N in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).



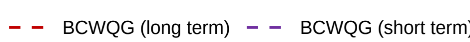


Figure 21: Concentrations of Nitrite−N in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Nitrite−N was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

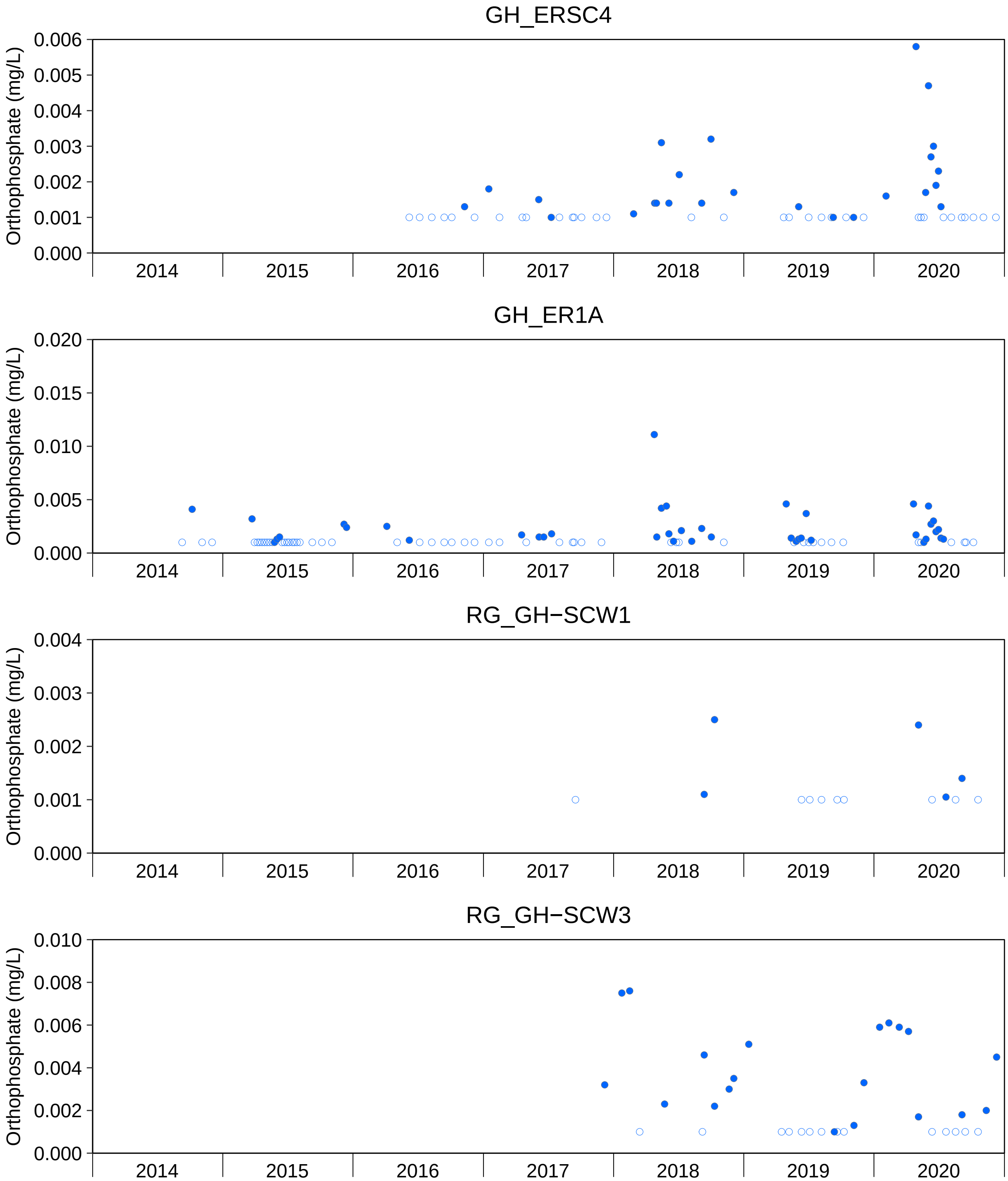


Figure 22: Concentrations of Orthophosphate in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

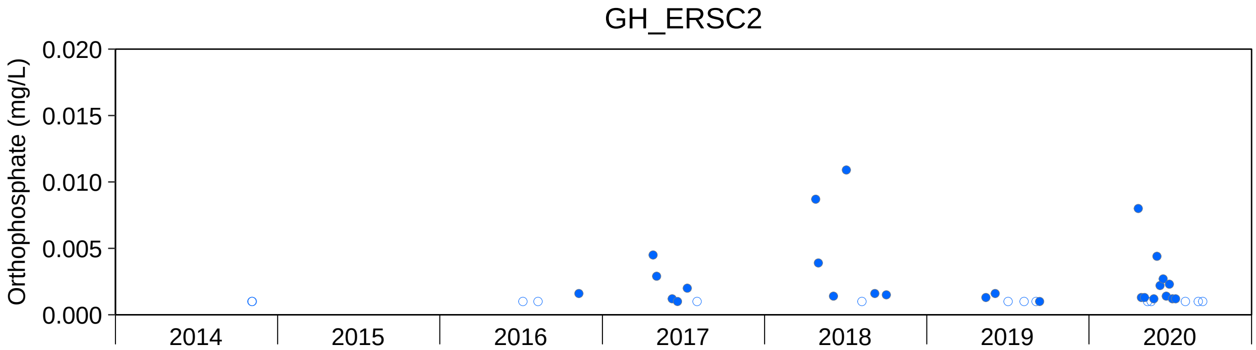


Figure 22: Concentrations of Orthophosphate in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Orthophosphate was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

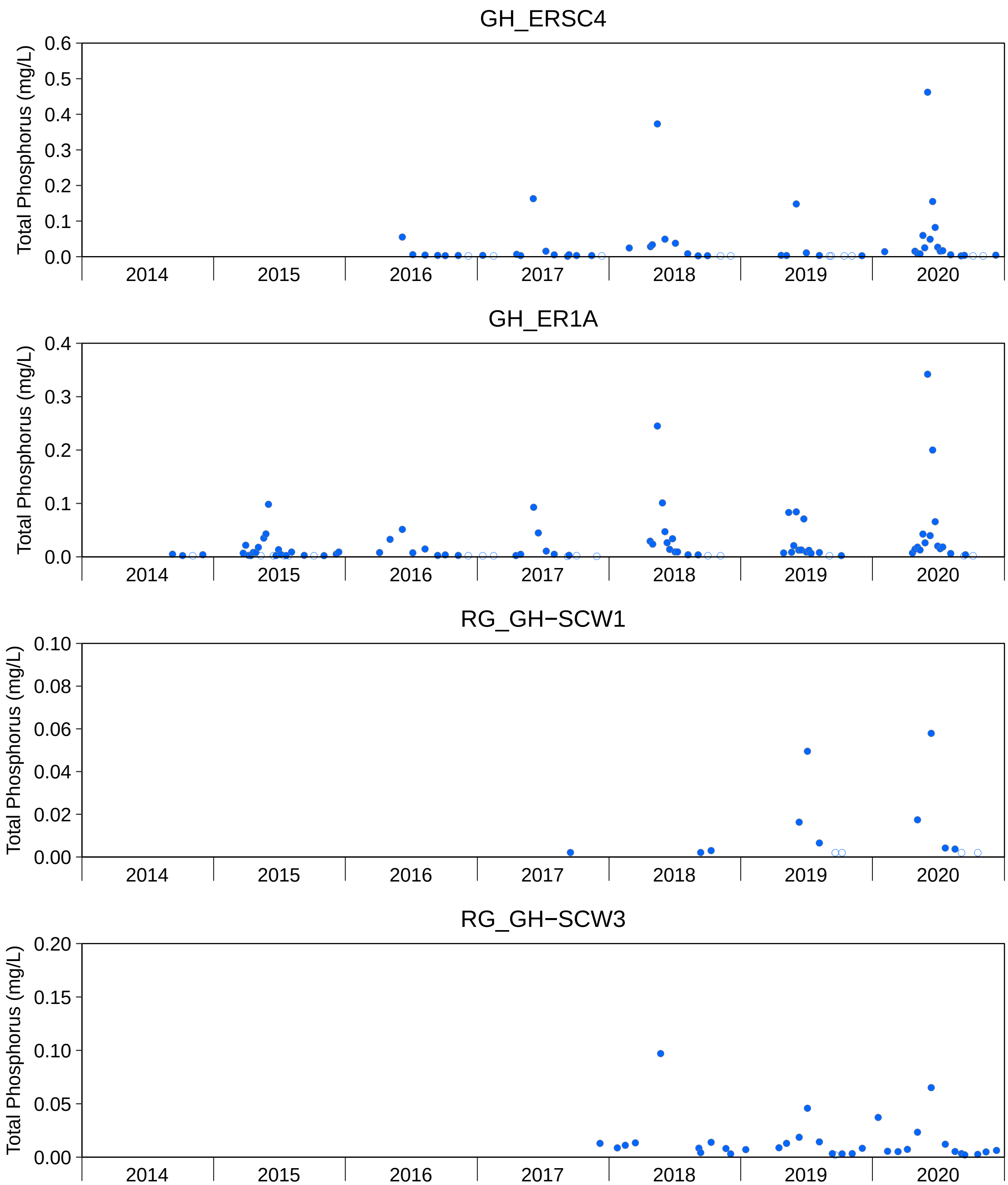


Figure 2 : Concentrations of Total Phosphorus in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Phosphorus was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

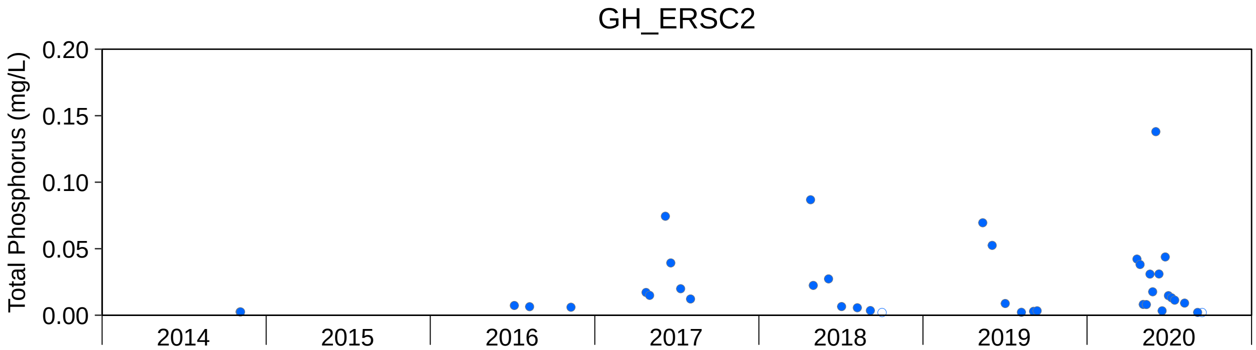


Figure 2 : Concentrations of Total Phosphorus in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Phosphorus was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

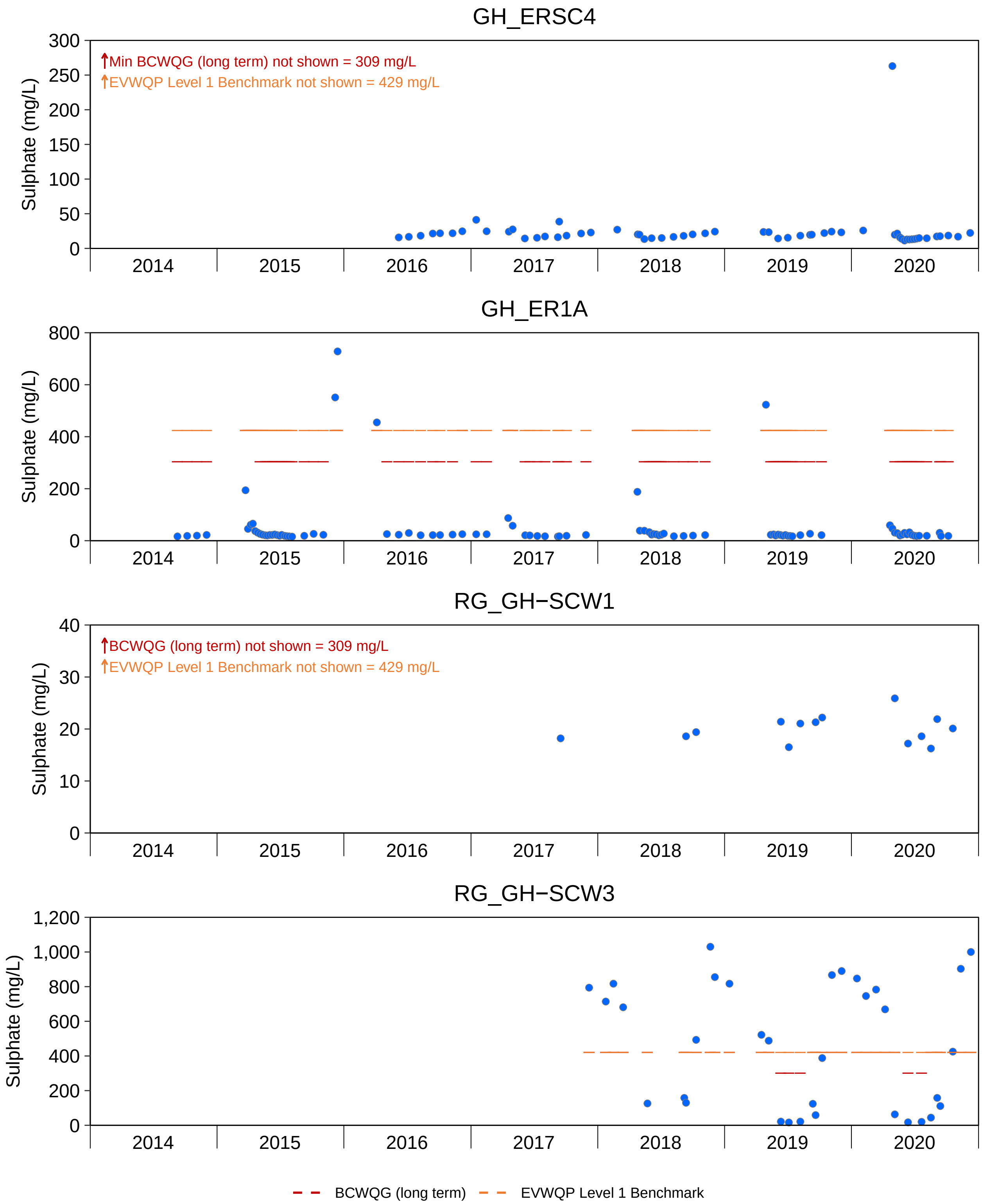


Figure 24: Concentrations of Sulphate in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

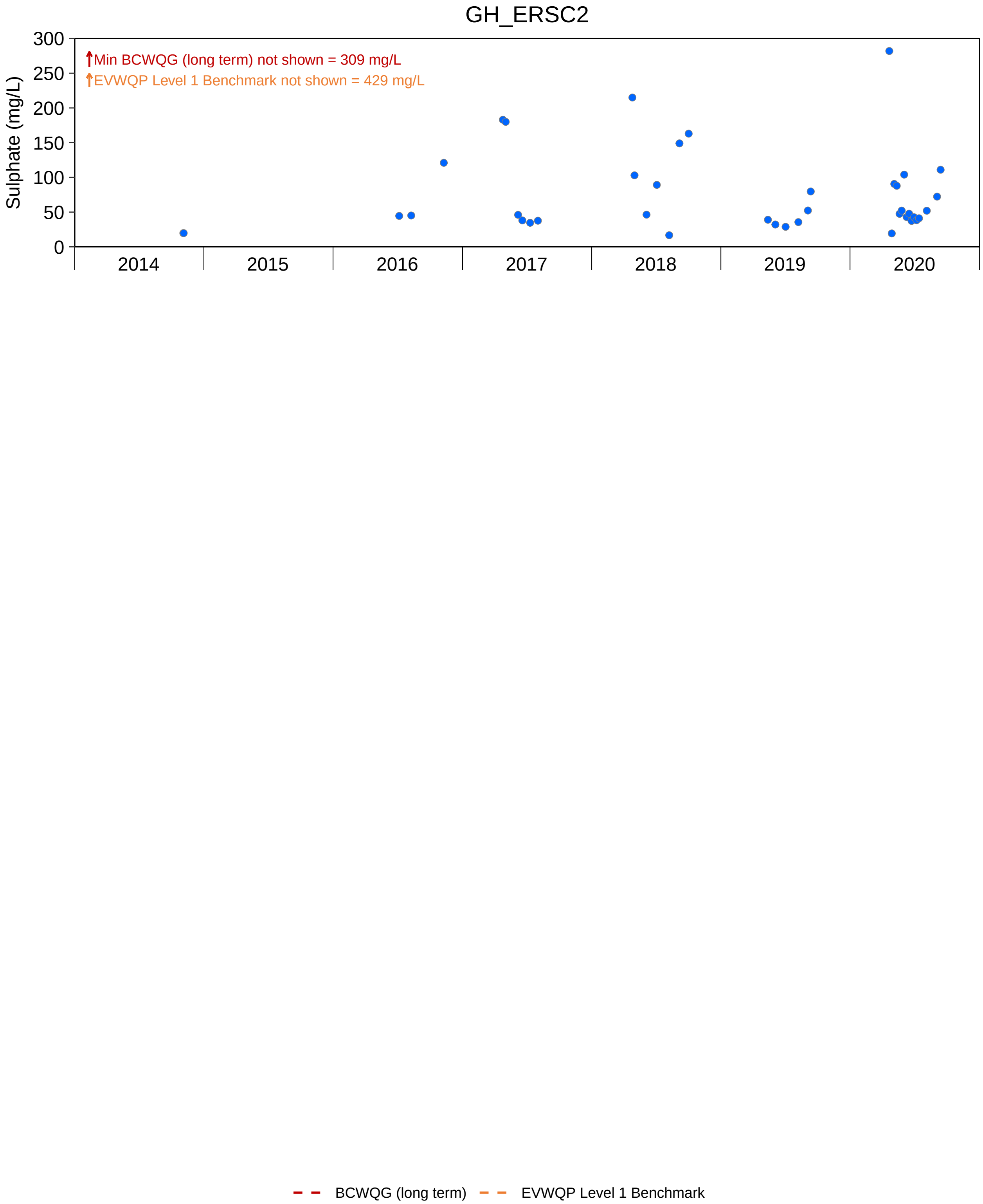


Figure 24: Concentrations of Sulphate in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Sulphate was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

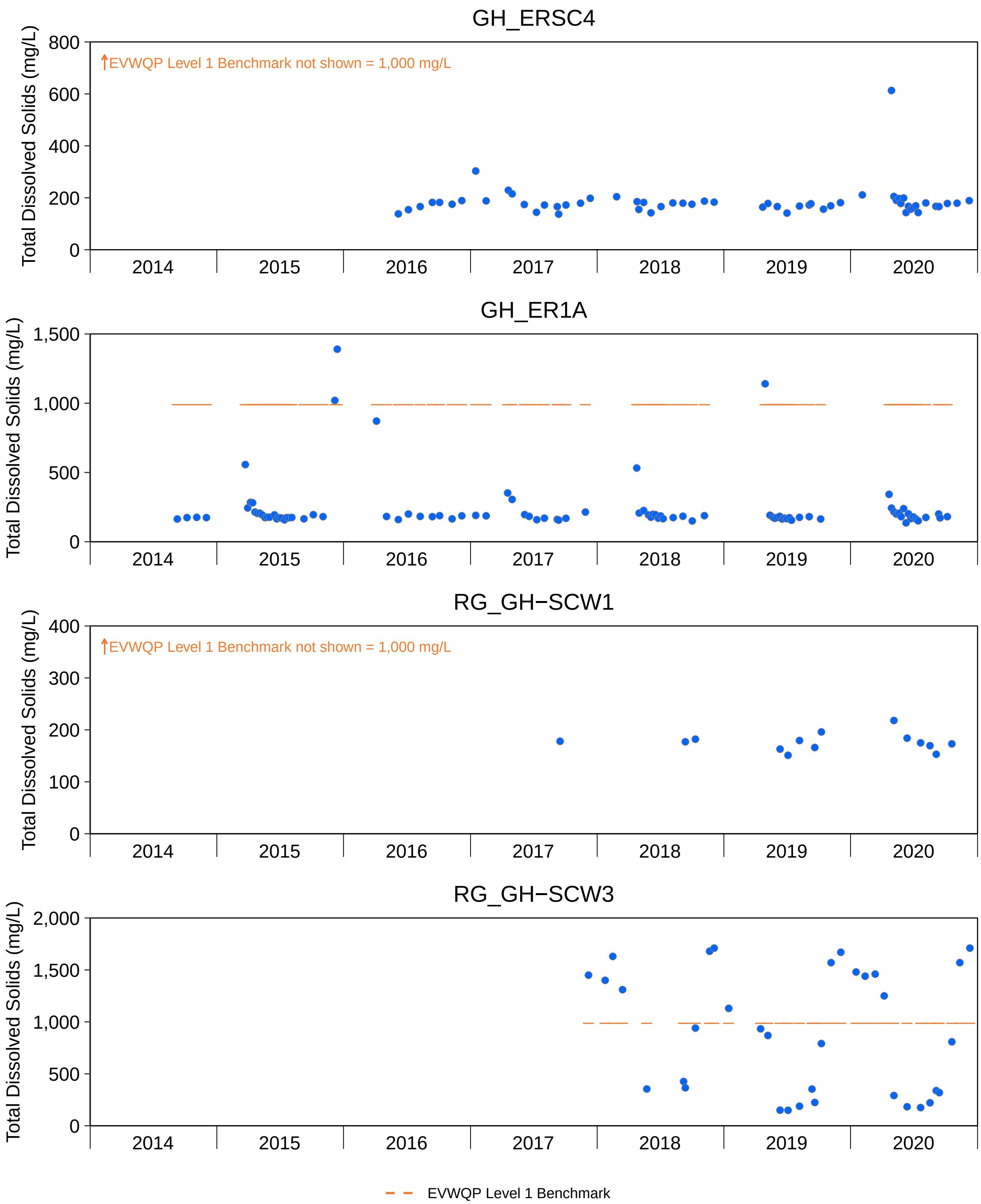


Figure 25: Concentrations of Total Dissolved Solids S in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total dissolved solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

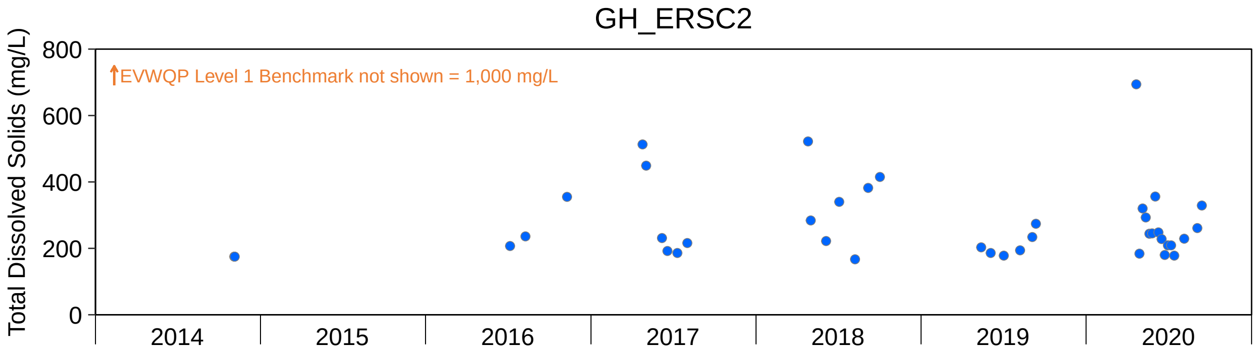


Figure 25: Concentrations of Total Dissolved Solids S in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total dissolved solids was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

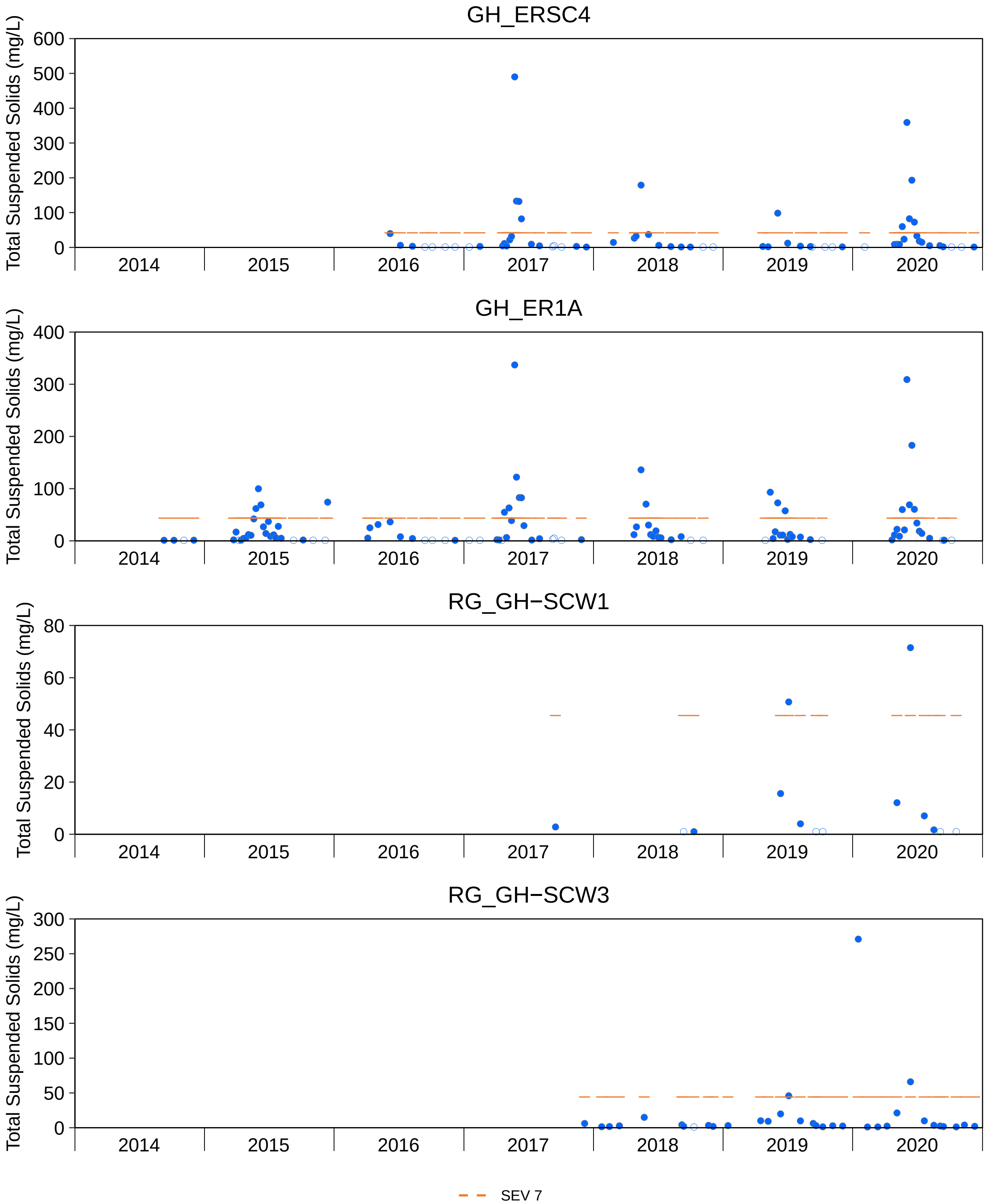
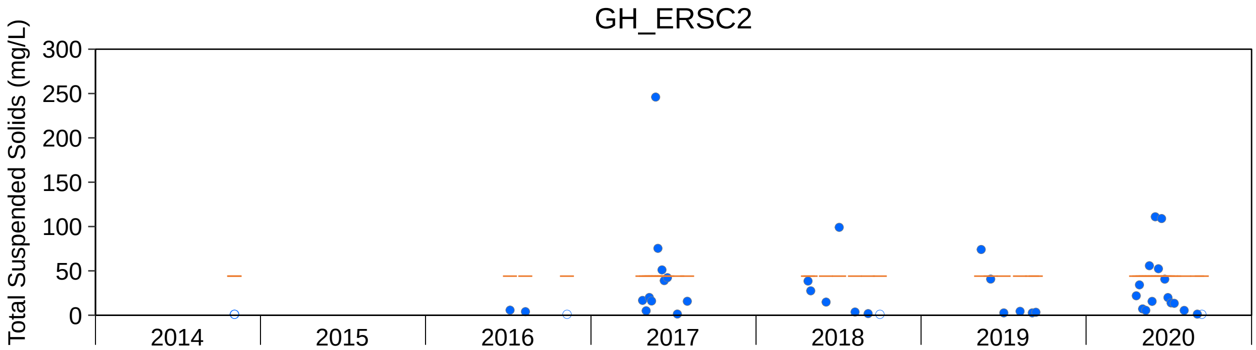


Figure 26: Concentrations of Total Suspended Solids SS in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Concentrations of TSS were plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. The TSS benchmark at severity of ill effect (SEV) level 7 (TSS = 46 mg/L) is associated with moderate habitat degradation and impaired homing (based on modeling by Newcombe and Jensen (1996), assuming one week of exposure to juvenile and adult salmonids, with TSS particle sizes 0.5-250 µm; see Appendix Table D.3).



SEV 7

Figure 26: Concentrations of Total Suspended Solids SS in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Concentrations of TSS were plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. The TSS benchmark at severity of ill effect (SEV) level 7 (TSS = 46 mg/L) is associated with moderate habitat degradation and impaired homing (based on modeling by Newcombe and Jensen (1996), assuming one week of exposure to juvenile and adult salmonids, with TSS particle sizes 0.5-250 µm; see Appendix Table D.3).

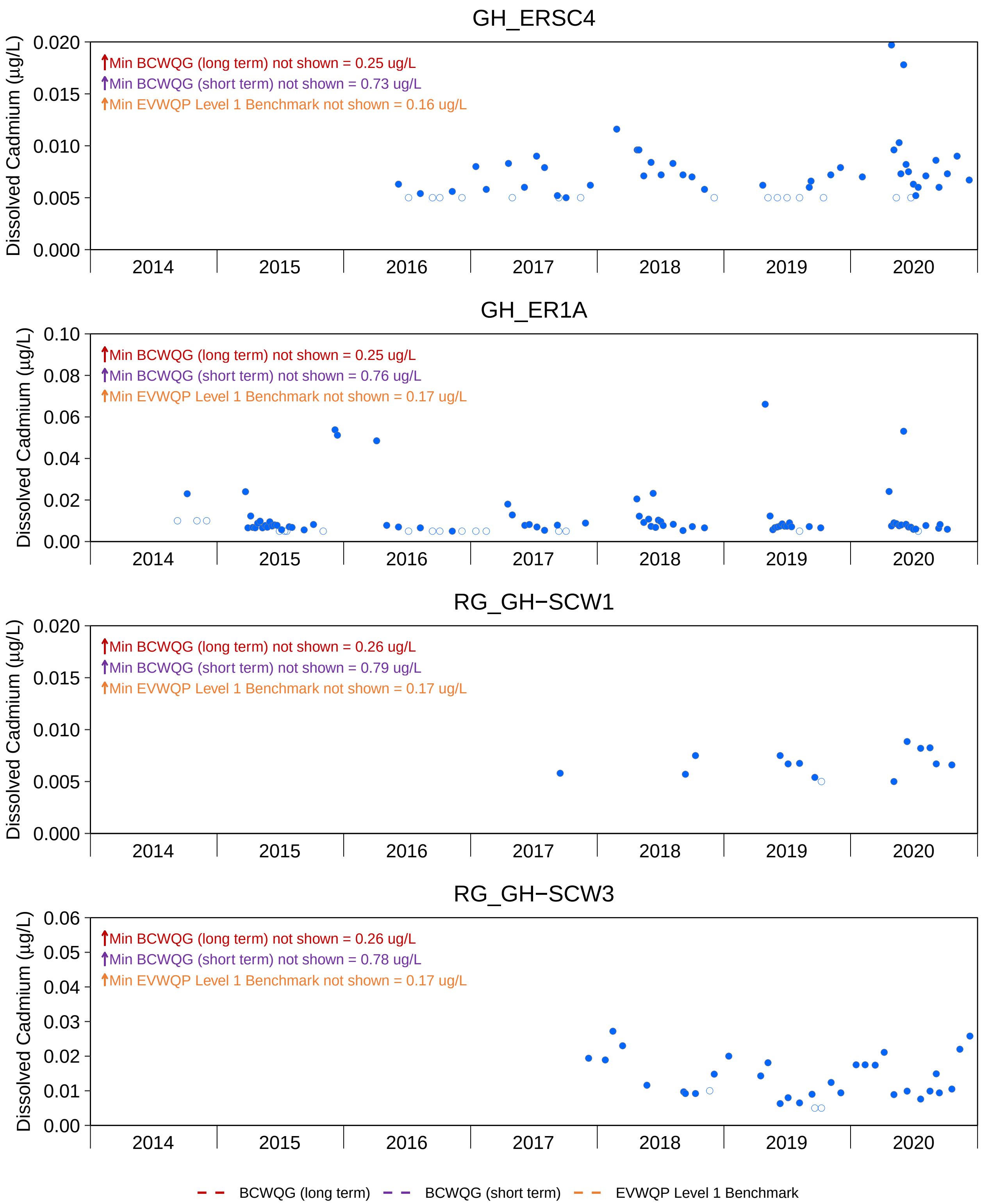


Figure 2 : Concentrations of Dissolved Cadmium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved cadmium was plotted because it was identified as a mine − related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

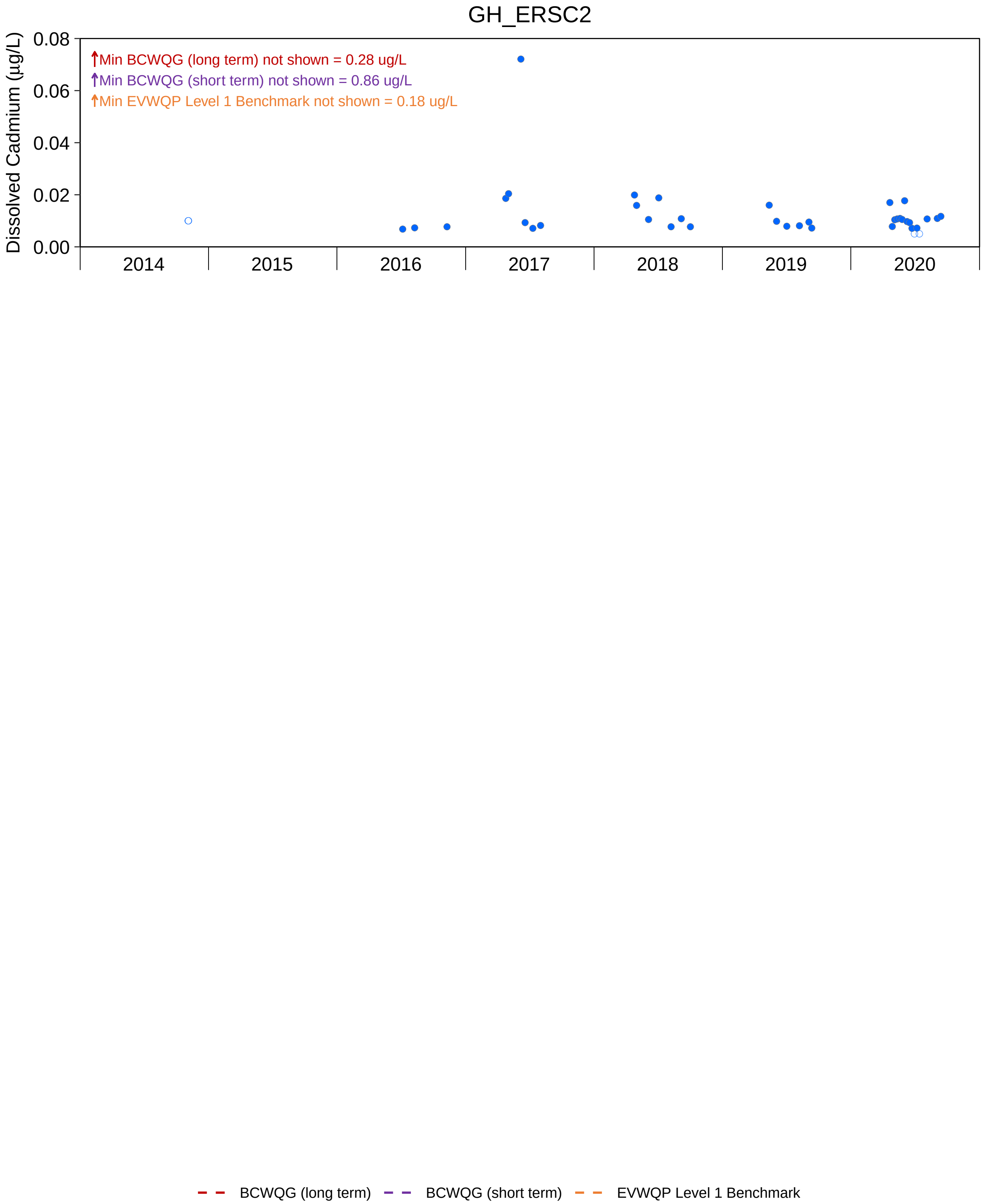


Figure 2 : Concentrations of Dissolved Cadmium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Dissolved cadmium was plotted because it was identified as a mine − related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

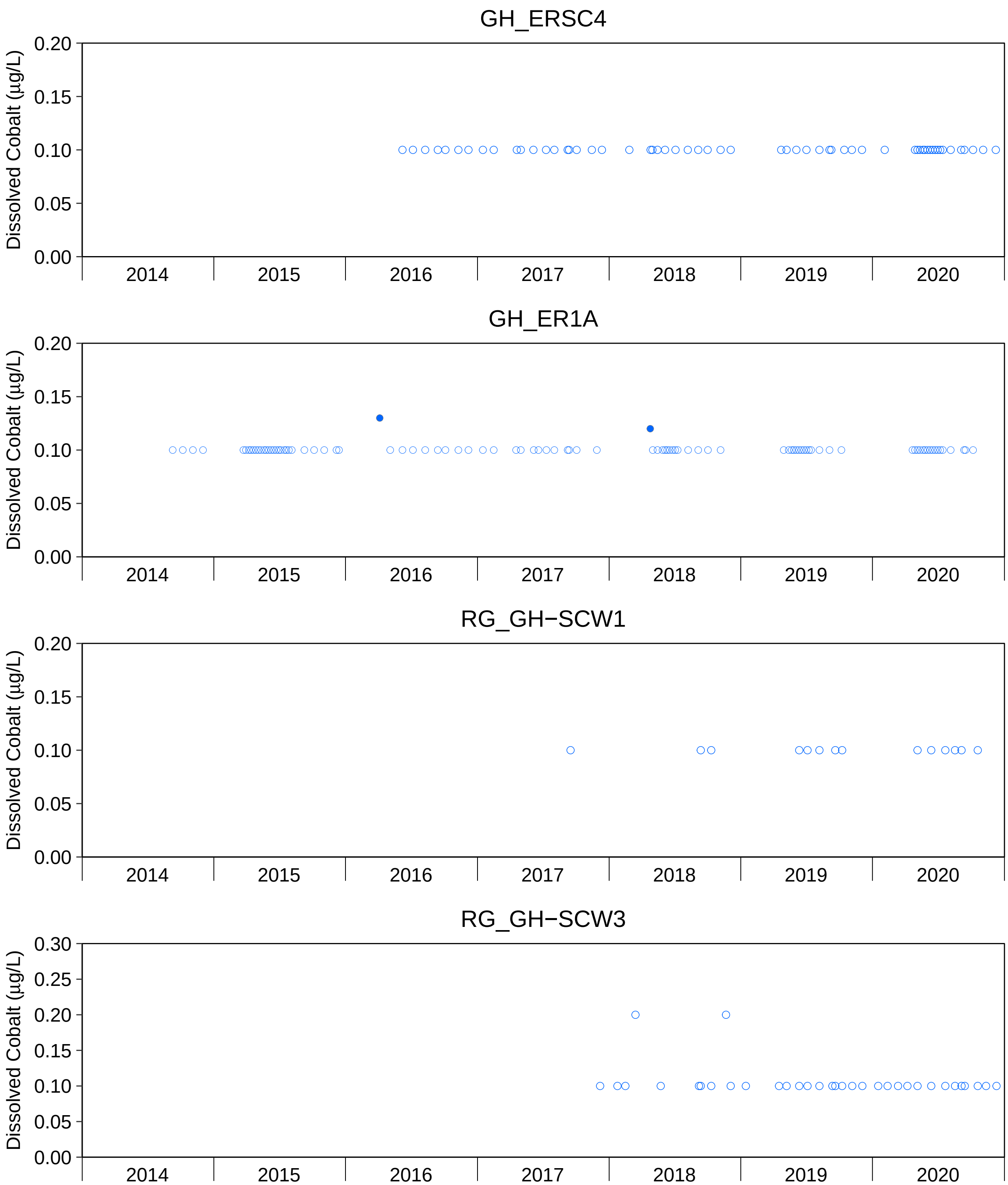


Figure 2 : Concentrations of Dissolved Cobalt in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved cobalt was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long-term average BCWQG for total cobalt is 4 µg/L.

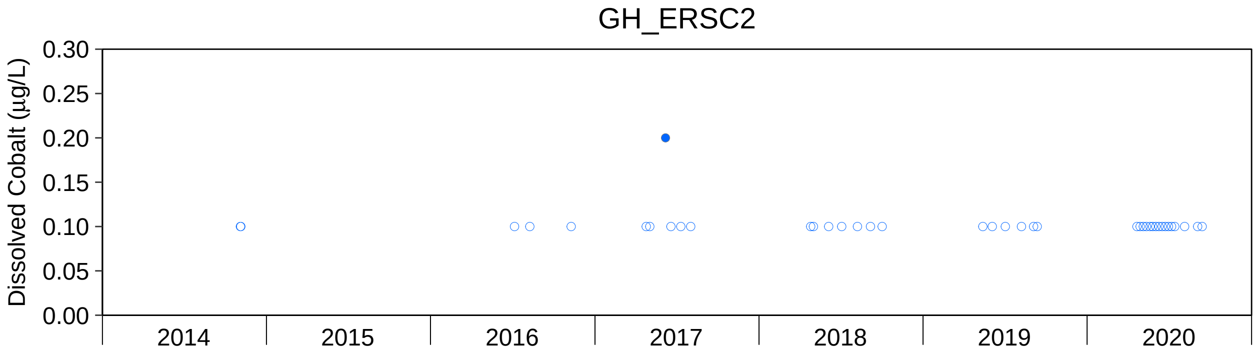


Figure 2 : Concentrations of Dissolved Cobalt in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Dissolved cobalt was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long-term average BCWQG for total cobalt is 4 µg/L.

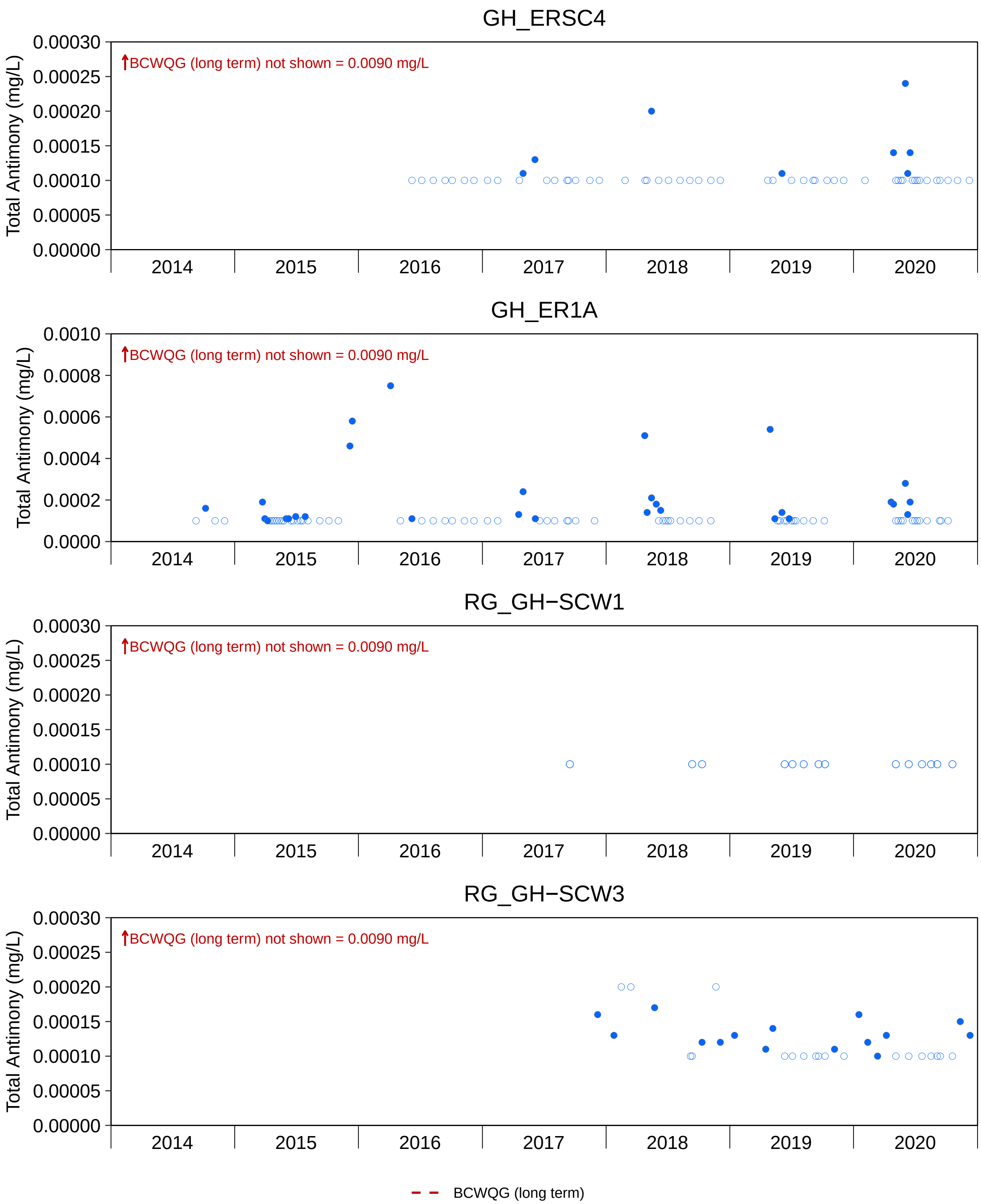


Figure 29: Concentrations of Total Antimony in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

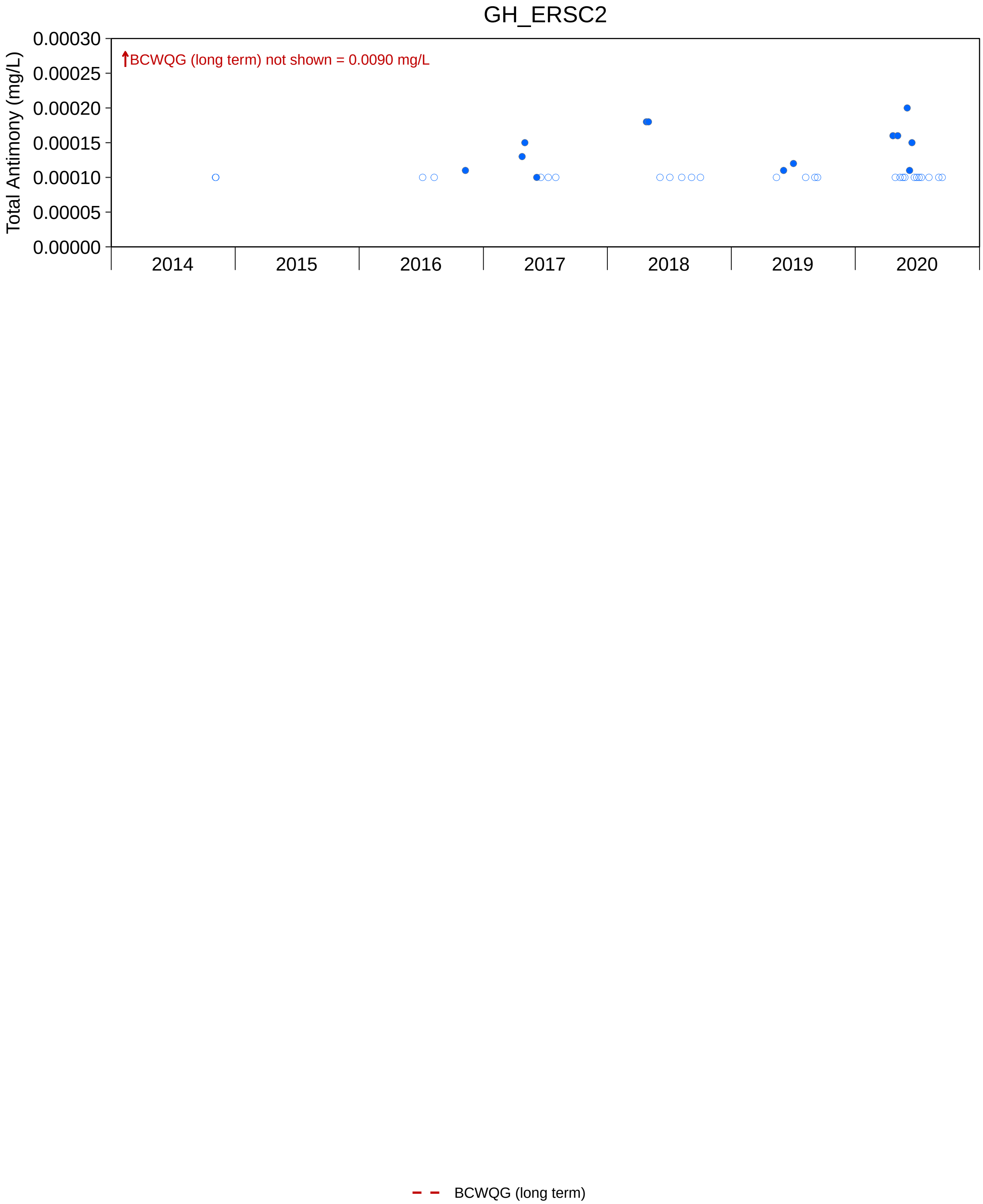


Figure 29: Concentrations of Total Antimony in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total antimony was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

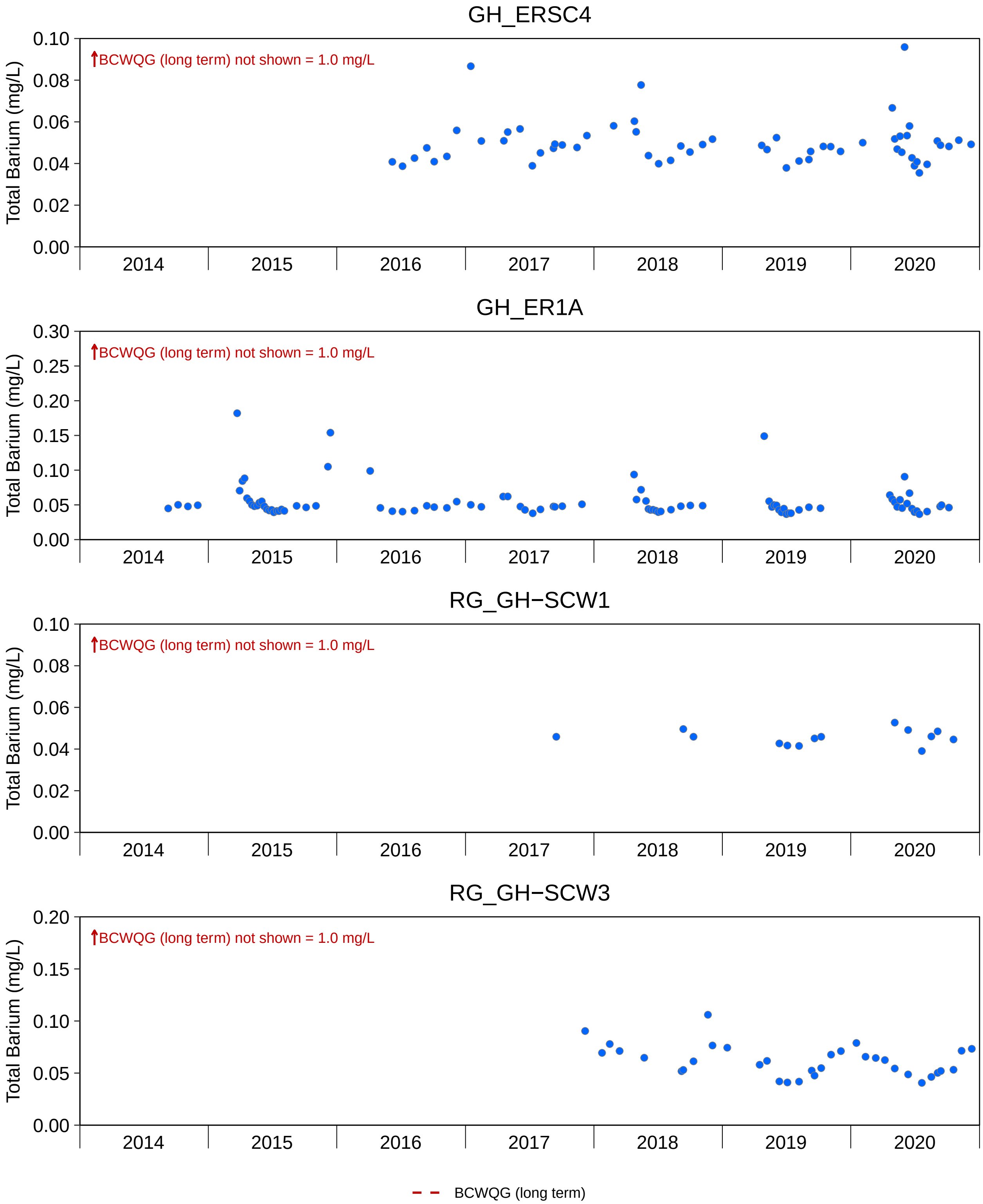


Figure : Concentrations of Total Barium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

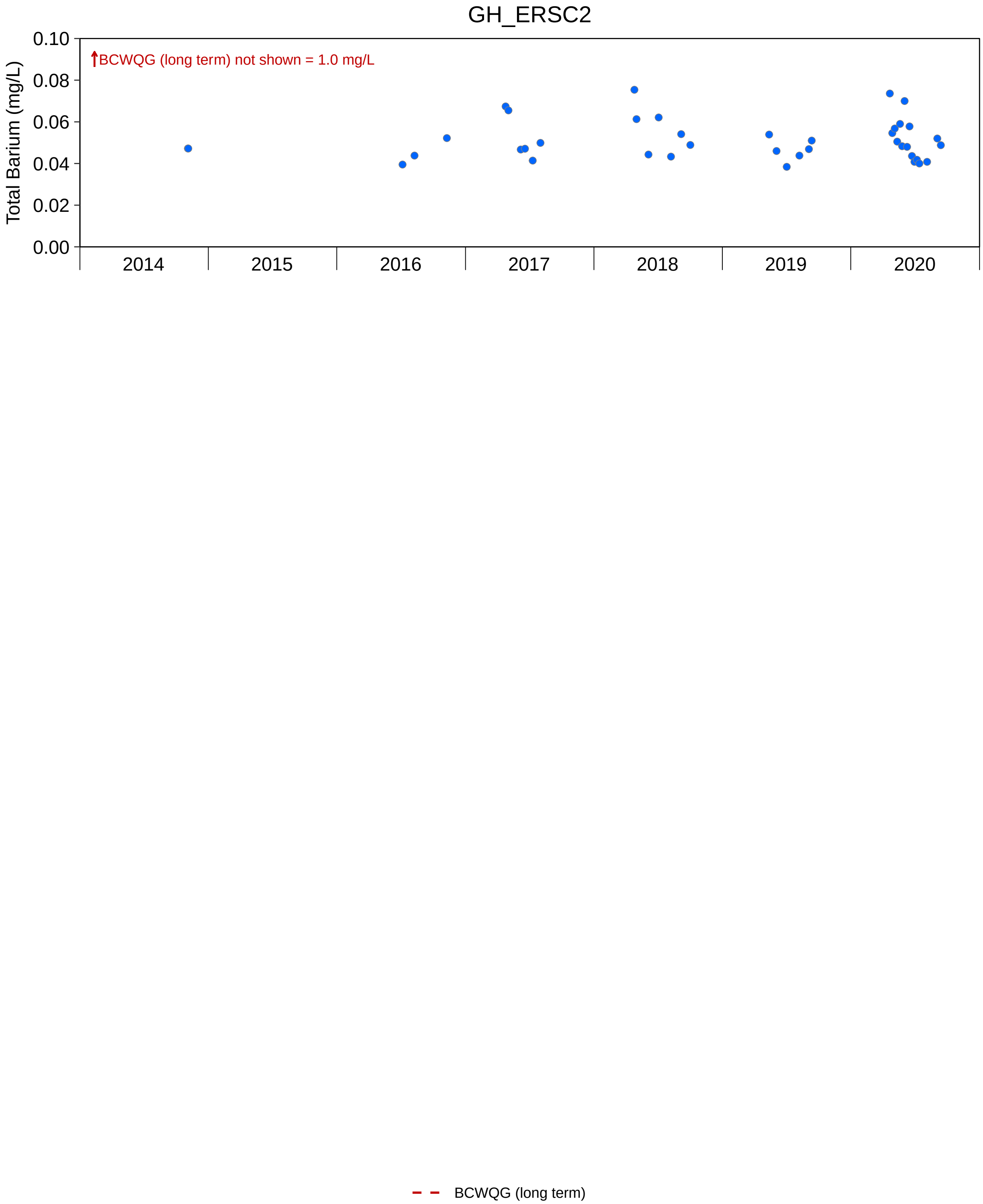


Figure : Concentrations of Total Barium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total barium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

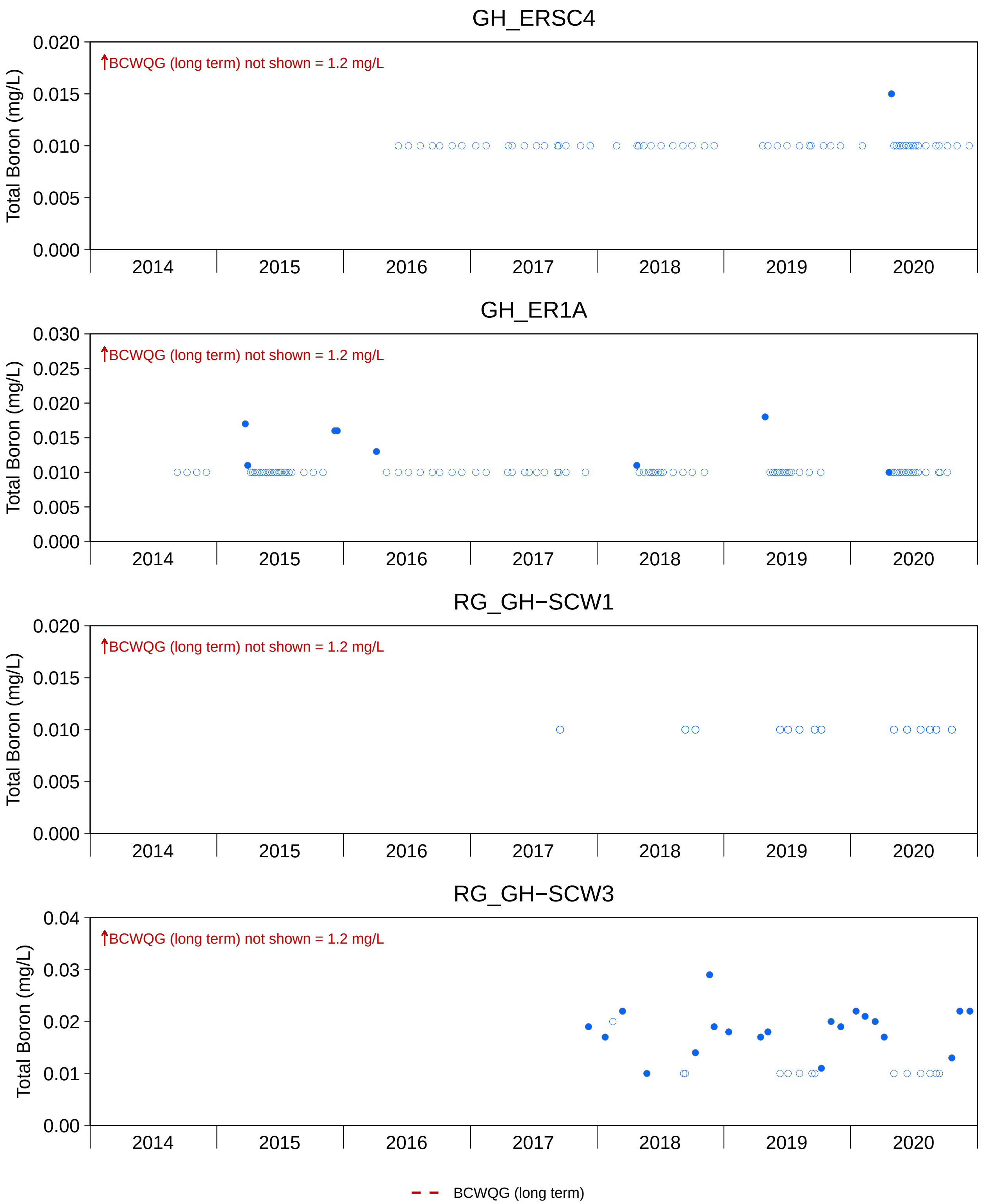


Figure 1: Concentrations of Total Boron in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

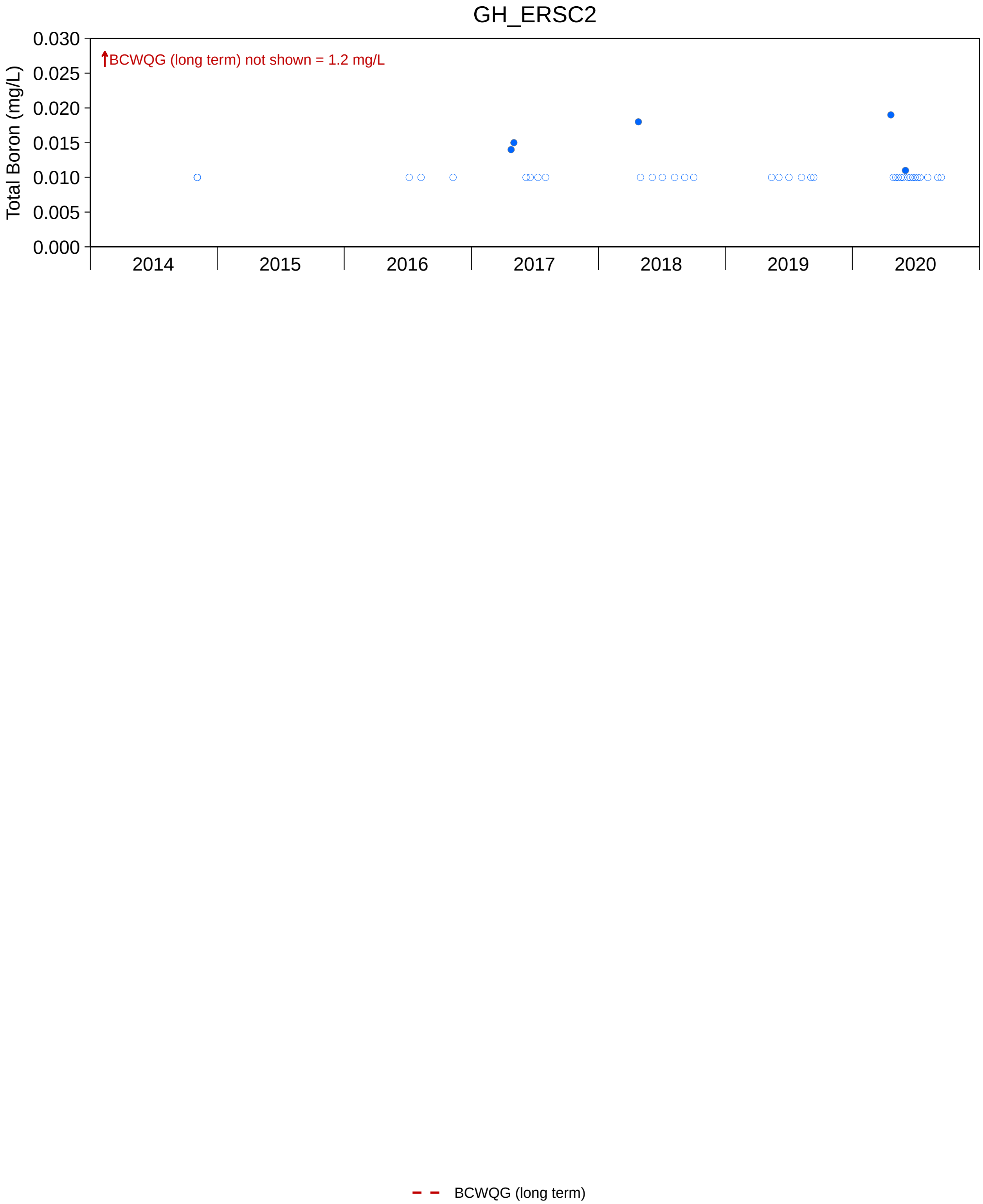


Figure 1: Concentrations of Total Boron in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total boron was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

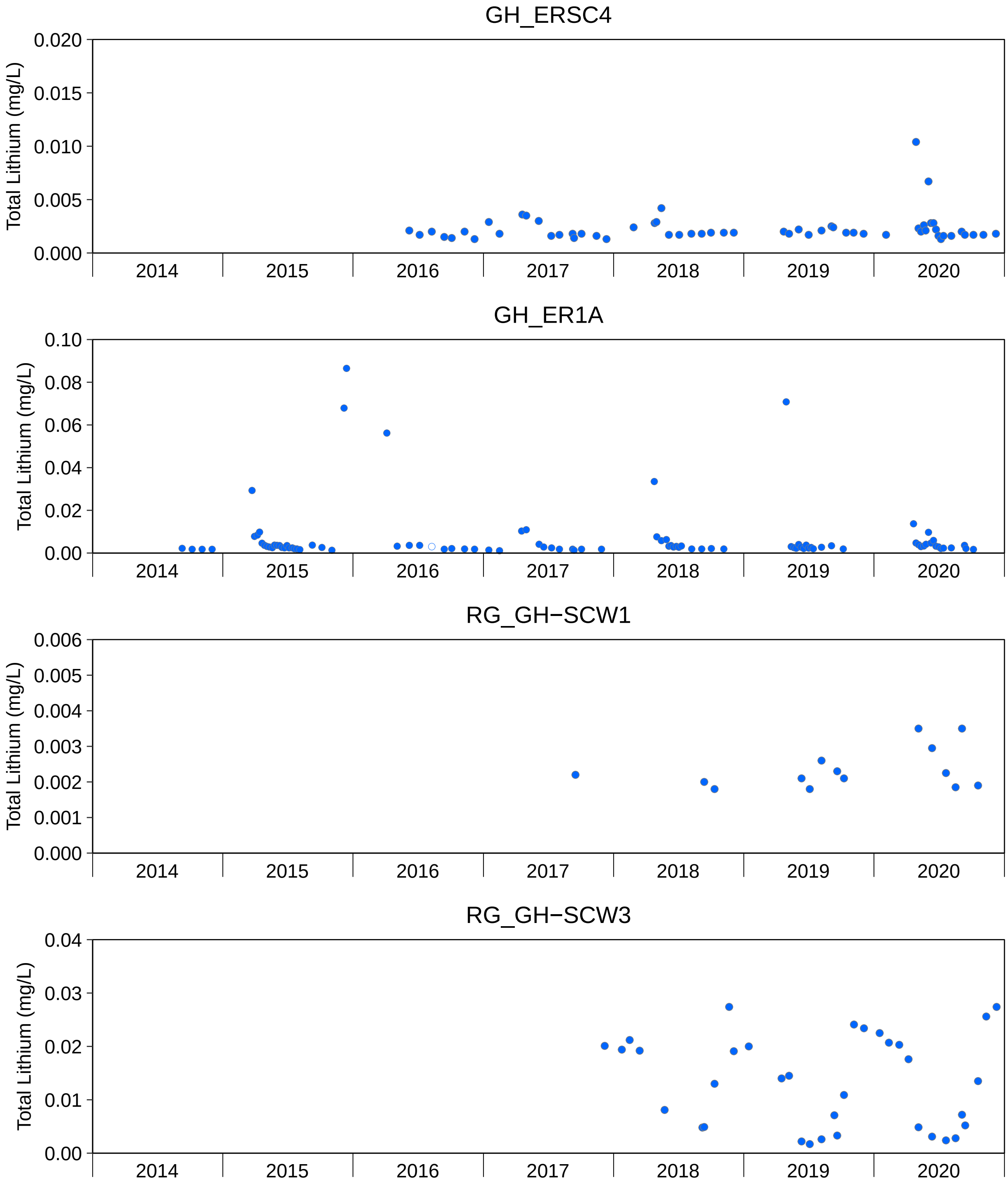


Figure 2: Concentrations of Total Lithium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

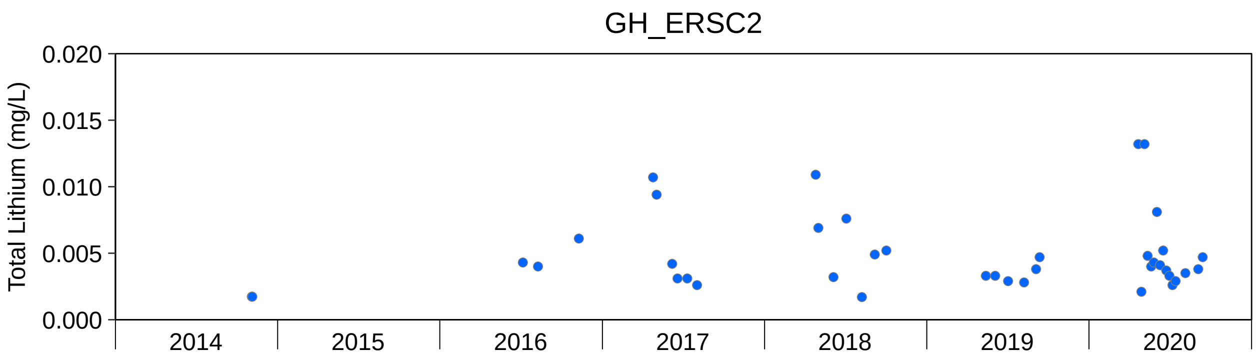


Figure 2: Concentrations of Total Lithium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total lithium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

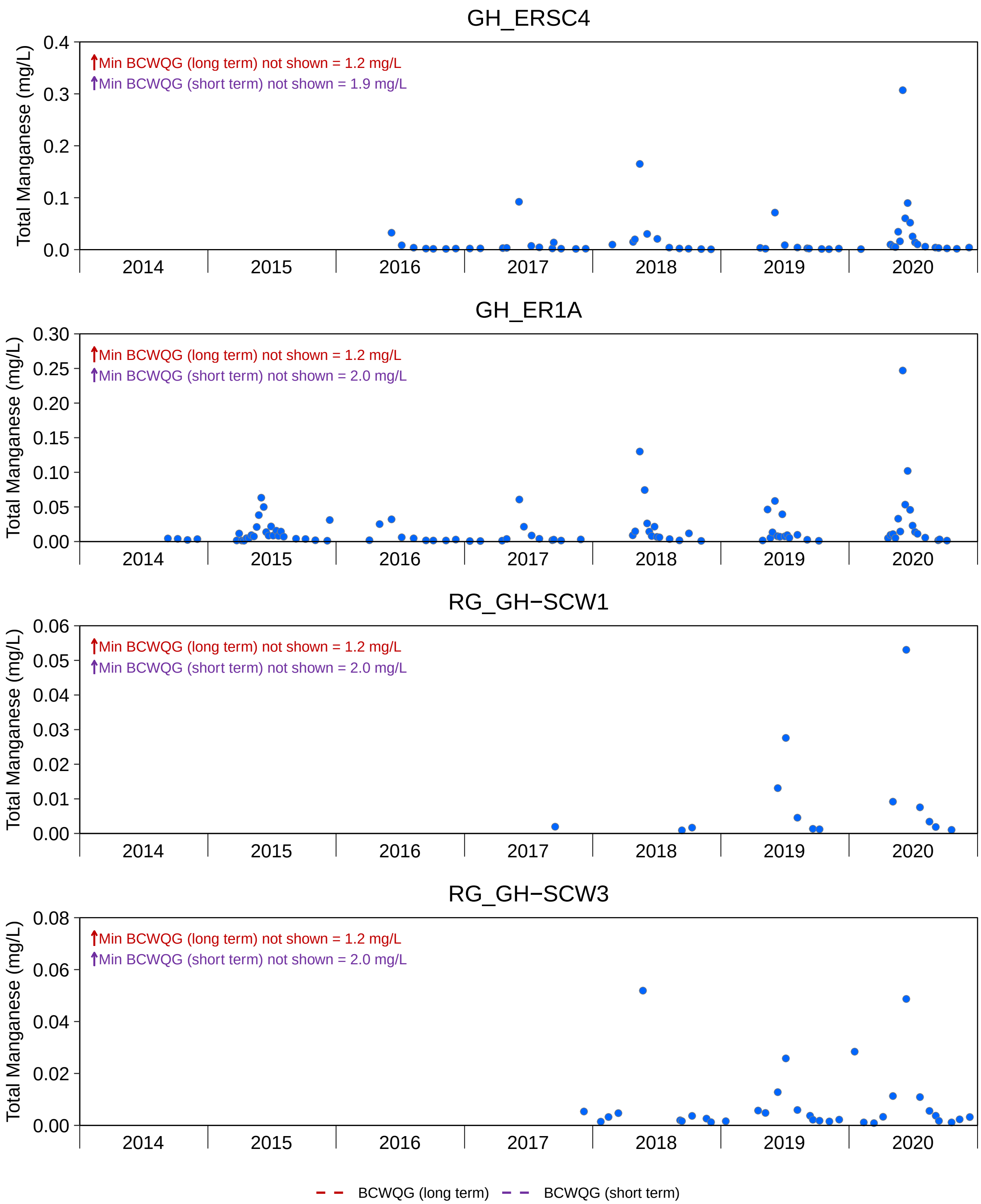


Figure : Concentrations of Total Manganese in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total manganese was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

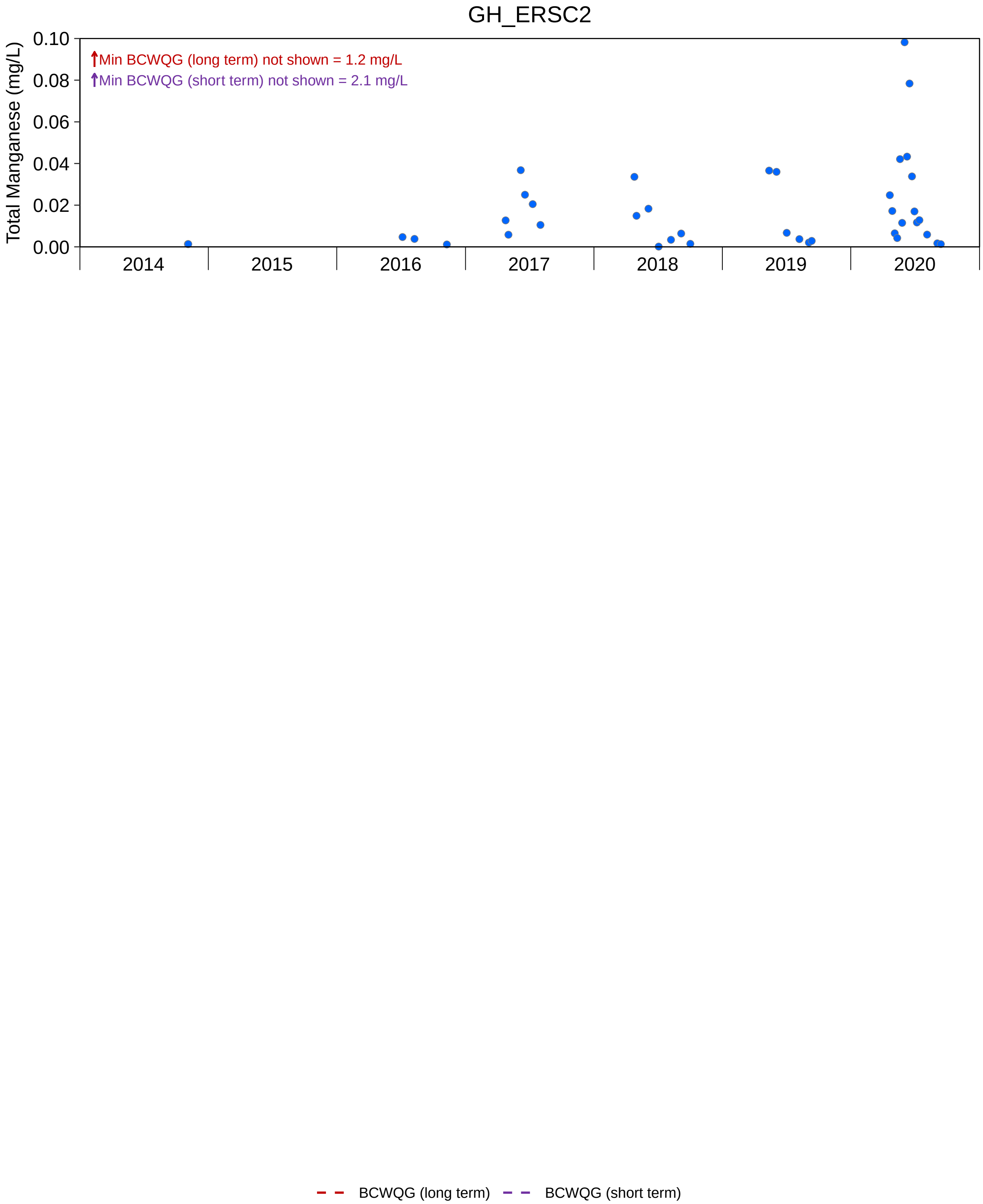


Figure : Concentrations of Total Manganese in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total manganese was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

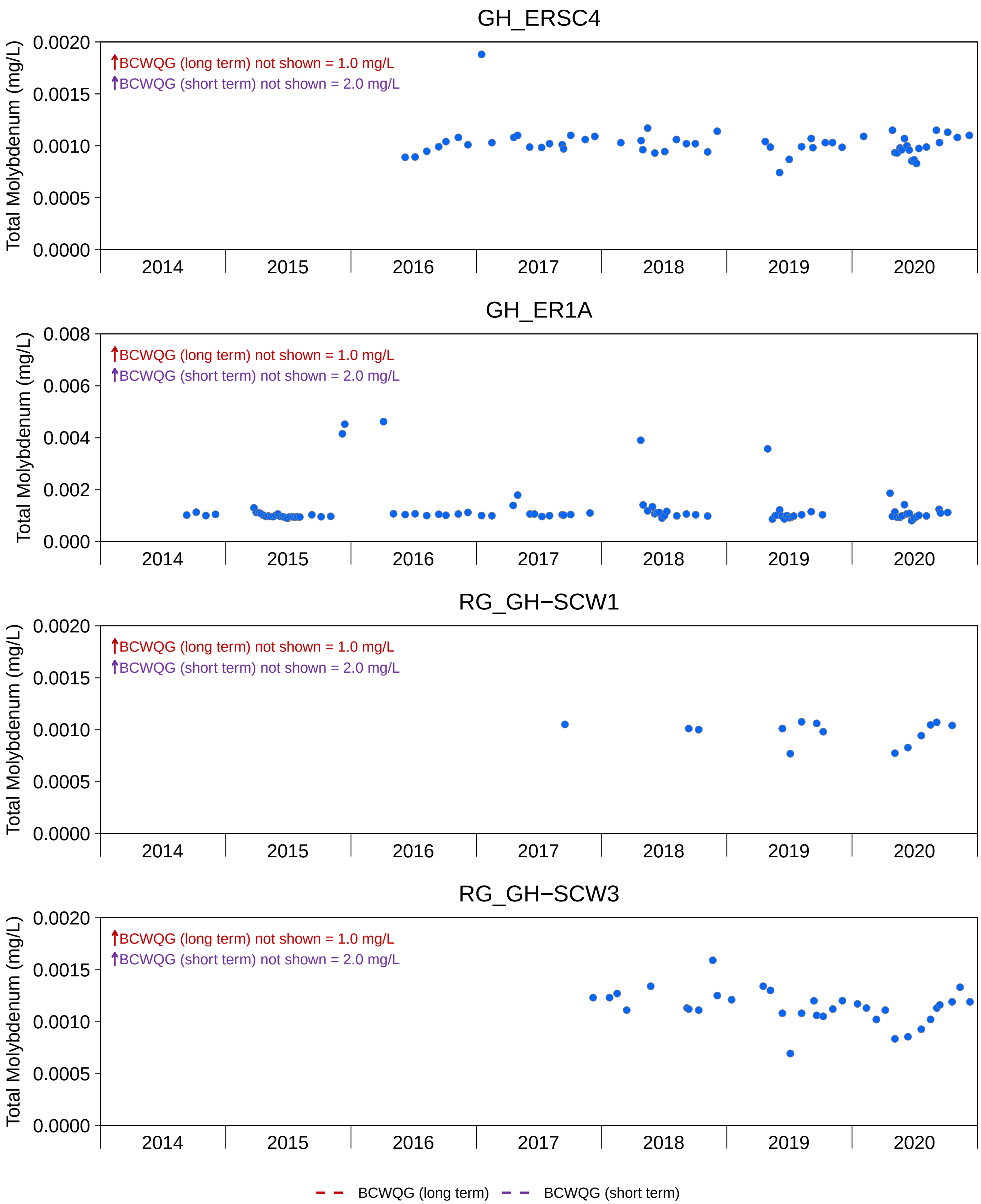


Figure 4: Concentrations of Total Molybdenum in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

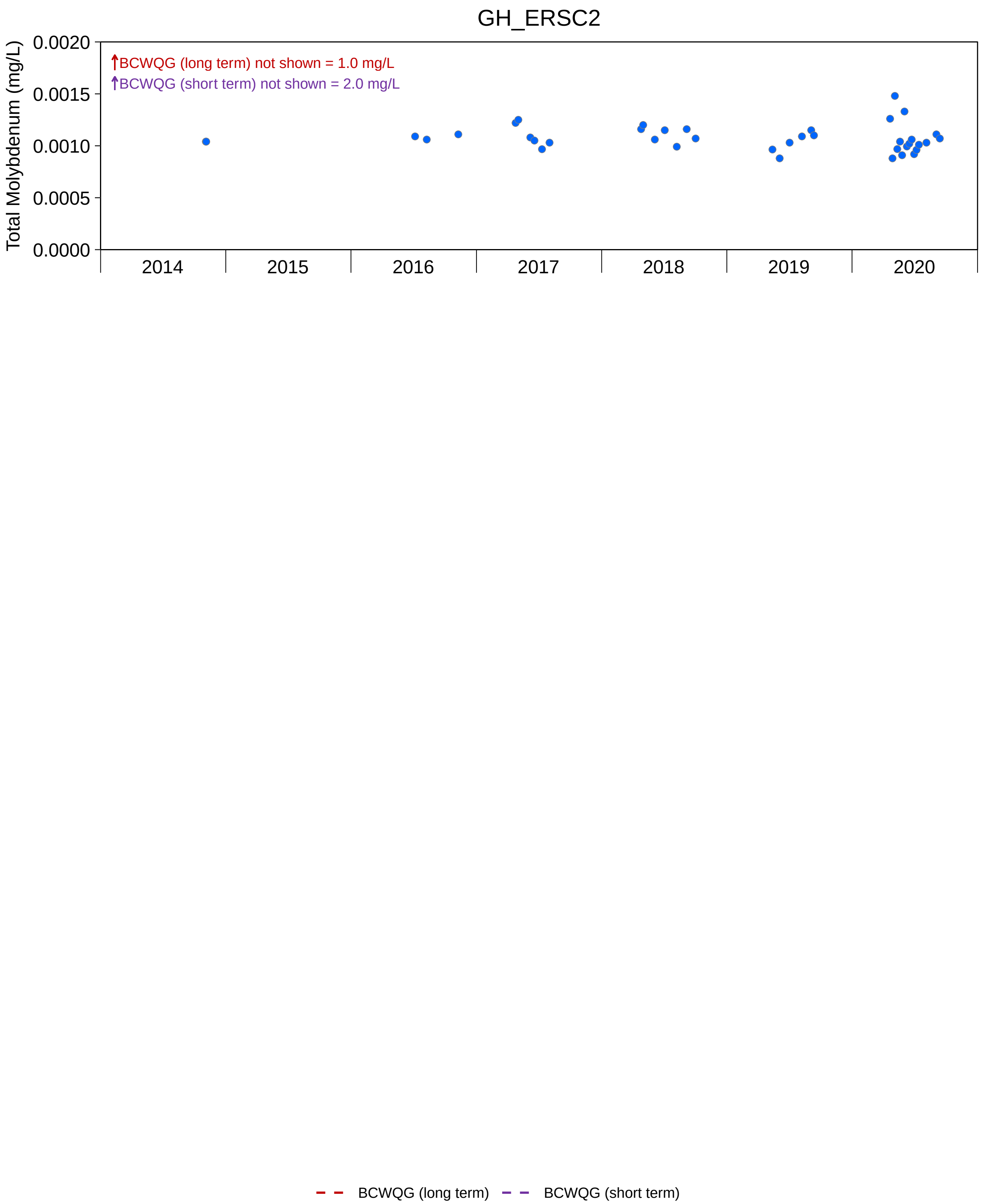


Figure 4: Concentrations of Total Molybdenum in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total Molybdenum was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

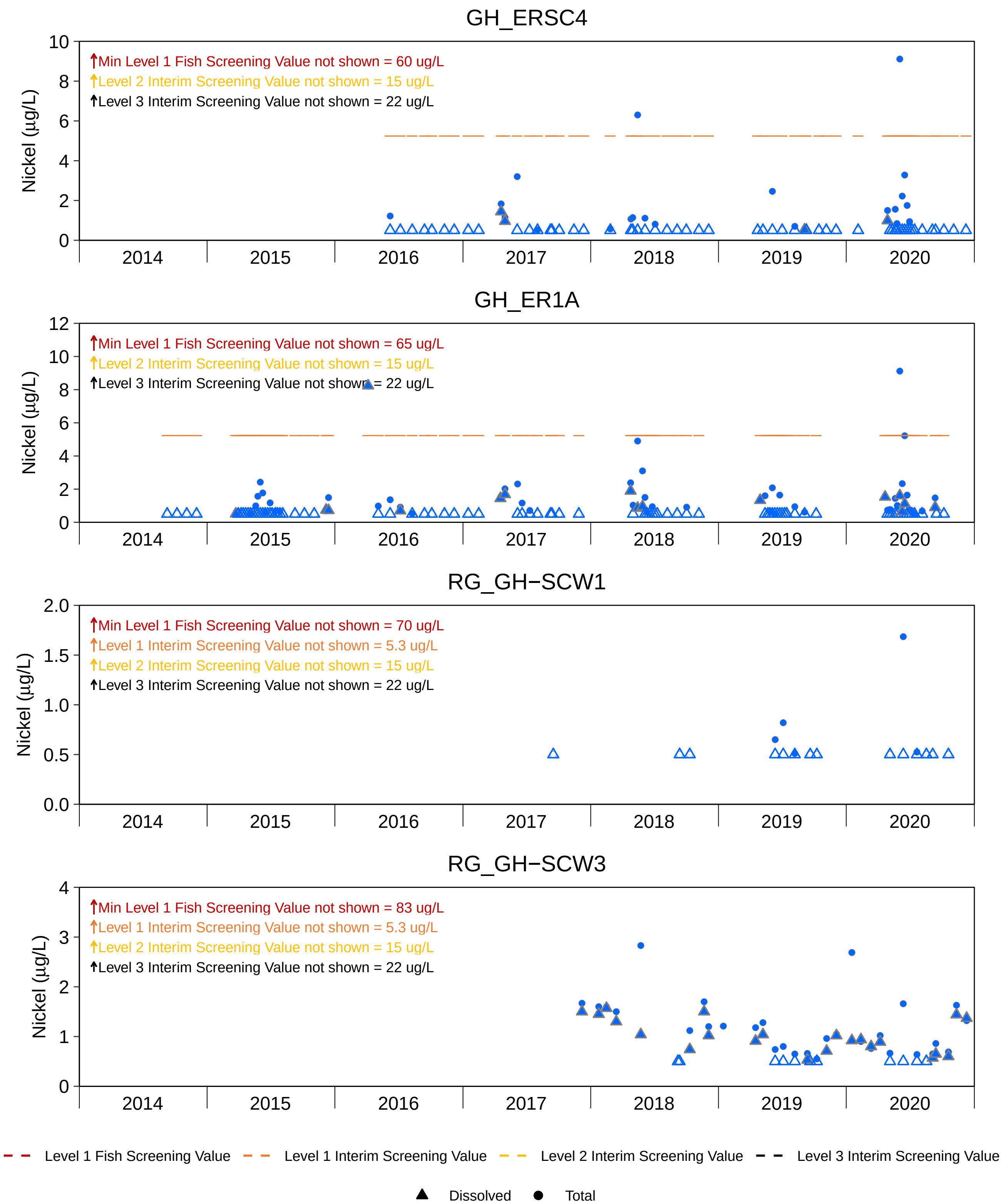


Figure 5: Concentrations of Total Nickel in Samples from the from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only.

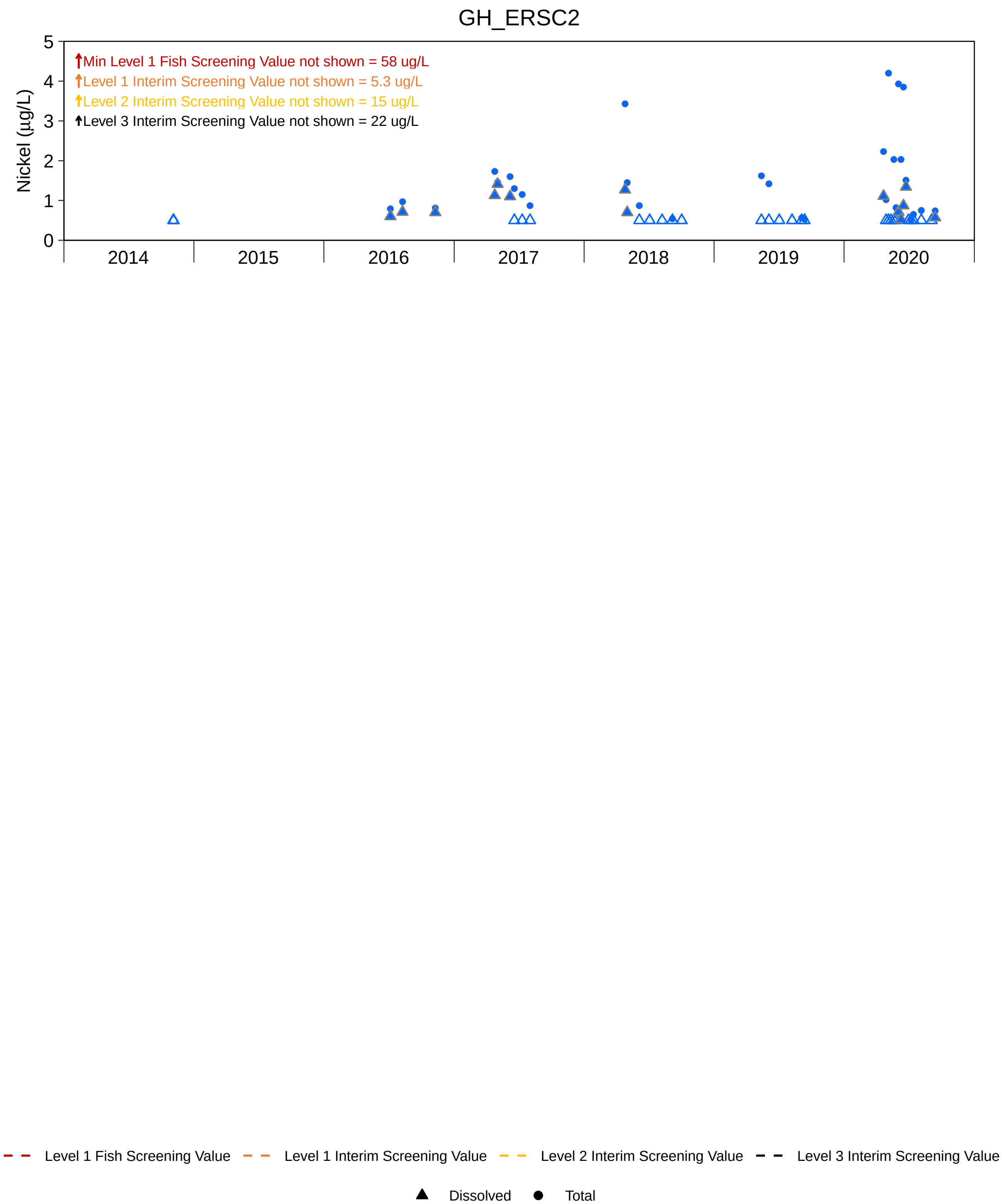


Figure 5: Concentrations of Total Nickel in Samples from the from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total Nickel was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved nickel is also provided for context on bioavailability. The nickel guidelines presented apply to total nickel only.

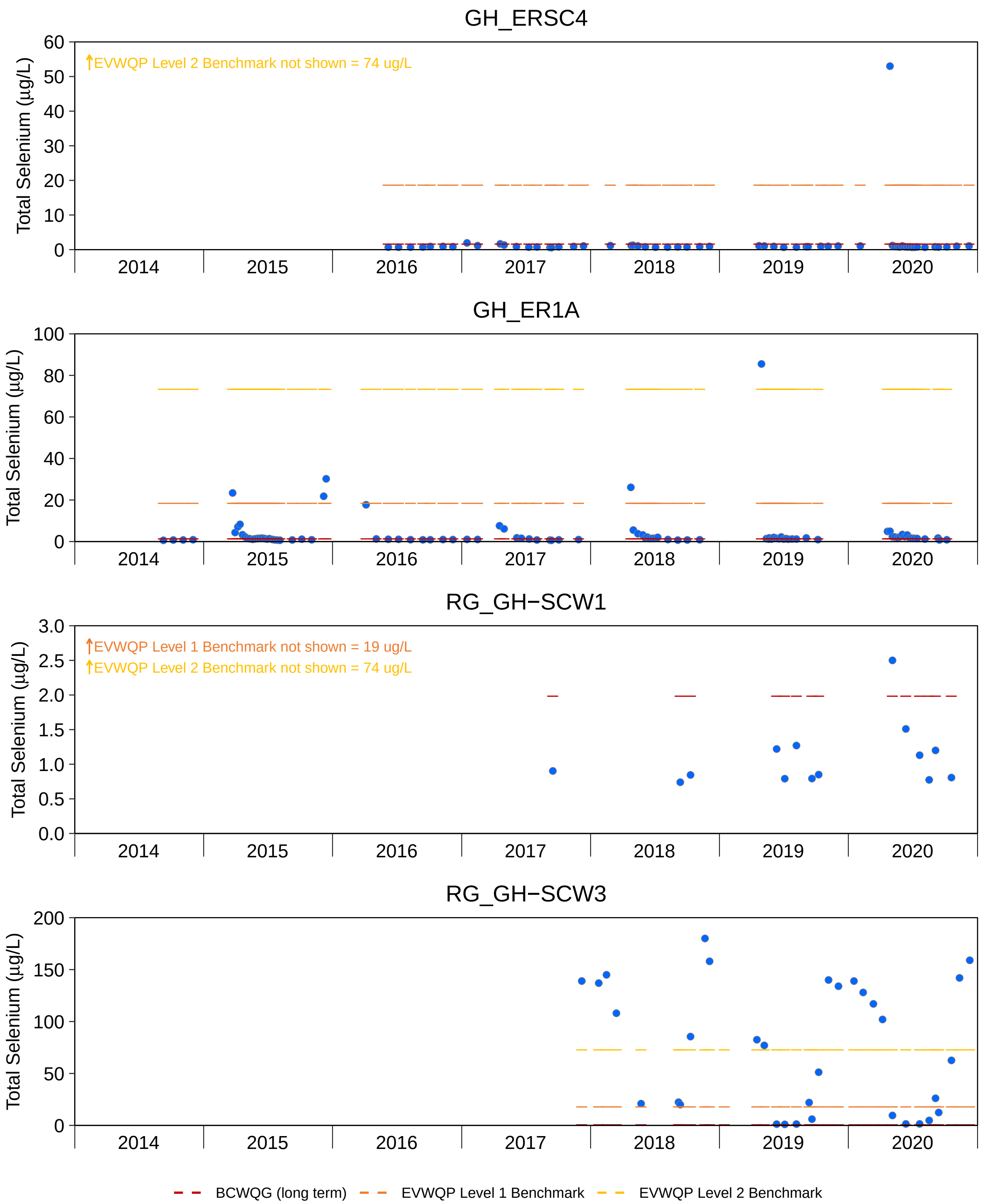


Figure 6: Concentrations of Total Selenium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

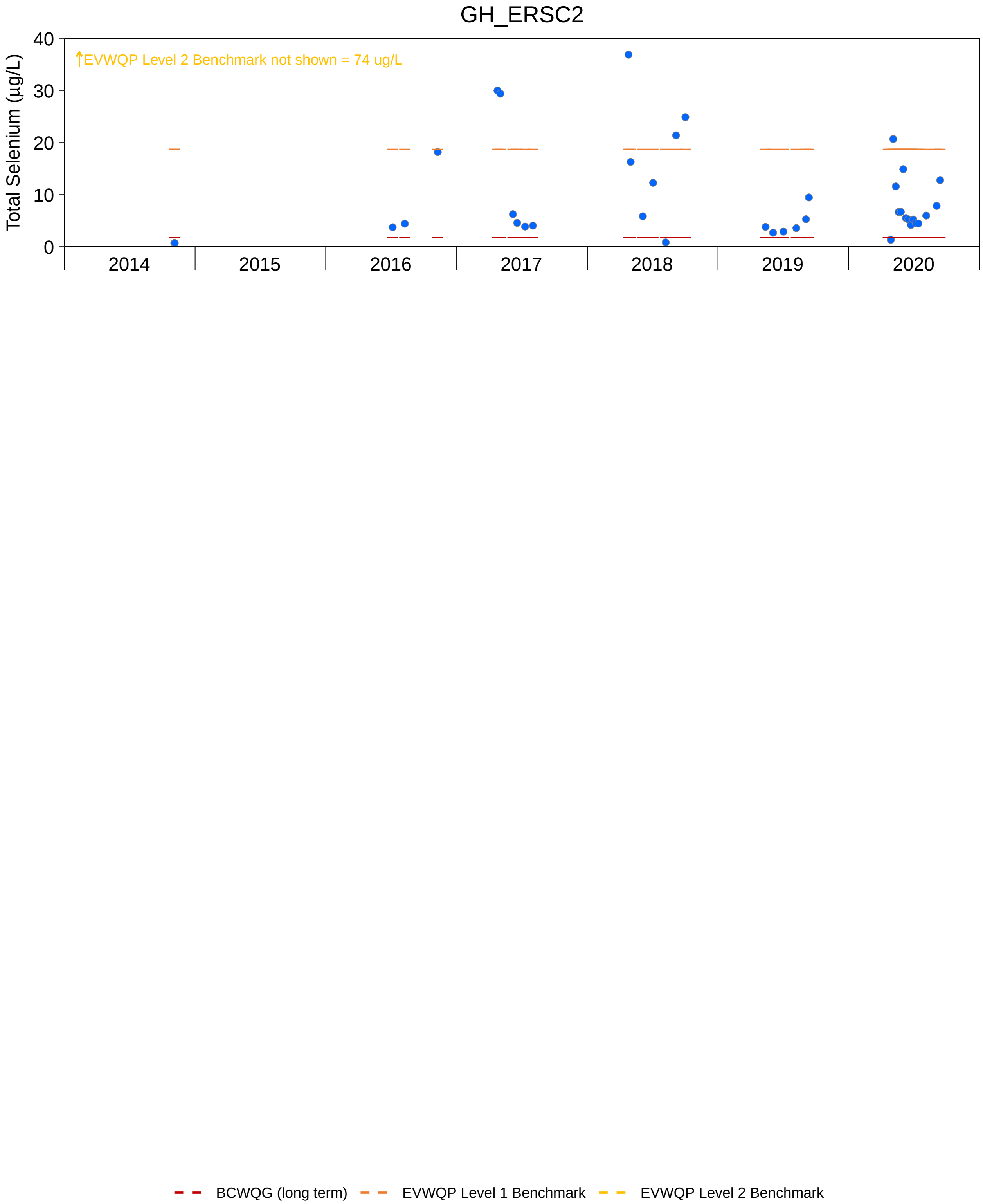


Figure 6: Concentrations of Total Selenium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total selenium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

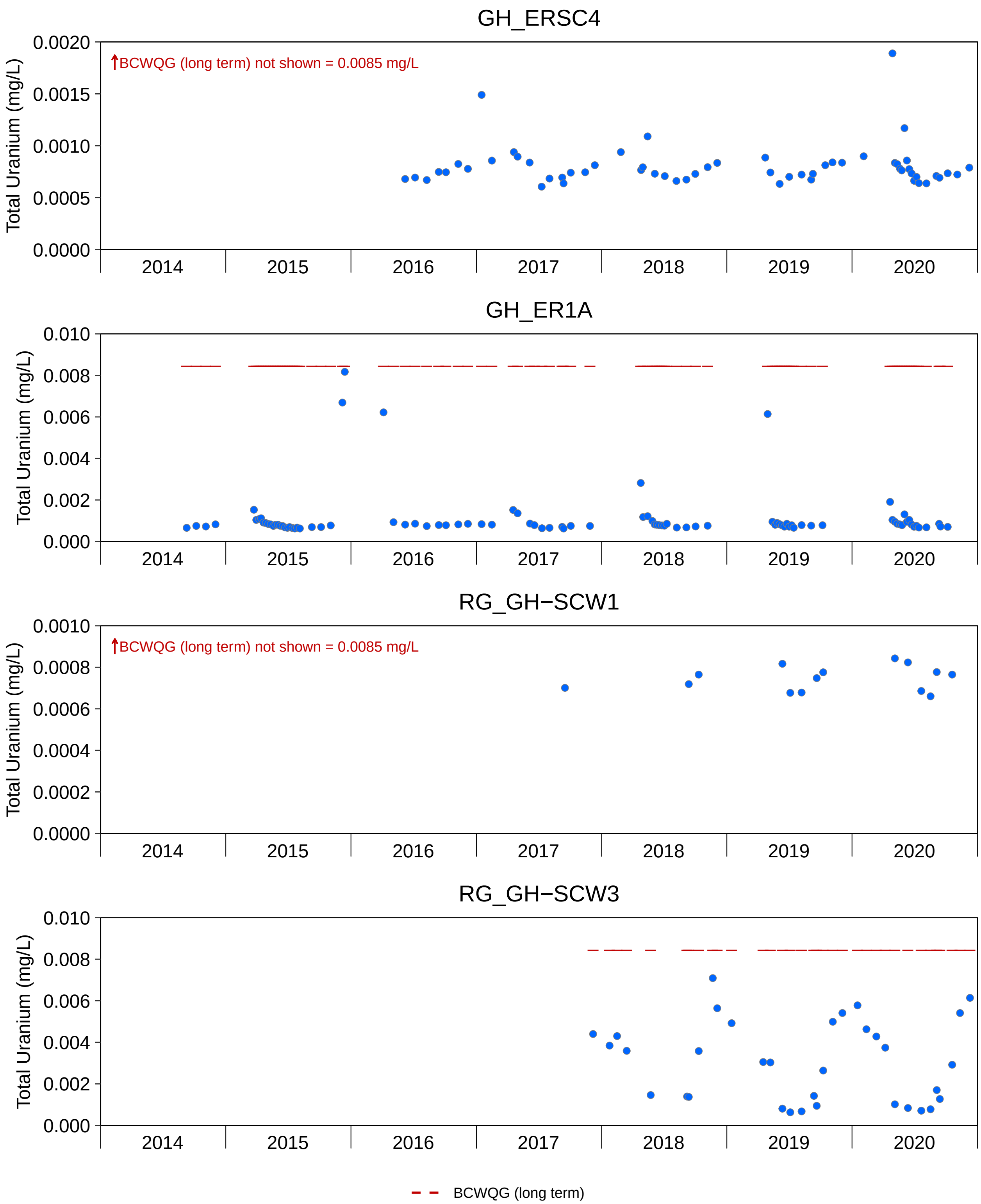


Figure : Concentrations of Total Uranium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

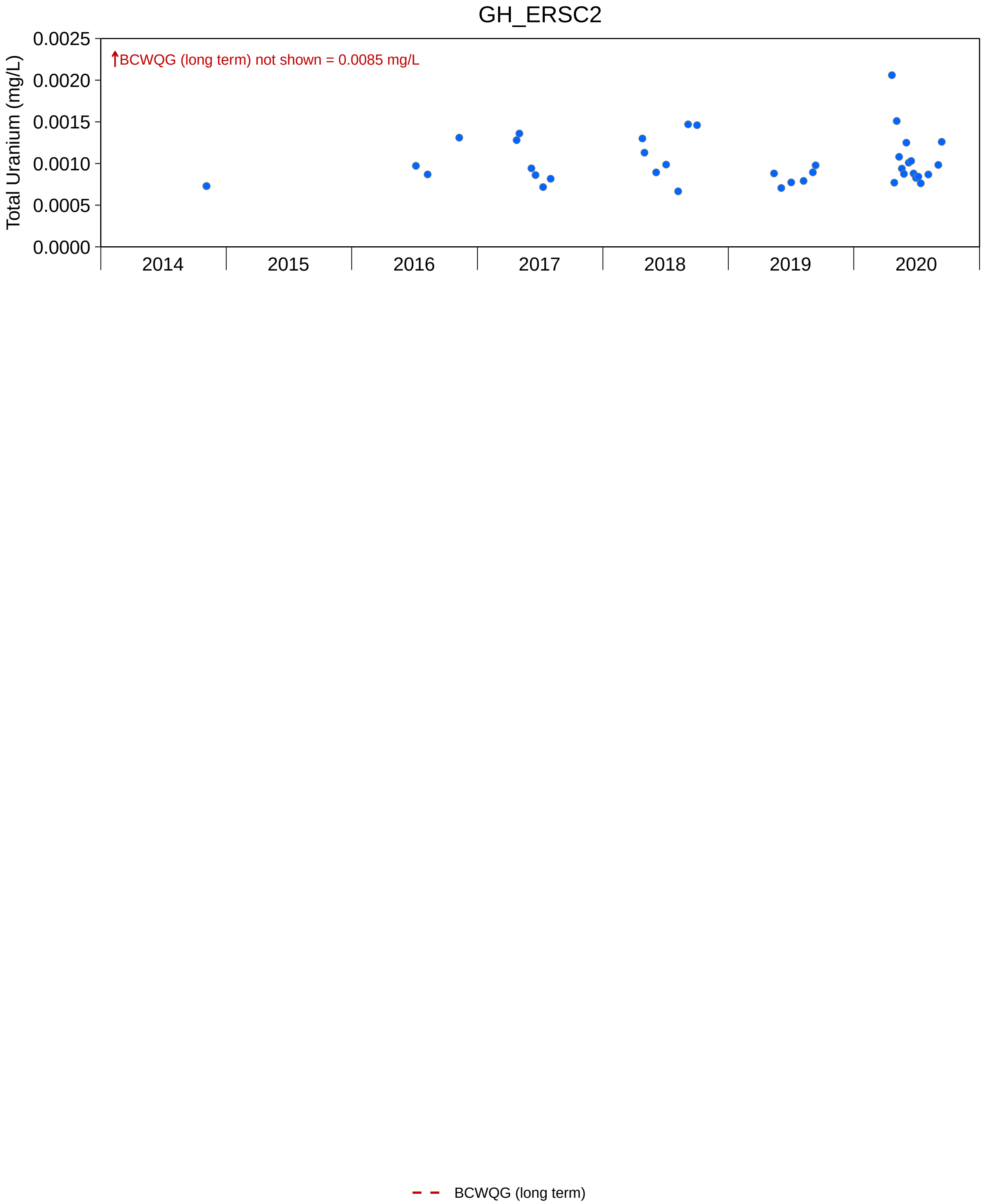


Figure : Concentrations of Total Uranium in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total uranium was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

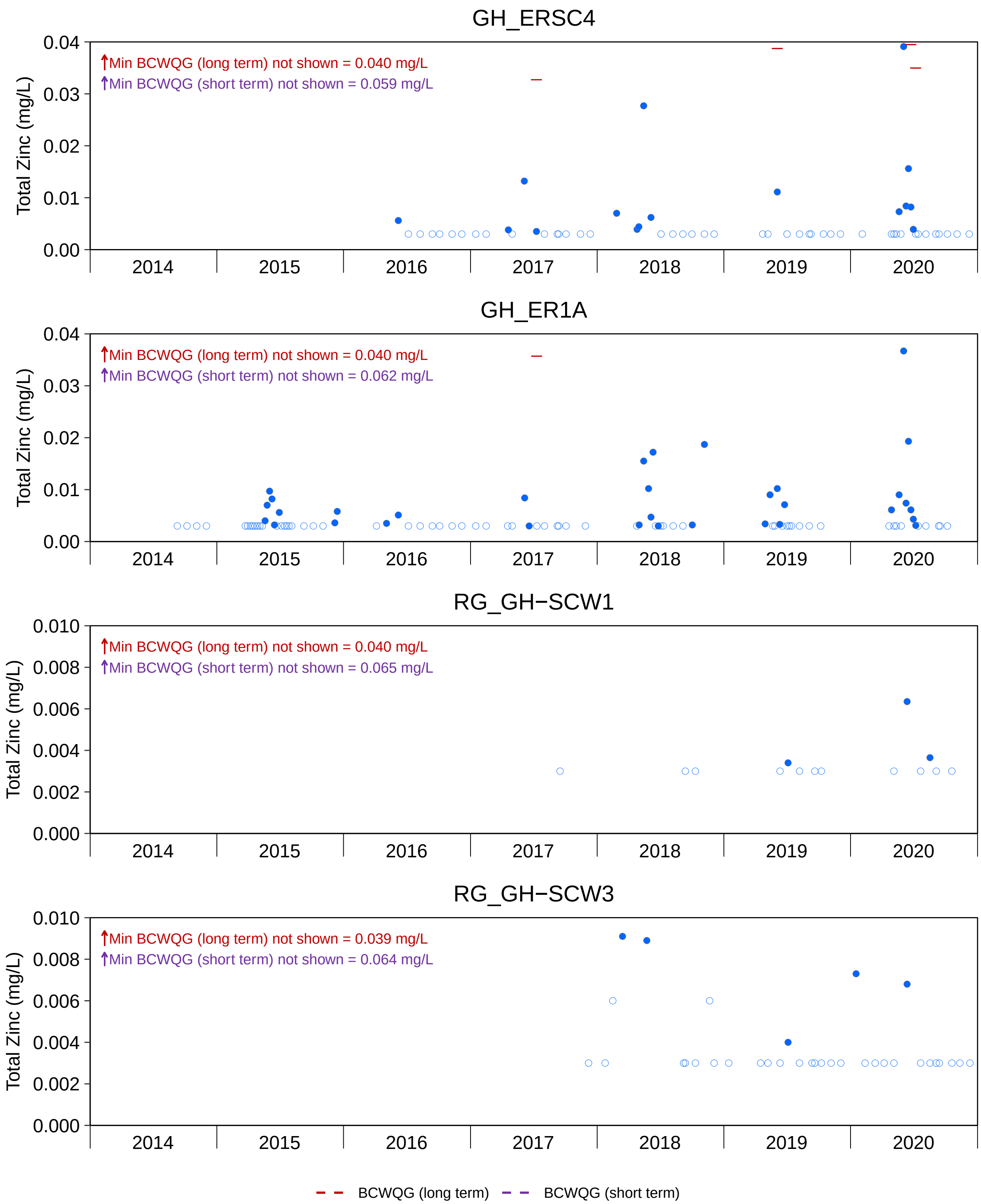


Figure : Concentrations of Total Zinc in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total zinc was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

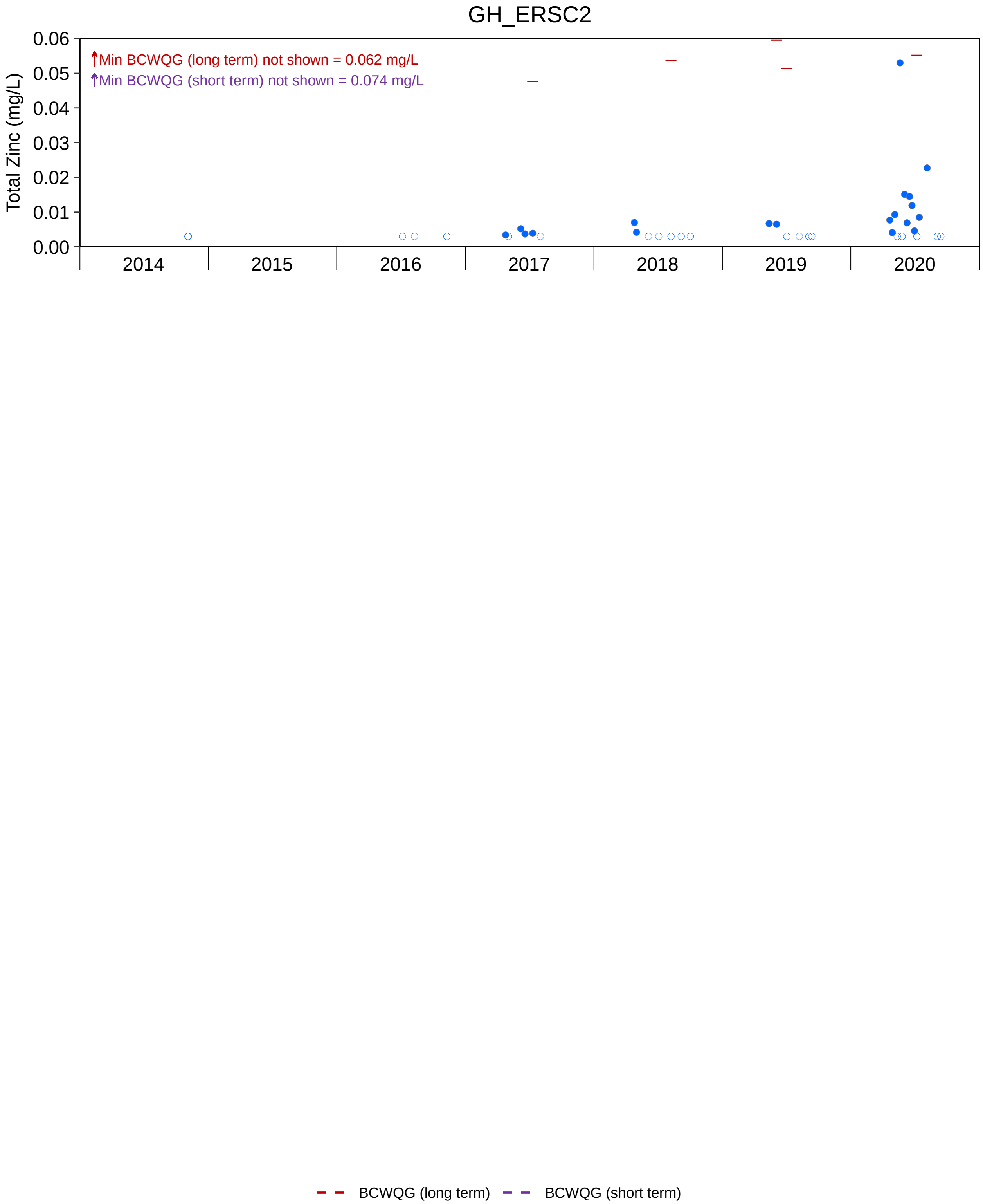


Figure : Concentrations of Total Zinc in Samples from the Elk River Side Channel Monitoring Stations, 2014 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Total zinc was plotted because it was identified as a mine −related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

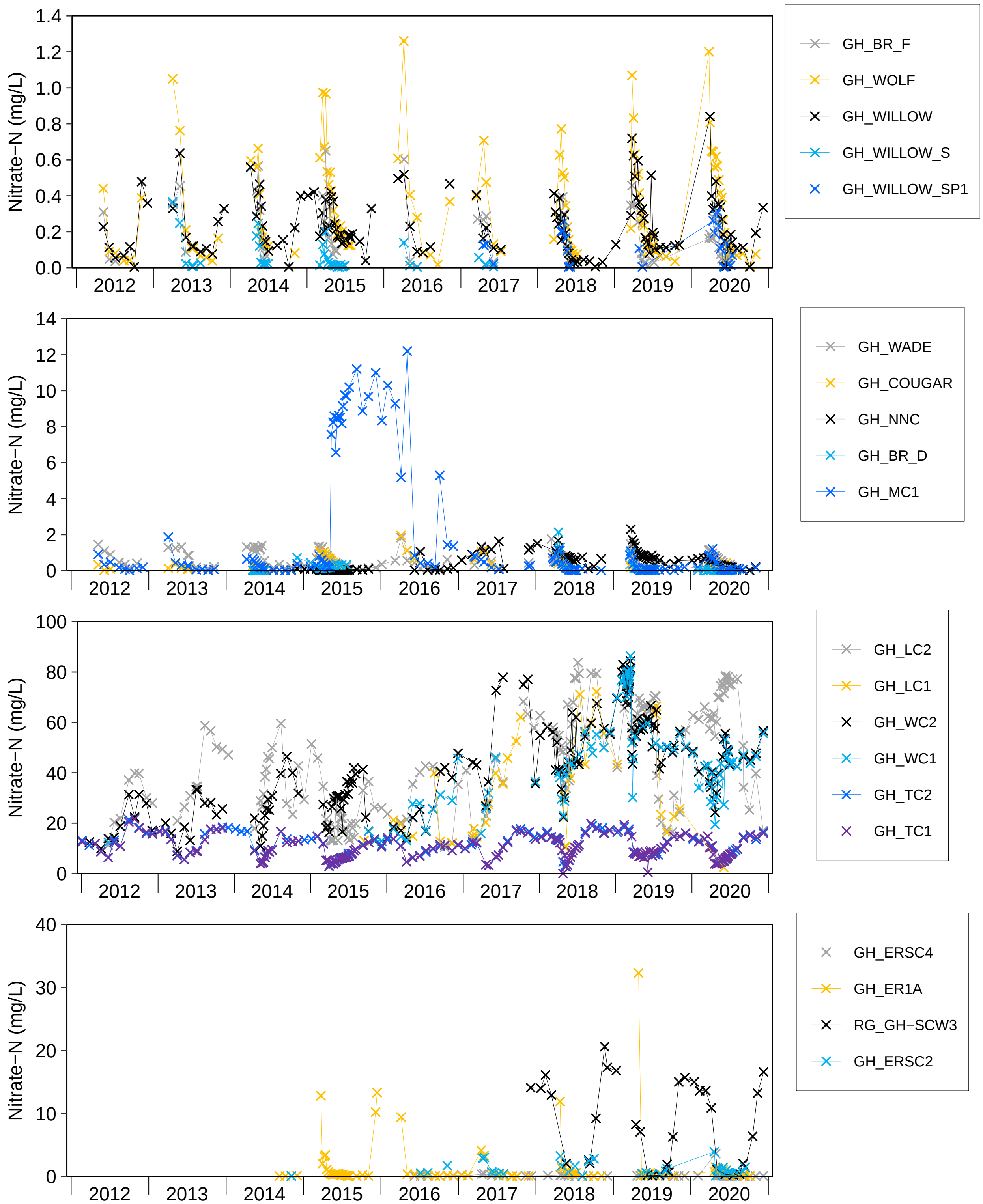


Figure 9: oncentrations of itrate in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0050 and 0.0050 mg/L). Nitrate-N was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

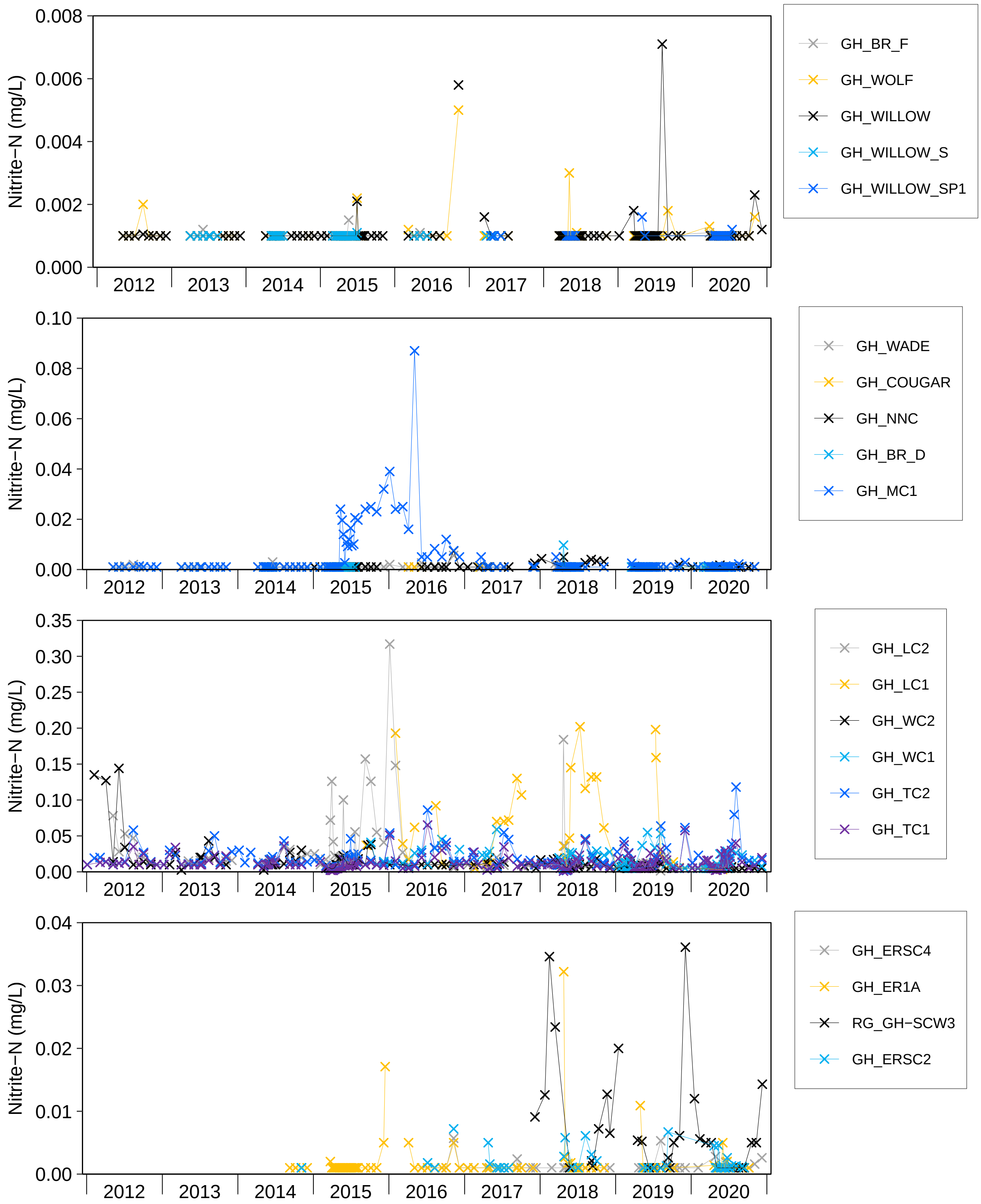


Figure 4 : oncentrations of itrite in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0010 and 0.10 mg/L). Nitrite-N was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

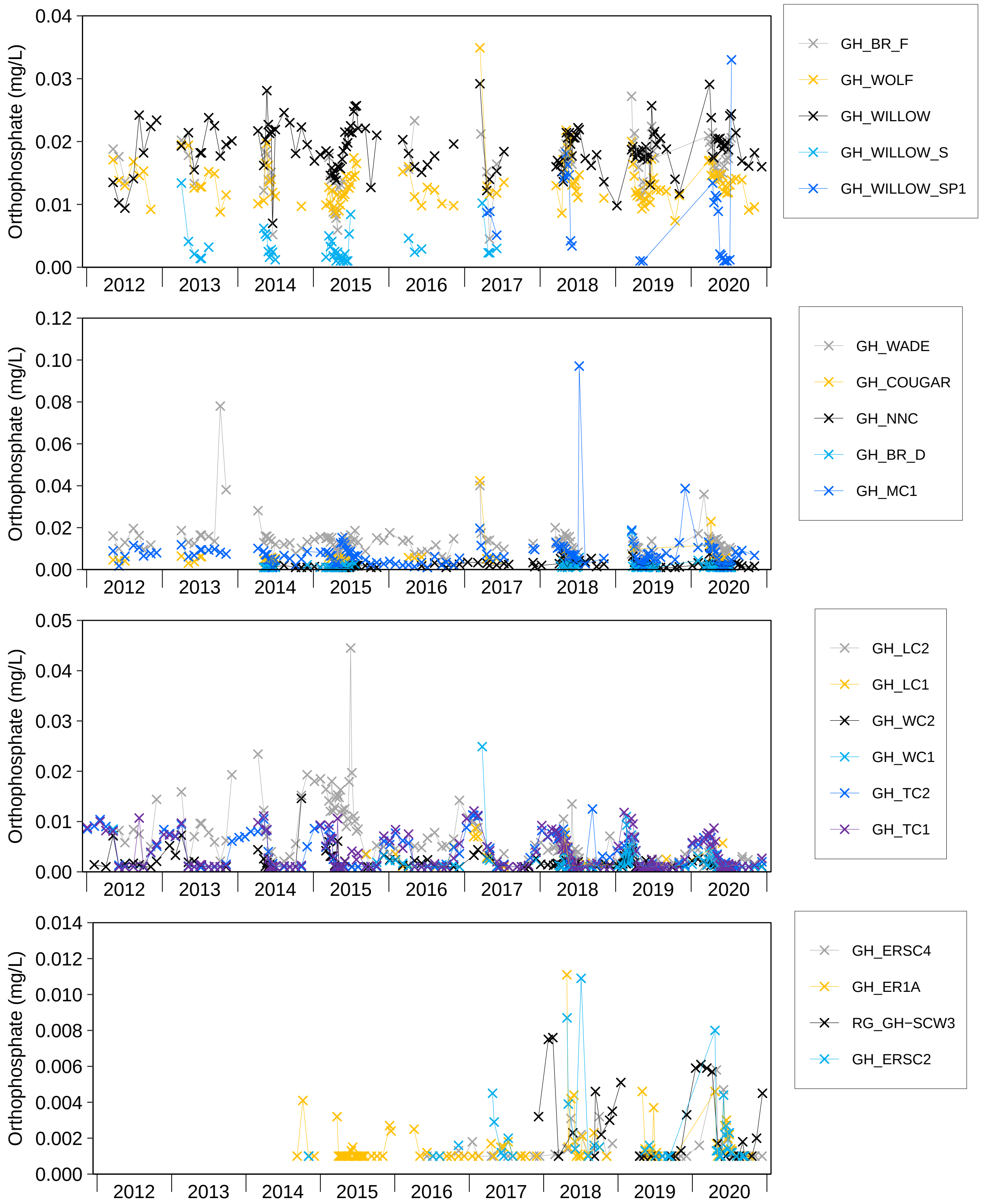


Figure 41: oncentrations of rt o os ate in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0010 and 0.0010 mg/L). Orthophosphate was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

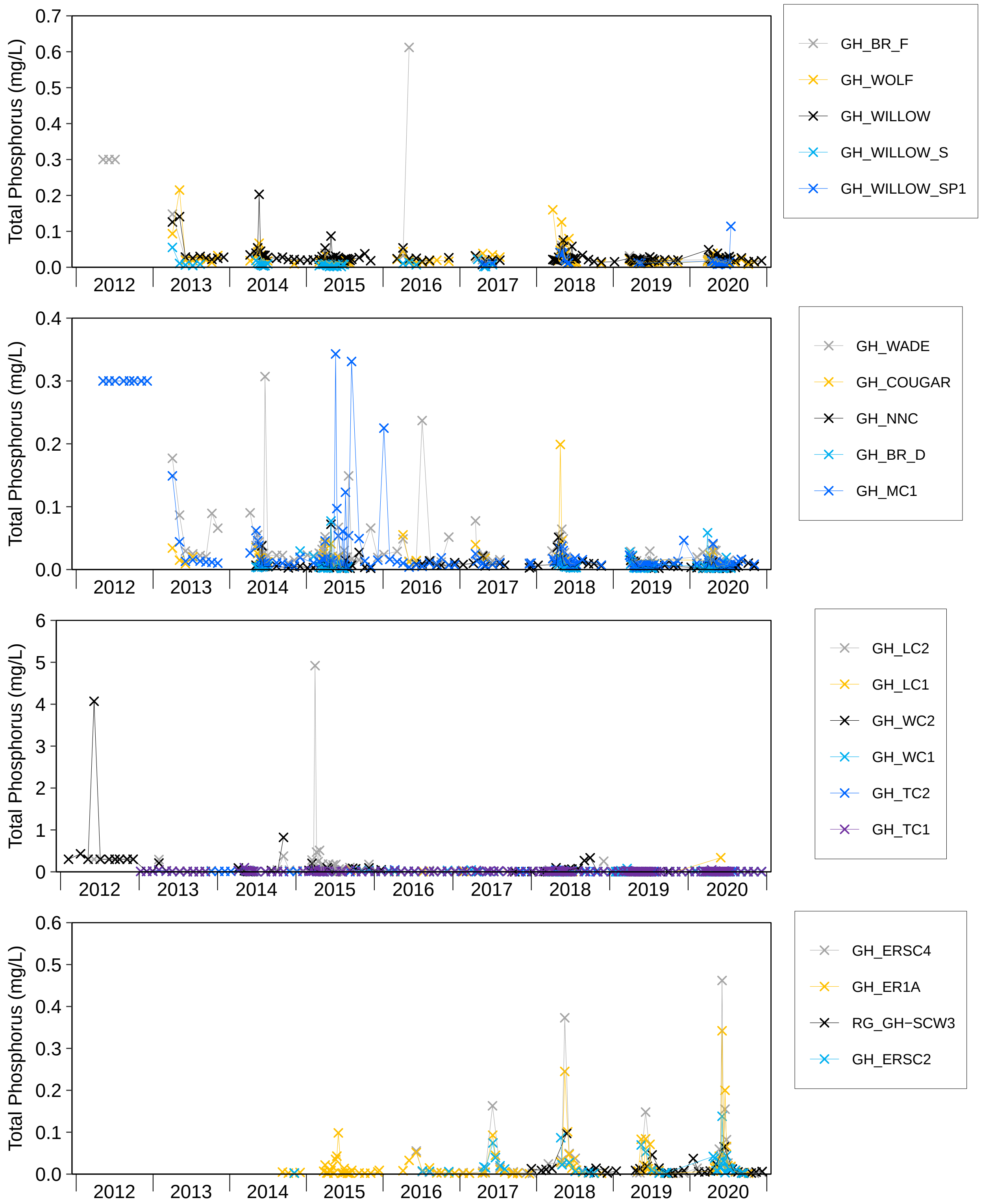


Figure 42: oncentrations of ota os orus in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0010 and 0.30 mg/L). Total phosphorus was plotted based on EMC input, because this constituent was assessed in the GHO Cougar Pit Extension Joint Application.

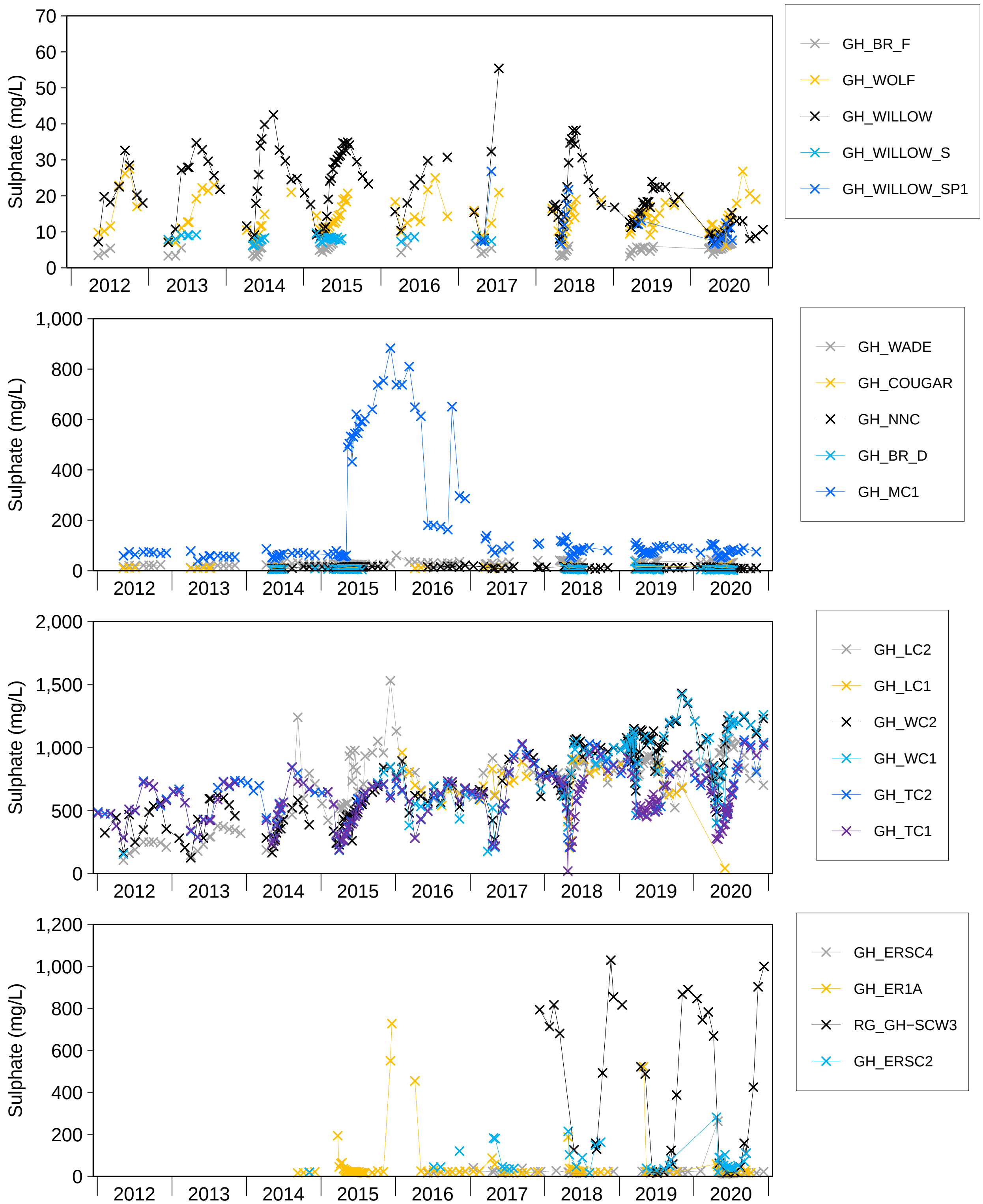


Figure 4 : oncentrations of Su ate in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). Sulphate was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

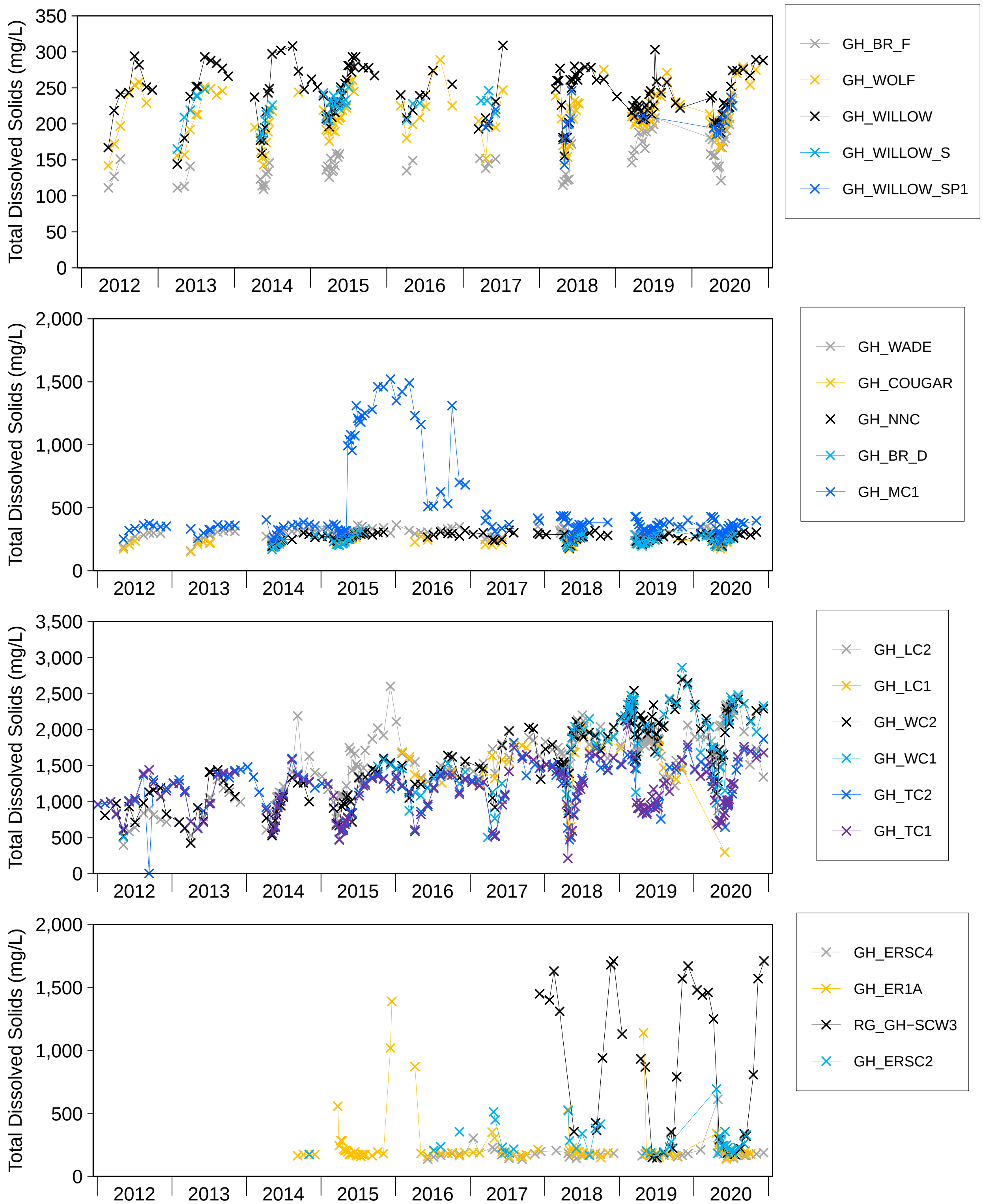


Figure 44: oncentrations of ota isso ed So ids S in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). TDS was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

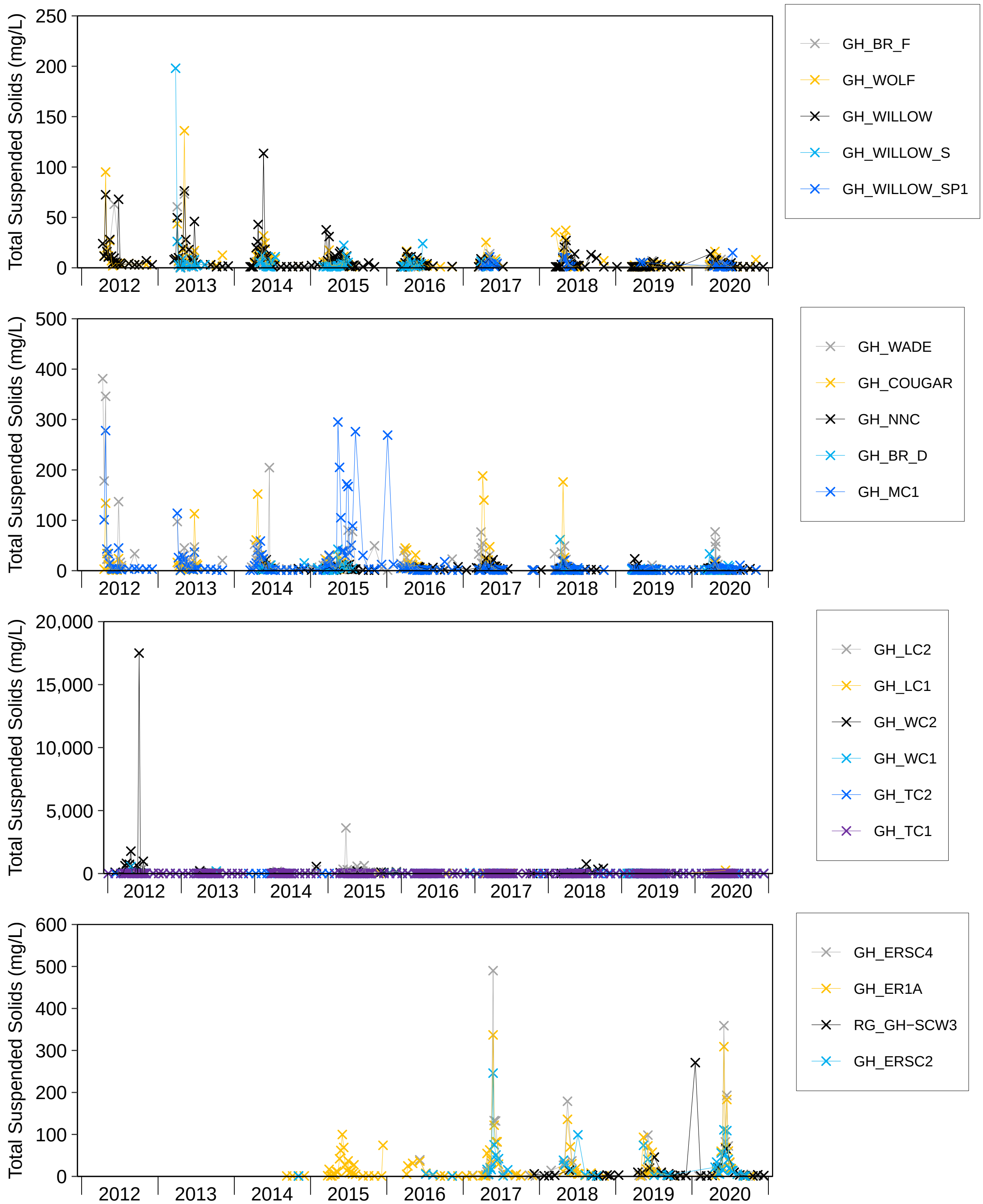


Figure 45: oncentrations of ota Sus ended So ids SS in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 1.0 and 5.0 mg/L). TSS was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability.

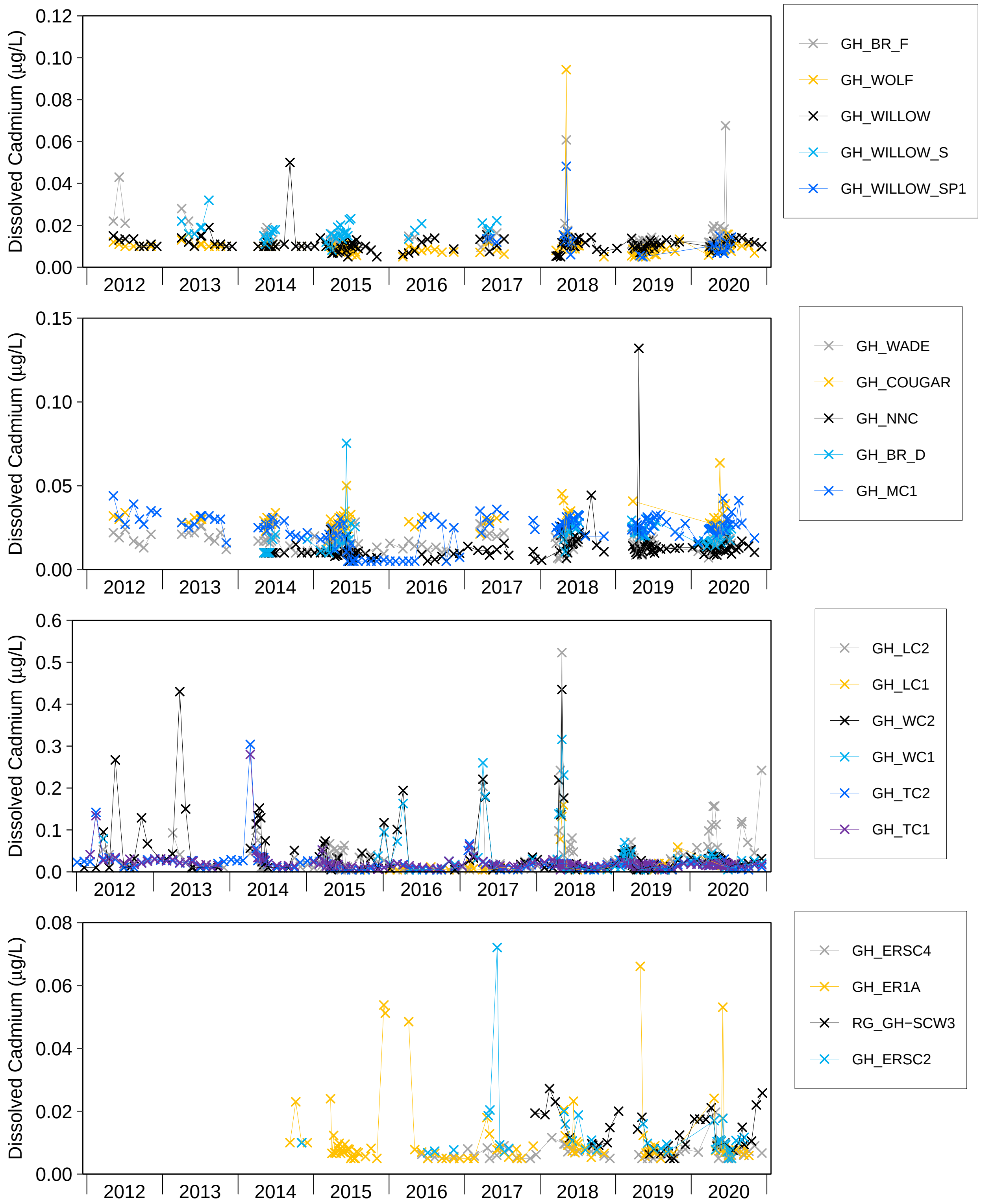


Figure 46: oncentrations of isso ed admium in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0050 and 0.050 mg/L). Dissolved cadmium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

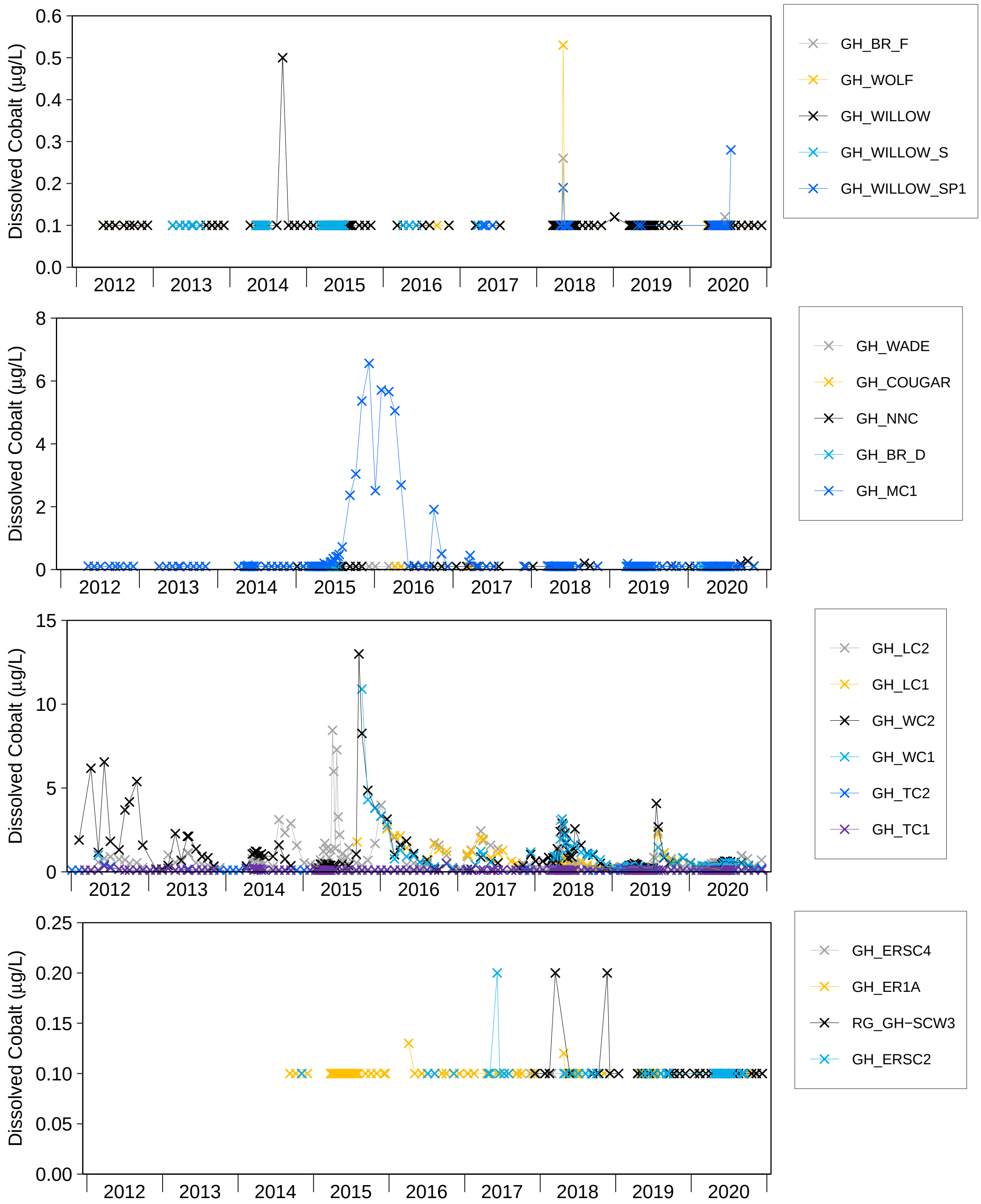


Figure 4 : oncentrations of isso ed o a t in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.10 and 0.50 mg/L). Dissolved cobalt was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

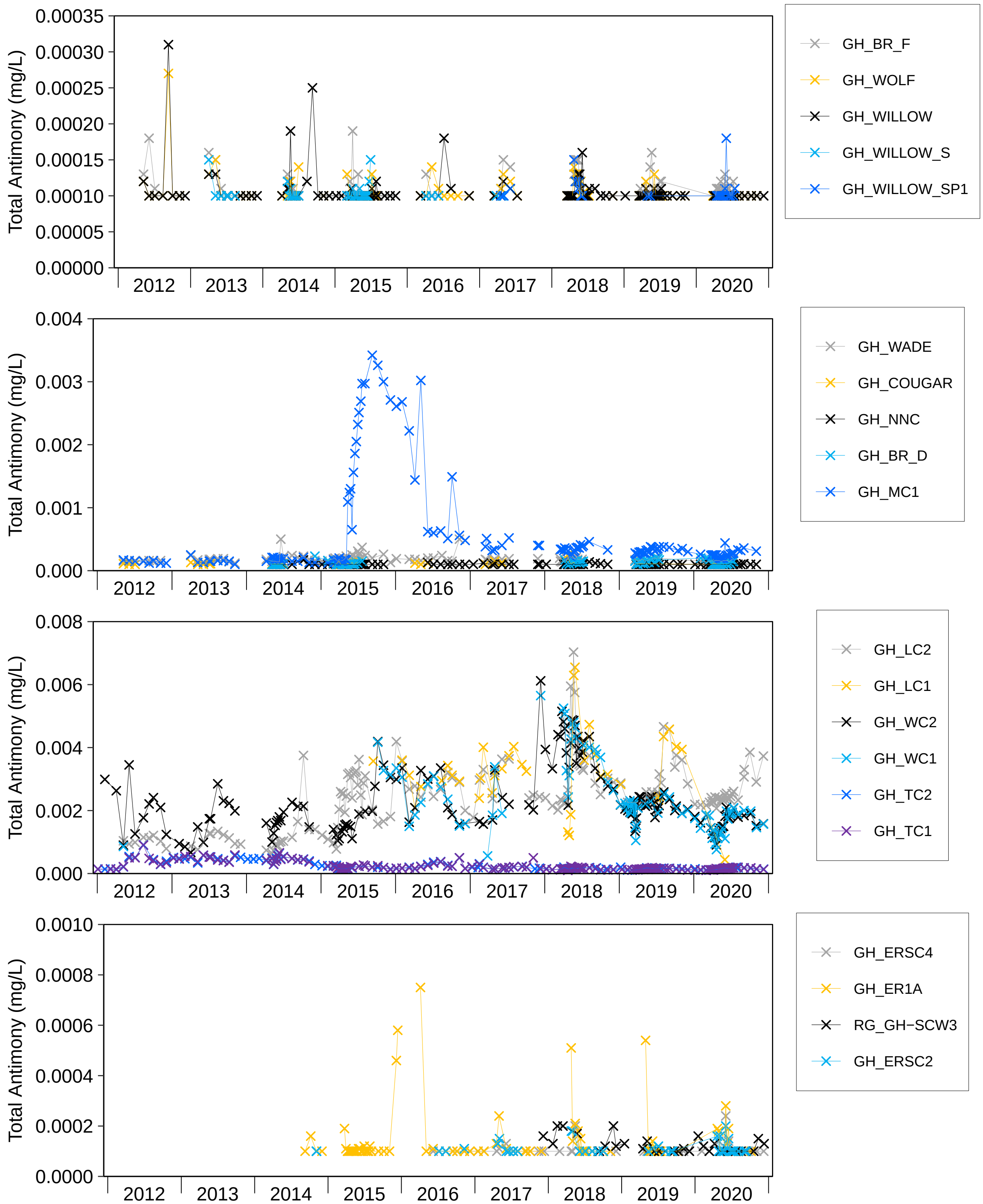


Figure 4 : oncentrations of ota Antimon in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.00010 and 0.00050 mg/L). Total antimony was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

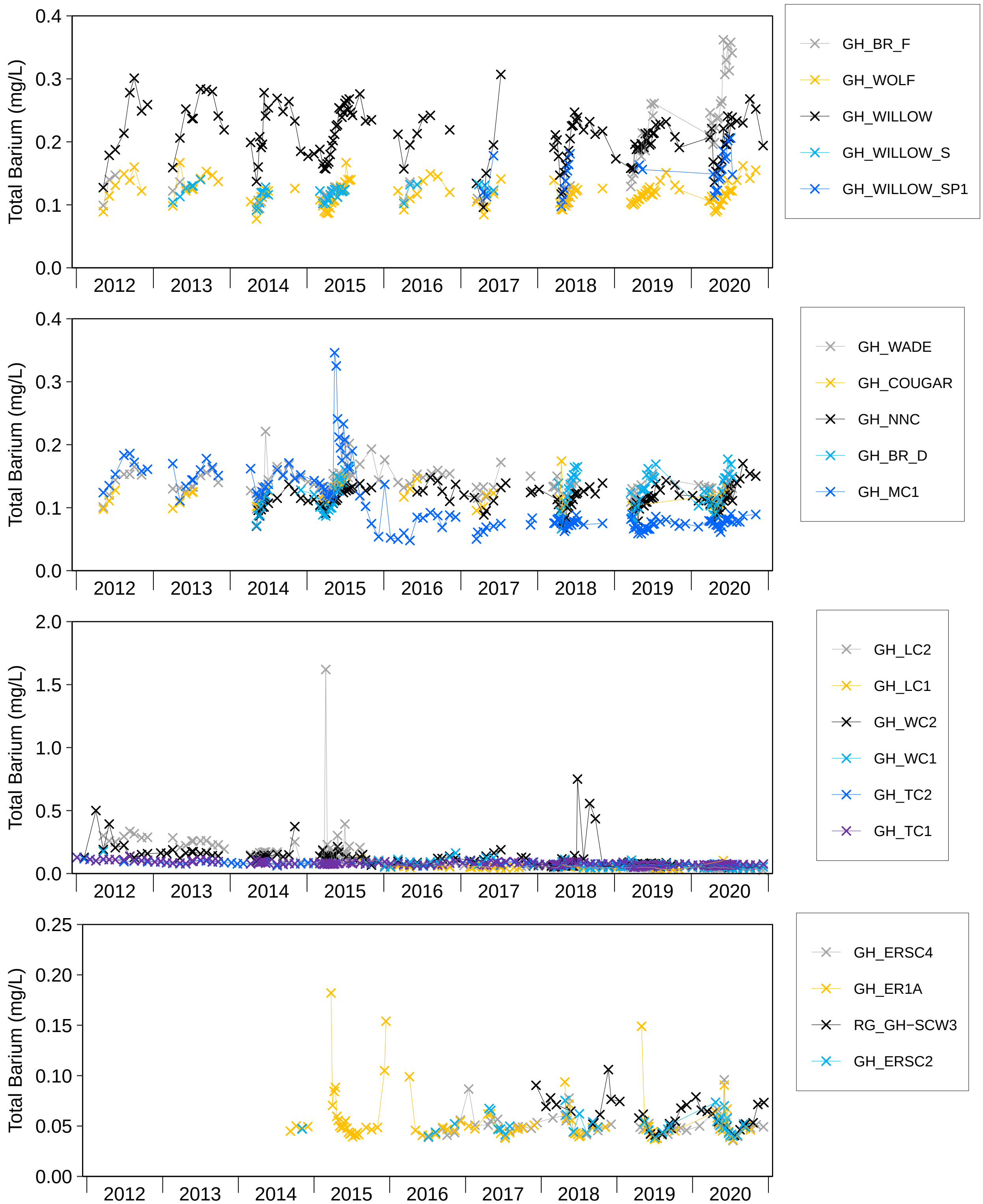


Figure 49: oncentrations of ota arium in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). Total barium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

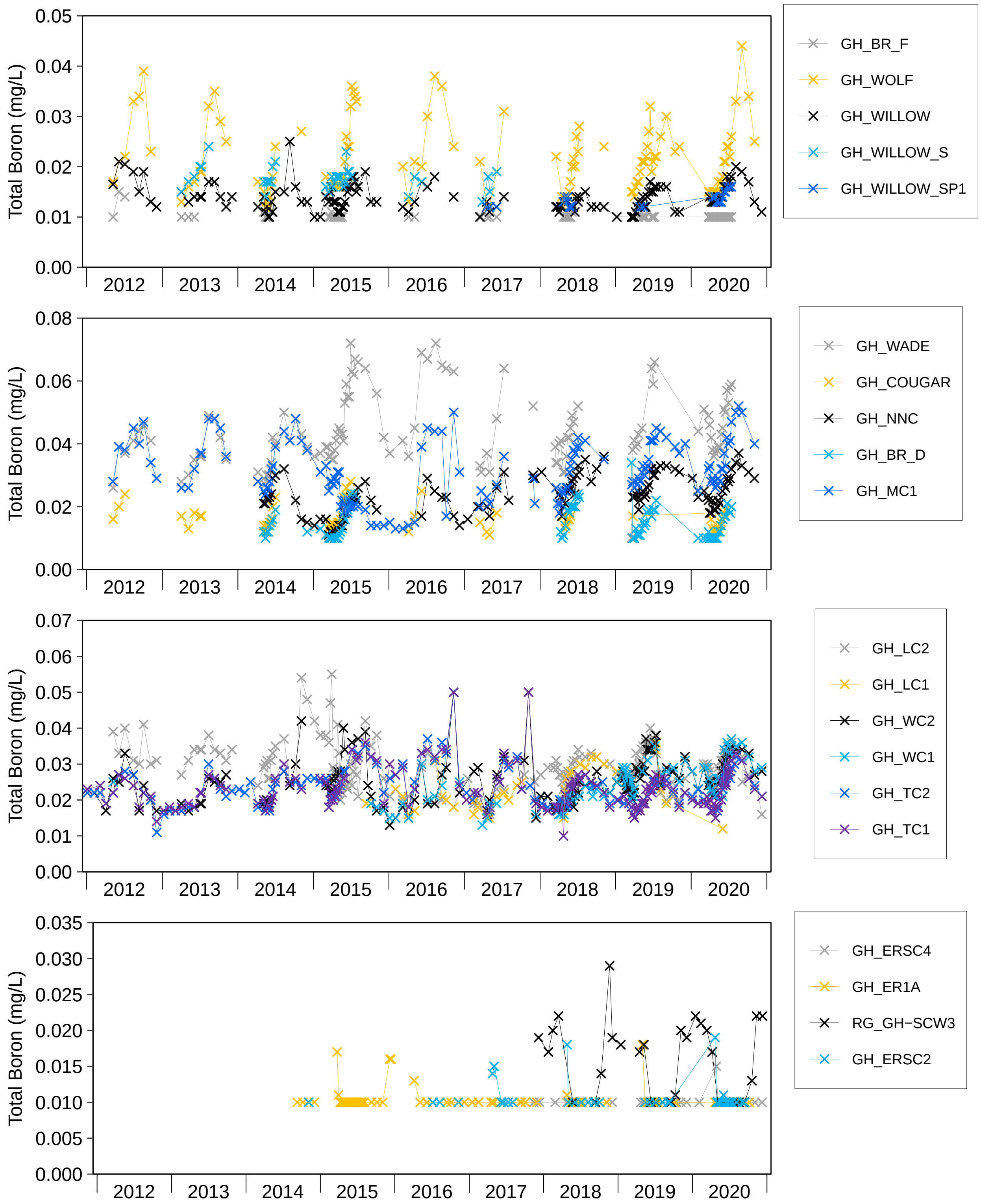


Figure 5 : Time Series Plots for Total Boron Concentrations from West−side Tributaries and Side Channel Monitoring Stations, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.010 and 0.050 mg/L). Total boron was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

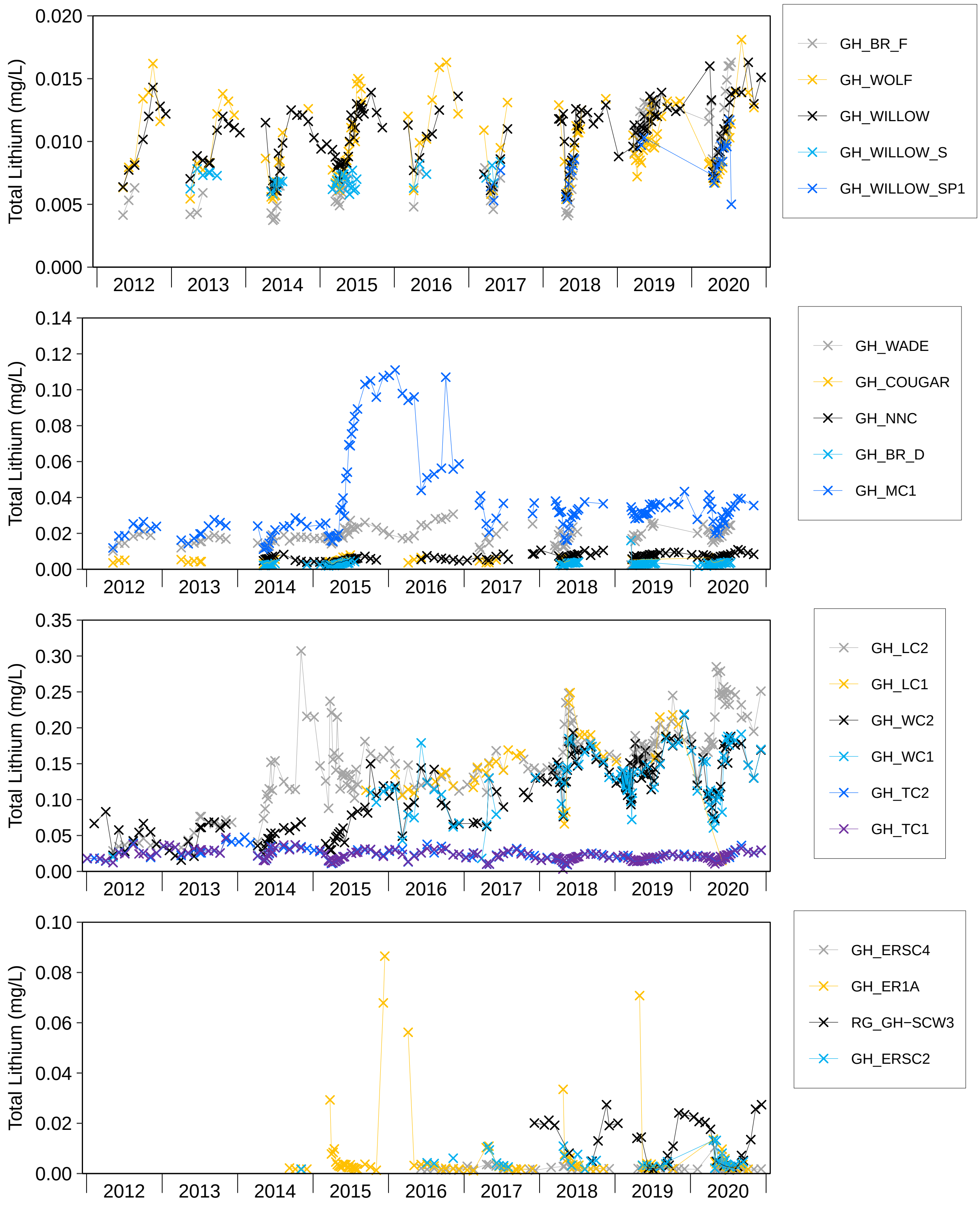


Figure 51: oncentrations of ota it ium in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0030 and 0.0030 mg/L). Total lithium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

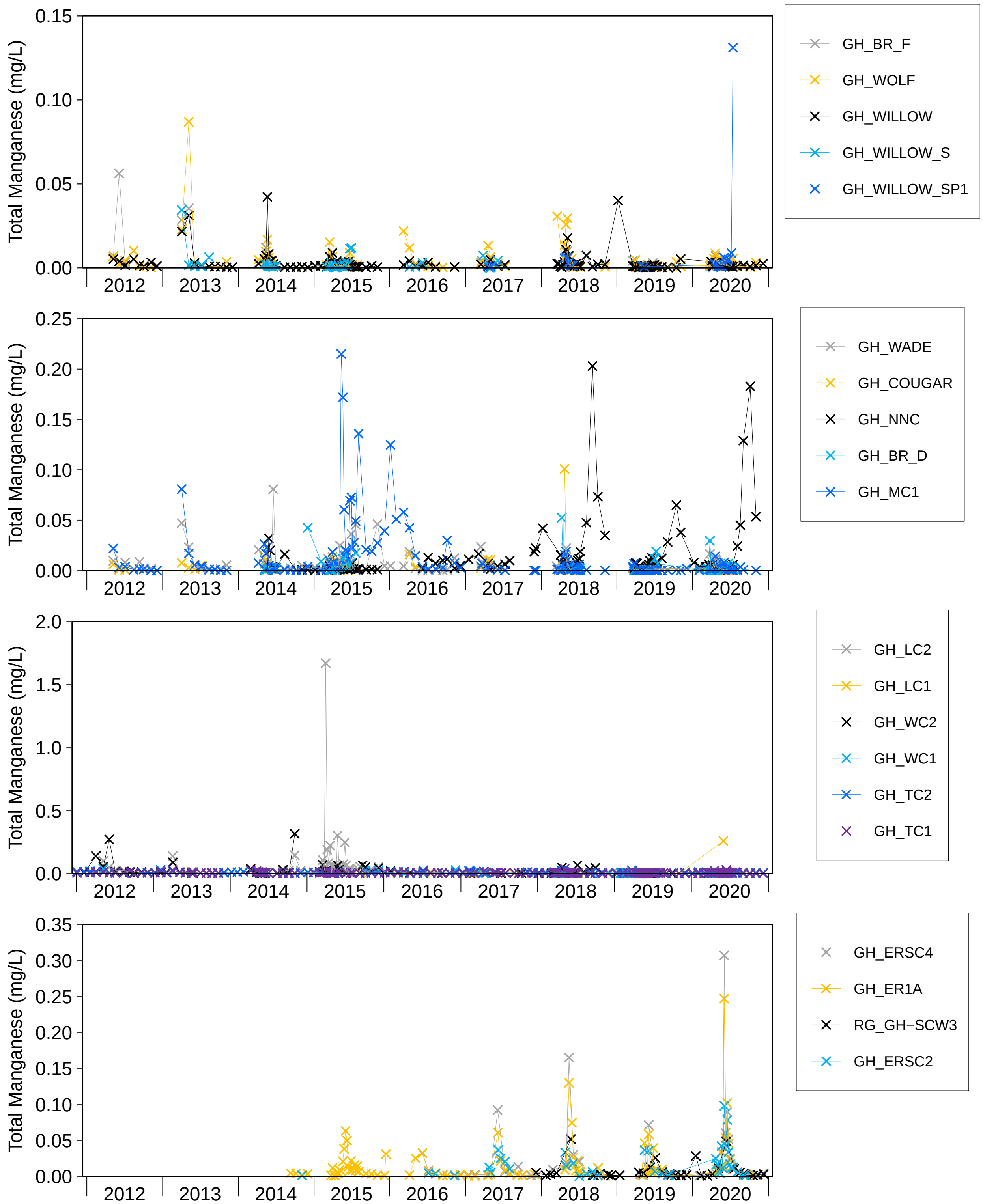


Figure 52: oncentrations of ota an anese in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.00010 and 0.00070 mg/L). Total manganese was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

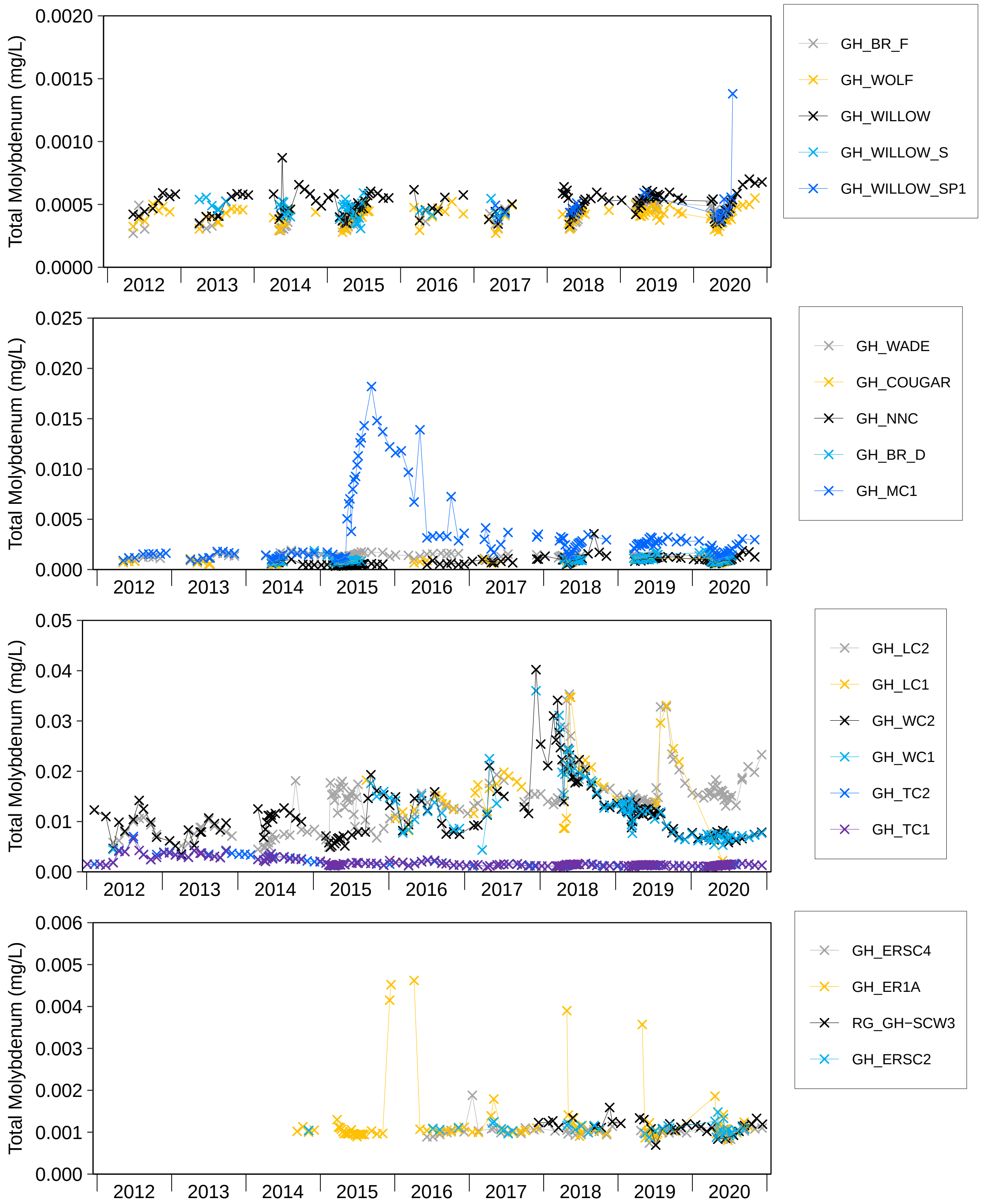


Figure 5 : oncentrations of ota o denum in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). Total molybdenum was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

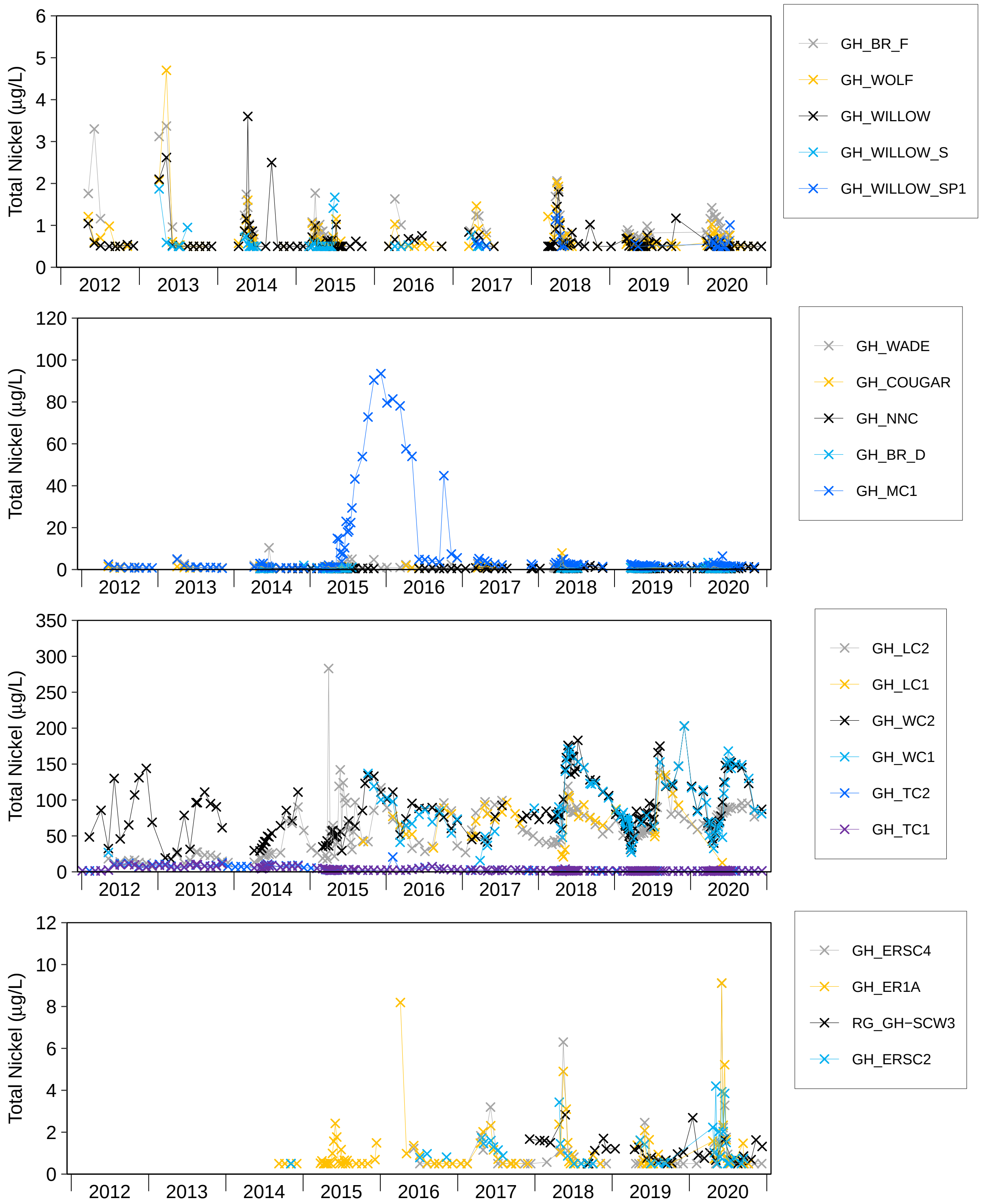


Figure D.54: Time Series Plots for Total Nickel Concentrations from West−side Tributaries and Side Channel Monitoring Stations, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.50 and 2.5 µg/L). Total nickel was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

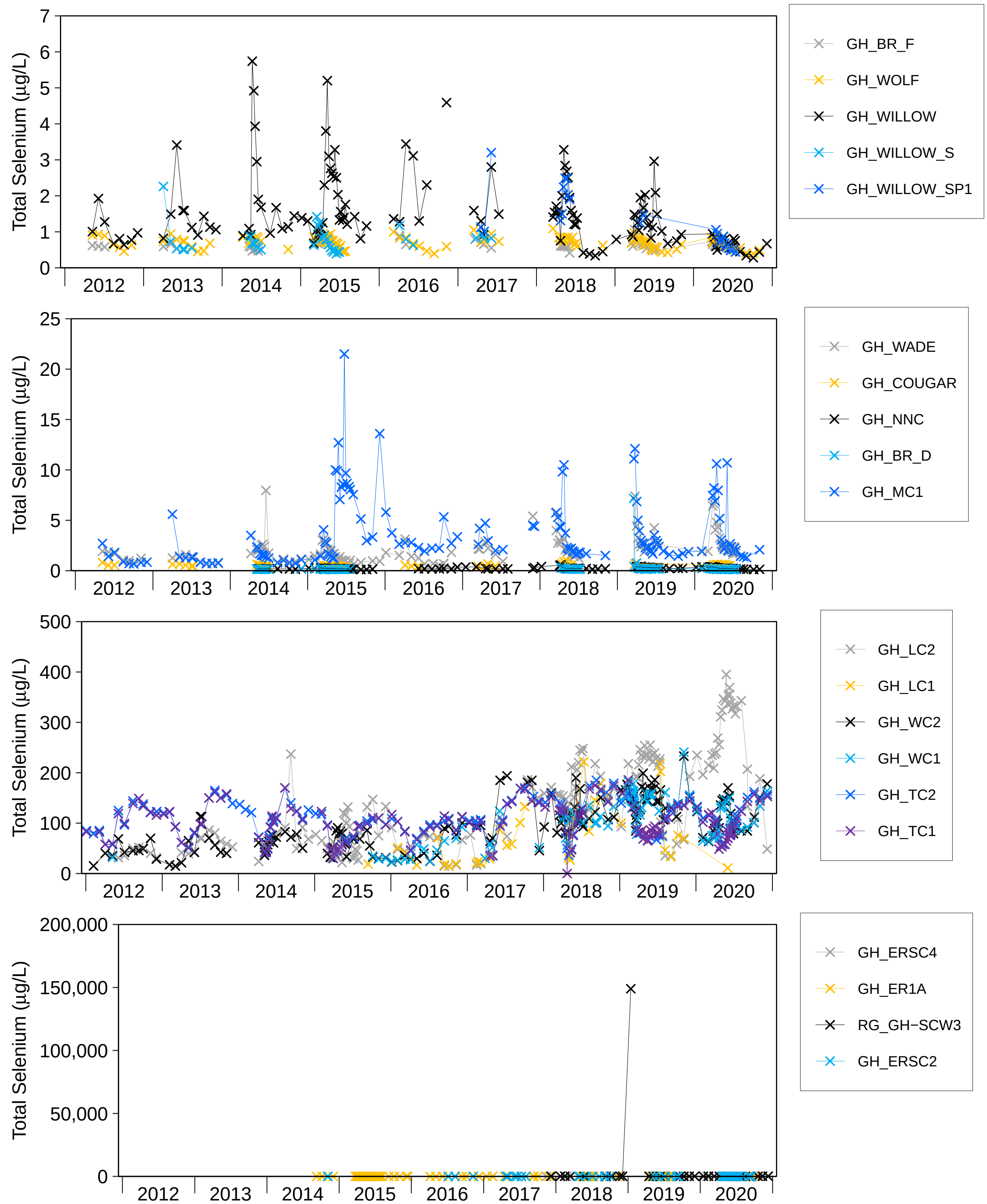


Figure 55: oncentrations of ota Se enium in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). Total selenium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

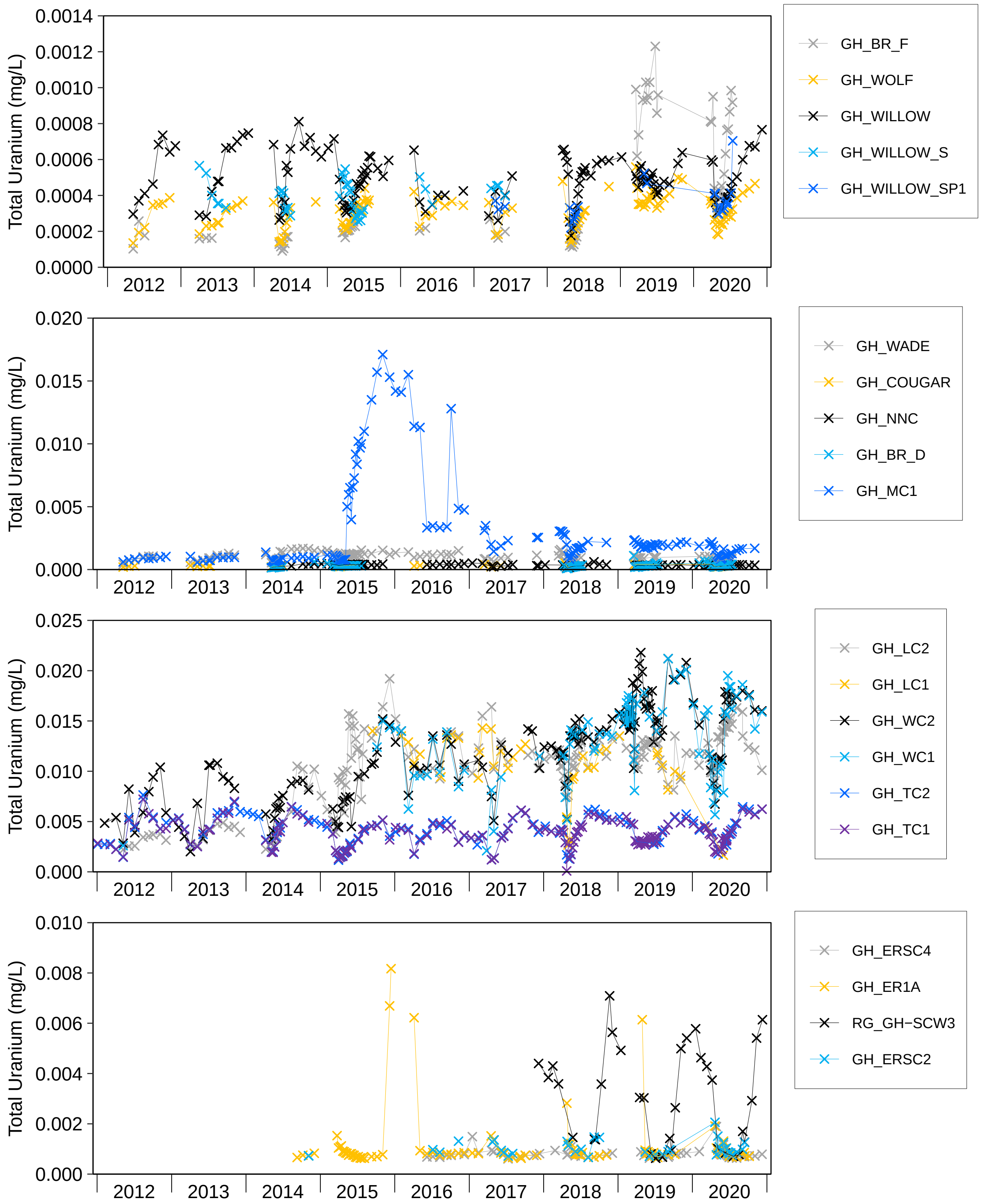


Figure 56: oncentrations of ota ranium in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: No values below the laboratory reporting limit (LRL). Total uranium was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

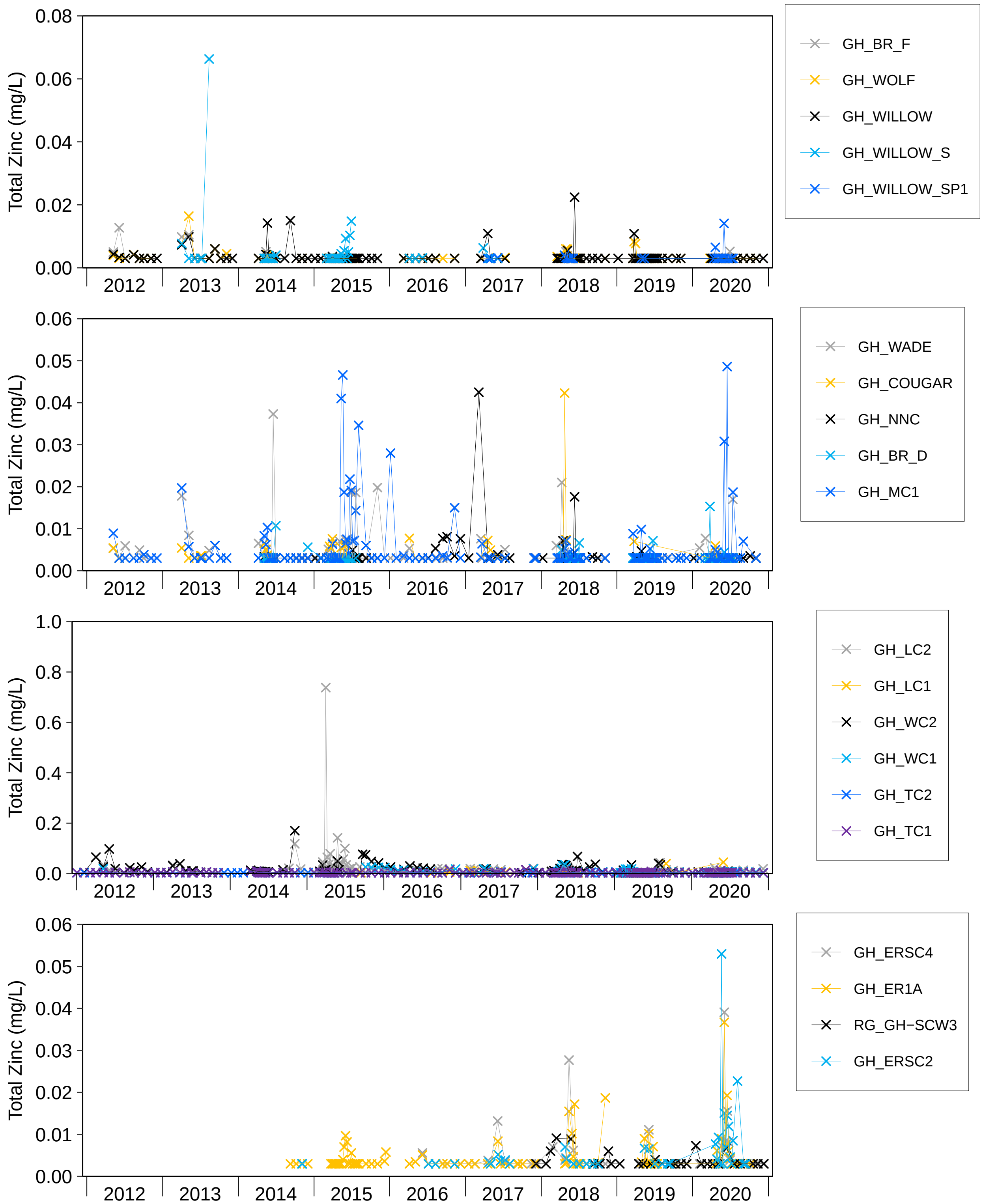


Figure 5 : oncentrations of ota inc in Sam es o ected from West side ri utaries and Side anne onitorin Stations 2 12 to 2 2

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (LRLs between 0.0030 and 0.018 mg/L). Total zinc was plotted because it was identified as a mine-related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018).

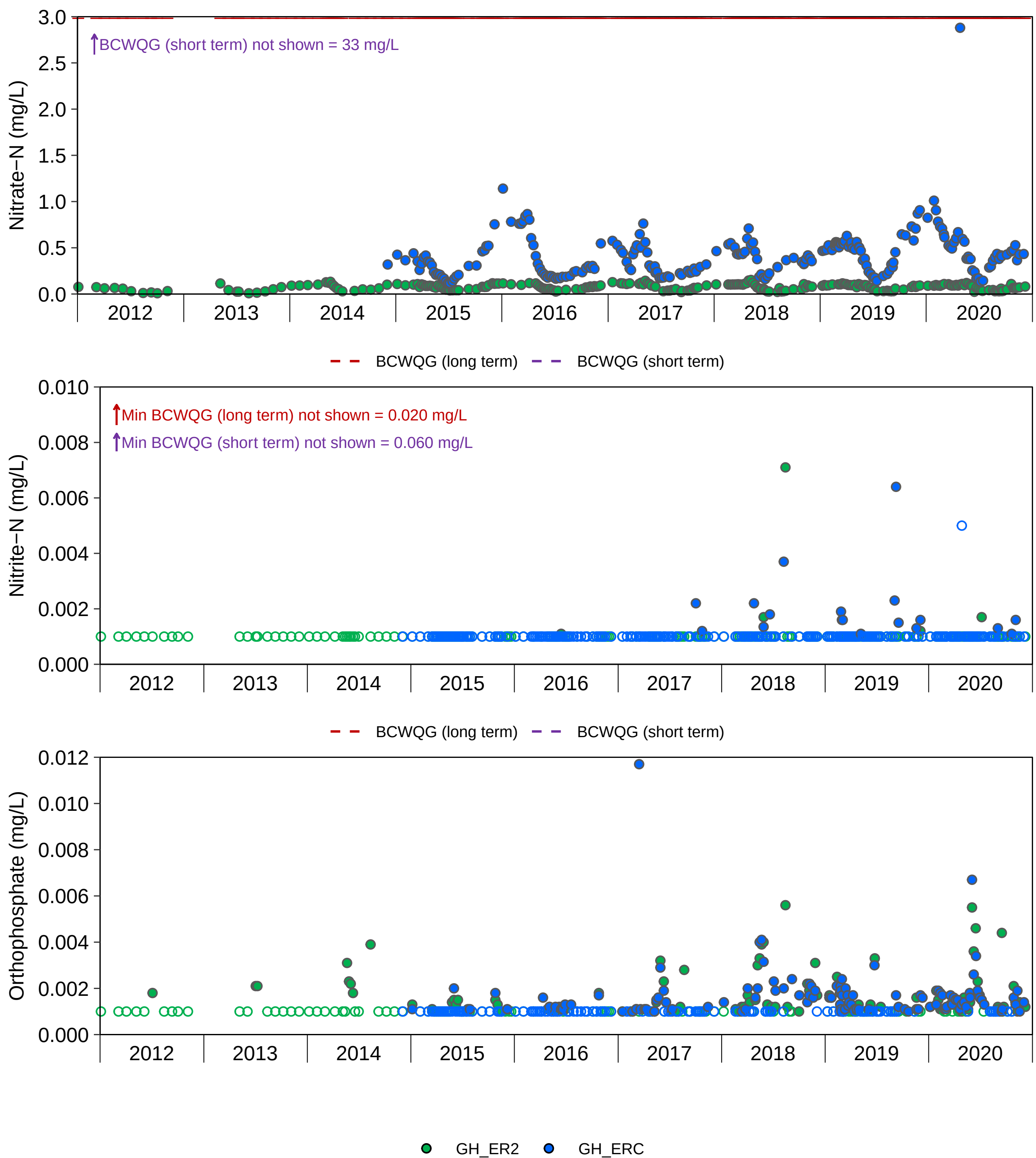


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3. Nitrate EVWQP Level 1 Benchmark not shown because it is the same as the long term BCWQG.

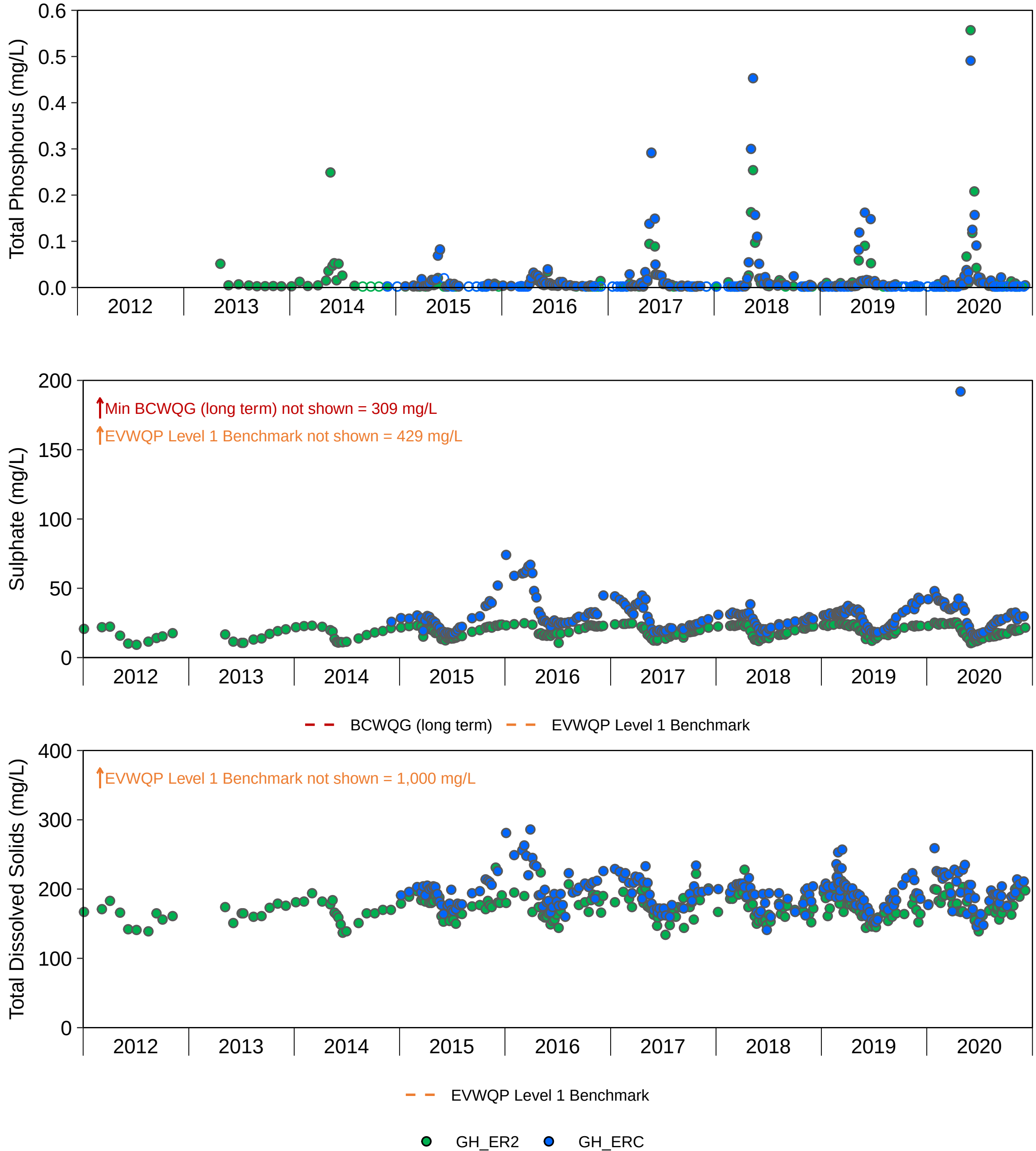


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

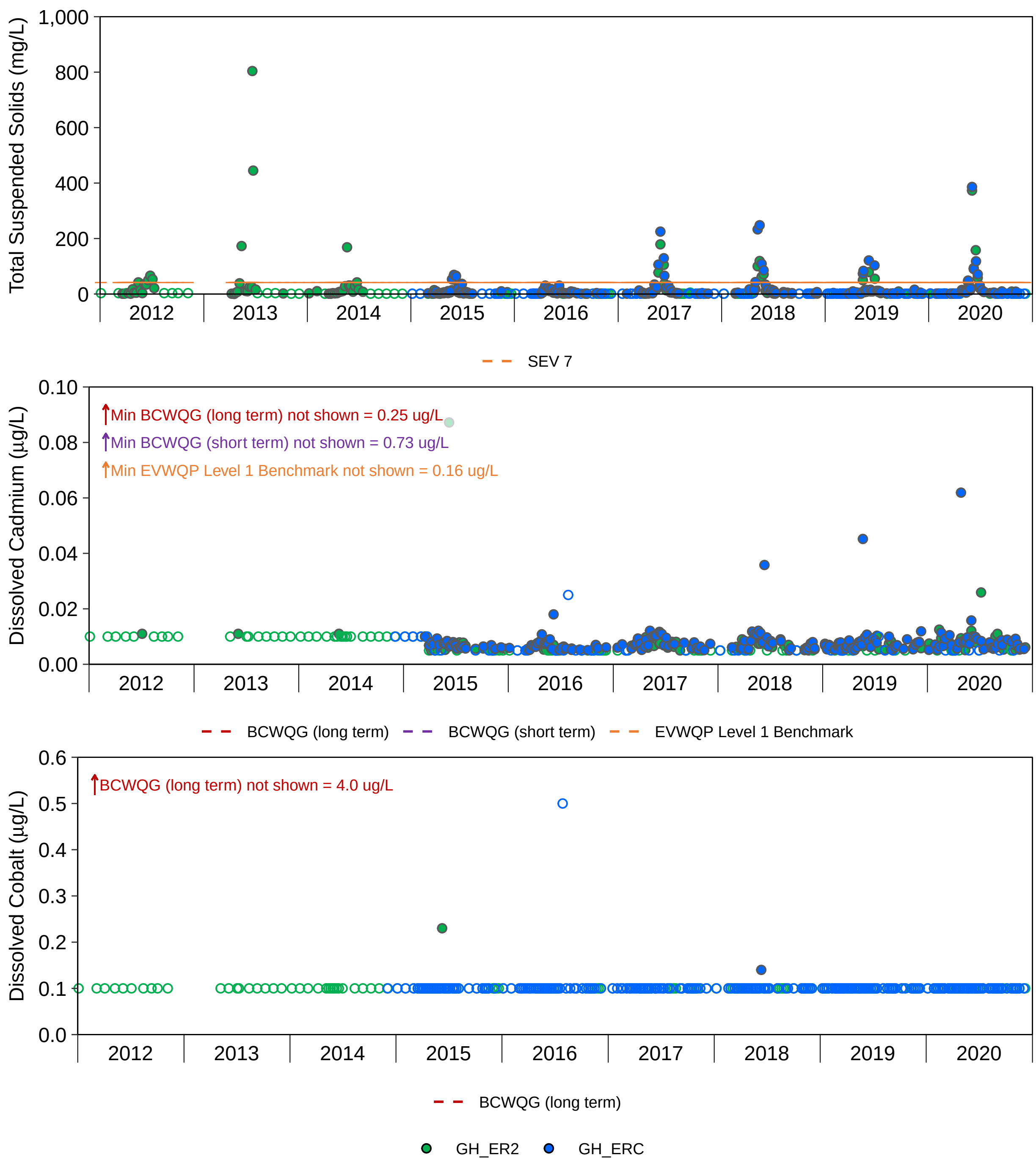


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

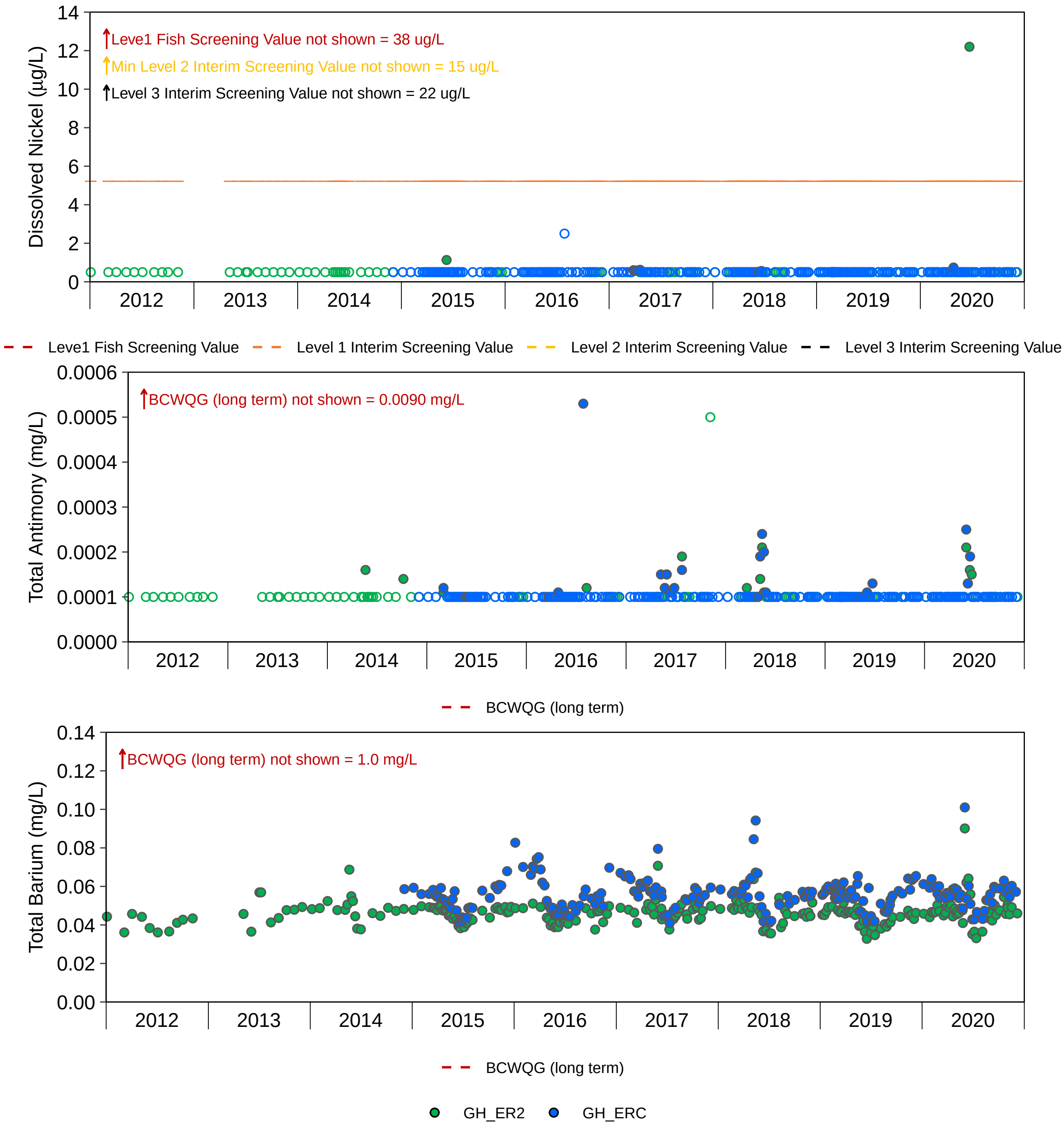


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

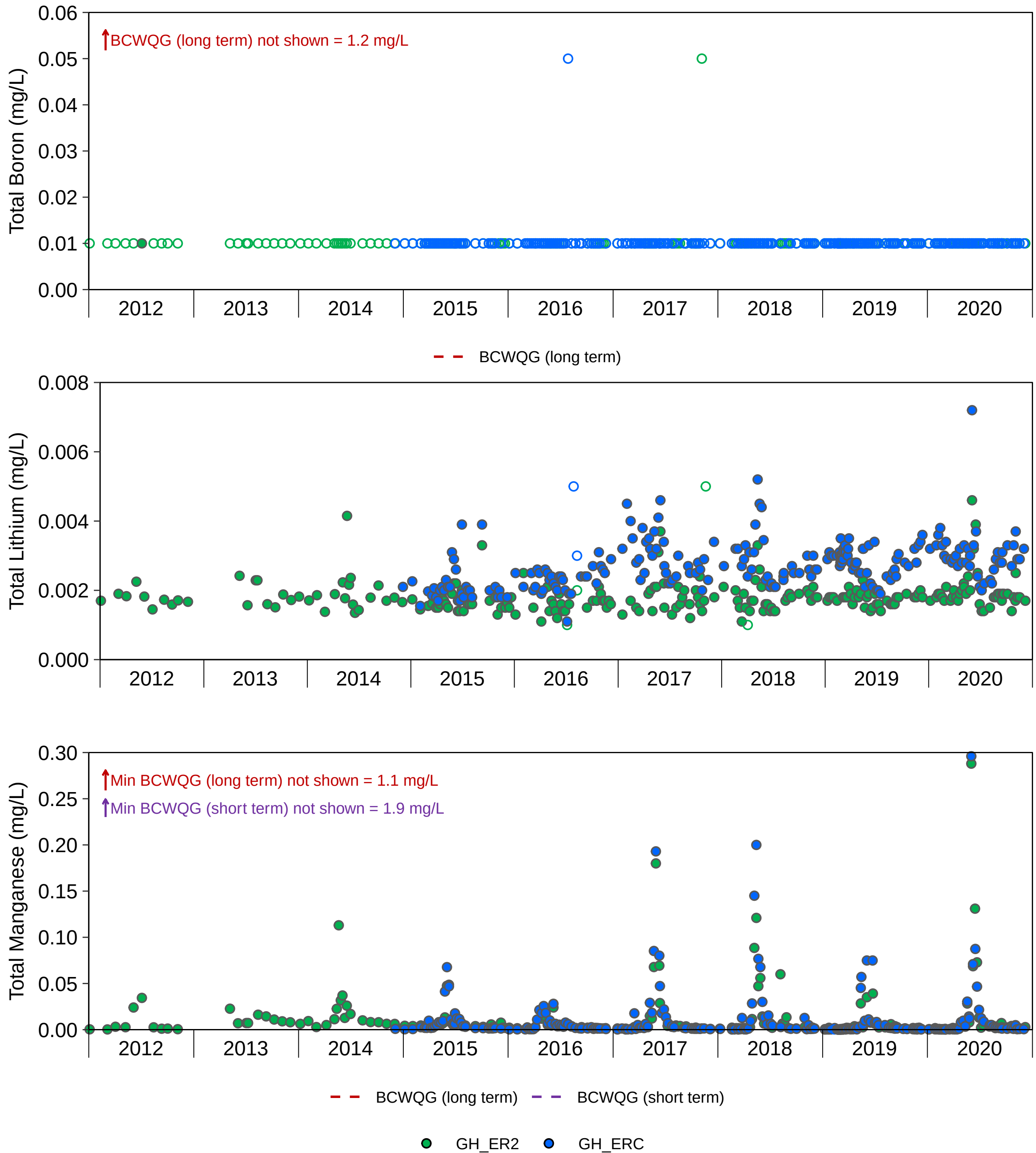


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

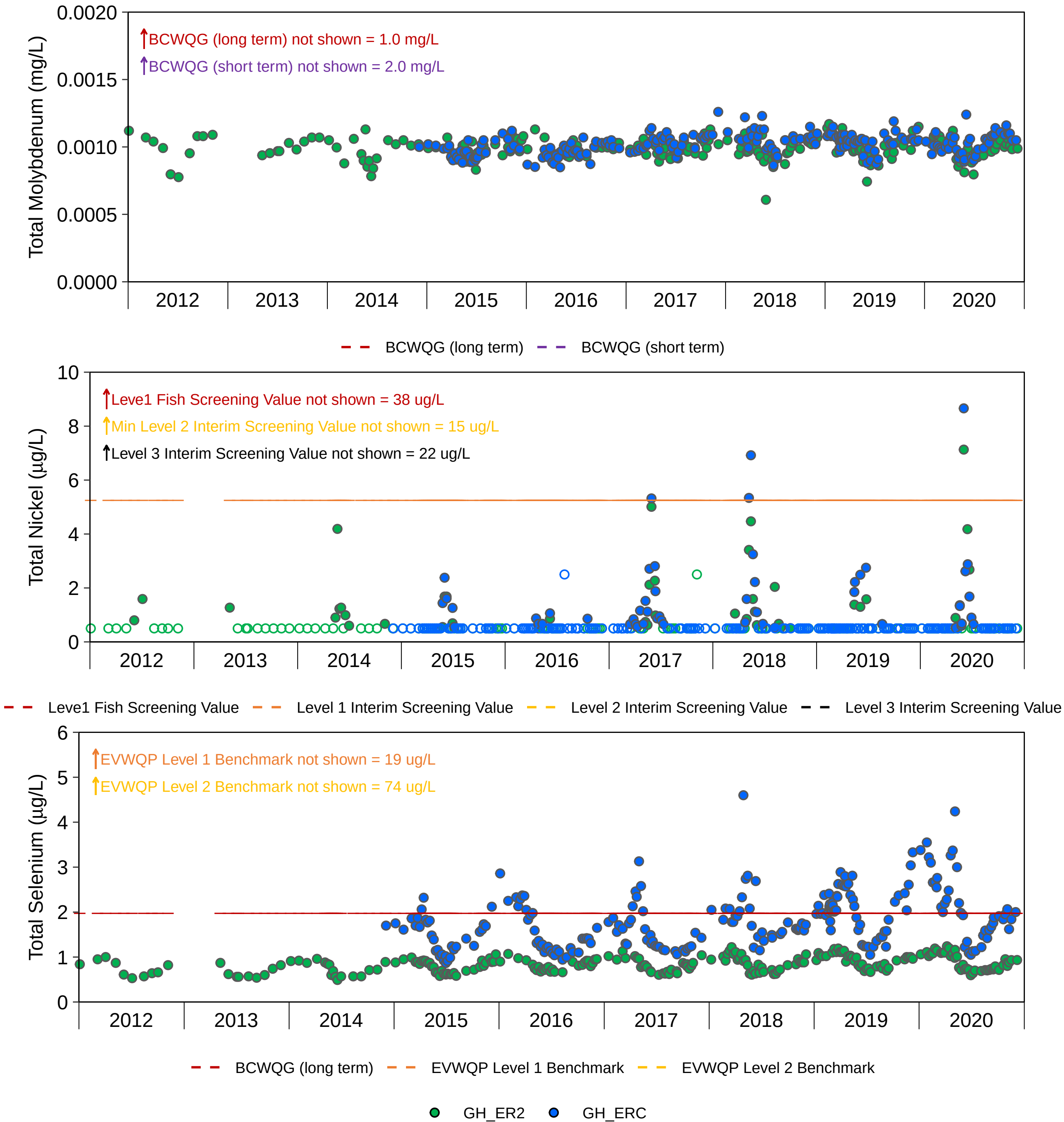


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

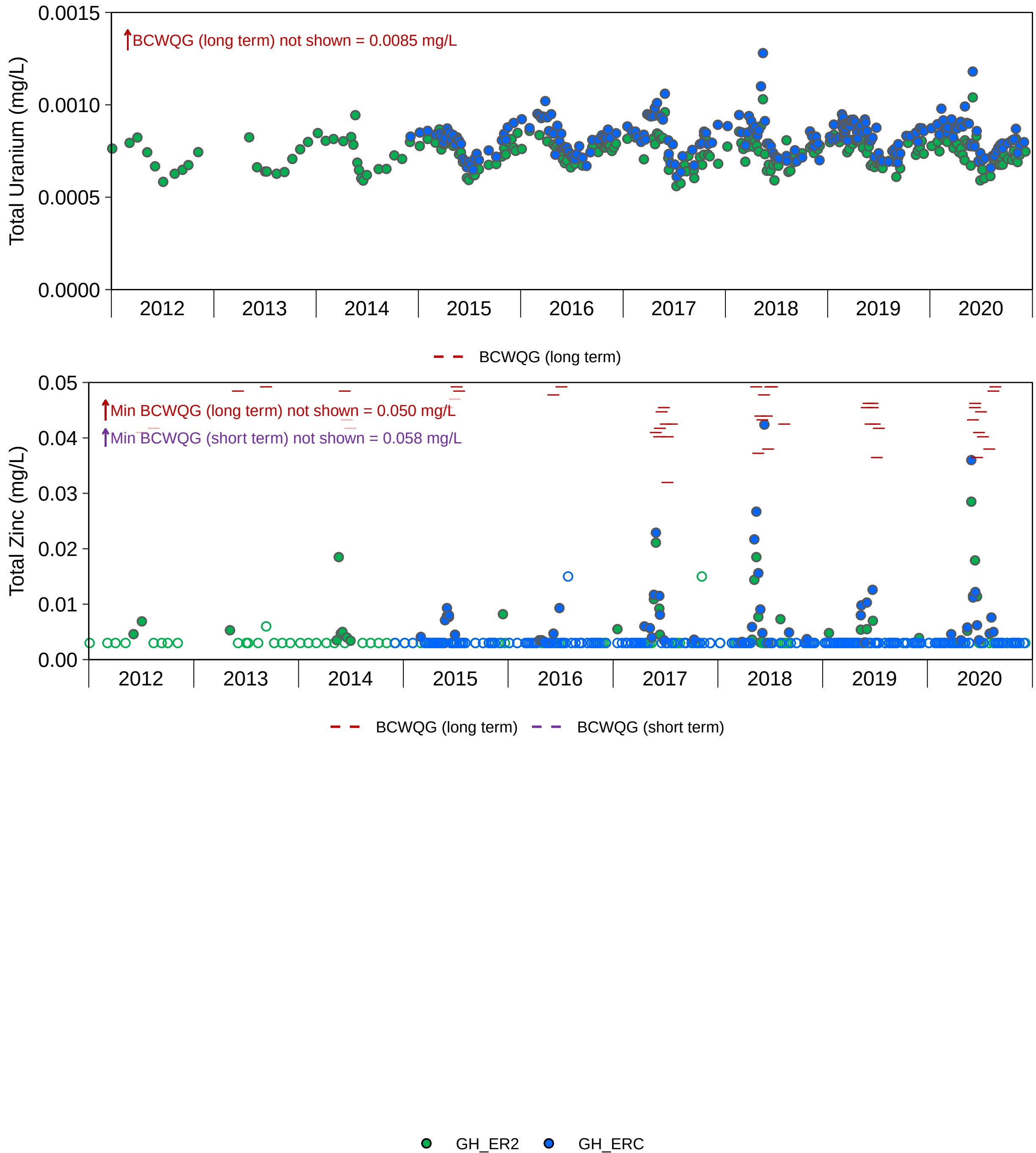


Figure D.58: Concentrations of Constituents in Samples Collected from Main Stem Elk River Stations Downstream (Mine−Exposed, GH_ERC) and Upstream (Reference, GH_ER2) of Mine Influence, 2012 to 2020

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Total suspended solids (TSS) was plotted based on EMC input, aiming to assess the potential effects of total suspended solids on fish use and habitat availability. Orthophosphate and phosphorus were also plotted based on EMC input, because these constituents were assessed in the GHO Cougar Pit Extension Joint Application. Dissolved nickel is provided for bioavailability context. All other constituents were plotted because they were identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). No BCWQG or EVWQP benchmarks exist for dissolved cobalt. Long−term average BCWQG for total cobalt is 4 µg/L. TSS effect level benchmarks based on modeling by Newcombe and Jensen (1996), see Section 2.3.

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
Janurary	1-Jan-20	0	0
	2-Jan-20	0	0
	3-Jan-20	0	0
	4-Jan-20	0	0
	5-Jan-20	0	0
	6-Jan-20	0	0
	7-Jan-20	0	0
	8-Jan-20	0	0
	9-Jan-20	0	0
	10-Jan-20	0	0
	11-Jan-20	0	0
	12-Jan-20	0	0
	13-Jan-20	0	0
	14-Jan-20	0	0
	15-Jan-20	0	0
	16-Jan-20	0	0
	17-Jan-20	0	0
	18-Jan-20	0	0
	19-Jan-20	0	0
	20-Jan-20	0	0
	21-Jan-20	0	0
	22-Jan-20	0	0
	23-Jan-20	0	0
	24-Jan-20	0	0
	25-Jan-20	0	0
	26-Jan-20	0	0
	27-Jan-20	0	0
	28-Jan-20	0	0
	29-Jan-20	0	0
	30-Jan-20	0	0
	31-Jan-20	0	0
February	1-Feb-20	0	0
	2-Feb-20	0	0
	3-Feb-20	0	0
	4-Feb-20	0	0
	5-Feb-20	0	0
	6-Feb-20	0	0
	7-Feb-20	0	0
	8-Feb-20	0	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
February	9-Feb-20	0	0
	10-Feb-20	0	0
	11-Feb-20	0	0
	12-Feb-20	0	0
	13-Feb-20	0	0
	14-Feb-20	0	0
	15-Feb-20	0	0
	16-Feb-20	0	0
	17-Feb-20	0	0
	18-Feb-20	0	0
	19-Feb-20	0	0
	20-Feb-20	0	0
	21-Feb-20	0	0
	22-Feb-20	0	0
	23-Feb-20	0	0
	24-Feb-20	0	0
	25-Feb-20	0	0
	26-Feb-20	0	0
	27-Feb-20	0	0
	28-Feb-20	0	0
	29-Feb-20	0	0
March	1-Mar-20	0	0
	2-Mar-20	0	0
	3-Mar-20	0	0
	4-Mar-20	0	0
	5-Mar-20	0	0
	6-Mar-20	0	0
	7-Mar-20	0	0
	8-Mar-20	0	0
	9-Mar-20	0	0
	10-Mar-20	0	0
	11-Mar-20	0	0
	12-Mar-20	0	0
	13-Mar-20	0	0
	14-Mar-20	0	0
	15-Mar-20	0	0
	16-Mar-20	0	0
	17-Mar-20	0	0
	18-Mar-20	0	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
March	19-Mar-20	0	0
	20-Mar-20	0	0
	21-Mar-20	0	0
	22-Mar-20	0	0
	23-Mar-20	0	0
	24-Mar-20	0	0
	25-Mar-20	0	0
	26-Mar-20	0	0
	27-Mar-20	0	0
	28-Mar-20	0	0
	29-Mar-20	0	0
	30-Mar-20	0	0
	31-Mar-20	0	0
April	1-Apr-20	0	0
	2-Apr-20	0	0
	3-Apr-20	0	0
	4-Apr-20	0	0
	5-Apr-20	0	0
	6-Apr-20	0	0
	7-Apr-20	0	0
	8-Apr-20	0	0
	9-Apr-20	0	0
	10-Apr-20	0	0
	11-Apr-20	0	0
	12-Apr-20	0	0
	13-Apr-20	0	0
	14-Apr-20	0	0
	15-Apr-20	0	0
	16-Apr-20	0	0
	17-Apr-20	0	0
	18-Apr-20	0	0
	19-Apr-20	0	0
	20-Apr-20	0	0
	21-Apr-20	0	0
	22-Apr-20	0	0
	23-Apr-20	0	0
	24-Apr-20	0	0
	25-Apr-20	0	0
	26-Apr-20	0	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
April	27-Apr-20	0	0
	28-Apr-20	0	0
	29-Apr-20	0	0
	30-Apr-20	0	0
May	1-May-20	0	0
	2-May-20	0	0
	3-May-20	0	0
	4-May-20	0	0
	5-May-20	0	0
	6-May-20	0	0
	7-May-20	0	0
	8-May-20	0	0
	9-May-20	0	0
	10-May-20	0	0
	11-May-20	0	0
	12-May-20	0	0
	13-May-20	0	0
	14-May-20	0	0
	15-May-20	0	0
	16-May-20	1,500	0
	17-May-20	1,500	0
	18-May-20	1,500	0
	19-May-20	1,500	0
	20-May-20	1,500	0
	21-May-20	1,500	0
	22-May-20	1,500	0
	23-May-20	1,500	0
	24-May-20	1,500	0
	25-May-20	1,500	0
	26-May-20	1,500	0
	27-May-20	1,500	0
	28-May-20	1,500	0
	29-May-20	1,500	0
	30-May-20	1,500	0
	31-May-20	1,500	0
June	1-Jun-20	1,500	0
	2-Jun-20	1,500	0
	3-Jun-20	1,500	0
	4-Jun-20	1,500	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
June	5-Jun-20	1,500	0
	6-Jun-20	1,500	0
	7-Jun-20	1,500	0
	8-Jun-20	1,500	0
	9-Jun-20	1,500	0
	10-Jun-20	1,500	0
	11-Jun-20	1,500	0
	12-Jun-20	1,500	0
	13-Jun-20	1,500	0
	14-Jun-20	1,500	0
	15-Jun-20	1,500	0
	16-Jun-20	1,500	0
	17-Jun-20	1,500	0
	18-Jun-20	1,500	0
	19-Jun-20	1,500	0
	20-Jun-20	1,500	0
	21-Jun-20	1,500	0
	22-Jun-20	1,500	0
	23-Jun-20	1,500	0
	24-Jun-20	1,500	0
	25-Jun-20	1,500	0
	26-Jun-20	1,500	0
	27-Jun-20	1,500	0
	28-Jun-20	1,500	0
	29-Jun-20	1,500	0
	30-Jun-20	1,500	0
July	1-Jul-20	1,500	0
	2-Jul-20	1,500	0
	3-Jul-20	1,500	0
	4-Jul-20	2,000	0
	5-Jul-20	2,000	0
	6-Jul-20	2,000	0
	7-Jul-20	2,000	0
	8-Jul-20	2,000	0
	9-Jul-20	2,000	0
	10-Jul-20	2,000	0
	11-Jul-20	2,000	0
	12-Jul-20	2,000	0
	13-Jul-20	2,000	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
July	14-Jul-20	2,000	0
	15-Jul-20	2,000	0
	16-Jul-20	2,000	0
	17-Jul-20	2,000	0
	18-Jul-20	2,000	0
	19-Jul-20	2,000	0
	20-Jul-20	2,000	0
	21-Jul-20	2,000	0
	22-Jul-20	2,000	0
	23-Jul-20	2,000	0
	24-Jul-20	2,000	0
	25-Jul-20	2,000	0
	26-Jul-20	2,000	0
	27-Jul-20	2,000	0
	28-Jul-20	2,000	0
	29-Jul-20	2,000	0
	30-Jul-20	2,000	0
	31-Jul-20	2,000	0
August	1-Aug-20	2,000	1,000
	2-Aug-20	2,000	1,000
	3-Aug-20	2,000	1,000
	4-Aug-20	2,000	1,000
	5-Aug-20	700	1,000
	6-Aug-20	700	1,000
	7-Aug-20	700	1,000
	8-Aug-20	700	1,000
	9-Aug-20	700	1,000
	10-Aug-20	700	1,000
	11-Aug-20	700	1,000
	12-Aug-20	700	1,000
	13-Aug-20	700	1,000
	14-Aug-20	700	1,000
	15-Aug-20	700	1,000
	16-Aug-20	700	1,000
	17-Aug-20	700	1,000
	18-Aug-20	700	1,000
	19-Aug-20	700	1,000
	20-Aug-20	700	1,000
	21-Aug-20	700	1,000

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
August	22-Aug-20	700	1,000
	23-Aug-20	700	1,000
	24-Aug-20	700	1,000
	25-Aug-20	700	1,000
	26-Aug-20	700	1,000
	27-Aug-20	700	1,000
	28-Aug-20	700	1,000
	29-Aug-20	700	1,000
	30-Aug-20	700	1,000
	31-Aug-20	700	1,000
September	1-Sep-20	700	1,000
	2-Sep-20	700	1,000
	3-Sep-20	700	1,000
	4-Sep-20	700	1,000
	5-Sep-20	700	1,000
	6-Sep-20	700	1,000
	7-Sep-20	700	1,000
	8-Sep-20	700	1,000
	9-Sep-20	700	1,000
	10-Sep-20	700	1,000
	11-Sep-20	700	1,000
	12-Sep-20	700	1,000
	13-Sep-20	700	1,000
	14-Sep-20	700	1,000
	15-Sep-20	700	1,000
	16-Sep-20	700	1,000
	17-Sep-20	700	1,000
	18-Sep-20	700	1,000
	19-Sep-20	700	1,000
	20-Sep-20	700	1,000
	21-Sep-20	700	1,000
	22-Sep-20	700	1,000
	23-Sep-20	700	1,000
	24-Sep-20	700	1,000
	25-Sep-20	700	1,000
	26-Sep-20	700	1,000
	27-Sep-20	700	1,000
	28-Sep-20	700	1,000
	29-Sep-20	0	1,000

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
September	30-Sep-20	0	1,000
October	1-Oct-20	0	1,000
	2-Oct-20	0	1,000
	3-Oct-20	0	1,000
	4-Oct-20	0	1,000
	5-Oct-20	0	1,000
	6-Oct-20	0	1,000
	7-Oct-20	0	1,000
	8-Oct-20	0	1,000
	9-Oct-20	0	1,000
	10-Oct-20	0	1,000
	11-Oct-20	0	1,000
	12-Oct-20	0	1,000
	13-Oct-20	0	1,000
	14-Oct-20	0	1,000
	15-Oct-20	0	1,000
	16-Oct-20	0	1,000
	17-Oct-20	0	1,000
	18-Oct-20	0	1,000
	19-Oct-20	0	1,000
	20-Oct-20	0	1,000
	21-Oct-20	0	1,000
	22-Oct-20	0	1,000
	23-Oct-20	0	1,000
	24-Oct-20	0	1,000
	25-Oct-20	0	1,000
	26-Oct-20	0	0
	27-Oct-20	0	0
	28-Oct-20	0	0
	29-Oct-20	0	0
	30-Oct-20	0	0
	31-Oct-20	0	0
November	1-Nov-20	0	0
	2-Nov-20	0	0
	3-Nov-20	0	0
	4-Nov-20	0	0
	5-Nov-20	0	0
	6-Nov-20	0	0
	7-Nov-20	0	0

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
November	8-Nov-20	0	0
	9-Nov-20	0	0
	10-Nov-20	0	0
	11-Nov-20	0	0
	12-Nov-20	0	1,000
	13-Nov-20	0	1,000
	14-Nov-20	0	1,000
	15-Nov-20	0	1,000
	16-Nov-20	0	1,000
	17-Nov-20	0	1,000
	18-Nov-20	0	1,000
	19-Nov-20	0	1,000
	20-Nov-20	0	1,000
	21-Nov-20	0	1,000
	22-Nov-20	0	1,000
	23-Nov-20	0	1,000
	24-Nov-20	0	1,000
	25-Nov-20	0	1,000
	26-Nov-20	0	1,000
	27-Nov-20	0	1,000
	28-Nov-20	0	1,000
	29-Nov-20	0	1,000
	30-Nov-20	0	1,000
December	1-Dec-20	0	1,000
	2-Dec-20	0	1,000
	3-Dec-20	0	1,000
	4-Dec-20	0	1,000
	5-Dec-20	0	1,000
	6-Dec-20	0	700
	7-Dec-20	0	700
	8-Dec-20	0	700
	9-Dec-20	0	700
	10-Dec-20	0	700
	11-Dec-20	0	700
	12-Dec-20	0	700
	13-Dec-20	0	700
	14-Dec-20	0	700
	15-Dec-20	0	700
	16-Dec-20	0	700

Table D.1: Daily Pit Pumping Rates, Discharged to Leask and Wolfram Creeks, 2020

Month	Date	Phase 3 to Wolfram (gpm)	Phase 6 To Leask (gpm)
December	17-Dec-20	0	700
	18-Dec-20	0	700
	19-Dec-20	0	700
	20-Dec-20	0	700
	21-Dec-20	0	700
	22-Dec-20	0	700
	23-Dec-20	0	700
	24-Dec-20	0	700
	25-Dec-20	0	700
	26-Dec-20	0	700
	27-Dec-20	0	700
	28-Dec-20	0	700
	29-Dec-20	0	700
	30-Dec-20	0	700
	31-Dec-20	0	700

Note: gpm = gallon per minute.

Table D.2: British Columbia Water Quality Guidelines, Site-Specific Elk Valley Water Quality Plan (EVWWQP) Benchmarks, and Interim Screening Values for Parameters Assessed in the GHO LAEMP, 2020

Variable		Units	British Columbia Water Quality Guidelines [a]				Site-Specific Benchmark [b]
			Long-term Average	Short-term Maximum	Year	Status	
Non-Metals	Total Alkalinity	mg/L	For dissolved calcium = < 4mg/L, WQG = <10 For dissolved calcium = 4 to 8 mg/L, WQG = 10 to 20 For dissolved calcium = > 8 mg/L, WQG = > 20	-	2015	Working	-
Non-Metals	Unionized Ammonia [c]	mg/L	pH and Temperature dependent (tabular)	pH and Temperature dependent (tabular)	2009	Approved	-
Non-Metals	Chloride	mg/L	150	600	2003	Approved	-
Non-Metals	Fluoride	mg/L	-	For hardness ≤ 10 mg/L, WQG = 0.4 For hardness > 10 mg/L, WQG = [-51.73 + 92.57 × log$_{10}$(hardness)]×0.01 Maximum applicable hardness = 385 mg/L	1990	Approved	-
Non-Metals	Nitrate-N	mg/L	3	33	2009	Approved	EVWQP benchmark = BCWQG = 3 mg/L
Non-Metals	Nitrite-N [d]	mg/L	0.02 to 0.20	0.06 to 0.60	2009	Approved	-
Non-Metals	Dissolved oxygen [e]	mg/L	For buried embryo/alevin life stages, WQG (water column) = 11 WQG (interstitial) = 8 For other life stages, WQG (water column) = 8	For buried embryo/alevin life stages, WQG (water column) = 9 WQG (interstitial) = 6 For other life stages, WQG (water column) = 5	1997	Approved	-
Non-Metals	pH [f]	pH units	6.5 - 9.0		1991	Approved	-
Non-Metals	Sulphate [g]	mg/L	128 to 429 Maximum applicable hardness = 250 mg/L	-	2013	Approved	Level 1 EVWQP Benchmark = BCWQG = 429 mg/L
Non-Metals	Total Dissolved Solids	mg/L	-	-	-	-	Level 1 EVWQP Benchmark = 1,000 mg/L
Metals and Metalloids – Total	Antimony (III)	mg/L	0.009	-	2015	Working	-
Metals and Metalloids – Total	Arsenic	mg/L	-	0.005	2002	Approved	-
Metals and Metalloids – Total	Barium	mg/L	1	-	2015	Working	-
Metals and Metalloids – Total	Beryllium	mg/L	0.00013	-	2015	Working	-
Metals and Metalloids – Total	Boron	mg/L	1.2	-	2003	Approved	-
Metals and Metalloids – Total	Chromium [h]	mg/L	For Cr(VI), WQG = 0.001 For Cr(III), WQG = 0.0089	-	2015	Working	-
Metals and Metalloids – Total	Iron	mg/L	-	1	2008	Approved	-
Metals and Metalloids – Total	Lead [g]	mg/L	For hardness ≤ 8 mg/L, none proposed For hardness 8 to 360 mg/L, WQG = 0.001×{3.31+ exp[1.273 × ln(hardness) - 4.704]} No more than 20% of samples in a 30-d period should be >1.5X the guideline. Maximum applicable hardness = 360 mg/L	For hardness ≤ 8 mg/L, WQG ≤ 0.003 For hardness 8 to 360 mg/L, WQG = 0.001×{exp[1.273 × ln(hardness) - 1.460]} Maximum applicable hardness = 360 mg/L	1987	Approved	-
Metals and Metalloids – Total	Manganese [g]	mg/L	For hardness 37 to 450 mg/L, WQG ≤ 0.004 × hardness + 0.605 Maximum applicable hardness = 450 mg/L	For hardness 25 to 259 mg/L, WQG ≤ 0.01102 × hardness + 0.54 Maximum applicable hardness = 259 mg/L	2001	Approved	-
Metals and Metalloids – Total	Mercury [i]	mg/L	MeHg ≤ 0.5% of THg, WQG = 0.00002 Else, WQG = [0.0001/(MeHg/THg)] OR When MeHg = 0.5% of THg, WQG= 0.00002 When MeHg = 1.0% of THg, WQG = 0.00001 When MeHg = 8.0% of THg, WQG= 0.00000125	-	2001	Approved	-
Metals and Metalloids – Total	Molybdenum	mg/L	1	2	1986	Approved	-
Metals and Metalloids – Total	Nickel [g]	mg/L	-	-	-	-	Level 1 Interim Screening Value = 0.0053 Level 2 Interim Screening Value = 0.015 Level 3 Interim Screening Value = 0.022
Metals and Metalloids – Total	Selenium	µg/L	2	-	2014	Approved	Level 1 EVWQP Benchmark = 19 Level 2 EVWQP Benchmark = 74
Metals and Metalloids – Total	Silver [f]	mg/L	For hardness ≤ 100 mg/L, WQG = 0.00005 For hardness > 100 mg/L, WQG = 0.0015	For hardness ≤ 100 mg/L, WQG = 0.0001 For hardness > 100 mg/L, WQG = 0.003	1996	Approved	-
Metals and Metalloids – Total	Thallium	mg/L	0.0008	-	1997	Working	-
Metals and Metalloids – Total	Uranium	mg/L	0.0085	-	2011	Working	-
Metals and Metalloids – Total	Zinc [g]	mg/L	For hardness ≤ 90 mg/L, WQG = 0.0075 For hardness 90 to 330 mg/L, WQG = [7.5 + 0.75 (hardness - 90)]×0.001; Maximum applicable hardness = 330 mg/L	For hardness ≤ 90 mg/L, WQG = 0.033 For hardness 90 to 500 mg/L, WQG = [33 + 0.75 (hardness - 90)]×0.001; Maximum applicable hardness = 500 mg/L	1999	Approved	-
Metals and Metalloids – Dissolved	Aluminum	mg/L	When pH ≥ 6.5, WQG = 0.05 When pH < 6.5, WQG = exp[1.6 - 3.327(median pH)+ 0.402 (median pH)^2]	When pH ≥ 6.5, WQG = 0.1 When pH < 6.5, WQG = exp[1.209 - 2.426(pH)+ 0.286 (pH)^2]	2001	Approved	-
Metals and Metalloids – Dissolved	Cadmium [g]	µg/L	For hardness = 3.4 to 285 mg/L, WQG = {exp[0.736×ln(hardness) - 4.943]} Maximum applicable hardness = 285 mg/L	For hardness = 7 to 455 mg/L, WQG = {exp[1.03×ln(hardness)-5.274]} Maximum applicable hardness = 455 mg/L	2015	Approved	Level 1 EVWQP Benchmark = $10^{0.83(\log(\text{hardness}))-2.53}$ Maximum applicable hardness = 285 mg/L
Metals and Metalloids – Dissolved	Copper	mg/L	Biotic Ligand Model	Biotic Ligand Model	2019	Approved	-
Metals and Metalloids – Dissolved	Iron	mg/L	-	WQG = 0.35 mg/L	2008	Approved	-

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (BCMOECCS 2019 and 2020). For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.

[b] When appropriate, site-specific Elk Valley Water Quality Plan Benchmarks (EVWQP; Teck 2014) or interim screening values were applied in addition to or instead of BC water quality guidelines. Interim screening values are displayed for nickel (Golder 2017; Coal Mountain Operations Aquatic Health Assessment Report).

[c] Temperature and pH dependent; range of minimum and maximum values.

[d] Dependent on concurrent chloride, range of values reported (BCMOECCS 2019)

[e] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.

[f] Unrestricted change permitted within this pH range.

[g] For hardness-based guidelines, concurrent hardness values were used for calculating guidelines. If hardness values exceeding the maximum applicable hardness, then guidelines were determined using the maximum applicable hardness. If hardness values is lower than the minimum hardness, then guidelines were determined using the minimum hardness.

[j] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[i] The most conservative guideline (0.00000125 mg/L) was applied.

Table D.3: Scale of the Severity (SEV) of Ill Effects associated with Excess Suspended Sediment (Newcombe and Jensen 1996), and Calculated Total Suspended Solids (TSS) Concentrations for Each SEV

SEV	Description of Effect	TSS (mg/L)[a]
Nil Effect		
0	No behavioral effects	0.004
Behavioral Effects		
1	Alarm reaction	0.01
2	Abandonment of cover	0.05
3	Avoidance response	0.2
Sublethal Effects		
4	Short-term reduction in feeding rates; short-term reduction in feeding success	0.8
5	Minor physiological stress: increase in rate of coughing; increased respiration rate	3
6	Moderate physiological stress	12
7	Moderate habitat degradation; impaired homing	46
8	Indications of major physiological stress: long-term reduction in feeding rate; long-term reduction in feeding success; poor condition	178
Lethal and Paralethal Effects		
9	Reduced growth rate: delayed hatching: reduced fish density	690
10	0-20% mortality; increased predation; moderate to severe habitat degradation	2,673
11	>20-40% mortality	10,354
12	>40-60% mortality	40,110
13	>60-80% mortality	155,384
14	>80-I00% mortality	601,953

[a] Calculated TSS concentration at each effect level using model by Newcombe and Jensen (1996). The benchmarks provided assume one week of exposure to juvenile and adult salmonids, with TSS particle sizes 0.5 to 250 µm (Group 1 from Newcombe and Jensen 1996).

Table D.4: Concentrations of Selenium Species Measured in Water Samples Collected Concurrent with Benthic Invertebrate Tissue Samples, September 2020

Exposure	Location	Station	Date	Benthic Invertebrate Tissue Selenium (µg/g d.w.)	Total Selenium (µg/L)	Dissolved Selenium (µg/L)	Dimethylselenoxide (µg/L)	Methylseleninic Acid (µg/L)	Selenite (µg/L)	Selenate (µg/L)	Selenocyanate (µg/L)	Selenomethionine (µg/L)	Selenosulfate (µg/L)	Selenium - Unknown[a] (µg/L)	Unknown Selenium Species[b] (µg/L)	Dimethylselenoxide + Methylseleninic Acid (µg/L)
Reference	Main Stem Elk River	GH_ER2 / RG_ELUGH	17-Sep-20	6.7 8.3 3.8	0.696	0.737	<0.010	<0.010	<0.050	0.689	<0.040	<0.010	<0.060	<0.010	<0.060	<0.020
Mine-Exposed	Elk River Side Channel	GH_ERSC4	12-Sep-20	8.6 5.3 6.9	0.744	0.846	<0.010	<0.010	<0.050	0.645	<0.040	<0.010	<0.060	<0.010	<0.060	<0.020
		GH_ER1A	11-Sep-20	6.3 9.1 6.3	1.56	1.54	<0.010	<0.010	<0.050	1.35	<0.040	<0.010	<0.060	<0.010	<0.060	<0.020
		RG_ERSC5	11-Sep-20	12 11 6.6	1.24	1.15	<0.010	<0.010	<0.050	1.14	<0.040	<0.010	<0.060	<0.010	<0.060	<0.020
	Tributary	GH_TC2 / RG_THCK	10-Sep-20	59 59 59	125	125	0.183	0.246	5.79	120	<0.040	<0.010	<0.060	<0.010	<0.060	0.429
	Elk River Side Channel	RG_GH-SCW3	13-Sep-20	6.9 9.1 14	11.4	12.2	0.015	0.018	0.452	11.3	<0.040	<0.010	<0.060	<0.010	<0.060	0.033
		GH_ERSC2	13-Sep-20	14 28 17	12.3	11.4	<0.010	0.019	0.442	11.4	<0.040	<0.010	<0.060	<0.010	<0.060	0.019
		RG_SCDTC	13-Sep-20	8.0 11 13	12.4	13.6	0.022	0.024	0.543	12.4	<0.040	<0.010	<0.060	<0.010	<0.060	0.046
	Main Stem Elk River	GH_ERC / RG_EL20	17-Sep-20	9.5 13 8.8 9.7 7.3	1.71	1.62	<0.010	<0.010	0.085	1.56	<0.040	<0.010	<0.060	<0.010	<0.060	<0.020

[a] An unknown selenium species eluting between MeSe(IV) and SeMet is also reported [Se Unk A]. Research at Brooks Applied Labs (BAL) has indicated that [Se Unk A] is a product of the oxidation of volatile selenium species present in some client samples.
[b] The total concentration of any remaining unidentified selenium-containing species detected in each sample has also been reported as [Unk Se Sp].

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)
GH_BR_F	n	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
	Annual Minimum	121	7.66	7.99	10.0	129	0.0379	<0.001	<0.005	3.87	<0.5	0.0620	<0.0001	0.000180	0.196	<0.00002	<0.01	<0.0001	<0.0001	0.0120	<0.00005
	Annual Maximum	235	8.55	8.74	13.1	225	0.348	0.00110	0.0326	11.1	<0.5	0.137	0.000130	0.000240	0.362	<0.00002	0.0100	0.000490	0.000130	0.193	0.000135
	Annual Mean	175	8.36	8.46	11.1	168	0.128	0.00101	0.0101	5.88	<0.5	0.105	0.000110	0.000214	0.275	<0.00002	0.0100	0.000180	0.000105	0.0851	0.0000786
	Annual Median	175	8.38	8.50	10.8	161	0.0903	<0.001	0.00760	5.51	<0.5	0.108	0.000110	0.000210	0.260	<0.00002	<0.01	0.000130	<0.0001	0.0790	0.0000630
	% < LRL	0%	0%	0%	0%	0%	0%	94%	24%	0%	100%	0%	18%	0%	0%	100%	88%	41%	65%	0%	47%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WOLF	n	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Annual Minimum	167	7.62	8.20	9.60	153	0.00990	<0.001	<0.005	6.16	0.190	0.0820	<0.0001	0.000150	0.0888	<0.00002	0.0140	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	279	8.61	8.62	12.8	235	1.20	0.00160	0.153	26.8	<0.5	0.140	<0.0001	0.000290	0.162	0.0000230	0.0440	0.000540	0.000230	0.443	0.000309
	Annual Mean	214	8.41	8.42	11.2	192	0.358	0.00104	0.0188	12.8	0.250	0.113	<0.0001	0.000189	0.117	0.0000201	0.0212	0.000160	0.000110	0.106	0.0000811
	Annual Median	208	8.45	8.43	10.9	188	0.266	<0.001	0.00750	11.7	0.260	0.114	<0.0001	0.000180	0.113	<0.00002	0.0180	0.000110	<0.0001	0.0640	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0%	86%	5%	0%	86%	0%	100%	0%	0%	95%	0%	43%	76%	5%	67%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WILLOW	n	20	20	21	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Annual Minimum	188	8.02	7.55	7.60	180	<0.005	<0.001	<0.005	6.78	0.330	0.0890	<0.0001	0.000190	0.136	<0.00002	0.0110	<0.0001	<0.0001	0.0120	<0.00005
	Annual Maximum	289	8.64	8.32	12.3	280	0.841	0.00230	0.158	15.3	0.770	0.167	<0.0001	0.000260	0.268	<0.00002	0.0200	0.000220	0.000105	0.163	0.000127
	Annual Mean	236	8.42	8.12	10.5	224	0.249	0.00108	0.0176	10.0	0.384	0.123	<0.0001	0.000221	0.204	<0.00002	0.0151	0.000114	0.000100	0.0535	0.0000603
	Annual Median	228	8.44	8.17	10.3	224	0.189	<0.001	0.00835	9.50	0.340	0.123	<0.0001	0.000220	0.206	<0.00002	0.0140	<0.0001	<0.0001	0.0430	<0.00005
	% < LRL	0%	0%	0%	0%	0%	5.0%	90%	20%	0%	75%	0%	100%	0%	0%	100%	0%	65%	95%	0%	75%
	% > BCWQG[a]	-	0%	0%	5%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	5%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WILLOW_SP1	n	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Annual Minimum	185	7.83	7.56	3.14	173	<0.005	<0.001	<0.005	6.62	<0.5	0.0860	<0.0001	0.000160	0.114	<0.00002	0.0130	<0.0001	<0.0001	0.0170	<0.00005
	Annual Maximum	237	8.54	8.65	12.6	233	0.313	0.00120	0.331	12.4	<0.5	0.131	0.000180	0.000970	0.206	0.0000290	0.0160	0.000300	0.000330	0.602	0.000228
	Annual Mean	205	8.41	8.33	9.99	197	0.136	0.00102	0.0390	8.47	<0.5	0.113	0.000108	0.000265	0.157	0.0000207	0.0143	0.000145	0.000118	0.0986	0.0000782
	Annual Median	203	8.47	8.37	10.3	197	0.119	<0.001	0.0101	8.26	<0.5	0.118	<0.0001	0.000200	0.149	<0.00002	0.0140	0.000120	<0.0001	0.0520	<0.00005
	% < LRL	0%	0%	0%	0%	0%	8%	92%	8%	0%	100%	0%	77%	0%	0%	92%	0%	46%	85%	0%	54%
	% > BCWQG[a]	-	0%	0%	8%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	8%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WADE	n	19	19	21	21	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
	Annual Minimum	208	7.98	8.18	9.60	182	0.118	<0.001	<0.005	10.1	<0.5	0.0870	0.000140	0.000210	0.107	<0.00002	0.0360	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	346	8.59	8.88	12.9	295	1.18	0.00140	0.0185	43.7	0.730	0.142	0.000180	<0.0005	0.154	0.0000240	0.0590	0.000600	0.000290	0.510	0.000335
	Annual Mean	274	8.46	8.47	11.0	236	0.557	0.00102	0.00932	28.6	0.528	0.125	0.000157	0.000279	0.126	0.0000206	0.0461	0.000191	0.000135	0.110	0.000105
	Annual Median	270	8.51	8.51	10.9	243	0.523	<0.001	0.00840	28.8	<0.5	0.127	0.000160	0.000275	0.131	<0.00002	0.0450	0.000110	<0.0001	0.0350	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	95%	26%	0%	79%	0%	0%	5%	0%	84%	0%	47%	74%	32%	58%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)
GH_COUGAR	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	174	7.95	8.13	10.1	165	0.0277	<0.001	<0.005	10.4	<0.5	0.0660	<0.0001	0.000230	0.0914	<0.00002	0.0120	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	248	8.52	8.59	12.8	222	0.415	0.00110	0.0163	27.4	0.800	0.138	0.000120	0.000370	0.132	<0.00002	0.0190	0.000310	0.000210	0.358	0.000271
	Annual Mean	216	8.41	8.38	11.3	197	0.178	0.00101	0.00918	14.0	0.543	0.0937	0.000105	0.000260	0.111	<0.00002	0.0149	0.000125	0.000111	0.0704	0.0000758
	Annual Median	228	8.43	8.44	11.0	198	0.186	<0.001	0.00870	12.8	<0.5	0.0945	0.000100	0.000250	0.112	<0.00002	0.0145	<0.0001	<0.0001	0.0385	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	92%	8%	0%	75%	0%	50%	0%	0%	100%	0%	75%	83%	8%	75%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_NNC	n	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
	Annual Minimum	196	8.00	7.63	8.26	184	0.00700	<0.001	<0.005	8.18	0.190	0.0650	<0.0001	0.000120	0.0778	<0.00002	0.0180	<0.0001	<0.0001	0.0170	<0.00005
	Annual Maximum	310	8.58	8.25	11.9	273	0.750	0.00170	0.449	15.7	0.590	0.131	0.000120	0.000710	0.170	<0.00002	0.0370	0.00792	0.000320	0.257	0.0000910
	Annual Mean	265	8.38	8.00	10.0	238	0.335	0.00105	0.0296	10.8	0.253	0.101	0.000101	0.000225	0.117	<0.00002	0.0255	0.000411	0.000114	0.0625	0.0000549
	Annual Median	270	8.45	8.00	9.88	238	0.273	<0.001	0.0105	10.0	0.200	0.106	<0.0001	0.000170	0.111	<0.00002	0.0250	<0.0001	<0.0001	0.0380	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	81%	19%	0%	85%	0%	92%	0%	0%	100%	0%	69%	85%	0%	73%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	4%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_BR_D	n	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Annual Minimum	193	7.87	7.88	8.40	164	<0.005	<0.001	<0.005	1.94	<0.5	0.0660	<0.0001	0.000180	0.0881	<0.00002	<0.01	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	314	8.61	8.29	12.9	286	0.108	0.00130	0.0325	5.96	<0.5	0.113	0.000240	0.00116	0.177	0.000114	0.0210	0.00269	0.000540	1.85	0.000955
	Annual Mean	250	8.38	8.07	10.6	225	0.0226	0.00102	0.0111	4.42	<0.5	0.0880	0.000130	0.000308	0.124	0.0000247	0.0134	0.000238	0.000122	0.131	0.0000977
	Annual Median	256	8.38	8.09	10.2	222	0.00885	<0.001	0.00910	4.52	<0.5	0.0890	0.000110	0.000255	0.119	<0.00002	0.0120	<0.0001	<0.0001	0.0355	<0.00005
	% < LRL	0%	0%	0%	0%	0%	25.0%	95%	25%	0%	100%	0%	35%	0%	0%	95%	35%	65%	95%	5%	80%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	5%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	5%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_MC1	n	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
	Annual Minimum	229	7.83	8.23	8.30	201	0.00710	<0.001	<0.005	51.6	0.680	0.121	0.000190	0.000200	0.0612	<0.00002	0.0250	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	429	8.61	8.85	13.1	286	1.21	0.00220	0.0875	107	4.24	0.202	0.000440	0.000390	0.0903	0.0000240	0.0520	0.000460	0.000440	0.490	0.000329
	Annual Mean	345	8.49	8.52	10.9	242	0.287	0.00111	0.0165	75.6	1.62	0.165	0.000264	0.000261	0.0774	0.0000202	0.0355	0.000156	0.000128	0.0747	0.0000886
	Annual Median	350	8.52	8.55	11.0	244	0.0918	<0.001	0.00955	74.4	1.14	0.168	0.000250	0.000255	0.0780	<0.00002	0.0325	0.000100	<0.0001	0.0510	0.0000510
	% < LRL	0%	0%	0%	0%	0%	0.0%	73%	23%	0%	0%	0%	0%	0%	0%	95%	0%	45%	64%	14%	50%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_LC2	n	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
	Annual Minimum	874	7.76	8.07	9.47	227	17.0	<0.005	<0.005	677	2.77	<0.1	0.00207	0.000260	0.0259	<0.00002	0.0160	<0.0001	0.000250	<0.01	<0.00005
	Annual Maximum	2,450	8.46	8.92	14.8	324	78.5	0.0230	0.169	1,080	7.00	0.230	0.00385	0.000510	0.0543	<0.00004	0.0360	<0.0002	0.00106	0.0320	<0.0001
	Annual Mean	1,943	8.25	8.38	11.3	271	63.1	0.00597	0.0168	906.2	4.76	0.156	0.00253	0.000417	0.0448	<0.00002	0.0289	<0.0001	0.000500	0.0115	<0.00005
	Annual Median	2,030	8.26	8.33	11.1	272	66.1	<0.005	0.00880	940	4.61	0.140	0.00240	0.000410	0.0465	<0.00002	0.0290	<0.0001	0.000480	<0.01	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	72%	24%	0%	0%	14%	0%	0%	0%	100%	0%	100%	0%	90%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%	3%	100%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	93%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	97%	-	-	-	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)
GH_LC1	n	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Annual Minimum	298	8.25	8.11	7.79	164	2.39	0.00320	0.0126	42.3	0.550	0.124	0.000440	0.00270	0.103	0.000258	0.0120	0.00664	0.00205	5.46	0.00302
	Annual Maximum	298	8.25	8.12	10.8	164	2.39	0.00320	0.0126	42.3	0.550	0.124	0.000440	0.00270	0.103	0.000258	0.0120	0.00664	0.00205	5.46	0.00302
	Annual Mean	298	8.25	8.11	9.31	164	2.39	0.00320	0.0126	42.3	0.550	0.124	0.000440	0.00270	0.103	0.000258	0.0120	0.00664	0.00205	5.46	0.00302
	Annual Median	298	8.25	8.11	9.31	164	2.39	0.00320	0.0126	42.3	0.550	0.124	0.000440	0.00270	0.103	0.000258	0.0120	0.00664	0.00205	5.46	0.00302
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[a]	-	0%	0%	50%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	100%	0%	100%	0%	-	0%
	% > BCWQG[b]	-	-	-	50%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	100%	0%
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WC2	n	25	25	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Annual Minimum	1,110	8.13	8.20	9.47	230	24.3	<0.005	<0.005	487	<2.5	<0.1	0.000910	0.000190	0.0435	<0.00002	0.0210	<0.0001	0.000190	<0.01	<0.00005
	Annual Maximum	2,420	8.48	8.63	15.3	318	56.6	0.00780	0.0212	1,250	4.90	0.140	0.00210	0.000400	0.0701	<0.00004	0.0350	0.000230	0.000640	0.124	<0.0001
	Annual Mean	1,948	8.29	8.47	11.4	265	42.9	0.00521	0.00898	994.5	3.96	0.104	0.00161	0.000232	0.0580	<0.00002	0.0282	0.000109	0.000405	0.0233	<0.00005
	Annual Median	2,080	8.28	8.51	11.2	260	43.6	<0.005	0.00710	1,070	4.10	<0.1	0.00161	0.000220	0.0577	<0.00002	0.0280	<0.0001	0.000380	<0.01	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	88%	36%	0%	4%	80%	0%	12%	0%	100%	0%	88%	0%	60%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%	0%	100%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	88%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	100%	-	-	-	-	100%	-	-	100%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_WC1	n	25	25	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Annual Minimum	983	8.08	8.15	9.05	214	19.4	<0.005	<0.005	402	<2.5	<0.1	0.000760	0.000180	0.0425	<0.00002	0.0210	<0.0001	0.000180	<0.01	<0.00005
	Annual Maximum	2,480	8.46	8.63	14.1	313	55.7	0.0295	0.524	1,260	5.10	0.160	0.00209	0.000400	0.0775	<0.00004	0.0370	0.000480	0.000650	0.239	0.000140
	Annual Mean	1,875	8.29	8.42	11.0	260	40.4	0.0122	0.0365	956.3	3.82	0.105	0.00157	0.000246	0.0582	<0.00002	0.0284	0.000123	0.000387	0.0416	0.0000539
	Annual Median	2,040	8.28	8.41	10.5	263	43.0	0.00720	0.0110	1,070	4.00	<0.1	0.00157	0.000230	0.0566	<0.00002	0.0280	<0.0001	0.000330	0.0240	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	36%	20%	0%	8%	80%	0%	4%	0%	100%	0%	84%	0%	28%	92%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%	0%	96%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	80%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	96%	-	-	-	-	100%	-	-	96%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_TC2	n	21	21	32	33	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Annual Minimum	646	8.17	8.01	9.30	172	3.99	0.00450	0.00740	314	8.50	0.0700	0.000110	0.000170	0.0646	<0.00002	0.0170	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	1,870	8.52	8.81	16.3	261	16.5	0.118	0.256	1,060	17.1	0.140	0.000200	0.000360	0.0757	<0.00002	0.0320	0.000380	0.000140	0.186	0.000145
	Annual Mean	1,255	8.35	8.34	12.5	209	9.53	0.0235	0.0452	672	11.4	0.0855	0.000160	0.000232	0.0689	<0.00002	0.0249	0.000130	0.000103	0.0430	0.0000591
	Annual Median	1,250	8.36	8.32	12.5	203	8.89	0.0155	0.0202	672	9.60	0.0700	0.000160	0.000220	0.0686	<0.00002	0.0260	<0.0001	<0.0001	0.0290	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	10%	0%	0%	0%	62%	0%	0%	0%	100%	0%	67%	90%	5%	86%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%	19%	95%	0%	-	0%	-	0%	0%	0%	0%	0%	-	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	19%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	67%	-	-	-	-	100%	-	-	95%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_TC1	n	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
	Annual Minimum	666	8.21	8.20	7.90	171	3.72	0.00220	<0.005	273	6.67	0.0750	0.000100	0.000150	0.0596	<0.00002	0.0150	<0.0001	<0.0001	<0.01	<0.00005
	Annual Maximum	1,760	8.53	8.67	13.7	263	16.0	0.0399	0.0476	1,040	17.2	0.140	0.000200	0.000470	0.0786	0.0000560	0.0330	0.00160	0.000360	0.776	0.000439
	Annual Mean	1,150	8.40	8.41	10.4	210	8.58	0.0122	0.0179	604	11.3	0.0985	0.000153	0.000240	0.0684	0.0000214	0.0233	0.000197	0.000120	0.0944	0.0000849
	Annual Median	1,025	8.43	8.41	9.58	206	7.30	0.00985	0.0163	546	9.60	0.0980	0.000160	0.000235	0.0676	<0.00002	0.0235	0.000105	<0.0001	0.0650	<0.00005
	% < LRL	0%	0%	0%	0%	0%	0.0%	13%	3%	0%	0%	53%	0%	0%	0%	94%	0%	50%	78%	16%	59%
	% > BCWQG[a]	-	0%	0%	6%	0%	100%	0%	6%	78%	0%	-	0%	-	0%	0%	0%	3%	0%	-	0%
	% > BCWQG[b]	-	-	-	6%	-	0%	0%	6%	-	0%	0%	-	0%	-	-	-	-	0%	0%	0%
	% > Level 1 EVWQP Benchmark	63%	-	-	-	-	100%	-	-	78%	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)
GH_BR_F	n	17	17	17	17	17	17	17	17	17	17	17	17	17
	Annual Minimum	0.00770	0.000230	0.000328	<0.0005	0.000445	<0.00001	<0.00001	0.000295	<0.003	<0.003	0.00000790	0.000530	<0.01
	Annual Maximum	0.0163	0.00705	0.000520	0.00142	0.000725	0.0000130	<0.00001	0.000984	0.00520	0.0806	0.0000676	0.00117	0.0730
	Annual Mean	0.0118	0.00229	0.000436	0.000921	0.000599	0.0000105	<0.00001	0.000628	0.00315	0.00998	0.0000175	0.000737	0.0159
	Annual Median	0.0116	0.00225	0.000458	0.000840	0.000614	<0.00001	<0.00001	0.000632	<0.003	0.00570	0.0000138	0.000690	<0.01
	% < LRL	0%	0%	0%	6%	0%	76%	100%	0%	88%	18%	0%	0%	65%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_WOLF	n	21	21	21	21	21	21	21	21	21	21	21	21	21
	Annual Minimum	0.00670	0.000470	0.000285	<0.0005	0.000393	<0.00001	<0.00001	0.000182	<0.003	<0.003	0.00000570	0.000310	<0.01
	Annual Maximum	0.0181	0.00852	0.000550	0.00103	0.000870	0.0000140	0.0000100	0.000466	<0.003	0.0109	0.0000158	0.000740	0.0190
	Annual Mean	0.00974	0.00247	0.000395	0.000618	0.000640	0.0000102	0.0000100	0.000307	<0.003	0.00420	0.00000983	0.000510	0.0104
	Annual Median	0.00840	0.00153	0.000383	0.000570	0.000622	<0.00001	<0.00001	0.000288	<0.003	0.00350	0.00000940	0.000520	<0.01
	% < LRL	0%	0%	0%	38%	0%	95%	95%	0%	100%	43%	0%	0%	95%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_WILLOW	n	20	20	20	20	20	20	20	20	20	20	20	20	20
	Annual Minimum	0.00710	0.000620	0.000348	<0.0005	0.000279	<0.00001	<0.00001	0.000305	<0.003	<0.003	0.00000720	0.000240	<0.01
	Annual Maximum	0.0163	0.00373	0.000701	0.000670	0.000942	<0.00001	<0.00001	0.000766	<0.003	0.00455	0.0000141	0.000495	0.0110
	Annual Mean	0.0117	0.00149	0.000495	0.000534	0.000641	<0.00001	<0.00001	0.000465	<0.003	0.00332	0.0000110	0.000374	0.0100
	Annual Median	0.0116	0.00130	0.000460	<0.0005	0.000666	<0.00001	<0.00001	0.000404	<0.003	<0.003	0.0000114	0.000370	<0.01
	% < LRL	0%	0%	0%	60%	0%	100%	100%	0%	100%	65%	0%	0%	95%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_WILLOW_SP1	n	13	13	13	13	13	13	13	13	13	13	13	13	13
	Annual Minimum	0.00500	0.000430	0.000365	<0.0005	0.000438	<0.00001	<0.00001	0.000297	<0.003	<0.003	0.00000660	0.000310	<0.01
	Annual Maximum	0.0117	0.131	0.00138	0.00101	0.00106	<0.00001	0.0000110	0.000704	0.0141	0.0145	0.0000149	0.000590	0.106
	Annual Mean	0.00841	0.0128	0.000512	0.000590	0.000688	<0.00001	0.0000101	0.000380	0.00412	0.00492	0.00000983	0.000451	0.0178
	Annual Median	0.00840	0.00230	0.000429	0.000550	0.000683	<0.00001	<0.00001	0.000349	<0.003	0.00440	0.00000920	0.000450	<0.01
	% < LRL	0%	0%	0%	38%	0%	100%	92%	0%	85%	23%	0%	0%	85%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_WADE	n	19	19	19	19	19	19	19	19	19	19	19	19	19
	Annual Minimum	0.0150	0.000170	0.000885	<0.0005	0.00163	<0.00001	<0.00001	0.000570	<0.003	<0.003	0.00000700	0.000350	<0.01
	Annual Maximum	0.0251	0.0166	0.00145	0.00163	0.00667	0.0000170	0.0000220	0.00105	0.0170	0.0210	0.0000268	0.000750	0.0160
	Annual Mean	0.0204	0.00387	0.00116	0.000847	0.00301	0.0000106	0.0000116	0.000797	0.00419	0.00522	0.0000167	0.000522	0.0106
	Annual Median	0.0212	0.00175	0.00117	0.000720	0.00238	<0.00001	<0.00001	0.000795	<0.003	0.00340	0.0000171	0.000520	<0.01
	% < LRL	0%	0%	0%	5%	0%	79%	79%	0%	63%	47%	0%	0%	79%
	% > BCWQG[a]	-	0%	0%	0%	68%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)
	n	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.00370	0.000570	0.000614	<0.0005	0.000490	<0.00001	<0.00001	0.000201	<0.003	<0.003	0.0000224	0.000450	<0.01
	Annual Maximum	0.00640	0.00802	0.00109	0.00134	0.000631	0.0000130	0.0000340	0.000428	0.00590	0.0493	0.0000636	0.00114	0.0430
	Annual Mean	0.00475	0.00203	0.000774	0.000731	0.000560	0.0000103	0.0000136	0.000295	0.00324	0.00758	0.0000329	0.000610	0.0128
	Annual Median	0.00450	0.00101	0.000759	0.000665	0.000574	<0.00001	0.0000105	0.000274	<0.003	0.00325	0.0000292	0.000565	<0.01
GH_COUGAR	% < LRL	0%	0%	0%	8%	0%	92%	42%	0%	92%	50%	0%	0%	75%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	26	26	26	26	26	26	26	26	26	26	26	26	26
	Annual Minimum	0.00500	0.000630	0.000591	<0.0005	0.000105	<0.00001	<0.00001	0.000209	<0.003	<0.003	0.00000870	0.000270	<0.01
	Annual Maximum	0.0109	0.183	0.00187	0.00129	0.000405	<0.00001	0.0000210	0.000421	0.00350	0.00910	0.0000195	0.000560	0.0660
	Annual Mean	0.00729	0.0196	0.000989	0.000568	0.000241	<0.00001	0.0000111	0.000324	0.00302	0.00358	0.0000124	0.000394	0.0175
	Annual Median	0.00725	0.00407	0.000922	<0.0005	0.000220	<0.00001	<0.00001	0.000332	<0.003	<0.003	0.0000119	0.000385	<0.01
GH_NNC	% < LRL	0%	0%	0%	77%	0%	100%	88%	0%	96%	58%	4%	0%	65%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	20	20	20	20	20	20	20	20	20	20	20	20	20
	Annual Minimum	0.00170	0.000150	0.000686	<0.0005	0.000103	<0.00001	<0.00001	0.000204	<0.003	<0.003	0.0000138	0.000510	<0.01
	Annual Maximum	0.00410	0.0295	0.00185	0.00337	0.000303	0.0000320	0.000107	0.000674	0.0153	0.0156	0.0000253	0.00116	0.0130
	Annual Mean	0.00296	0.00360	0.00110	0.000816	0.000162	0.0000111	0.0000150	0.000364	0.00369	0.00468	0.0000196	0.000745	0.0102
	Annual Median	0.00290	0.00179	0.000924	0.000635	0.000149	<0.00001	<0.00001	0.000309	<0.003	0.00400	0.0000181	0.000670	<0.01
GH_BR_D	% < LRL	0%	0%	0%	20%	0%	95%	80%	0%	90%	20%	0%	0%	95%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	22	22	22	22	22	22	22	22	22	22	22	22	22
	Annual Minimum	0.0199	0.000190	0.00128	0.00124	0.00130	<0.00001	<0.00001	0.000830	<0.003	<0.003	0.0000166	0.000340	<0.01
	Annual Maximum	0.0414	0.0142	0.00304	0.00641	0.0107	0.0000140	0.0000300	0.00220	0.0486	0.0383	0.0000425	0.00154	0.0420
	Annual Mean	0.0306	0.00289	0.00195	0.00198	0.00401	0.0000102	0.0000115	0.00144	0.00739	0.00530	0.0000265	0.000601	0.0115
	Annual Median	0.0311	0.00185	0.00185	0.00166	0.00235	<0.00001	<0.00001	0.00140	<0.003	<0.003	0.0000252	0.000550	<0.01
GH_MC1	% < LRL	0%	0%	0%	0%	0%	95%	73%	0%	68%	73%	0%	0%	95%
	% > BCWQG[a]	-	0%	0%	0%	73%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	5%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	29	29	29	29	29	29	29	29	29	29	29	29	29
	Annual Minimum	0.129	0.000480	0.0131	0.0572	0.0485	<0.00001	0.0000270	0.00904	<0.003	<0.003	0.00000930	0.000410	<0.01
	Annual Maximum	0.285	0.00428	0.0233	0.0956	0.395	<0.00002	0.0000510	0.0163	0.0227	0.00930	0.000242	0.00121	<0.02
	Annual Mean	0.221	0.000933	0.0162	0.0773	0.272	<0.00001	0.0000387	0.0129	0.00604	0.00326	0.0000583	0.000926	0.0101
	Annual Median	0.232	0.000780	0.0157	0.0809	0.311	<0.00001	0.0000390	0.0134	0.00300	<0.003	0.0000340	0.000950	<0.01
GH_LC2	% < LRL	0%	0%	0%	0%	0%	100%	0%	0%	55%	93%	21%	0%	97%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	100%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	100%	97%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	100%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.5: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2019

Station	Summary Statistic	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)
	n	1	1	1	1	1	1	1	1	1	1	1	1	1
	Annual Minimum	0.0153	0.258	0.00221	0.0127	0.0112	0.0000970	0.000181	0.00166	0.0449	0.00450	0.0000151	0.000310	<0.01
	Annual Maximum	0.0153	0.258	0.00221	0.0127	0.0112	0.0000970	0.000181	0.00166	0.0449	0.00450	0.0000151	0.000310	<0.01
	Annual Mean	0.0153	0.258	0.00221	0.0127	0.0112	0.0000970	0.000181	0.00166	0.0449	0.00450	0.0000151	0.000310	<0.01
	Annual Median	0.0153	0.258	0.00221	0.0127	0.0112	0.0000970	0.000181	0.00166	0.0449	0.00450	0.0000151	0.000310	<0.01
GH_LC1	% < LRL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	100%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	25	25	25	25	25	25	25	25	25	25	25	25	25
	Annual Minimum	0.0734	0.00116	0.00581	0.0401	0.0637	<0.00001	0.0000130	0.00674	<0.003	<0.003	<0.00001	0.000270	<0.01
	Annual Maximum	0.188	0.00275	0.00820	0.154	0.178	<0.00002	0.0000310	0.0180	0.00950	0.0156	0.0000375	0.00108	<0.02
	Annual Mean	0.138	0.00167	0.00707	0.100	0.114	0.0000100	0.0000196	0.0141	0.00339	0.00350	0.0000259	0.000389	<0.01
	Annual Median	0.148	0.00151	0.00707	0.0870	0.104	<0.00001	0.0000170	0.0155	<0.003	<0.003	0.0000269	0.000350	<0.01
GH_WC2	% < LRL	0%	0%	0%	0%	0%	96%	12%	0%	88%	96%	8%	28%	100%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	92%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	100%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	100%	92%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	100%	-	-	-	-	-	-	-	-	-
	n	25	25	25	25	25	25	25	25	25	25	25	25	25
	Annual Minimum	0.0605	0.00104	0.00530	0.0325	0.0645	<0.00001	0.0000110	0.00568	<0.003	<0.003	<0.000005	0.000220	<0.01
	Annual Maximum	0.191	0.00622	0.00768	0.168	0.164	<0.00002	0.0000310	0.0195	<0.006	0.0145	0.0000437	0.00128	0.0250
	Annual Mean	0.135	0.00215	0.00685	0.0965	0.103	<0.00001	0.0000203	0.0135	0.00317	0.00418	0.0000214	0.000404	0.0106
	Annual Median	0.148	0.00191	0.00685	0.0862	0.0931	<0.00001	0.0000180	0.0155	<0.003	<0.003	0.0000235	0.000340	<0.01
GH_WC1	% < LRL	0%	0%	0%	0%	0%	100%	12%	0%	96%	80%	20%	16%	96%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	80%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	100%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	100%	84%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	100%	-	-	-	-	-	-	-	-	-
	n	21	21	21	21	21	21	21	21	21	21	21	21	21
	Annual Minimum	0.0134	0.00204	0.000984	0.000920	0.0581	<0.00001	<0.00001	0.00179	<0.003	<0.003	<0.000005	<0.0002	<0.01
	Annual Maximum	0.0362	0.0122	0.00165	0.00171	0.162	<0.00001	0.0000150	0.00646	0.00590	0.00510	0.0000303	0.000590	<0.02
	Annual Mean	0.0225	0.00618	0.00134	0.00121	0.108	<0.00001	0.0000104	0.00414	0.00322	0.00312	0.0000150	0.000351	0.0101
	Annual Median	0.0205	0.00575	0.00137	0.00116	0.107	<0.00001	<0.00001	0.00395	<0.003	<0.003	0.0000159	0.000330	<0.01
GH_TC2	% < LRL	0%	0%	0%	0%	0%	100%	86%	0%	90%	90%	5%	14%	90%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	90%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	32	32	32	32	32	32	32	32	32	32	32	32	32
	Annual Minimum	0.0106	0.00103	0.00101	0.000830	0.0484	<0.00001	<0.00001	0.00193	<0.003	<0.003	0.0000131	<0.0002	<0.01
	Annual Maximum	0.0321	0.0284	0.00164	0.00231	0.157	0.0000200	0.0000340	0.00624	0.0122	0.00940	0.0000220	0.000940	0.0170
	Annual Mean	0.0204	0.00647	0.00130	0.00128	0.0945	0.0000105	0.0000118	0.00368	0.00345	0.00340	0.0000172	0.000383	0.0106
	Annual Median	0.0202	0.00528	0.00130	0.00122	0.0895	<0.00001	<0.00001	0.00350	<0.003	<0.003	0.0000172	0.000375	<0.01
GH_TC1	% < LRL	0%	0%	0%	0%	0%	91%	66%	0%	81%	78%	0%	6%	84%
	% > BCWQG[a]	-	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	0%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	0%	78%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	0%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.6: Temporal Changes in Water Chemistry Analytes at West-side Tributary Stations, GHO LAEMP, 2012 to 2020

Parameter	Status	Station	Annual Variation [a]		Q1. Is there a positive or negative change in concentrations since the base year (b) of monitoring? Magnitude of Difference (MOD)[b] and Significance (bolded) from Base Year (b) [c]									Q2. Is the 2020 annual mean greater or less than all annual historical means (2012 to 2019) and the previous year (2019)?[c]										
			DF	P-Value	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020 vs. 2012 to 2019	2020 vs. 2019
Total Selenium	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	<0.001	b	-10	-	-	-19	-	-13	-22	-26	A	AB	-	-	BCD	-	ABC	CD	D	ns	ns
		GH_WILLOW	7	<0.001	b	39	60	60	109	-	-7.2	15	-41	BC	ABC	AB	AB	A	-	CD	BC	D	ns	↓
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	<0.001	b	-27	-0.030	-29	-25	13	-	-	39	AB	B	AB	B	B	AB	-	-	A	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	<0.001	-	-	b	-12	24	8.1	25	55	3.9	-	-	BC	C	AB	BC	AB	A	BC	ns	↓
		GH_BR_D	1	0.072	-	-	-	b	-	-	-	-	ns	-	-	-	ns	-	-	-	-	ns	ns	-
		GH_MC1	8	<0.001	b	4.4	4.8	286	136	125	91	103	130	D	BCD	CD	A	A	AB	ABCD	ABC	A	ns	ns
		GH_LC2	8	<0.001	b	48	87	100	20	75	347	241	448	C	C	BC	BC	C	BC	A	AB	A	ns	ns
		GH_LC1	3	<0.001	-	-	-	-	b	52	282	84	-	-	-	-	-	B	B	A	AB	-	-	-
		GH_WC2	8	<0.001	b	1.7	53	21	11	186	193	291	178	B	B	B	B	B	A	A	A	A	ns	ns
		GH_WC1	3	<0.001	-	-	-	-	b	-	139	261	145	-	-	-	-	C	-	B	A	B	ns	↓
		GH_TC2	8	<0.001	b	9.5	12	-16	-10	5.7	32	12	19	BCD	ABC	ABC	D	CD	ABC	A	ABC	AB	ns	ns
		GH_TC1	8	<0.001	b	6.5	4.9	-20	-13	-0.010	28	12	8.5	BC	ABC	ABC	D	CD	BC	A	AB	AB	ns	ns
Nitrate-N	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	0.003	b	71	-	-	39	-	-42	25	24	AB	A	-	-	A	-	B	A	A	ns	ns
		GH_WILLOW	7	<0.001	b	68	29	68	34	-	-50	62	20	AB	A	A	A	A	-	B	A	A	ns	ns
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	<0.001	b	-40	-36	-70	-73	-64	-	-	-74	A	ABC	AB	CD	D	BCD	-	-	CD	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	<0.001	-	-	b	166	524	3,556	3,536	4,557	908	-	-	D	CD	BC	A	A	A	B	ns	↓
		GH_BR_D	1	<0.001	-	-	-	b	-	-	-	-	-95	-	-	-	A	-	-	-	-	B	↓	-
		GH_MC1	8	<0.001	b	-7.9	-53	1,702	859	-7.0	-61	-64	-34	B	B	B	A	A	B	B	B	B	ns	ns
		GH_LC2	8	<0.001	b	53	32	-0.67	-11	31	135	65	98	CD	ABCD	ABCD	CD	D	BCD	A	ABC	AB	ns	ns
		GH_LC1	3	<0.001	-	-	-	-	b	69	147	20	-	-	-	-	-	C	AB	A	BC	-	-	-
		GH_WC2	8	<0.001	b	9.5	61	31	34	189	184	217	141	C	BC	B	BC	BC	A	A	A	A	ns	ns
		GH_WC1	3	<0.001	-	-	-	-	b	-	107	159	89	-	-	-	-	C	-	AB	A	B	ns	↓
		GH_TC2	8	<0.001	b	-1.8	-7.7	-30	-28	-23	-3.7	-9.4	-16	A	AB	AB	D	CD	BCD	AB	ABC	ABCD	ns	ns
		GH_TC1	8	<0.001	b	-9.4	-18	-36	-31	-27	-5.8	-16	-24	A	ABC	ABCD	E	DE	CDE	AB	ABCD	BCDE	ns	ns

- P-value < 0.05.
- > 20% Decrease in concentration.
- > 33% Decrease in concentration.
- > 43% Decrease in concentration.
- > 50% Decrease in concentration.
- > 25% Increase in concentration.
- > 50% Increase in concentration.
- > 75% Increase in concentration.
- > 100% Increase in concentration.
- **bold** Significant increase or decrease from base year (b).
- Significantly < than all historical years (or 2018).
- Significantly > than all historical years (or 2018).

Notes: "ns" = not significant. "-" = insufficient data.

[a] *Year* p-value from an ANOVA with factors *Year* and *Month*.

[b] Magnitude of Difference (MOD) = $[Mean_{given\ year} - Mean_{year\ b}] / Mean_{year\ b} \times 100\%$.

[c] Significance among year determined using all pairwise comparisons using Tukey's honestly significant differences method. Years that share a letter are not significantly different. Letters assigned such that the mean with highest magnitude is assigned "A".

Table D.6: Temporal Changes in Water Chemistry Analytes at West-side Tributary Stations, GHO LAEMP, 2012 to 2020

Parameter	Status	Station	Annual Variation [a]		Q1. Is there a positive or negative change in concentrations since the base year (b) of monitoring? Magnitude of Difference (MOD)[b] and Significance (bolded) from Base Year (b) [c]									Q2. Is the 2020 annual mean greater or less than all annual historical means (2012 to 2019) and the previous year (2019)?[c]										
			DF	P-Value	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020 vs. 2012 to 2019	2020 vs. 2019
Sulphate	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	0.423	b	ns	-	-	ns	-	ns	ns	ns	ns	ns	-	-	ns	-	ns	ns	ns	ns	ns
		GH_WILLOW	7	<0.001	b	22	45	37	28	-	30	5.6	-40	C	ABC	A	AB	ABC	-	ABC	BC	D	↓	↓
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	<0.001	b	-4.8	31	23	63	53	-	-	49	D	D	BC	C	A	AB	-	-	ABC	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	<0.001	-	-	b	31	38	5.3	-8.8	5.9	-7.0	-	-	C	AB	A	BC	C	BC	C	ns	ns
		GH_BR_D	1	<0.001	-	-	-	b	-	-	-	-	-30	-	-	-	A	-	-	-	-	B	↓	-
		GH_MC1	8	<0.001	b	-18	-3.3	405	439	44	35	27	23	B	B	B	A	A	B	B	B	B	ns	ns
		GH_LC2	8	<0.001	b	43	161	283	269	305	324	319	360	C	C	B	A	AB	A	A	A	A	ns	ns
		GH_LC1	3	0.812	-	-	-	-	b	ns	ns	ns	-	-	-	-	-	ns	ns	ns	ns	-	-	-
		GH_WC2	8	<0.001	b	4.2	8.0	51	78	84	143	204	192	E	E	DE	CD	C	BC	AB	A	A	ns	ns
		GH_WC1	3	<0.001	-	-	-	-	b	-	48	81	72	-	-	-	-	C	-	B	A	AB	ns	ns
		GH_TC2	8	<0.001	b	7.7	19	4.0	11	21	38	36	43	B	B	AB	B	B	AB	A	A	A	ns	ns
		GH_TC1	8	<0.001	b	3.1	13	0.73	11	19	39	35	38	C	C	BC	C	C	ABC	A	AB	AB	ns	ns
Total Dissolved Solids	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	<0.001	b	3.5	-	-	14	-	16	12	15	C	BC	-	-	A	-	A	AB	A	ns	ns
		GH_WILLOW	7	0.011	b	2.9	11	11	6.9	-	9.9	0.77	8.0	A	A	A	A	A	-	A	A	A	ns	ns
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	<0.001	b	3.6	16	22	24	17	-	-	18	C	BC	AB	A	A	AB	-	-	AB	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	<0.001	-	-	b	12	11	13	8.6	1.6	10	-	-	B	A	A	A	AB	B	A	ns	↑
		GH_BR_D	1	0.642	-	-	-	b	-	-	-	-	ns	-	-	-	ns	-	-	-	-	ns	ns	-
		GH_MC1	8	<0.001	b	0.030	5.3	166	159	15	16	8.9	13	B	B	B	A	A	B	B	B	B	ns	ns
		GH_LC2	8	<0.001	b	40	86	130	126	150	177	158	182	D	C	B	AB	AB	A	A	A	A	ns	ns
		GH_LC1	3	0.279	-	-	-	-	b	ns	ns	ns	-	-	-	-	-	ns	ns	ns	ns	-	-	-
		GH_WC2	8	<0.001	b	5.4	13	33	56	78	103	152	134	G	G	FG	EF	DE	CD	BC	A	AB	ns	ns
		GH_WC1	3	<0.001	-	-	-	-	b	-	42	72	55	-	-	-	-	C	-	B	A	AB	ns	ns
		GH_TC2	8	0.037	b	87	96	76	87	98	117	113	132	B	AB	AB	AB	AB	AB	A	A	A	ns	ns
		GH_TC1	8	<0.001	b	2.9	10	-0.91	6.3	14	27	22	26	C	C	ABC	C	BC	ABC	A	AB	A	ns	ns

P-value < 0.05.
> 20% Decrease in concentration.
> 33% Decrease in concentration.
> 43% Decrease in concentration.
> 50% Decrease in concentration.
bold Significant increase or decrease from base year (b).
Significantly < than all historical years (or 2018).
Significantly > than all historical years (or 2018).

> 25% Increase in concentration.
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> 75% Increase in concentration.
> 100% Increase in concentration.

Notes: "ns" = not significant. "-" = insufficient data.

[a] *Year* p-value from an ANOVA with factors *Year* and *Month*.

[b] Magnitude of Difference (MOD) = $[Mean_{given\ year} - Mean_{year\ b}] / Mean_{year\ b} \times 100\%$.

[c] Significance among year determined using all pairwise comparisons using Tukey's honestly significant differences method. Years that share a letter are not significantly different. Letters assigned such that the mean with highest magnitude is assigned "A".

Table D.6: Temporal Changes in Water Chemistry Analytes at West-side Tributary Stations, GHO LAEMP, 2012 to 2020

Parameter	Status	Station	Annual Variation [a]		Q1. Is there a positive or negative change in concentrations since the base year (b) of monitoring? Magnitude of Difference (MOD)[b] and Significance (bolded) from Base Year (b) [c]									Q2. Is the 2020 annual mean greater or less than all annual historical means (2012 to 2019) and the previous year (2019)?[c]										
			DF	P-Value	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020 vs. 2012 to 2019	2020 vs. 2019
Total Nickel	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	0.041	b	12	-	-	-41	-	-4.2	-31	-35	A	A	-	-	A	-	A	A	A	ns	ns
		GH_WILLOW	7	0.788	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns	ns	-	ns	ns	ns	ns	ns
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	0.049	b	21	13	16	-16	-23	-	-	-35	A	A	A	A	A	A	-	-	A	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	0.001	-	-	b	4.2	19	23	89	-5.6	22	-	-	B	B	AB	AB	A	B	AB	ns	ns
		GH_BR_D	1	0.272	-	-	-	b	-	-	-	-	ns	-	-	-	ns	-	-	-	-	ns	ns	-
		GH_MC1	8	<0.001	b	22	-3.6	1,308	1,463	170	129	54	79	B	B	B	A	A	B	B	B	B	-	-
		GH_LC2	8	<0.001	b	47	188	405	372	481	417	512	550	C	C	B	A	AB	A	A	A	A	-	-
		GH_LC1	3	0.083	-	-	-	-	b	ns	ns	ns	-	-	-	-	-	ns	ns	ns	ns	-	-	-
		GH_WC2	8	<0.001	b	-28	-28	-6.8	11	-9.3	53	37	40	ABCD	D	CD	BCD	ABC	BCD	A	AB	AB	-	-
		GH_WC1	3	0.001	-	-	-	-	b	-	61	24	35	-	-	-	-	B	-	A	AB	A	-	-
		GH_TC2	8	<0.001	b	107	77	-32	1.7	-49	-66	-73	-73	B	A	A	BC	B	CD	DE	E	E	-	-
		GH_TC1	8	<0.001	b	81	49	-42	-24	-54	-69	-74	-73	BC	A	AB	DE	CD	EF	FG	G	G	-	-
Uranium	Reference	GH_BR_F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mine-exposed	GH_WOLF	5	<0.001	b	8.1	-	-	28	-	23	58	30	D	CD	-	-	BC	-	BCD	A	B	ns	↓
		GH_WILLOW	7	0.016	b	4.9	22	-1.2	-13	-	3.8	2.6	4.0	AB	AB	A	AB	B	-	AB	AB	AB	ns	ns
		GH_WILLOW_SP1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WILLOW_S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_WADE	6	<0.001	b	13	62	56	47	16	-	-	12	B	B	A	A	A	B	-	-	B	ns	-
		GH_COUGAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GH_NNC	6	0.029	-	-	b	25	23	4.3	8.3	4.7	4.9	-	-	A	A	A	A	A	A	A	ns	ns
		GH_BR_D	1	0.077	-	-	-	b	-	-	-	-	ns	-	-	-	ns	-	-	-	-	ns	ns	-
		GH_MC1	8	<0.001	b	2.5	9.6	580	701	177	154	138	94	C	C	C	A	A	B	B	B	BC	ns	ns
		GH_LC2	8	<0.001	b	29	95	279	306	324	294	296	332	C	C	B	A	A	A	A	A	A	ns	ns
		GH_LC1	3	0.002	-	-	-	-	b	-2.1	-24	-24	-	-	-	-	-	A	AB	C	BC	-	-	-
		GH_WC2	8	<0.001	b	3.0	21	50	89	82	119	190	154	F	F	EF	DE	BCD	CD	ABC	A	AB	ns	ns
		GH_WC1	3	<0.001	-	-	-	-	b	-	20	60	34	-	-	-	-	C	-	BC	A	B	ns	↓
		GH_TC2	8	<0.001	b	25	31	-8.8	2.0	-6.4	14	12	20	BCD	AB	A	D	BCD	CD	ABCD	ABCD	ABC	ns	ns
		GH_TC1	8	<0.001	b	19	19	-14	-2.7	-8.5	11	8.2	13	ABC	A	A	C	ABC	BC	AB	AB	AB	ns	ns

P-value < 0.05.
> 20% Decrease in concentration.
> 33% Decrease in concentration.
> 43% Decrease in concentration.
> 50% Decrease in concentration.
bold Significant increase or decrease from base year (b).
Significantly < than all historical years (or 2018).
Significantly > than all historical years (or 2018).
> 25% Increase in concentration.
> 50% Increase in concentration.
> 75% Increase in concentration.
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Notes: "ns" = not significant. "-" = insufficient data.

[a] *Year* p-value from an ANOVA with factors *Year* and *Month*.

[b] Magnitude of Difference (MOD) = $[\text{Mean}_{\text{given year}} - \text{Mean}_{\text{year b}}] / \text{Mean}_{\text{year b}} \times 100\%$.

[c] Significance among year determined using all pairwise comparisons using Tukey's honestly significant differences method. Years that share a letter are not significantly different. Letters assigned such that the mean with highest magnitude is assigned "A".

Table D.7: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP, 2020

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)
	n	19	19	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19
	Annual Minimum	143	8.21	7.35	8.50	128	0.0282	<0.001	<0.005	11.3	0.230	0.0980	<0.0001	<0.0001	0.0355	<0.00002	<0.01	0.000230
	Annual Maximum	613	8.44	8.42	12.5	185	3.60	0.00280	0.0308	263	6.55	0.174	0.000240	0.00249	0.0959	0.000249	0.0150	0.00701
	Annual Mean	200	8.36	8.22	10.6	146	0.260	0.00126	0.0110	29.4	0.632	0.135	0.000112	0.000416	0.0509	0.0000404	0.0103	0.00111
	Annual Median	178	8.35	8.27	10.4	144	0.0748	<0.001	0.00750	15.7	0.260	0.135	<0.0001	0.000190	0.0492	<0.00002	<0.01	0.000380
GH_ERSC4	% < LRL	0%	0%	0%	0%	0%	0%	79%	26%	0%	63%	0%	79%	5%	0%	74%	95%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	5%	0%	0%	0%	0%	-	0%	-	0%	5%	0%	26%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
	Annual Minimum	136	8.26	7.81	9.12	129	0.0227	<0.001	<0.005	17.9	0.280	0.0860	<0.0001	0.000120	0.0366	<0.00002	<0.01	0.000100
	Annual Maximum	342	8.47	8.38	12.3	233	1.48	<0.005	0.0933	59.3	<2.5	0.175	0.000280	0.00240	0.0906	0.000215	0.0100	0.00686
	Annual Mean	197	8.38	8.23	10.5	148	0.568	0.00109	0.0186	27.0	0.397	0.140	0.000128	0.000459	0.0518	0.0000402	0.0100	0.00116
	Annual Median	181	8.39	8.24	10.6	143	0.530	<0.001	0.0104	22.9	0.330	0.145	<0.0001	0.000250	0.0477	<0.00002	<0.01	0.000650
GH_ER1A	% < LRL	0%	0%	0%	0%	0%	0%	82%	29%	0%	59%	0%	71%	0%	0%	71%	94%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	6%	0%	29%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	6	6	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6
	Annual Minimum	153	8.24	7.97	8.23	130	0.0287	<0.001	0.00750	16.2	0.310	0.124	<0.0001	0.000150	0.0390	<0.00002	<0.01	0.000180
	Annual Maximum	218	8.43	8.47	10.8	158	0.620	0.00120	0.120	25.9	<0.5	0.186	<0.0001	0.000480	0.0527	0.0000415	<0.01	0.00140
	Annual Mean	179	8.34	8.22	9.92	143	0.229	0.00103	0.0413	20.0	0.350	0.155	<0.0001	0.000222	0.0467	0.0000236	<0.01	0.000476
	Annual Median	174	8.34	8.25	10.4	142	0.192	<0.001	0.0127	19.4	0.350	0.154	<0.0001	0.000173	0.0473	<0.00002	<0.01	0.000295
RG_GH-SCW1	% < LRL	0%	0%	0%	0%	0%	0.0%	83%	0%	0%	67%	0%	100%	0%	0%	83%	100%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	17%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	13	13	10	10	13	13	13	13	13	13	13	13	13	13	13	13	13
	Annual Minimum	175	8.18	7.27	8.27	133	0.219	<0.001	0.00595	17.1	<0.5	<0.1	<0.0001	0.000150	0.0406	<0.00002	<0.01	<0.0001
	Annual Maximum	1,710	8.41	8.44	12.7	260	16.6	0.0143	0.0654	1,000	16.8	0.160	0.000160	0.000600	0.0789	0.0000460	0.0220	0.00155
	Annual Mean	865	8.32	7.88	10.5	193	7.29	0.00322	0.0192	445	8.33	0.126	0.000115	0.000277	0.0586	0.0000236	0.0152	0.000396
	Annual Median	808	8.34	7.90	10.5	171	6.36	<0.005	0.0195	425	7.15	0.120	<0.0001	0.000240	0.0544	<0.00002	0.0130	0.000200
RG_GH-SCW3	% < LRL	0%	0%	0%	0%	0%	0.0%	77%	0%	0%	15%	38%	54%	0%	0%	85%	46%	15%
	% > BCWQG[a]	-	0%	0%	0%	0%	54%	0%	0%	46%	0%	-	0%	-	0%	0%	0%	15%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	46%	-	-	-	-	54%	-	-	46%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Annual Minimum	178	8.30	8.08	8.73	128	0.107	<0.001	<0.005	19.3	<0.5	0.0970	<0.0001	0.000130	0.0400	<0.00002	<0.01	0.000200
	Annual Maximum	694	8.46	8.51	12.5	173	3.91	0.00460	0.682	282	8.25	0.149	0.000200	0.00105	0.0736	0.0000870	0.0190	0.00460
	Annual Mean	275	8.39	8.32	10.3	149	1.01	0.00162	0.0509	73.1	1.51	0.132	0.000117	0.000391	0.0516	0.0000337	0.0106	0.00142
	Annual Median	244	8.40	8.30	10.0	147	0.785	0.00105	0.00640	49.8	0.850	0.136	<0.0001	0.000285	0.0496	<0.00002	<0.01	0.000975
GH_ERSC2	% < LRL	0%	0%	0%	0%	0%	0%	50%	44%	0%	13%	0%	69%	0%	0%	56%	88%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	6%	0%	6%	0%	0%	-	0%	-	0%	0%	0%	50%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	6%	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.7: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP, 2020

Station	Summary Statistic	Total Cobalt (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)
	n	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
	Annual Minimum	<0.0001	<0.01	<0.00005	0.00130	0.000960	0.000830	<0.0005	0.000663	<0.00001	<0.00001	0.000638	<0.003	<0.003	<0.000005	0.295	<0.01
	Annual Maximum	0.00197	5.03	0.00317	0.0104	0.307	0.00115	0.00911	0.0530	0.0000970	0.000156	0.00189	0.0391	0.00430	0.0000197	1.33	<0.01
	Annual Mean	0.000283	0.616	0.000390	0.00266	0.0343	0.00100	0.00141	0.00360	0.0000169	0.0000235	0.000832	0.00639	0.00326	0.00000840	0.403	<0.01
	Annual Median	<0.0001	0.133	0.000115	0.00200	0.00973	0.000988	<0.0005	0.000798	<0.00001	<0.00001	0.000763	<0.003	<0.003	0.00000730	0.351	<0.01
GH_ERSC4	% < LRL	58%	11%	32%	0%	0%	0%	58%	0%	74%	63%	0%	68%	74%	11%	84%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	0%	16%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	5%	5%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
	Annual Minimum	<0.0001	0.0100	<0.00005	0.00170	0.00132	0.000806	<0.0005	0.000779	<0.00001	<0.00001	0.000675	<0.003	<0.003	<0.000005	0.320	<0.01
	Annual Maximum	0.00173	4.85	0.00267	0.0137	0.247	0.00186	0.00912	0.00494	0.0000880	0.000132	0.00191	0.0367	0.00360	0.0000531	1.28	<0.01
	Annual Mean	0.000292	0.680	0.000414	0.00431	0.0345	0.00109	0.00173	0.00225	0.0000173	0.0000235	0.000918	0.00700	0.00305	0.0000109	0.467	<0.01
	Annual Median	0.000120	0.253	0.000172	0.00330	0.0112	0.00101	0.000770	0.00191	<0.00001	<0.00001	0.000823	<0.003	<0.003	0.00000760	0.401	<0.01
GH_ER1A	% < LRL	41%	0%	29%	0%	0%	0%	18%	0%	76%	59%	0%	53%	88%	6%	71%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	47%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	0%	18%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	6%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	Annual Minimum	<0.0001	<0.01	<0.00005	0.00185	0.00104	0.000773	<0.0005	0.000774	<0.00001	<0.00001	0.000660	<0.003	<0.003	0.00000500	0.352	<0.01
	Annual Maximum	0.000335	0.794	0.000509	0.00350	0.0530	0.00107	0.00168	0.00250	0.0000125	0.0000235	0.000843	0.00635	0.00310	0.00000885	0.436	<0.01
	Annual Mean	0.000139	0.174	0.000143	0.00266	0.0127	0.000950	0.000702	0.00132	0.0000104	0.0000122	0.000759	0.00367	0.00302	0.00000727	0.384	<0.01
	Annual Median	<0.0001	0.0550	0.0000685	0.00260	0.00548	0.000991	<0.0005	0.00116	<0.00001	<0.00001	0.000771	<0.003	<0.003	0.00000745	0.374	<0.01
RG_GH-SCW1	% < LRL	83%	17%	50%	0%	0%	0%	67%	0%	83%	83%	0%	67%	83%	0%	67%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	17%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	0%	0%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Annual Minimum	<0.0001	0.0110	<0.00005	0.00240	0.000880	0.000834	<0.0005	0.00142	<0.00001	<0.00001	0.000708	<0.003	<0.003	0.00000760	0.391	<0.01
	Annual Maximum	0.000420	0.970	0.000669	0.0274	0.0487	0.00133	0.00269	0.159	0.0000170	0.0000270	0.00614	0.00730	0.00710	0.0000258	2.14	0.0180
	Annual Mean	0.000143	0.182	0.000152	0.0133	0.00941	0.00108	0.00108	0.0696	0.0000108	0.0000125	0.00302	0.00362	0.00362	0.0000148	1.15	0.0112
	Annual Median	<0.0001	0.0570	0.0000640	0.0135	0.00330	0.00113	0.000860	0.0626	<0.00001	<0.00001	0.00292	<0.003	<0.003	0.0000149	1.15	<0.01
RG_GH-SCW3	% < LRL	77%	0%	46%	0%	0%	0%	8%	0%	85%	85%	0%	85%	85%	0%	31%	85%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	85%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	0%	0%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	0%	62%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	46%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Annual Minimum	<0.0001	0.0180	<0.00005	0.00210	0.00129	0.000879	<0.0005	0.00135	<0.00001	<0.00001	0.000762	<0.003	<0.003	<0.000005	0.380	<0.01
	Annual Maximum	0.000730	2.00	0.00108	0.0132	0.0982	0.00148	0.00420	0.0499	0.0000360	0.0000590	0.00206	0.0530	0.00460	0.0000177	1.60	0.0170
	Annual Mean	0.000241	0.549	0.000329	0.00522	0.0256	0.00106	0.00161	0.0105	0.0000144	0.0000200	0.00106	0.0108	0.00329	0.0000101	0.568	0.0104
	Annual Median	0.000125	0.259	0.000174	0.00405	0.0149	0.00103	0.000920	0.00634	<0.00001	<0.00001	0.000961	0.00730	<0.003	0.0000104	0.471	<0.01
GH_ERSC2	% < LRL	31%	0%	13%	0%	0%	0%	19%	0%	63%	56%	0%	31%	69%	13%	75%	94%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	-
	% > BCWQG[b]	0%	19%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	0%	13%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.8: Temporal Changes in Water Chemistry Analytes at Elk River Side Channel Stations, GHO LAEMP, 2015 to 2020

Parameter	Status	Station	Annual Variation [a]		Q1. Is there a positive or negative change in concentrations since the base year (b) of monitoring? Magnitude of Difference (MOD)[b] and Significance (bolded) from Base Year (b) [c]						Q2. Is the 2020 annual mean greater or less than all annual historical means (2015 to 2019) and the previous year (2019)?[c]							
			DF	P-Value	2015	2016	2017	2018	2019	2020	2015	2016	2017	2018	2019	2020	2020 vs. 2015 to 2019	2020 vs. 2019
Total Selenium	Mine-exposed	GH_ERSC4	4	0.373	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.250	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.297	-	-	-	b	ns	ns	-	-	-	ns	ns	ns	ns	ns
		GH_ERSC2	1	0.850	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-
Nitrate-N	Mine-exposed	GH_ERSC4	4	0.329	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.745	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.652	-	-	-	b	ns	ns	-	-	-	ns	ns	ns	ns	ns
		GH_ERSC2	1	0.856	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-
Sulphate	Mine-exposed	GH_ERSC4	4	0.744	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.860	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.958	-	-	-	b	ns	ns	-	-	-	ns	ns	ns	ns	ns
		GH_ERSC2	1	0.488	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-
Total Dissolved Solids	Mine-exposed	GH_ERSC4	4	0.103	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.923	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.897	-	-	-	b	ns	ns	-	-	-	ns	ns	ns	ns	ns
		GH_ERSC2	1	0.197	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-
Total Nickel	Mine-exposed	GH_ERSC4	4	0.299	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.565	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.040	-	-	-	b	-32	-25	-	-	-	A	B	AB	ns	ns
		GH_ERSC2	1	0.090	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-
Uranium	Mine-exposed	GH_ERSC4	4	0.677	-	b	ns	ns	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
		GH_ER1A	5	0.827	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		RG_GH-SCW3	2	0.945	-	-	-	b	ns	ns	-	-	-	ns	ns	ns	ns	ns
		GH_ERSC2	1	0.892	-	-	-	b	-	ns	-	-	-	ns	-	ns	ns	-

P-value < 0.05.
> 20% Decrease in concentration.
> 33% Decrease in concentration.
> 43% Decrease in concentration.
> 50% Decrease in concentration.
> 25% Increase in concentration.
> 50% Increase in concentration.
> 75% Increase in concentration.
> 100% Increase in concentration.
bold Significant increase or decrease from base year (b).
Significantly < than all historical years (or 2018).
Significantly > than all historical years (or 2018).

Notes: "ns" = not significant. "-" = insufficient data.

[a] *Year* p-value from an ANOVA with factors *Year* and *Month*.

[b] Magnitude of Difference (MOD) = $[\text{Mean}_{\text{given year}} - \text{Mean}_{\text{year b}}] / \text{Mean}_{\text{year b}} \times 100\%$.

[c] Significance among year determined using all pairwise comparisons using Tukey's honestly significant differences method. Years that share a letter are not significantly different. Letters assigned such that the mean with highest magnitude is assigned "A".

Table D.9: Statistical Comparisons of Differences in Monthly Mean Concentrations of Water Quality Parameters Between GHO LAEMP Side Channel Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and the Elk River Main Stem Station Upstream of Mine Operations (GH_ER2), 2016 to 2020

ANOVA Model[a]					Post-hoc Contrasts with Upstream Station (GH_ER2)[b] and Magnitude of Difference (MOD) by Station[c]						T-Test for Overall difference	
					GH_ERSC4		GH_ER1A		GH_ERSC2		P-Value	MOD
Parameter	Model Term	DF	F	P-Value	P-Value	MOD	P-Value	MOD	P-Value	MOD		
Nitrate-N	Year	4	0.14	0.969	-	-	-	-	-	-	-	-
	Station	2	42	<0.001	0.006	31%	<0.001	351%	<0.001	1462%		
	Year x Station	8	0.73	0.669	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Nitrite-N	Year	4	0.94	0.454	-						<0.001	77%
	Station	2	0.69	0.512								
	Year x Station	8	0.9	0.516								
	Error	25		-								
Orthophosphate	Year	4	4	0.898	-						0.075	ns
	Station	2	2	0.169								
	Year x Station	8	8	0.926								
	Error	95		-								
Total Phosphorus	Year	4	4	0.470	-						0.062	ns
	Station	2	2	0.637								
	Year x Station	8	8	0.817								
	Error	95		-								
Sulphate	Year	4	0.27	0.897	-	-	-	-	-	-	-	-
	Station	2	37	<0.001	0.032	13%	<0.001	63%	<0.001	295%		
	Year x Station	8	0.88	0.539	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Total Dissolved Solids	Year	4	0.27	0.899	-	-	-	-	-	-	-	-
	Station	2	14	<0.001	0.130	ns	0.004	22%	<0.001	59%		
	Year x Station	8	0.88	0.535	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Total Suspended Solids (mg/L)	Year	4	2.76	0.033	-						<0.001	56%
	Station	2	0	0.613								
	Year x Station	8	0.12	0.998								
	Error	86		-								
Cadmium (Dissolved)	Year	4	3.088	0.020	-						0.015	17%
	Station	2	2.6	0.078								
	Year x Station	8	0.61	0.764								
	Error	89		-								
Cobalt (Dissolved)	Year	Concentrations < LRL			Concentrations < LRL						-	-
	Station											
	Year x Station											
	Error											
Antimony (Total)	Year	4	0.37	0.827	-						0.010	28%
	Station	2	2	0.219								
	Year x Station	8	0.1	0.996								
	Error	21		-								
Barium (Total)	Year	4	1.27	0.286	-						<0.001	10%
	Station	2	1.3	0.285								
	Year x Station	8	0.7	0.688								
	Error	99		-								
Boron (Total)	Year	Concentrations < LRL			Concentrations < LRL						-	-
	Station											
	Year x Station											
	Error											
Lithium (Total)	Year	4	0.12	0.976	-	-	-	-	-	-	-	-
	Station	2	14	<0.001	0.005	15%	<0.001	97%	<0.001	150%		
	Year x Station	8	0.5	0.882	-	-	-	-	-	-		
	Error	96		-	-	-	-	-	-	-		
Manganese (Total)	Year	4	0.49	0.744	-						0.118	ns
	Station	2	0	0.838								
	Year x Station	8	0.6	0.752								
	Error	99		-								
Molybdenum (Total)	Year	4	0.20	0.939	-	-	-	-	-	-	-	-
	Station	2	4	0.015	0.027	4%	0.002	21%	<0.001	12%		
	Year x Station	8	0.5	0.857	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Nickel (Total)	Year	4	1.01	0.408	-						<0.001	51%
	Station	2	0	0.732								
	Year x Station	8	0.1	0.998								
	Error	53		-								
Selenium (Total)	Year	4	0.72	0.578	-	-	-	-	-	-	-	-
	Station	2	59	<0.001	0.068	ns	<0.001	109%	<0.001	920%		
	Year x Station	8	0.9	0.506	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Uranium (Total)	Year	4	0.04	0.997	-	-	-	-	-	-	-	-
	Station	2	6	0.003	0.004	7%	0.002	29%	<0.001	40%		
	Year x Station	8	0.7	0.664	-	-	-	-	-	-		
	Error	99		-	-	-	-	-	-	-		
Zinc (Total)	Year	4	2.75	0.044	-						0.045	22%
	Station	2	0	0.629								
	Year x Station	7	0.9	0.493								
	Error	34		-								

P-value < 0.05.

Positive MOD (higher concentration of analyte at side-channel station relative to GH_ER2).

Negative MOD (lower concentration of analyte at side-channel station relative to GH_ER2).

Note: "-" indicates analysis not applicable. "ns" indicates not significant. "LRL" indicates laboratory reporting limit.

[a] Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as $\log_{10}$(Side Channel) − $\log_{10}$(GH_ER2) with Year, Station and Year x Station as model terms. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included

[b] Post-hoc calculated as a one-sample t-test on the relative differences between each station [$\log_{10}$(Side Channel) − $\log_{10}$(GH_ER2)] for parameters with a significant station term in the ANOVA model.

[c] Magnitude of difference (MOD) calculated as the side channel concentration (10^[$\log_{10}$(side-channel)]) minus the upstream concentration (10^[$\log_{10}$(GH_ER2)]) divided by the downstream concentration (10^[$\log_{10}$(GH_ER2)]) and multiplied by 100 to represent the percent difference between the side channel station and upstream, relative to upstream.

Table D.10: Statistical Comparisons of Differences in Monthly Mean Concentrations of Water Quality Parameters Between GHO LAEMP Side Channel Stations (GH_ERSC4, GH_E1A, GH_ERSC2) and the Main Stem Station Downstream of Mine Operations (GH_ERC), 2016 to 2020

ANOVA Model[a]					Post-hoc Contrasts with Downstream Station (GH_ERC)[b] and Magnitude of Difference (MOD) by Station[c]						T-Test for Overall difference	
					GH_ERSC4		GH_ER1A		GH_ERSC2			
Parameter	Model Term	DF	F	P-Value	P-Value	MOD	P-Value	MOD	P-Value	MOD	P-Value	MOD
Nitrate-N	Year	4	0.16	0.960	-	-	-	-	-	-		
	Station	2	40	<0.001	<0.001	-76%	0.534	ns	<0.001	190%	-	-
	Year x Station	8	0.64	0.746	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Nitrite-N	Year	4	0.67	0.617								
	Station	2	0.53	0.591	-						0.002	47%
	Year x Station	7	0.8	0.555								
	Error	35	-									
Sulphate	Year	4	0.49	0.743	-	-	-	-	-	-		
	Station	2	45	<0.001	<0.001	-25%	0.539	ns	<0.001	161%	-	-
	Year x Station	8	0.98	0.455	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Total Dissolved Solids	Year	4	0.52	0.720	-	-	-	-	-	-		
	Station	2	16	<0.001	0.071	ns	0.136	ns	<0.001	46%	-	-
	Year x Station	8	0.91	0.512	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Total Suspended Solids (mg/L)	Year	4	0.58	0.678								
	Station	2	0.34	0.715	-						0.301	ns
	Year x Station	8	0.35	0.943								
	Error	88	-									
Cadmium (Dissolved)	Year	4	0.688	0.602	-	-	-	-	-	-		
	Station	2	7.0	0.001	0.045	-0.088	0.214	ns	0.001	0.359	-	-
	Year x Station	8	0.87	0.543	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Cobalt (Dissolved)	Year											
	Station	Concentrations < LRL			Concentrations < LRL						-	-
	Year x Station											
	Error											
Antimony (Total)	Year	4	0.34	0.847								
	Station	2	2	0.108	-						0.101	ns
	Year x Station	8	0.3	0.973								
	Error	24	-									
Barium (Total)	Year	4	0.63	0.644								
	Station	2	2.3	0.102	-						<0.001	-8%
	Year x Station	8	0.8	0.577								
	Error	99	-									
Boron (Total)	Year											
	Station	Concentrations < LRL			Concentrations < LRL						-	-
	Year x Station											
	Error											
Lithium (Total)	Year	4	0.58	0.680	-	-	-	-	-	-		
	Station	2	16	<0.001	<0.001	-27%	0.122	ns	<0.001	69%	-	-
	Year x Station	8	0.5	0.837	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Manganese (Total)	Year	4	0.59	0.671								
	Station	2	2	0.178	-						0.014	28%
	Year x Station	8	0.3	0.969								
	Error	99	-									
Molybdenum (Total)	Year	4	0.31	0.869	-	-	-	-	-	-		
	Station	2	4	0.017	0.548	ns	0.014	16%	0.001	5%	-	-
	Year x Station	8	0.4	0.895	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Nickel (Total)	Year	4	0.96	0.436								
	Station	2	0	0.611	-						<0.001	33%
	Year x Station	8	0.1	0.997								
	Error	55	-									
Selenium (Total)	Year	4	0.38	0.821	-	-	-	-	-	-		
	Station	2	66	<0.001	<0.001	-41%	0.674	ns	<0.001	396%	-	-
	Year x Station	8	0.9	0.535	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Uranium (Total)	Year	4	0.21	0.931	-	-	-	-	-	-		
	Station	2	6	0.003	0.395	ns	0.033	17%	<0.001	26%	-	-
	Year x Station	8	0.7	0.657	-	-	-	-	-	-		
	Error	99	-		-	-	-	-	-	-		
Zinc (Total)	Year	4	1.42	0.245								
	Station	2	0	0.930	-						0.667	ns
	Year x Station	7	1.3	0.265								
	Error	40	-									

P-value < 0.05.

Positive MOD (higher concentration of analyte at side-channel station relative to GH_ERC).

Negative MOD (lower concentration of analyte at side-channel station relative to GH_ERC).

Note: "-" indicates analysis not applicable; "ns" indicates not significant; "LRL" indicates laboratory reporting limit.

[a] Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as $\log_{10}$(Side Channel) − $\log_{10}$(GH_ERC) with Year, Station and Year x Station as model terms. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc calculated as a one-sample t-test on the relative differences between each station [$\log_{10}$(Side Channel) − $\log_{10}$(GH_ERC)] for parameters with a significant station term in the ANOVA model.

[c] Magnitude of difference (MOD) calculated as the side channel concentration (10^[$\log_{10}$(side-channel)]) minus the downstream concentration (10^[$\log_{10}$(GH_ERC)]) divided by the downstream concentration (10^[$\log_{10}$(GH_ERC)]) and multiplied by 100 to represent the percent difference between the side channel station and downstream, relative to downstream.

Table D.11: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP, 2020

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)
GH_ER2	n	43	43	41	41	43	43	43	43	43	43	43	43	43	43	43	43	43
	Annual Minimum	139	7.94	7.86	8.90	122	0.0238	<0.001	<0.005	10.4	0.230	0.0880	<0.0001	<0.0001	0.0331	<0.00002	<0.01	0.000190
	Annual Maximum	206	8.51	9.12	12.6	156	0.119	0.00170	0.428	25.4	0.910	0.200	0.000210	0.00317	0.0901	0.000210	<0.01	0.00486
	Annual Mean	178	8.31	8.25	10.8	145	0.0738	0.00102	0.0261	18.9	0.320	0.142	0.000106	0.000279	0.0479	0.0000299	<0.01	0.000599
	Annual Median	176	8.32	8.18	10.5	148	0.0856	<0.001	0.00760	18.3	0.300	0.144	<0.0001	0.000120	0.0467	<0.00002	<0.01	0.000290
	% < LRL	0%	0%	0%	0%	0%	0%	98%	19%	0%	65%	0%	91%	26%	0%	88%	100%	0%
	% > BCWQG[a]	-	0%	2%	0%	0%	0%	0%	9%	0%	0%	-	0%	-	0%	5%	0%	12%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	9%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_ERC	n	42	42	41	41	42	42	42	42	42	42	42	42	42	42	42	42	42
	Annual Minimum	146	8.05	7.50	8.74	127	0.133	<0.001	<0.005	15.9	0.290	0.0760	<0.0001	<0.0001	0.0429	<0.00002	<0.01	0.000190
	Annual Maximum	259	8.53	9.09	11.9	164	2.88	<0.005	0.124	192	2.90	0.780	0.000250	0.00247	0.101	0.000252	<0.01	0.00628
	Annual Mean	198	8.29	8.15	10.5	150	0.532	0.00102	0.0140	33.8	0.446	0.153	0.000106	0.000252	0.0563	0.0000288	<0.01	0.000618
	Annual Median	195	8.30	8.15	10.5	152	0.434	<0.001	0.00765	29.7	0.355	0.140	<0.0001	0.000125	0.0562	<0.00002	<0.01	0.000275
	% < LRL	0%	0%	0%	0%	0%	0%	93%	36%	0%	60%	0%	93%	26%	0%	88%	100%	0%
	% > BCWQG[a]	-	0%	2%	0%	0%	0%	0%	5%	0%	0%	-	0%	-	0%	2%	0%	12%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	5%	-	0%	0%	-	0%	-	-	-	-
	% > Level 1 EVWQP Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.11: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP, 2020

Station	Summary Statistic	Total Cobalt (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)
GH_ER2	n	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	Annual Minimum	<0.0001	<0.01	<0.00005	0.00140	0.000560	0.000796	<0.0005	0.000596	<0.00001	<0.00001	0.000591	<0.003	<0.003	<0.000005	0.289	<0.01
	Annual Maximum	0.00169	3.30	0.00250	0.00460	0.288	0.00112	0.00713	0.00124	0.0000610	0.0000990	0.00104	0.0285	0.0603	0.000502	0.415	0.0680
	Annual Mean	0.000182	0.245	0.000189	0.00200	0.0163	0.000996	0.000869	0.000896	0.0000127	0.0000155	0.000744	0.00438	0.00486	0.0000191	0.356	0.0115
	Annual Median	<0.0001	0.0210	<0.00005	0.00180	0.00272	0.00101	<0.0005	0.000877	<0.00001	<0.00001	0.000744	<0.003	<0.003	0.00000720	0.361	<0.01
	% < LRL	88%	26%	72%	0%	0%	0%	86%	0%	88%	86%	0%	88%	79%	16%	79%	91%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	2%	2%	2%	-
	% > BCWQG[b]	0%	9%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	2%	0%	-	-	-	-	-	2%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_ERC	n	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
	Annual Minimum	<0.0001	<0.01	<0.00005	0.00200	0.000130	0.000889	<0.0005	0.00105	<0.00001	<0.00001	0.000659	<0.003	<0.003	<0.000005	0.332	<0.01
	Annual Maximum	0.00194	4.72	0.00299	0.00720	0.296	0.00124	0.00866	0.00424	0.0000860	0.000148	0.00118	0.0360	0.0366	0.0000619	0.694	0.0340
	Annual Mean	0.000179	0.269	0.000194	0.00306	0.0157	0.00103	0.000870	0.00214	0.0000134	0.0000157	0.000830	0.00460	0.00431	0.00000866	0.404	0.0108
	Annual Median	<0.0001	0.0120	<0.00005	0.00295	0.00159	0.00103	<0.0005	0.00198	<0.00001	<0.00001	0.000818	<0.003	<0.003	0.00000710	0.392	<0.01
	% < LRL	79%	45%	67%	0%	0%	0%	76%	0%	88%	86%	0%	74%	81%	17%	86%	93%
	% > BCWQG[a]	0%	-	0%	-	0%	0%	0%	43%	0%	0%	0%	0%	0%	0%	5%	-
	% > BCWQG[b]	0%	7%	0%	-	0%	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 EVWQP Benchmark	-	-	-	-	-	-	2%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 EVWQP Benchmark	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 EVWQP Benchmark	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table D.12: Temporal Changes in Water Chemistry Analytes at Main Stem Elk River Stations Downstream (GH_ERC) and Upstream (GH_ER2) of Mine Influence, GHO LAEMP, 2012 to 2020

Parameter	Status	Station	Annual Variation [a]		Q1. Is there a positive or negative change in concentrations since the base year (b) of monitoring? Magnitude of Difference (MOD)[b] and Significance (bolded) from Base Year (b) [c]									Q2. Is the 2020 annual mean greater or less than all annual historical means (2012 to 2019) and the previous year (2019)?[c]										
			DF	P-Value	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020 vs. 2012 to 2019	2020 vs. 2019
Total Selenium	Reference	GH_ER2	8	<0.001	b	-5.5	-2.1	3.6	12	10	13	22	17	D	D	D	CD	BC	BC	AB	A	AB	ns	ns
	Mine-exposed	GH_ERC	5	<0.001	-	-	-	b	1.7	-1.5	19	31	34	-	-	-	C	BC	C	AB	A	A	ns	ns
Nitrate-N	Reference	GH_ER2	8	<0.001	b	13	88	105	98	102	88	95	91	B	B	A	A	A	A	A	A	A	ns	ns
	Mine-exposed	GH_ERC	5	<0.001	-	-	-	b	17	-1.3	15	38	44	-	-	-	B	AB	B	AB	A	A	ns	ns
Sulphate	Reference	GH_ER2	8	<0.001	b	4.5	11	20	29	19	21	28	19	D	CD	BC	AB	A	AB	AB	A	AB	ns	ns
	Mine-exposed	GH_ERC	5	<0.001	-	-	-	b	35	-0.35	-4.2	5.4	12	-	-	-	B	A	B	B	B	AB	ns	ns
Total Dissolved Solids	Reference	GH_ER2	8	<0.001	b	7.4	4.4	10	12	9.6	7.5	5.7	12	C	AB	BC	AB	A	AB	AB	ABC	A	ns	ns
	Mine-exposed	GH_ERC	5	<0.001	-	-	-	b	10	-0.34	-2.9	-2.0	1.2	-	-	-	B	A	B	B	B	B	ns	ns
Total Nickel	Reference	GH_ER2	8	0.155	b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	-	-
	Mine-exposed	GH_ERC	5	0.277	-	-	-	b	ns	ns	ns	ns	ns	-	-	-	ns	ns	ns	ns	ns	ns	-	-
Uranium	Reference	GH_ER2	8	0.026	b	2.7	2.9	3.5	7.0	1.7	4.8	5.1	3.6	B	AB	AB	AB	A	AB	AB	AB	AB	ns	ns
	Mine-exposed	GH_ERC	5	0.393	-	-	-	b	ns	ns	ns	ns	ns	-	-	-	ns	ns	ns	ns	ns	ns	ns	ns

P-value < 0.05.
\> 20% Decrease in concentration.
\> 33% Decrease in concentration.
\> 43% Decrease in concentration.
\> 50% Decrease in concentration.
\> 25% Increase in concentration.
\> 50% Increase in concentration.
\> 75% Increase in concentration.
\> 100% Increase in concentration.
bold Significant increase or decrease from base year (b).
Significantly < than all historical years (or 2018).
Significantly > than all historical years (or 2018).

Notes: "ns" = not significant. "-" = insufficient data.

[a] *Year* p-value from an ANOVA with factors *Year* and *Month*.

[b] Magnitude of Difference (MOD) = $[\text{Mean}_{\text{given year}} - \text{Mean}_{\text{year b}}] / \text{Mean}_{\text{year b}} \times 100\%$.

[c] Significance among year determined using all pairwise comparisons using Tukey's honestly significant differences method. Years that share a letter are not significantly different. Letters assigned such that the mean with highest magnitude is assigned "A".

Table D.13: Difference in Monthly Mean Concentrations of Water Quality Parameters Between Stations Downstream (GH_ERC) and Upstream (GH_GH2) of Mining Operations, GHO LAEMP, 2016 to 2020

ANOVA Model Testing for Relative Difference Between Areas (Downstream − Upstream) Among Years [a]					Post-hoc Contrasts[b] (Downstream vs. Upstream) and Magnitude of Difference (MOD[c]) (Downstream Relative to Upstream)				
					P-value (MOD)				
Parameter	**Model Term**	**DF**	**F**	**P-value**	**2016**	**2017**	**2018**	**2019**	**2020**
Nitrate-N	Year	4	2.75	0.037	<0.001 (420%)	<0.001 (330%)	<0.001 (440%)	<0.001 (525%)	<0.001 (566%)
	Error	55	-	-					
Nitrite-N	Year	Concentrations < LRL			Concentrations < LRL				
	Error								
Orthophosphate	Year	4	0.09	0.984	0.375 (4%)				
	Error	42	-	-					
Total Phosphorus	Year	4	0.59	0.668	0.361 (8%)				
	Error	50	-	-					
Sulphate	Year	4	4.34	0.004	<0.001 (84%)	<0.001 (47%)	<0.001 (39%)	<0.001 (44%)	<0.001 (65%)
	Error	55	-	-					
Total Dissolved Solids	Year	4	2.83	0.033	<0.001 (20%)	<0.001 (10%)	<0.001 (9%)	<0.001 (12%)	<0.001 (10%)
	Error	55	-	-					
Total Suspended Solids (mg/L)	Year	4	2.76	0.039	0.015 (44%)	0.020 (46%)	0.020 (130%)	0.533 (16%)	0.698 (-7%)
	Error	45	-	-					
Cadmium (Dissolved)	Year	4	1.41	0.244	0.146 (9%)				
	Error	53	-	-					
Cobalt (Dissolved)	Year	Concentrations < LRL			Concentrations < LRL				
	Error								
Antimony (Total)	Year	Concentrations < LRL			Concentrations < LRL				
	Error								
Barium (Total)	Year	4	1.69	0.165	<0.001 (22%)				
	Error	55	-	-					
Boron (Total)	Year	Concentrations < LRL			Concentrations < LRL				
	Error								
Lithium (Total)	Year	4	2.53	0.051	<0.001 (58%)				
	Error	54	-	-					
Manganese (Total)	Year	4	1.43	0.237	0.003 (-30%)				
	Error	55	-	-					
Methylmercury (Total)	Year	Concentrations < LRL			Concentrations < LRL				
	Error								
Molybdenum (Total)	Year	4	5.98	<0.001	0.107 (-4%)	0.025 (5%)	0.001 (8%)	0.003 (5%)	0.068 (3%)
	Error	55	-	-					
Nickel (Total)	Year	4	0.76	0.566	0.024 (15%)				
	Error	16	-	-					
Selenium (Total)	Year	4	3.64	0.011	<0.001 (82%)	<0.001 (78%)	<0.001 (111%)	<0.001 (115%)	<0.001 (128%)
	Error	55	-	-					
Uranium (Total)	Year	4	1.12	0.355	<0.001 (10%)				
	Error	55	-	-					
Zinc (Total)	Year	4	0.60	0.667	0.061 (17%)				
	Error	19	-	-					

P-value < 0.05.

Positive MOD (higher concentration of analyte at the Downstream station relative to Upstream).

Negative MOD (lower concentration of analyte at Downstream station relative to Upstream).

[a] One way Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as log_{10}(downstream) − log_{10}(upstream) with year. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc calculated as a one-sample t-test on the relative differences between stations [log_{10}(downstream) − log_{10}(upstream)]. Conducted separately by year when there was a significant year term in the ANOVA model.

[c] Magnitude of difference (MOD) calculated as the downstream concentration 10^($Mean_{GH\_ERC}$] minus the upstream concentration 10^($Mean_{GH\_GH2}$) divided by the upstream concentration 10^($Mean_{GH\_GH2}$) and multplied by 100% ($Mean_{GH\_XXX}$ is in log_{10} units) to represent the percent difference between the downstream and upstream stations, relative to upstream.

APPENDIX D
WATER QUALITY SELENIUM SPECIATION
LAB REPORTS

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

October 19, 2020

Teck Resources Limited - Vancouver
Cait Good
421 Pine Avenue
Sparwood, B.C. CANADA V0B2G0
Cait.Good@Teck.com

Re: REP

Ms. Good,

On October 1, 2020, Brooks Applied Labs (BAL) received ten (10) aqueous samples.

Sample fractions for *RG_UCWER_WS_LAEMP_GHO_2020-09_NAL* were received with the sample shipment, even though this sample was not described on the chain-of-custody (COC) form. Total recoverable Se, dissolved Se, and Se speciation fractions for this sample were logged in under laboratory IDs 2040047-28, 2040047-29, and 2040047-30, respectively. The client was notified, and BAL was instructed to dispose of the samples. Consequently, no results are reported for *RG_UCWER_WS_LAEMP_GHO_2020-09_NAL* (laboratory IDs = 2040047-28, 2040047-29, and 2040047-30).

The samples were logged-in for total recoverable selenium [*Se*], dissolved Se [*Se*], and Se speciation analyses, according to the chain-of-custody (COC) form. The sample fractions logged in for Se speciation and dissolved Se had been field-filtered prior to receipt at BAL; sample fractions for total recoverable and dissolved Se had also been preserved by the client prior to receipt. All samples were stored according to BAL SOPs.

Total Recoverable and Dissolved Se
Each aqueous sample fraction for total recoverable or dissolved Se was digested in a closed vessel (bomb) with nitric and hydrochloric acids. The resulting digests were analyzed for Se content via inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). The ICP-QQQ-MS instrumentation uses advanced interference removal techniques to ensure accuracy of the sample results. For more information, please visit the *Interference Reduction Technology* section on our website, brooksapplied.com.

Selenium Speciation
Each aqueous sample was analyzed for selenium speciation using ion chromatography inductively coupled plasma collision reaction cell mass spectrometry (IC-ICP-CRC-MS). Selenium species are chromatographically separated on an ion exchange column and then quantified using inductively coupled plasma collision reaction cell mass spectrometry (ICP-CRC-MS); for more information on this determinative technique, please visit the *Interference Reduction Technology* section on our website. The chromatographic method applied for the analyses provides greater retention of methylseleninic acid and selenomethionine, allowing for more definitive quantitation of these species.

In accordance with the quotation issued for this project, selenium speciation was defined as dissolved selenite [*Se(IV)*], selenate [*Se(VI)*], selenocyanate [*SeCN*], methylseleninic acid [*MeSe(IV)*], selenomethionine [*SeMet*], selenosulfate [$SeSO_3$], and dimethylselenoxide [*DMSeO*]. An unknown selenium species eluting between MeSe(IV) and SeMet is also reported [*Se Unk A*]. Research at BAL has indicated that [*Se Unk A*] is a product of the oxidation of volatile selenium species present in some client samples. The total concentration of any remaining unidentified selenium-containing species detected in each sample has also been reported as [*Unk Se Sp]*.

DMSeO elutes early in the chromatographic run due to the nature of the molecule and the applied chromatographic separation method. Since this species elutes near the dead volume, additional selenium species may coelute. Alternate methods can be applied, upon client request, to increase the separation of DMSeO from potentially co-eluting selenium species.

Chromatographic interference, as indicated by an elevated baseline or co-eluting peak, was observed for selenosulfate in sample 2040047-24. Due to potential bias in the obtained result, the affected data point has been qualified as estimated (**J-1**). Upon client request, Brooks Applied Labs can apply a higher dilution to these samples to potentially mitigate the chromatographic interference, but a higher dilution would elevate the detection limit for SeMet above the client's requested limit of 0.010µg/L.

The results were not method blank corrected, as described in the calculations section of the relevant BAL SOPs and were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

In instances where a matrix spike/matrix spike duplicate (MS/MSD) set was spiked at a level less than the native sample concentration, the recoveries and the relative percent difference (RPD) are not considered valid indicators of data quality. In such instances, the recoveries of the laboratory fortified blanks (BS) and/or standard reference materials (SRM) demonstrate the accuracy of the applied methods. When the spiking level was less than 25% of the native sample concentration, the spike recovery was not reported (NR) and the relative percent difference (RPD) of the MS/MSD set was not calculated (N/C).

Except for the item noted above, all data were reported without qualification (aside from concentration qualifiers). All associated quality control sample results met the acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page.

Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Jeremy Maute
Senior Project Manager
Jeremy@brooksapplied.com

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations /certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/> or review Tables 1 and 2 in our Accreditation Information. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 3/23/2020)

E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Please see narrative for explanation.
J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1	Estimated value. A full explanation is presented in the narrative.
M	Duplicate precision (RPD) was not within acceptance criteria. Please see narrative for explanation.
N	Spike recovery was not within acceptance criteria. Please see narrative for explanation.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.
Z	Holding time and/or preservation requirements not established for this method; however, BAL recommendations for holding time were not followed. Please see narrative for explanation.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Accreditation Information

Table 1. Accredited method/matrix/analytes for TNI

Issued by: State of Florida Dept. of Health (The NELAC Institute 2016 Standard)
Issued on: July 27, 2020; Valid to: June 30, 2021
Certificate Number: E87982-35

Method	Matrix	TNI Accredited Analyte(s)
EPA 1638	Non-Potable Waters	Ag, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn
EPA 200.8	Non-Potable Waters	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
EPA 6020	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn
BAL-5000	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn, Hardness
	Solids/Chemicals	Ag, As, B, Be, Cd, Co, Cr, Cu, Pb, Mo, Ni, Sb, Se, Sn, Sr, Tl, V, Zn
	Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
EPA 1640	Non-Potable Waters	Ag, As, Cd, Cu, Pb, Ni, Zn
EPA 1631E	Non-Potable Waters, Solids/Chemicals & Biological	Total Mercury
EPA 1630	Non-Potable Waters	Methyl Mercury
BAL-3200	Solids/Chemicals & Biological	Methyl Mercury
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs
BAL-4200	Non-Potable Waters	Se(IV), Se(VI)
BAL-4201	Non-Potable Waters	Se(IV), Se(VI)
BAL-4300	Non-Potable Waters Solid/Chemicals	Cr(VI)
SM2340B	Non-Potable Waters	Hardness

Accreditation Information

Table 2. Accredited method/matrix/analytes for ISO (1), Non-Governmental TNI (2), and DoD/DOE (3)

Issued by: ANAB

Issued on: January 10, 2020; Valid to: March 30, 2022

Method	Matrix	ISO and Non-Gov. TNI Accredited Analyte(s)	DoD/DOE Accredited Analytes
EPA 1638 Mod EPA 200.8 Mod EPA 6020 Mod BAL-5000	Non-Potable Waters	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn	Ag, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, Ni, Sb, Se, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, Zn	Ag, As, Cd, Cr, Cu, Pb, Ni, Se, Zn
EPA 1640 Mod	Non-Potable Waters	Ag, As, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Tl, V, Zn	Not Accredited
EPA 1631E Mod BAL-3100 (waters) BAL-3101 (solids)	Non-Potable Waters, Solids/Chemicals & Biological/Food	Total Mercury	Total Mercury
EPA 1630 Mod BAL-3200	Non-Potable Waters, Solids/Chemicals Biological	Methyl Mercury	Methyl Mercury (excluding Solids/Chemicals)
EPA 1632A Mod BAL-3300	Non-Potable Waters Solids/Chemicals	Inorganic Arsenic, As(III)	Inorganic Arsenic. As(III) for waters only.
	Biological/Food	Inorganic Arsenic	Inorganic Arsenic (excluding Food)
AOAC 2015.01 Mod BAL-5000 by BAL-5040	Food	As, Cd, Hg, Pb	Not Accredited
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs	Not Accredited
	Biological by BAL-4115	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4101	Food by BAL-4116	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4200	Non-Potable Waters	Se(IV), Se(VI), SeCN	Not Accredited
BAL-4201	Non-Potable Waters	Se(IV), Se(VI), SeCN, SeMet	Not Accredited
BAL-4300	Non-Potable Waters, Solid/Chemicals	Cr(VI)	Cr(VI)
SM 3500-Fe BAL-4500	Non-Potable Waters	Fe, Fe(II)	Not Accredited
SM2340B	Non-Potable Waters	Hardness	Hardness
SM 2540G EPA 160.3 BAL-0501	Solids/Chemicals & Biological	% Dry Weight	% Dry Weight

(1) ISO/IEC 17025:2017 – Certificate Number ADE-1447.2
(2) Non-Governmental NELAC Institute 2016 Standard – Certificate Number ADE-1447.1
(3) Department of Defense/Energy Consolidated Quality Systems Manual v. 5.3 – Certificate Numbers ADE-1447 for DoD, ADE-1447.3 for DOE.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-01	WS	Sample	09/17/2020	10/01/2020
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-02	WS	Sample	09/17/2020	10/01/2020
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-03	WS	Sample	09/17/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-04	WS	Sample	09/12/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-05	WS	Sample	09/12/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-06	WS	Sample	09/12/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-07	WS	Sample	09/11/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-08	WS	Sample	09/11/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-09	WS	Sample	09/11/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-10	WS	Sample	09/10/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-11	WS	Sample	09/10/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-12	WS	Sample	09/10/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-13	WS	Sample	09/13/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-14	WS	Sample	09/13/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-15	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-16	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-17	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-18	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-19	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-20	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-21	WS	Sample	09/13/2020	10/01/2020

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-22	WS	Sample	09/10/2020	10/01/2020
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-23	WS	Sample	09/10/2020	10/01/2020
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-24	WS	Sample	09/10/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-25	WS	Sample	09/15/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-26	WS	Sample	09/15/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-27	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-28	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-29	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-30	WS	Sample	09/15/2020	10/01/2020

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
DMSeO	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
MeSe(IV)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se	Water	EPA 1638 Mod	10/01/2020	10/03/2020	B202657	2001198
Se Unk A	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se(IV)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se(VI)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeCN	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeMet	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeSO3	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Unk Se Sp	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL										
2040047-01	Se	WS	TR	0.696		0.192	0.528	µg/L	B202657	2001198
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL										
2040047-02	Se	WS	D	0.737		0.192	0.528	µg/L	B202657	2001198
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL										
2040047-03	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-03	MeSe(IV)	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-03	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-03	Se(IV)	WS	D	≤ 0.050	U	0.050	0.125	µg/L	B202664	2001191
2040047-03	Se(VI)	WS	D	0.689		0.060	0.125	µg/L	B202664	2001191
2040047-03	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-03	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-03	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-03	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL										
2040047-04	Se	WS	TR	0.744		0.192	0.528	µg/L	B202657	2001198
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL										
2040047-05	Se	WS	D	0.846		0.192	0.528	µg/L	B202657	2001198
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL										
2040047-06	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-06	MeSe(IV)	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-06	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-06	Se(IV)	WS	D	≤ 0.050	U	0.050	0.125	µg/L	B202664	2001191
2040047-06	Se(VI)	WS	D	0.645		0.060	0.125	µg/L	B202664	2001191
2040047-06	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-06	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-06	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-06	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL										
2040047-07	Se	WS	TR	1.56		0.192	0.528	µg/L	B202657	2001198
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL										
2040047-08	Se	WS	D	1.54		0.192	0.528	µg/L	B202657	2001198

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL										
2040047-09	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-09	MeSe(IV)	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-09	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-09	Se(IV)	WS	D	≤ 0.050	U	0.050	0.125	µg/L	B202664	2001191
2040047-09	Se(VI)	WS	D	1.35		0.060	0.125	µg/L	B202664	2001191
2040047-09	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-09	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-09	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-09	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL										
2040047-10	Se	WS	TR	1.24		0.192	0.528	µg/L	B202657	2001198
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL										
2040047-11	Se	WS	D	1.15		0.192	0.528	µg/L	B202657	2001198
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL										
2040047-12	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-12	MeSe(IV)	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-12	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-12	Se(IV)	WS	D	≤ 0.050	U	0.050	0.125	µg/L	B202664	2001191
2040047-12	Se(VI)	WS	D	1.14		0.060	0.125	µg/L	B202664	2001191
2040047-12	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-12	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-12	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-12	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL										
2040047-13	Se	WS	TR	11.4		0.192	0.528	µg/L	B202657	2001198
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL										
2040047-14	Se	WS	D	12.2		0.192	0.528	µg/L	B202657	2001198

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL										
2040047-15	DMSeO	WS	D	0.015	J	0.010	0.025	µg/L	B202664	2001191
2040047-15	MeSe(IV)	WS	D	0.018	J	0.010	0.025	µg/L	B202664	2001191
2040047-15	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-15	Se(IV)	WS	D	0.452		0.050	0.125	µg/L	B202664	2001191
2040047-15	Se(VI)	WS	D	11.3		0.060	0.125	µg/L	B202664	2001191
2040047-15	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-15	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-15	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-15	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL										
2040047-16	Se	WS	TR	12.3		0.192	0.528	µg/L	B202657	2001198
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL										
2040047-17	Se	WS	D	11.4		0.192	0.528	µg/L	B202657	2001198
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL										
2040047-18	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-18	MeSe(IV)	WS	D	0.019	J	0.010	0.025	µg/L	B202664	2001191
2040047-18	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-18	Se(IV)	WS	D	0.442		0.050	0.125	µg/L	B202664	2001191
2040047-18	Se(VI)	WS	D	11.4		0.060	0.125	µg/L	B202664	2001191
2040047-18	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-18	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-18	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-18	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL										
2040047-19	Se	WS	TR	12.4		0.192	0.528	µg/L	B202657	2001198
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL										
2040047-20	Se	WS	D	13.6		0.192	0.528	µg/L	B202657	2001198

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL										
2040047-21	DMSeO	WS	D	0.022	J	0.010	0.025	µg/L	B202664	2001191
2040047-21	MeSe(IV)	WS	D	0.024	J	0.010	0.025	µg/L	B202664	2001191
2040047-21	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-21	Se(IV)	WS	D	0.543		0.050	0.125	µg/L	B202664	2001191
2040047-21	Se(VI)	WS	D	12.4		0.060	0.125	µg/L	B202664	2001191
2040047-21	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-21	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-21	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-21	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
RG_THCK_WS_LAEMP_GHO_2020-09_NAL										
2040047-22	Se	WS	TR	125		0.192	0.528	µg/L	B202657	2001198
RG_THCK_WS_LAEMP_GHO_2020-09_NAL										
2040047-23	Se	WS	D	125		0.192	0.528	µg/L	B202657	2001198
RG_THCK_WS_LAEMP_GHO_2020-09_NAL										
2040047-24	DMSeO	WS	D	0.183		0.010	0.025	µg/L	B202664	2001191
2040047-24	MeSe(IV)	WS	D	0.246		0.010	0.025	µg/L	B202664	2001191
2040047-24	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-24	Se(IV)	WS	D	5.79		0.050	0.125	µg/L	B202664	2001191
2040047-24	Se(VI)	WS	D	120		0.060	0.125	µg/L	B202664	2001191
2040047-24	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-24	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-24	SeSO3	WS	D	≤ 0.060	J-1 U	0.060	0.125	µg/L	B202664	2001191
2040047-24	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
RG_EL20_WS_LAEMP_GHO_2020-09_NAL										
2040047-25	Se	WS	TR	1.71		0.192	0.528	µg/L	B202657	2001198
RG_EL20_WS_LAEMP_GHO_2020-09_NAL										
2040047-26	Se	WS	D	1.62		0.192	0.528	µg/L	B202657	2001198

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_EL20_WS_LAEMP_GHO_2020-09_NAL										
2040047-27	DMSeO	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-27	MeSe(IV)	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-27	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-27	Se(IV)	WS	D	0.085	J	0.050	0.125	µg/L	B202664	2001191
2040047-27	Se(VI)	WS	D	1.56		0.060	0.125	µg/L	B202664	2001191
2040047-27	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-27	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-27	SeSO3	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-27	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191

Accuracy & Precision Summary

Batch: B202657
Lab Matrix: Water
Method: EPA 1638 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits
B202657-BS1	**Blank Spike, (2035012)**							
	Se		200.0	186.5	µg/L	93%	75-125	
B202657-BS2	**Blank Spike, (2035012)**							
	Se		200.0	185.8	µg/L	93%	75-125	
B202657-BS3	**Blank Spike, (2035012)**							
	Se		200.0	184.7	µg/L	92%	75-125	
B202657-BS4	**Blank Spike, (2035012)**							
	Se		200.0	185.9	µg/L	93%	75-125	
B202657-BS5	**Blank Spike, (2035012)**							
	Se		200.0	181.8	µg/L	91%	75-125	
B202657-BS6	**Blank Spike, (2035012)**							
	Se		200.0	181.4	µg/L	91%	75-125	
B202657-BS7	**Blank Spike, (2035012)**							
	Se		200.0	182.7	µg/L	91%	75-125	
B202657-BS8	**Blank Spike, (2035012)**							
	Se		200.0	181.2	µg/L	91%	75-125	
B202657-SRM1	**Reference Material (2033007, T221)**							
	Se		3.800	3.462	µg/L	91%	75-125	
B202657-SRM2	**Reference Material (2033007, T221)**							
	Se		3.800	3.423	µg/L	90%	75-125	
B202657-SRM3	**Reference Material (2033007, T221)**							
	Se		3.800	3.730	µg/L	98%	75-125	

Accuracy & Precision Summary

Batch: B202657
Lab Matrix: Water
Method: EPA 1638 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B202657-SRM4	**Reference Material (2033007, T221)**								
	Se		3.800	3.612	µg/L	95%	75-125		
B202657-SRM5	**Reference Material (2033007, T221)**								
	Se		3.800	3.430	µg/L	90%	75-125		
B202657-SRM6	**Reference Material (2033007, T221)**								
	Se		3.800	3.530	µg/L	93%	75-125		
B202657-SRM7	**Reference Material (2033007, T221)**								
	Se		3.800	3.338	µg/L	88%	75-125		
B202657-SRM8	**Reference Material (2033007, T221)**								
	Se		3.800	3.256	µg/L	86%	75-125		
B202657-DUPB	**Duplicate, (2040047-04)**								
	Se	0.744		0.723	µg/L			3%	20
B202657-MSB	**Matrix Spike, (2040047-04)**								
	Se	0.744	220.0	205.4	µg/L	93%	75-125		
B202657-MSDB	**Matrix Spike Duplicate, (2040047-04)**								
	Se	0.744	220.0	208.3	µg/L	94%	75-125	1%	20
B202657-DUPC	**Duplicate, (2040047-13)**								
	Se	11.40		11.53	µg/L			1%	20
B202657-MSC	**Matrix Spike, (2040047-13)**								
	Se	11.40	220.0	219.8	µg/L	95%	75-125		
B202657-MSDC	**Matrix Spike Duplicate, (2040047-13)**								
	Se	11.40	220.0	219.5	µg/L	95%	75-125	0.2%	20

Accuracy & Precision Summary

Batch: B202657
Lab Matrix: Water
Method: EPA 1638 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B202657-DUPD	**Duplicate, (2040047-25)**								
	Se	1.707		1.422	µg/L			18%	20
B202657-MSD	**Matrix Spike, (2040047-25)**								
	Se	1.707	220.0	208.5	µg/L	94%	75-125		
B202657-MSDD	**Matrix Spike Duplicate, (2040047-25)**								
	Se	1.707	220.0	210.4	µg/L	95%	75-125	0.9%	20

Accuracy & Precision Summary

Batch: B202664
Lab Matrix: Water
Method: SOP BAL-4201

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B202664-BS1	**Blank Spike, (1923027)**								
	MeSe(IV)		5.095	5.632	µg/L	111%	75-125		
	Se(IV)		5.000	4.915	µg/L	98%	75-125		
	Se(VI)		5.000	4.792	µg/L	96%	75-125		
	SeCN		5.015	4.805	µg/L	96%	75-125		
	SeMet		4.932	4.895	µg/L	99%	75-125		
B202664-DUP3	**Duplicate, (2040046-21)**								
	DMSeO	0.068		0.062	µg/L			8%	25
	MeSe(IV)	0.082		0.082	µg/L			0.6%	25
	Se Unk A	ND		ND	µg/L			N/C	25
	Se(IV)	2.943		2.953	µg/L			0.3%	25
	Se(VI)	107.6		106.7	µg/L			0.9%	25
	SeCN	ND		ND	µg/L			N/C	25
	SeMet	ND		ND	µg/L			N/C	25
	SeSO3	ND		ND	µg/L			N/C	25
	Unk Se Sp	ND		ND	µg/L			N/C	25
B202664-MS3	**Matrix Spike, (2040046-21)**								
	Se(IV)	2.943	4.900	7.456	µg/L	92%	75-125		
	Se(VI)	107.6	5.100	110.0	µg/L	NR	75-125		
	SeCN	ND	4.905	4.552	µg/L	93%	75-125		
	SeMet	ND	0.9885	0.995	µg/L	101%	75-125		
B202664-MSD3	**Matrix Spike Duplicate, (2040046-21)**								
	Se(IV)	2.943	4.900	7.537	µg/L	94%	75-125	1%	25
	Se(VI)	107.6	5.100	109.5	µg/L	NR	75-125	N/C	25
	SeCN	ND	4.905	4.621	µg/L	94%	75-125	1%	25
	SeMet	ND	0.9885	0.981	µg/L	99%	75-125	1%	25

Method Blanks & Reporting Limits

Batch: B202657
Matrix: Water
Method: EPA 1638 Mod
Analyte: Se

Sample	Result	Units
B202657-BLK1	0.090	µg/L
B202657-BLK2	0.106	µg/L
B202657-BLK3	0.020	µg/L
B202657-BLK4	0.071	µg/L
B202657-BLK5	0.086	µg/L
B202657-BLK6	0.073	µg/L
B202657-BLK7	0.011	µg/L
B202657-BLK8	0.091	µg/L
Average:	0.068	
Limit:	0.480	

MDL: 0.175
MRL: 0.480

Method Blanks & Reporting Limits

Batch: B202664
Matrix: Water
Method: SOP BAL-4201
Analyte: DMSeO

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Analyte: MeSe(IV)

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Analyte: Se Unk A

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Method Blanks & Reporting Limits

Analyte: Se(IV)

Sample	Result	Units
B202664-BLK1	0.001	µg/L
B202664-BLK2	0.001	µg/L
B202664-BLK3	0.001	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.001 **MDL:** 0.010
Limit: 0.025 **MRL:** 0.025

Analyte: Se(VI)

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.012
Limit: 0.025 **MRL:** 0.025

Analyte: SeCN

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.008
Limit: 0.025 **MRL:** 0.025

Analyte: SeMet

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Method Blanks & Reporting Limits

Analyte: SeSO3

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.012
Limit: 0.025 **MRL:** 0.025

Analyte: Unk Se Sp

Sample	Result	Units
B202664-BLK1	0.00	µg/L
B202664-BLK2	0.00	µg/L
B202664-BLK3	0.00	µg/L
B202664-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.012
Limit: 0.025 **MRL:** 0.025

Sample Containers

Lab ID: 2040047-01
Sample: RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/17/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-02
Sample: RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/17/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-03
Sample: RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/17/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-04
Sample: GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/12/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Sample Containers

Lab ID: 2040047-05
Sample: GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/12/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-06
Sample: GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/12/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-07
Sample: GH_ER1A_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/11/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-08
Sample: GH_ER1A_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/11/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Sample Containers

Lab ID: 2040047-09
Sample: GH_ER1A_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/11/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-10
Sample: RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-11
Sample: RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-12
Sample: RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Sample Containers

Lab ID: 2040047-13
Sample: RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-14
Sample: RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-15
Sample: RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-16
Sample: GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #7 - 2040047

Sample Containers

Lab ID: 2040047-17
Sample: GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-18
Sample: GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-19
Sample: RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-20
Sample: RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Sample Containers

Lab ID: 2040047-21
Sample: RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/13/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-22
Sample: RG_THCK_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-23
Sample: RG_THCK_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-24
Sample: RG_THCK_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/10/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Sample Containers

Lab ID: 2040047-25
Sample: RG_EL20_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-26
Sample: RG_EL20_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-27
Sample: RG_EL20_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Lab ID: 2040047-28
Sample: RG_UCWER_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Sample Containers

Lab ID: 2040047-29
Sample: RG_UCWER_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided - TM	120 mL	na	10% HNO3 (BAL)	1950008	<2	Styrofoam Cooler #9 - 2040047

Lab ID: 2040047-30
Sample: RG_UCWER_WS_LAEMP_GHO_2020-09_NAL
Report Matrix: WS
Sample Type: Sample + Sum
Collected: 09/15/2020
Received: 10/01/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
B	XTRA_VOL	15 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047
C	XTRA_VOL	120 mL	na	none	na	na	Styrofoam Cooler #7 - 2040047

Shipping Containers

Styrofoam Cooler #7 - 2040047

Received: October 1, 2020 7:00
Tracking No: 81528 via Courier
Coolant Type: Ice
Temperature: 0.3 °C
Description: Styrofoam Cooler #7
Damaged in transit? No
Returned to client? No
Comments: IR #21
Custody seals present? No
Custody seals intact? No
COC present? Yes

Styrofoam Cooler #9 - 2040047

Received: October 1, 2020 7:00
Tracking No: 81528 via Courier
Coolant Type: Ice
Temperature: 7.3 °C
Description: Styrofoam Cooler #9
Damaged in transit? No
Returned to client? No
Comments: IR #21
Custody seals present? No
Custody seals intact? No
COC present? Yes

Teck
Confidential

COC ID: **GHO LAEMP Sept 2020 (20-22)** TURNAROUND TIME:

PROJECT/CLIENT INFO				LABORATORY			
Facility Name	REP			Lab Name	Brooks Applied Labs		
Project Manager	Cait Good			Lab Contact	Ben Wozniak		
Email	cait.good@teck.com			Email	ben@brooksapplied.com		
Address	421 Pine Avenue			Address	18804 North Creek Parkway		
City	Sparwood	Province	BC	City	Bothell	Province	WA
Postal Code	V0B 2G0	Country	Canada	Postal Code	98011	Country	USA
Phone Number	250-425-8202			Phone Number	206-632-6206		

	Excel	PDF	EDD
cait.good@teck.com	x	x	x
teckcoal@equisonline.com			x
carlie meyer@teck.com	x	x	x
jtester@minnow.ca	x	x	x
jings@minnow.ca	x	x	x

SAMPLE DETAILS / **ANALYSIS REQUESTED** — Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	Total Selenium (HNO3, P)	Dissolved Selenium (HNO3, F/P)	Selenium Speciation (F)
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	RG_ELUGH	WS	No	9/17/2020	13:20	G	3	X	X	X
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	GH_ERSC4	WS	No	9/12/2020	13:00	G	3	X	X	X
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	GH_ER1A	WS	No	9/11/2020	14:00	G	3	X	X	X
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	RG_ERSC5	WS	No	9/10/2020	16:45	G	3	X	X	X
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	RG_GH-SCW3	WS	No	9/13/2020	14:45	G	3	X	X	X
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	GH_ERSC2	WS	No	9/13/2020	14:00	G	3	X	X	X
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	RG_SCDTC	WS	No	9/13/2020	12:20	G	3	X	X	X
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	RG_THCK	WS	No	9/10/2020	15:45	G	3	X	X	X
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	RG_EL20	WS	No	9/15/2020	14:30	G	3	X	X	X

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

Purchase Order Number - VPO00690100.
Samples for total selenium have been preserved in the field. Dissolved selenium have been filtered and preserved. Speciation samples have been filtered and frozen.

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	
Jennifer Ings/Minnow	9/24/20 9:00	Jen Kely BAL	10/1/20 7:00

NB OF BOTTLES RETURNED/DESCRIPTION

Regular (default) x
Priority (2-3 business days) - 50% surcharge
Emergency (1 Business Day) - 100% surcharge
For Emergency <1 Day, ASAP or Weekend - Contact ALS

Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Sampler's Signature		Date/Time	9/24/20 9:00

STRAIGHT BILL OF LADING
NOT NEGOTIABLE

RW HOT SHOT SERVICE INC.
250-425-7447
24 Hour Hot Shot Service

No. 81528

Sparwood, BC
Kamloops, BC
Terrace, BC

Vancouver, BC
Prince George, BC
Tumbler Ridge, BC

Elkford, BC
Calgary, AB
Edmonton, AB

Ft. McMurray, AB
Hinton, AB
Red Deer, AB

Montreal, QC
Gillette, WY
Spokane, WA

Shelby, MT

INVOICE TO	DATE: Sept 30/20
BILL OF LADING #	PURCHASE ORDER NUMBER
SHIPPER (FROM): Teck Coal Ltd	CONSIGNEE (TO): Brooks Applied Labs
STREET: West Line Creek Treatment	STREET: 18804 N. Creek Parkway
CITY/PROVINCE: Sparwood, BC / POSTAL CODE	CITY/PROVINCE: Bothell, WA / POSTAL CODE: 98011

SPECIAL INSTRUCTIONS

PACKAGES	DESCRIPTION OF ARTICLES AND SPECIAL MARKS	WEIGHT (Subject to Correction)
10	Coolers - Water Samples	400 LBS

PAPS# RWHV81528

FREIGHT CHARGES
SHIPPER TO CHECK
☐PREPAID ☐COLLECT
If not indicated, shipping will automatically move collect.

FEE
WAITING
XPU
CHARGES
FSC
US
SUB TOTAL
GST
TOTAL $
IF AT OWNER'S RISK, WRITE ORD HERE

UNIT #

DECLARED VALUATION: Maximum liability of carrier is $2.00 per lb. ($4.41 per kilogram) unless declared valuation states otherwise. $

DRIVER'S SIGNATURE - PICK UP BY	PICK UP TIME	DRIVER'S SIGNATURE - DELIVERY BY	FINISH TIME

NOTICE OF CLAIM: (a) No carrier is liable for loss, damage or delay of any goods under the Bill of Lading unless notice, therefor setting out particulars of the origin, destination and date of shipment of the goods and the estimated amount claimed respect of such loss, damage or delay is given in writing to the originating carrier or the delivering carrier within sixty (60) days after the delivery of the goods, or in the case of failure to make delivery within nine (9) months from the date of shipment. (b) The final statement of the claim must be filed within nine (9) months from the date of shipment together with a copy of the paid freight bill. RECEIVED at the point of origin on the date specified from the consignor mentioned herein, the property herein described, in apparent good order, except as noted (contents and condition of contents of package unknown) marked, consigned and destined as indicated below, which the carrier agrees to carry and to deliver to the consignee at the said destination, subject to the rates and classification in effect on the date of shipment. It is mutually agreed, as to each carrier of all or any of the goods over all or any portion of the route to destination, and as to each party at any time interested in all or any of the goods, that every service to be performed hereunder shall be subject to all the conditions standard Bill of Lading, in power at the date of issuing, which are hereby agreed by the consignor and accepted for himself and his assigns. Printed or written, including conditions set aside by the standard Bill of Lading, in power at the date of issuing, which are hereby agreed by the consignor and accepted for himself and his assigns. The Contract for the carriage of the goods listed in the Bill of Lading is governed by regulation in force in the jurisdiction at the time and place of shipment and is subject to the conditions set out in such conditions.

SHIPPER PRINT	CONSIGNEE PRINT	DATE: 10-1-20
SHIPPER SIGN	CONSIGNEE SIGN	TIME: 7:00

NUMBER OF PIECES RECEIVED: 10

WHITE: Office YELLOW: Carrier PINK: Consignee GOLDENROAD: Shipper GST # 864540398RT0001

AMIGOS PRINTING

Cooler ID: Styro #7 **COC** (Y/N): Y **Temperature:** 0.3 **IR:** 21

Coolant Type: Ice Blue Ice Ambient

Notes:

Sampling Locations:	44		45		46		47		48	
Sample Types:	T/D	SP	T/D	SP	T/D	SP	T/D	SP	T/D	SP
Container Types:	120	120	120	120	120	120	120	120	120	120

Opened By: DJR **Date:** 10/1/20

Effective 7/29/20 Revision 004

STRAIGHT BILL OF LADING
NOT NEGOTIABLE

RW HOT SHOT SERVICE INC.
250-425-7447
24 Hour Hot Shot Service

No. 81528

COPY

Sparwood, BC · Kamloops, BC · Terrace, BC · Vancouver, BC · Prince George, BC · Tumbler Ridge, BC · Elkford, BC · Calgary, AB · Edmonton, AB · Ft. McMurray, AB · Hinton, AB · Red Deer, AB · Montreal, QC · Gillette, WY · Spokane, WA · Shelby, MT

INVOICE TO	DATE
BILL OF LADING #	PURCHASE ORDER NUMBER
SHIPPER (FROM)	CONSIGNEE (TO)
STREET	STREET
CITY/PROVINCE / POSTAL CODE	CITY/PROVINCE / POSTAL CODE
SPECIAL INSTRUCTIONS	

PACKAGES	DESCRIPTION OF ARTICLES AND SPECIAL MARKS	WEIGHT (Subject to Correction)
	PAPS# RWHV81528	

UNIT #

DECLARED VALUATION: Maximum liability of carrier is $2.00 per lb. ($4.41 per kilogram) unless declared valuation states otherwise. $

DRIVER'S SIGNATURE - PICK UP BY	PICK UP TIME	DRIVER'S SIGNATURE - DELIVERY BY	FINISH TIME

FREIGHT CHARGES
SHIPPER TO CHECK
☐PREPAID ☐COLLECT
If not indicated, shipping will automatically move collect.

FEE
WAITING
XPU
CHARGES
FSC
US
SUB TOTAL
GST
TOTAL $
IF AT OWNER'S RISK, WRITE ORD HERE

NOTICE OF CLAIM: (a) No carrier is liable for loss, damage or delay of any goods under the Bill of Lading unless notice, therefor setting out particulars of the origin, destination and date of shipment of the goods and the estimated amount claimed in respect of such loss, damage or delay is given in writing to the originating carrier or the delivering carrier within sixty (60) days after the delivery of the goods, or in the case of failure to make delivery within nine (9) months from the date of shipment. (b) The final statement of the claim must be filed within nine (9) months from the date of shipment together with a copy of the paid freight bill. RECEIVED at the point of origin on the date specified from the consignor mentioned herein, the property herein described, in apparent good order, except as noted (contents and condition of contents of package unknown) marked, consigned and destined as indicated below, which the carrier agrees to carry and to deliver to the consignee at the said destination, subject to the rates and classification in effect on the date of shipment. It is mutually agreed, as to each carrier of all or any of the goods over all or any portion of the route to destination, and as to each party of any time interested in all or any of the goods, that every service to be performed hereunder shall be subject to all the conditions standard Bill of Lading, in power at the date of issuing, which are hereto agreed by the consignor and accepted for himself and his assigns. Printed or written, including conditions set aside by the standard Bill of Lading, in power at the date of issuing, which are hereby agreed by the consignor and accepted for himself and his assigns. The Contract for the carriage of the goods listed in the Bill of Lading is governed by regulation in force in the jurisdiction at the time and place of shipment and is subject to the conditions set out in such conditions.

SHIPPER PRINT	CONSIGNEE PRINT	DATE
SHIPPER SIGN	CONSIGNEE SIGN	TIME

WHITE: Office YELLOW: Carrier PINK: Consignee GOLDENROAD: Shipper GST # 864540398RT0001 NUMBER OF PIECES RECEIVED

ALGOOS PRINTING

Cooler ID: **COC (Y/N)** **Temperature:** **IR:**

Coolant Type: Ice Blue Ice Ambient

Notes:

Sampling Locations: RG

Sample Types:	T/D	SP	T/D	SP	T/D	SP	T/D	SP	T/D	SP
	RO									
Container Types:		BSL BNIO								

Opened By: DSN **Date:**

Effective 7/29/20 Revision 004

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations /certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/> or review Tables 1 and 2 in our Accreditation Information. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 3/23/2020)

E An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H Holding time and/or preservation requirements not met. Please see narrative for explanation.
J Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1 Estimated value. A full explanation is presented in the narrative.
M Duplicate precision (RPD) was not within acceptance criteria. Please see narrative for explanation.
N Spike recovery was not within acceptance criteria. Please see narrative for explanation.
R Rejected, unusable value. A full explanation is presented in the narrative.
U Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.
Z Holding time and/or preservation requirements not established for this method; however, BAL recommendations for holding time were not followed. Please see narrative for explanation.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Accreditation Information

Table 1. Accredited method/matrix/analytes for TNI

Issued by: State of Florida Dept. of Health (The NELAC Institute 2016 Standard)
Issued on: July 27, 2020; Valid to: June 30, 2021
Certificate Number: E87982-35

Method	Matrix	TNI Accredited Analyte(s)
EPA 1638	Non-Potable Waters	Ag, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn
EPA 200.8	Non-Potable Waters	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
EPA 6020	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn
BAL-5000	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn, Hardness
	Solids/Chemicals	Ag, As, B, Be, Cd, Co, Cr, Cu, Pb, Mo, Ni, Sb, Se, Sn, Sr, Tl, V, Zn
	Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
EPA 1640	Non-Potable Waters	Ag, As, Cd, Cu, Pb, Ni, Zn
EPA 1631E	Non-Potable Waters, Solids/Chemicals & Biological	Total Mercury
EPA 1630	Non-Potable Waters	Methyl Mercury
BAL-3200	Solids/Chemicals & Biological	Methyl Mercury
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs
BAL-4200	Non-Potable Waters	Se(IV), Se(VI)
BAL-4201	Non-Potable Waters	Se(IV), Se(VI)
BAL-4300	Non-Potable Waters Solid/Chemicals	Cr(VI)
SM2340B	Non-Potable Waters	Hardness

Brooks Applied Labs

Accreditation Information

Table 2. Accredited method/matrix/analytes for ISO (1), Non-Governmental TNI (2), and DoD/DOE (3)

Issued by: ANAB

Issued on: January 10, 2020; Valid to: March 30, 2022

Method	Matrix	ISO and Non-Gov. TNI Accredited Analyte(s)	DoD/DOE Accredited Analytes
EPA 1638 Mod EPA 200.8 Mod EPA 6020 Mod BAL-5000	Non-Potable Waters	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn	Ag, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, Ni, Sb, Se, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, Zn	Ag, As, Cd, Cr, Cu, Pb, Ni, Se, Zn
EPA 1640 Mod	Non-Potable Waters	Ag, As, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Tl, V, Zn	Not Accredited
EPA 1631E Mod BAL-3100 (waters) BAL-3101 (solids)	Non-Potable Waters, Solids/Chemicals & Biological/Food	Total Mercury	Total Mercury
EPA 1630 Mod BAL-3200	Non-Potable Waters, Solids/Chemicals Biological	Methyl Mercury	Methyl Mercury (excluding Solids/Chemicals)
EPA 1632A Mod BAL-3300	Non-Potable Waters Solids/Chemicals	Inorganic Arsenic, As(III)	Inorganic Arsenic. As(III) for waters only.
	Biological/Food	Inorganic Arsenic	Inorganic Arsenic (excluding Food)
AOAC 2015.01 Mod BAL-5000 by BAL-5040	Food	As, Cd, Hg, Pb	Not Accredited
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs	Not Accredited
	Biological by BAL-4115	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4101	Food by BAL-4116	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4200	Non-Potable Waters	Se(IV), Se(VI), SeCN	Not Accredited
BAL-4201	Non-Potable Waters	Se(IV), Se(VI), SeCN, SeMet	Not Accredited
BAL-4300	Non-Potable Waters, Solid/Chemicals	Cr(VI)	Cr(VI)
SM 3500-Fe BAL-4500	Non-Potable Waters	Fe, Fe(II)	Not Accredited
SM2340B	Non-Potable Waters	Hardness	Hardness
SM 2540G EPA 160.3 BAL-0501	Solids/Chemicals & Biological	% Dry Weight	% Dry Weight

(1) ISO/IEC 17025:2017 – Certificate Number ADE-1447.2
(2) Non-Governmental NELAC Institute 2016 Standard – Certificate Number ADE-1447.1
(3) Department of Defense/Energy Consolidated Quality Systems Manual v. 5.3 – Certificate Numbers ADE-1447 for DoD, ADE-1447.3 for DOE.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-01	WS	Sample	09/17/2020	10/01/2020
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-02	WS	Sample	09/17/2020	10/01/2020
RG_ELUGH_WS_LAEMP_GHO_2020-09_NAL	2040047-03	WS	Sample	09/17/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-04	WS	Sample	09/12/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-05	WS	Sample	09/12/2020	10/01/2020
GH_ERSC4_WS_LAEMP_GHO_2020-09_NAL	2040047-06	WS	Sample	09/12/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-07	WS	Sample	09/11/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-08	WS	Sample	09/11/2020	10/01/2020
GH_ER1A_WS_LAEMP_GHO_2020-09_NAL	2040047-09	WS	Sample	09/11/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-10	WS	Sample	09/10/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-11	WS	Sample	09/10/2020	10/01/2020
RG_ERSC5_WS_LAEMP_GHO_2020-09_NAL	2040047-12	WS	Sample	09/10/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-13	WS	Sample	09/13/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-14	WS	Sample	09/13/2020	10/01/2020
RG_GH-SCW3_WS_LAEMP_GHO_2020-09_NAL	2040047-15	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-16	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-17	WS	Sample	09/13/2020	10/01/2020
GH_ERSC2_WS_LAEMP_GHO_2020-09_NAL	2040047-18	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-19	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-20	WS	Sample	09/13/2020	10/01/2020
RG_SCDTC_WS_LAEMP_GHO_2020-09_NAL	2040047-21	WS	Sample	09/13/2020	10/01/2020

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-22	WS	Sample	09/10/2020	10/01/2020
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-23	WS	Sample	09/10/2020	10/01/2020
RG_THCK_WS_LAEMP_GHO_2020-09_NAL	2040047-24	WS	Sample	09/10/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-25	WS	Sample	09/15/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-26	WS	Sample	09/15/2020	10/01/2020
RG_EL20_WS_LAEMP_GHO_2020-09_NAL	2040047-27	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-28	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-29	WS	Sample	09/15/2020	10/01/2020
RG_UCWER_WS_LAEMP_GHO_2020-09_NAL	2040047-30	WS	Sample	09/15/2020	10/01/2020

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
DMSeO	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
DMSeO	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
MeSe(IV)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
MeSe(IV)	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
Se Unk A	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se Unk A	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
Se(IV)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se(IV)	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
Se(VI)	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Se(VI)	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
SeCN	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeCN	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
SeMet	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeMet	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
SeSO3	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
SeSO3	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271
Unk Se Sp	Water	SOP BAL-4201	10/02/2020	10/03/2020	B202664	2001191
Unk Se Sp	Water	SOP BAL-4201	10/22/2020	10/24/2020	B202887	2001271

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_THCK_WS_LAEMP_GHO_2020-09_NAL										
2040047-24	DMSeO	WS	D	0.183		0.010	0.025	µg/L	B202664	2001191
2040047-24	DMSeO	WS	D	0.851		0.040	0.100	µg/L	B202887	2001271
2040047-24	DMSeO	WS	D	0.638		0.040	0.100	µg/L	B202887	2001271
2040047-24	MeSe(IV)	WS	D	0.246		0.010	0.025	µg/L	B202664	2001191
2040047-24	MeSe(IV)	WS	D	0.274		0.040	0.100	µg/L	B202887	2001271
2040047-24	MeSe(IV)	WS	D	0.270		0.040	0.100	µg/L	B202887	2001271
2040047-24	Se Unk A	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-24	Se Unk A	WS	D	≤ 0.040	U	0.040	0.100	µg/L	B202887	2001271
2040047-24	Se Unk A	WS	D	≤ 0.040	U	0.040	0.100	µg/L	B202887	2001271
2040047-24	Se(IV)	WS	D	5.79		0.050	0.125	µg/L	B202664	2001191
2040047-24	Se(IV)	WS	D	6.46		0.200	0.500	µg/L	B202887	2001271
2040047-24	Se(IV)	WS	D	6.33		0.200	0.500	µg/L	B202887	2001271
2040047-24	Se(VI)	WS	D	120		0.060	0.125	µg/L	B202664	2001191
2040047-24	Se(VI)	WS	D	133		0.240	0.500	µg/L	B202887	2001271
2040047-24	Se(VI)	WS	D	128		0.240	0.500	µg/L	B202887	2001271
2040047-24	SeCN	WS	D	≤ 0.040	U	0.040	0.125	µg/L	B202664	2001191
2040047-24	SeCN	WS	D	≤ 0.160	U	0.160	0.500	µg/L	B202887	2001271
2040047-24	SeCN	WS	D	≤ 0.160	U	0.160	0.500	µg/L	B202887	2001271
2040047-24	SeMet	WS	D	≤ 0.010	U	0.010	0.025	µg/L	B202664	2001191
2040047-24	SeMet	WS	D	≤ 0.040	U	0.040	0.100	µg/L	B202887	2001271
2040047-24	SeMet	WS	D	≤ 0.040	U	0.040	0.100	µg/L	B202887	2001271
2040047-24	SeSO3	WS	D	≤ 0.060	J-1 U	0.060	0.125	µg/L	B202664	2001191
2040047-24	SeSO3	WS	D	≤ 0.240	U	0.240	0.500	µg/L	B202887	2001271
2040047-24	SeSO3	WS	D	≤ 0.240	U	0.240	0.500	µg/L	B202887	2001271
2040047-24	Unk Se Sp	WS	D	≤ 0.060	U	0.060	0.125	µg/L	B202664	2001191
2040047-24	Unk Se Sp	WS	D	≤ 0.240	U	0.240	0.500	µg/L	B202887	2001271
2040047-24	Unk Se Sp	WS	D	≤ 0.240	U	0.240	0.500	µg/L	B202887	2001271

Results in Sequence 2001191 = Original results reported in ***2040047_Final Report***.
Results in Sequence 2001271 = Confirmation results subsequent to initial reporting.

APPENDIX E
Assessment of Groundwater – Surface Water Interactions
(SNC-LAVALIN 2021)

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May 28, 2021 Ref: 655483

Teck Coal Limited
124B Aspen Drive
Sparwood, BC V0B 2G0

ATTENTION: Allie Ferguson, Lead Regional Water Monitoring

REFERENCE: Assessment of Groundwater – Surface Water Interactions in Support of the GHO LAEMP

1 Introduction

SNC-Lavalin Inc. (SNC-Lavalin) has evaluated groundwater and surface water interactions proximal to the Elk River side channel in support of the Greenhills Operations (GHO) Local Aquatic Effects Monitoring Program (LAEMP); herein referred to as "the Project". An understanding of local aquatic effects of the west side tributaries of GHO to immediate receiving environments is required in Section 8.3.4 of Permit 107517[1] as outlined below:

- "*The permittee must complete to the satisfaction of the director a study design for a LAEMP which will focus on the upper Elk River and the Elk River side channel and tributaries located on the west side of Greenhills Operation between EMS sites 0200389 and E3000090 for 2017-2020 by June 1, 2017. The study design must be reviewed by the EMC and be designed to an appropriate temporal scale to capture short term, local effects to the immediate receiving environment. Any changes to the approved study design must be reported in the annual LAEMP report*."

This report provides an update to the groundwater and surface water assessments, incorporating 2020 data (SNC-Lavalin, 2019; 2020).

1.1 Background

GHO is one of Teck's five coal mines in the Elk Valley. The Elk River side channel is located between the Elk River and the western flank of the Greenhills Ridge at GHO and flows from directly south of Leask Creek to south of Thompson Creek, where it converges with the Elk River (Drawing 1). The area shown in Drawing 1 is referred to as the study area for this purpose of this report.

Since 2017, Minnow Environmental Inc. (Minnow) and Lotic Environmental Ltd. (Lotic) have completed and implemented a Study Design and monitoring program for the GHO LAEMP (Minnow and Lotic, 2017; 2018a; 2018b; 2019; 2020). In support of the LAEMP, SNC-Lavalin reviewed and compiled groundwater and surface water information available within and proximal to the Elk River side channel (SNC-Lavalin, 2019;

[1] Permit 107517, amended March 11, 2021.

2020). The SNC-Lavalin reports presented summaries of groundwater and surface water data, assessments of the potential groundwater–surface water interactions, and identified gaps in knowledge. Table A summarizes the data gaps identified in the initial assessment conducted in support of the 2018 LAEMP (SNC-Lavalin, 2019).

Table A: Data Gaps Identified in 2018

Area	Data Gap/Uncertainty	Recommendations
Side Channel and Associated Tributaries	Surface water stations are not surveyed to a common datum.	› Survey surface water stations to a datum common with groundwater monitoring wells.
Wolfram Creek	Shallow groundwater conditions between Wolfram Pond and the side channel (GH_ER1A) are unknown.	› Install a groundwater monitoring network upgradient of GH_ER1A. › Collect groundwater level and quality data from newly installed wells. › Review results from seep survey conducted at GHO.
Thompson Creek	Groundwater conditions in the vicinity of Thompson Creek confluence and further south in the side channel are unknown.	› Install a groundwater monitoring network in the vicinity of the confluence with Thompson Creek and further to the south where pooled areas have been mapped and sampled and an influence from Thompson Creek suspected. › Review results from seep survey conducted at GHO.
Pools and Permanently Wetted Area	There is increasing mine-influence in pools and the permanently wetted area in the side channel noted in 2018 as compared to 2017, which is identified as an uncertainty.	› Field mapping, as well as analytical data associated with additional pools included in the 2019 program. › Comparison of results to surface water and groundwater trends.
Downgradient of the Side Channel (GH_MW-ERSC-1)	The origin of periodic mine-influenced water in monitoring well GH_MW-ERSC-1 is not well understood.	› Improve the groundwater monitoring network in the vicinity of this well. › Review results from seep survey conducted at GHO.

Since the initial assessment, groundwater investigations near the Elk River side channel have been on-going as part of other programs including the GHO Site-Specific Groundwater Monitoring Program (SSGMP), Regional Groundwater Monitoring Program (RGMP), Cougar Pit Phase 5 and 7-2 Project (CPP), and the Mass Balance Investigation (MBI). Significant overlap between the groundwater components of the LAEMP and these programs exist, and many of the gaps identified in Table A are being filled as part of these programs and discussed further in sections below.

1.2 Objective

The objective of this study is to use 2020 data to provide an update on the current understanding of groundwater-surface water interaction along the Elk River side channel to support Key Question #4 in the LAEMP:

› *What is the interaction between surface water and groundwater in the Elk River side channel?*

As a supplement to the 2020 GHO LAEMP Report, this report assists Teck in meeting their commitments to the Environmental Monitoring Committee (EMC) to consider groundwater as part of the LAEMP.

2 Updated Groundwater-Surface Water Assessment

2.1 Overview

Groundwater data were collected in 2020 as part of the on-going GHO SSGMP, RGMP, CPP, and MBI programs as shown in Table B. Monitoring well and relevant surface water locations are shown on Drawing 2. Borehole logs are included as Attachment A. For this report and consistent with the LAEMP, results for the Project are discussed from north to south and split into: Reach 3 (Upstream and Downstream of GH_ER1A), Reach 2 and Reach 1 (West and East/Middle). Reach 3 Upstream of GH_ER1A is further subdivided into Upstream of the Side Channel and Upstream of Wolfram Creek, and Downstream of the Confluence with Wolfram Creek.

Table B: Summary of Relevant 2020 Groundwater Data

Well ID	Water Level Data	Chemistry Data	Source
Reach 3 (Upstream of GH_ER1A)			
Upstream of Side Channel and Upstream of Wolfram Creek			
RG_MW_LC3A	Y (M and C)	Y	MBI
RG_MW_LC3B	Y (M and C)	Y	MBI
RG_MW_LC3C	N (Dry)	N (Dry)	MBI
GH_MW_WC1-A	Y (M and C)	Y	SSGMP/CPP
GH_MW_WC1-B	Y (M and C)	Y	SSGMP/CPP
GH_MW_WC1-C	Y (M and C)	Y	SSGMP/CPP
Downstream of Confluence with Wolfram Creek			
RG_MW_LCWC1	Y (M and C)	Y	MBI
GH_GA-MW-2	Y (M and C)	Y	SSGMP/RGMP
RG_MW_WC2A	Y (M and C)	Y	MBI
RG_MW_WC2B	Y (M and C)	Y	MBI
Reach 3 (Downstream of GH_ER1A)			
No wells	NA	NA	NA

Table B (Cont'd): Summary of Relevant 2020 Groundwater Data

Well ID	Water Level Data	Chemistry Data	Source
Reach 2			
GH_GA-MW-3	Y (M and C)	Y	SSGMP/RGMP
RG_MW_ER3A	Y*	Y	MBI
RG_MW_ER3B	Y*	Y	MBI
Reach 1 – East/Middle			
RG_MW_ER6A	Y*	Y	MBI
RG_MW_ER6A	Y*	Y	MBI
Reach 1 – West			
RG_MW_ER4A	Y*	Y	MBI
RG_MW_ER4B	Y*	Y	MBI
RG_MW_ER5A	Y*	Y	MBI
RG_MW_ER5B	Y*	Y	MBI

Notes: 'Y' - data are available; 'Y*' – data collected but not processed or available for use; M – Manual water levels available; C – continuous/pressure transducer water levels available.

The 2019 *Assessment of Groundwater – Surface Water Interaction in Support of the GHO LAEMP* report included an assessment of groundwater related to the Wolfram and Thompson drainages (SNC-Lavalin, 2020a). The groundwater quality in the Leask drainage, upgradient of the side channel, was not included in the 2019 assessment as it was described in detail in the 2018 groundwater-surface water interaction assessment (SNC-Lavalin, 2019). Although the Leask drainage was not inferred to influence surface water quality in the side channel, recent water quality data assessed as part of the MBI indicates that groundwater south of Leask Sedimentation Pond (Leask Pond) is mine-impacted (RG_MW_LC3A/B/C). This monitoring location has been included in this assessment to further confirm or refute any potential mine-influence from groundwater to the side channel. Since 2020, additional monitoring wells upstream of the side channel and in Reaches 1 through 3 have been installed as part of the MBI and have been included in the assessment.

Groundwater elevations and analytical chemistry results from monitoring wells sampled in 2020 as part of the SSGMP and RGMP have been reported and summarized in the *2020 Annual Report: Elk Valley Regional and Site-Specific Groundwater Monitoring Programs*; herein referred to as the "2020 Annual Report" (SNC-Lavalin, 2021a) and the *2020 RGMP Update (SNC-Lavalin, 2020c)*. Groundwater elevations and analytical results for the MBI have been reported and summarized in the *Phase 1 Drilling Report, Mass Balance Investigation* (SNC-Lavalin, 2021b). Groundwater elevations and analytical results from 2019 for monitoring wells GH_MW-WC1-A/B/C sampled as part of the CPP are presented in the *2019 Hydrogeology Field Program Results, Greenhills Operations* report (SNC-Lavalin, 2021c).

Surface water results including water levels, and analytical chemistry data for select stations have been provided by Teck and Minnow. Relevant surface water stations and wetted areas are shown on Drawing 2 as well as groundwater fed isolated pools previously identified in 2018 and 2019 (SNC-Lavalin, 2020a).

A bedrock ridge exists near the ground surface near Wolfram, Leask and Thompson Creek. New hydrometric stations (GH_LC3, GH_WC4, GH_TC3) were installed in 2020 as part of the MBI program on the exposed bedrock ridge inn the creeks at locations where the flow and load are inferred to be constrained at surface. Staff gauge measurements were taken three times in 2020 and results were presented in the MBI Phase 1 Drilling Report (SNC-Lavalin, 2020b).

Groundwater and surface water results were compared to the *Contaminated Sites Regulation*[2] (CSR) Standards (ENV, 2019) and the *BC Water Quality Guidelines*[3] (BCWQG) (ENV, 2018); these are the primary screening criteria utilized for the SSGMP and RGMP, as outlined in the 2020 Annual Report (SNC-Lavalin, 2021a). To understand potential groundwater pathways of mine-related constituents, Piper plots, dissolved selenium to sulphate (as sulphur [S]) ratios and time series graphs for available groundwater and surface water order constituents (OC), as defined in Teck's Environmental Management Act[4] (EMA) Permit, that have historically exceeded applicable criteria (nitrate-N, sulphate, and dissolved selenium) are shown in Figures 2 to 6 and 8 to 22. Some data points for locations GH_ER2, GH_ERC, GH_ERSC2, GH_ERSC4, GH_LC2, GH_TC1 and GH_TC2 were not plotted on the Piper diagrams due to lab error resulting in incorrect bicarbonate results. This does not alter the interpretation of the results.

2.2 Reach 3 and Upstream of Side Channel

The discussion below is divided based on the surface water flow path as follows: side channel upstream of the confluence with Wolfram Creek which is seasonally connected to the Elk River; Wolfram Creek situated in the valley bottom (i.e., Wolfram Pond discharge); and side channel downstream of GH_ER1A after the confluence with Wolfram Creek.

2.2.1 Upstream of Side Channel and Upstream of Confluence with Wolfram Creek

Table C presents a summary of 2020 water level and water quality results for the area upstream of the side channel and upstream of the confluence with Wolfram Creek.

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2 *Contaminated Sites Regulation* (CSR), B.C. Reg. 375/96, includes amendments up to B.C. Reg. 161/2020, February 1, 2021.
3 *British Columbia Approved Water Quality Guidelines, includes Working Water Quality Guidelines for BC* (BCWQG). British Columbia Ministry of Environment & Climate Change Strategy, updated July 2020.
4 *Environmental Management Act* (EMA), B.C. Reg. 161/2020 / effective February 1, 2021.

Table C: Summary of 2020 Groundwater and Surface Water Monitoring and Sampling Results Upstream of Side Channel and Upstream of Confluence with Wolfram Creek

Groundwater and Surface Water Information		Description	Reference
Monitoring Locations	Relevant Monitoring Wells	GH_GA-MW-2, GH_MW_WC1-A/B/C, RG_MW_LC3A/B/C, RG_MW_LCWC1, RG_MW_WC2A/B	Drawing 2
	Relevant Surface Water Monitoring Stations	GH_ERSC4, GH_ER2, GH_LC1, GH_LC2, GH_LC3, GH_WC1, GH_WC2, GH_WC4	
Water Levels	Groundwater and Surface Water Levels	› Continuous surface water levels are available for GH_ERSC4 from January 1 to August 4, 2020; river levels were below the bottom of the staff gauge from January 1 to April 29, 2020 and starting again August 4, 2020. A review of the hydrograph indicates surface water levels peaked at GH_ERSC4 in June 2020 due to the spring freshet. › At GH_GA-MW-2, GH_MW-WC1-A/B/C, RG_MW_LC3A/B groundwater levels generally fluctuate like GH_ERSC4, peaking in the spring freshet and subsequently declining. Monitoring well RG_MW_LC3C has been dry since installation.	Drawing 3 Figure 1
	Hydraulic Gradients	› Vertical hydraulic gradients at shallow/intermediate well pairs RG_MW_LC3A/B and GH_MW_WC1-B/C were downward in June (data are only available for wells GH_MW_WC1-B/C, wells RG_MW_LC3A/B were not yet installed), August and September. This is the first year of data for RG_MW_LC3A/B. Vertical gradients at GH_MW_WC1-B/C were like previous years. › Vertical hydraulic gradients at intermediate/deep well pair (GH_MW_WC1-A/B) were upward in June, August and September. This is like previous years.	
Water Quality	Water Type and Sulphate (as S) to Dissolved Selenium Ratios	› GH_ER2, 5 km upstream of Leask Creek, is a calcium-bicarbonate water type and is natural non-contact water based on the sulphate (as S) to dissolved selenium ratios. The water type at GH_ERSC4 was mostly calcium-bicarbonate but in one sample in April shifted to a calcium-sulphate water type due to the increased influence of mine-influenced water from Leask Creek during spring freshet. A plot of the sulphate (as S) to dissolved selenium ratios for GH_ERSC4 indicates the water is generally natural non-contact water except for the sample collected April 28, 2020 which was influenced by Leask Creek. › The water type at GH_MW_WC1-A/B/C is calcium-bicarbonate. Dissolved selenium to sulphate (as S) ratios indicates water in this area is not mine influenced. › The water types at RG_MW_LC3-A/B were calcium-bicarbonate in June and August when mixing was occurring more with the Elk River, and calcium-sulphate in October and December when there was less mixing with the Elk River and greater mixing from Leask Creek. Sulphate (as S) to dissolved selenium ratios indicate a mixture between the mine-influenced water originating from Leask Creek and natural non-contact water.	Figures 2A, 2B, 3, 4, 5, 6
	OC Concentrations	› Concentrations of OC at GH_ERSC4 have historically been less than the applicable criteria and like concentrations farther upstream in the Elk River (GH_ER2). An exception to this is the April 28, 2020 sample where the OC were higher than at GH_ER2. This is interpreted to be due to influence from Leask Creek as the water type shifted to be like the pond for this sample. Groundwater concentrations of OC at shallow well GH_MW_WC1-C, were like surface water upstream and downstream in the side channel (GH_ERSC4 and GH_ER1A), respectively.	

The downward vertical gradients in the shallow/intermediate well nests, along with the water quality results, support previous years conclusions that the side channel in this area infiltrates (i.e., loses) to ground and that groundwater is not influencing water quality or quantity in the side channel. Surface water quality at ERSC-4 in the side channel was generally like the Elk River at GH_ER2; however, there was one sample collected April 28, 2020 that indicated mine-influence from Leask Creek which could be related to the spring snow melt.

Additional hydrometric stations were installed in Leask Creek (GH_LC3) and Wolfram Creek (GH_WC4) in 2020 as part of the MBI program; results will be analyzed and reported on as part of the MBI program.

2.2.2 Downstream of Confluence with Wolfram Creek

Table D presents a summary of 2020 water level and water quality results for the area downstream of the confluence with Wolfram Creek.

Table D: Summary of 2020 Groundwater and Surface Water Monitoring and Sampling Results Downstream of Confluence with Wolfram Creek

<table>
<tr><th colspan="2">Groundwater and Surface Water Information</th><th>Description</th><th>Reference</th></tr>
<tr><td rowspan="2">Monitoring Locations</td><td>Relevant Monitoring Wells</td><td>GH_GA-MW-2, RG_MW_LCWC1, RG_MW_WC2A/B</td><td rowspan="2">Drawing 2</td></tr>
<tr><td>Relevant Surface Water Monitoring Stations</td><td>GH_WC1, GH_WC2</td></tr>
<tr><td rowspan="2">Water Levels</td><td>Groundwater and Surface Water Levels</td><td>› Like 2019, surface water flow in the channel near the outlet of Wolfram Pond in 2020 was only present in June and July; no overland flow had been observed in 2017 or 2018. This indicates most of the surface water in Wolfram Creek infiltrates to ground near the ponds, like previous years interpretations. Groundwater fed pool SC3-P13, located near the side channel south of Wolfram Pond, is in this area (SNC-Lavalin, 2020a) however pools were not monitored in 2020, as per the 2020 GHO LAEMP study design.
› Groundwater elevations in 2020 at GH_GA-MW-2 were like those observed in previous years. Groundwater elevations for new monitoring wells RG_MW_LCWC1 and RG_MW_WC2A/B are limited to August to October 2020, therefore interpretations are not possible regarding seasonal fluctuations. However, seasonal trends were like the other nearby monitoring locations.</td><td rowspan="2">Drawing 3
Figure 1</td></tr>
<tr><td>Hydraulic Gradients</td><td>› Vertical hydraulic gradients at shallow/intermediate well nest RG_MW_WC2A/B were downward in June, August and September.</td></tr>
<tr><td rowspan="2">Water Quality</td><td>Water Type and Sulphate (as S) to Dissolved Selenium Ratios</td><td>› Wolfram Pond was a calcium-sulphate water type and monitoring wells GH_GW-MW-2, RG_MW_WC2A/B, and RG_MW_LCWC1 were all calcium-sulphate water type like Wolfram Pond. Dissolved selenium to sulphate (as S) ratios indicates GH_GA-MW-2, RG_MW_LCWC1 and RG_MW_WC2A/B are mine-influenced.
› Until 2017, groundwater at GH_GA-MW-2 had been predominantly calcium-bicarbonate type water (like the Elk River monitoring location GH_ER2), suggesting that infiltration of surface water in the side channel occurs (SNC-Lavalin, 2020a). However, increases in sulphate concentrations over time have shifted the water type to predominantly calcium-sulphate-bicarbonate. This shift, along with higher concentrations of other constituents of interest OC, suggest that groundwater in the area over time is more influenced by mine-influenced surface water from Wolfram Pond/Creek.</td><td>Figures 2A, 2B, 3</td></tr>
<tr><td>OC Concentrations</td><td>› Like previous years, concentrations of OC in surface water from Wolfram Creek and Ponds (GH_WC1 and GH_WC2) in 2020 were greater than the applicable screening criteria. Deep monitoring well GH_GA-MW-2 (near GH_WC1) has had measurable concentrations of OC above the primary screening criteria, but they are lower than in Wolfram Creek (GH_WC1 and GH_WC2). OC concentrations at RG_MW_LCWC1 and RG_MW_WC2A/B are in the same range as GH_GA-MW-2. Dissolved selenium concentrations at RG_MW_WC2B increased in Q3 and Q4 which corresponds to an increase in surface water (GH_WC1, GH_WC2).
› Surface water station GH_ER1A is in the side channel downstream of Wolfram Creek. Concentrations of OC that seasonally (i.e. during spring freshet) exceed the primary screening criteria and that are higher relative to concentrations upstream at GH_ERSC4 have been measured at this surface water station since 2017. Seasonal (April to June) changes of up to one order of magnitude in concentrations in OC at this location are interpreted to be due to the snow melt in the Wolfram drainage, the existence of a shallow groundwater flow path from mine-influenced Wolfram Creek, and a seasonal groundwater contribution to the side channel. This is supported by the presence of groundwater fed pool SC3-P13 upstream of the confluence with the side channel (SNC-Lavalin, 2020a); in April 2019 this groundwater fed pool had OC concentrations like GH_ER1A, no water quality data is available for this location from 2020. Like 2019, after the entire Reach 3 was wetted in July, concentrations of OC at GH_ER1A decreased and were closer to concentrations at upstream GH_ERSC4 indicating mixing with the Elk River water had occurred and the mine influence on the creek decreased.</td><td>Figures 4, 5, 6</td></tr>
</table>

Downward vertical hydraulic gradients at and water quality shallow/intermediate well nest RG_MW_WC2A/B along with the surface water groundwater quality results in 2020 support previous years conclusions that surface water is generally losing to ground in Reach 3 downstream of the confluence with Wolfram Creek. Water quality in the side channel varies seasonally due to differences in flows throughout the year. From April to June, due to snow melt in the Wolfram drainage, the existence of a shallow groundwater flow path and groundwater contributions to the side channel during this time, OC concentrations at GH_ER1A increase. Once Reach 3 is fully wet, typically in May/June, the Elk River is the main influence at GH_ER1A and OC concentrations decrease.

2.2.3 Downstream of GH_ER1A

Surface water elevations at GH_ER1A have fluctuated by approximately 1.5 m since 2017. Measurable (i.e., non-zero) surface water elevations at GH_ER1A only commence in the spring (late-April to July) compared to the more continuous hydrograph for GH_ERSC4. This suggests that infiltration occurs along the upper portion of Reach 3 (Figure 1) and no groundwater base flow was present. This is also supported by the fact there are no groundwater fed pools/wetted areas in this area (SNC-Lavalin, 2020a).

2.3 Reach 2 (Wetted Area)

A permanently wetted area (Reach 2) is located at the confluence of Thompson Creek and the side channel. A greater mean surface flow through the winter months at Thompson Creek contributes to continued wetness in this area (Teck, 2017). No pit pumping has been directed to Thompson Creek since 2017. Table E presents a summary of 2020 water level and water quality results for Reach 2.

Table E: Summary of 2020 Groundwater and Surface Water Monitoring and Sampling Results Reach 2 (Wetted Area)

Groundwater and Surface Water Information		Description	Reference
Monitoring Locations	Relevant Monitoring Wells	GH_GA-MW-3, RG_MW_ER3A/B	Drawing 2
	Relevant Surface Water Monitoring Stations	GH_TC1, GH_TC2, GH_ERSC2, RG_GH-SCW1, RG_GH-SCW2, RG_GH–SCW3	
Water Levels	Groundwater and Surface Water Elevations	› Seasonal fluctuations in groundwater levels at GH_GA-MW-3 suggest this well is predominantly influenced by snow melt in the upper catchment rather than from the side channel with peak elevations occurring between April and May; groundwater levels fluctuated similarly in 2020 as historically.	Drawing 3 Figure 7
	Hydraulic Gradients	› The vertical hydraulic gradient at shallow/intermediate well nest RG_MW_ER3A/B was 0.012 m/m downward in September 2020.	
Water Quality	Water Type and Sulphate (as S) to Dissolved Selenium Ratios	› GH_ERSC2 is generally a calcium-bicarbonate water type with one calcium-sulphate water type result in April. RG_GH–SCW3 water type is calcium-bicarbonate which is like the side channel when the side channel is wet (i.e. spring freshet) and shifts to calcium-sulphate which is more like Thompson Creek when the side channel is dry (fall and winter). Dissolved selenium to sulphate (as S) ratios indicates a similar shift where water in these locations is less influenced by mine-influenced water from Thompson Creek when mixing with water in the side channel and more influenced by Thompson Creek when the side channel is dry. › Water type at monitoring well GH_GA-MW-3 also varies throughout the year, shifting to be like Thompson Creek in June and November 2020. Dissolved selenium to sulphate as S ratios indicates a similar shift to being more mine-influenced in June and November due to increased influence from Thompson Creek. Only two samples are available for monitoring wells RG_MW_ER3A/B however they have similar ratios and water types as GH_GA-MW-3.	Figures 8, 9
	OC Concentrations	› Monitoring well GH_GA-MW-3 has historically had elevated concentrations of OC relative to the primary screening criteria, however they are less than concentrations in surface water from the Thompson Creek. › In the wetted area (RG_GH–SCW3) and the side channel (GH_ERSC2), OC concentrations fluctuate depending on the amount of water in the side channel i.e., concentrations are lower from approximately April to October and higher from October to March.	Figures 10, 11, 12

Of the side channel surface water locations, samples were only collected in 2020 from RG_GH-SCW3 located at the outlet for Reach 2. An additional hydrometric station was also installed in Thompson Creek in 2020 as part of the MBI program (GH_TC3); results will be analyzed and reported on as part of the MBI program.

The downward vertical hydraulic gradient at shallow/intermediate well nest RG_MW_ER3A/B, along with the water quality results for surface and groundwater monitoring locations in Reach 2 for 2020 support previous conclusions that surface water is losing to ground in Reach 2. Thompson Creek appears to be the main influence on water quality in the side channel in Reach 2 and this influence is greater when the side channel is dry and less when it is wet.

2.4 Reach 1 (West and East/Middle)

Table F presents a summary of 2020 water level and water quality results for Reach 1.

Table F: Summary of 2020 Groundwater and Surface Water Monitoring and Sampling Results Reach 1 (West and East/Middle)

Groundwater and Surface Water Information		Description	Reference
Monitoring Locations	Relevant Monitoring Wells	RG_MW_ER4A/B, RG_MW_ER5A/B, RG_MW_ER6A/B	Drawing 2
	Relevant Surface Water Monitoring Stations and Groundwater Fed Pools	Surface Water: GH_ERSC2, ERSCDS, GH_ERC Groundwater Fed Pools: SC2-P1, SC2-P2 and SC2-P3 (SNC-Lavalin, 2020a)	
Water Levels	Groundwater and Surface Water Elevations	› The side channel is interpreted to receive flow from the groundwater-fed wetted area between Reach 2 and station GH_ERCS2 in the spring and summer, and then in the fall flows are inferred to infiltrate to ground in this area. Surface water levels at ERSCDS, located near the southern confluence between the side channel and the Elk River, historically have fluctuated by approximately 1 m, with the greatest levels measured between late-April and late-July. In 2020 the staff gauge was lost in the freshet in early May.	Drawing 3 Figure 7
	Hydraulic Gradients	› Vertical hydraulic gradients at RG_MW_ER4A/B, RG_MW_ER5A/B, and RG_MW_ER6A/B were all downward in September 2020	
Water Quality	2020 Relevant Water Quality Results	The water types at the groundwater monitoring wells were: › Calcium-bicarbonate at RG_MW_ER4A/B. › Calcium-sodium-bicarbonate at RG_MW_ER5A. › Calcium-sulphate at RG_MW_ER5B and RG_MW_ER6B. › Sodium-bicarbonate at RG_MW_ER6A. Dissolved selenium to sulphate (as S) ratios indicates the groundwater monitoring wells are non-contact water except for shallow wells RG_MW_ER5B and RG_MW_ER6B which are mine-influenced. Water type in the groundwater fed pools is calcium-sulphate and ratios indicate they are mine-influenced (SNC-Lavalin, 2020a). The groundwater pathway for mine influenced water to these wells is still being evaluated in the MBI.	Figures 13A, 13B, 14, 15, 16, 17

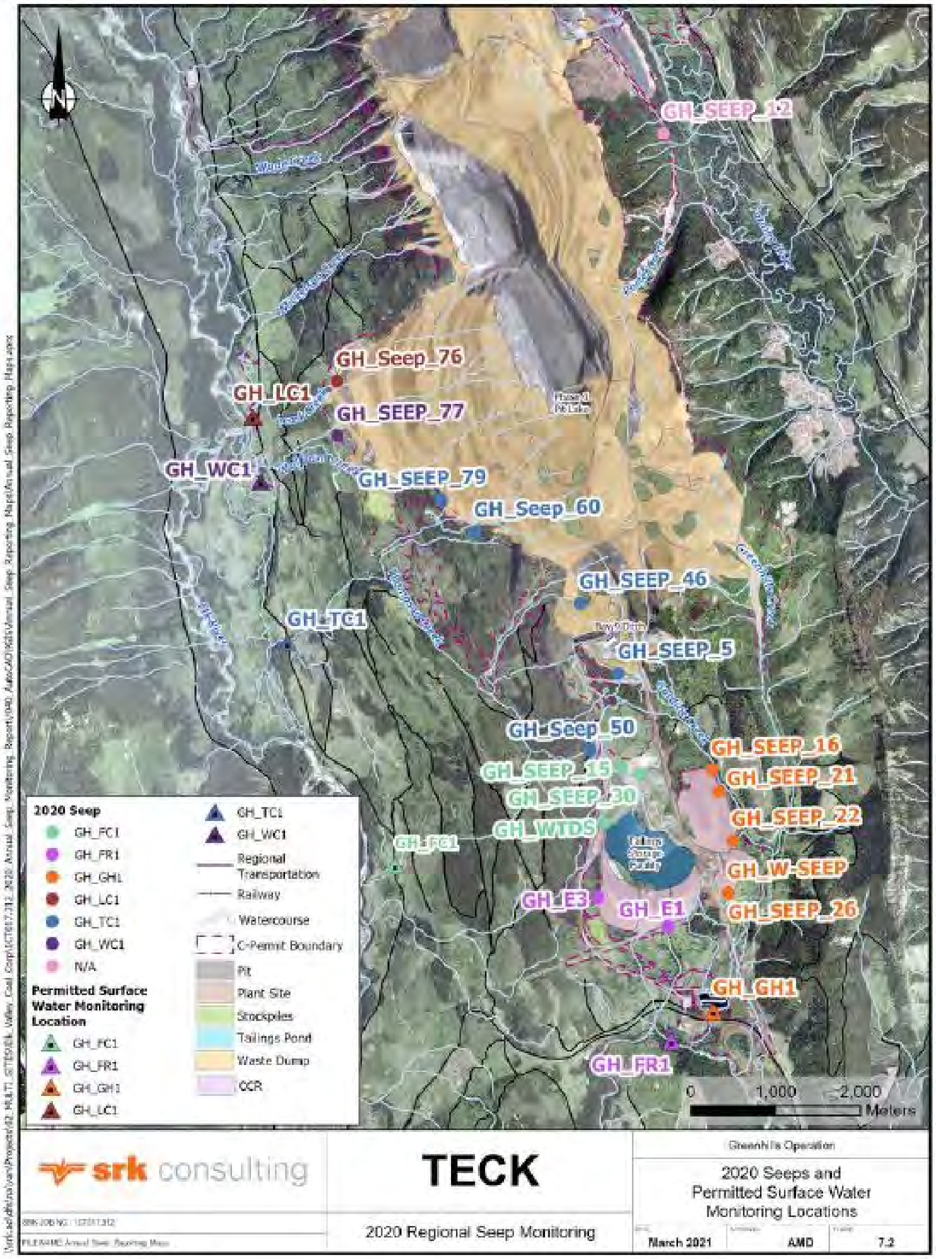
As discussed in the 2019 report (SNC-Lavalin, 2020a), and confirmed by sampling and observations in 2020, pools SC2-P1, SC2-P2 and SC2-P3 have been present generally year-round since they were first observed in 2017 and 2018, indicating they are groundwater fed. The groundwater pathway to these pools is being evaluated in the MBI.

Limited groundwater data were available for Reach 1 given monitoring wells were installed in 2020, however, based on previous years data the side channel was interpreted to receive flow from the groundwater-fed wetted area between Reach 2 and station GH_ERCS2 in the spring and summer, and then in the fall flows are inferred to infiltrate to ground in this area. Additional data and analysis are required to determine the source of the mine-influenced water at RG_MW_ER5B and RG_MW_ER6B and the groundwater pathway leading to the groundwater fed pools (SC2-P1, SC2-P2, SC2-P3). This will be conducted through the MBI in 2021.

2.5 Seep Monitoring Data

Since 2018, SRK Consulting has conducted the Elk Valley Regional Seep Monitoring Program (SRK Consulting, 2021). In 2020 seeps were visited at least twice; during high flows (between March 15, 2020 and July 15, 2020) and during low flow (outside high flow window, generally between September and November). Review of the locations visited indicate there were no seeps in the Regional Seep Monitoring Program that were useful in the understanding of the Elk River side channel as shown in Figure A

Figure A: Seeps Identified in 2020 Elk Valley Regional Seep Monitoring Program – Greenhills Operation



3 Conclusions

The Elk River side channel undergoes seasonal flooding and braiding with variable flow throughout the year. The surficial deposits underlying the side channel generally comprise fluvial and glaciofluvial sand and gravels (SNC-Lavalin, 2019).

Updated hydrographs, vertical gradients, and water quality data continue to support the conceptual model that the side channel predominantly infiltrates to ground and recharges groundwater. A review of the mapping performed by Minnow and Lotic since 2017 suggests that the seasonal flow in the side channel infiltrates to ground across most of the channel and develops isolated pools in seasons outside of freshet, except at Pools SC3-P13 (near the confluence with Wolfram Creek), and SC2-P3, SC2-P1, and SC2-P2 (downstream of Thompson Creek) which are groundwater fed (SNC-Lavalin, 2020a). However, these pools are not interpreted to produce sustained flows in the side channel given that SC3-P13 is not persistent on a year over year basis and the other three pools are relatively small (maximum size approximately 15 m by 3 m; SNC-Lavalin, 2020a).

Like previous years, concentrations of OC generally increase along the side channel flow path, which is inferred to result from loading of OC from mine-influenced tributaries on the west side of GHO. In Reach 3, upstream of the confluence with Wolfram Creek, surface water quality in the side channel (ERSC-4) was generally like the Elk River at GH_ER2; however, there is periodic influence from Leask Creek. In Reach 3 downstream of the confluence with Wolfram Creek, water quality in the side channel varies seasonally. From April to June OC concentrations at GH_ER1A increase due to snow melt in the Wolfram drainage and the existence of a shallow groundwater flow path and groundwater contributions to the side channel during this time. Once Reach 3 is fully wet, typically in July, the Elk River is the main influence at GH_ER1A and OC concentrations decrease. In Reach 2, Thompson Creek appears to be the main influence on water quality in the side channel and this influence is greater when the side channel is dry and less when it is wet.

The 2018 LAEMP recommended to fill data gaps/uncertainties associated with groundwater–surface water interaction along the Elk River side channel. Several of the gaps have been addressed by work conducted in 2020 and remaining gaps are planned to be addressed by new monitoring well installations in 2021 and collection of additional groundwater data in support of on-going programs such as the GHO SSGMP, RGMP, MBI, and CPP. Table G presents a summary of the data gaps and recommendations established in the 2018 LAEMP, and the status of the gaps as of the end of 2020.

Table G: Status of Data Gaps After 2020 Work

Area	Data Gap/Uncertainty	Recommendations	Status
Side Channel and Associated Tributaries	Surface water stations are not surveyed to a common datum.	› Survey surface water stations to a common with groundwater monitoring wells.	› Surface water stations ERSCDS, ER1-A and ERSC4 have been surveyed and tied into the current groundwater monitoring network. The data gap/uncertainty has been addressed.
Wolfram Creek	Shallow groundwater conditions between Wolfram Pond and the side channel (GH_ER1A) are unknown.	› Install a groundwater monitoring network upgradient of GH_ER1A. › Collect groundwater level and quality data from newly installed wells. › Review results from seep survey conducted at GHO.	› A review of seeps from the Regional Seep Monitoring Program indicated no relevant seeps. › Six monitoring wells were installed in three locations in 2020 near Leask and Wolfram Creeks as part of the MBI (RG_MW_LC3A/B/C, RG_MW_LCWC1, RG_MW_WC2A/B). These wells will continue to be monitored in 2021 and results for the new monitoring wells will be evaluated as part of the MBI. › Additional work planned for 2021 as part of the MBI that would be relevant to the understanding of groundwater and surface water interaction are: – additional seep reconnaissance and sampling in the Elk River Side Channel (seeps were identified in the MBI that were not identified in the Regional Seep Monitoring Program; the seep reconnaissance will be covering areas not covered in the Regional Seep Monitoring Program); – flow and load accretion studies; – geophysical surveys to determine depth to bedrock; – install additional monitoring wells; and – groundwater sampling.

Table G (Cont'd): Status of Data Gaps After 2020 Work

Area	Data Gap/Uncertainty	Recommendations	Status
Thompson Creek	Groundwater conditions in the vicinity of Thompson Creek confluence and further south in the side channel are unknown.	› Install a groundwater monitoring network in the vicinity of the confluence with Thompson Creek and further to the south where pooled areas have been mapped and sampled and an influence from Thompson Creek suspected. Review results from seep survey conducted at GHO.	› Twelve monitoring wells were installed in six locations in 2020 as part of the MBI (RG_MW_ER3A/B to RG_MW_ER6A/B). As above, no relevant seeps identified from Regional Seep Monitoring Program, but additional studies are planned to investigate groundwater surface water interaction as part of the MBI as outlined above.
Downgradient of the Side Channel (GH_MW-ERSC-1)	The origin of periodic mine-influenced water in monitoring well GH_MW-ERSC-1 is not well understood.	› Improve the groundwater monitoring network in the vicinity of this well. › Review results from seep survey conducted at GHO.	› This area is not considered to be relevant to interactions in the side channel as they related to the LAEMP; therefore, this gap should be considered through the MBI and GHO SSGMP. Three monitoring wells were installed in two locations in 2020 as part of the MBI (RG_MW_ER7A/B and RG_MW_ER8). › As above, no relevant seeps identified from Regional Seep Monitoring Program, but further investigation is planned as part of the MBI.

4 Recommendations for Future Monitoring

Teck has fulfilled the Permit 107517 Section 8.3.4 requirement for a LAEMP to be conducted from 2017 to 2020, focussing on the local area of the upper Elk River, the Elk River side channel, and tributaries located on the west side of Greenhills Ridge. Where concerns remain, the GHO LAEMP monitoring will be incorporated into existing monitoring programs through established program update frameworks, as appropriate, such that these residual concerns continue to be addressed. Therefore, monitoring locations relevant to study question #4 of the LAEMP that are currently monitored under the MBI and GHO LAEMP only (Table B) are to be incorporated into the SSGMP. Table H summarizes the status of the monitoring locations that have historically been included in the LAEMP and their status relative to their inclusion or future inclusion in the SSGMP. Locations that are recommended to be assessed for potential inclusion in the SSGMP were identified based on results assessed to date, their historic utility in the LAEMP and future utility in continuing to understand groundwater-surface water interactions in the side channel. "Locations to be reviewed in 2022" would be reviewed in early 2022 during preparation of the 2021 SSGMP annual report to determine whether these locations should be added to the SSGMP. Similarly, "MBI locations installed in 2021" will be reviewed in early 2023 during preparation of the 2022 SSGMP annual report to determine whether they will be added to the SSGMP.

Table H: Future Monitoring Locations

Monitoring Location Type	Locations Currently Being Monitored in SSGMP	Locations Recommended to be Assessed for Potential Inclusion in SSGMP in 2021	Locations to be Reviewed in 2022 for Potential Inclusion in SSGMP	MBI Locations to be Installed in 2021 and Reviewed in 2023 for Potential Inclusion in SSGMP
Surface Water	GH_ER1A, GH_ERC, GH_ERSC2, GH_ERSC4, GH_LC1, GH_LC2, GH_MC1, GH_TC1, GH_TC2, GH_WC1, GH_WC2*	GH_ER2, GH_ERUS, ERSCDS, GH_SCW1, GH_SCW3	GH_LC3, GH_WC3, GH_WC4, GH_TC3	--
Groundwater-fed Isolated Pools	--	SC2-P1, SC2-P2, SC2-P3, SC3-P13	NA	NA
Groundwater	GH_GA-MW-2, GH_GA-MW-3	RG_MW_LC3A/B/C, GH_MW_WC1-A/B/C RG_MW_WC2A/B, RG_MW_ER3A/B RG_MW_ER4A/B,	GH_MW_LC1-A/B, GH_MW_LC2-A/B, RG_MW_LCWC1, RG_MW_ER5A/B, RG_MW_ER6A/B;	RG_MW_ER9A/B, RG_MW_ER10A/B, RG_MW_ER11A/B

Notes: NA – not applicable, * Data is currently being reviewed under RGMP and SSGMP where applicable.

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Teck Coal Ltd., 2017. 2017 Elk Valley Regional Water Quality Model Update – Overview Report (with Annexes), dated October 2017.

6 Closure

We trust this report meets your current requirements and greatly appreciate the opportunity to assist Teck with this project. If you have any questions, please contact Stefan Humphries in our Nelson office at 250.354.1664.

Emma Canham, MSc
Project Hydrogeologist
Environment & Geoscience
Engineering, Design & Project Management

PROFESSIONAL GEOSCIENTIST
PROVINCE OF
S. A. HUMPHRIES
#31909
BRITISH COLUMBIA

May 28/21

Stefan Humphries, MSc, P.Geo.
Senior Hydrogeologist
Environment & Geoscience
Engineering, Design & Project Management

EC/tr/jrs
P:\CP\TECK COAL LTD\GHO\655483 - GHO_GW_SW_INTERACTION\50_DEL\55_OTH_20210528_655483_LRPT_GHO_LAEMP_FINAL.DOCX
enc.

Figures

1: Hydrograph for Reach 3 and Precipitation Data
2A: Piper Diagram for Upstream and Reach 3 Groundwater Wells
2B: Piper Diagram for Upstream and Reach 3 Surface Water
3: Upstream and Reach 3 - Se:SO4 (S) Ratios
4: Nitrate-N Concentrations Upstream and Reach 3
5: Sulphate Concentrations Upstream and Reach 3
6: Dissolved Selenium Concentrations Upstream and Reach 3
7: Hydrograph for Reaches 2 and 1 and Precipitation Data
8: Piper Diagram for Reach 2 Groundwater Wells and Surface Water
9: Reach 2 - Se:SO4 (S) Ratios
10: Nitrate-N Concentrations in Reach 2
11: Sulphate Concentrations in Reach 2
12: Dissolved Selenium Concentrations in Reach 2
13A: Piper Diagram for Reach 1 Groundwater Wells
13B: Piper Diagram for Reach 1 Surface Water
14: Reach 1 - Se:SO4 (S) Ratios
15: Nitrate-N Concentrations in Reach 1
16: Sulphate Concentrations in Reach 1
17: Dissolved Selenium Concentrations in Reach 1

Drawings

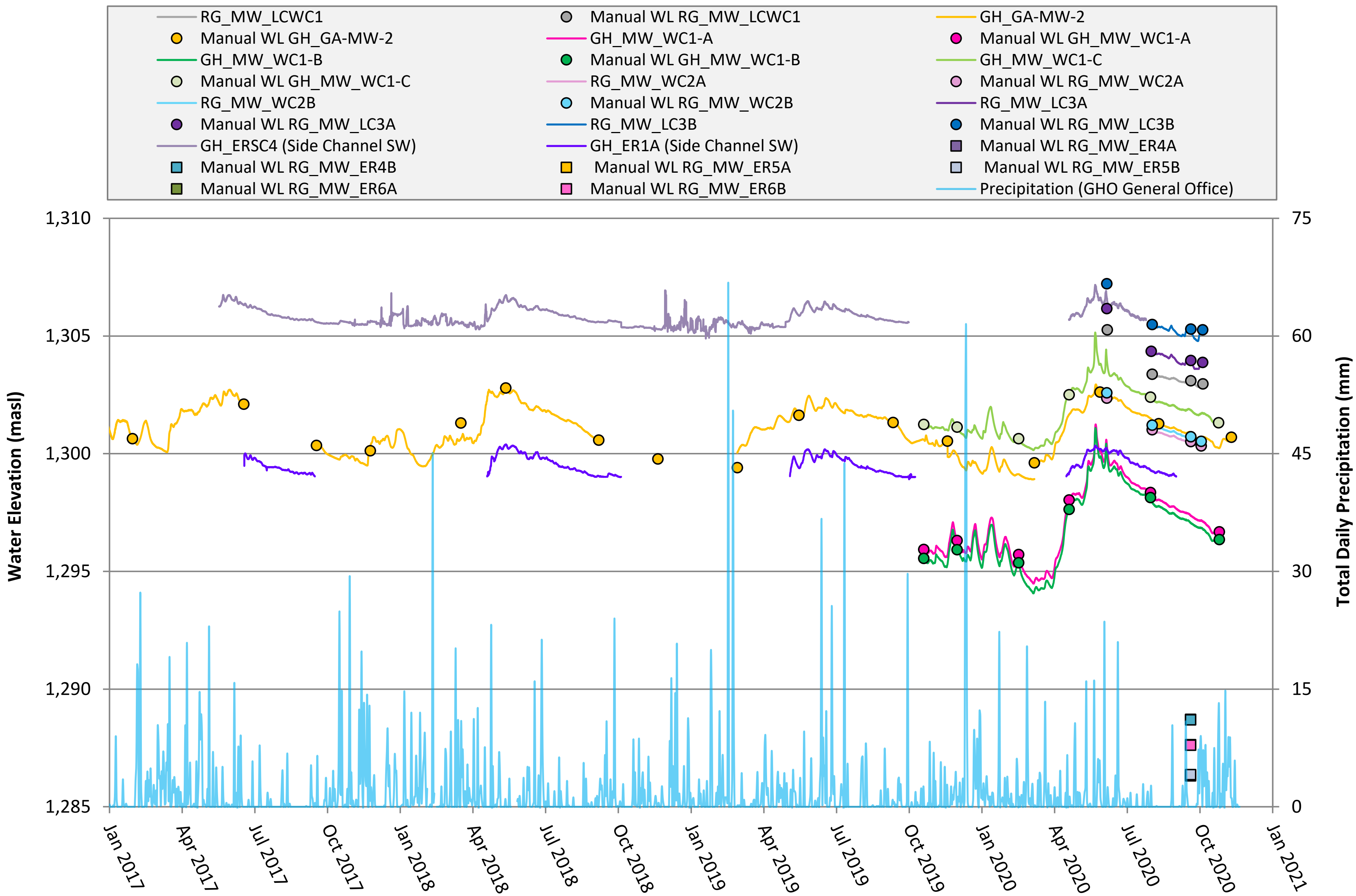
1: Site Location Plan
2: GHO Elk River Side Channel Site Plan
3: Groundwater Elevation and Inferred Groundwater Flow Direction – Elk Valley

Attachment

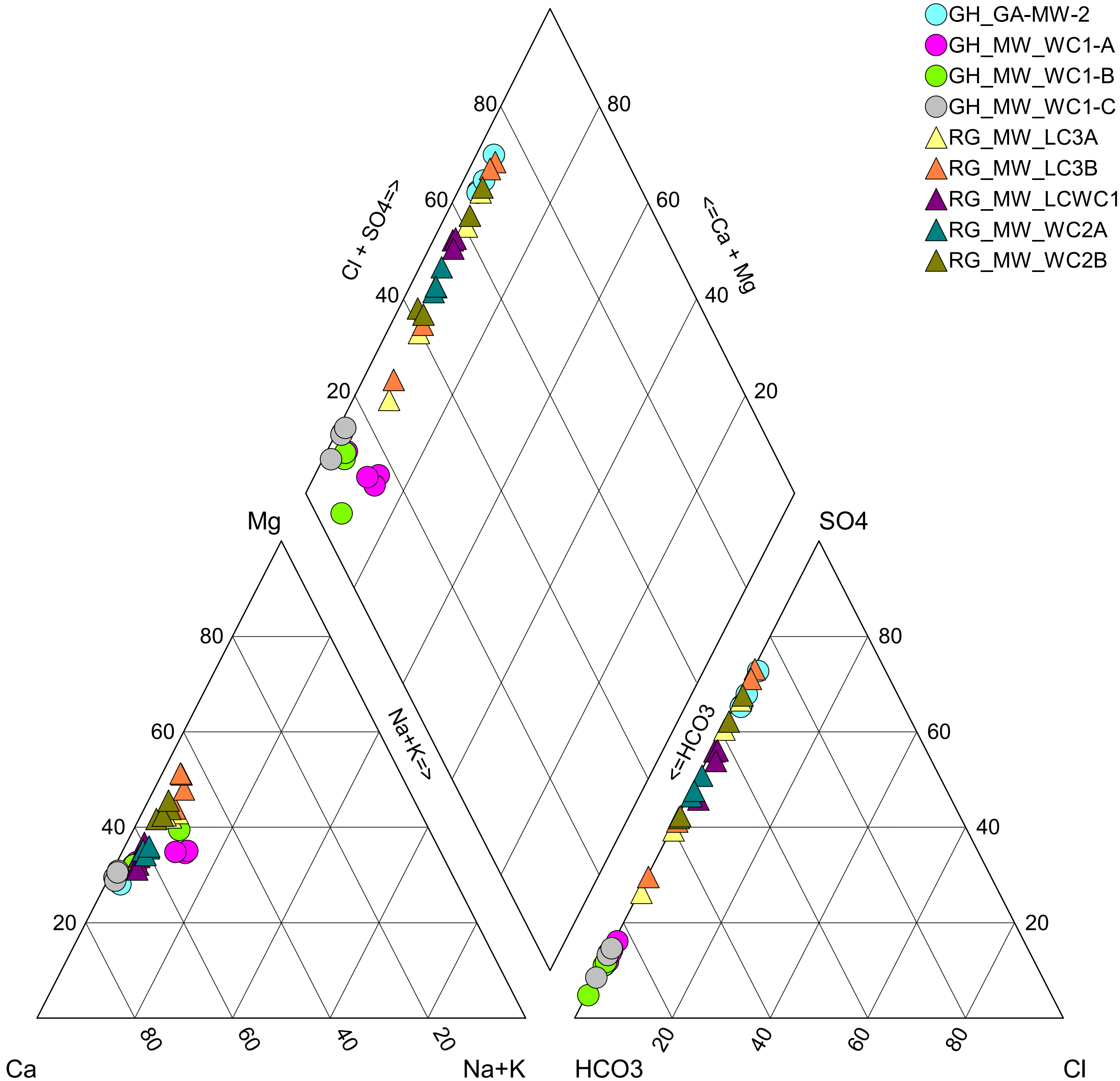
A: Borehole Logs

Figures

Figure 01: Hydrograph for Upstream and Reach 3

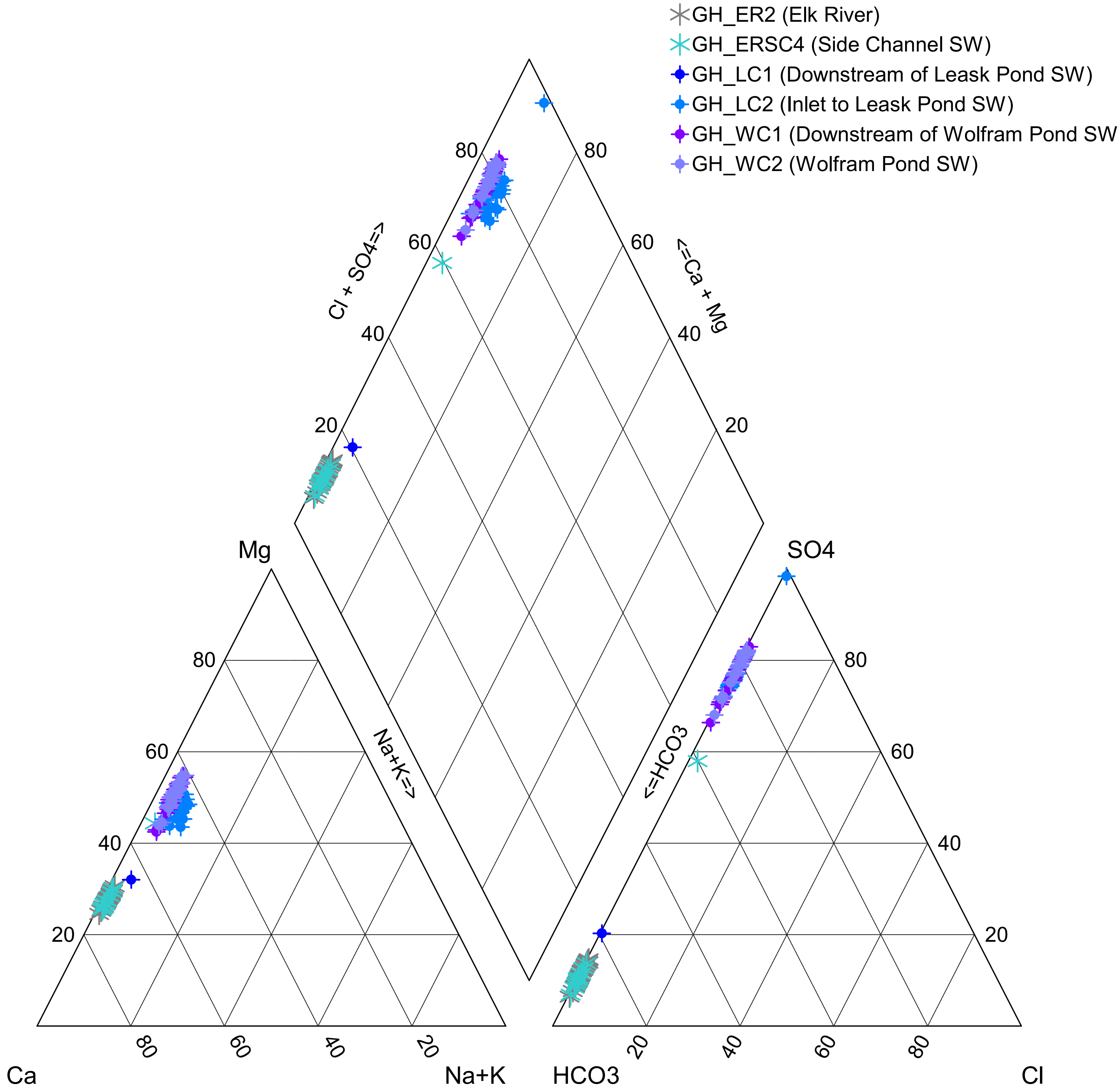


Note: Surface water elevations normalized based on available survey data



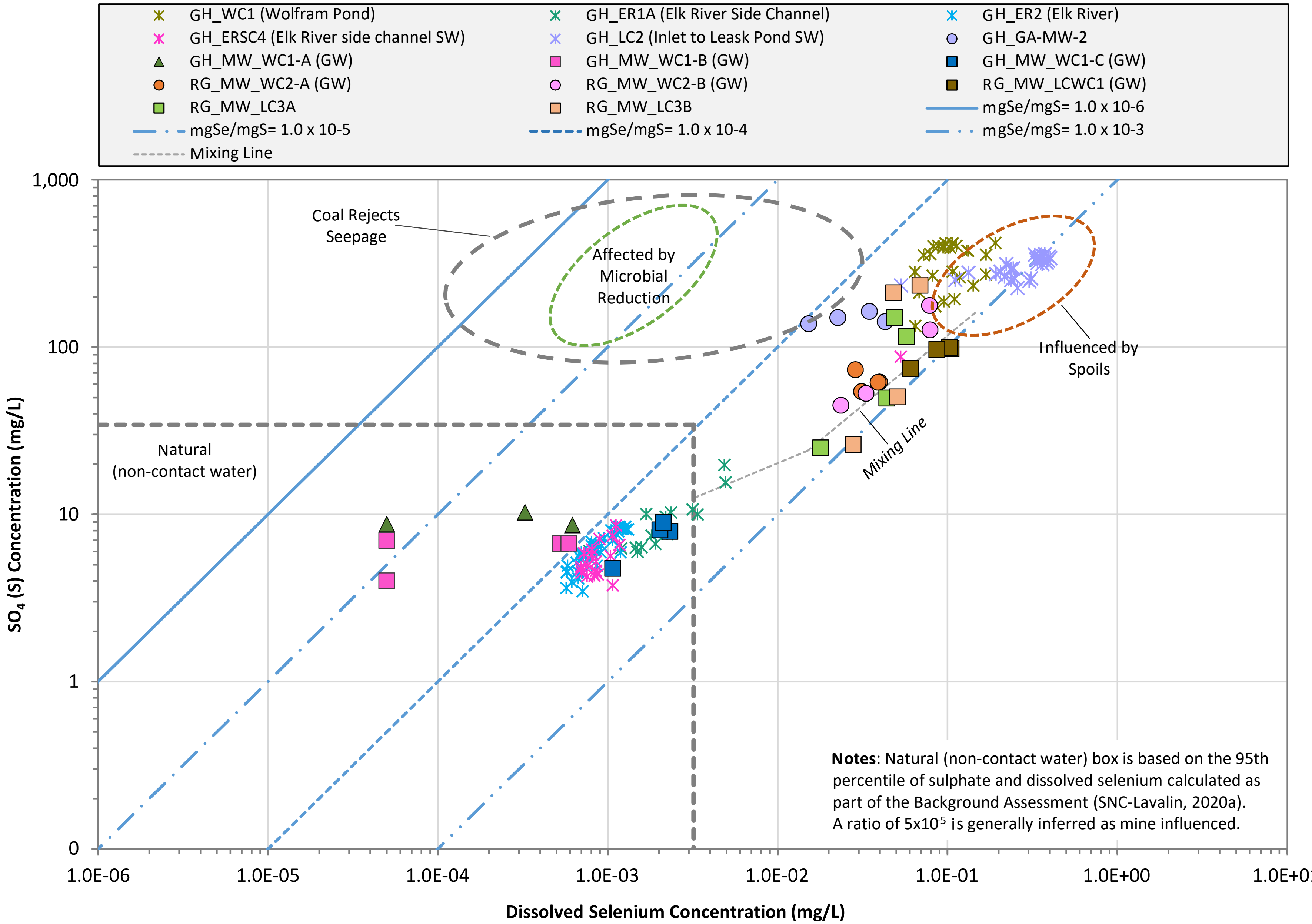
DESCRIPTION:	Figure 2A: Piper Diagram for Upstream and Reach 3 Groundwater Wells

	PROJECT: GHO LAEMP	PROJECT NO: 655483
	CLIENT: Teck Coal Limited	DATE: 2021-04-27



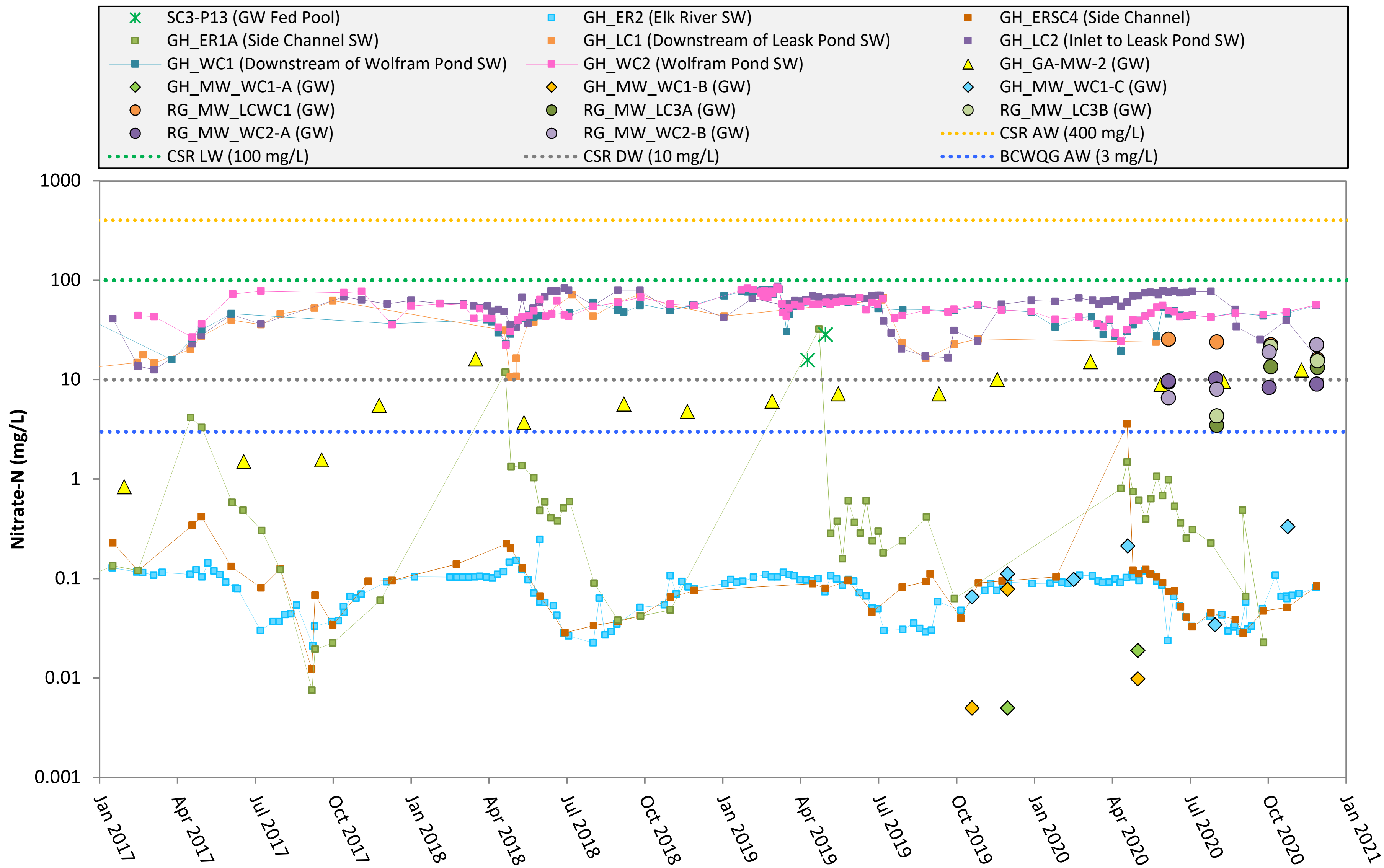
DESCRIPTION:	Figure 2B: Piper Diagram for Upstream and Reach 3 Surface Water	
	PROJECT: GHO LAEMP	PROJECT NO: 655483
	CLIENT: Teck Coal Limited	DATE: 2021-05-28

Figure 3: Upstream and Reach 3 - Se:SO_4 (S) Ratios



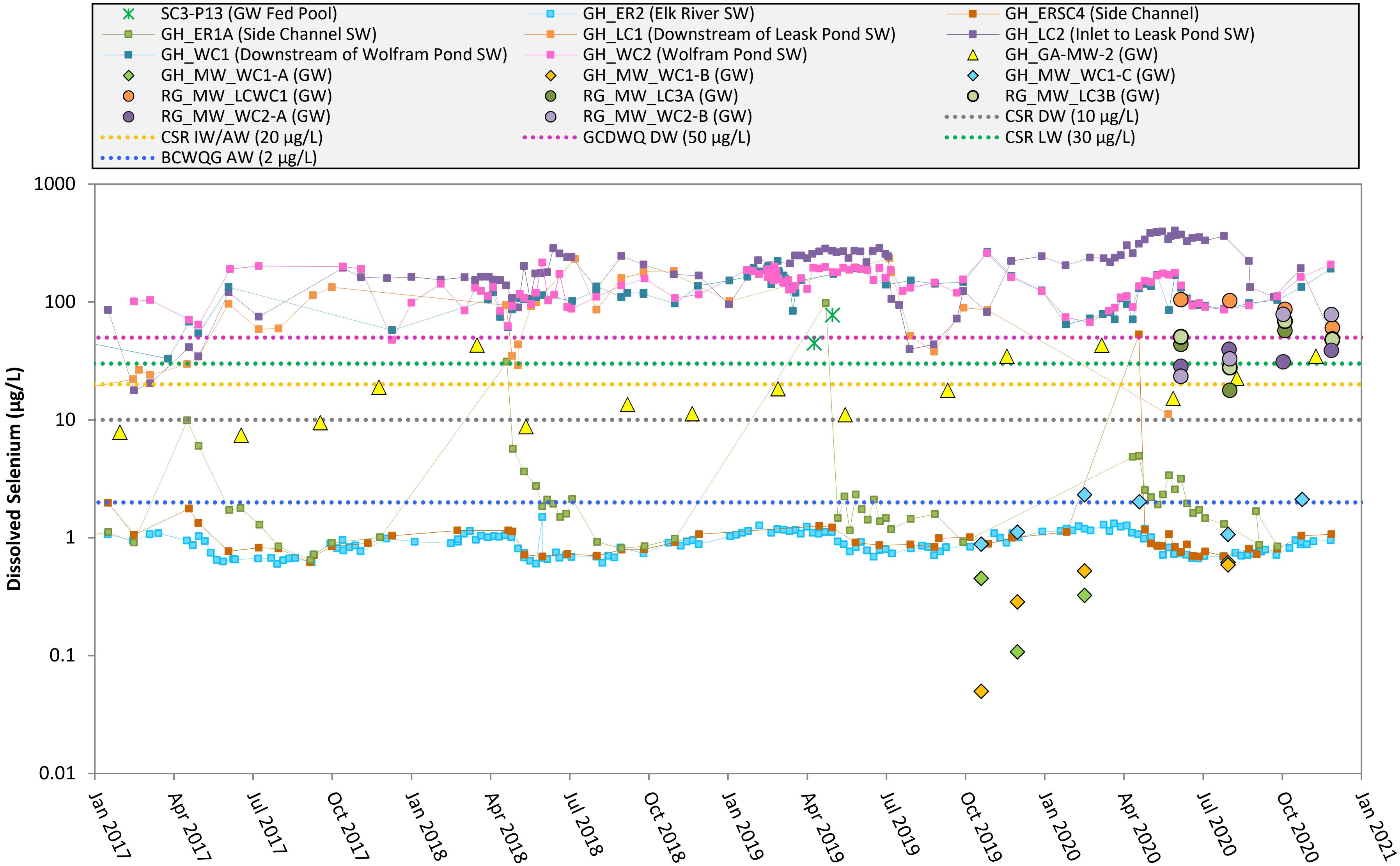
Notes: Natural (non-contact water) box is based on the 95th percentile of sulphate and dissolved selenium calculated as part of the Background Assessment (SNC-Lavalin, 2020a). A ratio of $5x10^{-5}$ is generally inferred as mine influenced.

Figure 04: Upstream and Reach 3 - Nitrate-N Concentrations



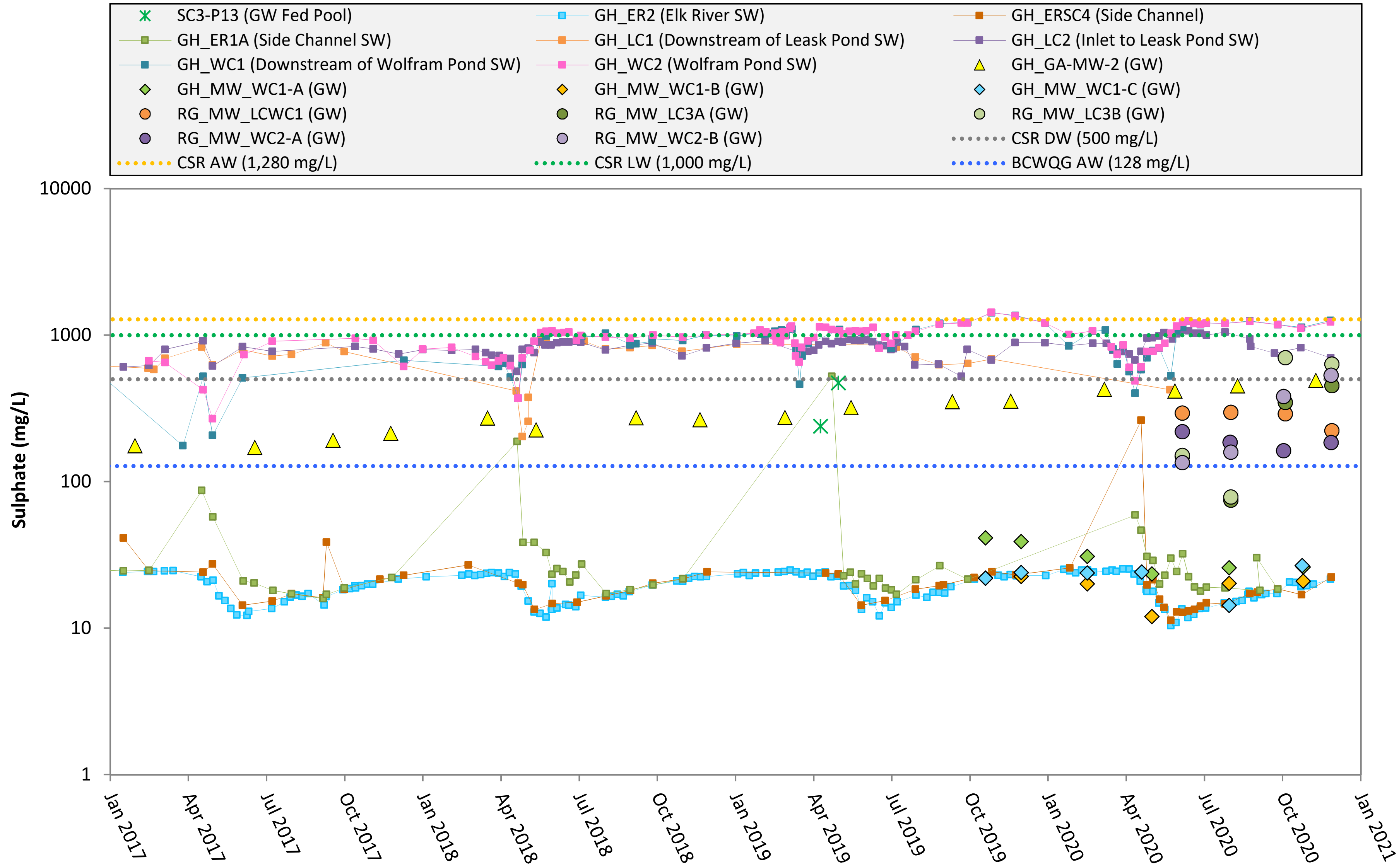
Note: Only groundwater fed pools are presented.
For concentrations measured below the analytical detection limit, the detection limit (0.005 mg/L) was utilized for plotting purposes.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

Figure 05: Upstream and Reach 3 - Dissolved Selenium



Note: Only groundwater fed pools are presented. No data collected for SC3-P13 in 2020.
For concentrations measured below the analytical detection limit, the detection limit (0.05 µg/L) was utilized for plotting purposes.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

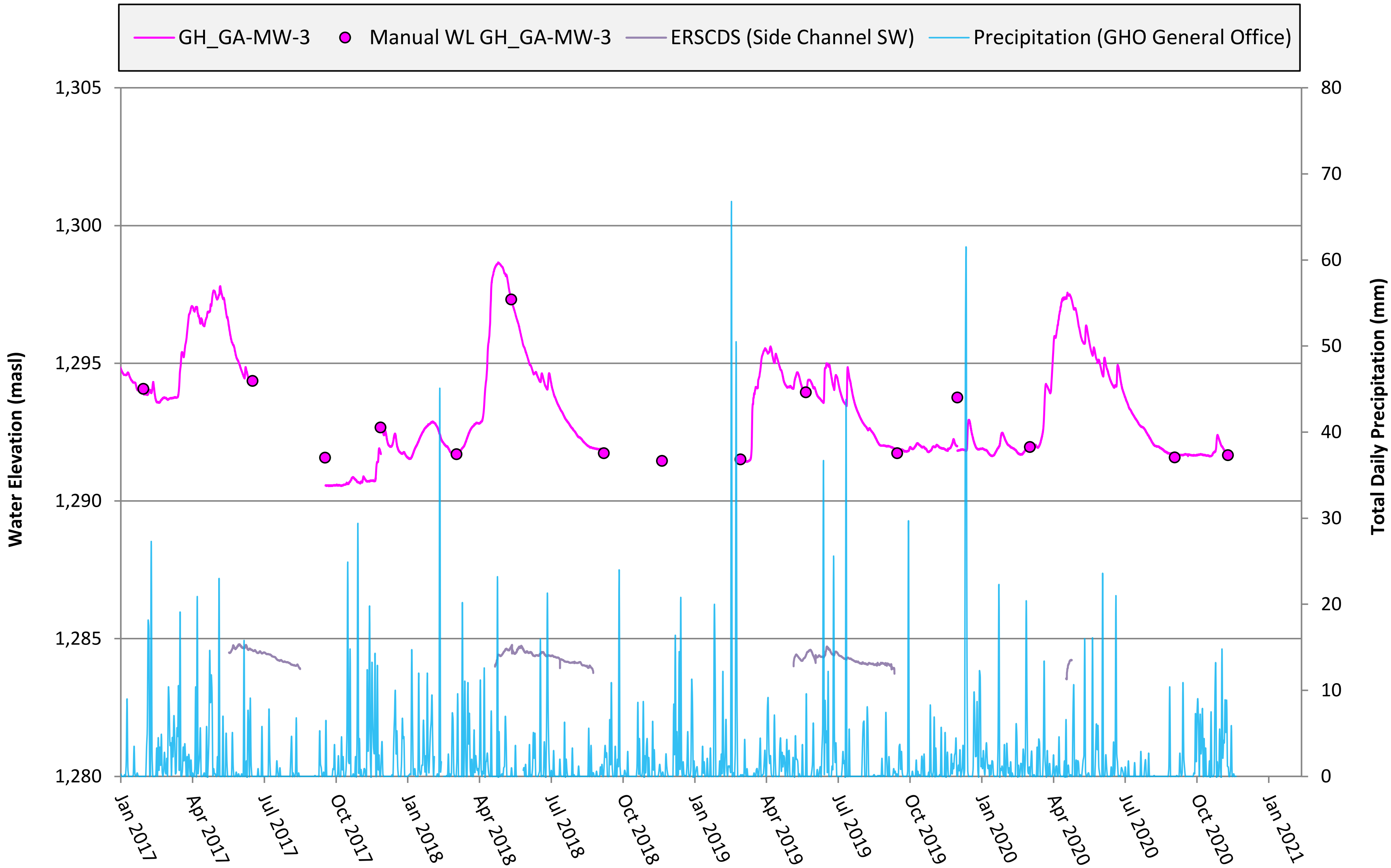
Figure 06: Upstream and Reach 3 - Sulphate Concentrations



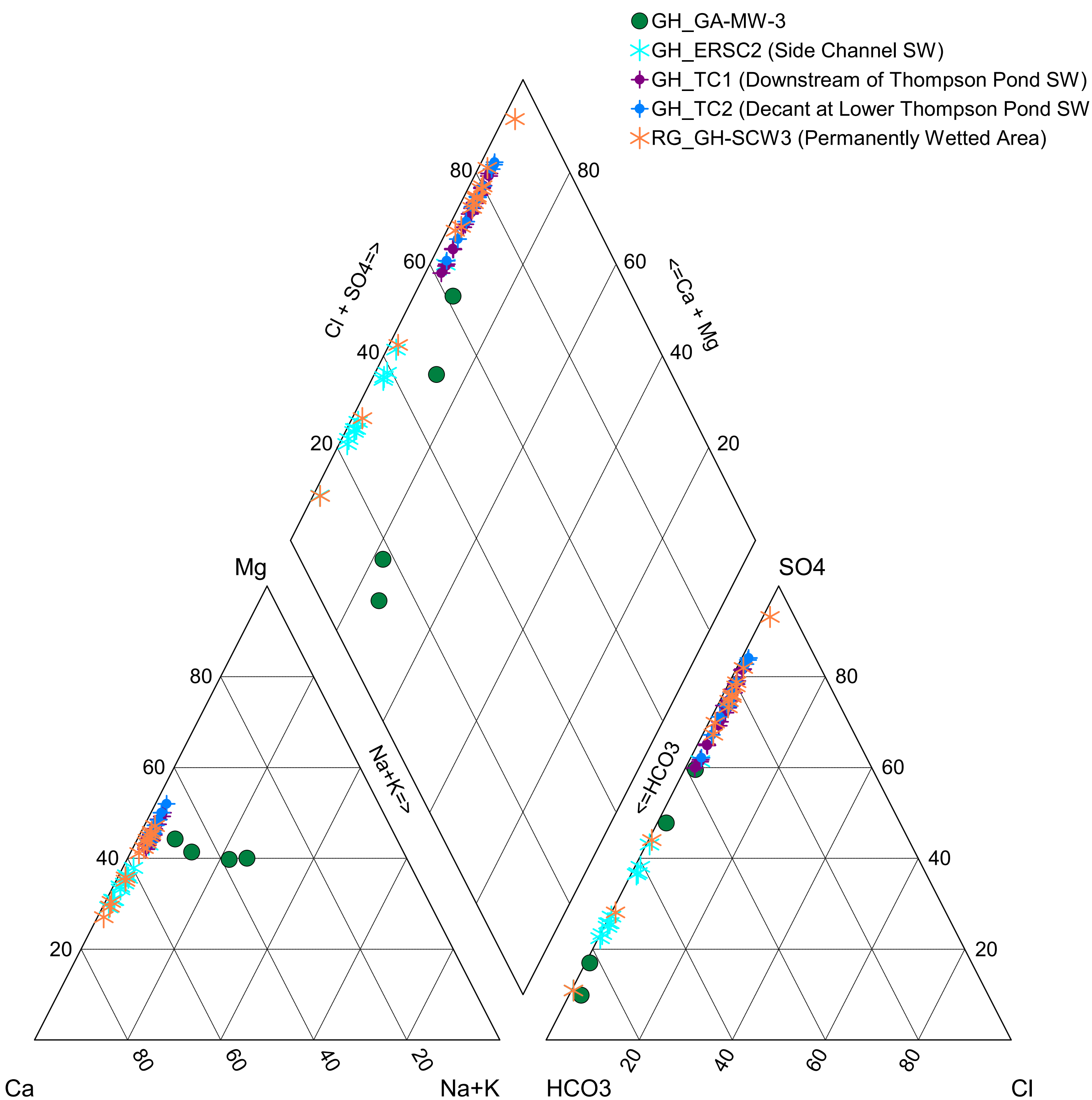
Note: Only groundwater fed pools are presented.

Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

Figure 07: Hydrograph for Reach 2 and 1



Note: Surface water elevations normalized based on available survey data.



DESCRIPTION: Figure 08: Piper Diagram for Reach 2 Groundwater Wells and Surface Water		
	PROJECT: GHO LAEMP	PROJECT NO: 655483
	CLIENT: Teck Coal Limited	DATE: 2021-05-28

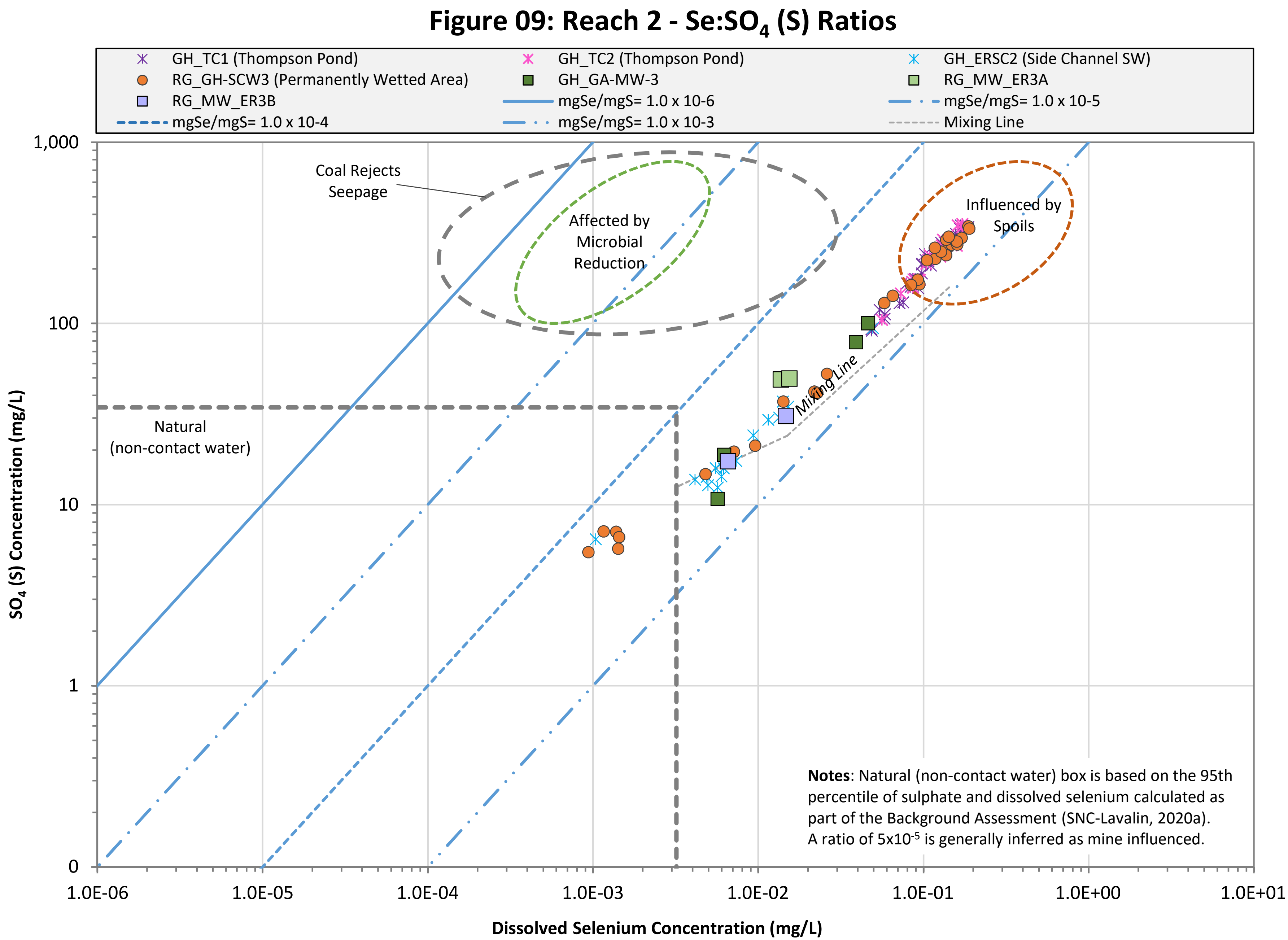
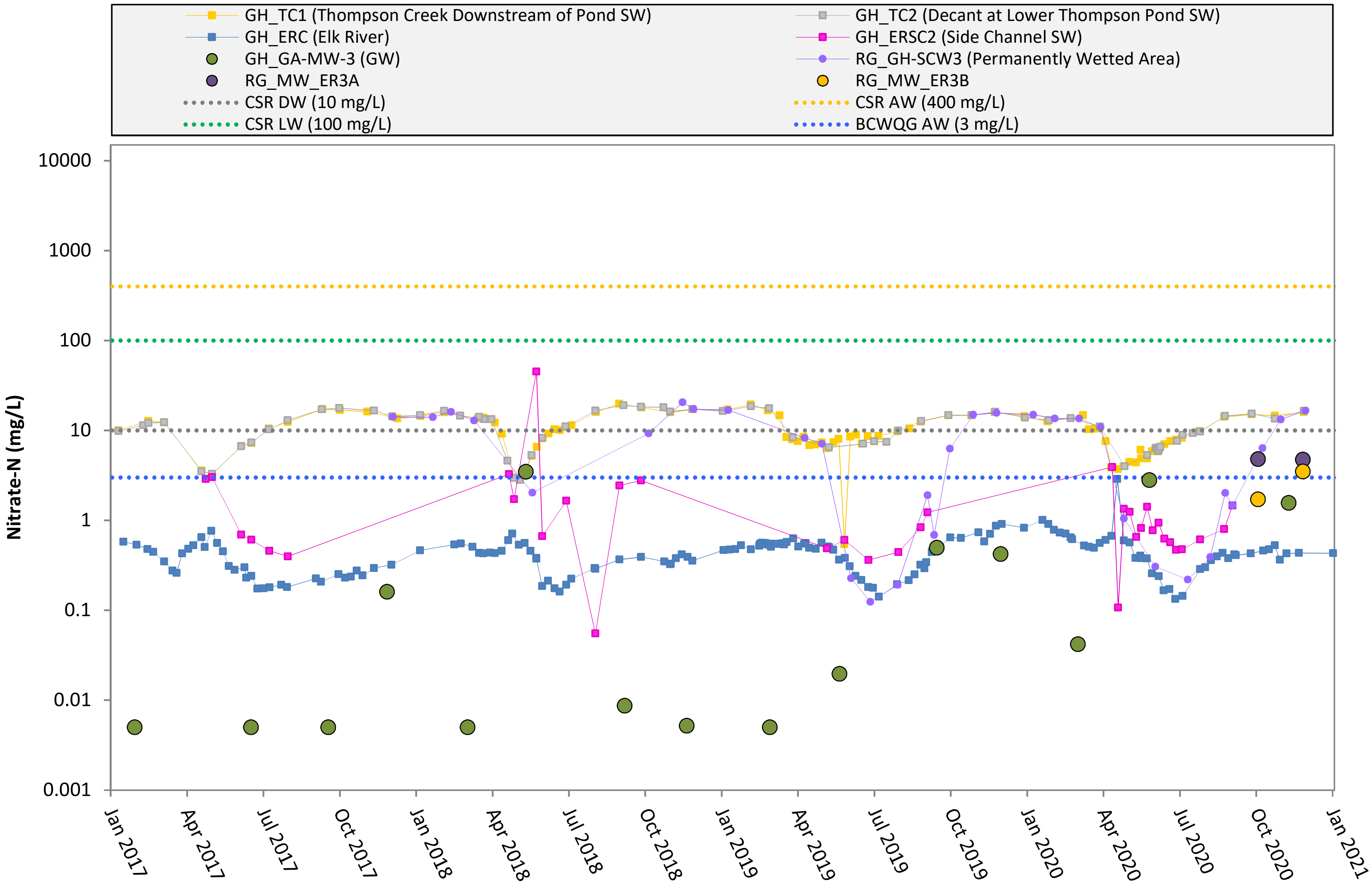


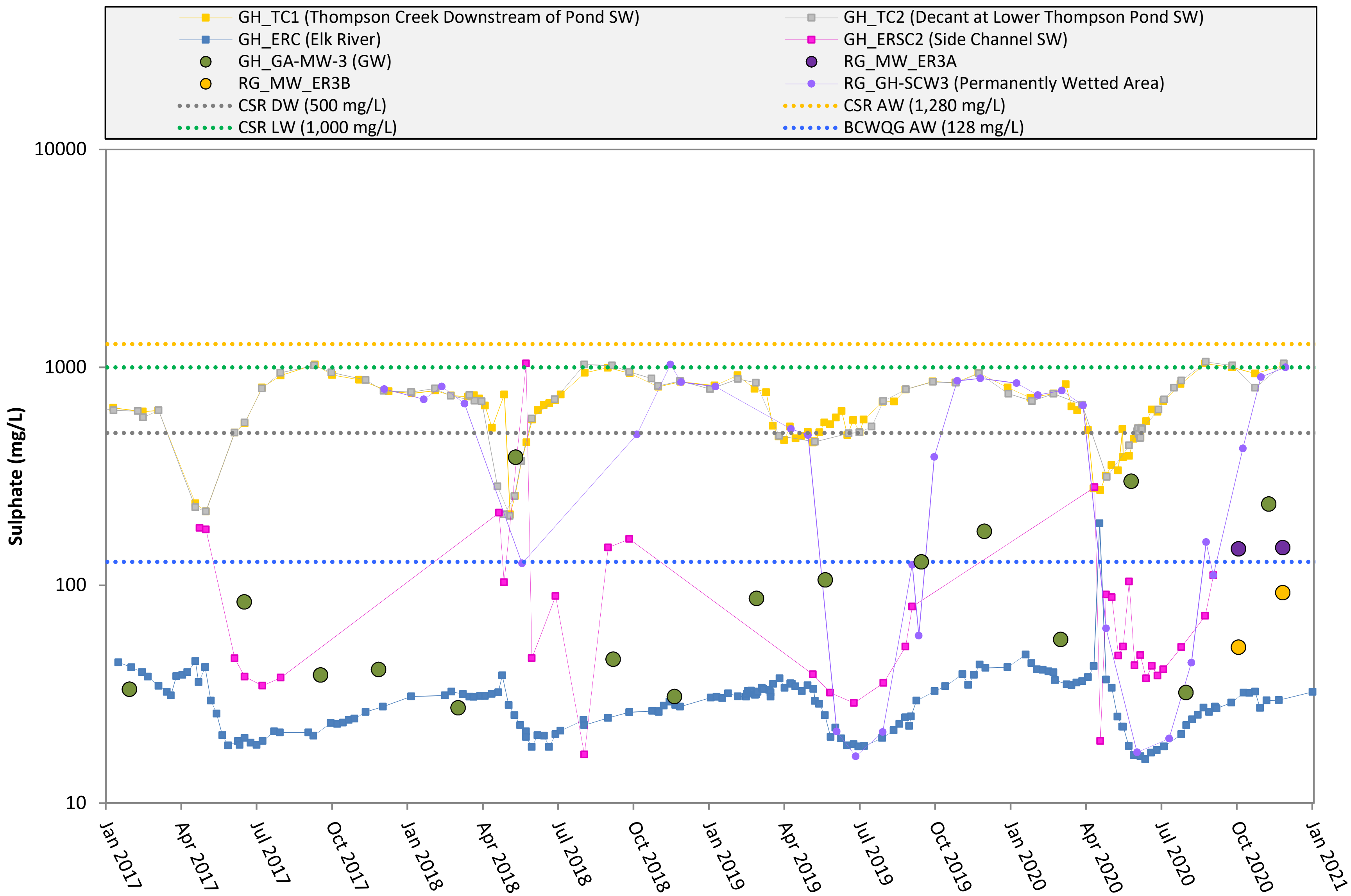
Figure 09: Reach 2 - Se:SO4 (S) Ratios
GH_TC1 (Thompson Pond)
GH_TC2 (Thompson Pond)
GH_ERSC2 (Side Channel SW)
RG_GH-SCW3 (Permanently Wetted Area)
GH_GA-MW-3
RG_MW_ER3A
RG_MW_ER3B
mgSe/mgS= 1.0 x 10-6
mgSe/mgS= 1.0 x 10-5
mgSe/mgS= 1.0 x 10-4
mgSe/mgS= 1.0 x 10-3
Mixing Line
Coal Rejects Seepage
Affected by Microbial Reduction
Influenced by Spoils
Natural (non-contact water)
Mixing Line
Notes: Natural (non-contact water) box is based on the 95th percentile of sulphate and dissolved selenium calculated as part of the Background Assessment (SNC-Lavalin, 2020a).
A ratio of 5x10-5 is generally inferred as mine influenced.
SO4 (S) Concentration (mg/L)
1,000
100
10
1
0
1.0E-06
1.0E-05
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E+00
1.0E+01
Dissolved Selenium Concentration (mg/L)

Figure 10: Reach 2 - Nitrate-N Concentrations

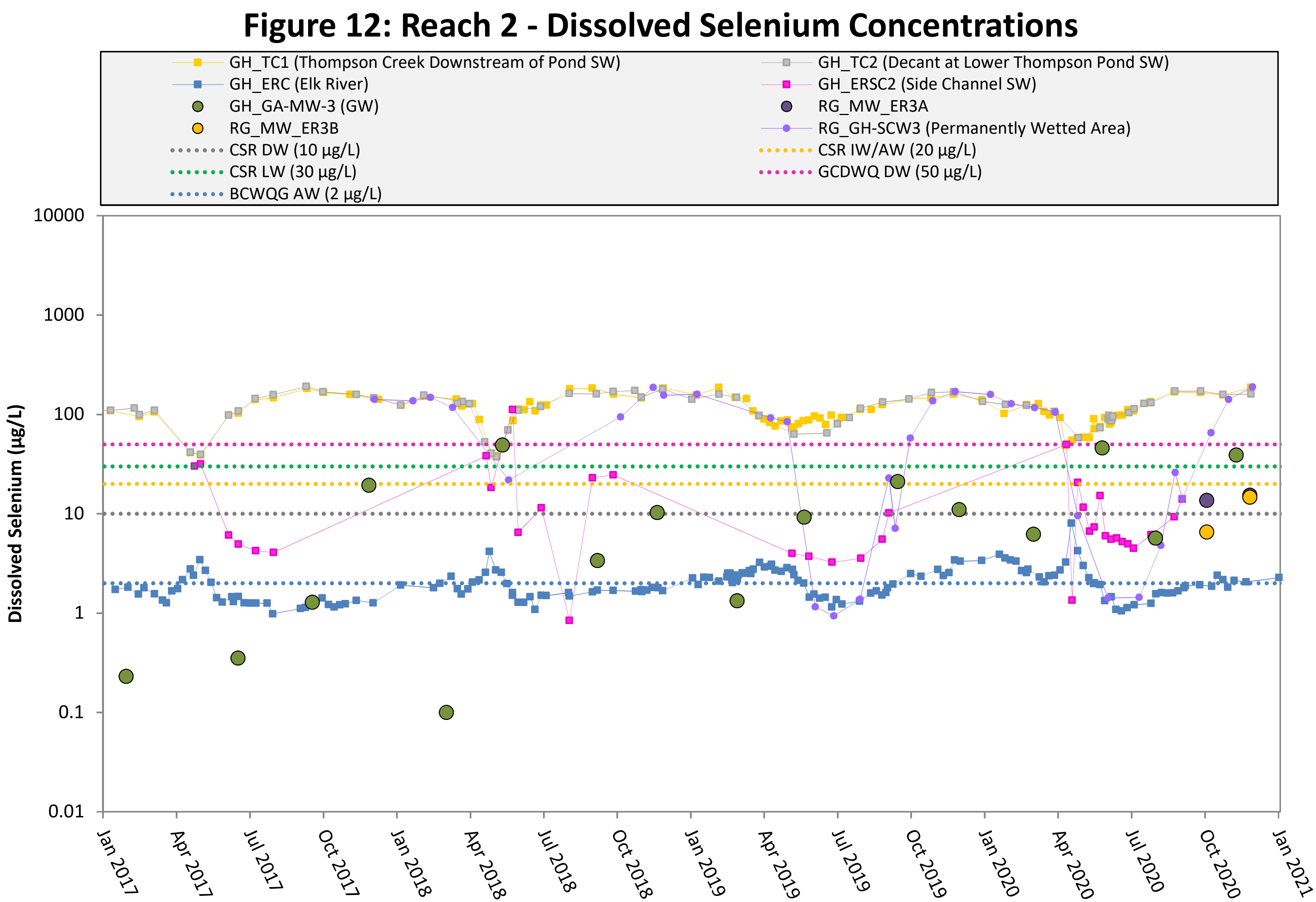


Note: Surface water location RG_GHSCW2 (permanently wetted area) was not sampled in 2019 and was therefore not included in the time-series graph.
For concentrations measured below the analytical detection limit, the detection limit (0.005 mg/L) was utilized for plotting purposes.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

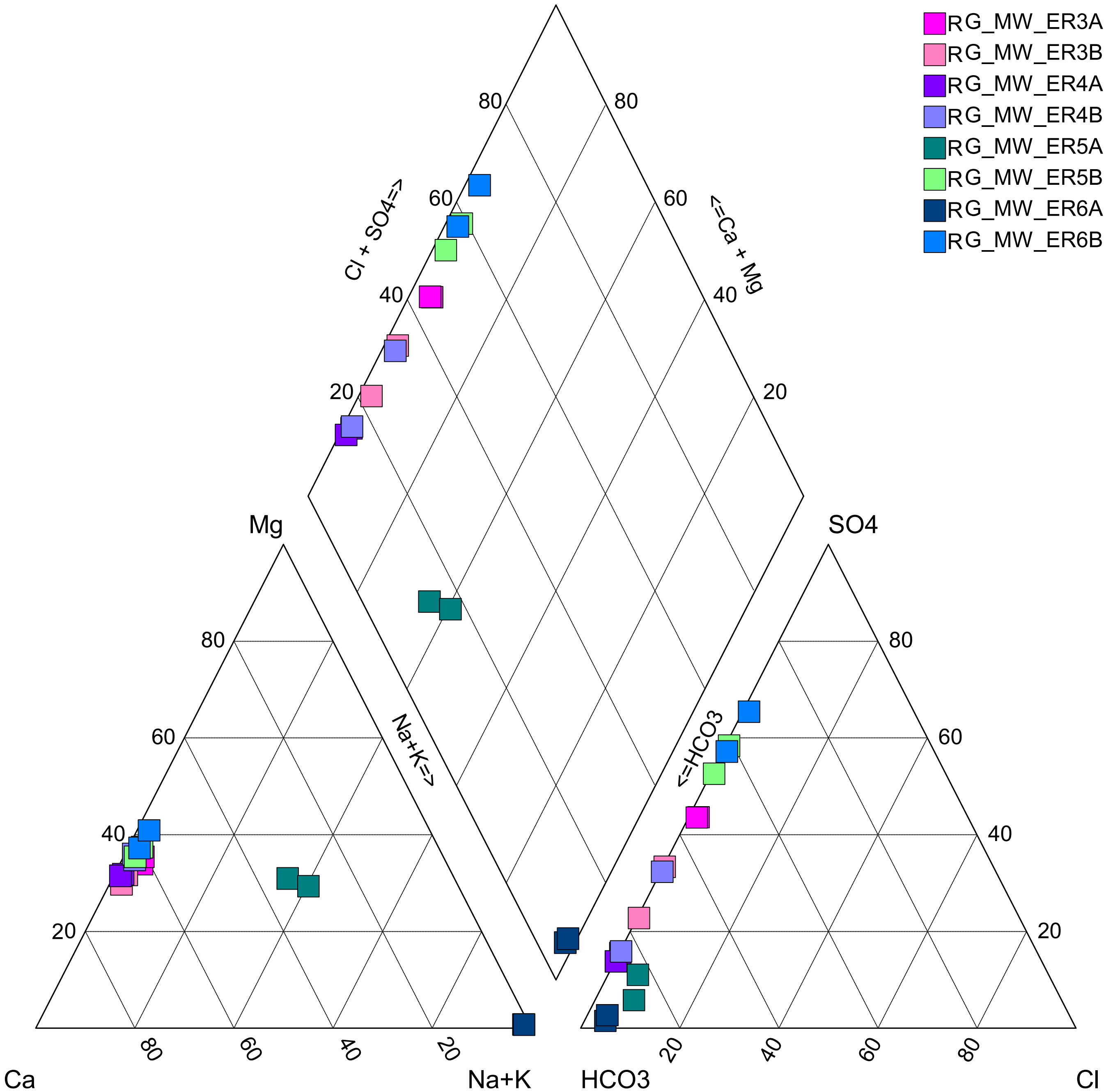
Figure 11: Reach 2 - Sulphate Concentrations



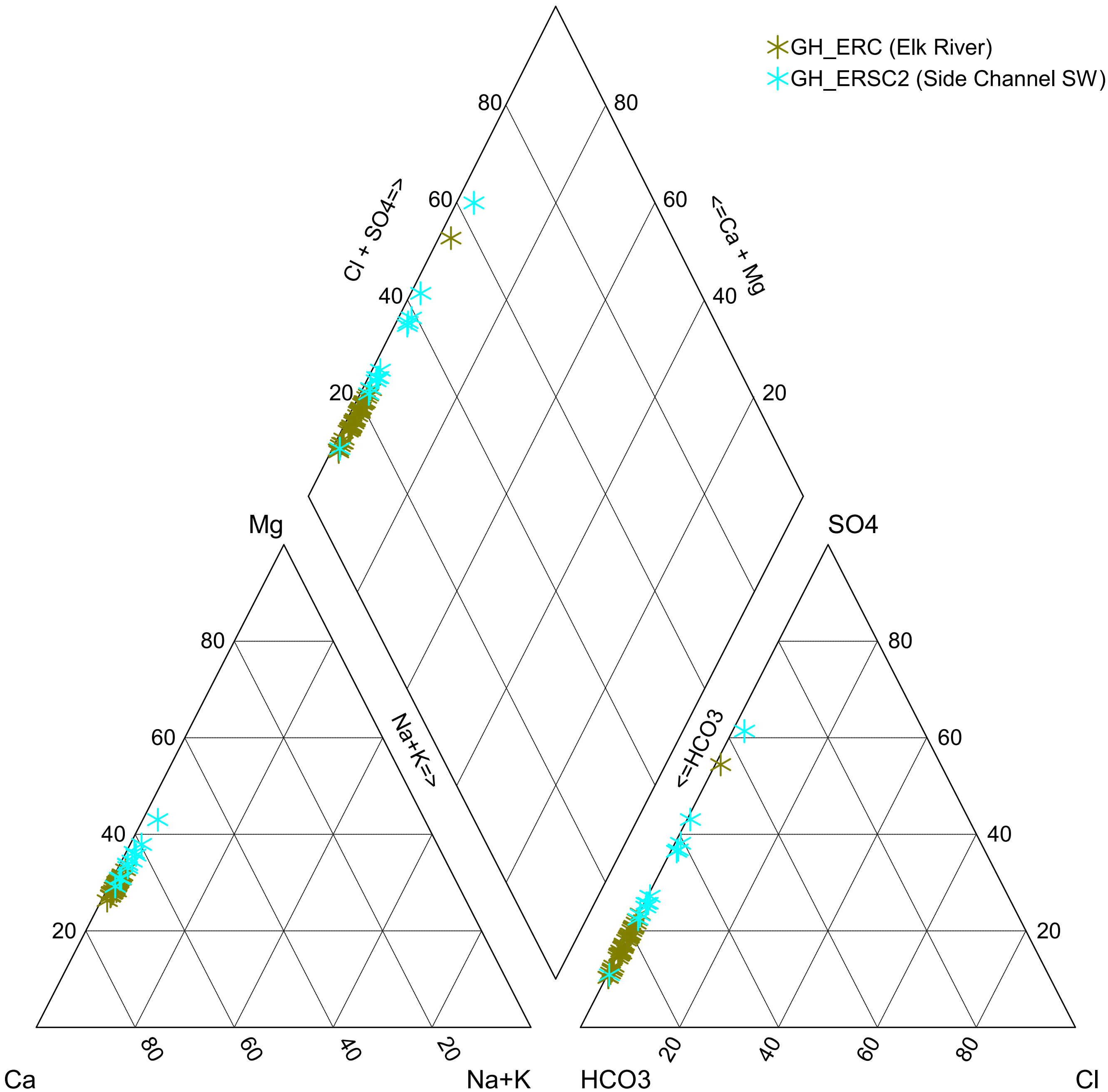
Note: Surface water location RG_GHSCW2 (permanently wetted area) was not sampled in 2019 and was therefore not included in the time-series graph.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.



Note: Surface water location RG_GHSCW2 (permanently wetted area) was not sampled in 2019 and was therefore not included in the time-series graph.
For concentrations measured below the analytical detection limit, the detection limit (0.10 µg/L) was utilized for plotting purposes.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.



DESCRIPTION: Figure 13A: Piper Diagram for Reach 1 Groundwater Wells		
	PROJECT: GHO LAEMP	PROJECT NO: 655483
	CLIENT: Teck Coal Limited	DATE: 2021-04-27



DESCRIPTION:	Figure 13B: Piper Diagram for Reach 1 Surface Water

	PROJECT: GHO LAEMP	PROJECT NO: 655483
	CLIENT: Teck Coal Limited	DATE: 2021-05-27

Figure 14: Reach 1 - Se:SO_4 (S) Ratios

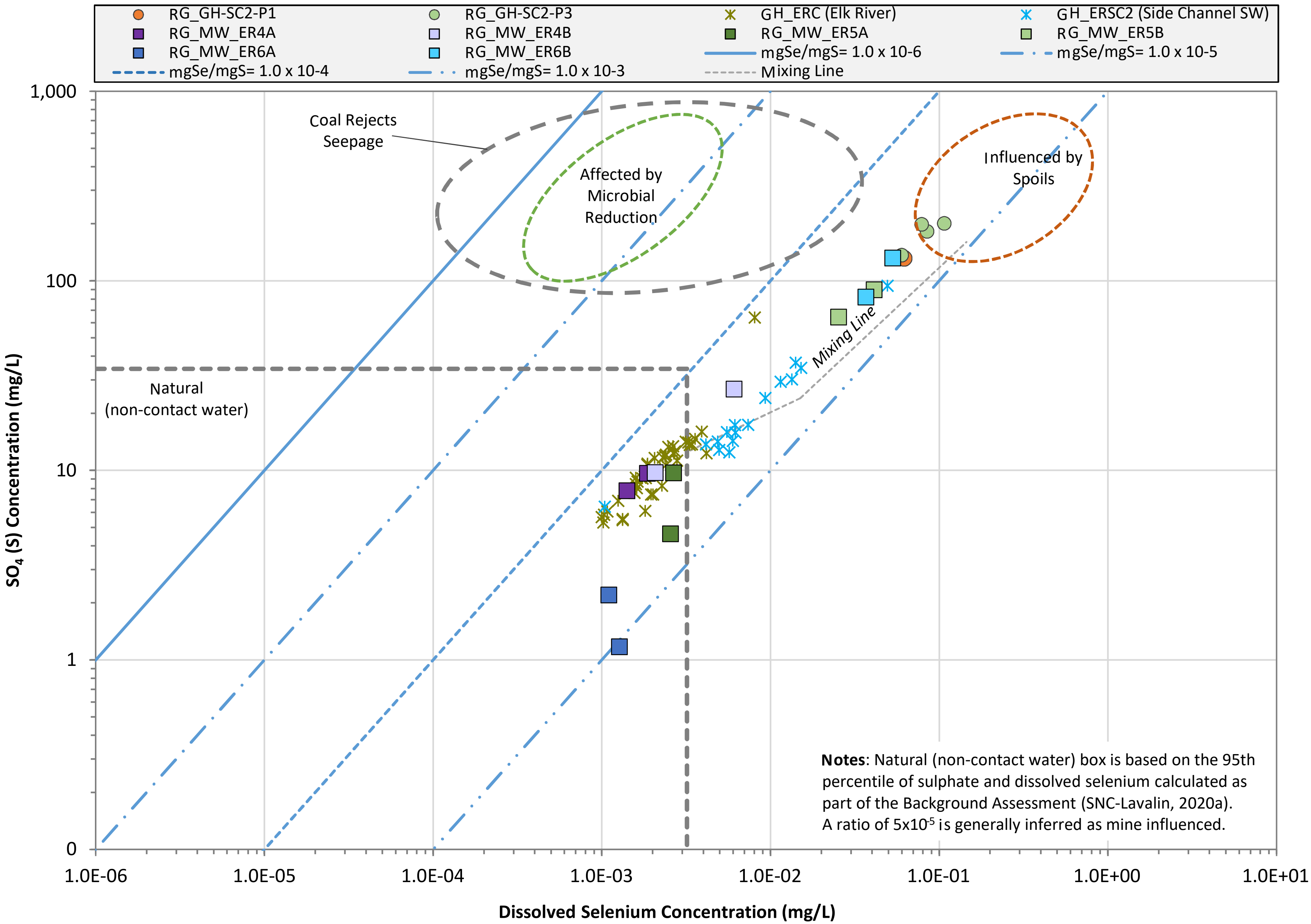
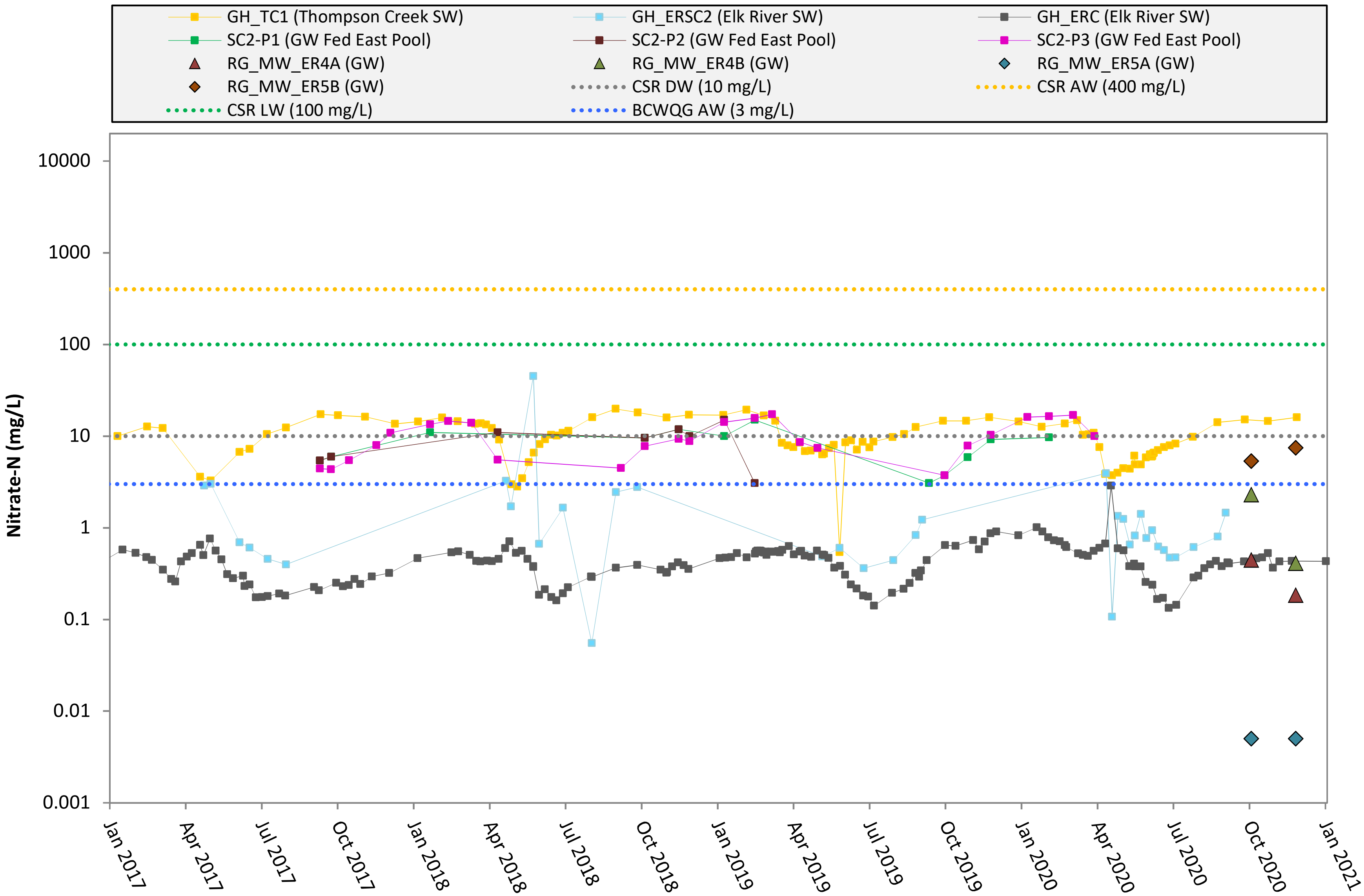
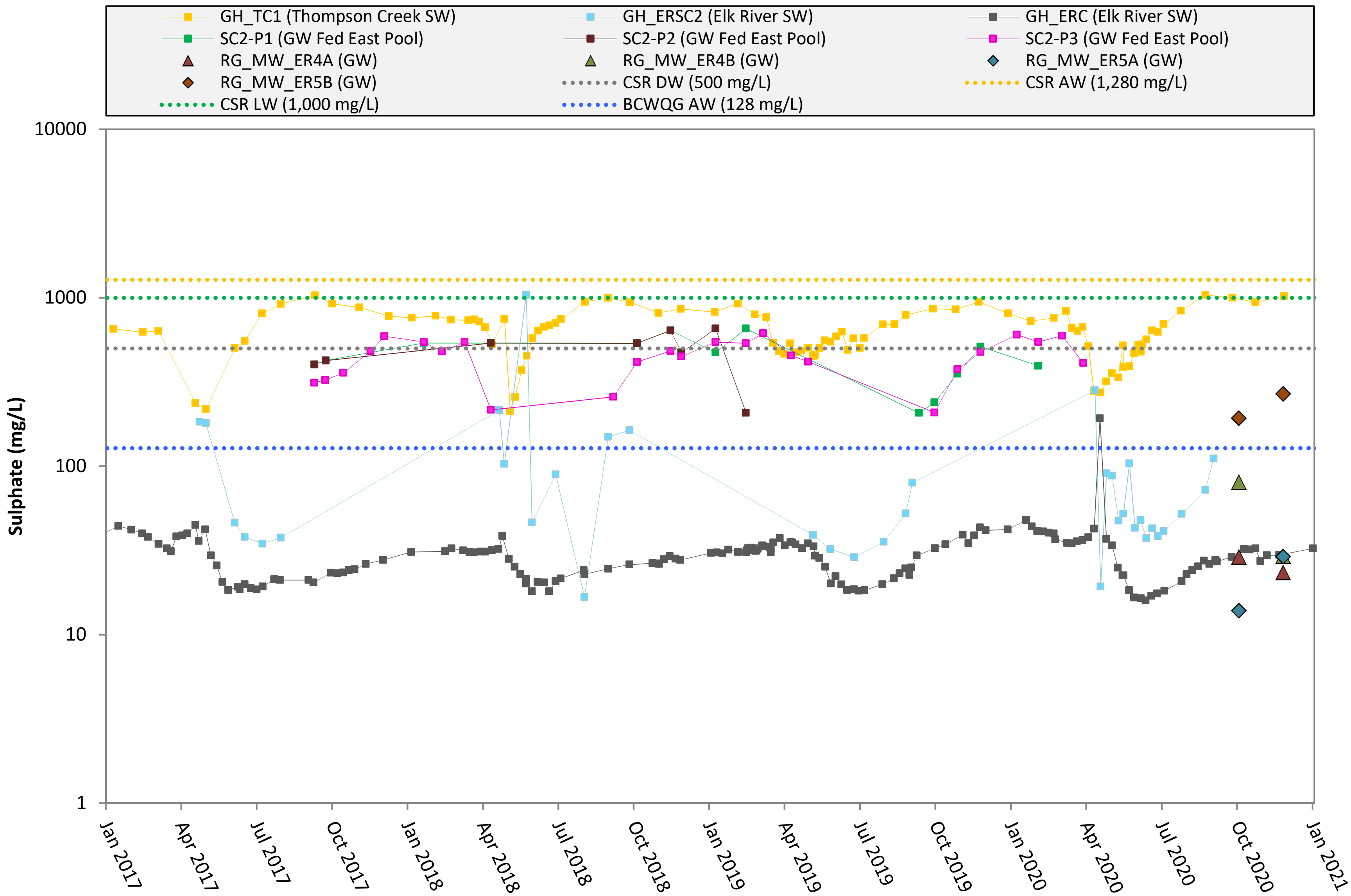


Figure 15: Reach 1 - Nitrate-N Concentrations



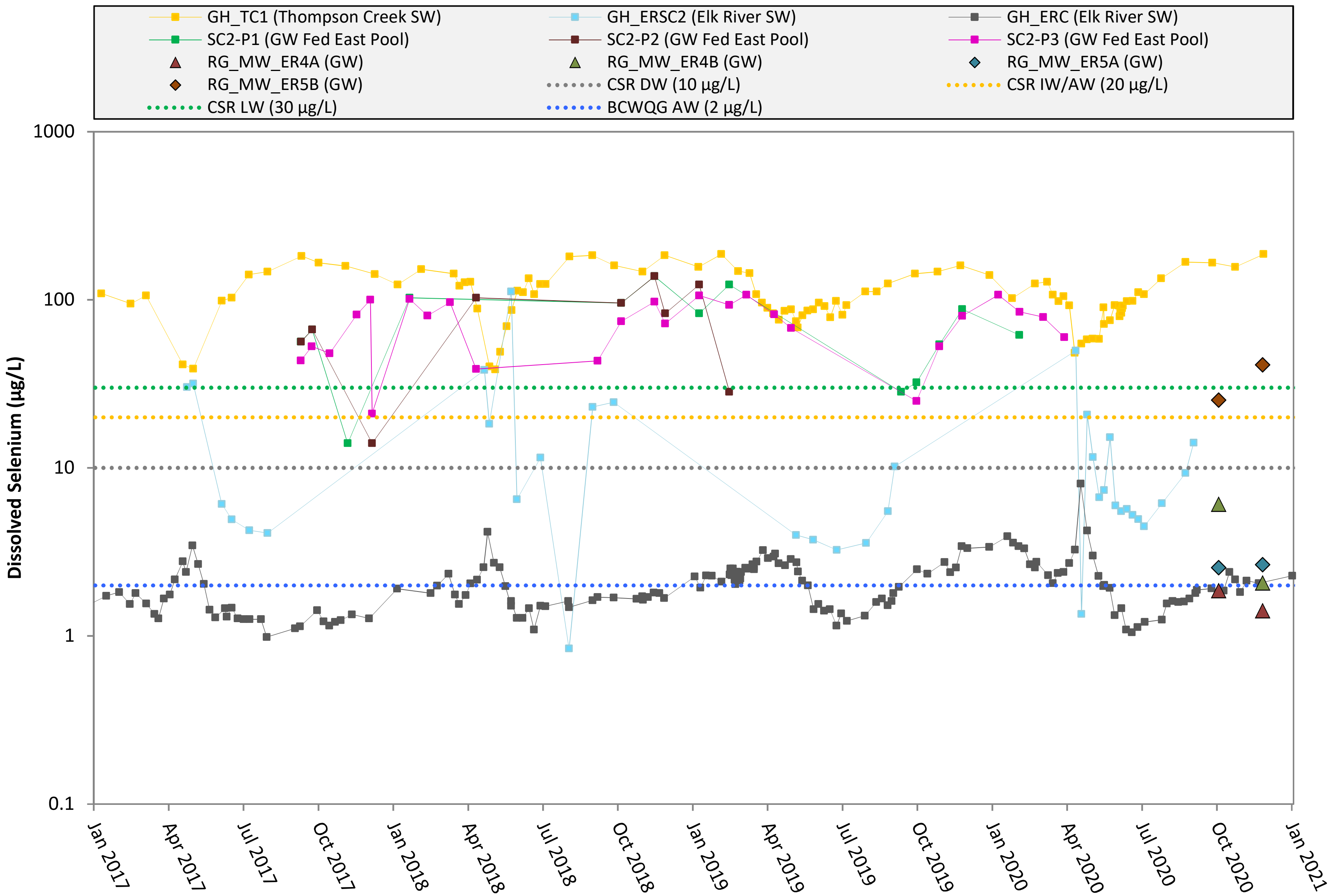
Note: Only results for isolated pools obersved in 2019 are presented along with historical data for these pools.
For concentrations measured below the analytical detection limit, the detection limit (0.005 mg/L) was utilized for plotting purposes.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

Figure 16: Reach 1 - Sulphate Concentrations



Note: Only results for isolated pools obersved in 2019 are presented along with historical data for these pools.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

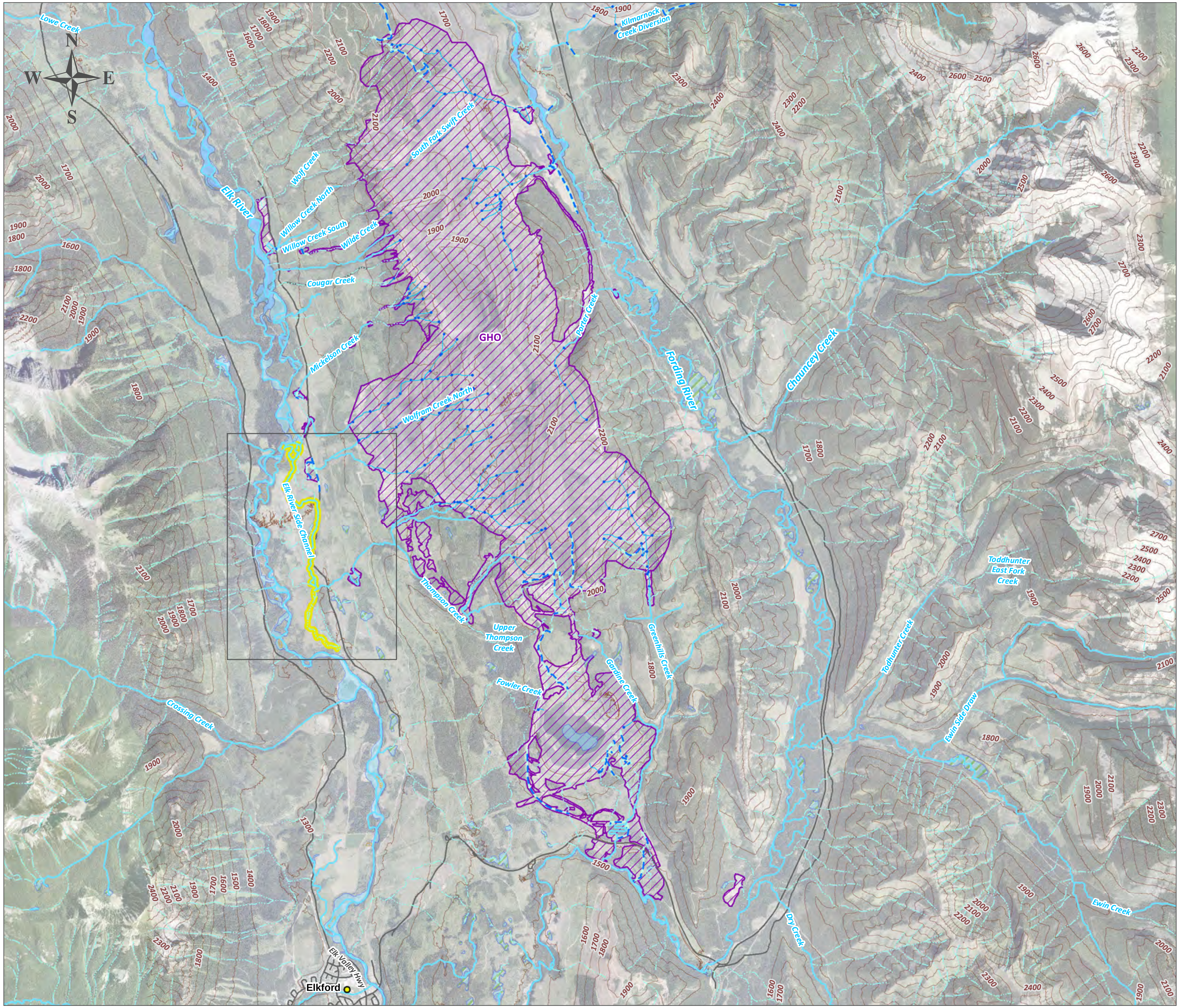
Figure 17: Reach 1 - Dissolved Selenium Concentrations

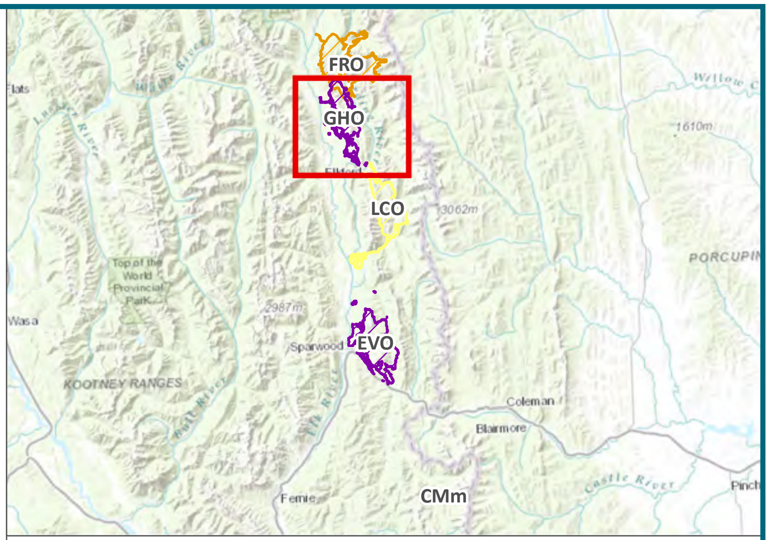


Note: Only results for groundwater fed pools are presented.
Logarithmic scale has been applied based on distribution of concentrations relative to applicable screening criteria.

Drawings

1: Site Location Plan
2: GHO Elk River Side Channel Site Plan
3: Groundwater Elevation and Inferred Groundwater Flow Direction – Elk Valley





Legend

Water Features

- Stream
- Stream Ditch
- Subsurface
- Intermittent and Indefinite Stream
- Island
- Lake
- River Bed
- Wetland
- Elk River Side Channel

Site Features

- Highway
- Secondary Road
- Topographic Contours (100m)
- CMO Permitted Boundary
- EVO Permitted Boundary
- FRO Permitted Boundary
- GHO Permitted Boundary
- LCO Permitted Boundary

Notes:
1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale; however, scale bar will remain accurate.
3. Intended for illustration purposes. Accuracy has not been verified for construction or navigation purposes.

References:
1.
2. BCGOV ILMB Crown Registry and Geographic Base Branch (CRGB) (data accessed through www.GeoBC.gov.bc.ca)
3. GPS Data Collected using an eTrex. Accuracy expected to be approximately +/- 3.5m.

Revisons:
0 - AO -2021-05-27 - FINAL - EC

0 550 1,100 2,200 3,300 4,400 5,500 Metres

Client:
Teck Coal Ltd.

Project Location:
Greenhills Operations, BC

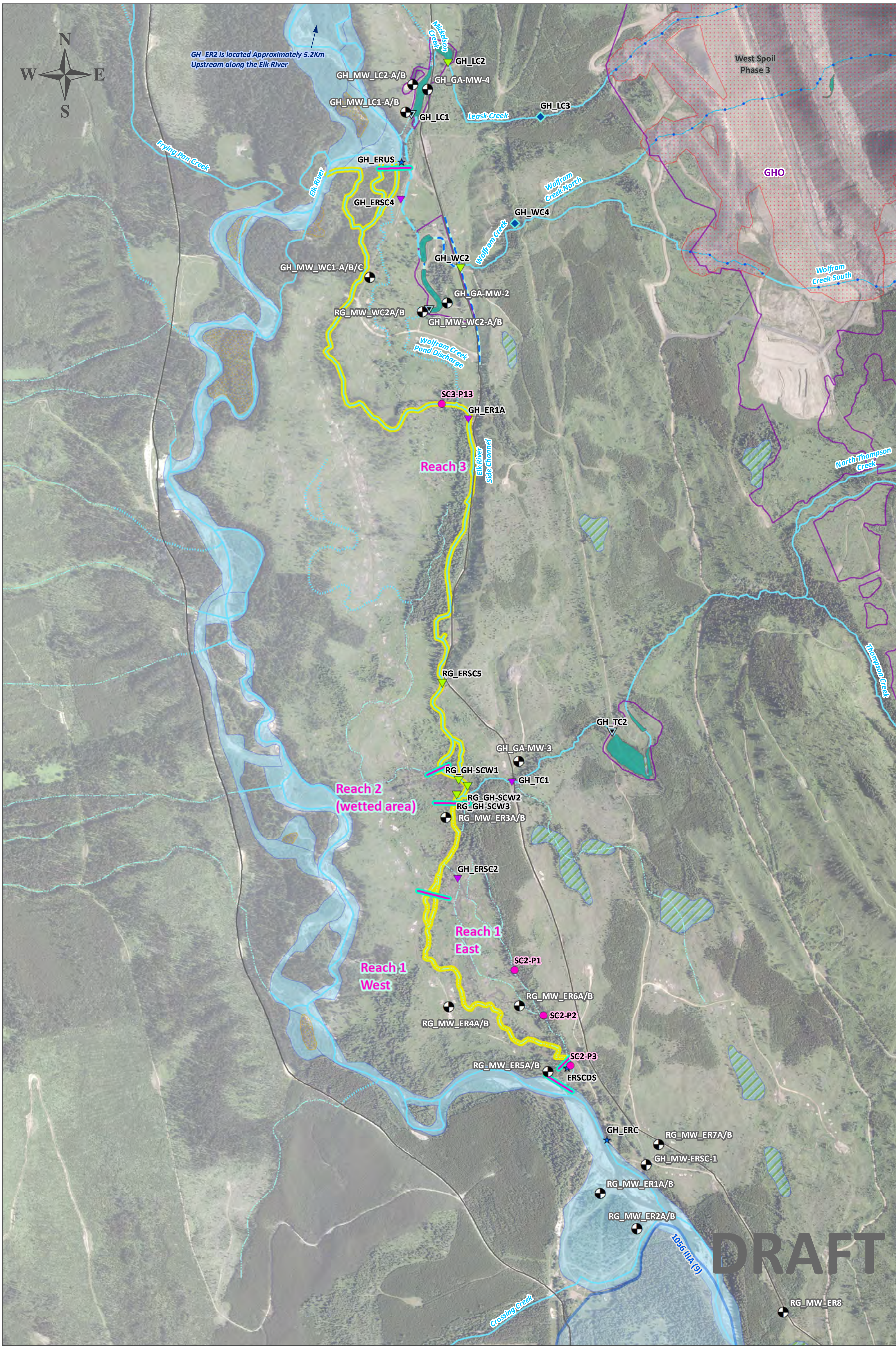
SNC·LAVALIN

Site Location Plan

BY: CW	SCALE: 1:70,000	DATE: 2021-05-27	REF No:
CHK'D: EC	Proj Coord Sys: NAD 1983 UTM Zone 11N		Drawing 1

MXD Path: \\Sli2606\projects\Current Projects\Teck Coal Ltd\GIS\CAD\GIS\Map Series\655483_GHO\2021 LAEMP\655483-001.mxd

Project Path: P:\Current Projects\Teck Coal Ltd\GIS\Exports\655483_GHO



Legend

Groundwater Station
- Monitoring Well

Surface Water Stations
- Surface Water
- Compliance Point
- Receiving Environment Surface Water Monitoring Station
- Authorized Discharge
- Permitted / non-permitted surface water monitoring station
- Groundwater Fed Pools

Site Features
- Secondary Road
- Mapped Aquifers
- GHO Permitted Boundary
- Waste Dump (Spoils)
- Reach Boundary
- Tailings/Settling Pond

Water Features
- Intermittent Stream
- Ditch
- Indefinite Stream
- Stream
- Subsurface
- Elk River Side Channel
- Island
- Lake
- River Bed
- Wetland
- Water Pipeline

Notes:
1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale, however scale bar will remain accurate.
3. Intended for illustration purposes, accuracy has not been verified for construction or navigation purposes.

References:
1. Information provided by Teck Coal Ltd.
2. Mapped Aquifers are from Water Resources Atlas (BC ENV)

Revisons:
0 - CW - 2021-04-06- DRAFT - EC

0 95 190 380 570 760 Metres

Client:
Teck Coal Ltd.

Project Location:
Greenhills Operations, BC

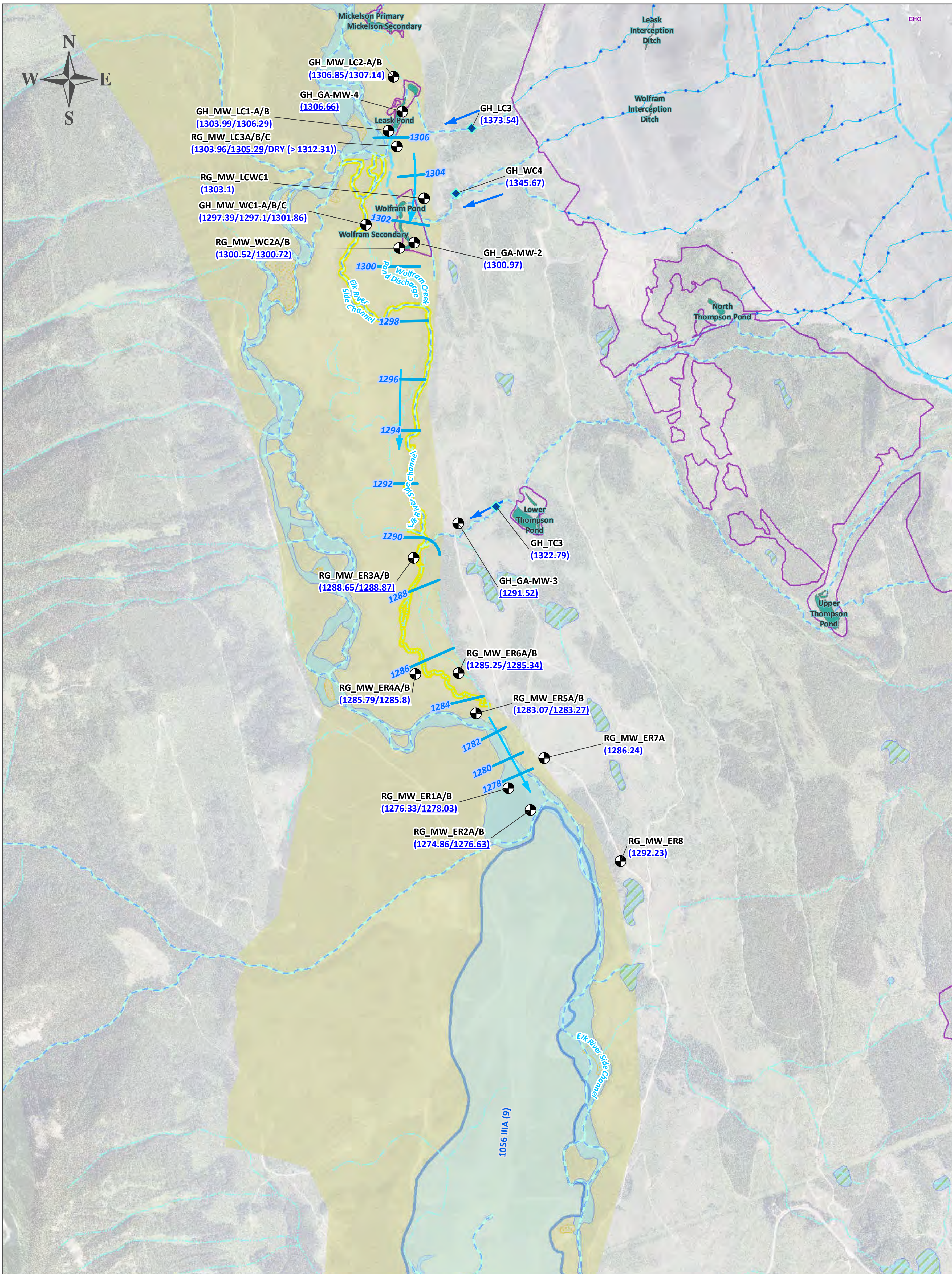
SNC·LAVALIN

GHO Elk River Side Channel Site Plan

CHK'D: EC	DATE: 2021-05-27	SCALE: 1:15,000	REF No:
BY: CW	COORD SYS: NAD 1983 UTM Zone 11N		Drawing 2

MXD Path: \\Sli2606\projects\Current Projects\Teck Coal Ltd\GISCAD\GIS\Map Series\655483_GHO\2021 LAEMP\655483-002.mxd

Project Path: \\Sli2606\projects\Current Projects\Teck Coal Ltd\GISCAD\GIS\Map Series\655483_GHO\



Hydrometric Stations
Monitoring Well
Inferred Valley-bottom Flow Direction
Inferred Groundwater Contours
Inferred Upland or Tributary Valley-bottom Groundwater Flow
Water Pipeline
GHO Permitted Boundary
Tailings/Settling Pond
Intermittent + Indefinite Stream
Stream + Stream Ditch
Subsurface
Elk River Side Channel
Mapped Aquifers

Island
Lake
River Bed
Wetland
Interpreted Main Valley-bottom Extent

1150.71 Groundwater Elevation (masl) September 30, 2020 - Used for contouring

1150.71 Groundwater Elevation (masl) September 30, 2020 - Not used for contouring

Notes:
1. Intended for illustration purposes only.
2. Original in colour.
3. Site location is approximate.

References:
1. Information provided by Teck Coal Ltd.
2.Elk Valley Orthophoto, 2019 provided by Teck Coal Ltd

Revisons:
0 -AO - 2021-05-26 - FINAL - EC

0 165 330 660 990 1,320 Metres

Client:
Teck Coal Limited

Project Location:
Greenhills Operations, BC

SNC·LAVALIN

Groundwater Elevation and Inferred Groundwater Flow Direction – Elk Valley

CHK'D: EC	DATE: 2021-05-27	SCALE: 1:26,000	REF No:
BY: AO	COORD SYS: NAD 1983 UTM Zone 11N		Drawing 003

Project Path: \\Sli2606\projects\Current Projects\Teck Coal Ltd\GISCAD\Exports\666653\MBI Drilling Report_2020

MXD Path: \\Sli2606\projects\Current Projects\Teck Coal Ltd\GISCAD\GIS\Map Series\655483_GHO\2021 LAEMP\655483-003-GWElevInferredFlow_ElkValley.mxd

Attachment A

Borehole Logs

PROJECT No.: 11.1422.0052

RECORD OF MONITORING WELL: GA-MW-02

LOCATION: See Location Plan

N: 5552115 E: 648291

BORING DATE: September 19, 2012

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		1310.00							Stick-up = 1.02 m
0	Barber Rig – Air Rotary, Tervita	(SP) SAND, coarse-grained, trace fine gravel, angular, poorly-graded, grey		0.00							
					1	GRAB					
											19 Sep 2012 ∇
5		(GP) GRAVEL, coarse-grained, sub-rounded, brown		1305.00 5.00							Bentonite Pellets
					2	GRAB					
7		(CI) SILTY CLAY, some fine gravel, brown, cohesive, water content is close to plastic limit, very soft		1303.00 7.00							
					3	GRAB					
10				1300.00							

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: TG

CHECKED: JW

DATA ENTRY: IPG

PROJECT No.: 11.1422.0052

RECORD OF MONITORING WELL: GA-MW-02

SHEET 2 OF 3

LOCATION: See Location Plan

N: 5552115 E: 648291

BORING DATE: September 19, 2012

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —— W —— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Barber Rig – Air Rotary; Tervita	(GW) GRAVEL, coarse-grained, sub-angular, well graded, grey		10.00	4	GRAB					
11		(CI) SILTY CLAY, with some fine gravel, brown, cohesive, very soft, w~PL		1298.50 11.50							
14					5	GRAB					
15											Bentonite Pellets
17		(SP) SAND, coarse-grained, some fine gravel, angular, poorly-graded, dark grey		1292.80 17.20							
18					6	GRAB					
19		(GW) GRAVEL, coarse-grained, sub-angular, well graded, grey		1290.50 19.50	7	GRAB					
20											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TG

CHECKED: JW

PROJECT No.: 11.1422.0052

RECORD OF MONITORING WELL: GA-MW-02

LOCATION: See Location Plan

N: 5552115 E: 648291

BORING DATE: September 19, 2012

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	PIEZOMETER OR STANDPIPE INSTALLATION
20	Barber Rig – Air Rotary, Tervita	(GW) GRAVEL, coarse-grained, sub-angular, well graded, grey *(continued)*				Bentonite Pellets
21–22				7	GRAB	10/20 Sand
23		(ML) SILT, some fine gravel, trace coarse gravel, dark grey, non-cohesive, dry	1287.00 / 23.00	8	GRAB	
24		(SP) SAND, coarse-grained, some fine gravel, angular, poorly-graded, dark grey	1286.00 / 24.00			
26–27				9	GRAB	Slotted Section 10/20 Sand
28		— Bedrock at 28.5 m				
29		NOTES: Encountered BEDROCK at 28.5 m. Standpipe installed to 29.0 m. Groundwater level measured at 11.0 mGL on September 19, 2012.				Bentonite Pellets
		(SP) SAND, coarse-grained, coarse gravel, bits of bedrock, sub-angular, poorly-graded, light grey	1280.50 / 29.60	10	GRAB	
30		End of MONITORING WELL.				

Column headings (no data recorded): STRATA PLOT; BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - O) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (Wp —— oW —— Wl) (10, 20, 30, 40); ADDITIONAL LAB. TESTING

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: TG

CHECKED: JW

PROJECT No.: 11.1422.0052

RECORD OF MONITORING WELL: GA-MW-3S

LOCATION: See Location Plan

N: 5550296 E: 648578

BORING DATE: September 23, 2012

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		1294.00							
	Barber Rig – Air Rotary, Tervita	(SP) SAND, coarse-grained, sub-angular, poorly-graded, dark grey, homogenous, moist		0.00							
2					1	GRAB					
3											Bentonite Pellets
4.5		(SP) GRAVELY SAND, coarse-grained, fine gravel, poorly-graded, sub-angular, grey		1289.50 4.50							
7					2	GRAB					10/20 Sand; 23 Sep 2012 ∇
9											Slotted Section 10/20 Sand
10											

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TG
CHECKED: JW

PROJECT No.: 11.1422.0052

RECORD OF MONITORING WELL: GA-MW-3S

LOCATION: See Location Plan

N: 5550296 E: 648578

BORING DATE: September 23, 2012

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q- ● rem V. ⊕ U- O (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ OW ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Barber Rig – Air Rotary / Tervita	(SP) GRAVELY SAND, coarse-grained, fine gravel, poorly-graded, sub-angular, grey *(continued)*									
11					3	GRAB					
12											Slotted Section 10/20 Sand
13					4	GRAB					
14				1279.60 / 14.40							Bentonite Pellets
		End of MONITORING WELL. NOTES: Encountered BEDROCK at 14.4 m									
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TG

CHECKED: JW

SNC·LAVALIN

Client: **Teck Coal Limited**	Location: **Greenhills Operations**	**Borehole No. : GH_BH_WC1-A/B**

Drilling Contractor: Owen's Drilling	Date Monitored: 2019 10 28	Project Number: 658004
Drilling Method: Dual Rotary	Ground Surface Elev. (m): 1305.901	Borehole Logged By: AH
Borehole Dia. (m): 0.15	Top of Casing Elev. (m): 1306.761 1306.775	Date Drilled: 2019 10 01
Pipe/Slotted Pipe Dia. (m): 0.05/0.05	Northing: 5552217.211 Easting: 647987.230	Log Typed By: VL

Drilling Legend: Sample Interval; Air Rotary

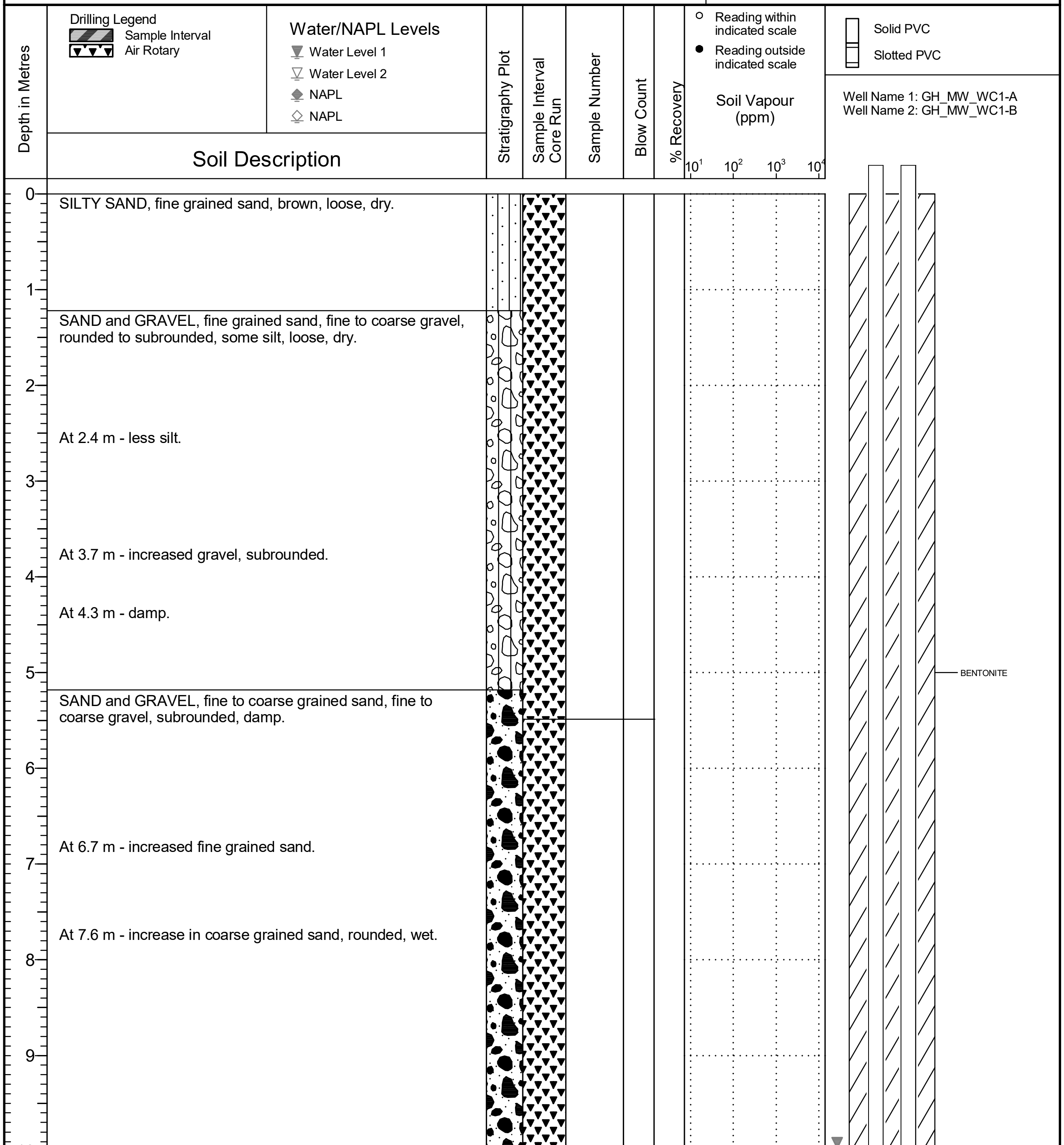
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description
0	SILTY SAND, fine grained sand, brown, loose, dry.
1.2	SAND and GRAVEL, fine grained sand, fine to coarse gravel, rounded to subrounded, some silt, loose, dry.
2.4	At 2.4 m - less silt.
3.7	At 3.7 m - increased gravel, subrounded.
4.3	At 4.3 m - damp.
5.2	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subrounded, damp.
6.7	At 6.7 m - increased fine grained sand.
7.6	At 7.6 m - increase in coarse grained sand, rounded, wet.



NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4
10	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subrounded, damp. *(continued)*						
13.7	At 13.7 m - some silt, some sand, fine grained.						
15.2	At 15.2 m - less silt, less fine grained sand.						
15.7	At 15.7 m - loose.						
18.3	SAND, fine grained, some silt, trace gravel, fine, brown, loose, wet.						
20							

BENTONITE

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 3 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4	Well
20	SAND, fine grained, some silt, trace gravel, fine, brown, loose, wet. *(continued)*							
22	At 21.9 m - dark brown, small pieces of black shale in sand.							
23.4	At 23.4 m - silty, dark grey, loose, loose, wet.							
25								BENTONITE
30								

NOTES

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 4 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

○ Reading within indicated scale; ● Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) 10^1 10^2 10^3 10^4

Depth in Metres	Soil Description
30	SAND, fine grained, some silt, trace gravel, fine, brown, loose, wet. *(continued)*
32.5	At 32.5 m - some clay, decreased moisture content.
35.7	At 35.7 m - medium dense.
37.5	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subangular, grey, wet.
39.3	At 39.3 m - some silt, damp.
40	

Well construction labels: BENTONITE; GH_MW_WC1-B; SAND; BENTONITE

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

GH_MW_GHC-1A

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 5 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4	Well
40	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subangular, some silt, grey, damp.							
41								
42								
43								
44	SILTY SAND, coarse grained sand, some gravel, fine to coarse, subrounded, loose, wet.							
45								BENTONITE
	At 45.4 m - increased gravel, increased density, damp.							
46								
47								
48								
49								
50								

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

SNC·LAVALIN

Client **Teck Coal Limited**		**Borehole No. : GH_BH_WC1-A/B**
Location **Greenhills Operations**		PAGE 6 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm)

Depth in Metres	Soil Description
50	SILTY SAND, coarse grained sand, some gravel, fine to coarse, subrounded, loose, wet. *(continued)*
51	At 50.9 m - decreased gravel, increased density.
	At 51.5 m - some clay.
52	At 52.4 m - medium dense.
53	
54	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded, trace silt, medium dense, wet.
55	
56	SILTY SAND, fine to coarse grained sand, trace gravel, subrounded, loose, wet.
57	At 57.0 m - less gravel.
	SILTY SAND, fine grained sand, trace gravel, brown, loose, wet.
58	
59	
60	

BENTONITE

NOTES

GH_MW_GHC-1B

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 7 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4
60	SILTY SAND, fine grained sand, trace gravel, brown, loose, wet. *(continued)*						
61	At 61.0 m - increase coarse grained sand.						
62							
63	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded to subangular, grey-black, wet.						
64							
65							
66							
67							
68	At 68.6 m - less gravel, increased sand.						
69							
70							

BENTONITE

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

GH_MW_GHC-1B

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 8 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) 10^1 10^2 10^3 10^4

Depth (m)	Soil Description
70	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded to subangular, grey-black, wet. *(continued)*
71.6	At 71.6 m - some gravel, fine, subangular, light brown to black.
73.8	At 73.8 m - decreased moisture content.
74.7	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded to subangular, some silt, grey-black.
76.5	At 76.5 m - wet.
76.7	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded, light brown-black.
77.7	At 77.7 m - some gravel, coarse, rounded to subrounded.
79.2	At 79.2 m - subrounded to subangular, light grey to black, wet.

Well annotations: BENTONITE; GH_MW_WC1-A; SAND

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-A/B**
	Location **Greenhills Operations**	PAGE 9 OF 9

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.901	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.761 1306.775	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552217.211	Easting: 647987.230	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

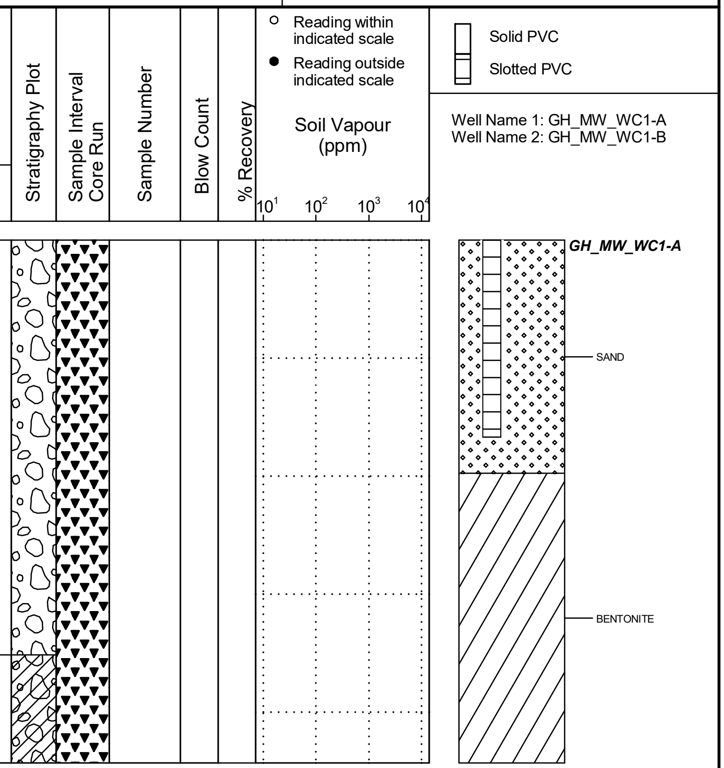
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-A
Well Name 2: GH_MW_WC1-B

Depth in Metres	Soil Description
80	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded, light brown-black. *(continued)* At 80.0 m - abundant water.
83.5	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, subrounded to subangular, some clay, light grey to black, damp.
84.4	Bottom of hole at 84.4 m.



NOTES

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-C**
	Location **Greenhills Operations**	PAGE 1 OF 2

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.826	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.676	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552218.134	Easting: 647985.348	Log Typed By:	VL

Drilling Legend: Sample Interval; Air Rotary

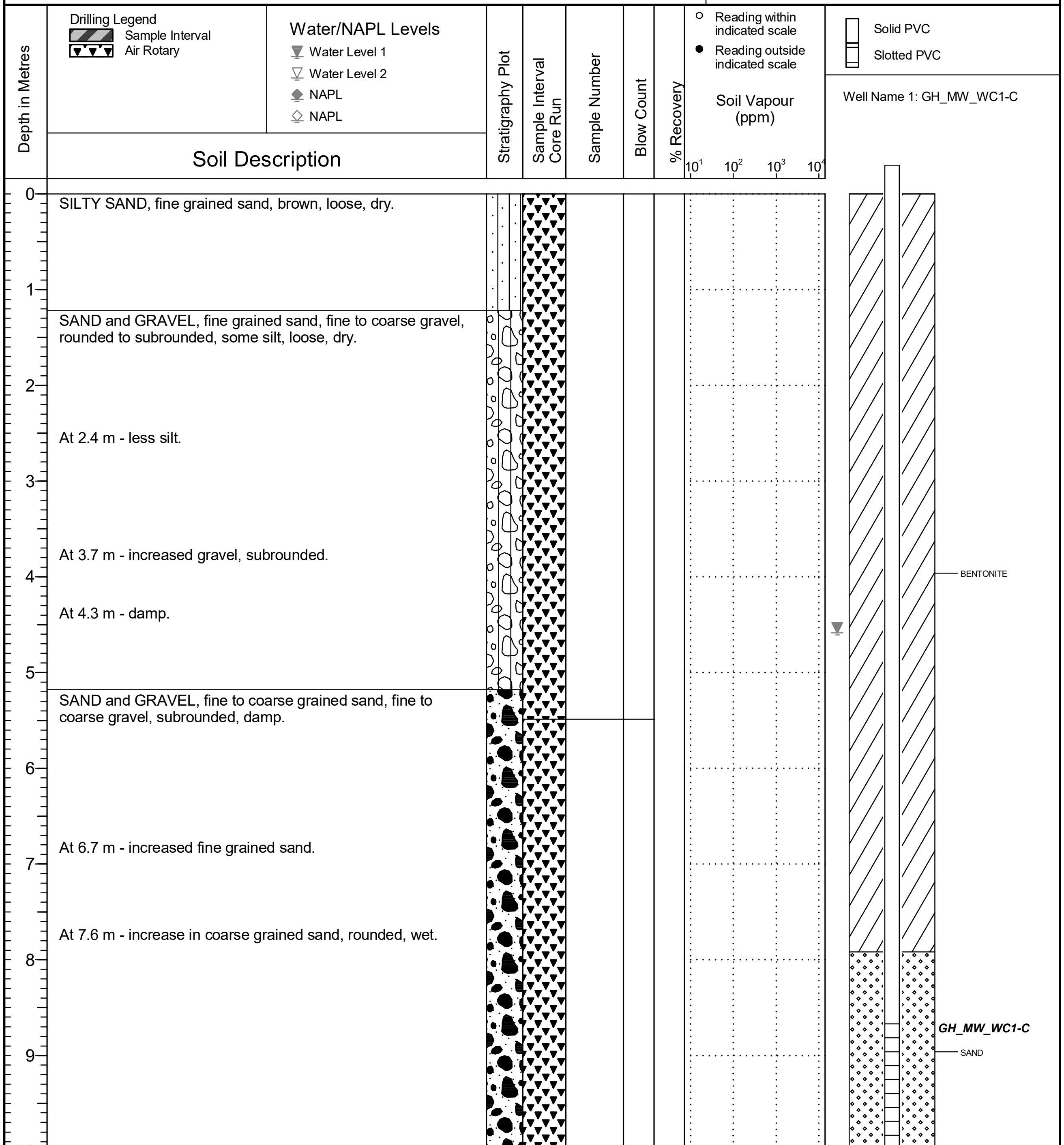
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: GH_MW_WC1-C

Depth in Metres	Soil Description
0	SILTY SAND, fine grained sand, brown, loose, dry.
~1.2	SAND and GRAVEL, fine grained sand, fine to coarse gravel, rounded to subrounded, some silt, loose, dry.
	At 2.4 m - less silt.
	At 3.7 m - increased gravel, subrounded.
	At 4.3 m - damp.
~5.2	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subrounded, damp.
	At 6.7 m - increased fine grained sand.
	At 7.6 m - increase in coarse grained sand, rounded, wet.



NOTES

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : GH_BH_WC1-C**
	Location **Greenhills Operations**	

Drilling Contractor	Owen's Drilling	Date Monitored	2019 10 28	Project Number:	658004
Drilling Method	Dual Rotary	Ground Surface Elev. (m)	1305.826	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1306.676	Date Drilled:	2019 10 01
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552218.134	Easting: 647985.348	Log Typed By:	VL

Drilling Legend
- Sample Interval
- Air Rotary

Water/NAPL Levels
- Water Level 1
- Water Level 2
- NAPL
- NAPL

- Reading within indicated scale
- Reading outside indicated scale

- Solid PVC
- Slotted PVC

Well Name 1: GH_MW_WC1-C

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4
10	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subrounded, damp. *(continued)*						
	Bottom of hole at 10.7 m.						

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

GH_MW_WC1-C
SAND
BENTONITE

NOTES

QA/QC: KC 2020 12 03 Print Date:2020-12-04

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER3A**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1291.504	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1292.483	Date Drilled:	2020 09 12
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5550079.667	Easting: 648288.173	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

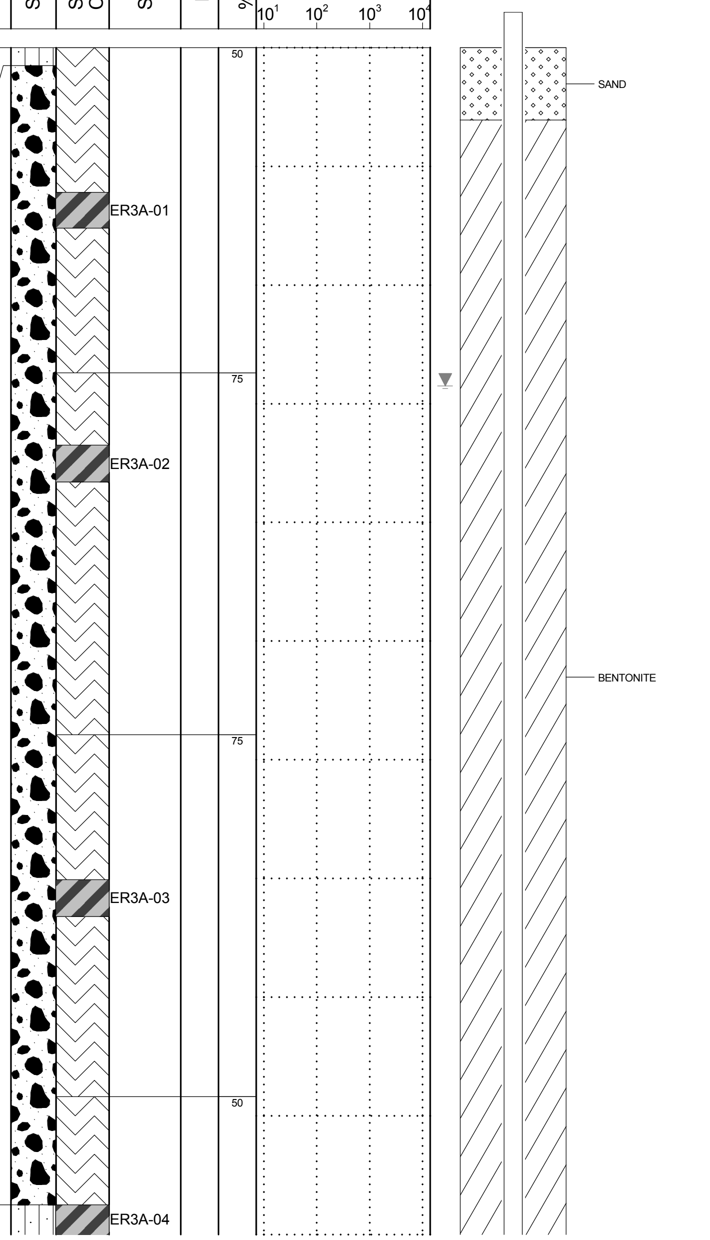
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

○ Reading within indicated scale; ● Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER3A

Depth in Metres	Soil Description	Sample Number	% Recovery
0	SAND, fine grained, some silt, brown, medium dense, dry, some organics (roots).		50
	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, brown-grey, loose, damp.		
	At 1.5 m - wet.	ER3A-01	
	Below 2.7 m - trace silt, containing cobbles.		75
		ER3A-02	
	Below 5.8 m - trace to some silt.		75
		ER3A-03	
			50
	SAND, fine grained, some silt, brown, loose, wet.	ER3A-04	
10			



NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER3A**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 3

Drilling Contractor: Mud Bay Drilling Co. Ltd.
Drilling Method: Vibratory Sonic
Borehole Dia. (m): 0.15
Pipe/Slotted Pipe Dia. (m): 0.05/0.05

Date Monitored: 2020 09 30
Ground Surface Elev. (m): 1291.504
Top of Casing Elev. (m): 1292.483
Northing: 5550079.667
Easting: 648288.173

Project Number: 631283
Borehole Logged By: GG
Date Drilled: 2020 09 12
Log Typed By: VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

○ Reading within indicated scale
● Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER3A

Depth in Metres	Soil Description	Sample Number	% Recovery	Well
10	SAND, fine grained, some silt, brown, loose, wet. *(continued)*			
12			80	
12.8	At 12.8 m - lense of silt and clay (150 mm), brown-grey, soft.			
13	SAND, fine to medium grained, dark grey, medium dense, wet.	ER3A-05		
15			120	BENTONITE
15.2	SILT and CLAY, dark grey, very soft, low plasticity, wet, interlayed fine grained sand.			
18	Below 18.0 m - soft, brown-grey, laminations of light brown, medium plasticity.		100	
20				

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER3A**
	Location **Regional Groundwater Monitoring**	PAGE 3 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1291.504	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1292.483	Date Drilled:	2020 09 12
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5550079.667	Easting: 648288.173	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER3A

Depth in Metres	Soil Description	Sample Number	% Recovery
20	SILT and CLAY, dark grey, very soft, low plasticity, wet, interlayed fine grained sand. *(continued)*	ER3A-06	
21			50
21.6	SAND, fine to medium grained, brown, medium dense, wet.		
22		ER3A-07	
22.2	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, wet.		
24			60
25		ER3A-08	
25.6	SAND and SILT (TILL), fine grained sand, some gravel, fine to coarse, subangular, dark grey, dense, wet.		
26	BEDROCK, shale, dark grey, competent with minor fractures, soft.		
26.5	Bottom of hole at 26.5 m.		

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Well construction: BENTONITE; RG_MW_ER3A; SAND; BENTONITE; SLOUGH

NOTES
Bolded sample denotes sample analyzed.

FINAL

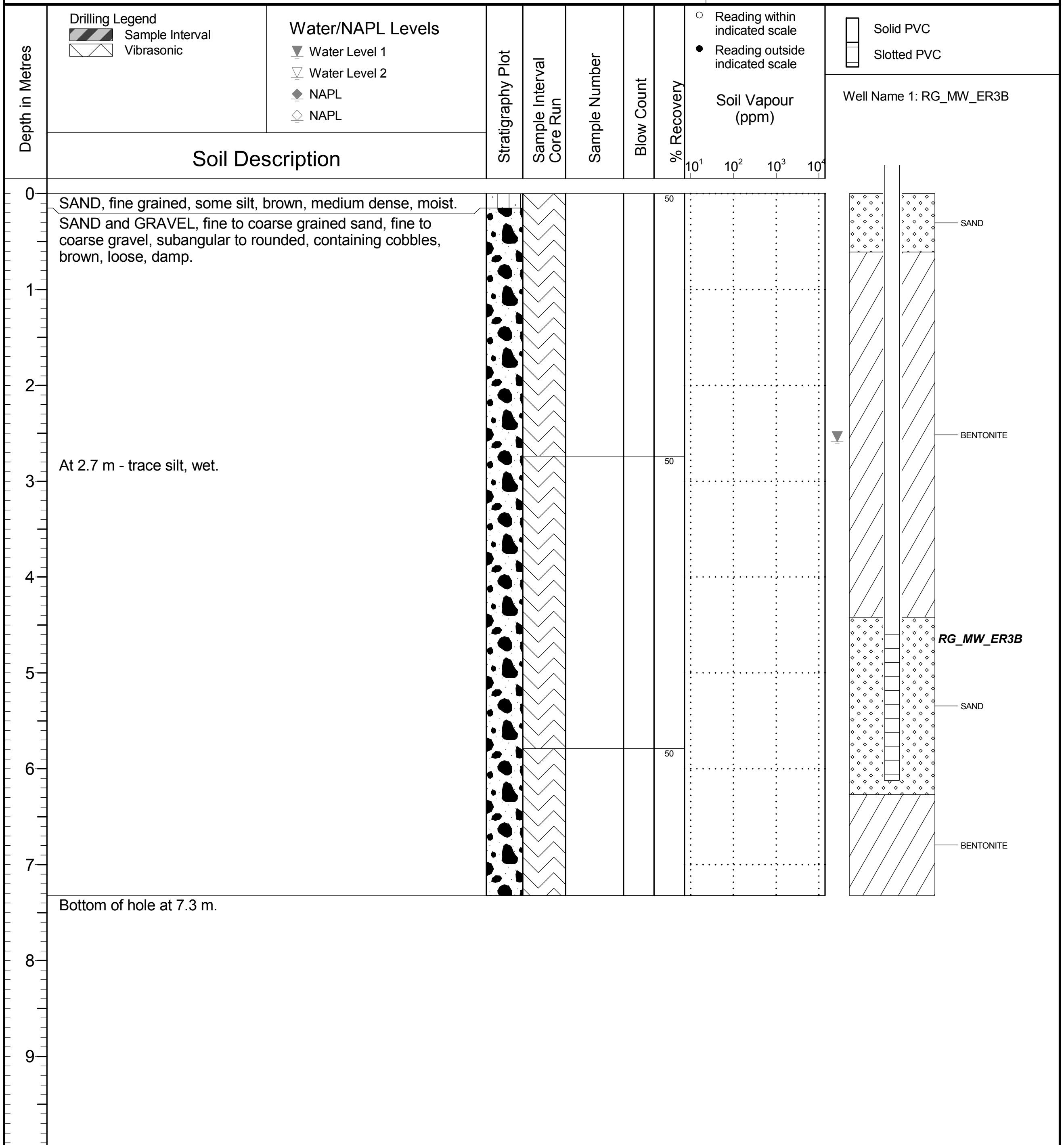
SNC·LAVALIN

Client
Teck Coal Limited

Location
Regional Groundwater Monitoring

Borehole No. : RG_BH_ER3B

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1291.456	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1292.533	Date Drilled:	2020 09 12
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5550080.308	Easting: 648288.225	Log Typed By:	VL



NOTES

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER4A**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1288.706	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1289.470	Date Drilled:	2020 09 13
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549329.563	Easting: 648300.186	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

○ Reading within indicated scale; ● Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER4A

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) (10^1, 10^2, 10^3, 10^4)

Depth (m)	Soil Description	Sample Number	% Recovery
0	SAND, fine grained, some silt, dark brown, medium dense, damp, organics (roots).		50
	GRAVELLY SAND, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, brown, loose, damp.		
1	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, damp.	ER4A-01	
3	At 2.7 m - wet. Between 2.7 m and 5.8 m - limited recovery.		30
5.5	SILTY SAND, fine grained sand, brown, very loose, wet.	ER4A-02	
6	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, wet.		40
8		ER4A-03	
9	Below 9.1 m - subangular to subrounded gravel, subangular to subrounded cobbles.		60
10			

Well construction: SAND; BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER4A**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1288.706	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1289.470	Date Drilled:	2020 09 13
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549329.563	Easting: 648300.186	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER4A

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) (10^1, 10^2, 10^3, 10^4)

Depth (m)	Soil Description	Sample Number	% Recovery
10	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, wet. *(continued)*	ER4A-04	
~11.9			20
~14.9		ER4A-05	100
~15.4	GRAVELLY SILT (TILL), fine to coarse gravel, angular, some clay, black, dense, wet.		
~16.3	BEDROCK, siltstone, black, fractured, very soft.		
~17.9			100
20			

Well annotations: BENTONITE (approx. 10–13 m); RG_MW_ER4A; SAND (approx. 13–15.4 m); BENTONITE (approx. 15.4–20 m)

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER4A**
	Location **Regional Groundwater Monitoring**	PAGE 3 OF 3

Drilling Contractor: Mud Bay Drilling Co. Ltd.	Date Monitored: 2020 09 30	Project Number: 631283
Drilling Method: Vibratory Sonic	Ground Surface Elev. (m): 1288.706	Borehole Logged By: GG
Borehole Dia. (m): 0.15	Top of Casing Elev. (m): 1289.470	Date Drilled: 2020 09 13
Pipe/Slotted Pipe Dia. (m): 0.05/0.05	Northing: 5549329.563 Easting: 648300.186	Log Typed By: VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): ○ Reading within indicated scale; ● Reading outside indicated scale; 10^1 10^2 10^3 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER4A

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm)	Well
20	BEDROCK, siltstone, black, fractured, very soft. *(continued)*							BENTONITE; SLOUGH
21	Bottom of hole at 21.0 m.							

Depth scale: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER4B**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 1

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1288.688	Borehole Logged By:	GG
Borehole Dia. (m)	0.18	Top of Casing Elev. (m)	1289.455	Date Drilled:	2020 09 13
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549328.936	Easting: 648299.824	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER4B

Columns: Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) 10^1 10^2 10^3 10^4

Depth (m)	Soil Description	% Recovery
0	SAND, fine grained, trace silt, brown, loose, dry, organics (roots).	100
	GRAVELLY SAND, fine to coarse grained sand, fine to coarse gravel, subrounded to rounded, brown, loose, dry.	
1.5	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose. Below 2.1 m - moist. At 2.7 m - wet.	50
4.3		40
5.8		100
6.1	SANDY GRAVEL, fine to coarse gravel, subangular to rounded, fine to coarse grained sand, trace silt, containing cobbles, brown, loose, wet.	
8.8	Bottom of hole at 8.8 m.	

Well construction (top to bottom): SAND; BENTONITE; RG_MW_ER4B SAND; BENTONITE; SLOUGH

NOTES

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER5A**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1286.308	Borehole Logged By:	GG
Borehole Dia. (m)	0.10	Top of Casing Elev. (m)	1287.035	Date Drilled:	2020 09 14
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549073.673	Easting: 648692.078	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

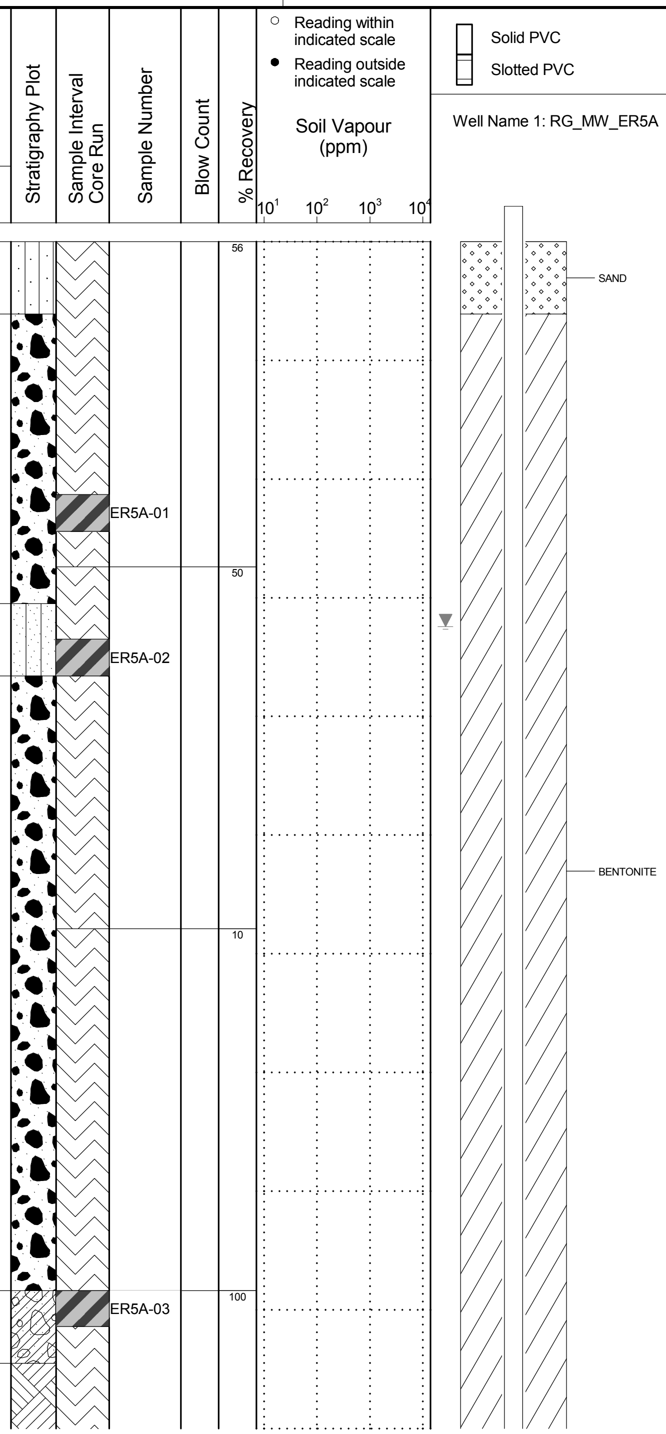
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER5A

Depth in Metres	Soil Description	Sample Number	% Recovery
0	SAND, fine grained, some silt, dark brown, medium dense, damp, organics (roots).		56
0.6	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, dry. Below 2.1 m - moist. Between 2.4 m and 3.0 m - log/wood debris.	ER5A-01	50
3.0	SILTY SAND, fine to medium grained sand, brown, very loose, wet.	ER5A-02	
3.6	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, dry.		10
8.8	GRAVELLY SILT (TILL), fine gravel, subangular to rounded, trace sand, fine to coarse grained, black, firm, wet.	ER5A-03	100
9.4	BEDROCK, shale, black, competent with minor fractures, soft.		
10			



NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER5A**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1286.308	Borehole Logged By:	GG
Borehole Dia. (m)	0.10	Top of Casing Elev. (m)	1287.035	Date Drilled:	2020 09 14
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549073.673	Easting: 648692.078	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER5A

Depth in Metres	Soil Description	% Recovery
10	BEDROCK, shale, black, competent with minor fractures, soft. *(continued)*	100
11.6		90
14.6		90
15.5	Below 15.5 m - slightly more fractures.	
18	Bottom of hole at 18.0 m.	

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

BENTONITE

RG_MW_ER5A

SAND

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC • LAVALIN	Client: **Teck Coal Limited**	**Borehole No. : RG_BH_ER5B**
	Location: **Regional Groundwater Monitoring**	PAGE 1 OF 1

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1286.366	Borehole Logged By:	GG
Borehole Dia. (m)	0.18	Top of Casing Elev. (m)	1287.042	Date Drilled:	2020 09 14
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549074.166	Easting: 648691.348	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

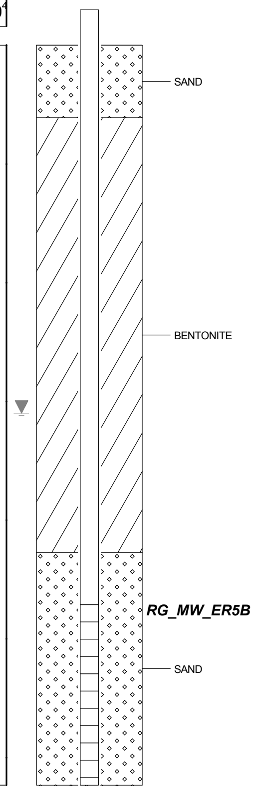
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): ○ Reading within indicated scale; ● Reading outside indicated scale; 10^1 10^2 10^3 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER5B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery
0	SAND, fine grained, some silt, dark brown, medium dense, dry.		Vibrasonic			100
	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, dry.					
	Below 1.5 m - damp.					
	At 2.7 m - wet.					
3	Between 2.9 m and 3.4 m - wood debris/log.		Vibrasonic			20
6.2	Bottom of hole at 6.2 m.					



NOTES

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC·LAVALIN

Client: **Teck Coal Limited**

Greenhills Well 9

Location: **Regional Groundwater Monitoring**

Borehole No. : RG_BH_ER6A

GH_POTW09

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1287.641
Borehole Dia. (m)	0.10	Top of Casing Elev. (m)	1288.292
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549333.683	Easting: 648579.607

Project Number:	631283
Borehole Logged By:	GG
Date Drilled:	2020 09 14
Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

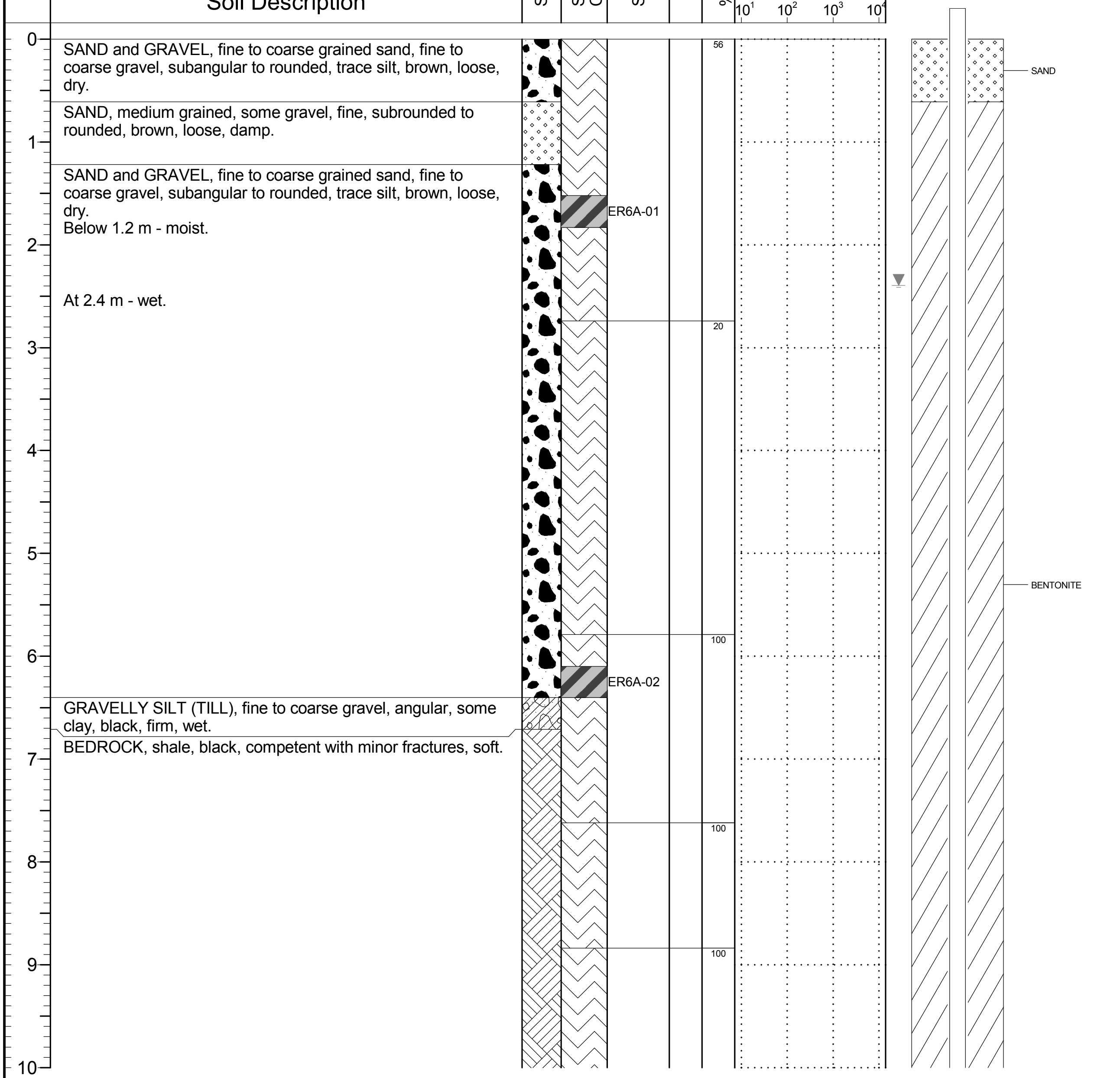
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER6A

Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm)



SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, brown, loose, dry.

SAND, medium grained, some gravel, fine, subrounded to rounded, brown, loose, damp.

SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, brown, loose, dry.
Below 1.2 m - moist.

At 2.4 m - wet.

GRAVELLY SILT (TILL), fine to coarse gravel, angular, some clay, black, firm, wet.

BEDROCK, shale, black, competent with minor fractures, soft.

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client: **Teck Coal Limited** Greenhills Well 10 Location: **Regional Groundwater Monitoring**	**Borehole No. : RG_BH_ER6A**
		PAGE 2 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283 GH_POTW10
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1287.641	Borehole Logged By:	GG
Borehole Dia. (m)	0.10	Top of Casing Elev. (m)	1288.292	Date Drilled:	2020 09 14
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549333.683	Easting: 648579.607	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

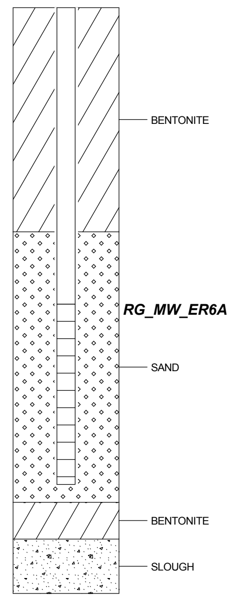
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER6A

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4
10	BEDROCK, shale, black, competent with minor fractures, soft. *(continued)*						
11.9						90	
14.9	Bottom of hole at 14.9 m.						



NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_ER6B**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 1

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 09 30	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1287.620	Borehole Logged By:	GG
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1288.332	Date Drilled:	2020 09 15
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5549333.222	Easting: 648580.061	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

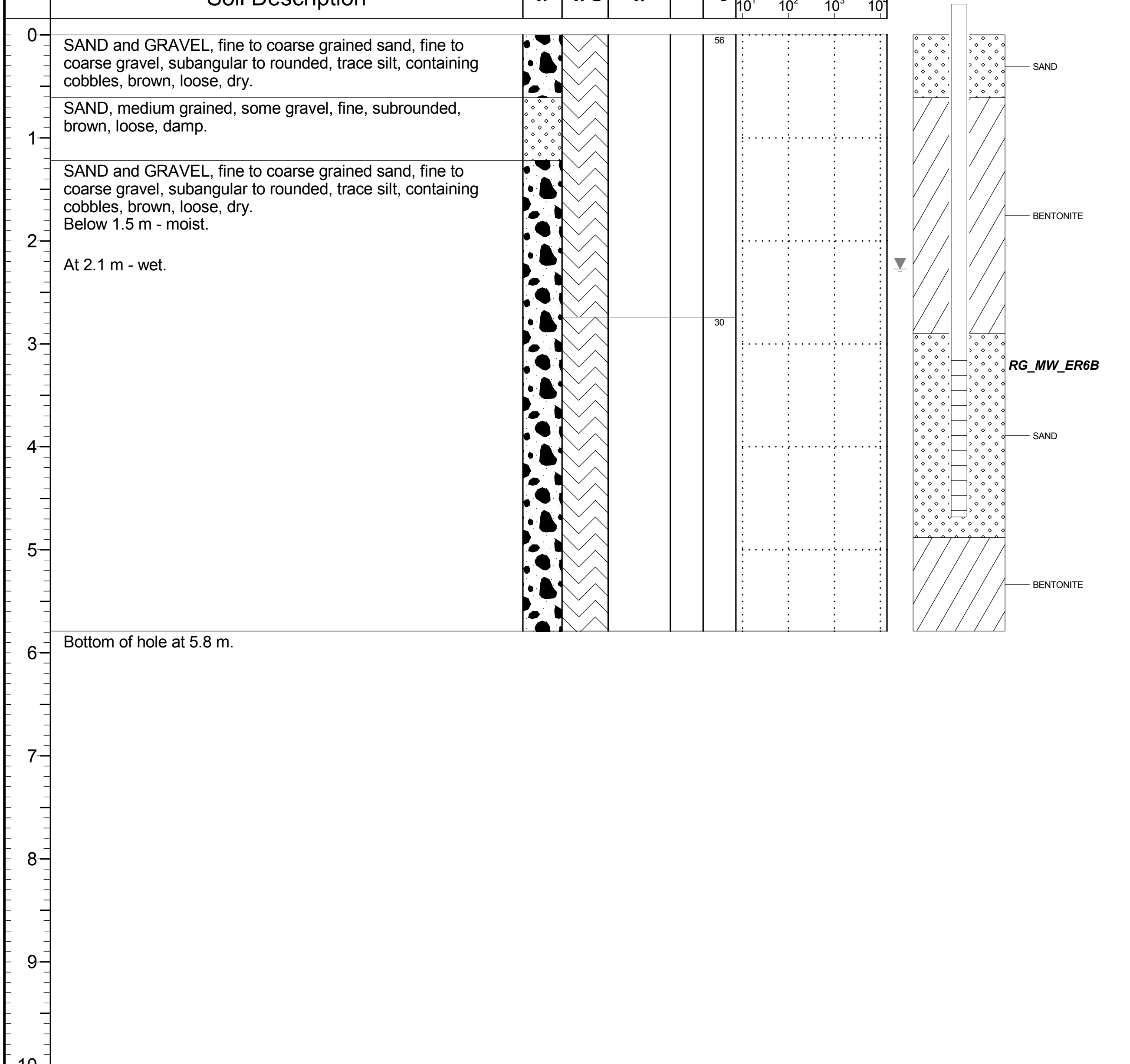
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_ER6B

Depth in Metres	Soil Description	% Recovery
0–0.6	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, dry.	56
0.6–1.2	SAND, medium grained, some gravel, fine, subrounded, brown, loose, damp.	
1.2–5.8	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, subangular to rounded, trace silt, containing cobbles, brown, loose, dry. Below 1.5 m - moist. At 2.1 m - wet.	30 (from 2.75)
5.8	Bottom of hole at 5.8 m.	



NOTES

QA/QC: LLH 2020 10 20 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client: **Teck Coal Limited**	**Borehole No. : RG_BH_LC3A**
	Greenhills Well 15 Location **Regional Groundwater Monitoring**	PAGE 1 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283 GH_POTW15
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.325	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.040	Date Drilled:	2020 06 05
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552736.051	Easting: 648181.849	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LC3A

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Depth in Metres	Soil Description	Sample Number	% Recovery
0	SILTY CLAY (TOPSOIL), some gravel, fine to coarse, rounded to subrounded, medium plastic, damp, organics.		60
0.6	SILTY CLAY, trace gravel, fine, rounded to subrounded, grey-brown, mottled, high plastic, damp.	06-05-2020-01	
1.8	SILTY GRAVEL, some clay, grey-brown, mottled, low plastic, damp.	06-05-2020-02	
2.7	At 2. 7 m - increased gravel, fine, rounded to subrounded.	06-05-2020-03	70
3.9	SANDY CLAY, fine grained sand, some silt, trace gravel, fine, rounded to subrounded, high plastic, damp.	06-05-2020-04	
4.8	SILTY GRAVEL, fine to coarse gravel, rounded to subrounded, some sand, coarse grained, some clay, wet.	06-05-2020-05	60
		06-06-2020-12	
		06-05-2020-06	
7.0	CLAYEY GRAVEL, fine to coarse gravel, subrounded to subangular, containing cobbles, trace silt, trace sand, coarse grained, mottling, dense.	06-05-2020-07	
		06-05-2020-08	60
9.5	At 9.5 m - becomes loose, damp.	06-05-2020-09	
10			

BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LC3A**
	Location **Regional Groundwater Monitoring**	

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.325	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.040	Date Drilled:	2020 06 05
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552736.051	Easting: 648181.849	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): ○ Reading within indicated scale; ● Reading outside indicated scale; scale 10^1, 10^2, 10^3, 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LC3A

Depth in Metres	Soil Description	Sample Number	% Recovery
10	CLAYEY GRAVEL, fine to coarse gravel, subrounded to subangular, containing cobbles, trace silt, trace sand, coarse grained, mottling, dense. *(continued)*	06-05-2020-10	
11	At 11.3 m - dry.	06-05-2020-11	
12			60
	GRAVEL, fine to coarse, rounded, containing cobbles, some sand, fine to coarse grained, trace silt, wet.	06-05-2020-12	
13		06-05-2020-13	
14	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, rounded to subrounded, containing cobbles, trace silt, trace clay, wet.	06-05-2020-14 06-05-2020-15	
15			120
	CLAY and GRAVEL, fine to coarse gravel, rounded to subrounded, brown, very dense.	06-05-2020-16	
16	At 15.8 m - grey.	06-05-2020-17	
	At 16.5 m - increased coarse gravel.		
17		06-05-2020-18	
	SAND and GRAVEL, coarse grained sand, rounded to subrounded, fine gravel, trace coarse gravel, rounded to subrounded, some silt, brown, loose, wet.		
18		06-06-2020-02	110
19		06-06-2020-01	
	SAND, fine to medium grained, some silt, trace gravel, fine, subrounded, trace clay, brown, loose, wet.		
20		06-06-2020-03	

Well construction: BENTONITE; RG_MW_LC3A; SAND; BENTONITE

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LC3A**
	Location **Regional Groundwater Monitoring**	PAGE 3 OF 3

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.325	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.040	Date Drilled:	2020 06 05
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552736.051	Easting: 648181.849	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): ○ Reading within indicated scale; ● Reading outside indicated scale; scale 10^1, 10^2, 10^3, 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LC3A

Depth in Metres	Soil Description	Sample Number	% Recovery
20	SAND, fine to medium grained, some silt, trace gravel, fine, subrounded, trace clay, brown, loose, wet. *(continued)* At 20.1 m - increased fine grained sand, increased silt.	06-06-2020-04	130
21	At 21.0 m - increased fine gravel, loose.		
21.6	SILTY SAND, fine grained sand, some clay, trace gravel, fine, rounded to subrounded, dense, wet.	06-06-2020-05 06-06-2020-06 06-06-2020-07	100
23.5	At 23.5 m - increased fine gravel.	06-06-2020-08	
24.7	SILTY SAND, fine grained sand, some clay, trace gravel, fine, dense, damp.	06-06-2020-09	
25.6	SILTY CLAY, some sand, medium grained, dense, high plasticity, damp.	06-06-2020-10	
26.5	SILTY SAND, fine to medium grained sand, some clay, high plasticity, moist.		100
27.4	Bottom of hole at 27.4 m.		

Well: BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LC3B**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.281	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.075	Date Drilled:	2020 06 06
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552736.874	Easting: 648181.728	Log Typed By:	VL

Drilling Legend
- Sample Interval
- Vibrasonic

Water/NAPL Levels
- Water Level 1
- Water Level 2
- NAPL
- NAPL

- Reading within indicated scale
- Reading outside indicated scale

- Solid PVC
- Slotted PVC

Well Name 1: RG_MW_LC3B

Depth in Metres	Soil Description	% Recovery
0	SILTY CLAY, trace gravel, fine, trace sand, fine grained, grey, high plasticity, damp.	40
~1.8	SILTY GRAVEL, fine to coarse gravel, rounded to subrounded, some sand, coarse grained, some clay, mottled, high plasticity, moist.	
~2.7		40
~3.0	GRAVEL, fine to coarse, rounded to subrounded, containing cobbles, some clay, loose, moist.	
~4.3	CLAYEY SAND, fine grained sand, some gravel, fine to coarse, rounded to subrounded, dense, damp.	
~5.8		0
~8.8		20
9	CLAYEY GRAVEL, fine to coarse gravel, rounded to subrounded, containing cobbles, some silt, loose, wet.	

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Depth scale: 0 1 2 3 4 5 6 7 8 9 10

BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LC3B**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.281	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.075	Date Drilled:	2020 06 06
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552736.874	Easting: 648181.728	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

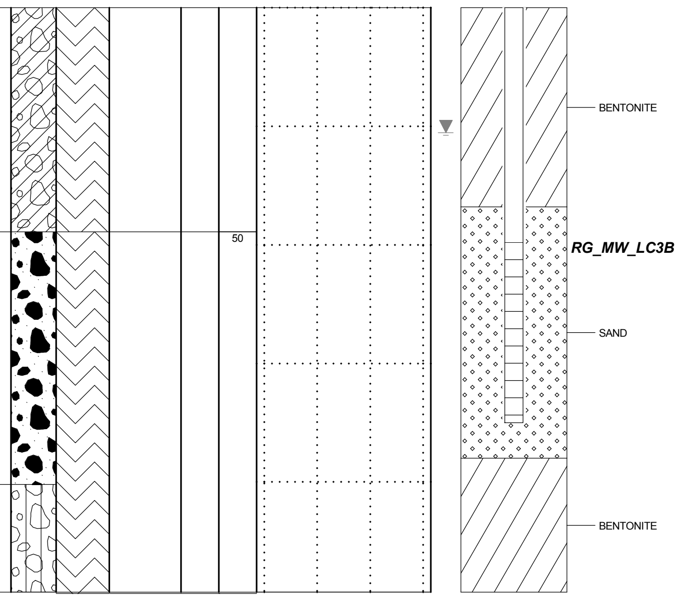
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

○ Reading within indicated scale; ● Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LC3B

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4
10	CLAYEY GRAVEL, fine to coarse gravel, rounded to subrounded, containing cobbles, some silt, loose, wet. *(continued)*						
12	GRAVEL, fine to coarse, rounded, containing cobbles (0.1 m), some sand, coarse grained, subrounded, trace silt, loose, wet.					50	
14	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, rounded, some silt, trace clay, dense, moist.						
15	Bottom of hole at 14.9 m.						



NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC • LAVALIN

SNC • LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LC3C**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 1

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	n/a	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1318.255	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1319.112	Date Drilled:	2020 06 06
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552738.075	Easting: 648181.424	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LC3C

Depth in Metres	Soil Description	% Recovery
0	SILTY CLAY, some gravel, fine to coarse, subrounded, grey-brown, loose, dry.	50
2.1	SILTY GRAVEL, fine to coarse gravel, subrounded, containing cobbles, some clay, loose, dry.	
3.0	At 3.0 m - damp	
4.0	SANDY CLAY, fine grained sand, some silt, trace gravel, fine, dense, high plastic, damp.	
5.5	SILTY GRAVEL, fine to coarse gravel, rounded to subrounded, some sand, coarse grained, trace clay, trace silt, loose, wet.	
6.7	CLAYEY GRAVEL, fine to coarse gravel, subrounded to subangular, containing cobbles, trace silt, dense, high plastic, damp.	
9.1	Bottom of hole at 9.1 m.	

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Well construction: BENTONITE; RG_MW_LC3C; SAND; BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LCWC1**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1310.453	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1311.258	Date Drilled:	2020 06 07
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552399.910	Easting: 648356.101	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

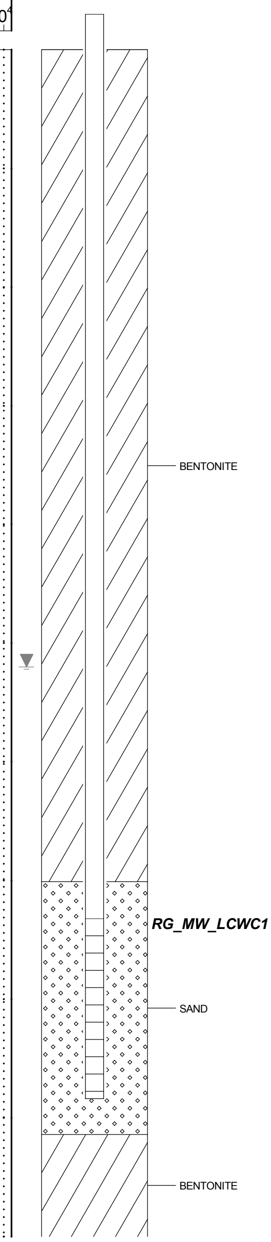
Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LCWC1

Depth in Metres	Soil Description	Sample Number	% Recovery
0	TOPSOIL.		50
	SILTY CLAY, trace gravel, fine, trace sand, coarse grained, medium dense, high plastic, damp.	06-07-2020-01	
		06-07-2020-03	65
	SANDY CLAY, fine to coarse grained sand, some silt, loose, moist.	06-07-2020-02	
		06-07-2020-04	
	SAND and GRAVEL, coarse grained sand, subrounded, fine to coarse gravel, subrounded, containing cobbles.		25
		06-07-2020-05	
		06-07-2020-10	
	SILTY SAND, coarse grained sand, trace gravel, fine, some clay, moist.	06-07-2020-06	120
	SILTY SAND, fine grained sand, some clay, trace gravel, fine, loose to medium dense, damp.	06-07-2020-07	
10			

Soil Vapour (ppm): 10^1 10^2 10^3 10^4



NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_LCWC1**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 2

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1310.453	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1311.258	Date Drilled:	2020 06 07
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552399.910	Easting: 648356.101	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): ○ Reading within indicated scale; ● Reading outside indicated scale; 10^1 10^2 10^3 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_LCWC1

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm)	Well
10	SILTY SAND, fine grained sand, some clay, trace gravel, fine, loose to medium dense, damp. *(continued)* At 10.5 m - increased density.							
11				06-07-2020-08				BENTONITE
				06-07-2020-09				
12	Bottom of hole at 11.9 m.							
13								
14								
15								
16								
17								
18								
19								
20								

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_WC2A**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 4

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1304.009	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1304.868	Date Drilled:	2020 06 08
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552079.286	Easting: 648195.937	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Soil Vapour (ppm): Reading within indicated scale; Reading outside indicated scale. Scale: 10^1, 10^2, 10^3, 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_WC2A

Depth in Metres	Soil Description	Sample Number	% Recovery
0	SILTY SAND (TOPSOIL), black, damp, organics.		60
1	SILTY SAND, fine to medium grained sand, trace clay, grey-brown, loose, low plasticity, damp.	06-07-2020-01	
2.5	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, rounded, trace silt, loose, wet.	06-07-2020-02	50
		06-07-2020-03	
		06-07-2020-05	
		06-07-2020-04	
6.1	SAND and GRAVEL, coarse grained sand, fine gravel, rounded, trace silt, clean, wet.	06-07-2020-06	90
		06-07-2020-07	
7.6	CLAY, trace silt, grey, medium dense, high plasticity, moist.	06-07-2020-08	
8.8	GRAVEL and COBBLES, rounded to subrounded, well graded, clean, wet.		25

BENTONITE

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC-LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_WC2A**
	Location **Regional Groundwater Monitoring**	PAGE 2 OF 4

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1304.009	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1304.868	Date Drilled:	2020 06 08
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552079.286	Easting: 648195.937	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Soil Vapour (ppm): 10^1 10^2 10^3 10^4

Solid PVC; Slotted PVC

Well Name 1: RG_MW_WC2A

Depth in Metres	Soil Description	Sample Number	% Recovery
10	GRAVEL and COBBLES, rounded to subrounded, well graded, clean, wet. *(continued)*	06-07-2020-09	
12		06-07-2020-10	90
12.8	SAND, fine to medium grained, some silt, trace gravel, fine, loose, wet. At 13.1 m - increased sand, fine grained, increased silt, black inclusions. At 13.4 m - medium to coarse grained sand.	06-07-2020-11	
14		06-07-2020-12	
		06-07-2020-13	
15	SILTY SAND, fine to medium grained sand, some clay, brown-grey, loose, medium plasticity, moist.	06-08-2020-01	100
		06-08-2020-02	
17	At 17.1 m - decreased clay, increased medium grained sand.	06-08-2020-04	
		06-08-2020-03	
18	SAND, fine to coarse grained, some silt, well graded, brown, loose, low plasticity, wet.	06-08-2020-05	30

BENTONITE

NOTES
Bolded sample denotes sample analyzed.

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_WC2A**
	Location **Regional Groundwater Monitoring**	PAGE 3 OF 4

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1304.009
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1304.868
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552079.286	Easting: 648195.937
Project Number:	631283		
Borehole Logged By:	AH		
Date Drilled:	2020 06 08		
Log Typed By:	VL		

Drilling Legend: Sample Interval; Vibrasonic

Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

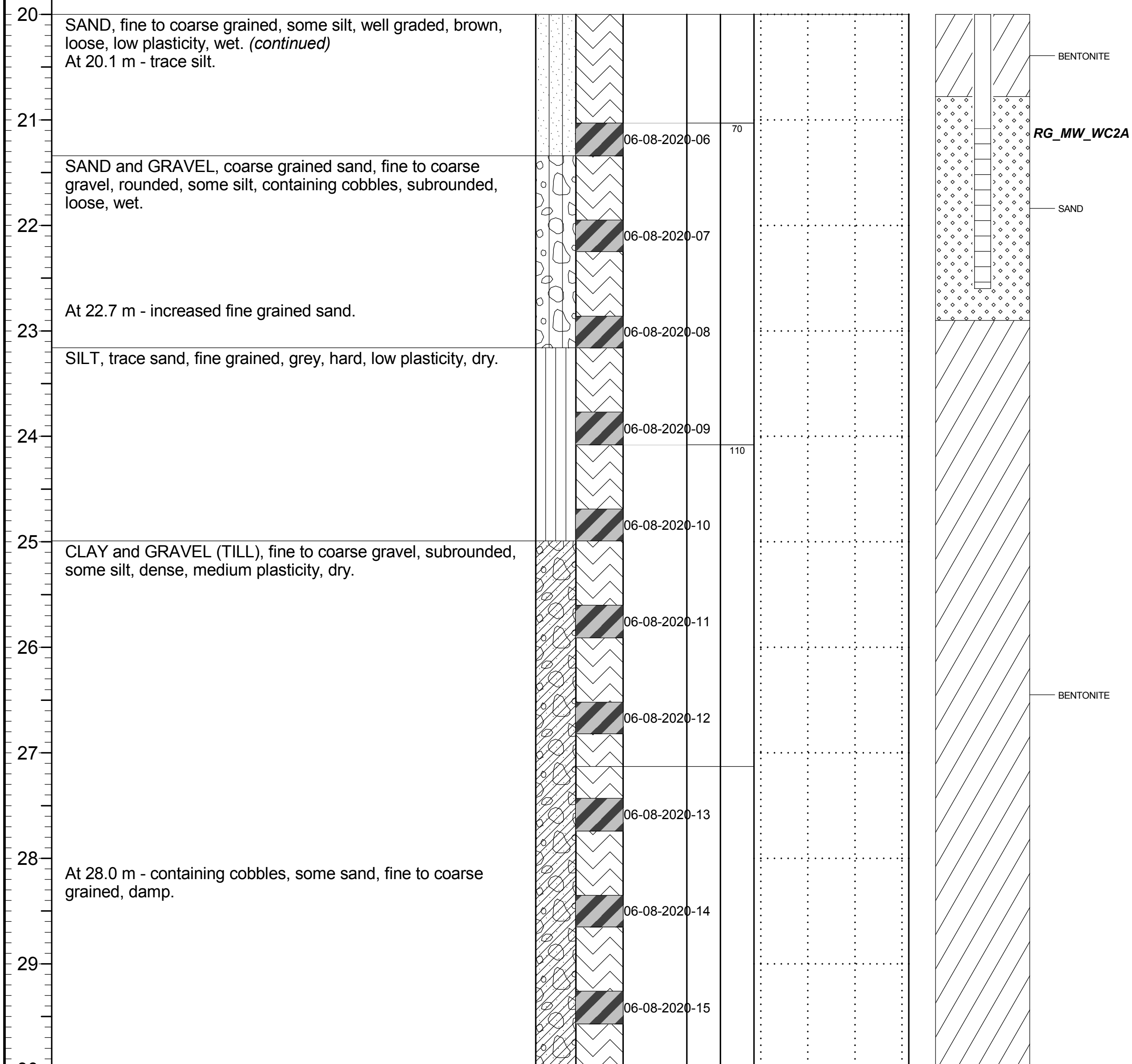
Well Name 1: RG_MW_WC2A

Depth in Metres | Soil Description | Stratigraphy Plot | Sample Interval Core Run | Sample Number | Blow Count | % Recovery | Soil Vapour (ppm) 10^1 10^2 10^3 10^4

Depth (m)	Soil Description
20	SAND, fine to coarse grained, some silt, well graded, brown, loose, low plasticity, wet. *(continued)* At 20.1 m - trace silt.
21.3	SAND and GRAVEL, coarse grained sand, fine to coarse gravel, rounded, some silt, containing cobbles, subrounded, loose, wet. At 22.7 m - increased fine grained sand.
23.2	SILT, trace sand, fine grained, grey, hard, low plasticity, dry.
25	CLAY and GRAVEL (TILL), fine to coarse gravel, subrounded, some silt, dense, medium plasticity, dry. At 28.0 m - containing cobbles, some sand, fine to coarse grained, damp.

Sample Numbers: 06-08-2020-06, 06-08-2020-07, 06-08-2020-08, 06-08-2020-09, 06-08-2020-10, 06-08-2020-11, 06-08-2020-12, 06-08-2020-13, 06-08-2020-14, 06-08-2020-15

% Recovery: 70; 110



NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC·LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_WC2A**
	Location **Regional Groundwater Monitoring**	PAGE 4 OF 4

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1304.009	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1304.868	Date Drilled:	2020 06 08
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552079.286	Easting: 648195.937	Log Typed By:	VL

Drilling Legend
Sample Interval
Vibrasonic

Water/NAPL Levels
Water Level 1
Water Level 2
NAPL
NAPL

Reading within indicated scale
Reading outside indicated scale

Solid PVC
Slotted PVC

Well Name 1: RG_MW_WC2A

Depth in Metres	Soil Description	Stratigraphy Plot	Sample Interval Core Run	Sample Number	Blow Count	% Recovery	Soil Vapour (ppm) 10^1 10^2 10^3 10^4	Well
30	CLAY and GRAVEL (TILL), fine to coarse gravel, subrounded, some silt, dense, medium plasticity, dry. *(continued)*							BENTONITE
	Bottom of hole at 30.5 m.							

Depth scale: 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

FINAL

SNC•LAVALIN	Client **Teck Coal Limited**	**Borehole No. : RG_BH_WC2B**
	Location **Regional Groundwater Monitoring**	PAGE 1 OF 1

Drilling Contractor	Mud Bay Drilling Co. Ltd.	Date Monitored	2020 06 16	Project Number:	631283
Drilling Method	Vibratory Sonic	Ground Surface Elev. (m)	1304.038	Borehole Logged By:	AH
Borehole Dia. (m)	0.15	Top of Casing Elev. (m)	1304.795	Date Drilled:	2020 06 08
Pipe/Slotted Pipe Dia. (m)	0.05/0.05	Northing: 5552078.858	Easting: 648197.172	Log Typed By:	VL

Drilling Legend: Sample Interval; Vibrasonic

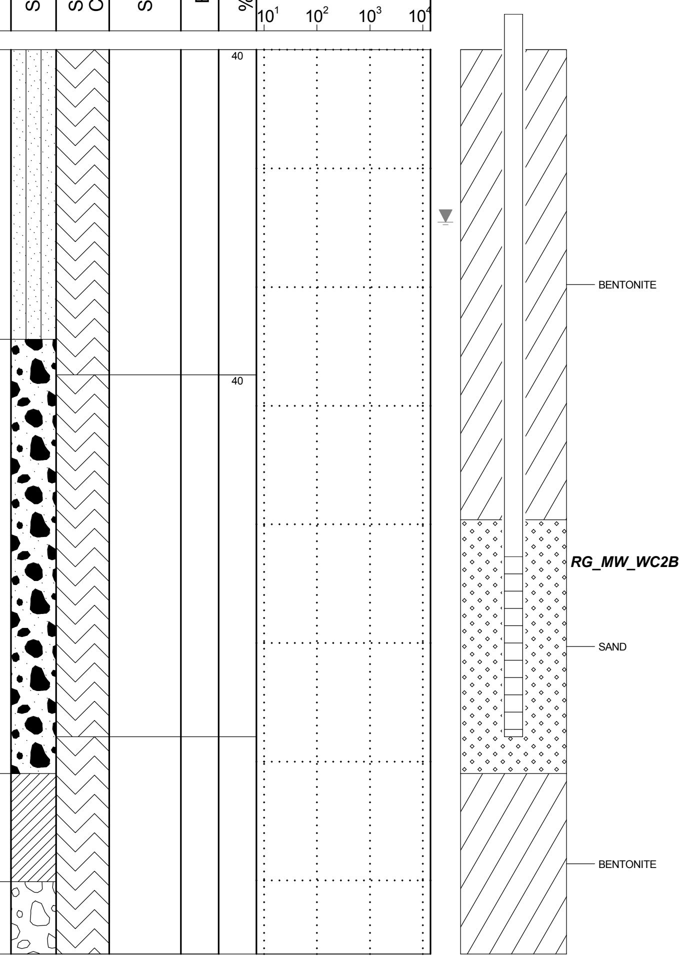
Water/NAPL Levels: Water Level 1; Water Level 2; NAPL; NAPL

Reading within indicated scale; Reading outside indicated scale

Solid PVC; Slotted PVC

Well Name 1: RG_MW_WC2B

Depth in Metres	Soil Description
0	SILTY SAND, fine to medium grained sand, trace clay, poorly graded, grey-brown, loose, low plasticity.
1.8	At 1.8 m - mottling.
2.45	SAND and GRAVEL, fine to coarse grained sand, fine to coarse gravel, rounded, containing cobbles, trace silt, loose, wet.
6.1	CLAY, trace silt, grey, medium dense, high plastic, moist.
7.0	SAND and GRAVEL, coarse grained sand, fine gravel, rounded, trace silt, wet.
7.6	Bottom of hole at 7.6 m.



NOTES
Bolded sample denotes sample analyzed.

QA/QC: LLH 2020 09 02 Print Date:2020-12-02

Ministry of
Environment and
Climate Change Strategy

BRITISH COLUMBIA

Declaration of Competency

The Ministry of Environment and Climate Change Strategy relies on the work, advice, recommendations and in some cases decision making of qualified professionals[1], under government's professional reliance regime. With this comes an assumption that professionals who undertake work in relation to ministry legislation, regulations and codes of practice have the knowledge, experience and objectivity necessary to fulfill this role.

1. Name of Qualified Professional Stefan Humphries

   Title Senior Hydrogeologist

2. Are you a registered member of a professional association in B.C.? ☐ Yes ☐ No

   Name of Association: EGBC Registration # 31909

3. Brief description of professional services:

   Senior review of Groundwater report

This declaration of competency is collected under section 26(c) of the *Freedom of Information and Protection of Privacy Act* for the purposes of increasing government transparency and ensuring professional ethics and accountability. By signing and submitting this statement you consent to its publication and its disclosure outside of Canada. This consent is valid from the date submitted and cannot be revoked. If you have any questions about the collection, use or disclosure of your personal information please contact the Ministry of Environment and Climate Change Strategy Headquarters Office at 1-800-663-7867.

Declaration

I am a qualified professional with the knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the specific work described above.

Signature:

X

Print Name: Stefan Humphries

Date signed: May 28/21

Witnessed by:

X

Print Name: Randy Williams

[1] *Qualified Professional, in relation to a duty or function under ministry legislation, means an individual who*

a) *is registered in British Columbia with a professional association, is acting under that organization's code of ethics, and is subject to disciplinary action by that association, and*

b) *through suitable education, experience, accreditation and knowledge, may reasonably be relied on to provide advice within his or her area of expertise, which area of expertise is applicable to the duty or function.*

BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

Conflict of Interest Disclosure Statement

A qualified professional [1] providing services to either the Ministry of Environment and Climate Change Strategy ("ministry"), or to a regulated person for the purpose of obtaining an authorization from the ministry, or pursuant to a requirement imposed under the *Environmental Management Act,* the *Integrated Pest Management Act* or the *Park Act* has a real or perceived conflict of interest when the qualified professional, or their relatives, close associates or personal friends have a financial or other interest in the outcome of the work being performed.

A real or perceived conflict of interest occurs when a qualified professional has

a) an ownership interest in the regulated person's business;

b) an opportunity to influence a decision that leads to financial benefits from the regulated person or their business other than a standard fee for service (e.g. bonuses, stock options, other profit sharing arrangements);

c) a personal or professional interest in a specific outcome;

d) the promise of a long term or ongoing business relationship with the regulated person, that is contingent upon a specific outcome of work;

e) a spouse or other family member who will benefit from a specific outcome; or

f) any other interest that could be perceived as a threat to the independence or objectivity of the qualified professional in performing a duty or function.

Qualified professionals who work under ministry legislation must take care in the conduct of their work that potential conflicts of interest within their control are avoided or mitigated. Precise rules in conflict of interest are not possible and professionals must rely on guidance of their professional associations, their common sense, conscience and sense of personal integrity.

Declaration

I Stefan Humphries (Print First and Last Name), as a member of EGBC (Print Name of Professional Association) declare

Select one of the following:

☑ Absence from conflict of interest

Other than the standard fee I will receive for my professional services, I have no financial or other interest in the outcome of this Sparwood Area Groundwater Report (application/project/work/etc.). I further declare that should a conflict of interest arise in the future during the course of this work, I will fully disclose the circumstances in writing and without delay to Douglas Hill (Insert Ministry Contact Name), erring on the side of caution.

BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

☐ Real or perceived conflict of interest

Description and nature of conflict(s):

____

____

____

I will maintain my objectivity, conducting my work in accordance with my Code of Ethics and standards of practice.

In addition, I will take the following steps to mitigate the real or perceived conflict(s) I have disclosed, to ensure the public interest remains paramount:

____

____

____

Further, I acknowledge that this disclosure may be interpreted as a threat to my independence and will be considered by the statutory decision maker accordingly.

This conflict of interest disclosure statement is collected under section 26(c) of the *Freedom of Information and Protection of Privacy Act* for the purposes of increasing government transparency and ensuring professional ethics and accountability. By signing and submitting this statement you consent to its publication and its disclosure outside of Canada. This consent is valid from the date submitted and cannot be revoked. If you have any questions about the collection, use or disclosure of your personal information please contact the Ministry of Environment and Climate Change Strategy Headquarters Office at 1-800-663-7867.

Signature:	Witnessed by:
X [signature]	X [signature]
Print name: Stefan Humphries	Print name: Randy Williams
Date: May 31/21	

[1]Qualified Professional, in relation to a duty or function under ministry legislation, means an individual who

a) *is registered in British Columbia with a professional association, is acting under that organization's code of ethics, and is subject to disciplinary action by that association, and*

b) *through suitable education, experience, accreditation and knowledge, may reasonably be relied on to provide advice within his or her area of expertise, which area of expertise is applicable to the duty or function.*

APPENDIX F
BENTHIC INVERTEBRATE COMMUNITY COMPOSITION

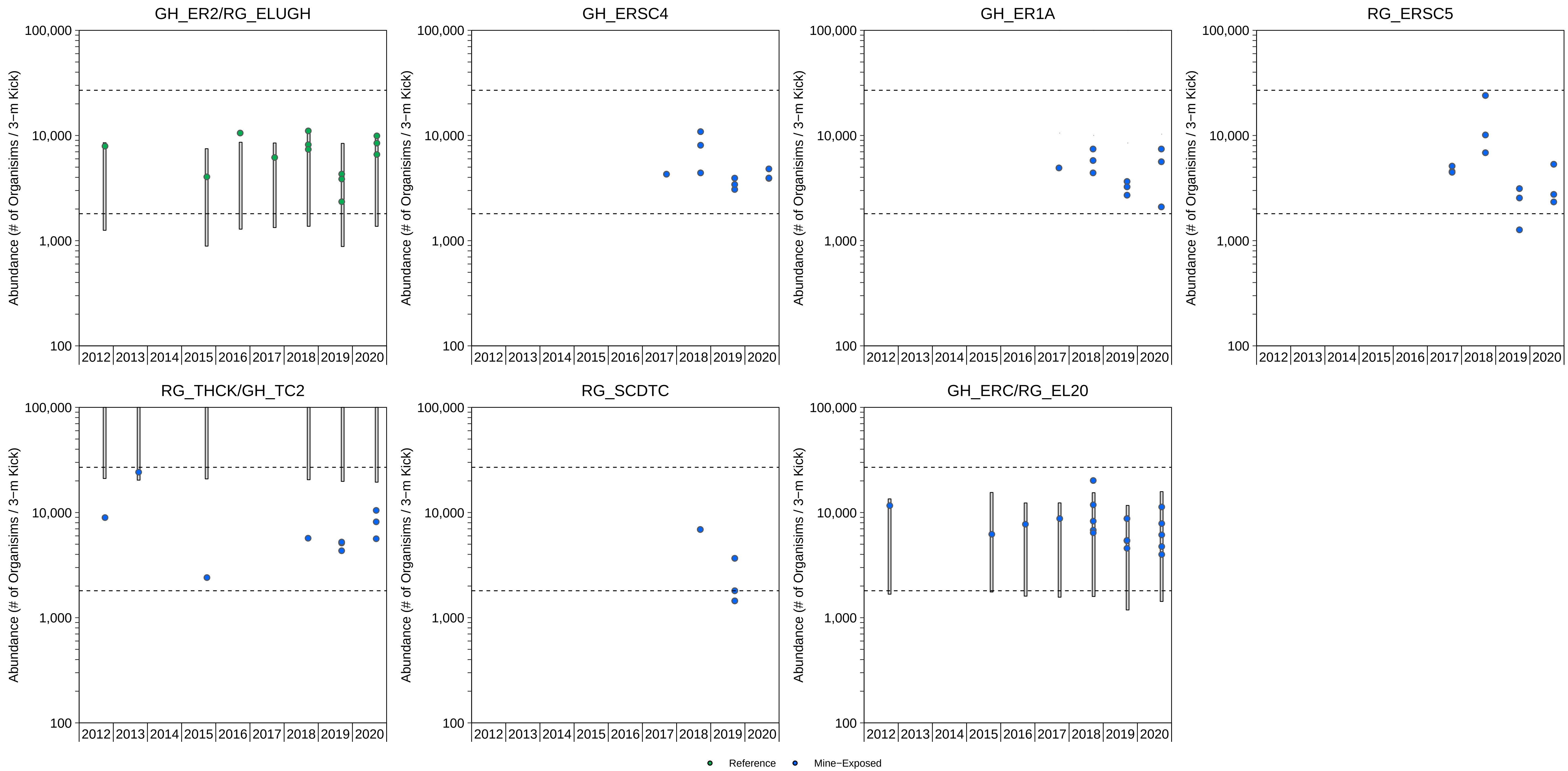


Figure 1: ent ic In erte rate ommunit A undance G A September 2 12 to 2 2

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

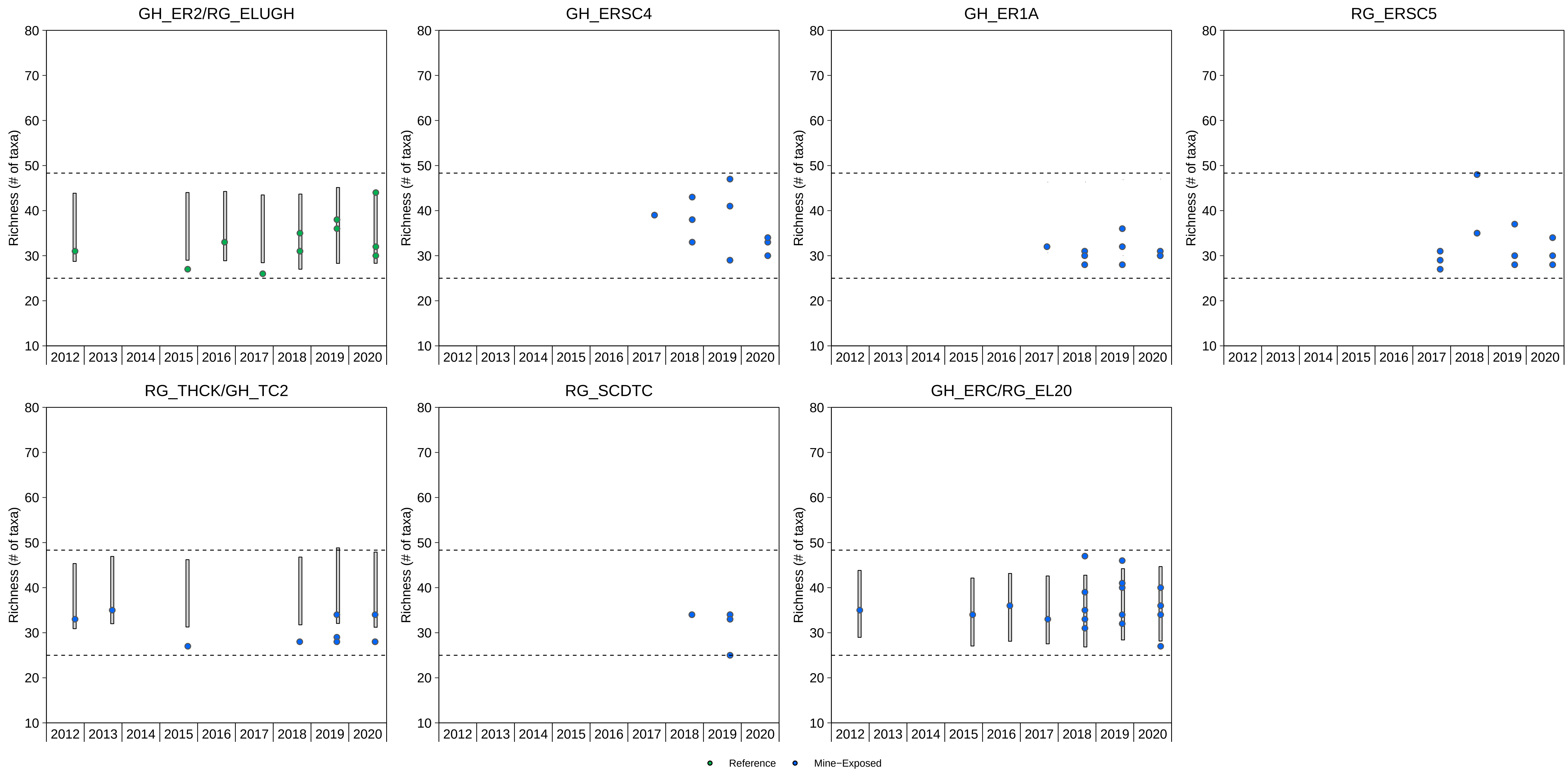


Figure .2: ent ic In erte rate ommunit ic ness G A September 2 12 to 2 2

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

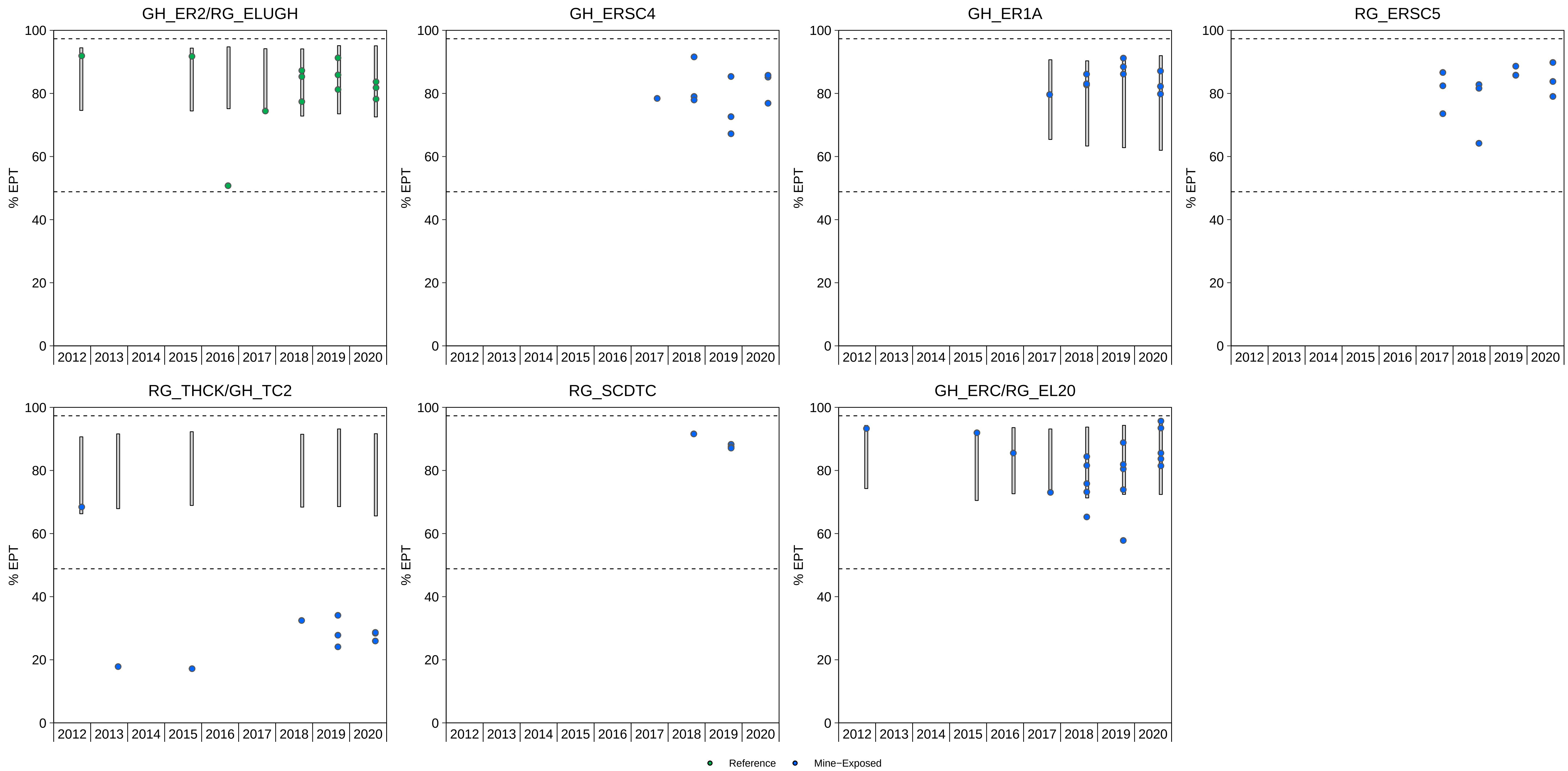


Figure .3: ent ic In erte rate ommunit G A September 2 12 to 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines. EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

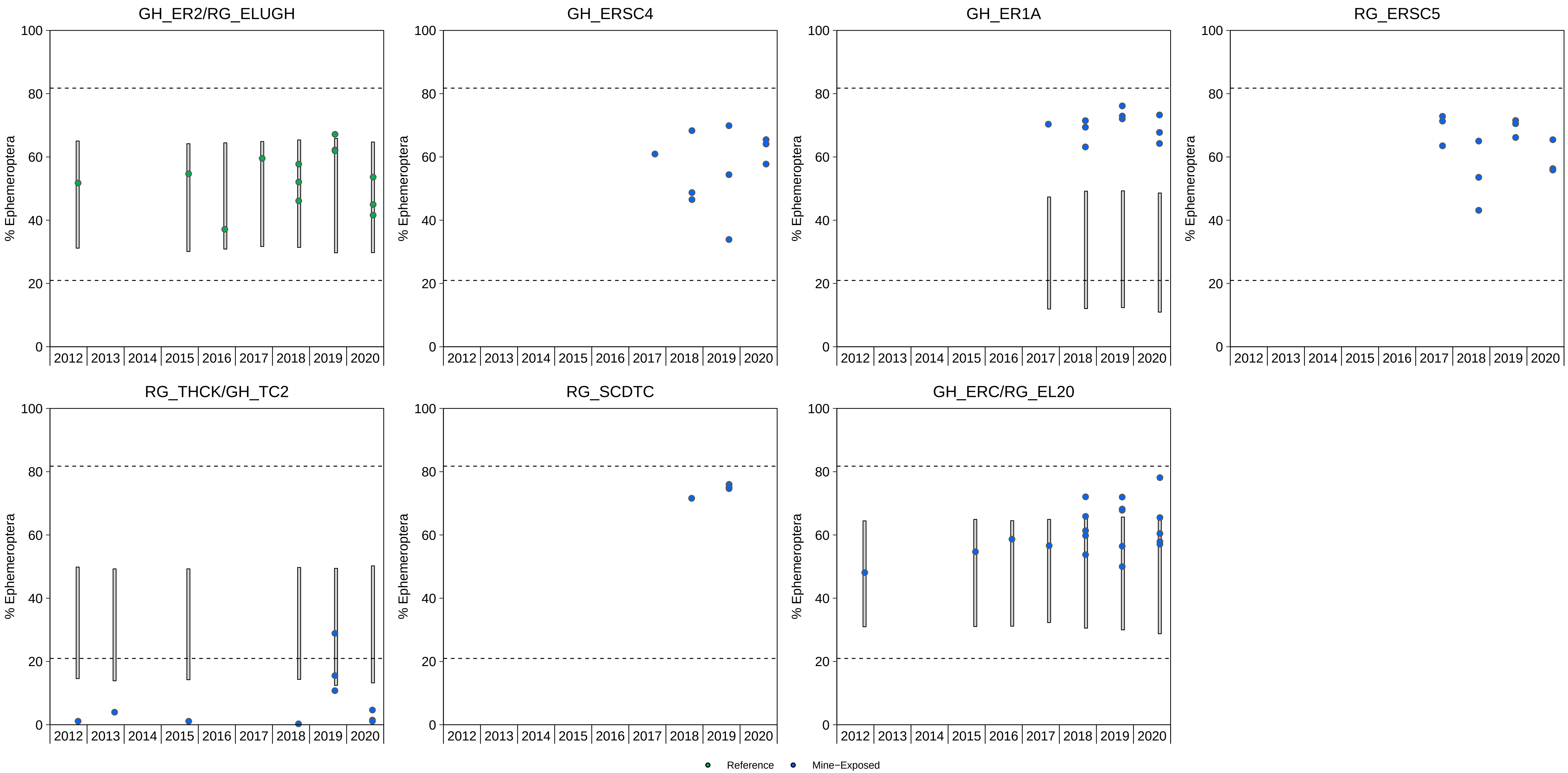


Figure .4: ent ic In erte rate ommunit emero tera G A September 2 12 to 2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

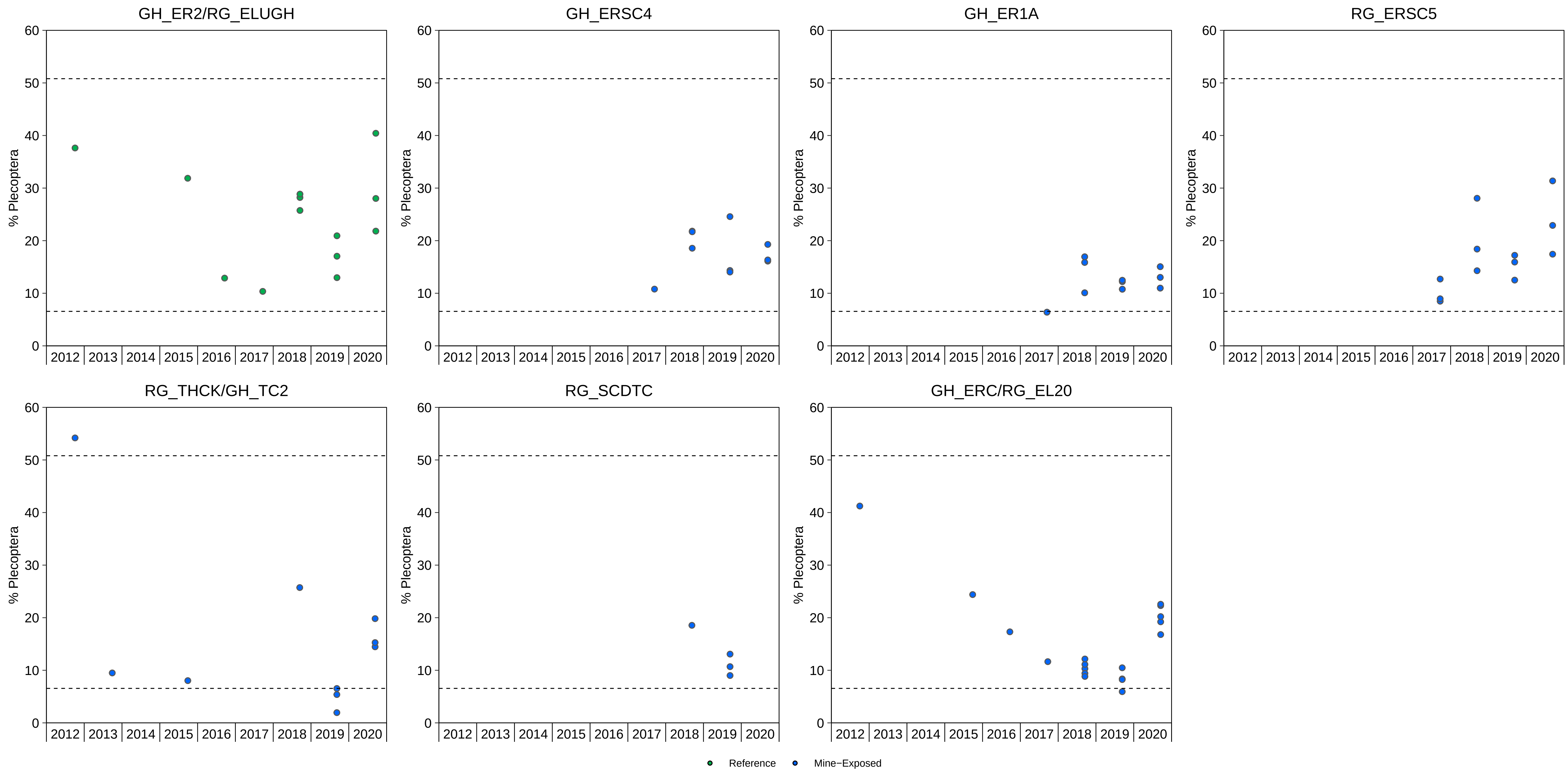


Figure 5: ent ic In erte rate ommunit eco tera G A September 2 12 to 2 2

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

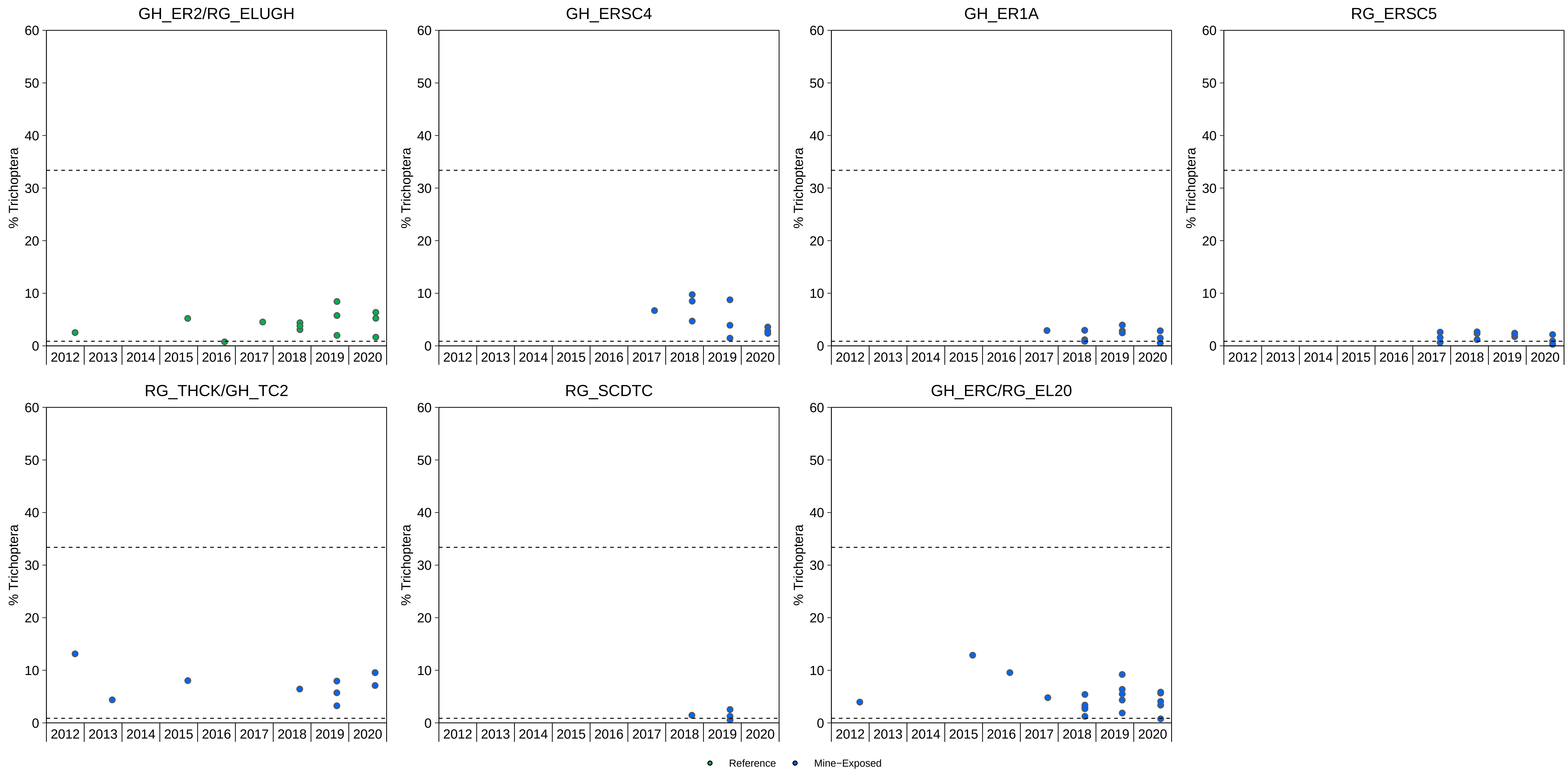


Figure 6: ent ic In erte rate ommunit ric o tera G A September 2 12 to 2 2

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

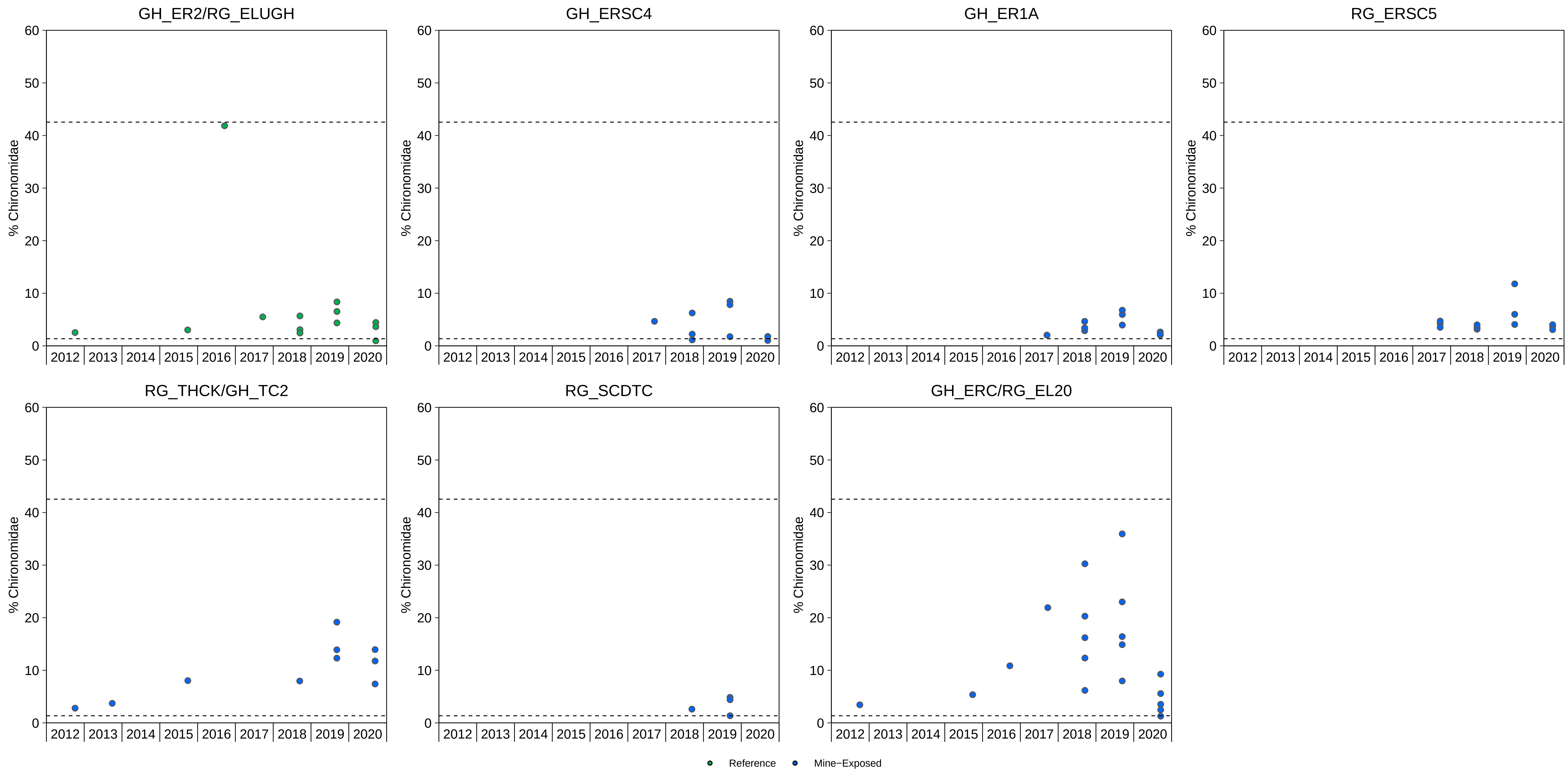


Figure : **ent ic In erte rate ommunit ironomidae G A September 2 12 to 2 2**

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

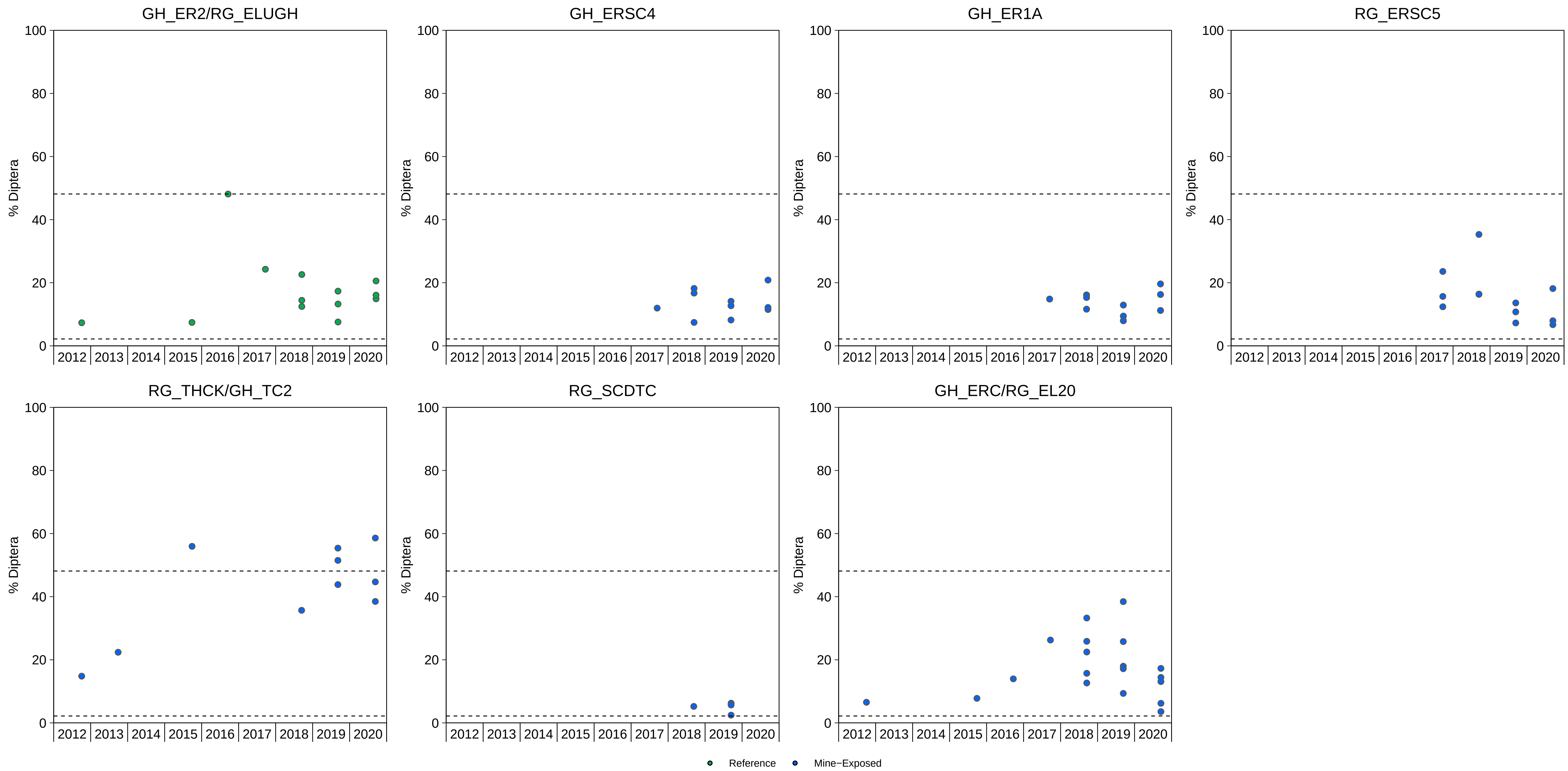


Figure .8: ent ic In erte rate ommunit i tera G A September 2 12 to2020

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines.

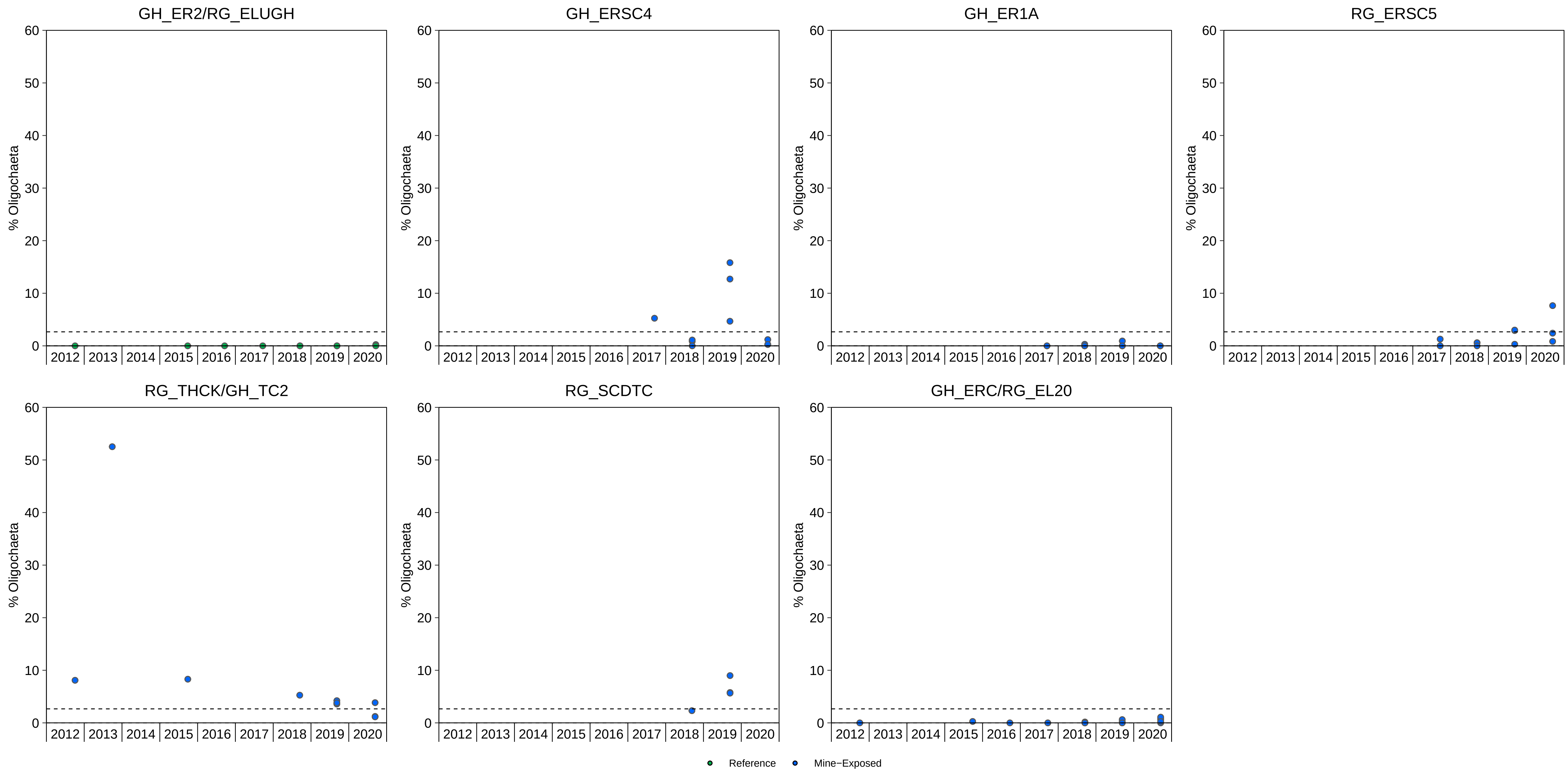


Figure 9: ent ic In erte rate ommunit i oc aeta G A September 2 12 to 2 2

Notes: Site specific normal ranges using regression models shown with grey shading (when available). Regional normal ranges using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program (RAEMP; Minnow 2020) shown as dashed horizontal lines, with the minimum value = 0%.

Table F.1: Regional Normal Ranges for Benthic Invertebrate Endpoints, GHO LAEMP, September 2020

Endpoint	Regional Normal Range	
	Minimum	Maximum
Abundance (# org/ 3-min kick)	1,805	26,927
LPL Richness (# of taxa)	25.0	48.3
EPT (%)	48.8	97.3
Ephemeroptera (%)	21.0	81.8
Trichoptera (%)	0.87	33.4
Plecoptera (%)	6.56	50.9
Chironomidae (%)	1.35	42.6
Diptera (%)	2.21	48.1
Oligochaeta (%)	0	2.66

Note: EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Regional normal ranges were calculated using percentiles of reference areas from 2012 to 2019 from the Regional Aquatic Environmental Monitoring Program

Table F.2: Site-Specific Ranges for Benthic Invertebrate Endpoints, GHO LAEMP, September 2020

Area	Location	Area Code	Abundance (# org/3-min kick)		LPL Richness (# of taxa)		EPT (%)		Ephemeroptera (%)	
			Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Reference	Main stem	RG_ELUGH / GH_ER2	1,351	10,180	28.7	43.7	72	95	30	65
Mine-exposed	Tributary	RG_THCK / GH_TC2	17,983	1,118,071	31.3	48.1	66	91	13	50
	Main stem	RG_EL20 / GH_ERC	1,431	15,969	28.1	44.6	72	95	29	64

Note: EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Site specific normal ranges were calculated using multiple regression models (RAEMP 2020). Site-specific normal ranges could not be calculated for side channel stations.

Table F.3: Benthic Invertebrate Community Data, GHO LAEMP, 2020

Area Type	Reference			Mine-exposed																
Station	GH_ER2 / RG_ELUGH			GH_ERSC4			GH_ER1A			RG_ERSC5			RG_THCK			GH_ERC / EL20				
Sample ID	RG_ELUGH_BIC-1	RG_ELUGH_BIC-2	RG_ELUGH_BIC-3	GH_ERSC4_BIC-1	GH_ERSC4_BIC-2	GH_ERSC4_BIC-3	GH_ER1A_BIC-1	GH_ER1A_BIC-2	GH_ER1A_BIC-3	RG_ERSC5_BIC-1	RG_ERSC5_BIC-2	RG_ERSC5_BIC-3	RG_THCK_BIC-1	RG_THCK_BIC-2	RG_THCK_BIC-3	RG_EL20_BIC-1	RG_EL20_BIC-2	RG_EL20_BIC-3	RG_EL20_BIC-4	RG_EL20_BIC-5
Sample Date	17-Sep-20	17-Sep-20	17-Sep-20	12-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20	15-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	20	0	0	20	14	11	5	0	20	0	0	0	0	0	0	0	0	0	0	100
Ameletus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Baetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acentrella	0	25	0	0	0	0	0	53	0	0	0	0	0	0	0	32	42	0	88	0
Acentrella	27	74	211	113	242	111	209	474	398	239	233	113	33	68	0	284	104	185	236	496
Baetis fuscatus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis rhodani group	326	542	329	210	504	356	346	921	682	447	1,038	203	33	272	120	945	354	475	559	1,204
Diphetor hageni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ephemerellidae	280	240	480	140	273	67	85	433	140	114	171	62	0	0	0	260	356	330	183	280
Caudatella	0	0	0	0	14	0	0	0	0	7	14	0	0	0	0	0	0	0	0	0
Drunella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella grandis group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Drunella coloradensis	0	0	0	0	0	0	0	17	0	0	14	8	0	0	0	20	0	0	0	0
Drunella doddsii	180	460	360	10	129	167	55	33	320	36	171	123	0	20	0	560	300	400	383	140
Ephemerella	0	0	0	0	0	0	0	17	0	7	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	1,620	1,880	1,560	1,360	1,335	833	560	1,400	2,500	457	843	754	0	20	0	2,880	789	770	1,000	1,760
Cinygmula	20	20	80	0	0	0	0	133	100	29	43	15	0	0	0	0	33	40	0	120
Epeorus	100	380	200	0	29	67	35	67	140	71	129	123	0	0	0	360	122	50	117	80
Rhithrogena	920	840	320	660	531	667	240	167	460	100	343	77	17	0	0	2,060	311	500	933	1,940
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	265	60	40	60	29	22	0	33	0	29	100	77	0	0	0	500	111	180	167	520
| Family: Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweltsa	0	64	0	15	14	22	10	0	20	0	14	8	0	0	0	87	11	10	44	80
| Family: Leuctridae	61	40	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
Paraleuctra	122	60	0	0	14	0	0	0	0	0	0	0	0	0	0	20	0	0	17	0
| Family: Nemouridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka	0	0	0	0	0	0	0	0	0	0	0	0	18	64	23	0	0	0	0	0
Zapada	25	120	80	10	120	39	11	50	20	30	125	35	0	107	0	96	22	60	17	40
Zapada oregonensis group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zapada cinctipes	76	120	80	10	137	117	29	67	100	98	375	35	1,049	1,008	1,577	24	11	20	0	20
Zapada columbiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Perlidae	0	0	60	20	0	11	20	0	0	0	0	0	0	0	0	0	0	10	17	0
Hesperoperla	61	220	220	30	57	89	10	33	360	0	14	8	0	0	0	40	33	30	150	0
| Family: Perlodidae	0	40	80	30	14	0	5	0	20	43	43	31	0	0	0	260	111	60	50	80
Isoperla	0	0	0	0	0	0	5	0	0	0	14	0	0	0	0	100	11	0	0	0
Kogotus	20	0	20	0	0	0	0	17	20	0	14	8	0	0	0	0	11	10	17	0
Megarcys	41	40	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
Skwala	0	0	0	0	0	11	0	0	0	0	14	0	0	0	0	0	0	0	0	0
| Family: Pteronarcyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Taeniopterygidae	2,524	1,920	860	320	543	311	140	533	580	207	957	431	50	0	0	1,120	444	580	883	540
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Apataniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Pedomoecus sierra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Brachycentridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus	40	140	160	75	100	62	25	33	40	0	65	0	0	0	0	180	100	60	150	0
Brachycentrus americanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema	0	0	0	0	0	0	0	0	0	7	0	0	0	0	21	0	0	0	0	0
| Family: Glossosomatidae	0	0	20	11	0	12	10	33	0	7	0	0	0	0	0	20	22	0	0	40
Glossosoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydropsychidae	0	160	60	0	0	12	0	0	0	0	0	0	0	21	0	320	67	40	50	0
Arctopsyche	80	120	100	0	0	12	10	0	0	0	16	0	0	0	0	80	22	40	17	0

Table F.3: Benthic Invertebrate Community Data, GHO LAEMP, 2020

Area Type	Reference			Mine-exposed																
Station	**GH_ER2 / RG_ELUGH**			**GH_ERSC4**			**GH_ER1A**			**RG_ERSC5**			**RG_THCK**			**GH_ERC / EL20**				
Sample ID	RG_ELUGH_BIC-1	RG_ELUGH_BIC-2	RG_ELUGH_BIC-3	GH_ERSC4_BIC-1	GH_ERSC4_BIC-2	GH_ERSC4_BIC-3	GH_ER1A_BIC-1	GH_ER1A_BIC-2	GH_ER1A_BIC-3	RG_ERSC5_BIC-1	RG_ERSC5_BIC-2	RG_ERSC5_BIC-3	RG_THCK_BIC-1	RG_THCK_BIC-2	RG_THCK_BIC-3	RG_EL20_BIC-1	RG_EL20_BIC-2	RG_EL20_BIC-3	RG_EL20_BIC-4	RG_EL20_BIC-5
Sample Date	17-Sep-20	17-Sep-20	17-Sep-20	12-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20	15-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20
Hydropsyche	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parapsyche	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Hydroptilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroptila	0	0	0	0	0	0	0	0	0	0	0	0	0	41	42	0	0	0	0	0
Family: Lepidostomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma	0	0	0	0	0	0	0	0	0	0	0	0	0	41	146	20	0	0	0	0
Family: Limnephilidae	0	0	0	0	14	12	0	0	0	0	0	0	17	0	0	0	0	0	0	0
Family: Rhyacophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila	0	40	60	0	0	0	10	0	0	7	0	8	183	472	229	20	22	20	17	0
Rhyacophila betteni group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	0
Rhyacophila brunnea/vemna group	20	60	20	32	0	0	5	17	0	0	0	0	183	144	229	0	0	0	17	0
Rhyacophila atrata complex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila narvae	0	0	0	22	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Curculionidae	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Dytiscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subfamily: Hydroporinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Elmidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterlimnius	20	0	0	60	43	44	5	17	20	7	14	0	1,200	1,572	1,114	0	0	0	0	0
Narpus	0	0	0	0	0	0	0	0	0	0	0	0	0	28	26	0	0	0	0	0
Family: Hydrophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bezzia/ Palpomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Mallochohelea	40	140	60	10	0	22	0	0	20	0	0	0	17	40	0	0	22	0	0	20
Family: Chironomidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Constempellina sp. C	20	22	0	0	0	0	0	0	0	0	0	12	0	0	0	0	14	0	22	0
Corynocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	22	0	0	0	13	0	0	0	0	0	12	30	165	74	23	0	12	0	0
Stempellinella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	22	0	0	0	0	0	0	0	0	21	0	0	0	0	0	28	12	0	0
Pagastia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potthastia gaedii group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0
Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brillia	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	12	0	0
Corynoneura	0	0	0	0	0	0	0	0	0	0	0	0	276	328	1,109	0	0	0	0	0
Eukiefferiella	60	198	213	40	0	0	28	17	60	57	64	24	55	187	139	187	120	220	108	0
Hydrobaenus	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	12	0	0
Limnophyes	0	22	0	0	0	13	0	0	0	10	0	0	0	0	0	0	0	12	22	20
Orthocladius complex	0	88	0	0	0	0	0	0	0	0	0	0	0	0	0	23	30	93	65	80
Orthocladius lignicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parorthocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus	0	22	0	0	34	13	0	0	0	0	0	36	0	0	0	23	15	12	0	0
Thienemanniella	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia	0	44	27	0	34	27	28	100	80	19	107	0	55	234	139	23	15	12	0	0
Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Dixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa	0	0	0	0	0	0	0	0	0	0	0	0	117	0	80	0	0	0	0	0

Table F.3: Benthic Invertebrate Community Data, GHO LAEMP, 2020

Area Type	Reference			Mine-exposed																			
Station	GH_ER2 / RG_ELUGH			GH_ERSC4			GH_ER1A			RG_ERSC5			RG_THCK			GH_ERC / EL20				
Sample ID	RG_ELUGH_BIC-1	RG_ELUGH_BIC-2	RG_ELUGH_BIC-3	GH_ERSC4_BIC-1	GH_ERSC4_BIC-2	GH_ERSC4_BIC-3	GH_ER1A_BIC-1	GH_ER1A_BIC-2	GH_ER1A_BIC-3	RG_ERSC5_BIC-1	RG_ERSC5_BIC-2	RG_ERSC5_BIC-3	RG_THCK_BIC-1	RG_THCK_BIC-2	RG_THCK_BIC-3	RG_EL20_BIC-1	RG_EL20_BIC-2	RG_EL20_BIC-3	RG_EL20_BIC-4	RG_EL20_BIC-5
Sample Date	17-Sep-20	17-Sep-20	17-Sep-20	12-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20	15-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20
| Family: Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelifera/ Metachela	0	0	20	0	14	0	0	0	20	0	0	0	17	0	0	0	44	10	33	0
Clinocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neoplasta	0	40	0	30	43	11	10	33	60	14	0	0	117	60	540	0	44	20	117	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	1,080	1,280	740	300	386	667	140	733	1,080	50	114	400	83	220	60	260	189	330	500	140
| Family: Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosimulium/Helodon	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium	0	96	0	50	43	44	25	0	60	14	14	15	1,600	1,740	3,780	160	0	10	0	20
| Family: Tanyderidae	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	10	17	0
| Family: Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	10	14	0	5	17	40	14	14	0	150	100	200	0	0	0	0	0
Hexatoma	40	0	0	10	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Rhabdomastix	0	20	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
| Order: Thysanoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Feltriidae	0	0	0	0	0	0	0	0	0	0	0	0	33	20	20	0	0	0	0	0
Feltria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atractides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	80	40	60	40	0	33	25	50	20	7	29	54	0	0	0	0	22	30	33	20
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	0	0	20	0	0	0	0	0	0	0	0	0	0	20	20	0	0	0	0	0
| Family: Torrenticolidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus	0	40	60	20	0	0	0	0	0	0	0	0	0	0	0	20	0	0	17	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	0	0	17	0	0	14	0	17	0	0	20	0	0	0	20
| Family: Hydrozetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	0	0	0	0	0	0	0	0	0	0	17	860	180	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	17	40	140	0	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Basommatophora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Planorbidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Tubificinae with hair chaetae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals:	**8,169**	**9,784**	**6,600**	**3,719**	**4,743**	**3,911**	**2,095**	**5,514**	**7,420**	**2,129**	**5,167**	**2,670**	**5,383**	**7,912**	**10,089**	**11,067**	**3,967**	**4,697**	**6,044**	**7,800**

Table F.4: Summary of Benthic Invertebrate Endpoints Collected by 3-Minute Kick and Sweep Sampling, GHO LAEMP, September 2020

Area	Area Code	Station	Abundance (# org/ 3-min kick)	LPL Richness (# of taxa)	EPT		Ephemeroptera		Trichoptera		Plecoptera		Chironomidae		Diptera		Oligochaeta	
					Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)	Abundance (# org/ 3-min kick)	Relative Abundance (%)
Reference	RG_ELUGH / GH_ER2	RG_ELUGH_1	8,460	32	7,080	84	3,520	42	140	1.7	3,420	40	80	0.9	1,260	15	20	0.24
		RG_ELUGH_2	9,920	44	7,760	78	4,460	45	520	5.2	2,780	28	440	4.4	2,040	21	20	0.20
		RG_ELUGH_3	6,600	30	5,400	82	3,540	54	420	6.4	1,440	22	240	3.6	1,060	16	0	0
Mine-exposed	GH_ERSC4	GH_ERSC4_1	3,910	33	3,330	85	2,560	65	140	3.6	630	16	40	1.0	450	12	10	0.26
		GH_ERSC4_2	4,814	30	4,129	86	3,086	64	114	2.4	929	19	86	1.8	586	12	57	1.19
		GH_ERSC4_3	3,944	34	3,033	77	2,278	58	111	2.8	644	16	67	1.7	822	21	11	0.28
	GH_ERA1	GH_ER1A_1	2,095	30	1,825	87	1,535	73	60	2.9	230	11	55	2.6	235	11	0	0
		GH_ER1A_2	5,633	31	4,633	82	3,817	68	83	1.5	733	13	117	2.1	917	16	0	0
		GH_ER1A_3	7,440	30	5,940	80	4,780	64	40	0.5	1,120	15	160	2.2	1,460	20	0	0
	RG_ERSC5	RG_ERSC5_1	2,336	30	1,957	84	1,529	65	21	0.9	407	17	86	3.7	186	8.0	179	7.65
		RG_ERSC5_2	5,329	34	4,786	90	3,000	56	114	2.1	1,671	31	214	4.0	357	6.7	129	2.41
		RG_ERSC5_3	2,754	28	2,177	79	1,538	56	8	0.3	631	23	85	3.1	500	18	23	0.84
	RG_THCK / GH_TC2	RG_THCK_1	5,633	28	1,600	28	83	1.5	400	7.1	1,117	20	417	7.4	2,517	45	217	3.85
		RG_THCK_2	8,160	34	2,340	29	380	4.7	780	9.6	1,180	14	960	12	3,140	38	100	1.23
		RG_THCK_3	10,480	28	2,720	26	120	1.1	1,000	9.5	1,600	15	1,460	14	6,140	59	120	1.15
	RG_EL20 / GH_ERC	RG_EL20_1	11,300	36	10,560	93	7,400	65	640	5.7	2,520	22	280	2.5	700	6.2	0	0
		RG_EL20_2	3,989	36	3,411	86	2,411	60	233	5.8	767	19	222	5.6	522	13	33	0.84
		RG_EL20_3	4,750	40	3,870	81	2,750	58	160	3.4	960	20	440	9.3	820	17	30	0.63
		RG_EL20_4	6,133	34	5,133	84	3,500	57	250	4.1	1,383	23	217	3.5	883	14	67	1.09
		RG_EL20_5	7,860	27	7,520	96	6,140	78	60	0.8	1,320	17	100	1.3	280	3.6	20	0.25

Note: EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

APPENDIX F

BENTHIC INVERTEBRATE COMMUNITY

LAB REPORT

Methods and QC Report 2020

Project ID: GHO LAEMP (20-22)

Client: Minnow Environmental

Prepared by:
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Table of Contents

Sample Reception

On September 29, 2020, Cordillera Consulting received 20 benthic samples from Minnow Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.
See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Sample	CC#	Date	Size	# of Jars
RG_ELUGH_BIC-1_2020-09-17	CC210922	9/17/2020	400µM	1
RG_ELUGH_BIC-2_2020-09-17	CC210923	9/17/2020	400µM	1
RG_ELUGH_BIC-3_2020-09-17	CC210924	9/17/2020	400µM	1
GH_ERSC4_BIC-1_2020-09-12	CC210925	9/12/2020	400µM	1
GH_ERSC4_BIC-2_2020-09-12	CC210926	9/12/2020	400µM	1
GH_ERSC4_BIC-3_2020-09-12	CC210927	9/12/2020	400µM	1
GH_ER1A_BIC-1_2020-09-11	CC210928	9/11/2020	400µM	1
GH_ER1A_BIC-2_2020-09-11	CC210929	9/11/2020	400µM	1
GH_ER1A_BIC-3_2020-09-12	CC210930	9/12/2020	400µM	1
RG_ERSC5_BIC-1_2020-09-11	CC210931	9/11/2020	400µM	1
RG_ERSC5_BIC-2_2020-09-11	CC210932	9/11/2020	400µM	1
RG_ERSC5_BIC-3_2020-09-11	CC210933	9/11/2020	400µM	1
RG_THCK_BIC-1_2020-09-10	CC210934	9/10/2020	400µM	1
RG_THCK_BIC-2_2020-09-10	CC210935	9/10/2020	400µM	1
RG_THCK_BIC-3_2020-09-10	CC210936	9/10/2020	400µM	2
RG_EL20_BIC-1_2020-09-15	CC210937	9/15/2020	400µM	1
RG_EL20_BIC-2_2020-09-16	CC210938	9/16/2020	400µM	1
RG_EL20_BIC-3_2020-09-16	CC210939	9/16/2020	400µM	1
RG_EL20_BIC-4_2020-09-16	CC210940	9/16/2020	400µM	1
RG_EL20_BIC-5_2020-09-16	CC210941	9/16/2020	400µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Sample	Date	CC#	400 micron fraction	
			% Sampled	# Invertebrates
RG_ELUGH_BIC-1_2020-09-17	17-Sep-20	CC210922	5%	423
RG_ELUGH_BIC-2_2020-09-17	17-Sep-20	CC210923	5%	496
RG_ELUGH_BIC-3_2020-09-17	17-Sep-20	CC210924	5%	330
GH_ERSC4_BIC-1_2020-09-12	12-Sep-20	CC210925	10%	391
GH_ERSC4_BIC-2_2020-09-12	12-Sep-20	CC210926	7%	337
GH_ERSC4_BIC-3_2020-09-12	12-Sep-20	CC210927	9%	355
GH_ER1A_BIC-1_2020-09-11	11-Sep-20	CC210928	20%	419
GH_ER1A_BIC-2_2020-09-11	11-Sep-20	CC210929	6%	338
GH_ER1A_BIC-3_2020-09-12	12-Sep-20	CC210930	5%	372
RG_ERSC5_BIC-1_2020-09-11	11-Sep-20	CC210931	14%	327
RG_ERSC5_BIC-2_2020-09-11	11-Sep-20	CC210932	7%	373
RG_ERSC5_BIC-3_2020-09-11	11-Sep-20	CC210933	13%	358

RG_THCK_BIC-1_2020-09-10	10-Sep-20	CC210934	6%	408
RG_THCK_BIC-2_2020-09-10	10-Sep-20	CC210935	5%	408
RG_THCK_BIC-3_2020-09-10	10-Sep-20	CC210936	5%	525
RG_EL20_BIC-1_2020-09-15	15-Sep-20	CC210937	5%	565
RG_EL20_BIC-2_2020-09-16	16-Sep-20	CC210938	9%	359
RG_EL20_BIC-3_2020-09-16	16-Sep-20	CC210939	10%	475
RG_EL20_BIC-4_2020-09-16	16-Sep-20	CC210940	6%	368
RG_EL20_BIC-5_2020-09-16	16-Sep-20	CC210941	5%	393

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculated sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \%OM$$

Table 3 Summary of sorting efficiency

		Total from Sample	Percent Efficiency
Site - QC, Sample - QC1, CC# - CC210930, Percent sampled = 5%, Sieve size = 400			
No Invertebrates Found	0		
Total:	**0**	**372**	**100%**
Site - QC, Sample - QC2, CC# - CC210933, Percent sampled = 13%, Sieve size = 400			
Diptera	1		
Chironomidae	1		
Trichoptera	1		

	Total:	**3**	**358**	**99%**

Site - QC, Sample - QC3, CC# - CC210940, Percent sampled = 6%, Sieve size = 400				
Chironomidae		1		
Baetidae		1		
Ephemerellidae		2		
Heptageniidae		5		
Trichoptera		1		
	Total:	**10**	**368**	**97%**

Sorting Quality Control - Sub-Sampling QC

Certain Provincial and Mining projects require additional sorting checks in the form of sub-sampling QC, (Environmental Effects Monitoring (EEM) protocol). This ensured that any fraction of the total sample that was examined was actually an accurate representation of the number of total organisms. Organisms from the additional sub-samples were not identified; rather total organism count only was compared.

Sub-Sampling efficiency was measured on 10% of the number of sub-sampled samples in the project. Ex. In a project where 50 of 100 total samples were processed through subsampling using a Marchant box, then 10% of 50; or 5 samples were used for sub sampling efficiency.

Sub-Sampling efficiency was performed by fractioning the entire sample into sub-sample percentages. On each sub-sampled portion, a total organism count was recorded and compared to the rest of the sub-samples. In order to pass, all fractions were required to be within 20% of total organism count.

Example: If 300 organisms are found in 10% of the sample, the sorter will continue to sample in 10% fractions until the entire sample is separated. They will then count the total number of organisms in each of the 10 fractions of 10% and compare the organism count.

When divergence is >20% the sorting manager examines for the source of the problem and takes steps to correct it. With the Marchant box, the problem typically rested with how the box is flipped back to the upright position. For this reason, subsampling was performed by experienced employees only. Another common source of error would be the type of debris in the sample. Samples with algae or heavy with periphyton have a higher incident of failure due to clumping than clear samples.

Table 4 Summary of Sub Sample efficiency

Station ID		Organisms in Subsample																				Sorter		Actual Total	Precision		Accuracy	
CC#	Sample Name	1	2	3	4	5	6	7	8	9	10											By	Time		Percent Range		Min	Max
210928	GH_ERIA_BIC-1	418	452	402	479	446																TV	260	2197	1.33	16.08	1.50	9.01
210939	RG_EC20_BIC-3	468	393	409	411	433	456	427	413	448	422											AR	600	4280	0.48	16.03	0.23	9.35

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual[1], SAFIT[2] , and PNAMP[3] were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomists

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae
Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

Taxonomic QC

Taxonomic QC was performed in house by someone other than the original taxonomist.

- Quality control protocol involved complete, blind re-identification and re-enumeration of at least 10% of samples by a second SFS-certified taxonomist.
- Samples for taxonomic quality control were randomly selected and quality control procedures were conducted as the project progresses through the laboratories.

- The second (QC) taxonomist will calculate and record four types of errors:
    1. Misidentification error
    2. Enumeration error
    3. Questionable taxonomic resolution error
    4. Insufficient taxonomic resolution error

The QC coordinator then calculates the following estimates of taxonomic precision.

1. The percent total identification error rate is calculated as:

$$\frac{Sum\ of\ incorrect\ identifications}{total\ organisms\ counted\ in\ audit} * (100)$$

The average total identification error rate of audited samples did not exceed 5%. All samples that exceed a 5% error rate were re-evaluated to determine whether repeated errors or patterns in error contributed.

2. The percent difference in enumeration (PDE) to quantify the consistency of specimen counts.

$$PDE = \frac{|n_1 - n_2|}{n_1 + n_2} x100$$

3. The percent taxonomic disagreement (PTD) to quantify the shared precision between two sets of identifications.

$$PTD = \left(1 - \left[\frac{a}{N}\right]\right) x100$$

4. Bray Curtis dissimilarity Index to quantify the differences in identifications.

$$BC_{ij} = 1 - \frac{2C_{ij}}{S_j + S_i}$$

Error Summary

All samples report errors within the acceptable limits for CABIN Laboratory methods (less than 5% error).

Table 5 Summary of taxonomic error following QC

Site	Taxa Identified	% Error	PDE	PTD	Bray - Curtis Dissimilarity index
Site - 2020, Sample - RG_ELUGH_BIC-2_2020-09-17, CC# - CC210923, Percent sampled = 5%, Sieve size = 400	495	0.00	0.10090817	0.80645161	0.00706357
Site - 2020, Sample - RG_THCK_BIC-1_2020-09-10, CC# - CC210934, Percent sampled = 6%, Sieve size = 400	338	0.00	0.14771049	0.5899705	0.00443131

There will always be disagreements between taxonomists regarding the degree of taxonomic resolution in immature specimens and when laboratories make use of different keys for certain groups (Mollusks is an especially disputed group). It is always possible that some taxa found by the original taxonomist were overlooked in QC.

All of the Taxonomic QC samples that were observed passed testing according to the CABIN misidentification protocols. See the tables below for results from taxonomic QC audit.

Error Rationale

Site - 2020, Sample - RG_ELUGH_BIC-2_2020-09-17, CC# - CC210923, Percent sampled = 5%, Sieve size = 400	Laboratory Count	QC Audit Count	Agreement	Misidentification	Questionable Taxonomic Resolution	Enumeration	Insufficient Taxonomic Resolution	Comments
Acentrella	1	1						
Arctopsyche	6	6						
Baetidae	6	7	No			X		
Baetis	3	2	No			X		
Baetis rhodani group	22	22						
Brachycentrus	2	2						

Brachycentrus americanus	5	5						
Capniidae	3	3						
Chironomidae	2	2						
Chloroperlidae	3	3						
Cinygmula	1	1						
Constempellina sp. C	1	1						
Diamesa	1	1						
Drunella doddsii	23	23						
Enchytraeus	1	1						
Epeorus	19	19						
Ephemerellidae	12	12						
Eukiefferiella	9	8	No			X		
Haploperla	2	2						
Heptageniidae	94	93	No			X		
Hesperoperla	11	11						
Hydropsychidae	8	8						
Lebertia	2	2						
Leuctridae	2	2						
Limnophyes	1	1						
Mallochohelea	7	7						
Megarcys	2	2						
Micropsectra	1	1						
Nemouridae	2	3	No			X		
Neoplasta	2	2						
Orthocladius complex	4	4						
Paraleuctra	3	3						
Paraperla	1	1						
Pericoma/Telmatoscopus	64	64						
Perlodidae	2	2						
Prosimulium/Helodon	1	1						
Rhabdomastix	1	1						
Rheocricotopus	1	1						
Rhithrogena	42	41	No			X		
Rhyacophila	2	2						
Rhyacophila brunnea/vemna group	3	3						
Simuliidae	1	1						
Simulium	4	4						
Stygothrombium	1	1						
Sweltsa	2	2						
Taeniopterygidae	96	97	No			X		
Testudacarus	2	2						
Tvetenia	2	2						

Zapada	5	5						
Zapada cinctipes	5	5						
Total:	**496**	**495**						
					0	**7**	**0**	
% Total Misidentification Rate =	misidentifications	x100	0.00	**Pass**				
	total number	=						
Site - 2020, Sample - RG_THCK_BIC-1_2020-09-10, CC# - CC210934, Percent sampled = 6%, Sieve size = 400	**Laboratory Count**	**QC Audit Count**	**Agreement**	**Misidentification**	**Questionable Taxonomic Resolution**	**Enumeration**	**Insufficient Taxonomic Resolution**	**Comments**
Baetidae	2	2						
Baetis	1	1						
Baetis rhodani group	1	1						
Chelifera/ Metachela	1	1						
Chironomidae	10	10						
Chironomidae	1	1						
Corynoneura	5	5						
Dicranota	9	9						
Dixa	7	7						
Elmidae	26	27	No			X		
Enchytraeus	13	13						
Eukiefferiella	1	1						
Feltria	2	2						
Gammarus	1	1						
Gastropoda	1	1						
Heterlimnius	42	42						
Heterlimnius	4	4						
Hydrozetidae	1	1						
Hymenoptera	1	1						
Limnephilidae	1	1						
Malenka	1	1						
Mallochohelea	1	1						
Micropsectra	1	1						
Nemouridae	1	1						
Nemouridae	3	3						
Neoplasta	7	7						
Orthocladiinae	6	5	No			X		
Parapsyche almota	1	1						

Pericoma/Telmatoscopus	5	5						
Pisidium	1	1						
Rhithrogena	1	1						
Rhyacophila	11	11						
Rhyacophila brunnea/vemna group	11	11						
Simuliidae	1	1						
Simulium	95	95						
Taeniopterygidae	3	3						
Tvetenia	1	1						
Zapada cinctipes	59	58	No			X		
Total:	**339**	**338**						
					0	**3**	**0**	
% Total Misidentification Rate =	misidentifications	x100 =	0.00	**Pass**				
	total number							

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Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015). http://www.safit.org/Docs/SAFIT_Taxonomic_Literature_Database_1_March_2011.enl

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APPENDIX G
BENTHIC INVERTEBRATE TISSUE CHEMISTRY

Table G.1: Selenium Benchmarks for Benthic Invertebrates Tissue in the Elk Valley

Endpoint	Tissue Type	Benchmark: Selenium Value (µg/g dw)	Benchmark: Type	Benchmark: Description	Source
Benthic Invertebrates	Whole body	4 [a]	BC guideline	Interim guideline for aquatic dietary tissue based on weight of evidence of lowest published toxicity thresholds and no uncertainty factor applied	BCMOE (2014)
	Whole body	13	Site-specific benchmark	Level 1 (~10% effect) benchmark for growth, reproduction and survival of invertebrates	Golder (2014a)
	Whole body	20	Site-specific benchmark	Level 2 (~20% effect) benchmark for growth, reproduction and survival of invertebrates	Golder (2014a)
	Whole body	27	Site-specific benchmark	Level 3 (~50% effect) benchmark for growth, reproduction and survival of invertebrates	Golder (2014a)
	Whole body	11	Site-specific benchmark	Level 1 (~10% effect) benchmark for dietary effects to juvenile fish (growth)	Golder (2014a)
	Whole body	18 [b]	Site-specific benchmark	Level 2 (~20% effect) benchmark for dietary effects to juvenile fish (growth)	Golder (2014a)
	Whole body	26	Site-specific benchmark	Level 3 (~50% effect) benchmark for dietary effects to juvenile fish (growth)	Golder (2014a)
	Whole body	15	Site-specific benchmark	Level 1 (~10% effect) benchmark for dietary effects to juvenile birds	Golder (2014a)
	Whole body	22	Site-specific benchmark	Level 2 (~20% effect) benchmark for dietary effects to juvenile birds	Golder (2014a)
	Whole body	41	Site-specific benchmark	Level 3 (~50% effect) benchmark for dietary effects to juvenile birds	Golder (2014a)

[a] BC guidelines were not used in assessment of benthic invertebrate tissue selenium concentrations. Assessment was completed relative to site-specific benchmarks only.

[b] Site-specific benchmark not applicable to dietary effects to juvenile westslope cutthroat trout for reasons outlined in Golder 2014a.

Table G.2: Metal Concentrations in Composite Benthic Invertebrate Tissue Samples, September 2020

Analyte			Units	Reference			Mine-exposed											
				GH_ER2 / RG_ELUGH			GH_ERSC4			GH_ER1A			RG_ERSC5			GH_TC2 / RG_THCK		
				RG_ELUGH_INV-1_2020-09-17	RG_ELUGH_INV-2_2020-09-17	RG_ELUGH_INV-3_2020-09-17	RG_ERSC4_INV-1_2020-09-12	RG_ERSC4_INV-2_2020-09-12	RG_ERSC4_INV-3_2020-09-12	RG_ER1A_INV-1_2020-09-11	RG_ER1A_INV-2_2020-09-12	RG_ER1A_INV-3_2020-09-12	RG_ERSC5_INV-1_2020-09-11	RG_ERSC5_INV-2_2020-09-11	RG_ERSC5_INV-3_2020-09-11	RG_THCK_INV-1_2020-09-10	RG_THCK_INV-2-2020-09-10	RG_THCK_INV-3_2020-09-10
				17-Sep-20	17-Sep-20	17-Sep-20	12-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20
Physical Tests	Moisture		%	67.6	70.2	79.8	79.5	76.7	79.8	72.5	78.9	79.6	63.9	73.5	79.6	78.1	83.2	82.8
Metals	Lithium	7Li	µg/g dw	0.501	0.511	0.889	0.501	0.184	0.327	0.379	1.3	0.337	3.1	1.3	6.3	1.3	3.7	4.3
	Boron	11B	µg/g dw	1.3	1.2	0.608	1.3	0.440	0.741	0.718	3.1	0.845	7.6	4.1	16	3.5	3.7	5.0
	Sodium	23Na	µg/g dw	3,009	3,317	5,813	4,431	2,969	2,926	3,969	5,094	2,648	4,800	3,726	10,589	5,415	8,014	6,999
	Magnesium	24Mg	µg/g dw	1,331	1,300	1,181	1,905	1,318	1,332	1,713	1,805	1,317	2,338	1,887	3,086	1,772	4,363	5,072
	Aluminium	27Al	µg/g dw	756	720	282	894	214	485	423	2,334	479	7,028	2,732	13,156	1,239	665	1,278
	Phosphorous	31P	µg/g dw	10,016	11,196	11,077	13,337	7,953	10,749	11,867	12,154	9,016	13,154	10,107	10,029	10,975	12,925	13,413
	Potassium	39K	µg/g dw	10,587	11,209	12,191	13,326	7,777	8,312	11,556	14,851	9,311	16,084	10,923	16,706	13,362	13,530	14,391
	Calcium	44Ca	µg/g dw	1,700	2,139	1,192	2,888	1,605	1,937	2,008	3,982	1,937	5,162	2,782	6,400	14,039	99,733	123,336
	Titanium	49Ti	µg/g dw	60	39	29	61	14	35	26	223	35	578	235	959	96	56	112
	Vanadium	51V	µg/g dw	1.6	1.5	0.797	1.6	0.520	0.945	0.962	4.5	1.2	13	6.1	22	2.5	1.4	2.3
	Chromium	52Cr	µg/g dw	4.7	6.5	6.2	4.8	3.3	2.9	4.5	8.2	3.6	57	31	84	13	3.6	6.9
	Manganese	55Mn	µg/g dw	62	58	23	187	51	165	64	162	62	132	117	259	51	27	36
	Iron	57Fe	µg/g dw	459	544	278	710	231	395	339	1,233	320	3,352	1,508	6,142	773	635	908
	Cobalt	59Co	µg/g dw	0.724	1.0	0.827	2.4	0.768	0.879	0.816	3.4	1.0	7.5	4.9	7.2	0.996	0.429	0.773
	Nickel	60Ni	µg/g dw	9.6	14	15	13	6.3	5.7	14	33	10	117	66	174	30	8.5	20
	Copper	63Cu	µg/g dw	17	14	14	32	22	21	21	23	19	35	28	36	27	65	63
	Zinc	66Zn	µg/g dw	363	214	175	411	294	217	333	247	280	296	325	247	250	71	66
	Arsenic	75As	µg/g dw	1.0	1.3	0.667	1.6	0.679	1.1	0.605	3.0	0.889	3.6	1.4	3.2	0.671	3.2	3.6
	Selenium	77Se	µg/g dw	6.7	8.3	3.8	8.6	5.3	6.9	6.3	9.1	6.3	12	11	6.6	59	17	25
	Strontium	88Sr	µg/g dw	7.9	9.0	3.8	11	5.7	7.4	7.9	13	7.1	20	11	23	43	232	279
	Molybdenum	95Mo	µg/g dw	0.381	0.511	0.207	0.935	0.359	0.571	0.277	0.848	0.370	1.6	0.957	2.6	0.443	0.488	0.580
	Silver	107Ag	µg/g dw	0.172	0.127	0.185	0.296	0.139	0.154	0.175	0.124	0.127	0.127	0.121	0.318	0.183	0.820	0.677
	Cadmium	111Cd	µg/g dw	1.4	1.6	1.2	8.9	2.0	3.1	1.2	8.8	2.9	14	9.8	4.0	0.759	0.686	0.686
	Tim	118Sn	µg/g dw	0.099	0.214	0.110	0.422	0.214	0.224	0.082	0.718	0.340	1.2	0.279	0.767	0.453	0.650	1.9
	Antimony	121Sb	µg/g dw	0.052	0.103	0.029	0.091	0.025	0.050	0.045	0.155	0.066	0.272	0.198	0.409	0.041	0.028	0.033
	Barium	137Ba	µg/g dw	34	28	9.6	46	20	41	29	59	31	126	62	263	100	259	273
	Mercury	202Hg	µg/g dw	0.097	0.075	0.075	0.112	0.097	0.097	0.112	0.060	0.090	0.067	0.067	0.112	0.098	<0.028	0.029
	Thallium	205Tl	µg/g dw	0.020	0.031	0.021	0.039	0.014	0.020	0.018	0.057	0.021	0.115	0.064	0.281	0.097	0.211	0.198
	Lead	208Pb	µg/g dw	0.206	0.205	0.117	0.313	0.072	0.165	0.165	0.644	0.150	1.6	0.536	3.0	0.365	0.160	0.252
	Uranium	238U	µg/g dw	0.059	0.057	0.024	0.088	0.031	0.063	0.054	0.139	0.052	0.311	0.174	0.633	0.215	0.104	0.226

Value > upper limit of normal range of selenium (8.74 µg/g dw; Minnow 2020).

Value > EVWQP level 1 benchmark of 11 µg/g dw for dietary effects of selenium to fish. (Level 1 benchmark for effects to invertebrates is 13 µg/g dw dw.)

Value > EVWQP level 2 benchmark of 18 µg/g dw for dietary effects of selenium to fish.

Value > EVWQP level 3 benchmark of 26 µg/g dw for dietary effects of selenium to fish. (41 µg/g dw is the level 3 benchmark for dietary effects of selenium to birds.)

Note: For each level, the lowest benchmark is shown (i.e, most conservative benchmark of effects to benthic invertebrates, dietary effects to fish, and dietary effects to birds).

Table G.2: Metal Concentrations in Composite Benthic Invertebrate Tissue Samples, September 2020

Analyte			Units	Mine-exposed													
				RG_GH_SCW3			GH_ERSC2			RG_SCDTC			GH_ERC / RG_EL20				
				RG_GH-SCW3_INV-1_2020-09-13	RG_GH-SCW3_INV-2_2020-09-13	RG_GH-SCW3_INV-3_2020-09-13	GH_ERSC2_INV-1_2020-09-13	GH_ERSC2_INV-2_2020-09-13	GH_ERSC2_INV-3_2020-09-13	RG_SCDTC_INV-1_2020-09-13	RG_SCDTC_INV-2_2020-09-13	RG_SCDTC_INV-3_2020-09-13	RG_EL20_INV-1_2020-09-15	RG_EL20_INV-2_2020-09-16	RG_EL20_INV-3_2020-09-16	RG_EL20_INV-4_2020-09-16	RG_EL20_INV-5_2020-09-16
				13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	15-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20
Physical Tests	Moisture		%	75.6	89.0	76.0	74.4	65.8	72.7	75.9	80.3	79.9	73.2	76.8	70.7	77.5	62.5
Metals	Lithium	7Li	µg/g dw	5.3	3.3	1.6	2.0	2.7	1.4	1.3	1.7	2.3	0.305	0.528	0.616	0.363	1.5
	Boron	11B	µg/g dw	14	13	3.7	5.6	7.4	3.9	3.1	4.6	7.4	0.773	1.3	1.4	0.988	2.4
	Sodium	23Na	µg/g dw	8,614	17,952	10,193	3,488	2,917	2,819	3,003	3,678	4,427	2,743	3,706	2,913	3,120	2,952
	Magnesium	24Mg	µg/g dw	2,159	2,367	4,324	2,162	2,142	2,193	1,763	2,466	2,946	1,510	1,962	1,634	1,698	1,909
	Aluminium	27Al	µg/g dw	9,792	4,648	2,970	4,720	6,006	3,135	2,850	4,583	5,773	496	1,053	1,046	614	2,145
	Phosphorous	31P	µg/g dw	9,991	8,923	13,301	11,317	10,207	9,427	10,047	12,130	11,232	11,139	12,913	11,339	11,918	10,147
	Potassium	39K	µg/g dw	18,767	25,380	11,500	14,287	16,231	11,930	9,815	11,517	16,771	11,367	11,816	11,361	11,132	9,505
	Calcium	44Ca	µg/g dw	3,775	4,425	4,920	2,684	3,185	1,805	2,466	3,648	3,779	2,203	3,369	2,488	2,663	5,052
	Titanium	49Ti	µg/g dw	652	370	211	390	501	251	241	416	407	39	70	85	51	196
	Vanadium	51V	µg/g dw	15	9.2	6.1	7.6	11	6.0	5.4	11	11	2.2	2.4	2.3	1.4	6.3
	Chromium	52Cr	µg/g dw	13	24	24	12	11	8.5	23	19	19	34	9.1	19	6.4	80
	Manganese	55Mn	µg/g dw	106	63	92	173	162	75	36	46	255	94	80	80	62	164
	Iron	57Fe	µg/g dw	3,207	2,269	1,794	1,875	2,688	1,478	1,572	2,136	2,963	1,050	962	1,092	581	2,710
	Cobalt	59Co	µg/g dw	2.3	3.7	2.3	3.2	3.2	2.0	3.0	5.1	3.6	2.9	3.2	2.3	2.1	7.8
	Nickel	60Ni	µg/g dw	47	71	56	35	39	26	48	49	54	69	21	45	14	163
	Copper	63Cu	µg/g dw	18	14	26	38	24	19	22	23	31	16	21	19	18	25
	Zinc	66Zn	µg/g dw	169	103	254	320	382	302	254	273	356	233	181	147	178	186
	Arsenic	75As	µg/g dw	2.1	1.5	0.926	1.6	2.7	1.1	1.3	1.8	2.2	1.7	2.1	2.5	2.3	2.1
	Selenium	77Se	µg/g dw	6.9	9.1	14	14	28	17	8.0	11	13	9.5	13	8.8	9.7	7.3
	Strontium	88Sr	µg/g dw	13	23	19	10	14	7.6	11	15	17	7.6	16	11	9.4	12
	Molybdenum	95Mo	µg/g dw	3.0	1.4	0.511	1.4	1.6	0.946	0.519	0.603	1.1	0.763	0.786	0.885	0.672	0.824
	Silver	107Ag	µg/g dw	0.106	0.067	0.200	0.154	0.214	0.176	0.109	0.097	0.210	0.084	0.080	0.139	0.084	0.160
	Cadmium	111Cd	µg/g dw	0.942	0.915	3.0	4.8	7.4	2.1	7.3	12	6.1	2.6	4.1	2.6	2.7	2.1
	Tim	118Sn	µg/g dw	0.356	0.194	0.323	0.340	0.467	0.255	0.810	0.672	0.464	0.467	0.957	0.281	0.515	0.124
	Antimony	121Sb	µg/g dw	0.235	0.206	0.070	0.136	0.182	0.121	0.066	0.116	0.314	0.088	0.209	0.171	0.094	0.121
	Barium	137Ba	µg/g dw	200	96	79	129	189	106	55	100	334	55	49	40	34	118
	Mercury	202Hg	µg/g dw	0.097	0.060	0.120	0.135	0.410	0.166	0.088	0.083	0.127	0.068	0.049	0.059	0.039	0.049
	Thallium	205Tl	µg/g dw	0.168	0.094	0.066	0.080	0.146	0.077	0.074	0.112	0.132	0.040	0.064	0.055	0.043	0.210
	Lead	208Pb	µg/g dw	2.4	1.1	1.0	1.6	2.7	1.3	0.642	1.1	3.2	0.191	0.316	0.329	0.194	1.3
	Uranium	238U	µg/g dw	0.507	0.670	0.114	0.308	0.431	0.242	0.111	0.169	0.604	0.085	0.091	0.104	0.072	0.179

Value > upper limit of normal range of selenium (8.74 µg/g dw; Minnow 2020).

Value > EVWQP level 1 benchmark of 11 µg/g dw for dietary effects of selenium to fish. (Level 1 benchmark for effects to invertebrates is 13 µg/g dw dw.)

Value > EVWQP level 2 benchmark of 18 µg/g dw for dietary effects of selenium to fish.

Value > EVWQP level 3 benchmark of 26 µg/g dw for dietary effects of selenium to fish. (41 µg/g dw is the level 3 benchmark for dietary effects of selenium to birds.)

Note: For each level, the lowest benchmark is shown (i.e, most conservative benchmark of effects to benthic invertebrates, dietary effects to fish, and dietary effects to birds).

Table G.3: Concentrations of Selenium Species Measured in Benthic Invertebrate Tissue Samples and Concentrations Predicted Using the B-Tool, September 2020

Exposure	Location	Station	Date	Measured Benthic Invertebrate Tissue Selenium (µg/g d.w.)	Average Measured Benthic Invertebrate Tissue Selenium (µg/g d.w.)	Predicted Benthic Invertebrate Tissue Selenium using the B-Tool (µg/g d.w.)
Reference	Main Stem Elk River	GH_ER2 / RG_ELUGH	17-Sep-20	6.7	6.27	6.27
				8.3		
				3.8		
Mine-Exposed	Elk River Side Channel	GH_ERSC4	12-Sep-20	8.6	6.93	6.08
				5.3		
				6.9		
		GH_ER1A	11-Sep-20	6.3	7.23	5.97
				9.1		
				6.3		
		RG_ERSC5	11-Sep-20	12	9.87	6.03
				11		
				6.6		
	Tributary	GH_TC2 / RG_THCK	10-Sep-20	59	33.67	45.40
				17		
				25		
	Elk River Side Channel	RG_GH-SCW3	13-Sep-20	6.9	10.00	9.64
				9.1		
				14		
		GH_ERSC2	13-Sep-20	14	19.67	8.54
				28		
				17		
		RG_SCDTC	13-Sep-20	8.0	10.67	10.72
				11		
				13		
	Main Stem Elk River	GH_ERC / RG_EL20	17-Sep-20	9.5	9.66	6.45
				13		
				8.8		
				9.7		
				7.3		

Notes: The b-tool is a predictive selenium bioaccumulation tool that accounts for selenium speciation (Bruyn and Luoma 2021). d.w. = dry weight.

APPENDIX G
BENTHIC INVERTEBRATE TISSUE
CHEMISTRY LAB REPORT

TrichAnalytics Inc.

Tissue Microchemistry Analysis Report

Client:	Jess Tester Aquatic Scientist Minnow Environmental	Date Received:	29 Sep 2020
		Date of Analysis:	06 Oct 2020
		Final Report Date:	07 Oct 2020
Phone:	(250) 595-1627	Project No.:	2020-151
Email:	jtester@minnow.ca	Method No.:	MET-002.04

Client Project: Teck Coal/Minnow Environmental GHO LAEMP (20-22)

Analytical Request: Benthic Invertebrate Tissue Microchemistry (total metals and moisture) – 29 samples. See chain of custody form provided for sample identification numbers.

Notes:

Analytical results are expressed in part per million (ppm) dry weight.
Samples quantified using DORM-4, NIST-1566b, and NIST-2976 certified reference standards.
Aluminum concentrations above 1,000 ppm are outside linear range of the calibration curve.
CoC transcription error noted for five samples were corrected as per Client confirmation.
Client specific DQO for Selenium accuracy is 90 - 110% of the certified value; (average achieved 103%; range 98 - 108%).
RPD values calculated according to the British Columbia Environmental Laboratory Manual (2020) criteria.

This report provides the analytical results only for tissue samples noted above as received from the Client.

Reviewed and Approved by Jennie Christensen, PhD, RPBio — Date: 07 Oct 2020

TrichAnalytics Inc.
207-1753 Sean Heights
Saanichton, BC V8M 0B3
www.trichanalytics.com

CALA Testing Accreditation No. A4196

Teck Coal Limited

Tissue Analysis Results

		Client ID	RG_ELUGH_INV-1_2020-09-17	RG_ELUGH_INV-2_2020-09-17	RG_ELUGH_INV-3_2020-09-17	RG_ERSC4_INV-1_2020-09-12	RG_ERSC4_INV-2_2020-09-12
		Lab ID	100	101	102	103	104
		Wet Weight (g)	0.2163	0.0998	0.1771	0.3399	0.6730
		Dry Weight (g)	0.0701	0.0297	0.0357	0.0696	0.1568
		Moisture (%)	67.6	70.2	79.8	79.5	76.7
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	0.501	0.511	0.889	0.501	0.184
11B	0.092	0.307	1.3	1.2	0.608	1.3	0.440
23Na	3.1	10	3,009	3,317	5,813	4,431	2,969
24Mg	0.049	0.163	1,331	1,300	1,181	1,905	1,318
27Al	0.040	0.133	756	720	282	894	214
31P	79	263	10,016	11,196	11,077	13,337	7,953
39K	11	37	10,587	11,209	12,191	13,326	7,777
44Ca	20	67	1,700	2,139	1,192	2,888	1,605
49Ti	0.270	0.900	60	39	29	61	14
51V	0.047	0.157	1.6	1.5	0.797	1.6	0.520
52Cr	0.646	2.2	4.7	6.5	6.2	4.8	3.3
55Mn	0.009	0.030	62	58	23	187	51
57Fe	4.1	14	459	544	278	710	231
59Co	0.004	0.013	0.724	1.0	0.827	2.4	0.768
60Ni	0.015	0.050	9.6	14	15	13	6.3
63Cu	0.008	0.027	17	14	14	32	22
66Zn	0.783	2.6	363	214	175	411	294
75As	0.392	1.3	1.0	1.3	0.667	1.6	0.679
77Se	0.348	1.2	6.7	8.3	3.8	8.6	5.3
88Sr	0.001	0.003	7.9	9.0	3.8	11	5.7
95Mo	0.026	0.087	0.381	0.511	0.207	0.935	0.359
107Ag	0.001	0.003	0.172	0.127	0.185	0.296	0.139
111Cd	0.076	0.253	1.4	1.6	1.2	8.9	2.0
118Sn	0.021	0.070	0.099	0.214	0.110	0.422	0.214
121Sb	0.006	0.020	0.052	0.103	0.029	0.091	0.025
137Ba	0.001	0.003	34	28	9.6	46	20
202Hg	0.028	0.093	0.097	0.075	0.075	0.112	0.097
205Tl	0.001	0.003	0.020	0.031	0.021	0.039	0.014
208Pb	0.001	0.003	0.206	0.205	0.117	0.313	0.072
238U	0.001	0.003	0.059	0.057	0.024	0.088	0.031

Notes:

ppm = parts per million

DL = detection limit

LOQ = limit of quantitation

< = less than detection limit

g = grams

% = percent

		Client ID	RG_ERSC4_INV-3_2020-09-12	RG_ER1A_INV-1_2020-09-11	RG_ER1A_INV-2_2020-09-12	RG_ER1A_INV-3_2020-09-12	RG_ERSC5_INV-1_2020-09-11
		Lab ID	105	106	107	108	109
		Wet Weight (g)	0.3962	0.3846	0.3161	0.5152	0.0673
		Dry Weight (g)	0.0802	0.1058	0.0667	0.1052	0.0243
		Moisture (%)	79.8	72.5	78.9	79.6	63.9
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	0.327	0.379	1.3	0.337	3.1
11B	0.092	0.307	0.741	0.718	3.1	0.845	7.6
23Na	3.1	10	2,926	3,969	5,094	2,648	4,800
24Mg	0.049	0.163	1,332	1,713	1,805	1,317	2,338
27Al	0.040	0.133	485	423	2,334	479	7,028
31P	79	263	10,749	11,867	12,154	9,016	13,154
39K	11	37	8,312	11,556	14,851	9,311	16,084
44Ca	20	67	1,937	2,008	3,982	1,937	5,162
49Ti	0.270	0.900	35	26	223	35	578
51V	0.047	0.157	0.945	0.962	4.5	1.2	13
52Cr	0.646	2.2	2.9	4.5	8.2	3.6	57
55Mn	0.009	0.030	165	64	162	62	132
57Fe	4.1	14	395	339	1,233	320	3,352
59Co	0.004	0.013	0.879	0.816	3.4	1.0	7.5
60Ni	0.015	0.050	5.7	14	33	10	117
63Cu	0.008	0.027	21	21	23	19	35
66Zn	0.783	2.6	217	333	247	280	296
75As	0.392	1.3	1.1	0.605	3.0	0.889	3.6
77Se	0.348	1.2	6.9	6.3	9.1	6.3	12
88Sr	0.001	0.003	7.4	7.9	13	7.1	20
95Mo	0.026	0.087	0.571	0.277	0.848	0.370	1.6
107Ag	0.001	0.003	0.154	0.175	0.124	0.127	0.127
111Cd	0.076	0.253	3.1	1.2	8.8	2.9	14
118Sn	0.021	0.070	0.224	0.082	0.718	0.340	1.2
121Sb	0.006	0.020	0.050	0.045	0.155	0.066	0.272
137Ba	0.001	0.003	41	29	59	31	126
202Hg	0.028	0.093	0.097	0.112	0.060	0.090	0.067
205Tl	0.001	0.003	0.020	0.018	0.057	0.021	0.115
208Pb	0.001	0.003	0.165	0.165	0.644	0.150	1.6
238U	0.001	0.003	0.063	0.054	0.139	0.052	0.311

Notes:

ppm = parts per million

DL = detection limit

LOQ = limit of quantitation

< = less than detection limit

g = grams

% = percent

Teck Coal Limited

Tissue Analysis Results

		Client ID	RG_ERSC5_INV-2_2020-09-11	RG_ERSC5_INV-3_2020-09-11	RG_GH-SCW3_INV-1_2020-09-13	RG_GH-SCW3_INV-2_2020-09-13	RG_GH-SCW3_INV-3_2020-09-13
		Lab ID	110	111	112	113	114
		Wet Weight (g)	0.2997	0.2047	0.2049	0.8008	0.1260
		Dry Weight (g)	0.0793	0.0417	0.0499	0.0877	0.0302
		Moisture (%)	73.5	79.6	75.6	89.0	76.0
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	1.3	6.3	5.3	3.3	1.6
11B	0.092	0.307	4.1	16	14	13	3.7
23Na	3.1	10	3,726	10,589	8,614	17,952	10,193
24Mg	0.049	0.163	1,887	3,086	2,159	2,367	4,324
27Al	0.040	0.133	2,732	13,156	9,792	4,648	2,970
31P	79	263	10,107	10,029	9,991	8,923	13,301
39K	11	37	10,923	16,706	18,767	25,380	11,500
44Ca	20	67	2,782	6,400	3,775	4,425	4,920
49Ti	0.270	0.900	235	959	652	370	211
51V	0.047	0.157	6.1	22	15	9.2	6.1
52Cr	0.646	2.2	31	84	13	24	24
55Mn	0.009	0.030	117	259	106	63	92
57Fe	4.1	14	1,508	6,142	3,207	2,269	1,794
59Co	0.004	0.013	4.9	7.2	2.3	3.7	2.3
60Ni	0.015	0.050	66	174	47	71	56
63Cu	0.008	0.027	28	36	18	14	26
66Zn	0.783	2.6	325	247	169	103	254
75As	0.392	1.3	1.4	3.2	2.1	1.5	0.926
77Se	0.348	1.2	11	6.6	6.9	9.1	14
88Sr	0.001	0.003	11	23	13	23	19
95Mo	0.026	0.087	0.957	2.6	3.0	1.4	0.511
107Ag	0.001	0.003	0.121	0.318	0.106	0.067	0.200
111Cd	0.076	0.253	9.8	4.0	0.942	0.915	3.0
118Sn	0.021	0.070	0.279	0.767	0.356	0.194	0.323
121Sb	0.006	0.020	0.198	0.409	0.235	0.206	0.070
137Ba	0.001	0.003	62	263	200	96	79
202Hg	0.028	0.093	0.067	0.112	0.097	0.060	0.120
205Tl	0.001	0.003	0.064	0.281	0.168	0.094	0.066
208Pb	0.001	0.003	0.536	3.0	2.4	1.1	1.0
238U	0.001	0.003	0.174	0.633	0.507	0.670	0.114

Notes:

ppm = parts per million

DL = detection limit

LOQ = limit of quantitation

< = less than detection limit

g = grams

% = percent

Teck Coal Limited

Tissue Analysis Results

		Client ID	GH_ERSC2_INV-1_2020-09-13	GH_ERSC2_INV-2_2020-09-13	GH_ERSC2_INV-3_2020-09-13	RG_SCDTC_INV-1_2020-09-13	RG_SCDTC_INV-2_2020-09-13
		Lab ID	115	116	117	118	119
		Wet Weight (g)	0.4977	0.2072	0.4334	0.2289	0.3085
		Dry Weight (g)	0.1272	0.0709	0.1182	0.0552	0.0608
		Moisture (%)	74.4	65.8	72.7	75.9	80.3
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	2.0	2.7	1.4	1.3	1.7
11B	0.092	0.307	5.6	7.4	3.9	3.1	4.6
23Na	3.1	10	3,488	2,917	2,819	3,003	3,678
24Mg	0.049	0.163	2,162	2,142	2,193	1,763	2,466
27Al	0.040	0.133	4,720	6,006	3,135	2,850	4,583
31P	79	263	11,317	10,207	9,427	10,047	12,130
39K	11	37	14,287	16,231	11,930	9,815	11,517
44Ca	20	67	2,684	3,185	1,805	2,466	3,648
49Ti	0.270	0.900	390	501	251	241	416
51V	0.047	0.157	7.6	11	6.0	5.4	11
52Cr	0.646	2.2	12	11	8.5	23	19
55Mn	0.009	0.030	173	162	75	36	46
57Fe	4.1	14	1,875	2,688	1,478	1,572	2,136
59Co	0.004	0.013	3.2	3.2	2.0	3.0	5.1
60Ni	0.015	0.050	35	39	26	48	49
63Cu	0.008	0.027	38	24	19	22	23
66Zn	0.783	2.6	320	382	302	254	273
75As	0.392	1.3	1.6	2.7	1.1	1.3	1.8
77Se	0.348	1.2	14	28	17	8.0	11
88Sr	0.001	0.003	10	14	7.6	11	15
95Mo	0.026	0.087	1.4	1.6	0.946	0.519	0.603
107Ag	0.001	0.003	0.154	0.214	0.176	0.109	0.097
111Cd	0.076	0.253	4.8	7.4	2.1	7.3	12
118Sn	0.021	0.070	0.340	0.467	0.255	0.810	0.672
121Sb	0.006	0.020	0.136	0.182	0.121	0.066	0.116
137Ba	0.001	0.003	129	189	106	55	100
202Hg	0.028	0.093	0.135	0.410	0.166	0.088	0.083
205Tl	0.001	0.003	0.080	0.146	0.077	0.074	0.112
208Pb	0.001	0.003	1.6	2.7	1.3	0.642	1.1
238U	0.001	0.003	0.308	0.431	0.242	0.111	0.169

Notes:

ppm = parts per million

DL = detection limit

LOQ = limit of quantitation

< = less than detection limit

g = grams

% = percent

Teck Coal Limited

Tissue Analysis Results

		Client ID	RG_SCDTC_INV-3_2020-09-13	RG_THCK_INV-1_2020-09-10	RG_THCK_INV-2-2020-09-10	RG_THCK_INV-3_2020-09-10	RG_EL20_INV-1_2020-09-15
		Lab ID	120	121	122	123	124
		Wet Weight (g)	0.3435	0.2625	1.7626	0.3068	0.1683
		Dry Weight (g)	0.0692	0.0576	0.2969	0.0529	0.0451
		Moisture (%)	79.9	78.1	83.2	82.8	73.2
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	2.3	1.3	3.7	4.3	0.305
11B	0.092	0.307	7.4	3.5	3.7	5.0	0.773
23Na	3.1	10	4,427	5,415	8,014	6,999	2,743
24Mg	0.049	0.163	2,946	1,772	4,363	5,072	1,510
27Al	0.040	0.133	5,773	1,239	665	1,278	496
31P	79	263	11,232	10,975	12,925	13,413	11,139
39K	11	37	16,771	13,362	13,530	14,391	11,367
44Ca	20	67	3,779	14,039	99,733	123,336	2,203
49Ti	0.270	0.900	407	96	56	112	39
51V	0.047	0.157	11	2.5	1.4	2.3	2.2
52Cr	0.646	2.2	19	13	3.6	6.9	34
55Mn	0.009	0.030	255	51	27	36	94
57Fe	4.1	14	2,963	773	635	908	1,050
59Co	0.004	0.013	3.6	0.996	0.429	0.773	2.9
60Ni	0.015	0.050	54	30	8.5	20	69
63Cu	0.008	0.027	31	27	65	63	16
66Zn	0.783	2.6	356	250	71	66	233
75As	0.392	1.3	2.2	0.671	3.2	3.6	1.7
77Se	0.348	1.2	13	59	17	25	9.5
88Sr	0.001	0.003	17	43	232	279	7.6
95Mo	0.026	0.087	1.1	0.443	0.488	0.580	0.763
107Ag	0.001	0.003	0.210	0.183	0.820	0.677	0.084
111Cd	0.076	0.253	6.1	0.759	0.686	0.686	2.6
118Sn	0.021	0.070	0.464	0.453	0.650	1.9	0.467
121Sb	0.006	0.020	0.314	0.041	0.028	0.033	0.088
137Ba	0.001	0.003	334	100	259	273	55
202Hg	0.028	0.093	0.127	0.098	<0.028	0.029	0.068
205Tl	0.001	0.003	0.132	0.097	0.211	0.198	0.040
208Pb	0.001	0.003	3.2	0.365	0.160	0.252	0.191
238U	0.001	0.003	0.604	0.215	0.104	0.226	0.085

Notes:

ppm = parts per million

DL = detection limit

LOQ = limit of quantitation

< = less than detection limit

g = grams

% = percent

		Client ID	RG_EL20_INV-2_2020-09-16	RG_EL20_INV-3_2020-09-16	RG_EL20_INV-4_2020-09-16	RG_EL20_INV-5_2020-09-15
		Lab ID	125	126	127	128
		Wet Weight (g)	0.2372	0.1993	0.3443	0.2298
		Dry Weight (g)	0.0550	0.0583	0.0773	0.0861
		Moisture (%)	76.8	70.7	77.5	62.5
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.004	0.013	0.528	0.616	0.363	1.5
11B	0.092	0.307	1.3	1.4	0.988	2.4
23Na	3.1	10	3,706	2,913	3,120	2,952
24Mg	0.049	0.163	1,962	1,634	1,698	1,909
27Al	0.040	0.133	1,053	1,046	614	2,145
31P	79	263	12,913	11,339	11,918	10,147
39K	11	37	11,816	11,361	11,132	9,505
44Ca	20	67	3,369	2,488	2,663	5,052
49Ti	0.270	0.900	70	85	51	196
51V	0.047	0.157	2.4	2.3	1.4	6.3
52Cr	0.646	2.2	9.1	19	6.4	80
55Mn	0.009	0.030	80	80	62	164
57Fe	4.1	14	962	1,092	581	2,710
59Co	0.004	0.013	3.2	2.3	2.1	7.8
60Ni	0.015	0.050	21	45	14	163
63Cu	0.008	0.027	21	19	18	25
66Zn	0.783	2.6	181	147	178	186
75As	0.392	1.3	2.1	2.5	2.3	2.1
77Se	0.348	1.2	13	8.8	9.7	7.3
88Sr	0.001	0.003	16	11	9.4	12
95Mo	0.026	0.087	0.786	0.885	0.672	0.824
107Ag	0.001	0.003	0.080	0.139	0.084	0.160
111Cd	0.076	0.253	4.1	2.6	2.7	2.1
118Sn	0.021	0.070	0.957	0.281	0.515	0.124
121Sb	0.006	0.020	0.209	0.171	0.094	0.121
137Ba	0.001	0.003	49	40	34	118
202Hg	0.028	0.093	0.049	0.059	0.039	0.049
205Tl	0.001	0.003	0.064	0.055	0.043	0.210
208Pb	0.001	0.003	0.316	0.329	0.194	1.3
238U	0.001	0.003	0.091	0.104	0.072	0.179

Notes:
ppm = parts per million
DL = detection limit
LOQ = limit of quantitation
< = less than detection limit
g = grams
% = percent

Teck Coal Limited

Tissue QA/QC Relative Percent Difference Results

		GH_ERSC2_INV-1_2020-09-13			RG_THCK_INV-2-2020-09-10			RG_EL20_INV-3_2020-09-16		
		115			122			126		
Parameter	DL (ppm)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)
7Li	0.004	2.0	1.6	22.2	3.7	3.6	2.7	0.616	0.556	10.2
11B	0.092	5.6	4.5	21.8	3.7	4.4	17.3	1.4	1.3	7.4
23Na	3.1	3,488	3,730	6.7	8,014	8,669	7.9	2,913	2,866	1.6
24Mg	0.049	2,162	2,414	11.0	4,363	4,739	8.3	1,634	1,618	1.0
27Al	0.040	4,720	3,550	28.3	665	772	14.9	1,046	1,065	1.8
31P	79	11,317	13,165	15.1	12,925	14,365	10.6	11,339	11,761	3.7
39K	11	14,287	16,015	11.4	13,530	15,960	16.5	11,361	10,713	5.9
44Ca	20	2,684	2,826	5.2	99,733	89,022	11.3	2,488	2,574	3.4
49Ti	0.270	390	320	19.7	56	63	11.8	85	78	8.6
51V	0.047	7.6	6.5	15.6	1.4	1.4	0.0	2.3	2.4	4.3
52Cr	0.646	12	12	0.0	3.6	3.9	-	19	26	31.1
55Mn	0.009	173	187	7.8	27	28	3.6	80	80	0.0
57Fe	4.1	1,875	1,682	10.9	635	572	10.4	1,092	1,210	10.3
59Co	0.004	3.2	3.3	3.1	0.429	0.443	3.2	2.3	2.4	4.3
60Ni	0.015	35	33	5.9	8.5	9.7	13.2	45	62	31.8
63Cu	0.008	38	49	25.3	65	71	8.8	19	18	5.4
66Zn	0.783	320	432	29.8	71	73	2.8	147	168	13.3
75As	0.392	1.6	1.7	-	3.2	2.8	-	2.5	2.2	-
77Se	0.348	14	15	6.9	17	19	11.1	8.8	8.8	0.0
88Sr	0.001	10	11	9.5	232	225	3.1	11	11	0.0
95Mo	0.026	1.4	1.4	0.0	0.488	0.458	6.3	0.885	0.862	2.6
107Ag	0.001	0.154	0.154	0.0	0.820	0.672	19.8	0.139	0.126	9.8
111Cd	0.076	4.8	6.0	22.2	0.686	0.686	-	2.6	2.4	8.0
118Sn	0.021	0.340	0.348	2.3	0.650	0.577	11.9	0.281	0.285	1.4
121Sb	0.006	0.136	0.132	3.0	0.028	0.022	-	0.171	0.138	21.4
137Ba	0.001	129	148	13.7	259	209	21.4	40	40	0.0
202Hg	0.028	0.135	0.153	-	<0.028	0.029	-	0.059	0.039	-
205Tl	0.001	0.080	0.070	13.3	0.211	0.197	6.9	0.040	0.050	22.2
208Pb	0.001	1.6	1.5	6.5	0.160	0.162	1.2	0.329	0.306	7.2
238U	0.001	0.308	0.280	9.5	0.104	0.114	9.2	0.104	0.075	32.4

Notes:

ppm = parts per million

RPD = relative percent difference

DL = detection limit

< = less than detection limit

% = percent

Data Quality Objectives:

Laboratory Duplicates - RPD ≤40% for all elements, except Ca and Sr, which are ≤60%

Minimum DQOs apply to individual samples at concentrations above 10x DL

Tissue QA/QC Accuracy and Precision Results

		Sample Group ID	01			02		
Parameter	DL (ppm)	Certified Conc. (ppm)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)
7Li	0.004	1.21	1.2	101	5.7	1.2	99	10.6
11B	0.092	4.5	5.9	131	2.4	5.0	112	6.0
23Na	3.1	14,000	15,046	108	7.1	14,525	104	5.9
24Mg	0.049	910	939	103	7.5	982	108	5.2
27Al	0.040	197.2	209	106	4.4	196	100	7.0
31P	79	8,000	7,746	97	7.8	8,759	110	2.9
39K	11	15,500	15,919	103	6.6	16,299	105	4.0
44Ca	20	2,360	2,285	97	6.6	2,520	107	3.4
49Ti	0.270	12.24	15	122	7.9	12	102	7.1
51V	0.047	1.57	1.6	100	12.5	1.8	114	6.9
52Cr	0.646	1.87	2.0	106	8.1	2.0	104	2.2
55Mn	0.009	3.17	3.3	103	8.1	3.4	108	2.0
57Fe	4.1	343	382	111	6.8	390	114	4.5
59Co	0.004	0.25	0.281	112	7.9	0.268	107	3.2
60Ni	0.015	1.34	1.5	109	9.0	1.4	106	3.1
63Cu	0.008	15.7	17	110	6.2	17	111	6.3
66Zn	0.783	51.6	56	108	2.9	55	108	3.1
75As	0.392	6.87	6.8	99	4.7	7.3	106	4.6
77Se	0.348	3.45	3.4	98	2.7	3.7	108	4.8
88Sr	0.001	10.1	11	107	6.7	11	112	2.8
95Mo	0.026	0.29	0.296	102	11.2	0.322	111	6.4
107Ag	0.001	0.0252	0.030	120	17.0	0.029	117	14.3
111Cd	0.076	0.299	0.359	120	5.0	0.367	123	6.6
118Sn	0.021	0.061	0.061	100	8.7	0.073	120	14.4
121Sb	0.006	0.011	0.012	105	16.0	0.011	100	0.0
137Ba	0.001	8.6	10	120	5.4	9.1	105	6.4
202Hg	0.028	0.412	0.437	106	8.2	0.486	118	5.2
205Tl	0.001	0.0013	-	-	-	-	-	-
208Pb	0.001	0.404	0.415	103	15.0	0.474	117	5.3
238U	0.001	0.05	0.050	100	14.6	0.055	110	9.3

Notes:

ppm = parts per million; % = percent; DL = detection limit; RSD = relative standard deviation

Data Quality Objectives:

Accuracy: DQO of 60 - 140% of the certified values for B, Ti, Ag, Sn, Sb, and Ba.
Accuracy: DQO of 90 - 110% of the certified values for Se.
Accuracy: DQO of 70 - 130% of the certified values for all other elements provided.
Precision: DQO of ≤20% for all elements.
DORM-4 used for all parameters except B, Ti, Sb, Ba, and Al where NIST-1566b was used.
Tl certified concentration from NIST-2976.
Accuracy and precision for Tl are not reported as the certified concentration is too close to the reportable detection limit.

Teck Coal Limited
Sample Group Information

Sample Group ID	Client ID	Lab ID	Date of Analysis
01	RG_ELUGH_INV-1_2020-09-17	100	06 Oct 2020
	RG_ELUGH_INV-2_2020-09-17	101	
	RG_ELUGH_INV-3_2020-09-17	102	
	RG_ERSC4_INV-1_2020-09-12	103	
	RG_ERSC4_INV-2_2020-09-12	104	
	RG_ERSC4_INV-3_2020-09-12	105	
	RG_ER1A_INV-1_2020-09-11	106	
	RG_ER1A_INV-2_2020-09-12	107	
	RG_ER1A_INV-3_2020-09-12	108	
	RG_ERSC5_INV-1_2020-09-11	109	
	RG_ERSC5_INV-2_2020-09-11	110	
	RG_ERSC5_INV-3_2020-09-11	111	
	RG_GH-SCW3_INV-1_2020-09-13	112	
	RG_GH-SCW3_INV-2_2020-09-13	113	
	RG_GH-SCW3_INV-3_2020-09-13	114	
	GH_ERSC2_INV-1_2020-09-13	115	
02	GH_ERSC2_INV-2_2020-09-13	116	06 Oct 2020
	GH_ERSC2_INV-3_2020-09-13	117	
	RG_SCDTC_INV-1_2020-09-13	118	
	RG_SCDTC_INV-2_2020-09-13	119	
	RG_SCDTC_INV-3_2020-09-13	120	
	RG_THCK_INV-1_2020-09-10	121	
	RG_THCK_INV-2-2020-09-10	122	
	RG_THCK_INV-3_2020-09-10	123	
	RG_EL20_INV-1_2020-09-15	124	
	RG_EL20_INV-2_2020-09-16	125	
	RG_EL20_INV-3_2020-09-16	126	
	RG_EL20_INV-4_2020-09-16	127	
	RG_EL20_INV-5_2020-09-15	128	

TrichAnalytics Inc. 207-1753 Sean Heights, Saanichton, BC, V8M 0B3 Ph: (250) 532-1084	Chain of Custody (COC) for LA-ICP-MS Analysis
Invoicing	Reporting (if different from Invoicing)

Project Number: GHO LAEMP (20-22) (PO 707822)

Company Name:	Teck Coal Limited	Company Name:	Minnow Environmental
Contact Name:	Cait Good	Contact Name:	Jess Tester
Address:	421 Pine Avenue	Address:	2 Lamb Street
City, Province:	Sparwood, BC	City, Province:	Georgetown, ON
Postal Code:	V0B 2G0	Postal Code:	L7G 2G7
Phone:	250-425-8202	Phone:	250-595-1627
Email:	cait.goog@teck.com	Email:	jtester@minnow.ca

Sample Analysis Requested

Trich Sample ID:		Sample Identification:		Species	Sample type
100	1	RG_ELUGH_INV-1_2020-09-17	✓	-	Composite-taxa benthic invertebrate tissue samples
101	2	RG_ELUGH_INV-2_2020-09-17	✓	-	Composite-taxa benthic invertebrate tissue samples
102	3	RG_ELUGH_INV-3_2020-09-17	✓	-	Composite-taxa benthic invertebrate tissue samples
103	4	RG_ERSC4_INV-1_2020-09-12 ▲	✓ ok	-	Composite-taxa benthic invertebrate tissue samples
104	5	RG_ERSC4_INV-2_2020-09-12 ▲	✓ ok	-	Composite-taxa benthic invertebrate tissue samples
105	6	RG_ERSC4_INV-3_2020-09-12 ▲	✓ ok	-	Composite-taxa benthic invertebrate tissue samples
106	7	RG_ER1A_INV-1_2020-09-11 ▲	✓ ok	-	Composite-taxa benthic invertebrate tissue samples
107	8	RG_ER1A_INV-2_2020-09-~~11~~ 12 * ▲	✓	-	Composite-taxa benthic invertebrate tissue samples
108	9	RG_ER1A_INV-3_2020-09-~~11~~ 12 * ▲	✓	-	Composite-taxa benthic invertebrate tissue samples
109	10	RG_ERSC5_INV-1_2020-09-11	✓	-	Composite-taxa benthic invertebrate tissue samples
110	11	RG_ERSC5_INV-2_2020-09-11	✓	-	Composite-taxa benthic invertebrate tissue samples
111	12	RG_ERSC5_INV-3_2020-09-11	✓	-	Composite-taxa benthic invertebrate tissue samples
112	13	RG_GH-SCW3_INV-1_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
113	14	RG_GH-SCW3_INV-2_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
114	15	RG_GH-SCW3_INV-3_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
115	16	GH_ERSC2_INV-1_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
116	17	GH_ERSC2_INV-2_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
117	18	GH_ERSC2_INV-3_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
118	19	RG_SCDTC_INV-1_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples
119	20	RG_SCDTC_INV-2_2020-09-13	✓	-	Composite-taxa benthic invertebrate tissue samples

Sample(s) Released By: Jennifer Ings	Sample(s) Received By: GERIENE LABINE
Signature:	Signature: Geriene LB
Date Sent:	Date Received: 30 SEP 2020 (PROJECT #: 2020-151)
Sample(s) Returned to Client By:	Shipping Conditions:
	Shipping Container:
Signature:	Date Sent:

* Sample container reads "2020-09-12". GOL 30 Sep 2020. Corrections applied as per Client email 30 Sep 2020. DJS
▲ Sample container reads "GH_". GOL 30 Sep 2020

TrichAnalytics Inc. 207-1753 Sean Heights, Saanichton, BC, V8M 0B3 Ph: (250) 532-1084		Chain of Custody (COC) for LA-ICP-MS Analysis	
Invoicing		Reporting (if different from Invoicing)	
Project Number: GHO LAEMP (20-22) (PO 707822)			
Company Name:	Teck Coal Limited	Company Name:	Minnow Environmental
Contact Name:	Cait Good	Contact Name:	Jess Tester
Address:	421 Pine Avenue	Address:	2 Lamb Street
City, Province:	Sparwood, BC	City, Province:	Georgetown, ON
Postal Code:	V0B 2G0	Postal Code:	L7G 2G7
Phone:	250-425-8202	Phone:	250-595-1627
Email:	cait.goog@teck.com	Email:	jtester@minnow.ca

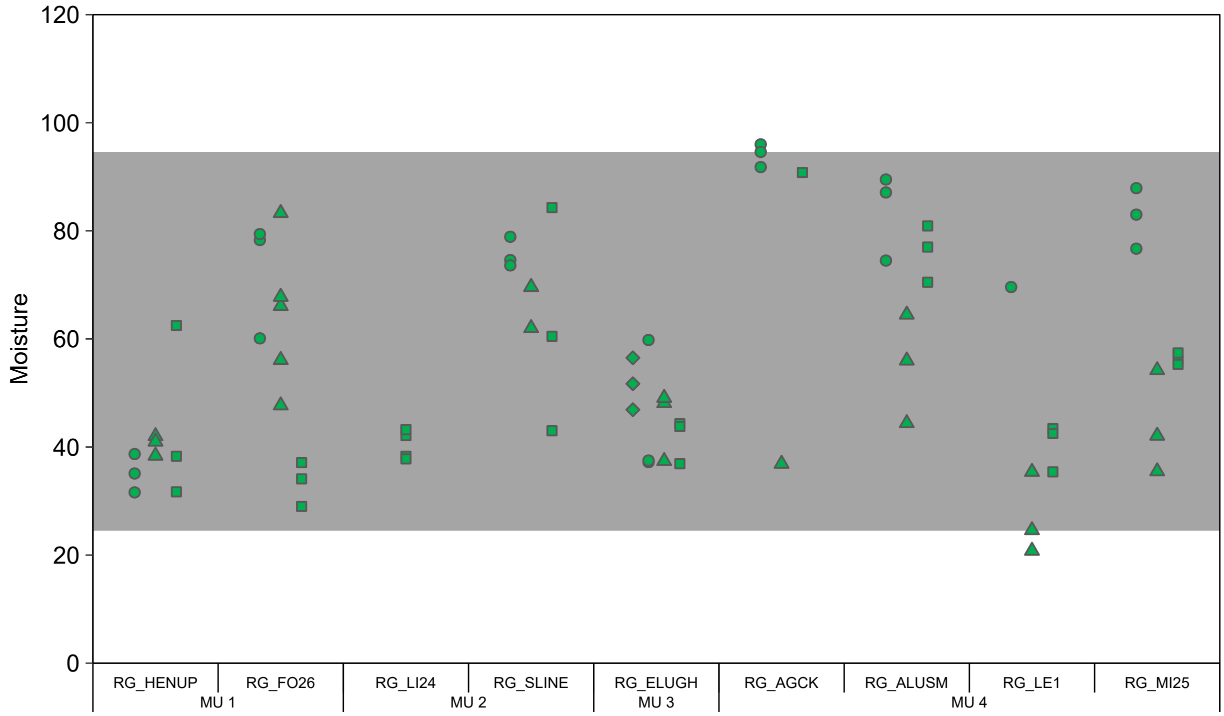
Sample Analysis Requested

	Sample Identification:		Sample Type: Species	Sample type
120	21	RG_SCDTC_INV-3_2020-09-13 ✓	-	Composite-taxa benthic invertebrate tissue samples
121	22	RG_THCK_INV-1_2020-09-10 ✓	-	Composite-taxa benthic invertebrate tissue samples
122	23	RG_THCK_INV-2-2020-09-10 ✓	-	Composite-taxa benthic invertebrate tissue samples
123	24	RG_THCK_INV-3_2020-09-10 ✓	-	Composite-taxa benthic invertebrate tissue samples
124	25	RG_EL20_INV-1_2020-09-15 ✓	-	Composite-taxa benthic invertebrate tissue samples
125	26	RG_EL20_INV-2_2020-09-~~15~~ 16 ** ✓	-	Composite-taxa benthic invertebrate tissue samples
126	27	RG_EL20_INV-3_2020-09-~~15~~ 16 ** ✓	-	Composite-taxa benthic invertebrate tissue samples
127	28	RG_EL20_INV-4_2020-09-~~15~~ 16 ** ✓	-	Composite-taxa benthic invertebrate tissue samples
128	29	RG_EL20_INV-5_2020-09-15 ✓	-	Composite-taxa benthic invertebrate tissue samples
	30			
	31			
	32			
	33			
	34			
	35			
	36			
	37			
	38			
	39			
	40			

Sample(s) Released By: Jennifer Ings	Sample(s) Received By: GERIENE LABINE
Signature:	Signature: Gerienne LB
Date Sent:	Date Received: 30 SEP 2020 (PROJECT #: 2020-151)
Sample(s) Returned to Client By:	Shipping Conditions:
	Shipping Container:
Signature:	Date Sent:

** Sample container reads "2020-09-16." GL 30Sep2020. Corrections applied as per client email. 30 Sep 2020 KJS

APPENDIX H
DATA COLLECTED CONCURRENT WITH SEPTEMBER BIOLOGICAL SAMPLES



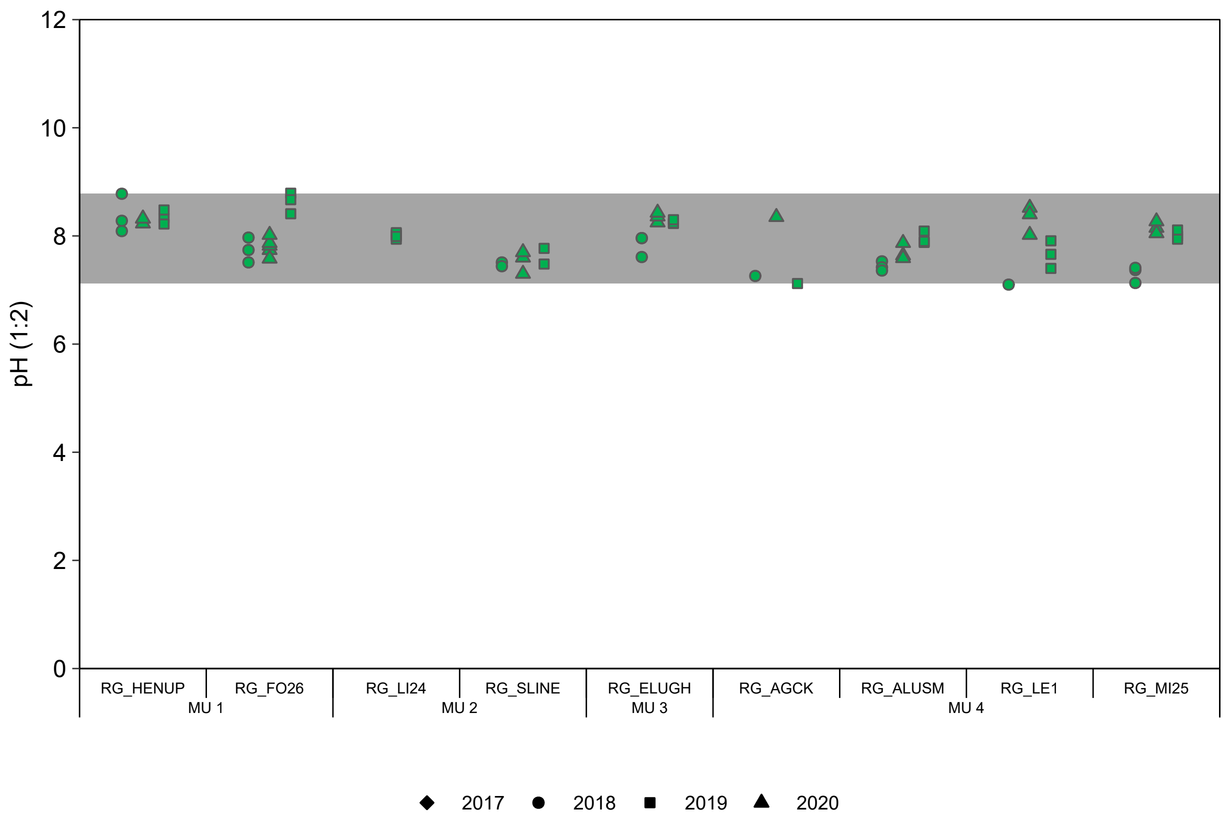


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

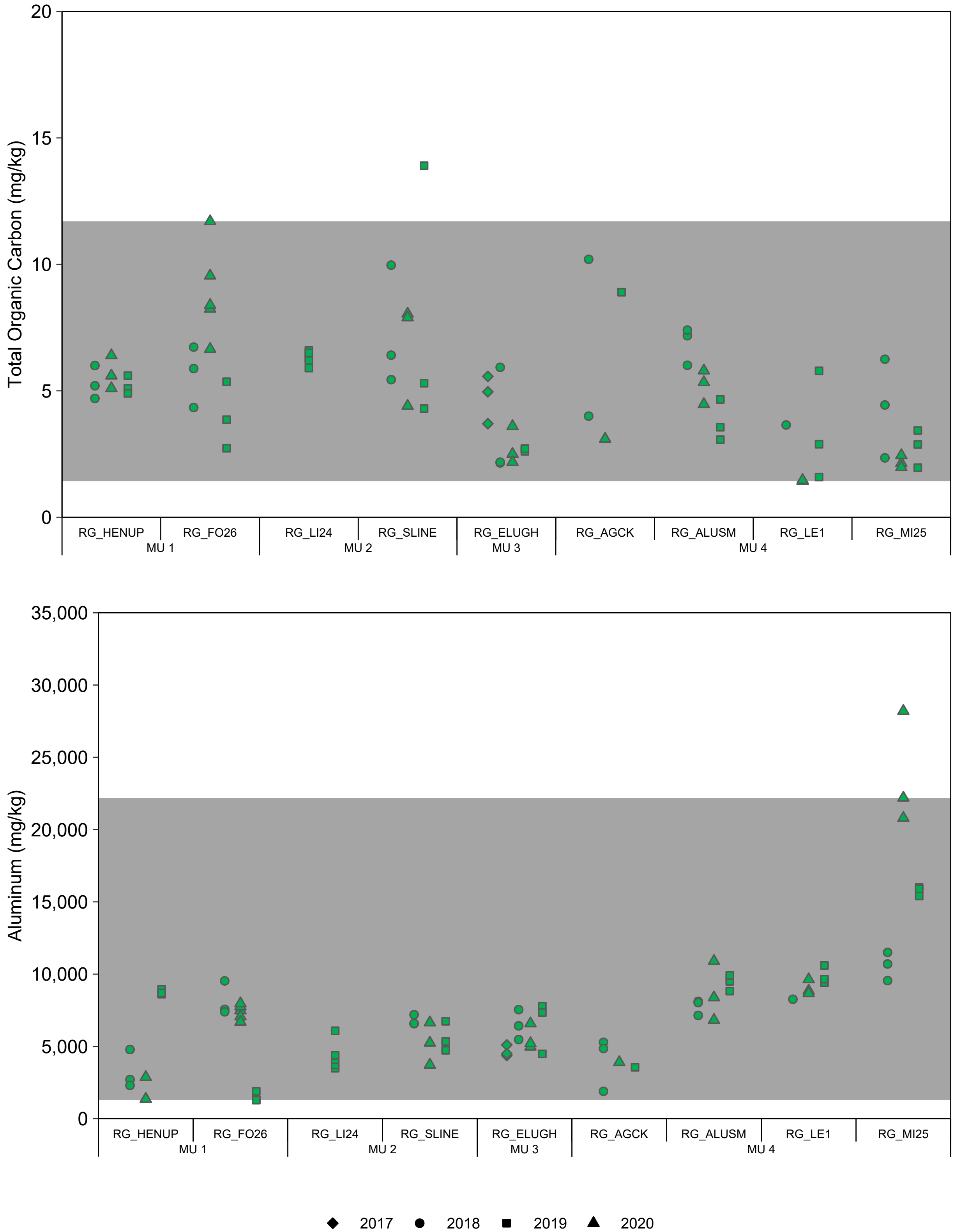


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

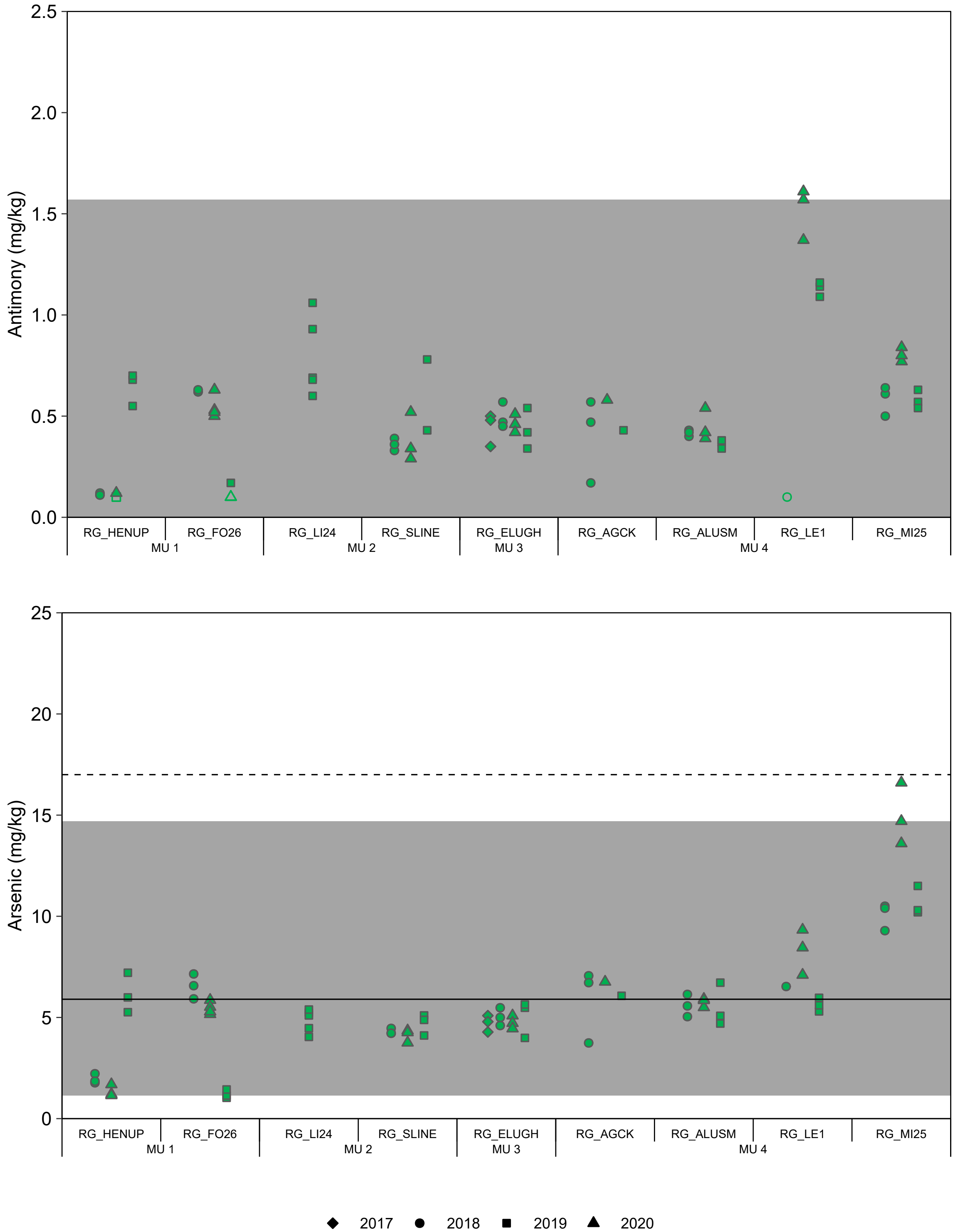


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

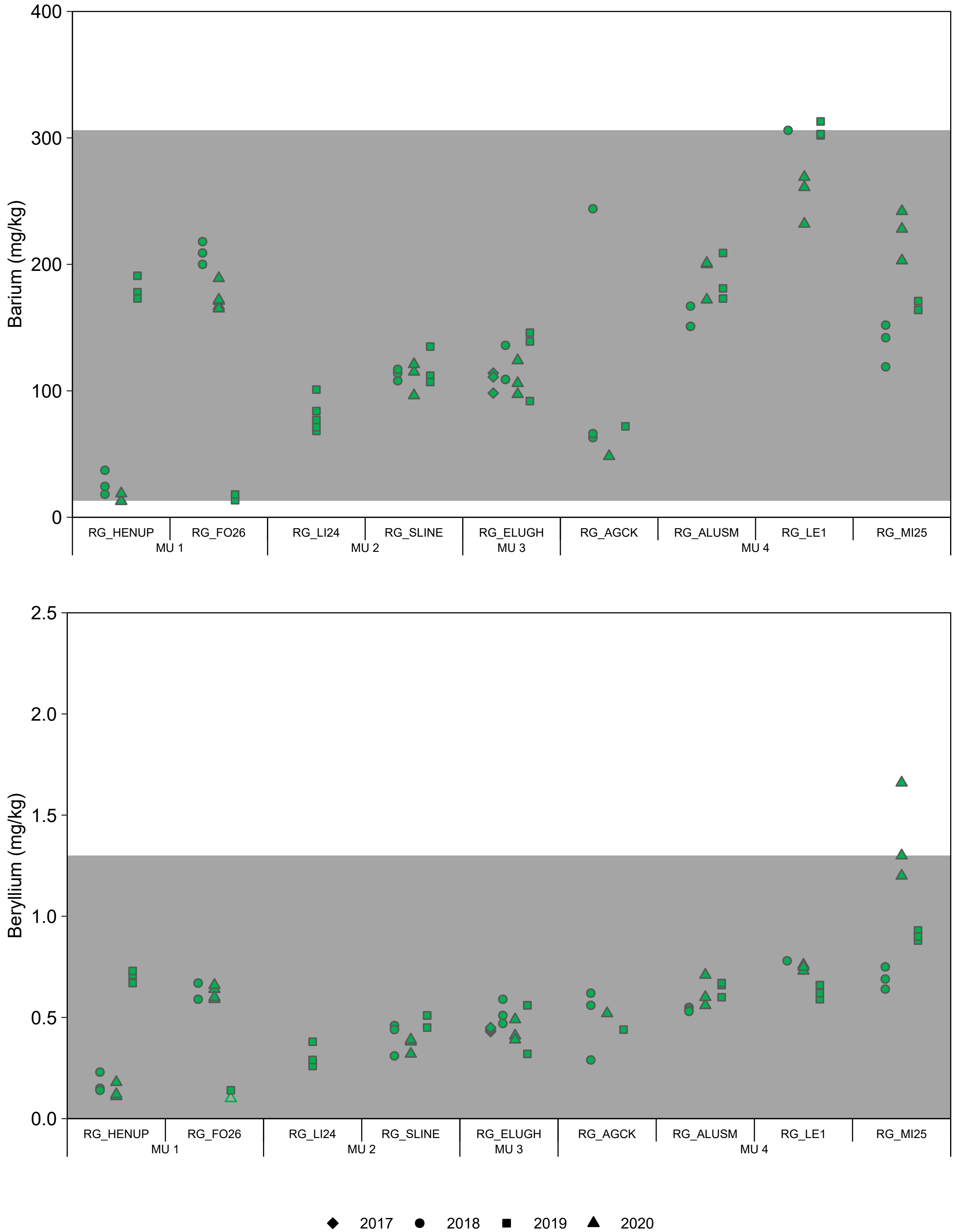


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

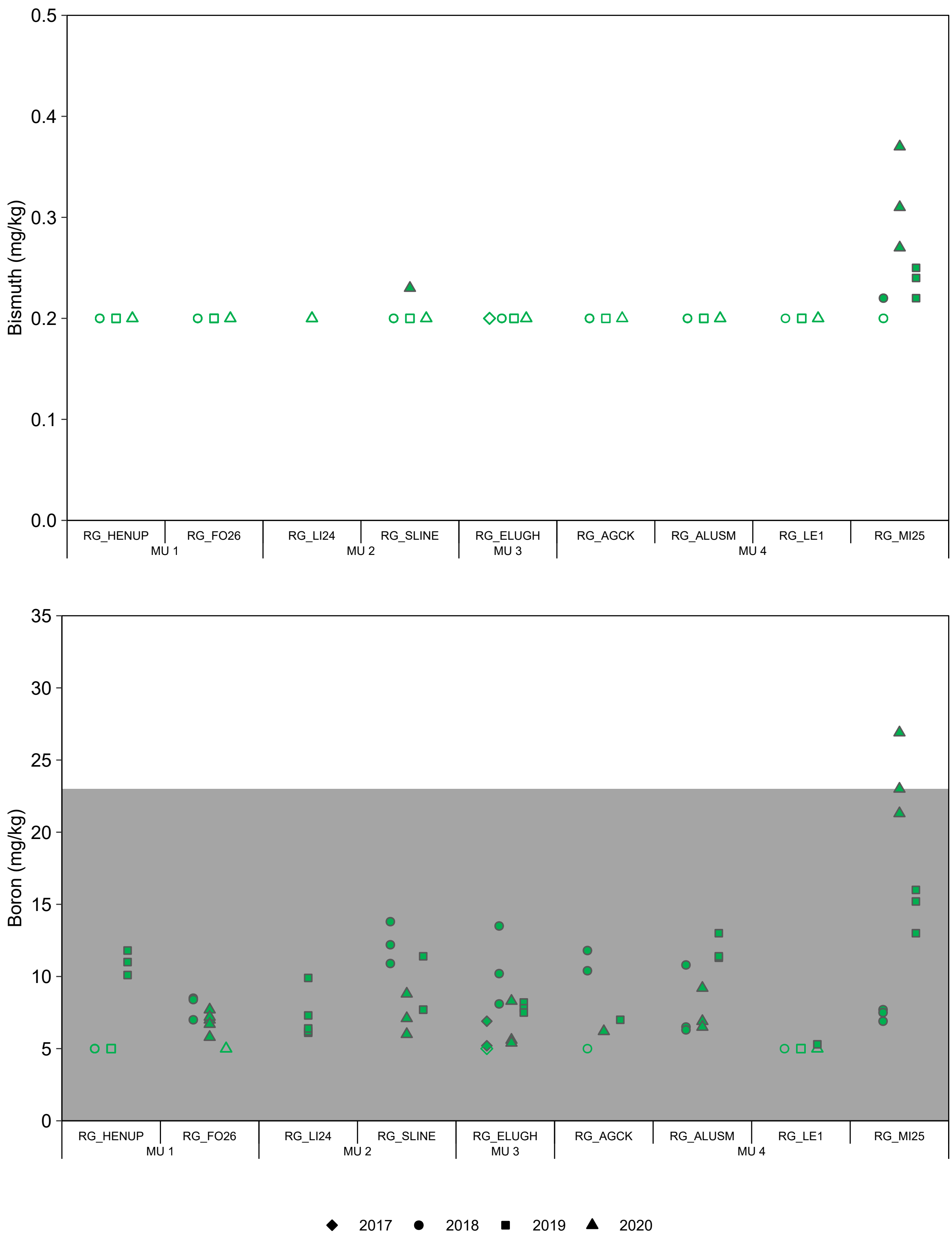


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

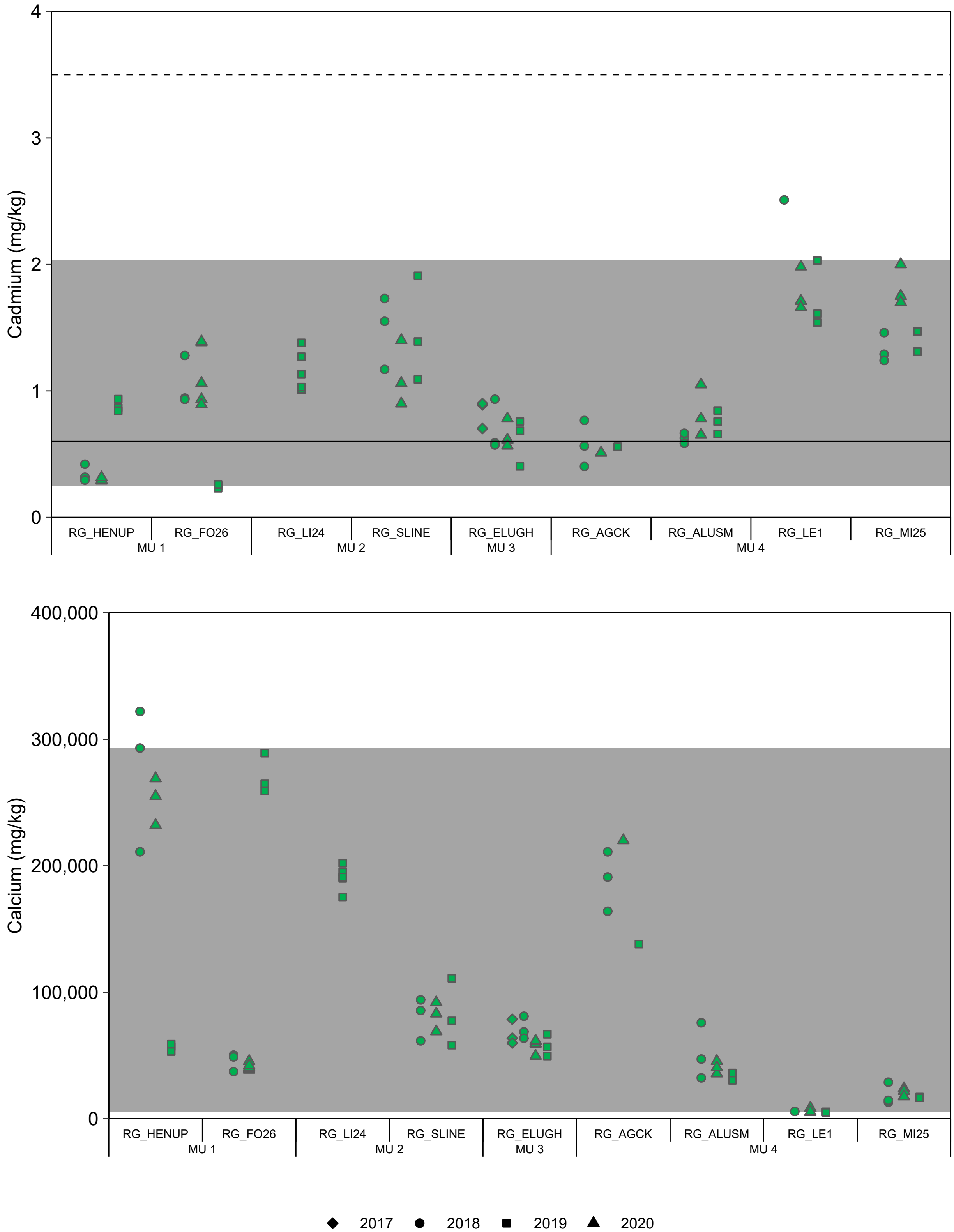


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

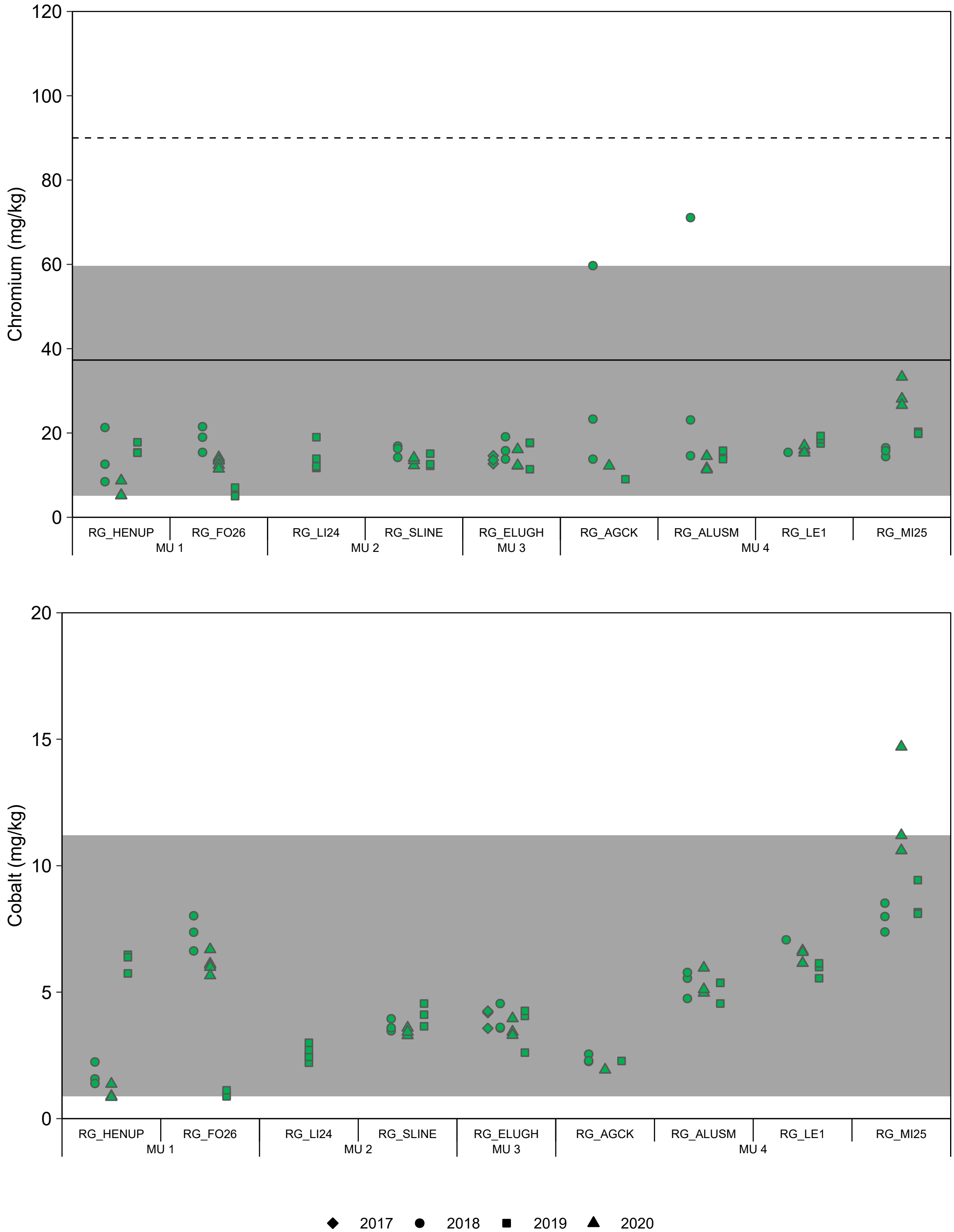


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

Notes: Solid line indicates the lower SQG. Hashed line indicates the Upper SQG. Shading represents the normal range (2.5th to 97.5th percentiles of 2017 and 2020 reference area data collected in the RAEMP, Minnow 2018). Values below the LRL limit are shown with open symbols. PAH= Polycyclic Aromatic Hydrocarbons. RAEMP= Regional Aquatic Environmental Monitoring Program. MU= Management Unit.

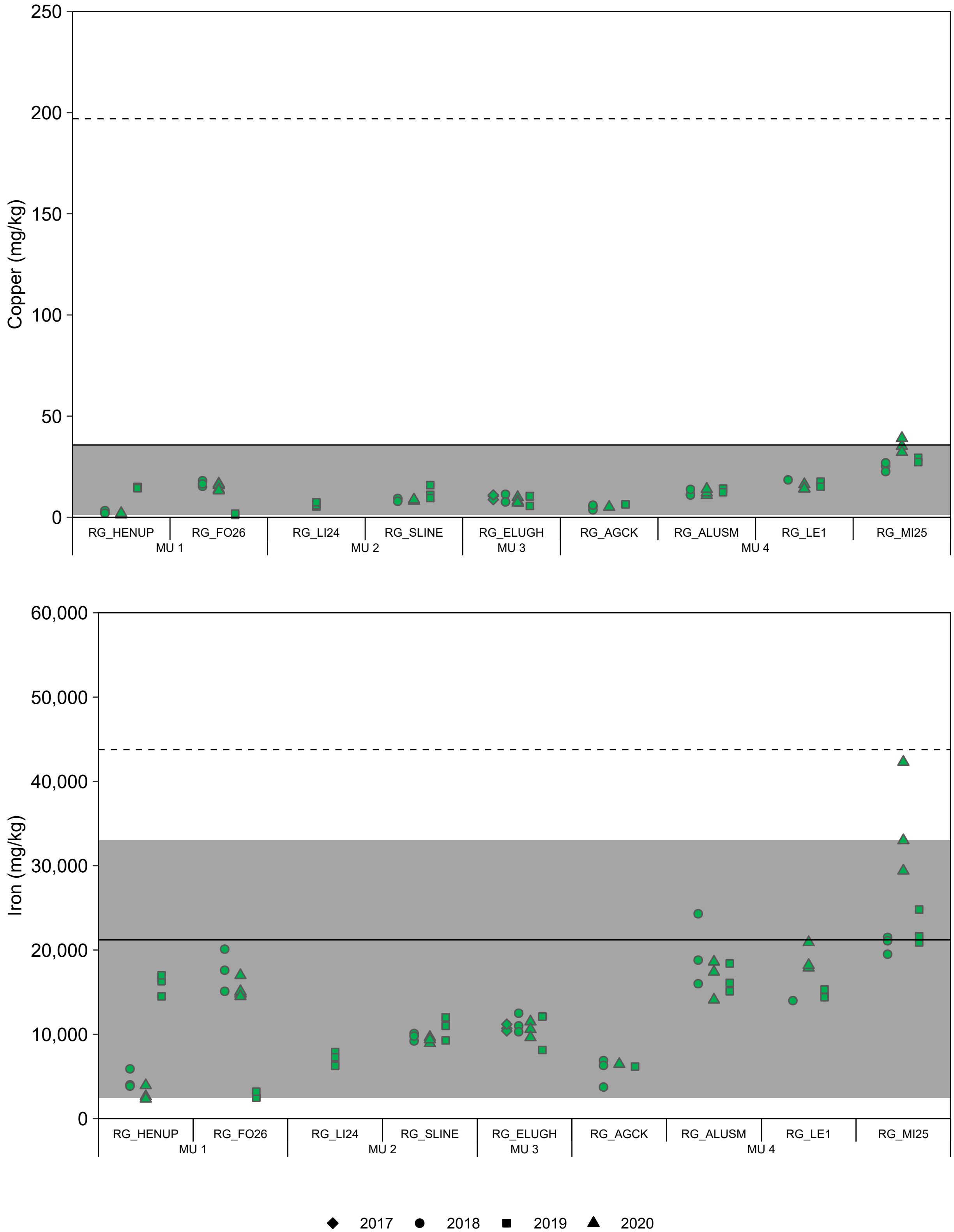


Figure 1: Sediment eta and A oncentrations from eference otic Areas Sam ed durin t e A innow 2 2 from 2 1 to 2 2 sed to a cu ate orma an es

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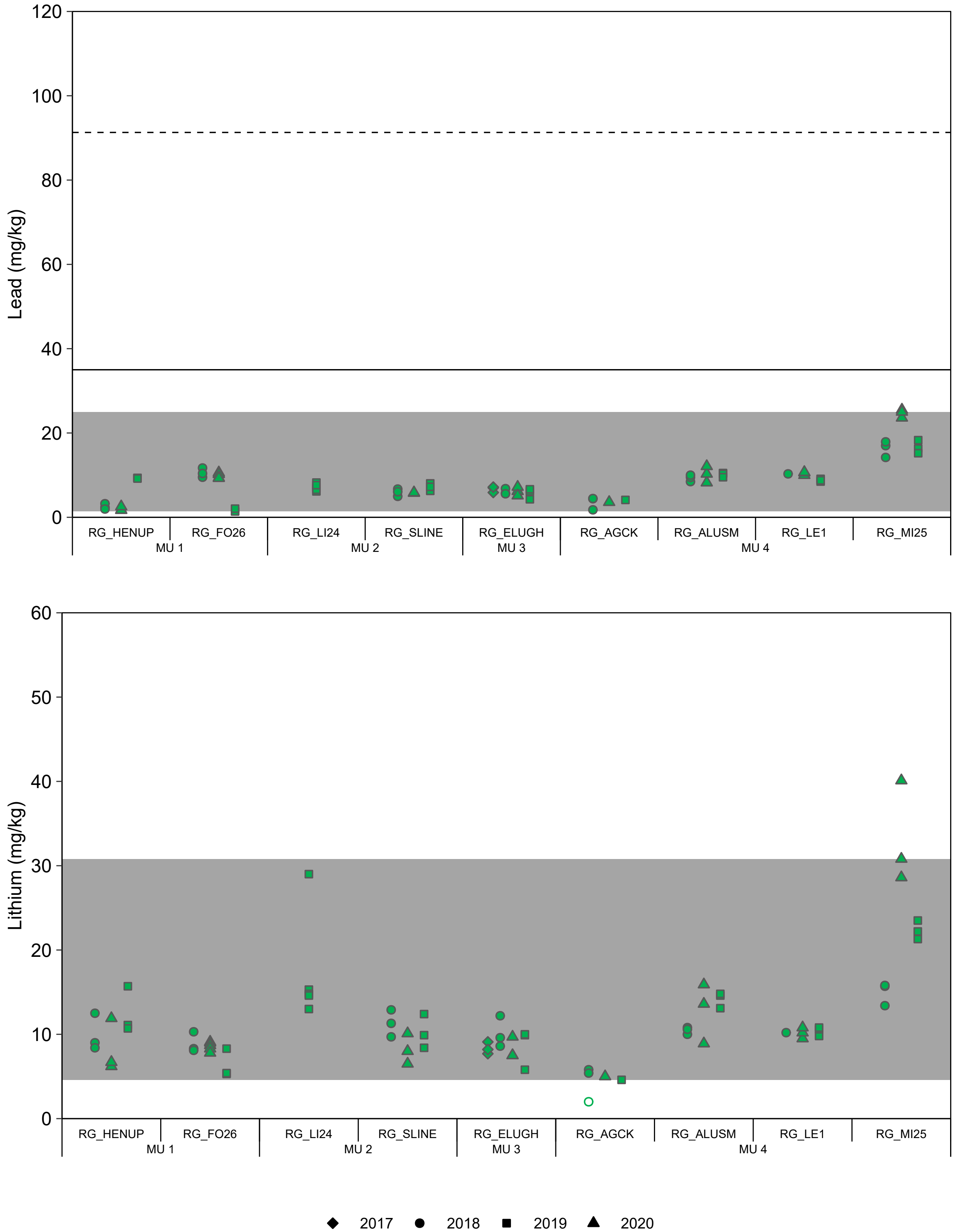

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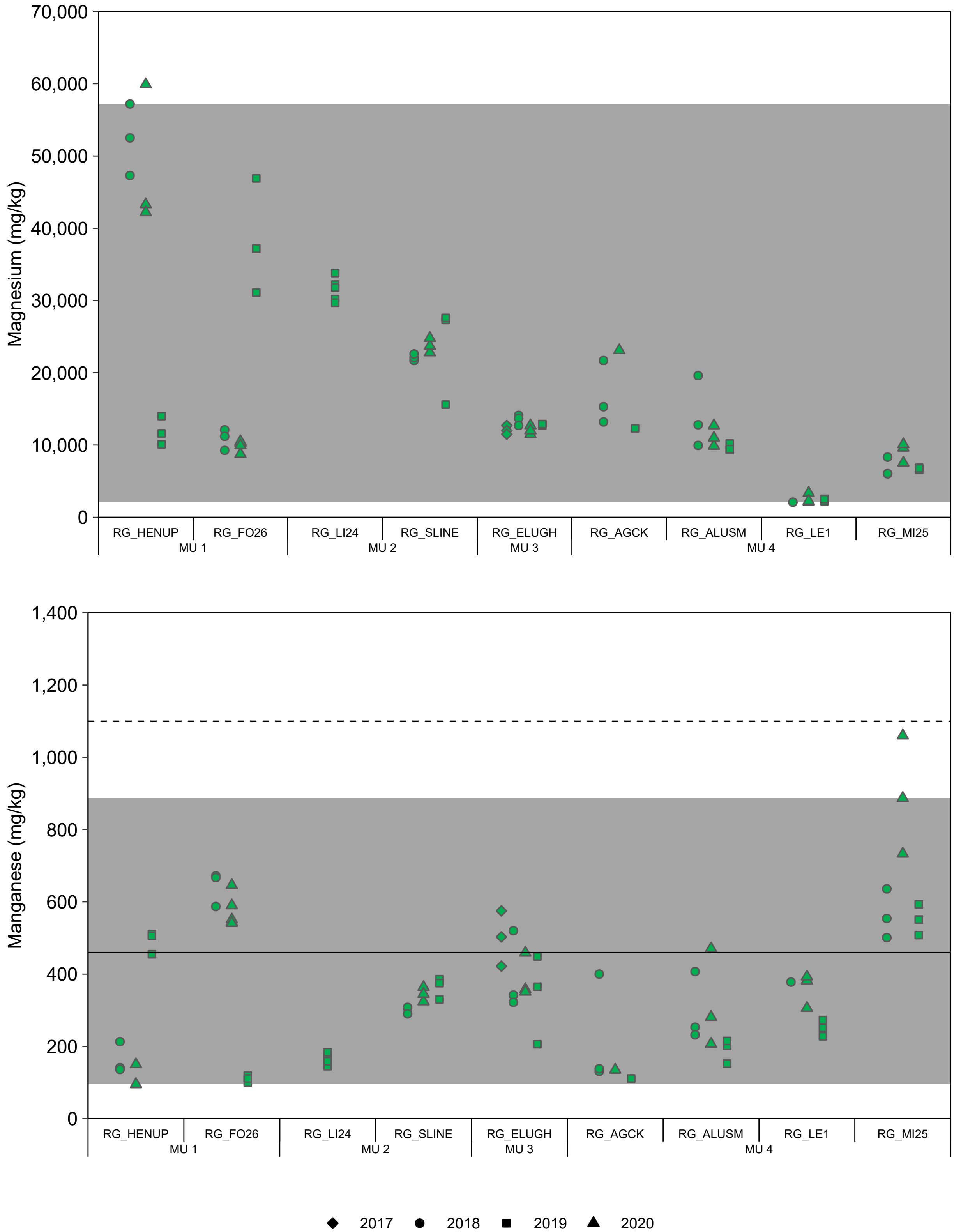

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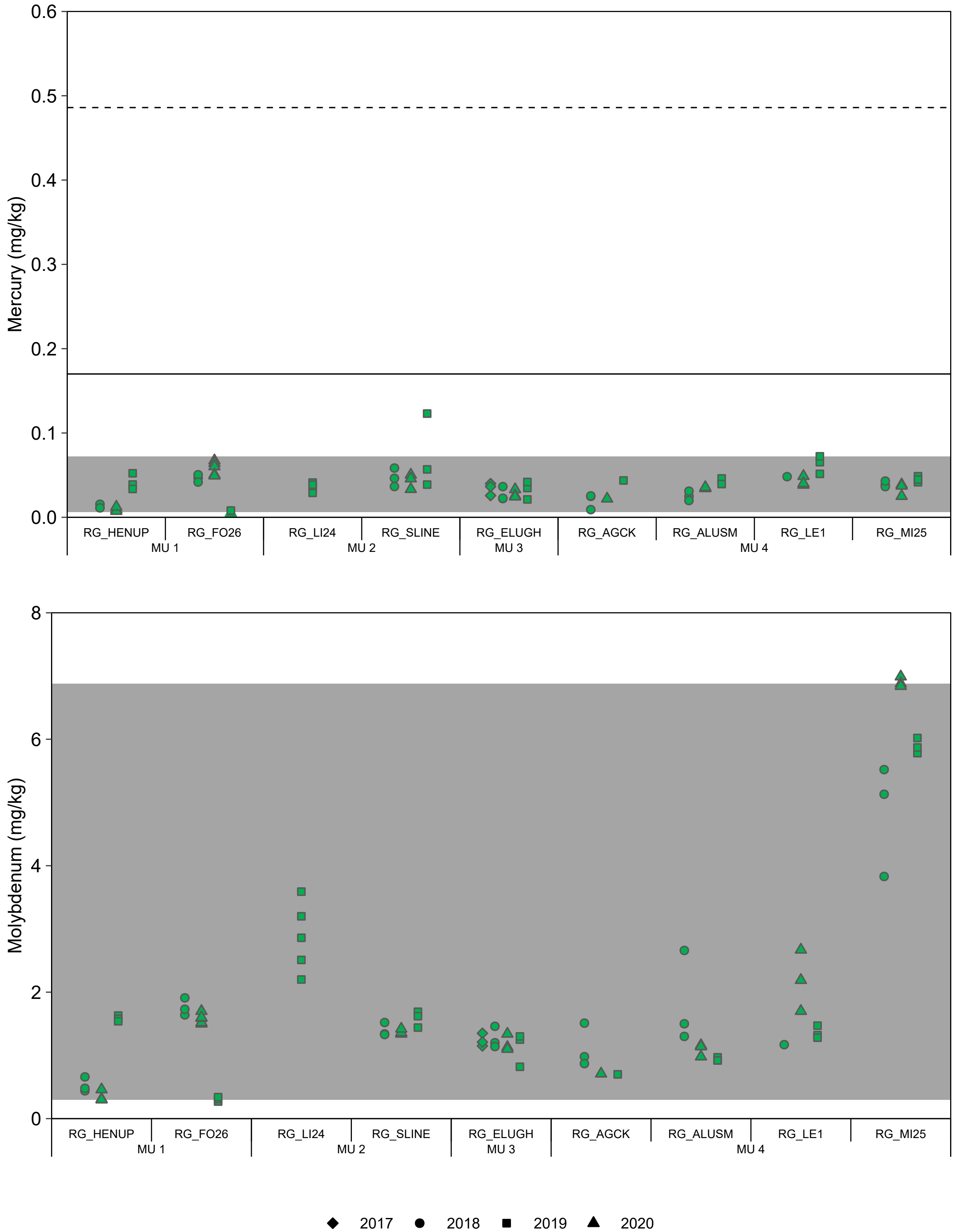

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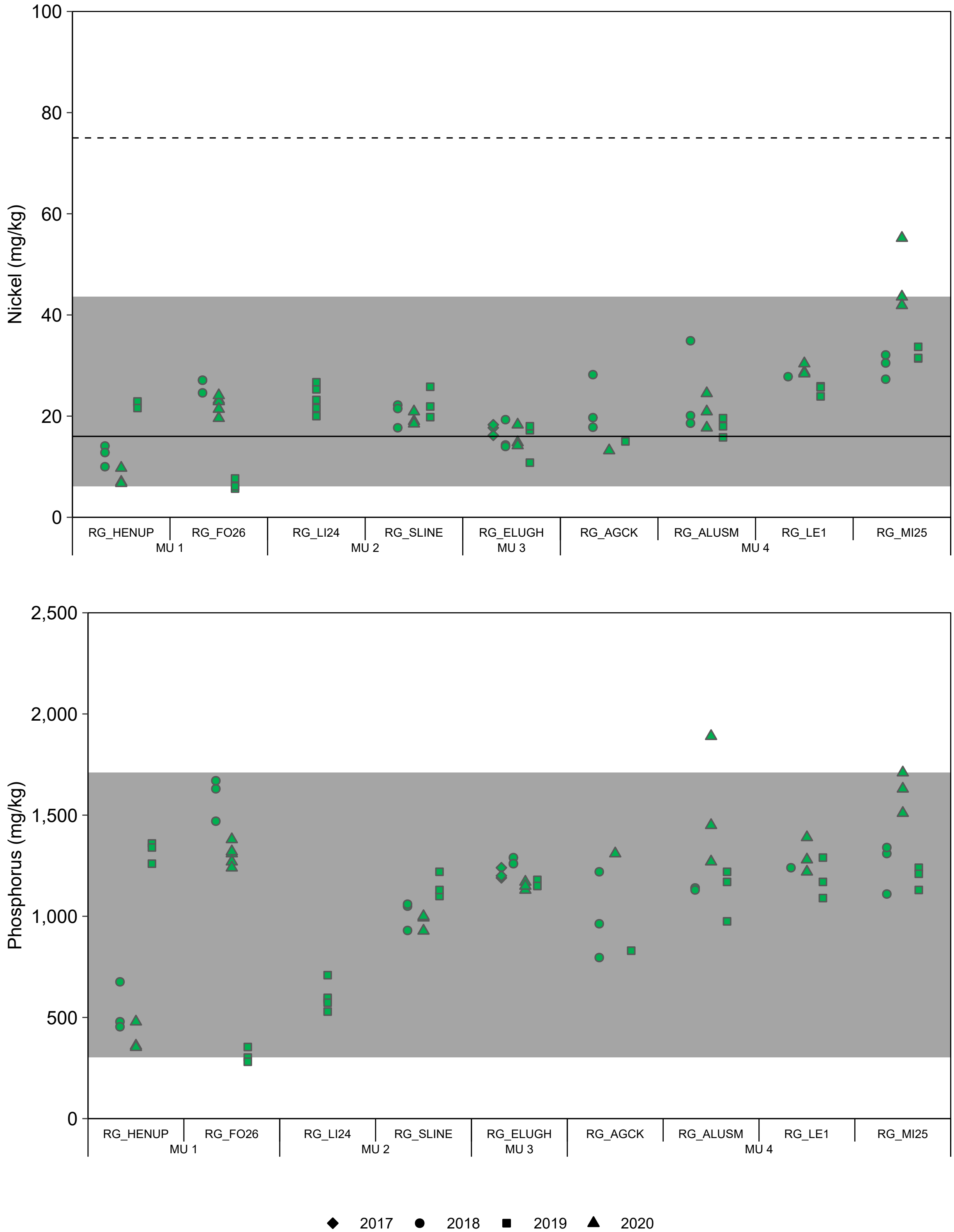

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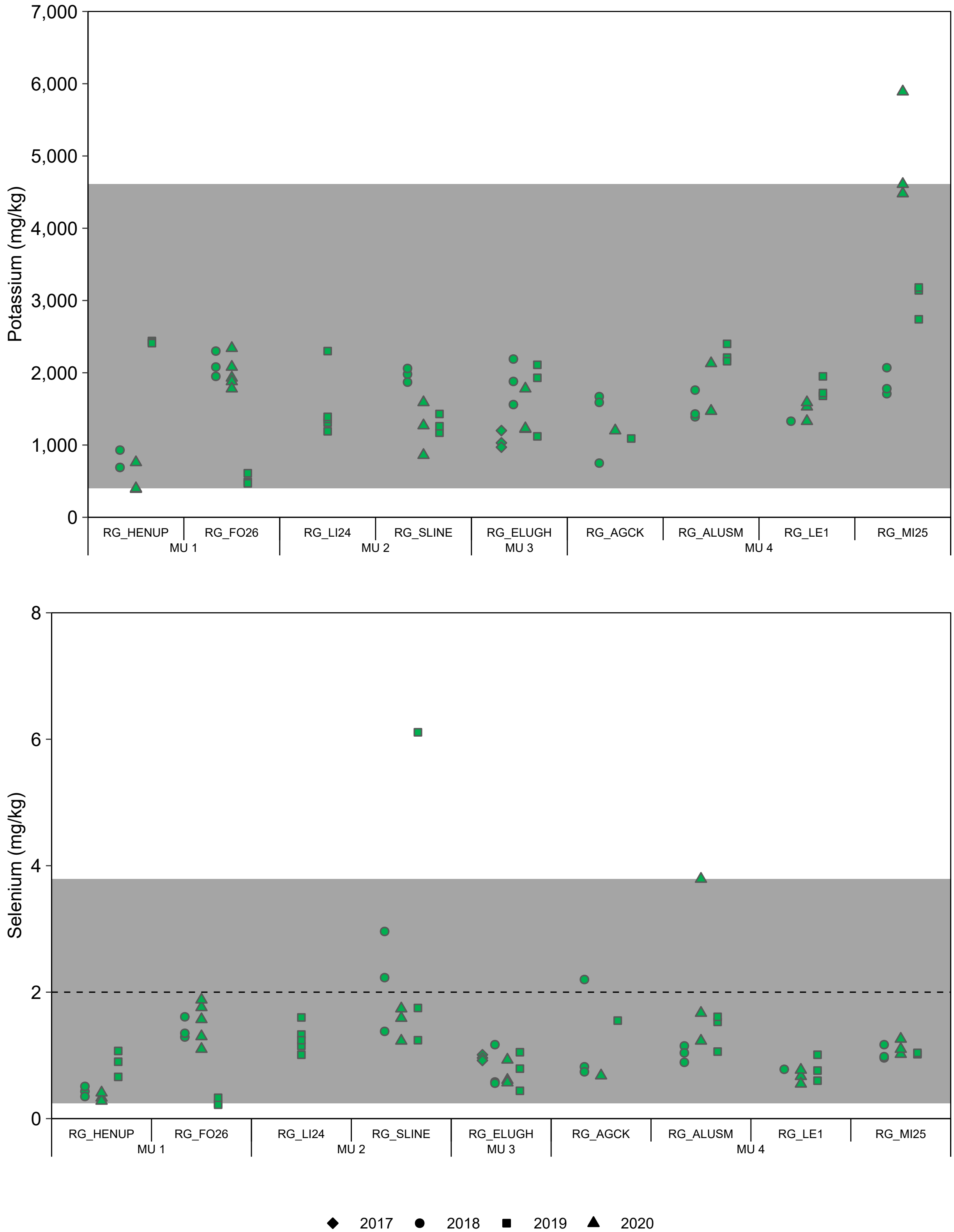

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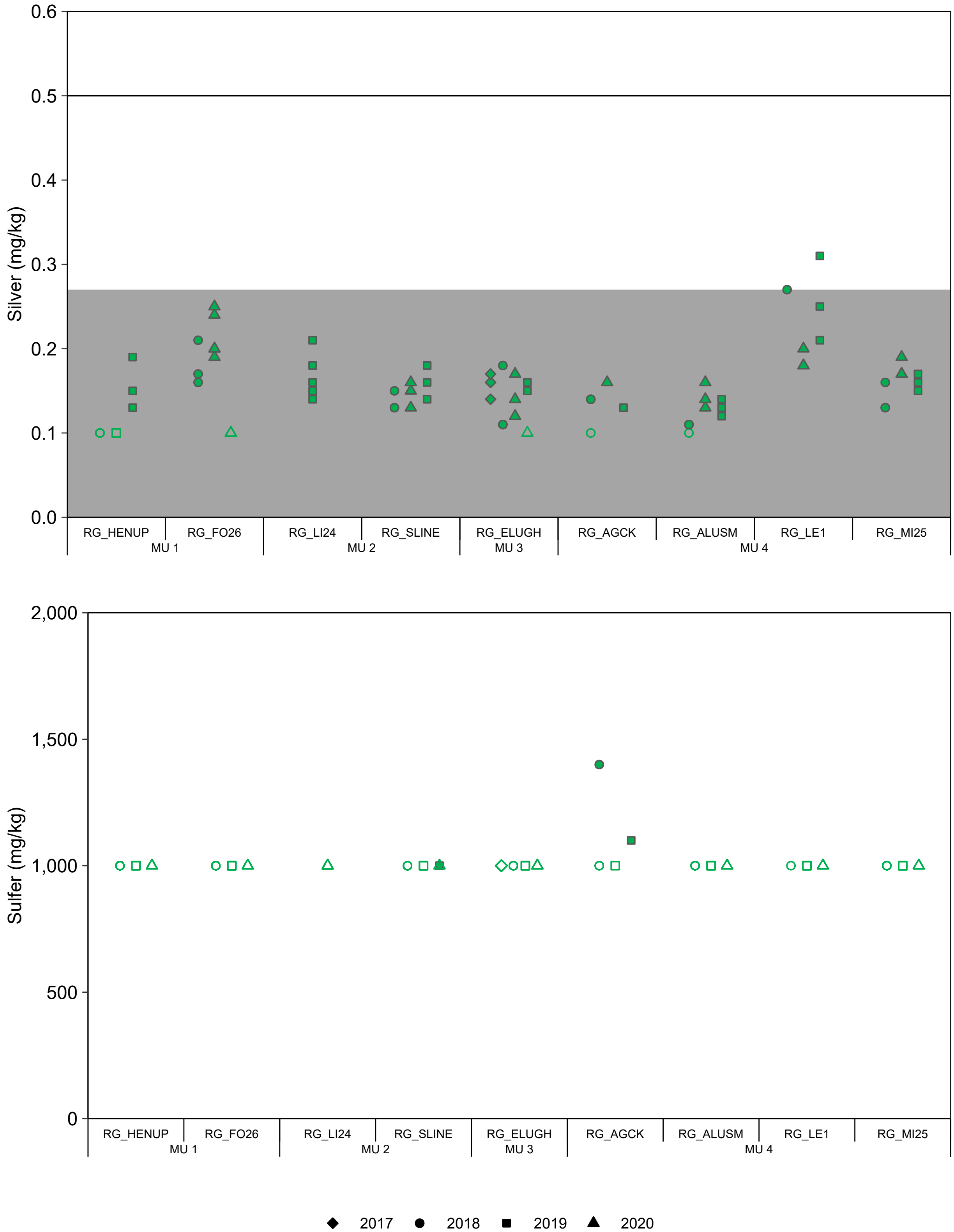

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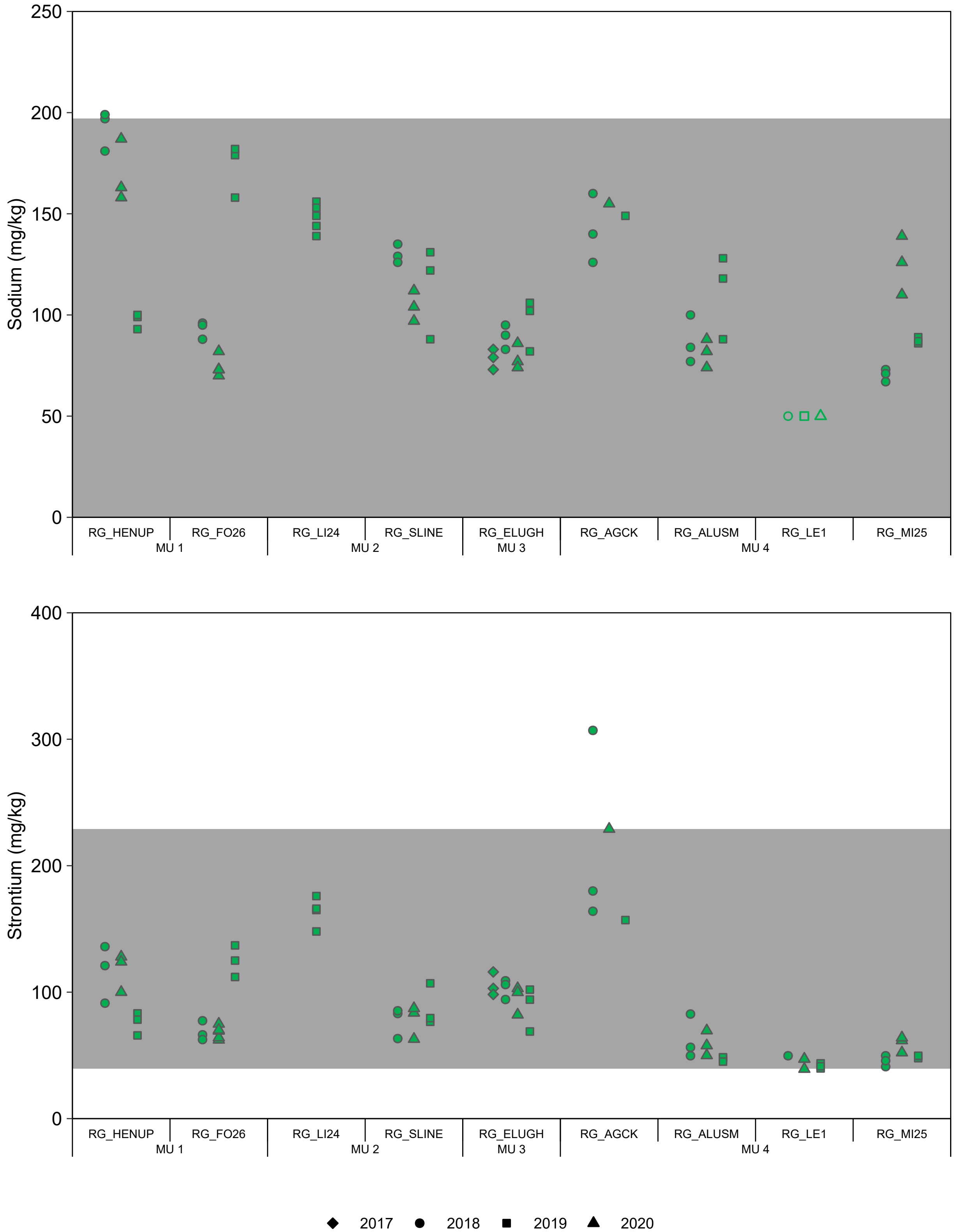

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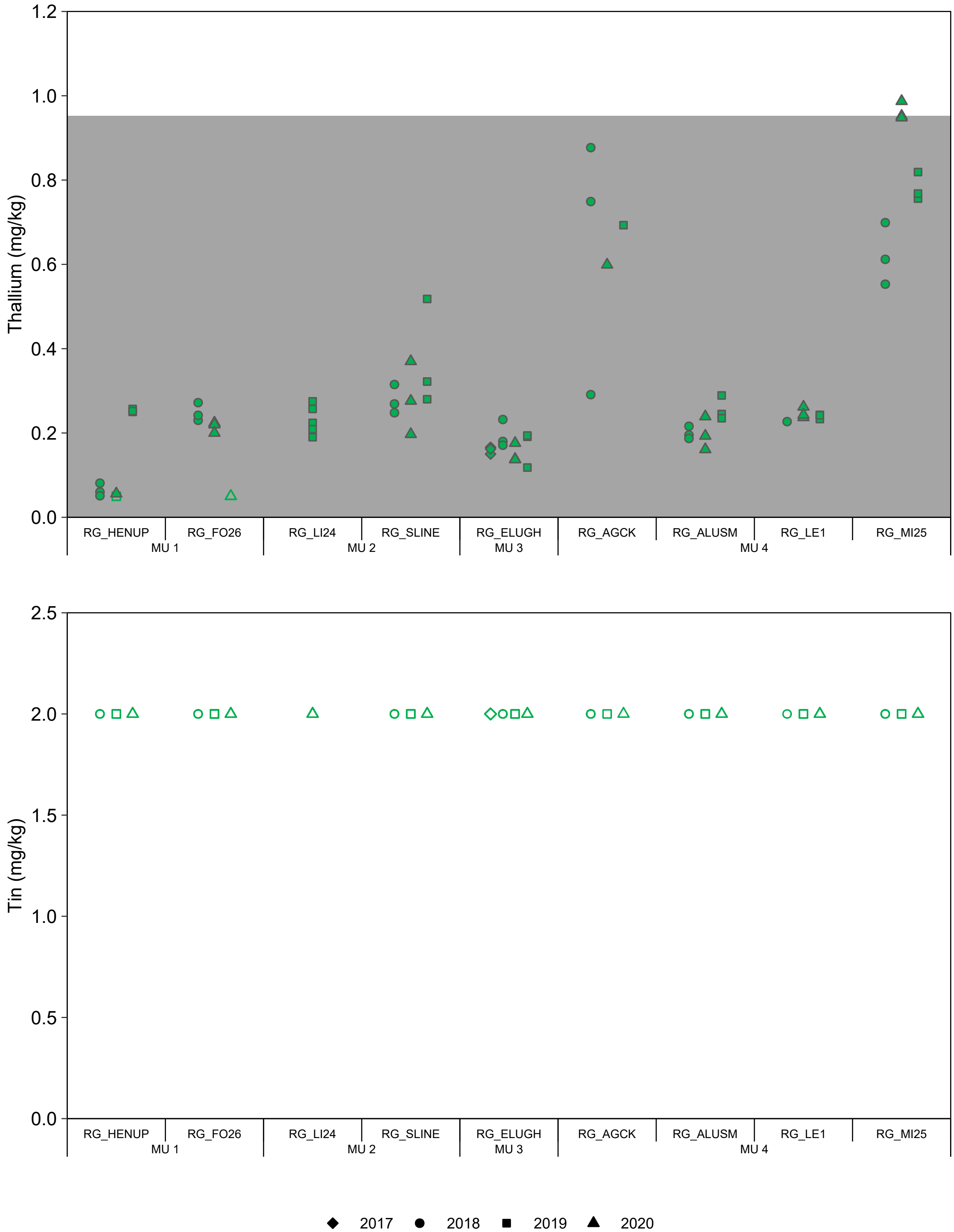

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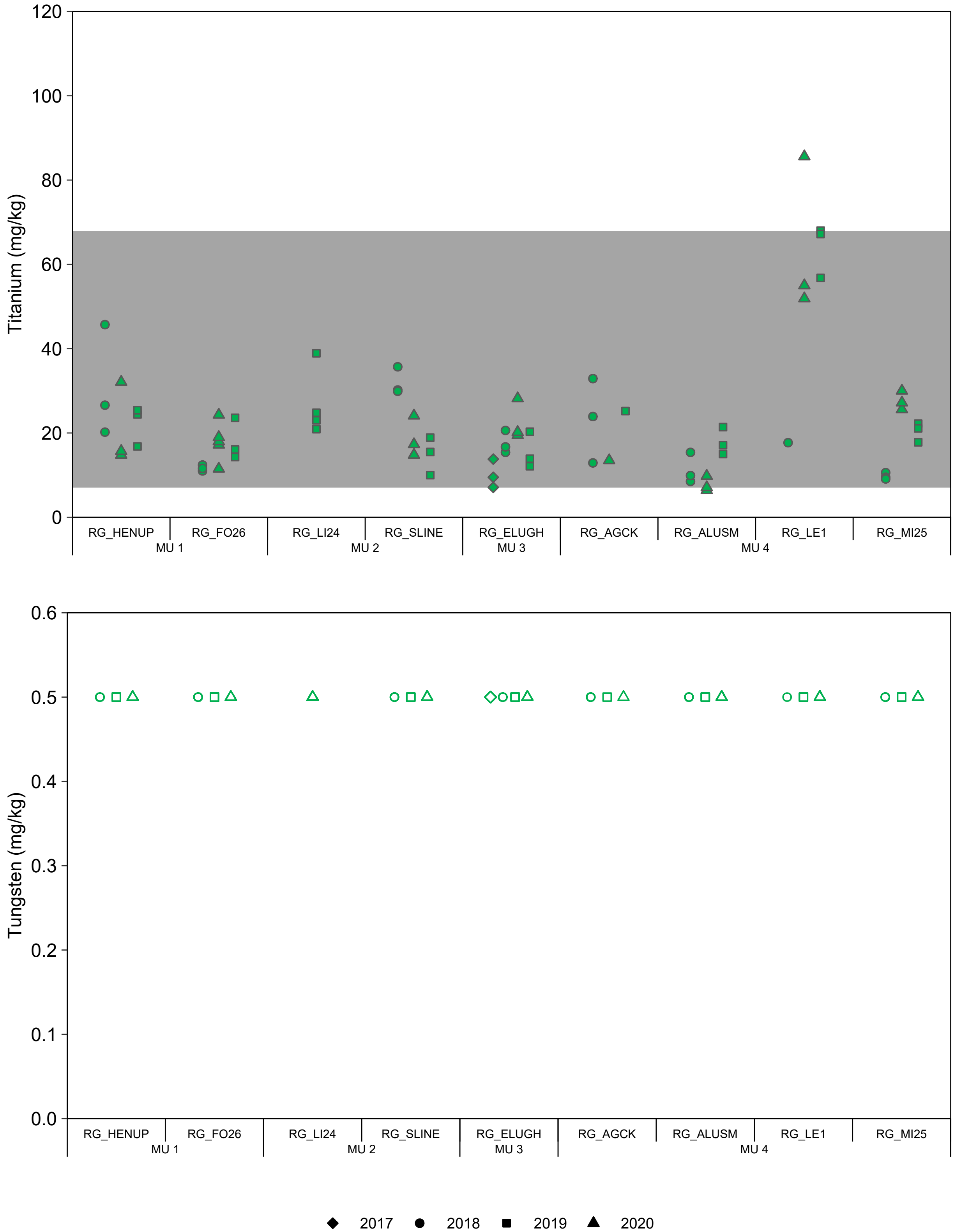

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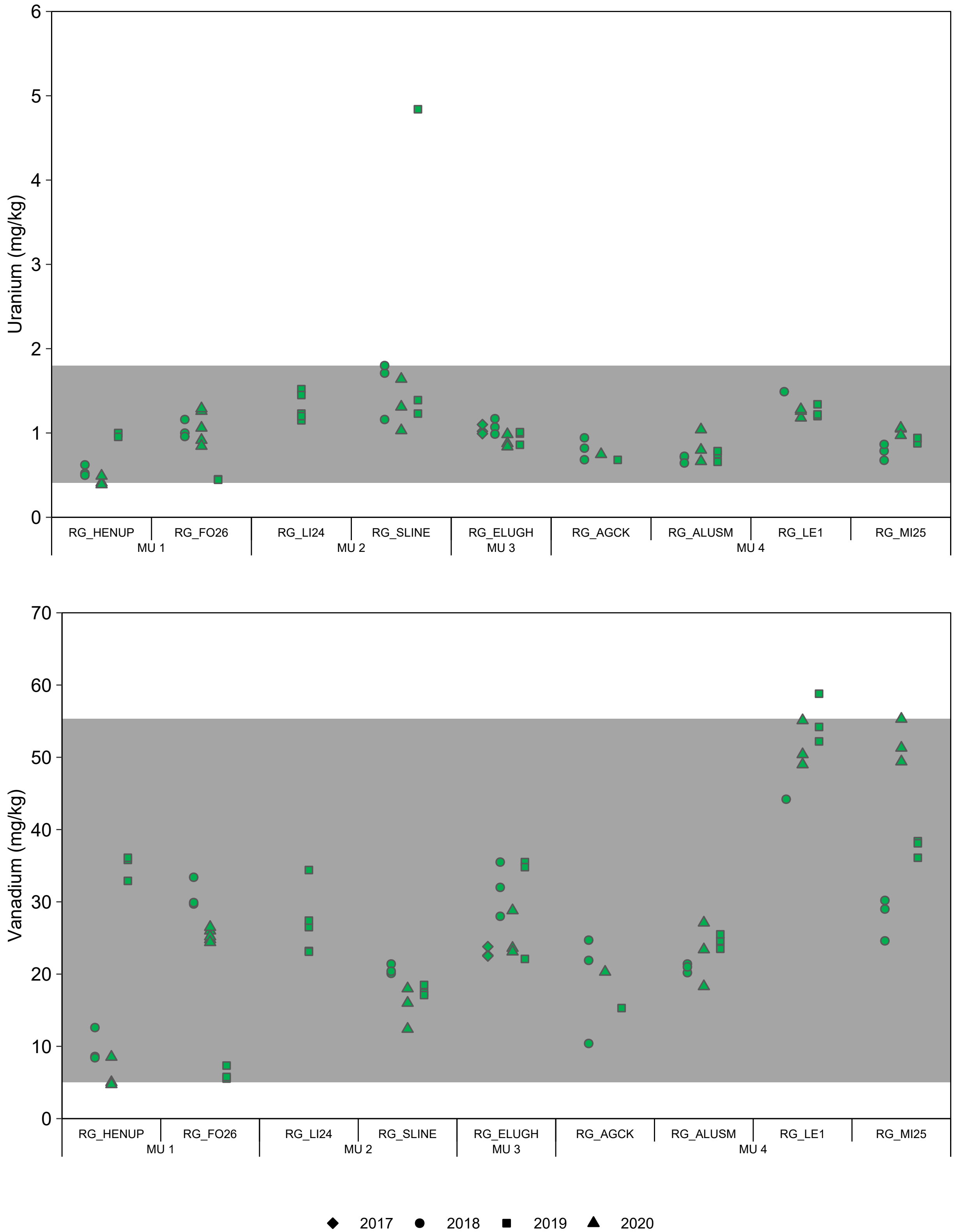

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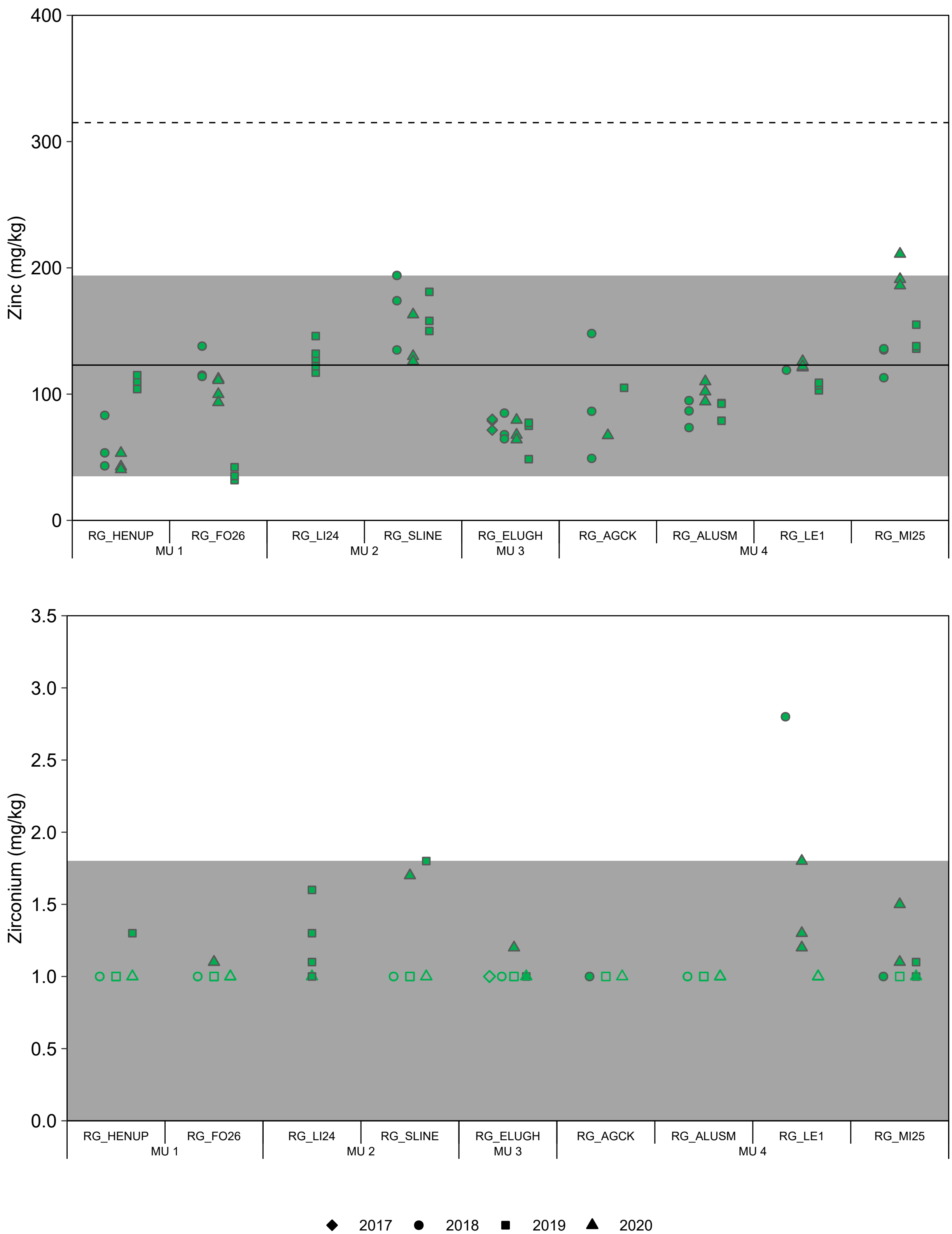

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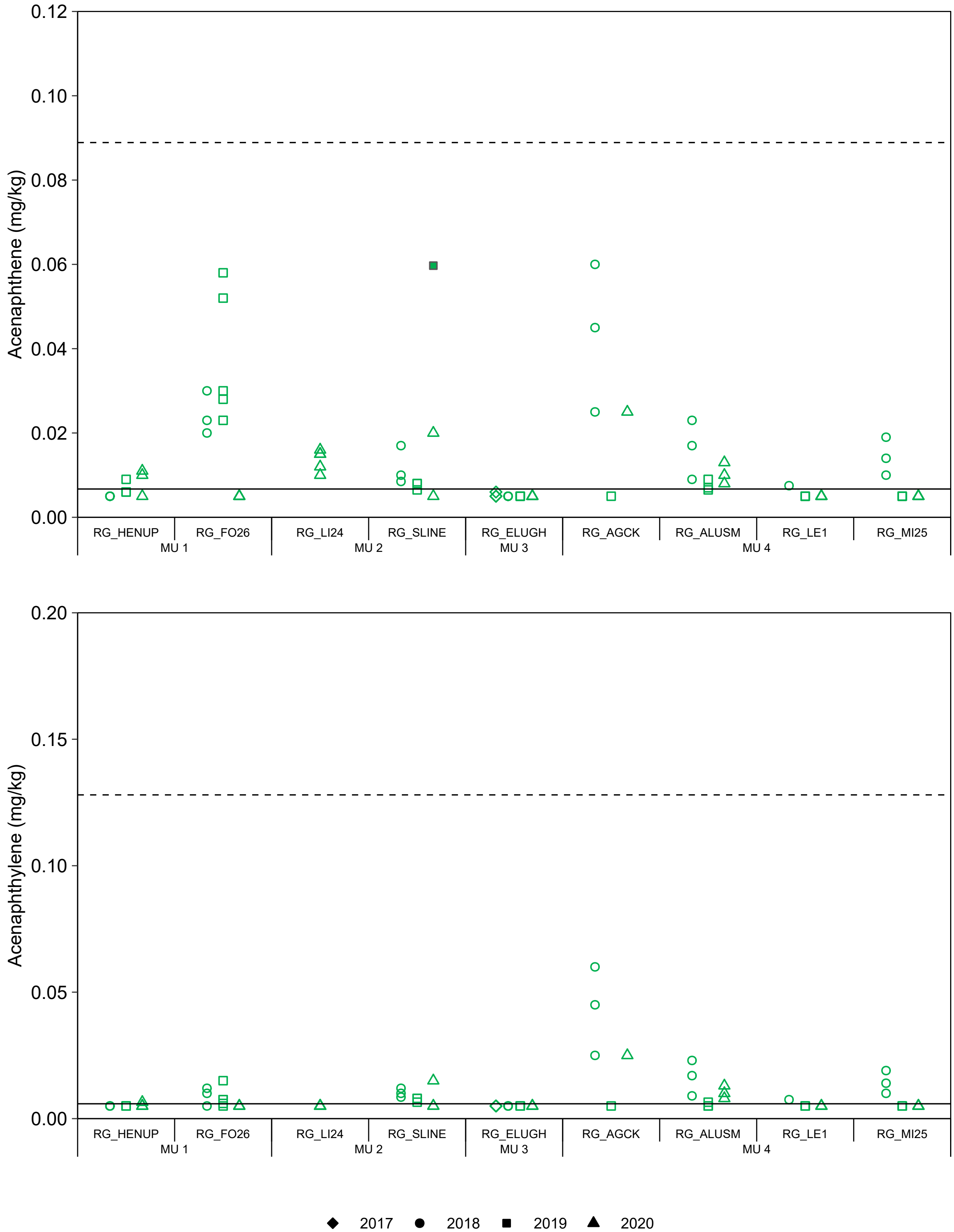

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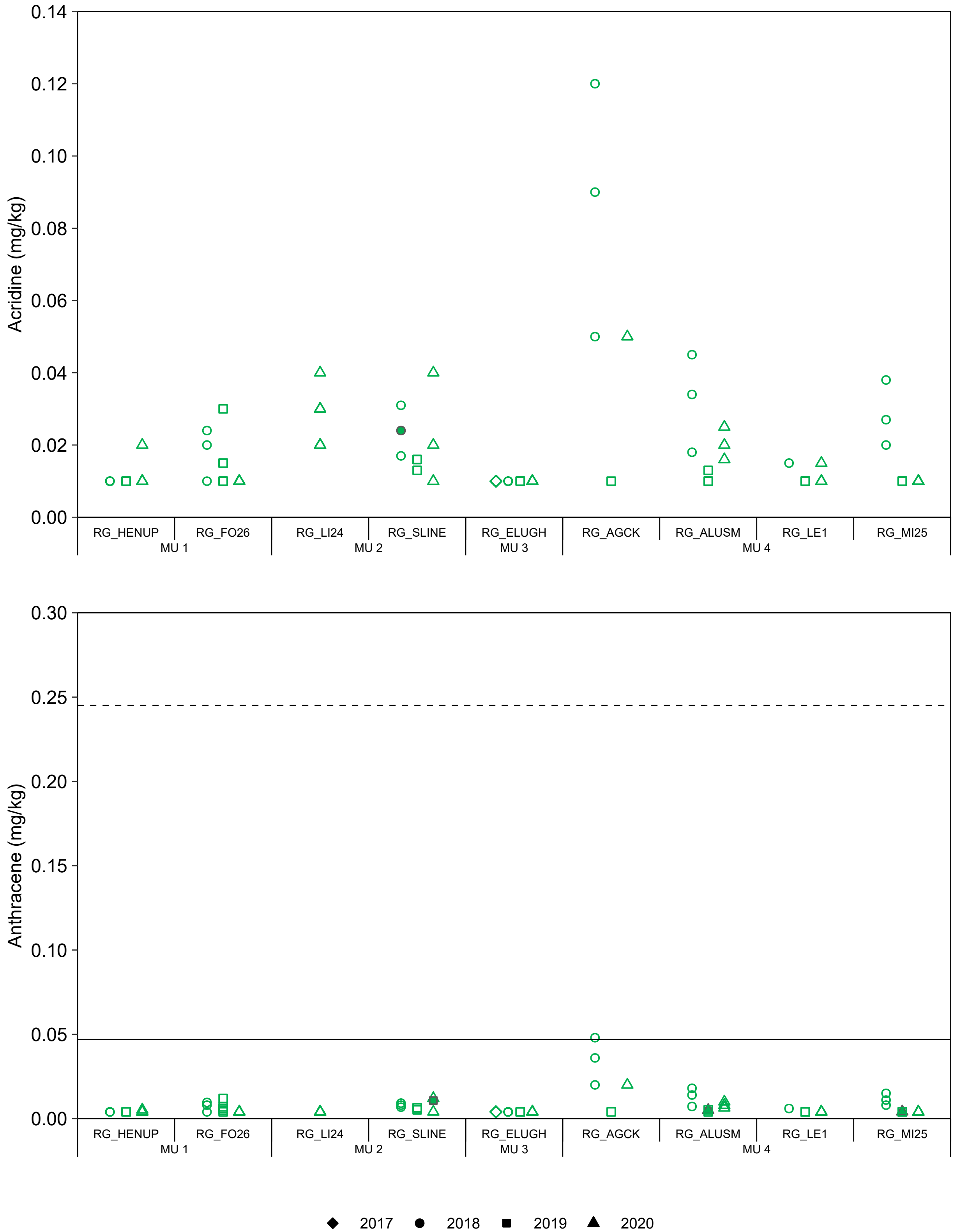

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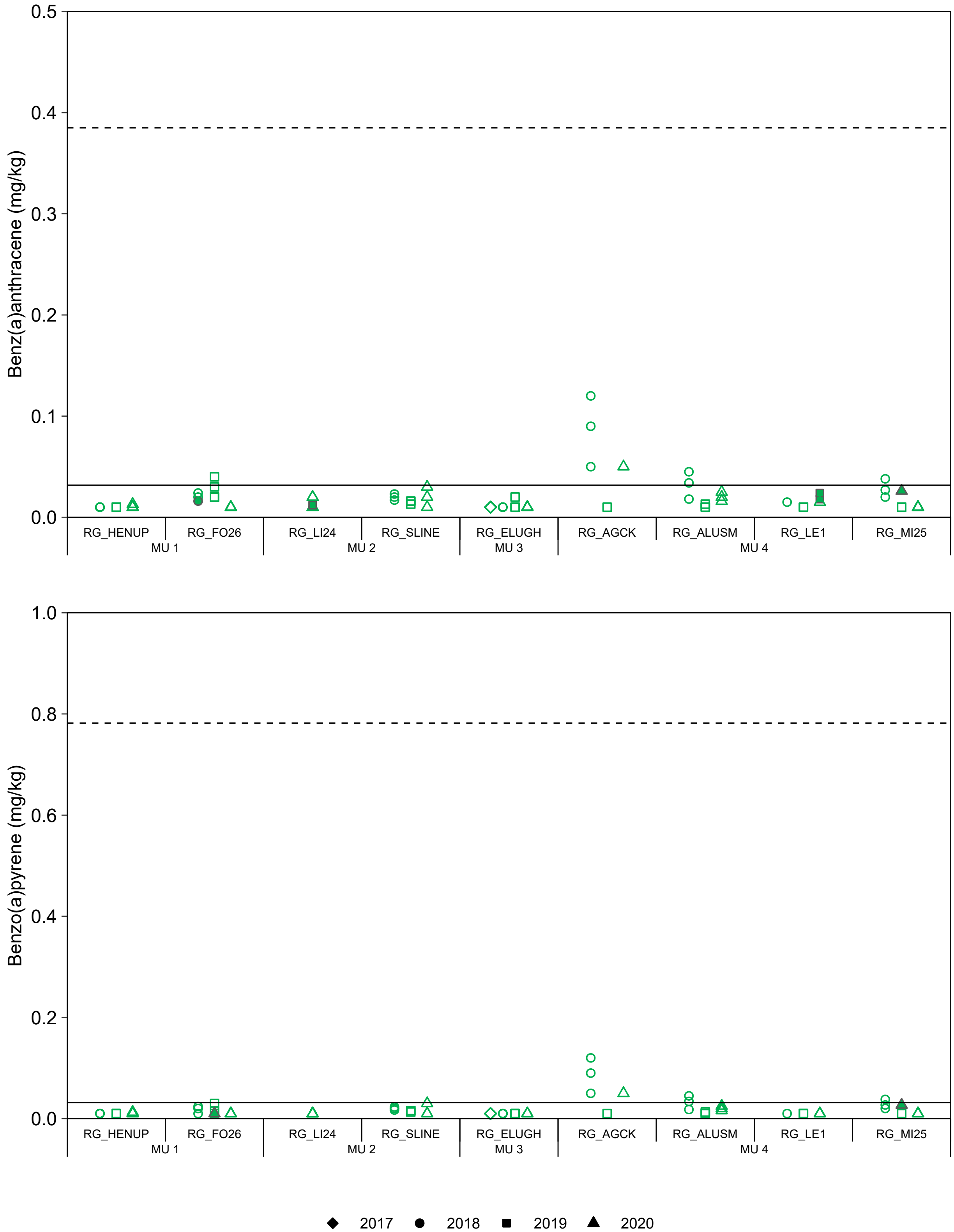

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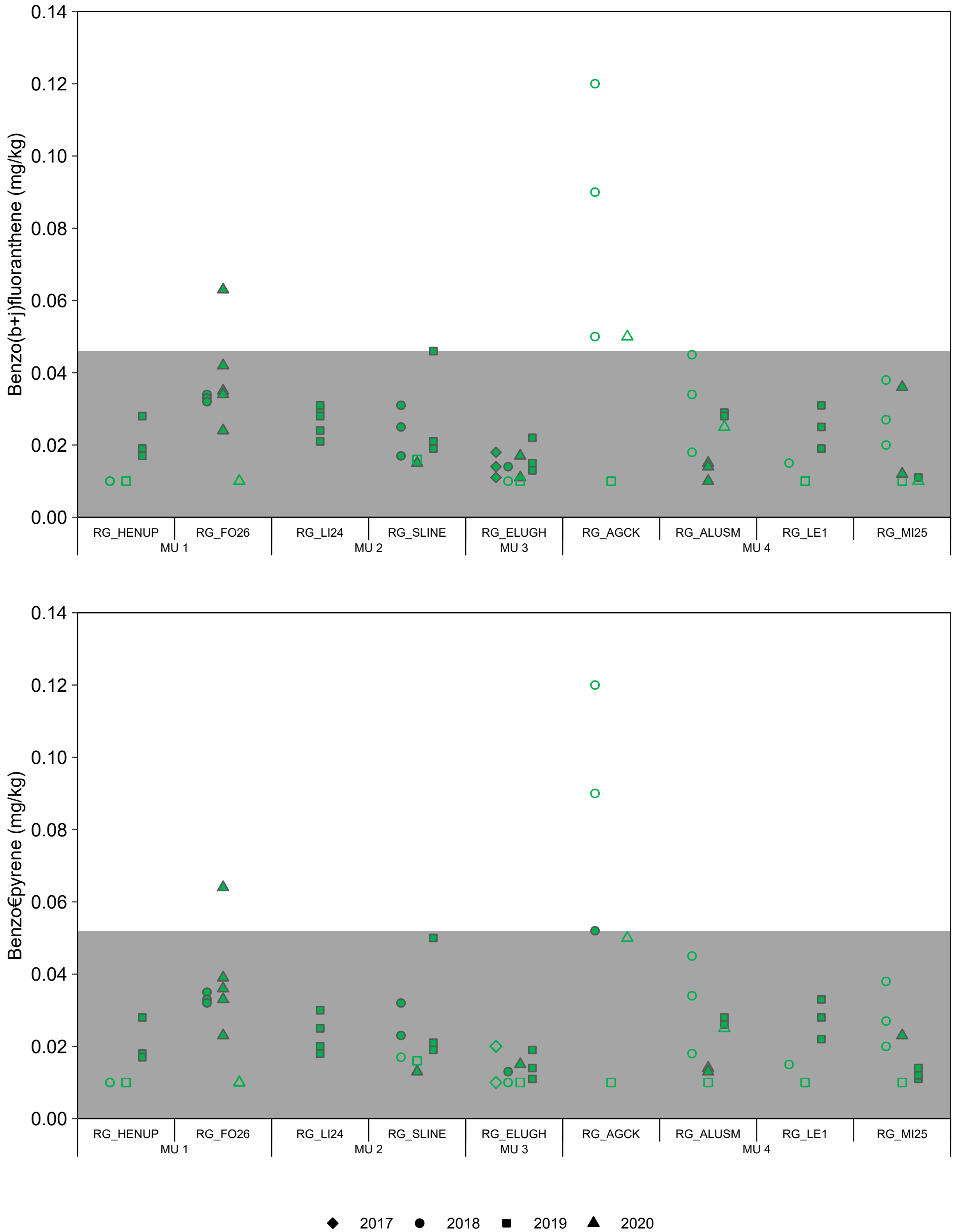

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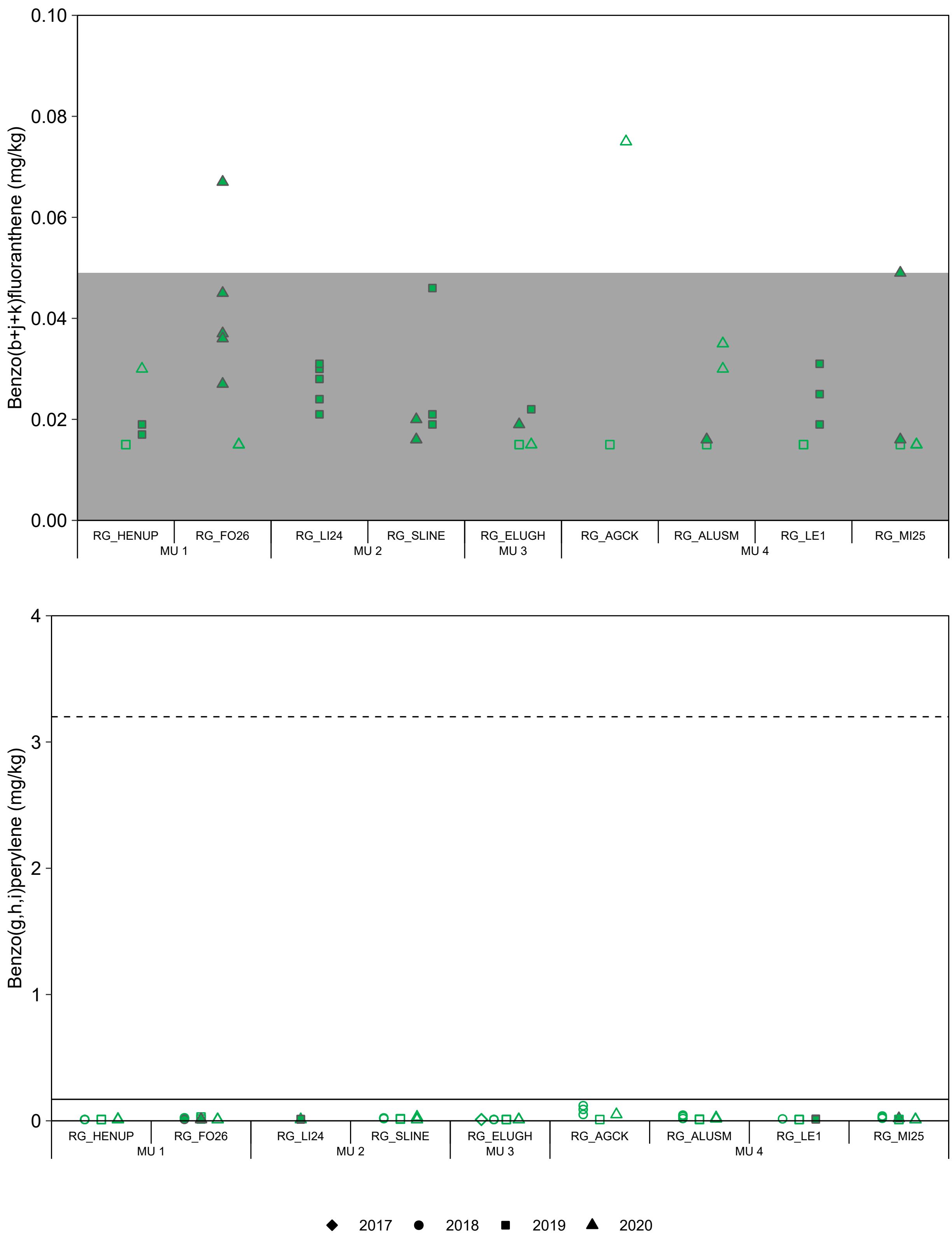

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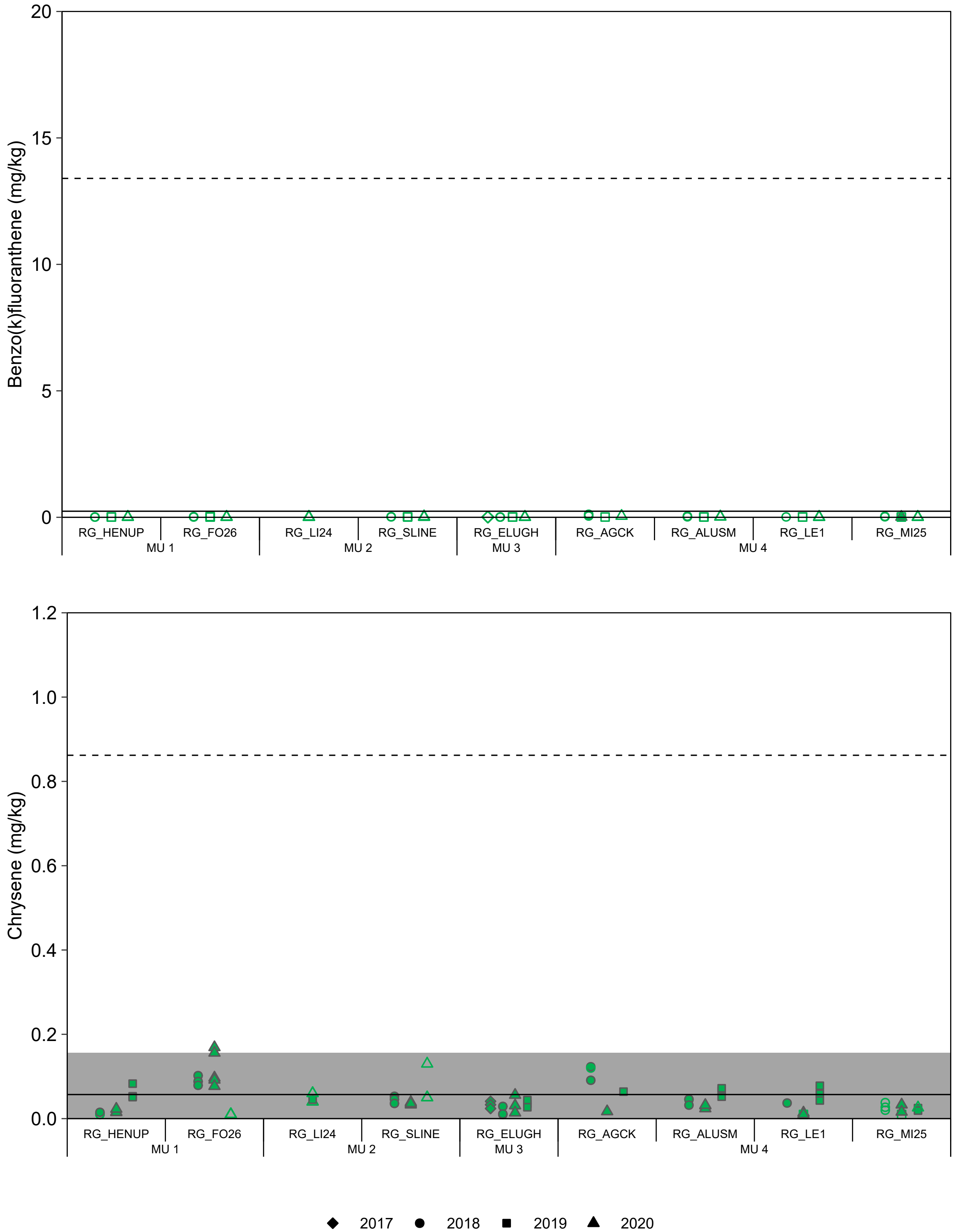

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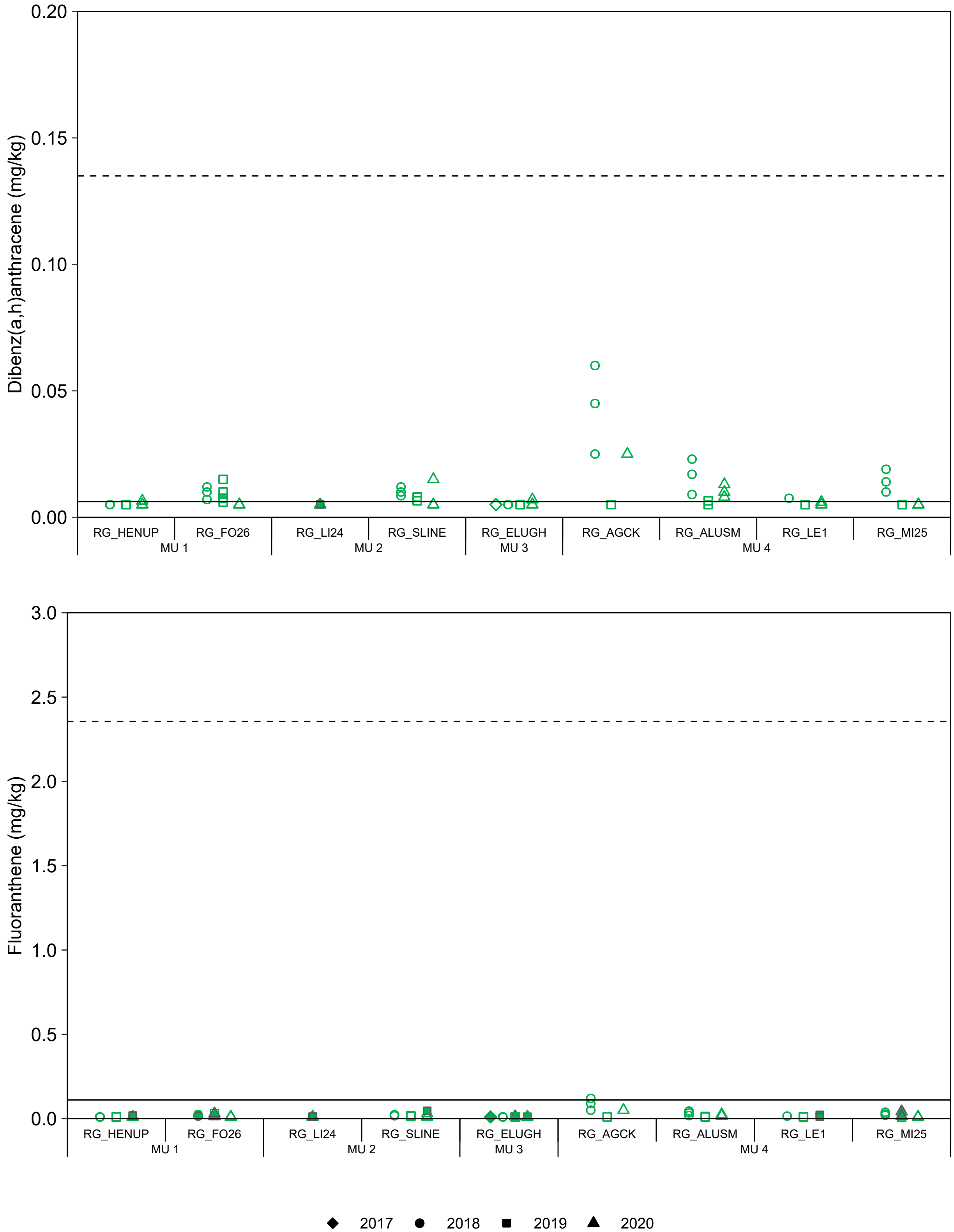

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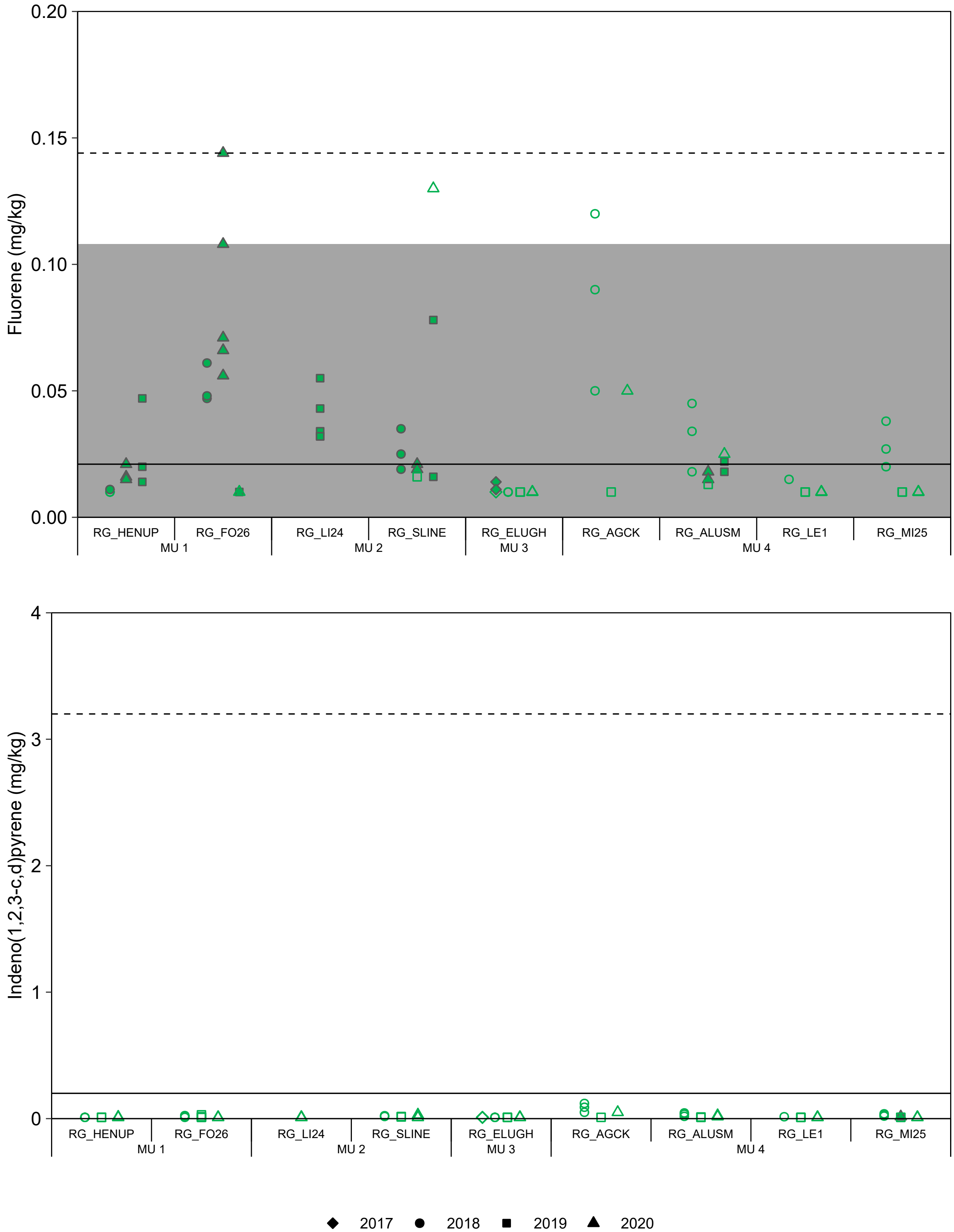

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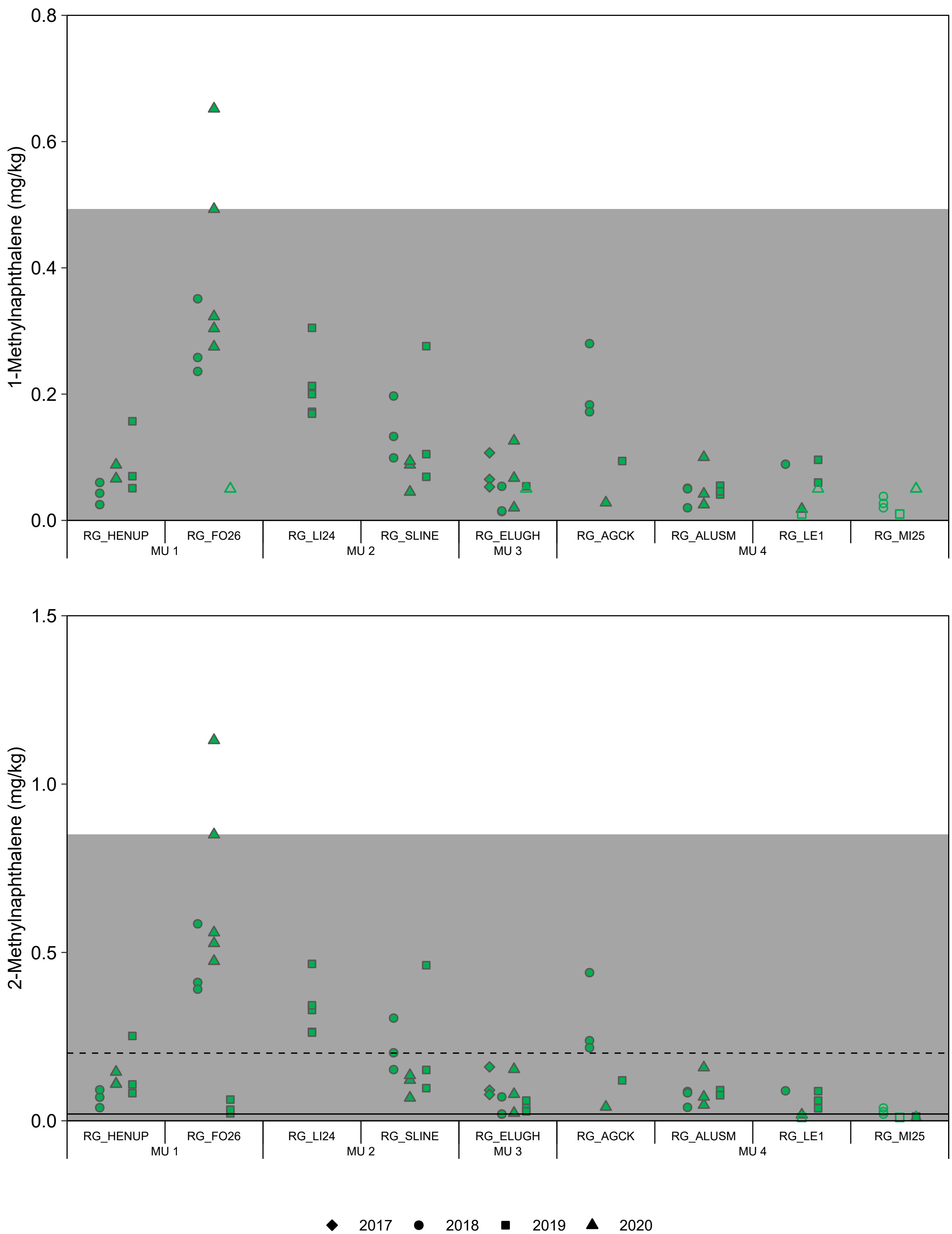

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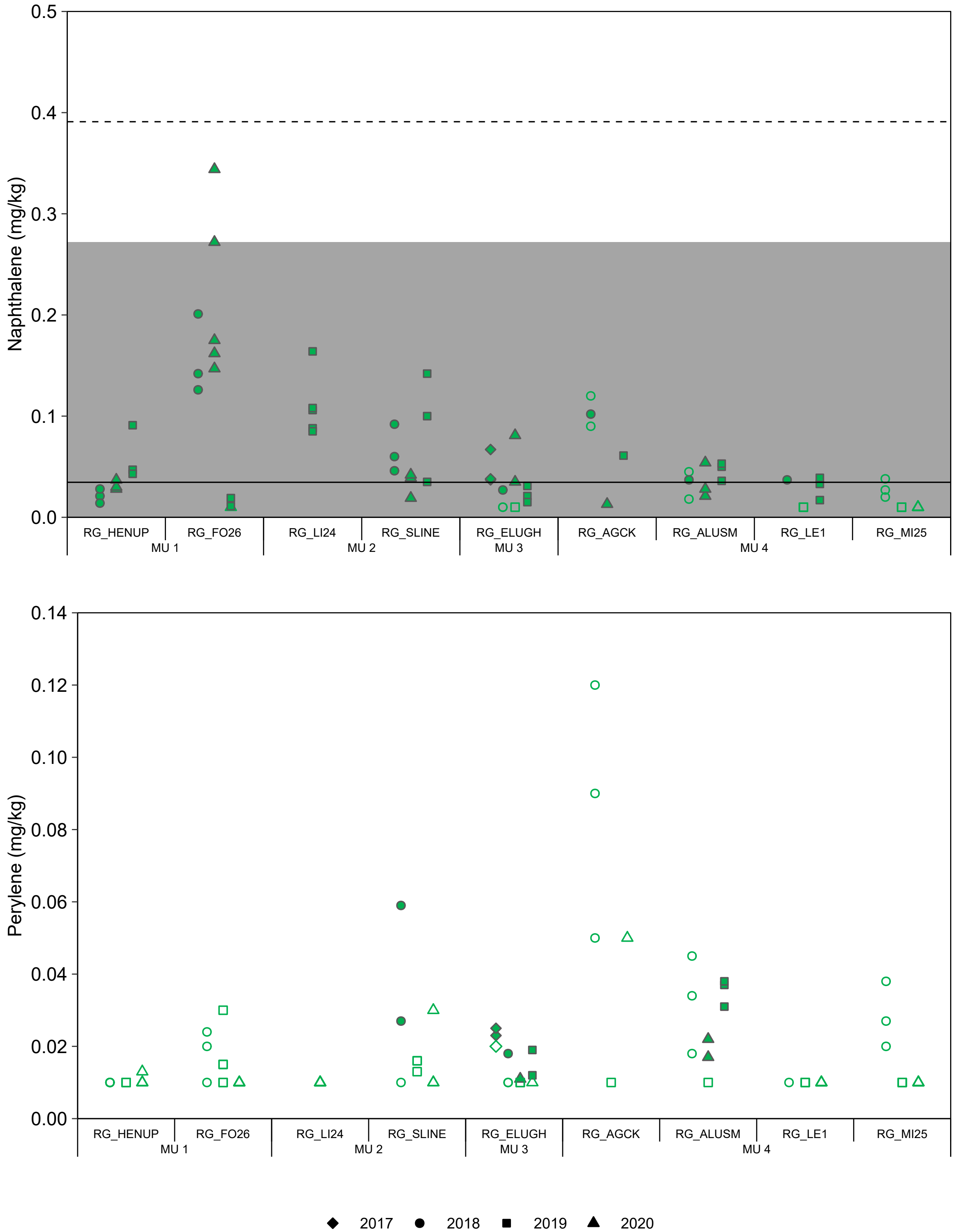

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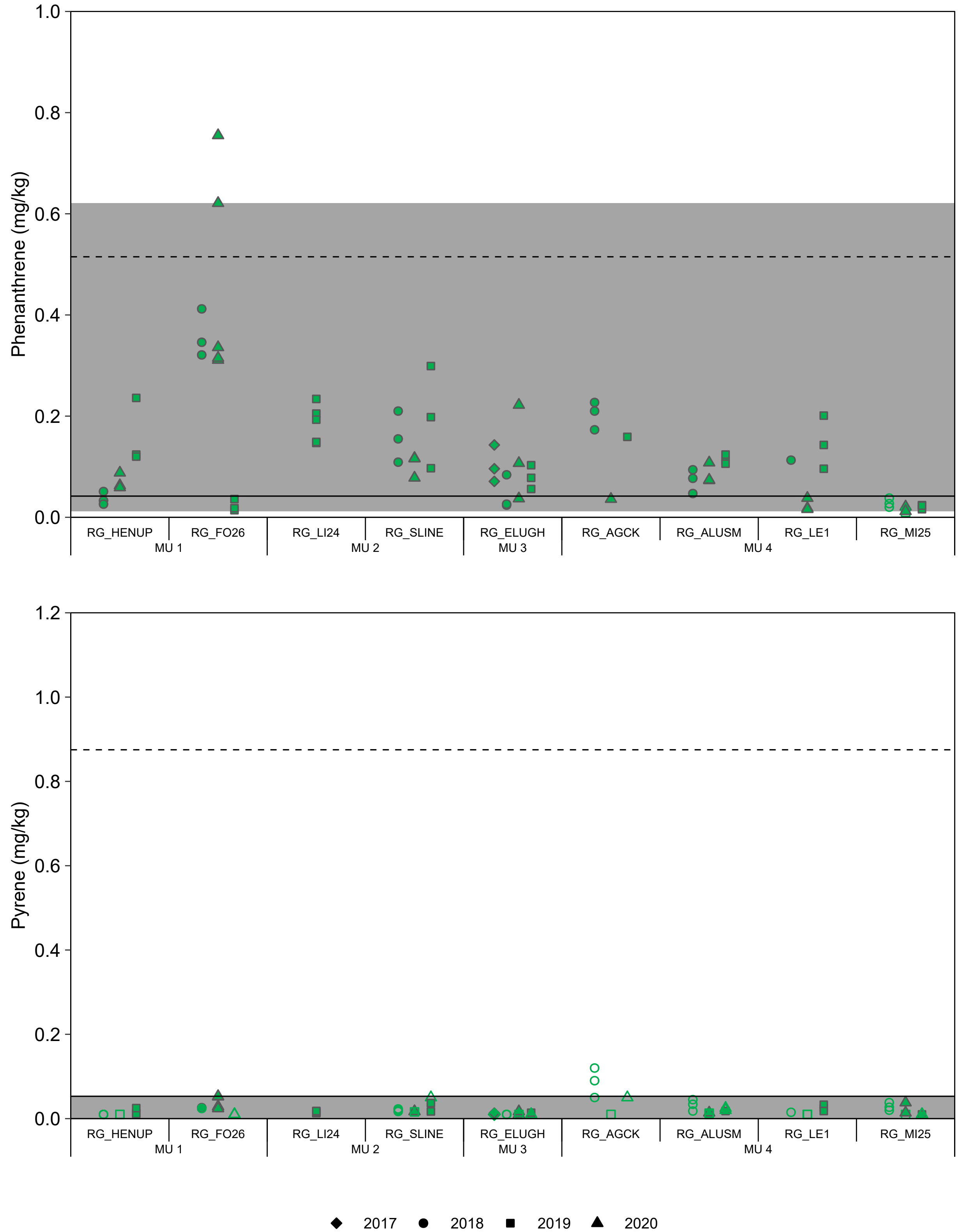

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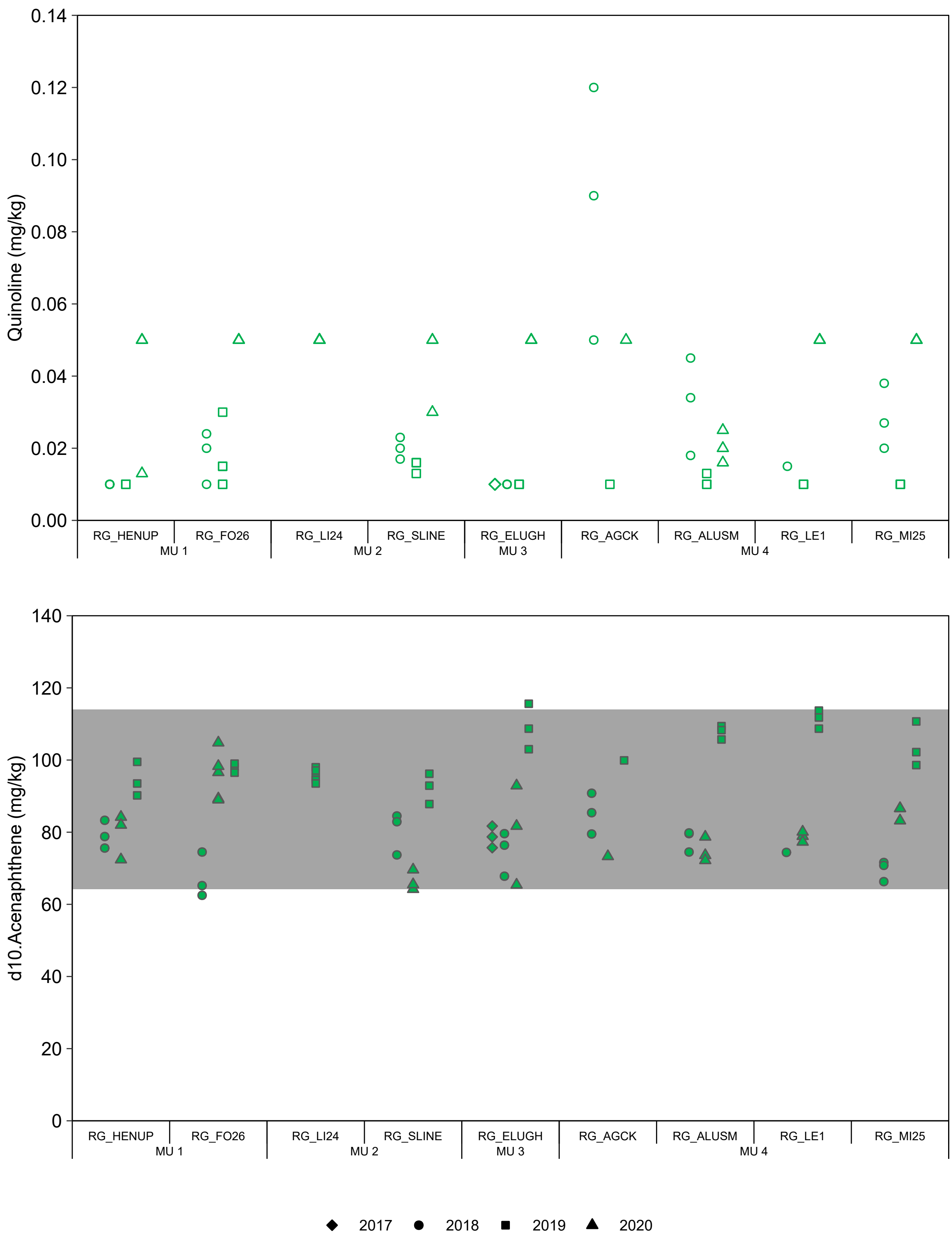

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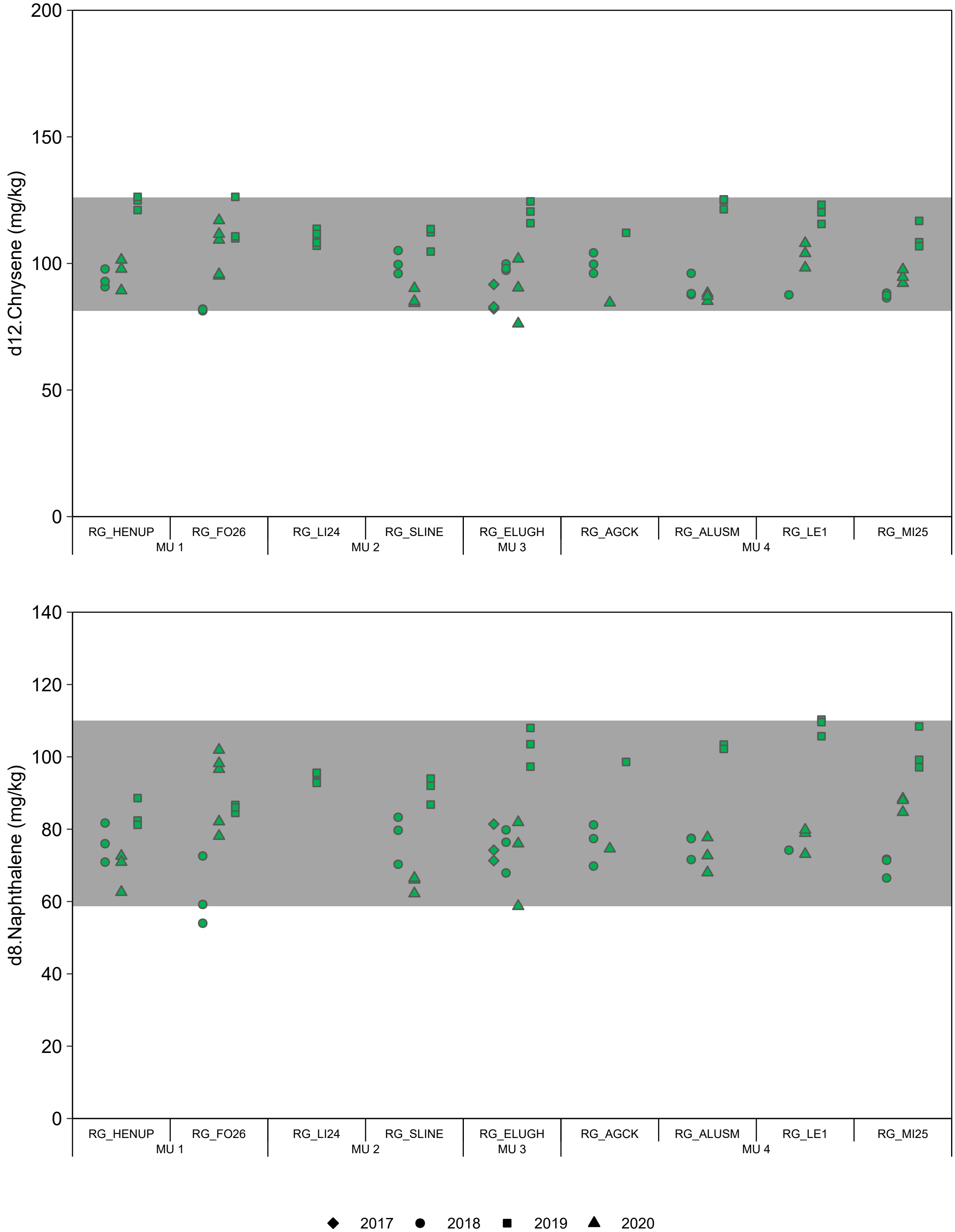

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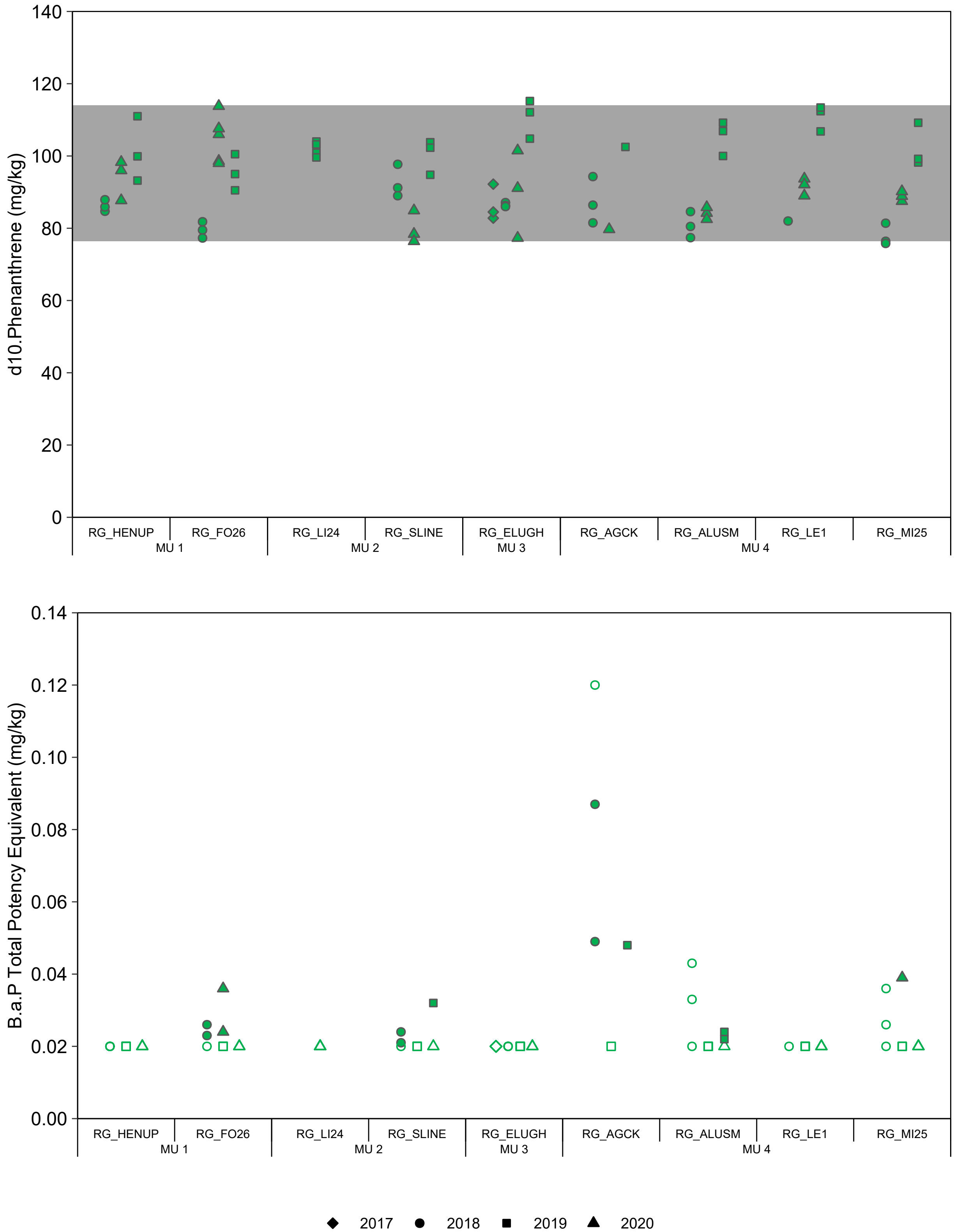

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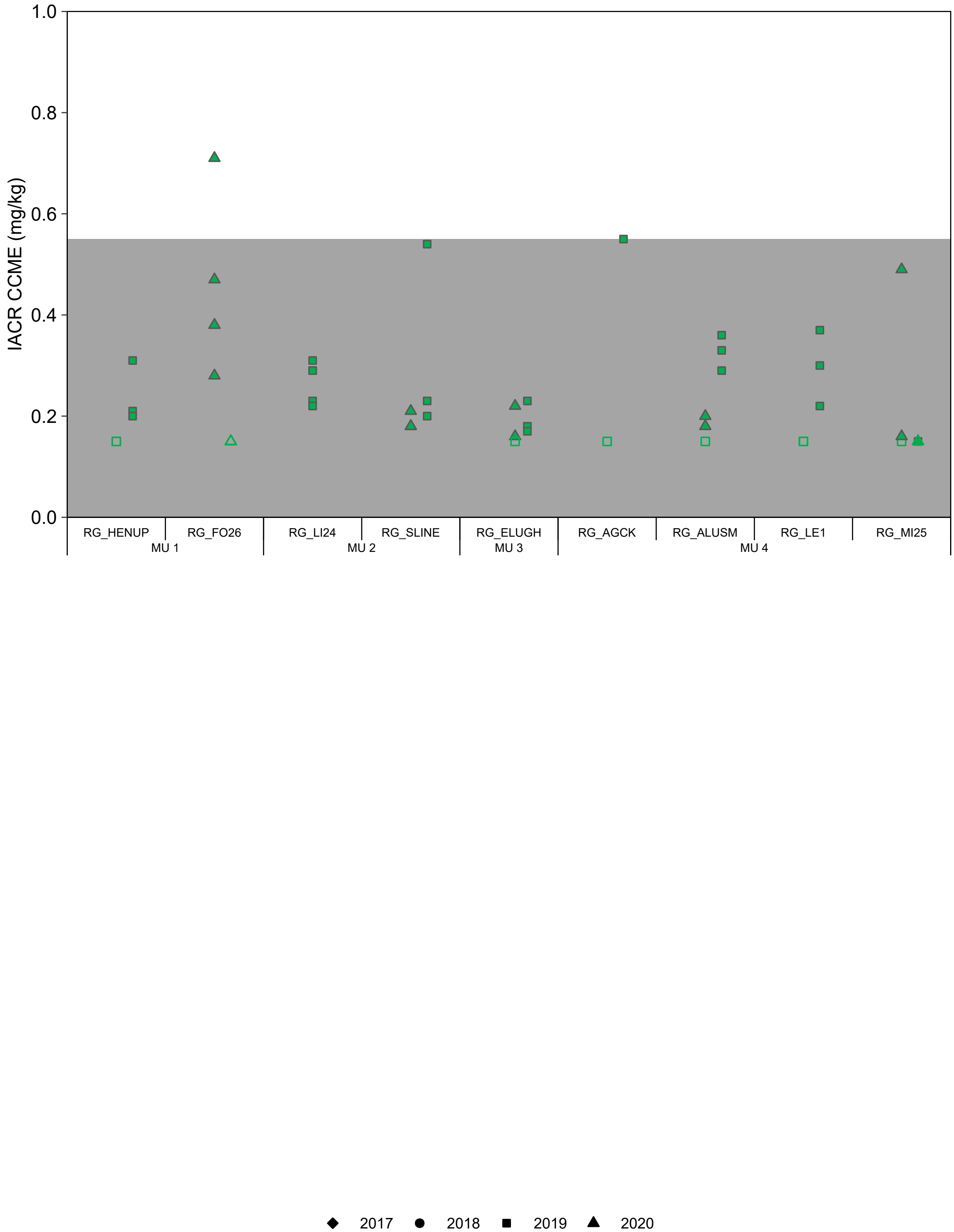

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Table H.1: Kick and Sweep Locations at Mine-exposed and Reference Areas, GHO LAEMP, September 2020

Station Parameters		Reference	Mine-exposed				
		RG_ELUGH	RG_ERSC4	RG_ER1A	RG_ERSC5	RG_THCK	RG_EL20
Station 1	Easting	646601	648090	648356	648271	648506	649144
	Northing	5557456	5552562	5551269	5550620	5550236	5548516
	Date	17-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	15-Sep-20
	Samplers' Initials	JT	JT	JT	JT	JT	JT
	Number of Jars	1	1	1	1	1	1
	Total Kick Distance (m)	8	12	7	7	6	9
	Full Transect (Yes / No)	no	no	yes	yes	yes	no
	Number of Transects	NA	NA	3.5	3	5	NA
Station 2	Easting	649104	648099	648382	648258	648561	649104
	Northing	5548590	5552596	5551376	5550653	5550221	5548590
	Date	16-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	16-Sep-20
	Samplers' Initials	JT	JT	JT	JT	JT	JT
	Number of Jars	1	1	1	1	1	1
	Total Kick Distance (m)	8	9	8	11	9	8
	Full Transect (Yes / No)	no	no	no	no	yes	no
	Number of Transects	NA	NA	NA	2.5	9	NA
Station 3	Easting	649064	648390	648390	648275	648592	649064
	Northing	5548639	5551411	5551411	5550696	5550242	5548639
	Date	16-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	10-Sep-20	16-Sep-20
	Samplers' Initials	JT	JT	JT	JT	JT	JT
	Number of Jars	1	1	1	1	2	1
	Total Kick Distance (m)	9	7.5	7.5	7	8	9
	Full Transect (Yes / No)	no	no	no	yes	yes	no
	Number of Transects	too swift	NA	NA	3.5	6	too swift
Station 4	Easting	648892	-	-	-	-	648892
	Northing	5548811	-	-	-	-	5548811
	Date	16-Sep-20	-	-	-	-	16-Sep-20
	Samplers' Initials	JT	-	-	-	-	JT
	Number of Jars	1	-	-	-	-	1
	Total Kick Distance (m)	10	-	-	-	-	10
	Full Transect (Yes / No)	no	-	-	-	-	no
	Number of Transects	NA	-	-	-	-	NA
Station 5	Easting	648892	-	-	-	-	648892
	Northing	5548824	-	-	-	-	5548824
	Date	16-Sep-20	-	-	-	-	16-Sep-20
	Samplers' Initials	JT	-	-	-	-	JT
	Number of Jars	1	-	-	-	-	1
	Total Kick Distance (m)	12	-	-	-	-	12
	Full Transect (Yes / No)	no	-	-	-	-	no
	Number of Transects	NA	-	-	-	-	NA

Note: "-" = not applicable as fewer than five stations were sampled. NA = number of transects not applicable, as there were no full transects.

Table H.2: Habitat Information Associated with Mine-exposed and Reference Areas Sampled during the Benthic Invertebrate Survey, GHO LAEMP, September 2020

Station ID		Reference	Mine-exposed							
		RG_ELUGH	RG_ERSC4	RG_ER1A	RG_ERSC5	RG_THCK	RG_GHSCW3	RG_ERSC2	RG_SCDTC	RG_EL20
Waterbody		Elk River	Elk River Side Channel	Elk River Side Channel	Elk River Side Channel	Thompson Creek	Elk River Side Channel	Elk River Side Channel	Elk River Side Channel	Elk River Side Channel
Date Sampled		17-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	15-Sep-20
Weather		smoky	smoky	sunny	sunny	sunny	smoky	smoky	very smoky	smoky, light breeze
Air Temperature (°C)		10	-	20	7	7	10	10	7	15
Zone 11 UTMs - E		646601	648090	648356	648274	648595	648331	648340	648221	649144
Zone 11 UTMs - N		5557456	5552562	5551269	5550609	5550238	5550167	5549813	5549577	5548516
Samplers' Initials		JT, AS	JT, EH	JT, AS	JT, AS	JT, AS	JT, EH	JT, EH	JT, EH	JT, AS
Surrounding Land Use		livestock	livestock, mining	livestock, mining	livestock, mining	logging, livestock, mining	mining	livestock, mining	logging, mining	livestock, mining, campers
Length of Reach Assessed (m)		100	100	100	100	100	50	50	50	100
Substrate	% Bedrock	0	0	0	0	0	0	0	0	0
	% Boulder	0	0	0	0	0	0	0	0	5
	% Cobble	85	20	80	50	70	0	5	60	70
	% Gravel	10	55	20	35	15	20	5	20	15
	% Sand	5	20	0	10	15	20	10	10	10
	% Fines	0	5	0	5	0	60	80	10	0
Water Clarity		clear	clear	clear	clear	clear	clear	clear	clear	clear
Water Colour		colourless	colourless	colourless	colourless	colourless	colourless	colourless	colourless	colourless
Canopy Coverage (%)		1-25	76-100	26-50	26-50	51-75	1-25	1-25	1-25	1-25
Vegetation		ferns and grasses, shrubs	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs	ferns and grasses, shrubs, deciduous trees	ferns and grasses, shrubs, deciduous trees
Dominant Vegetation		shrubs	coniferous trees	coniferous trees	coniferous trees	shrubs	ferns/grass	ferns/grass	ferns/grass	coniferous trees
Macrophyte Coverage (%)		0	0	0	0	0	0	0	0	0
Dominant Macrophyte		na	na	na	na	na	na	na	na	na
Periphyton Cover (1-5)		2 - Rocks slightly slippery, yellow-brown to light green colour, (0.5-1 mm thick)	2 - Rocks slightly slippery, yellow-brown to light green colour, (0.5-1 mm thick)	2 - Rocks slightly slippery, yellow-brown to light green colour, (0.5-1 mm thick)	3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5 mm thick)	4 - Rocks are very slippery, numerous clumps (5-20 mm thick)	1 - Rocks not slippery, no obvious colour (<0.5 mm thick)	1 - Rocks not slippery, no obvious colour (<0.5 mm thick)	2 - Rocks slightly slippery, yellow-brown to light green colour, (0.5-1 mm thick)	2 - Rocks slightly slippery, yellow-brown to light green colour, (0.5-1 mm thick)

Notes: "-" indicates no data available. na = not applicable.

Table H.3: Channel Measurements, GHO LAEMP, September 2020

Group	Site	Replicate	Measurement	Station 1	Station 2	Station 3	Station 4	Station 5	Mean
Reference	RG_ELUGH	1	Depth (cm)	14	31	38	21	27	**26.0**
Reference	RG_ELUGH	1	Velocity (m/s)	0.267	0.416	0.439	0.358	0.194	**0.370**
Reference	RG_ELUGH	1	Bankfull Width (m)			84.00			**-**
Reference	RG_ELUGH	1	Wetted Width (m)			27.00			**-**
Reference	RG_ELUGH	1	Bankfull-Wetted Depth (cm)			100			**-**
Reference	RG_ELUGH	2	Depth (cm)	24	28	28	24	24	**26.0**
Reference	RG_ELUGH	2	Velocity (m/s)	0.45	0.664	1.333	1.129	1.101	**0.894**
Reference	RG_ELUGH	2	Bankfull Width (m)			92.00			**-**
Reference	RG_ELUGH	2	Wetted Width (m)			41.00			**-**
Reference	RG_ELUGH	2	Bankfull-Wetted Depth (cm)			100			**-**
Reference	RG_ELUGH	3	Depth (cm)	20	24	28	22	27	**23.5**
Reference	RG_ELUGH	3	Velocity (m/s)	0.252	0.403	0.548	0.536	0.57	**0.435**
Reference	RG_ELUGH	3	Bankfull Width (m)			105.00			**-**
Reference	RG_ELUGH	3	Wetted Width (m)			25.00			**-**
Reference	RG_ELUGH	3	Bankfull-Wetted Depth (cm)			100			**-**
Mine-exposed	RG_ERSC4	1	Depth (cm)	18	25	29	22	24	**23.5**
Mine-exposed	RG_ERSC4	1	Velocity (m/s)	0.443	0.518	0.285	0.69	0.763	**0.484**
Mine-exposed	RG_ERSC4	1	Bankfull Width (m)			11.53			**-**
Mine-exposed	RG_ERSC4	1	Wetted Width (m)			8.40			**-**
Mine-exposed	RG_ERSC4	1	Bankfull-Wetted Depth (cm)			63			**-**
Mine-exposed	RG_ERSC4	2	Depth (cm)	24	28	28	24	24	**26.0**
Mine-exposed	RG_ERSC4	2	Velocity (m/s)	0.45	0.664	1.333	1.129	1.101	**0.894**
Mine-exposed	RG_ERSC4	2	Bankfull Width (m)			92.00			**-**
Mine-exposed	RG_ERSC4	2	Wetted Width (m)			41.00			**-**
Mine-exposed	RG_ERSC4	2	Bankfull-Wetted Depth (cm)			100			**-**
Mine-exposed	RG_ERSC4	3	Depth (cm)	20	24	28	22	27	**23.5**
Mine-exposed	RG_ERSC4	3	Velocity (m/s)	0.252	0.403	0.548	0.536	0.57	**0.435**
Mine-exposed	RG_ERSC4	3	Bankfull Width (m)			105.00			**-**
Mine-exposed	RG_ERSC4	3	Wetted Width (m)			25.00			**-**
Mine-exposed	RG_ERSC4	3	Bankfull-Wetted Depth (cm)			100			**-**
Mine-exposed	RG_ER1A	1	Depth (cm)	14	14.5	21	18	24	**16.9**
Mine-exposed	RG_ER1A	1	Velocity (m/s)	0.197	0.432	0.327	0.456	0.412	**0.353**
Mine-exposed	RG_ER1A	1	Bankfull Width (m)			7.87			**-**
Mine-exposed	RG_ER1A	1	Wetted Width (m)			6.18			**-**
Mine-exposed	RG_ER1A	1	Bankfull-Wetted Depth (cm)			63			**-**
Mine-exposed	RG_ER1A	2	Depth (cm)	22	17	20	28	28	**21.8**
Mine-exposed	RG_ER1A	2	Velocity (m/s)	0.197	0.292	0.318	0.2	0.188	**0.252**
Mine-exposed	RG_ER1A	2	Bankfull Width (m)			10.80			**-**
Mine-exposed	RG_ER1A	2	Wetted Width (m)			8.15			**-**
Mine-exposed	RG_ER1A	2	Bankfull-Wetted Depth (cm)			110			**-**
Mine-exposed	RG_ER1A	3	Depth (cm)	16	10.5	13	14	13.5	**13.4**
Mine-exposed	RG_ER1A	3	Velocity (m/s)	0.591	0.365	0.193	0.352	0.825	**0.375**
Mine-exposed	RG_ER1A	3	Bankfull Width (m)			7.55			**-**
Mine-exposed	RG_ER1A	3	Wetted Width (m)			5.40			**-**
Mine-exposed	RG_ER1A	3	Bankfull-Wetted Depth (cm)			73			**-**
Mine-exposed	RG_ERSC5	1	Depth (cm)	17	13	12	15	8.5	**14.3**
Mine-exposed	RG_ERSC5	1	Velocity (m/s)	0.258	0.656	0.368	0.456	0.196	**0.435**
Mine-exposed	RG_ERSC5	1	Bankfull Width (m)			7.57			**-**
Mine-exposed	RG_ERSC5	1	Wetted Width (m)			6.53			**-**
Mine-exposed	RG_ERSC5	1	Bankfull-Wetted Depth (cm)			62			**-**
Mine-exposed	RG_ERSC5	2	Depth (cm)	17	10	8	9	10	**11.0**
Mine-exposed	RG_ERSC5	2	Velocity (m/s)	0.389	0.421	0.661	0.198	0.429	**0.417**
Mine-exposed	RG_ERSC5	2	Bankfull Width (m)			7.74			**-**
Mine-exposed	RG_ERSC5	2	Wetted Width (m)			5.20			**-**
Mine-exposed	RG_ERSC5	2	Bankfull-Wetted Depth (cm)			64			**-**
Mine-exposed	RG_ERSC5	3	Depth (cm)	21	16.5	17	27	30	**20.4**
Mine-exposed	RG_ERSC5	3	Velocity (m/s)	0.711	0.182	0.192	0.313	0.36	**0.350**
Mine-exposed	RG_ERSC5	3	Bankfull Width (m)			7.02			**-**
Mine-exposed	RG_ERSC5	3	Wetted Width (m)			3.81			**-**
Mine-exposed	RG_ERSC5	3	Bankfull-Wetted Depth (cm)			80			**-**
Mine-exposed	RG_THCK	1	Depth (cm)	10	14	12	5	14	**10.3**
Mine-exposed	RG_THCK	1	Velocity (m/s)	0.42	0.202	0.54	0.21	0.218	**0.343**
Mine-exposed	RG_THCK	1	Bankfull Width (m)			4.70			**-**
Mine-exposed	RG_THCK	1	Wetted Width (m)			2.66			**-**
Mine-exposed	RG_THCK	1	Bankfull-Wetted Depth (cm)			86			**-**
Mine-exposed	RG_THCK	2	Depth (cm)	15	8.5	9	7	12.5	**9.9**
Mine-exposed	RG_THCK	2	Velocity (m/s)	0.474	0.541	0.222	0.586	0.299	**0.456**
Mine-exposed	RG_THCK	2	Bankfull Width (m)			8.24			**-**
Mine-exposed	RG_THCK	2	Wetted Width (m)			2.29			**-**
Mine-exposed	RG_THCK	2	Bankfull-Wetted Depth (cm)			41			**-**
Mine-exposed	RG_THCK	3	Depth (cm)	13	8	7	14	11.5	**10.5**
Mine-exposed	RG_THCK	3	Velocity (m/s)	0.352	0.235	0.294	0.354	0.409	**0.309**
Mine-exposed	RG_THCK	3	Bankfull Width (m)			3.83			**-**
Mine-exposed	RG_THCK	3	Wetted Width (m)			2.39			**-**
Mine-exposed	RG_THCK	3	Bankfull-Wetted Depth (cm)			48			**-**

Table H.3: Channel Measurements, GHO LAEMP, September 2020

Replicate				Station 1	2	3	4	5	Mean
Mine-exposed	RG_SCDTC	1	Depth (cm)	9	14	9	11	13	**10.8**
			Velocity (m/s)	0.026	0.014	0.011	0.021	0.012	**0.018**
			Bankfull Width (m)			4.15			**-**
			Wetted Width (m)			2.90			**-**
			Bankfull-Wetted Depth (cm)			106			**-**
		2	Depth (cm)	8.5	9	10	8	6	**8.9**
			Velocity (m/s)	0.024	0.016	0.016	0.019	0.032	**0.019**
			Bankfull Width (m)			5.25			**-**
			Wetted Width (m)			2.90			**-**
			Bankfull-Wetted Depth (cm)			800			**-**
		3	Depth (cm)	6	7	5	5	6	**5.8**
			Velocity (m/s)	0.013	0.072	0.055	0.14	0.046	**0.070**
			Bankfull Width (m)			5.02			**-**
			Wetted Width (m)			2.05			**-**
			Bankfull-Wetted Depth (cm)			104			**-**
	RG_EL20	1	Depth (cm)	25	16	12	14	16	**16.8**
			Velocity (m/s)	0.86	0.808	0.945	1.07	0.993	**0.921**
			Bankfull Width (m)			140.00			**-**
			Wetted Width (m)			38.00			**-**
			Bankfull-Wetted Depth (cm)			300			**-**
		2	Depth (cm)	36	47	47	34	23	**41.0**
			Velocity (m/s)	0.495	0.669	0.878	0.829	0.803	**0.718**
			Bankfull Width (m)			136.00			**-**
			Wetted Width (m)			24.00			**-**
			Bankfull-Wetted Depth (cm)			300			**-**
		3	Depth (cm)	33	41	39	30	41	**35.8**
			Velocity (m/s)	0.718	0.84	0.783	0.532	0.842	**0.718**
			Bankfull Width (m)			120.00			**-**
			Wetted Width (m)			18.00			**-**
			Bankfull-Wetted Depth (cm)			300			**-**
		4	Depth (cm)	22	26	24	22	32	**23.5**
			Velocity (m/s)	0.714	0.808	0.913	0.622	0.676	**0.764**
			Bankfull Width (m)			100.00			**-**
			Wetted Width (m)			34.00			**-**
			Bankfull-Wetted Depth (cm)			300			**-**
		5	Depth (cm)	11	17	20	12	24	**15.0**
			Velocity (m/s)	0.331	0.257	0.253	0.551	0.401	**0.348**
			Bankfull Width (m)			85.00			**-**
			Wetted Width (m)			22.00			**-**
			Bankfull-Wetted Depth (cm)			250			**-**

Notes: Velocity measurements were taken at five randomly chosen locations throughout the kick sample area. Velocity was measured at the bottom of the water column. "-" = mean not applicable.

Table H.4: *In Situ* Water Quality Measured at Biological Monitoring Areas, GHO LAEMP, September 2020

Field Parameters		Reference	Mine-exposed							
		GH_ER2 / RG_ELUGH	RG_ERSC4	RG_ER1A	RG_ERSC5	RG_THCK	RG_GHSCW3	RG_ERSC2	RG_SCDTC	GH_ERC / RG_EL20
Station 1	Date	17-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	15-Sep-20
	Temperature (°C)	10.1	8.50	9.90	7.60	14.8	10.2	9.70	8.70	8.90
	Dissolved Oxygen (mg/L)	9.63	8.51	10.6	10.6	9.80	8.30	8.73	7.81	9.45
	Dissolved Oxygen (%)	85.9	72.0	93.1	89.2	99.1	74.0	76.7	67.1	81.4
	Conductivity (µS/cm)	203	200	229	207	1,581	347	342	344	223
	Specific Conductivity (µS/cm)	284	292	321	311	1,961	483	484	499	323
	pH	8.30	8.11	8.34	8.25	8.51	8.44	8.40	8.28	8.03
Station 2	Date	17-Sep-20	12-Sep-20	11-Sep-20	11-Sep-20	10-Sep-20	-	-	13-Sep-20	16-Sep-20
	Temperature (°C)	9.80	9.20	10.4	15.0	14.1	-	-	9.00	7.70
	Dissolved Oxygen (mg/L)	9.62	8.78	9.03	11.1	9.84	-	-	8.49	8.99
	Dissolved Oxygen (%)	84.9	76.3	81.0	93.0	96.4	-	-	73.5	75.5
	Conductivity (µS/cm)	201	203	232	208	1,555	-	-	248	217
	Specific Conductivity (µS/cm)	284	291	321	312	1,962	-	-	501	323
	pH	8.33	8.17	8.32	8.25	8.30	-	-	8.31	7.96
Station 3	Date	17-Sep-20	12-Sep-20	12-Sep-20	11-Sep-20	10-Sep-20	-	-	13-Sep-20	16-Sep-20
	Temperature (°C)	9.70	10.1	8.00	7.70	14.8	-	-	8.80	8.20
	Dissolved Oxygen (mg/L)	9.52	8.50	9.37	9.85	9.83	-	-	8.33	8.94
	Dissolved Oxygen (%)	8.38	75.7	79.2	82.5	99.2	-	-	71.7	75.8
	Conductivity (µS/cm)	201	208	215	208	1,555	-	-	351	220
	Specific Conductivity (µS/cm)	284	290	319	311	1,963	-	-	508	324
	pH	8.30	8.21	7.98	8.23	8.31	-	-	8.31	7.96
Station 4	Date	-	-	-	-	-	-	-	-	16-Sep-20
	Temperature (°C)	-	-	-	-	-	-	-	-	9.40
	Dissolved Oxygen (mg/L)	-	-	-	-	-	-	-	-	9.63
	Dissolved Oxygen (%)	-	-	-	-	-	-	-	-	84.2
	Conductivity (µS/cm)	-	-	-	-	-	-	-	-	224
	Specific Conductivity (µS/cm)	-	-	-	-	-	-	-	-	319
	pH	-	-	-	-	-	-	-	-	8.07
Station 5	Date	-	-	-	-	-	-	-	-	16-Sep-20
	Temperature (°C)	-	-	-	-	-	-	-	-	8.70
	Dissolved Oxygen (mg/L)	-	-	-	-	-	-	-	-	8.73
	Dissolved Oxygen (%)	-	-	-	-	-	-	-	-	76.3
	Conductivity (µS/cm)	-	-	-	-	-	-	-	-	216
	Specific Conductivity (µS/cm)	-	-	-	-	-	-	-	-	313
	pH	-	-	-	-	-	-	-	-	8.04

Note: '-' = not applicable as fewer than five stations were sampled.

Table H.5: Chemistry of Water Samples Collected Concurrent with Biological Samples, GHO LAEMP, September 2020

	Analyte	Units	LRL	BC Water Quality Guidelines		Reference	Mine-exposed							
				30-Day Average	Short-term Maximum	GH_ER2 / RG_ELUGH	GH_ERSC4	GH_ER1A	RG_ERSC5	GH_TC2 / RG_THCK	RG_GH_SCW3	GH_ERSC2	RG_SCDTC	GH_ERC / RG_EL20
						17-Sep-20	13-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	15-Sep-20
Physical Tests	Conductivity (@ 25°C)	µS/cm	2.0	-	-	281	278	307	295	1,860	463	459	494	298
	Hardness (as $CaCO_3$)	mg/L	0.50	-	-	157	160	173	167	1,270	267	257	282	171
	pH	pH	0.10	6.5 - 9.0		8.25	8.32	8.31	8.30	8.31	8.32	8.36	8.33	8.32
	ORP	mV	-1,000	-	-	302	454	516	375	446	474	463	469	419
	Total Suspended Solids	mg/L	1.0	-	-	<1.0	1.60	<1.0	<1.0	4.90	1.70	<1.0	2.30	<1.0
	Total Dissolved Solids	mg/L	20	-	-	146	166	200	187	1,740	319	329	347	190
	Turbidity	NTU	0.10	-	-	0.530	0.640	0.620	0.690	1.28	1.20	0.950	3.07	0.500
Anions and Nutrients	Acidity (as $CaCO_3$)	mg/L	1.0	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	1.0	-	-	140	146	144	145	183	144	148	150	148
	Alkalinity, Carbonate (as $CaCO_3$)	mg/L	1.0	-	-	<1.0	1.20	1.60	<1.0	1.20	1.20	2.80	2.40	1.60
	Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	1.0	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as $CaCO_3$)	mg/L	1.0	10 - 20 minimum		140	147	146	145	184	146	151	153	150
	Ammonia as N	mg/L	0.0050	2.4 - 8.3	0.46 - 1.6	<0.0050	<0.0050	<0.0050	0.00860	0.0231	0.00780	<0.0050	<0.0050	0.00950
	Bromide (Br)	mg/L	0.050	-	-	<0.050	<0.050	<0.050	<0.050	<0.25	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	0.50	150	600	0.330	0.260	0.330	0.320	12.9	1.27	1.28	1.39	0.320
	Fluoride (F)	mg/L	0.020	-	1.5 - 1.9[a]	0.146	0.159	0.162	0.164	<0.10	0.148	0.149	0.146	0.150
	Ion Balance	%	-100	-	-	100	97.1	97.6	97.4	97.4	101	95.3	98.2	96.2
	Nitrate (as N)	mg/L	0.0050	3.0	32.8	0.0225	0.0282	0.486	0.342	14.1	1.47	1.46	1.76	0.398
	Nitrite (as N)	mg/L	0.0010	0.02 - 0.2	0.06 - 0.6	<0.0010	<0.0010	<0.0010	<0.0010	0.0132	<0.0010	<0.0010	0.00120	<0.0010
	Total Kjeldahl Nitrogen	mg/L	0.050	-	-	<0.050	<0.050	0.161	0.194	<0.050	0.251	0.231	0.235	<0.050
	Orthophosphate-Dissolved (as P)	mg/L	0.0010	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00130
	Phosphorus (P)-Total	mg/L	0.0020	-	-	<0.0020	0.00360	<0.0020	<0.0020	0.00360	0.00210	<0.0020	0.00410	<0.0020
	Sulphate (SO_4)	mg/L	0.30	309 - 429[a]	-	16.6	17.6	30.2	26.1	1,030	111	111	125	27.3
	Anion Sum	meq/L	-	-	-	3.15	3.32	3.60	3.48	26.6	5.37	5.47	5.83	3.61
	Cation Sum	meq/L	-	-	-	3.17	3.23	3.51	3.39	25.9	5.42	5.22	5.73	3.47
	Cation - Anion Balance	%	-	-	-	0.200	-1.40	-1.20	-1.30	-1.30	0.500	-2.40	-0.900	-2.00
Organic / Inorganic Carbon	Dissolved Organic Carbon	mg/L	0.50	-	-	<0.50	<0.50	<0.50	<0.50	2.30	<0.50	1.17	0.570	<0.50
	Total Organic Carbon	mg/L	0.50	-	-	<0.50	<0.50	<0.50	<0.50	2.45	0.570	1.26	0.650	<0.50
Total Metals	Aluminum (Al)	mg/L	0.0030	-	-	0.00490	0.0147	0.00850	0.00820	0.0140	0.0163	0.0103	0.0247	0.00560
	Antimony (Sb)	mg/L	0.00010	0.009	-	<0.00010	<0.00010	<0.00010	<0.00010	0.000180	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00010	-	0.005	0.000100	0.000140	0.000120	0.000120	0.000260	0.000150	0.000140	0.000170	<0.00010
	Barium (Ba)	mg/L	0.00010	1.0	-	0.0457	0.0488	0.0477	0.0475	0.0718	0.0520	0.0488	0.0546	0.0570
	Beryllium (Be)	µg/L	0.020	0.13	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)	mg/L	0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	0.010	1.2	-	<0.010	<0.010	<0.010	<0.010	0.0290	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	µg/L	0.0050	-	-	0.00850	0.00970	0.0105	0.00900	0.0157	0.0125	0.0103	0.0225	0.00870
	Calcium (Ca)	mg/L	0.050	-	-	43.1	43.3	48.8	46.8	249	60.7	59.5	64.1	50.1
	Chromium (Cr)	mg/L	0.00010	-	-	0.000240	0.000240	0.000200	0.000210	<0.00010	0.000200	0.000220	0.000230	0.000240
	Cobalt (Co)	µg/L	0.10	4.0	110	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)	mg/L	0.00050	0.006 - 0.01[a]	0.016 - 0.04[a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.010	-	1.0	<0.010	0.0210	0.0130	0.0110	0.0260	0.0210	0.0180	0.0320	<0.010
	Lead (Pb)	mg/L	0.000050	0.009 - 0.02[a]	0.13 - 0.42[a]	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000510	<0.000050
	Lithium (Li)	mg/L	0.0010	-	-	0.00220	0.00170	0.00360	0.00290	0.0308	0.00520	0.00470	0.00600	0.00300
	Magnesium (Mg)	mg/L	0.10	-	-	9.68	10.3	12.6	12.1	165	23.1	22.6	25.1	11.3
	Manganese (Mn)	mg/L	0.00010	1.3 - 2.6[a]	2.2 - 3.4[a]	0.00153	0.00309	0.00182	0.00169	0.00262	0.00173	0.00129	0.00201	0.00115
	Mercury (Hg)	µg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000590	<0.00050
	Molybdenum (Mo)	mg/L	0.000050	0.073	-	0.00104	0.00103	0.00124	0.00122	0.00171	0.00116	0.00107	0.00112	0.00124

Value > 30-day average chronic guideline.
Value > short-term maximum guideline.
Notes: "-" indicates no guideline. LRL = laboratory reporting limit.

Table H.5: Chemistry of Water Samples Collected Concurrent with Biological Samples, GHO LAEMP, September 2020

	Analyte	Units	LRL	BC Water Quality Guidelines		Reference	Mine-exposed							
				30-Day Average	Short-term Maximum	GH_ER2 / RG_ELUGH	GH_ERSC4	GH_ER1A	RG_ERSC5	GH_TC2 / RG_THCK	RG_GH_SCW3	GH_ERSC2	RG_SCDTC	GH_ERC / RG_EL20
						17-Sep-20	13-Sep-20	10-Sep-20	10-Sep-20	10-Sep-20	13-Sep-20	13-Sep-20	13-Sep-20	15-Sep-20
Total Metals	Nickel (Ni)	mg/L	0.00050	0.13 - 0.15[a]	-	<0.00050	<0.00050	0.00147	0.00107	0.00132	0.000860	0.000740	0.000840	<0.00050
	Potassium (K)	mg/L	0.050	-	-	0.363	0.362	0.433	0.425	2.40	0.575	0.532	0.633	0.418
	Selenium (Se)	µg/L	0.050	-	2.0	0.778	0.726	1.68	1.36	153	13.4	13.3	14.3	2.03
	Silicon (Si)	mg/L	0.10	-	-	1.77	1.93	1.81	1.78	2.97	2.08	1.94	1.99	1.99
	Silver (Ag)	mg/L	0.000010	0.0015	0.003	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	-	-	0.639	0.634	0.882	0.827	12.4	1.68	1.62	1.89	0.948
	Strontium (Sr)	mg/L	0.00020	-	-	0.223	0.200	0.218	0.213	0.638	0.241	0.241	0.258	0.209
	Thallium (Tl)	mg/L	0.000010	0.0008	-	<0.000010	<0.000010	<0.000010	<0.000010	0.0000110	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000010	0.0085	-	0.000689	0.000692	0.000855	0.000800	0.00643	0.00127	0.00126	0.00139	0.000711
	Vanadium (V)	mg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	0.0030	0.05 - 0.19[a]	0.08 - 0.34[a]	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0030	0.05	0.10	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	0.000180	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.0001	-	-	0.000110	<0.00010	0.000120	<0.00010	0.000270	0.000110	0.000110	0.000130	<0.00010
	Barium (Ba)	mg/L	0.000100	-	-	0.0486	0.0479	0.0465	0.0468	0.0720	0.0493	0.0475	0.0544	0.0554
	Beryllium (Be)	µg/L	0.020	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)	mg/L	0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	0.010	-	-	<0.010	<0.010	<0.010	<0.010	0.0270	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	µg/L	0.0050	0.28 - 0.46[a]	0.9 - 2.8[a]	0.00510	0.00600	0.00640	0.00830	0.0165	0.00940	0.0117	0.00930	0.00720
	Calcium (Ca)	mg/L	0.050	-	-	46.3	47.3	49.1	48.3	256	68.0	64.9	69.9	48.9
	Chromium (Cr)	mg/L	0.00010	-	-	0.000220	0.000180	0.000210	0.000230	<0.00010	0.000170	0.000190	0.000180	0.000220
	Cobalt (Co)	µg/L	0.10	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)	mg/L	0.00050	-	-	<0.00020	<0.00020	<0.00020	<0.00020	0.000210	<0.00020	<0.00020	<0.00020	<0.00020
	Iron (Fe)	mg/L	0.010	-	0.35	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0010	-	-	0.00190	0.00180	0.00370	0.00310	0.0329	0.00550	0.00530	0.00640	0.00310
	Magnesium (Mg)	mg/L	0.10	-	-	10.0	10.1	12.3	11.3	152	23.6	23.0	26.1	11.8
	Manganese (Mn)	mg/L	0.00010	-	-	0.00115	0.00178	0.000990	0.000850	0.000320	0.000580	0.000530	0.000460	0.000690
	Mercury (Hg)	mg/L	0.0000050	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000050	-	-	0.00109	0.00102	0.00105	0.00101	0.00153	0.00113	0.00135	0.00122	0.00118
	Nickel (Ni)	mg/L	0.00050	-	-	<0.00050	<0.00050	0.000900	0.000580	0.000680	0.000650	0.000570	0.000640	<0.00050
	Potassium (K)	mg/L	0.050	-	-	0.380	0.346	0.446	0.422	2.44	0.540	0.534	0.615	0.432
	Selenium (Se)	µg/L	0.050	-	-	0.862	0.707	1.58	1.40	147	14.2	14.1	15.2	1.80
	Silicon (Si)	mg/L	0.050	-	-	1.74	1.78	1.81	1.75	2.84	1.80	1.78	1.82	1.93
	Silver (Ag)	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	-	-	0.665	0.641	0.904	0.815	12.0	1.72	1.68	1.95	1.00
	Strontium (Sr)	mg/L	0.00020	-	-	0.228	0.213	0.206	0.202	0.616	0.259	0.252	0.276	0.211
	Thallium (Tl)	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000010	-	-	0.000649	0.000667	0.000869	0.000786	0.00622	0.00124	0.00124	0.00133	0.000762
	Vanadium (V)	mg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	0.0010	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00400

Value > 30-day average chronic guideline.
Value > short-term maximum guideline.
Notes: "-" indicates no guideline. LRL = laboratory reporting limit.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_ELUGH-1					RG_ELUGH-2					RG_ELUGH-3				
17-Sep-20					17-Sep-20					17-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	9.0	-	**1**	0	0	6.1	-	**1**	0	0	11.0	-
2	0	0	6.5	-	**2**	0	0	10.4	-	**2**	0	0	5.0	-
3	0	0	7.5	-	**3**	0	0	6.6	-	**3**	0	0	6.2	-
4	0	0	5.8	-	**4**	0	0	5.4	-	**4**	0	0	7.2	-
5	0	0	5.1	-	**5**	0	0	5.3	-	**5**	0	0	6.6	-
6	0	0	5.8	-	**6**	0	0	6.2	-	**6**	0	0	12.0	-
7	0	0	11.6	-	**7**	0	0	10.8	-	**7**	0	0	9.1	-
8	0	0	5.5	-	**8**	0	0	8.1	-	**8**	0	0	5.5	-
9	0	0	5.1	-	**9**	0	0	7.1	-	**9**	0	0	9.7	-
10	0	0	8.2	0.25	**10**	0	0	10.5	0.5	**10**	0	0	6.3	0.25
11	0	0	9.8	-	**11**	0	0	12.1	-	**11**	0	0	7.2	-
12	0	0	10.5	-	**12**	0	0	8.4	-	**12**	0	0	7.4	-
13	0	0	18.5	-	**13**	0	0	11.0	-	**13**	0	0	7.3	-
14	0	0	5.5	-	**14**	0	0	3.8	-	**14**	0	0	7.1	-
15	0	0	11.5	-	**15**	0	0	11.0	-	**15**	0	0	9.8	-
16	0	0	3.8	-	**16**	0	0	11.0	-	**16**	0	0	4.2	-
17	0	0	6.5	-	**17**	0	0	7.2	-	**17**	0	0	8.1	-
18	0	0	5.7	-	**18**	0	0	5.4	-	**18**	0	0	10.0	-
19	0	0	4.8	-	**19**	0	0	6.3	-	**19**	0	0	11.2	-
20	0	0	6.6	0	**20**	0	0	5.7	0.25	**20**	0	0	6.3	0.5
21	0	0	10.2	-	**21**	0	0	9.6	-	**21**	0	0	8.5	-
22	0	0	6.4	-	**22**	0	0	14.2	-	**22**	0	0	7.3	-
23	0	0	7.6	-	**23**	0	0	7.1	-	**23**	0	0	8.8	-
24	0	0	7.0	-	**24**	0	0	6.1	-	**24**	0	0	12.0	-
25	0	0	4.8	-	**25**	0	0	4.4	-	**25**	0	0	5.0	-
26	0	0	12.7	-	**26**	0	0	3.6	-	**26**	0	0	10.2	-
27	0	0	5.4	-	**27**	0	0	2.2	-	**27**	0	0	5.6	-
28	0	0	5.1	-	**28**	0	0	3.8	-	**28**	0	0	7.2	-
29	0	0	4.8	-	**29**	0	0	11.5	-	**29**	0	0	5.5	-
30	0	0	3.8	0	**30**	0	0	13.2	0.5	**30**	0	0	5.2	0.25
31	0	0	7.4	-	**31**	0	0	8.2	-	**31**	0	0	8.2	-
32	0	0	11.2	-	**32**	0	0	5.1	-	**32**	0	0	7.4	-
33	0	0	7.5	-	**33**	0	0	7.6	-	**33**	0	0	13.5	-
34	0	0	7.4	-	**34**	0	0	7.7	-	**34**	0	0	9.5	-
35	0	0	3.8	-	**35**	0	0	3.5	-	**35**	0	0	6.0	-
36	0	0	5.7	-	**36**	0	0	9.6	-	**36**	0	0	7.0	-
37	0	0	7.6	-	**37**	0	0	11.4	-	**37**	0	0	7.2	-
38	0	0	5.1	-	**38**	0	0	4.1	-	**38**	0	0	4.9	-
39	0	0	6.8	-	**39**	0	0	9.9	-	**39**	0	0	6.5	-
40	0	0	5.2	0.5	**40**	0	0	9.2	0.5	**40**	0	0	8.4	0.25
41	0	0	6.3	-	**41**	0	0	8.6	-	**41**	0	0	5.2	-
42	0	0	9.0	-	**42**	0	0	6.8	-	**42**	0	0	6.7	-
43	0	0	4.3	-	**43**	0	0	13.0	-	**43**	0	0	15.5	-
44	0	0	6.5	-	**44**	0	0	7.4	-	**44**	0	0	12.5	-
45	0	0	5.0	-	**45**	0	0	9.1	-	**45**	0	0	8.2	-
46	0	0	4.7	-	**46**	0	0	10.2	-	**46**	0	0	7.2	-
47	0	0	5.3	-	**47**	0	0	5.5	-	**47**	0	0	6.6	-
48	0	0	5.5	-	**48**	0	0	9.9	-	**48**	0	0	4.8	-
49	0	0	7.4	-	**49**	0	0	7.6	-	**49**	0	0	6.5	-
50	0	0	6.3	0.25	**50**	0	0	7.6	0.25	**50**	0	0	9.8	0.25
51	0	0	6.5	-	**51**	0	0	8.0	-	**51**	0	0	8.2	-
52	0	0	5.8	-	**52**	0	0	6.8	-	**52**	0	0	5.0	-
53	0	0	7.8	-	**53**	0	0	4.2	-	**53**	0	0	10.0	-
54	0	0	9.4	-	**54**	0	0	12.5	-	**54**	0	0	7.2	-
55	0	0	9.4	-	**55**	0	0	11.1	-	**55**	0	0	8.1	-
56	0	0	6.7	-	**56**	0	0	6.2	-	**56**	0	0	6.6	-
57	0	0	7.0	-	**57**	0	0	9.1	-	**57**	0	0	6.0	-
58	0	0	6.3	-	**58**	0	0	8.2	-	**58**	0	0	6.8	-
59	0	0	2.8	-	**59**	0	0	9.3	-	**59**	0	0	7.0	-
60	0	0	6.8	0.75	**60**	0	0	10.2	0.5	**60**	0	0	10.0	0.5
61	0	0	10.5	-	**61**	0	0	7.6	-	**61**	0	0	6.7	-
62	0	0	9.1	-	**62**	0	0	13.5	-	**62**	0	0	7.0	-
63	0	0	9.2	-	**63**	0	0	5.5	-	**63**	0	0	5.1	-
64	0	0	6.8	-	**64**	0	0	8.1	-	**64**	0	0	10.2	-
65	0	0	7.1	-	**65**	0	0	5.9	-	**65**	0	0	6.2	-
66	0	0	5.1	-	**66**	0	0	4.2	-	**66**	0	0	9.1	-
67	0	0	4.6	-	**67**	0	0	16.0	-	**67**	0	0	6.0	-
68	0	0	7.8	-	**68**	0	0	6.7	-	**68**	0	0	7.0	-
69	0	0	7.1	-	**69**	0	0	4.6	-	**69**	0	0	6.0	-
70	0	0	9.2	0.5	**70**	0	0	11.2	0.25	**70**	0	0	9.7	0.75
71	0	0	12.3	-	**71**	0	0	5.8	-	**71**	0	0	11.0	-
72	0	0	7.0	-	**72**	0	0	7.5	-	**72**	0	0	7.8	-
73	0	0	4.7	-	**73**	0	0	6.8	-	**73**	0	0	7.2	-
74	0	0	8.9	-	**74**	0	0	3.5	-	**74**	0	0	9.4	-
75	0	0	11.8	-	**75**	0	0	9.6	-	**75**	0	0	4.1	-
76	0	0	5.1	-	**76**	0	0	12.5	-	**76**	0	0	4.5	-
77	0	0	5.4	-	**77**	0	0	11.9	-	**77**	0	0	12.0	-
78	0	0	12.5	-	**78**	0	0	12.2	-	**78**	0	0	6.1	-
79	0	0	9.5	-	**79**	0	0	6.8	-	**79**	0	0	4.9	-
80	0	0	5.5	0.5	**80**	0	0	7.5	0.25	**80**	0	0	6.0	0.25
81	0	0	5.7	-	**81**	0	0	3.9	-	**81**	0	0	6.7	-
82	0	0	5.7	-	**82**	0	0	7.5	-	**82**	0	0	7.5	-
83	0	0	6.7	-	**83**	0	0	6.2	-	**83**	0	0	8.9	-
84	0	0	7.5	-	**84**	0	0	12.1	-	**84**	0	0	6.2	-
85	0	0	6.8	-	**85**	0	0	11.4	-	**85**	0	0	12.5	-
86	0	0	9.2	-	**86**	0	0	3.7	-	**86**	0	0	8.2	-
87	0	0	7.2	-	**87**	0	0	8.3	-	**87**	0	0	11.5	-
88	0	0	4.6	-	**88**	0	0	8.5	-	**88**	0	0	5.5	-
89	0	0	6.6	-	**89**	0	0	9.5	-	**89**	0	0	9.2	-
90	0	0	4.2	0.25	**90**	0	0	5.6	0.25	**90**	0	0	9.6	0.25
91	0	0	12.7	-	**91**	0	0	5.6	-	**91**	0	0	7.2	-
92	0	0	7.5	-	**92**	0	0	5.9	-	**92**	0	0	8.7	-
93	0	0	5.5	-	**93**	0	0	12.2	-	**93**	0	0	6.3	-
94	0	0	7.0	-	**94**	0	0	9.1	-	**94**	0	0	11.8	-
95	0	0	5.5	-	**95**	0	0	4.4	-	**95**	0	0	5.5	-
96	0	0	7.1	-	**96**	0	0	11.0	-	**96**	0	0	10.2	-
97	0	0	10.0	-	**97**	0	0	4.3	-	**97**	0	0	8.0	-
98	0	0	4.0	-	**98**	0	0	10.2	-	**98**	0	0	4.6	-
99	0	0	6.1	-	**99**	0	0	8.1	-	**99**	0	0	6.2	-
100	0	0	6.0	0.25	**100**	0	0	5.5	0.5	**100**	0	0	6.5	0.25
Average C_c, C_p and Embed. =	**0**	**0**	**-**	**0.33**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.38**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.35**
Calcite Index (CI) =		**0.00**			**Calcite Index (CI) =**		**0.00**			**Calcite Index (CI) =**		**0.00**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_ERSC4-1					RG_ERSC4-2					RG_ERSC4-3				
12-Sep-20					12-Sep-20					12-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	1.8	-	**1**	0	0	2.9	-	**1**	0	0	6.2	-
2	0	0	1.2	-	**2**	0	0	2.8	-	**2**	0	0	4.3	-
3	0	0	3.3	-	**3**	0	0	4.6	-	**3**	0	0	4.1	-
4	0	0	2.7	-	**4**	0	0	3.2	-	**4**	0	0	3.2	-
5	0	0	3.2	-	**5**	0	0	4.0	-	**5**	0	0	4.9	-
6	0	0	1.9	-	**6**	0	0	4.8	-	**6**	0	0	2.1	-
7	0	0	3.1	-	**7**	0	0	2.6	-	**7**	0	0	4.2	-
8	0	0	2.1	-	**8**	0	0	1.9	-	**8**	0	0	4.3	-
9	0	0	1.2	-	**9**	0	0	2.3	-	**9**	0	0	8.4	-
10	0	0	2.2	0.25	**10**	0	0	2.7	0	**10**	0	0	6.8	0.25
11	0	0	1.5	-	**11**	0	0	3.7	-	**11**	0	0	4.4	-
12	0	0	2.2	-	**12**	0	0	2.9	-	**12**	0	0	5.1	-
13	0	0	2.7	-	**13**	0	0	5.7	-	**13**	0	0	5.9	-
14	0	0	1.7	-	**14**	0	0	6.2	-	**14**	0	0	6.5	-
15	0	0	2.0	-	**15**	0	0	2.7	-	**15**	0	0	4.4	-
16	0	0	-	-	**16**	0	0	5.6	-	**16**	0	0	3.2	-
17	0	0	2.4	-	**17**	0	0	5.0	-	**17**	0	0	12.2	-
18	0	0	3.3	-	**18**	0	0	8.4	-	**18**	0	0	5.0	-
19	0	0	3.0	-	**19**	0	0	3.1	-	**19**	0	0	7.4	-
20	0	0	2.5	0.5	**20**	0	0	4.3	0.25	**20**	0	0	5.0	0.25
21	0	0	2.8	-	**21**	0	0	2.7	-	**21**	0	0	9.3	-
22	0	0	2.4	-	**22**	0	0	4.1	-	**22**	0	0	2.5	-
23	0	0	2.2	-	**23**	0	0	2.4	-	**23**	0	0	4.6	-
24	0	0	0.8	-	**24**	0	0	3.1	-	**24**	0	0	3.2	-
25	0	0	-	-	**25**	0	0	4.2	-	**25**	0	0	4.4	-
26	0	0	2.1	-	**26**	0	0	5.1	-	**26**	0	0	5.1	-
27	0	0	2.0	-	**27**	0	0	8.0	-	**27**	0	0	7.2	-
28	0	0	2.1	-	**28**	0	0	4.9	-	**28**	0	0	8.9	-
29	0	0	3.0	-	**29**	0	0	3.9	-	**29**	0	0	7.5	-
30	0	0	1.5	0.25	**30**	0	0	6.5	0	**30**	0	0	8.1	0.25
31	0	0	2.2	-	**31**	0	0	4.7	-	**31**	0	0	13.2	-
32	0	0	3.1	-	**32**	0	0	6.7	-	**32**	0	0	3.6	-
33	0	0	1.5	-	**33**	0	0	4.1	-	**33**	0	0	5.4	-
34	0	0	3.6	-	**34**	0	0	-	-	**34**	0	0	3.4	-
35	0	0	2.5	-	**35**	0	0	6.4	-	**35**	0	0	11.9	-
36	0	0	-	-	**36**	0	0	1.7	-	**36**	0	0	2.5	-
37	0	0	2.1	-	**37**	0	0	2.0	-	**37**	0	0	10.0	-
38	0	0	2.2	-	**38**	0	0	4.7	-	**38**	0	0	3.5	-
39	0	0	2.3	-	**39**	0	0	7.2	-	**39**	0	0	10.9	-
40	0	0	1.9	0.5	**40**	0	0	3.7	0	**40**	0	0	6.2	0.25
41	0	0	2.5	-	**41**	0	0	5.2	-	**41**	0	0	9.4	-
42	0	0	2.8	-	**42**	0	0	2.4	-	**42**	0	0	2.4	-
43	0	0	2.3	-	**43**	0	0	3.3	-	**43**	0	0	9.6	-
44	0	0	2.4	-	**44**	0	0	6.4	-	**44**	0	0	11.2	-
45	0	0	2.4	-	**45**	0	0	4.9	-	**45**	0	0	6.4	-
46	0	0	1.5	-	**46**	0	0	4.4	-	**46**	0	0	6.4	-
47	0	0	2.8	-	**47**	0	0	4.6	-	**47**	0	0	7.8	-
48	0	0	1.0	-	**48**	0	0	3.5	-	**48**	0	0	8.4	-
49	0	0	1.7	-	**49**	0	0	3.9	-	**49**	0	0	4.4	-
50	0	0	2.6	0.5	**50**	0	0	3.5	0.5	**50**	0	0	13.4	0.25
51	0	0	3.2	-	**51**	0	0	4.5	-	**51**	0	0	4.6	-
52	0	0	1.5	-	**52**	0	0	4.6	-	**52**	0	0	5.4	-
53	0	0	2.6	-	**53**	0	0	3.6	-	**53**	0	0	9.3	-
54	0	0	1.7	-	**54**	0	0	-	-	**54**	0	0	1.9	-
55	0	0	1.7	-	**55**	0	0	2.8	-	**55**	0	0	15.2	-
56	0	0	1.9	-	**56**	0	0	4.0	-	**56**	0	0	7.2	-
57	0	0	2.1	-	**57**	0	0	3.7	-	**57**	0	0	9.0	-
58	0	0	-	-	**58**	0	0	3.2	-	**58**	0	0	5.0	-
59	0	0	2.3	-	**59**	0	0	4.3	-	**59**	0	0	5.7	-
60	0	0	3.4	0.5	**60**	0	0	7.4	0.25	**60**	0	0	2.4	0.5
61	0	0	2.2	-	**61**	0	0	4.7	-	**61**	0	0	4.4	-
62	0	0	1.9	-	**62**	0	0	7.4	-	**62**	0	0	4.7	-
63	0	0	3.0	-	**63**	0	0	4.6	-	**63**	0	0	4.5	-
64	0	0	2.5	-	**64**	0	0	4.6	-	**64**	0	0	5.1	-
65	0	0	2.5	-	**65**	0	0	4.4	-	**65**	0	0	8.3	-
66	0	0	3.5	-	**66**	0	0	5.7	-	**66**	0	0	12.2	-
67	0	0	1.0	-	**67**	0	0	3.9	-	**67**	0	0	5.4	-
68	0	0	1.7	-	**68**	0	0	2.2	-	**68**	0	0	11.4	-
69	0	0	-	-	**69**	0	0	6.4	-	**69**	0	0	5.5	-
70	0	0	2.6	0.5	**70**	0	0	5.9	0.75	**70**	0	0	6.1	0.5
71	0	0	3.4	-	**71**	0	0	3.9	-	**71**	0	0	6.9	-
72	0	0	1.9	-	**72**	0	0	4.4	-	**72**	0	0	5.9	-
73	0	0	2.4	-	**73**	0	0	3.9	-	**73**	0	0	8.8	-
74	0	0	2.2	-	**74**	0	0	5.5	-	**74**	0	0	6.5	-
75	0	0	3.0	-	**75**	0	0	5.5	-	**75**	0	0	6.5	-
76	0	0	2.4	-	**76**	0	0	1.7	-	**76**	0	0	4.2	-
77	0	0	2.4	-	**77**	0	0	-	-	**77**	0	0	6.8	-
78	0	0	2.6	-	**78**	0	0	2.8	-	**78**	0	0	5.7	-
79	0	0	1.8	-	**79**	0	0	3.4	-	**79**	0	0	12.7	-
80	0	0	1.6	0.5	**80**	0	0	2.2	0	**80**	0	0	6.0	0.5
81	0	0	1.3	-	**81**	0	0	2.6	-	**81**	0	0	7.0	-
82	0	0	2.4	-	**82**	0	0	6.2	-	**82**	0	0	18.0	-
83	0	0	-	-	**83**	0	0	2.7	-	**83**	0	0	12.5	-
84	0	0	2.3	-	**84**	0	0	8.7	-	**84**	0	0	4.2	-
85	0	0	1.3	-	**85**	0	0	5.7	-	**85**	0	0	10.9	-
86	0	0	1.5	-	**86**	0	0	3.6	-	**86**	0	0	8.6	-
87	0	0	1.5	-	**87**	0	0	4.1	-	**87**	0	0	11.1	-
88	0	0	2.8	-	**88**	0	0	3.7	-	**88**	0	0	5.3	-
89	0	0	1.2	-	**89**	0	0	6.1	-	**89**	0	0	16.2	-
90	0	0	2.3	0.25	**90**	0	0	4.6	0.75	**90**	0	0	7.3	0.25
91	0	0	1.2	-	**91**	0	0	2.9	-	**91**	0	0	15.5	-
92	0	0	1.9	-	**92**	0	0	6.3	-	**92**	0	0	6.1	-
93	0	0	-	-	**93**	0	0	3.1	-	**93**	0	0	2.7	-
94	0	0	1.3	-	**94**	0	0	4.0	-	**94**	0	0	5.3	-
95	0	0	1.2	-	**95**	0	0	2.4	-	**95**	0	0	2.2	-
96	0	0	2.3	-	**96**	0	0	2.4	-	**96**	0	0	11.7	-
97	0	0	2.9	-	**97**	0	0	2.7	-	**97**	0	0	5.6	-
98	0	0	1.6	-	**98**	0	0	2.7	-	**98**	0	0	7.5	-
99	0	0	2.2	-	**99**	0	0	1.4	-	**99**	0	0	5.4	-
100	0	0	2.3	0.5	**100**	0	0	2.7	0	**100**	0	0	7.5	0.25
Average C_c, C_p and Embed. =	**0**	**0**	**-**	**0.43**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.25**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.33**
Calcite Index (CI) =		**0.00**			**Calcite Index (CI) =**		**0.00**			**Calcite Index (CI) =**		**0.00**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_ER1A-1					RG_ER1A-2					RG_ER1A-3				
11-Sep-20					11-Sep-20					12-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	12.5	-	**1**	0	0	4.1	-	**1**	0	0	4.3	-
2	0	0	9.3	-	**2**	0	0	4.2	-	**2**	0	0	5.5	-
3	0	0	6.2	-	**3**	0	0	3.8	-	**3**	0	0	5.2	-
4	0	0	7.8	-	**4**	0	0	3.5	-	**4**	0	0	4.9	-
5	0	0	9.1	-	**5**	0	0	3.6	-	**5**	0	0	2.9	-
6	0	1	10.2	-	**6**	0	0	5.8	-	**6**	0	0	4.4	-
7	0	0	7.0	-	**7**	0	0	3.2	-	**7**	0	0	5.3	-
8	0	0	8.0	-	**8**	0	0	3.4	-	**8**	0	1	4.2	-
9	0	0	9.8	-	**9**	0	0	3.4	-	**9**	0	0	3.1	-
10	0	0	7.8	0.25	**10**	0	0	3.0	0.25	**10**	0	0	4.2	0
11	0	0	8.1	-	**11**	0	0	2.9	-	**11**	0	0	3.6	-
12	0	0	7.9	-	**12**	0	0	3.5	-	**12**	0	0	1.8	-
13	0	0	7.2	-	**13**	0	0	2.5	-	**13**	0	0	5.4	-
14	0	0	6.0	-	**14**	0	0	2.6	-	**14**	0	0	7.8	-
15	0	0	9.5	-	**15**	0	0	4.8	-	**15**	0	0	3.1	-
16	0	0	7.2	-	**16**	0	0	3.0	-	**16**	0	0	2.8	-
17	0	0	11.3	-	**17**	0	0	4.1	-	**17**	0	0	4.9	-
18	0	0	6.1	-	**18**	0	0	4.4	-	**18**	0	0	5.0	-
19	0	0	10.4	-	**19**	0	0	2.5	-	**19**	0	0	3.2	-
20	0	0	9.6	0	**20**	0	0	4.2	0.25	**20**	0	0	6.0	0
21	0	0	7.5	-	**21**	0	0	3.1	-	**21**	0	0	4.1	-
22	0	0	11.6	-	**22**	0	0	-	-	**22**	0	0	3.2	-
23	0	0	7.4	-	**23**	0	0	4.2	-	**23**	0	0	3.2	-
24	0	0	5.0	-	**24**	0	0	2.8	-	**24**	0	0	12.1	-
25	0	0	5.6	-	**25**	0	0	4.2	-	**25**	0	0	3.6	-
26	0	0	11.3	-	**26**	0	0	2.9	-	**26**	0	0	7.2	-
27	0	0	5.7	-	**27**	0	0	4.9	-	**27**	0	0	4.6	-
28	0	0	7.6	-	**28**	0	0	4.5	-	**28**	0	0	2.8	-
29	0	0	11.5	-	**29**	0	0	4.5	-	**29**	0	0	7.1	-
30	0	0	10.4	0.25	**30**	0	0	3.5	0.5	**30**	0	0	6.0	0.25
31	0	0	5.8	-	**31**	0	0	3.5	-	**31**	0	0	6.8	-
32	0	0	11.0	-	**32**	0	0	4.6	-	**32**	0	0	4.7	-
33	0	0	10.5	-	**33**	0	0	3.4	-	**33**	0	0	8.5	-
34	0	1	13.5	-	**34**	0	0	3.3	-	**34**	0	0	4.7	-
35	0	0	12.0	-	**35**	0	0	3.2	-	**35**	0	0	8.6	-
36	0	0	9.2	-	**36**	0	0	2.3	-	**36**	0	0	3.4	-
37	0	0	-	-	**37**	0	0	4.4	-	**37**	0	0	4.4	-
38	0	0	6.0	-	**38**	0	0	5.4	-	**38**	0	0	3.5	-
39	0	0	10.0	-	**39**	0	0	5.8	-	**39**	0	0	2.1	-
40	0	1	10.0	0.25	**40**	0	0	3.5	0	**40**	0	0	4.6	0
41	0	0	9.0	-	**41**	0	0	6.2	-	**41**	0	0	3.6	-
42	0	0	10.0	-	**42**	0	0	5.8	-	**42**	0	0	3.2	-
43	0	0	10.0	-	**43**	0	0	4.3	-	**43**	0	0	3.7	-
44	0	0	6.5	-	**44**	0	0	-	-	**44**	0	0	4.4	-
45	0	0	8.0	-	**45**	0	0	3.1	-	**45**	0	0	4.6	-
46	0	0	6.0	-	**46**	0	0	4.3	-	**46**	0	0	4.7	-
47	0	0	19.0	-	**47**	0	0	4.4	-	**47**	0	0	3.6	-
48	0	0	11.2	-	**48**	0	0	3.5	-	**48**	0	0	5.3	-
49	0	0	6.5	-	**49**	0	0	4.2	-	**49**	0	1	4.4	-
50	0	0	4.6	0	**50**	0	0	3.8	0.25	**50**	0	0	5.6	0.5
51	0	0	6.3	-	**51**	0	0	4.6	-	**51**	0	1	2.9	-
52	0	0	8.4	-	**52**	0	0	3.2	-	**52**	0	0	5.0	-
53	0	0	10.3	-	**53**	0	0	3.8	-	**53**	0	0	2.7	-
54	0	1	6.2	-	**54**	0	0	4.5	-	**54**	0	0	1.8	-
55	0	0	8.0	-	**55**	0	0	3.4	-	**55**	0	0	8.5	-
56	0	0	9.2	-	**56**	0	0	3.6	-	**56**	0	0	4.6	-
57	0	0	3.1	-	**57**	0	0	4.4	-	**57**	0	0	3.1	-
58	0	0	7.0	-	**58**	0	0	4.9	-	**58**	0	0	3.3	-
59	0	0	7.7	-	**59**	0	0	6.2	-	**59**	0	0	7.0	-
60	0	0	9.1	0.25	**60**	0	0	3.1	0.5	**60**	0	0	4.4	0.25
61	0	0	7.8	-	**61**	0	1	3.5	-	**61**	0	0	-	-
62	0	0	9.5	-	**62**	0	0	3.9	-	**62**	0	0	3.2	-
63	0	0	12.0	-	**63**	0	0	2.6	-	**63**	0	0	3.9	-
64	0	1	8.2	-	**64**	0	0	3.3	-	**64**	0	1	4.2	-
65	0	0	9.2	-	**65**	0	0	5.1	-	**65**	0	0	7.4	-
66	0	0	9.4	-	**66**	0	0	6.0	-	**66**	0	0	4.6	-
67	0	0	5.4	-	**67**	0	0	8.4	-	**67**	0	0	4.4	-
68	0	0	11.3	-	**68**	0	0	4.2	-	**68**	0	0	5.1	-
69	0	0	11.8	-	**69**	0	0	3.3	-	**69**	0	0	4.0	-
70	0	0	11.2	0.25	**70**	0	0	5.4	0.5	**70**	0	0	5.1	0
71	0	0	12.6	-	**71**	0	0	4.6	-	**71**	0	0	6.0	-
72	0	0	8.2	-	**72**	0	0	-	-	**72**	0	0	4.7	-
73	0	0	5.3	-	**73**	0	0	4.0	-	**73**	0	0	2.5	-
74	0	0	8.1	-	**74**	0	0	5.9	-	**74**	0	0	4.0	-
75	0	1	10.2	-	**75**	0	0	5.6	-	**75**	0	0	3.3	-
76	0	0	13.2	-	**76**	0	0	4.2	-	**76**	0	0	3.7	-
77	0	0	9.5	-	**77**	0	0	2.4	-	**77**	0	0	7.5	-
78	0	0	8.5	-	**78**	0	0	4.3	-	**78**	0	0	3.9	-
79	0	0	6.7	-	**79**	0	0	-	-	**79**	0	0	6.2	-
80	0	0	5.2	0	**80**	0	0	3.1	0.25	**80**	0	0	8.2	0.5
81	0	0	5.0	-	**81**	0	0	2.5	-	**81**	0	0	5.0	-
82	0	0	6.5	-	**82**	0	0	4.1	-	**82**	0	0	2.7	-
83	0	0	10.5	-	**83**	0	0	3.8	-	**83**	0	0	7.1	-
84	0	0	6.7	-	**84**	0	0	4.3	-	**84**	0	1	7.5	-
85	0	0	7.1	-	**85**	0	0	5.9	-	**85**	0	0	5.0	-
86	0	0	12.0	-	**86**	0	0	4.5	-	**86**	0	0	7.2	-
87	0	0	5.7	-	**87**	0	0	5.6	-	**87**	0	0	3.4	-
88	0	0	8.0	-	**88**	0	0	5.5	-	**88**	0	0	5.4	-
89	0	0	5.7	-	**89**	0	0	4.6	-	**89**	0	0	6.1	-
90	0	0	9.6	0.25	**90**	0	0	5.2	0.5	**90**	0	0	4.6	0
91	0	0	-	-	**91**	0	0	6.8	-	**91**	0	0	9.0	-
92	0	0	11.0	-	**92**	0	0	4.6	-	**92**	0	0	6.2	-
93	0	0	7.0	-	**93**	0	0	5.0	-	**93**	0	0	6.9	-
94	0	0	11.7	-	**94**	0	0	4.5	-	**94**	0	0	7.2	-
95	0	0	7.1	-	**95**	0	0	3.5	-	**95**	0	0	2.5	-
96	0	0	5.1	-	**96**	0	0	4.1	-	**96**	0	0	9.4	-
97	0	0	3.5	-	**97**	0	0	5.5	-	**97**	0	0	3.6	-
98	0	0	8.4	-	**98**	0	0	6.3	-	**98**	0	0	5.9	-
99	0	0	3.9	-	**99**	0	0	4.5	-	**99**	0	0	6.8	-
100	0	0	3.0	0.5	**100**	0	0	4.8	0.5	**100**	0	0	7.2	0
Average C_c, C_p and Embed. =	**0**	**0.06**	**-**	**0.20**	**Average C_c, C_p and Embed. =**	**0**	**0.01**	**-**	**0.35**	**Average C_c, C_p and Embed. =**	**0**	**0.05**	**-**	**0.15**
Calcite Index (CI) =		**0.06**			**Calcite Index (CI) =**		**0.01**			**Calcite Index (CI) =**		**0.05**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_ERSC5-1					RG_ERSC5-2					RG_ERSC5-3				
11-Sep-20					11-Sep-20					11-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	7.9	-	**1**	0	0	9.7	-	**1**	0	0	6.5	-
2	0	0	3.4	-	**2**	0	0	5.8	-	**2**	0	0	3.3	-
3	0	0	2.2	-	**3**	0	0	9.4	-	**3**	0	0	9.4	-
4	0	0	1.2	-	**4**	0	0	9.2	-	**4**	0	0	4.6	-
5	0	0	4.8	-	**5**	0	0	9.9	-	**5**	0	0	7.0	-
6	0	0	4.1	-	**6**	0	0	9.5	-	**6**	0	0	3.1	-
7	0	0	1.8	-	**7**	0	0	8.7	-	**7**	0	0	9.5	-
8	0	0	3.4	-	**8**	0	0	3.2	-	**8**	0	1	3.2	-
9	0	0	-	-	**9**	0	0	5.2	-	**9**	0	1	5.1	-
10	0	0	15.2	0.5	**10**	0	0	4.8	0	**10**	0	0	4.3	0.5
11	0	0	-	-	**11**	0	0	8.2	-	**11**	0	0	3.4	-
12	0	0	2.4	-	**12**	0	0	10.4	-	**12**	0	0	2.9	-
13	0	0	3.0	-	**13**	0	0	5.7	-	**13**	0	0	11.9	-
14	0	0	5.3	-	**14**	0	0	2.2	-	**14**	0	0	5.1	-
15	0	0	4.2	-	**15**	0	0	5.3	-	**15**	0	0	3.2	-
16	0	0	-	-	**16**	0	1	4.0	-	**16**	0	0	4.4	-
17	0	0	1.8	-	**17**	0	0	11.4	-	**17**	0	0	1.1	-
18	0	0	3.5	-	**18**	0	0	6.6	-	**18**	0	0	4.4	-
19	0	0	2.6	-	**19**	0	0	6.4	-	**19**	0	0	3.9	-
20	0	0	2.5	0.5	**20**	0	0	4.8	0	**20**	0	0	4.8	0.25
21	0	0	3.7	-	**21**	0	0	2.6	-	**21**	0	0	4.5	-
22	0	0	2.3	-	**22**	0	0	7.0	-	**22**	0	0	4.2	-
23	0	0	2.3	-	**23**	0	0	2.0	-	**23**	0	0	3.1	-
24	0	0	-	-	**24**	0	0	6.5	-	**24**	0	0	3.5	-
25	0	0	2.3	-	**25**	0	0	6.6	-	**25**	0	0	4.6	-
26	0	0	4.3	-	**26**	0	0	6.2	-	**26**	0	0	11.5	-
27	0	0	5.1	-	**27**	0	0	5.5	-	**27**	0	0	4.0	-
28	0	0	2.7	-	**28**	0	0	7.8	-	**28**	0	1	5.2	-
29	0	0	10.6	-	**29**	0	0	6.9	-	**29**	0	0	3.4	-
30	0	0	12.2	0.25	**30**	0	0	7.5	0	**30**	0	1	8.8	0.5
31	0	0	3.5	-	**31**	0	0	7.4	-	**31**	0	0	4.7	-
32	0	0	6.4	-	**32**	0	0	8.5	-	**32**	0	0	8.8	-
33	0	0	2.0	-	**33**	0	0	1.0	-	**33**	0	1	4.0	-
34	0	0	2.5	-	**34**	0	0	5.1	-	**34**	0	1	4.6	-
35	0	0	5.7	-	**35**	0	0	7.4	-	**35**	0	0	5.6	-
36	0	0	3.7	-	**36**	0	0	8.0	-	**36**	0	0	4.2	-
37	0	0	2.3	-	**37**	0	0	6.1	-	**37**	0	0	2.9	-
38	0	0	3.3	-	**38**	0	0	6.2	-	**38**	0	0	3.9	-
39	0	0	2.2	-	**39**	0	0	13.0	-	**39**	0	0	13.1	-
40	0	0	5.0	0.75	**40**	0	0	9.0	0.25	**40**	0	0	4.2	0.25
41	0	0	4.5	-	**41**	0	0	4.2	-	**41**	0	0	2.1	-
42	0	0	4.8	-	**42**	0	0	5.6	-	**42**	0	1	7.3	-
43	0	0	3.8	-	**43**	0	0	2.0	-	**43**	0	1	5.5	-
44	0	0	6.0	-	**44**	0	0	3.2	-	**44**	0	1	12.6	-
45	0	0	6.6	-	**45**	0	0	4.4	-	**45**	0	0	5.4	-
46	0	0	3.9	-	**46**	0	0	3.2	-	**46**	0	1	2.8	-
47	0	0	2.1	-	**47**	0	0	6.9	-	**47**	0	1	7.2	-
48	0	0	3.4	-	**48**	0	0	5.5	-	**48**	0	1	4.3	-
49	0	0	4.0	-	**49**	0	0	3.0	-	**49**	0	0	-	-
50	0	0	1.3	0.25	**50**	0	0	6.1	0.25	**50**	0	0	2.9	0.25
51	0	0	2.1	-	**51**	0	0	8.2	-	**51**	0	0	5.3	-
52	0	0	2.3	-	**52**	0	0	7.6	-	**52**	0	0	2.3	-
53	0	0	4.4	-	**53**	0	0	9.6	-	**53**	0	0	4.3	-
54	0	0	1.6	-	**54**	0	0	8.4	-	**54**	0	0	4.4	-
55	0	0	3.2	-	**55**	0	0	6.4	-	**55**	0	0	3.1	-
56	0	0	3.1	-	**56**	0	0	6.5	-	**56**	0	0	5.0	-
57	0	0	4.1	-	**57**	0	0	6.5	-	**57**	0	0	7.2	-
58	0	0	3.9	-	**58**	0	0	11.3	-	**58**	0	0	7.9	-
59	0	0	2.4	-	**59**	0	0	8.0	-	**59**	0	0	6.4	-
60	0	0	2.4	0.5	**60**	0	0	6.0	0	**60**	0	0	3.9	0.25
61	0	0	2.9	-	**61**	0	0	7.0	-	**61**	0	0	2.8	-
62	0	0	3.4	-	**62**	0	0	7.9	-	**62**	0	0	5.5	-
63	0	0	4.4	-	**63**	0	0	5.0	-	**63**	0	0	7.1	-
64	0	0	-	-	**64**	0	0	9.5	-	**64**	0	0	3.9	-
65	0	0	1.1	-	**65**	0	0	7.5	-	**65**	0	0	4.3	-
66	0	0	2.4	-	**66**	0	0	2.7	-	**66**	0	0	4.0	-
67	0	0	1.4	-	**67**	0	0	7.6	-	**67**	0	0	9.8	-
68	0	0	2.1	-	**68**	0	0	5.4	-	**68**	0	0	4.4	-
69	0	0	2.1	-	**69**	0	0	19.0	-	**69**	0	0	6.9	-
70	0	0	2.6	0.5	**70**	0	0	10.4	0.25	**70**	0	0	4.2	0.25
71	0	0	4.8	-	**71**	0	0	6.8	-	**71**	0	0	6.5	-
72	0	0	2.4	-	**72**	0	0	8.1	-	**72**	0	0	4.5	-
73	0	0	2.9	-	**73**	0	0	7.2	-	**73**	0	0	5.6	-
74	0	0	2.4	-	**74**	0	0	17.5	-	**74**	0	0	4.4	-
75	0	0	3.3	-	**75**	0	0	7.0	-	**75**	0	0	10.9	-
76	0	0	-	-	**76**	0	0	1.4	-	**76**	0	0	6.5	-
77	0	0	1.6	-	**77**	0	0	6.5	-	**77**	0	0	5.1	-
78	0	0	5.1	-	**78**	0	0	7.4	-	**78**	0	0	3.5	-
79	0	0	1.0	-	**79**	0	0	2.3	-	**79**	0	0	4.2	-
80	0	0	3.9	0.75	**80**	0	0	7.6	0.25	**80**	0	0	6.4	0.5
81	0	0	3.3	-	**81**	0	0	9.4	-	**81**	0	0	8.3	-
82	0	0	1.2	-	**82**	0	0	3.2	-	**82**	0	0	4.5	-
83	0	0	17.1	-	**83**	0	0	14.0	-	**83**	0	0	7.5	-
84	0	0	4.3	-	**84**	0	0	8.2	-	**84**	0	0	4.8	-
85	0	0	2.8	-	**85**	0	0	8.0	-	**85**	0	0	3.2	-
86	0	0	2.4	-	**86**	0	0	5.5	-	**86**	0	0	16.5	-
87	0	0	3.1	-	**87**	0	0	13.0	-	**87**	0	0	4.0	-
88	0	0	2.5	-	**88**	0	0	8.2	-	**88**	0	0	3.4	-
89	0	0	7.5	-	**89**	0	0	5.9	-	**89**	0	0	5.6	-
90	0	0	4.0	0.5	**90**	0	0	8.5	0	**90**	0	0	11.2	0.25
91	0	0	2.1	-	**91**	0	0	9.2	-	**91**	0	0	4.8	-
92	0	0	5.3	-	**92**	0	0	10.5	-	**92**	0	0	4.4	-
93	0	0	3.3	-	**93**	0	0	9.4	-	**93**	0	0	4.4	-
94	0	0	2.4	-	**94**	0	0	6.6	-	**94**	0	0	4.8	-
95	0	0	-	-	**95**	0	0	4.0	-	**95**	0	0	4.1	-
96	0	0	4.1	-	**96**	0	0	9.4	-	**96**	0	0	10.7	-
97	0	0	3.6	-	**97**	0	0	8.3	-	**97**	0	0	3.4	-
98	0	0	2.1	-	**98**	0	0	6.5	-	**98**	0	0	4.4	-
99	0	0	6.2	-	**99**	0	0	8.0	-	**99**	0	0	-	-
100	0	0	5.4	0.5	**100**	0	0	5.0	0.25	**100**	0	0	2.9	-
Average C_c, C_p and Embed. =	**0**	**0**	**-**	**0.50**	**Average C_c, C_p and Embed. =**	**0**	**0.01**	**-**	**0.13**	**Average C_c, C_p and Embed. =**	**0**	**0.12**	**-**	**0.33**
Calcite Index (CI) =		**0.00**			**Calcite Index (CI) =**		**0.01**			**Calcite Index (CI) =**		**0.12**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_THCK-1					RG_THCK-2					RG_THCK-3				
10-Sep-20					10-Sep-20					10-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	1	10.2	-	**1**	0	0	4.1	-	**1**	0	1	7.5	-
2	0	1	9.8	-	**2**	0	0	2.5	-	**2**	0	1	9.5	-
3	0	1	9.5	-	**3**	0	0	6.7	-	**3**	0	0	7.0	-
4	0	0	10.5	-	**4**	0	0	4.8	-	**4**	0	0	2.9	-
5	0	1	4.9	-	**5**	0	1	5.9	-	**5**	0	1	10.2	-
6	0	1	3.0	-	**6**	0	1	7.2	-	**6**	0	1	11.0	-
7	0	1	2.5	-	**7**	0	0	9.1	-	**7**	0	1	10.5	-
8	0	0	6.6	-	**8**	0	0	1.1	-	**8**	0	1	10.5	-
9	0	1	4.2	-	**9**	0	1	4.9	-	**9**	0	1	9.2	-
10	0	1	4.3	0.25	**10**	0	0	6.0	0.5	**10**	1	1	12.1	0.75
11	0	1	7.9	-	**11**	0	0	3.3	-	**11**	0	1	9.5	-
12	0	1	5.2	-	**12**	0	0	3.2	-	**12**	0	1	6.4	-
13	2	1	10.2	-	**13**	0	1	4.1	-	**13**	0	0	9.2	-
14	0	1	6.9	-	**14**	0	0	6.5	-	**14**	0	1	8.9	-
15	0	1	sand	-	**15**	0	0	-	-	**15**	0	1	9.5	-
16	0	1	11.7	-	**16**	0	0	5.2	-	**16**	0	1	10.4	-
17	0	0	2.0	-	**17**	0	1	3.8	-	**17**	0	1	7.1	-
18	0	1	8.0	-	**18**	0	0	2.5	-	**18**	1	1	3.8	-
19	0	1	7.5	-	**19**	0	1	3.4	-	**19**	0	1	5.6	-
20	0	0	8.5	0.5	**20**	0	0	6.3	0.25	**20**	0	1	3.9	0.25
21	0	1	9.4	-	**21**	0	1	10.9	-	**21**	0	1	4.6	-
22	0	0	7.0	-	**22**	0	1	4.3	-	**22**	0	1	2.1	-
23	1	1	4.6	-	**23**	0	0	4.8	-	**23**	0	0	1.4	-
24	2	1	12.2	-	**24**	0	1	5.2	-	**24**	0	1	7.8	-
25	0	1	3.5	-	**25**	0	0	3.7	-	**25**	0	1	6.5	-
26	1	1	6.4	-	**26**	0	1	5.8	-	**26**	0	1	3.2	-
27	1	1	12.5	-	**27**	0	0	3.5	-	**27**	0	1	4.3	-
28	0	0	6.0	-	**28**	0	1	3.2	-	**28**	0	1	7.5	-
29	1	1	11.0	-	**29**	0	1	5.9	-	**29**	1	1	11.0	-
30	0	1	9.0	0	**30**	0	0	6.4	0.25	**30**	1	1	6.6	0.25
31	0	1	11.1	-	**31**	0	0	-	-	**31**	0	1	7.6	-
32	1	1	5.5	-	**32**	0	1	6.5	-	**32**	0	1	4.0	-
33	1	1	14.0	-	**33**	0	0	4.0	-	**33**	1	1	5.2	-
34	0	1	5.0	-	**34**	0	0	4.0	-	**34**	0	1	4.1	-
35	1	1	8.0	-	**35**	0	0	1.9	-	**35**	0	0	-	-
36	0	1	9.3	-	**36**	0	1	6.3	-	**36**	0	1	3.0	-
37	0	0	-	-	**37**	0	1	4.1	-	**37**	0	1	2.9	-
38	0	1	3.8	-	**38**	0	0	2.0	-	**38**	0	1	7.8	-
39	1	1	6.5	-	**39**	0	0	3.4	-	**39**	0	1	2.9	-
40	1	1	11.0	0.25	**40**	0	0	3.1	0	**40**	0	0	2.6	0
41	1	1	4.0	-	**41**	0	1	3.5	-	**41**	0	1	4.5	-
42	0	1	9.5	-	**42**	0	1	8.3	-	**42**	0	1	-	-
43	0	1	7.5	-	**43**	0	0	2.3	-	**43**	1	1	4.0	-
44	1	1	8.1	-	**44**	0	0	2.9	-	**44**	0	0	-	-
45	0	1	4.0	-	**45**	0	0	2.5	-	**45**	0	1	15.1	-
46	0	1	sand	-	**46**	0	1	5.4	-	**46**	0	0	-	-
47	0	1	9.8	-	**47**	0	1	4.1	-	**47**	0	1	2.6	-
48	0	1	11.0	-	**48**	0	0	3.6	-	**48**	0	1	8.4	-
49	0	1	6.1	-	**49**	0	0	6.0	-	**49**	0	1	10.6	-
50	0	0	2.1	0.5	**50**	0	0	2.0	0.25	**50**	0	1	1.9	0
51	0	1	6.4	-	**51**	0	1	3.9	-	**51**	0	0	-	-
52	0	0	2.2	-	**52**	0	1	4.7	-	**52**	0	0	-	-
53	0	1	14.5	-	**53**	0	0	2.5	-	**53**	0	1	3.7	-
54	1	1	12.0	-	**54**	0	0	3.5	-	**54**	0	0	-	-
55	0	0	-	-	**55**	0	0	3.2	-	**55**	1	1	3.2	-
56	0	0	1.2	-	**56**	0	0	2.5	-	**56**	1	1	4.2	-
57	0	1	1.5	-	**57**	0	0	2.4	-	**57**	0	1	4.6	-
58	0	1	6.7	-	**58**	0	1	4.6	-	**58**	0	1	10.5	-
59	1	1	9.0	-	**59**	0	0	3.2	-	**59**	0	0	3.6	-
60	1	1	12.2	0.5	**60**	0	0	7.3	0	**60**	0	1	5.0	0
61	0	1	12.4	-	**61**	0	0	1.1	-	**61**	0	1	3.7	-
62	1	1	13.6	-	**62**	0	0	6.4	-	**62**	0	1	3.0	-
63	0	1	sand	-	**63**	0	0	5.9	-	**63**	0	1	2.8	-
64	0	1	9.5	-	**64**	0	0	10.3	-	**64**	0	1	3.6	-
65	0	0	3.0	-	**65**	0	0	4.7	-	**65**	0	1	4.1	-
66	0	1	6.3	-	**66**	0	0	15.2	-	**66**	0	1	7.0	-
67	0	1	9.6	-	**67**	0	0	5.5	-	**67**	0	1	6.2	-
68	0	1	7.8	-	**68**	0	0	1.6	-	**68**	2	1	16.5	-
69	1	1	8.2	-	**69**	0	0	3.4	-	**69**	0	1	5.0	-
70	0	1	3.0	0.5	**70**	0	0	4.8	0	**70**	0	1	6.9	0.25
71	0	0	-	-	**71**	0	1	4.7	-	**71**	0	1	4.5	-
72	0	0	sand	-	**72**	0	0	-	-	**72**	0	1	5.4	-
73	0	0	-	-	**73**	0	1	9.1	-	**73**	0	1	13.0	-
74	0	1	7.7	-	**74**	0	0	2.6	-	**74**	0	1	7.9	-
75	2	1	12.0	-	**75**	0	0	2.3	-	**75**	0	1	-	-
76	1	1	12.2	-	**76**	0	1	4.2	-	**76**	0	1	-	-
77	0	1	6.6	-	**77**	0	1	6.5	-	**77**	0	1	4.4	-
78	0	1	9.6	-	**78**	0	0	sand	-	**78**	0	1	5.6	-
79	0	1	1.2	-	**79**	0	0	6.1	-	**79**	0	1	1.4	-
80	1	1	10.7	0.5	**80**	0	1	5.1	0.25	**80**	0	1	4.5	0
81	0	1	11.4	-	**81**	0	1	2.1	-	**81**	0	1	9.0	-
82	0	1	7.5	-	**82**	0	0	1.9	-	**82**	1	1	9.5	-
83	0	0	2.4	-	**83**	0	1	8.5	-	**83**	0	1	10.7	-
84	0	1	6.0	-	**84**	0	1	5.9	-	**84**	0	1	10.0	-
85	0	1	1.8	-	**85**	0	1	3.2	-	**85**	0	1	-	-
86	0	0	1.0	-	**86**	0	0	4.0	-	**86**	0	0	-	-
87	0	1	8.0	-	**87**	0	1	5.3	-	**87**	0	0	1.8	-
88	0	1	1.4	-	**88**	0	0	3.1	-	**88**	0	1	7.4	-
89	0	1	sand	-	**89**	0	1	4.8	-	**89**	0	1	-	-
90	1	1	5.5	0.25	**90**	0	0	3.6	0	**90**	0	1	9.0	0
91	0	0	sand	-	**91**	0	1	10.8	-	**91**	0	1	10.0	-
92	0	1	7.5	-	**92**	0	0	-	-	**92**	0	0	-	-
93	1	1	12.3	-	**93**	0	0	6.3	-	**93**	0	1	4.6	-
94	1	1	1.7	-	**94**	0	1	5.2	-	**94**	0	0	-	-
95	0	0	sand	-	**95**	0	0	3.2	-	**95**	0	1	10.4	-
96	1	1	10.2	-	**96**	0	0	1.4	-	**96**	0	1	1.2	-
97	0	1	sand	-	**97**	0	0	3.6	-	**97**	0	1	-	-
98	1	1	6.1	-	**98**	0	1	3.5	-	**98**	1	1	9.5	-
99	0	0	1.7	-	**99**	0	1	3.5	-	**99**	0	0	15.5	-
100	0	1	6.6	0	**100**	0	0	3.7	0.25	**100**	0	1	5.5	0.25
Average C_c, C_p and Embed. =	**0.29**	**0.80**	**-**	**0.33**	**Average C_c, C_p and Embed. =**	**0**	**0.37**	**-**	**0.18**	**Average C_c, C_p and Embed. =**	**0.12**	**0.83**	**-**	**0.18**
Calcite Index (CI) =		**1.09**			**Calcite Index (CI) =**		**0.37**			**Calcite Index (CI) =**		**0.95**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_SCDTC-1					RG_SCDTC-2					RG_SCDTC-3				
13-Sep-20					13-Sep-20					13-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	4.5	-	**1**	0	0	4.8	-	**1**	0	0	5.5	-
2	0	0	4.2	-	**2**	0	0	4.1	-	**2**	0	0	15.9	-
3	0	0	5.6	-	**3**	0	0	4.7	-	**3**	0	0	5.0	-
4	0	0	3.4	-	**4**	0	0	4.5	-	**4**	0	0	5.2	-
5	0	0	3.5	-	**5**	0	0	4.7	-	**5**	0	0	9.4	-
6	0	0	6.5	-	**6**	0	0	11.9	-	**6**	0	0	-	-
7	0	0	4.0	-	**7**	0	0	4.8	-	**7**	0	0	5.5	-
8	0	0	3.2	-	**8**	0	0	6.2	-	**8**	0	0	7.7	-
9	0	0	8.5	-	**9**	0	0	3.3	-	**9**	0	0	3.1	-
10	0	0	5.3	0	**10**	0	0	5.2	0.25	**10**	0	0	6.4	0
11	0	0	3.2	-	**11**	0	0	6.7	-	**11**	0	0	-	-
12	0	0	5.0	-	**12**	0	0	5.6	-	**12**	0	0	6.6	-
13	0	0	4.6	-	**13**	0	0	2.2	-	**13**	0	0	4.4	-
14	0	0	4.3	-	**14**	0	0	4.7	-	**14**	0	0	-	-
15	0	0	10.4	-	**15**	0	0	5.0	-	**15**	0	0	11.5	-
16	0	0	8.9	-	**16**	0	0	7.9	-	**16**	0	0	5.3	-
17	0	0	4.3	-	**17**	0	0	16.0	-	**17**	0	0	7.3	-
18	0	0	4.5	-	**18**	0	0	3.5	-	**18**	0	0	3.6	-
19	0	0	6.8	-	**19**	0	0	7.1	-	**19**	0	0	8.4	-
20	0	0	6.9	0.25	**20**	0	0	4.2	0.25	**20**	0	0	5.6	0.5
21	0	0	6.3	-	**21**	0	0	-	-	**21**	0	0	8.6	-
22	0	0	6.4	-	**22**	0	0	2.4	-	**22**	0	0	11.0	-
23	0	0	5.4	-	**23**	0	0	13.0	-	**23**	0	0	3.4	-
24	0	0	2.6	-	**24**	0	0	5.1	-	**24**	0	0	7.5	-
25	0	0	4.3	-	**25**	0	0	6.4	-	**25**	0	0	10.1	-
26	0	0	3.9	-	**26**	0	0	9.8	-	**26**	0	0	5.4	-
27	0	0	7.4	-	**27**	0	0	10.5	-	**27**	0	0	3.4	-
28	0	0	-	-	**28**	0	0	8.6	-	**28**	0	0	1.8	-
29	0	0	13.0	-	**29**	0	0	4.6	-	**29**	0	0	5.7	-
30	0	0	3.8	0.25	**30**	0	0	6.6	0.75	**30**	0	0	7.0	0.25
31	0	0	9.4	-	**31**	0	0	-	-	**31**	0	0	-	-
32	0	0	4.1	-	**32**	0	0	4.4	-	**32**	0	0	6.2	-
33	0	0	7.4	-	**33**	0	0	2.9	-	**33**	0	0	4.8	-
34	0	0	3.3	-	**34**	0	0	14.0	-	**34**	0	0	4.0	-
35	0	0	8.3	-	**35**	0	0	2.6	-	**35**	0	0	5.3	-
36	0	0	7.9	-	**36**	0	0	16.0	-	**36**	0	0	3.4	-
37	0	0	6.2	-	**37**	0	0	5.2	-	**37**	0	0	7.7	-
38	0	0	7.8	-	**38**	0	0	5.6	-	**38**	0	0	2.9	-
39	0	0	5.0	-	**39**	0	0	4.1	-	**39**	0	0	5.8	-
40	0	0	4.1	0.25	**40**	0	0	3.9	0	**40**	0	0	4.6	0.25
41	0	0	4.1	-	**41**	0	0	5.7	-	**41**	0	0	8.8	-
42	0	0	4.2	-	**42**	0	0	3.1	-	**42**	0	0	5.2	-
43	0	0	6.6	-	**43**	0	0	-	-	**43**	0	0	4.0	-
44	0	0	3.8	-	**44**	0	0	3.4	-	**44**	0	0	4.3	-
45	0	0	4.5	-	**45**	0	0	6.5	-	**45**	0	0	8.4	-
46	0	0	3.3	-	**46**	0	0	2.7	-	**46**	0	0	6.4	-
47	0	0	1.9	-	**47**	0	0	4.5	-	**47**	0	0	3.1	-
48	0	0	4.0	-	**48**	0	0	6.3	-	**48**	0	0	4.8	-
49	0	0	5.3	-	**49**	0	0	7.1	-	**49**	0	0	4.5	-
50	0	0	6.0	0.5	**50**	0	0	6.2	0.75	**50**	0	0	4.3	0.25
51	0	0	4.2	-	**51**	0	0	4.4	-	**51**	0	0	-	-
52	0	0	-	-	**52**	0	0	5.8	-	**52**	0	0	3.6	-
53	0	0	7.4	-	**53**	0	0	6.3	-	**53**	0	0	8.1	-
54	0	0	8.1	-	**54**	0	0	4.4	-	**54**	0	0	2.5	-
55	0	0	2.5	-	**55**	0	0	5.4	-	**55**	0	0	2.5	-
56	0	0	4.8	-	**56**	0	0	5.7	-	**56**	0	0	7.3	-
57	0	0	8.6	-	**57**	0	0	6.0	-	**57**	0	0	2.6	-
58	0	0	4.1	-	**58**	0	0	7.8	-	**58**	0	0	-	-
59	0	0	5.5	-	**59**	0	0	5.0	-	**59**	0	0	6.8	-
60	0	0	6.6	0.25	**60**	0	0	7.5	0.75	**60**	0	0	2.8	0
61	0	0	8.7	-	**61**	0	0	3.4	-	**61**	0	0	3.0	-
62	0	0	5.2	-	**62**	0	0	5.7	-	**62**	0	0	3.4	-
63	0	0	4.9	-	**63**	0	0	3.9	-	**63**	0	0	3.7	-
64	0	0	6.7	-	**64**	0	0	6.4	-	**64**	0	0	-	-
65	0	0	4.1	-	**65**	0	0	10.8	-	**65**	0	0	7.6	-
66	0	0	4.5	-	**66**	0	0	3.7	-	**66**	0	0	4.3	-
67	0	0	15.5	-	**67**	0	0	4.4	-	**67**	0	0	3.4	-
68	0	0	4.3	-	**68**	0	0	4.5	-	**68**	0	0	9.2	-
69	0	0	4.8	-	**69**	0	0	4.7	-	**69**	0	0	7.2	-
70	0	0	4.8	0.25	**70**	0	0	11.1	0	**70**	0	0	10.0	0.75
71	0	0	3.2	-	**71**	0	0	4.9	-	**71**	0	0	5.1	-
72	0	0	2.8	-	**72**	0	0	3.6	-	**72**	0	0	8.6	-
73	0	0	4.4	-	**73**	0	0	5.0	-	**73**	0	0	3.2	-
74	0	0	3.8	-	**74**	0	0	4.2	-	**74**	0	0	4.2	-
75	0	0	2.2	-	**75**	0	0	4.4	-	**75**	0	0	4.0	-
76	0	0	4.2	-	**76**	0	0	-	-	**76**	0	0	9.8	-
77	0	0	5.9	-	**77**	0	0	3.4	-	**77**	0	0	4.8	-
78	0	0	10.6	-	**78**	0	0	5.3	-	**78**	0	0	5.7	-
79	0	0	3.7	-	**79**	0	0	15.0	-	**79**	0	0	6.2	-
80	0	0	3.3	0	**80**	0	0	3.6	0	**80**	0	0	2.8	0
81	0	0	9.6	-	**81**	0	0	8.0	-	**81**	0	0	13.0	-
82	0	0	5.5	-	**82**	0	0	12.4	-	**82**	0	0	4.7	-
83	0	0	3.2	-	**83**	0	0	4.7	-	**83**	0	0	6.2	-
84	0	0	6.9	-	**84**	0	0	4.9	-	**84**	0	0	5.6	-
85	0	0	3.2	-	**85**	0	0	5.9	-	**85**	0	0	7.3	-
86	0	0	3.4	-	**86**	0	0	3.8	-	**86**	0	0	4.3	-
87	0	0	15.1	-	**87**	0	0	11.3	-	**87**	0	0	2.4	-
88	0	0	3.8	-	**88**	0	0	5.7	-	**88**	0	0	5.1	-
89	0	0	5.6	-	**89**	0	0	8.4	-	**89**	0	0	5.5	-
90	0	0	4.3	0.5	**90**	0	0	13.0	0.75	**90**	0	0	4.8	0.25
91	0	0	-	-	**91**	0	0	2.9	-	**91**	0	0	2.9	-
92	0	0	3.3	-	**92**	0	0	4.3	-	**92**	0	0	6.7	-
93	0	0	5.4	-	**93**	0	0	6.5	-	**93**	0	0	-	-
94	0	0	3.5	-	**94**	0	0	6.4	-	**94**	0	0	5.0	-
95	0	0	6.1	-	**95**	0	0	3.5	-	**95**	0	0	13.0	-
96	0	0	4.2	-	**96**	0	0	7.8	-	**96**	0	0	7.5	-
97	0	0	3.6	-	**97**	0	0	4.6	-	**97**	0	0	5.5	-
98	0	0	5.4	-	**98**	0	0	2.7	-	**98**	0	0	5.2	-
99	0	0	5.5	-	**99**	0	0	3.2	-	**99**	0	0	4.5	-
100	0	0	2.8	0.25	**100**	0	0	7.1	0.5	**100**	0	0	6.0	0
Average C_c, C_p and Embed. =	**0**	**0**	**-**	**0.25**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.40**	**Average C_c, C_p and Embed. =**	**0**	**0**	**-**	**0.23**
Calcite Index (CI) =		**0.00**			**Calcite Index (CI) =**		**0.00**			**Calcite Index (CI) =**		**0.00**		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_EL20-1				
15-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	7.2	-
2	0	0	5.5	-
3	0	0	5.6	-
4	0	0	3.8	-
5	0	0	5.2	-
6	0	0	8.3	-
7	0	0	7.2	-
8	0	0	3.8	-
9	0	0	4.4	-
10	0	0	6.5	0.25
11	0	0	6.4	-
12	0	0	9.9	-
13	0	0	6.8	-
14	0	0	4.9	-
15	0	0	3.8	-
16	0	0	7.7	-
17	0	0	5.8	-
18	0	0	4.7	-
19	0	0	2.9	-
20	0	0	5.0	0.25
21	0	0	4.0	-
22	0	0	5.9	-
23	0	0	6.6	-
24	0	0	4.6	-
25	0	0	7.2	-
26	0	0	7.8	-
27	0	0	5.9	-
28	0	0	8.9	-
29	0	0	4.1	-
30	0	0	6.4	0.5
31	0	0	8.1	-
32	0	0	5.6	-
33	0	0	5.7	-
34	0	0	4.8	-
35	0	0	7.6	-
36	0	0	6.9	-
37	0	0	7.1	-
38	0	0	3.6	-
39	0	0	4.7	-
40	0	0	7.9	0.25
41	0	0	7.9	-
42	0	0	11.5	-
43	0	0	2.8	-
44	0	0	5.4	-
45	0	0	3.0	-
46	0	0	6.3	-
47	0	0	5.2	-
48	0	0	2.5	-
49	0	0	12.5	-
50	0	0	5.8	0.25
51	0	0	5.1	-
52	0	0	5.3	-
53	0	0	7.8	-
54	0	0	3.5	-
55	0	0	3.4	-
56	0	0	5.6	-
57	0	0	4.4	-
58	0	0	7.1	-
59	0	0	5.2	-
60	0	0	6.3	0.5
61	0	0	4.3	-
62	0	0	7.0	-
63	0	0	6.6	-
64	0	0	7.4	-
65	0	0	5.9	-
66	0	0	3.4	-
67	0	0	4.4	-
68	0	0	5.2	-
69	0	0	2.3	-
70	0	0	2.7	0
71	0	0	4.8	-
72	0	0	3.1	-
73	0	0	-	-
74	0	0	8.2	-
75	0	0	5.4	-
76	0	0	4.9	-
77	0	0	4.2	-
78	0	0	3.8	-
79	0	0	3.8	-
80	0	0	8.2	0
81	0	0	8.5	-
82	0	0	6.5	-
83	0	0	3.6	-
84	0	0	7.5	-
85	0	0	5.0	-
86	0	0	7.4	-
87	0	0	11.0	-
88	0	0	7.9	-
89	0	0	2.8	-
90	0	0	6.5	0.25
91	0	0	5.5	-
92	0	0	9.5	-
93	0	0	7.4	-
94	0	0	-	-
95	0	0	10.2	-
96	0	0	6.9	-
97	0	0	10.5	-
98	0	0	6.4	-
99	0	0	4.0	-
100	0	0	8.1	0.25
Average C_c, C_p and Embed. =	0	0	-	0.25
Calcite Index (CI) =		0.00		

RG_EL20-2				
16-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	9.0	-
2	0	0	9.4	-
3	0	0	9.0	-
4	0	0	7.5	-
5	0	0	8.5	-
6	0	0	7.1	-
7	0	0	5.4	-
8	0	0	12.6	-
9	0	0	7.4	-
10	0	0	5.2	0.25
11	0	0	11.5	-
12	0	0	11.5	-
13	0	0	11.8	-
14	0	0	11.1	-
15	0	0	7.2	-
16	0	0	11.4	-
17	0	0	10.9	-
18	0	0	11.2	-
19	0	0	10.1	-
20	0	0	8.2	0.25
21	0	0	9.4	-
22	0	0	8.0	-
23	0	0	6.6	-
24	0	0	6.0	-
25	0	0	8.2	-
26	0	0	7.4	-
27	0	0	6.5	-
28	0	0	5.3	-
29	0	0	7.2	-
30	0	0	5.8	0.5
31	0	0	10.0	-
32	0	0	6.2	-
33	0	0	9.1	-
34	0	0	7.6	-
35	0	0	5.5	-
36	0	0	7.0	-
37	0	0	5.5	-
38	0	0	6.5	-
39	0	0	5.5	-
40	0	0	3.0	0
41	0	0	4.0	-
42	0	0	9.0	-
43	0	0	10.0	-
44	0	0	8.4	-
45	0	0	9.3	-
46	0	0	11.5	-
47	0	0	6.4	-
48	0	0	13.0	-
49	0	0	9.5	-
50	0	0	6.2	0.5
51	0	0	15.5	-
52	0	0	8.5	-
53	0	0	13.5	-
54	0	0	7.6	-
55	0	0	6.3	-
56	0	0	12.8	-
57	0	0	7.1	-
58	0	0	6.6	-
59	0	0	3.8	-
60	0	0	4.3	0.5
61	0	0	5.7	-
62	0	0	7.2	-
63	0	0	9.0	-
64	0	0	12.8	-
65	0	0	9.5	-
66	0	0	11.4	-
67	0	0	10.6	-
68	0	0	9.2	-
69	0	0	6.0	-
70	0	0	10.8	0.25
71	0	0	10.5	-
72	0	0	5.7	-
73	0	0	-	-
74	0	0	5.1	-
75	0	0	5.2	-
76	0	0	8.5	-
77	0	0	11.5	-
78	0	0	10.2	-
79	0	0	12.5	-
80	0	0	7.9	0.25
81	0	0	6.0	-
82	0	0	2.5	-
83	0	0	10.5	-
84	0	0	9.8	-
85	0	0	10.4	-
86	0	0	11.5	-
87	0	0	7.7	-
88	0	0	9.1	-
89	0	0	15.4	-
90	0	0	8.5	0.25
91	0	0	6.0	-
92	0	0	9.2	-
93	0	0	7.5	-
94	0	0	6.3	-
95	0	0	8.5	-
96	0	0	7.3	-
97	0	0	5.0	-
98	0	0	6.2	-
99	0	0	5.4	-
100	0	0	5.0	0.5
Average C_c, C_p and Embed. =	0	0	-	0.33
Calcite Index (CI) =		0.00		

RG_EL20-3				
16-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	4.2	-
2	0	0	5.3	-
3	0	0	8.1	-
4	0	0	12.2	-
5	0	0	4.5	-
6	0	0	8.1	-
7	0	0	9.9	-
8	0	0	5.5	-
9	0	0	7.1	-
10	0	0	5.5	0.5
11	0	0	9.5	-
12	0	0	15.0	-
13	0	0	8.5	-
14	0	0	-	-
15	0	0	5.1	-
16	0	0	6.2	-
17	0	0	6.5	-
18	0	0	9.5	-
19	0	0	19.6	-
20	0	0	7.2	0.5
21	0	0	14.0	-
22	0	0	5.4	-
23	0	0	4.8	-
24	0	0	12.6	-
25	0	0	5.9	-
26	0	0	11.4	-
27	0	0	4.5	-
28	0	0	7.6	-
29	0	0	7.4	-
30	0	0	9.3	0.25
31	0	0	5.0	-
32	0	0	10.3	-
33	0	0	5.6	-
34	0	0	14.2	-
35	0	0	13.0	-
36	0	0	9.7	-
37	0	0	5.6	-
38	0	0	8.7	-
39	0	0	6.2	-
40	0	0	6.4	0.5
41	0	0	12.2	-
42	0	0	10.4	-
43	0	0	5.0	-
44	0	0	13.2	-
45	0	0	4.4	-
46	0	0	11.5	-
47	0	0	12.2	-
48	0	0	8.5	-
49	0	0	11.5	-
50	0	0	9.5	0.75
51	0	0	16.0	-
52	0	0	8.6	-
53	0	0	8.9	-
54	0	0	7.9	-
55	0	0	10.8	-
56	0	0	8.4	-
57	0	0	11.6	-
58	0	0	8.6	-
59	0	0	6.5	-
60	0	0	2.5	0.25
61	0	0	11.4	-
62	0	0	10.5	-
63	0	0	6.2	-
64	0	0	-	-
65	0	0	10.2	-
66	0	0	11.3	-
67	0	0	4.4	-
68	0	0	11.5	-
69	0	0	8.6	-
70	0	0	8.6	0.5
71	0	0	6.2	-
72	0	0	12.4	-
73	0	0	7.5	-
74	0	0	6.2	-
75	0	0	4.1	-
76	0	0	7.8	-
77	0	0	6.8	-
78	0	0	6.9	-
79	0	0	11.6	-
80	0	0	4.2	0.25
81	0	0	5.6	-
82	0	0	4.8	-
83	0	0	11.9	-
84	0	0	5.6	-
85	0	0	9.8	-
86	0	0	4.5	-
87	0	0	5.2	-
88	0	0	6.8	-
89	0	0	4.6	-
90	0	0	9.0	0.5
91	0	0	8.6	-
92	0	0	12.0	-
93	0	0	9.1	-
94	0	0	5.1	-
95	0	0	15.2	-
96	0	0	13.3	-
97	0	0	7.5	-
98	0	0	11.9	-
99	0	0	8.5	-
100	0	0	10.0	0.75
Average C_c, C_p and Embed. =	0	0	-	0.48
Calcite Index (CI) =		0.00		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.6: Pebble Counts and Calcite Measurements at Benthic Invertebrate Sampling Locations, GHO LAEMP, September 2020

RG_EL20-4					RG_EL20-5				
16-Sep-20					16-Sep-20				
Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)	Pebble	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embeddedness (%)
1	0	0	5.0	-	1	0	0	-	-
2	0	0	6.5	-	2	0	0	2.5	-
3	0	0	9.2	-	3	0	0	-	-
4	0	0	3.8	-	4	0	0	2.0	-
5	0	0	7.3	-	5	0	0	-	-
6	0	0	4.7	-	6	0	0	10.8	-
7	0	0	9.1	-	7	0	0	3.2	-
8	0	0	6.4	-	8	0	0	10.0	-
9	0	0	5.3	-	9	0	0	2.8	-
10	0	0	7.3	0.25	10	0	0	4.4	0.25
11	0	0	8.0	-	11	0	0	-	-
12	0	0	-	-	12	0	0	4.5	-
13	0	0	7.6	-	13	0	0	2.5	-
14	0	0	9.2	-	14	0	0	4.2	-
15	0	0	6.1	-	15	0	0	6.0	-
16	0	0	5.3	-	16	0	0	3.9	-
17	0	0	5.5	-	17	0	0	4.2	-
18	0	0	5.6	-	18	0	0	3.8	-
19	0	0	9.4	-	19	0	0	10.6	-
20	0	0	6.2	0.5	20	0	0	3.8	0.25
21	0	0	9.0	-	21	0	0	11.2	-
22	0	0	5.4	-	22	0	0	6.1	-
23	0	0	2.8	-	23	0	0	-	-
24	0	0	10.4	-	24	0	0	5.1	-
25	0	0	10.0	-	25	0	0	-	-
26	0	0	8.6	-	26	0	0	6.3	-
27	0	0	5.7	-	27	0	0	2.7	-
28	0	0	8.7	-	28	0	0	7.0	-
29	0	0	7.0	-	29	0	0	3.4	-
30	0	0	6.2	0.25	30	0	0	3.9	0.5
31	0	0	4.8	-	31	0	0	2.9	-
32	0	0	10.3	-	32	0	0	4.0	-
33	0	0	7.2	-	33	0	0	3.7	-
34	0	0	3.6	-	34	0	0	2.7	-
35	0	0	7.3	-	35	0	0	8.8	-
36	0	0	7.2	-	36	0	0	4.8	-
37	0	0	7.2	-	37	0	0	3.6	-
38	0	0	8.4	-	38	0	0	10.2	-
39	0	0	6.7	-	39	0	0	6.0	-
40	0	0	6.3	0.5	40	0	0	5.5	0.25
41	0	0	6.3	-	41	0	0	7.0	-
42	0	0	6.5	-	42	0	0	3.0	-
43	0	0	10.5	-	43	0	0	2.3	-
44	0	0	9.1	-	44	0	0	3.2	-
45	0	0	4.6	-	45	0	0	4.4	-
46	0	0	-	-	46	0	0	6.8	-
47	0	0	5.6	-	47	0	0	3.5	-
48	0	0	8.9	-	48	0	0	1.9	-
49	0	0	8.9	-	49	0	0	3.8	-
50	0	0	3.8	0.25	50	0	0	5.0	0
51	0	0	9.2	-	51	0	0	-	-
52	0	0	5.5	-	52	0	0	8.3	-
53	0	0	5.4	-	53	0	0	6.1	-
54	0	0	7.2	-	54	0	0	3.5	-
55	0	0	7.4	-	55	0	0	5.0	-
56	0	0	7.9	-	56	0	0	14.5	-
57	0	0	6.5	-	57	0	0	9.5	-
58	0	0	8.5	-	58	0	0	6.0	-
59	0	0	6.5	-	59	0	0	5.0	-
60	0	0	9.4	0.5	60	0	0	3.5	0
61	0	0	7.3	-	61	0	0	6.0	-
62	0	0	8.2	-	62	0	0	6.0	-
63	0	0	8.2	-	63	0	0	4.6	-
64	0	0	9.4	-	64	0	0	6.2	-
65	0	0	7.1	-	65	0	0	4.5	-
66	0	0	5.7	-	66	0	0	4.2	-
67	0	0	8.3	-	67	0	0	4.2	-
68	0	0	4.1	-	68	0	0	4.0	-
69	0	0	6.5	-	69	0	0	11.5	-
70	0	0	7.6	0.25	70	0	0	11.5	0.5
71	0	0	6.4	-	71	0	0	4.5	-
72	0	0	5.0	-	72	0	0	8.5	-
73	0	0	3.2	-	73	0	0	3.5	-
74	0	0	7.1	-	74	0	0	5.7	-
75	0	0	6.2	-	75	0	0	12.0	-
76	0	0	6.4	-	76	0	0	2.0	-
77	0	0	6.0	-	77	0	0	8.5	-
78	0	0	5.5	-	78	0	0	8.5	-
79	0	0	4.8	-	79	0	0	3.4	-
80	0	0	11.5	0.5	80	0	0	6.2	0.25
81	0	0	5.2	-	81	0	0	6.8	-
82	0	0	4.2	-	82	0	0	5.0	-
83	0	0	4.0	-	83	0	0	7.2	-
84	0	0	11.5	-	84	0	0	-	-
85	0	0	4.9	-	85	0	0	6.1	-
86	0	0	9.5	-	86	0	0	2.5	-
87	0	0	7.2	-	87	0	0	3.5	-
88	0	0	5.3	-	88	0	0	-	-
89	0	0	10.0	-	89	0	0	8.6	-
90	0	0	3.8	0.25	90	0	0	4.7	0
91	0	0	9.3	-	91	0	0	5.5	-
92	0	0	6.0	-	92	0	0	4.0	-
93	0	0	9.1	-	93	0	0	7.5	-
94	0	0	6.8	-	94	0	0	2.8	-
95	0	0	14.0	-	95	0	0	6.0	-
96	0	0	11.2	-	96	0	0	6.6	-
97	0	0	9.1	-	97	0	0	7.2	-
98	0	0	10.7	-	98	0	0	8.1	-
99	0	0	6.5	-	99	0	0	6.0	-
100	0	0	8.9	0.5	100	0	0	4.0	0.25
Average C_c, C_p and Embed. =	0	0	-	0.38	Average C_c, C_p and Embed. =	0	0	-	0.23
Calcite Index (CI) =		0.00			Calcite Index (CI) =		0.00		

Notes: "-" indicates intermediate axis not measurable, or embeddedness measurement not required. Intermediate axis is the measurement across the intermediate access of the pebble and presented in cm.

Table H.7: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2020

	Analyte	Units	LRL	BC Sediment Quality Guidelines		Reference							
						GH_ER2 / RG_ELUGH							
				Lower SQG	Upper SQG	RG_ ELUGH-1	RG_ ELUGH-2	RG_ ELUGH-3	Minimum	Median	Maximum	Mean	Standard Deviation
						17-Sep-20	17-Sep-20	17-Sep-20					
Physical Tests	Moisture	%	0.25	-	-	44.3	43.8	36.9	36.9	43.8	44.3	41.7	4.14
	pH(1:2 Soil:Water)	pH	0.10	-	-	8.23	8.24	8.30	8.23	8.24	8.30	8.26	0.0379
Particle Size	% Gravel (>2 mm)	%	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
	% Sand (2.00 mm - 1.00 mm)	%	1.0	-	-	<1.00	1.50	<1.00	<1.00	<1.00	1.50	1.17	-
	% Sand (1.00 mm - 0.50 mm)	%	1.0	-	-	8.10	6.20	1.50	1.50	6.20	8.10	5.27	3.40
	% Sand (0.50 mm - 0.25 mm)	%	1.0	-	-	17.8	13.7	15.7	13.7	15.7	17.8	15.7	2.05
	% Sand (0.25 mm - 0.125 mm)	%	1.0	-	-	21.1	28.1	31.6	21.1	28.1	31.6	26.9	5.35
	% Sand (0.125 mm - 0.063 mm)	%	1.0	-	-	15.2	19.4	20.7	15.2	19.4	20.7	18.4	2.87
	% Silt (0.063 mm - 0.0312 mm)	%	1.0	-	-	16.4	13.4	13.2	13.2	13.4	16.4	14.3	1.79
	% Silt (0.0312 mm - 0.004 mm)	%	1.0	-	-	17.2	13.8	13.4	13.4	13.8	17.2	14.8	2.09
	% Clay (<4 µm)	%	1.0	-	-	3.40	3.30	3.50	3.30	3.40	3.50	3.40	0.100
	Texture	-	-	-	-	Sandy loam	Loamy sand	Loamy sand					
	Total Organic Carbon	%	0.050	-	-	2.71	2.61	2.71	2.61	2.71	2.71	2.68	0.0577
Metals	Aluminum (Al)	mg/kg	50	-	-	7,780	7,340	4,480	4,480	7,340	7,780	6,530	1,790
	Antimony (Sb)	mg/kg	0.10	-	-	0.420	0.540	0.340	0.340	0.420	0.540	0.433	0.101
	Arsenic (As)	mg/kg	0.10	5.9	17	5.48	5.64	3.99	3.99	5.48	5.64	5.04	0.910
	Barium (Ba)	mg/kg	0.50	-	-	139	146	91.9	91.9	139	146	126	29.4
	Beryllium (Be)	mg/kg	0.10	-	-	0.560	0.560	0.320	0.320	0.560	0.560	0.480	0.139
	Bismuth (Bi)	mg/kg	0.20	-	-	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	-
	Boron (B)	mg/kg	5.0	-	-	8.20	7.80	7.50	7.50	7.80	8.20	7.83	0.351
	Cadmium (Cd)	mg/kg	0.020	0.60	3.5	0.684	0.758	0.403	0.403	0.684	0.758	0.615	0.187
	Calcium (Ca)	mg/kg	50	-	-	66,700	56,800	49,500	49,500	56,800	66,700	57,700	8,630
	Chromium (Cr)	mg/kg	0.50	37	90	17.6	17.7	11.4	11.4	17.6	17.7	15.6	3.61
	Cobalt (Co)	mg/kg	0.10	-	-	4.06	4.26	2.61	2.61	4.06	4.26	3.64	0.900
	Copper (Cu)	mg/kg	0.50	36	197	10.3	10.5	5.63	5.63	10.3	10.5	8.81	2.76
	Iron (Fe)	mg/kg	50	21,200	43,766	12,100	12,100	8,140	8,140	12,100	12,100	10,800	2,290
	Lead (Pb)	mg/kg	0.50	35	91	6.17	6.64	4.27	4.27	6.17	6.64	5.69	1.25
	Lithium (Li)	mg/kg	2.0	-	-	9.90	10.0	5.80	5.80	9.90	10.0	8.57	2.40
	Magnesium (Mg)	mg/kg	20	-	-	12,900	12,700	12,900	12,700	12,900	12,900	12,800	115
	Manganese (Mn)	mg/kg	1.0	460	1,100	365	449	206	206	365	449	340	123
	Mercury (Hg)	mg/kg	0.0050	0.17	0.49	0.0347	0.0419	0.0212	0.0212	0.0347	0.0419	0.0326	0.0105
	Molybdenum (Mo)	mg/kg	0.10	25	23000	1.25	1.30	0.820	0.820	1.25	1.30	1.12	0.264
	Nickel (Ni)	mg/kg	0.50	16	75	17.2	18.0	10.8	10.8	17.2	18.0	15.3	3.95
	Phosphorus (P)	mg/kg	50	-	-	1,180	1,150	1,150	1,150	1,150	1,180	1,160	17.3
	Potassium (K)	mg/kg	100	-	-	2,110	1,930	1,120	1,120	1,930	2,110	1,720	527
	Selenium (Se)	mg/kg	0.20	2.0	-	0.790	1.05	0.440	0.440	0.790	1.05	0.760	0.306
	Silver (Ag)	mg/kg	0.10	0.50	-	0.150	0.160	<0.100	<0.100	0.150	0.160	0.137	0.00667
	Sodium (Na)	mg/kg	50	-	-	106	102	82.0	82.0	102	106	96.7	12.9
	Strontium (Sr)	mg/kg	0.50	-	-	102	94.1	68.9	68.9	94.1	102	88.3	17.3
	Sulfur (S)	mg/kg	1,000	-	-	<1,000	<1,000	<1,000	-	-	-	-	-
	Thallium (Tl)	mg/kg	0.050	-	-	0.191	0.194	0.118	0.118	0.191	0.194	0.168	0.0430
	Tin (Sn)	mg/kg	2.0	-	-	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	-
	Titanium (Ti)	mg/kg	1.0	-	-	12.1	20.3	13.9	12.1	13.9	20.3	15.4	4.31
	Tungsten (W)	mg/kg	0.50	-	-	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	-
	Uranium (U)	mg/kg	0.050	-	-	0.993	1.01	0.860	0.860	0.993	1.01	0.954	0.0821
	Vanadium (V)	mg/kg	0.20	-	-	35.5	34.8	22.1	22.1	34.8	35.5	30.8	7.54
	Zinc (Zn)	mg/kg	2.0	123	315	74.9	77.3	48.5	48.5	74.9	77.3	66.9	16.0
	Zirconium (Zr)	mg/kg	1.0	-	-	<1.00	1.00	<1.00	<1.00	<1.00	1.00	1.00	-
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0050	0.0067	0.089	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acenaphthylene	mg/kg	0.0050	0.0059	0.13	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acridine	mg/kg	0.010	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Anthracene	mg/kg	0.0040	0.047	0.25	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	-
	Benz(a)anthracene	mg/kg	0.010	0.032	0.39	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(a)pyrene	mg/kg	0.010	0.032	0.78	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(b&j)fluoranthene	mg/kg	0.010	-	-	0.0150	0.0220	0.0130	0.0130	0.0150	0.0220	0.0167	0.00473
	Benzo(b+j+k)fluoranthene	mg/kg	0.015	-	-	<0.0150	0.0220	<0.0150	<0.0150	<0.0150	0.0220	0.0173	-
	Benzo(e)pyrene	mg/kg	0.010	-	-	0.0140	0.0190	0.0110	0.0110	0.0140	0.0190	0.0147	0.00404
	Benzo(g,h,i)perylene	mg/kg	0.010	0.17	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(k)fluoranthene	mg/kg	0.010	0.24	13	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Chrysene	mg/kg	0.010	0.057	0.86	0.0350	0.0440	0.0270	0.0270	0.0350	0.0440	0.0353	0.00850
	Dibenz(a,h)anthracene	mg/kg	0.0050	0.0062	0.14	<0.00500	<0.00700	<0.00500	<0.00500	<0.00500	<0.00700	<0.00500	-
	Fluoranthene	mg/kg	0.010	0.11	2.4	<0.0100	0.0110	<0.0100	<0.0100	<0.0100	0.0110	0.0103	-
	Fluorene	mg/kg	0.010	0.021	0.14	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.010	0.20	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	1-Methylnaphthalene	mg/kg	0.010	-	-	<0.0500	0.0540	<0.0500	<0.0500	<0.0500	0.0540	0.0513	-
	2-Methylnaphthalene	mg/kg	0.010	0.020	0.20	0.0380	0.0600	0.0280	0.0280	0.0380	0.0600	0.0420	0.0164
	Naphthalene	mg/kg	0.010	0.035	0.39	0.0210	0.0310	0.0150	0.0150	0.0210	0.0310	0.0223	0.00808
	Perylene	mg/kg	0.010	-	-	0.0120	0.0190	<0.0100	<0.0100	0.0120	0.0190	0.0137	0.00467
	Phenanthrene	mg/kg	0.010	0.042	0.52	0.0780	0.103	0.0560	0.0560	0.0780	0.103	0.0790	0.0235
	Pyrene	mg/kg	0.010	0.053	0.88	<0.0100	0.0140	<0.0100	<0.0100	<0.0100	0.0140	0.0113	-
	Quinoline	mg/kg	0.010	-	-	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	-
	d10-Acenaphthene	%	-	-	-	103	116	109	103	109	116	109	6.31
	d12-Chrysene	%	-	-	-	116	124	120	116	120	124	120	4.30
	d8-Naphthalene	%	-	-	-	97.3	108	104	97.3	104	108	103	5.37
	d10-Phenanthrene	%	-	-	-	105	115	112	105	112	115	111	5.34
	B(a)P Total Potency Equivalent	mg/kg	0.020	-	-	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	-
	IACR (CCME)	mg/kg	0.15	-	-	0.180	0.230	0.170	0.170	0.180	0.230	0.193	0.0321

Value > Lower SQG.
Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table H.7: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2020

	Analyte	Units	LRL	BC Sediment Quality Guidelines		Mine-exposed									
						RG_GH-SCW3									
				Lower SQG	Upper SQG	RG_GH_ SCW3-1	RG_GH_ SCW3-2	RG_GH_ SCW3-3	RG_GH_ SCW3-4	RG_GH_ SCW3-5	Minimum	Median	Maximum	Mean	Standard Deviation
						13-Sep-20	13-Sep-20	13-Sep-20	16-Sep-20	16-Sep-20					
Physical Tests	Moisture	%	0.25	-	-	48.9	51.0	47.8	45.6	44.3	44.3	47.8	51.0	47.5	2.65
	pH(1:2 Soil:Water)	pH	0.10	-	-	8.17	8.15	8.12	8.18	8.24	8.12	8.17	8.24	8.17	0.0444
Particle Size	% Gravel (>2 mm)	%	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
	% Sand (2.00 mm - 1.00 mm)	%	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
	% Sand (1.00 mm - 0.50 mm)	%	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
	% Sand (0.50 mm - 0.25 mm)	%	1.0	-	-	<1.00	<1.00	<1.00	1.10	<1.00	<1.00	<1.00	1.10	1.02	-
	% Sand (0.25 mm - 0.125 mm)	%	1.0	-	-	7.20	5.60	6.80	5.70	9.00	5.60	6.80	9.00	6.86	1.38
	% Sand (0.125 mm - 0.063 mm)	%	1.0	-	-	22.1	20.2	19.2	17.6	18.1	17.6	19.2	22.1	19.4	1.80
	% Silt (0.063 mm - 0.0312 mm)	%	1.0	-	-	29.0	31.3	30.6	31.0	32.1	29.0	31.0	32.1	30.8	1.15
	% Silt (0.0312 mm - 0.004 mm)	%	1.0	-	-	34.4	36.7	36.1	37.4	34.4	34.4	36.1	37.4	35.8	1.36
	% Clay (<4 μm)	%	1.0	-	-	6.30	5.50	6.40	7.00	5.10	5.10	6.30	7.00	6.06	0.757
	Texture	-	-	-	-	Silt loam	'Silt loam	'Silt loam	'Silt loam	'Silt loam					
	Total Organic Carbon	%	0.050	-	-	5.50	5.25	5.33	6.22	5.00	5.00	5.33	6.22	5.46	0.461
Metals	Aluminum (Al)	mg/kg	50	-	-	9,460	8,920	9,460	8,300	6,320	6,320	8,920	9,460	8,490	1,300
	Antimony (Sb)	mg/kg	0.10	-	-	0.330	0.400	0.430	0.480	0.450	0.330	0.430	0.480	0.418	0.0572
	Arsenic (As)	mg/kg	0.10	5.9	17	5.22	5.17	5.47	5.01	4.93	4.93	5.17	5.47	5.16	0.209
	Barium (Ba)	mg/kg	0.50	-	-	164	164	171	136	113	113	164	171	150	24.5
	Beryllium (Be)	mg/kg	0.10	-	-	0.630	0.620	0.660	0.610	0.470	0.470	0.620	0.660	0.598	0.0740
	Bismuth (Bi)	mg/kg	0.20	-	-	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	-
	Boron (B)	mg/kg	5.0	-	-	12.2	11.2	11.7	11.3	8.10	8.10	11.3	12.2	10.9	1.61
	Cadmium (Cd)	mg/kg	0.020	0.60	3.5	0.917	0.914	1.00	0.936	0.694	0.694	0.917	1.00	0.892	0.116
	Calcium (Ca)	mg/kg	50	-	-	37,800	34,700	34,700	45,100	49,300	34,700	37,800	49,300	40,300	6,580
	Chromium (Cr)	mg/kg	0.50	37	90	18.9	18.2	19.2	19.5	16.8	16.8	18.9	19.5	18.5	1.08
	Cobalt (Co)	mg/kg	0.10	-	-	5.02	4.90	5.22	4.65	4.02	4.02	4.90	5.22	4.76	0.463
	Copper (Cu)	mg/kg	0.50	36	197	13.7	13.3	15.0	12.8	10.3	10.3	13.3	15.0	13.0	1.73
	Iron (Fe)	mg/kg	50	21,200	43,766	13,200	13,000	13,600	12,300	11,200	11,200	13,000	13,600	12,700	942
	Lead (Pb)	mg/kg	0.50	35	91	7.78	7.83	8.29	7.07	6.22	6.22	7.78	8.29	7.44	0.809
	Lithium (Li)	mg/kg	2.0	-	-	12.5	11.6	12.8	11.4	8.80	8.80	11.6	12.8	11.4	1.58
	Magnesium (Mg)	mg/kg	20	-	-	12,100	11,100	11,300	12,900	13,600	11,100	12,100	13,600	12,200	1,060
	Manganese (Mn)	mg/kg	1.0	460	1,100	378	360	384	387	338	338	378	387	369	20.4
	Mercury (Hg)	mg/kg	0.0050	0.17	0.49	0.0543	0.0598	0.0621	0.0572	0.0431	0.0431	0.0572	0.0621	0.0553	0.00742
	Molybdenum (Mo)	mg/kg	0.10	25	23000	1.23	1.28	1.31	1.21	1.26	1.21	1.26	1.31	1.26	0.0396
	Nickel (Ni)	mg/kg	0.50	16	75	21.1	20.6	22.5	20.8	18.0	18.0	20.8	22.5	20.6	1.63
	Phosphorus (P)	mg/kg	50	-	-	1,230	1,140	1,180	1,120	1,180	1,120	1,180	1,230	1,170	42.4
	Potassium (K)	mg/kg	100	-	-	2,310	2,140	2,250	2,150	1,530	1,530	2,150	2,310	2,080	313
	Selenium (Se)	mg/kg	0.20	2.0	-	1.72	1.59	1.81	2.22	1.31	1.31	1.72	2.22	1.73	0.333
	Silver (Ag)	mg/kg	0.10	0.50	-	0.210	0.190	0.220	0.210	0.160	0.160	0.210	0.220	0.198	0.0239
	Sodium (Na)	mg/kg	50	-	-	98.0	94.0	94.0	97.0	92.0	92.0	94.0	98.0	95.0	2.45
	Strontium (Sr)	mg/kg	0.50	-	-	73.1	68.2	73.4	78.6	75.0	68.2	73.4	78.6	73.7	3.75
	Sulfur (S)	mg/kg	1,000	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	-	-	-	-	-
	Thallium (Tl)	mg/kg	0.050	-	-	0.236	0.243	0.253	0.236	0.187	0.187	0.236	0.253	0.231	0.0256
	Tin (Sn)	mg/kg	2.0	-	-	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	-
	Titanium (Ti)	mg/kg	1.0	-	-	11.7	14.2	13.5	18.8	19.7	11.7	14.2	19.7	15.6	3.49
	Tungsten (W)	mg/kg	0.50	-	-	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	-
	Uranium (U)	mg/kg	0.050	-	-	0.995	0.963	0.986	1.05	0.975	0.963	0.986	1.05	0.994	0.0336
	Vanadium (V)	mg/kg	0.20	-	-	36.7	34.7	36.5	34.7	28.2	28.2	34.7	36.7	34.2	3.47
	Zinc (Zn)	mg/kg	2.0	123	315	84.1	81.4	86.3	80.5	72.6	72.6	81.4	86.3	81.0	5.21
	Zirconium (Zr)	mg/kg	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0050	0.0067	0.089	<0.0410	<0.0510	<0.0400	<0.0200	<0.0160	<0.0160	<0.0400	<0.0510	<0.0160	-
	Acenaphthylene	mg/kg	0.0050	0.0059	0.13	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acridine	mg/kg	0.010	-	-	0.0610	0.0520	<0.0500	<0.0250	<0.0200	<0.0200	<0.0500	0.0610	0.0346	0.00509
	Anthracene	mg/kg	0.0040	0.047	0.25	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	-
	Benz(a)anthracene	mg/kg	0.010	0.032	0.39	0.0330	0.0340	0.0270	0.0130	0.0130	0.0130	0.0270	0.0340	0.0240	0.0104
	Benzo(a)pyrene	mg/kg	0.010	0.032	0.78	0.0110	0.0150	0.0110	<0.0100	<0.0100	<0.0100	0.0110	0.0150	0.0114	0.00196
	Benzo(b&j)fluoranthene	mg/kg	0.010	-	-	0.0940	0.0980	0.0800	0.0380	0.0320	0.0320	0.0800	0.0980	0.0684	0.0313
	Benzo(b+j+k)fluoranthene	mg/kg	0.015	-	-	0.0940	0.0980	0.0800	0.0380	0.0320	0.0320	0.0800	0.0980	0.0684	0.0313
	Benzo(e)pyrene	mg/kg	0.010	-	-	0.0890	0.0940	0.0800	0.0360	0.0310	0.0310	0.0800	0.0940	0.0660	0.0301
	Benzo(g,h,i)perylene	mg/kg	0.010	0.17	3.2	0.0260	0.0270	0.0250	0.0130	0.0110	0.0110	0.0250	0.0270	0.0204	0.00773
	Benzo(k)fluoranthene	mg/kg	0.010	0.24	13	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
	Chrysene	mg/kg	0.010	0.057	0.86	<0.220	<0.240	0.191	0.0900	0.0800	0.0800	0.0900	0.191	0.120	0.0614
	Dibenz(a,h)anthracene	mg/kg	0.0050	0.0062	0.14	0.0166	0.0153	0.0121	<0.00500	<0.00600	<0.00500	0.0121	0.0166	0.0108	0.00236
	Fluoranthene	mg/kg	0.010	0.11	2.4	0.0370	0.0300	0.0260	0.0120	0.0120	0.0120	0.0260	0.0370	0.0234	0.0111
	Fluorene	mg/kg	0.010	0.021	0.14	0.0470	0.0480	0.0460	0.0220	0.0190	0.0190	0.0460	0.0480	0.0364	0.0146
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.010	0.20	3.2	0.0130	0.0140	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0140	0.0114	0.000566
	1-Methylnaphthalene	mg/kg	0.010	-	-	0.588	0.612	0.532	0.256	0.228	0.228	0.532	0.612	0.443	0.186
	2-Methylnaphthalene	mg/kg	0.010	0.020	0.20	0.944	0.993	0.850	0.437	0.390	0.390	0.850	0.993	0.723	0.287
	Naphthalene	mg/kg	0.010	0.035	0.39	0.226	0.233	0.197	0.127	0.127	0.127	0.197	0.233	0.182	0.0520
	Perylene	mg/kg	0.010	-	-	0.0170	0.0160	0.0120	0.0190	0.0170	0.0120	0.0170	0.0190	0.0162	0.00259
	Phenanthrene	mg/kg	0.010	0.042	0.52	0.687	0.708	0.590	0.273	0.248	0.248	0.590	0.708	0.501	0.224
	Pyrene	mg/kg	0.010	0.053	0.88	0.0580	0.0600	0.0490	0.0240	0.0220	0.0220	0.0490	0.0600	0.0426	0.0184
	Quinoline	mg/kg	0.010	-	-	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	-
	d10-Acenaphthene	%	-	-	-	114	110	109	105	110	105	110	114	110	3.41
	d12-Chrysene	%	-	-	-	120	113	114	114	116	113	114	120	115	2.87
	d8-Naphthalene	%	-	-	-	107	101	103	99.5	105	99.5	103	107	103	2.85
	d10-Phenanthrene	%	-	-	-	113	105	106	104	109	104	106	113	107	3.38
	B(a)P Total Potency Equivalent	mg/kg	0.020	-	-	0.0440	0.0460	0.0370	<0.0200	<0.0200	<0.0200	0.0370	0.0460	0.0334	0.00486
	IACR (CCME)	mg/kg	0.15	-	-	0.880	0.920	0.790	0.380	0.340	0.340	0.790	0.920	0.662	0.280

Value > Lower SQG.

Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table H.7: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2020

	Analyte	Units	LRL	BC Sediment Quality Guidelines		Mine-exposed									
						GH_ERC / RG_EL20									
				Lower SQG	Upper SQG	RG_EL20-1	RG_EL20-2	RG_EL20-3	RG_EL20-4	RG_EL20-5	Minimum	Median	Maximum	Mean	Standard Deviation
						15-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20	16-Sep-20					
Physical Tests	Moisture	%	0.25	-	-	26.3	33.7	25.5	31.6	23.8	23.8	26.3	33.7	28.2	4.24
Physical Tests	pH(1:2 Soil:Water)	pH	0.10	-	-	8.42	8.48	8.50	8.54	8.48	8.42	8.48	8.54	8.48	0.0434
Particle Size	% Gravel (>2 mm)	%	1.0	-	-	3.50	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	3.50	1.50	-
Particle Size	% Sand (2.00 mm - 1.00 mm)	%	1.0	-	-	4.00	1.80	1.40	<1.00	1.10	<1.00	1.40	4.00	1.86	1.26
Particle Size	% Sand (1.00 mm - 0.50 mm)	%	1.0	-	-	7.20	3.40	11.1	3.70	20.8	3.40	7.20	20.8	9.24	7.18
Particle Size	% Sand (0.50 mm - 0.25 mm)	%	1.0	-	-	12.9	5.70	29.0	29.9	54.0	5.70	29.0	54.0	26.3	18.7
Particle Size	% Sand (0.25 mm - 0.125 mm)	%	1.0	-	-	17.3	31.6	18.6	31.9	14.3	14.3	18.6	31.9	22.7	8.37
Particle Size	% Sand (0.125 mm - 0.063 mm)	%	1.0	-	-	16.3	31.5	14.2	17.9	3.50	3.50	16.3	31.5	16.7	10.0
Particle Size	% Silt (0.063 mm - 0.0312 mm)	%	1.0	-	-	16.9	13.7	11.2	8.40	2.50	2.50	11.2	16.9	10.5	5.48
Particle Size	% Silt (0.0312 mm - 0.004 mm)	%	1.0	-	-	18.0	9.10	10.8	5.90	2.60	2.60	9.10	18.0	9.28	5.80
Particle Size	% Clay (<4 µm)	%	1.0	-	-	3.80	2.50	2.90	1.90	1.10	1.10	2.50	3.80	2.44	1.02
Particle Size	Texture	-	-	-	-	Sandy loam	Loamy sand	Loamy sand	Sand	Sand					
	Total Organic Carbon	%	0.050	-	-	3.11	1.66	2.01	1.52	1.59	1.52	1.66	3.11	1.98	0.660
Metals	Aluminum (Al)	mg/kg	50	-	-	4,320	5,040	5,870	5,540	5,300	4,320	5,300	5,870	5,210	586
Metals	Antimony (Sb)	mg/kg	0.10	-	-	0.350	0.310	0.350	0.320	0.360	0.310	0.350	0.360	0.338	0.0217
Metals	Arsenic (As)	mg/kg	0.10	5.9	17	4.41	3.82	4.81	4.30	4.99	3.82	4.41	4.99	4.47	0.459
Metals	Barium (Ba)	mg/kg	0.50	-	-	81.1	90.7	95.0	92.2	93.3	81.1	92.2	95.0	90.5	5.46
Metals	Beryllium (Be)	mg/kg	0.10	-	-	0.360	0.350	0.440	0.390	0.420	0.350	0.390	0.440	0.392	0.0383
Metals	Bismuth (Bi)	mg/kg	0.20	-	-	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	-
Metals	Boron (B)	mg/kg	5.0	-	-	6.30	6.60	9.10	7.60	7.20	6.30	7.20	9.10	7.36	1.10
Metals	Cadmium (Cd)	mg/kg	0.020	0.60	3.5	0.559	0.422	0.540	0.488	0.565	0.422	0.540	0.565	0.515	0.0601
Metals	Calcium (Ca)	mg/kg	50	-	-	90,100	47,800	88,000	56,500	83,300	47,800	83,300	90,100	73,100	19,600
Metals	Chromium (Cr)	mg/kg	0.50	37	90	13.9	12.2	15.8	13.5	14.6	12.2	13.9	15.8	14.0	1.33
Metals	Cobalt (Co)	mg/kg	0.10	-	-	2.74	2.76	2.97	3.02	3.09	2.74	2.97	3.09	2.92	0.158
Metals	Copper (Cu)	mg/kg	0.50	36	197	6.58	5.61	6.83	5.96	6.78	5.61	6.58	6.83	6.35	0.540
Metals	Iron (Fe)	mg/kg	50	21,200	43,766	8,920	8,280	9,700	8,980	9,940	8,280	8,980	9,940	9,160	664
Metals	Lead (Pb)	mg/kg	0.50	35	91	3.96	4.14	4.45	4.66	4.34	3.96	4.34	4.66	4.31	0.271
Metals	Lithium (Li)	mg/kg	2.0	-	-	6.60	6.40	7.50	6.60	6.40	6.40	6.60	7.50	6.70	0.458
Metals	Magnesium (Mg)	mg/kg	20	-	-	14,200	12,300	14,500	12,100	11,600	11,600	12,300	14,500	12,900	1,320
Metals	Manganese (Mn)	mg/kg	1.0	460	1,100	385	260	333	294	372	260	333	385	329	52.4
Metals	Mercury (Hg)	mg/kg	0.0050	0.17	0.49	0.0166	0.0160	0.0161	0.0137	0.0115	0.0115	0.0160	0.0166	0.0148	0.00215
Metals	Molybdenum (Mo)	mg/kg	0.10	25	23000	1.24	0.880	1.17	0.960	1.18	0.880	1.17	1.24	1.09	0.156
Metals	Nickel (Ni)	mg/kg	0.50	16	75	13.5	11.0	13.1	11.9	13.4	11.0	13.1	13.5	12.6	1.09
Metals	Phosphorus (P)	mg/kg	50	-	-	1,090	1,100	1,280	1,100	1,070	1,070	1,100	1,280	1,130	85.8
Metals	Potassium (K)	mg/kg	100	-	-	1,120	1,310	1,610	1,500	1,460	1,120	1,460	1,610	1,400	190
Metals	Selenium (Se)	mg/kg	0.20	2.0	-	0.480	0.390	0.430	0.360	0.320	0.320	0.390	0.480	0.396	0.0619
Metals	Silver (Ag)	mg/kg	0.10	0.50	-	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-
Metals	Sodium (Na)	mg/kg	50	-	-	106	85.0	111	89.0	97.0	85.0	97.0	111	97.6	11.0
Metals	Strontium (Sr)	mg/kg	0.50	-	-	124	66.3	111	78.1	116	66.3	111	124	99.1	25.3
Metals	Sulfur (S)	mg/kg	1,000	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	-	-	-	-	-
Metals	Thallium (Tl)	mg/kg	0.050	-	-	0.153	0.142	0.162	0.148	0.150	0.142	0.150	0.162	0.151	0.00735
Metals	Tin (Sn)	mg/kg	2.0	-	-	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	-
Metals	Titanium (Ti)	mg/kg	1.0	-	-	18.7	16.2	16.7	15.4	14.0	14.0	16.2	18.7	16.2	1.73
Metals	Tungsten (W)	mg/kg	0.50	-	-	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	-
Metals	Uranium (U)	mg/kg	0.050	-	-	1.02	0.798	1.03	0.836	0.925	0.798	0.925	1.03	0.922	0.105
Metals	Vanadium (V)	mg/kg	0.20	-	-	21.7	22.9	27.1	26.3	26.3	21.7	26.3	27.1	24.9	2.40
Metals	Zinc (Zn)	mg/kg	2.0	123	315	49.3	48.5	54.8	53.1	55.3	48.5	53.1	55.3	52.2	3.13
Metals	Zirconium (Zr)	mg/kg	1.0	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0050	0.0067	0.089	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
Polycyclic Aromatic Hydrocarbons	Acenaphthylene	mg/kg	0.0050	0.0059	0.13	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
Polycyclic Aromatic Hydrocarbons	Acridine	mg/kg	0.010	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Anthracene	mg/kg	0.0040	0.047	0.25	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	-
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene	mg/kg	0.010	0.032	0.39	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene	mg/kg	0.010	0.032	0.78	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Benzo(b&j)fluoranthene	mg/kg	0.010	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Benzo(b+j+k)fluoranthene	mg/kg	0.015	-	-	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	-
Polycyclic Aromatic Hydrocarbons	Benzo(e)pyrene	mg/kg	0.010	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Benzo(g,h,i)perylene	mg/kg	0.010	0.17	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Benzo(k)fluoranthene	mg/kg	0.010	0.24	13	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Chrysene	mg/kg	0.010	0.057	0.86	<0.0250	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0250	<0.0150	-
Polycyclic Aromatic Hydrocarbons	Dibenz(a,h)anthracene	mg/kg	0.0050	0.0062	0.14	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	-
Polycyclic Aromatic Hydrocarbons	Fluoranthene	mg/kg	0.010	0.11	2.4	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Fluorene	mg/kg	0.010	0.021	0.14	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene	mg/kg	0.010	0.20	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	1-Methylnaphthalene	mg/kg	0.010	-	-	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	-
Polycyclic Aromatic Hydrocarbons	2-Methylnaphthalene	mg/kg	0.010	0.020	0.20	0.0550	0.0100	0.0150	0.0100	0.0150	0.0100	0.0150	0.0550	0.0210	0.0192
Polycyclic Aromatic Hydrocarbons	Naphthalene	mg/kg	0.010	0.035	0.39	0.0300	<0.0100	<0.0100	<0.0100	0.0100	<0.0100	<0.0100	0.0300	0.0140	0.0113
Polycyclic Aromatic Hydrocarbons	Perylene	mg/kg	0.010	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Phenanthrene	mg/kg	0.010	0.042	0.52	0.0510	0.0200	0.0290	0.0230	0.0290	0.0200	0.0290	0.0510	0.0304	0.0122
Polycyclic Aromatic Hydrocarbons	Pyrene	mg/kg	0.010	0.053	0.88	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-
Polycyclic Aromatic Hydrocarbons	Quinoline	mg/kg	0.010	-	-	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	-
Polycyclic Aromatic Hydrocarbons	d10-Acenaphthene	%	-	-	-	104	108	102	109	111	102	108	111	107	3.79
Polycyclic Aromatic Hydrocarbons	d12-Chrysene	%	-	-	-	116	119	111	117	119	111	117	119	116	3.27
Polycyclic Aromatic Hydrocarbons	d8-Naphthalene	%	-	-	-	101	103	97.5	102	104	97.5	102	104	102	2.65
Polycyclic Aromatic Hydrocarbons	d10-Phenanthrene	%	-	-	-	106	109	104	108	109	104	108	109	107	2.47
Polycyclic Aromatic Hydrocarbons	B(a)P Total Potency Equivalent	mg/kg	0.020	-	-	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	-
Polycyclic Aromatic Hydrocarbons	IACR (CCME)	mg/kg	0.15	-	-	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150	-

Value > Lower SQG.
Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table H.8: Summary Statistics for Analyte Concentrations in Sediment from Lotic Reference Areas, Used to Calculate Normal Range Values, 2017 to 2020 (Minnow 2020)

Parameter	Data Collected from 2017 to 2020 (Minnow 2020)						
	n	Percent Censored (%)	Minimum	Maximum	Mean	2.5th Percentile	97.5th percentile
Moisture	76	0	20.8	96.0	55.8	24.6	94.6
pH 1:9	4	0	7.04	7.38	7.23	7.04	7.38
pH (1:2)	69	0	7.10	8.79	7.92	7.12	8.78
Total Organic Carbon	75	0	1.43	13.9	5.06	1.43	11.7
Aluminum (mg/kg)	76	0	1,280	28,200	7,423	1,310	22,200
Antimony (mg/kg)	76	6.58	<0.1	1.61	0.537	<0.1	1.57
Arsenic (mg/kg)	76	0	1.03	16.6	5.75	1.14	14.7
Barium (mg/kg)	76	0	12.7	313	141	13.0	306
Beryllium (mg/kg)	76	2.63	<0.1	1.66	0.539	<0.11	1.30
Bismuth (mg/kg)	76	89.5	<0.2	0.370	0.207	<0.2	0.310
Boron (mg/kg)	76	22.4	<5	26.9	8.48	<5	23.0
Cadmium (mg/kg)	76	0	0.230	2.51	1.01	0.250	2.03
Calcium (mg/kg)	76	0	4,940	322,000	90,210	5,170	293,000
Chromium (mg/kg)	76	0	5.02	71.1	16.4	5.15	59.7
Cobalt (mg/kg)	76	0	0.850	14.7	4.78	0.880	11.2
Copper (mg/kg)	76	0	1.17	39.1	12.3	1.23	35.2
Iron (mg/kg)	76	0	2,350	42,300	13,151	2,480	33,000
Lead (mg/kg)	76	0	1.37	25.5	8.45	1.48	25.0
Lithium (mg/kg)	76	1.32	<2	40.1	11.6	4.60	30.8
Magnesium (mg/kg)	76	0	2,090	59,900	17,479	2,130	57,200
Manganese (mg/kg)	76	0	94.5	1,060	365	95.4	887
Mercury (mg/kg)	76	1.32	<0.005	0.123	0.0372	0.00630	0.0723
Molybdenum (mg/kg)	76	0	0.270	6.99	1.90	0.300	6.88
Nickel (mg/kg)	76	0	5.67	55.2	21.5	6.12	43.6
Phosphorus (mg/kg)	76	0	281	1,890	1,094	302	1,710
Potassium (mg/kg)	76	0	390	5,890	1,734	400	4,610
Selenium (mg/kg)	76	0	0.220	6.11	1.16	0.240	3.79
Silver (mg/kg)	76	15.8	<0.1	0.310	0.154	<0.1	0.270
Sodium (mg/kg)	76	9.21	<50	199	107	<50	197
Strontium (mg/kg)	76	0	39.2	307	90.6	39.7	229
Sulphur (mg/kg)	76	96.1	<1000	1,400	1,007	<1000	1,100
Thallium (mg/kg)	76	6.58	<0.05	0.987	0.303	<0.05	0.952
Tin (mg/kg)	76	100	<2	<2	<2	<2	<2
Titanium (mg/kg)	76	0	6.40	85.6	22.6	7.10	68.0
Tungsten (mg/kg)	76	100	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium (mg/kg)	76	0	0.389	4.84	1.03	0.411	1.80
Vanadium (mg/kg)	76	0	4.74	58.8	26.8	5.02	55.3
Zinc (mg/kg)	76	0	31.9	211	106	35.1	194
Zirconium (mg/kg)	76	72.4	<1	2.80	1.09	<1	1.80
Acenaphthene (mg/kg)	76	98.7	<0.005	0.0597	0.00573	<0.005	<0.058
Acenaphthylene (mg/kg)	76	100	<0.005	<0.06	<0.005	<0.005	<0.045
Acridine (mg/kg)	76	98.7	<0.01	0.0240	0.0102	<0.01	<0.024
Anthracene (mg/kg)	76	96.1	<0.004	0.0107	0.00412	<0.004	0.00500
Benz(a)anthracene (mg/kg)	76	93.4	<0.01	0.0260	0.0108	<0.01	0.0240
Benzo(a)pyrene (mg/kg)	76	97.4	<0.01	0.0270	0.0103	<0.01	0.0100
Benzo(b+j)fluoranthene (mg/kg)	76	43.4	<0.01	0.0630	0.0189	<0.01	0.0460
Benzo€pyrene (mg/kg)	76	48.7	<0.01	0.0640	0.0186	<0.01	0.0520
Benzo(b+j+k)fluoranthene (mg/kg)	51	47.1	<0.015	0.0670	0.0218	<0.015	0.0490
Benzo(g,h,i)perylene (mg/kg)	76	85.5	<0.01	0.0190	0.0106	<0.01	0.0160
Benzo(k)fluoranthene (mg/kg)	76	98.7	<0.01	0.0130	0.0101	<0.01	<0.013
Chrysene (mg/kg)	76	26.3	<0.01	0.169	0.0410	<0.01	0.156
Dibenz(a,h)anthracene (mg/kg)	76	98.7	<0.005	0.00510	0.00500	<0.005	<0.005
Fluoranthene (mg/kg)	76	77.6	<0.01	0.0460	0.0124	<0.01	0.0420
Fluorene (mg/kg)	76	55.3	<0.01	0.144	0.0230	<0.01	0.108
Indeno(1,2,3-c,d)pyrene (mg/kg)	76	98.7	<0.01	0.0160	0.0101	<0.01	<0.016
1-Methylnaphthalene (mg/kg)	76	22.4	<0.01	0.652	0.105	<0.01	0.493
2-Methylnaphthalene (mg/kg)	76	11.8	<0.01	1.13	0.164	<0.01	0.850
Naphthalene (mg/kg)	76	26.3	<0.01	0.344	0.0562	<0.01	0.272
Perylene (mg/kg)	76	82.9	<0.01	0.0590	0.0131	<0.01	0.0380
Phenanthrene (mg/kg)	76	5.26	<0.01	0.755	0.132	0.0120	0.621
Pyrene (mg/kg)	76	59.2	<0.01	0.0530	0.0156	<0.01	0.0520
Quinoline (mg/kg)	76	100	<0.01	<0.12	<0.01	<0.01	<0.09
d10.Acenaphthene (mg/kg)	76	0	62.5	116	86.7	64.2	114
d12.Chrysene (mg/kg)	76	0	76.2	126	102	81.3	126
d8.Naphthalene (mg/kg)	76	0	54.0	110	82.9	58.7	110
d10.Phenanthrene (mg/kg)	76	0	75.8	115	93.4	76.4	114
B.a.P Total Potency Equivalent (mg/kg)	76	82.9	<0.02	0.0870	0.0226	<0.02	0.0490
IACR CCME (mg/kg)	51	29.4	<0.15	0.710	0.248	<0.15	0.550

Percent Censoring > 75%.

Notes: No normal ranges were used for analytes with greater than 75 % censoring.

APPENDIX H
WATER QUALITY LAB REPORTS

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 05-SEP-20
Report Date: 19-JAN-21 13:37 (MT)
Version: FINAL REV. 2

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2499489
Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: REP-GHO-2020-09-04
Legal Site Desc:

Comments: 19-JAN-2021 Alkalinity (Species) result revised on L2499489-1 to -5.

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2499489-1	L2499489-2	L2499489-3	L2499489-4	L2499489-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20
	Sampled Time	12:45	13:15	10:00	12:15	14:00
	Client ID	RG_GH-SCW3_WS_2020-09-04-1245	RG_GH-SCW1_WS_2020-09-04-1315	RG_RIVER_WS_2020-09-04-1000	RG_FBLANK_WS_2020-09-04-1215	RG_TRIP_WS_2020-09-04-1400
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	526	275	281	<2.0	<2.0
	Hardness (as CaCO3) (mg/L)	353	167	166	<0.50	HTC <0.50
	pH (pH)	8.30	8.31	8.29	5.71	5.57
	ORP (mV)	439	475	409	411	477
	Total Suspended Solids (mg/L)	2.4	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	DLHC 338	DLHC 153	DLHC 152	<10	<10
	Turbidity (NTU)	1.46	0.69	0.61	<0.10	<0.10
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	1.7	1.7
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	148	139	132	<1.0	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	1.6	2.2	1.4	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	150	142	133	<1.0	<1.0
	Ammonia as N (mg/L)	0.0216	0.0096	<0.0050	RRV 0.0150	RRV 0.201
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	1.94	0.31	0.31	<0.10	<0.10
	Fluoride (F) (mg/L)	0.155	0.171	0.170	<0.020	<0.020
	Ion Balance (%)	111	102	106	0.0	0.0
	Nitrate (as N) (mg/L)	2.02	0.182	0.181	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	TKNI <0.050	<0.050	<0.050	<0.050	RRV 0.151
	Orthophosphate-Dissolved (as P) (mg/L)	0.0018	0.0014	0.0014	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	0.0033	<0.0020	<0.0020	<0.0020	<0.0020
	Sulfate (SO4) (mg/L)	158	21.9	22.4	<0.30	<0.30
	Anion Sum (meq/L)	6.49	3.32	3.16	<0.10	<0.10
	Cation Sum (meq/L)	7.18	3.38	3.36	<0.10	<0.10
	Cation - Anion Balance (%)	5.0	0.9	3.1	0.0	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	0.82	<0.50	<0.50	<0.50	
	Total Organic Carbon (mg/L)	0.67	<0.50	<0.50	<0.50	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0603	0.0125	0.0120	<0.0030	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00017	0.00015	0.00013	<0.00010	<0.00010
	Barium (Ba)-Total (mg/L)	0.0502	0.0485	0.0478	<0.00010	<0.00010
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (ug/L)	0.0165	0.0096	0.0119	<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2499489-1	L2499489-2	L2499489-3	L2499489-4	L2499489-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20
	Sampled Time	12:45	13:15	10:00	12:15	14:00
	Client ID	RG_GH-SCW3_WS_2020-09-04-1245	RG_GH-SCW1_WS_2020-09-04-1315	RG_RIVER_WS_2020-09-04-1000	RG_FBLANK_WS_2020-09-04-1215	RG_TRIP_WS_2020-09-04-1400
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	82.0	49.2	49.1	<0.050	<0.050
	Chromium (Cr)-Total (mg/L)	0.00026	0.00018	0.00020	<0.00010	<0.00010
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.065	0.018	0.016	<0.010	<0.010
	Lead (Pb)-Total (mg/L)	0.000064	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0072	0.0035	0.0023	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	38.4	12.2	12.1	<0.10	<0.10
	Manganese (Mn)-Total (mg/L)	0.00372	0.00187	0.00183	<0.00010	<0.00010
	Mercury (Hg)-Total (ug/L)	0.00056	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.00113	0.00107	0.00110	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00065	<0.00050	0.00054	<0.00050	<0.00050
	Potassium (K)-Total (mg/L)	0.700	0.390	0.371	<0.050	<0.050
	Selenium (Se)-Total (ug/L)	26.1	1.20	1.07	<0.050	<0.050
	Silicon (Si)-Total (mg/L)	2.14	1.95	1.89	<0.10	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	2.74	0.722	0.716	<0.050	<0.050
	Strontium (Sr)-Total (mg/L)	0.286	0.217	0.224	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00170	0.000777	0.000748	<0.000010	<0.000010
	Vanadium (V)-Total (mg/L)	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00014	0.00014	<0.00010	<0.00010	
	Barium (Ba)-Dissolved (mg/L)	0.0522	0.0457	0.0466	<0.00010	
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (ug/L)	0.0149	0.0067	0.0088	<0.0050	
	Calcium (Ca)-Dissolved (mg/L)	82.0	47.9	47.5	<0.050	<0.050
	Chromium (Cr)-Dissolved (mg/L)	0.00018	0.00022	0.00019	<0.00010	
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10	<0.10	<0.10	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2499489-1	L2499489-2	L2499489-3	L2499489-4	L2499489-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20	04-SEP-20
	Sampled Time	12:45	13:15	10:00	12:15	14:00
	Client ID	RG_GH-SCW3_WS_2020-09-04-1245	RG_GH-SCW1_WS_2020-09-04-1315	RG_RIVER_WS_2020-09-04-1000	RG_FBLANK_WS_2020-09-04-1215	RG_TRIP_WS_2020-09-04-1400
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0078	0.0028	0.0027	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	35.9	11.4	11.5	<0.10	<0.0050
	Manganese (Mn)-Dissolved (mg/L)	0.00096	0.00074	0.00082	<0.00010	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00111	0.00108	0.00105	<0.000050	
	Nickel (Ni)-Dissolved (mg/L)	0.00057	<0.00050	<0.00050	<0.00050	
	Potassium (K)-Dissolved (mg/L)	0.711	0.400	0.412	<0.050	<0.050
	Selenium (Se)-Dissolved (ug/L)	24.4	1.07	1.08	<0.050	
	Silicon (Si)-Dissolved (mg/L)	1.90	1.70	1.74	<0.050	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	2.68	0.735	0.753	<0.050	<0.050
	Strontium (Sr)-Dissolved (mg/L)	0.301	0.232	0.223	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00162	0.000726	0.000704	<0.000010	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0016	0.0010	<0.0010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Nickel (Ni)-Total	MB-LOR	L2499489-4, -5
Laboratory Control Sample	Bismuth (Bi)-Total	MES	L2499489-1, -2, -3, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2499489-5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2499489-5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2499489-5
Matrix Spike	Barium (Ba)-Total	MS-B	L2499489-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2499489-1, -2, -3, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2499489-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2499489-1, -2, -3, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2499489-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2499489-1, -2, -3, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2499489-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2499489-1, -2, -3, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

ALS Test Code	Matrix	Test Description	Method Reference**
C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

Reference Information

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-L-IC-N-CL Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL Water Electrical Conductivity (EC) APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-CL Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL Water Ammonia, Total (as N) J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

REP-GHO-2020-09-04

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0

Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R5223334								
WG3403953-11 LCS								
Acidity (as CaCO3)			91.3		%		85-115	12-SEP-20
WG3403953-10 MB								
Acidity (as CaCO3)			1.4		mg/L		2	12-SEP-20
ALK-MAN-CL	**Water**							
Batch R5223321								
WG3403880-14 LCS								
Alkalinity, Total (as CaCO3)			99.7		%		85-115	12-SEP-20
WG3403880-13 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-SEP-20
BE-D-L-CCMS-VA	**Water**							
Batch R5223224								
WG3402812-2 LCS								
Beryllium (Be)-Dissolved			97.5		%		80-120	12-SEP-20
WG3402812-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	12-SEP-20
BE-T-L-CCMS-VA	**Water**							
Batch R5222495								
WG3401906-3 DUP		**L2499489-1**						
Beryllium (Be)-Total		<0.000020	<0.000020	RPD-NA	mg/L	N/A	20	11-SEP-20
WG3401906-2 LCS								
Beryllium (Be)-Total			101.5		%		80-120	11-SEP-20
WG3401906-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	11-SEP-20
WG3401906-4 MS		**L2499489-2**						
Beryllium (Be)-Total			101.2		%		70-130	11-SEP-20
BR-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Bromide (Br)			102.3		%		85-115	06-SEP-20
WG3400344-6 LCS								
Bromide (Br)			106.4		%		85-115	06-SEP-20
WG3400344-5 MB								
Bromide (Br)			<0.050		mg/L		0.05	06-SEP-20
WG3400344-9 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BR-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-9 MB								
Bromide (Br)			<0.050		mg/L		0.05	06-SEP-20
WG3400344-8 MS		**L2499489-5**						
Bromide (Br)			101.9		%		75-125	06-SEP-20
C-DIS-ORG-LOW-CL	**Water**							
Batch R5222037								
WG3402501-2 LCS								
Dissolved Organic Carbon			104.3		%		80-120	10-SEP-20
WG3402501-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	10-SEP-20
Batch R5222076								
WG3402559-2 LCS								
Dissolved Organic Carbon			96.8		%		80-120	10-SEP-20
WG3402559-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	10-SEP-20
C-TOT-ORG-LOW-CL	**Water**							
Batch R5222037								
WG3402501-2 LCS								
Total Organic Carbon			104.5		%		80-120	10-SEP-20
WG3402501-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	10-SEP-20
Batch R5222076								
WG3402559-2 LCS								
Total Organic Carbon			98.1		%		80-120	10-SEP-20
WG3402559-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	10-SEP-20
CL-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Chloride (Cl)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Chloride (Cl)			106.0		%		85-115	06-SEP-20
WG3400344-6 LCS								
Chloride (Cl)			106.6		%		85-115	06-SEP-20
WG3400344-5 MB								
Chloride (Cl)			<0.10		mg/L		0.1	06-SEP-20
WG3400344-9 MB								
Chloride (Cl)			<0.10		mg/L		0.1	06-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-8 MS		**L2499489-5**						
Chloride (Cl)			102.7		%		75-125	06-SEP-20
EC-L-PCT-CL	**Water**							
Batch R5223321								
WG3403880-14 LCS								
Conductivity (@ 25C)			96.9		%		90-110	12-SEP-20
WG3403880-13 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	12-SEP-20
F-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Fluoride (F)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Fluoride (F)			107.1		%		90-110	06-SEP-20
WG3400344-6 LCS								
Fluoride (F)			105.4		%		90-110	06-SEP-20
WG3400344-5 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-SEP-20
WG3400344-9 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-SEP-20
WG3400344-8 MS		**L2499489-5**						
Fluoride (F)			101.6		%		75-125	06-SEP-20
HG-D-CVAA-VA	**Water**							
Batch R5221867								
WG3402401-11 DUP		**L2499489-1**						
Mercury (Hg)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	11-SEP-20
WG3402401-10 LCS								
Mercury (Hg)-Dissolved			92.9		%		80-120	11-SEP-20
WG3402401-9 MB		**NP**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	11-SEP-20
HG-T-U-CVAF-VA	**Water**							
Batch R5222623								
WG3403303-2 LCS								
Mercury (Hg)-Total			111.6		%		80-120	12-SEP-20
WG3403303-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	12-SEP-20
	Water							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL	**Water**							
Batch R5224003								
WG3404942-2 LCS		**TMRM**						
Calcium (Ca)-Dissolved			101.8		%		80-120	15-SEP-20
Magnesium (Mg)-Dissolved			103.6		%		80-120	15-SEP-20
Potassium (K)-Dissolved			99.1		%		80-120	15-SEP-20
Sodium (Na)-Dissolved			101.3		%		80-120	15-SEP-20
WG3404942-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	15-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	15-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	15-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	15-SEP-20
MET-D-CCMS-VA	**Water**							
Batch R5223224								
WG3402812-2 LCS								
Aluminum (Al)-Dissolved			100.9		%		80-120	12-SEP-20
Antimony (Sb)-Dissolved			101.2		%		80-120	12-SEP-20
Arsenic (As)-Dissolved			100.4		%		80-120	12-SEP-20
Barium (Ba)-Dissolved			100.2		%		80-120	12-SEP-20
Bismuth (Bi)-Dissolved			115.8		%		80-120	12-SEP-20
Boron (B)-Dissolved			102.9		%		80-120	12-SEP-20
Cadmium (Cd)-Dissolved			99.8		%		80-120	12-SEP-20
Calcium (Ca)-Dissolved			103.4		%		80-120	12-SEP-20
Chromium (Cr)-Dissolved			97.7		%		80-120	12-SEP-20
Cobalt (Co)-Dissolved			100.9		%		80-120	12-SEP-20
Copper (Cu)-Dissolved			98.2		%		80-120	12-SEP-20
Iron (Fe)-Dissolved			94.4		%		80-120	12-SEP-20
Lead (Pb)-Dissolved			99.2		%		80-120	12-SEP-20
Lithium (Li)-Dissolved			102.5		%		80-120	12-SEP-20
Magnesium (Mg)-Dissolved			99.0		%		80-120	12-SEP-20
Manganese (Mn)-Dissolved			103.9		%		80-120	12-SEP-20
Molybdenum (Mo)-Dissolved			102.7		%		80-120	12-SEP-20
Nickel (Ni)-Dissolved			102.3		%		80-120	12-SEP-20
Potassium (K)-Dissolved			100.5		%		80-120	12-SEP-20
Selenium (Se)-Dissolved			99.1		%		80-120	12-SEP-20
Silicon (Si)-Dissolved			100.4		%		60-140	12-SEP-20
Silver (Ag)-Dissolved			103.7		%		80-120	12-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5223224								
WG3402812-2 LCS								
Sodium (Na)-Dissolved			107.2		%		80-120	12-SEP-20
Strontium (Sr)-Dissolved			107.1		%		80-120	12-SEP-20
Thallium (Tl)-Dissolved			98.8		%		80-120	12-SEP-20
Tin (Sn)-Dissolved			101.1		%		80-120	12-SEP-20
Titanium (Ti)-Dissolved			100.1		%		80-120	12-SEP-20
Uranium (U)-Dissolved			103.7		%		80-120	12-SEP-20
Vanadium (V)-Dissolved			98.3		%		80-120	12-SEP-20
Zinc (Zn)-Dissolved			96.2		%		80-120	12-SEP-20
WG3402812-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	12-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	12-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	12-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	12-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	12-SEP-20
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	12-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-20
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	12-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	12-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	12-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	12-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	12-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	12-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	12-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5223224								
WG3402812-1 MB		**NP**						
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	12-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	12-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	12-SEP-20
MET-T-CCMS-VA	**Water**							
Batch R5222495								
WG3401906-3 DUP		**L2499489-1**						
Aluminum (Al)-Total		0.0603	0.0536		mg/L	12	20	11-SEP-20
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-SEP-20
Arsenic (As)-Total		0.00017	0.00018		mg/L	3.1	20	11-SEP-20
Barium (Ba)-Total		0.0502	0.0502		mg/L	0.0	20	11-SEP-20
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	11-SEP-20
Boron (B)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	11-SEP-20
Cadmium (Cd)-Total		0.0000165	0.0000188		mg/L	13	20	11-SEP-20
Calcium (Ca)-Total		82.0	83.5		mg/L	1.7	20	11-SEP-20
Chromium (Cr)-Total		0.00026	0.00021	J	mg/L	0.00005	0.0002	11-SEP-20
Cobalt (Co)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-SEP-20
Copper (Cu)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	11-SEP-20
Iron (Fe)-Total		0.065	0.066		mg/L	0.9	20	11-SEP-20
Lead (Pb)-Total		0.000064	0.000063		mg/L	0.7	20	11-SEP-20
Lithium (Li)-Total		0.0072	0.0072		mg/L	0.5	20	11-SEP-20
Magnesium (Mg)-Total		38.4	37.9		mg/L	1.2	20	11-SEP-20
Manganese (Mn)-Total		0.00372	0.00357		mg/L	4.0	20	11-SEP-20
Molybdenum (Mo)-Total		0.00113	0.00113		mg/L	0.2	20	11-SEP-20
Potassium (K)-Total		0.700	0.676		mg/L	3.4	20	11-SEP-20
Selenium (Se)-Total		0.0261	0.0270		mg/L	3.2	20	11-SEP-20
Silicon (Si)-Total		2.14	2.12		mg/L	1.1	20	11-SEP-20
Silver (Ag)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	11-SEP-20
Sodium (Na)-Total		2.74	2.65		mg/L	3.5	20	11-SEP-20
Strontium (Sr)-Total		0.286	0.289		mg/L	1.2	20	11-SEP-20
Thallium (Tl)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	11-SEP-20
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-SEP-20
Titanium (Ti)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	11-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5222495								
WG3401906-3 DUP		**L2499489-1**						
Uranium (U)-Total		0.00170	0.00166		mg/L	1.9	20	11-SEP-20
Vanadium (V)-Total		0.00050	<0.00050	RPD-NA	mg/L	N/A	20	11-SEP-20
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	11-SEP-20
WG3401906-2 LCS								
Aluminum (Al)-Total			100.7		%		80-120	11-SEP-20
Antimony (Sb)-Total			101.8		%		80-120	11-SEP-20
Arsenic (As)-Total			97.3		%		80-120	11-SEP-20
Barium (Ba)-Total			98.8		%		80-120	11-SEP-20
Bismuth (Bi)-Total			101.3		%		80-120	11-SEP-20
Boron (B)-Total			105.8		%		80-120	11-SEP-20
Cadmium (Cd)-Total			101.1		%		80-120	11-SEP-20
Calcium (Ca)-Total			99.6		%		80-120	11-SEP-20
Chromium (Cr)-Total			99.5		%		80-120	11-SEP-20
Cobalt (Co)-Total			97.9		%		80-120	11-SEP-20
Copper (Cu)-Total			97.2		%		80-120	11-SEP-20
Iron (Fe)-Total			96.5		%		80-120	11-SEP-20
Lead (Pb)-Total			97.4		%		80-120	11-SEP-20
Lithium (Li)-Total			100.5		%		80-120	11-SEP-20
Magnesium (Mg)-Total			101.8		%		80-120	11-SEP-20
Manganese (Mn)-Total			99.6		%		80-120	11-SEP-20
Molybdenum (Mo)-Total			98.4		%		80-120	11-SEP-20
Nickel (Ni)-Total			98.9		%		80-120	11-SEP-20
Potassium (K)-Total			97.3		%		80-120	11-SEP-20
Selenium (Se)-Total			101.5		%		80-120	11-SEP-20
Silicon (Si)-Total			102.4		%		80-120	11-SEP-20
Silver (Ag)-Total			96.5		%		80-120	11-SEP-20
Sodium (Na)-Total			103.9		%		80-120	11-SEP-20
Strontium (Sr)-Total			103.9		%		80-120	11-SEP-20
Thallium (Tl)-Total			98.4		%		80-120	11-SEP-20
Tin (Sn)-Total			98.2		%		80-120	11-SEP-20
Titanium (Ti)-Total			96.2		%		80-120	11-SEP-20
Uranium (U)-Total			96.9		%		80-120	11-SEP-20
Vanadium (V)-Total			100.5		%		80-120	11-SEP-20
Zinc (Zn)-Total			101.5		%		80-120	11-SEP-20
WG3401906-1 MB								

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5222495								
WG3401906-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	11-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	11-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	11-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	11-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	11-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	11-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	11-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	11-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	11-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	11-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	11-SEP-20
Nickel (Ni)-Total			0.00053	MB-LOR	mg/L		0.0005	11-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	11-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	11-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	11-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	11-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	11-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	11-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	11-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	11-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	11-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	11-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	11-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	11-SEP-20
WG3401906-4 MS		**L2499489-2**						
Aluminum (Al)-Total			98.6		%		70-130	11-SEP-20
Antimony (Sb)-Total			98.7		%		70-130	11-SEP-20
Arsenic (As)-Total			99.6		%		70-130	11-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5222495								
WG3401906-4 MS		**L2499489-2**						
Barium (Ba)-Total			N/A	MS-B	%		-	11-SEP-20
Bismuth (Bi)-Total			94.0		%		70-130	11-SEP-20
Boron (B)-Total			100.4		%		70-130	11-SEP-20
Cadmium (Cd)-Total			103.2		%		70-130	11-SEP-20
Calcium (Ca)-Total			N/A	MS-B	%		-	11-SEP-20
Chromium (Cr)-Total			101.0		%		70-130	11-SEP-20
Cobalt (Co)-Total			98.5		%		70-130	11-SEP-20
Copper (Cu)-Total			97.6		%		70-130	11-SEP-20
Iron (Fe)-Total			98.9		%		70-130	11-SEP-20
Lead (Pb)-Total			95.6		%		70-130	11-SEP-20
Lithium (Li)-Total			101.1		%		70-130	11-SEP-20
Magnesium (Mg)-Total			N/A	MS-B	%		-	11-SEP-20
Manganese (Mn)-Total			97.9		%		70-130	11-SEP-20
Molybdenum (Mo)-Total			97.5		%		70-130	11-SEP-20
Potassium (K)-Total			102.2		%		70-130	11-SEP-20
Selenium (Se)-Total			103.2		%		70-130	11-SEP-20
Silicon (Si)-Total			94.2		%		70-130	11-SEP-20
Silver (Ag)-Total			98.5		%		70-130	11-SEP-20
Sodium (Na)-Total			105.5		%		70-130	11-SEP-20
Strontium (Sr)-Total			N/A	MS-B	%		-	11-SEP-20
Thallium (Tl)-Total			91.3		%		70-130	11-SEP-20
Tin (Sn)-Total			100.9		%		70-130	11-SEP-20
Titanium (Ti)-Total			98.4		%		70-130	11-SEP-20
Uranium (U)-Total			95.1		%		70-130	11-SEP-20
Vanadium (V)-Total			103.2		%		70-130	11-SEP-20
Zinc (Zn)-Total			101.7		%		70-130	11-SEP-20
Batch R5223235								
WG3403119-3 DUP		**L2499489-1**						
Aluminum (Al)-Total		0.0603	0.0807		mg/L	12	20	12-SEP-20
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-SEP-20
Arsenic (As)-Total		0.00017	0.00021		mg/L	9.6	20	12-SEP-20
Barium (Ba)-Total		0.0502	0.0505		mg/L	1.4	20	12-SEP-20
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	12-SEP-20
Boron (B)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	12-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5223235								
WG3403119-3 DUP		**L2499489-1**						
Cadmium (Cd)-Total		0.0000165	0.0000147		mg/L	14	20	12-SEP-20
Calcium (Ca)-Total		82.0	87.5		mg/L	0.7	20	12-SEP-20
Chromium (Cr)-Total		0.00026	0.00030		mg/L	12	20	12-SEP-20
Cobalt (Co)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-SEP-20
Copper (Cu)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	12-SEP-20
Iron (Fe)-Total		0.065	0.090		mg/L	7.1	20	12-SEP-20
Lead (Pb)-Total		0.000064	0.000053		mg/L	0.3	20	12-SEP-20
Lithium (Li)-Total		0.0072	0.0079		mg/L	0.7	20	12-SEP-20
Magnesium (Mg)-Total		38.4	36.6		mg/L	1.1	20	12-SEP-20
Manganese (Mn)-Total		0.00372	0.00383		mg/L	3.2	20	12-SEP-20
Molybdenum (Mo)-Total		0.00113	0.00116		mg/L	6.9	20	12-SEP-20
Nickel (Ni)-Total		0.00065	0.00074		mg/L	13	20	12-SEP-20
Potassium (K)-Total		0.700	0.722		mg/L	0.3	20	12-SEP-20
Selenium (Se)-Total		0.0261	0.0255		mg/L	2.7	20	12-SEP-20
Silicon (Si)-Total		2.14	2.14		mg/L	3.3	20	12-SEP-20
Silver (Ag)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	12-SEP-20
Sodium (Na)-Total		2.74	2.72		mg/L	0.8	20	12-SEP-20
Strontium (Sr)-Total		0.286	0.344		mg/L	0.2	20	12-SEP-20
Thallium (Tl)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	12-SEP-20
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-SEP-20
Titanium (Ti)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	12-SEP-20
Uranium (U)-Total		0.00170	0.00163		mg/L	1.3	20	12-SEP-20
Vanadium (V)-Total		0.00050	0.00079		mg/L	5.8	20	12-SEP-20
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3403119-2 LCS								
Aluminum (Al)-Total			97.8		%		80-120	12-SEP-20
Antimony (Sb)-Total			108.7		%		80-120	12-SEP-20
Arsenic (As)-Total			98.0		%		80-120	12-SEP-20
Barium (Ba)-Total			103.7		%		80-120	12-SEP-20
Bismuth (Bi)-Total			128.6	MES	%		80-120	12-SEP-20
Boron (B)-Total			100.8		%		80-120	12-SEP-20
Cadmium (Cd)-Total			99.9		%		80-120	12-SEP-20
Calcium (Ca)-Total			103.4		%		80-120	12-SEP-20
Chromium (Cr)-Total			100.9		%		80-120	12-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5223235								
WG3403119-2 LCS								
Cobalt (Co)-Total			99.9		%		80-120	12-SEP-20
Copper (Cu)-Total			100.2		%		80-120	12-SEP-20
Iron (Fe)-Total			86.5		%		80-120	12-SEP-20
Lead (Pb)-Total			99.3		%		80-120	12-SEP-20
Lithium (Li)-Total			101.5		%		80-120	12-SEP-20
Magnesium (Mg)-Total			98.3		%		80-120	12-SEP-20
Manganese (Mn)-Total			99.6		%		80-120	12-SEP-20
Molybdenum (Mo)-Total			109.0		%		80-120	12-SEP-20
Nickel (Ni)-Total			99.3		%		80-120	12-SEP-20
Potassium (K)-Total			99.97		%		80-120	12-SEP-20
Selenium (Se)-Total			99.7		%		80-120	12-SEP-20
Silicon (Si)-Total			99.5		%		80-120	12-SEP-20
Silver (Ag)-Total			109.7		%		80-120	12-SEP-20
Sodium (Na)-Total			109.9		%		80-120	12-SEP-20
Strontium (Sr)-Total			109.0		%		80-120	12-SEP-20
Thallium (Tl)-Total			99.5		%		80-120	12-SEP-20
Tin (Sn)-Total			97.7		%		80-120	12-SEP-20
Titanium (Ti)-Total			97.1		%		80-120	12-SEP-20
Uranium (U)-Total			102.3		%		80-120	12-SEP-20
Vanadium (V)-Total			97.6		%		80-120	12-SEP-20
Zinc (Zn)-Total			94.1		%		80-120	12-SEP-20
WG3403119-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	12-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	12-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	12-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	12-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	12-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	12-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	12-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5223235								
WG3403119-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	12-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	12-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	12-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	12-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	12-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	12-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	12-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	12-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	12-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	12-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	12-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	12-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	12-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	12-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	12-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	12-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	12-SEP-20
WG3403119-4 MS		**L2499489-2**						
Aluminum (Al)-Total			94.2		%		70-130	12-SEP-20
Antimony (Sb)-Total			102.3		%		70-130	12-SEP-20
Arsenic (As)-Total			98.1		%		70-130	12-SEP-20
Barium (Ba)-Total			N/A	MS-B	%		-	12-SEP-20
Bismuth (Bi)-Total			96.8		%		70-130	12-SEP-20
Boron (B)-Total			101.3		%		70-130	12-SEP-20
Cadmium (Cd)-Total			96.5		%		70-130	12-SEP-20
Calcium (Ca)-Total			N/A	MS-B	%		-	12-SEP-20
Chromium (Cr)-Total			98.3		%		70-130	12-SEP-20
Cobalt (Co)-Total			93.8		%		70-130	12-SEP-20
Copper (Cu)-Total			92.1		%		70-130	12-SEP-20
Iron (Fe)-Total			98.3		%		70-130	12-SEP-20
Lead (Pb)-Total			93.8		%		70-130	12-SEP-20
Lithium (Li)-Total			101.9		%		70-130	12-SEP-20
Magnesium (Mg)-Total			N/A	MS-B	%		-	12-SEP-20

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5223235								
WG3403119-4 MS		**L2499489-2**						
Manganese (Mn)-Total			96.7		%		70-130	12-SEP-20
Molybdenum (Mo)-Total			101.4		%		70-130	12-SEP-20
Nickel (Ni)-Total			93.9		%		70-130	12-SEP-20
Potassium (K)-Total			95.3		%		70-130	12-SEP-20
Selenium (Se)-Total			99.4		%		70-130	12-SEP-20
Silicon (Si)-Total			90.0		%		70-130	12-SEP-20
Silver (Ag)-Total			102.3		%		70-130	12-SEP-20
Sodium (Na)-Total			106.3		%		70-130	12-SEP-20
Strontium (Sr)-Total			N/A	MS-B	%		-	12-SEP-20
Thallium (Tl)-Total			92.3		%		70-130	12-SEP-20
Tin (Sn)-Total			96.9		%		70-130	12-SEP-20
Titanium (Ti)-Total			94.6		%		70-130	12-SEP-20
Uranium (U)-Total			96.7		%		70-130	12-SEP-20
Vanadium (V)-Total			94.9		%		70-130	12-SEP-20
Zinc (Zn)-Total			94.2		%		70-130	12-SEP-20
NH3-L-F-CL	**Water**							
Batch R5215097								
WG3400120-33 LCS								
Ammonia as N			106.2		%		85-115	08-SEP-20
WG3400120-32 MB								
Ammonia as N			<0.0050		mg/L		0.005	08-SEP-20
NO2-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Nitrite (as N)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Nitrite (as N)			98.6		%		90-110	06-SEP-20
WG3400344-6 LCS								
Nitrite (as N)			101.1		%		90-110	06-SEP-20
WG3400344-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-SEP-20
WG3400344-9 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-SEP-20
WG3400344-8 MS		**L2499489-5**						
Nitrite (as N)			102.3		%		75-125	06-SEP-20
	Water							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Nitrate (as N)			107.1		%		90-110	06-SEP-20
WG3400344-6 LCS								
Nitrate (as N)			107.0		%		90-110	06-SEP-20
WG3400344-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-SEP-20
WG3400344-9 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-SEP-20
WG3400344-8 MS		**L2499489-5**						
Nitrate (as N)			103.2		%		75-125	06-SEP-20
ORP-CL	**Water**							
Batch R5219182								
WG3401255-7 CRM		**CL-ORP**						
ORP			219		mV		210-230	09-SEP-20
WG3401255-9 CRM		**CL-ORP**						
ORP			220		mV		210-230	09-SEP-20
WG3401255-8 DUP		**L2499489-5**						
ORP		477	472	J	mV	5.6	15	09-SEP-20
P-T-L-COL-CL	**Water**							
Batch R5221078								
WG3401635-30 LCS								
Phosphorus (P)-Total			98.3		%		80-120	10-SEP-20
WG3401635-29 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	10-SEP-20
PH-CL	**Water**							
Batch R5223321								
WG3403880-14 LCS								
pH			6.99		pH		6.9-7.1	12-SEP-20
PO4-DO-L-COL-CL	**Water**							
Batch R5214796								
WG3399182-10 LCS								
Orthophosphate-Dissolved (as P)			103.5		%		80-120	05-SEP-20
WG3399182-9 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	05-SEP-20
	Water							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-CL	**Water**							
Batch R5216116								
WG3400344-7 DUP		**L2499489-5**						
Sulfate (SO4)		<0.30	<0.30	RPD-NA	mg/L	N/A	20	06-SEP-20
WG3400344-10 LCS								
Sulfate (SO4)			105.2		%		90-110	06-SEP-20
WG3400344-6 LCS								
Sulfate (SO4)			105.5		%		90-110	06-SEP-20
WG3400344-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	06-SEP-20
WG3400344-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	06-SEP-20
WG3400344-8 MS		**L2499489-5**						
Sulfate (SO4)			103.2		%		75-125	06-SEP-20
SOLIDS-TDS-CL	**Water**							
Batch R5222602								
WG3402232-5 LCS								
Total Dissolved Solids			96.0		%		85-115	11-SEP-20
WG3402232-4 MB								
Total Dissolved Solids			<10		mg/L		10	11-SEP-20
TKN-L-F-CL	**Water**							
Batch R5216736								
WG3400602-2 LCS								
Total Kjeldahl Nitrogen			100.6		%		75-125	09-SEP-20
WG3400602-4 LCS								
Total Kjeldahl Nitrogen			79.8		%		75-125	09-SEP-20
WG3400602-8 LCS								
Total Kjeldahl Nitrogen			91.1		%		75-125	09-SEP-20
WG3400602-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-SEP-20
WG3400602-3 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-SEP-20
WG3400602-7 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-SEP-20
TSS-L-CL	**Water**							
Batch R5222451								
WG3402220-4 LCS								
Total Suspended Solids			86.9		%		85-115	11-SEP-20
WG3402220-3 MB								
Total Suspended Solids			<1.0		mg/L		1	11-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-CL	**Water**							
Batch **R5212646**								
WG3399343-5 **LCS**								
Turbidity			97.9		%		85-115	06-SEP-20
WG3399343-4 **MB**								
Turbidity			<0.10		NTU		0.1	06-SEP-20

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	04-SEP-20 12:45	09-SEP-20 18:45	0.25	126	hours	EHTR-FM
	2	04-SEP-20 13:15	09-SEP-20 18:45	0.25	126	hours	EHTR-FM
	3	04-SEP-20 10:00	09-SEP-20 18:45	0.25	129	hours	EHTR-FM
	4	04-SEP-20 12:15	09-SEP-20 18:45	0.25	126	hours	EHTR-FM
	5	04-SEP-20 14:00	09-SEP-20 18:45	0.25	125	hours	EHTR-FM
pH							
	1	04-SEP-20 12:45	12-SEP-20 12:00	0.25	191	hours	EHTR-FM
	2	04-SEP-20 13:15	12-SEP-20 12:00	0.25	191	hours	EHTR-FM
	3	04-SEP-20 10:00	12-SEP-20 12:00	0.25	194	hours	EHTR-FM
	4	04-SEP-20 12:15	12-SEP-20 12:00	0.25	192	hours	EHTR-FM
	5	04-SEP-20 14:00	12-SEP-20 12:00	0.25	190	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2499489 were received on 05-SEP-20 08:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID: REP-GHO-2020-09-04

TURNAROUND TIME:

PROJECT/CLIENT INFO			
Facility Name / Job#	Regional Effects Program		
Project Manager	Cait Good		
Email	cait.good@teck.com		
Address	421 Pine Ave		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

LABORATORY			
Lab Name	ALS Calgary		
Lab Contact	Lyudmyla Shvets		
Email	lyudmyla.shvets@alsglobal.com		
Address	2559 29 Street NE		
City	Calgary	Province	AB
Postal Code	T1Y 7B5	Country	Canada
Phone Number	1 403 407 1794		

	Excel	PDF	EDD
cait.good@teck.com	x	x	
teckcoal@equisonline.com			x
carlie.meyer@teck.com	x	x	x
scott.gordon@lotic.co	x	x	x
Jtester@minnow.ca	x	x	x

VPO00689999

L2499489-COFC

SAMPLE DETAILS / ANALYSIS REQUESTED (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	TECKCOAL-ROUTINE-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-T-U-CVAF-VA	HG-D-CVAF-VA	TECKCOAL-MET-T-VA	TECKCOAL-MET-D-VA
FILTERED									x			x		x
PRESERV.									x	x		x	x	x
RG_GH-SCW3_WS_20200904-1245	RG_GH-SC3	WS	NO	2020/09/04	12:45	G	7	X	X	X	X	X	X	X
RG_GH-SCW1_WS_20200904-1315	RG_GH-SC1	WS	NO	2020/09/04	13:15	G	7	X	X	X	X	X	X	X
RG_RIVER_WS_20200904-1000	RG_RIVER	WS	No	2020/09/04	10:00	G	7	X	X	X	X	X	X	X
RG_FBLANK_WS_20200904-1215	RG_FBLANK	WS	No	2020/09/04	12:15	G	7	X	X	X	X	X	X	X
RG_TRIP_WS_20200904-1400	RG_TRIP	WS	No	2020/09/04	14:00	G	4	X		X	X		X	

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

GHO LAEMP VPO00692401 L2499489

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
Scott Gordon / Lotic Environmental	2020/09/04 14:00	[signature]	9/5 0830

NB OF BOTTLES RETURNED/DESCRIPTION

Regular (default)	x
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Scott Gordon	Mobile #	780-385-0186
Sampler's Signature	[signature]	Date/Time	2020/09/04 14:00

4.2

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 12-SEP-20
Report Date: 19-SEP-20 12:59 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2502324

Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: GHO LAEMP Sept 2020
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2502324-1	L2502324-2	L2502324-3	L2502324-4	L2502324-6
	Description	WS	WS	WS	WS	WS
	Sampled Date	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20
	Sampled Time	15:45	16:45	16:45	16:45	14:00
	Client ID	RG_THCK_WS_LAEMP_GHO_2020-09_NP	RG_ERSC5_WS_LAEMP_GHO_2020-09_NP	RG_RIVER1_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK1_WS_LAEMP_GHO_2020-09_NP	GH_ER1A_WS_LAEMP_GHO_2020-09_N
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	1860	295	296	<2.0	307
	Hardness (as CaCO3) (mg/L)	1270	167	172	<0.50	173
	pH (pH)	8.31	8.30	8.30	4.99	8.31
	ORP (mV)	446	375	520	406	516
	Total Suspended Solids (mg/L)	4.9	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	DLHC 1740	DLHC 187	DLHC 186	<10	DLHC 200
	Turbidity (NTU)	1.28	0.69	0.77	<0.10	0.62
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	1.5	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	183	145	140	<1.0	144
	Alkalinity, Carbonate (as CaCO3) (mg/L)	1.2	<1.0	<1.0	<1.0	1.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	184	145	140	<1.0	146
	Ammonia as N (mg/L)	0.0231	0.0086	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	DLHC <0.25	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	DLHC 12.9	0.32	0.32	<0.10	0.33
	Fluoride (F) (mg/L)	DLHC <0.10	0.164	0.162	<0.020	0.162
	Ion Balance (%)	97.4	97.4	103	0.0	97.6
	Nitrate (as N) (mg/L)	DLHC 14.1	0.342	0.342	<0.0050	0.486
	Nitrite (as N) (mg/L)	DLHC 0.0132	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	TKNI <0.050	0.194	0.144	<0.050	0.161
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	0.0036	<0.0020	<0.0020	<0.0020	<0.0020
	Sulfate (SO4) (mg/L)	DLHC 1030	26.1	26.1	<0.30	30.2
	Anion Sum (meq/L)	26.6	3.48	3.39	<0.10	3.60
	Cation Sum (meq/L)	25.9	3.39	3.49	<0.10	3.51
	Cation - Anion Balance (%)	-1.3	-1.3	1.5	0.0	-1.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.30	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon (mg/L)	2.45	<0.50	<0.50	<0.50	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0140	0.0082	0.0141	<0.0030	0.0085
	Antimony (Sb)-Total (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00026	0.00012	0.00014	<0.00010	0.00012
	Barium (Ba)-Total (mg/L)	0.0718	0.0475	0.0483	RRV 0.00021	0.0477
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.029	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (ug/L)	0.0157	0.0090	0.0099	<0.0050	0.0105

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2502324-1	L2502324-2	L2502324-3	L2502324-4	L2502324-6
	Description	WS	WS	WS	WS	WS
	Sampled Date	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20
	Sampled Time	15:45	16:45	16:45	16:45	14:00
	Client ID	RG_THCK_WS_LAEMP_GHO_2020-09_NP	RG_ERSC5_WS_LAEMP_GHO_2020-09_NP	RG_RIVER1_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK1_WS_LAEMP_GHO_2020-09_NP	GH_ER1A_WS_LAEMP_GHO_2020-09_N
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	249	46.8	46.8	<0.050	48.8
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00021	0.00020	<0.00010	0.00020
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.026	0.011	0.019	<0.010	0.013
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0308	0.0029	0.0030	<0.0010	0.0036
	Magnesium (Mg)-Total (mg/L)	165	12.1	12.5	<0.10	12.6
	Manganese (Mn)-Total (mg/L)	0.00262	0.00169	0.00211	<0.00010	0.00182
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.00171	0.00122	0.00107	<0.000050	0.00124
	Nickel (Ni)-Total (mg/L)	0.00132	0.00107	0.00107	<0.00050	0.00147
	Potassium (K)-Total (mg/L)	2.40	0.425	0.421	<0.050	0.433
	Selenium (Se)-Total (ug/L)	153	1.36	1.42	<0.050	1.68
	Silicon (Si)-Total (mg/L)	2.97	1.78	1.79	<0.10	1.81
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.4	0.827	0.846	0.132 RRV	0.882
	Strontium (Sr)-Total (mg/L)	0.638	0.213	0.213	<0.00020	0.218
	Thallium (Tl)-Total (mg/L)	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00013 RRV	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00643	0.000800	0.000822	<0.000010	0.000855
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00027	<0.00010	<0.00010	<0.00010	0.00012
	Barium (Ba)-Dissolved (mg/L)	0.0720	0.0468	0.0480	<0.00010	0.0465
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.027	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (ug/L)	0.0165	0.0083	0.0082	<0.0050	0.0064
	Calcium (Ca)-Dissolved (mg/L)	256	48.3	49.6	<0.050	49.1
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00023	0.00020	<0.00010	0.00021
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2502324-1	L2502324-2	L2502324-3	L2502324-4	L2502324-6
	Description	WS	WS	WS	WS	WS
	Sampled Date	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20	10-SEP-20
	Sampled Time	15:45	16:45	16:45	16:45	14:00
	Client ID	RG_THCK_WS_LAEMP_GHO_2020-09_NP	RG_ERSC5_WS_LAEMP_GHO_2020-09_NP	RG_RIVER1_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK1_WS_LAEMP_GHO_2020-09_NP	GH_ER1A_WS_LAEMP_GHO_2020-09_N
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	0.00021	<0.00020	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0329	0.0031	0.0031	<0.0010	0.0037
	Magnesium (Mg)-Dissolved (mg/L)	152	11.3	11.7	<0.10	12.3
	Manganese (Mn)-Dissolved (mg/L)	0.00032	0.00085	0.00092	<0.00010	0.00099
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00153	0.00101	0.00100	<0.000050	0.00105
	Nickel (Ni)-Dissolved (mg/L)	0.00068	0.00058	0.00057	<0.00050	0.00090
	Potassium (K)-Dissolved (mg/L)	2.44	0.422	0.446	<0.050	0.446
	Selenium (Se)-Dissolved (ug/L)	147	1.40	1.38	<0.050	1.58
	Silicon (Si)-Dissolved (mg/L)	2.84	1.75	1.76	<0.050	1.81
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.0	0.815	0.847	<0.050	0.904
	Strontium (Sr)-Dissolved (mg/L)	0.616	0.202	0.208	<0.00020	0.206
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00622	0.000786	0.000807	<0.000010	0.000869
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Selenium (Se)-Total	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2502324-1, -2, -3, -4, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2502324-1, -2, -3, -4, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by

Reference Information

subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-L-IC-N-CL Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL Water Electrical Conductivity (EC) APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL Water Ammonia, Total (as N) J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL Water Oxidation redution potential by elect. ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL Water Phosphorus (P)-Total APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Reference Information

PH-CL Water pH APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL Water Orthophosphate-Dissolved (as P) APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL Water Total Dissolved Solids APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL Water Total Kjeldahl Nitrogen APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL Water Total Suspended Solids APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL Water Turbidity APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GHO LAEMP Sept 2020

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R5224327								
WG3405383-17 LCS								
Acidity (as CaCO3)			103.9		%		85-115	15-SEP-20
WG3405383-16 MB								
Acidity (as CaCO3)			1.7		mg/L		2	15-SEP-20
ALK-MAN-CL	**Water**							
Batch R5226926								
WG3406781-11 LCS								
Alkalinity, Total (as CaCO3)			99.8		%		85-115	17-SEP-20
WG3406781-14 LCS								
Alkalinity, Total (as CaCO3)			103.0		%		85-115	17-SEP-20
WG3406781-10 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	17-SEP-20
WG3406781-13 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	17-SEP-20
BE-D-L-CCMS-VA	**Water**							
Batch R5226820								
WG3405995-2 LCS								
Beryllium (Be)-Dissolved			95.4		%		80-120	17-SEP-20
WG3405995-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	17-SEP-20
BE-T-L-CCMS-VA	**Water**							
Batch R5226940								
WG3405856-2 LCS								
Beryllium (Be)-Total			98.5		%		80-120	17-SEP-20
WG3405856-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	17-SEP-20
BR-L-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Bromide (Br)			104.3		%		85-115	12-SEP-20
WG3404056-13 MB								
Bromide (Br)			<0.050		mg/L		0.05	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Bromide (Br)			120.2		%		75-125	12-SEP-20
C-DIS-ORG-LOW-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-LOW-CL	**Water**							
Batch R5226924								
WG3406749-2 LCS								
Dissolved Organic Carbon			90.7		%		80-120	16-SEP-20
WG3406749-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	16-SEP-20
C-TOT-ORG-LOW-CL	**Water**							
Batch R5226924								
WG3406749-2 LCS								
Total Organic Carbon			92.2		%		80-120	16-SEP-20
WG3406749-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	16-SEP-20
CL-L-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Chloride (Cl)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Chloride (Cl)			101.5		%		85-115	12-SEP-20
WG3404056-13 MB								
Chloride (Cl)			<0.10		mg/L		0.1	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Chloride (Cl)			119.7		%		75-125	12-SEP-20
EC-L-PCT-CL	**Water**							
Batch R5226926								
WG3406781-11 LCS								
Conductivity (@ 25C)			95.1		%		90-110	17-SEP-20
WG3406781-14 LCS								
Conductivity (@ 25C)			95.4		%		90-110	17-SEP-20
WG3406781-10 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	17-SEP-20
WG3406781-13 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	17-SEP-20
F-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Fluoride (F)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Fluoride (F)			101.9		%		90-110	12-SEP-20
WG3404056-13 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-13 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Fluoride (F)			120.5		%		75-125	12-SEP-20
HG-D-CVAA-VA	**Water**							
Batch R5228437								
WG3407162-6 LCS								
Mercury (Hg)-Dissolved			97.2		%		80-120	18-SEP-20
WG3407162-5 MB		**NP**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	18-SEP-20
WG3407162-8 MS		**L2502324-4**						
Mercury (Hg)-Dissolved			88.1		%		70-130	18-SEP-20
HG-T-U-CVAF-VA	**Water**							
Batch R5226825								
WG3406751-2 LCS								
Mercury (Hg)-Total			91.8		%		80-120	17-SEP-20
WG3406751-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	17-SEP-20
WG3406751-8 MS		**L2502324-3**						
Mercury (Hg)-Total			86.8		%		70-130	17-SEP-20
MET-D-CCMS-VA	**Water**							
Batch R5226820								
WG3405995-2 LCS								
Aluminum (Al)-Dissolved			98.8		%		80-120	17-SEP-20
Antimony (Sb)-Dissolved			88.5		%		80-120	17-SEP-20
Arsenic (As)-Dissolved			93.9		%		80-120	17-SEP-20
Barium (Ba)-Dissolved			97.1		%		80-120	17-SEP-20
Bismuth (Bi)-Dissolved			98.4		%		80-120	17-SEP-20
Boron (B)-Dissolved			92.8		%		80-120	17-SEP-20
Cadmium (Cd)-Dissolved			94.0		%		80-120	17-SEP-20
Calcium (Ca)-Dissolved			97.7		%		80-120	17-SEP-20
Chromium (Cr)-Dissolved			95.1		%		80-120	17-SEP-20
Cobalt (Co)-Dissolved			94.1		%		80-120	17-SEP-20
Copper (Cu)-Dissolved			92.0		%		80-120	17-SEP-20
Iron (Fe)-Dissolved			92.4		%		80-120	17-SEP-20
Lead (Pb)-Dissolved			96.8		%		80-120	17-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5226820								
WG3405995-2 LCS								
Lithium (Li)-Dissolved			97.1		%		80-120	17-SEP-20
Magnesium (Mg)-Dissolved			92.0		%		80-120	17-SEP-20
Manganese (Mn)-Dissolved			96.0		%		80-120	17-SEP-20
Molybdenum (Mo)-Dissolved			90.9		%		80-120	17-SEP-20
Nickel (Ni)-Dissolved			95.7		%		80-120	17-SEP-20
Potassium (K)-Dissolved			97.1		%		80-120	17-SEP-20
Selenium (Se)-Dissolved			91.3		%		80-120	17-SEP-20
Silicon (Si)-Dissolved			95.5		%		60-140	17-SEP-20
Silver (Ag)-Dissolved			90.4		%		80-120	17-SEP-20
Sodium (Na)-Dissolved			98.3		%		80-120	17-SEP-20
Strontium (Sr)-Dissolved			92.9		%		80-120	17-SEP-20
Thallium (Tl)-Dissolved			95.7		%		80-120	17-SEP-20
Tin (Sn)-Dissolved			90.6		%		80-120	17-SEP-20
Titanium (Ti)-Dissolved			88.3		%		80-120	17-SEP-20
Uranium (U)-Dissolved			96.1		%		80-120	17-SEP-20
Vanadium (V)-Dissolved			95.6		%		80-120	17-SEP-20
Zinc (Zn)-Dissolved			94.4		%		80-120	17-SEP-20
WG3405995-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	17-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	17-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	17-SEP-20
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	17-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-20
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	17-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	17-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5226820								
WG3405995-1 MB		**NP**						
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	17-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	17-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-20
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	17-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	17-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	17-SEP-20
MET-T-CCMS-VA	**Water**							
Batch R5226940								
WG3405856-2 LCS								
Aluminum (Al)-Total			104.2		%		80-120	17-SEP-20
Antimony (Sb)-Total			109.6		%		80-120	17-SEP-20
Arsenic (As)-Total			103.0		%		80-120	17-SEP-20
Barium (Ba)-Total			110.2		%		80-120	17-SEP-20
Bismuth (Bi)-Total			103.7		%		80-120	17-SEP-20
Boron (B)-Total			100.8		%		80-120	17-SEP-20
Cadmium (Cd)-Total			107.3		%		80-120	17-SEP-20
Calcium (Ca)-Total			101.6		%		80-120	17-SEP-20
Chromium (Cr)-Total			103.3		%		80-120	17-SEP-20
Cobalt (Co)-Total			103.1		%		80-120	17-SEP-20
Copper (Cu)-Total			103.0		%		80-120	17-SEP-20
Iron (Fe)-Total			102.5		%		80-120	17-SEP-20
Lead (Pb)-Total			102.2		%		80-120	17-SEP-20
Lithium (Li)-Total			96.6		%		80-120	17-SEP-20
Magnesium (Mg)-Total			99.3		%		80-120	17-SEP-20
Manganese (Mn)-Total			108.1		%		80-120	17-SEP-20
Molybdenum (Mo)-Total			101.2		%		80-120	17-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5226940								
WG3405856-2 LCS								
Nickel (Ni)-Total			104.7		%		80-120	17-SEP-20
Potassium (K)-Total			106.0		%		80-120	17-SEP-20
Selenium (Se)-Total			104.9		%		80-120	17-SEP-20
Silicon (Si)-Total			103.8		%		80-120	17-SEP-20
Silver (Ag)-Total			107.2		%		80-120	17-SEP-20
Sodium (Na)-Total			104.5		%		80-120	17-SEP-20
Strontium (Sr)-Total			103.4		%		80-120	17-SEP-20
Thallium (Tl)-Total			103.6		%		80-120	17-SEP-20
Tin (Sn)-Total			104.4		%		80-120	17-SEP-20
Titanium (Ti)-Total			101.0		%		80-120	17-SEP-20
Uranium (U)-Total			99.5		%		80-120	17-SEP-20
Vanadium (V)-Total			101.8		%		80-120	17-SEP-20
Zinc (Zn)-Total			109.3		%		80-120	17-SEP-20
WG3405856-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	17-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	17-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	17-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	17-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	17-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	17-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	17-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	17-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	17-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	17-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	17-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	17-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	17-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	17-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5226940								
WG3405856-1 MB								
Silicon (Si)-Total			<0.10		mg/L		0.1	17-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	17-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	17-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	17-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	17-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	17-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	17-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	17-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	17-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	17-SEP-20
Batch R5230596								
WG3407139-2 LCS								
Aluminum (Al)-Total			103.6		%		80-120	18-SEP-20
Antimony (Sb)-Total			115.7		%		80-120	18-SEP-20
Arsenic (As)-Total			105.6		%		80-120	18-SEP-20
Barium (Ba)-Total			108.0		%		80-120	18-SEP-20
Bismuth (Bi)-Total			108.7		%		80-120	18-SEP-20
Boron (B)-Total			102.9		%		80-120	18-SEP-20
Cadmium (Cd)-Total			105.2		%		80-120	18-SEP-20
Calcium (Ca)-Total			103.6		%		80-120	18-SEP-20
Chromium (Cr)-Total			106.7		%		80-120	18-SEP-20
Cobalt (Co)-Total			106.2		%		80-120	18-SEP-20
Copper (Cu)-Total			103.8		%		80-120	18-SEP-20
Iron (Fe)-Total			105.9		%		80-120	18-SEP-20
Lead (Pb)-Total			107.8		%		80-120	18-SEP-20
Lithium (Li)-Total			96.5		%		80-120	18-SEP-20
Magnesium (Mg)-Total			102.1		%		80-120	18-SEP-20
Manganese (Mn)-Total			107.5		%		80-120	18-SEP-20
Molybdenum (Mo)-Total			102.7		%		80-120	18-SEP-20
Nickel (Ni)-Total			103.4		%		80-120	18-SEP-20
Potassium (K)-Total			103.2		%		80-120	18-SEP-20
Selenium (Se)-Total			106.6		%		80-120	18-SEP-20
Silicon (Si)-Total			104.2		%		80-120	18-SEP-20
Silver (Ag)-Total			106.1		%		80-120	18-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5230596								
WG3407139-2 LCS								
Sodium (Na)-Total			109.8		%		80-120	18-SEP-20
Strontium (Sr)-Total			102.7		%		80-120	18-SEP-20
Thallium (Tl)-Total			106.1		%		80-120	18-SEP-20
Tin (Sn)-Total			105.7		%		80-120	18-SEP-20
Titanium (Ti)-Total			105.9		%		80-120	18-SEP-20
Uranium (U)-Total			105.0		%		80-120	18-SEP-20
Vanadium (V)-Total			108.4		%		80-120	18-SEP-20
Zinc (Zn)-Total			106.6		%		80-120	18-SEP-20
WG3407139-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	18-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	18-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	18-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	18-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	18-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	18-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	18-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	18-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	18-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	18-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	18-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	18-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	18-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5230596								
WG3407139-1 MB								
Tin (Sn)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	18-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	18-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	18-SEP-20
NH3-L-F-CL	**Water**							
Batch R5224062								
WG3404326-19 DUP		**L2502324-6**						
Ammonia as N		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	14-SEP-20
WG3404326-18 LCS								
Ammonia as N			103.9		%		85-115	15-SEP-20
WG3404326-17 MB								
Ammonia as N			<0.0050		mg/L		0.005	15-SEP-20
WG3404326-20 MS		**L2502324-6**						
Ammonia as N			109.0		%		75-125	14-SEP-20
NO2-L-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Nitrite (as N)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Nitrite (as N)			102.2		%		90-110	12-SEP-20
WG3404056-13 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Nitrite (as N)			121.8		%		75-125	12-SEP-20
NO3-L-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Nitrate (as N)			102.8		%		90-110	12-SEP-20
WG3404056-13 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Nitrate (as N)			119.8		%		75-125	12-SEP-20
ORP-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ORP-CL	**Water**							
Batch R5224232								
WG3404997-4 CRM		**CL-ORP**						
ORP			224		mV		210-230	15-SEP-20
P-T-L-COL-CL	**Water**							
Batch R5229838								
WG3407574-18 LCS								
Phosphorus (P)-Total			100.3		%		80-120	18-SEP-20
WG3407574-17 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	18-SEP-20
PH-CL	**Water**							
Batch R5226926								
WG3406781-11 LCS								
pH			7.00		pH		6.9-7.1	17-SEP-20
WG3406781-14 LCS								
pH			7.00		pH		6.9-7.1	17-SEP-20
PO4-DO-L-COL-CL	**Water**							
Batch R5222820								
WG3403419-15 DUP		**L2502324-4**						
Orthophosphate-Dissolved (as P)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3403419-14 LCS								
Orthophosphate-Dissolved (as P)			99.1		%		80-120	12-SEP-20
WG3403419-13 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	12-SEP-20
WG3403419-16 MS		**L2502324-4**						
Orthophosphate-Dissolved (as P)			97.5		%		70-130	12-SEP-20
SO4-IC-N-CL	**Water**							
Batch R5223278								
WG3404056-15 DUP		**L2502324-4**						
Sulfate (SO4)		<0.30	<0.30	RPD-NA	mg/L	N/A	20	12-SEP-20
WG3404056-14 LCS								
Sulfate (SO4)			103.7		%		90-110	12-SEP-20
WG3404056-13 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	12-SEP-20
WG3404056-16 MS		**L2502324-4**						
Sulfate (SO4)			119.7		%		75-125	12-SEP-20
SOLIDS-TDS-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TDS-CL	**Water**							
Batch R5226876								
WG3405388-9 DUP		**L2502324-1**						
Total Dissolved Solids		1740	1730		mg/L	0.7	20	16-SEP-20
WG3405388-8 LCS								
Total Dissolved Solids			101.4		%		85-115	16-SEP-20
WG3405388-7 MB								
Total Dissolved Solids			<10		mg/L		10	16-SEP-20
TKN-L-F-CL	**Water**							
Batch R5224612								
WG3405544-9 DUP		**L2502324-4**						
Total Kjeldahl Nitrogen		<0.050	<0.050	RPD-NA	mg/L	N/A	20	16-SEP-20
WG3405544-2 LCS								
Total Kjeldahl Nitrogen			108.2		%		75-125	16-SEP-20
WG3405544-4 LCS								
Total Kjeldahl Nitrogen			111.8		%		75-125	16-SEP-20
WG3405544-6 LCS								
Total Kjeldahl Nitrogen			110.4		%		75-125	16-SEP-20
WG3405544-8 LCS								
Total Kjeldahl Nitrogen			110.5		%		75-125	16-SEP-20
WG3405544-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	16-SEP-20
WG3405544-3 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	16-SEP-20
WG3405544-5 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	16-SEP-20
WG3405544-7 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	16-SEP-20
WG3405544-10 MS		**L2502324-4**						
Total Kjeldahl Nitrogen			111.3		%		70-130	16-SEP-20
TSS-L-CL	**Water**							
Batch R5226690								
WG3405393-2 LCS								
Total Suspended Solids			94.8		%		85-115	16-SEP-20
WG3405393-1 MB								
Total Suspended Solids			<1.0		mg/L		1	16-SEP-20
TURBIDITY-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-CL	**Water**							
Batch R5222915								
WG3403353-11 LCS								
Turbidity			96.5		%		85-115	12-SEP-20
WG3403353-10 MB								
Turbidity			<0.10		NTU		0.1	12-SEP-20

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	10-SEP-20 15:45	15-SEP-20 12:45	0.25	117	hours	EHTR-FM
	2	10-SEP-20 16:45	15-SEP-20 12:45	0.25	116	hours	EHTR-FM
	3	10-SEP-20 16:45	15-SEP-20 12:45	0.25	116	hours	EHTR-FM
	4	10-SEP-20 16:45	15-SEP-20 12:45	0.25	116	hours	EHTR-FM
	6	10-SEP-20 14:00	15-SEP-20 12:45	0.25	119	hours	EHTR-FM
pH							
	1	10-SEP-20 15:45	17-SEP-20 14:00	0.25	166	hours	EHTR-FM
	2	10-SEP-20 16:45	17-SEP-20 14:00	0.25	165	hours	EHTR-FM
	3	10-SEP-20 16:45	17-SEP-20 14:00	0.25	165	hours	EHTR-FM
	4	10-SEP-20 16:45	17-SEP-20 14:00	0.25	165	hours	EHTR-FM
	6	10-SEP-20 14:00	17-SEP-20 14:00	0.25	168	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2502324 were received on 12-SEP-20 09:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	GHO LAEMP Sept 2020	TURNAROUND TIME:	

PROJECT/CLIENT INFO

Facility Name	REP
Project Manager	Cait Good
Email	cait.good@teck.com
Address	421 Pine Avenue
City	Sparwood
Province	BC
Postal Code	V0B 2G0
Country	Canada
Phone Number	250-425-8202

LABORATORY

Lab Name	ALS Calgary
Lab Contact	Lyudmyla Shvets
Email	lyudmyla.shvets@alsglobal.com
Address	2559 29 Street NE
City	Calgary
Province	AB
Postal Code	T1Y 7B5
Country	Canada
Phone Number	1 403 407 1794

	Excel	PDF	EDD
cait.good@teck.com	x	x	x
teckcoal@equisonline.com			x
Jings@minnow.ca	x	x	x
carlie.meyer@teck.com	x	x	x
jtester@minnow.ca	x	x	x

PO number: 689999

SAMPLE DETAILS / **ANALYSIS REQUESTED** (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

L2502324-COFC

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	TECKCOAL-ROUTINE-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-T-U-CVAF-VA	HG-D-CVAF-VA	TECKCOAL-MET-T-VA	TECKCOAL-MET-D-VA
FILTERED								N	F	N	N	F	N	F
PRESERVATIVE									H2SO4	H2SO4		HCL	HNO3	HNO3
RG_THCK_WS_LAEMP_GHO_2020-09_NP	RG_THCK	WS	No	9/10/2020	15:45	G	7	1	1	1	1	1	1	1
RG_ERSC5_WS_LAEMP_GHO_2020-09_NP	RG_ERSC5	WS	No	9/10/2020	16:45	G	7	1	1	1	1	1	1	1
RG_RIVER1_WS_LAEMP_GHO_2020-09_NP	RG_RIVER	WS	No	9/10/2020	16:45	G	7	1	1	1	1	1	1	1
RG_FBLANK1_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK	WS	No	9/10/2020	16:45	G	7	1	1	1	1	1	1	1
RG_TRIP1_WS_LAEMP_GHO_2020-09_NP	RG_TRIP (Lab pre-filled)	WS	No	9/10/2020	16:45	G	7	1		1	1		1	
GH_ER1A_WS_LAEMP_GHO_2020-09_N	GH_ER1A	WS	No	9/11/2020	14:00	G	7	1	1	1	1	1	1	1

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION
	Jennifer Ings	September 11, 2020	9/11 0920 5°C

NB OF BOTTLES RETURNED/DESCRIPTION

Regular (default)	x
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Sampler's Signature		Date/Time	September 11, 2020

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 15-SEP-20
Report Date: 21-SEP-20 17:28 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2503391

Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: RAEMP Sept 2020
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-1	L2503391-2	L2503391-3	L2503391-4	L2503391-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	12-SEP-20	12-SEP-20	13-SEP-20
	Sampled Time	10:30	08:40	15:15	09:25	09:20
	Client ID	RG_EL1_WS_RAEMP_2020-09_NP	RG_ELDFE_WS_RAEMP_2020-09_NP	RG_UCWER_WS_LAEMP_GHO_2020-09_NP	RG_FODGH_WS_LAEMP_GHO_2020-09_NP	RG_GRDS_WS_RAEMP_2020-09_NP
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	439	431	336	743	576
	Hardness (as CaCO3) (mg/L)	240	244	192	449	333
	pH (pH)	8.38	8.39	8.33	8.40	8.45
	ORP (mV)	409	440	416	443	464
	Total Suspended Solids (mg/L)	1.3	2.3	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	294 DLHC	279 DLHC	215 DLHC	557 DLHC	392 DLHC
	Turbidity (NTU)	0.87	1.23	0.28	0.34	0.51
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	163	169	148	195	181
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.8	4.6	2.4	6.4	9.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	167	173	150	202	190
	Ammonia as N (mg/L)	0.0128	<0.0050	0.0056	<0.0050	0.0100
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	3.20	3.15	0.30	1.54	1.35
	Fluoride (F) (mg/L)	0.198	0.197	0.193	0.169	0.226
	Ion Balance (%)	96.1	96.6	96.8	102	96.0
	Nitrate (as N) (mg/L)	2.03	1.76	0.0810	12.0	0.440
	Nitrite (as N) (mg/L)	<0.0010	0.0021	<0.0010	0.0019	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.071 TKNI	0.102 TKNI	<0.25	<0.25 TKNI	0.106
	Orthophosphate-Dissolved (as P) (mg/L)	0.0018	<0.0010	0.0036	0.0012	0.0024
	Phosphorus (P)-Total (mg/L)	0.0056	0.0033	0.0056	<0.0020	0.0041
	Sulfate (SO4) (mg/L)	74.3	72.4	46.8	192	151
	Anion Sum (meq/L)	5.13	5.19	4.01	8.94	7.02
	Cation Sum (meq/L)	4.93	5.02	3.88	9.11	6.74
	Cation - Anion Balance (%)	-2.0	-1.7	-1.6	0.9	-2.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.45	<0.50	2.01	1.59	1.75
	Total Organic Carbon (mg/L)	1.54	<0.50	1.74	1.65	1.46
Total Metals	Aluminum (Al)-Total (mg/L)	0.0082	0.0138	<0.0030	0.0036	0.0070
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00012	<0.00010
	Arsenic (As)-Total (mg/L)	0.00021	0.00022	0.00022	0.00012	0.00017
	Barium (Ba)-Total (mg/L)	0.0763	0.0800	0.0792	0.110	0.0646
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (ug/L)	0.0148	0.0153	0.0080	0.0235	0.0145

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-6	L2503391-7	L2503391-8	L2503391-9	L2503391-10
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	14-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	11:20	12:48	14:00	12:00	12:00
	Client ID	RG_BACK_WS_RAEMP_2020-09_NP	RG_MIDBO_WS_RAEMP_2020-09_NP	RG_ELUEL_WS_LAEMP_GHO_2020-09_NP	GH_ERSC2_WS_LAEMP_GHO_2020-09_NP	GH_ERSC4_WS_LAEMP_GHO_2020-09_NP
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	402	523	308	459	278
	Hardness (as CaCO3) (mg/L)	222	297	174	257	160
	pH (pH)	8.46	8.46	8.33	8.36	8.32
	ORP (mV)	440	362	452	463	454
	Total Suspended Solids (mg/L)	7.7	<1.0	<1.0	<1.0	1.6
	Total Dissolved Solids (mg/L)	243 DLHC	369 DLHC	216 DLHC	329 DLHC	166 DLHC
	Turbidity (NTU)	3.27	0.56	0.41	0.95	0.64
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	183	170	147	148	146
	Alkalinity, Carbonate (as CaCO3) (mg/L)	8.2	9.2	2.0	2.8	1.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	191	179	149	151	147
	Ammonia as N (mg/L)	0.0509	0.0202	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	1.25	2.38	0.35	1.28	0.26
	Fluoride (F) (mg/L)	0.157	0.153	0.157	0.149	0.159
	Ion Balance (%)	95.9	99.2	98.1	95.3	97.1
	Nitrate (as N) (mg/L)	0.461	1.34	0.383	1.46	0.0282
	Nitrite (as N) (mg/L)	<0.0010	0.0018	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.128	0.317	0.063	0.231	<0.050
	Orthophosphate-Dissolved (as P) (mg/L)	0.0323	<0.0010	0.0011	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	0.0307	0.0026	<0.0020	<0.0020	0.0036
	Sulfate (SO4) (mg/L)	46.7	117	27.3	111	17.6
	Anion Sum (meq/L)	4.87	6.19	3.60	5.47	3.32
	Cation Sum (meq/L)	4.67	6.14	3.53	5.22	3.23
	Cation - Anion Balance (%)	-2.1	-0.4	-0.9	-2.4	-1.4
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.34	1.32	0.99	1.17	<0.50
	Total Organic Carbon (mg/L)	1.86	1.32	0.87	1.26	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.124	0.0047	0.0071	0.0103	0.0147
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00027	0.00020	0.00013	0.00014	0.00014
	Barium (Ba)-Total (mg/L)	0.113	0.125	0.0577	0.0488	0.0488
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.016	0.012	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (ug/L)	0.0356	0.0234	0.0082	0.0103	0.0097

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-11	L2503391-12			
	Description	WS	WS			
	Sampled Date	13-SEP-20	13-SEP-20			
	Sampled Time	12:00	12:00			
	Client ID	RG_GH_SCW3_WS_LAEMP_GHO_2020-09_NP	RG_SCDTC_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	463	494			
	Hardness (as CaCO3) (mg/L)	267	282			
	pH (pH)	8.32	8.33			
	ORP (mV)	474	469			
	Total Suspended Solids (mg/L)	1.7	2.3			
	Total Dissolved Solids (mg/L)	319 DLHC	347 DLHC			
	Turbidity (NTU)	1.20	3.07			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	144	150			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	1.2	2.4			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	146	153			
	Ammonia as N (mg/L)	0.0078	<0.0050			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	1.27	1.39			
	Fluoride (F) (mg/L)	0.148	0.146			
	Ion Balance (%)	101	98.2			
	Nitrate (as N) (mg/L)	1.47	1.76			
	Nitrite (as N) (mg/L)	<0.0010	0.0012			
	Total Kjeldahl Nitrogen (mg/L)	0.251	0.235			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total (mg/L)	0.0021	0.0041			
	Sulfate (SO4) (mg/L)	111	125			
	Anion Sum (meq/L)	5.37	5.83			
	Cation Sum (meq/L)	5.42	5.73			
	Cation - Anion Balance (%)	0.5	-0.9			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	<0.50	0.57			
	Total Organic Carbon (mg/L)	0.57	0.65			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0163	0.0247			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00015	0.00017			
	Barium (Ba)-Total (mg/L)	0.0520	0.0546			
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (ug/L)	0.0125	0.0225			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2503391-1	L2503391-2	L2503391-3	L2503391-4	L2503391-5
	Sample ID	L2503391-1	L2503391-2	L2503391-3	L2503391-4	L2503391-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	12-SEP-20	12-SEP-20	13-SEP-20
	Sampled Time	10:30	08:40	15:15	09:25	09:20
	Client ID	RG_EL1_WS_RAEMP_2020-09_NP	RG_ELDFE_WS_RAEMP_2020-09_NP	RG_UCWER_WS_LAEMP_GHO_2020-09_NP	RG_FODGH_WS_LAEMP_GHO_2020-09_NP	RG_GRDS_WS_RAEMP_2020-09_NP
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	58.2	57.9	46.0	93.5	68.0
	Chromium (Cr)-Total (mg/L)	0.00029	0.00027	0.00047	0.00013	0.00017
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.014	0.021	<0.010	<0.010	0.012
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0065	0.0067	0.0010	0.0179	0.0059
	Magnesium (Mg)-Total (mg/L)	19.1	18.1	14.7	39.9	34.0
	Manganese (Mn)-Total (mg/L)	0.00225	0.00265	0.00074	0.00123	0.00191
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.00120	0.00121	0.00145	0.000969	0.00108
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00062	<0.00050
	Potassium (K)-Total (mg/L)	0.638	0.650	0.380	1.23	0.739
	Selenium (Se)-Total (ug/L)	10.5	9.23	2.81	51.2	25.4
	Silicon (Si)-Total (mg/L)	2.09	2.12	2.25	2.34	2.43
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	2.55	2.70	0.519	2.09	1.60
	Strontium (Sr)-Total (mg/L)	0.217	0.232	0.0558	0.144	0.141
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00116	0.00109	0.00177	0.00217	0.00192
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00017	0.00021	0.00019	0.00011	0.00014
	Barium (Ba)-Dissolved (mg/L)	0.0753	0.0779	0.0788	0.113	0.0649
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (ug/L)	0.010	0.0087	<0.0050	0.0242	0.0139
	Calcium (Ca)-Dissolved (mg/L)	63.4	65.9	51.5	106	74.4
	Chromium (Cr)-Dissolved (mg/L)	0.00025	0.00022	0.00042	0.00013	0.00014
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-6	L2503391-7	L2503391-8	L2503391-9	L2503391-10
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	14-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	11:20	12:48	14:00	12:00	12:00
	Client ID	RG_BACK_WS_RAEMP_2020-09_NP	RG_MIDBO_WS_RAEMP_2020-09_NP	RG_ELUEL_WS_LAEMP_GHO_2020-09_NP	GH_ERSC2_WS_LAEMP_GHO_2020-09_NP	GH_ERSC4_WS_LAEMP_GHO_2020-09_NP
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	50.1	67.6	47.3	59.5	43.3
	Chromium (Cr)-Total (mg/L)	0.00022	0.00015	0.00025	0.00022	0.00024
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.135	0.011	<0.010	0.018	0.021
	Lead (Pb)-Total (mg/L)	0.000119	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0135	0.0081	0.0026	0.0047	0.0017
	Magnesium (Mg)-Total (mg/L)	19.7	25.8	11.9	22.6	10.3
	Manganese (Mn)-Total (mg/L)	0.0114	0.00210	0.00111	0.00129	0.00309
	Mercury (Hg)-Total (ug/L)	0.00120	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.000418	0.000864	0.00106	0.00107	0.00103
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00071	<0.00050	0.00074	<0.00050
	Potassium (K)-Total (mg/L)	0.766	0.848	0.410	0.532	0.362
	Selenium (Se)-Total (ug/L)	8.86	12.7	1.64	13.3	0.726
	Silicon (Si)-Total (mg/L)	3.62	2.48	2.09	1.94	1.93
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	4.97	4.24	0.891	1.62	0.634
	Strontium (Sr)-Total (mg/L)	0.155	0.171	0.207	0.241	0.200
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.000347	0.00127	0.000787	0.00126	0.000692
	Vanadium (V)-Total (mg/L)	0.00072	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00021	0.00018	<0.00010	0.00011	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.109	0.121	0.0563	0.0475	0.0479
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.016	0.012	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (ug/L)	0.0102	0.0179	<0.0050	0.0117	0.0060
	Calcium (Ca)-Dissolved (mg/L)	55.7	74.0	50.1	64.9	47.3
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00012	0.00021	0.00019	0.00018
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-11	L2503391-12			
	Description	WS	WS			
	Sampled Date	13-SEP-20	13-SEP-20			
	Sampled Time	12:00	12:00			
	Client ID	RG_GH_SCW3_WS_LAEMP_GHO_2020-09_NP	RG_SCDTC_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	60.7	64.1			
	Chromium (Cr)-Total (mg/L)	0.00020	0.00023			
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10			
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)	0.021	0.032			
	Lead (Pb)-Total (mg/L)	<0.000050	0.000051			
	Lithium (Li)-Total (mg/L)	0.0052	0.0060			
	Magnesium (Mg)-Total (mg/L)	23.1	25.1			
	Manganese (Mn)-Total (mg/L)	0.00173	0.00201			
	Mercury (Hg)-Total (ug/L)	<0.00050	0.00059			
	Molybdenum (Mo)-Total (mg/L)	0.00116	0.00112			
	Nickel (Ni)-Total (mg/L)	0.00086	0.00084			
	Potassium (K)-Total (mg/L)	0.575	0.633			
	Selenium (Se)-Total (ug/L)	13.4	14.3			
	Silicon (Si)-Total (mg/L)	2.08	1.99			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	1.68	1.89			
	Strontium (Sr)-Total (mg/L)	0.241	0.258			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			
	Uranium (U)-Total (mg/L)	0.00127	0.00139			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00011	0.00013			
	Barium (Ba)-Dissolved (mg/L)	0.0493	0.0544			
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (ug/L)	0.0094	0.0093			
	Calcium (Ca)-Dissolved (mg/L)	68.0	69.9			
	Chromium (Cr)-Dissolved (mg/L)	0.00017	0.00018			
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-1	L2503391-2	L2503391-3	L2503391-4	L2503391-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	12-SEP-20	12-SEP-20	13-SEP-20
	Sampled Time	10:30	08:40	15:15	09:25	09:20
	Client ID	RG_EL1_WS_RAEMP_2020-09_NP	RG_ELDFE_WS_RAEMP_2020-09_NP	RG_UCWER_WS_LAEMP_GHO_2020-09_NP	RG_FODGH_WS_LAEMP_GHO_2020-09_NP	RG_GRDS_WS_RAEMP_2020-09_NP
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0086	0.0086	0.0013	0.0223	0.0070
	Magnesium (Mg)-Dissolved (mg/L)	19.9	19.3	15.5	44.6	35.7
	Manganese (Mn)-Dissolved (mg/L)	0.00096	0.00090	0.00023	0.00084	0.00060
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00119	0.00123	0.00149	0.000976	0.00114
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Dissolved (mg/L)	0.640	0.643	0.389	1.31	0.760
	Selenium (Se)-Dissolved (ug/L)	10.7	9.24	2.89	56.4	26.4
	Silicon (Si)-Dissolved (mg/L)	2.04	1.95	2.15	2.30	2.22
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	2.66	2.89	0.555	2.26	1.67
	Strontium (Sr)-Dissolved (mg/L)	0.234	0.246	0.0612	0.156	0.154
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00116	0.00108	0.00177	0.00219	0.00192
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0013	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-6	L2503391-7	L2503391-8	L2503391-9	L2503391-10
	Description	WS	WS	WS	WS	WS
	Sampled Date	13-SEP-20	12-SEP-20	14-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	11:20	12:48	14:00	12:00	12:00
	Client ID	RG_BACK_WS_RAEMP_2020-09_NP	RG_MIDBO_WS_RAEMP_2020-09_NP	RG_ELUEL_WS_LAEMP_GHO_2020-09_NP	GH_ERSC2_WS_LAEMP_GHO_2020-09_NP	GH_ERSC4_WS_LAEMP_GHO_2020-09_NP
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0159	0.0097	0.0030	0.0053	0.0018
	Magnesium (Mg)-Dissolved (mg/L)	20.0	27.2	12.0	23.0	10.1
	Manganese (Mn)-Dissolved (mg/L)	0.00031	0.00153	0.00062	0.00053	0.00178
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000413	0.000872	0.00109	0.00135	0.00102
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00057	<0.00050
	Potassium (K)-Dissolved (mg/L)	0.734	0.857	0.392	0.534	0.346
	Selenium (Se)-Dissolved (ug/L)	9.04	12.7	1.70	14.1	0.707
	Silicon (Si)-Dissolved (mg/L)	3.19	2.21	1.89	1.78	1.78
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	5.05	4.31	0.901	1.68	0.641
	Strontium (Sr)-Dissolved (mg/L)	0.163	0.187	0.225	0.252	0.213
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000326	0.00127	0.000739	0.00124	0.000667
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2503391-11	L2503391-12			
	Description	WS	WS			
	Sampled Date	13-SEP-20	13-SEP-20			
	Sampled Time	12:00	12:00			
	Client ID	RG_GH_SCW3_WS_LAEMP_GHO_2020-09_NP	RG_SCDTC_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020			
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0055	0.0064			
	Magnesium (Mg)-Dissolved (mg/L)	23.6	26.1			
	Manganese (Mn)-Dissolved (mg/L)	0.00058	0.00046			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00113	0.00122			
	Nickel (Ni)-Dissolved (mg/L)	0.00065	0.00064			
	Potassium (K)-Dissolved (mg/L)	0.540	0.615			
	Selenium (Se)-Dissolved (ug/L)	14.2	15.2			
	Silicon (Si)-Dissolved (mg/L)	1.80	1.82			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	1.72	1.95			
	Strontium (Sr)-Dissolved (mg/L)	0.259	0.276			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.00124	0.00133			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Selenium (Se)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L2503391-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The

Reference Information

carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-L-IC-N-CL Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL Water Electrical Conductivity (EC) APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL Water Ammonia, Total (as N) J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL Water Oxidation redution potential by elect. ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

Reference Information

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

RAEMP Sept 2020

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R5224717								
WG3405808-8 LCS								
Acidity (as CaCO3)			99.2		%		85-115	16-SEP-20
WG3405808-7 MB								
Acidity (as CaCO3)			1.7		mg/L		2	16-SEP-20
ALK-MAN-CL	**Water**							
Batch R5226926								
WG3406781-5 LCS								
Alkalinity, Total (as CaCO3)			100.2		%		85-115	17-SEP-20
WG3406781-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	17-SEP-20
BE-D-L-CCMS-VA	**Water**							
Batch R5230167								
WG3407100-2 LCS								
Beryllium (Be)-Dissolved			95.4		%		80-120	18-SEP-20
WG3407100-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	18-SEP-20
BE-T-L-CCMS-VA	**Water**							
Batch R5230865								
WG3407524-2 LCS								
Beryllium (Be)-Total			95.4		%		80-120	18-SEP-20
WG3407524-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	18-SEP-20
BR-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	16-SEP-20
WG3406632-2 LCS								
Bromide (Br)			106.1		%		85-115	16-SEP-20
WG3406632-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Bromide (Br)			95.3		%		75-125	16-SEP-20
C-DIS-ORG-LOW-CL	**Water**							
Batch R5230793								
WG3407917-3 DUP		**L2503391-9**						
Dissolved Organic Carbon		1.17	1.26		mg/L	7.4	20	18-SEP-20
WG3407917-2 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-LOW-CL	**Water**							
Batch R5230793								
WG3407917-2 LCS								
Dissolved Organic Carbon			104.8		%		80-120	18-SEP-20
WG3407917-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	18-SEP-20
WG3407917-4 MS		**L2503391-9**						
Dissolved Organic Carbon			85.4		%		70-130	18-SEP-20
Batch R5230829								
WG3408067-10 LCS								
Dissolved Organic Carbon			91.4		%		80-120	18-SEP-20
WG3408067-9 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	18-SEP-20
C-TOT-ORG-LOW-CL	**Water**							
Batch R5230793								
WG3407917-3 DUP		**L2503391-9**						
Total Organic Carbon		1.26	1.27		mg/L	0.5	20	18-SEP-20
WG3407917-2 LCS								
Total Organic Carbon			107.9		%		80-120	18-SEP-20
WG3407917-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	18-SEP-20
WG3407917-4 MS		**L2503391-9**						
Total Organic Carbon			87.1		%		70-130	18-SEP-20
Batch R5230829								
WG3408067-10 LCS								
Total Organic Carbon			113.5		%		80-120	18-SEP-20
WG3408067-9 MB								
Total Organic Carbon			<0.50		mg/L		0.5	18-SEP-20
CL-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Chloride (Cl)		2.38	2.28		mg/L	4.0	20	16-SEP-20
WG3406632-2 LCS								
Chloride (Cl)			100.4		%		85-115	16-SEP-20
WG3406632-1 MB								
Chloride (Cl)			<0.10		mg/L		0.1	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Chloride (Cl)			108.7		%		75-125	16-SEP-20
EC-L-PCT-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-L-PCT-CL	**Water**							
Batch R5226926								
WG3406781-5 LCS								
Conductivity (@ 25C)			94.2		%		90-110	17-SEP-20
WG3406781-4 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	17-SEP-20
F-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Fluoride (F)		0.153	0.153		mg/L	0.5	20	16-SEP-20
WG3406632-2 LCS								
Fluoride (F)			96.8		%		90-110	16-SEP-20
WG3406632-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Fluoride (F)			102.3		%		75-125	16-SEP-20
HG-D-CVAA-VA	**Water**							
Batch R5231716								
WG3408817-7 DUP		**L2503391-7**						
Mercury (Hg)-Dissolved		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	21-SEP-20
WG3408817-2 LCS								
Mercury (Hg)-Dissolved			98.6		%		80-120	21-SEP-20
WG3408817-6 LCS								
Mercury (Hg)-Dissolved			98.8		%		80-120	21-SEP-20
WG3408817-1 MB		**NP**						
Mercury (Hg)-Dissolved			<0.000005C		mg/L		0.000005	21-SEP-20
WG3408817-5 MB		**NP**						
Mercury (Hg)-Dissolved			<0.000005C		mg/L		0.000005	21-SEP-20
HG-T-U-CVAF-VA	**Water**							
Batch R5230988								
WG3408258-7 DUP		**L2503391-2**						
Mercury (Hg)-Total		<0.00050	<0.00050	RPD-NA	ug/L	N/A	20	19-SEP-20
WG3408258-2 LCS								
Mercury (Hg)-Total			98.4		%		80-120	19-SEP-20
WG3408258-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	19-SEP-20
WG3408258-8 MS		**L2503391-12**						
Mercury (Hg)-Total			97.2		%		70-130	19-SEP-20
MET-D-CCMS-VA	**Water**							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5230167								
WG3407100-2 LCS								
Aluminum (Al)-Dissolved			98.8		%		80-120	18-SEP-20
Antimony (Sb)-Dissolved			101.0		%		80-120	18-SEP-20
Arsenic (As)-Dissolved			96.2		%		80-120	18-SEP-20
Barium (Ba)-Dissolved			99.4		%		80-120	18-SEP-20
Bismuth (Bi)-Dissolved			106.9		%		80-120	18-SEP-20
Boron (B)-Dissolved			91.9		%		80-120	18-SEP-20
Cadmium (Cd)-Dissolved			99.4		%		80-120	18-SEP-20
Calcium (Ca)-Dissolved			101.2		%		80-120	18-SEP-20
Chromium (Cr)-Dissolved			95.7		%		80-120	18-SEP-20
Cobalt (Co)-Dissolved			96.4		%		80-120	18-SEP-20
Copper (Cu)-Dissolved			97.2		%		80-120	18-SEP-20
Iron (Fe)-Dissolved			89.9		%		80-120	18-SEP-20
Lead (Pb)-Dissolved			100.3		%		80-120	18-SEP-20
Lithium (Li)-Dissolved			97.7		%		80-120	18-SEP-20
Magnesium (Mg)-Dissolved			95.4		%		80-120	18-SEP-20
Manganese (Mn)-Dissolved			95.0		%		80-120	18-SEP-20
Molybdenum (Mo)-Dissolved			104.4		%		80-120	18-SEP-20
Nickel (Ni)-Dissolved			97.0		%		80-120	18-SEP-20
Potassium (K)-Dissolved			95.5		%		80-120	18-SEP-20
Selenium (Se)-Dissolved			103.9		%		80-120	18-SEP-20
Silicon (Si)-Dissolved			97.7		%		60-140	18-SEP-20
Silver (Ag)-Dissolved			105.1		%		80-120	18-SEP-20
Sodium (Na)-Dissolved			99.6		%		80-120	18-SEP-20
Strontium (Sr)-Dissolved			103.5		%		80-120	18-SEP-20
Thallium (Tl)-Dissolved			102.2		%		80-120	18-SEP-20
Tin (Sn)-Dissolved			98.1		%		80-120	18-SEP-20
Titanium (Ti)-Dissolved			92.9		%		80-120	18-SEP-20
Uranium (U)-Dissolved			100.2		%		80-120	18-SEP-20
Vanadium (V)-Dissolved			96.6		%		80-120	18-SEP-20
Zinc (Zn)-Dissolved			97.2		%		80-120	18-SEP-20
WG3407100-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	18-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5230167								
WG3407100-1 MB		**NP**						
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	18-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	18-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	18-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	18-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	18-SEP-20
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	18-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	18-SEP-20
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	18-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	18-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	18-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	18-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	18-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	18-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	18-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	18-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	18-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	18-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	18-SEP-20
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	18-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	18-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	18-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	18-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	18-SEP-20
MET-T-CCMS-VA	**Water**							
Batch R5230865								
WG3407524-2 LCS								
Aluminum (Al)-Total			99.6		%		80-120	18-SEP-20
Antimony (Sb)-Total			104.3		%		80-120	18-SEP-20
Arsenic (As)-Total			101.7		%		80-120	18-SEP-20
Barium (Ba)-Total			107.9		%		80-120	18-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5230865								
WG3407524-2 LCS								
Bismuth (Bi)-Total			102.5		%		80-120	18-SEP-20
Boron (B)-Total			96.1		%		80-120	18-SEP-20
Cadmium (Cd)-Total			102.7		%		80-120	18-SEP-20
Calcium (Ca)-Total			99.7		%		80-120	18-SEP-20
Chromium (Cr)-Total			103.0		%		80-120	18-SEP-20
Cobalt (Co)-Total			99.7		%		80-120	18-SEP-20
Copper (Cu)-Total			99.5		%		80-120	18-SEP-20
Iron (Fe)-Total			104.9		%		80-120	18-SEP-20
Lead (Pb)-Total			102.5		%		80-120	18-SEP-20
Lithium (Li)-Total			97.4		%		80-120	18-SEP-20
Magnesium (Mg)-Total			99.3		%		80-120	18-SEP-20
Manganese (Mn)-Total			100.3		%		80-120	18-SEP-20
Molybdenum (Mo)-Total			102.2		%		80-120	18-SEP-20
Nickel (Ni)-Total			99.5		%		80-120	18-SEP-20
Potassium (K)-Total			101.8		%		80-120	18-SEP-20
Selenium (Se)-Total			101.6		%		80-120	18-SEP-20
Silicon (Si)-Total			107.5		%		80-120	18-SEP-20
Silver (Ag)-Total			103.3		%		80-120	18-SEP-20
Sodium (Na)-Total			101.0		%		80-120	18-SEP-20
Strontium (Sr)-Total			105.5		%		80-120	18-SEP-20
Thallium (Tl)-Total			102.0		%		80-120	18-SEP-20
Tin (Sn)-Total			103.1		%		80-120	18-SEP-20
Titanium (Ti)-Total			95.6		%		80-120	18-SEP-20
Uranium (U)-Total			102.7		%		80-120	18-SEP-20
Vanadium (V)-Total			101.8		%		80-120	18-SEP-20
Zinc (Zn)-Total			97.9		%		80-120	18-SEP-20
WG3407524-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	18-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	18-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	18-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5230865								
WG3407524-1 MB								
Calcium (Ca)-Total			<0.050		mg/L		0.05	18-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	18-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	18-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	18-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	18-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	18-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	18-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	18-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	18-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	18-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	18-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	18-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	18-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	18-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	18-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	18-SEP-20
NH3-L-F-CL	**Water**							
Batch R5228422								
WG3406742-11 DUP		**L2503391-5**						
Ammonia as N		0.0100	0.0102		mg/L	2.0	20	17-SEP-20
WG3406742-10 LCS								
Ammonia as N			97.1		%		85-115	17-SEP-20
WG3406742-9 MB								
Ammonia as N			<0.0050		mg/L		0.005	17-SEP-20
WG3406742-12 MS		**L2503391-5**						
Ammonia as N			94.7		%		75-125	17-SEP-20
NO2-L-IC-N-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Nitrite (as N)		0.0018	0.0019		mg/L	5.4	20	16-SEP-20
WG3406632-2 LCS								
Nitrite (as N)			98.3		%		90-110	16-SEP-20
WG3406632-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Nitrite (as N)			108.5		%		75-125	16-SEP-20
NO3-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Nitrate (as N)		1.34	1.35		mg/L	1.0	20	16-SEP-20
WG3406632-2 LCS								
Nitrate (as N)			98.8		%		90-110	16-SEP-20
WG3406632-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Nitrate (as N)			106.0		%		75-125	16-SEP-20
ORP-CL	**Water**							
Batch R5225056								
WG3405837-2 CRM		**CL-ORP**						
ORP			220		mV		210-230	16-SEP-20
P-T-L-COL-CL	**Water**							
Batch R5230972								
WG3408145-7 DUP		**L2503391-12**						
Phosphorus (P)-Total		0.0041	0.0039		mg/L	5.2	20	19-SEP-20
WG3408145-10 LCS								
Phosphorus (P)-Total			99.5		%		80-120	19-SEP-20
WG3408145-6 LCS								
Phosphorus (P)-Total			97.6		%		80-120	19-SEP-20
WG3408145-5 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	19-SEP-20
WG3408145-9 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	19-SEP-20
WG3408145-8 MS		**L2503391-12**						
Phosphorus (P)-Total			116.1		%		70-130	19-SEP-20
PH-CL	**Water**							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-CL	**Water**							
Batch R5226926								
WG3406781-5 LCS								
pH			7.00		pH		6.9-7.1	17-SEP-20
PO4-DO-L-COL-CL	**Water**							
Batch R5224224								
WG3404933-6 LCS								
Orthophosphate-Dissolved (as P)			104.8		%		80-120	15-SEP-20
WG3404933-5 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	15-SEP-20
SO4-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-3 DUP		**L2503391-7**						
Sulfate (SO4)		117	118		mg/L	0.6	20	16-SEP-20
WG3406632-2 LCS								
Sulfate (SO4)			100.1		%		90-110	16-SEP-20
WG3406632-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	16-SEP-20
WG3406632-4 MS		**L2503391-7**						
Sulfate (SO4)			N/A	MS-B	%		-	16-SEP-20
SOLIDS-TDS-CL	**Water**							
Batch R5229601								
WG3406333-11 LCS								
Total Dissolved Solids			103.9		%		85-115	17-SEP-20
WG3406333-5 LCS								
Total Dissolved Solids			98.3		%		85-115	17-SEP-20
WG3406333-10 MB								
Total Dissolved Solids			<10		mg/L		10	17-SEP-20
WG3406333-4 MB								
Total Dissolved Solids			<10		mg/L		10	17-SEP-20
TKN-L-F-CL	**Water**							
Batch R5226059								
WG3406476-12 LCS								
Total Kjeldahl Nitrogen			104.7		%		75-125	17-SEP-20
WG3406476-2 LCS								
Total Kjeldahl Nitrogen			99.6		%		75-125	17-SEP-20
WG3406476-4 LCS								
Total Kjeldahl Nitrogen			106.0		%		75-125	17-SEP-20
WG3406476-6 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-L-F-CL	**Water**							
Batch R5226059								
WG3406476-6 LCS								
Total Kjeldahl Nitrogen			103.7		%		75-125	17-SEP-20
WG3406476-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-20
WG3406476-11 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-20
WG3406476-3 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-20
WG3406476-5 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-20
TSS-L-CL	**Water**							
Batch R5229505								
WG3406130-4 LCS								
Total Suspended Solids			93.1		%		85-115	17-SEP-20
WG3406130-8 LCS								
Total Suspended Solids			113.1		%		85-115	17-SEP-20
WG3406130-3 MB								
Total Suspended Solids			<1.0		mg/L		1	17-SEP-20
WG3406130-7 MB								
Total Suspended Solids			<1.0		mg/L		1	17-SEP-20
TURBIDITY-CL	**Water**							
Batch R5225305								
WG3405584-3 DUP		**L2503391-1**						
Turbidity		0.87	0.88		NTU	0.9	15	16-SEP-20
WG3405584-2 LCS								
Turbidity			99.0		%		85-115	16-SEP-20
WG3405584-1 MB								
Turbidity			<0.10		NTU		0.1	16-SEP-20

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	13-SEP-20 10:30	16-SEP-20 12:30	0.25	74	hours	EHTR-FM
	2	12-SEP-20 08:40	16-SEP-20 12:30	0.25	100	hours	EHTR-FM
	3	12-SEP-20 15:15	16-SEP-20 12:30	0.25	93	hours	EHTR-FM
	4	12-SEP-20 09:25	16-SEP-20 12:30	0.25	99	hours	EHTR-FM
	5	13-SEP-20 09:20	16-SEP-20 12:30	0.25	75	hours	EHTR-FM
	6	13-SEP-20 11:20	16-SEP-20 12:30	0.25	73	hours	EHTR-FM
	7	12-SEP-20 12:48	16-SEP-20 12:30	0.25	96	hours	EHTR-FM
	8	14-SEP-20 14:00	16-SEP-20 12:30	0.25	47	hours	EHTR-FM
	9	13-SEP-20 12:00	16-SEP-20 12:30	0.25	72	hours	EHTR-FM
	10	13-SEP-20 12:00	16-SEP-20 12:30	0.25	72	hours	EHTR-FM
	11	13-SEP-20 12:00	16-SEP-20 12:30	0.25	72	hours	EHTR-FM
	12	13-SEP-20 12:00	16-SEP-20 12:30	0.25	72	hours	EHTR-FM
Turbidity							
	2	12-SEP-20 08:40	16-SEP-20 06:45	3	4	days	EHTR
	3	12-SEP-20 15:15	16-SEP-20 06:45	3	4	days	EHTL
	4	12-SEP-20 09:25	16-SEP-20 06:45	3	4	days	EHTR
	7	12-SEP-20 12:48	16-SEP-20 06:45	3	4	days	EHTL
pH							
	1	13-SEP-20 10:30	17-SEP-20 14:00	0.25	100	hours	EHTR-FM
	2	12-SEP-20 08:40	17-SEP-20 14:00	0.25	125	hours	EHTR-FM
	3	12-SEP-20 15:15	17-SEP-20 14:00	0.25	119	hours	EHTR-FM
	4	12-SEP-20 09:25	17-SEP-20 14:00	0.25	125	hours	EHTR-FM
	5	13-SEP-20 09:20	17-SEP-20 14:00	0.25	101	hours	EHTR-FM
	6	13-SEP-20 11:20	17-SEP-20 14:00	0.25	99	hours	EHTR-FM
	7	12-SEP-20 12:48	17-SEP-20 14:00	0.25	121	hours	EHTR-FM
	8	14-SEP-20 14:00	17-SEP-20 14:00	0.25	72	hours	EHTR-FM
	9	13-SEP-20 12:00	17-SEP-20 14:00	0.25	98	hours	EHTR-FM
	10	13-SEP-20 12:00	17-SEP-20 14:00	0.25	98	hours	EHTR-FM
	11	13-SEP-20 12:00	17-SEP-20 14:00	0.25	98	hours	EHTR-FM
	12	13-SEP-20 12:00	17-SEP-20 14:00	0.25	98	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Water by IC (Low Level)							
	2	12-SEP-20 08:40	16-SEP-20 08:35	3	4	days	EHTR
	3	12-SEP-20 15:15	16-SEP-20 08:35	3	4	days	EHTL
	4	12-SEP-20 09:25	16-SEP-20 08:35	3	4	days	EHTR
	7	12-SEP-20 12:48	16-SEP-20 08:35	3	4	days	EHTL
Nitrite in Water by IC (Low Level)							
	2	12-SEP-20 08:40	16-SEP-20 08:35	3	4	days	EHTR
	3	12-SEP-20 15:15	16-SEP-20 08:35	3	4	days	EHTL
	4	12-SEP-20 09:25	16-SEP-20 08:35	3	4	days	EHTR
	7	12-SEP-20 12:48	16-SEP-20 08:35	3	4	days	EHTL

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2503391 were received on 15-SEP-20 10:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the

US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID: RAEMP Sept 2020

TURNAROUND TIME:

PROJECT/CLIENT INFO				LABORATORY			
Facility Name	REP			Lab Name	ALS Calgary		
Project Manager	Cait Good			Lab Contact	Lyudmyla Shvets		
Email	cait.good@teck.com			Email	lyudmyla.shvets@alsglobal.com		
Address	421 Pine Avenue			Address	2559 29 Street NE		
City	Sparwood	Province	BC	City	Calgary	Province	AB
Postal Code	V0B 2G0	Country	Canada	Postal Code	T1Y 7B5	Country	Canada
Phone Number	250-425-8202			Phone Number	1 403 407 1794		

	Excel	PDF	EDD
cait.good@teck.com	x	x	x
teckcoal@equisonline.com			x
Jings@minnow.ca	x	x	x
carlie.meyer@teck.com	x	x	x
sweech@minnow.ca	x	x	x

PO number: 689999

L2503391-COFC

SAMPLE DETAILS / ANALYSIS REQUESTED

Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	TECKCOAL-ROUTINE-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-T-U-CVAF-VA	HG-D-CVAF-VA	TECKCOAL-MET-T-VA	TECKCOAL-MET-D-VA
FILTERED								N	F	N	N	F	N	F
PRESERVATIVE									H2SO4	H2SO4		HCL	HNO3	HNO3
RG_EL1_WS_RAEMP_2020-09_NP	RG_EL1	WS	No	9/13/2020	10:30	G	7	1	1	1	1	1	1	1
RG_ELDFE_WS_RAEMP_2020-09_NP	RG_ELDFE	WS	No	9/12/2020	8:40	G	7	1	1	1	1	1	1	1
RG_UCWER_WS_LAEMP_GHO_2020-09_NP	RG_UCWER	WS	No	9/12/2020	15:15	G	7	1	1	1	1	1	1	1
RG_FODGH_WS_LAEMP_GHO_2020-09_NP	RG_FODGH	WS	No	9/12/2020	9:25	G	7	1	1	1	1	1	1	1
RG_GRDS_WS_RAEMP_2020-09_NP	RG_GRDS	WS	No	9/13/2020	9:20	G	7	1	1	1	1	1	1	1
RG_BACK_WS_RAEMP_2020-09_NP	RG_BACK	WS	No	9/13/2020	11:20	G	7	1	1	1	1	1	1	1
RG_MIDBO_WS_RAEMP_2020-09_NP	RG_MIDBO	WS	No	9/12/2020	12:48	G	7	1	1	1	1	1	1	1
RG_ELUEL_WS_LAEMP_GHO_2020-09_NP	RG_ELUEL	WS	No	9/14/2020	14:00	G	7	1	1	1	1	1	1	1

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
	Jennifer Ings	September 14, 2020		9/15/2020

NB OF BOTTLES RETURNED/DESCRIPTION					
Regular (default)	x	Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Priority (2-3 business days) - 50% surcharge		Sampler's Signature		Date/Time	September 14, 2020
Emergency (1 Business Day) - 100% surcharge					
For Emergency <1 Day, ASAP or Weekend - Contact ALS					

4

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 16-SEP-20
Report Date: 19-JAN-21 17:13 (MT)
Version: FINAL REV. 2

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2504022

Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: GHO LAEMP Sept 2020
Legal Site Desc:

Comments:
19-JAN-2021 Alkalinity (Species) result revised on L2504022-1 to -4.

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2504022-1	L2504022-2	L2504022-3	L2504022-4	
	Description	WS	WS	WS	WS	
	Sampled Date	15-SEP-20	15-SEP-20	15-SEP-20	15-SEP-20	
	Sampled Time	14:30	14:30	14:30	14:30	
	Client ID	RG_EL20_WS_LAEMP_GHO_2020-09_NP	RG_RIVER_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK2_WS_LAEMP_GHO_2020-09_NP	RG_TRIP2_WS_LAEMP_GHO_2020-09_NP	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	298	297	<2.0	<2.0	
	Hardness (as CaCO3) (mg/L)	171	165	<0.50		
	pH (pH)	8.32	8.18	5.50	5.54	
	ORP (mV)	419	329	358	391	
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Total Dissolved Solids (mg/L)	190 DLHC	183 DLHC	<10	<10	
	Turbidity (NTU)	0.50	0.11	<0.10	<0.10	
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.6	<1.0	1.8	
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	148	<1.0	<1.0	<1.0	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	1.6	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	150	<1.0	<1.0	<1.0	
	Ammonia as N (mg/L)	0.0095	0.0056	0.0147 RRV	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.32	0.31	<0.10	<0.10	
	Fluoride (F) (mg/L)	0.150	0.146	<0.020	<0.020	
	Ion Balance (%)	96.2	93.5	0.0	0.0	
	Nitrate (as N) (mg/L)	0.398	0.393	<0.0050	<0.0050	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Orthophosphate-Dissolved (as P) (mg/L)	0.0013	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Sulfate (SO4) (mg/L)	27.3	27.0	<0.30	<0.30	
	Anion Sum (meq/L)	3.61	3.59	<0.10	<0.10	
	Cation Sum (meq/L)	3.47	3.36	<0.10	<0.10	
	Cation - Anion Balance (%)	-2.0	-3.3	0.0	0.0	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	<0.50	<0.50	<0.50		
	Total Organic Carbon (mg/L)	<0.50	<0.50	<0.50	<0.50	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0056	0.0066	<0.0030	<0.0030	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	<0.00010	0.00018	<0.00010	<0.00010	
	Barium (Ba)-Total (mg/L)	0.0570	0.0552	<0.00010	<0.00010	
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Total (ug/L)	0.0087	0.0071	<0.0050	<0.0050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2504022-1	L2504022-2	L2504022-3	L2504022-4
	Description	WS	WS	WS	WS
	Sampled Date	15-SEP-20	15-SEP-20	15-SEP-20	15-SEP-20
	Sampled Time	14:30	14:30	14:30	14:30
	Client ID	RG_EL20_WS_LAEMP_GHO_2020-09_NP	RG_RIVER_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK2_WS_LAEMP_GHO_2020-09_NP	RG_TRIP2_WS_LAEMP_GHO_2020-09_NP
Grouping	**Analyte**				
WATER					
Total Metals	Calcium (Ca)-Total (mg/L)	50.1	47.4	<0.050	<0.050
	Chromium (Cr)-Total (mg/L)	0.00024	0.00023	<0.00010	<0.00010
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0030	0.0028	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	11.3	12.4	<0.10	<0.10
	Manganese (Mn)-Total (mg/L)	0.00115	0.00116	<0.00010	<0.00010
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.00124	0.00110	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Total (mg/L)	0.418	0.430	<0.050	<0.050
	Selenium (Se)-Total (ug/L)	2.03	1.70	<0.050	<0.050
	Silicon (Si)-Total (mg/L)	1.99	2.06	<0.10	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.948	0.928	<0.050	<0.050
	Strontium (Sr)-Total (mg/L)	0.209	0.216	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.000711	0.000785	<0.000010	<0.000010
	Vanadium (V)-Total (mg/L)	<0.00050	0.00069	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	
	Barium (Ba)-Dissolved (mg/L)	0.0554	0.0560	<0.00010	
	Beryllium (Be)-Dissolved (ug/L)	<0.020	<0.020	<0.020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (ug/L)	0.0072	0.0069	<0.0050	
	Calcium (Ca)-Dissolved (mg/L)	48.9	46.5	<0.050	<0.050
	Chromium (Cr)-Dissolved (mg/L)	0.00022	0.00022	<0.00010	
	Cobalt (Co)-Dissolved (ug/L)	<0.10	<0.10	<0.10	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2504022-1	L2504022-2	L2504022-3	L2504022-4	
	Description	WS	WS	WS	WS	
	Sampled Date	15-SEP-20	15-SEP-20	15-SEP-20	15-SEP-20	
	Sampled Time	14:30	14:30	14:30	14:30	
	Client ID	RG_EL20_WS_LAEMP_GHO_2020-09_NP	RG_RIVER_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK2_WS_LAEMP_GHO_2020-09_NP	RG_TRIP2_WS_LAEMP_GHO_2020-09_NP	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0031	0.0027	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)	11.8	12.0	<0.10	<0.0050	
	Manganese (Mn)-Dissolved (mg/L)	0.00069	0.00070	<0.00010		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00118	0.00107	<0.000050		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Potassium (K)-Dissolved (mg/L)	0.432	0.421	<0.050	<0.050	
	Selenium (Se)-Dissolved (ug/L)	1.80	1.72	<0.050		
	Silicon (Si)-Dissolved (mg/L)	1.93	1.92	<0.050		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	0.998	0.910	<0.050	<0.050	
	Strontium (Sr)-Dissolved (mg/L)	0.211	0.208	<0.00020		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.000762	0.000775	<0.000010		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0040	<0.0010	<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Beryllium (Be)-Total	MES	L2504022-2, -3
Laboratory Control Sample	Antimony (Sb)-Total	MES	L2504022-2, -3
Laboratory Control Sample	Lithium (Li)-Total	MES	L2504022-2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L2504022-1, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2504022-1, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2504022-2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2504022-1, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2504022-2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2504022-2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2504022-1, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2504022-2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by

Reference Information

subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-L-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL	Water	Electrical Conductivity (EC)	APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL	Water	Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

Reference Information

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GHO LAEMP Sept 2020

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R5229719								
WG3407723-5 LCS								
Acidity (as CaCO3)			102.4		%		85-115	18-SEP-20
WG3407723-4 MB								
Acidity (as CaCO3)			1.7		mg/L		2	18-SEP-20
ALK-MAN-CL	**Water**							
Batch R5229761								
WG3407727-11 LCS								
Alkalinity, Total (as CaCO3)			101.6		%		85-115	18-SEP-20
WG3407727-10 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-SEP-20
BE-D-L-CCMS-VA	**Water**							
Batch R5231479								
WG3407962-3 DUP		**L2504022-1**						
Beryllium (Be)-Dissolved		<0.000020	<0.000020	RPD-NA	mg/L	N/A	20	19-SEP-20
WG3407962-2 LCS								
Beryllium (Be)-Dissolved			103.7		%		80-120	19-SEP-20
WG3407962-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	19-SEP-20
Batch R5232289								
WG3409357-2 LCS								
Beryllium (Be)-Dissolved			92.7		%		80-120	22-SEP-20
WG3409357-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	22-SEP-20
BE-T-L-CCMS-VA	**Water**							
Batch R5231746								
WG3407895-2 LCS								
Beryllium (Be)-Total			97.4		%		80-120	21-SEP-20
WG3407895-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	21-SEP-20
WG3407895-4 MS		**L2504022-1**						
Beryllium (Be)-Total			102.2		%		70-130	21-SEP-20
Batch R5232289								
WG3409293-2 LCS								
Beryllium (Be)-Total			120.7	MES	%		80-120	22-SEP-20
WG3409293-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	22-SEP-20
BR-L-IC-N-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BR-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Bromide (Br)			112.0		%		85-115	16-SEP-20
WG3406632-9 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-SEP-20
C-DIS-ORG-LOW-CL	**Water**							
Batch R5231450								
WG3408396-2 LCS								
Dissolved Organic Carbon			109.1		%		80-120	19-SEP-20
WG3408396-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	19-SEP-20
C-TOT-ORG-LOW-CL	**Water**							
Batch R5231450								
WG3408396-2 LCS								
Total Organic Carbon			115.6		%		80-120	19-SEP-20
WG3408396-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	19-SEP-20
CL-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Chloride (Cl)			100.7		%		85-115	16-SEP-20
WG3406632-9 MB								
Chloride (Cl)			<0.10		mg/L		0.1	16-SEP-20
EC-L-PCT-CL	**Water**							
Batch R5229761								
WG3407727-11 LCS								
Conductivity (@ 25C)			93.7		%		90-110	18-SEP-20
WG3407727-10 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	18-SEP-20
F-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Fluoride (F)			95.7		%		90-110	16-SEP-20
WG3406632-9 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-SEP-20
HG-D-CVAA-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-D-CVAA-VA	**Water**							
Batch R5231937								
WG3409373-2 LCS								
Mercury (Hg)-Dissolved			98.0		%		80-120	22-SEP-20
WG3409373-1 MB		**NP**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	22-SEP-20
WG3409373-4 MS		**L2504022-2**						
Mercury (Hg)-Dissolved			97.6		%		70-130	22-SEP-20
HG-T-U-CVAF-VA	**Water**							
Batch R5231644								
WG3409074-6 DUP		**L2504022-2**						
Mercury (Hg)-Total		<0.00050	<0.00050	RPD-NA	ug/L	N/A	20	21-SEP-20
WG3409074-2 LCS								
Mercury (Hg)-Total			90.4		%		80-120	21-SEP-20
WG3409074-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	21-SEP-20
MET-D-CCMS-CL	**Water**							
Batch R5226619								
WG3407012-2 LCS		**TMRM**						
Calcium (Ca)-Dissolved			102.1		%		80-120	17-SEP-20
Magnesium (Mg)-Dissolved			103.7		%		80-120	17-SEP-20
Potassium (K)-Dissolved			101.9		%		80-120	17-SEP-20
Sodium (Na)-Dissolved			99.96		%		80-120	17-SEP-20
WG3407012-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	17-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	17-SEP-20
MET-D-CCMS-VA	**Water**							
Batch R5231479								
WG3407962-3 DUP		**L2504022-1**						
Aluminum (Al)-Dissolved		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	19-SEP-20
Antimony (Sb)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	19-SEP-20
Arsenic (As)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	19-SEP-20
Barium (Ba)-Dissolved		0.0554	0.0556		mg/L	0.3	20	19-SEP-20
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	19-SEP-20
Boron (B)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	19-SEP-20
Cadmium (Cd)-Dissolved		0.0000072	<0.0000050	RPD-NA	mg/L	N/A	20	19-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5231479								
WG3407962-3 DUP		**L2504022-1**						
Calcium (Ca)-Dissolved		48.9	49.5		mg/L	1.2	20	19-SEP-20
Chromium (Cr)-Dissolved		0.00022	0.00023		mg/L	1.2	20	19-SEP-20
Cobalt (Co)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	19-SEP-20
Copper (Cu)-Dissolved		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	19-SEP-20
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	19-SEP-20
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	19-SEP-20
Lithium (Li)-Dissolved		0.0031	0.0031		mg/L	0.8	20	19-SEP-20
Magnesium (Mg)-Dissolved		11.8	11.6		mg/L	1.7	20	19-SEP-20
Manganese (Mn)-Dissolved		0.00069	0.00076		mg/L	11	20	19-SEP-20
Molybdenum (Mo)-Dissolved		0.00118	0.00117		mg/L	0.3	20	19-SEP-20
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	19-SEP-20
Potassium (K)-Dissolved		0.432	0.418		mg/L	3.4	20	19-SEP-20
Selenium (Se)-Dissolved		0.00180	0.00175		mg/L	3.1	20	19-SEP-20
Silicon (Si)-Dissolved		1.93	1.90		mg/L	1.2	20	19-SEP-20
Silver (Ag)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	19-SEP-20
Sodium (Na)-Dissolved		0.998	0.947		mg/L	5.3	20	19-SEP-20
Strontium (Sr)-Dissolved		0.211	0.222		mg/L	5.0	20	19-SEP-20
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	19-SEP-20
Tin (Sn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	19-SEP-20
Titanium (Ti)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	19-SEP-20
Uranium (U)-Dissolved		0.000762	0.000732		mg/L	4.1	20	19-SEP-20
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	19-SEP-20
Zinc (Zn)-Dissolved		0.0040	0.0037		mg/L	6.4	20	19-SEP-20
WG3407962-2 LCS								
Aluminum (Al)-Dissolved			101.4		%		80-120	19-SEP-20
Antimony (Sb)-Dissolved			104.2		%		80-120	19-SEP-20
Arsenic (As)-Dissolved			99.6		%		80-120	19-SEP-20
Barium (Ba)-Dissolved			106.4		%		80-120	19-SEP-20
Bismuth (Bi)-Dissolved			96.4		%		80-120	19-SEP-20
Boron (B)-Dissolved			105.6		%		80-120	19-SEP-20
Cadmium (Cd)-Dissolved			98.9		%		80-120	19-SEP-20
Calcium (Ca)-Dissolved			106.6		%		80-120	19-SEP-20
Chromium (Cr)-Dissolved			103.3		%		80-120	19-SEP-20
Cobalt (Co)-Dissolved			98.7		%		80-120	19-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5231479								
WG3407962-2 LCS								
Copper (Cu)-Dissolved			97.4		%		80-120	19-SEP-20
Iron (Fe)-Dissolved			98.9		%		80-120	19-SEP-20
Lead (Pb)-Dissolved			100.6		%		80-120	19-SEP-20
Lithium (Li)-Dissolved			110.0		%		80-120	19-SEP-20
Magnesium (Mg)-Dissolved			97.0		%		80-120	19-SEP-20
Manganese (Mn)-Dissolved			100.3		%		80-120	19-SEP-20
Molybdenum (Mo)-Dissolved			106.3		%		80-120	19-SEP-20
Nickel (Ni)-Dissolved			99.2		%		80-120	19-SEP-20
Potassium (K)-Dissolved			102.2		%		80-120	19-SEP-20
Selenium (Se)-Dissolved			97.6		%		80-120	19-SEP-20
Silicon (Si)-Dissolved			103.2		%		60-140	19-SEP-20
Silver (Ag)-Dissolved			108.9		%		80-120	19-SEP-20
Sodium (Na)-Dissolved			101.8		%		80-120	19-SEP-20
Strontium (Sr)-Dissolved			117.8		%		80-120	19-SEP-20
Thallium (Tl)-Dissolved			99.5		%		80-120	19-SEP-20
Tin (Sn)-Dissolved			101.8		%		80-120	19-SEP-20
Titanium (Ti)-Dissolved			92.9		%		80-120	19-SEP-20
Uranium (U)-Dissolved			101.6		%		80-120	19-SEP-20
Vanadium (V)-Dissolved			100.1		%		80-120	19-SEP-20
Zinc (Zn)-Dissolved			97.9		%		80-120	19-SEP-20
WG3407962-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	19-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	19-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	19-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	19-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	19-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	19-SEP-20
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	19-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	19-SEP-20

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5231479								
WG3407962-1 MB		**NP**						
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	19-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	19-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	19-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	19-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	19-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	19-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	19-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	19-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	19-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	19-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	19-SEP-20
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	19-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	19-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	19-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	19-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	19-SEP-20
Batch R5232289								
WG3409357-2 LCS								
Aluminum (Al)-Dissolved			103.1		%		80-120	22-SEP-20
Antimony (Sb)-Dissolved			103.4		%		80-120	22-SEP-20
Arsenic (As)-Dissolved			101.9		%		80-120	22-SEP-20
Barium (Ba)-Dissolved			103.1		%		80-120	22-SEP-20
Bismuth (Bi)-Dissolved			106.7		%		80-120	22-SEP-20
Boron (B)-Dissolved			91.6		%		80-120	22-SEP-20
Cadmium (Cd)-Dissolved			101.1		%		80-120	22-SEP-20
Calcium (Ca)-Dissolved			100.3		%		80-120	22-SEP-20
Chromium (Cr)-Dissolved			102.0		%		80-120	22-SEP-20
Cobalt (Co)-Dissolved			102.7		%		80-120	22-SEP-20
Copper (Cu)-Dissolved			100.7		%		80-120	22-SEP-20
Iron (Fe)-Dissolved			106.1		%		80-120	22-SEP-20
Lead (Pb)-Dissolved			104.2		%		80-120	22-SEP-20
Lithium (Li)-Dissolved			92.9		%		80-120	22-SEP-20
Magnesium (Mg)-Dissolved			104.2		%		80-120	22-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5232289								
WG3409357-2 LCS								
Manganese (Mn)-Dissolved			102.2		%		80-120	22-SEP-20
Molybdenum (Mo)-Dissolved			98.9		%		80-120	22-SEP-20
Nickel (Ni)-Dissolved			99.4		%		80-120	22-SEP-20
Potassium (K)-Dissolved			105.6		%		80-120	22-SEP-20
Selenium (Se)-Dissolved			101.9		%		80-120	22-SEP-20
Silicon (Si)-Dissolved			99.3		%		60-140	22-SEP-20
Silver (Ag)-Dissolved			104.5		%		80-120	22-SEP-20
Sodium (Na)-Dissolved			102.4		%		80-120	22-SEP-20
Strontium (Sr)-Dissolved			104.9		%		80-120	22-SEP-20
Thallium (Tl)-Dissolved			104.5		%		80-120	22-SEP-20
Tin (Sn)-Dissolved			100.3		%		80-120	22-SEP-20
Titanium (Ti)-Dissolved			101.3		%		80-120	22-SEP-20
Uranium (U)-Dissolved			105.0		%		80-120	22-SEP-20
Vanadium (V)-Dissolved			103.3		%		80-120	22-SEP-20
Zinc (Zn)-Dissolved			103.6		%		80-120	22-SEP-20
WG3409357-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	22-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	22-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	22-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	22-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	22-SEP-20
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	22-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	22-SEP-20
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	22-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	22-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	22-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	22-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5232289								
WG3409357-1 MB		**NP**						
Potassium (K)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	22-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	22-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	22-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	22-SEP-20
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	22-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	22-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	22-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	22-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	22-SEP-20
MET-T-CCMS-VA	**Water**							
Batch R5231746								
WG3407895-2 LCS								
Aluminum (Al)-Total			100.2		%		80-120	21-SEP-20
Antimony (Sb)-Total			100.0		%		80-120	21-SEP-20
Arsenic (As)-Total			95.7		%		80-120	21-SEP-20
Barium (Ba)-Total			102.4		%		80-120	21-SEP-20
Bismuth (Bi)-Total			97.6		%		80-120	21-SEP-20
Boron (B)-Total			97.3		%		80-120	21-SEP-20
Cadmium (Cd)-Total			103.7		%		80-120	21-SEP-20
Calcium (Ca)-Total			102.2		%		80-120	21-SEP-20
Chromium (Cr)-Total			101.7		%		80-120	21-SEP-20
Cobalt (Co)-Total			99.7		%		80-120	21-SEP-20
Copper (Cu)-Total			97.5		%		80-120	21-SEP-20
Iron (Fe)-Total			97.3		%		80-120	21-SEP-20
Lead (Pb)-Total			96.7		%		80-120	21-SEP-20
Lithium (Li)-Total			98.8		%		80-120	21-SEP-20
Magnesium (Mg)-Total			90.7		%		80-120	21-SEP-20
Manganese (Mn)-Total			105.7		%		80-120	21-SEP-20
Molybdenum (Mo)-Total			93.0		%		80-120	21-SEP-20
Nickel (Ni)-Total			99.99		%		80-120	21-SEP-20
Potassium (K)-Total			102.8		%		80-120	21-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5231746								
WG3407895-2 LCS								
Selenium (Se)-Total			100.3		%		80-120	21-SEP-20
Silicon (Si)-Total			97.0		%		80-120	21-SEP-20
Silver (Ag)-Total			98.1		%		80-120	21-SEP-20
Sodium (Na)-Total			102.3		%		80-120	21-SEP-20
Strontium (Sr)-Total			102.0		%		80-120	21-SEP-20
Thallium (Tl)-Total			100.0		%		80-120	21-SEP-20
Tin (Sn)-Total			94.8		%		80-120	21-SEP-20
Titanium (Ti)-Total			98.5		%		80-120	21-SEP-20
Uranium (U)-Total			94.6		%		80-120	21-SEP-20
Vanadium (V)-Total			100.5		%		80-120	21-SEP-20
Zinc (Zn)-Total			101.2		%		80-120	21-SEP-20
WG3407895-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	21-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	21-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	21-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	21-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	21-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	21-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	21-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	21-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	21-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	21-SEP-20

Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5231746								
WG3407895-1 MB								
Sodium (Na)-Total			<0.050		mg/L		0.05	21-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	21-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	21-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	21-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	21-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	21-SEP-20
WG3407895-4 MS		**L2504022-1**						
Aluminum (Al)-Total			97.3		%		70-130	21-SEP-20
Antimony (Sb)-Total			100.8		%		70-130	21-SEP-20
Arsenic (As)-Total			96.1		%		70-130	21-SEP-20
Barium (Ba)-Total			N/A	MS-B	%		-	21-SEP-20
Bismuth (Bi)-Total			94.0		%		70-130	21-SEP-20
Boron (B)-Total			102.1		%		70-130	21-SEP-20
Cadmium (Cd)-Total			101.0		%		70-130	21-SEP-20
Calcium (Ca)-Total			N/A	MS-B	%		-	21-SEP-20
Chromium (Cr)-Total			98.8		%		70-130	21-SEP-20
Cobalt (Co)-Total			95.0		%		70-130	21-SEP-20
Copper (Cu)-Total			92.5		%		70-130	21-SEP-20
Iron (Fe)-Total			94.4		%		70-130	21-SEP-20
Lead (Pb)-Total			93.3		%		70-130	21-SEP-20
Lithium (Li)-Total			102.2		%		70-130	21-SEP-20
Magnesium (Mg)-Total			N/A	MS-B	%		-	21-SEP-20
Manganese (Mn)-Total			99.7		%		70-130	21-SEP-20
Molybdenum (Mo)-Total			100.9		%		70-130	21-SEP-20
Nickel (Ni)-Total			93.9		%		70-130	21-SEP-20
Potassium (K)-Total			102.8		%		70-130	21-SEP-20
Selenium (Se)-Total			102.1		%		70-130	21-SEP-20
Silicon (Si)-Total			90.3		%		70-130	21-SEP-20
Silver (Ag)-Total			100.9		%		70-130	21-SEP-20
Sodium (Na)-Total			102.4		%		70-130	21-SEP-20
Strontium (Sr)-Total			N/A	MS-B	%		-	21-SEP-20
Thallium (Tl)-Total			92.9		%		70-130	21-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5231746								
WG3407895-4 MS		**L2504022-1**						
Tin (Sn)-Total			99.7		%		70-130	21-SEP-20
Titanium (Ti)-Total			99.5		%		70-130	21-SEP-20
Uranium (U)-Total			96.3		%		70-130	21-SEP-20
Vanadium (V)-Total			99.9		%		70-130	21-SEP-20
Zinc (Zn)-Total			97.9		%		70-130	21-SEP-20
Batch R5232289								
WG3409293-2 LCS								
Aluminum (Al)-Total			108.3		%		80-120	22-SEP-20
Antimony (Sb)-Total			120.3	MES	%		80-120	22-SEP-20
Arsenic (As)-Total			105.8		%		80-120	22-SEP-20
Barium (Ba)-Total			107.5		%		80-120	22-SEP-20
Bismuth (Bi)-Total			110.7		%		80-120	22-SEP-20
Boron (B)-Total			94.3		%		80-120	22-SEP-20
Cadmium (Cd)-Total			110.9		%		80-120	22-SEP-20
Calcium (Ca)-Total			107.3		%		80-120	22-SEP-20
Chromium (Cr)-Total			105.9		%		80-120	22-SEP-20
Cobalt (Co)-Total			104.7		%		80-120	22-SEP-20
Copper (Cu)-Total			104.0		%		80-120	22-SEP-20
Iron (Fe)-Total			103.7		%		80-120	22-SEP-20
Lead (Pb)-Total			112.7		%		80-120	22-SEP-20
Lithium (Li)-Total			120.1	MES	%		80-120	22-SEP-20
Magnesium (Mg)-Total			109.8		%		80-120	22-SEP-20
Manganese (Mn)-Total			105.0		%		80-120	22-SEP-20
Molybdenum (Mo)-Total			106.7		%		80-120	22-SEP-20
Nickel (Ni)-Total			102.8		%		80-120	22-SEP-20
Potassium (K)-Total			111.3		%		80-120	22-SEP-20
Selenium (Se)-Total			103.1		%		80-120	22-SEP-20
Silicon (Si)-Total			102.7		%		80-120	22-SEP-20
Silver (Ag)-Total			118.7		%		80-120	22-SEP-20
Sodium (Na)-Total			104.9		%		80-120	22-SEP-20
Strontium (Sr)-Total			114.7		%		80-120	22-SEP-20
Thallium (Tl)-Total			113.8		%		80-120	22-SEP-20
Tin (Sn)-Total			108.9		%		80-120	22-SEP-20
Titanium (Ti)-Total			103.3		%		80-120	22-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5232289								
WG3409293-2 LCS								
Uranium (U)-Total			112.2		%		80-120	22-SEP-20
Vanadium (V)-Total			106.2		%		80-120	22-SEP-20
Zinc (Zn)-Total			109.5		%		80-120	22-SEP-20
WG3409293-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	22-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	22-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	22-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	22-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	22-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	22-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	22-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	22-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	22-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	22-SEP-20
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	22-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	22-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	22-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	22-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	22-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	22-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	22-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	22-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	22-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	22-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	22-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	22-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	22-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5233287								
WG3409293-1 MB								
Vanadium (V)-Total			<0.00050		mg/L		0.0005	23-SEP-20
NH3-L-F-CL	**Water**							
Batch R5229599								
WG3407646-22 LCS								
Ammonia as N			106.0		%		85-115	18-SEP-20
WG3407646-21 MB								
Ammonia as N			<0.0050		mg/L		0.005	18-SEP-20
NO2-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Nitrite (as N)			101.2		%		90-110	16-SEP-20
WG3406632-9 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-SEP-20
NO3-L-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Nitrate (as N)			99.0		%		90-110	16-SEP-20
WG3406632-9 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-SEP-20
ORP-CL	**Water**							
Batch R5228156								
WG3407057-2 CRM		**CL-ORP**						
ORP			222		mV		210-230	17-SEP-20
P-T-L-COL-CL	**Water**							
Batch R5230972								
WG3408145-19 DUP		**L2504022-4**						
Phosphorus (P)-Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	19-SEP-20
WG3408145-18 LCS								
Phosphorus (P)-Total			98.0		%		80-120	19-SEP-20
WG3408145-17 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	19-SEP-20
WG3408145-20 MS		**L2504022-4**						
Phosphorus (P)-Total			77.3		%		70-130	19-SEP-20
PH-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-CL	**Water**							
Batch R5229761								
WG3407727-11 LCS								
pH			6.98		pH		6.9-7.1	18-SEP-20
PO4-DO-L-COL-CL	**Water**							
Batch R5226819								
WG3405836-6 LCS								
Orthophosphate-Dissolved (as P)			107.0		%		80-120	16-SEP-20
WG3405836-5 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	16-SEP-20
WG3405836-18 MS		**L2504022-3**						
Orthophosphate-Dissolved (as P)			106.1		%		70-130	16-SEP-20
SO4-IC-N-CL	**Water**							
Batch R5226660								
WG3406632-10 LCS								
Sulfate (SO4)			100.4		%		90-110	16-SEP-20
WG3406632-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	16-SEP-20
SOLIDS-TDS-CL	**Water**							
Batch R5232371								
WG3408576-2 LCS								
Total Dissolved Solids			101.3		%		85-115	21-SEP-20
WG3408576-1 MB								
Total Dissolved Solids			<10		mg/L		10	21-SEP-20
TKN-L-F-CL	**Water**							
Batch R5228968								
WG3407350-2 LCS								
Total Kjeldahl Nitrogen			95.1		%		75-125	18-SEP-20
WG3407350-4 LCS								
Total Kjeldahl Nitrogen			117.8		%		75-125	19-SEP-20
WG3407350-6 LCS								
Total Kjeldahl Nitrogen			100.4		%		75-125	19-SEP-20
WG3407350-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	18-SEP-20
WG3407350-3 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	19-SEP-20
TSS-L-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TSS-L-CL	**Water**							
Batch R5231562								
WG3408575-2 LCS								
Total Suspended Solids			90.1		%		85-115	21-SEP-20
WG3408575-1 MB								
Total Suspended Solids			<1.0		mg/L		1	21-SEP-20
TURBIDITY-CL	**Water**							
Batch R5228150								
WG3406697-3 LCS								
Turbidity			98.5		%		85-115	17-SEP-20
WG3406697-2 MB								
Turbidity			<0.10		NTU		0.1	17-SEP-20

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	15-SEP-20 14:30	17-SEP-20 12:15	0.25	46	hours	EHTR-FM
	2	15-SEP-20 14:30	17-SEP-20 12:15	0.25	46	hours	EHTR-FM
	3	15-SEP-20 14:30	17-SEP-20 12:15	0.25	46	hours	EHTR-FM
	4	15-SEP-20 14:30	17-SEP-20 12:15	0.25	46	hours	EHTR-FM
pH							
	1	15-SEP-20 14:30	18-SEP-20 14:00	0.25	72	hours	EHTR-FM
	2	15-SEP-20 14:30	18-SEP-20 14:00	0.25	72	hours	EHTR-FM
	3	15-SEP-20 14:30	18-SEP-20 14:00	0.25	72	hours	EHTR-FM
	4	15-SEP-20 14:30	18-SEP-20 14:00	0.25	72	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2504022 were received on 16-SEP-20 08:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	GHO LAEMP Sept 2020	TURNAROUND TIME:	

PROJECT/CLIENT INFO

Facility Name	REP		
Project Manager	Cait Good		
Email	cait.good@teck.com		
Address	421 Pine Avenue		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

LABORATORY

Lab Name	ALS Calgary		
Lab Contact	Lyudmyla Shvets		
Email	lyudmyla.shvets@alsglobal.com		
Address	2559 29 Street NE		
City	Calgary	Province	AB
Postal Code	T1Y 7B5	Country	Canada
Phone Number	1 403 407 1794		

	Excel	PDF	EDD
cait.good@teck.com	x	x	x
teckcoal@equisonline.com			x
jings@minnow.ca	x	x	x
carlie.meyer@teck.com	x	x	x
jtester@minnow.ca	x	x	x

PO number: 689999

SAMPLE DETAILS / **ANALYSIS REQUESTED**

Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

L2504022-COFC

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	TECKCOAL-ROUTINE-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-T-U-CVAF-VA	HG-D-CVAF-VA	TECKCOAL-MET-T-VA	TECKCOAL-MET-D-VA
Filtered								N	F	N	N	F	N	F
Preserved									H2SO4	H2SO4		HCL	HNO3	HNO3
RG_EL20_WS_LAEMP_GHO_2020-09_NP	RG_EL20	WS	No	9/15/2020	14:30	G	7	1	1	1	1	1	1	1
RG_RIVER_WS_LAEMP_GHO_2020-09_NP	RG_RIVER	WS	No	9/15/2020	14:30	G	7	1	1	1	1	1	1	1
RG_FBLANK2_WS_LAEMP_GHO_2020-09_NP	RG_FBLANK	WS	No	9/15/2020	14:30	G	7	1	1	1	1	1	1	1
RG_TRIP2 _WS_LAEMP_GHO_2020-09_NP	RG_TRIP	WS	No	9/15/2020	14:30	G	7	1		1	1		1	

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	
	Jennifer Ings	September 14, 2020		9/16 8:50

NB OF BOTTLES RETURNED/DESCRIPTION					
Regular (default)	x	Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Priority (2-3 business days) - 50% surcharge		Sampler's Signature		Date/Time	September 15 2020
Emergency (1 Business Day) - 100% surcharge					
For Emergency <1 Day, ASAP or Weekend - Contact ALS					

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 18-SEP-20
Report Date: 25-SEP-20 10:57 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2505298

Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: GHO LAEMP Sept 2020
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505298-1	L2505298-2			
	Description	WS	WS			
	Sampled Date	17-SEP-20	17-SEP-20			
	Sampled Time	13:20	13:20			
	Client ID	RG_ELUGH_WS_LAEMP_GHO_2020-09_NP	RG_TRIP_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	281	<2.0			
	Hardness (as CaCO3) (mg/L)	157				
	pH (pH)	8.25	5.64			
	ORP (mV)	302	457			
	Total Suspended Solids (mg/L)	<1.0	<1.0			
	Total Dissolved Solids (mg/L)	146 DLHC	<10			
	Turbidity (NTU)	0.53	<0.10			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.5			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	140	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	140	<1.0			
	Ammonia as N (mg/L)	<0.0050	<0.0050			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	0.33	<0.10			
	Fluoride (F) (mg/L)	0.146	<0.020			
	Ion Balance (%)	100	0.0			
	Nitrate (as N) (mg/L)	0.0225	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	<0.050	<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020			
	Sulfate (SO4) (mg/L)	16.6	<0.30			
	Anion Sum (meq/L)	3.15	<0.10			
	Cation Sum (meq/L)	3.17	<0.10			
	Cation - Anion Balance (%)	0.2	0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	<0.50				
	Total Organic Carbon (mg/L)	<0.50	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0049	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00010	<0.00010			
	Barium (Ba)-Total (mg/L)	0.0457	<0.00010			
	Beryllium (Be)-Total (ug/L)	<0.020	<0.020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (ug/L)	0.0085	<0.0050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505298-1	L2505298-2			
	Description	WS	WS			
	Sampled Date	17-SEP-20	17-SEP-20			
	Sampled Time	13:20	13:20			
	Client ID	RG_ELUGH_WS_LAEMP_GHO_2020-09_NP	RG_TRIP_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	43.1	<0.050			
	Chromium (Cr)-Total (mg/L)	0.00024	<0.00010			
	Cobalt (Co)-Total (ug/L)	<0.10	<0.10			
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)	<0.010	<0.010			
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0022	<0.0010			
	Magnesium (Mg)-Total (mg/L)	9.68	<0.10			
	Manganese (Mn)-Total (mg/L)	0.00153	<0.00010			
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050			
	Molybdenum (Mo)-Total (mg/L)	0.00104	<0.000050			
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050			
	Potassium (K)-Total (mg/L)	0.363	<0.050			
	Selenium (Se)-Total (ug/L)	0.778	<0.050			
	Silicon (Si)-Total (mg/L)	1.77	<0.10			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	0.639	<0.050			
	Strontium (Sr)-Total (mg/L)	0.223	<0.00020			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			
	Uranium (U)-Total (mg/L)	0.000689	<0.000010			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD	LAB			
	Aluminum (Al)-Dissolved (mg/L)	<0.0030				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00011				
	Barium (Ba)-Dissolved (mg/L)	0.0486				
	Beryllium (Be)-Dissolved (ug/L)	<0.020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (ug/L)	0.0051				
	Calcium (Ca)-Dissolved (mg/L)	46.3	<0.050			
	Chromium (Cr)-Dissolved (mg/L)	0.00022				
	Cobalt (Co)-Dissolved (ug/L)	<0.10				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505298-1	L2505298-2			
	Description	WS	WS			
	Sampled Date	17-SEP-20	17-SEP-20			
	Sampled Time	13:20	13:20			
	Client ID	RG_ELUGH_WS_LAEMP_GHO_2020-09_NP	RG_TRIP_WS_LAEMP_GHO_2020-09_NP			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00020				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0019				
	Magnesium (Mg)-Dissolved (mg/L)	9.98	<0.0050			
	Manganese (Mn)-Dissolved (mg/L)	0.00115				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00109				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Potassium (K)-Dissolved (mg/L)	0.380	<0.050			
	Selenium (Se)-Dissolved (ug/L)	0.862				
	Silicon (Si)-Dissolved (mg/L)	1.74				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	0.665	<0.050			
	Strontium (Sr)-Dissolved (mg/L)	0.228				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	0.000649				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2505298-1
Matrix Spike	Boron (B)-Dissolved	MS-B	L2505298-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2505298-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2505298-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2505298-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2505298-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2505298-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2505298-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2505298-1, -2
Matrix Spike	Cobalt (Co)-Total	MS-B	L2505298-1, -2
Matrix Spike	Lithium (Li)-Total	MS-B	L2505298-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2505298-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2505298-1, -2
Matrix Spike	Nickel (Ni)-Total	MS-B	L2505298-1, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2505298-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2505298-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2505298-1, -2
Matrix Spike	Uranium (U)-Total	MS-B	L2505298-1, -2
Matrix Spike	Nitrate (as N)	MS-B	L2505298-1, -2
Matrix Spike	Sulfate (SO4)	MS-B	L2505298-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

Reference Information

C-TOT-ORG-LOW-CL Water Total Organic Carbon APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-L-IC-N-CL Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL Water Electrical Conductivity (EC) APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-CL Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL Water Ammonia, Total (as N) J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GHO LAEMP Sept 2020

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R5231675								
WG3409068-5 LCS								
Acidity (as CaCO3)			97.4		%		85-115	19-SEP-20
WG3409068-4 MB								
Acidity (as CaCO3)			1.6		mg/L		2	19-SEP-20
ALK-MAN-CL	**Water**							
Batch R5231980								
WG3409502-11 LCS								
Alkalinity, Total (as CaCO3)			101.7		%		85-115	21-SEP-20
WG3409502-10 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	21-SEP-20
BE-D-L-CCMS-VA	**Water**							
Batch R5232851								
WG3409290-2 LCS								
Beryllium (Be)-Dissolved			97.1		%		80-120	23-SEP-20
WG3409290-1 MB		**NP**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	23-SEP-20
BE-T-L-CCMS-VA	**Water**							
Batch R5231880								
WG3408361-2 LCS								
Beryllium (Be)-Total			95.9		%		80-120	21-SEP-20
WG3408361-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	21-SEP-20
BR-L-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Bromide (Br)			104.0		%		85-115	18-SEP-20
WG3408040-5 MB								
Bromide (Br)			<0.050		mg/L		0.05	18-SEP-20
C-DIS-ORG-LOW-CL	**Water**							
Batch R5232266								
WG3409784-6 LCS								
Dissolved Organic Carbon			109.2		%		80-120	21-SEP-20
WG3409784-5 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	21-SEP-20
C-TOT-ORG-LOW-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TOT-ORG-LOW-CL	**Water**							
Batch R5232266								
WG3409784-6 LCS								
Total Organic Carbon			102.4		%		80-120	21-SEP-20
WG3409784-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	21-SEP-20
CL-L-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Chloride (Cl)			99.0		%		85-115	18-SEP-20
WG3408040-5 MB								
Chloride (Cl)			<0.10		mg/L		0.1	18-SEP-20
EC-L-PCT-CL	**Water**							
Batch R5231980								
WG3409502-11 LCS								
Conductivity (@ 25C)			100.1		%		90-110	21-SEP-20
WG3409502-10 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	21-SEP-20
F-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Fluoride (F)			97.1		%		90-110	18-SEP-20
WG3408040-5 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-SEP-20
HG-D-CVAA-VA	**Water**							
Batch R5233684								
WG3411190-7 DUP		**L2505298-1**						
Mercury (Hg)-Dissolved		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	24-SEP-20
WG3411190-6 LCS								
Mercury (Hg)-Dissolved			95.5		%		80-120	24-SEP-20
WG3411190-5 MB		**NP**						
Mercury (Hg)-Dissolved			<0.000005C		mg/L		0.000005	24-SEP-20
HG-T-U-CVAF-VA	**Water**							
Batch R5233172								
WG3410889-7 DUP		**L2505298-1**						
Mercury (Hg)-Total		<0.00050	<0.00050	RPD-NA	ug/L	N/A	20	23-SEP-20
WG3410889-2 LCS								
Mercury (Hg)-Total			94.4		%		80-120	23-SEP-20
WG3410889-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-T-U-CVAF-VA	**Water**							
Batch R5233172								
WG3410889-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	23-SEP-20
MET-D-CCMS-CL	**Water**							
Batch R5232258								
WG3410198-2 LCS		**TMRM**						
Calcium (Ca)-Dissolved			99.6		%		80-120	22-SEP-20
Magnesium (Mg)-Dissolved			106.7		%		80-120	22-SEP-20
Potassium (K)-Dissolved			104.2		%		80-120	22-SEP-20
Sodium (Na)-Dissolved			99.3		%		80-120	22-SEP-20
WG3410198-6 LCS		**TMRM**						
Calcium (Ca)-Dissolved			92.3		%		80-120	22-SEP-20
Magnesium (Mg)-Dissolved			101.5		%		80-120	22-SEP-20
Potassium (K)-Dissolved			102.1		%		80-120	22-SEP-20
Sodium (Na)-Dissolved			96.6		%		80-120	22-SEP-20
WG3410198-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	22-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
WG3410198-5 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	22-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	22-SEP-20
MET-D-CCMS-VA	**Water**							
Batch R5232851								
WG3409290-2 LCS								
Aluminum (Al)-Dissolved			98.8		%		80-120	23-SEP-20
Antimony (Sb)-Dissolved			102.2		%		80-120	23-SEP-20
Arsenic (As)-Dissolved			100.2		%		80-120	23-SEP-20
Barium (Ba)-Dissolved			112.5		%		80-120	23-SEP-20
Bismuth (Bi)-Dissolved			96.5		%		80-120	23-SEP-20
Boron (B)-Dissolved			93.5		%		80-120	23-SEP-20
Cadmium (Cd)-Dissolved			95.6		%		80-120	23-SEP-20
Calcium (Ca)-Dissolved			100.3		%		80-120	23-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5232851								
WG3409290-2 LCS								
Chromium (Cr)-Dissolved			99.3		%		80-120	23-SEP-20
Cobalt (Co)-Dissolved			96.6		%		80-120	23-SEP-20
Copper (Cu)-Dissolved			98.0		%		80-120	23-SEP-20
Iron (Fe)-Dissolved			98.2		%		80-120	23-SEP-20
Lead (Pb)-Dissolved			97.1		%		80-120	23-SEP-20
Lithium (Li)-Dissolved			96.7		%		80-120	23-SEP-20
Magnesium (Mg)-Dissolved			94.1		%		80-120	23-SEP-20
Manganese (Mn)-Dissolved			99.96		%		80-120	23-SEP-20
Molybdenum (Mo)-Dissolved			102.3		%		80-120	23-SEP-20
Nickel (Ni)-Dissolved			98.5		%		80-120	23-SEP-20
Potassium (K)-Dissolved			103.6		%		80-120	23-SEP-20
Selenium (Se)-Dissolved			104.8		%		80-120	23-SEP-20
Silicon (Si)-Dissolved			103.0		%		60-140	23-SEP-20
Silver (Ag)-Dissolved			104.6		%		80-120	23-SEP-20
Sodium (Na)-Dissolved			98.8		%		80-120	23-SEP-20
Strontium (Sr)-Dissolved			107.6		%		80-120	23-SEP-20
Thallium (Tl)-Dissolved			100.5		%		80-120	23-SEP-20
Tin (Sn)-Dissolved			98.7		%		80-120	23-SEP-20
Titanium (Ti)-Dissolved			96.6		%		80-120	23-SEP-20
Uranium (U)-Dissolved			99.0		%		80-120	23-SEP-20
Vanadium (V)-Dissolved			101.7		%		80-120	23-SEP-20
Zinc (Zn)-Dissolved			104.9		%		80-120	23-SEP-20
WG3409290-1 MB		**NP**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	23-SEP-20
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	23-SEP-20
Boron (B)-Dissolved			<0.010		mg/L		0.01	23-SEP-20
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	23-SEP-20
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	23-SEP-20
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	23-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R5232851								
WG3409290-1 MB		**NP**						
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	23-SEP-20
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	23-SEP-20
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	23-SEP-20
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	23-SEP-20
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	23-SEP-20
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	23-SEP-20
Potassium (K)-Dissolved			<0.050		mg/L		0.05	23-SEP-20
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	23-SEP-20
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	23-SEP-20
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	23-SEP-20
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	23-SEP-20
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	23-SEP-20
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	23-SEP-20
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	23-SEP-20
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	23-SEP-20
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	23-SEP-20
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	23-SEP-20
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	23-SEP-20
MET-T-CCMS-VA	**Water**							
Batch R5231880								
WG3408361-2 LCS								
Aluminum (Al)-Total			113.5		%		80-120	21-SEP-20
Antimony (Sb)-Total			109.4		%		80-120	21-SEP-20
Arsenic (As)-Total			111.1		%		80-120	21-SEP-20
Barium (Ba)-Total			116.3		%		80-120	21-SEP-20
Bismuth (Bi)-Total			117.8		%		80-120	21-SEP-20
Boron (B)-Total			97.7		%		80-120	21-SEP-20
Cadmium (Cd)-Total			112.0		%		80-120	21-SEP-20
Calcium (Ca)-Total			106.2		%		80-120	21-SEP-20
Chromium (Cr)-Total			116.5		%		80-120	21-SEP-20
Cobalt (Co)-Total			110.2		%		80-120	21-SEP-20
Copper (Cu)-Total			110.0		%		80-120	21-SEP-20
Iron (Fe)-Total			100.1		%		80-120	21-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5231880								
WG3408361-2 LCS								
Lead (Pb)-Total			114.7		%		80-120	21-SEP-20
Lithium (Li)-Total			114.3		%		80-120	21-SEP-20
Magnesium (Mg)-Total			104.2		%		80-120	21-SEP-20
Manganese (Mn)-Total			111.1		%		80-120	21-SEP-20
Molybdenum (Mo)-Total			104.3		%		80-120	21-SEP-20
Nickel (Ni)-Total			108.0		%		80-120	21-SEP-20
Potassium (K)-Total			107.9		%		80-120	21-SEP-20
Selenium (Se)-Total			105.6		%		80-120	21-SEP-20
Silicon (Si)-Total			110.6		%		80-120	21-SEP-20
Silver (Ag)-Total			105.3		%		80-120	21-SEP-20
Sodium (Na)-Total			109.7		%		80-120	21-SEP-20
Strontium (Sr)-Total			117.8		%		80-120	21-SEP-20
Thallium (Tl)-Total			108.6		%		80-120	21-SEP-20
Tin (Sn)-Total			101.8		%		80-120	21-SEP-20
Titanium (Ti)-Total			113.4		%		80-120	21-SEP-20
Uranium (U)-Total			110.7		%		80-120	21-SEP-20
Vanadium (V)-Total			113.9		%		80-120	21-SEP-20
Zinc (Zn)-Total			107.0		%		80-120	21-SEP-20
WG3408361-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	21-SEP-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Boron (B)-Total			<0.010		mg/L		0.01	21-SEP-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	21-SEP-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	21-SEP-20
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Iron (Fe)-Total			<0.010		mg/L		0.01	21-SEP-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Lithium (Li)-Total			<0.0010		mg/L		0.001	21-SEP-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	21-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R5231880								
WG3408361-1 MB								
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Potassium (K)-Total			<0.050		mg/L		0.05	21-SEP-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	21-SEP-20
Silicon (Si)-Total			<0.10		mg/L		0.1	21-SEP-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	21-SEP-20
Sodium (Na)-Total			<0.050		mg/L		0.05	21-SEP-20
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	21-SEP-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	21-SEP-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	21-SEP-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	21-SEP-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	21-SEP-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	21-SEP-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	21-SEP-20
NH3-L-F-CL	**Water**							
Batch R5232236								
WG3409307-22 LCS								
Ammonia as N			97.1		%		85-115	21-SEP-20
WG3409307-21 MB								
Ammonia as N			<0.0050		mg/L		0.005	21-SEP-20
NO2-L-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Nitrite (as N)			100.1		%		90-110	18-SEP-20
WG3408040-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-SEP-20
NO3-L-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Nitrate (as N)			99.4		%		90-110	18-SEP-20
WG3408040-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	18-SEP-20
ORP-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ORP-CL	**Water**							
Batch R5231796								
WG3409206-2 CRM		**CL-ORP**						
ORP			225		mV		210-230	21-SEP-20
P-T-L-COL-CL	**Water**							
Batch R5234676								
WG3410736-14 LCS								
Phosphorus (P)-Total			98.5		%		80-120	23-SEP-20
WG3410736-13 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	23-SEP-20
PH-CL	**Water**							
Batch R5231980								
WG3409502-11 LCS								
pH			7.00		pH		6.9-7.1	21-SEP-20
PO4-DO-L-COL-CL	**Water**							
Batch R5230746								
WG3407781-6 LCS								
Orthophosphate-Dissolved (as P)			101.5		%		80-120	18-SEP-20
WG3407781-5 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	18-SEP-20
SO4-IC-N-CL	**Water**							
Batch R5230801								
WG3408040-6 LCS								
Sulfate (SO4)			99.4		%		90-110	18-SEP-20
WG3408040-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	18-SEP-20
SOLIDS-TDS-CL	**Water**							
Batch R5233145								
WG3409473-17 LCS								
Total Dissolved Solids			95.9		%		85-115	22-SEP-20
WG3409473-16 MB								
Total Dissolved Solids			<10		mg/L		10	22-SEP-20
TKN-L-F-CL	**Water**							
Batch R5231791								
WG3409258-12 LCS								
Total Kjeldahl Nitrogen			93.7		%		75-125	21-SEP-20
WG3409258-16 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-L-F-CL	**Water**							
Batch R5231791								
WG3409258-16 LCS								
Total Kjeldahl Nitrogen			95.0		%		75-125	21-SEP-20
WG3409258-2 LCS								
Total Kjeldahl Nitrogen			94.1		%		75-125	21-SEP-20
WG3409258-20 LCS								
Total Kjeldahl Nitrogen			97.7		%		75-125	21-SEP-20
WG3409258-4 LCS								
Total Kjeldahl Nitrogen			101.8		%		75-125	21-SEP-20
WG3409258-8 LCS								
Total Kjeldahl Nitrogen			97.6		%		75-125	21-SEP-20
WG3409258-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
WG3409258-11 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
WG3409258-15 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
WG3409258-19 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
WG3409258-3 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
WG3409258-7 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	21-SEP-20
TSS-L-CL	**Water**							
Batch R5233042								
WG3409472-6 LCS								
Total Suspended Solids			89.8		%		85-115	22-SEP-20
WG3409472-5 MB								
Total Suspended Solids			<1.0		mg/L		1	22-SEP-20
TURBIDITY-CL	**Water**							
Batch R5230765								
WG3407666-9 LCS								
Turbidity			98.5		%		85-115	18-SEP-20
WG3407666-8 MB								
Turbidity			<0.10		NTU		0.1	18-SEP-20

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	17-SEP-20 13:20	21-SEP-20 13:15	0.25	96	hours	EHTR-FM
	2	17-SEP-20 13:20	21-SEP-20 13:15	0.25	96	hours	EHTR-FM
pH							
	1	17-SEP-20 13:20	21-SEP-20 14:00	0.25	97	hours	EHTR-FM
	2	17-SEP-20 13:20	21-SEP-20 14:00	0.25	97	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2505298 were received on 18-SEP-20 09:25.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	GHO LAEMP Sept 2020	TURNAROUND TIME:	

PROJECT/CLIENT INFO

Facility Name	REP
Project Manager	Cait Good
Email	cait.good@teck.com
Address	421 Pine Avenue
City	Sparwood
Province	BC
Postal Code	V0B 2G0
Country	Canada
Phone Number	250-425-8202

LABORATORY

Lab Name	ALS Calgary
Lab Contact	Lyudmyla Shvets
Email	lyudmyla.shvets@alsglobal.com
Address	2559 29 Street NE
City	Calgary
Province	AB
Postal Code	T1Y 7B5
Country	Canada
Phone Number	1 403 407 1794

	Excel	PDF	EDD
cait.good@teck.com	x	x	x
teckcoal@equisonline.com			x
jings@minnow.ca	x	x	x
carlie.meyer@teck.com	x	x	x
jtester@minnow.ca	x	x	x

PO number: 689999

SAMPLE DETAILS / **ANALYSIS REQUESTED** (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

L2505298-COFC

Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	TECKCOAL-ROUTINE-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-T-U-CVAF-VA	HG-D-CVAF-VA	TECKCOAL-MET-T-VA	TECKCOAL-MET-D-VA
Filtered								N	F	N	N	F	N	F
Preservative									H2SO4	H2SO4		HCL	HNO3	HNO3
RG_ELUGH_WS_LAEMP_GHO_2020-09_NP	RG_ELUGH	WS	No	9/17/2020	13:20	G	7	1	1	1	1	1	1	1
RG_TRIP _WS_LAEMP_GHO_2020-09_NP	RG_TRIP	WS	No	9/17/2020	13:20	G	4	1		1	1		1	

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
	Jennifer Ings	September 17, 2020		09/18 9:35

Regular (default)	x	Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Priority (2-3 business days) - 50% surcharge					
Emergency (1 Business Day) - 100% surcharge		Sampler's Signature		Date/Time	September 17, 2020
For Emergency <1 Day, ASAP or Weekend - Contact ALS					

5a

APPENDIX H
SEDIMENT QUALITY LAB REPORT

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 19-SEP-20
Report Date: 30-SEP-20 15:29 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2505807

Project P.O. #: VPO00689999
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: GHO LAEMP Sept 2020
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-1	L2505807-2	L2505807-3	L2505807-4	L2505807-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	17-SEP-20	17-SEP-20	17-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	09:11	10:40	12:20	16:10	16:20
	Client ID	RG_ELUGH_SE-1-2020-09-17-0911	RG_ELUGH_SE-2-2020-09-17-1040	RG_ELUGH_SE-3-2020-09-17-1220	RG_GH-SCW3_SE-1-2020-09-13-1610	RG_GH-SCW3_SE-2-2020-09-13-1620
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	44.3	43.8	36.9	48.9	51.0
	pH (1:2 soil:water) (pH)	8.23	8.24	8.30	8.17	8.15
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	1.5	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	8.1	6.2	1.5	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	17.8	13.7	15.7	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	21.1	28.1	31.6	7.2	5.6
	% Sand (0.125mm - 0.063mm) (%)	15.2	19.4	20.7	22.1	20.2
	% Silt (0.063mm - 0.0312mm) (%)	16.4	13.4	13.2	29.0	31.3
	% Silt (0.0312mm - 0.004mm) (%)	17.2	13.8	13.4	34.4	36.7
	% Clay (<4um) (%)	3.4	3.3	3.5	6.3	5.5
	Texture	Sandy loam	Loamy sand	Loamy sand	Silt loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.71	2.61	2.71	5.50	5.25
Metals	Aluminum (Al) (mg/kg)	7780	7340	4480	9460	8920
	Antimony (Sb) (mg/kg)	0.42	0.54	0.34	0.33	0.40
	Arsenic (As) (mg/kg)	5.48	5.64	3.99	5.22	5.17
	Barium (Ba) (mg/kg)	139	146	91.9	164	164
	Beryllium (Be) (mg/kg)	0.56	0.56	0.32	0.63	0.62
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	8.2	7.8	7.5	12.2	11.2
	Cadmium (Cd) (mg/kg)	0.684	0.758	0.403	0.917	0.914
	Calcium (Ca) (mg/kg)	66700	56800	49500	37800	34700
	Chromium (Cr) (mg/kg)	17.6	17.7	11.4	18.9	18.2
	Cobalt (Co) (mg/kg)	4.06	4.26	2.61	5.02	4.90
	Copper (Cu) (mg/kg)	10.3	10.5	5.63	13.7	13.3
	Iron (Fe) (mg/kg)	12100	12100	8140	13200	13000
	Lead (Pb) (mg/kg)	6.17	6.64	4.27	7.78	7.83
	Lithium (Li) (mg/kg)	9.9	10.0	5.8	12.5	11.6
	Magnesium (Mg) (mg/kg)	12900	12700	12900	12100	11100
	Manganese (Mn) (mg/kg)	365	449	206	378	360
	Mercury (Hg) (mg/kg)	0.0347	0.0419	0.0212	0.0543	0.0598
	Molybdenum (Mo) (mg/kg)	1.25	1.30	0.82	1.23	1.28
	Nickel (Ni) (mg/kg)	17.2	18.0	10.8	21.1	20.6
	Phosphorus (P) (mg/kg)	1180	1150	1150	1230	1140
	Potassium (K) (mg/kg)	2110	1930	1120	2310	2140
	Selenium (Se) (mg/kg)	0.79	1.05	0.44	1.72	1.59
	Silver (Ag) (mg/kg)	0.15	0.16	<0.10	0.21	0.19

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-6	L2505807-7	L2505807-8	L2505807-9	L2505807-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	13-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	16-SEP-20
	Sampled Time	16:30	15:00	15:15	12:44	08:55
	Client ID	RG_GH-SCW3_SE-3-2020-09-13-1630	RG_GH-SCW3_SE-4-2020-09-16-1500	RG_GH-SCW3_SE-5-2020-09-16-1515	RG_EL20_SE-1-2020-09-15-1244	RG_EL20_SE-2-2020-09-16-0855
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	47.8	45.6	44.3	26.3	33.7
	pH (1:2 soil:water) (pH)	8.12	8.18	8.24	8.42	8.48
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	3.5	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	4.0	1.8
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	7.2	3.4
	% Sand (0.50mm - 0.25mm) (%)	<1.0	1.1	<1.0	12.9	5.7
	% Sand (0.25mm - 0.125mm) (%)	6.8	5.7	9.0	17.3	31.6
	% Sand (0.125mm - 0.063mm) (%)	19.2	17.6	18.1	16.3	31.5
	% Silt (0.063mm - 0.0312mm) (%)	30.6	31.0	32.1	16.9	13.7
	% Silt (0.0312mm - 0.004mm) (%)	36.1	37.4	34.4	18.0	9.1
	% Clay (<4um) (%)	6.4	7.0	5.1	3.8	2.5
	Texture	Silt loam	Silt loam	Silt loam	Sandy loam	Loamy sand
Organic / Inorganic Carbon	Total Organic Carbon (%)	5.33	6.22	5.00	3.11	1.66
Metals	Aluminum (Al) (mg/kg)	9460	8300	6320	4320	5040
	Antimony (Sb) (mg/kg)	0.43	0.48	0.45	0.35	0.31
	Arsenic (As) (mg/kg)	5.47	5.01	4.93	4.41	3.82
	Barium (Ba) (mg/kg)	171	136	113	81.1	90.7
	Beryllium (Be) (mg/kg)	0.66	0.61	0.47	0.36	0.35
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	11.7	11.3	8.1	6.3	6.6
	Cadmium (Cd) (mg/kg)	1.00	0.936	0.694	0.559	0.422
	Calcium (Ca) (mg/kg)	34700	45100	49300	90100	47800
	Chromium (Cr) (mg/kg)	19.2	19.5	16.8	13.9	12.2
	Cobalt (Co) (mg/kg)	5.22	4.65	4.02	2.74	2.76
	Copper (Cu) (mg/kg)	15.0	12.8	10.3	6.58	5.61
	Iron (Fe) (mg/kg)	13600	12300	11200	8920	8280
	Lead (Pb) (mg/kg)	8.29	7.07	6.22	3.96	4.14
	Lithium (Li) (mg/kg)	12.8	11.4	8.8	6.6	6.4
	Magnesium (Mg) (mg/kg)	11300	12900	13600	14200	12300
	Manganese (Mn) (mg/kg)	384	387	338	385	260
	Mercury (Hg) (mg/kg)	0.0621	0.0572	0.0431	0.0166	0.0160
	Molybdenum (Mo) (mg/kg)	1.31	1.21	1.26	1.24	0.88
	Nickel (Ni) (mg/kg)	22.5	20.8	18.0	13.5	11.0
	Phosphorus (P) (mg/kg)	1180	1120	1180	1090	1100
	Potassium (K) (mg/kg)	2250	2150	1530	1120	1310
	Selenium (Se) (mg/kg)	1.81	2.22	1.31	0.48	0.39
	Silver (Ag) (mg/kg)	0.22	0.21	0.16	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-11	L2505807-12	L2505807-13	L2505807-14	L2505807-15
	Description	SE	SE	SE	SE	SE
	Sampled Date	16-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	17-SEP-20
	Sampled Time	10:40	12:50	13:53	12:44	10:40
	Client ID	RG_EL20_SE-3-2020-09-16-1040	RG_EL20_SE-4-2020-09-16-1250	RG_EL20_SE-5-2020-09-16-1353	RG_RIVER_SE-5-2020-09-15-1244	RG_RIVER_SE-5-2020-09-17-1040
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	25.5	31.6	23.8	35.5	39.7
	pH (1:2 soil:water) (pH)	8.50	8.54	8.48	8.25	8.29
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	7.4	1.6
	% Sand (2.00mm - 1.00mm) (%)	1.4	<1.0	1.1	4.7	3.8
	% Sand (1.00mm - 0.50mm) (%)	11.1	3.7	20.8	7.4	6.3
	% Sand (0.50mm - 0.25mm) (%)	29.0	29.9	54.0	12.2	15.1
	% Sand (0.25mm - 0.125mm) (%)	18.6	31.9	14.3	15.9	17.0
	% Sand (0.125mm - 0.063mm) (%)	14.2	17.9	3.5	14.5	13.8
	% Silt (0.063mm - 0.0312mm) (%)	11.2	8.4	2.5	16.7	18.2
	% Silt (0.0312mm - 0.004mm) (%)	10.8	5.9	2.6	17.7	20.4
	% Clay (<4um) (%)	2.9	1.9	1.1	3.5	3.8
	Texture	Loamy sand	Sand	Sand	Sandy loam	Sandy loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.01	1.52	1.59	2.85	3.12
Metals	Aluminum (Al) (mg/kg)	5870	5540	5300	5520	7500
	Antimony (Sb) (mg/kg)	0.35	0.32	0.36	0.38	0.51
	Arsenic (As) (mg/kg)	4.81	4.30	4.99	4.93	5.67
	Barium (Ba) (mg/kg)	95.0	92.2	93.3	108	151
	Beryllium (Be) (mg/kg)	0.44	0.39	0.42	0.44	0.53
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	9.1	7.6	7.2	8.1	10.0
	Cadmium (Cd) (mg/kg)	0.540	0.488	0.565	0.644	0.727
	Calcium (Ca) (mg/kg)	88000	56500	83300	69800	58500
	Chromium (Cr) (mg/kg)	15.8	13.5	14.6	14.6	18.2
	Cobalt (Co) (mg/kg)	2.97	3.02	3.09	3.26	4.23
	Copper (Cu) (mg/kg)	6.83	5.96	6.78	9.12	10.8
	Iron (Fe) (mg/kg)	9700	8980	9940	10400	12100
	Lead (Pb) (mg/kg)	4.45	4.66	4.34	4.97	6.90
	Lithium (Li) (mg/kg)	7.5	6.6	6.4	7.1	10.2
	Magnesium (Mg) (mg/kg)	14500	12100	11600	11600	13200
	Manganese (Mn) (mg/kg)	333	294	372	370	399
	Mercury (Hg) (mg/kg)	0.0161	0.0137	0.0115	0.0259	0.0385
	Molybdenum (Mo) (mg/kg)	1.17	0.96	1.18	1.20	1.29
	Nickel (Ni) (mg/kg)	13.1	11.9	13.4	14.2	18.0
	Phosphorus (P) (mg/kg)	1280	1100	1070	1100	1230
	Potassium (K) (mg/kg)	1610	1500	1460	1430	1960
	Selenium (Se) (mg/kg)	0.43	0.36	0.32	0.64	0.74
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	0.12	0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-1	L2505807-2	L2505807-3	L2505807-4	L2505807-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	17-SEP-20	17-SEP-20	17-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	09:11	10:40	12:20	16:10	16:20
	Client ID	RG_ELUGH_SE-1-2020-09-17-0911	RG_ELUGH_SE-2-2020-09-17-1040	RG_ELUGH_SE-3-2020-09-17-1220	RG_GH-SCW3_SE-1-2020-09-13-1610	RG_GH-SCW3_SE-2-2020-09-13-1620
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	106	102	82	98	94
	Strontium (Sr) (mg/kg)	102	94.1	68.9	73.1	68.2
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.191	0.194	0.118	0.236	0.243
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	12.1	20.3	13.9	11.7	14.2
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.993	1.01	0.860	0.995	0.963
	Vanadium (V) (mg/kg)	35.5	34.8	22.1	36.7	34.7
	Zinc (Zn) (mg/kg)	74.9	77.3	48.5	84.1	81.4
	Zirconium (Zr) (mg/kg)	<1.0	1.0	<1.0	<1.0	<1.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.041 DLCI	<0.051 DLCI
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	<0.010	<0.010	<0.010	0.061	0.052
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	0.033	0.034
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	0.011	0.015
	Benzo(b&j)fluoranthene (mg/kg)	0.015	0.022	0.013	0.094	0.098
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	0.022	<0.015	0.094	0.098
	Benzo(e)pyrene (mg/kg)	0.014	0.019	0.011	0.089	0.094
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	0.026	0.027
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	0.035	0.044	0.027	<0.22 DLCI	<0.24 DLCI
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0070 DLCI	<0.0050	0.0166	0.0153
	Fluoranthene (mg/kg)	<0.010	0.011	<0.010	0.037	0.030
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	0.047	0.048
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	0.013	0.014
	1-Methylnaphthalene (mg/kg)	<0.050	0.054	<0.050	0.588	0.612
	2-Methylnaphthalene (mg/kg)	0.038	0.060	0.028	0.944	0.993
	Naphthalene (mg/kg)	0.021	0.031	0.015	0.226	0.233
	Perylene (mg/kg)	0.012	0.019	<0.010	0.017	0.016
	Phenanthrene (mg/kg)	0.078	0.103	0.056	0.687	0.708
	Pyrene (mg/kg)	<0.010	0.014	<0.010	0.058	0.060
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (%)	103.0	115.6	108.7	114.4	109.5
	Surrogate: d12-Chrysene (%)	115.9	124.5	120.5	120.2	113.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-6	L2505807-7	L2505807-8	L2505807-9	L2505807-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	13-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	16-SEP-20
	Sampled Time	16:30	15:00	15:15	12:44	08:55
	Client ID	RG_GH-SCW3_SE-3-2020-09-13-1630	RG_GH-SCW3_SE-4-2020-09-16-1500	RG_GH-SCW3_SE-5-2020-09-16-1515	RG_EL20_SE-1-2020-09-15-1244	RG_EL20_SE-2-2020-09-16-0855
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	94	97	92	106	85
	Strontium (Sr) (mg/kg)	73.4	78.6	75.0	124	66.3
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.253	0.236	0.187	0.153	0.142
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	13.5	18.8	19.7	18.7	16.2
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.986	1.05	0.975	1.02	0.798
	Vanadium (V) (mg/kg)	36.5	34.7	28.2	21.7	22.9
	Zinc (Zn) (mg/kg)	86.3	80.5	72.6	49.3	48.5
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.040 DLCI	<0.020 DLCI	<0.016 DLCI	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	<0.050 DLCI	<0.025 DLCI	<0.020 DLCI	<0.010	<0.010
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	0.027	0.013	0.013	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	0.011	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	0.080	0.038	0.032	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	0.080	0.038	0.032	<0.015	<0.015
	Benzo(e)pyrene (mg/kg)	0.080	0.036	0.031	<0.010	<0.010
	Benzo(g,h,i)perylene (mg/kg)	0.025	0.013	0.011	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	0.191	0.090	0.080	<0.025 DLCI	<0.015 DLCI
	Dibenz(a,h)anthracene (mg/kg)	0.0121	<0.0050	<0.0060 DLCI	<0.0050	<0.0050
	Fluoranthene (mg/kg)	0.026	0.012	0.012	<0.010	<0.010
	Fluorene (mg/kg)	0.046	0.022	0.019	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	0.532	0.256	0.228	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	0.850	0.437	0.390	0.055	0.010
	Naphthalene (mg/kg)	0.197	0.127	0.127	0.030	<0.010
	Perylene (mg/kg)	0.012	0.019	0.017	<0.010	<0.010
	Phenanthrene (mg/kg)	0.590	0.273	0.248	0.051	0.020
	Pyrene (mg/kg)	0.049	0.024	0.022	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (%)	109.4	104.8	110.2	104.4	108.3
	Surrogate: d12-Chrysene (%)	114.1	113.7	115.7	116.1	119.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-11	L2505807-12	L2505807-13	L2505807-14	L2505807-15
	Description	SE	SE	SE	SE	SE
	Sampled Date	16-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	17-SEP-20
	Sampled Time	10:40	12:50	13:53	12:44	10:40
	Client ID	RG_EL20_SE-3-2020-09-16-1040	RG_EL20_SE-4-2020-09-16-1250	RG_EL20_SE-5-2020-09-16-1353	RG_RIVER_SE-5-2020-09-15-1244	RG_RIVER_SE-5-2020-09-17-1040
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	111	89	97	92	110
	Strontium (Sr) (mg/kg)	111	78.1	116	95.7	94.7
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.162	0.148	0.150	0.177	0.194
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	16.7	15.4	14.0	16.8	20.0
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.03	0.836	0.925	1.03	0.985
	Vanadium (V) (mg/kg)	27.1	26.3	26.3	26.3	35.0
	Zinc (Zn) (mg/kg)	54.8	53.1	55.3	58.4	85.5
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	0.011	0.016
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	0.016
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010	0.010	0.014
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	DLCI <0.015	DLCI <0.015	DLCI <0.015	DLCI <0.030	0.032
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	0.071	<0.050
	2-Methylnaphthalene (mg/kg)	0.015	0.010	0.015	0.115	0.050
	Naphthalene (mg/kg)	<0.010	<0.010	0.010	0.054	0.026
	Perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.015
	Phenanthrene (mg/kg)	0.029	0.023	0.029	0.080	0.087
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (%)	101.8	108.9	111.3	108.7	109.2
	Surrogate: d12-Chrysene (%)	110.9	117.0	118.6	120.1	121.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2505807-1	L2505807-2	L2505807-3	L2505807-4	L2505807-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	17-SEP-20	17-SEP-20	17-SEP-20	13-SEP-20	13-SEP-20
	Sampled Time	09:11	10:40	12:20	16:10	16:20
	Client ID	RG_ELUGH_SE-1-2020-09-17-0911	RG_ELUGH_SE-2-2020-09-17-1040	RG_ELUGH_SE-3-2020-09-17-1220	RG_GH-SCW3_SE-1-2020-09-13-1610	RG_GH-SCW3_SE-2-2020-09-13-1620
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	97.3	108.0	103.5	106.7	101.0
	Surrogate: d10-Phenanthrene (%)	104.8	115.2	112.1	112.6	104.9
	IACR:Coarse	<0.050	<0.050	<0.050	<0.050	<0.050
	IACR:Fine	<0.050	<0.050	<0.050	0.053	0.055
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	0.044	0.046
	IACR (CCME)	0.18	0.23	0.17	0.88	0.92

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2505807-6	L2505807-7	L2505807-8	L2505807-9	L2505807-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	13-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	16-SEP-20
	Sampled Time	16:30	15:00	15:15	12:44	08:55
	Client ID	RG_GH-SCW3_SE-3-2020-09-13-1630	RG_GH-SCW3_SE-4-2020-09-16-1500	RG_GH-SCW3_SE-5-2020-09-16-1515	RG_EL20_SE-1-2020-09-15-1244	RG_EL20_SE-2-2020-09-16-0855
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	102.6	99.5	104.6	100.8	103.3
	Surrogate: d10-Phenanthrene (%)	106.5	104.3	108.8	105.6	109.3
	IACR:Coarse	<0.050	<0.050	<0.050	<0.050	<0.050
	IACR:Fine	<0.050	<0.050	<0.050	<0.050	<0.050
	B(a)P Total Potency Equivalent (mg/kg)	0.037	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	0.79	0.38	0.34	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2505807-11	L2505807-12	L2505807-13	L2505807-14	L2505807-15
	Sample ID	L2505807-11	L2505807-12	L2505807-13	L2505807-14	L2505807-15
	Description	SE	SE	SE	SE	SE
	Sampled Date	16-SEP-20	16-SEP-20	16-SEP-20	15-SEP-20	17-SEP-20
	Sampled Time	10:40	12:50	13:53	12:44	10:40
	Client ID	RG_EL20_SE-3-2020-09-16-1040	RG_EL20_SE-4-2020-09-16-1250	RG_EL20_SE-5-2020-09-16-1353	RG_RIVER_SE-5-2020-09-15-1244	RG_RIVER_SE-5-2020-09-17-1040
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	97.5	101.7	104.4	101.9	104.1
	Surrogate: d10-Phenanthrene (%)	103.5	107.7	109.1	105.8	111.5
	IACR:Coarse	<0.050	<0.050	<0.050	<0.050	<0.050
	IACR:Fine	<0.050	<0.050	<0.050	<0.050	<0.050
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	0.19

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic Interference due to co-elution.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAA-CL	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-CL	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

MOISTURE-CL	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C

PAH-TMB-H/A-MS-CL	Soil	PAH Tumbler Extraction (Hexane/Acetone)	EPA 3570/8270-GC/MS

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3545 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-CL	Soil	pH in soil (1:2 Soil:Water Extraction)	CSSS Ch. 16

Soil and de-ionized water (by volume) are mixed in a defined ratio. The slurry is allowed to stand, shaken, and then allowed to stand again prior to taking measurements. After equilibration, the pH of the liquid portion of the extract is measured by a pH meter. Field Measurement is recommended where accurate pH measurements are required, due to the 15 minute recommended hold time.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

GHO LAEMP Sept 2020

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2505807	Report Date: 30-SEP-20	Page 1 of 17

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0

Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R5242123								
WG3410171-4 IRM		**08-109_SOIL**						
Inorganic Carbon			96.3		%		80-120	29-SEP-20
WG3410171-2 LCS		**0.5**						
Inorganic Carbon			97.4		%		90-110	29-SEP-20
WG3410171-3 MB								
Inorganic Carbon			<0.050		%		0.05	29-SEP-20
C-TOT-LECO-SK	**Soil**							
Batch R5239836								
WG3410125-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			93.2		%		80-120	26-SEP-20
WG3410125-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			101.4		%		90-110	26-SEP-20
WG3410125-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	26-SEP-20
Batch R5239839								
WG3410124-1 DUP		**L2505807-5**						
Total Carbon by Combustion		6.76	6.86		%	1.6	20	26-SEP-20
WG3410124-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			99.1		%		80-120	26-SEP-20
WG3410124-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			99.4		%		90-110	26-SEP-20
WG3410124-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	26-SEP-20
HG-200.2-CVAA-CL	**Soil**							
Batch R5238497								
WG3412202-14 CRM		**TILL-1**						
Mercury (Hg)			108.0		%		70-130	26-SEP-20
WG3412202-9 CRM		**TILL-1**						
Mercury (Hg)			110.1		%		70-130	26-SEP-20
WG3412202-10 DUP		**L2505807-3**						
Mercury (Hg)		0.0212	0.0239		mg/kg	12	40	26-SEP-20
WG3412202-13 LCS								
Mercury (Hg)			107.0		%		80-120	26-SEP-20
WG3412202-8 LCS								
Mercury (Hg)			106.0		%		80-120	26-SEP-20
WG3412202-11 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	26-SEP-20
WG3412202-6 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-200.2-CVAA-CL	**Soil**							
Batch R5238497								
WG3412202-6 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	26-SEP-20
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-14 CRM		**TILL-1**						
Aluminum (Al)			110.6		%		70-130	25-SEP-20
Antimony (Sb)			96.2		%		70-130	25-SEP-20
Arsenic (As)			101.7		%		70-130	25-SEP-20
Barium (Ba)			102.2		%		70-130	25-SEP-20
Beryllium (Be)			105.2		%		70-130	25-SEP-20
Bismuth (Bi)			101.4		%		70-130	25-SEP-20
Boron (B)			4.0		mg/kg		0-8.2	25-SEP-20
Cadmium (Cd)			102.0		%		70-130	25-SEP-20
Calcium (Ca)			113.6		%		70-130	25-SEP-20
Chromium (Cr)			107.3		%		70-130	25-SEP-20
Cobalt (Co)			102.8		%		70-130	25-SEP-20
Copper (Cu)			102.4		%		70-130	25-SEP-20
Iron (Fe)			104.5		%		70-130	25-SEP-20
Lead (Pb)			93.6		%		70-130	25-SEP-20
Lithium (Li)			97.5		%		70-130	25-SEP-20
Magnesium (Mg)			113.2		%		70-130	25-SEP-20
Manganese (Mn)			102.4		%		70-130	25-SEP-20
Molybdenum (Mo)			97.8		%		70-130	25-SEP-20
Nickel (Ni)			102.6		%		70-130	25-SEP-20
Phosphorus (P)			101.4		%		70-130	25-SEP-20
Potassium (K)			111.7		%		70-130	25-SEP-20
Selenium (Se)			0.33		mg/kg		0.11-0.51	25-SEP-20
Silver (Ag)			0.23		mg/kg		0.13-0.33	25-SEP-20
Sodium (Na)			115.3		%		70-130	25-SEP-20
Strontium (Sr)			119.5		%		70-130	25-SEP-20
Thallium (Tl)			0.134		mg/kg		0.077-0.18	25-SEP-20
Tin (Sn)			1.0		mg/kg		0-3.1	25-SEP-20
Titanium (Ti)			124.4		%		70-130	25-SEP-20
Tungsten (W)			0.14		mg/kg		0-0.66	25-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-14 CRM		**TILL-1**						
Uranium (U)			106.6		%		70-130	25-SEP-20
Vanadium (V)			105.2		%		70-130	25-SEP-20
Zinc (Zn)			103.5		%		70-130	25-SEP-20
Zirconium (Zr)			0.7		mg/kg		0-1.8	25-SEP-20
WG3412202-9 CRM		**TILL-1**						
Aluminum (Al)			112.2		%		70-130	25-SEP-20
Antimony (Sb)			101.7		%		70-130	25-SEP-20
Arsenic (As)			105.6		%		70-130	25-SEP-20
Barium (Ba)			100.8		%		70-130	25-SEP-20
Beryllium (Be)			101.1		%		70-130	25-SEP-20
Bismuth (Bi)			101.9		%		70-130	25-SEP-20
Boron (B)			7.7		mg/kg		0-8.2	25-SEP-20
Cadmium (Cd)			106.0		%		70-130	25-SEP-20
Calcium (Ca)			109.0		%		70-130	25-SEP-20
Chromium (Cr)			109.8		%		70-130	25-SEP-20
Cobalt (Co)			106.7		%		70-130	25-SEP-20
Copper (Cu)			105.7		%		70-130	25-SEP-20
Iron (Fe)			106.3		%		70-130	25-SEP-20
Lead (Pb)			93.2		%		70-130	25-SEP-20
Lithium (Li)			97.7		%		70-130	25-SEP-20
Magnesium (Mg)			115.5		%		70-130	25-SEP-20
Manganese (Mn)			105.4		%		70-130	25-SEP-20
Molybdenum (Mo)			98.7		%		70-130	25-SEP-20
Nickel (Ni)			105.1		%		70-130	25-SEP-20
Phosphorus (P)			102.8		%		70-130	25-SEP-20
Potassium (K)			109.6		%		70-130	25-SEP-20
Selenium (Se)			0.32		mg/kg		0.11-0.51	25-SEP-20
Silver (Ag)			0.24		mg/kg		0.13-0.33	25-SEP-20
Sodium (Na)			114.2		%		70-130	25-SEP-20
Strontium (Sr)			117.4		%		70-130	25-SEP-20
Thallium (Tl)			0.129		mg/kg		0.077-0.18	25-SEP-20
Tin (Sn)			1.0		mg/kg		0-3.1	25-SEP-20
Titanium (Ti)			123.4		%		70-130	25-SEP-20
Tungsten (W)			0.15		mg/kg		0-0.66	25-SEP-20

Quality Control Report

Workorder: L2505807 Report Date: 30-SEP-20

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-9 CRM		**TILL-1**						
Uranium (U)			98.7		%		70-130	25-SEP-20
Vanadium (V)			109.1		%		70-130	25-SEP-20
Zinc (Zn)			103.2		%		70-130	25-SEP-20
Zirconium (Zr)			0.7		mg/kg		0-1.8	25-SEP-20
WG3412202-10 DUP		**L2505807-3**						
Aluminum (Al)		4480	5330		mg/kg	17	40	25-SEP-20
Antimony (Sb)		0.34	0.35		mg/kg	2.8	30	25-SEP-20
Arsenic (As)		3.99	4.11		mg/kg	2.7	30	25-SEP-20
Barium (Ba)		91.9	96.3		mg/kg	4.7	40	25-SEP-20
Beryllium (Be)		0.32	0.37		mg/kg	13	30	25-SEP-20
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	25-SEP-20
Boron (B)		7.5	8.2		mg/kg	9.1	30	25-SEP-20
Cadmium (Cd)		0.403	0.432		mg/kg	7.0	30	25-SEP-20
Calcium (Ca)		49500	49000		mg/kg	1.1	30	25-SEP-20
Chromium (Cr)		11.4	12.9		mg/kg	12	30	25-SEP-20
Cobalt (Co)		2.61	2.74		mg/kg	4.9	30	25-SEP-20
Copper (Cu)		5.63	6.01		mg/kg	6.5	30	25-SEP-20
Iron (Fe)		8140	8740		mg/kg	7.0	30	25-SEP-20
Lead (Pb)		4.27	4.52		mg/kg	5.7	40	25-SEP-20
Lithium (Li)		5.8	6.7		mg/kg	14	30	25-SEP-20
Magnesium (Mg)		12900	11700		mg/kg	9.6	30	25-SEP-20
Manganese (Mn)		206	215		mg/kg	4.2	30	25-SEP-20
Molybdenum (Mo)		0.82	0.86		mg/kg	4.0	40	25-SEP-20
Nickel (Ni)		10.8	11.4		mg/kg	5.4	30	25-SEP-20
Phosphorus (P)		1150	1140		mg/kg	1.5	30	25-SEP-20
Potassium (K)		1120	1410		mg/kg	23	40	25-SEP-20
Selenium (Se)		0.44	0.48		mg/kg	8.6	30	25-SEP-20
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	25-SEP-20
Sodium (Na)		82	84		mg/kg	2.1	40	25-SEP-20
Strontium (Sr)		68.9	71.7		mg/kg	3.9	40	25-SEP-20
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	25-SEP-20
Thallium (Tl)		0.118	0.134		mg/kg	12	30	25-SEP-20
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	25-SEP-20
Titanium (Ti)		13.9	14.0		mg/kg	0.7	40	25-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-10 DUP		**L2505807-3**						
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	25-SEP-20
Uranium (U)		0.860	0.865		mg/kg	0.6	30	25-SEP-20
Vanadium (V)		22.1	26.0		mg/kg	16	30	25-SEP-20
Zinc (Zn)		48.5	50.5		mg/kg	3.9	30	25-SEP-20
Zirconium (Zr)		<1.0	<1.0	RPD-NA	mg/kg	N/A	30	25-SEP-20
WG3412202-13 LCS								
Aluminum (Al)			101.9		%		80-120	25-SEP-20
Antimony (Sb)			99.7		%		80-120	25-SEP-20
Arsenic (As)			100.3		%		80-120	25-SEP-20
Barium (Ba)			100.9		%		80-120	25-SEP-20
Beryllium (Be)			98.3		%		80-120	25-SEP-20
Bismuth (Bi)			104.6		%		80-120	25-SEP-20
Boron (B)			89.4		%		80-120	25-SEP-20
Cadmium (Cd)			100.3		%		80-120	25-SEP-20
Calcium (Ca)			94.9		%		80-120	25-SEP-20
Chromium (Cr)			100.9		%		80-120	25-SEP-20
Cobalt (Co)			98.6		%		80-120	25-SEP-20
Copper (Cu)			97.6		%		80-120	25-SEP-20
Iron (Fe)			112.7		%		80-120	25-SEP-20
Lead (Pb)			104.2		%		80-120	25-SEP-20
Lithium (Li)			95.8		%		80-120	25-SEP-20
Magnesium (Mg)			106.2		%		80-120	25-SEP-20
Manganese (Mn)			97.3		%		80-120	25-SEP-20
Molybdenum (Mo)			93.5		%		80-120	25-SEP-20
Nickel (Ni)			99.1		%		80-120	25-SEP-20
Potassium (K)			95.0		%		80-120	25-SEP-20
Selenium (Se)			99.3		%		80-120	25-SEP-20
Silver (Ag)			95.7		%		80-120	25-SEP-20
Sodium (Na)			107.4		%		80-120	25-SEP-20
Strontium (Sr)			98.3		%		80-120	25-SEP-20
Sulfur (S)			102.9		%		80-120	25-SEP-20
Thallium (Tl)			98.6		%		80-120	25-SEP-20
Tin (Sn)			98.5		%		80-120	25-SEP-20
Titanium (Ti)			96.6		%		80-120	25-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-13 LCS								
Tungsten (W)			88.5		%		80-120	25-SEP-20
Uranium (U)			94.6		%		80-120	25-SEP-20
Vanadium (V)			101.4		%		80-120	25-SEP-20
Zinc (Zn)			95.3		%		80-120	25-SEP-20
Zirconium (Zr)			96.4		%		80-120	25-SEP-20
WG3412202-8 LCS								
Aluminum (Al)			106.1		%		80-120	25-SEP-20
Antimony (Sb)			103.6		%		80-120	25-SEP-20
Arsenic (As)			105.6		%		80-120	25-SEP-20
Barium (Ba)			103.6		%		80-120	25-SEP-20
Beryllium (Be)			100.7		%		80-120	25-SEP-20
Bismuth (Bi)			104.8		%		80-120	25-SEP-20
Boron (B)			98.4		%		80-120	25-SEP-20
Cadmium (Cd)			104.7		%		80-120	25-SEP-20
Calcium (Ca)			97.3		%		80-120	25-SEP-20
Chromium (Cr)			105.7		%		80-120	25-SEP-20
Cobalt (Co)			103.3		%		80-120	25-SEP-20
Copper (Cu)			103.3		%		80-120	25-SEP-20
Iron (Fe)			118.2		%		80-120	25-SEP-20
Lead (Pb)			105.4		%		80-120	25-SEP-20
Lithium (Li)			100.5		%		80-120	25-SEP-20
Magnesium (Mg)			112.0		%		80-120	25-SEP-20
Manganese (Mn)			103.2		%		80-120	25-SEP-20
Molybdenum (Mo)			98.1		%		80-120	25-SEP-20
Nickel (Ni)			103.0		%		80-120	25-SEP-20
Potassium (K)			100.9		%		80-120	25-SEP-20
Selenium (Se)			104.2		%		80-120	25-SEP-20
Silver (Ag)			99.0		%		80-120	25-SEP-20
Sodium (Na)			110.7		%		80-120	25-SEP-20
Strontium (Sr)			105.7		%		80-120	25-SEP-20
Sulfur (S)			105.1		%		80-120	25-SEP-20
Thallium (Tl)			99.2		%		80-120	25-SEP-20
Tin (Sn)			100.9		%		80-120	25-SEP-20
Titanium (Ti)			101.0		%		80-120	25-SEP-20

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-8 LCS								
Tungsten (W)			90.1		%		80-120	25-SEP-20
Uranium (U)			95.2		%		80-120	25-SEP-20
Vanadium (V)			107.5		%		80-120	25-SEP-20
Zinc (Zn)			100.5		%		80-120	25-SEP-20
Zirconium (Zr)			101.0		%		80-120	25-SEP-20
WG3412202-11 MB								
Aluminum (Al)			<50		mg/kg		50	25-SEP-20
Antimony (Sb)			<0.10		mg/kg		0.1	25-SEP-20
Arsenic (As)			<0.10		mg/kg		0.1	25-SEP-20
Barium (Ba)			<0.50		mg/kg		0.5	25-SEP-20
Beryllium (Be)			<0.10		mg/kg		0.1	25-SEP-20
Bismuth (Bi)			<0.20		mg/kg		0.2	25-SEP-20
Boron (B)			<5.0		mg/kg		5	25-SEP-20
Cadmium (Cd)			<0.020		mg/kg		0.02	25-SEP-20
Calcium (Ca)			<50		mg/kg		50	25-SEP-20
Chromium (Cr)			<0.50		mg/kg		0.5	25-SEP-20
Cobalt (Co)			<0.10		mg/kg		0.1	25-SEP-20
Copper (Cu)			<0.50		mg/kg		0.5	25-SEP-20
Iron (Fe)			<50		mg/kg		50	25-SEP-20
Lead (Pb)			<0.50		mg/kg		0.5	25-SEP-20
Lithium (Li)			<2.0		mg/kg		2	25-SEP-20
Magnesium (Mg)			<20		mg/kg		20	25-SEP-20
Manganese (Mn)			<1.0		mg/kg		1	25-SEP-20
Molybdenum (Mo)			<0.10		mg/kg		0.1	25-SEP-20
Nickel (Ni)			<0.50		mg/kg		0.5	25-SEP-20
Phosphorus (P)			<50		mg/kg		50	25-SEP-20
Potassium (K)			<100		mg/kg		100	25-SEP-20
Selenium (Se)			<0.20		mg/kg		0.2	25-SEP-20
Silver (Ag)			<0.10		mg/kg		0.1	25-SEP-20
Sodium (Na)			<50		mg/kg		50	25-SEP-20
Strontium (Sr)			<0.50		mg/kg		0.5	25-SEP-20
Sulfur (S)			<1000		mg/kg		1000	25-SEP-20
Thallium (Tl)			<0.050		mg/kg		0.05	25-SEP-20
Tin (Sn)			<2.0		mg/kg		2	25-SEP-20

Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-11 MB								
Titanium (Ti)			<1.0		mg/kg		1	25-SEP-20
Tungsten (W)			<0.50		mg/kg		0.5	25-SEP-20
Uranium (U)			<0.050		mg/kg		0.05	25-SEP-20
Vanadium (V)			<0.20		mg/kg		0.2	25-SEP-20
Zinc (Zn)			<2.0		mg/kg		2	25-SEP-20
Zirconium (Zr)			<1.0		mg/kg		1	25-SEP-20
WG3412202-6 MB								
Aluminum (Al)			<50		mg/kg		50	25-SEP-20
Antimony (Sb)			<0.10		mg/kg		0.1	25-SEP-20
Arsenic (As)			<0.10		mg/kg		0.1	25-SEP-20
Barium (Ba)			<0.50		mg/kg		0.5	25-SEP-20
Beryllium (Be)			<0.10		mg/kg		0.1	25-SEP-20
Bismuth (Bi)			<0.20		mg/kg		0.2	25-SEP-20
Boron (B)			<5.0		mg/kg		5	25-SEP-20
Cadmium (Cd)			<0.020		mg/kg		0.02	25-SEP-20
Calcium (Ca)			<50		mg/kg		50	25-SEP-20
Chromium (Cr)			<0.50		mg/kg		0.5	25-SEP-20
Cobalt (Co)			<0.10		mg/kg		0.1	25-SEP-20
Copper (Cu)			<0.50		mg/kg		0.5	25-SEP-20
Iron (Fe)			<50		mg/kg		50	25-SEP-20
Lead (Pb)			<0.50		mg/kg		0.5	25-SEP-20
Lithium (Li)			<2.0		mg/kg		2	25-SEP-20
Magnesium (Mg)			<20		mg/kg		20	25-SEP-20
Manganese (Mn)			<1.0		mg/kg		1	25-SEP-20
Molybdenum (Mo)			<0.10		mg/kg		0.1	25-SEP-20
Nickel (Ni)			<0.50		mg/kg		0.5	25-SEP-20
Phosphorus (P)			<50		mg/kg		50	25-SEP-20
Potassium (K)			<100		mg/kg		100	25-SEP-20
Selenium (Se)			<0.20		mg/kg		0.2	25-SEP-20
Silver (Ag)			<0.10		mg/kg		0.1	25-SEP-20
Sodium (Na)			<50		mg/kg		50	25-SEP-20
Strontium (Sr)			<0.50		mg/kg		0.5	25-SEP-20
Sulfur (S)			<1000		mg/kg		1000	25-SEP-20
Thallium (Tl)			<0.050		mg/kg		0.05	25-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R5237140								
WG3412202-6 MB								
Tin (Sn)			<2.0		mg/kg		2	25-SEP-20
Titanium (Ti)			<1.0		mg/kg		1	25-SEP-20
Tungsten (W)			<0.50		mg/kg		0.5	25-SEP-20
Uranium (U)			<0.050		mg/kg		0.05	25-SEP-20
Vanadium (V)			<0.20		mg/kg		0.2	25-SEP-20
Zinc (Zn)			<2.0		mg/kg		2	25-SEP-20
Zirconium (Zr)			<1.0		mg/kg		1	25-SEP-20
MOISTURE-CL	**Soil**							
Batch R5238042								
WG3411562-3 DUP		**L2505807-1**						
Moisture		44.3	43.8		%	1.2	20	24-SEP-20
WG3411562-2 LCS								
Moisture			98.3		%		90-110	24-SEP-20
WG3411562-1 MB								
Moisture			<0.25		%		0.25	24-SEP-20
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-2 DUP		**L2505807-1**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	26-SEP-20
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	26-SEP-20
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	26-SEP-20
Acridine		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Benzo(b&j)fluoranthene		0.015	0.020		mg/kg	32	50	26-SEP-20
Benzo(e)pyrene		0.014	0.017		mg/kg	15	50	26-SEP-20
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Chrysene		0.035	0.041		mg/kg	16	50	26-SEP-20
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	26-SEP-20
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
2-Methylnaphthalene		0.038	0.051		mg/kg	28	50	26-SEP-20
Naphthalene		0.021	0.026		mg/kg	21	50	26-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-2 DUP		**L2505807-1**						
Perylene		0.012	0.014		mg/kg	15	50	26-SEP-20
Phenanthrene		0.078	0.093		mg/kg	18	50	26-SEP-20
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	26-SEP-20
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	26-SEP-20
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	26-SEP-20
WG3413082-3 IRM		**ALS PAH RM2**						
Acenaphthene			102.6		%		60-130	26-SEP-20
Acenaphthylene			110.5		%		60-130	26-SEP-20
Anthracene			111.9		%		60-130	26-SEP-20
Acridine			104.0		%		60-130	26-SEP-20
Benz(a)anthracene			99.4		%		60-130	26-SEP-20
Benzo(a)pyrene			95.1		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			93.6		%		60-130	26-SEP-20
Benzo(e)pyrene			100.5		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			90.7		%		60-130	26-SEP-20
Benzo(k)fluoranthene			82.0		%		60-130	26-SEP-20
Chrysene			98.8		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			92.5		%		60-130	26-SEP-20
Fluoranthene			93.8		%		60-130	26-SEP-20
Fluorene			97.9		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			114.6		%		60-130	26-SEP-20
2-Methylnaphthalene			92.2		%		60-130	26-SEP-20
Naphthalene			97.3		%		50-130	26-SEP-20
Perylene			93.2		%		60-130	26-SEP-20
Phenanthrene			96.5		%		60-130	26-SEP-20
Pyrene			95.9		%		60-130	26-SEP-20
1-Methylnaphthalene			91.3		%		60-130	26-SEP-20
WG3413082-5 IRM		**ALS PAH RM2**						
Acenaphthene			102.8		%		60-130	26-SEP-20
Acenaphthylene			112.1		%		60-130	26-SEP-20
Anthracene			112.4		%		60-130	26-SEP-20
Acridine			101.8		%		60-130	26-SEP-20
Benz(a)anthracene			99.5		%		60-130	26-SEP-20
Benzo(a)pyrene			93.4		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			93.3		%		60-130	26-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-5 IRM		**ALS PAH RM2**						
Benzo(e)pyrene			99.6		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			88.7		%		60-130	26-SEP-20
Benzo(k)fluoranthene			89.9		%		60-130	26-SEP-20
Chrysene			99.9		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			86.7		%		60-130	26-SEP-20
Fluoranthene			94.7		%		60-130	26-SEP-20
Fluorene			97.0		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			108.7		%		60-130	26-SEP-20
2-Methylnaphthalene			94.1		%		60-130	26-SEP-20
Naphthalene			101.2		%		50-130	26-SEP-20
Perylene			89.0		%		60-130	26-SEP-20
Phenanthrene			96.6		%		60-130	26-SEP-20
Pyrene			96.2		%		60-130	26-SEP-20
1-Methylnaphthalene			93.0		%		60-130	26-SEP-20
WG3413082-9 IRM		**ALS PAH RM2**						
Acenaphthene			89.7		%		60-130	26-SEP-20
Acenaphthylene			102.9		%		60-130	26-SEP-20
Anthracene			105.1		%		60-130	26-SEP-20
Acridine			99.5		%		60-130	26-SEP-20
Benz(a)anthracene			92.7		%		60-130	26-SEP-20
Benzo(a)pyrene			89.1		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			87.4		%		60-130	26-SEP-20
Benzo(e)pyrene			93.7		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			80.0		%		60-130	26-SEP-20
Benzo(k)fluoranthene			69.2		%		60-130	26-SEP-20
Chrysene			89.3		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			77.6		%		60-130	26-SEP-20
Fluoranthene			84.8		%		60-130	26-SEP-20
Fluorene			86.5		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			105.8		%		60-130	26-SEP-20
2-Methylnaphthalene			83.9		%		60-130	26-SEP-20
Naphthalene			84.9		%		50-130	26-SEP-20
Perylene			95.5		%		60-130	26-SEP-20
Phenanthrene			87.9		%		60-130	26-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-9 IRM		**ALS PAH RM2**						
Pyrene			86.7		%		60-130	26-SEP-20
1-Methylnaphthalene			80.2		%		60-130	26-SEP-20
WG3413082-10 LCS								
Acenaphthene			100.3		%		60-130	26-SEP-20
Acenaphthylene			91.6		%		60-130	26-SEP-20
Anthracene			90.2		%		60-130	26-SEP-20
Acridine			87.5		%		60-130	26-SEP-20
Benz(a)anthracene			98.6		%		60-130	26-SEP-20
Benzo(a)pyrene			89.5		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			97.8		%		60-130	26-SEP-20
Benzo(e)pyrene			96.5		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			87.1		%		60-130	26-SEP-20
Benzo(k)fluoranthene			90.2		%		60-130	26-SEP-20
Chrysene			93.2		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			87.2		%		60-130	26-SEP-20
Fluoranthene			93.7		%		60-130	26-SEP-20
Fluorene			92.4		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			100.6		%		60-130	26-SEP-20
2-Methylnaphthalene			97.4		%		60-130	26-SEP-20
Naphthalene			102.0		%		50-130	26-SEP-20
Perylene			90.5		%		60-130	26-SEP-20
Phenanthrene			99.3		%		60-130	26-SEP-20
Pyrene			97.8		%		60-130	26-SEP-20
1-Methylnaphthalene			95.4		%		60-130	26-SEP-20
Quinoline			90.7		%		60-130	26-SEP-20
WG3413082-4 LCS								
Acenaphthene			105.8		%		60-130	26-SEP-20
Acenaphthylene			102.6		%		60-130	26-SEP-20
Anthracene			102.1		%		60-130	26-SEP-20
Acridine			93.8		%		60-130	26-SEP-20
Benz(a)anthracene			106.1		%		60-130	26-SEP-20
Benzo(a)pyrene			97.2		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			102.0		%		60-130	26-SEP-20
Benzo(e)pyrene			105.7		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			95.9		%		60-130	26-SEP-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-4 LCS								
Benzo(k)fluoranthene			102.2		%		60-130	26-SEP-20
Chrysene			101.8		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			94.7		%		60-130	26-SEP-20
Fluoranthene			102.5		%		60-130	26-SEP-20
Fluorene			100.0		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			106.3		%		60-130	26-SEP-20
2-Methylnaphthalene			103.2		%		60-130	26-SEP-20
Naphthalene			111.5		%		50-130	26-SEP-20
Perylene			97.9		%		60-130	26-SEP-20
Phenanthrene			106.7		%		60-130	26-SEP-20
Pyrene			105.6		%		60-130	26-SEP-20
1-Methylnaphthalene			104.4		%		60-130	26-SEP-20
Quinoline			97.6		%		60-130	26-SEP-20
WG3413082-6 LCS								
Acenaphthene			125.1		%		60-130	26-SEP-20
Acenaphthylene			115.0		%		60-130	26-SEP-20
Anthracene			110.9		%		60-130	26-SEP-20
Acridine			109.7		%		60-130	26-SEP-20
Benz(a)anthracene			121.5		%		60-130	26-SEP-20
Benzo(a)pyrene			110.3		%		60-130	26-SEP-20
Benzo(b&j)fluoranthene			118.8		%		60-130	26-SEP-20
Benzo(e)pyrene			119.7		%		60-130	26-SEP-20
Benzo(g,h,i)perylene			108.8		%		60-130	26-SEP-20
Benzo(k)fluoranthene			113.1		%		60-130	26-SEP-20
Chrysene			116.3		%		60-130	26-SEP-20
Dibenz(a,h)anthracene			108.9		%		60-130	26-SEP-20
Fluoranthene			117.7		%		60-130	26-SEP-20
Fluorene			115.1		%		60-130	26-SEP-20
Indeno(1,2,3-c,d)pyrene			114.3		%		60-130	26-SEP-20
2-Methylnaphthalene			120.5		%		60-130	26-SEP-20
Naphthalene			122.7		%		50-130	26-SEP-20
Perylene			114.6		%		60-130	26-SEP-20
Phenanthrene			123.8		%		60-130	26-SEP-20
Pyrene			121.6		%		60-130	26-SEP-20

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-6 LCS								
1-Methylnaphthalene			119.7		%		60-130	26-SEP-20
Quinoline			113.2		%		60-130	26-SEP-20
WG3413082-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	25-SEP-20
Acenaphthylene			<0.0050		mg/kg		0.005	25-SEP-20
Anthracene			<0.0040		mg/kg		0.004	25-SEP-20
Acridine			<0.010		mg/kg		0.01	25-SEP-20
Benz(a)anthracene			<0.010		mg/kg		0.01	25-SEP-20
Benzo(a)pyrene			<0.010		mg/kg		0.01	25-SEP-20
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	25-SEP-20
Benzo(e)pyrene			<0.010		mg/kg		0.01	25-SEP-20
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	25-SEP-20
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	25-SEP-20
Chrysene			<0.010		mg/kg		0.01	25-SEP-20
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	25-SEP-20
Fluoranthene			<0.010		mg/kg		0.01	25-SEP-20
Fluorene			<0.010		mg/kg		0.01	25-SEP-20
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	25-SEP-20
2-Methylnaphthalene			<0.010		mg/kg		0.01	25-SEP-20
Naphthalene			<0.010		mg/kg		0.01	25-SEP-20
Perylene			<0.010		mg/kg		0.01	25-SEP-20
Phenanthrene			<0.010		mg/kg		0.01	25-SEP-20
Pyrene			<0.010		mg/kg		0.01	25-SEP-20
1-Methylnaphthalene			<0.050		mg/kg		0.05	25-SEP-20
Quinoline			<0.050		mg/kg		0.05	25-SEP-20
Surrogate: d8-Naphthalene			98.9		%		50-130	25-SEP-20
Surrogate: d10-Acenaphthene			101.0		%		60-130	25-SEP-20
Surrogate: d10-Phenanthrene			99.0		%		60-130	25-SEP-20
Surrogate: d12-Chrysene			106.6		%		60-130	25-SEP-20
WG3413082-7 MB								
Acenaphthene			<0.0050		mg/kg		0.005	26-SEP-20
Acenaphthylene			<0.0050		mg/kg		0.005	26-SEP-20
Anthracene			<0.0040		mg/kg		0.004	26-SEP-20
Acridine			<0.010		mg/kg		0.01	26-SEP-20
Benz(a)anthracene			<0.010		mg/kg		0.01	26-SEP-20

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-CL	**Soil**							
Batch R5238377								
WG3413082-7 MB								
Benzo(a)pyrene			<0.010		mg/kg		0.01	26-SEP-20
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	26-SEP-20
Benzo(e)pyrene			<0.010		mg/kg		0.01	26-SEP-20
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	26-SEP-20
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	26-SEP-20
Chrysene			<0.010		mg/kg		0.01	26-SEP-20
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	26-SEP-20
Fluoranthene			<0.010		mg/kg		0.01	26-SEP-20
Fluorene			<0.010		mg/kg		0.01	26-SEP-20
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	26-SEP-20
2-Methylnaphthalene			<0.010		mg/kg		0.01	26-SEP-20
Naphthalene			<0.010		mg/kg		0.01	26-SEP-20
Perylene			<0.010		mg/kg		0.01	26-SEP-20
Phenanthrene			<0.010		mg/kg		0.01	26-SEP-20
Pyrene			<0.010		mg/kg		0.01	26-SEP-20
1-Methylnaphthalene			<0.050		mg/kg		0.05	26-SEP-20
Quinoline			<0.050		mg/kg		0.05	26-SEP-20
Surrogate: d8-Naphthalene			104.4		%		50-130	26-SEP-20
Surrogate: d10-Acenaphthene			108.2		%		60-130	26-SEP-20
Surrogate: d10-Phenanthrene			101.6		%		60-130	26-SEP-20
Surrogate: d12-Chrysene			110.0		%		60-130	26-SEP-20
PH-1:2-CL	**Soil**							
Batch R5238676								
WG3412993-12 DUP		**L2505807-15**						
pH (1:2 soil:water)		8.29	8.30	J	pH	0.01	0.2	26-SEP-20
WG3412993-11 IRM		**SAL-STD10**						
pH (1:2 soil:water)			7.73		pH		7.4-8	26-SEP-20
WG3412993-8 IRM		**SAL-STD10**						
pH (1:2 soil:water)			7.70		pH		7.4-8	26-SEP-20
WG3412993-10 LCS								
pH (1:2 soil:water)			7.00		pH		6.8-7.2	26-SEP-20
WG3412993-7 LCS								
pH (1:2 soil:water)			7.01		pH		6.8-7.2	26-SEP-20
PSA-PIPET-DETAIL-SK	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R5241413								
WG3412293-1 DUP		**L2505807-13**						
% Gravel (>2mm)		<1.0	<1.0	RPD-NA	%	N/A	5	28-SEP-20
% Sand (2.00mm - 1.00mm)		1.1	1.5	J	%	0.4	5	28-SEP-20
% Sand (1.00mm - 0.50mm)		20.8	23.0	J	%	2.1	5	28-SEP-20
% Sand (0.50mm - 0.25mm)		54.0	53.8	J	%	0.2	5	28-SEP-20
% Sand (0.25mm - 0.125mm)		14.3	12.5	J	%	1.8	5	28-SEP-20
% Sand (0.125mm - 0.063mm)		3.5	3.0	J	%	0.4	5	28-SEP-20
% Silt (0.063mm - 0.0312mm)		2.5	2.4	J	%	0.1	5	28-SEP-20
% Silt (0.0312mm - 0.004mm)		2.6	2.6	J	%	0.0	5	28-SEP-20
% Clay (<4um)		1.1	1.1	J	%	0.0	5	28-SEP-20
WG3412293-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			2.7		%		0-7.6	28-SEP-20
% Sand (1.00mm - 0.50mm)			4.1		%		0-8.9	28-SEP-20
% Sand (0.50mm - 0.25mm)			9.8		%		5.3-15.3	28-SEP-20
% Sand (0.25mm - 0.125mm)			13.9		%		10-20	28-SEP-20
% Sand (0.125mm - 0.063mm)			12.2		%		7.3-17.3	28-SEP-20
% Silt (0.063mm - 0.0312mm)			15.9		%		9.9-19.9	28-SEP-20
% Silt (0.0312mm - 0.004mm)			22.8		%		17.6-27.6	28-SEP-20
% Clay (<4um)			18.5		%		13.4-23.4	28-SEP-20
Batch R5242117								
WG3412291-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			2.5		%		0-7.6	29-SEP-20
% Sand (1.00mm - 0.50mm)			3.8		%		0-8.9	29-SEP-20
% Sand (0.50mm - 0.25mm)			9.9		%		5.3-15.3	29-SEP-20
% Sand (0.25mm - 0.125mm)			14.9		%		10-20	29-SEP-20
% Sand (0.125mm - 0.063mm)			13.1		%		7.3-17.3	29-SEP-20
% Silt (0.063mm - 0.0312mm)			14.6		%		9.9-19.9	29-SEP-20
% Silt (0.0312mm - 0.004mm)			22.4		%		17.6-27.6	29-SEP-20
% Clay (<4um)			18.7		%		13.4-23.4	29-SEP-20

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID: **GHO LAEMP Sept 2020** | TURNAROUND TIME:

PROJECT/CLIENT INFO

Facility Name	REP
Project Manager	Cait Good
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Jings@minnow.ca	x	x	x
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jtester@minnow.ca	x	x	x

PO number: 689999

SAMPLE DETAILS / ANALYSIS REQUESTED

Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

L2505807-COFC

	Sample ID	Sample Location	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	C-TOC-SK	MET-CCME+FULL-CL	MOISTURE-CL - % Moisture	PSA-PIPET-DETAIL-SK Particle Size	PAH-TMB-D/A-MS-CL-PAHs
Filtered									N	N	N	N	N
Preservation									NONE	NONE	NONE	NONE	NONE
1	RG_ELUGH_SE-1-2020-09-17-0911	RG_ELUGH	SE	No	9/17/2020	9:11	G	2	X	X	X	X	X
2	RG_ELUGH_SE-2-2020-09-17-1040	RG_ELUGH	SE	No	9/17/2020	10:40	G	2	X	X	X	X	X
3	RG_ELUGH_SE-3-2020-09-17-1220	RG_ELUGH	SE	No	9/17/2020	12:20	G	2	X	X	X	X	X
4	RG_GH-SCW3_SE-1-2020-09-13-1610	RG_GH-SCW3	SE	No	9/13/2020	16:10	G	2	X	X	X	X	X
5	RG_GH-SCW3_SE-2-2020-09-13-1620	RG_GH-SCW3	SE	No	9/13/2020	16:20	G	2	X	X	X	X	X
6	RG_GH-SCW3_SE-3-2020-09-13-1630	RG_GH-SCW3	SE	No	9/13/2020	16:30	G	2	X	X	X	X	X
7	RG_GH-SCW3_SE-4-2020-09-16-1500	RG_GH-SCW3	SE	No	9/16/2020	15:00	G	2	X	X	X	X	X
8	RG_GH-SCW3_SE-5-2020-09-16-1515	RG_GH-SCW3	SE	No	9/16/2020	15:15	G	2	X	X	X	X	X
9	RG_EL20_SE-1-2020-09-15-1244	RG_EL20	SE	No	9/15/2020	12:44	G	2	X	X	X	X	X
10	RG_EL20_SE-2-2020-09-16-0855	RG_EL20	SE	No	9/16/2020	8:55	G	2	X	X	X	X	X
11	RG_EL20_SE-3-2020-09-16-1040	RG_EL20	SE	No	9/16/2020	10:40	G	2	X	X	X	X	X
12	RG_EL20_SE-4-2020-09-16-1250	RG_EL20	SE	No	9/16/2020	12:50	G	2	X	X	X	X	X
13	RG_EL20_SE-5-2020-09-16-1353	RG_EL20	SE	No	9/16/2020	13:53	G	2	X	X	X	X	X
14	RG_RIVER_SE-5-2020-09-15-1244	RG_RIVER	SE	No	15-Sep-20	12:44	G	2	X	X	X	X	X
15	RG_RIVER_SE-5-2020-09-17-1040	RG_RIVER	SE	No	17-Sep-20	10:40	G	2	X	X	X	X	X

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
Jennifer Ings	September 18, 2020	DK	9/19 0830

5°C

NB OF BOTTLES RETURNED/DESCRIPTION

Regular (default)	x
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Jennifer Ings	Mobile #	519-500-3444
Sampler's Signature		Date/Time	September 18, 2020

APPENDIX I
BIOLOGICAL TRIGGERS

APPENDIX I BIOLOGICAL TRIGGERS

I1 INTRODUCTION

I1.1 Background

Biological triggers for potential monitoring and management action are required as part of Teck's Adaptive Management Plan (AMP; Teck 2018). Generally, triggers are intended as a simple way to identify potential unexpected monitoring results that may require management action. Additionally, information provided from the analysis of biological triggers may lead to responses under the AMP response framework if necessary, and as such would be reported within the annual AMP report. Draft biological triggers were developed in the 2018 AMP (Teck 2018) under Management Question 5 for three measurement endpoints:

- Percent EPT (% EPT; Ephemeroptera, Plecoptera, and Trichoptera) – based on travelling kick samples (CABIN protocol), generally three replicates per location per sampling event.
- Benthic invertebrate tissue selenium (BIT Se) – generally several replicates collected per location per sampling event, where each replicate is a composite sample of invertebrates.
- Westslope cutthroat trout muscle tissue selenium (WCT Se) – generally 8 replicates collected per location per sampling event, where each replicate corresponds to a sample from a single fish.

These three endpoints are evaluated (where data are available) in other sections of the Local Aquatic Effects Monitoring Program (LAEMP) and the Regional Aquatic Effects Monitoring Program (RAEMP) reports, and therefore there is some degree of redundancy in the analysis of biological triggers. Data collected during the RAEMP is incorporated into the aquatic data integration tool (ADIT), which together is used to characterize the state of the aquatic environment. Biological trigger analyses are not identical to the evaluations in the LAEMP, RAEMP and, by extension, the ADIT, and are expected to be complementary to these other analyses. The methods applied for biological trigger analyses in this report reflect refinements made in consultation with the EMC since the draft triggers were developed in the 2018 AMP (Teck 2018). The 2020 GHO LAEMP represents the first time that biological triggers have been evaluated and reported (i.e., implemented) in LAEMP reports. Through future iterative biological trigger evaluations, the process and/or biological triggers may adjust over time.

I2 METHODS

I2.1 Overview

As outlined in Section I1.1, analyses for biological triggers are meant to be complementary to other analyses conducted in the LAEMPs and RAEMP. For the 2020 GHO LAEMP, biological trigger analyses only included two of the three measurement endpoints (% EPT and BIT Se) since fish tissue sampling was not conducted, as per the GHO LAEMP study design.

For the purpose of application of the biological triggers, expectations for the endpoints evaluated (both the % EPT and BIT Se for the 2020 GHO LAEMP) were based on projected water quality, not on measured water quality. Thus, the triggers should detect biological results that were unexpected, regardless of whether those results are due to unexpected water quality or due to unexpected relationships between water quality and biological endpoints. Biological triggers were therefore only applied at locations where water quality projections were available[1]. Specifically, two of the mine-exposed areas (RG_THCK and GH_ERC) included in the 2020 GHO LAEMP were evaluated for biological trigger events. Data for other areas studied under the GHO LAEMP (GH_ER2, GH_ERSC4, GH_ER1A, GH_ERSC5, RG_GH-SCW3, GH_ERSC2, and RG_SCDTC) were not available to be evaluated relative to biological triggers but were assessed elsewhere as part of the main 2020 GHO LAEMP report.

Methodological details are discussed for each of the biological trigger metrics below.

I2.2 Percent EPT

Data for percent EPT were compared to:

- Normal range: The lower limit of habitat-adjusted normal range (2.5th percentile).
- Expectations: The % EPT corresponding to the predicted ADIT score. The predicted ADIT scores correspond to potential effects on benthic invertebrate community (BIC) endpoints, based on relationships between water quality projections (for nitrate, sulphate and cadmium)[2] and invertebrate toxicity endpoints originally developed for the EVWQP (Teck 2014). A predicted ADIT score of 3 corresponds to 50% or greater

[1] Biological triggers have not been developed for lentic habitats, because water quality projections are not generally available for lentic locations. For two of the three endpoints (BIT Se and WCT Se; % EPT not relevant in lentic areas), if projections become available for lentic habitats then triggers could be developed in future, using the available lentic bioaccumulation model from water to invertebrates (updated in 2020), and the invertebrate to fish bioaccumulation model (which should be applicable to both lotic and lentic habitats).

[2] Notes: (a) Selenium not included because selenium effects on BIC endpoints were not expected. (b) Projections were based on the highest maximum monthly mean across all flow scenarios (low, average, high).

effects to reproduction of the water flea *Ceriodaphnia dubia*, 2 corresponds to 20 to 50% effects, 1 corresponds to 10 to 20% effects, and 0 corresponds to effect levels of 10% or less. Predicted % EPT values are then converted into a value against which the measured % EPT values can be compared as follows: An ADIT score of 0 corresponds to expected % EPT ≥ the 10th percentile of the habitat-adjusted normal range; an ADIT score of 1 corresponds to expected % EPT between the 10th percentile and the 2.5th percentile of the habitat-adjusted normal range (and is therefore identical in application to the lower limit of normal range); an ADIT score of 2 corresponds to expected % EPT between the 2.5th percentile and half of the 2.5th percentile of the habitat-adjusted normal range; finally, an ADIT score of 3 corresponds to expected % EPT ≤ half of the 2.5th percentile and ≥ 0. Individual replicate habitat-adjusted normal ranges were used at each location for establishing the % EPT limits associated with each ADIT score. In summary, this component of the biological trigger for % EPT asks whether the measured ADIT score –-calculated based on measured % EPT relative to normal ranges– is greater than the ADIT score that was predicted based on water quality projections.

Benthic invertebrate community data for % EPT collected in September for the 2020 GHO LAEMP were included in the biological trigger analysis.

I2.3 Benthic Invertebrate Tissue Selenium (BIT Se)

Data for BIT Se were compared to:

- Normal range: The upper limit of regional normal range (97.5th percentile).
- Expectations: The upper limit of the 95% prediction interval based on the water to BIT bioaccumulation model. The model was originally developed in the EVWQP (Golder 2014) was updated (Golder 2020) and the updated best fit relationship is $log_{10}[Se]_{inv} = 0.720 + 0.071\ \times log_{10}[Se]_{aq}$. Prediction intervals were estimated for BIT Se for individual replicates, taking into account that the data points for the original model were based on geometric means rather than individual replicates (Azimuth 2021, In Preparation).

Benthic invertebrate tissue selenium data collected in September for the 2020 GHO LAEMP were included in the biological trigger analysis.

Although effects benchmarks are not part of the trigger, they are relevant for interpreting potential significance and responses. Consequently, the EVWQP Level 1, 2, and 3 benchmarks for the most sensitive receptor (juvenile fish via dietary exposure) are included in plots (11, 18, and 26 mg/kg respectively).

I3 RESULTS

I3.1 Percent EPT

Individual replicates for the % EPT endpoint for the two mine-exposed areas (RG_THCK and GH_ERC) were each assessed against their respective biological trigger values for the September sampling period (Appendix Table I.1, Appendix Figure I.1). Neither mine-exposed area (RG_THCK with three replicates and GH_ERC with five replicates) had replicates that reached the biological trigger, and therefore no action is required based on this biological trigger.

I3.2 Benthic Invertebrate Tissue Selenium (BIT Se)

Benthic invertebrate tissue selenium concentrations for the two mine-exposed area (RG_THCK and GH_ERC) were assessed against their respective biological trigger for the September sampling period (Appendix Table I.2, Appendix Figure I.2). In Thompson Creek (RG_THCK), all three replicates exceeded the biological trigger, with concentrations of selenium in tissue ranging from 17 to 59 mg/kg dw. This is consistent with previous findings that biological monitoring results collected downstream of the Thompson Creek sedimentation/buffer ponds were not as expected (Teck 2020b). This issue is currently being addressed through the AMP response framework (Section 1.5; Teck 2020b). In the main stem Elk River station downstream of GHO (GH_ERC), one of five replicates had a selenium concentration in tissue of 13 mg/kg dw, which exceeded the normal range and exceeded the upper 95% prediction limit of the biological trigger (11.7 mg/kg) by 10.8%. Given that only one of the four replicates marginally exceed the biological trigger, this result likely does not warrant further investigation for GH_ERC.

Table I.1: Biological Trigger Analysis for % EPT in Thompson Creek (RG_THCK) and the Elk River (GH_ERC), September 2020

Waterbody		Area	Stream Type	Replicate	Reported Value	ADIT Value [a]	Lower 2.5th Percentile of the Habitat Adjusted Normal Range
Thompson Creek	Mine-exposed	RG_THCK/ GH_TC2	T	1	28.4	0	66.1
				2	28.7	0	67.4
				3	26.0	0	66.9
Elk River	Mine-exposed	GH_ERC/ RG_EL20	M	1	93.5	78.62	73.1
				2	85.5	77.61	72.5
				3	81.5	77.34	72.3
				4	83.7	78.75	73.5
				5	95.7	81.12	76.3

Shaded cells signify those individual replicates that reached a biological trigger (i.e. lower than both the ADIT value [as based on predicted water quality] and the lower 2.5th percentile of habitat-adjusted normal range).

Notes: % EPT = percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). ADIT = Aquatic Data Integration Tool. T = tributary. M = main stem.

[a] Information pertaining to the calculation of the ADIT value is shown in Appendix I.

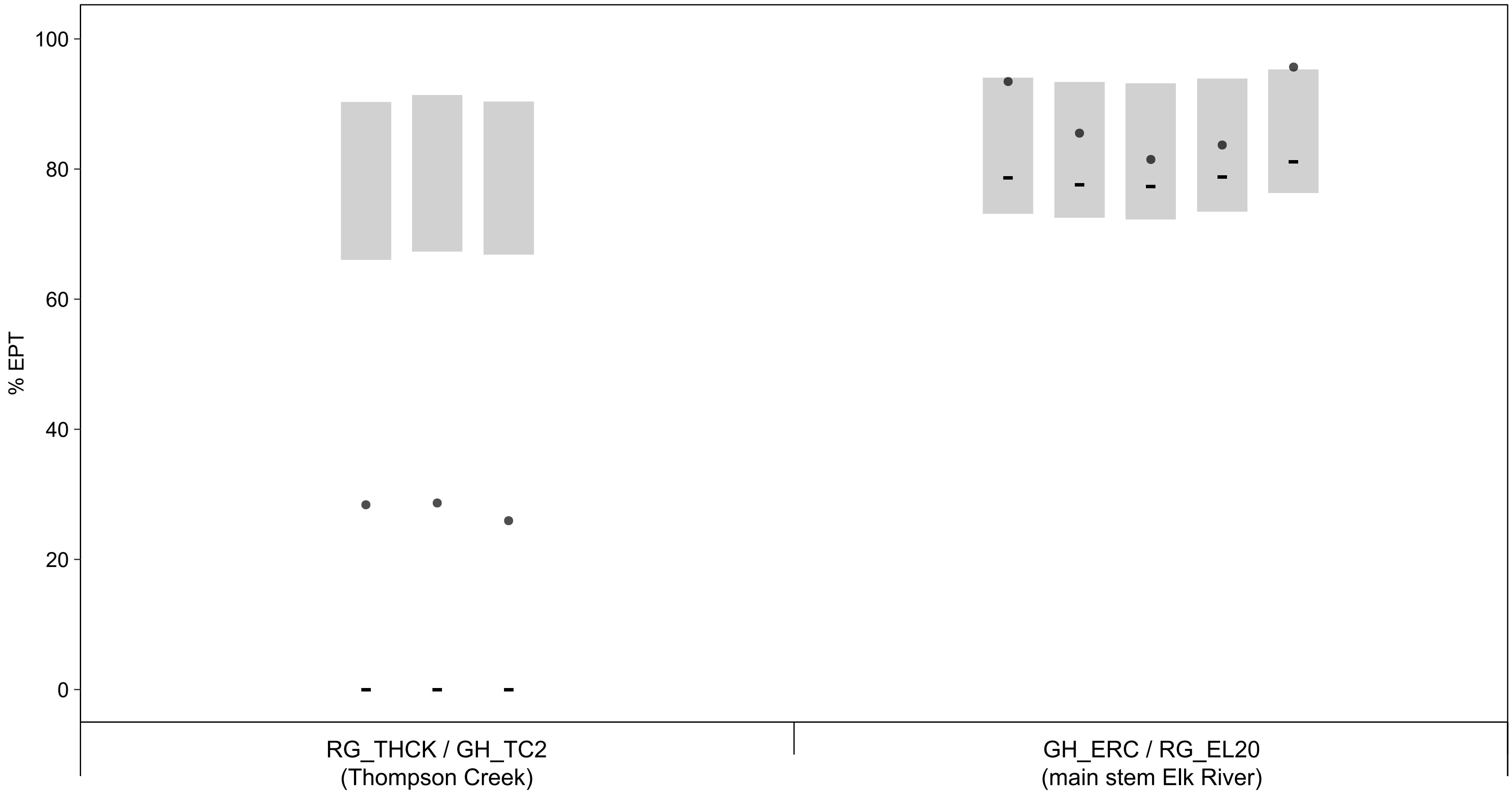

Figure I.1: **io o ica ri er Ana sis for in ine osed Areas G om son ree and G i er Se tem er 2 2**

Notes: EPT = Ephemeroptera, Plecoptera, Trichoptera. Black bars indicate the lower limit of the predicted Aquatic Data Integration Tool (ADIT) score for the location. Black dots represent values that do not exceed the trigger (below 2.5th percentile of NR and below lower limit of predicted ADIT score). Gray shading represents the habitat-adjusted normal range for each replicate.

Table I.2: Biological Trigger Analysis for Selenium Concentrations in Benthic Invertebrate Tissue in Thompson Creek (RG_THCK) and the Elk River (GH_ERC), September 2020

Waterbody		Stream Type	Area	Date	Replicate	Predicted Selenium Water Concentration (mg/L)	Benthic Invertebrate Selenium Tissue		
							Upper 95% Prediction Limit (mg/kg dw)	Upper 97.5th Percentile of Normal Range (mg/kg dw)	Reported Concentration (mg/kg dw)
Thompson Creek	Mine-exposed	T	RG_THCK/ GH_TC2	10-Sep-20	1	189	15.4	8.7	59
		T	RG_THCK/ GH_TC2	10-Sep-20	2	189	15.4	8.7	17
		T	RG_THCK/ GH_TC2	10-Sep-20	3	189	15.4	8.7	25
Elk River	Mine-exposed	M	GH_ERC/ RG_EL20	15-Sep-20	1	4.30	11.7	8.7	9.5
		M	GH_ERC/ RG_EL20	16-Sep-20	2	4.30	11.7	8.7	13
		M	GH_ERC/ RG_EL20	16-Sep-20	3	4.30	11.7	8.7	8.8
		M	GH_ERC/ RG_EL20	16-Sep-20	4	4.30	11.7	8.7	9.7
		M	GH_ERC/ RG_EL20	15-Sep-20	5	4.30	11.7	8.7	7.3

Shaded cells signify those individual replicates that were associated with a biological trigger (i.e. higher than both the upper 95% prediction limit [as based on predicted water quality] and the upper 97.5th percentile of normal range).

Notes: T = tributary. M = main stem.

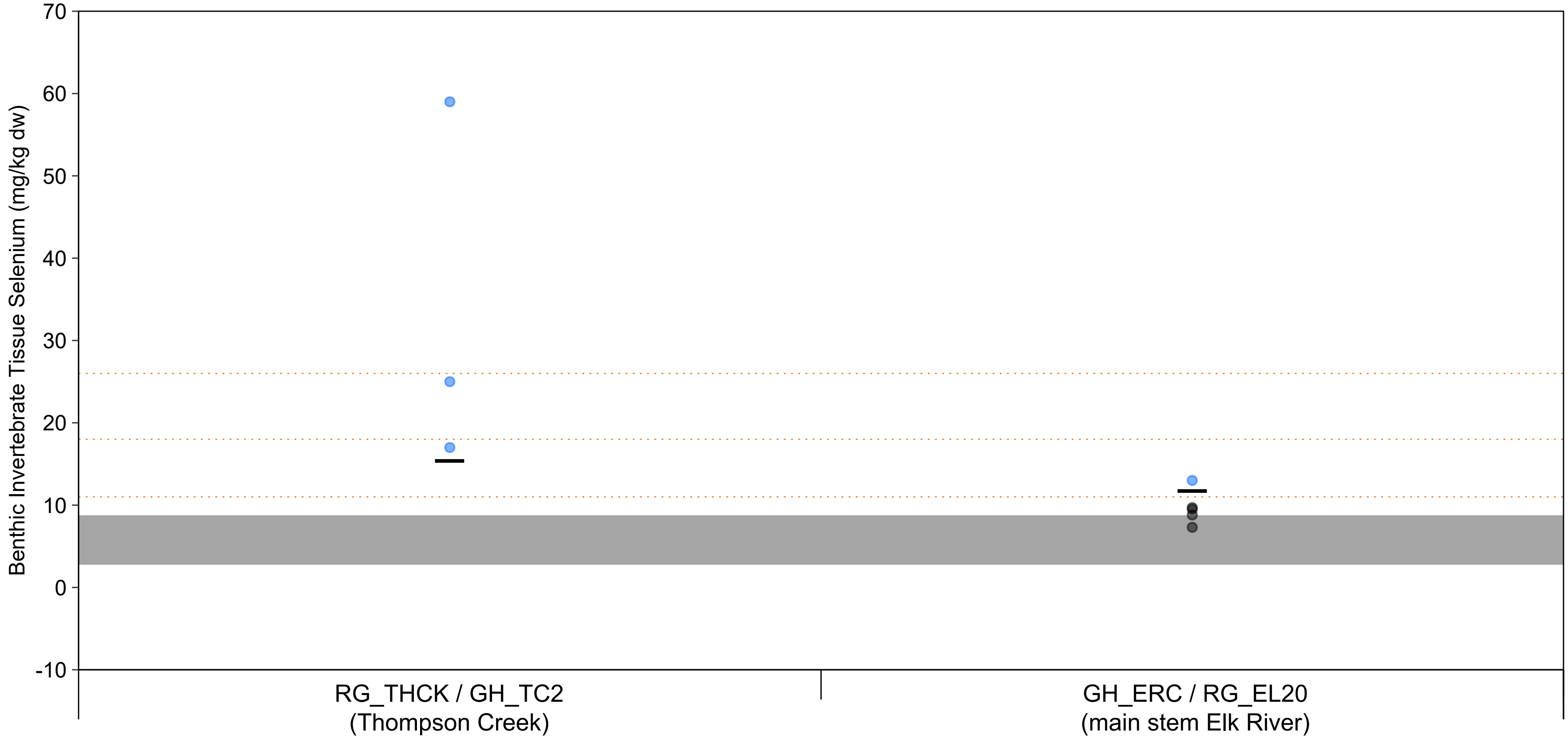

Figure I 2: io o ica ri er Ana sis for Se enium oncentrations in ent ic In erte rate issue in ine osed Areas G om son ree and G i er Se tem er 2 2

Notes: mg/kg dw = milligrams per kilogram dry weight. Black bars indicate the upper 95th prediction interval of the bioaccumulation model. Blue dots represent values exceeding the trigger (above the 97.5th percentile of normal range and above upper 95% prediction interval). Black dots represent values that do not exceed the trigger. Dotted lines indicate EVWQP benchmarks (11, 18, and 26 mg/kg, respectively) for juvenile fish. Gray shading represents the reference area normal range, defined as the 2.5th and 97.5th percentiles of the distribution of reference area data (pooled 1996 to 2019 data) reported in the RAEMP (Minnow 2020).

I4 SUMMARY

Neither of the two mine-exposed areas (RG_THCK and GH_ERC) exceeded the % EPT biological trigger, and therefore did not show "unexpected" benthic invertebrate community conditions in 2020. The biological trigger for benthic invertebrate tissue concentrations of selenium was reached in three of three replicates at area RG_THCK and in one of five replicates at area GH_ERC. The biological trigger exceedances for the replicates at RG_THCK are likely related to concentrations of aqueous non-selenate selenium species (Section 6.3). Aqueous non-selenate species are known to be more readily accumulated by aquatic biota than the oxidized form selenate (i.e., more bioavailable). Higher than expected concentrations of selenium in benthic invertebrate tissue at RG_THCK have been identified prior to 2020. In response to this, AMP response actions in 2019 focused on initiating further investigations, which are outlined in detail in the 2019 Annual AMP report (Teck 2020b). Briefly, the Selenium Speciation Monitoring Program will investigate the current hypothesis that suggests the elevated selenium in benthic invertebrate tissue may be caused by increased aqueous concentrations of non-selenate species, which may be produced in upstream sedimentation ponds (Section 1.5; Teck 2020b). Concurrent with that investigation of cause, Teck is advancing several possible adjustments, which may include habitat management and/or pond management modifications (Teck 2020b). Teck plans to implement fish-relocation projects within the Thompson sedimentation pond systems to reduce the potential risk to fish (Teck 2020b).

As discussed in the main report, biological triggers are consistent with the findings of the GHO LAEMP. Current biological triggers were sufficient to identify monitoring areas where biological responses are occurring, based on the integrated assessment conducted in the LAEMP, and no additional triggers are recommended at this time.

I5 REFERENCES

Azimuth (Azimuth Consulting Group Inc). 2021 (In Prep). Development of biological triggers for the Elk Valley Adaptive Management Plan.

Golder (Golder Associates). 2014. Benchmark Derivation Report for Selenium. Annex E of the Elk Valley Water Quality Plan. Prepared for Teck Coal Limited. July.

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