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Technical Report Overview

Report: Koocanusa Reservoir Monitoring Program Annual Report, 2018

Overview: This annual report provides an overview of the environmental monitoring activities that were conducted in 2018 in the Canadian portion of Koocanusa Reservoir and a summary of the associated results. This report is required under Permit 107517.

This report was prepared by Minnow Environmental Inc.

For More Information

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

Koocanusa Reservoir Monitoring Program Annual Report, 2018

Prepared for:
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Prepared by:
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June 2019

Koocanusa Reservoir Monitoring Program Annual Report, 2018

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EXECUTIVE SUMMARY

Background

In 2014, the Elk Valley Water Quality Plan (EVWQP) served as a basis for issuance of Permit 107517 ("the Permit") from the British Columbia Ministry of Environment and Climate Change Strategy (ENV; formerly Ministry of Environment [MOE]). The Permit specifies water quality limits and site performance objectives (SPOs) for monitoring stations located downstream from the mines and the requirement to implement a Regional Aquatic Effects Monitoring Program (RAEMP). Overarching objectives of the RAEMP are to monitor, assess, and interpret indicators of aquatic ecosystem condition related to mine operations and to inform adaptive management relative to expectations established in approved plans for mine development and the Permit at each of six management units (MUs).

Under the RAEMP, Koocanusa Reservoir is categorized as its own management unit (MU6) based on unique geographic features, hydrodynamic/habitat characteristics, and consideration of potential mine-influences. In 2018, the Koocanusa Reservoir Monitoring Program was updated, building upon previous studies, as a comprehensive three-year initiative designed to assess whether physico-chemical and biological conditions in Koocanusa Reservoir differ downstream compared to upstream of the Elk River confluence within the Canadian portion of the reservoir, and whether or not conditions are changing over time. In accordance with this monitoring program and conditions of ENV Permit 107517 (Section 10.8), this annual report provides an overview of the environmental monitoring activities that were conducted in 2018 in the Canadian portion of Koocanusa Reservoir, together with a summary of the associated results. Principal findings from 2018 Koocanusa Reservoir monitoring are summarized below.

Water Quality

Water quality data indicated that concentrations of the Order constituents dissolved cadmium, nitrate, total selenium, and sulphate, were below respective guidelines at all Koocanusa Reservoir permitted stations in 2018, including at Order Station RG_DSELK, except for selenium concentrations in April 2018. In April 2018, the monthly sample was taken from the shoreline (not from the permitted location) due to safety concerns and insufficient water depth of the reservoir. The average selenium concentration at this Order Station in April 2018 was 2.7 µg/L, which exceeded the permit limit of 2 µg/L. Of the remaining water quality constituents analyzed, total zinc concentrations were above BC water quality guidelines in April and May. These exceedances were also observed upstream of the Elk River confluence, and as such, do not appear to be mining related. Assessment of water quality-based productivity indicators showed that the reservoir is generally oligotrophic to mesotrophic, with short periods of eutrophication occurring in the spring (April to June), and that phosphorus was continually limiting in 2018. Water chemistry and productivity indicators at individual Koocanusa Reservoir monitoring stations in 2018 were within respective ranges observed during previous years of monitoring, suggesting no substantial changes since 2014.

Assessment of Elk River mixing in Koocanusa Reservoir indicated that under low pool and riverine conditions present April 2018, flow from the Elk River was confined to the eastern half of the reservoir (channel) until becoming substantially mixed approximately 4 to 5 km downstream of the Elk River confluence. Under intermediate to full pool conditions in June and August, Elk River flow appeared mainly confined to the lower third of the water column across the entire width of the reservoir with substantial mixing not occurring within approximately 14 to 15 km downstream of the Elk River.

Sediment Quality

Concentrations of all metals and polycyclic aromatic hydrocarbons (PAHs) in sediment at all profundal and littoral stations located downstream and upstream of the Elk River were well below applicable provincial severe effects level (SEL) sediment quality guidelines. Sediment collected at both profundal and littoral stations located downstream of the Elk River showed elevated concentrations of several metals and PAHs compared to respective profundal and littoral stations located upstream of the Elk River. Of the elevated parameters, concentrations of cadmium, 2 methylnaphthalene, and phenanthrene were elevated above applicable lowest effect level (LEL) sediment quality guidelines only downstream of the Elk River. Arsenic, iron, manganese, and nickel occurred at concentrations above applicable LEL sediment quality guidelines at profundal and/or littoral stations upstream and downstream of the Elk River. Sediment chemistry at Koocanusa Reservoir downstream and upstream areas in 2018 showed parameter concentrations that were generally within respective ranges observed during previous years of monitoring, suggesting no substantial changes since 2013.

Selenium concentrations in particulate material filtered from reservoir water at Station RG_DSELK, and at Montana stations (International Boundary, Tenmile Creek, and Forebay) in 2018 were above the applicable sediment quality guideline for selenium. Selenium concentrations in particulate material were higher at RG_DSELK than at stations in the Montana portion of the reservoir in July and September 2018.

Plankton Community and Tissue Chemistry

Plankton community data showed no significant differences in phytoplankton or zooplankton total density, total richness, or total biomass between areas located downstream and upstream of the Elk River in August 2018. Phytoplankton and zooplankton community metrics at the Koocanusa

Reservoir downstream and upstream areas in late-summer 2018, were within respective ranges observed during previous years of monitoring, suggesting no changes since 2014. Zooplankton community total richness, total density, and total biomass were significantly higher downstream compared to upstream of the Elk River confluence in June 2018 suggesting potential seasonality differences in plankton community response between June and late summer.

Comparison of two zooplankton community sampling techniques was completed in 2018 between surficial (top 10 m) and entire water column samples collected in late summer (August and September, respectively). The surface (top 10 m) community results indicated lower zooplankton richness, but higher total density and total biomass (as well as community composition differences) suggesting that sampling methodology is an important consideration in comparing data between the Canadian and Montana portions of the reservoir.

Selenium concentrations in zooplankton tissue were significantly higher downstream compared to upstream of the Elk River in June and September 2018. The concentrations of selenium in zooplankton tissue were above the applicable BC interim chronic dietary guideline for invertebrate tissues, but below the EVWQP Level 1 benchmarks at both the downstream and upstream areas in September 2018. Zooplankton tissue selenium concentrations within the Montana portion of the reservoir for 2017 and 2018 were lower than observed for both areas in the Canadian portion of the reservoir. With the exception of the mean tissue selenium concentration from International Boundary in October 2018, all data from Montana were below the BC chronic interim guideline and EVWQP benchmarks. In general, zooplankton tissue selenium concentrations observed at areas within the Canadian portion of the reservoir downstream and upstream areas of the Elk River in 2018 were similar to concentrations reported in previous years, suggesting no changes over time.

Benthic Invertebrate Community and Tissue Chemistry

Benthic invertebrate community data indicated significantly lower richness, total density of nematodes, and total and relative density of Ostracoda downstream compared to upstream of the Elk River in August 2018. Benthic invertebrate tissue selenium concentrations were higher downstream relative to upstream in April, but similar between these areas in August. Benthic invertebrate tissue selenium concentrations were above the interim BCMOE selenium guideline of 4 µg/g dw at profundal areas both upstream and downstream of the Elk River in 2018. Mean tissue selenium concentrations were above the interim BCMOE selenium guideline as well, but below the EVWQP Level 1 benchmarks. Benthic invertebrate community metrics and tissue selenium concentrations at downstream and upstream areas in 2018 were within respective ranges observed since 2014.

Fish Health and Tissue Chemistry

Fish health assessment focused on peamouth chub and redside shiner because these species are abundant at all study areas, have relatively small home range size, and are not an important sport fish. Fish health endpoint comparisons for these species indicated no consistent differences and/or direction of differences between areas located downstream and upstream of the Elk River over the period from 2014 to 2018. Heavier relative liver weight was consistently shown in female redside shiner at the Elk River area, and in male redside shiner at the Gold Creek area, compared to the Sand Creek upstream area in 2016 and 2018. A greater proportion of YOY were observed in redside shiner populations downstream of the Elk River compared to upstream in 2018, which suggests no adverse influences on recruitment.

Selenium concentrations in peamouth chub, redside shiner, and northern pikeminnow muscle tissue were below applicable BC tissue guidelines and US EPA criterion at all study areas. Tissue selenium concentrations in peamouth chub muscle were higher at downstream areas, while those in redside shiner muscle were higher at the Gold Creek area, compared to the upstream area in the Canadian portion of the reservoir. Mean selenium concentrations in westslope cutthroat trout muscle tissue were above the BC tissue guidelines in samples collected from just north of the mouth, and at the mouth of, the Elk River, but all were lower than the US EPA criterion and EVWQP Level 1 benchmark. Selenium concentrations in muscle tissue of sport fish and sucker species were generally similar downstream and upstream of the Elk River, and similar between the Canadian and Montana portions of the reservoir, in 2018. Selenium concentrations in muscle tissues collected from all fish species at the Koocanusa Reservoir downstream and upstream areas in 2018 were generally within respective ranges observed at the same respective study areas for each species during previous years of monitoring.

Selenium concentrations in ovaries of northern pikeminnow, peamouth, and redside shiners were above the BC guideline in all areas. Northern pikeminnow and redside shiners were above both the criteria and benchmark at the Elk River. Selenium concentrations in ovaries of peamouth chub and redside shiner at downstream areas of the Canadian portion of the reservoir were similar to, or lower than, concentrations observed in ovaries of these species at the area upstream of the Elk River in 2018. Selenium concentrations in ovary tissues collected from all fish species at the Koocanusa Reservoir downstream and upstream areas in 2018 were generally within respective ranges observed at the same respective study areas for each species during previous years of monitoring.

Similar to previous years, mercury concentrations in muscle tissue of peamouth chub, redside shiner, northern pikeminnow, and various sport fish (including bull trout, Kokanee, mountain whitefish, rainbow trout, and yellow perch) were above the BC guideline for protection of wildlife in 2018. However, similar mercury concentrations were indicated in muscle tissue of all of these fish species downstream compared to upstream of the Elk River, and investigations completed by Teck for water quality and human consumption indicate mercury it not a mine-related constituent.

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ACRONYMS AND ABBREVIATIONS

AMP – Adaptive Management Plan

ANOVA – Analysis of Variance

ANCOVA – Analysis of Covariance

BAL – Brooks Analytical Laboratory

BC – British Columbia

BCMOE – British Columbia Ministry of Environment

BCWQG – British Columbia Water Quality Guidelines

CABIN – Canadian Aquatic Biomonitoring Network

CALA – Canadian Association for Laboratory Accreditation Inc.

CES – Critical Effect Sizes

CRM – Certified Reference Materials

CTD – Profiler that Measures Conductivity, Temperature, and Depth

DELT - Internal or External Deformities, Erosions (fin and gill), Lesions, or Tumors

DO – Dissolved Oxygen

DS – Downstream

DSS – Digital Sampling Sensor

EEM – Environmental Effects Monitoring

EMC – Environmental Monitoring Committee

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

EVFFHC - Elk Valley Fish and Fish Habitat Committee

EVWQP – Elk Valley Water Quality Plan

EWT – Early Warning Triggers

FLNRO - Ministry of Forests, Lands, Natural Resource Operations, and Rural Development

GSI – Gonadosomatic Index

GPS – Global Positioning System

HR-ICP-MS – High Resolution Inductively Coupled Plasma Mass Spectrometry

HSD – Honestly Significant Difference

IS – Independent Scientist

KNC – Ktunaxa Nation Council

KS – Kolmogorov-Smirnov statistical test

LEL – Lowest Effect Level

LPL – Lowest Practical Level

LRL – Laboratory Reporting Limit

LSI – Liver Somatic Index

MAD – Median Absolute Deviation

MCT – Measure of Central Tendency

MOD – Magnitude of Difference

MOE – British Columbia Ministry of Environment

MT DEQ – Montana Department of Environmental Quality

MU – Management Unit

NMDS – Non-metric Multi-dimensional Scaling Ordination

N:P – Nitrogen to Phosphorus Ratio

NSC – Northern Pikeminnow

PAH – Polycyclic Aromatic Hydrocarbon

PCC – Peamouth Chub

PEL – Probable Effect Level

QA/QC – Quality Assurance / Quality Control

RAEMP – Regional Aquatic Effects Monitoring Program

RSC – Redside Shiner

SD – Standard Deviation

SEL – Severe Effect Level

SPO – Site Performance Objective

SRC – Saskatchewan Research Council

TEL – Threshold Effect Level

TOC – Total Organic Carbon

TSI – Trophic Status Index

TSS – Total Suspended Solids

US – Upstream

USACE – U.S. Army Corps of Engineers

USEPA – U.S. Environmental Protection Agency

UTM – Universal Transverse Mercator system

WSC – Water Survey of Canada

WSQG – Working Sediment Quality Guidelines

YOY – Young-of-the-year

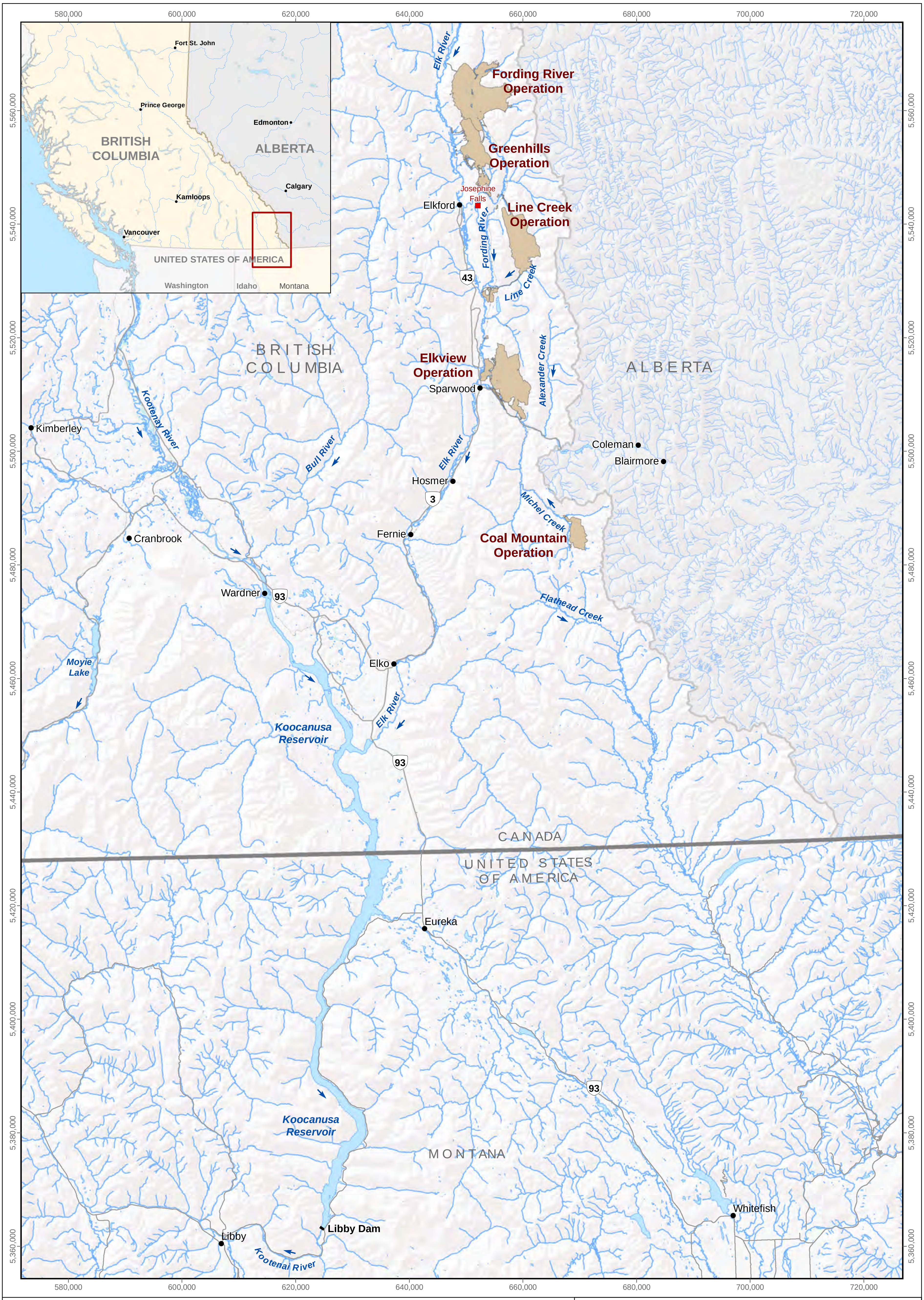
1 INTRODUCTION

1.1 Background

Teck Coal Limited (Teck) owns and operates five steelmaking coal mines within the Elk River watershed of southeastern British Columbia (BC; Figure 1.1). From its headwaters near Elk Lakes, the Elk River flows in a southwesterly direction into Koocanusa Reservoir approximately 20 kilometres (km; 12 miles) upstream from the border between Canada and the United States. Operated by the United States Army Corps of Engineers (USACE), Koocanusa Reservoir was created by the construction of Libby Dam in Montana to provide flood protection, hydroelectric power, and recreational benefits. At full pool, the reservoir is 155 km (96 miles) in length, approximately 68 km (42 miles) of which occurs within Canada and the remaining 87 km (54 miles) within the United States (Figure 1.1). In addition to the Elk River, the Kootenay (Kootenai) and the Bull rivers supply the majority of inflow to the reservoir (26%, 62%, and 11%, respectively, of mean annual inflow; Woods 1982; Hamilton et al. 1990). Water levels within Koocanusa Reservoir are generally lowest in late winter/early spring (March through May) and highest in summer/early fall (August and September). The normal annual pool fluctuation of the reservoir is about 35 m. At maximum drawdown, a reduction in reservoir total length up to 53%, volume up to 85%, mean depth up to 51%, and total surface area up to 69% generally occurs, with the largest relative changes occurring in the Canadian portion of the reservoir (Hamilton et al. 1990). This results in riverine conditions during low-pool for the Canadian portion of the reservoir.

In 2014, the Elk Valley Water Quality Plan (EVWQP) served as a basis for issuance of Permit 107517 (“the Permit”) from the British Columbia Ministry of Environment and Climate Change Strategy (ENV; formerly Ministry of Environment [MOE]). The Permit specifies water quality limits and site performance objectives (SPOs) for monitoring stations located downstream from the mines and the requirement to implement a Regional Aquatic Effects Monitoring Program (RAEMP). Overarching objectives of the RAEMP are to monitor, assess, and interpret indicators of aquatic ecosystem condition related to mine operations and to inform adaptive management relative to expectations established in approved plans for mine development and the Permit at each of six management units (MUs).

Consistent with the RAEMP, the Koocanusa Reservoir [MU6] objective is to monitor, assess, and interpret indicators of aquatic ecosystem condition related to mine operations, and to inform adaptive management relative to expectations established in approved plans for mine development and in Permit 107517. In accordance with Permit 107517 and the RAEMP, annual



LEGEND

■ Libby Dam

▨ Teck Coal Mine Operation

Location of Teck Coal Mine Operations Relative to Koocanusa Reservoir

0 10 20 40
km

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Projection: North American Datum 1983 UTM Zone 11
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Figure 1.1

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 1.1 Teck Coal Limited Operation USA.mxd monitoring programs were designed, accepted, and implemented for Koocanusa Reservoir beginning in 2013, which was followed by the development of a comprehensive three-year monitoring program, referred to as the Koocanusa Reservoir Monitoring Program (Minnow 2014, 2015a, 2016, 2018a,b). These programs were designed to assess whether physico-chemical and biological conditions in Koocanusa Reservoir differ downstream compared to upstream of the Elk River confluence within the Canadian portion of the reservoir, and whether or not conditions are changing over time. Questions specific to the Canadian portion of the reservoir, listed below, were developed to focus the monitoring program:

- Are concentrations of mine-related water quality constituents different downstream of the Elk River compared to upstream?
- Are concentrations of key mine-related water quality constituents (i.e., nitrate, selenium, sulphate, and cadmium) changing over time, are the changes consistent with projections, and are concentrations below respective guidelines and site performance objectives (SPOs)?
- Is productivity (based on nutrient concentrations in water) different downstream of the Elk River compared to upstream and is productivity changing over time?
- Are concentrations of mine-related constituents in sediment that benthic invertebrates are exposed to different downstream of the Elk River compared to upstream and are concentrations changing over time?
- Do phytoplankton, zooplankton, and/or benthic invertebrate community structure differ downstream of the Elk River compared to upstream, and are the differences changing over time?
- Are selenium concentrations in zooplankton different downstream of the Elk River compared to upstream, and are the differences changing over time?
- Are selenium concentrations in benthic invertebrates greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?
- Is fish health different downstream of the Elk River compared to upstream, and are differences in fish health endpoints changing over time?
- Are there differences in fish recruitment downstream of the Elk River compared to upstream?

- Are selenium concentrations in fish tissue greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?

The Koocanusa Reservoir Monitoring Program was designed with technical advice and input from an Environmental Monitoring Committee (EMC)[1], whose role includes review of submissions and provision of technical advice and input to Teck and the ENV Director as a condition under Permit 107517 (Minnow 2018b). In the most recently amended version of the Permit (April 2019; Section 10.8), requirements outlined for the Koocanusa Reservoir Monitoring Program include:

> *"The Permittee must prepare on an annual basis a report summarizing activities and monitoring results. The report must be submitted to the Lake Koocanusa Monitoring and Research Working Group (Lake Koocanusa Working Group) and the EMC by June 30 of each year."*

Accordingly, this annual report provides an overview of environmental monitoring activities conducted in the Canadian portion of Koocanusa Reservoir, along with the associated results, in 2018. Notably, a condition of acceptance of the most recent Koocanusa Reservoir Monitoring Program study design by ENV (2018) was to incorporate data collected from the Montana portion of the reservoir into three-year comprehensive Koocanusa Reservoir Monitoring Program reports. Data from the Montana portion of the reservoir have been integrated and in cases in which data were excluded from the 2018 analysis, a technical rationale is provided. Additional requirements included providing selenium and nitrate loadings to the Koocanusa reservoir, collecting turbidity measurements with all *in situ* profiles, measure dissolved selenium in suspended sediment at Order station RG_DSELK, and collecting additional zooplankton samples in June to assess seasonal changes.

1.2 Linkages to Teck's Adaptive Management Plan

As required in Permit 107517 Section 11, Teck has developed an Adaptive Management Plan (AMP) to support implementation of the EVWQP to achieve water quality and calcite targets, protect human health and the environment, and where necessary, restored, and to facilitate continuous improvement of water quality in the Elk Valley (Teck 2018a). 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. The AMP also identifies key uncertainties that need to be reduced to fill gaps in current understanding and support achievement of the EVWQP objectives.

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[1] 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 (IS).

Monitoring data and evaluations conducted within the Koocanusa Reservoir Monitoring Program are designed primarily to provide supportive information to help answer AMP Management Question #5 (worded as “Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?”), and Key Uncertainty 5.1 (worded as “How will monitoring data be used to identify potentially important mine-related effects on the aquatic ecosystem?”). The RAEMP, including results from the Koocanusa Reservoir Monitoring Program, will evaluate data to address these AMP questions. Should management responses be required associated with findings from this analysis, additional investigations or adjustments may be required.

Data and analysis conducted for the Koocanusa Reservoir Monitoring Program will also contribute to answering AMP Management Question #2 (worded as “Will the aquatic ecosystem be protected by meeting the long-term site performance objectives?”) through the assessment of aquatic ecosystem health under a range of current conditions and identifying areas where biological effects may be occurring due to one or more mine-related constituents. These programs will also contribute information to help reduce Key Uncertainty 2.1 (worded as “How will the science-based benchmarks be validated and updated?”) and Key Uncertainty 2.2 (worded as “How will the integrated assessment methodology used to derive area-based SPOs be validated and updated?”). Assessments associated with these AMP components will primarily be conducted separately from the Koocanusa Reservoir Monitoring Program.

Specific information collected under the Koocanusa Reservoir Monitoring Program will also be used to support evaluation required for Management Question 6 (worded as “Is water quality being managed to be protective of human health?”). Assessments associated with these AMP components will be conducted outside of the Koocanusa Reservoir Monitoring Program.

Finally, the AMP is required under Permit 107517 to contain triggers for management actions. Teck currently has drafted triggers for a subset of biological endpoints that are considered to be relatively sensitive and representative of the aquatic ecosystem. Please refer to the AMP (Teck 2018a) 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.

2 METHODS

2.1 General Overview

The Koocanusa Reservoir Monitoring Program was designed to evaluate changes in water quality, sediment quality, and/or biota in the reservoir downstream relative to upstream of the Elk River confluence, and whether any identified changes can be attributed to influences from the Elk River and mining activities. To address the study questions described in Section 1.1, the 2018 Koocanusa Reservoir Monitoring Program included evaluation of the following components:

- Water quality (physical and chemical), sediment quality (physical and chemical), and tissues of zooplankton, benthic invertebrates, and fish (for chemical analysis);
- Mixing assessment;
- Phytoplankton, zooplankton, and benthic invertebrate community analysis; and
- Fish health and recruitment assessment.

Objectives of this annual monitoring report are to provide an overview of environmental monitoring activities conducted in 2018 in the Canadian portion of Koocanusa Reservoir, along with the associated results (Table 2.1). Analysis of results include statistical evaluations to identify potential differences in key endpoints between areas located downstream and upstream of the Elk River confluence, and to qualitatively compare these results to data from previous monitoring. Field sampling was conducted during two spring sampling events and one late summer sampling event (Table 2.2). During initial spring sampling event conducted April 23rd to 30th, water quality, sediment quality, benthic invertebrate tissue, fish health and tissue chemistry, and mixing specific conductance and turbidity vertical profiles were completed. The second spring sampling event, conducted June 5th to 10th, included water quality, large-volume particulate, zooplankton tissue and community, and fish tissue. The late summer sampling event, conducted August 27th to September 2nd, included water quality, sediment quality, phytoplankton community, zooplankton and benthic invertebrate community and tissue, and fish tissue and recruitment. Due to a laboratory error, one benthic invertebrate tissue chemistry sample collected in August was invalidated, and was recollected on October 9, 2018.

To the extent possible, sampling locations used in 2018 were similar to those used in previous monitoring (2014 to 2016; Minnow 2018a), and consistent with the approved 2018 to 2020 study design. Biological sampling (profundal sediment quality, plankton community and tissue, and benthic invertebrate community and tissue) was completed at one transect downstream of the Elk River (RG_T4) and one transect upstream of the Elk River (RG_TN), with each transect including five sampling stations (Figure 2.1). Fish sampling (fish health and fish tissue assessments) were

Table 2.1: Summary of Receptors, Assessment Endpoints, Measurement Endpoints, and Evaluation Criteria for Koocanusa Reservoir, 2018 to 2020

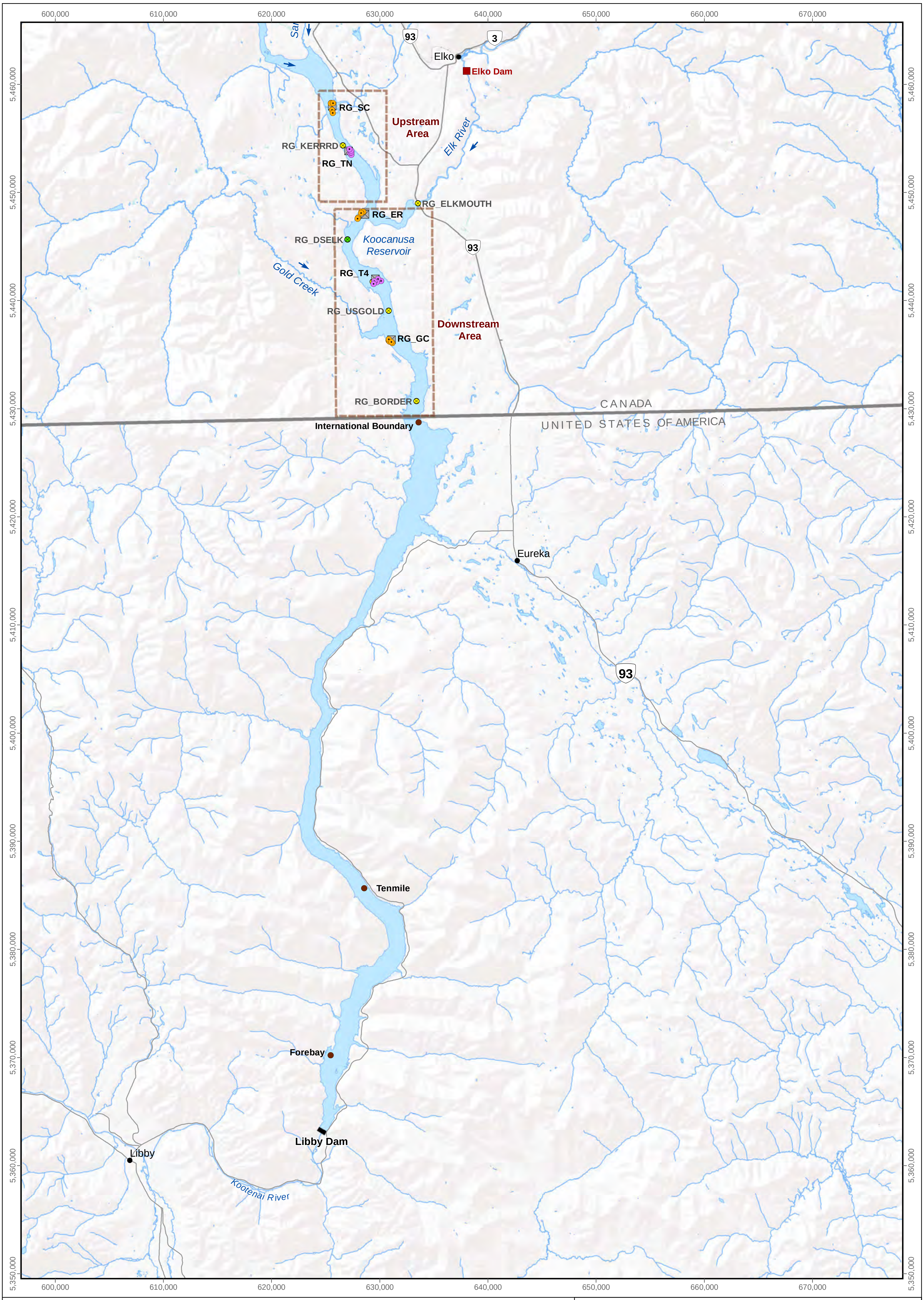
Receptor Group	Focal Species (if Relevant)	Assessment Endpoint	Measurement Endpoint	Evaluation Criteria	Indicator Type
All	Not specific	Not specific	Sediment chemistry	Comparison of results relative to guidelines, between downstream and upstream of the Elk River, and to past observations	Indirect
			Water chemistry	Comparison of concentrations of mine-related constituents relative to SPOs and guidelines, nutrients relative to trophic classifications, between downstream and upstream of the Elk River, and to past observations	Indirect
Phytoplankton and Zooplankton	Not applicable	Abundance and assemblage	Density Richness Biomass Major community group	Comparison of results between downstream and upstream of the Elk River and to past observations	Direct
			Tissue selenium concentrations	Comparison of results relative to guidelines and effect benchmarks, between downstream and upstream of the Elk River, and to past observations	Indirect
Benthic Invertebrates	Not applicable	Abundance and assemblage	Density Richness Major community group	Comparison of results between downstream and upstream of the Elk River and to past observations	Direct
			Tissue selenium concentrations	Comparison of results relative to guidelines and effect benchmarks, between downstream and upstream of the Elk River, and to past observations	Indirect
Fish	Peamouth chub and redside shiner	Population health assessment	Survival (age) Growth (body weight against age) Reproduction (gonad weight against body weight) Energy storage (condition - body weight against length and liver weight against body weight)	Comparison of results between downstream and upstream of the Elk River and to past observations	Direct
			Tissue selenium concentrations	Comparison of results relative to guidelines and effect benchmarks, between downstream and upstream of the Elk River, and to past observations	Indirect
	Redside shiner	Recruitment (non-lethal assessment)	Survival (length frequency distribution) Growth (whole body weight and length) Reproduction (relative abundance / % composition of young-of-the-year) Energy storage (condition - body weight against length)	Comparison of results between downstream and upstream of the Elk River and to past observations	Direct
	Northern pikeminnow, yellow perch, bull trout, etc.	Fish health, and human health risk from fish consumption	Tissue chemistry	Comparison of results relative to guidelines and effect benchmarks, between downstream and upstream of the Elk River, to past observations, and to human health effect benchmarks (evaluated outside of the monitoring program)	Indirect

Table 2.2: **Overview of the 2018 Koocanusa Reservoir Monitoring Program Study Design**

Study Area	Biological Area Code	Biological Area Description	Spring 2018 [a,b]													Summer 2018											
			Water [a,b]			Sediment		Benthic Invertebrates [a]	Plankton [b]		Fish					Water			Sediment		Plankton			Benthic Invertebrates		Fish	
											Fish Health [a]		Tissue Chemistry														
			Mixing Study	Chemistry	*In Situ* Water Quality	Quality (Chemistry and Composition)[a]	Large-Volume Particulate [b]	Tissue Chemistry	Zooplankton Tissue Chemistry	Zooplankton Community	Peamouth Chub	Redside Shiner	Peamouth Chub [a]	Redside Shiner [b]	Sport Fish [a,b]	Mixing Study	Chemistry	*In Situ* Water Quality	Quality (Chemistry and Composition)	Large-Volume Particulate	Phytoplankton Community	Zooplankton Tissue Chemistry	Zooplankton Community	Community	Tissue Chemistry	Sport Fish Tissue Chemistry	Redside Shiner Recruitment
Upstream of the Elk River	RG_SC	near the mouth of Sand Creek	1	1	1	5	-	5	-	-	55	80	10	10	8	1	1	1	-	-	-	-	-	-	-	8	100
	RG_TN	near the RG_KERRRD permitted water quality station		1	1	-	-	1	5	5	-	-	-	-	-		1	5	5	-	5	10	5	5	1	-	-
Elk River	RG_ER	near the mouth of Elk River		1	1	5	-	5	-	-	55	80	10	10	8		1	1	-	-	-	-	-	-	-	8	100
Downstream of the Elk River	RG_DSELK	Order station downstream of the mouth of the Elk River		-	-	-	1	-	-	-	-	-	-	-	-		-	-	-	1	-	-	-	-	-	-	-
	RG_T4	near the RG_GRASMERE permitted water quality station		1	1	-	-	1	5	5	-	-	-	-	-		1	5	5	-	5	10	5	5	1	-	-
	RG_GC	near the mouth of Gold Creek		1	1	5	-	5	-	-	55	80	10	10	8		1	1	-	-	-	-	-	-	-	8	100

[a] Sampling completed in April

[b] Sampling completed in June



LEGEND

- Permitted Water Quality Station
- Order Water Quality Station and Large-volume Suspended Sediment Location
- Littoral Sediment and Benthic Invertebrate (Tissue Chemistry) Sampling Location
- Profundal Sediment, Plankton (Community and Tissue Chemistry), and Benthic Invertebrate (Community and Tissue Chemistry) Sampling Location
- ☒ Water Chemistry and In Situ Monitoring Station
- Montana DEQ Zooplankton, Large-volume Suspended Sediment and Water Quality Monitoring Station

Sampling Locations for Water, Sediment, Plankton, and Benthic Invertebrates in Koocanusa Reservoir, 2018

0 5 10 20
km

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Projection: North American Datum 1983 UTM Zone 11
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Figure 2.1

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 2.1Sampling Locations.mxd conducted at two areas downstream from the mouth of the Elk River (RG_ER) and Gold Creek (RG_GC), and one upstream area (Sand Creek; RG_SC; Figure 2.2). Routine water quality monitoring data that were collected by Teck at their permitted downstream water quality monitoring stations (RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER, of which RG_DSELK is an Order station) and upstream water quality monitoring station (RG_KERRRD; Figure 2.1; Teck 2019) were also summarized within this annual report. In addition, data collected by Montana in 2018 including water quality, particulate chemistry, and zooplankton tissue chemistry data from three stations (International Boundary, Tenmile Creek, and Forebay; Figure 2.1), as well as fish tissue chemistry data (Figure 2.2), were included in the data evaluations when appropriate.

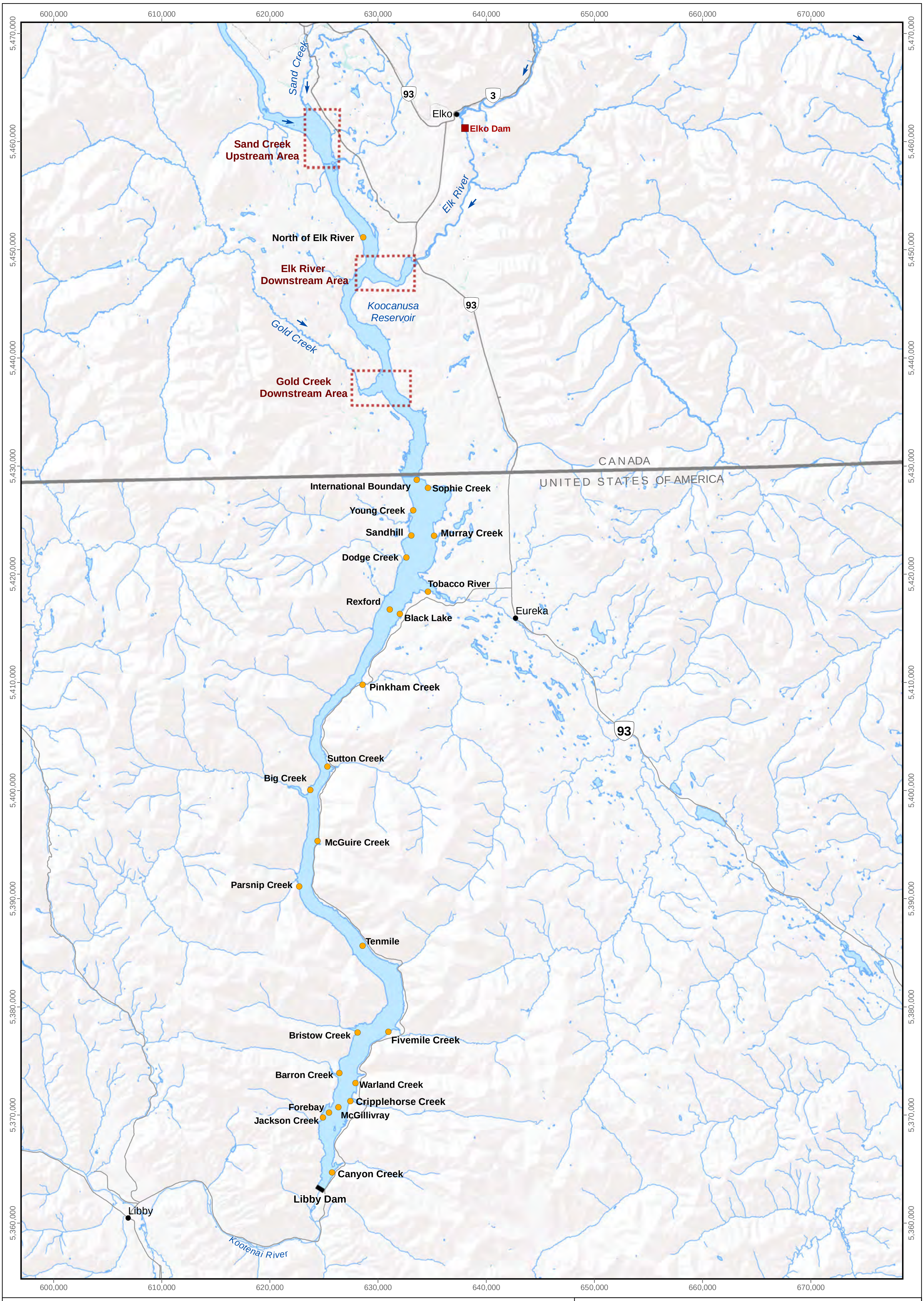
2.2 Water Quality

2.2.1 Overview

Water quality assessment conducted in 2018 included the collection of water chemistry samples and *in situ* field measures. Water chemistry data from Teck's permitted water quality monitoring program in the reservoir (RG_KERRRD, RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER; see Figure 2.1), samples collected concurrently with biological samples (RG_SC, RG_TN, RG_ER, RG_T4, and RG_GC), and routine water quality monitoring data from the Montana portion of the reservoir (International Boundary, Tenmile Creek, and Forebay; Figure 2.1) were included in the evaluation. Consistent with monitoring completed previously at the Canadian portion of the reservoir, *in situ* water quality (field parameters) were measured at each biological monitoring area and at the upstream and downstream stations in April, June, and August 2018 (Table 2.2). Water chemistry data collected during Teck's routine water quality monitoring was also used to evaluate productivity. An assessment of mixing of the Elk River within the Canadian portion of the Koocanusa Reservoir (based on specific conductance, water temperature, and turbidity measurements) was completed during three separate events in 2018 (i.e., April, June, and August sampling). In addition, as per the ENV (2018) permit, a summary of monthly nitrate and selenium loadings to the Koocanusa reservoir are provided.

2.2.2 Water Chemistry Sampling and Laboratory Analysis

Permit 107517 requires the collection of water samples at five permitted stations located within the Canadian portion of the reservoir ('Permitted Water Quality Station' on Figure 2.1). Four of these stations are referred to as receiving water sampling sites (RG_KERRRD, RG_GRASMERE, RG_USGOLD, RG_BORDER), while the fifth station (RG_DSELK; EMS E300230) is an Order station for which SPOs have been established. Water samples were collected weekly from April 1st to July 15th, and monthly during ice-free conditions outside this period. Five water quality



LEGEND

● Montana DEQ Fish Sampling Station

▨ British Columbia Fish Sampling Area

Fishing Locations in Koocanusa Reservoir, 2018

0 5 10 20
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 11
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Date: June 2019
Project 187202.0007

Figure 2.2

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 2.2 Fishing Locations.mxd samples (RG_SC, RG_TN, RG_ER, RG_T4, and RG_GC; 'Water Quality Station' on Figure 2.1) were also collected concurrent with the three biological sampling events (Table 2.2). Water sampling methods for the additional sites were collected following Teck's Koocanusa Reservoir Water Quality Monitoring Plan (Teck 2018b). Because thermal stratification was not observed during any of the sampling events in 2018, three water chemistry samples were collected at the each station, including one sample collected 3 m from the water surface, one sample collected 3 m above the substrate, and one sample at the mid-point, of the water column. Finally, samples collected from three stations located in the Montana portion of the reservoir (International Boundary, Tenmile Creek, and Forebay; Figure 2.1) were collected on a monthly basis during the ice-free period. All Montana water quality samples were collected at 3 m from the surface and 3 m from the bottom.

A summary of water quality parameters and associated monitoring frequency has been provided in Table 2.3 for the five permitted stations (conventional parameters, major ions, nutrients, total and dissolved metals, and chlorophyll-a), and in Table 2.4 for samples associated with the biological program components (with the addition of polycyclic aromatic hydrocarbons [PAHs]). Water chemistry samples from all Canadian stations were analyzed by ALS Environmental (Calgary, Alberta). The analyses were completed in accordance with procedures described in the most recent edition of the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials, and Discrete Ambient Air" (Province of BC 2015) as per Permit 107517 requirements. Quality Assurance/Quality Control (QA/QC) applied to the laboratory analyses included assessment of the ability to achieve minimum laboratory reporting limits (LRLs; Table 2.4), show undetectable parameter concentrations in blank samples, and evaluation of matrix spikes, certified reference materials (CRMs), and laboratory duplicates, the latter of which was used to assess accuracy and precision of laboratory data.

2.2.3 Field Parameters

In situ water quality was taken from a central location within each of the five plankton and benthic invertebrate sampling stations located upstream (Transect Stations RG_TN-1 through RG_TN-5) and downstream of the Elk River (Transect Stations RG_T4-1 through RG_T4-5), as well as at fish sampling areas (Sand Creek, Elk River, and Gold Creek areas; Figures 2.1 and 2.2). *In situ* water temperature, dissolved oxygen (DO), pH, specific conductance (i.e., temperature-standardized measurement of conductivity), and turbidity[2] measurements were collected as vertical profiles conducted at 0.5 to 1 m intervals (depending on total depth) during biological

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[2] Turbidity was not included as a field parameter in the 2018 to 2020 monitoring study design, however, under a permit condition received with the study design approval letter (ENV 2018), turbidity measurements were collected with *in situ* profiles beginning in 2018.

Table 2.3: Summary of Koocanusa Reservoir Routine Water Quality Monitoring Program

Permitted Station		ENV EMS Number	Sampling Parameter and Associated Monitoring Frequency						
			Field Parameters [a]	Conventional Parameters [b]	Major Ions [c]	Nutrients [d]	Total and Dissolved Metals Scan [e]	Secchi Depth and Chlorophyll-a	Selenium Speciation Sampling [f]
Order	RG_DSELK	E300230	M	M/EH	M/EH	M/EH	M/EH	M	Q
Receiving	RG_KERRRD	E300095	M	M/EH	M/EH	M/EH	M/EH	M	-
	RG_GRASMERE	E300092	M	M/EH	M/EH	M/EH	M/EH	M	-
	RG_USGOLD	E300093	M	M/EH	M/EH	M/EH	M/EH	M	-
	RG_BORDER	E300094	M	M	M	M	M	M	-

Notes: M = Monthly frequency, M/EH = Monthly frequency. Untstratified column samples consist of three grabs (3m from surface, 3m from bottom, mid-column). Stratified samples consist of one epilimnetic composite of water sampled from three depths (e.g., 1 m, 5 m, 10 m) and another hypolimnetic composite of water sampled from three depths (e.g., 20 m, 32 m, 45 m), Q = Quarterly frequency.

[a] Field parameters include specific conductance, dissolved oxygen, temperature, pH, and vertical profiles of dissolved oxygen and temperature.

[b] Conventional Parameters include specific conductance, total dissolved solids, total suspended solids, hardness, alkalinity, dissolved organic carbon, total organic carbon, turbidity.

[c] Major Ions include bromide, fluoride, calcium, chloride, magnesium, potassium, sodium, sulphate.

[d] Nutrients include ammonia, nitrate, nitrite, TKN, orthophosphate, total phosphorous.

[e] Metals (dissolved and total fractions) include 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, and zinc.

[f] Additional selenium speciation sampling in support of EVWQP baseline information and to fulfill the requirements of the West Line Creek Active Water Treatment Facility Bypass Approval (February 26, 2018).

Table 2.4: Laboratory Reporting Limits (LRLs) for Water and Sediment Samples

Analyte	Water [a]		Sediment	
	Units	LRL	Units	LRL
Moisture	-	-	%	0.25
pH	-	-	pH	0.1
% Gravel	-	-	%	1.0
% Sand	-	-	%	1.0
% Silt	-	-	%	1.0
% Clay	-	-	%	1.0
Total Organic Carbon (TOC)	mg/L	0.5	%	0.05
Dissolved Organic Carbon (DOC)	mg/L	0.5	-	-
Hardness (as CaCO3)	mg/L	0.50	-	-
Turbidity	NTU	0.10		
Alkalinity	mg/L	1	-	-
Total Dissolved Solids (TDS)	mg/L	10	-	-
Total Suspended Solids (TSS)	mg/L	1.0	-	-
Ammonia, Total (as N)	mg/L	0.0050	-	-
Bromide (Br)	mg/L	0.050	-	-
Chloride (Cl)	mg/L	0.500	-	-
Fluoride (F)	mg/L	0.020	-	-
Nitrate (as N)	mg/L	0.0050	-	-
Nitrite (as N)	mg/L	0.001	-	-
Total Kjeldahl Nitrogen	mg/L	0.050	-	-
Phosphorus (P)-Total	mg/L	0.0020	-	-
Orthophosphate	mg/L	0.0010	-	-
Sulphate (SO4)	mg/L	0.30	-	-
Acenaphthylene	-	-	mg/kg dw	0.005
Anthracene	-	-	mg/kg dw	0.004
Benz(a)anthracene	-	-	mg/kg dw	0.01
Benzo(a)pyrene	-	-	mg/kg dw	0.01
Benzo(b)fluoranthene	-	-	mg/kg dw	0.01
Benzo(b+j+k)fluoranthene	-	-	mg/kg dw	0.01
Benzo(g,h,i)perylene	-	-	mg/kg dw	0.01
Benzo(k)fluoranthene	-	-	mg/kg dw	0.01
Chrysene	-	-	mg/kg dw	0.01
Dibenz(a,h)anthracene	-	-	mg/kg dw	0.005
Fluoranthene	-	-	mg/kg dw	0.01
Fluorene	-	-	mg/kg dw	0.01
Indeno(1,2,3-c,d)pyrene	-	-	mg/kg dw	0.01
2-Methylnaphthalene	-	-	mg/kg dw	0.01
Naphthalene	-	-	mg/kg dw	0.01
Phenanthrene	-	-	mg/kg dw	0.01
Pyrene	-	-	mg/kg dw	0.01
Aluminum (Al)	mg/L	0.003	mg/kg dw	50
Antimony (Sb)	mg/L	0.0001	mg/kg dw	0.1
Arsenic (As)	mg/L	0.0001	mg/kg dw	0.1
Barium (Ba)	mg/L	0.00005	mg/kg dw	0.5
Beryllium (Be)	mg/L	0.00002	mg/kg dw	0.1
Bismuth (Bi)	mg/L	0.00005	mg/kg dw	0.2
Boron (B)	mg/L	0.01	mg/kg dw	5
Cadmium (Cd)	mg/L	0.000005	mg/kg dw	0.02
Calcium (Ca)	mg/L	0.05	mg/kg dw	50
Chromium (Cr)	mg/L	0.0001	mg/kg dw	0.5
Cobalt (Co)	mg/L	0.0001	mg/kg dw	0.1
Copper (Cu)	mg/L	0.0005	mg/kg dw	0.5
Iron (Fe)	mg/L	0.01	mg/kg dw	50
Lead (Pb)	mg/L	0.00005	mg/kg dw	0.5
Lithium (Li)	mg/L	0.001	mg/kg dw	2
Magnesium (Mg)	mg/L	0.005	mg/kg dw	20
Manganese (Mn)	mg/L	0.0001	mg/kg dw	1
Mercury (Hg)	mg/L	0.000005	mg/kg dw	0.005
Molybdenum (Mo)	mg/L	0.00005	mg/kg dw	0.1
Nickel (Ni)	mg/L	0.0005	mg/kg dw	0.5
Phosphorus (P)	-	-	mg/kg dw	50
Potassium (K)	mg/L	0.05	mg/kg dw	100
Selenium (Se)	mg/L	0.00005	mg/kg dw	0.2
Silver (Ag)	mg/L	0.00001	mg/kg dw	0.1
Sodium (Na)	mg/L	0.05	mg/kg dw	50
Strontium (Sr)	mg/L	0.0002	mg/kg dw	0.5
Sulphur (S)	-	-	mg/kg dw	100
Thallium (Tl)	mg/L	0.00001	mg/kg dw	0.05
Tin (Sn)	mg/L	0.0001	mg/kg dw	2
Titanium (Ti)	mg/L	0.01	mg/kg dw	1
Uranium (U)	mg/L	0.00001	mg/kg dw	0.05
Vanadium (V)	mg/L	0.0005	mg/kg dw	0.2
Zinc (Zn)	mg/L	0.003	mg/kg dw	2

Note: "-" indicates no data available

[a] Total and dissolved metals will be analyzed in water. Laboratory reporting limits are the same.

monitoring conducted in the Canadian portion of the reservoir in April, June, and August 2018 (Table 2.2). The *in situ* water quality measurements were taken using a calibrated YSI ProDSS (digital sampling system) handheld multi-parameter meter equipped with four DSS sensors (YSI Inc., Yellow Springs, OH). Additional water quality information collected to support interpretation of biological data at each station/area included Secchi depth and observations of water colour and clarity.

2.2.4 Data Analysis

The Koocanusa Reservoir Monitoring Program was designed to address the following questions specific to water quality:

- Are concentrations of mine-related water quality constituents different downstream of the Elk River compared to upstream?
- Are concentrations of key mine-related water quality constituents changing over time, are the changes consistent with projections, and are concentrations below respective guidelines and SPOs?
- Is productivity (based on nutrient concentrations in water) different downstream of the Elk River compared to upstream, and is productivity changing over time?

Assessment of water quality data included comparison to respective guidelines and EVWQP benchmarks, spatial comparisons between downstream and upstream stations, and qualitative comparisons to data collected during previous monitoring. The assessment of water chemistry was based on comparisons of monthly mean concentrations of constituents for which Early Warning Triggers (EWTs) have been established (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, total uranium, and total zinc) between the Order station (RG_DSELK) and routine water quality monitoring stations (RG_KERRRD, RG_GRASMERE, RG_USGOLD, and RG_BORDER). Constituents with EWTs were screened against British Columbia Water Quality Guidelines (BCWQG, BCMOE 2017a,b) as part of Teck's Annual Water Quality Monitoring Report (Teck 2019). Plots of the average concentrations of these constituents by depth in the water column at each station, and including applicable BCWQG and SPO benchmarks, were prepared to allow qualitative comparisons among stations. When available, data from the Montana portion of the reservoir were incorporated into the plots. These data were also compared to United States Environmental Protection Agency (US EPA) criteria where available, which included dissolved cadmium, total selenium, and total zinc. Water chemistry data from major inflows into Koocanusa Reservoir, namely the Kootenay River (Station RG_WARDB) and Elk River (Station RG_ELKMOUTH), which are monitored on a regular basis, were also included in the plots to provide additional perspective. Data for RG_USELK were included for historical reference only. RG_USELK was the upstream station prior to 2015, but due to its proximity to the Elk River, this monitoring station was relocated farther upstream, renamed RG_KERRRD, and sampled as the upstream station thereafter. Water chemistry data collected at biological monitoring stations/areas (RG_SC, RG_TN, RG_ER, RG_T4, and RG_GC) in 2018 were screened relative to BCWQG (where applicable), but were not included in the plots.

Water chemistry data were compared statistically between upstream (RG_KERRRD) and downstream (RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER) permit stations to evaluate potential mine-related influences on water quality of Koocanusa Reservoir[3]. Statistical analysis of the 2018 water chemistry data focused on the constituents for which EWTs have been established. Pairwise statistical comparisons of monthly mean parameter concentrations between water column depths (surface vs. middle, surface vs. bottom, and middle vs. bottom) was conducted using a paired t-test. If the assumption of normality (Shapiro-Wilks' test with significance level [α] ≥ 0.05) was not met, a non-parametric Wilcoxon signed rank test was used for these comparisons. A Bonferroni-adjusted α (0.1/3 = 0.033) was used for paired t-tests and Wilcoxon signed rank tests to control the Type I error rate for the pairwise comparisons (n = 3) for each station. Results of these analyses were used to determine whether water chemistry at each depth in the water column should be analyzed separately or pooled for subsequent spatial (i.e., station-to-station) statistical comparisons. Statistical comparisons were conducted on the mathematical differences in monthly mean concentrations between stations (i.e., mean concentration downstream of the Elk River less the mean concentration upstream of the Elk River) to remove the influence associated with differing sampling season.

Upstream and downstream station comparisons were conducted by testing whether differences in monthly mean parameter concentrations between stations were different from zero using a one-sample t-test (or Wilcoxon signed rank test when assumptions of normality were not met) by testing the hypothesis:

$$H_{01}: \mu_d = 0$$

The magnitude of difference (MOD) in parameter concentrations between stations was calculated if a significant difference was detected between stations as (using RG_USGOLD as an example):

$$\text{MOD} = \frac{(MCT_{RG\_USGOLD} - MCT_{RG\_KERRRD})}{MCT_{RG\_KERRRD}} \times 100\%$$

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[3] The only EWT parameter collected in 2018 at the Montana stations (International Boundary, Tenmile Creek, and Forebay) was sulphate; however, sample replication was insufficient from these stations to allow inclusion of these data in the water chemistry statistical comparisons discussed herein.

where MCT_{RG_USGOLD} and MCT_{RG_KERRRD} were the measure of central tendency (MCT) for the downstream and upstream stations, respectively (i.e., mean or median depending on whether the statistical comparison was conducted using a parametric or non-parametric method, respectively). The statistical analyses were conducted using R statistical software (R Core Team 2015).

The 2018 data for the order constituents, and constituents with EWTs for stations in both the Canadian and Montana portions of the reservoir, were plotted and qualitatively[4] compared with water chemistry data collected in previous years.

Monthly mean total phosphorus, total nitrogen, and chlorophyll-a concentrations, together with Secchi depth measurements, were used to categorize trophic status at permitted water sampling stations in the Canadian portion of Koocanusa Reservoir based on Nordin (1985) classifications for BC freshwaters (Table 2.5). In addition to qualitative comparison of trophic status (i.e., oligo-, meso-, or eutrophic), comparisons of plotted total phosphorus, total nitrogen, chlorophyll-a, Secchi depth, and nitrogen-to-phosphorus ratio[5] data were conducted to evaluated whether trophic status differed downstream compared to upstream of the Elk River confluence in Koocanusa Reservoir. Because these parameters were not assessed at stations within the Montana portion of the reservoir, categorization of the trophic status of the reservoir was completed only for the Canadian portion of the reservoir. Vertical *in situ* water quality profiles, completed at the time of biological sampling in August, were plotted to determine if thermal stratification or gradients in DO, pH, specific conductance, and/or turbidity occurred at the sampling areas under representative full pool reservoir conditions. The profile data were compared between downstream (RG_T4) and upstream (RG_TN) transects, and to profile data collected in previous years.

2.2.5 Mixing Assessment

Based on input from the EMC on February 21, 2018, concerns were raised regarding whether the Elk River is fully mixed within the reservoir at the downstream Order Station RG_DSELK, and that the Elk River may be influencing water quality at the upstream Permitted Station RG_KERRRD. To address this concern, a mixing assessment was conducted in Canadian portion of the reservoir under three pool conditions (low, intermediate, and full) in 2018 to evaluate Elk River mixing features in Koocanusa Reservoir. Specific conductance of the Elk River (RG_ELKMOUTH) is consistently greater than that of the Kootenay River (RG_WARDB), and therefore specific

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[4] Statistical comparisons between years will be completed after the third year of the 2018 to 2020 monitoring program.

[5] The examination of nitrogen to phosphorus ratios among Koocanusa Reservoir study areas/stations was included in the 2018 study based on recommendation by the EMC.

Table 2.5: Available Criteria for Trophic Status Classification

Variable	Source	Ultra-Oligotrophic	Oligotrophic	Mesotrophic	Meso-Eutrophic	Eutrophic	Hyper-Eutrophic
Total Phosphorus (µg/L)	OECD[a,h]	<4	<10	10 - 35	-	35 -1 00	>100
	Environment Canada[b]	<4	4 - 10	10 - 20	20 - 35	35 - 100	>100
	Quebec[a]	-	4 - 10	10 - 30	-	30 - 100	-
	Sweden[a]	-	<15	15 - 25	-	25 - 100	>100
	Carlson TSI[c,d]	<6	6 - 12	12 - 24	-	24 - 96	>96
	Nordin (BC Criteria)[e]	-	1 - 10	10 - 30	-	>30	-
	Nürnberg[a,f]	-	<10	10 - 30	-	31 - 100	<100
	Vollenweider and Karekes[g]	-	3 - 18	11 - 96	-	16 - 390	-
Chlorophyll-a (µg/L)	OECD	<1	<2.5	2.5 - 8	-	8 - 25	>25
	Environment Canada	<1	<2.5	2.5 - 8	-	8 - 25	>25
	Quebec	-	1 - 3	3 - 8	-	8 - 25	-
	Sweden	-	>3	3 - 7	-	7 - 40	>40
	Carlson TSI	<0.95	0.95 - 2.6	2.6 - 7.3	-	7.3 - 56	>56
	Nordin (BC Criteria)	-	0 - 2	2 - 7	-	>7	-
	Nürnberg	-	<3.5	3.5 - 9	-	9.1 - 25	>25
	Vollenweider and Karekes	-	0.3 - 4.5	3 - 11	-	2.7 - 78	-
Secchi Depth (m)	OECD	>12	>6	3 - 6	-	1.5 - 3	<1.5
	Environment Canada	>12	>6	3 - 6	-	1.5 - 3	<1.5
	Quebec	-	5 - 12	2.5 - 5	-	1 - 2.5	-
	Sweden	-	>3.96	2.43 - 3.96	-	0.91-2.43	<0.91
	Carlson TSI	>8	4 - 8	2 - 4	-	0.5 - 2	<0.25
	Nordin (BC Criteria)	-	>6	3 - 6	-	<3	-
	Nürnberg	-	-	-	-	-	-
	Vollenweider and Karekes	-	5.4 - 28	1.5 - 8.1	-	0.8 - 7	-
Total Nitrogen (µg/L)	OECD	-	-	-	-	-	-
	Environment Canada	-	-	-	-	-	-
	Quebec	-	-	-	-	-	-
	Sweden	-	<400	400 - 600	-	600 - 1,500	>1,500
	Carlson TSI	-	-	-	-	-	-
	Nordin (BC Criteria)	-	<100	100 - 500	-	500 - 1000	-
	Nürnberg	-	<350	350 - 650	-	651 - 1,200	>1,200
	Vollenweider and Karekes	-	310 - 1,600	360 - 1,400	-	390 - 6,100	-

Note: "-" indicates no data available

[a] Summarized in Galvez-Cloutier and Sanchez 2007.

[b] Environment Canada 2004.

[c] Carlson 1977.

[d] Values converted from Trophic Status Index (TSI) for comparison to other classifications.

[e] Nordin 1985, Criteria used in British Columbia.

[f] Nürnberg 2001.

[g] Vollenweider and Kerekes 1980.

[h] Organisation for Economic Co-operation and Development.

conductance measurements served as the primary means to evaluate Elk River mixing within the reservoir. Because temperature-driven differences in water density can also influence mixing features, water temperature data were also considered for the mixing assessment.

A Conductivity-Temperature-Depth (CTD) unit was used to collect profile data across transects under low (late April), intermediate (early June), and full (late August) levels in 2018. A CastAway-CTD® unit was used to continuously measure and log specific conductance, temperature, and depth data upon being lowered through the water column. In addition, turbidity was measured at 1 m intervals (0.5 m when less than 5 m deep) through the water column at the same locations as CTD deployment using a YSI ProDSS meter. Koocanusa Reservoir water levels were very low in the early spring (April and June) compared to summer (August; Figure 2.3), and therefore the location of CTD and ProDSS transects downstream of the Elk River differed between the spring and the summer sampling events (Figure 2.4). Transects were grouped closely together (approximately 250 m apart) near the Elk River confluence, and then at a distance of approximately 1,000 m from the Elk River confluence, transects were subsequently spaced approximately 1,000 m apart within the downstream area (Figure 2.4). Five transects were established upstream of the Elk River confluence to facilitate comparisons with the downstream data during each sampling event (Figure 2.4). Five evenly-spaced CTD and ProDSS profile stations were established at each downstream and upstream transect during each sampling event.

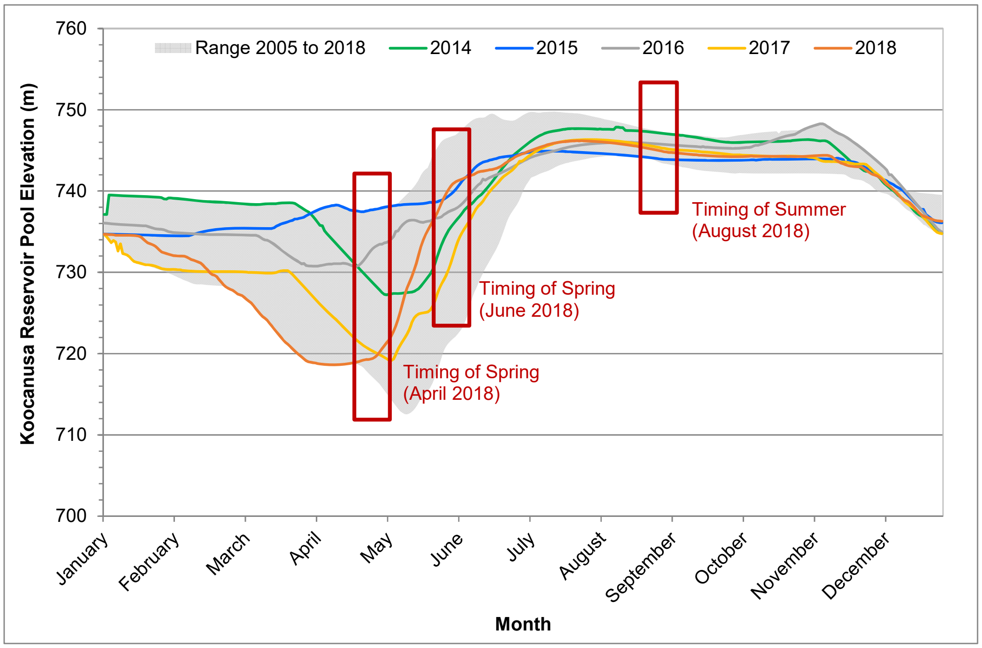
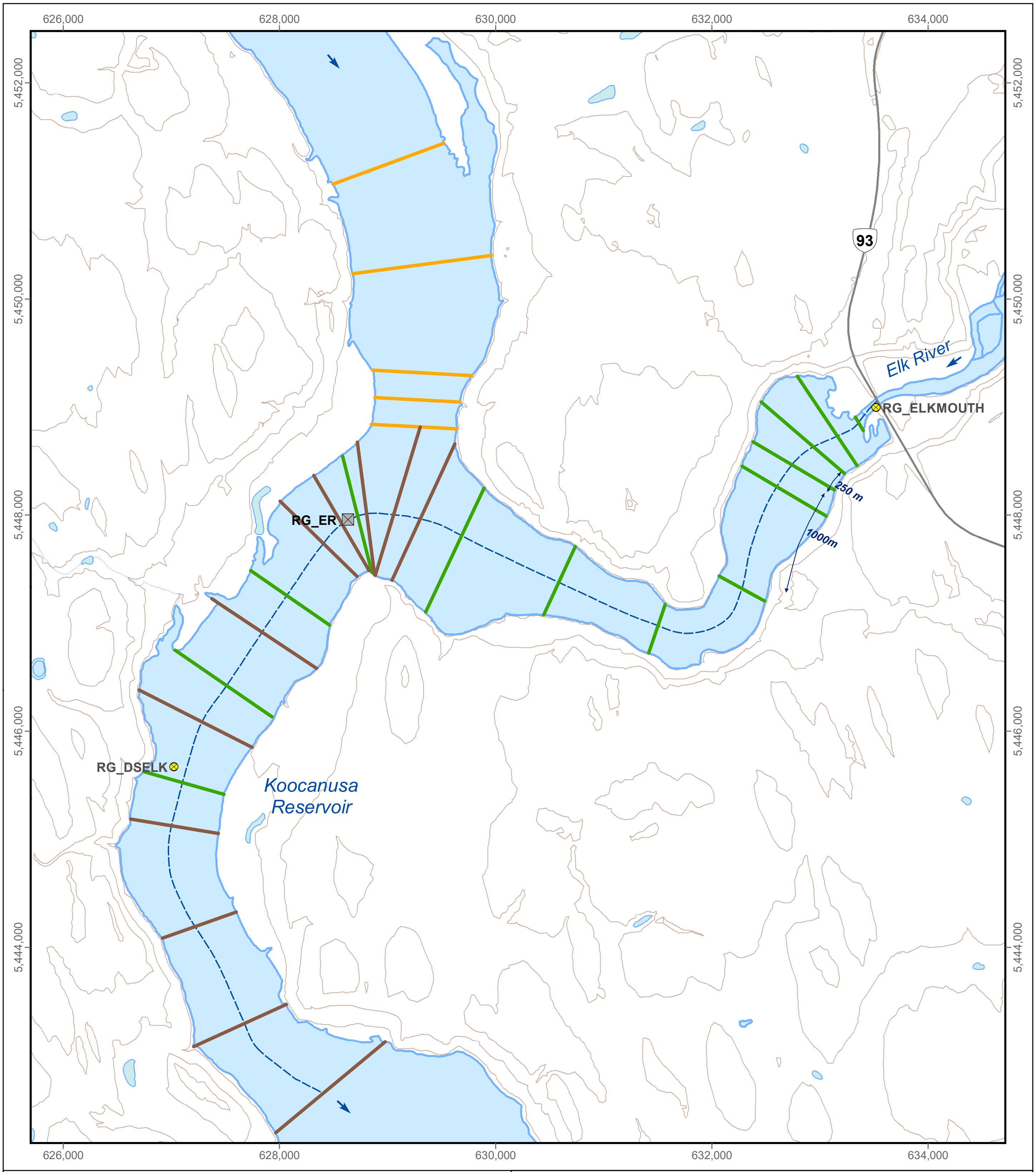


Figure 2.3: **Koocanusa Reservoir Water Surface (Pool) Elevation, 2014 to 2018**

Note: Shaded area is the historical daily range of water levels from 2005 to 2018. Data from United States Army Corps of Engineers (USACE 2018).



LEGEND

- ⊗ Permitted Water Quality Station
- ☒ Water Chemistry and In Situ Montoring Station
- 🟩 August CTD Profile Downstream Transect
- 🟫 April and June CTD Profile Downstream Transect
- 🟧 CTD Profile Upstream Transect
- --- Transect Center Line

Approximate Locations of CTD Transects Used for the Elk River Mixing Study at Koocanusa Reservoir, 2018

0 0.75 1.5 3 km

N W E S

Projection: North American Datum 1983 UTM Zone 11
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minnow environmental inc.
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Figure 2.4

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 2.4 Mixing Study in Koocanusa Reservoir, 2018.mxd

The evaluation of mixing included the generation of specific conductance, water temperature, and turbidity profile plots for the Koocanusa Reservoir for each of the April, June, and August sampling events. A straight transect was required for the depth profiles and thus the coordinates for the points along the transect. Thus, for each transect a linear model fit to the field coordinates (Northing~Easting), and the new coordinates for each point being taken as the closest point along the linear trend line from the model. Coordinates along the shorelines were not collected in the field, and thus the location of both shorelines was estimated by extending the trend line by the mean distance between transect stations in both directions. Once the x- and y-axes coordinates were estimated from the linear model, a depth profile was derived for each transect using a minimum convex polygon around the x- and y-axis locations and the maximum depth at each point, and then extrapolating the values for each parameter (specific conductance, temperature, and turbidity) horizontally between each station across the entire polygon. The parameter values were estimated using a spatial kriging model with a polynomial degree function of 1 and a range parameter (θ) set to the mean Euclidean distance between the points. The kriging spatial model takes into account the observed data and the correlation between data points under an assumed covariance function (exponential decline with distance between points) and was fit with generalized cross validation. The model was validated visually by comparing the predicted surface to the values in the observed data. The model was derived and extrapolated in R using the Krig and interpolate functions in the fields and raster packages. The interpolated values were visualized by placing the interpolated values in ten bins equally spaced between the maximum and minimum values for each month, which were then assigned a unique colour ramp for each parameter.

2.2.6 Nitrate and Selenium Loadings

Methods used to calculate nitrate and selenium loadings in the Koocanusa reservoir were taken from the Permit 107517 2017 Report of Monitoring Results in the Koocanusa Reservoir (Teck 2018d). Monthly average concentrations of selenium and nitrate measured at RG_ELKMOUTH relative to flow were used to estimate loadings in to the reservoir. Flow is not measured directly at RG_ELKMOUTH; rather, flow is scaled from the nearest continuous flow monitoring station on the Elk River which is located in Fernie, BC and is operated by the Water Survey of Canada. A factor of 1.53 is used to scale the flow measured at the Fernie hydrometric station to estimate flow at RG_ELKMOUTH which is located immediately upstream of the confluence of the Elk River and Koocanusa Reservoir at the Hwy 93 bridge.

This scaling method was derived by Golder Associates using current Environment Canada hydrometric gauges (Elk River at Fernie 08NK002) and historical hydrometric gauges (Elk River at Phillips Bridge 08NK005). Flow is prorated based on a relationship between monthly flows where RG_ELKMOUTH = RG_FERNIE x 1.53.

Estimated loads in the Koocanusa Reservoir (kg/month) are calculated using the following formula. Note that the calculated daily load is then multiplied by the number of days in each month to result in a monthly loading rate and meet the requirement for this report:

$$m^3/s * mg/L * 86.4 = kg/day * \text{number of days in each month}$$

2.3 Sediment Quality

2.3.1 Overview

Sediment quality was assessed as part of the 2018 monitoring program for the Canadian portion of the reservoir to characterize substrate chemistry and support interpretation for the biological component of the study. Sediment quality sampling was conducted in August in two profundal[6] areas (RG_T4 and RG_TN), consistent with the 2014 to 2016 monitoring program (Minnow 2018a). In addition, in response to advice from the EMC, sediment sampling was completed at littoral[7] stations downstream (RG_ER and RG_GC) and upstream (RG_SC) of the Elk River in April 2018 in each of the three fishing areas concurrent and co-located with littoral benthic invertebrate tissue samples (Figure 2.1; Table 2.2). Large-volume particulate samples were also included in 2018 to measure total selenium concentrations in suspended particulate at the Order station RG_DSELK to be compared to samples collected in the Montana portion of the Reservoir.

2.3.2 Sample Collection

Sediment samples for physical and chemical characterization in August were collected using a stainless steel Petite Ponar (0.023 m^2 sampling area). At each of the five stations downstream (RG_T4-1 to 5) and upstream of the Elk River (RG_TN-1 to 5), three grabs were collected to create a composite sediment sample consisting of the top three centimetres (cm) of sediment (i.e., the sediment fraction in which most benthic fauna generally reside [Kirchner 1975]). Following retrieval of each grab, the Ponar was gently opened and lifted to release the collected sediment into a clean plastic tub. If the grab was not complete to each edge of the Ponar, or lacked an intact sediment-water surface layer, it was discarded and a new grab was collected. If the grab was acceptable, the top three centimetres was removed and placed into a separate plastic tub. The procedure was repeated until three acceptable grabs were obtained, after which

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[6] Referring to the sediment collected from a deep basin of a lake/reservoir.

[7] Referring to sediment collected along the shoreline.

the sample was homogenized using a stainless steel spoon. The homogenized sediment was then transferred to a glass jar (for analysis of PAHs) and a large labelled polyethylene bag (for other analyses, as described below).

Littoral sediment samples were collected in April using a stainless steel spoon. Sampling occurred (concurrent with benthic and fish sampling) at five stations throughout the three sampling areas (RG_SC, RG_ER, and RG_GC; Figure 2.1), for a total of 15 samples. Samples were collected from shore, directly below the water surface, and consisted of only the top 3 cm of sediment. A minimum of five full spoon scoops were composited together in a clean white tub and the sample was homogenized before transferring to a glass jar and polyethylene bag for laboratory analysis. Sampling locations were recorded for each station using a handheld global positioning system (GPS) unit in Universal Transverse Mercator (UTM) coordinates. Following collection for all sediment samples, they were placed in a cooler containing ice and later transferred to a refrigerator for storage prior to shipment to an accredited analytical laboratory at the completion of the field study.

2.3.3 Laboratory Analysis

Sediment samples (whole sample not field-sieved) were sent to an accredited laboratory (ALS, Calgary) for analysis of PAHs, moisture content, particle size, total organic carbon (TOC), and metals/metalloids (hereafter collectively referred to as metals), using analytical methods consistent with ENV laboratory guidance manual (Province of BC 2013, 2015) as specified in Permit 107517. Sediment sampling quality assurance/quality control (QA/QC) included the collection and analysis of field duplicate samples (on a minimum of 10% of the total number of samples collected), as well as an assessment of the accuracy and precision of laboratory data (Province of BC 2015). Data quality was judged based on the ability to achieve minimum LRLs (Table 2.4), and review of the results from laboratory duplicate, spike recovery sample, blank sample, and CRM analyses (see Appendix B).

2.3.4 Data Analysis

Data from the 2018 Koocanusa Reservoir Monitoring Program were used to address the following question with regard to sediment quality:

- Are concentrations of mine-related constituents in sediment that benthic invertebrates are exposed to different downstream of the Elk River compared to upstream and are concentrations changing over time?

The assessment of sediment data included comparison to respective guidelines, spatial comparisons between downstream and upstream areas, and qualitative comparisons to data from the previous 2014 to 2016 monitoring period. Sediment particle size distribution were presented for each sampling event (August and April) using a stacked bar graph with concentrations of TOC plotted on the secondary axis. Sediment chemistry data were compared to applicable BC Working Sediment Quality Guidelines (WSQGs). The lower WSQGs (i.e., lowest effect level/threshold effect level – LEL/TEL) represent concentrations below which adverse biological effects would not be expected to occur (BCMOE 2017b). In contrast, the highest sediment quality guidelines (i.e., probable effect level/severe effect level – PEL/SEL) represent concentrations above which effects may be observed (BCMOE 2017b). Parameters with mean concentrations that exceeded the lowest WSQG were plotted. Selenium was plotted for all stations, even if concentrations were below sediment quality guidelines.

A pairwise t-test was used to evaluate differences in mean sediment chemistry between downstream and upstream areas in August (RG_T4 and RG_TN, respectively), whereas an analysis of variance (ANOVA) was conducted to compare samples collected from the littoral areas (RG_ER and RG_GC compared to RG_SC, respectively) in April. Data for both analyses were $\log_{10}$-transformed as required to meet test assumptions. If test assumptions were not met for the pairwise t-test, a rank transformation for a non-parametric test was used. A more conservative α of 0.5 was used for testing the assumptions to limit the use of the rank transformation in those instances where assumptions were violated. For the ANOVA, a post hoc pair-wise comparisons among the downstream (RG_ER and RG_GC) and upstream (RG_SC) were conducted using Tukey's Honestly Significant Difference (HSD) adjustment and least-squares means with α assessed at 0.1. In instances where normality could not be achieved through data transformation, or the assumption of homogeneity of variance could not be met (Levene's test; $\alpha = 0.05$), the non-parametric Kruskal-Wallis test was used for multiple-group comparisons followed by Dunn's Test for pair-wise multiple comparisons.

A MOD in parameter concentrations was calculated as a percentage difference in the measure of central tendency between the downstream area(s) and the upstream area as:

$$\text{MOD} = \frac{(MCT_{RG\_T4} - MCT_{RG\_TN})}{MCT_{RG\_TN}} \times 100\%$$

where MCT_{RG_T4} and MCT_{RG_TN} were the measures of central tendency for the downstream and upstream areas. Measures of central tendency were reported in the original data units as:

- means when no transformation was used;
- geometric means when a $\log_{10}$-transformation was used; and
- medians when a rank transformation was used.

Parameters that occurred at concentrations that exceeded the WSQG LEL guidelines in 2018 were qualitatively compared to values from 2013 to 2016 to potentially identify changes in sediment chemistry over time.

2.3.5 Large-Volume Particulate Samples

Large-volume water samples were collected from the order station RG_DSELK in June, July, and September, 2018, for the analysis of suspended particulate selenium concentrations (Figure 2.1). Following methods outlined in the Quality Assurance Project Plan (MT DEQ 2018; see Appendix B), an acid-washed Beta bottle was used to collect water samples from a depth of 3 m below the surface, which were emptied into two acid-washed 20 litre (L) carboys (one sample, one duplicate). Sample grabs were taken until both carboys were completely full. Additional grabs were conducted at 3 m below the water surface and 3 m above the bottom for the collection of water samples for analysis of total and dissolved selenium concentrations. Following collection, all samples were placed on ice in coolers. Large-volume particulate samples were shipped to Georgia State University (Atlanta, Georgia) to extract and dry the particulate before being sent to Brooks Analytical Laboratories (BAL; Bothell, Washington) for total selenium analysis. Samples for total and dissolved selenium concentrations in water were shipped directly to BAL. Results for the particulate samples were compared to applicable BC Working Sediment Quality Guidelines (WSQGs) for selenium. Data were acquired from the Montana portion of the reservoir (International Boundary, Tenmile Creek, and Forebay), and plots were developed and compared qualitatively.

2.4 Plankton

2.4.1 Overview

Phytoplankton community was collected in August 2018, and zooplankton community data were collected in August and September 2018 both upstream (RG_TN) and downstream (RG_T4) of the Elk River (Figure 2.1, Table 2.2). Zooplankton tissue was collected in August and September from the same stations as community samples. Zooplankton samples collected a few days apart between August (30th and 31st) and September (4th) were used for comparison between different sampling methods (discussed below), as well as to assess potential differences between downstream and upstream areas. In addition, following the study design acceptance (ENV June 8, 2018), new requirements specified that zooplankton community and tissue sampling be added in June (in all three sampling years) to assess seasonal changes between spring and late-summer. Zooplankton tissue samples were also collected from three Montana stations by DEQ (International Boundary, Tenmile Creek, and Forebay; Figure 2.1).

2.4.2 Sample Collection

2.4.2.1 Community Composition

Phytoplankton community samples were collected as depth-integrated samples through the top 10 m of the water column from five stations located upstream and five stations located downstream of the Elk River mouth (RG_TN-1 to RG_TN-5 and RG_T4-1 to RG_T4-5; Figure 2.1) in August 2018. Water samples were collected by lowering a 1 cm inside-diameter plastic tube, equipped with a weight, to a depth of 10 m (approximate photic zone) and, after crimping the tube to prevent water loss upon retrieval, the tube was pulled to the surface and water inside the tube emptied directly into a clean pail and mixed. A total of three grabs were composited to form a sample. From this composite, a 100 millilitre (mL) sample was collected into a collection bottle to which Lugol's solution was added to preserve the sample (Lugol's solution was added until a weak tea colour was achieved). The sample was mixed with Lugol's solution by gently tipping the jar twice. Samples were maintained at room temperature until shipment to the laboratory.

Zooplankton community samples were collected in June and September using a 19 cm diameter, fine mesh (i.e., 60 micrometre [µm]) plankton net, vertically hauled through the entire water column at each sampling station based on methods described by Province of BC (2013). The plankton net was lowered to a depth of 1.5 m from the sediment-water interface (to avoid disturbing the sediment, potentially resulting in addition of benthic organisms to the sample). In August, additional samples were also collected to a depth of 10 m to compare sampling methods. A composite sample, consisting of three vertical hauls, was collected for samples collected from the entire column, as well as 10 m depth, for each of the sampling stations at RG_TN (RG_TN-1 to RG_TN-5) and RG_T4 (RG_T4-1 to RG_T4-5). Upon retrieval of each vertical haul, the sample material was transferred into a pre-labelled plastic sampling jar, and, following retrieval of the third vertical haul, preserved to a level of 10% buffered formalin in ambient water. Samples were collected along with supporting measures, including *in situ* water quality profile and Secchi depth. The zooplankton community samples were stored at room temperature until shipment to the laboratory.

2.4.2.2 Tissue Chemistry

Zooplankton tissue samples were collected using an 80 µm mesh net (30 centimetre [cm] diameter) so that the sample targeted zooplankton, and was not confounded by the presence of phytoplankton. Two samples were collected at each station, the first represented by a composite of ten vertical hauls through the entire water column (beginning 1.5 m above the sediment-water interface), and the second represented by a composite of ten vertical hauls through the surficial 10 m of the water column (the second method was conducted only in August). Upon retrieval of each haul, as much water as possible was removed from the collected material before transferring the sample to a labelled, sterile cryovial. Following the tenth haul, the sample was placed in a cooler on ice and, at the completion of daily field sampling, frozen.

2.4.3 Laboratory Analysis

2.4.3.1 Community Composition

Phytoplankton community samples were sent to Plankton R Us in Winnipeg, Manitoba, where 10 mL aliquots of preserved sample were first gravity settled for 24 hours. Cell counts were performed using a modification of the Ütermohl technique (Nauwerck 1963), using an inverted microscope at magnifications of 125×, 400×, and 1200× with phase contrast illumination. Specimens were identified to the lowest taxonomic level possible. Cell counts were converted to wet weight biomass by approximating cell volume. Estimates of cell volume for each species were obtained by measuring up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider 1968; Rott 1981). A specific gravity of 1 was assumed for cellular mass.

Zooplankton community samples were sent to Salki Consultant Inc. in Winnipeg, Manitoba, where after standing for 72 hours, were decanted (60 µm filter on vacuum hose, back flushed) to 45 mL glass vials to standardize volume (40 mL) for analyses and long term storage. Samples were analyzed for species composition, abundance, and biomass of crustaceans and rotifers. Each sample underwent the following three levels of analysis:

- 1/10, 1/20, 1/40, or 1/80 (depending on zooplankton abundance in sample) of each sample was examined under a compound microscope at 63× to 160× magnification, and a minimum of 200 organisms were identified to species (crustaceans) or lowest practical level (rotifers), and assigned to instar size categories. Additionally, lengths (± 15 µm) of female and male adult specimens (n=20) of dominant species were measured in representative samples for biomass determinations;

- a sub-sample, representing 10 to 20% of the sample volume, was examined under a stereoscope at 12× magnification to identify and enumerate mature and gravid individuals of larger-sized species and rare (i.e., less abundant) species, and to assign these individuals to size classes; and

- the entire sample was examined under a stereoscope at 1/10 magnification to improve abundance/biomass estimates for any large-sized, less abundant species in the sample.

Under a compound microscope, Cyclopoida and Calanoida specimens (mature and immature) were identified to the species level, with the exception of nauplii (N1-N6) which were classified as either Calanoida (small or large) or Cyclopoida (small or large). Cladocera were identified to the species level, while rotifers were identified to genus. Taxonomic identifications were conducted primarily using Brooks (1957), Wilson (1959), and Yeatman (1959) taxonomic keys. Digital microscopic images of selected specimens were provided with the analytical data.

Zooplankton abundance was reported as individuals per litre (ind/L) based on volumes calculated from net mouth area, sample haul depth, and replication. Biomass estimates for each species were determined from:

- abundances of adults multiplied by mean adult wet weights developed from measured lengths (n=20 per adults of dominant species in representative samples), and length-weight relationships presented in Malley et al. (1989); and,
- abundances of various immature instar categories multiplied by weights of respective size categories determined from length-weight regressions (as per Malley et al. 1989).

Additional size measurements made on less common specimens were factored into the biomass calculations. Zooplankton biomass was reported in micrograms (wet weight) per litre (µg/L) of filtered water.

For both phytoplankton and zooplankton community samples, sub-sampling accuracy was assessed by performing replicate counts on 10% of samples. Replicate samples were chosen at random and processed at different times from the original sample to reduce bias.

2.4.3.2 Tissue Chemistry

Zooplankton tissue samples were shipped to Saskatchewan Research Council (SRC) in Saskatoon, Saskatchewan, for analysis of metals (including mercury) and selenium using high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) consistent with ENV laboratory guidance as specified in Permit 107517 (Province of BC 2015). At the laboratory, the samples were freeze dried prior to analysis, and thus concentrations were reported on a dry weight basis. Accuracy and precision of data was judged based on ability to achieve minimum LRLs (Table 2.6), review of the results from laboratory duplicate analysis, as well as a comparison to CRMs.

2.4.4 Data Analysis

Data from the plankton community and tissue chemistry sampling were used to address the following questions:

- Do phytoplankton and/or zooplankton community structure differ downstream of the Elk River compared to upstream and were the differences changing over time?

Table 2.6: Minimum Laboratory Reporting Limits (LRLs) for Tissue Samples

Analyte	Units	Plankton, Benthic Invertebrate, and Fish Tissue LRL [a]
Moisture	%	-
Aluminum (Al)	µg/g dw	2
Antimony (Sb)	µg/g dw	0.1
Arsenic (As)	µg/g dw	0.05
Barium (Ba)	µg/g dw	0.05
Beryllium (Be)	µg/g dw	0.01
Boron (B)	µg/g dw	1
Cadmium (Cd)	µg/g dw	0.01
Chromium (Cr)	µg/g dw	0.5
Cobalt (Co)	µg/g dw	0.01
Copper (Cu)	µg/g dw	0.05
Iron (Fe)	µg/g dw	2
Lead (Pb)	µg/g dw	0.01
Manganese (Mn)	µg/g dw	0.1
Mercury (Hg)	µg/g dw	0.005
Molybdenum (Mo)	µg/g dw	0.1
Nickel (Ni)	µg/g dw	0.05
Selenium (Se)	µg/g dw	0.05
Silver (Ag)	µg/g dw	0.01
Strontium (Sr)	µg/g dw	0.1
Thallium (Tl)	µg/g dw	0.05
Tin (Sn)	µg/g dw	0.05
Titanium (Ti)	µg/g dw	0.05
Uranium (U)	µg/g dw	0.005
Vanadium (V)	µg/g dw	0.1
Zinc (Zn)	µg/g dw	0.5

Note: "-" indicates no data available

[a] Laboratory reporting limits provided by SRC in Saskatoon, Saskatchewan.

- Are selenium concentrations in zooplankton different downstream of the Elk River compared to upstream, and were the differences changing over time?

2.4.4.1 Community Composition

Phytoplankton and zooplankton community data were compared between downstream and upstream study areas, and qualitatively to data from the previous monitoring period (2014 to 2016) using primary metrics of mean taxonomic richness [as identified to lowest practical level (LPL)], mean organism density (average number of cells or organisms per litre), and mean biomass (mass of cells or organisms per litre). Comparisons were made based on density as well as biomass. Relative density and relative biomass of key and/or dominant taxonomic groups were calculated as the density or biomass of each respective taxa and group relative to the total number of cells or organisms in the sample. Dominant taxa were defined as taxa representing at least 5% of the total cell or organism density at one or more stations. Community endpoints were summarized by reporting the minimum, maximum, mean, median, standard deviation (SD), and sample size for each sampling area. Zooplankton community data was compared between downstream (RG_T4) and upstream areas (RG_TN), and between spring and late-summer to determine if there were community differences when the reservoir was at half pool compared to full pool (June and September; as per ENV requirement on June 8, 2018). In addition comparisons were made between sampling methods (entire water column vs. 10 m) for the August and September sampling events to determine if there were apparent water column distribution differences within each area.

Phytoplankton and zooplankton community data were compared statistically between the downstream and upstream study areas (for like collection methods) using a pairwise t-test with α=0.1. A suite of transformations were applied to each endpoint and then tested to determine the transformation that would maximize normality, including: no transformation, $\log_{10}$ (or $\log_{10}[x+1]$ for counts that contain 0), square-root, and fourth-root. The transformation with the highest resulting p-value from a Shapiro-Wilk test was applied to the respective endpoint and carried forward for subsequent tests. In instances where normality could not be achieved through data transformation, the non-parametric Mann-Whitney test was conducted using untransformed data. In instances where the assumption of homogeneity of variances was not met (Levene's test; α = 0.05) but data were normally distributed, a two-sample t-test assuming unequal variances was conducted using transformed data (Ruxton 2006).

An observed effect size was calculated for each statistical comparison analyzed using a two-sample t-test as

Observed Effect Size = $(\bar{X}_{Downstream} - \bar{X}_{Upstream})/SD$

where $\bar{X}_{Downstream}$ and $\bar{X}_{Upstream}$ were the downstream and upstream area community endpoint means and the SD is an estimate of the upstream area standard deviation. The estimate of the upstream area standard deviation was either the pooled standard deviation from the two-sample t-test for equal variances, or the upstream area sample standard deviation when the two-sample t-test for unequal variances was applied. The effect size calculations were conducted on the transformed scale when the data were transformed for analysis. When the Mann-Whitney test was used, the observed effect size was estimated using median values instead of means, and the Pooled Median Absolute Deviations (MAD) instead of SD.

MAD $= median(\left|x_{Area}^{i} - median(x_{Area})\right|)$

where x_{Area}^{i} was each observation in the dataset, $median(x_{Area})$ was the median of the area to which x_{Area}^{i} belongs (i.e. downstream or upstream) and $|f(x)|$ was the absolute value of $f(x)$.

Non-metric multi-dimensional scaling (NMDS) was used to reduce the respective phytoplankton and zooplankton taxonomic data matrices to fewer dimensions. This method is used to visualize the level of similarity of samples based on the rank (e.g. sample A is more similar to Sample B than to Sample C) of the similarities (Clarke 1993). The NMDS takes the N-dimensional (here N = number of taxa) coordinates of each sample (i.e. area) and defines a set of new N-dimensional coordinates that reflect the locations (rank distances) among samples. NMDS results of non-transformed data often leads “to shallow interpretation in which only the pattern of a few, very common species is represented” (Clarke 1993). A suite of transformations were applied ($\log_{10}$, square root, fourth root, power 2, and power 4) and the resultant data matrix was assessed for normality based on the average skewness and kurtosis. The transformation with the lowest average skewness and kurtosis was deemed the preferred transformation to theoretically reduce the influence of dominant taxa. The NMDS was conducted on the lowest practical level taxonomic data matrix using relative abundances, and taxa occurring in fewer than 10% of the samples were removed from the dataset as their exclusion from multivariate analyses reduces ‘noise’ (Bailey et al. 2004). The analysis used the Bray-Curtis distance as the measure of relative community similarity or dissimilarity. A two-dimensional ordination solution was used when stress was < 0.2. Additional dimensions were used only when required to reduce the stress to <0.2. The analysis was conducted using the vegan package (version 2.5-1; Oksanen et al. 2018) in R (R Core Team 2015).

2.4.4.2 Tissue Chemistry

The assessment of zooplankton tissue data included comparison to the closest representative guidelines and benchmarks, and spatial comparisons between downstream and upstream areas of the reservoir. Concentrations of selenium in zooplankton tissues were compared to the interim chronic dietary BC guideline for invertebrate tissue (4 µg/g dry weight [dw]) and EVWQP Level 1 benchmarks for effects to benthic invertebrates (13 µg/g dw) and dietary effects to juvenile fish (11 µg/g dw).

Zooplankton tissue data was compared between downstream (RG_T4) and upstream areas (RG_TN) within both the June and September sampling periods, , compared between spring and late-summer to determine if there were temporal differences in selenium concentrations when the reservoir was at half pool compared to full pool within each area (June and September sampling events), and additionally compared between sampling methods (entire water column vs. 10 m for the August and September sampling events) using a pairwise t-test (see Section 2.4.4.1). The 2018 data were also plotted and compared qualitatively to data from the previous monitoring program (2014 to 2016). Data from Montana were available from 2016 to 2018, however, the data from 2016 was reported on a wet weight basis, and did not have moisture content available to do the proper conversion to dry weight. Therefore, only Montana data from 2017 and 2018 were incorporated in the data plots, and compared to the guideline and benchmarks.

2.5 Benthic Invertebrates

2.5.1 Overview

Benthic invertebrate community samples were collected from the Canadian portion of the reservoir in August 2018 at the profundal areas downstream (RG_T4) and upstream (RG_TN) of the Elk River (Table 2.2; Figure 2.1). Benthic invertebrate tissue samples were collected from RG_T4 and RG_TN in both April and August, however, due to laboratory error, the August tissue sample from RG_T4 had to be recollected in October. In addition, benthic invertebrate tissue samples were also collected concurrent with sediment quality samples collected from littoral areas downstream (RG_ER and RG_GC) and the upstream (RG_SC; Figure 2.1) in April.

2.5.2 Sample Collection

2.5.2.1 Community

Consistent with the 2014 to 2016 study, benthic invertebrate community sampling was completed at each of the five stations downstream and upstream of the Elk River (i.e., RG_T4-1 to RG_T4-5 and RG_TN-1 to RG_TN-5, respectively; Figure 2.1) in August 2018 when water levels were most stable, and benthic invertebrate communities were anticipated to be at peak biomass and diversity (BCMOE 2006). Benthic invertebrate community samples were collected using a stainless steel Petite Ponar sampler. A single sample, consisting of a composite of five Petite Ponar grabs, were collected at each station with care taken so that each grab captured the surface material and was full to each edge. Incomplete grabs were discarded, while each acceptable grab was field-sieved using 500 µm mesh bag. The retained material was carefully transferred into a plastic sampling jar containing both external and internal station identification labels. Benthic invertebrate samples were preserved to a level of 10% buffered formalin in ambient water and kept at ambient temperatures. Supporting measures collected along with each sample included *in situ* water measurements and Secchi depth.

2.5.2.2 Tissue Chemistry

A single composite benthic invertebrate tissue sample (each consisting of 20 petite Ponar grabs; four from each of the five sampling stations [RG_T4-1 to RG_T4-5 and RG_TN-1 to RG_TN-5] in each study area) was collected in April and August/October[8] of 2018. Each grab was placed into a 500 µm mesh sieve bag and sieved free of material less than the mesh size. The remaining material was transferred to a white enamel tray for removal of benthic organisms using tweezers. Visible organisms were removed from the debris/sediment and rinsed clean using ambient water. Similar to sampling conducted in 2014 to 2016, chironomids were targeted for tissue collection, but if chironomids were not present in sufficient numbers, other benthic invertebrates were added to the sample (and noted on field sheets) to achieve sufficient sample weight for analysis (approximately 0.5 grams [g]).

Benthic invertebrates were also collected in April 2018 along the shoreline margins (littoral areas), at the downstream Elk River, and Gold Creek sampling areas, and the upstream Sand Creek sampling area (n = 5 samples per area) concurrent with littoral sediment samples. Samples were collected with a kick net having a triangular aperture measuring 36 cm per side and 400 µm mesh (net recommended for the Canadian Aquatic Biomonitoring Network [CABIN] protocol). The net was swept back and forth along the shoreline to collect benthic invertebrates. The kick-net was rinsed with water to move debris and invertebrates into the collection cup at the bottom of the net. The sample was transferred to a white enamel tray and organisms were removed from the debris using tweezers until a minimum of 0.5 g of tissue was obtained for analysis. All benthic tissue samples collected in both April and August were transferred to sterile cryovials and frozen. Supporting measures for each sample included *in situ* water quality measurements, Secchi depth measurements for deeper stations, and GPS coordinates for samples collected in littoral areas in April.

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[8] Due to laboratory error, the sample was destroyed and was resampled at the next possible opportunity on October 9, 2018.

2.5.3 Laboratory Analysis

2.5.3.1 Community

Benthic invertebrate community samples were submitted to Zeas Inc. in Nobleton, Ontario, a certified benthic taxonomist, for analysis following standard sorting methods which incorporate recommended QA/QC procedures for assessing sub-sampling error and sorting recovery checks (Environment Canada 2012). Upon arrival at the laboratory, a biological stain was added to each sample to facilitate greater sorting accuracy. Samples were washed free of formalin in a 500 µm sieve and examined under a stereomicroscope at a magnification of at least ten times. Benthic invertebrates were removed from the sample debris and placed into vials containing a 70% ethanol solution according to major taxonomic groups (e.g., phyla, orders). A senior taxonomist enumerated and identified benthic organisms to LPL (typically to genus or species) using the most recent taxonomic keys. Following identification, representative specimens of new taxa were preserved in a 75% ethanol, 3% glycerol solution in separately labelled vials and added to the voucher collection for the project.

2.5.3.2 Tissue Chemistry

Benthic invertebrate tissue samples were shipped to SRC in Saskatoon, Saskatchewan, for analysis of metals (including mercury) and selenium using HR-ICP-MS consistent with ENV laboratory guidance (Province of BC 2015) as specified in Permit 107517. Samples were freeze dried prior to analysis, and concentrations were reported on a dw basis, along with moisture content to allow for conversion to wet weight (ww) values if required. Accuracy and precision of laboratory data were judged based on ability to achieve minimum LRLs (Table 2.6), review of the results from laboratory duplicate analysis, as well as a comparison to CRMs.

2.5.4 Data Analysis

Data from the benthic invertebrate community and tissue chemistry sampling were used to address the following questions:

- Are selenium concentrations in benthic invertebrates greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?
- Does benthic invertebrate community structure differ downstream of the Elk River compared to upstream, and are the differences changing over time?

2.5.4.1 Community

Benthic invertebrate community data were compared between downstream and upstream study areas, and qualitatively to data from the previous monitoring period (2014 to 2016) using primary metrics of mean taxonomic richness [as identified to lowest practical level (LPL)], mean organism density, and mean biomass. Benthic invertebrate communities were evaluated similar to plankton communities (Section 2.4.4.1). Primary metrics of mean taxonomic richness (as identified to LPL) and mean organism density (average number of organisms per m^2) were calculated, and the absolute and relative densities (calculated as the density of each respective taxa and group relative to the total number of organisms in the sample) of dominant taxa and groups were also calculated. Dominant taxa were defined as those species representing at least 5% of the total organism density at one or more stations. Community endpoints were summarized by reporting the mean, median, minimum, maximum, SD, and sample size for each sampling area.

A pairwise t-test was used to assess spatial differences in benthic invertebrate community endpoints in the area downstream from the Elk River compared to the upstream area, as described in Section 2.4.4.1. Data were compared qualitatively to data from the 2014 to 2016 monitoring program. Benthic invertebrate communities were also assessed using NMDS as described in Section 2.4.4.1.

2.5.4.2 Tissue Chemistry

Selenium concentrations in benthic invertebrates were plotted and compared to the BCMOE (2017a) interim guideline of 4 µg/g dw and the Level 1 benchmarks (Teck 2014) as per the EVWQP (i.e., 15, 13, and 11 µg/g dw for dietary effects on juvenile birds, effects on benthic invertebrate reproduction, and for dietary effects to juvenile fish, respectively), and were compared qualitatively to data from the 2014 to 2016 monitoring program.

2.6 Fish

2.6.1 Overview

Collection of fish was an integral component of the Canadian Koocanusa Reservoir monitoring program (Table 2.2). Peamouth chub (*Mylochelius caurinus*) and redside shiner (*Richardsonius balteatus*) were collected near the mouths of Sand Creek, Elk River, and Gold Creek (RG_SC, RG_ER, and RG_GC respectively; Figure 2.2) in spring (April), prior to spawning in 2018 to evaluate fish health. These species represent a food source for piscivorous fish (Lotic 2017), and were collected along with northern pikeminnow (*Ptychocheilus oregonensis*) for muscle and ovary tissue chemistry in 2018. Sport fish represent the highest trophic level in the reservoir and are an important resource for human consumption (Lotic 2017, Ramboll Environ 2016). Sport fish (e.g., bull trout [*Salvelinus confluentus*]) muscle using non-lethal methods (i.e., muscle plug) were also evaluated. These data were supplemented with fish tissue samples collected in the Montana portion of the reservoir from 2018 as well (Figure 2.2).

Redside shiner, which had the highest ovary mean selenium concentrations in the 2014 to 2016 monitoring program (Minnow 2018a) were also the focal species for assessment of recruitment (requested and supported by the EMC). Recruitment was assessed in August 2018 at each of the three fishing areas to confirm the presence of young-of-the-year (YOY) redside shiner, among other endpoints (Table 2.1).

2.6.2 Fish Population Health

An *a priori* power analysis was completed to determine sample sizes required to detect a difference of 20 to 30% in relative gonad size (standard Environmental Effects Monitoring [EEM] protocol; Environment Canada 2012; Appendix E). For the fish health assessment, 20 sexually mature female and 35 male peamouth chub were targeted in each of the three study areas (downstream areas of Elk River and Gold Creek, and the upstream area of Sand Creek; Figure 2.2) in April 2018 (i.e., immediately prior to spawning; Appendix B). The *a priori* power analysis indicated that more redside shiner (35 female and 45 males) would be required to detect a difference of 20 to 30% in relative gonad size in each of the three study areas (Appendix E). Redside shiners were sampled at the same time as peamouth chub. Fish were collected using very short-set gill nets (starting with a maximum set time of 15 minutes). Representatives from the Elk Valley Fish and Fish Habitat Committee (EVFFHC) attended the EMC meeting on January 23rd, 2018, where members indicated that if gill nets are requested, only small-mesh, short-set gill nets would be approved to avoid incidental mortalities of sport fish. This advice was followed in the application for the scientific fish collection permit submitted to the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRO).

Gill nets with mesh size specific for targeting peamouth chub (2”) and redside shiners (1”) were set on the bottom, and deployed in each fishing area for each species. The location of each net set (UTM coordinates), as well as the time of deployment and the time of retrieval, was recorded on field sheets. Captured peamouth chub and redside shiner were sacrificed by a decisive blow to the head and transported to a dedicated field laboratory for processing as soon as possible following capture (i.e., within hours).

Peamouth chub and redside shiner fork and total lengths were measured to the nearest millimeter using a standard measuring board. Fish weights were measured using appropriately-sized spring scales (e.g., 50 g, 100 g, and 300 g) or a digital balance (± 0.001 g). Each fish was opened and the sex and/or sexual maturity recorded. Whole gonads and livers were removed from each fish and weighed to the nearest milligram using an analytical balance with a surrounding draft shield. Whole ovaries and a skinless, boneless muscle fillet sample were collected from each sexually mature female being retained for tissue analysis and placed in separately labelled, polyethylene (Whirl-Pak®) bags. Following these measures, age structures (i.e., otoliths) were removed from each fish. Each age structure was wrapped separately in waxed paper and placed inside a labelled envelope. Internal or external deformities, erosions (fin and gill), lesions, or tumors (DELT) observed during processing (Sanders et al. 1999) and parasites were recorded on laboratory bench sheets. Samples (i.e., ovaries, muscle, and age structures) were stored frozen pending shipment to the respective laboratory for analysis.

2.6.3 Fish Tissue

The targeted species, the number of samples collected, and the timing of collection for the fish tissue chemistry assessment were as follows:

- sport fish muscle (non-lethal muscle plugs) collection from up to eight individuals per species in each of the three fishing areas in 2018 (Figure 2.2);
- peamouth chub and redside shiner ovary and muscle collection from up to 10 females per species per study area in April 2018, as part of the fish health assessment. These species were targeted in the 2014 to 2016 monitoring cycle and both had mean selenium concentrations in ovaries above the BC guideline; and
- northern pikeminnow ovary and muscle collection from up to 10 females per fishing area in early June 2018. Northern pikeminnow were collected in June rather than April (as per the 2014 to 2016 program) to determine if average ovary selenium concentrations above the EVWQP Level 1 benchmark for effects to fish reproduction observed in 2014 were potentially a result of pikeminnow having undeveloped ovaries (i.e., gonadosomatic index [GSI] <1 %).

The sport fish collection targeted species previously collected in Koocanusa Reservoir (i.e., bull trout, Kokanee [*Oncorhynchus nerka*], mountain whitefish [*Prosopium williamsoni*], rainbow trout [*Oncorhynchus mykiss*], westslope cutthroat trout [*Oncorhynchus clarki lewisi*], and yellow perch [*Perca flavescens*]; Minnow 2018a). Burbot (*Lota lota*) were not a target species for muscle tissue sampling based on concerns regarding low abundance[9] and the cultural importance of this fish species to the KNC. If burbot were caught, they were immediately released. In addition, previous analysis of burbot tissue confirmed that selenium concentrations were below the BC guideline and EVWQP Level 1 benchmarks, and not expected to cause effects (Minnow 2015b).

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[9] In recent years, lower Kootenay burbot populations were designated as critically imperiled and red-listed, meaning potentially extirpated, endangered, or threatened (BCMOE 2015)

Fish were collected using multiple methods. Very short-set gill nets (starting with a maximum set time of 15 minutes) were used to minimize effects to fish. Three foot-diameter hoop nets were also deployed (effective for catching yellow perch; Minnow 2018a) and were left to fish overnight (i.e., approximately 24 hours). Leads were attached to the opening of each net and typically set perpendicular to shore. Yellow perch were sacrificed as they were inadvertently introduced into Koocanusa Reservoir (Huston et al. 1984; Hamilton et al. 1990), and the FLNRO requested that perch collected during sampling be sacrificed (FLNRO 2018). Angling, although not effective in April due to water flow and turbidity, was used to target sport fish and supplement catches of other species, such as northern pikeminnow. Angling was conducted from a boat using a single hook baited with salted salmon roe or earthworms, and using fishing lures. In August 2018, some fish sampled were caught from anglers. The location (UTMs) of each net set or angling site, as well as the time of deployment and the time of retrieval, were recorded on field sheets.

For collection of tissues from fish that were sacrificed (i.e., peamouth chub, northern pikeminnow, redside shiner, and yellow perch), methods were consistent with those described in Section 2.6.2. For fish being sampled non-lethally (i.e., most sport fish), fish were lightly anaesthetized in a dilute clove oil solution prior to processing. Each fish was then weighed using appropriately-sized spring scales, near the top of the scale's range to so that measurements achieved a resolution of approximately one percent or less. Total length and fork length was determined using a standard measuring board (± 1 mm). External deformities, erosions (fin and gill), lesions, or tumors observed (i.e., DELT survey; Sanders et al. 1999) were recorded on field sheets. A muscle sample was collected using a biopsy punch (4 mm acu-punch). Following extraction of the biopsy sample, skin was removed from the sample using a scalpel and the remaining muscle placed into a sterile cryovial. Once each fish recovered from the anesthetic in a recovery bin, it was released back into the reservoir near its capture location.

Samples were stored frozen until shipment to an accredited laboratory.

2.6.3.1 Laboratory Analysis

Fish tissues collected for age analysis were submitted to AAE Technical Services in Winnipeg, Manitoba. Otoliths were prepared and read under a compound microscope using transmitted light. For each structure, the age and edge condition were recorded along with a confidence rating for the age determination. For the purpose of QA/QC, greater than 40% of samples were reassessed by a second individual at the laboratory.

Fish tissue samples for chemical analysis were submitted to SRC in Saskatoon, Saskatchewan, a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited laboratory, consistent with ENV laboratory guidance as specified in Permit 107517 (Province of BC 2015).

Samples were initially freeze-dried for determination of moisture content and then analyzed for metals (including mercury) using HR-ICP-MS. Results were reported on a dw basis, along with moisture content (based on the difference between wet and freeze-dried sample weights) to allow conversion to wet-weight values. Accuracy and precision of data was judged based on ability to achieve minimum LRLs (Table 2.6), replicate analysis of a minimum of 10% of samples, as well as a comparison to CRMs.

2.6.4 Fish Recruitment

A non-lethal sampling design was used to investigate if redside shiner recruitment was occurring, and to evaluate condition (among other non-lethal EEM endpoints) of YOY shiners between areas downstream of the Elk River (Elk River and Gold Creek) relative to upstream (Sand Creek). Seining was used in littoral areas to collect YOY redside shiner in each of the three study areas (Figure 2.2). Upon retrieval of the net, captured fish were identified, enumerated, and inspected for external abnormalities (i.e., DELT survey). Non-target fish were released alive at the capture location. Captured redside shiner were placed in aerated buckets of water and retained for processing (described below). Fish sampling targeted a minimum of 100 YOY redside shiner from each fishing area. The recruitment assessment focused on YOY versus non-YOY (mostly expected to be 1+ age category based on previous sampling; Minnow 2018a). Sufficient numbers of the non-YOY age class were not captured (e.g., greater than 100 redside shiner), so endpoints were not examined separately for non-YOY. Recorded supporting information included duration of sampling effort, sampling depth, area/distance sampled, UTM coordinates, and habitat descriptions.

Fish were lightly anaesthetized in a dilute clove oil solution prior to processing. Length (fork and total) were measured to the nearest hundredth of a millimetre using digital calipers, and fresh body weight was measured to the nearest milligram using an analytical balance with a repeatability (standard deviation) of ± 0.003 g. External deformities, erosions (fin and gill), lesions, or tumors observed during processing (i.e., DELT survey) were recorded on field sheets. Five redside shiners in each area of varying sizes were sacrificed for collection of otoliths according to methods described in Section 2.6.2. With the exception of fish sacrificed for aging, fish were placed into a recovery bucket following processing. Fish were released near the point of capture following completion of sampling.

2.6.5 Data Analysis

Data from the fish health and tissue chemistry sampling were used to address the following questions:

- Are selenium concentrations in fish tissue greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?
- Is fish health different downstream of the Elk River compared to upstream, and are differences in fish health endpoints changing over time?
- Are there differences in redside shiner recruitment downstream of the Elk River compared to upstream?

2.6.5.1 Health Assessment

Fish health endpoints representing four response categories, survival (mean age), growth (body weight-at-age, fork length-at-age), reproduction (gonad weight-at-body weight), and energy storage (body weight-at-fork length, liver weight-at-body weight), were evaluated separately for males and females of peamouth chub and redside shiner collected in each study area (Table 2.1). These are the endpoints reported for fish health assessments conducted by Canadian metal mines to satisfy EEM requirements under the *Fisheries Act* (Environment Canada 2012). Magnitudes of difference were interpreted relative to commonly accepted Critical Effect Sizes (CES; Munkittrick et al. 2009; Environment Canada 2012; Table 2.1). Results were also compared qualitatively to those from the previous monitoring period (2014 to 2016).

Summary statistics including mean, median, minimum, maximum, SD, standard error, and sample size were calculated by study area and fish sex for summary endpoints of age, body weight, fork length, condition factor (K = body weight/[fork length]^3×100,000), gonadosomatic index (GSI = gonad weight/body weight×100), and liver-somatic index (LSI = liver weight/body weight×100). Statistical analyses of datasets from the fish health survey were consistent with procedures outlined in the EEM technical guidance document (Environment Canada 2012), including the use of “adjusted” body weights in statistical analyses (whole body weight less the gonad and liver weights). Fish with parasites (e.g., tapeworms) were not used for the statistical analyses (fish health assessment), although a comparison of abnormalities between areas was completed.

Differences in mean age between study areas was compared using ANOVA. Other endpoints were compared using analysis of covariance (ANCOVA). Prior to conducting the ANOVA or ANCOVA tests, data was assessed for normality and homogeneity of variance, and log-transformed. Scatterplots of variable and covariate combinations were examined to identify outliers, leverage values or other unusual data, to confirm there is adequate overlap of data between areas being compared, and that there is a linear relationship between the variable and the covariate.

The first step in the ANCOVA analysis was to determine whether the slopes of the regression lines for both test areas were equal. This was accomplished by testing for a significant interaction term (dependent × covariate) in the ANCOVA model. If the interaction term was significant (i.e., regression slopes not equal, $p<0.05$), two methods were used to determine whether a full ANCOVA could proceed. In order of preference, these were 1) removal of influential points using Cook's distance and re-assessment of equality of slopes, and 2) coefficients of determination that consider slopes equal regardless of an interaction effect (Environment Canada 2012). If both methods proved unacceptable, the magnitude of difference calculation was estimated at both the minimum and maximum overlap of covariates between test areas (Environment Canada 2012). This resulted in a significant interaction effect (slopes are significantly different), but the calculation of the magnitude of difference at the minimum and maximum values of covariate overlap was not assigned statistical difference as it would for a full ANCOVA model. If the interaction term was not significant (i.e., homogeneous slopes between the two test populations), then the full ANCOVA model was run without the interaction term to test for differences in adjusted means between the two populations. The adjusted mean was then used as an estimate of the population mean based on the value of the covariate in the ANCOVA model.

For endpoints showing significant differences between areas, the magnitude of difference was calculated as described by Environment Canada (2012) using the mean (ANOVA), adjusted mean (ANCOVA with no significant interaction) or predicted values (ANCOVA with significant interaction). The anti-log of the mean, adjusted mean or predicted value were used in the equations for endpoints that are $\log_{10}$-transformed. In addition, the magnitude of difference for ANCOVA with a significant interaction were calculated for each of the minimum and maximum values of the covariate. The minimum detectable effect size was calculated as a percent difference from the reference mean (using the observed sample sizes and $\alpha = \beta = 0.1$).

2.6.5.2 Tissue Chemistry

Selenium concentrations in fish tissues were statistically compared between the downstream areas (RG_ER and RG_GC) and the upstream area (RG_SC) for 2018 for peamouth chub (PCC) and redside shiner (RSC). An ANOVA was used to compare the 2018 data. Selenium concentrations in all fish tissues (for both the Canadian and Montana portions of the reservoir) were also plotted and compared to the BCMOE (2017a) guidelines (for muscle [4 μg/g dw] and ovaries [11 μg/g dw]), the 2016 USEPA guidelines (for muscle [11.3 μg/g dw] and ovaries [15.1 μg/g dw]). Westslope cutthroat trout were also compared to species specific EVWQP Level 1 benchmark for reproduction (25 μg/g dw), and a Level 1 muscle equivalent benchmark to the ovary benchmark, based on the relationship observed between selenium in muscle and ovary in westslope cutthroat trout (15.5 μg/g dw). Data were also qualitatively compared to data from the previous monitoring period (2014 to 2016). Mercury concentrations in fish muscle relative to length were tested using an ANCOVA to adjust for body size, and were compared to the BC tissue residue guideline for the protection of wildlife (0.033 µg/g wet weight [ww]; BCMOE 2017a). The guideline was converted to a dry weight basis based on an average moisture content in fish muscle in the Koocanusa Reservoir.

2.6.5.3 Recruitment Assessment

Initial data analysis for the redside shiner recruitment survey included plotting size frequency distributions as described by Bonar (2002) and Gray et al. (2002), so that, together with age data, YOY could be distinguished from non-YOY. Fish health endpoints of fork length, fresh body weight, and Fulton's condition factor (body weight / fork length^3 x 10^5) were summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each fishing area. These endpoints were used as the basis for evaluating four response categories (survival, growth, reproduction, and energy storage; Table 2.1) according to the procedures outlined for a non-lethal, small-bodied fish assessment in EEM (Gray et al. 2002; Environment Canada 2012).

The proportion of YOY fish captured in each area were compared. Mean length and body weight for YOY was also compared between the three fishing areas using ANOVA, with the data inspected for normality and homogeneity of variance before applying parametric statistical procedures. In cases where data did not meet the assumptions of ANOVA, the Mann-Whitney test was used to test for differences between areas. Body weight at fork length (condition) was compared using ANCOVA based on the same transformations, scatter plot evaluations, and tests as described in Section 2.6.5.1. Similarly, the magnitude of observed differences and the minimum detectable effect sizes were calculated, and together with CES, compared as described in Section 2.6.5.1.

3 WATER QUALITY, PRODUCTIVITY, AND MIXING

3.1 Overview

In accordance with Permit 107517, water quality was monitored weekly from March 15th to July 15th, and monthly outside of this time period under ice-free conditions (excluding sampling periods that posed safety concerns) by Teck at five stations within the reservoir, including one location situated upstream from the Elk River (RG_KERRRD) and four downstream from the Elk River (RG_DSELK, RG_GRASMERE, RG_USGOLD, RG_BORDER; Figure 2.1). At each station, *in situ* measurements and water chemistry samples were collected. The water quality data collected by Teck were provided in an annual report (Teck 2018c), and are summarized in this report along with water quality information collected in August 2018 concurrently with biological sampling conducted at downstream (RG_T4) and upstream (RG_TN) transects in the Canadian portion of the reservoir. In addition to these data, water quality data from three stations in the Montana portion of the reservoir (International Boundary, Tenmile Creek, and Forebay) that were collected and provided by the Montana were compiled and reviewed to determine suitability for analysis with data from the Canadian portion of the reservoir. Water quality monitoring conducted in the Canadian portion of the reservoir in 2018 also included specific conductance, temperature, and turbidity profiling to evaluate Elk River mixing characteristics in the reservoir under low (late April), intermediate (early June), and full (late August) pool conditions. In addition, as per requirement from ENV, a summary of average monthly nitrate and selenium loadings to the Koocanusa reservoir is provided.

3.2 Water Quality

Average concentrations of the Order constituents dissolved cadmium, nitrate, and sulphate were below respective BC water quality guidelines at the Order station RG_DSELK, and at all other permitted water quality stations (RG_KERRRD, RG_GRASMERE, RG_USGOLD, and RG_BORDER) at all water column depths for all sampling events conducted in 2018 (Appendix Figures A.1, A.2 and A.4). Selenium concentrations were below the guideline in all months with the exception of RG_DSELK in April, as well as at other stations located downstream of the Elk River including RG_GRASMERE, RG_USGOLD, and RG_BORDER in April (Appendix Figure A.3). Due to unsafe sampling conditions near the Order Station RG_DSELK, water sampling was not completed at the permitted sampling location. Sampling was instead conducted at alternate locations along the east shoreline in April, and from both the east and west shorelines in May. Differences in water chemistry were indicated between the east and west shoreline water samples in May which suggested the shoreline samples were not representative of mixed water conditions between the Elk and Kootenay rivers (Teck 2019). The mixing study further corroborated the lack of mixing along the east shoreline in April transects (Section 3.5). As a result, water chemistry data taken near Station RG_DSELK in April were not representative of the Order station.

Total zinc concentrations were also above the BC water quality guideline downstream of the Elk River at stations RG_DSELK and RG_USGOLD, as well as upstream of the Elk River at Station RG_KERRRD, in the spring of 2018 (Appendix Figure A.16), likely reflecting highly turbid water received from both the Elk and Kootenay rivers during the freshet period. All other constituents with applicable EWTs occurred at concentrations below applicable BC water quality guidelines throughout 2018 at all of the permitted water quality stations (Appendix Figures A.1 to A.2, A.4 to A.15).

Monthly mean concentrations of manganese, molybdenum, nitrate, nitrite, phosphorus, selenium, sulphate, and TDS differed significantly among water column depths (surface vs. middle, surface vs. bottom, middle vs. bottom) at various reservoir stations in 2018 (Appendix Table A.8). For this reason, statistical comparisons of water quality between the downstream and upstream areas were conducted separately for each depth in the water column for all water quality constituents to which EWTs are applicable. Annual average concentrations of barium, lithium, nitrate, and selenium were significantly higher at all water column depths at all stations located downstream of the Elk River compared to the upstream station (Table 3.1). Annual average nitrate concentrations were significantly higher at the surface of the water column at all downstream stations, and also at mid-column at stations RG_DSELK and RG_BORDER, compared to the upstream station in 2018 (Table 3.1). Other notable differences in water chemistry included significantly lower annual average sulphate concentrations at the water column surface at the downstream stations RG_GRASMERE, RG_USGOLD, and RG_BORDER, and significantly lower annual average manganese concentrations at mid-column depth downstream at RG_GRASMERE and RG_USGOLD, compared to concentrations at the respective water column depths at the upstream monitoring station (Table 3.1).

Concentrations of constituents with EWTs taken during the biological monitoring programs downstream (RG_ER, RG_T4, and RG_GC) and upstream (RG_SC and RG_TN) of the Elk River confluence were generally below applicable BC water quality guidelines. Beryllium, chromium, cobalt, mercury, and selenium concentrations exceeded the long-term water quality guidelines in at least one sample downstream of the Elk River in April; and with the exception of cobalt and selenium, concentrations of these constituents also exceeded the long-term guidelines in at least one sample upstream of the Elk River in April (Appendix Table A.9). Selenium concentrations also exceeded the long-term guideline in June and August at downstream station RG_T4, but not at the upstream stations in 2018 (Appendix Table A.9). Iron exceeded the short-term water quality

Table 3.1: Statistical Comparisons of Aqueous Concentrations of Analytes by Depth based on Monthly Means Between Stations Located Downstream (RG_DSELK, RG_GRASMERE, RG_USGOLD, RG_BORDER) and Upstream (RG_KERRRD) of the Elk River, Koocanusa Reservoir Monitoring Program, 2018

Station	Total Barium (mg/L)						Total Lithium (mg/L)					
	Surface		Mid-depth		Bottom		Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.006	16	0.006	17	0.005	25	0.004	22	0.006	19	0.001	47
RG_GRASMERE	0.004	9	0.009	12	0.008	18	0.025	17	0.014	17	<0.001	36
RG_USGOLD	0.005	4	0.003	15	0.011	16	0.009	6	0.009	22	0.001	32
RG_BORDER	0.005	6	0.089	-	0.038	22	0.355	-	0.038	16	0.013	32

Station	Total Manganese (mg/L)						Total Molybdenum (mg/L)					
	Surface		Mid-depth		Bottom		Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.384	-	0.337	-	0.963	-	0.888	-	0.182	-	0.116	-
RG_GRASMERE	0.384	-	0.034	-19	0.463	-	0.332	-	0.617	-	0.575	-
RG_USGOLD	0.297	-	0.018	-34	0.407	-	0.385	-	0.945	-	0.720	-
RG_BORDER	0.187	-	0.211	-	0.746	-	0.099	-	0.514	-	0.927	-

Station	Nitrate-N (mg/L)						Nitrite-N (mg/L)					
	Surface		Mid-depth		Bottom		Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.004	82	0.002	118	0.001	277	0.004	16	0.035	24	-	-
RG_GRASMERE	0.004	79	<0.001	124	<0.001	254	0.009	20	0.089	-	-	-
RG_USGOLD	0.004	78	0.001	138	0.001	224	0.009	24	0.074	-	-	-
RG_BORDER	0.006	85	0.001	171	0.001	260	0.004	36	0.029	55	0.173	-

Station	Total Phosphorus (mg/L)[a]						Total Selenium (mg/L)					
	Surface		Mid-depth		Bottom		Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.139	-	0.147	-	0.200	-	0.008	162	0.006	195	0.001	467
RG_GRASMERE	0.429	-	0.444	-	0.500	-	0.004	113	0.001	124	<0.001	401
RG_USGOLD	0.221	-	0.552	-	0.337	-	0.014	128	0.002	146	<0.001	371
RG_BORDER	0.006	-48	0.131	-	0.368	-	0.016	125	0.002	133	<0.001	370

Station	Sulphate (mg/L)						Total Dissolved Solids (mg/L)					
	Surface		Mid-depth		Bottom		Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.062	-	0.600	-	0.276	-	0.913	-	0.663	-	0.619	-
RG_GRASMERE	0.033	-9	0.163	-	0.690	-	0.288	-	0.312	-	0.674	-
RG_USGOLD	0.019	-22	0.200	-	0.319	-	0.367	-	0.632	-	0.343	-
RG_BORDER	0.045	-12	0.139	-	0.419	-	0.444	-	0.514	-	0.997	-

Station	Total Uranium (mg/L)					
	Surface		Mid-depth		Bottom	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_DSELK	0.591	-	0.553	-	0.980	-
RG_GRASMERE	0.992	-	0.337	-	0.485	-
RG_USGOLD	0.302	-	0.265	-	0.076	-
RG_BORDER	0.133	-	0.146	-	0.972	-

▨ P-value < 0.05
🟦 Magnitude of difference is positive (concentration is greater at downstream station relative to upstream)
🟩 Magnitude of difference is negative (concentration is lower at downstream station relative to upstream)

Notes:
"-" = not enough data with detectable concentrations (< 5 values) for statistical comparison.
Comparisons conducted as a one-sample t-test or Wilcoxon signed rank test on the difference in monthly mean concentration (downstream − upstream).
Magnitude of difference (MOD) calculated as (MCTdownstream − MCTupstream)/MCTupstream × 100%. MCT = mean for t-test and median for Wilcoxon signed rank test.
Data for these consituents, with the exception of sulphate, was not available for Montana stations in 2018. Montana was not included in the sulphate comparisons due to limited sample size.
Not enough data above detection limits to complete analyses for dissolved cadmium, antimony, boron, dissolved cobalt, nickel and zinc.
[a] Phosphorus at Montana stations (International Boundary, Tenmile and Forebay) was measured as total phosphate-phosphorus, and not comparable.

guideline in samples collected downstream (RG_T4 and RG_GC) and upstream (RG_SC and RG_TN) of the Elk River only in April (Appendix Table A.9).

Concentrations of all constituents were typically highest in the winter and spring months in 2018 at all stations, and generally followed the same seasonal pattern observed during previous monitoring (Appendix Figure A.21). This observation is likely reflective of the reservoir drawdown rates and lower water levels conditions in the winter months. In general, concentrations of constituents with EWTs observed in 2018 at all permitted water quality stations both downstream and upstream of the Elk River were within the respective seasonal ranges observed from 2014 to 2016.

3.3 Productivity

Productivity was assessed through comparison of total nitrogen to total phosphorus concentration (N:P) ratios among the five permitted water quality monitoring stations (RG_KERRRD, RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER). Ratios of N:P greater than 15 indicate that phosphorus is limiting, whereas ratios less than 7 indicate that nitrogen is limiting, based on categories defined by McDowell et al. (2009) for mass concentrations. At the permitted water quality stations, annual median N:P ratios were consistently 15 or more throughout the water column in 2018, the only exception of which was at upstream Station RG_KERRRD near the water column surface, which fell between 7 and 15 (Figure 3.1). Accordingly, Koocanusa Reservoir downstream of the Elk River was phosphorus-limited in 2018, which was consistent with previous monitoring results (2014 to 2016) and historical studies (Hamilton et al. 1990; Richards 1997). Trophic status classification using Nordin (1985) categories for BC freshwaters suggested a brief period of eutrophic conditions in the spring (April through June) based on total nitrogen and phosphorus concentrations together with Secchi depth in the Canadian portion of the reservoir in 2018. However, the reservoir appeared to be oligotrophic for much of the remainder of the year based on total phosphorus and chlorophyll-a concentrations, or mesotrophic based on Secchi depth readings and total nitrogen concentrations (Table 3.2). This change in trophic status is likely reflective of the dynamic changes taking place in the reservoir from April to June, and the rapidly rising water levels experienced by the system during this period.

3.4 *In Situ* Water Quality Profiles

Within-year water temperature profiles conducted in August (i.e., annual ‘full’ pool levels) indicated similar temperatures in the epilimnion downstream and upstream of the Elk River, but a deeper established epilimnion downstream of the Elk River (17 to 19 m) compared to upstream (10 to 12 m) reflecting greater overall depth of the reservoir at the downstream transect (Figure 3.2). Dissolved oxygen concentration and pH data each showed similar values and

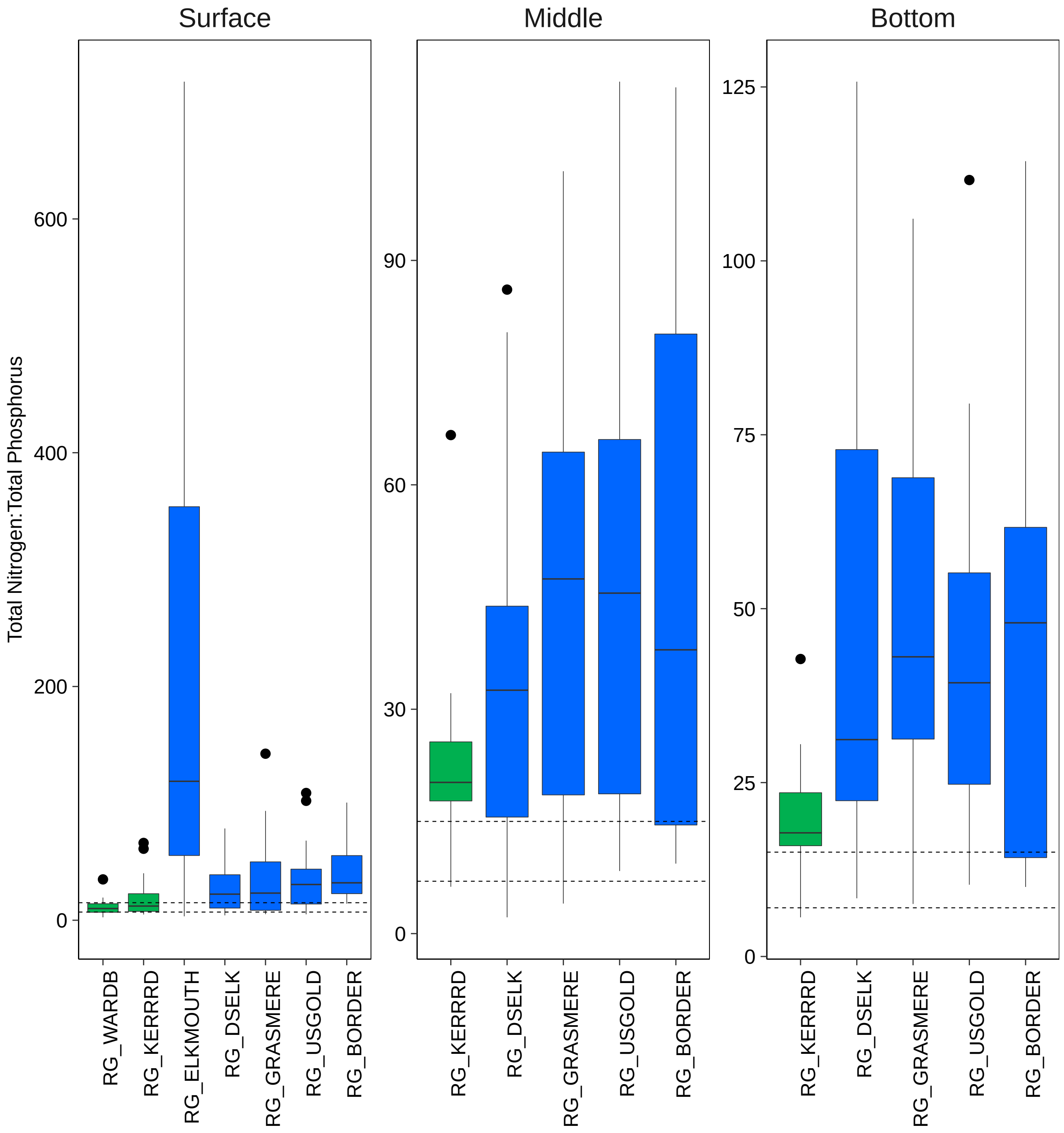


Figure 3.1: Ratio of Total Nitrogen to Total Phosphorus at Upstream (Green) and Downstream (Blue) Stations, Koocanusa Reservoir Monitoring Program, 2018

Notes: Total N:P ratios > 15 (hatched line) are indicative of phosphorus limited systems. Total N:P ratios < 7 (hatched line) are indicative of nitrogen limited systems. Total N:P ratios in between 7 and 15 indicate co-limitation.

Table 3.2. Trophic Level Classification Using Monthly Means of Productivitiy Measures, Koocanusa Reservoir Monitoring Program, 2018

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RG_WARDB	Total Phosphorus (mg/L)	0.016	0.014	0.021	0.018	0.090	0.024	0.016	0.008	0.010	0.011	0.010	0.009
RG_KERRRD		-	-	-	0.029	0.050	0.008	0.010	0.004	0.005	0.010	0.004	0.007
RG_ELKMOUTH		0.005	0.003	0.007	0.018	0.192	0.013	0.013	0.004	0.004	<0.002	0.006	<0.002
RG_DSELK		-	-	-	0.097	0.130	0.010	0.008	0.006	0.005	0.004	0.004	0.021
RG_GRASMERE		-	-	-	0.089	0.080	0.009	0.018	0.003	0.005	0.004	0.004	0.003
RG_USGOLD		-	-	-	0.074	0.056	0.009	0.009	0.005	0.004	0.003	0.004	0.004
RG_BORDER		-	-	-	0.024	0.037	0.009	0.008	0.004	0.005	0.004	0.003	0.003
INT BOUNDARY		-	-	-	-	-	-	-	-	-	-	-	-
TENMILE CREEK		-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY		-	-	-	-	-	-	-	-	-	-	-	-
RG_WARDB	Chlorophyll-a (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
RG_KERRRD		-	-	-	0.002	0.001	0.000	0.002	0.001	0.002	0.002	0.002	0.002
RG_ELKMOUTH		-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK		-	-	-	0.003	0.001	0.003	0.003	0.001	0.002	0.001	0.002	0.003
RG_GRASMERE		-	-	-	0.002	0.001	0.003	0.003	0.001	0.002	0.001	0.002	0.002
RG_USGOLD		-	-	-	0.002	0.001	0.002	0.003	0.001	0.002	0.002	0.002	0.003
RG_BORDER		-	-	-	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.002
INT BOUNDARY		-	-	-	-	-	-	-	-	-	-	-	-
TENMILE CREEK		-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY		-	-	-	-	-	-	-	-	-	-	-	-
RG_WARDB	Secchi Depth (m)	-	-	-	-	-	-	-	-	-	-	-	-
RG_KERRRD		-	-	-	-	0.2	1.1	2.6	5.5	2.8	3.9	7.1	-
RG_ELKMOUTH		-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK		-	-	-	1.0	0.2	2.2	3.0	6.3	4.0	3.0	5.1	5.6
RG_GRASMERE		-	-	-	-	0.2	2.3	2.9	5.4	4.0	3.5	5.3	4.5
RG_USGOLD		-	-	-	-	0.4	2.3	3.2	6.0	3.7	3.1	5.1	4.3
RG_BORDER		-	-	-	-	0.7	1.8	3.0	5.3	4.1	3.5	4.1	4.1
INT BOUNDARY		-	-	-	0.4	0.8	1.5	4.0	3.5	5.0	5.5	-	-
TENMILE CREEK		-	-	-	4.5	1.5	1.0	4.5	6.5	8.5	8.5	-	-
FOREBAY		-	-	-	5.0	1.5	2.5	4.5	6.0	7.0	8.0	-	-
RG_WARDB	Total Nitrogen (mg/L)	0.22	0.23	0.24	0.20	0.33	0.14	0.13	0.13	0.11	0.13	0.15	0.17
RG_KERRRD		-	-	-	0.20	0.41	0.14	0.17	0.16	0.15	0.10	0.23	0.18
RG_ELKMOUTH		1.78	1.57	1.69	1.43	1.07	1.02	1.16	1.42	1.55	1.40	1.04	1.43
RG_DSELK		-	-	-	0.78	0.71	0.32	0.27	0.28	0.30	0.33	0.33	0.33
RG_GRASMERE		-	-	-	0.73	0.57	0.33	0.29	0.29	0.25	0.33	0.31	0.28
RG_USGOLD		-	-	-	0.68	0.54	0.34	0.26	0.33	0.25	0.30	0.25	0.33
RG_BORDER		-	-	-	0.63	0.51	0.33	0.31	0.31	0.36	0.30	0.29	0.29
INT BOUNDARY		-	-	-	-	-	-	-	-	-	-	-	-
TENMILE CREEK		-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY		-	-	-	-	-	-	-	-	-	-	-	-

🟩 Oligotrophic
🟦 Mesotrophic
🟥 Eutrophic

Notes: Nordin 1985 criteria used in British Columbia for trophic level classification (see Table 2.5).

"-" data not available at this station during this month.

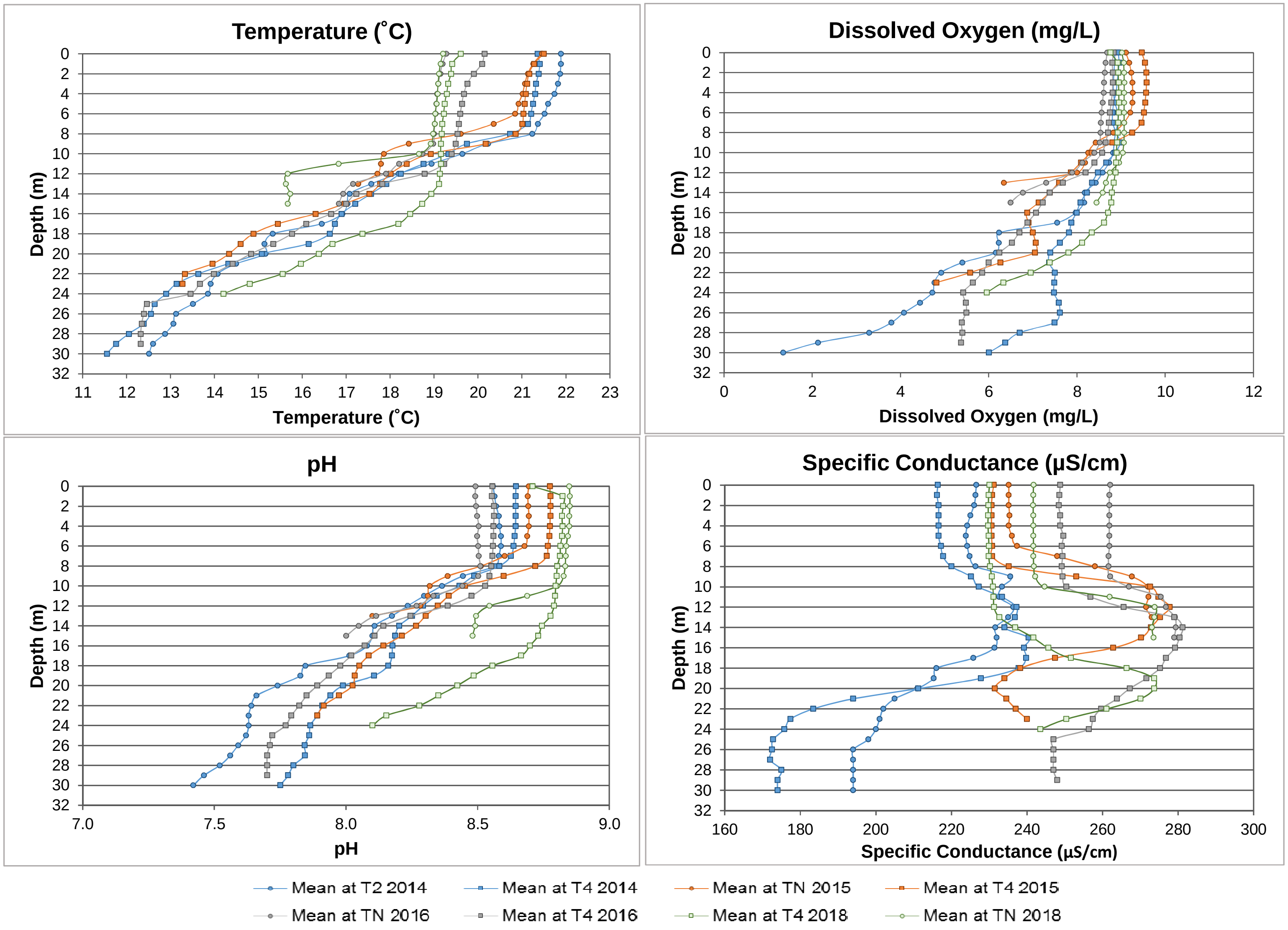


Figure 3.2: **Mean Across the Transect (n=5 Stations per Transect) of *In Situ* Water Quality Profiles Measured at Transects Located Downstream (RG_T4) and Upstream (T2/RG_TN) of the Elk River in Koocanusa Reservoir, August 2014, 2015, 2016, 2018**

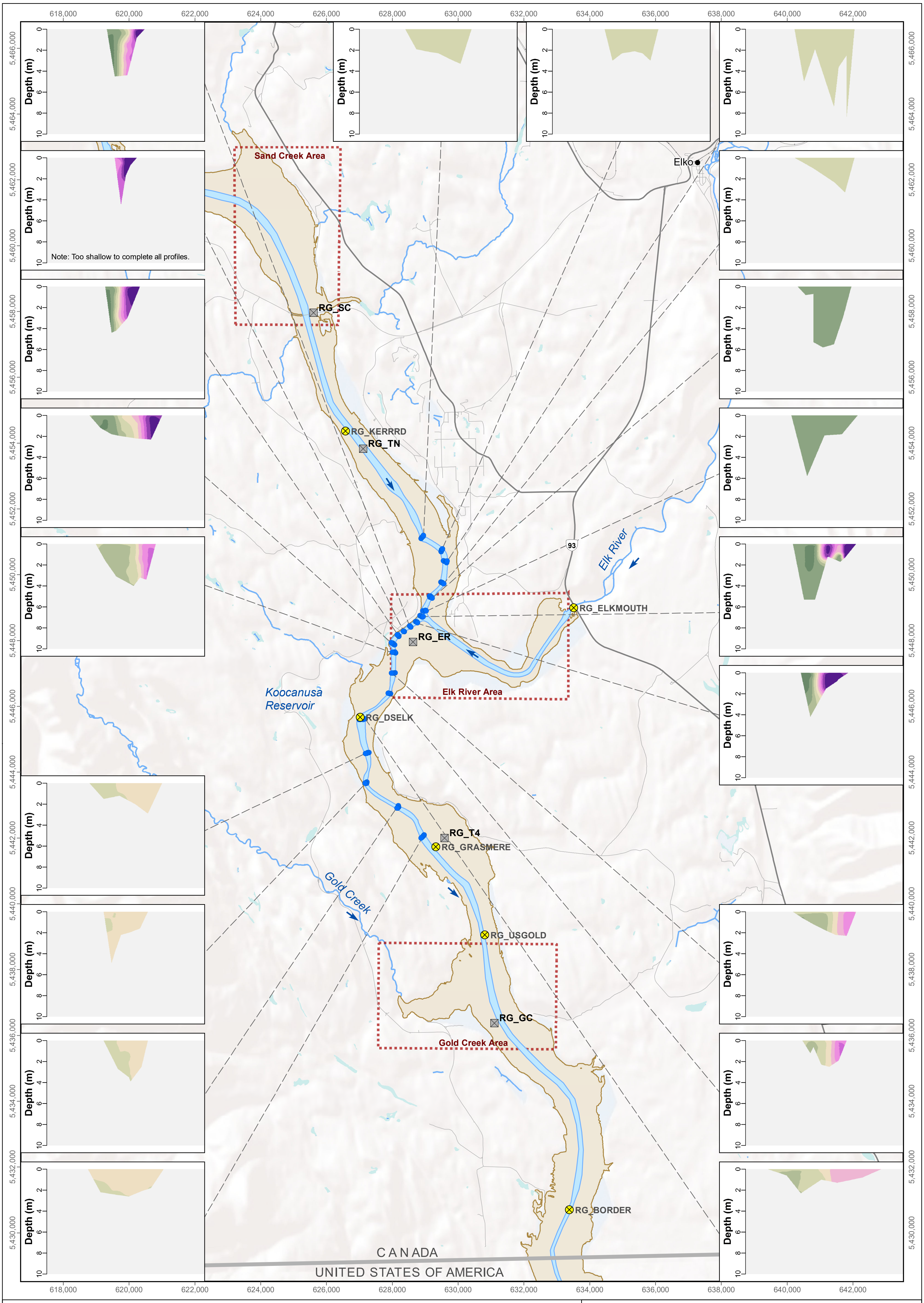
patterns with depth through the water column between transects located downstream and upstream of the Elk River in August 2018 (Figure 3.2). The dissolved oxygen concentration and pH profiles closely mirrored patterns in water temperature with depth at both transect locations (Figure 3.2). Specific conductance was noticeably lower downstream of the Elk River compared to upstream at all depths through the water column in August 2018 (Figure 3.2). In addition, specific conductance was higher in approximately the lower third of the water column compared to waters found above (both transects) and below (downstream transect only) at each respective transect location (Figure 3.2). Because specific conductance of Elk River water at Station RG_ELKMOUTH has consistently been higher than that at the Kootenay River (Station RG_WARDB), the occurrence of lower specific conductance downstream compared to upstream of the Elk River suggested a source affecting specific conductance located between the Kootenay and Elk rivers in Koocanusa Reservoir (Figure 3.2).

Temporal comparison of the August profile data indicated close similarity in water temperature, dissolved oxygen concentrations, and pH values, and in general patterns with depth for each of these parameters, between the downstream and upstream transects in 2018 compared to profiles conducted in August from 2014 to 2016 (Figure 3.2). Similarly, specific conductance was lower at the downstream compared area upstream area, and showed distinct elevation in the approximately lower third of the water column at both transect locations, in 2018 just as in all previous years of monitoring (Figure 3.2).

3.5 Mixing Study

In late April 2018, channelized, riverine flow conditions occurred within Canadian portion of the Koocanusa Reservoir reflecting low pool water levels. Specific conductance was approximately 45 to 50 microSiemens/centimetre (µS/cm) higher near the mouth of the Elk River compared to the upstream area (Figure 3.3). Specific conductance data indicated that Elk River flow was mainly confined to the eastern half of the reservoir until approximately midway between RG_DSELK and RG_GRASMERE, where substantial mixing (within 10 µS/cm) was evident both across and throughout the entire water column (approximately 4 to 5 km downstream of the Elk River). The tracking of changes in water temperature with progression from upstream to downstream of the Elk River in Koocanusa Reservoir closely mirrored patterns in specific conductance, corroborating confinement of the Elk River mixing to the eastern half of the channel until just downstream of RG_DSELK, where complete mixing throughout the water column was evident across the entire channel during the April survey (Figure 3.4).

In June and August under intermediate and full pool water levels, respectively (Figure 2.3), the Elk River discharge was characterized by elevated specific conductance and cooler water temperatures compared to reservoir waters located upstream of the Elk River mouth area



LEGEND

Specific Conductance (µS/cm)

🟩	249-254
🟩	254-259
🟩	259-263
🟨	263-268
🟨	268-273
🟪	273-278
🟪	278-283
🟪	283-287
🟪	287-292
🟪	292-297

● Transect Location

☒ Water Chemistry and In Situ Monitoring Station

⊗ Permitted Water Quality Station

▭ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for specific conductance.

Note: Reservoir channel outline is an approximate representation of the 2018 spring conditions.

Specific Conductance Profiles Conducted at Koocanusa Reservoir, April 2018

0 1.75 3.5 7
km

N
W E
S

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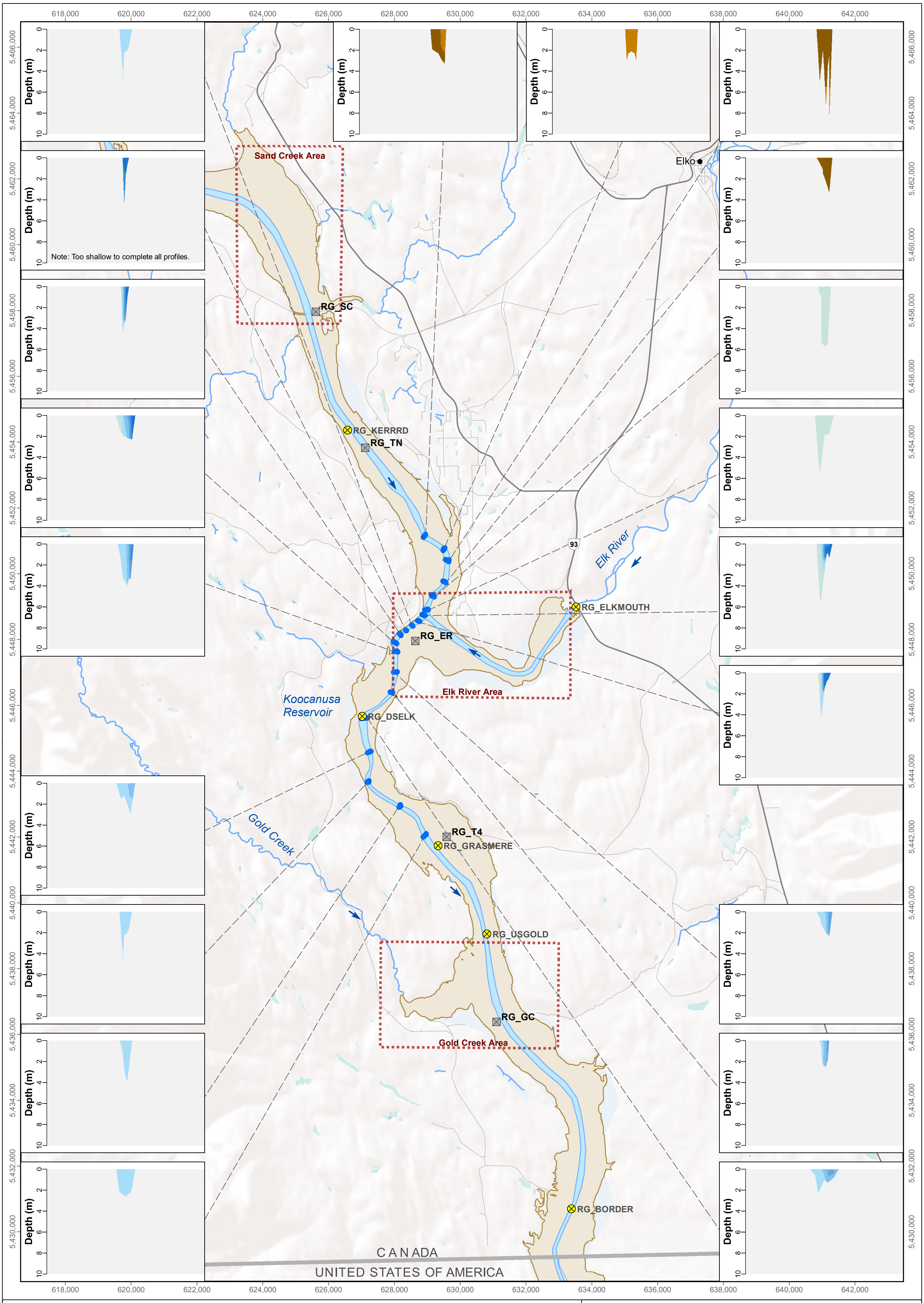
Figure 3.3

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 3.3 Koocanusa April Plume.mxd



LEGEND

Temperature (°C)

■ 8.85 - 10.0
■ 8.41 - 8.85
■ 7.98 - 8.41
■ 7.55 - 7.98
■ 7.12 - 7.55
■ 6.68 - 7.12
■ 6.25 - 6.68
■ 5.82 - 6.25
■ 5.38 - 5.82
■ 4.0 - 5.38

● Transect Location
☒ Water Chemistry and In Situ Monitoring Station
⊗ Permitted Water Quality Station
▭ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for temperature.
Note: Reservoir levels are an approximate representation of the 2018 spring conditions.

Water Temperature Profiles Conducted at Koocanusa Reservoir, April 2018

0 1.75 3.5 7
km

N
W E
S

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Figure 3.4

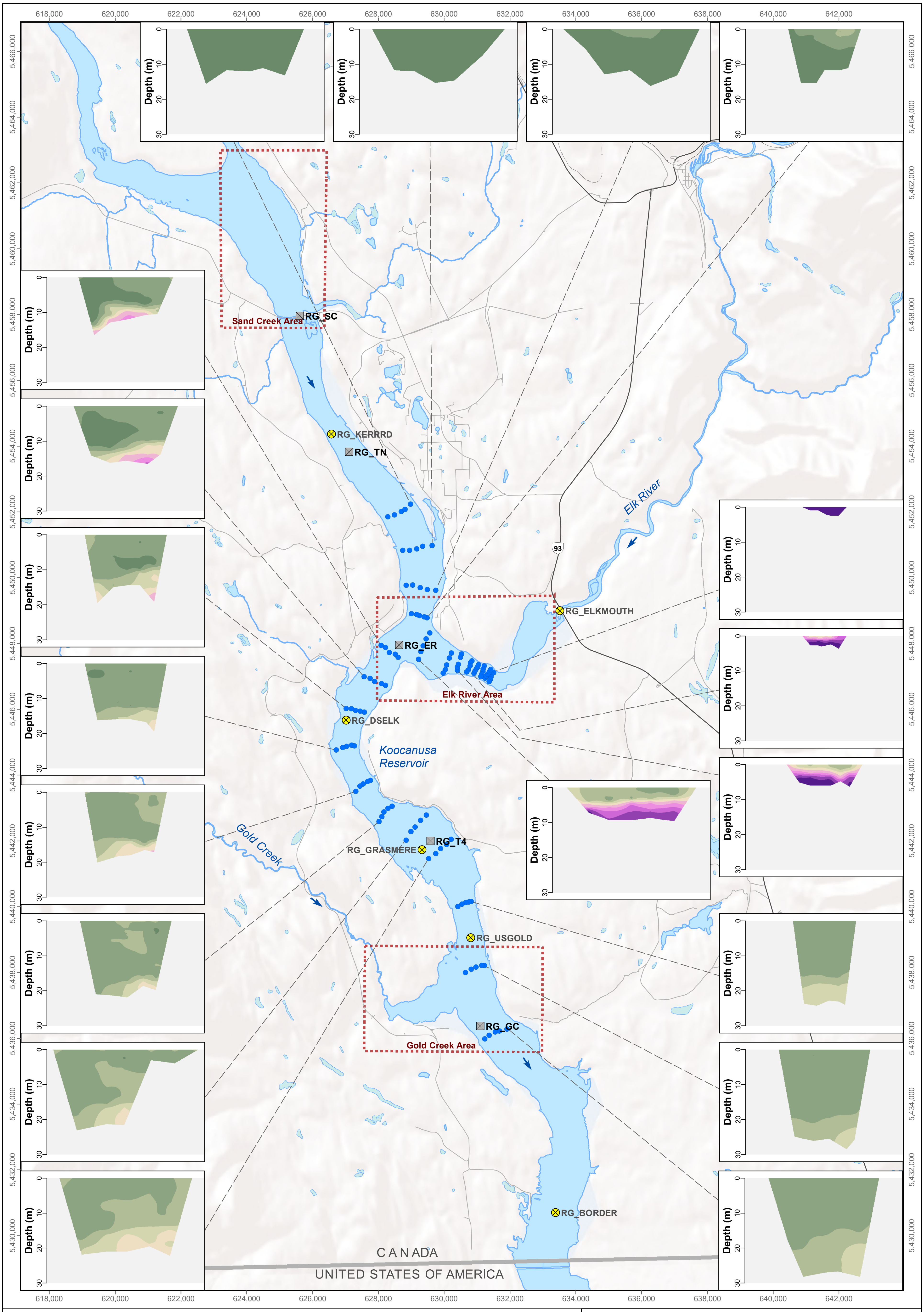
Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 3.4 Koocanusa April Temperature.mxd

(Figures 3.5 to 3.8). Profiles conducted further into the reservoir arm of the Elk River indicated that Elk River waters were generally confined to the bottom of the water column in June and August (Figures 3.5 and 3.6). In June and August, complete mixing of the Elk River with the reservoir waters had not occurred within approximately 15 km of the Elk River inlet (Figures 3.5 and 3.6). In August, an increase in specific conductance was occasionally observed at the lower third of the water column at downstream stations compared to shallower and deeper depths (Figure 3.6), similar to patterns observed at RG_DSELK during biological monitoring in August (Figure 3.2). This “inversion-layer” appears to be the result of the Elk River initially following the bottom contours of the reservoir before rising to mid-column as warmer water from the upper reservoir flows over cooler water situated along the bottom of the lower portion of the reservoir (Figures 3.6 and 3.8).

Turbidity measurements taken in June and August consistently indicated lower water clarity near the bottom of the water column compared to the surface regardless of whether profiles were conducted downstream or upstream of the Elk River (Figures 3.9 and 3.10). Although elevated turbidity was observed at the outlet of the Elk River to Koocanusa Reservoir in June, the non-conservative nature of substances that contribute to turbidity (e.g., particulate settling and/or resuspension in response to changes in system energy) precludes its use as an effective signature for the Elk River discharge as demonstrated by the June and August turbidity profiles (Figures 3.9 and 3.10).

3.6 Nitrate and Selenium Loadings

Monthly nitrate and selenium loadings were calculated based on the total monthly flow and the average nitrate and selenium concentrations relative to flow measured at stations RG_ELKMOUTH (Elk River) and RG_WARDB (Kootenay River). Monthly average loadings for both constituents were highest in May and June (coinciding with freshet), and higher in the Elk River compared to the Kootenay River (Table 3.3).



LEGEND

Specific Conductance (µS/cm)

🟩	188-198
🟩	198-207
🟩	207-217
🟨	217-226
🟨	226-235
🟪	235-245
🟪	245-254
🟪	254-263
🟪	263-273
🟪	273-283

●	Transect Location
☒	Water Chemistry and In Situ Monitoring Station
⊗	Permitted Water Quality Station
⬚	Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for specific conductance.

Specific Conductance Profiles Conducted at Koocanusa Reservoir, June 2018

0 1.75 3.5 7
km

N
W E
S

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Figure 3.5

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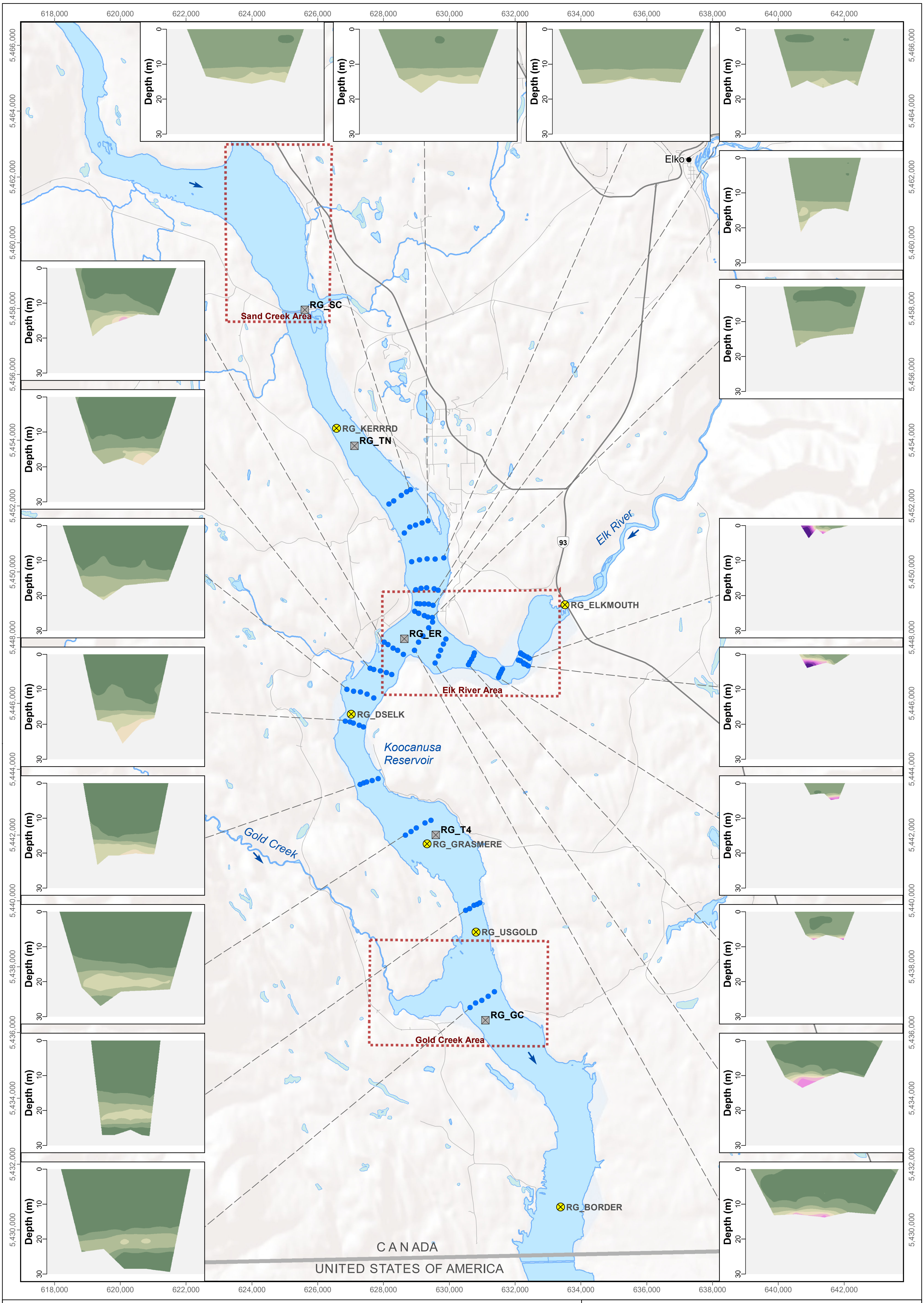

LEGEND

Specific Conductance (µS/cm)

- ■ 237-255
- ■ 255-272
- ■ 272-289
- ■ 289-306
- ■ 306-323
- ■ 323-341
- ■ 341-358
- ■ 358-375
- ■ 375-392
- ■ 392-409

- ● Transect Location
- ☒ Water Chemistry and In Situ Monitoring Station
- ⊗ Permitted Water Quality Station
- ⬚ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for specific conductance.

Specific Conductance Profiles Conducted at Koocanusa Reservoir, August 2018

0 1.75 3.5 7
km

N
W E
S

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Figure 3.6

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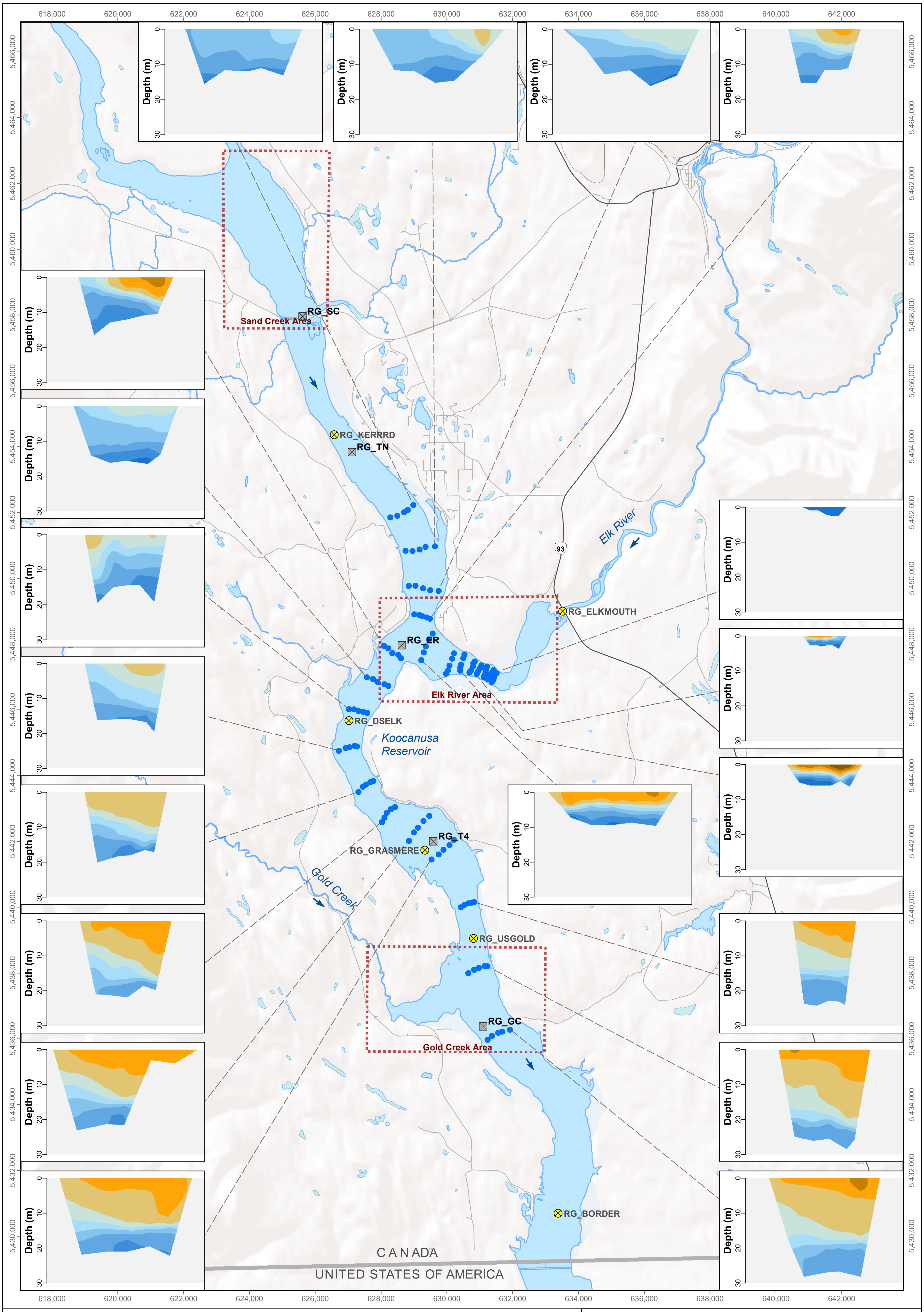

LEGEND

Temperature (°C)

- 🟫 16.53 - 18.0
- 🟫 15.80 - 16.53
- 🟧 15.07 - 15.80
- 🟨 14.34 - 15.07
- 🟩 13.62 - 14.34
- 🟦 12.89 - 13.62
- 🟦 12.16 - 12.89
- 🟦 11.43 - 12.16
- 🟦 10.70 - 11.43
- 🟦 9.0 - 10.70

- ● Transect Location
- ☒ Water Chemistry and In Situ Monitoring Station
- ⊗ Permitted Water Quality Station
- ▭ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for temperature.

Water Temperature Profiles Conducted at Koocanusa Reservoir, June 2018

0 1.75 3.5 7
km

N W E S

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Figure 3.7

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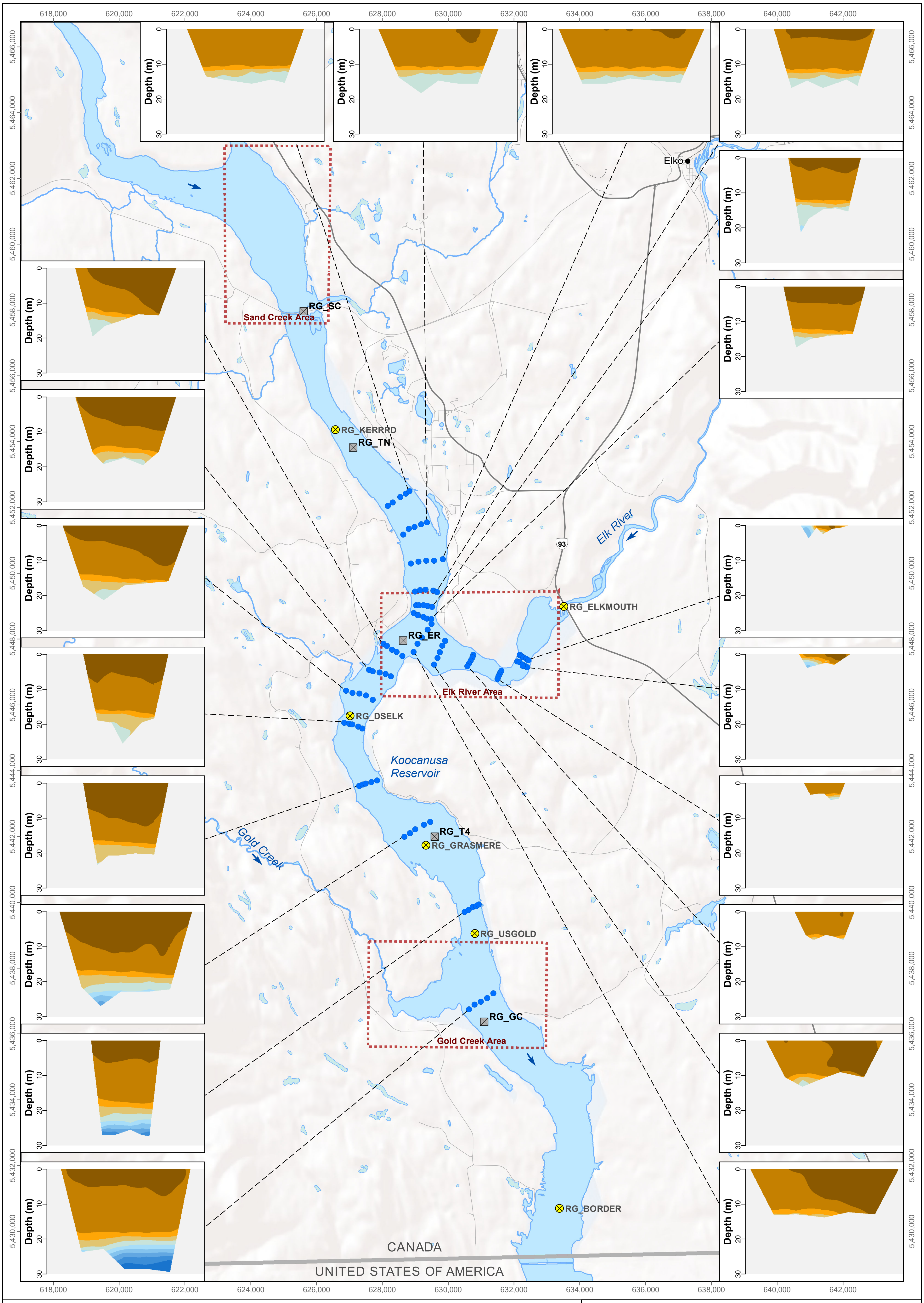

LEGEND

Temperature (°C)

- ■ 19.25 - 21.0
- ■ 18.34 - 19.25
- ■ 17.44 - 18.34
- ■ 16.53 - 17.44
- ■ 15.63 - 16.53
- ■ 14.73 - 15.63
- ■ 13.82 - 14.73
- ■ 12.92 - 13.82
- ■ 12.01 - 12.92
- ■ 11.0 - 12.01

- ● Transect Location
- ☒ Water Chemistry and In Situ Monitoring Station
- ⊗ Permitted Water Quality Station
- ⬚ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for temperature.

Water Temperature Profiles Conducted at Koocanusa Reservoir, August 2018

0 1.75 3.5 7
km

N
W E
S

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Figure 3.8

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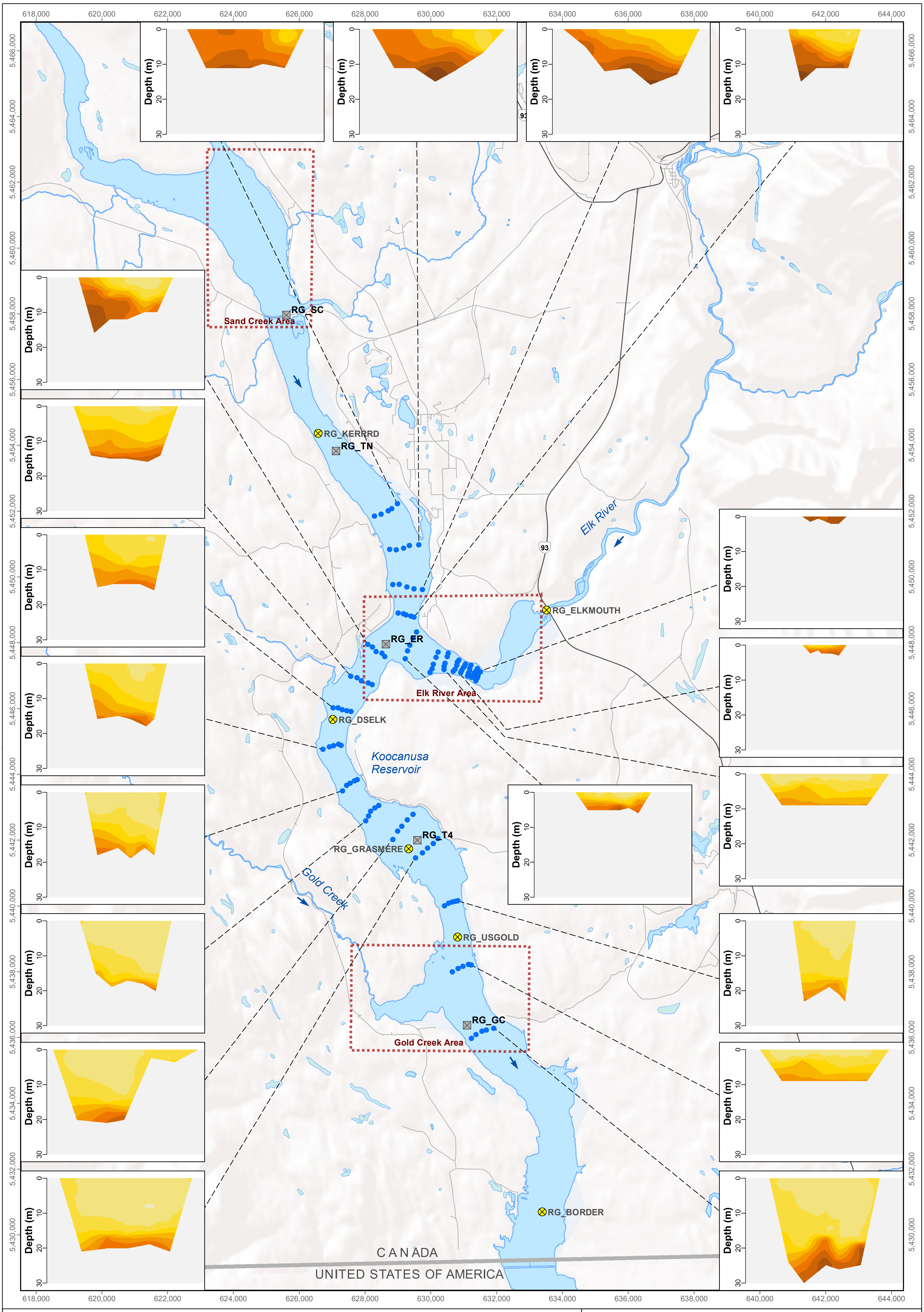

LEGEND

Turbidity (NTU)

🟨	0.20 - 1.93
🟨	1.93 - 3.66
🟨	3.66 - 5.39
🟨	5.39 - 7.12
🟧	7.12 - 8.85
🟧	8.85 - 10.58
🟧	10.58 - 12.31
🟧	12.31 - 14.04
🟫	14.04 - 15.77
🟫	15.77 - 17.50

● Transect Location

☒ Water Chemistry and In Situ Monitoring Station

⊗ Permitted Water Quality Station

▭ Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for turbidity.

Turbidity Profiles Conducted at Koocanusa Reservoir, June 2018

0 1.75 3.5 7
km

N
W E
S

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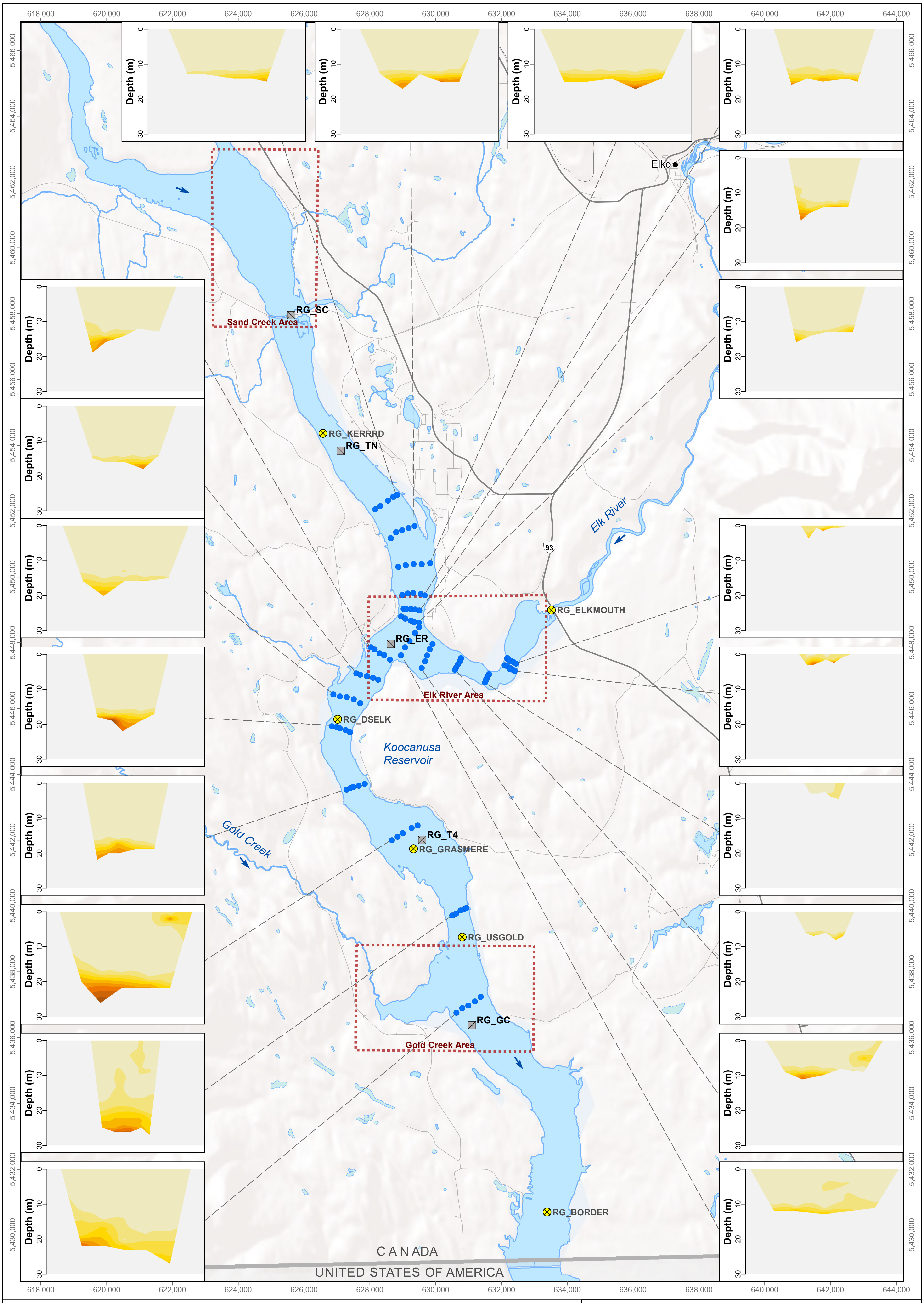
Figure 3.9

Document Path: S:\Projects\187202\187202.0007 - Teck Koocanusa 2018\GIS\Report\18-07 Figure 3.9 Koocanusa June Turbidity.mxd



LEGEND

Turbidity (NTU)

🟨	1.90 - 2.59
🟨	2.59 - 3.28
🟨	3.28 - 3.98
🟨	3.98 - 4.67
🟧	4.67 - 5.37
🟧	5.37 - 6.07
🟧	6.07 - 6.76
🟧	6.76 - 7.46
🟫	7.46 - 8.15
🟫	8.15 - 8.84

●	Transect Location
☒	Water Chemistry and In Situ Monitoring Station
⊗	Permitted Water Quality Station
▭	Fish (fish health, recruitment, and fish tissue) Sampling Area

Note: Color scheme set as 10% of the total range for turbidity.

Turbidity Profiles Conducted at Koocanusa Reservoir, August 2018

0 1.75 3.5 7
km

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Figure 3.10

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4 SEDIMENT QUALITY

4.1 Overview

Sediment samples were collected from profundal habitat along transects located downstream (RG_T4) and upstream (RG_TN) of the Elk River confluence with Koocanusa Reservoir in August 2018 consistent with the approved monitoring program study design (Appendix Table B.1). In addition, sediment samples were collected from littoral habitat at five stations at each of the two downstream areas (RG_ER and RG_GC) and one upstream area (RG_SC) used to assess fish health and tissues during sampling in April 2018 (Figure 2.1; Appendix Table B.2). Large-volume suspended sediment samples were also collected from RG_DSELK in June, July, and September 2018 for the analysis of particulate selenium concentrations in the epilimnion.

4.2 Sediment Particle Size and Chemistry

Sediment collected at profundal stations in August 2018 showed grain size being mostly composed of silt-sized material with the exception of two upstream stations, which contained more substantial amounts of sand-sized material than at all other stations (Figure 4.1). Statistical analysis of the grain size data indicated a significantly higher proportion of clay-sized material downstream compared to upstream of the Elk River, although the mean incremental difference in sediment clay content between areas was small (i.e., less than 10%). Sediment TOC content was slightly higher downstream of the Elk River than upstream, but no significant difference in TOC content was indicated between study areas. Sediment TOC content at each of the profundal transects was comparable to values reported for Koocanusa Reservoir by Iskandar and Shukla (1981; i.e., 1.1%), which are considered low and suggest an oligotrophic lake status. Sediment particle size at the both of the profundal transects in 2018 was similar to that observed during previous monitoring (i.e., 2014 to 2016). On average, sediment TOC content at the transect downstream of the Elk River was higher in 2018 than during previous monitoring, whereas at the upstream transect, sediment TOC content in 2018 was comparable to values observed in past monitoring.

Sediment collected at littoral stations in April 2018 was predominantly composed of silt-sized material at most of the Elk River mouth and Gold Creek downstream area stations, and although sand-sized material was more prevalent at the Sand Creek upstream area stations, no significant differences in dominant particle sizes were indicated among the three littoral areas (Figure 4.1; Appendix Table B.6). Sediment TOC content at littoral habitat was significantly higher at the Elk River mouth compared to the Sand Creek upstream area, but did not differ significantly between the Elk River mouth and Gold Creek downstream areas, nor between the Gold Creek downstream and Sand Creek upstream areas in April 2018 (Appendix Tables B.4 and B.6). However, the

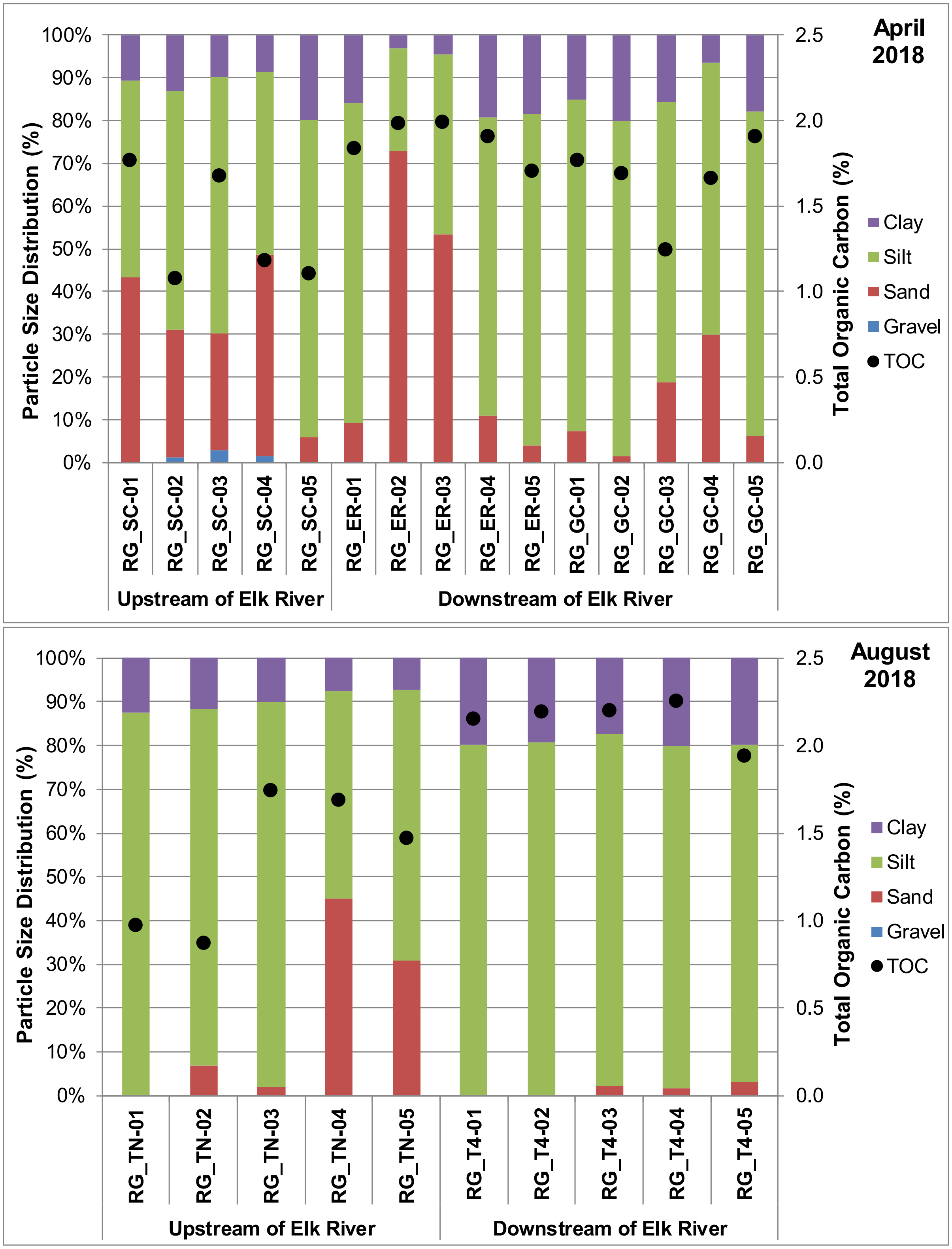

Figure 4.1: **Sediment Particle Size and Total Organic Carbon (TOC) Content at Koocanus Reservoir Littoral (April) and Profundal (August) Stations, 2018**

mean incremental difference in sediment TOC among all three study areas was small (i.e., maximum of 0.52%). Similar to transect station data collected in August 2018, the sediment TOC content at littoral habitat of each area was comparable to values reported by Iskandar and Shulkla (1981), and suggested an oligotrophic lake status.

Several metals (including selenium) and PAHs occurred at significantly higher concentrations in sediments collected at the downstream profundal transect stations and littoral Elk River mouth stations compared to respective upstream transect and Sand Creek stations during the August and April sampling events (Figure 4.2; Appendix Tables B.5 and B.6). Although concentrations of barium, mercury, potassium, and selenium occurred at significantly higher concentrations in littoral habitat sediment at the Gold Creek downstream area compared to the Sand Creek upstream area, no significant differences in concentrations of PAHs were indicated between the Gold Creek and Sand Creek areas (Appendix Table B.6). Among the metals, arsenic, cadmium, iron, manganese, and nickel occurred at concentrations above LEL of the BC sediment quality guidelines at one or more of the downstream profundal transect stations, Elk River mouth littoral stations, and/or Gold Creek littoral stations in 2018. However, with the exception of cadmium, these metals also occurred at concentrations above LEL sediment quality guidelines at one or more profundal transect and littoral habitat stations located upstream of the Elk River (Appendix Tables B.3 and B.4). Concentrations of the PAHs 2-methylnaphthalene and phenanthrene were elevated above LEL sediment quality guidelines in sediment at one or more of the downstream profundal transect stations and littoral Elk River mouth stations, and not at the any of the Gold Creek downstream area littoral stations, upstream profundal transect stations, or upstream Sand Creek area littoral stations in 2018. Concentrations of benz(a)anthracene, benzo(b&j)fluoranthene, chrysene, and dibenz(a,h)anthracene PAHs were above the LEL sediment quality guidelines at one littoral station at the Elk River Mouth in April 2018. Notably, concentrations of all metals and PAHs in sediment at all profundal transect and littoral habitat stations located downstream and upstream of the Elk River were below applicable provincial sediment quality Severe Effect Level (SEL) guidelines.

4.3 Particulate Selenium Concentrations

Large-volume particulate samples collected from RG_DSELK in June, July, and September 2018 were compared to the BC sediment quality guideline for selenium (2 mg/kg dw), and to samples from stations within the Montana portion of the reservoir (Figure 4.3). Particulate selenium concentrations from all sampling events on both sides of the border exceeded the sediment quality guideline for selenium (Table 2.1). Particulate selenium concentrations at RG_DSELK were higher in July and September compared to June (Table 4.1; Figure 4.3). Particulate selenium concentrations at RG_DSELK in July and September were higher compared to the

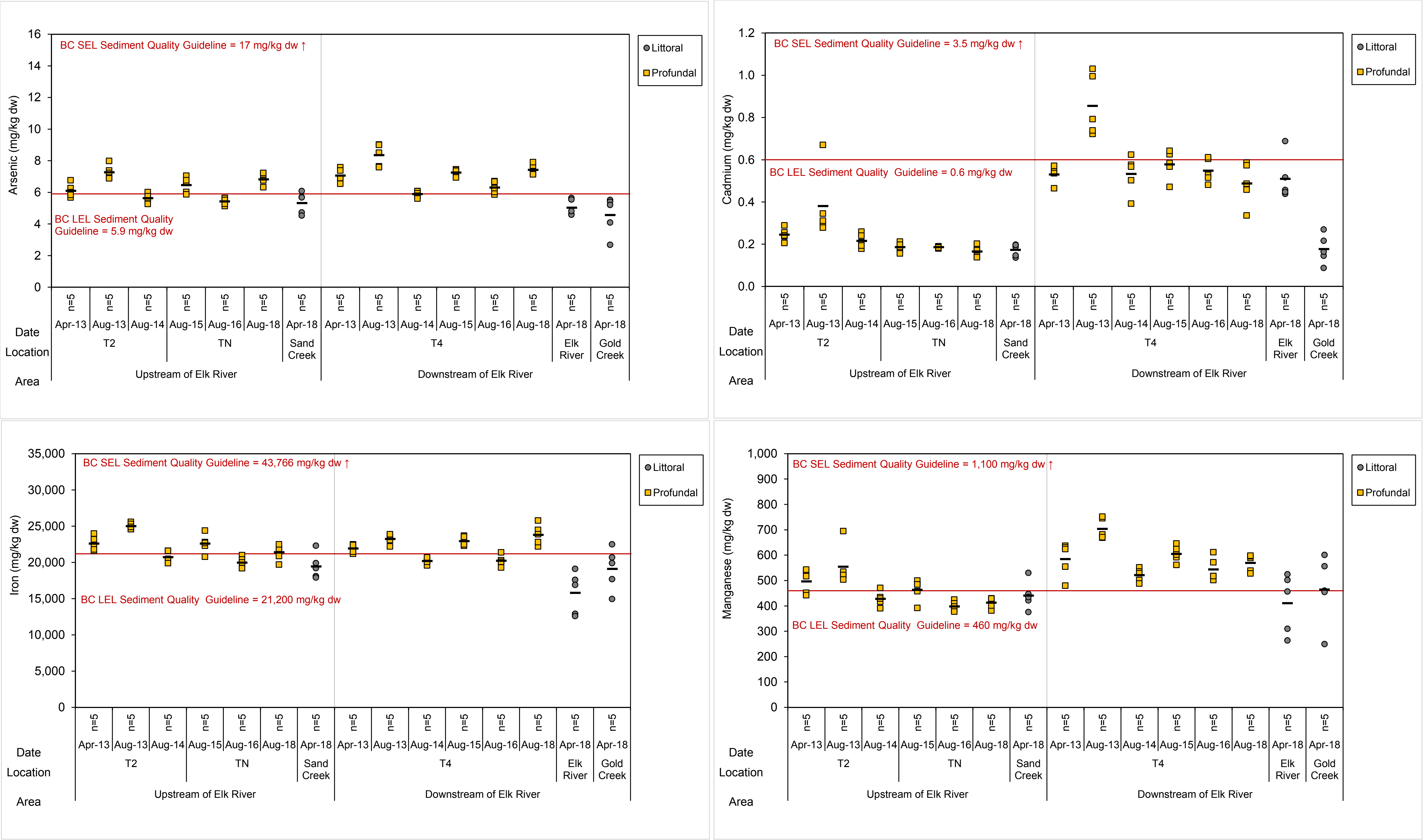

Figure 4.2: **Concentrations of Parameters in Sediment Samples that Exceeded the Lowest Effects Level (LEL) Guideline, Koocanusa Reservoir, 2013 to 2018**

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.
The upstream area was sampled at T2 until April 2015 and this area was relocated further upstream from the mouth of the Elk River (TN) beginning in August 2015.

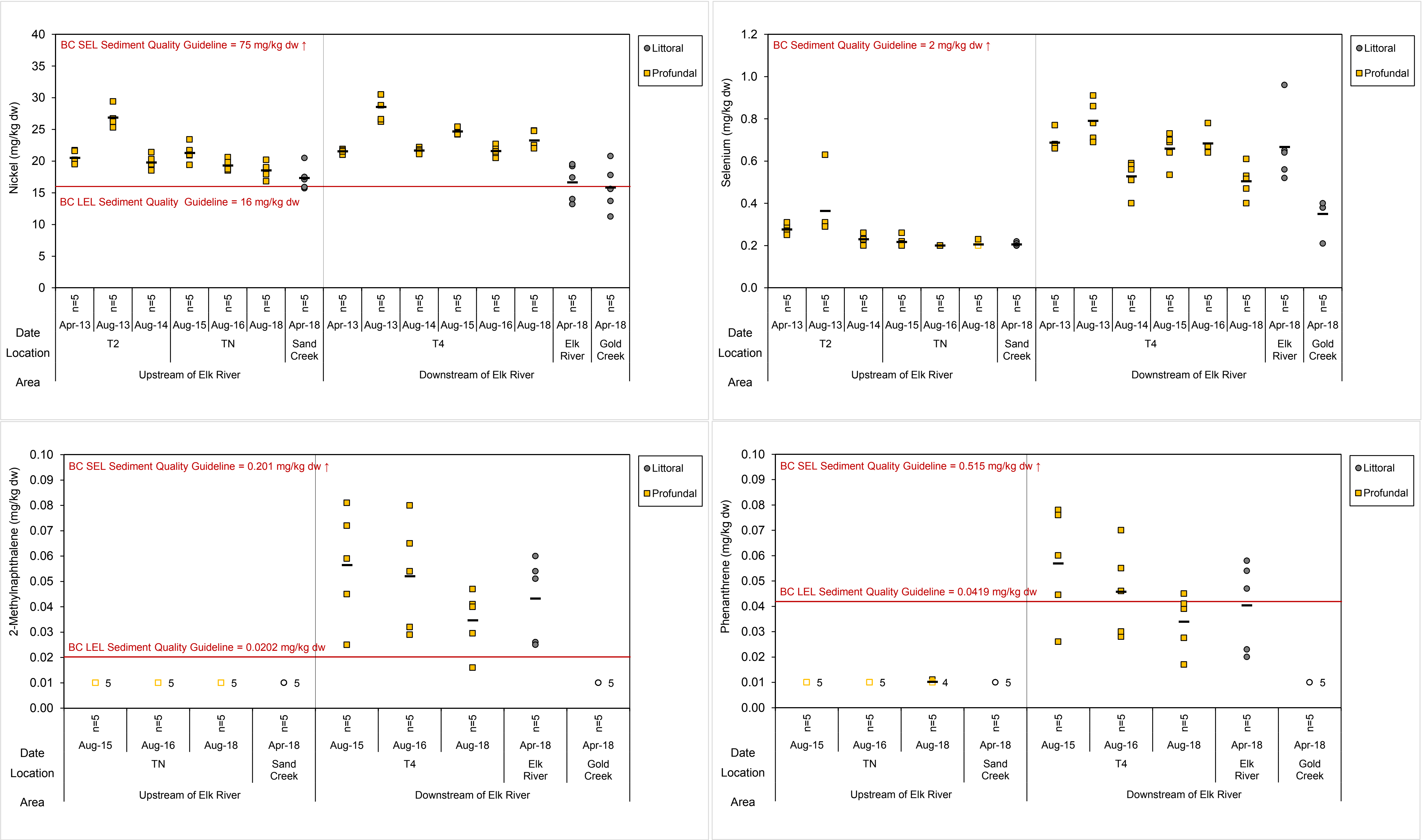

Figure 4.2: **Concentrations of Parameters in Sediment Samples that Exceeded the Lowest Effects Level (LEL) Guideline, Koocanusa Reservoir, 2013 to 2018**

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.
The upstream area was sampled at T2 until April 2015 and this area was relocated further upstream from the mouth of the Elk River (TN) beginning in August 2015.

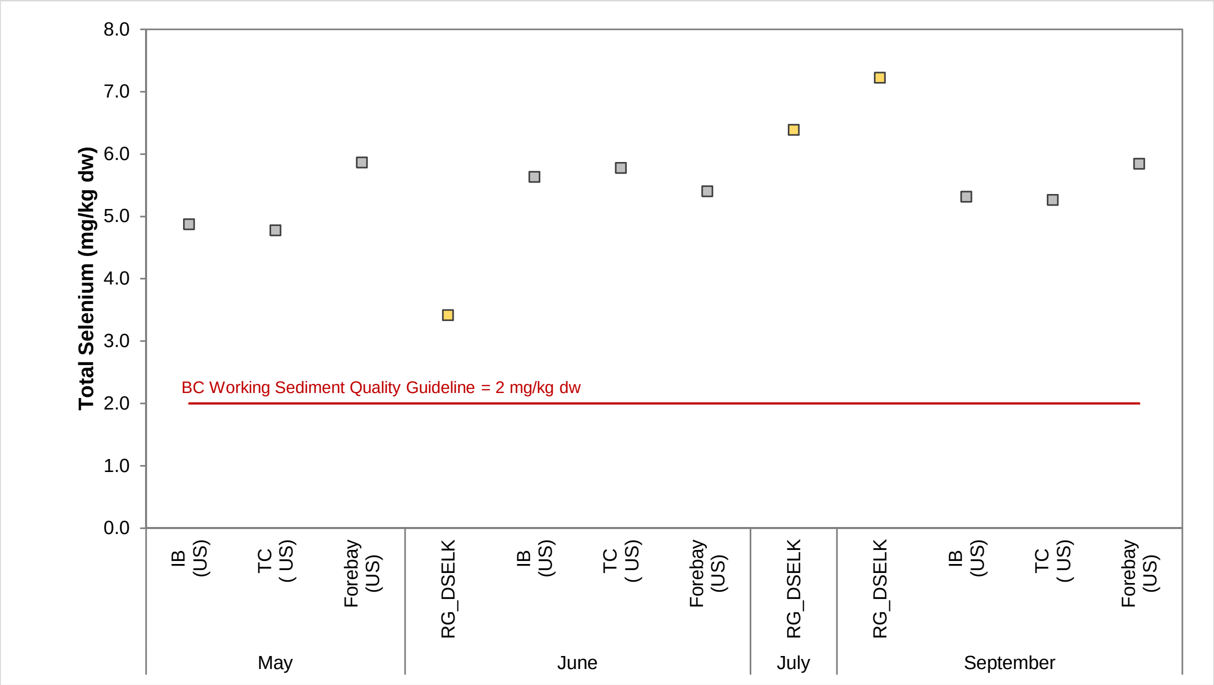

Figure 4.3: **Particulate Selenium Concentrations of Large-Volume Water Samples Collected from the Epilimnion of Canadian (RG_DSELK) and Montana (International Boundary, Tenmile Creek, and Forebay) Portions of Koocanusa Reservoir, 2018**

Note: Teck station is RG_DSELK (yellow). Montana stations (grey) include IB = International Boundary, TC = Tenmile Creek, and Forebay.

Table 4.1: Sediment Particulate Selenium Concentrations from Large-Volume Water Samples Collected in the Epilimnion at Koocanusa Reservoir, 2018

Analyte	Units	BC Sediment Quality Guideline [a]	Downstream of Elk River (RG_DSELK)					
			June		July		September	
			RG_DSELK_WS-20180613-1000	RG_DSELK_WS-20180613-1005 [b]	RG_DSELK_WS-20180731-1000	RG_DSELK_WS-20180731-1005 [b]	RG_DSELK_WS-20180904-1030	RG_DSELK_WS-20180904-1035 [b]
Selenium (Se)	mg/kg dw	2	3.50	3.33	6.31 [c]	6.46 [c]	6.96	7.49

Note: Shaded values were above the BC Sediment Quality Guideline.

[a] Working sediment quality guideline (BC MOE 2015).

[b] Duplicate sample taken.

[c] Brooks Applied Labs indicated that a thin plastic material was in the sample upon receipt from the University of Georgia and proceeded to exclude this material from the subsample taken for digestion. Minnow Environmental investigated the origins of the material and determined that it was not a precipitate, but a part of the containment material that was used during freeze-drying by the University of Georgia. Therefore, Brooks Applied Lab were correct in omitting it during the digestion of the sample.

Montana portion of the reservoir (Table 4.1; Figure 4.3). Concentrations from RG_DSELK were similar to selenium concentrations observed in zooplankton tissue samples (see Section 5.3.2), which indicated that zooplankton potentially contribute to the selenium concentrations observed in the large-volume particulate samples.

5 PLANKTON

5.1 Overview

Phytoplankton and zooplankton community structure, and zooplankton tissue selenium concentrations, were assessed at the same transects that sediment samples were collected in August/September 2018. Additional zooplankton community and tissue samples were also collected in June 2018 to explore potential changes between spring and summer seasons based on an ENV (2018) requirement. In addition, zooplankton tissue chemistry data from the Montana portion of the reservoir were incorporated into the 2018 dataset. Zooplankton community and tissue chemistry samples were collected as a composite sample through the entire water column depth in June and September at five stations along each of a downstream and upstream transect, and as a composite sample through the top 10 m of the water column at these same transects and stations in August. The additional samples retrieved in August were used to explore potential methodological influences on zooplankton community and/or tissue chemistry features. Zooplankton tissue chemistry data from the Montana portion of the reservoir were collected from the top 10 m of the water column employing comparable sampling gear to that used in the Canadian portion of the reservoir.

5.2 Phytoplankton Community Structure

Phytoplankton communities in Koocanusa Reservoir both upstream (RG_TN) and downstream (RG_T4) of the Elk River were numerically dominated by diatoms in addition to moderate numbers of other chrysophytes (golden algae) in August 2018 (Figure 5.1; Appendix Table C.2). The centric diatom *Cyclotella pseudostelligera* was the dominant species of phytoplankton at both areas, both in terms of density and biomass (Figure 5.2; Appendix Tables C.3 and C.6). The predominance of *C. pseudostelligera* at both Koocanusa Reservoir areas in August was previously hypothesized to reflect flow from the tributaries near each sampling area providing the upwelling necessary to prevent individual organisms from settling out of the photic zone, while at the same time supplying the silica/silicon/silicates materials required for frustule formation (H. Larratt, pers. comm. 2016). Relatively low nutrient concentrations within Koocanusa Reservoir were also hypothesized to prevent *C. pseudostelligera* from being outcompeted by other organisms such as blue-green algae, which prefer higher concentrations of nitrogen and phosphorus (i.e., more eutrophic conditions), leading to the dominance of the phytoplankton community by this diatom species (H. Larratt, pers. comm. 2016). The densities and biomass of other major phytoplankton groups, including chlorophytes, cryptophytes, cyanophytes, and dinoflagellates, were variable but generally low, each typically composing less than 5% of the community at each station (Figure 5.1). Phytoplankton community composition, as summarized

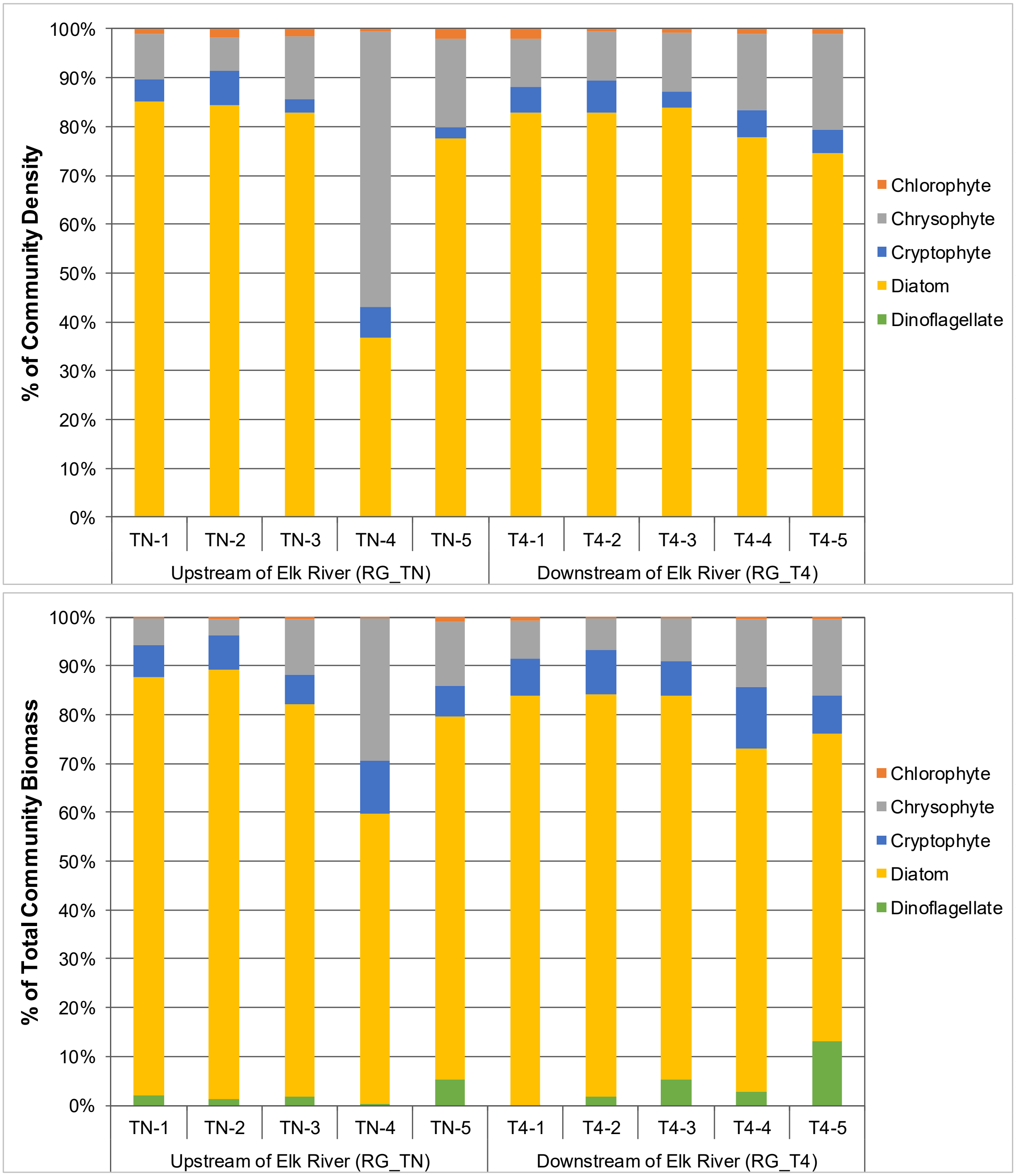

Figure 5.1: Relative Density and Biomass of Major Phytoplankton Groups in Koocanusa Reservoir, August 2018

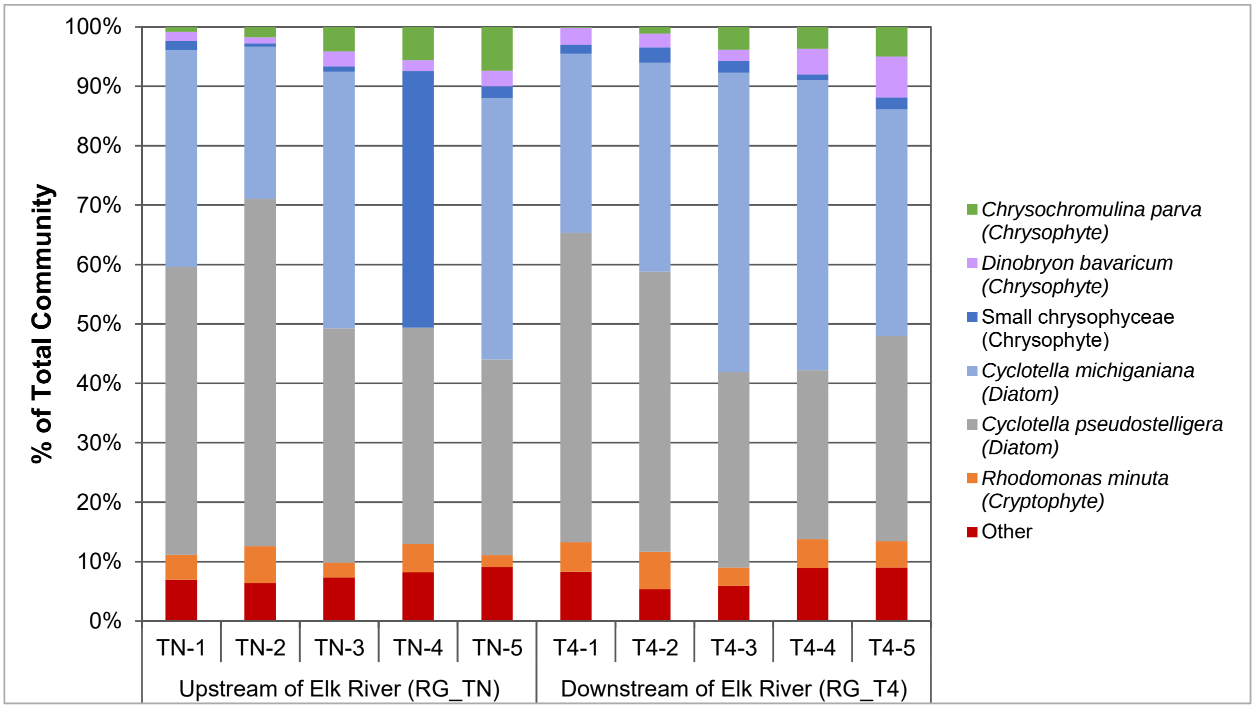

Figure 5.2: **Relative Density of Phytoplankton Taxa in Koocanusa Reservoir, August 2018**

Note: Only taxa comprising at least 5% of the total number of cells at one or more stations are depicted individually.

by NMDS, did not differ between downstream and upstream of the Elk River (Figure 5.3; Appendix Table C.28).

Phytoplankton total density, biomass, and richness did not differ significantly between the downstream and upstream areas (Figure 5.4). In addition, there were no consistent downstream-to-upstream differences in abundance or relative biomass of major phytoplankton groups in 2018 (Appendix Table C.28). In general, total density, biomass, richness, and composition of the phytoplankton community in 2018 was within the ranges shown for each respective endpoint from 2014 to 2016 at each of the downstream and upstream transects.

5.3 Zooplankton

5.3.1 Community Assessment

Zooplankton community richness, total density, and total biomass were significantly higher downstream compared to upstream of the Elk River confluence in June 2018, each at magnitudes of difference outside of the effect size range of ±2 standard deviations (SD; Appendix Table C.33). Among the dominant zooplankton groups, the absolute density and biomass of cyclopoid copepods and rotifers were both significantly greater at the downstream area than at the upstream area (Figure 5.5; Appendix Table C.33). Differences in the abundance of dominant taxa were

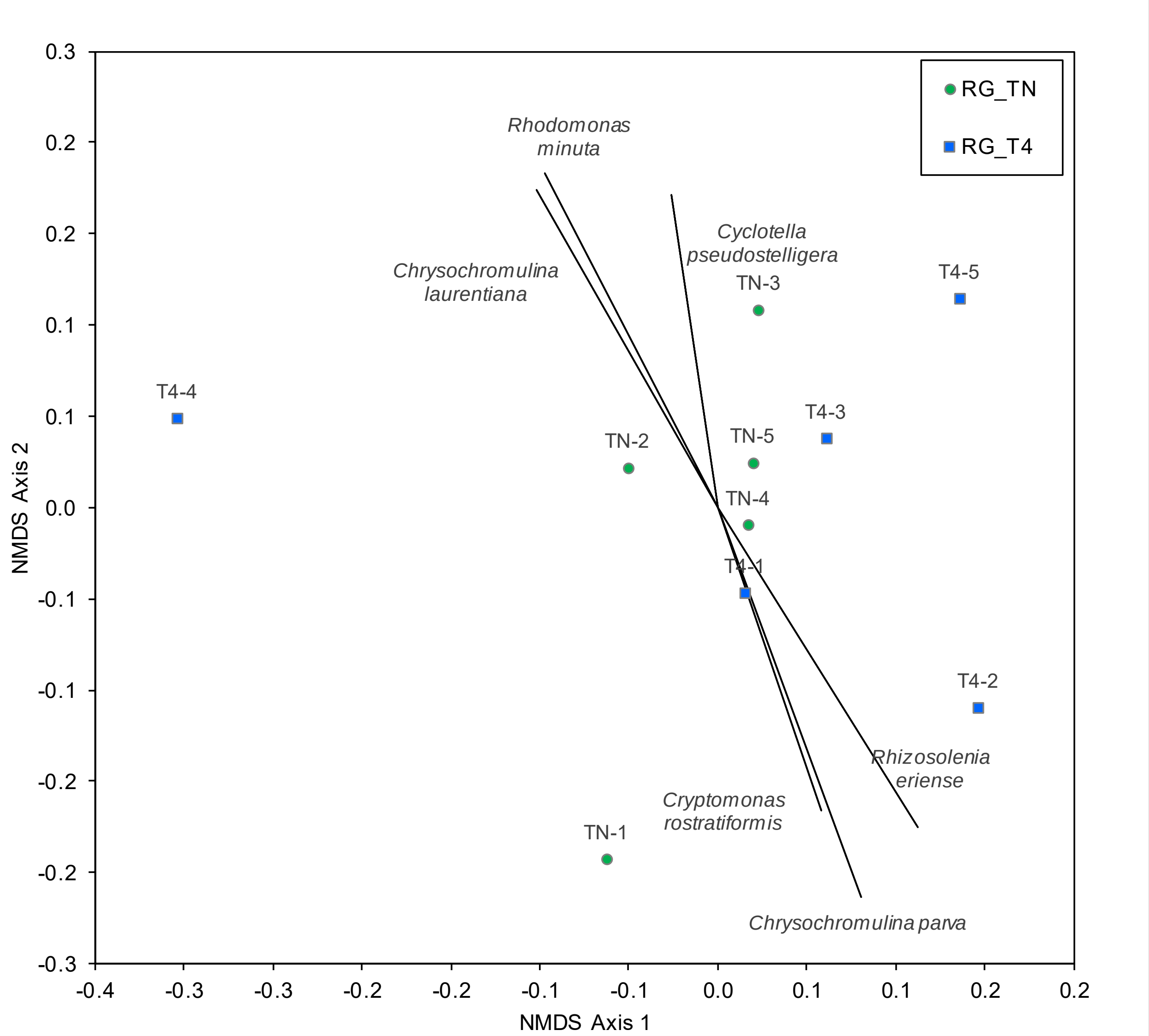

Figure 5.3: Phytoplankton Community Structure (Lowest Practical Level of Taxonomy) in Koocanusa Reservoir as Summarized by NMDS, 2018

Notes:
NMDS = Non-Metric Multidimensional Scaling
Stress = 0.0490 (based on a 3-dimentional ordination)
Relative taxa densities were 4th root transformed before NMDS calculation.
Taxa present at two or fewer stations were removed from the analysis.
Vectors represent the direction and relative magnitude of the Spearman correlation coefficients of taxa against NMDS axis scores with α = 0.05 and |rs| > 0.5.

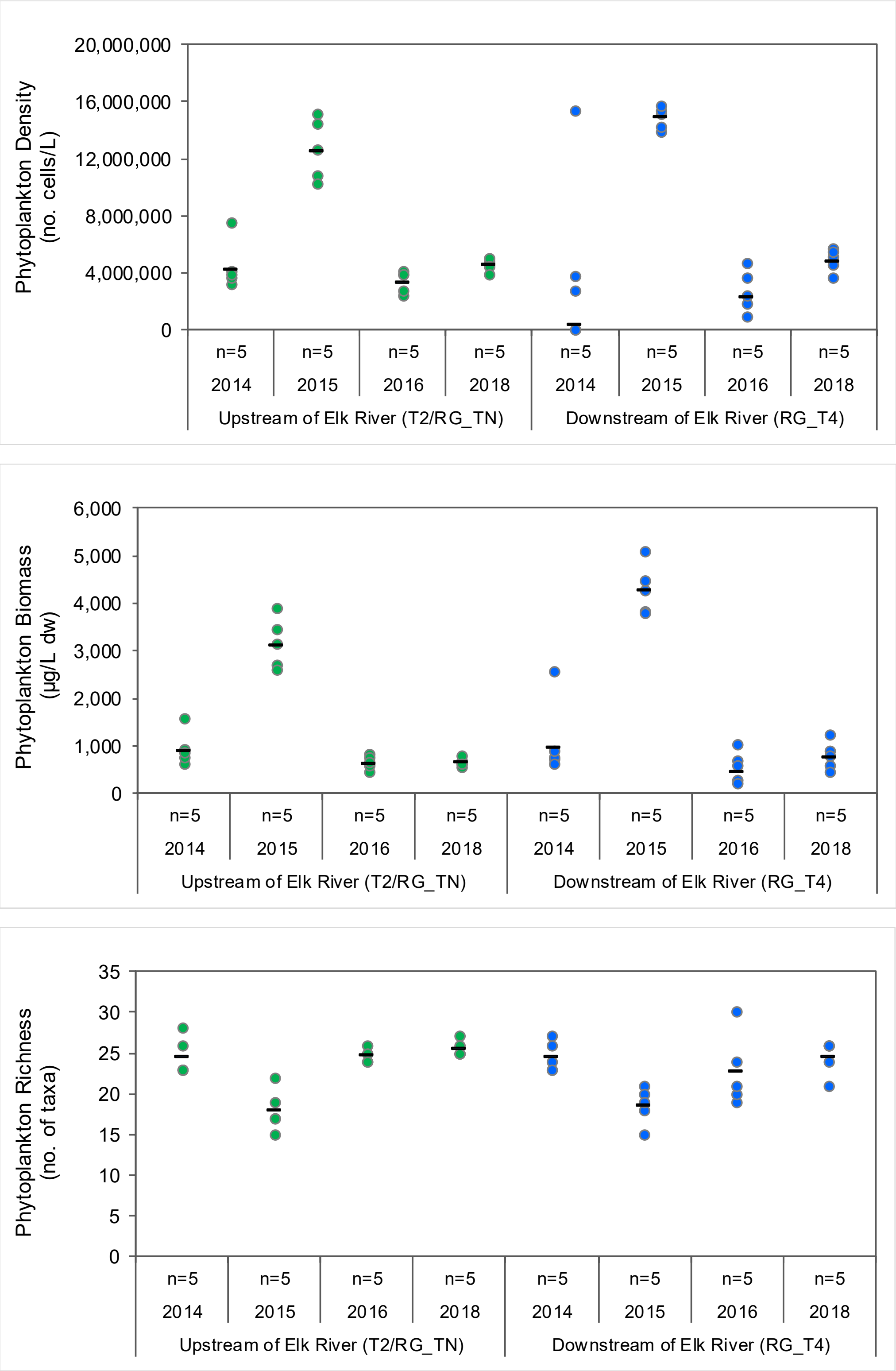

Figure 5.4: Phytoplankton Density (no. cells/L), Biomass (µg/L dw), and Richness (no. of taxa) in Koocanusa Reservoir, August 2014 to 2018

Notes: The upstream location was relocated further upstream from the mouth of the Elk River in August 2015 and 2016
Measure of Central Tendancy (geometric mean for density and biomass, mean for richness) shown with a black line.

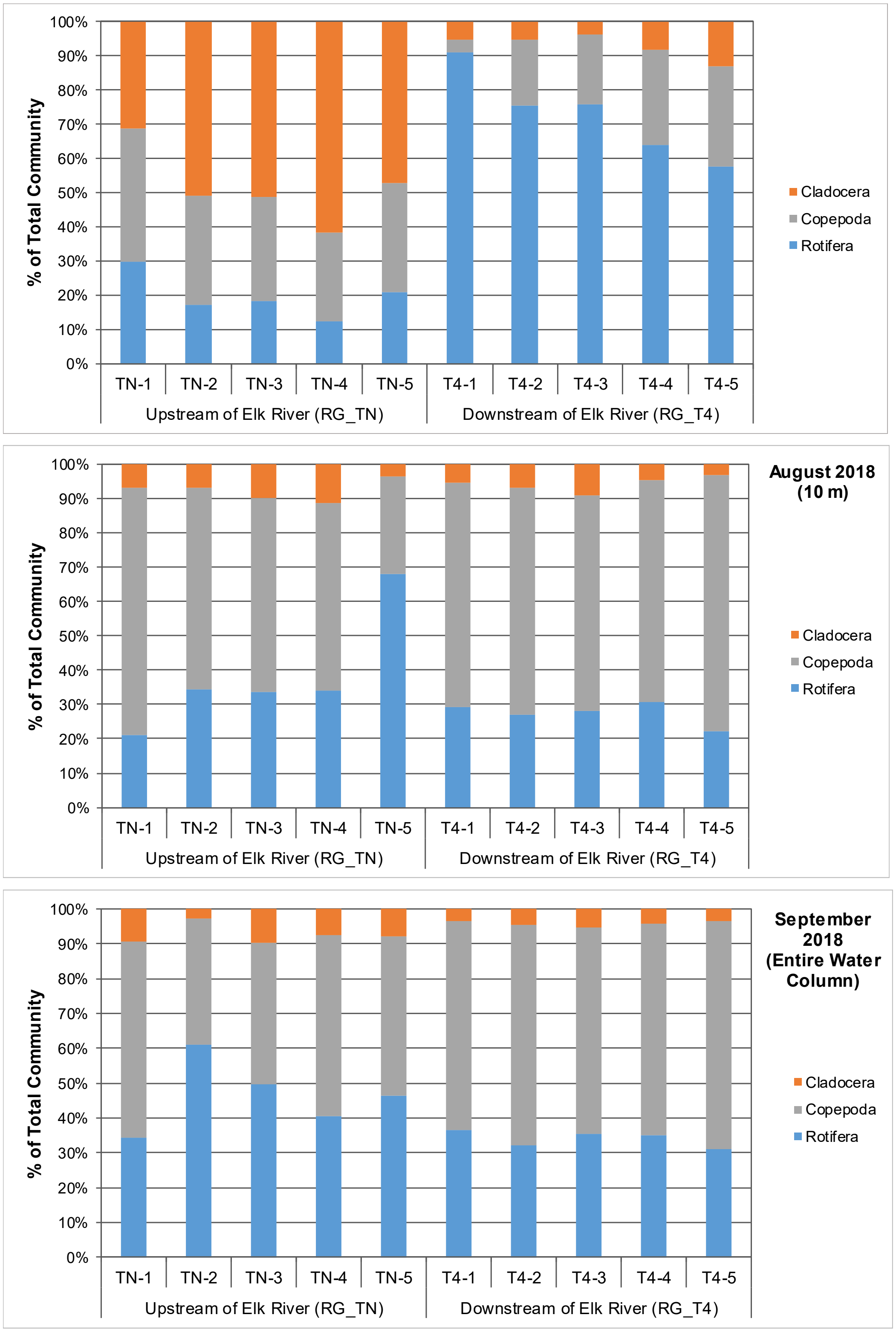

Figure 5.5: **Relative Density of Major Zooplankton Groups in Koocanusa Reservoir, 2018**

observed between downstream and upstream of the Elk River in June as well (Figure 5.6). Downstream of the Elk River (RG_T4) was dominated by rotifers, primarily *Keratella* spp., whereas upstream (RG_TN) *Daphnia galeata mendotae* (cladocerans) was the dominant taxa observed (Figure 5.6). These differences in zooplankton community features were supported by NMDS analysis (Figure 5.7).

In September, zooplankton community richness and total biomass did not differ significantly between the downstream and upstream areas, and although total density was significantly higher at the downstream area, the magnitude of difference was within the critical effect size range of ±2 SD (Appendix Table C.35). Similar to the June sampling event, absolute density and biomass of cyclopoid copepods was significantly higher at the downstream area compared to the upstream area in September, but no significant difference in rotifer absolute density was indicated between areas during the late summer sampling event (Figure 5.5; Appendix Table C.35). Although the absolute biomass of calanoid copepods and cladocerans differed significantly between the downstream and upstream study areas in September, the magnitudes of these differences were within the effect size range of ±2 SD (Appendix Table C.35). These differences in community structure were largely reflected in the NMDS analysis (Figure 5.8). Comparisons between surficial (top 10 m) and entire water column samples collected in late summer (August/September) indicated significantly lower richness, but significantly higher total density, total biomass, absolute density of cyclopoid copepods, and absolute biomass of calanoid copepods and cladocerans, in the surficial 10 m compared to the entire water column (Appendix Table C.40). The only notable seasonal differences that occurred between the two sampling events in 2018 included significantly lower absolute density and biomass of calanoid copepods, and a significantly higher absolute biomass of cladocerans in June compared to September (Appendix Table C.39).

Zooplankton density, richness, and biomass data collected in August 2018 at both the downstream and upstream areas were within respective ranges shown at each study area from 2014 to 2016 during the month of August, suggesting no substantial changes in zooplankton community features over time (Figure 5.9). Within year comparisons, based on data collected in 2018, indicated higher zooplankton density and biomass in June compared to September, but only at the downstream transect (Figure 5.9).

5.3.2 Tissue Selenium Concentrations

On average, selenium concentrations at both the downstream and upstream areas were below the BC guideline for invertebrate tissues for the June sampling event (Figure 5.10). Although average selenium concentrations in zooplankton tissues collected at both the downstream and upstream areas were slightly higher than the BC guideline (4 µg/g dw) for the August/September

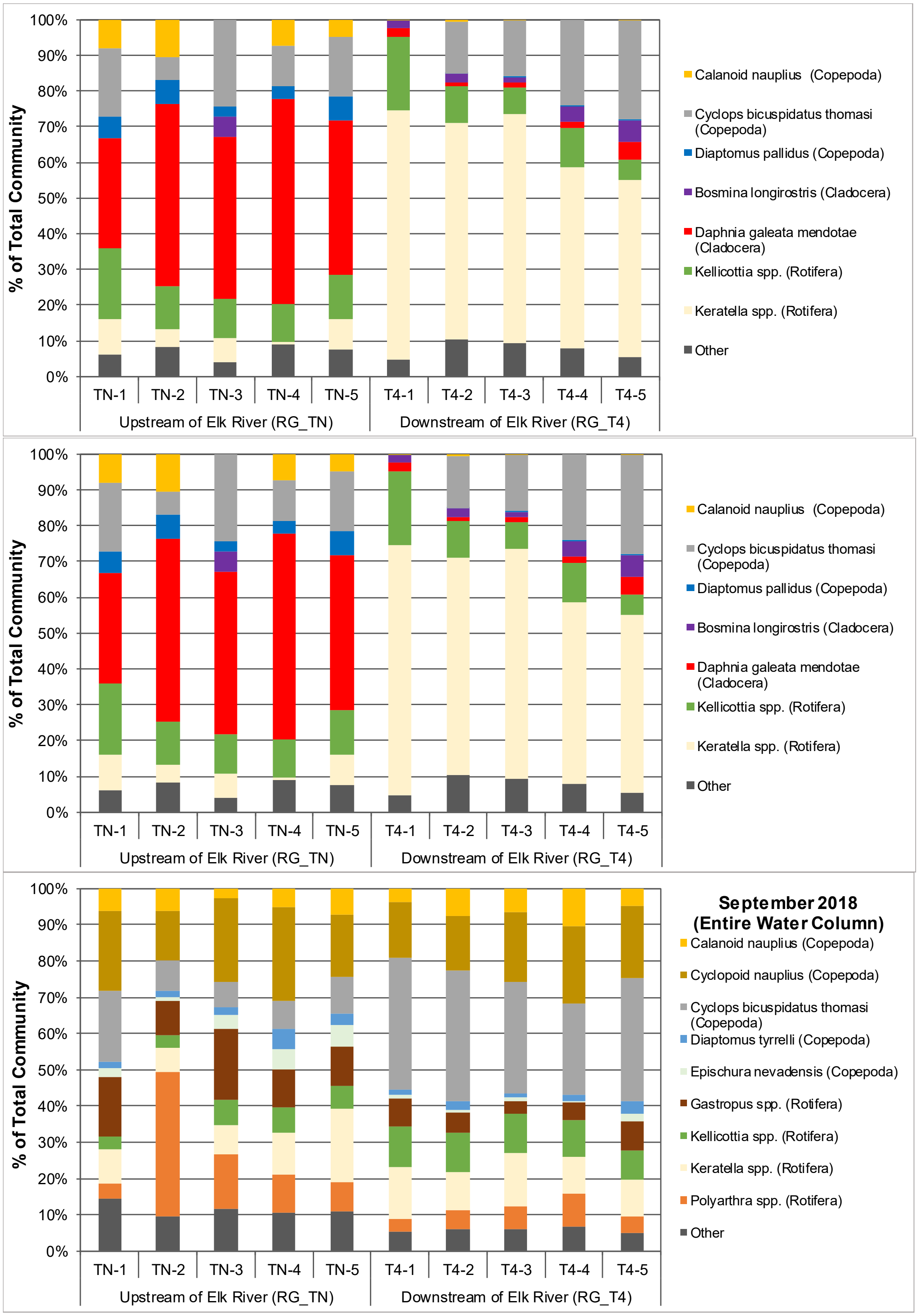

Figure 5.6: **Relative Density of Zooplankton Taxa in Koocanusa Reservoir, 2018**

Note: Only taxa comprising at least 5% of the total number of cells at one or more stations are depicted individually.

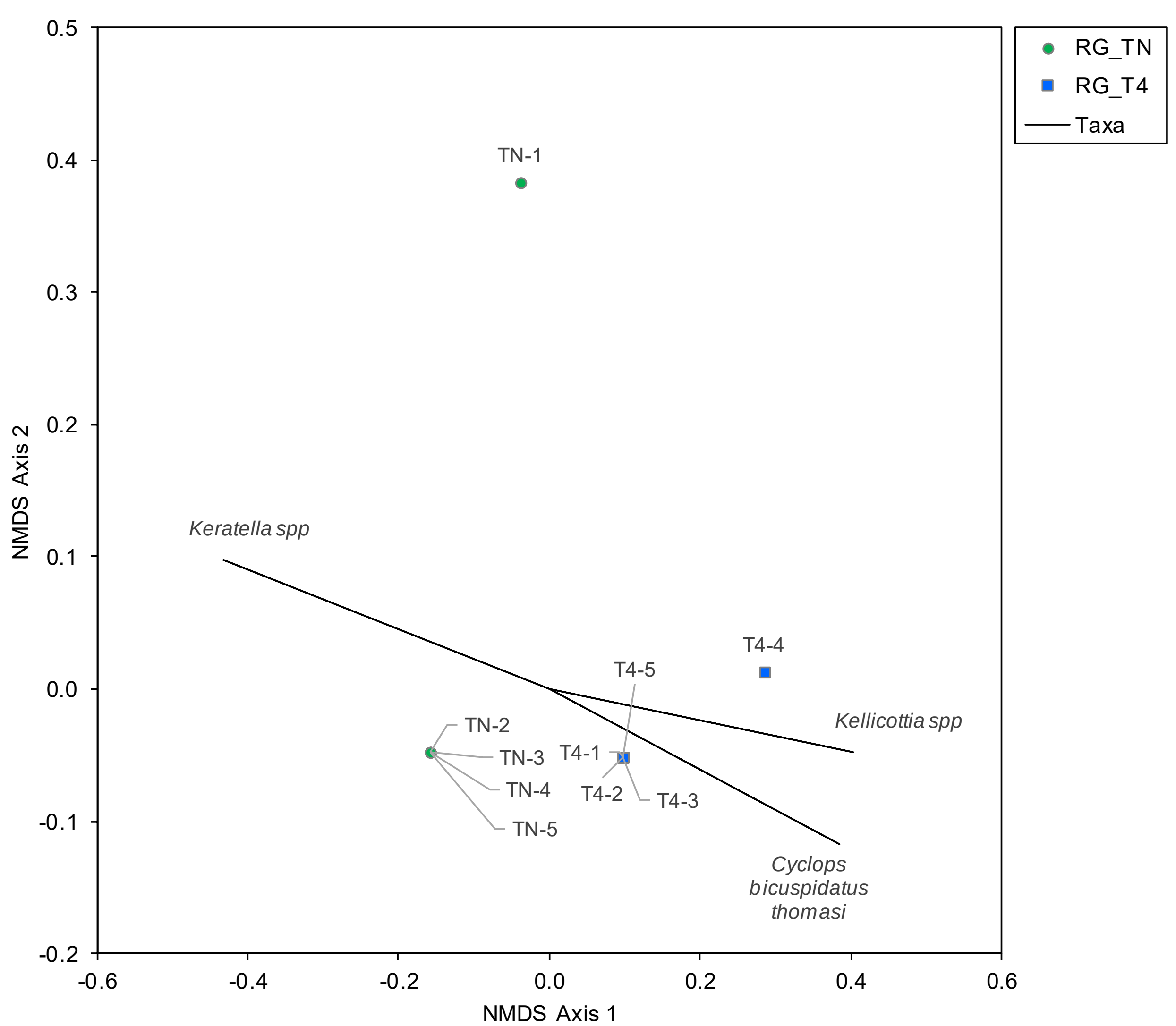

Figure 5.7: **Scatterplot of Non-Metric Multidimensional Scaling (NMDS) Axis Scores of Bray-Curtis Dissimilarities Calculated for Zooplankton Relative Densities for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, June 2018 (Entire Column Samples)**

Notes:
Stress = <0.001 (based on a 2-dimentional ordination)
Relative taxa densities were 4th root transformed before NMDS calculation.
Taxa present at two or fewer stations or accounted for less than 10% of the total density were removed from the analysis.
Vectors represent the direction and relative magnitude of the Spearman correlation coefficients of taxa against NMDS axis scores with α = 0.05 and |rs| > 0.5.

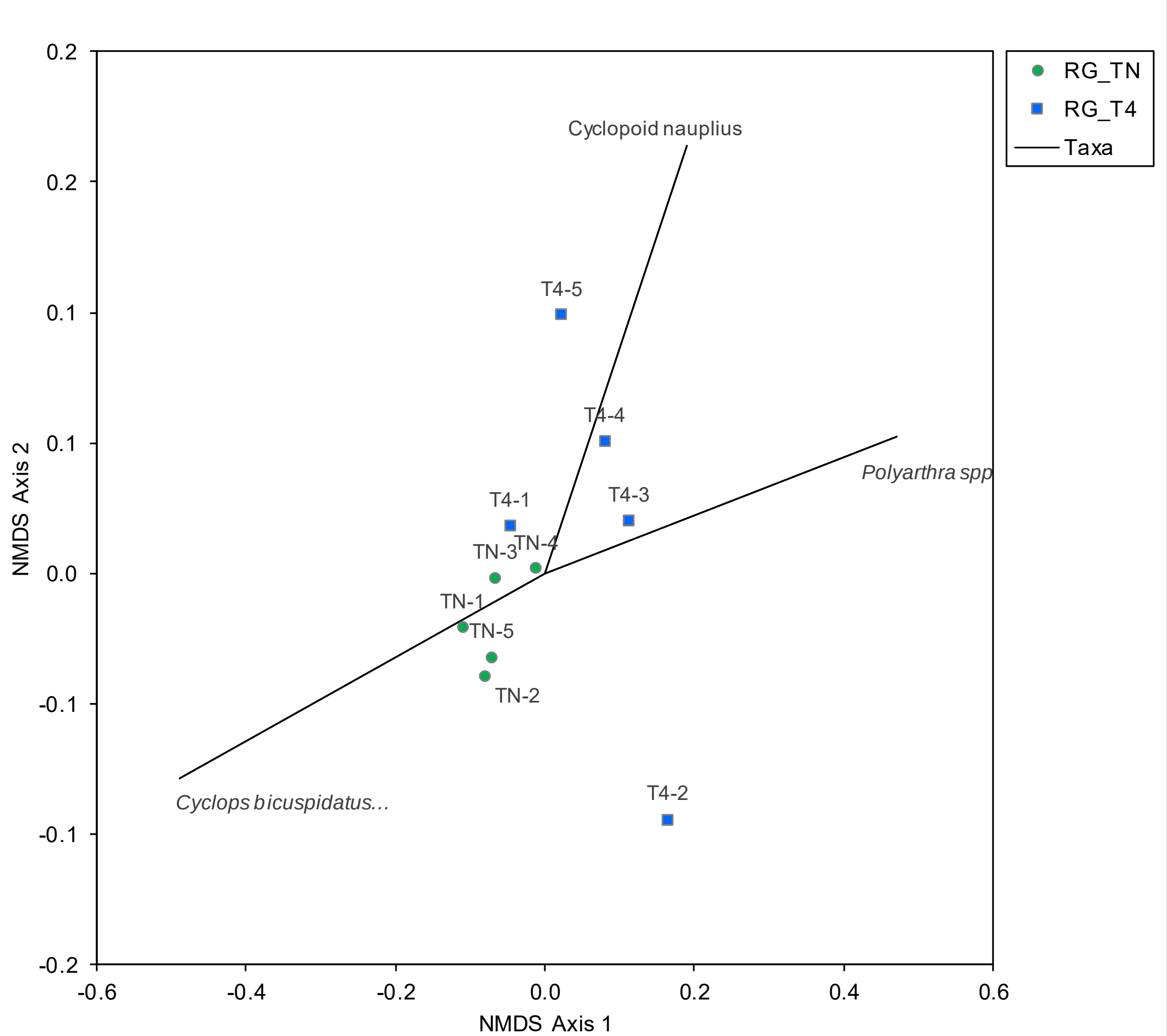

Figure 5.8: **Scatterplot of Non-Metric Multidimensional Scaling (NMDS) Axis Scores of Bray-Curtis Dissimilarities Calculated for Zooplankton Relative Densities for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, September 2018 (Entire Column Samples)**

Notes:
Stress = 0.030 (based on a 2-dimentional ordination)
Relative taxa densities were 4th root transformed before NMDS calculation.
Taxa present at two or fewer stations or accounted for less than 10% of the total density were removed from the analysis.
Vectors represent the direction and relative magnitude of the Spearman correlation coefficients of taxa against NMDS axis scores with α = 0.05 and |rs| > 0.5.

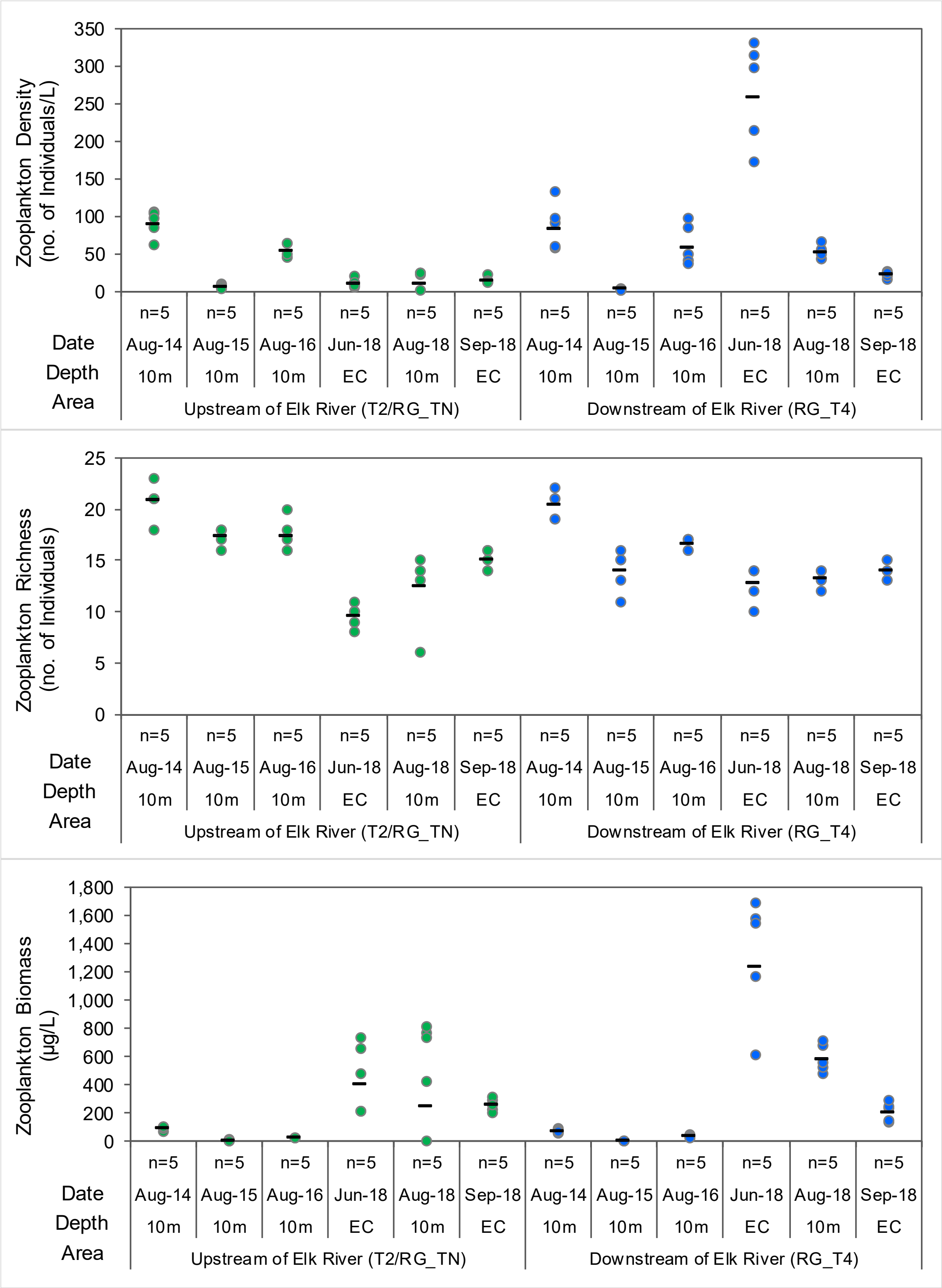

Figure 5.9: **Zooplankton Density (no. of organisms/L), Biomass (µg/L), and Richness (no. of taxa) in Koocanusa Reservoir, 2014, 2015, 2016, and 2018**

Notes:
The upstream location was relocated further upstream from the mouth of the Elk River in August 2015 and 2016, and 2018.
Measure of Central Tendancy (geometric mean for density and biomass; mean for richness) are plotted as horizontal lines. Depth "EC" refers to sampling the entire water column.

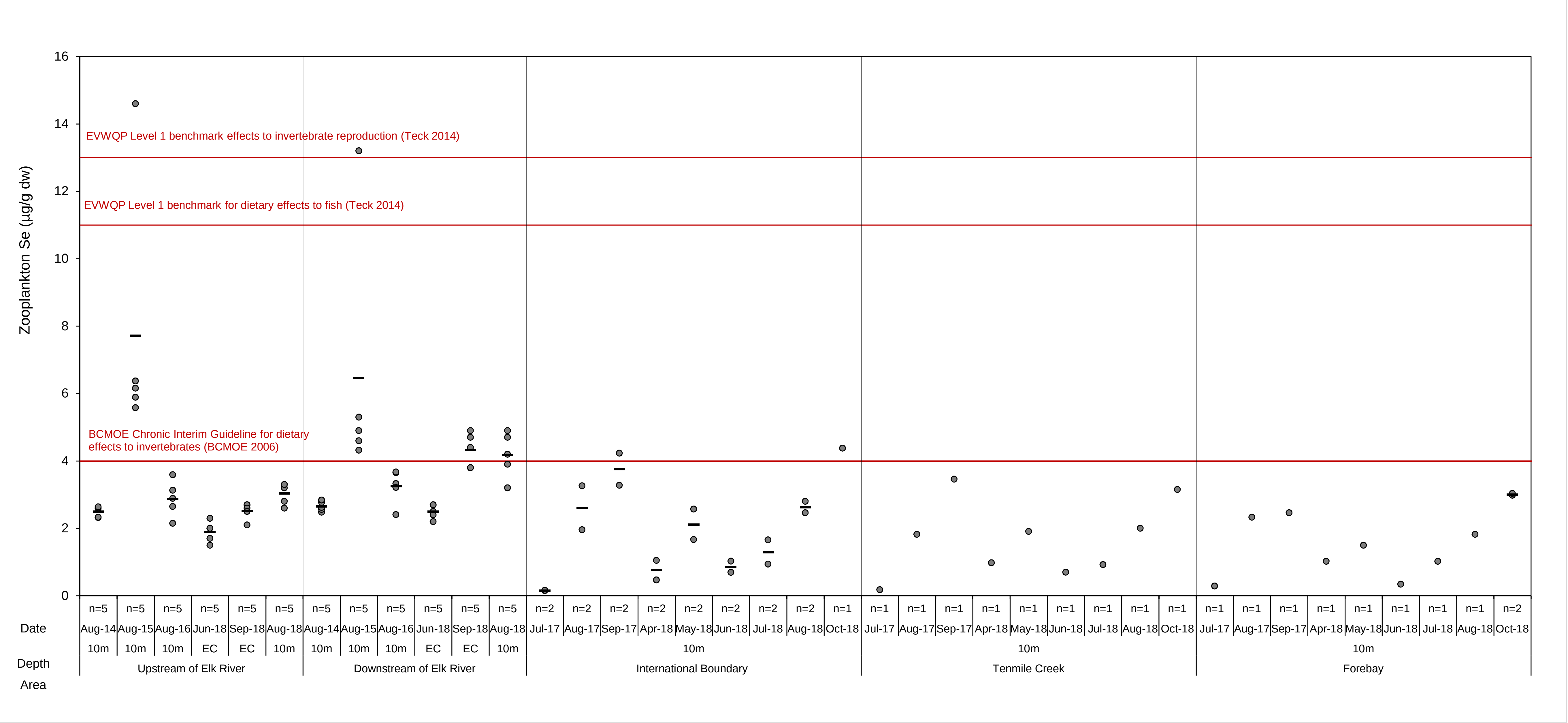

Figure 5.10: **Concentrations of Selenium (µg/g dw) in Zooplankton in Koocanusa Reservoir, 2014 to 2018**

Notes: Individual values are plotted. Means are plotted as horizontal lines. "EC" refers to sampling the entire water column.

Data from Montana stations for 2016 were reported on a wet weight basis (moisture content not available to convert to dry weight), and excluded from this plot.

sampling event, the tissue selenium concentrations were below the EVWQP Level 1 benchmarks for potential effects to benthic invertebrates (13 µg/g dw) and for dietary effects to juvenile fish (11 µg/g dw; Figure 5.10). Selenium concentrations in zooplankton were significantly higher downstream (RG_T4) compared to upstream (RG_TN) of the Elk River in June and in August/September (Appendix Tables C.30 to C.32), and were significantly higher in August/September compared to June at each transect (Appendix Table C.41). No significant difference in zooplankton selenium concentrations were indicated between samples collected from the surficial 10 m compared to the entire water column (Appendix Table C.40). Mean zooplankton tissue selenium concentrations within the Montana portion of the reservoir (International Boundary, Tenmile Creek, and Forebay stations) for 2017 and 2018 were lower than observed for both areas in the Canadian portion of the reservoir (downstream at RG_T4 and upstream at RG_TN; Figure 5.10). With the exception of the mean tissue selenium concentration from International Boundary in October 2018, all data from Montana were below the BC chronic interim guideline and EVWQP benchmarks (Figure 5.10). In general, zooplankton tissue selenium concentrations observed at areas within the Canadian portion of the reservoir downstream and upstream areas of the Elk River in 2018 were similar to concentrations reported in previous years (2014 to 2016) at like areas (Figure 5.10).

6 BENTHIC INVERTEBRATES

6.1 Overview

Benthic invertebrate community samples were collected at profundal areas located downstream (RG_T4) and upstream (RG_TN) from the confluence with Elk River in Koocanusa Reservoir (Appendix Table D.1). The benthic invertebrate community sampling occurred in August 2018, when water levels in the reservoir were likely to be most stable. Composite-taxa benthic invertebrate tissue samples were collected downstream (RG_T4) and upstream (RG_TN) of the Elk River in April and August/October, as well as at littoral areas near the Elk River mouth (RG ER) and Gold Creek (RG-GC) downstream areas and Sand Creek (RG-SC) upstream area in April for analysis of selenium concentrations in addition to other metals (Appendix Table D.2).

6.2 Community Structure

Total density of benthic invertebrates ranged from 502 to 3,670 organisms/m^2 downstream of, and 1,835 to 2,614 organisms/m^2 upstream of, the Elk River, with no significant difference in density indicated between areas (Figure 6.1; Appendix Tables D.6 and D.7). Richness downstream of the Elk River ranged from 7 to 12 taxa per sample, and although this was significantly lower than the 9 to 13 taxa per sample observed upstream of the Elk River, the magnitude of the difference between areas was within the natural effect size of ±2 SD (Figure 6.1; Appendix Table D.6 and D.7). Mean benthic invertebrate density in 2018 was lower downstream of the Elk River compared to 2014 to 2016, but was within the range shown at the upstream area from 2014 to 2016 (Figure 6.1). Mean benthic invertebrate richness at the downstream area in 2018 was within the range shown at the downstream area from 2014 to 2016, and was similar to that shown at the upstream area (Figure 6.1).

In general, the benthic invertebrate community was primarily composed of oligochaetes (mostly tubificinae) and insects (various species of chironomids, but mainly *Chironomus*, *Procladius*, and *Tanytarsus*) both downstream (RG_T4) and upstream (RG_TN) of the Elk River (Figures 6.2 and 6.3). The benthic invertebrate community structure differed between the downstream and upstream areas based on significantly lower total density of nematodes, and significantly lower total and relative density of Ostracoda, downstream compared to upstream, the magnitude of difference of which was outside an effect size of ±2 SD only for the Ostracoda endpoints (Appendix Table D.6 and D.7). These differences in benthic invertebrate community features were generally supported by NMDS analyses, which indicate that the stations upstream of the Elk River were grouped more closely with Nematoda, and *Candona* (Ostracoda; Figure 6.4; Appendix Table D.6). Separation between the two areas were also seen with regard to the taxa *Chironomus* (Chironomidae) and *Aulodrilus limobius* (Oligochaeate), which had lower densities downstream

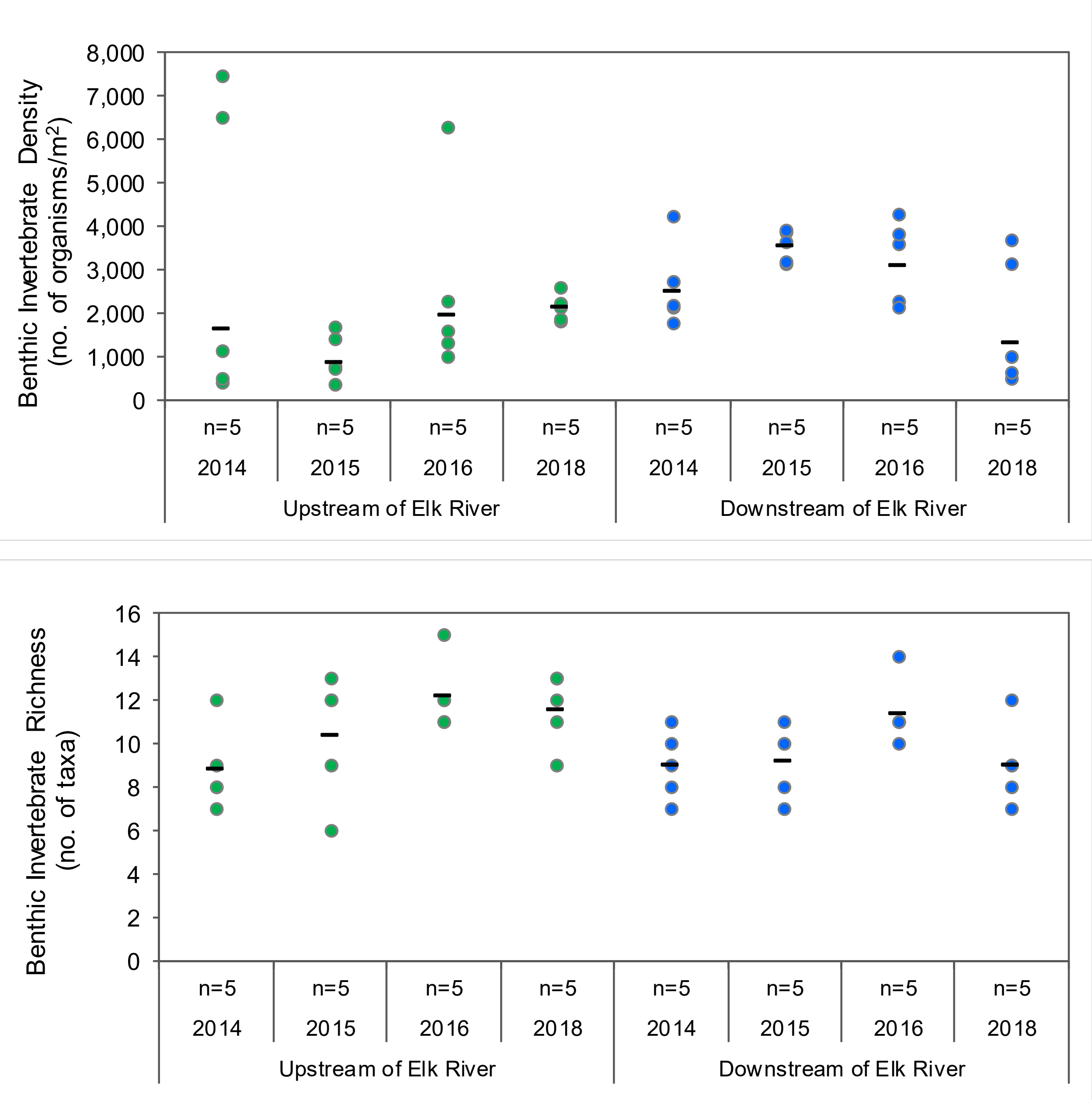

Figure 6.1: Benthic Invertebrate Density (No. Organisms/m2) and Richness (No. of Taxa) in Koocanusa Reservoir, August 2014 to 2018

Notes:
The upstream location was relocated further upstream from the mouth of the Elk River in August 2015, 2016, and 2018
Measure of Central Tendancy (geometric mean for density, mean for richness) shown with a black line.
Richness values from 2014 are not directly comparable to other years. Taxonomic resolution in some taxa was lower in 2014 than other years. Taxonomic corrections were applied separately for 2015 to 2018, to data from 2014.

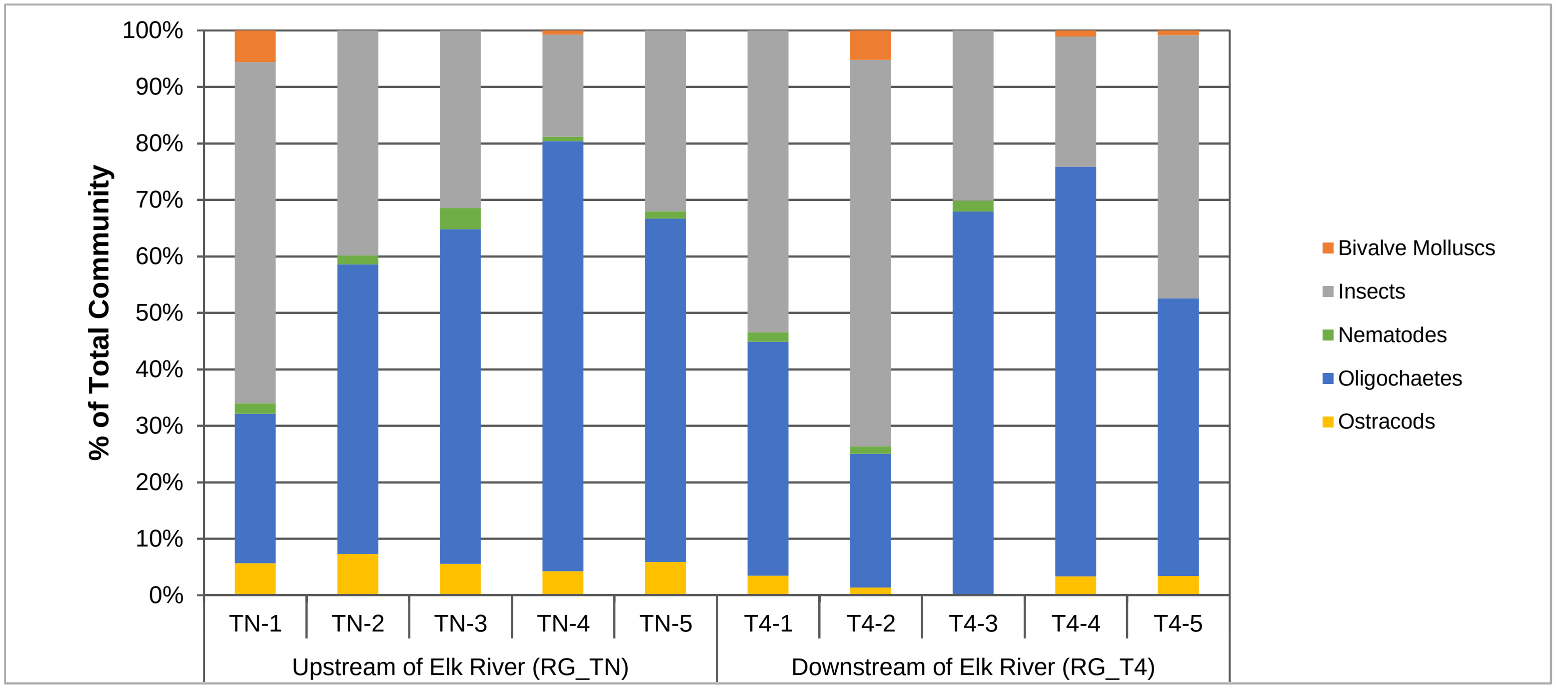

Figure 6.2: **Relative Density of Major Benthic Invertebrate Community Groups in Koocanusa Reservoir, August 2018**

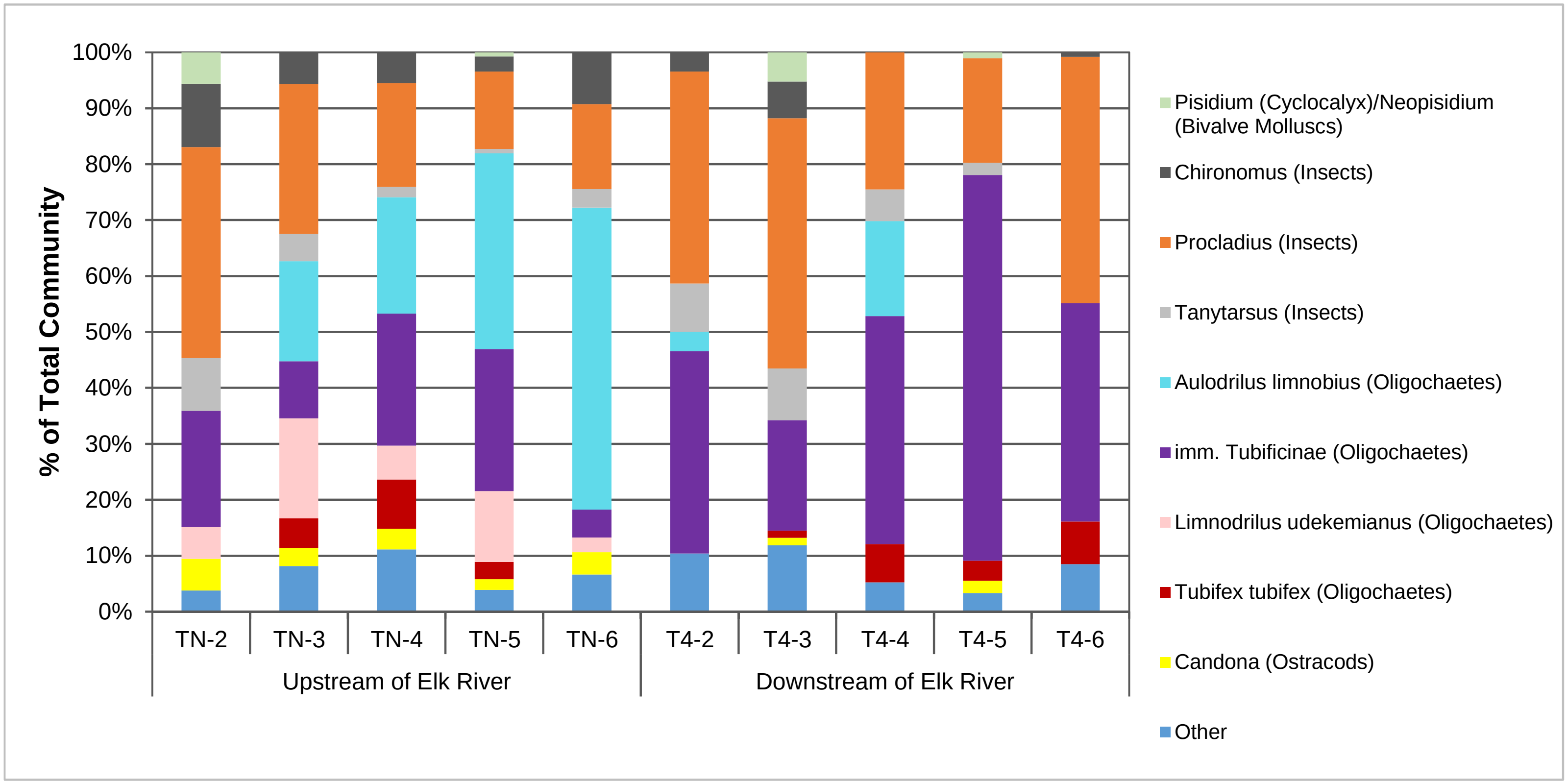

Figure 6.3: Relative Density of Benthic Invertebrate Taxa in Koocanusa Reservoir, August 2018

Note: Only taxa comprising at least 5% of the total number of individuals at one or more stations are depicted individually.

compared to upstream (Figure 6.3 and 6.4). Temporal comparison of the dominant benthic invertebrate community groups indicated lower total and relative density of Ostracoda both downstream and upstream of the Elk River in 2018 compared to previous monitoring.

6.3 Tissue Selenium Concentrations

Composite-taxa benthic invertebrate tissue samples collected in April and August were composed mainly of Chironomidae. Selenium concentrations in benthic invertebrate tissues were higher at the mouth of the Elk River (RG_ER) compared to upstream at Sand Creek (RG_SC) and downstream at Gold Creek (RG_GC) for samples collected from littoral habitat in April 2018, but similar selenium concentrations in benthic invertebrate tissues were observed between the downstream and upstream profundal (transects) samples collected in August/October (Figure 6.5). The mean selenium concentrations in benthic invertebrate tissues collected at littoral habitat of the Elk River and Sand Creek areas exceeded the interim BCMOE selenium guideline of 4 µg/g dw, but were less than the EVWQP Level 1 benchmarks (Figure 6.5). Selenium concentrations in profundal benthic invertebrate tissues collected in 2018 were above the interim BCMOE guideline of 4 µg/g dw, but below the EVWQP Level 1 benchmarks for potential effects to invertebrates (13 µg/g dw) and for dietary effects to fish (11 µg/g dw) at the downstream area as well as upstream area (Figure 6.5). Benthic invertebrate tissue selenium concentrations observed in 2018 at profundal transects located downstream and upstream of the Elk River were within respective ranges observed from 2014 to 2016 (Figure 6.5).

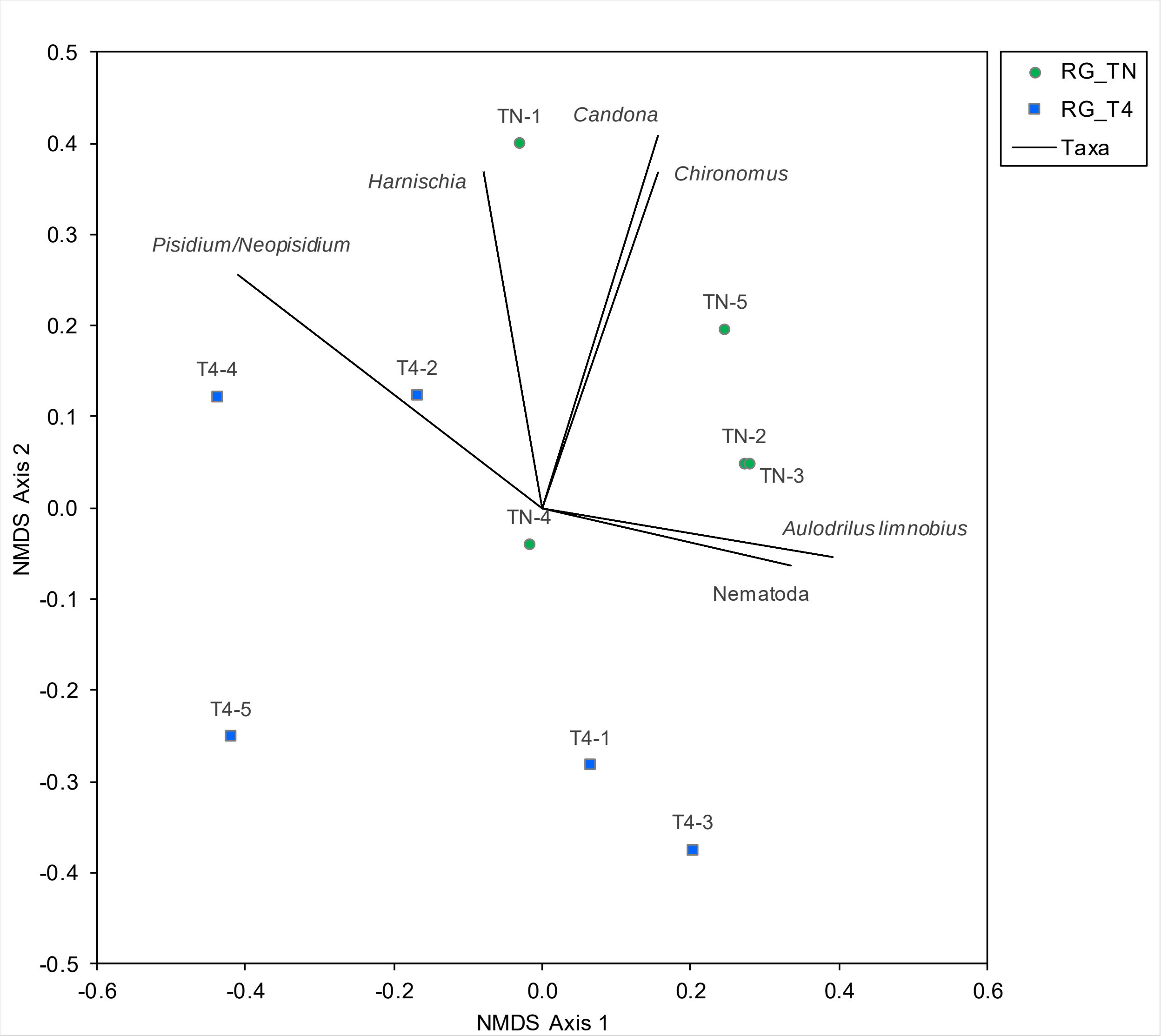

Figure 6.4: **Scatterplot of Non-Metric Multidimensional Scaling (NMDS) Axis Scores of Bray-Curtis Dissimilarities Calculated for Benthic Invertebrate Relative Densities at the LPL Level of Indentification for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018**

Notes:
Stress = 0.0455 (based on a 3-dimentional ordination)
Relative taxa densities were 4th root transformed before NMDS calculation.
Taxa present in only one sample were removed from the analysis.
Vectors represent the direction and relative magnitude of the Spearman correlation coefficients of taxa against NMDS axis scores with α = 0.05 and |rs| > 0.5.

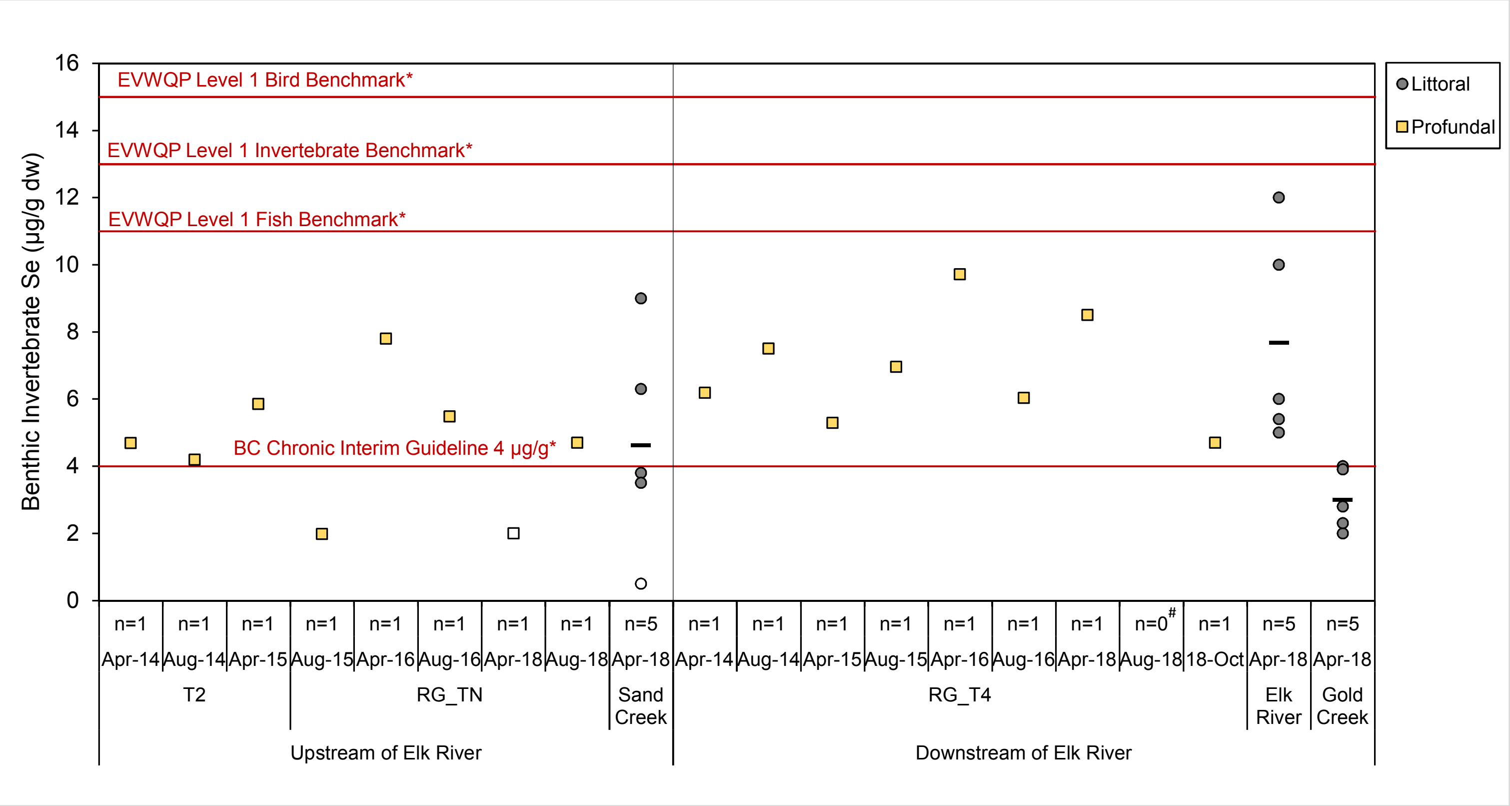

Figure 6.5: **Concentrations of Selenium (µg/g dw) in Composite Benthic Invertebrate Tissue Samples in Koocanusa Reservoir, 2014 to 2018**

Notes: Individual values are plotted. Means are plotted as horizontal lines when n > 1.

n = 1 represents a composite sample of 20 grabs taken across the entire transect.

Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

The upstream area was sampled at T2 until April 2015 and this area was relocated further upstream from the mouth of the Elk River (RG_TN) beginning in August 2015.

[#] Sample was inadvertently ruined in the analytical testing process (resampled October 9, 2018)

* 15 µg/g Level 1 Benchmark (Elk Valley Water Quality Plan [EVWQP]; Golder, 2014) for dietary effects to juvenile birds.

* 13 µg/g Level 1 Benchmark (EVWQP; Golder, 2014) for growth, reproduction, and survival of benthic invertebrates.

* 11 µg/g Level 1 Benchmark (EVWQP; Golder, 2014) for dietary effects to juvenile fish.

* 4 µg/g BC Chronic Interim Guideline for dietary effects to benthic invertebrates (BCMOE 2006).

7 FISH

7.1 Overview

Fish were sampled in the Canadian portion of the Koocanusa Reservoir to evaluate endpoints indicative of individual and population health as well as for tissue chemistry. Three areas were sampled in the reservoir, including two located downstream from the Elk River (Elk River Mouth [RG_ER] and Gold Creek [RG_GC]), and one located upstream from the Elk River (Sand Creek [RG_SC]; Figure 2.2). The fish health survey targeted the collection of peamouth chub and reside shiner in April 2018, prior to the spawning period for each species. Recruitment of redside shiners was also assessed in August 2018 at each of the three fishing areas by confirming the presence of young-of-the-year (YOY) redside shiner and, when applicable, evaluating YOY endpoints of body size and condition.

Fish tissues were collected from the same species used for the fish health survey in April 2018, as well as from northern pikeminnow in June 2018, and from sport fish in April, June, and August 2018 at areas within the Canadian portion of the reservoir. Data for tissue chemistry was qualitatively compared to data from the Montana portion of the reservoir collected from various sampling locations in 2018[10] (Figure 2.2). Although a formal fish community evaluation was not an objective of the fish survey, the relative abundances of the various species captured were summarized and compared to evaluate general differences in fish community composition among the study areas.

7.2 Fish Health and Population Assessment

7.2.1 Peamouth Chub

A total of 22, 18, and 20 female peamouth chub (PCC) were collected at Sand Creek (RG_SC), Elk River (RG_ER), and Gold Creek (RG_GC) study areas, respectively. The mean age of the female PCC captured at each of the downstream areas did not differ significantly from females collected from the upstream area, and ranged from 7 to 9 years (Table 7.1; Figure 7.1). Near the Elk River mouth (RG_ER), female PCC showed significantly lower condition than at the upstream area, but no other significant differences in health endpoints were indicated (Table 7.1; Figure 7.1). In addition to significantly lower condition, female PCC captured at the Gold Creek area also showed significantly lower body weight and significantly greater relative liver weight compared to female PCC sampled at the upstream area (RG_SC; Table 7.1; Figure 7.1). In all

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[10] Data provided by the Montana Department of Environmental Quality for numerous locations throughout the Montana portion of the reservoir (Figure 2.2).

Table 7.1: Statistical Comparisons of Peamouth Chub Health Endpoints between Sand Creek (Upstream), and Elk River and Gold Creek (Downstream) Areas, Koocanusa Reservoir Monitoring Program, 2018

Sex	Indicator	Endpoint	Variables		Sample Size			Test	ANCOVA Model Statistics			Summary Statistics[b]				Overall Test P-value (Area)	Pairwise Comparisons[c]			
									Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]						Elk River vs. Sand Creek		Gold Creek vs. Sand Creek	
			Response	Covariate	Sand Creek	Elk River	Gold Creek		Interaction P-value	Covariate P-value		Statistic	Sand Creek	Elk River	Gold Creek		P-value	Magnitude of Difference (%)[d]	P-value	Magnitude of Difference (%)[d]
Female	Survival	Age	log$_{10}$[Age]	-	22	18	20	ANOVA	-	-	-	Geometric Mean	7.97	8.88	6.86	0.124	-	-	-	-
	Body Size	Fork Length	Fork Length (cm)	-	22	18	20	ANOVA	-	-	-	Mean	23.0	23.0	22.2	0.283	-	-	-	-
		Body Weight	Adjusted Body Weight (g)	-	22	18	20	ANOVA	-	-	-	Mean	127	119	107	0.077	0.678	-	0.064	-15
	Energy Usage	Length-at-age	log$_{10}$[Fork Length (cm)]	log$_{10}$[Age]	22	18	20	ANCOVA	0.661	<0.001	7.83	Adjusted Mean	22.9	22.4	22.6	0.598	-	-	-	-
		Weight-at-age	log$_{10}$[Adjusted Body Weight (g)]	log$_{10}$[Age]	22	18	20	ANCOVA	0.602	<0.001	7.83	Adjusted Mean	124	109	109	0.090	0.155	-	0.143	-
		Relative Gonad Weight	log$_{10}$[Gonad Weight (g)]	log$_{10}$[Adjusted Body Weight (g)]	22	18	20	ANCOVA	0.147	<0.001	114	Adjusted Mean	7.29	6.37	8.48	0.047	0.442	-	0.366	-
	Energy Storage	Relative Liver Weight	log$_{10}$[Liver Weight (g)]	log$_{10}$[Adjusted Body Weight (g)]	22	18	20	ANCOVA	0.769	<0.001	114	Adjusted Mean	1.99	1.90	2.39	0.008	0.798	-	0.041	20
		Condition	log$_{10}$[Adjusted Body Weight (g)]	log$_{10}$[Fork Length (cm)]	22	18	20	ANCOVA	0.184	<0.001	22.6	Adjusted Mean	120	111	111	0.005	0.013	-7.7	0.014	-7.5
Male	Survival	Age	Age	-	32	35	36	K-W	-	-	-	Median	5.5	5	5.5	0.041	0.069	-9.1	1.000	-
	Energy Usage	Length-at-age	log$_{10}$[Fork Length (cm)]	log$_{10}$[Age]	32	35	36	ANCOVA	0.077	<0.001	5.52	Adjusted Mean	20.5	20.3	20.5	0.711	-	-	-	-
		Weight-at-age	log$_{10}$[Adjusted Body Weight (g)]	log$_{10}$[Age]	32	34	36	ANCOVA	0.118	<0.001	5.52	Adjusted Mean	89.5	85.2	93.0	0.340	-	-	-	-
		Relative Gonad Weight	log$_{10}$[Gonad Weight (g)]	log$_{10}$[Adjusted Body Weight (g)]	33	34	36	ANOVA	0.935	0.476	-	Geometric Mean	0.467	0.410	0.467	0.132	-	-	-	-
	Energy Storage	Relative Liver Weight	log$_{10}$[Liver Weight (g)]	log$_{10}$[Adjusted Body Weight (g)]	33	34	36	ANCOVA	0.391	<0.001	88.8	Adjusted Mean	1.18	1.05	1.24	0.030[f]	0.169	-	0.687	-
		Condition	log$_{10}$[Adjusted Body Weight (g)]	log$_{10}$[Fork Length (cm)]	33	34	36	ANCOVA	0.022[e]	<0.001	20.4	Adjusted Mean	87.5	88.2	90.6	0.254	-	-	-	-

▨	Area P-value < 0.1 or Interaction P-value < 0.05
🟦	Magnitude of Difference > 25% for Age, Weight-at-age, Relative Gonad Weight, and Relative Liver Weight or > 10% for Condition (EEM effect endpoint)
🟨	Covariate P-value > 0.05

Note: "-" indicates no data available

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for log$_{10}$-transformed variables), and adjusted mean are reported for Kruskal-Wallis, ANOVA and ANCOVA, respectively. The predicted means of the regression line equations are reported for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVA when a significant interaction is observed.

[c] Pairwise comparisons conducted using Tukey's honestly significant differences method (ANOVA and ANCOVA) or Dunn's test with Bonferroni adjustment (Kruskal-Wallis test).

[d] Calculated as the difference in measure of central tendency (MCT) between areas (downstream area minus upstream area), expressed as a percentage of the upstream area MCT.

[e] ANCOVA proceeded under the assumption that the slopes are practically parallel (R^2 of interaction model = 0.8942 and R^2 of parallel slope model = 0.8856; a difference < 0.02) following Environment Canada (2012).

[f] A significant difference was detected between the average rank values between RG_ER and RG_GC (not shown).

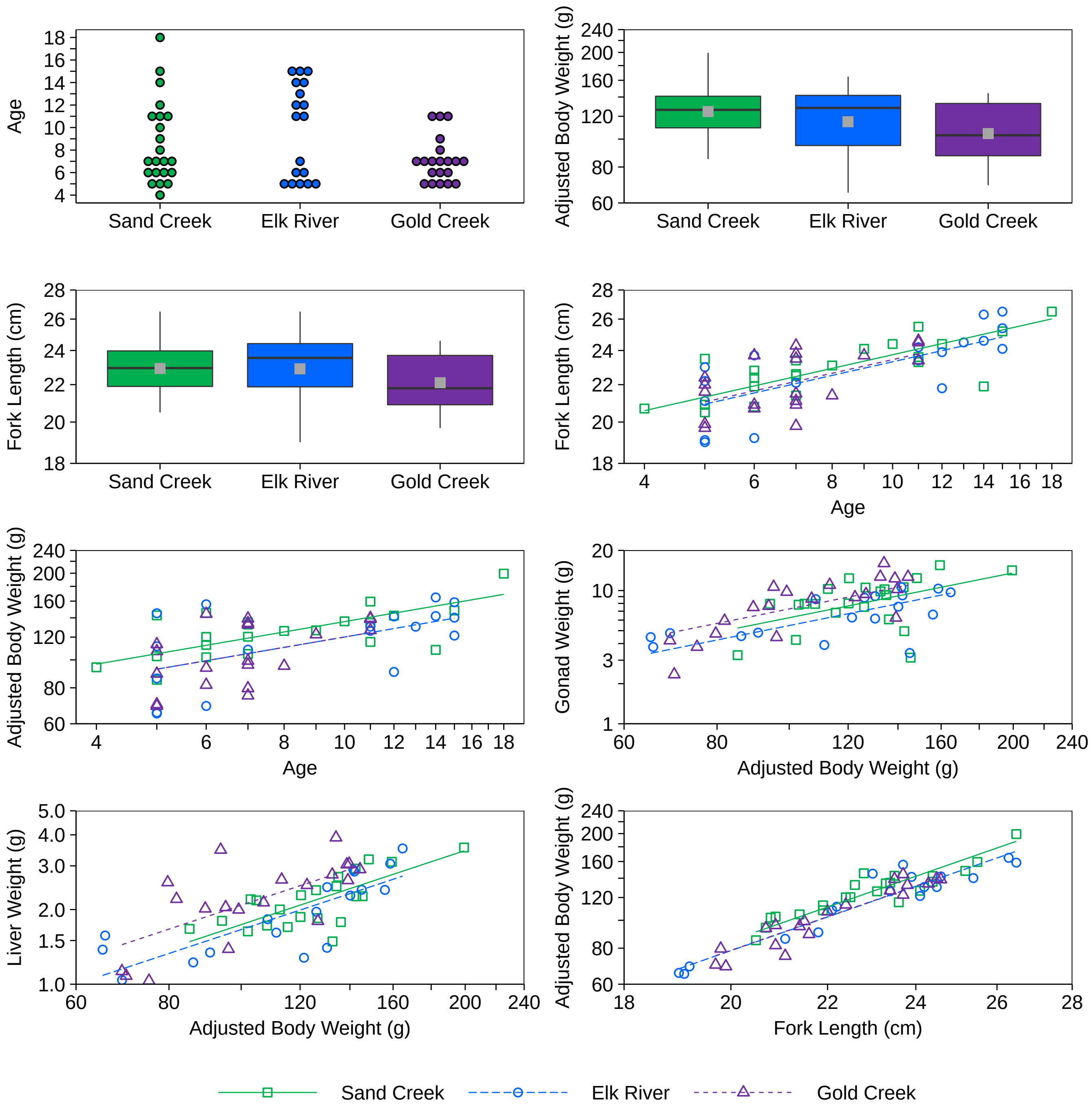

Figure 7.1: Plots to Support the Statistical Comparisons for Female Peamouth Chub Health Endpoints, Koocanusa Reservoir, 2018

Notes: Scatterplot x- and y-axes are $\log_{10}$-scaled. Outliers removed from the analysis are plotted as open symbols with an X through them.
Boxplot: box represents Q1, the median, and Q3. Whiskers extend to the minimum and maximum values; however, values above Q3 + 1.5IQR or below Q1 − 1.5IQR are plotted as individual points (IQR = Q3 − Q1) and the whiskers are truncated to the next value in the dataset. The mean is plotted as a square.

cases, the magnitude of these differences were within the applicable critical effect sizes (Table 7.1).

A total of 33, 35, and 36 male PCC were collected at the Sand Creek, Elk River, and Gold Creek areas, respectively. The mean age of male PCC ranged from 5 to 6 years among these three study areas, with only those captured at the Elk River area shown to be significantly younger compared to males captured at the Sand Creek area (Table 7.1; Figure 7.2). No other significant differences in male PCC health endpoints were indicated between each individual downstream area and the upstream area (Table 7.1; Figure 7.2).

Both sexes of PCC showed a relatively high incidence of tapeworms at all three study areas, ranging from 41.4% to 55.7% of individuals at each area, with the highest incidence occurring at the Gold Creek area (Table 7.2). Temporally, no consistent differences and/or no consistent direction of differences were shown for any of the PCC fish health endpoints for either of the sexes over the period from 2014 to 2018 between the Elk River mouth and upstream areas, nor between the Gold Creek and upstream areas (Table 7.3). In general, the incidence of tapeworms appeared higher in 2018 compared to that shown in previous monitoring years (2014 to 2016; Table 7.2).

7.2.2 Redside Shiner

A total of 33, 33, and 35 female redside shiner (RSC) were collected from the Sand Creek, Elk River, and Gold Creek areas, respectively. The median age of the female RSC captured at each of the downstream areas did not differ significantly from that at the upstream area, and ranged from 3 to 4 years among all areas (Table 7.4; Figure 7.3). Relative liver weight of Elk River area female RSC was significantly higher than females collected upstream at the Sand Creek area, the magnitude of which was outside of natural effect sizes (+25%; Table 7.4; Figure 7.3). Growth endpoints of length- and weight-at-age were both significantly higher in female RSC from the Gold Creek compared to Sand Creek areas, but the magnitude was within the applicable natural critical effect size.

A total of 48, 45, and 46 male RSC were collected from the Sand Creek, Elk River, and Gold Creek areas, respectively. The median age of the male RSC at the downstream areas did not differ significantly from that at the upstream area (Table 7.4; Figure 7.4). Male RSC sampled at the Gold Creek area showed significantly greater relative liver weight compared to those captured at the Sand Creek upstream area, the magnitude of which was slightly outside of applicable critical effect sizes (Table 7.4; Figure 7.4). However, no other significant differences in male RSC health endpoints were indicated between the Elk River and upstream area, nor between the Gold Creek and upstream areas, in 2018 (Table 7.4).

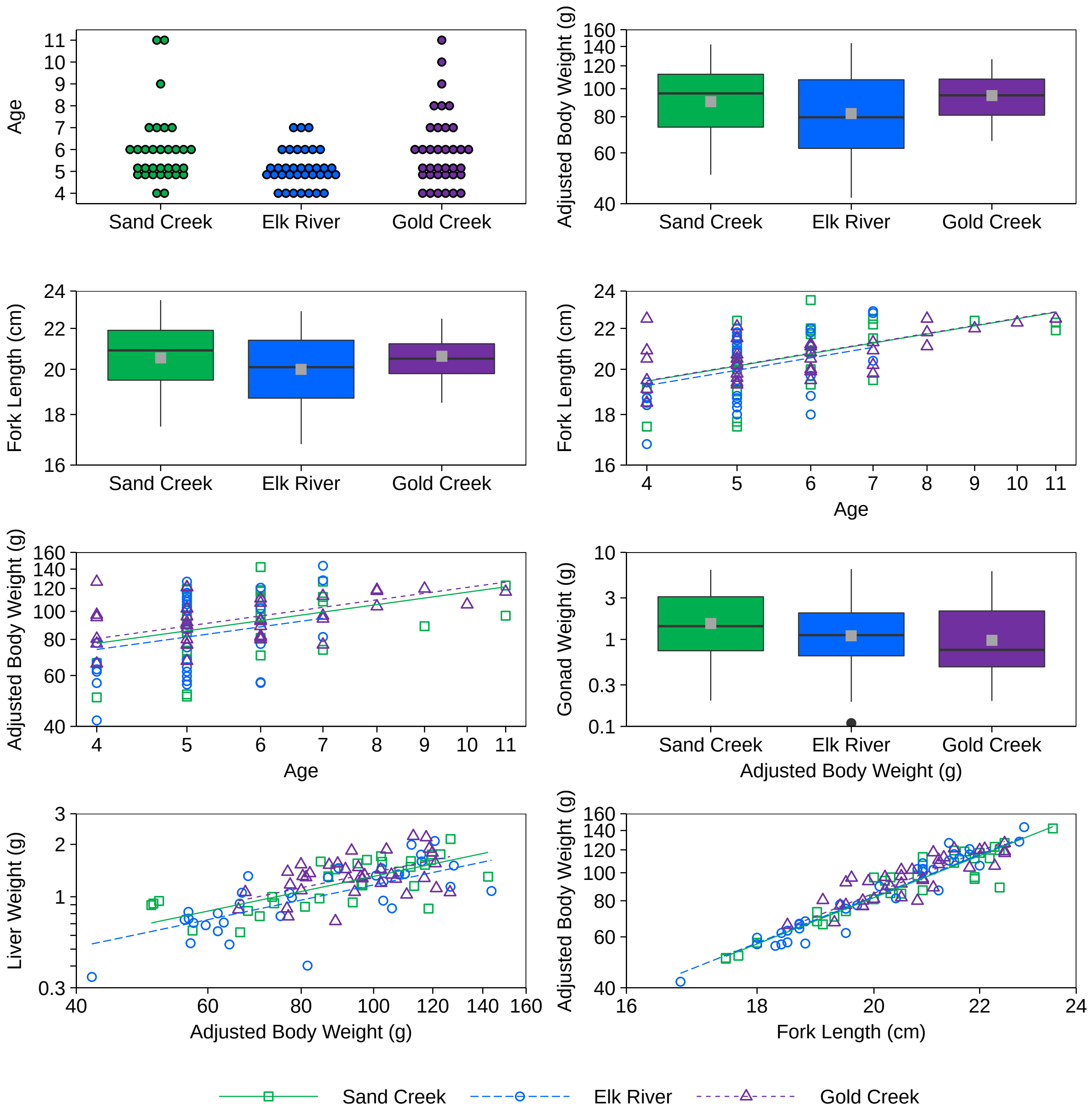

Figure 7.2: Plots to Support the Statistical Comparisons for Male Peamouth Chub Health Endpoints, Koocanusa Reservoir, 2018

Notes: Scatterplot x- and y-axes are $\log_{10}$-scaled. Outliers removed from the analysis are plotted as open symbols with an X through them.
Boxplot: box represents Q1, the median, and Q3. Whiskers extend to the minimum and maximum values; however, values above Q3 + 1.5IQR or below Q1 − 1.5IQR are plotted as individual points (IQR = Q3 − Q1) and the whiskers are truncated to the next value in the dataset. The mean is plotted as a square.

Table 7.2: Summary of Body Cavity Tapeworms at Sand Creek, Elk River, and Gold Creek Study Areas in Koocanusa Reservoir, 2014 to 2016, and 2018

Fish Species (Collection Month)	Study Area	Parasites (body cavity tapeworm)			
		2014	**2015**	**2016**	**2018**
Peamouth Chub (April)	Sand Creek	19%	10%	38%	42%
	Elk River	9.1%	1.9%	23%	41%
	Gold Creek	35%	5.3%	23%	56%
Redside Shiner (April)	Sand Creek	-	11%	30%	14%
	Elk River	-	46%	38%	24%
	Gold Creek	-	83%	37%	35%
Yellow Perch (April)	Sand Creek	-	0.038%	2.9%	0%
	Elk River	-	3.0%	20%	-
	Gold Creek	-	2.9%	7.1%	0%
Northern Pikeminnow (June)	Sand Creek	-	0%	7.7%	0%
	Elk River	-	0%	2.4%	17%
	Gold Creek	-	0%	3.1%	0%

Note: "-" indicates no data available

[a] Includes fish caught from the Oestreich Road sampling location in February 2014.

[b] Includes fish caught from the Englishman Creek sampling location in February 2014.

Table 7.3: Summary of Statistical Results for Fish Health Endpoints, 2014, 2015, 2016, and 2018

Sex	Response	Endpoint	Peamouth Chub				Redside Shiner	
			2014	2015	2016	2018	2016	2018
Female	Survival	Mean age	↑ O	O O	O ↓	O O	O O	O O
	Energy Use - Growth	Adjusted body weight-at-age	↑ O	O ↓	↓ ↓	O O	O O	O ↑
	Energy Use - Reproduction	Gonad weight-at-adjusted body weight	↓ O	O O	↑ ↑	O O	O O	O O
	Energy Storage	Condition (Adjusted body weight-at-fork length)	O ↓	O O	O O	↓ ↓	O O	O O
		Liver weight-at-adjusted body weight	O ↑	↓ ↓	↑ ↑	O ↑	↑ ↑	↑ O
Male	Survival	Mean age	↑ O	O O	O ↓	↓ O	O O	O O
	Energy Use - Growth	Adjusted body weight-at-age	O ↑	O O	O ↓	O O	O O	O O
	Energy Use - Reproduction	Gonad weight-at-adjusted body weight	O O	O -	↑ O	O O	O O	O O
	Energy Storage	Condition (Adjusted body weight-at-fork length)	↑ O	O O	O O	O O	↓ O	O O
		Liver weight-at-adjusted body weight	O ↑	O O	O O	↓ O	O ↑	O ↑

O : no significant difference

X : difference in slope of the relationship between areas

↓ : downstream fish significantly lower

↑ : downstream fish significantly higher

Blue symbols: Fish collected in Elk River relative to Sand Creek

Red symbols: Fish collected in Gold Creek relative to Sand Creek

Table 7.4: Statistical Comparisons of Redside Shiner Health Endpoints between Sand Creek (Upstream) and Elk River and Gold Creek (Downstream) Areas, Koocanusa Reservoir Monitoring Program, 2018

Sex	Indicator	Endpoint	Variables		Sample Size			Test	ANCOVA Model Statistics			Summary Statistics[b]				Overall Test P-value (Area)	Pairwise Comparisons[c]			
									Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]						Elk River vs. Sand Creek		Gold Creek vs. Sand Creek	
			Response	Covariate	Sand Creek	Elk River	Gold Creek		Interaction P-value	Covariate P-value		Statistic	Sand Creek	Elk River	Gold Creek		P-value	Magnitude of Difference (%)[d]	P-value	Magnitude of Difference (%)[d]
Female	Survival	Age	Age	-	33	35	35	K-W	-	-	-	Median	4	4	3	0.296	-	-	-	-
	Body Size	Fork Length	Fork Length (cm)	-	33	35	35	ANOVA	-	-	-	Mean	9.72	9.83	9.93	0.676	-	-	-	-
		Body Weight	Adjusted Body Weight (g)	-	33	35	35	ANOVA	-	-	-	Mean	10.6	10.8	11.2	0.743	-	-	-	-
	Energy Usage	Length-at-age	$\log_{10}$[Fork Length (cm)]	Age	33	35	35	ANCOVA	0.459	<0.001	3.51	Adjusted Mean	9.54	9.61	9.99	0.016	0.906	-	0.021	4.7
		Weight-at-age	$\log_{10}$[Adjusted Body Weight (g)]	Age	33	35	35	ANCOVA	0.526	<0.001	3.51	Adjusted Mean	10.1	10.2	11.5	0.042	0.972	-	0.059	14
		Relative Gonad Weight	$\log_{10}$[Gonad Weight (g)]	$\log_{10}$[Adjusted Body Weight (g)]	33	35	35	ANCOVA	0.056	<0.001	10.8	Adjusted Mean	0.442	0.412	0.429	0.750	-	-	-	-
	Energy Storage	Relative Liver Weight	$\log_{10}$[Liver Weight (g)]	$\log_{10}$[Adjusted Body Weight (g)]	33	35	35	ANCOVA	0.333	<0.001	10.8	Adjusted Mean	0.158	0.198	0.175	0.053	0.042	25	0.514	-
		Condition	$\log_{10}$[Adjusted Body Weight (g)]	$\log_{10}$[Fork Length (cm)]	33	35	35	ANCOVA	0.668	<0.001	9.78	Adjusted Mean	10.9	10.8	10.8	0.750	-	-	-	-
					33	35	34[e]	ANCOVA	0.640	<0.001	9.78	Adjusted Mean	10.9	10.8	10.9	0.859	-	-	-	-
Male	Survival	Age	Age	-	47	45	46	K-W	-	-	-	Median	3	3	3	0.008[f]	0.303	-	0.393	-
	Energy Usage	Length-at-age	$\log_{10}$[Fork Length (cm)]	$\log_{10}$[Age]	47	45	46	ANCOVA	0.882	<0.001	3.24	Adjusted Mean	9.37	9.51	9.27	0.151	-	-	-	-
		Weight-at-age	$\log_{10}$[Adjusted Body Weight (g)]	$\log_{10}$[Age]	47	44	46	ANCOVA	0.861	<0.001	3.24	Adjusted Mean	9.84	10.2	9.38	0.096[g]	0.551	-	0.439	-
		Relative Gonad Weight	$\log_{10}$[Gonad Weight (g)]	$\log_{10}$[Adjusted Body Weight (g)]	48	45	46	ANCOVA	0.885	<0.001	9.80	Adjusted Mean	0.102	0.0818	0.0949	0.113	-	-	-	-
	Energy Storage	Relative Liver Weight	$\log_{10}$[Liver Weight (g)]	$\log_{10}$[Adjusted Body Weight (g)]	48	45	46	ANCOVA	0.474	<0.001	9.80	Adjusted Mean	0.114	0.137	0.144	0.058	0.188	-	0.063	26
		Condition	$\log_{10}$[Adjusted Body Weight (g)]	$\log_{10}$[Fork Length (cm)]	48	45	46	ANCOVA	0.158	<0.001	9.38	Adjusted Mean	9.87	9.85	9.67	0.354	-	-	-	-
					48	45	45[f]	ANCOVA	0.568	<0.001	9.37	Adjusted Mean	9.84	9.81	9.73	0.706	-	-	-	-

▨	Area P-value < 0.1 or Interaction P-value < 0.05
🟦	Magnitude of Difference > 25% for Age, Weight-at-age, Relative Gonad Weight, and Relative Liver Weight or > 10% for Condition (EEM effect endpoint)
🟨	Covariate P-value > 0.05

Note: "-" indicates no data available

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Kruskal-Wallis, ANOVA and ANCOVA, respectively. The predicted means of the regression line equations are reported for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVA when a significant interaction is observed.

[c] Pairwise comparisons conducted using Tukey's honestly significant differences method (ANOVA and ANCOVA) or Dunn's test with Bonferroni adjustment (Kruskal-Wallis test).

[d] Calculated as the difference in measure of central tendency (MCT) between areas (downstream area minus upstream area), expressed as a percentage of the upstream area MCT.

[e] One outlier (Fish ID: RG_GC_RSC_85_20180428; Studentized residual = -4.6) was removed from the analysis.

[f] A significant difference was detected between the average rank values between RG_ER and RG_GC (not shown); however, the median values for the areas are the same.

[g] A significant difference was detected between the average rank values between RG_ER and RG_GC (not shown).

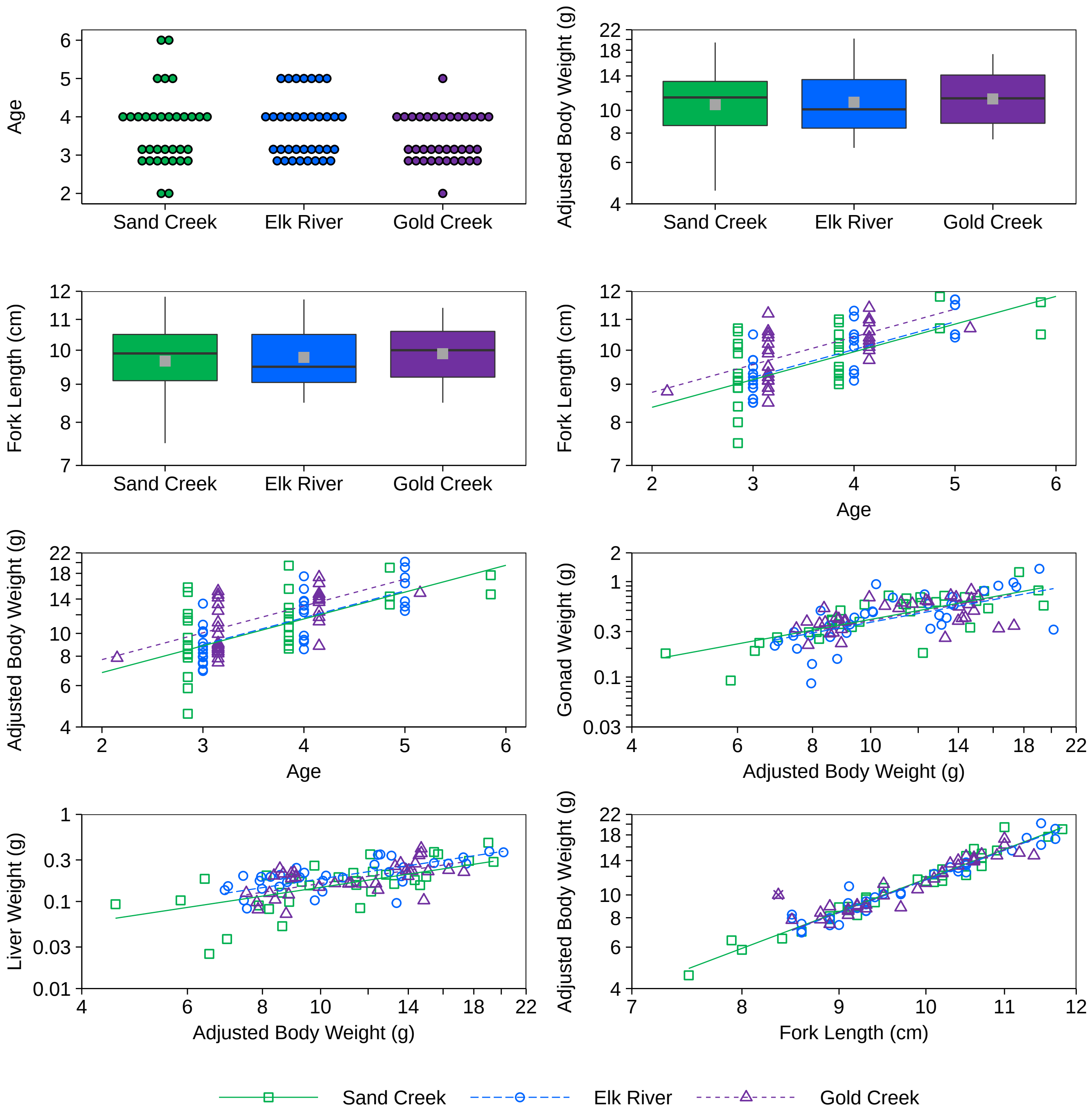

Figure 7.3: Plots to Support the Statistical Comparisons for Female Redside Shiner Health Endpoints, Koocanusa Reservoir, 2018

Notes: Scatterplot x- and y-axes are $\log_{10}$-scaled. Outliers removed from the analysis are plotted as open symbols with an X through them.
Boxplot: box represents Q1, the median, and Q3. Whiskers extend to the minimum and maximum values; however, values above Q3 + 1.5IQR or below Q1 − 1.5IQR are plotted as individual points (IQR = Q3 − Q1) and the whiskers are truncated to the next value in the dataset. The mean is plotted as a square.

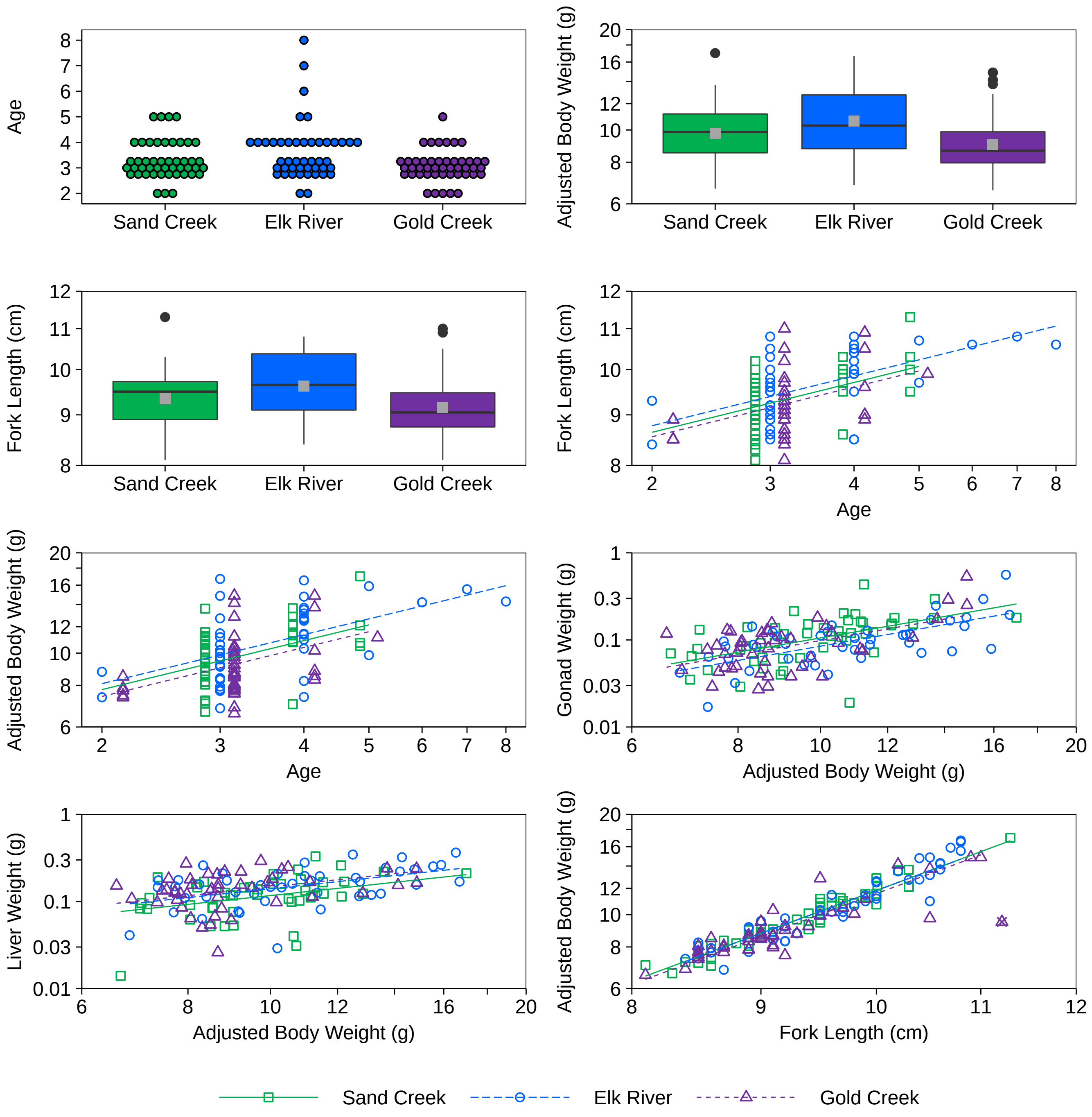

Figure 7.4: Plots to Support the Statistical Comparisons for Male Redside Shiner Health Endpoints, Koocanusa Reservoir, 2018

Notes: Scatterplot x- and y-axes are $\log_{10}$-scaled. Outliers removed from the analysis are plotted as open symbols with an X through them.
Boxplot: box represents Q1, the median, and Q3. Whiskers extend to the minimum and maximum values; however, values above Q3 + 1.5IQR or below Q1 − 1.5IQR are plotted as individual points (IQR = Q3 − Q1) and the whiskers are truncated to the next value in the dataset. The mean is plotted as a square.

Tapeworms were prevalent in both sexes of RSC, and similar to the PCC, the highest incidences of tapeworms occurred at the Gold Creek area compared to the Elk River downstream and Sand Creek upstream areas (Table 7.2). In general, the incidence of tapeworms in RSC was lower in 2018 than observed during previous monitoring (2014 to 2016; Table 7.2). Temporal comparison of fish health endpoints indicated consistently heavier relative liver weight in female RSC at the Elk River area, and in male RSC at the Gold Creek area, compared to the Sand Creek upstream area in 2016 and 2018 (Table 7.3). No consistent differences and/or no consistent direction of differences were shown for any of the other RSC fish health endpoints for either of the sexes between 2016 and 2018 between the Elk River mouth and upstream areas, nor between the Gold Creek and upstream areas (Table 7.3).

7.2.3 Redside Shiner Recruitment

A total of 380, 311, 293 RSC were captured from the Sand Creek, Elk River, and Gold Creek areas, respectively (Appendix Table E.9). Although the CPUE of RSC was lower at Elk River and Gold Creek downstream areas compared to the Sand Creek upstream area (CPUE of 0.46, 0.49, and 1.01, respectively), YOY required for completion of the recruitment survey were all captured in one or two seine hauls at each area, indicating that RSC were plentiful at each of the three study areas (Appendix Table E.9). Of the RSC captured in each area, 112, 117, and 145 were categorized as YOY from the Sand Creek, Elk River, and Gold Creek areas, respectively (Table 7.5). The corresponding proportion of YOY in these sampled populations was 29%, 38%, and 49%, respectively. Therefore, a higher proportion of YOY was observed at the downstream areas compared to the upstream area, suggesting no adverse influences on RSC recruitment at the downstream areas.

Indicators of body size, including both fork length and body weight, were significantly greater in RSC YOY captured downstream at the Elk River and Gold Creek areas compared to those captured at the Sand Creek area (Table 7.5; Figure 7.5 and 7.6). Despite being larger, RSC YOY at the Elk River and Gold Creek areas showed significantly lower condition compared to those captured at the Sand Creek area (Table 7.5). In general, the magnitude of the indicated differences between the downstream and upstream areas were within applicable natural effect sizes for each of the endpoints evaluated (Table 7.5).

7.3 Tissue Selenium Concentrations

7.3.1 Muscle

Muscle samples were collected from PCC, RSC, and bull trout, Kokanee, mountain whitefish, northern pikeminnow (NSC), rainbow trout, westslope cutthroat trout, and yellow perch in 2018. Mean muscle selenium concentrations in PCC captured in April were below the BCMOE guideline

Table 7.5: Statistical Comparisons of Redside Shiner YOY Health Endpoints between Sand Creek (Upstream) and Elk River and Gold Creek (Downstream) Areas, Koocanusa Reservoir Monitoring Program, 2018

Indicator	Endpoint	Variables		Sample Size			Test	ANCOVA Model Statistics			Summary Statistics[b]				Pairwise Comparisons[c]			
								Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					Elk River vs. Sand Creek		Gold Creek vs. Sand Creek	
		Response	Covariate	Sand Creek	Elk River	Gold Creek		Interaction P-value	Covariate P-value		Statistic	Sand Creek	Elk River	Gold Creek	P-value	Magnitude of Difference (%)[d]	P-value	Magnitude of Difference (%)[d]
Body Size	Fork Length	$\log_{10}$[Fork Length (mm)]	-	112	117	145	ANOVA	-	-	-	Geometric Mean	26.2	28.6	30.1	<0.001	8.8	<0.001	15
	Body Weight	$\log_{10}$[Body Weight (g)]	-	112	117	145	ANOVA	-	-	-	Geometric Mean	0.183	0.228	0.254	<0.001	25	0.001	39
Energy Storage	Condition	$\log_{10}$[Body Weight (g)]	$\log_{10}$[Fork Length (mm)]	112	117	145	ANCOVA	0.005[g]	<0.001	28.4	Adjusted Mean	0.230	0.224	0.215	0.173	-	<0.001	-6.5
				111[f]	117	145	ANCOVA	0.005[h]	<0.001	28.4	Adjusted Mean	0.231	0.224	0.215	0.065	-3.0	<0.001	-7.0

▨	Area P-value < 0.1 or Interaction P-value < 0.05
🟦	Magnitude of Difference > 10% for Condition (EEM effect endpoint)
🟨	Covariate P-value > 0.05

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Kruskal-Wallis, ANOVA and ANCOVA, respectively. The predicted means of the regression line equations are reported for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVA when a significant interaction is observed.

[c] Pairwise comparisons conducted using Tukey's honestly significant differences method (ANOVA and ANCOVA) or Dunn's test with Bonferroni adjustment (Kruskal-Wallis test).

[d] Calculated as the difference in measure of central tendency (MCT) between areas (downstream area minus upstream area), expressed as a percentage of the upstream area MCT (except for the K-S test; see footnote e).

[e] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the downstream area has a greater number of fish with length measures that are less than where the maximum difference in CRFDs was observed. A positive difference implies that the downstream area has fewer fish with length measures that are less than where the maximum difference in CRFDs was observed.

[f] One outlier (Fish ID: RG_SC_RSC_50_20180829; Studentized residual = -5.5) was removed from the analysis.

[g] ANCOVA proceeded under the assumption that the slopes are practically parallel (R^2 of interaction model = 0.9513 and R^2 of parallel slope model = 0.9499; a difference < 0.02) following Environment Canada (2012).

[h] ANCOVA proceeded under the assumption that the slopes are practically parallel (R^2 of interaction model = 0.9547 and R^2 of parallel slope model = 0.9534; a difference < 0.02) following Environment Canada (2012).

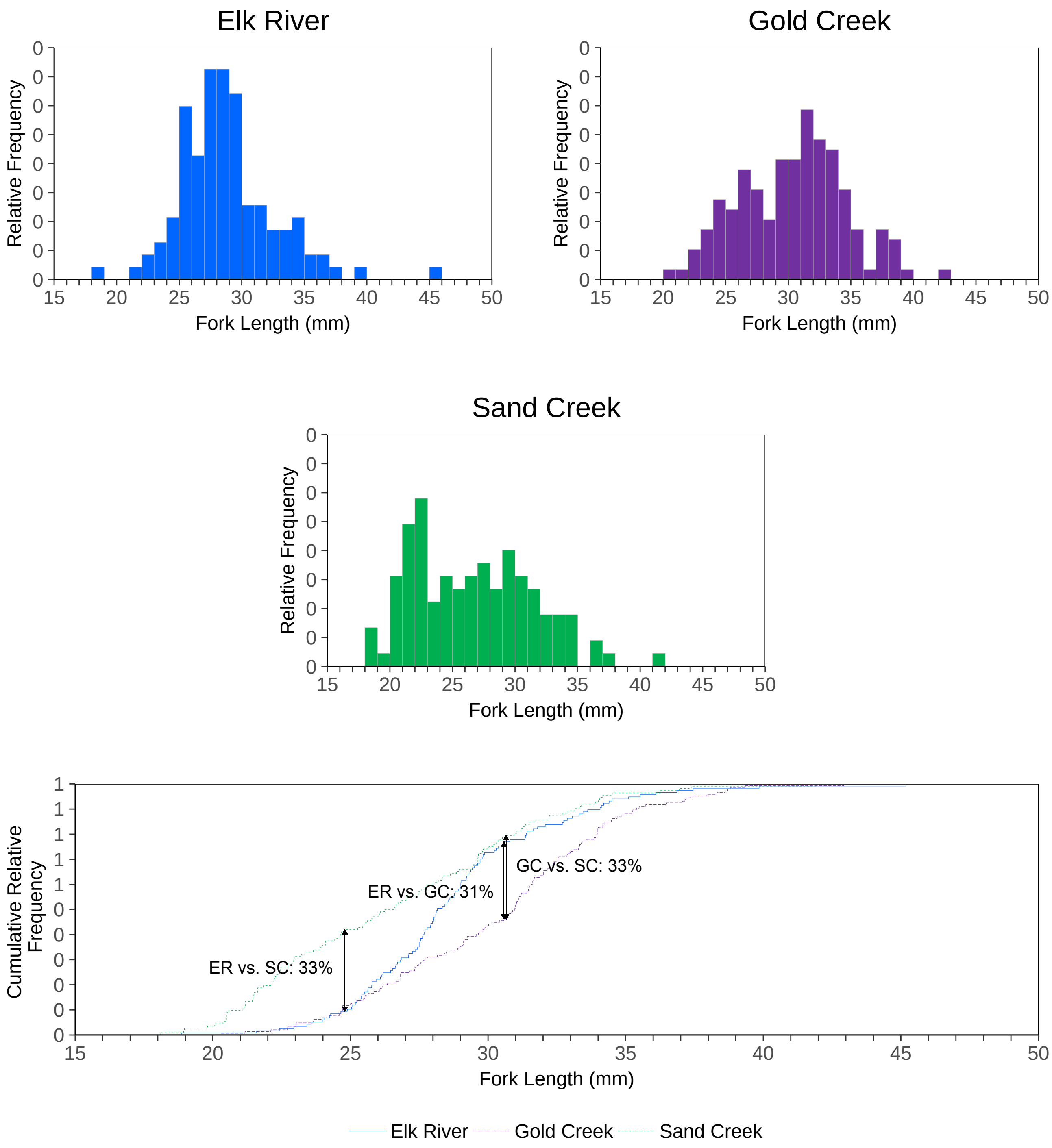

Figure 7.5: **Top − Length Frequency Distributions for Redside Shiner at Downstream (top) or Upstream (middle) Areas. Bottom − Cumulative Relative Frequency Distributions for Fork Length of Redside Shiner for Downstream and Upstream Areas, 2018**

Notes: Magnitude of difference = the maximum difference between the cumulative relative frequency distributions

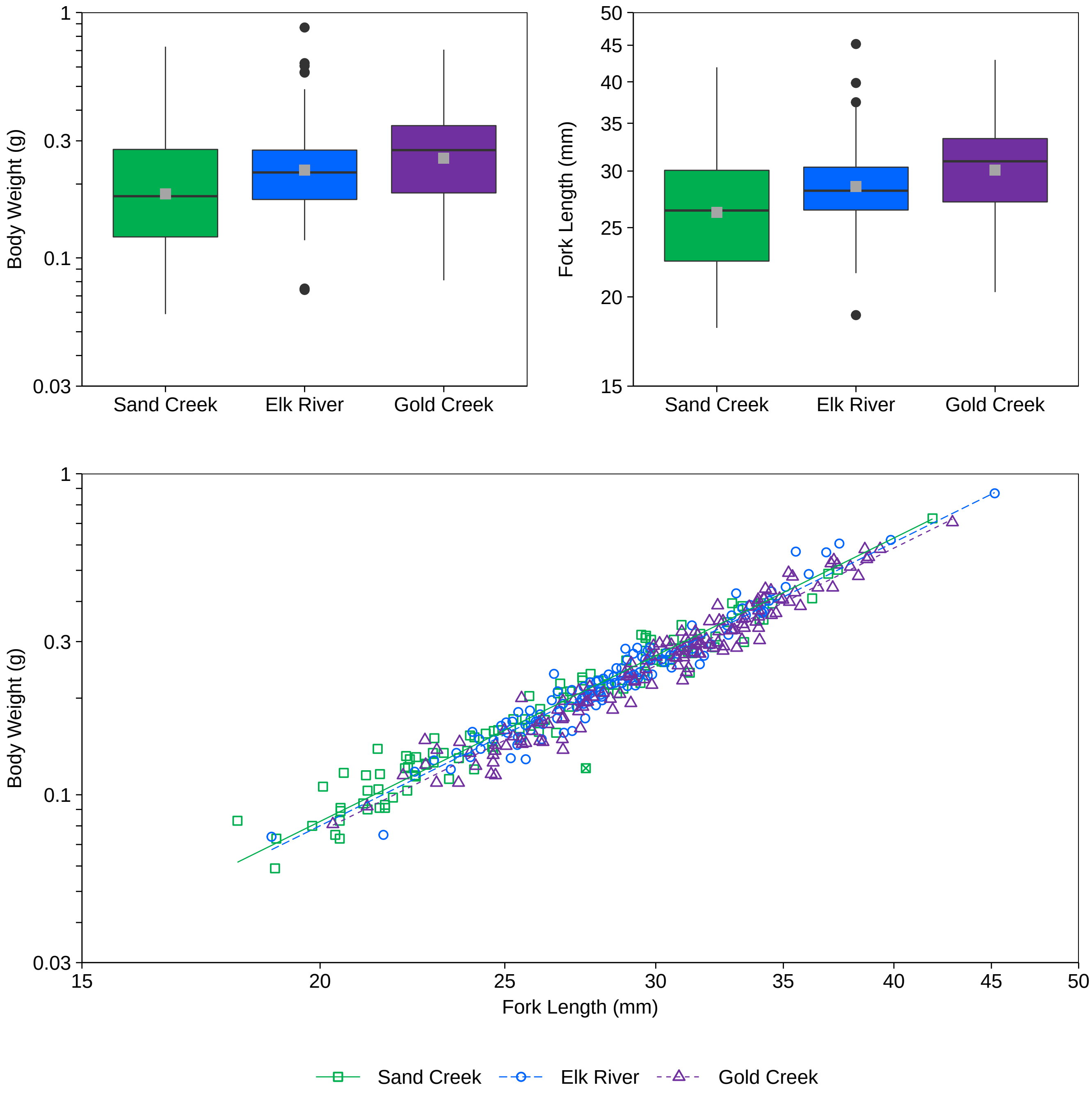

Figure 7.6: Plots to Support the Statistical Comparisons for Non−Lethal Redside Shiner Health Endpoints

Notes: Scatterplot x- and y-axes are $\log_{10}$-scaled. Outliers removed from the analysis are plotted as open symbols with an X through them.
Boxplot: box represents Q1, the median, and Q3. Whiskers extend to the minimum and maximum values; however, values above Q3 + 1.5IQR or below Q1 − 1.5IQR are plotted as individual points (IQR = Q3 − Q1) and the whiskers are truncated to the next value in the dataset. The mean is plotted as a square.

(4 µg/g dw) and the US EPA criterion (11.3 µg/g dw) at all three areas in the Canadian portion of the reservoir. Muscle tissue of PCC captured at the downstream Elk River and Gold Creek areas had significantly higher selenium concentrations than those captured at the upstream Sand Creek area (Table 7.6; Figure 7.7). Muscle selenium concentrations in PCC sampled at the Montana portion of the reservoir fell within the range observed among study areas north of the border (Figure 7.7). Muscle selenium concentrations in RSC were also below the BCMOE guideline and US EPA criterion at all areas in the Canadian portion of the reservoir. RSC captured at the Gold Creek area showed significantly higher muscle selenium concentrations compared to those captured at the Sand Creek area, although still below the respective guidelines (Table 7.6). The mean muscle selenium concentration in RSC sampled at Tenmile Creek in Montana was higher than observed elsewhere throughout the reservoir in 2018 (Figure 7.7). Mean muscle selenium concentrations in PCC and RSC captured at all Canadian areas within the reservoir in 2018 were similar to concentrations reported in previous years (based on species and area collected). Within the Montana portion of the reservoir, muscle selenium concentrations in PCC were lower in 2018 compared to previous studies for those stations at which more than one year of data were available (i.e., Tobacco River and Rexford study areas; Figure 7.7).

Mean concentrations of selenium in muscle tissue of NSC[11] were highest at the Elk River area compared to the Gold Creek and Sand Creek areas, and were also generally higher than in NSC muscle tissue collected within the Montana portion of the reservoir. Selenium concentrations in NSC were similar to those observed in previous years within the Canadian and Montana portions of the reservoir (Figure 7.7). Mean muscle selenium concentrations in rainbow trout, Kokanee, mountain whitefish, and bull trout sport fish in 2018 were similar in downstream portions of the reservoir in Canada and Montana compared to upstream of the Elk River, and were consistently below the applicable BCMOE guideline. Mean muscle selenium concentration in westslope cutthroat trout were above the BC guideline in samples collected in September near the mouth of the Elk River, but below the US EPA criteria and the EVWQP Level 1 equivalent muscle benchmark specific to westslope cutthroat trout. Mean muscle selenium concentrations in largescale and longnose suckers were similar throughout the reservoir, but exceeded the BCMOE guideline at Barron Creek and Jackson Creek stations, and at Rexford and Tenmile Creek stations, respectively, in 2018 (Figure 7.7). None of these samples were above the US EPA criterion.

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[11] Sample sizes were not large enough to include northern pikeminnow in the downstream to upstream comparisons for either muscle or ovary tissues.

Table 7.6: Statistical Comparisons of Redside Shiner (RSC) and Peamouth Chub (PCC) Muscle and Ovary Selenium Concentrations (mg/kg dw) between Downstream (Elk River and Gold Creek) and Upstream (Sand Creek) Areas, Koocanusa Reservoir Monitoring Program, 2018

Species		Sample Size			Measure of Central Tendancy				Overall Test P-value (Area)	Pairwise Comparisons[a]			
										Elk River vs. Sand Creek		Gold Creek vs. Sand Creek	
		Sand Creek	Elk River	Gold Creek	Statistic	Sand Creek	Elk River	Gold Creek		P-value	Magnitude of Difference (%)[b]	P-value	Magnitude of Difference (%)[b]
PCC	Muscle	10	10	10	Geometic Mean	1.82	2.67	2.48	0.025	0.028	47	0.085	36
	Ovary	10	10	10	Geometic Mean	10.4	13.2	10.2	0.398	-	-	-	-
RSC	Muscle	10	11	10	Geometic Mean	1.96	1.98	2.45	0.031	0.995	-	0.052	25
	Ovary	10	11	10	Geometic Mean	15.5	19.1	10.2	0.003	0.436	-	0.057	-34

▨ Area P-value < 0.1

🟦 Magnitude of Difference > 25%

[a] Pairwise comparisons conducted using Tukey's Honestly Significant Differences.

[b] Calculated as the difference in Measure of Central Tendency (MCT) between areas (downstream minus upstream), expressed as a percentage of the upstream area MCT.

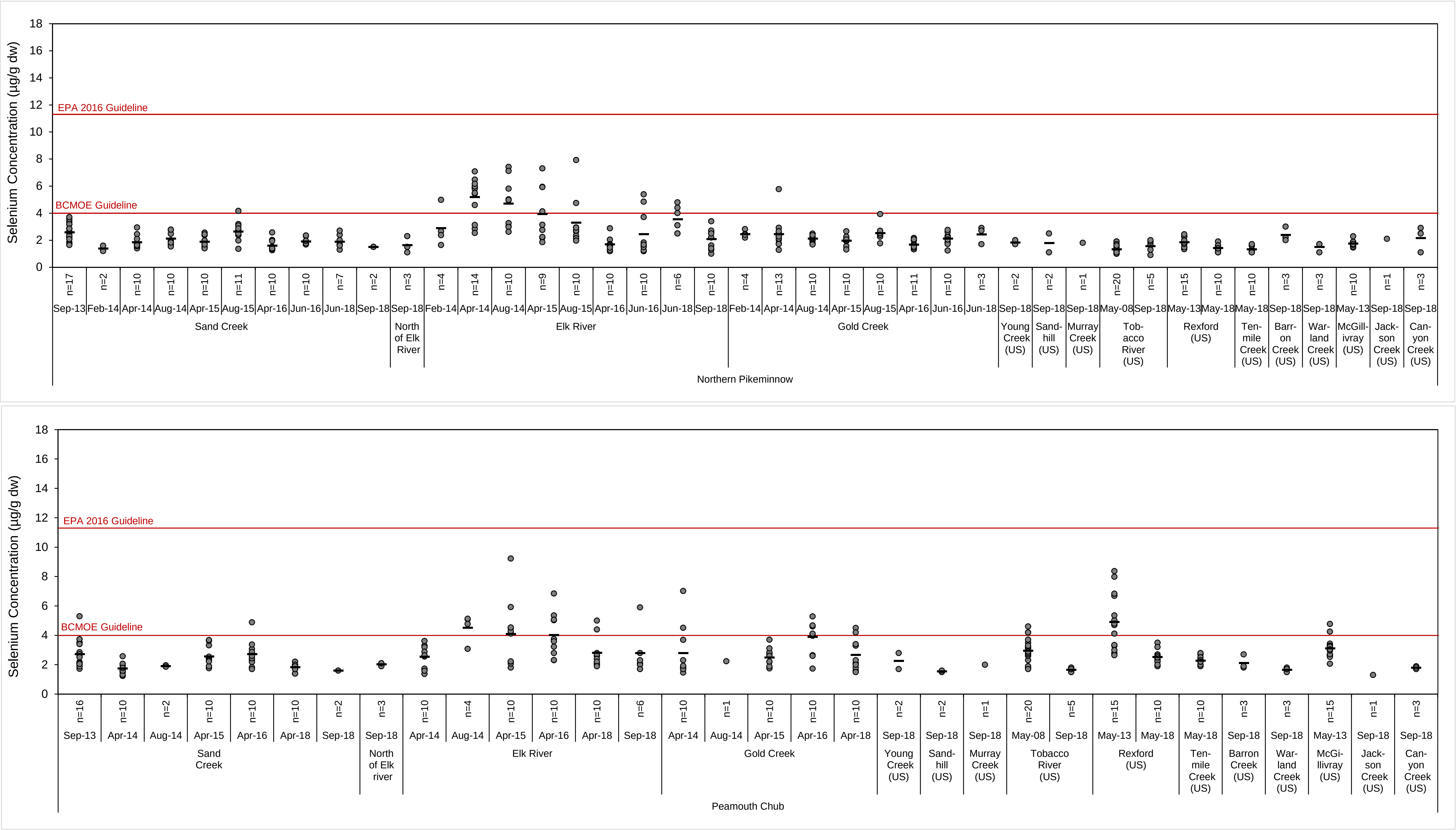

Figure 7.7: Concentrations of Selenium (µg/g dw) in Fish Muscle in Koocanusa Reservoir, 2008 to 2018

Notes: Individual values from muscle or filet are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MT DEQ. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ.

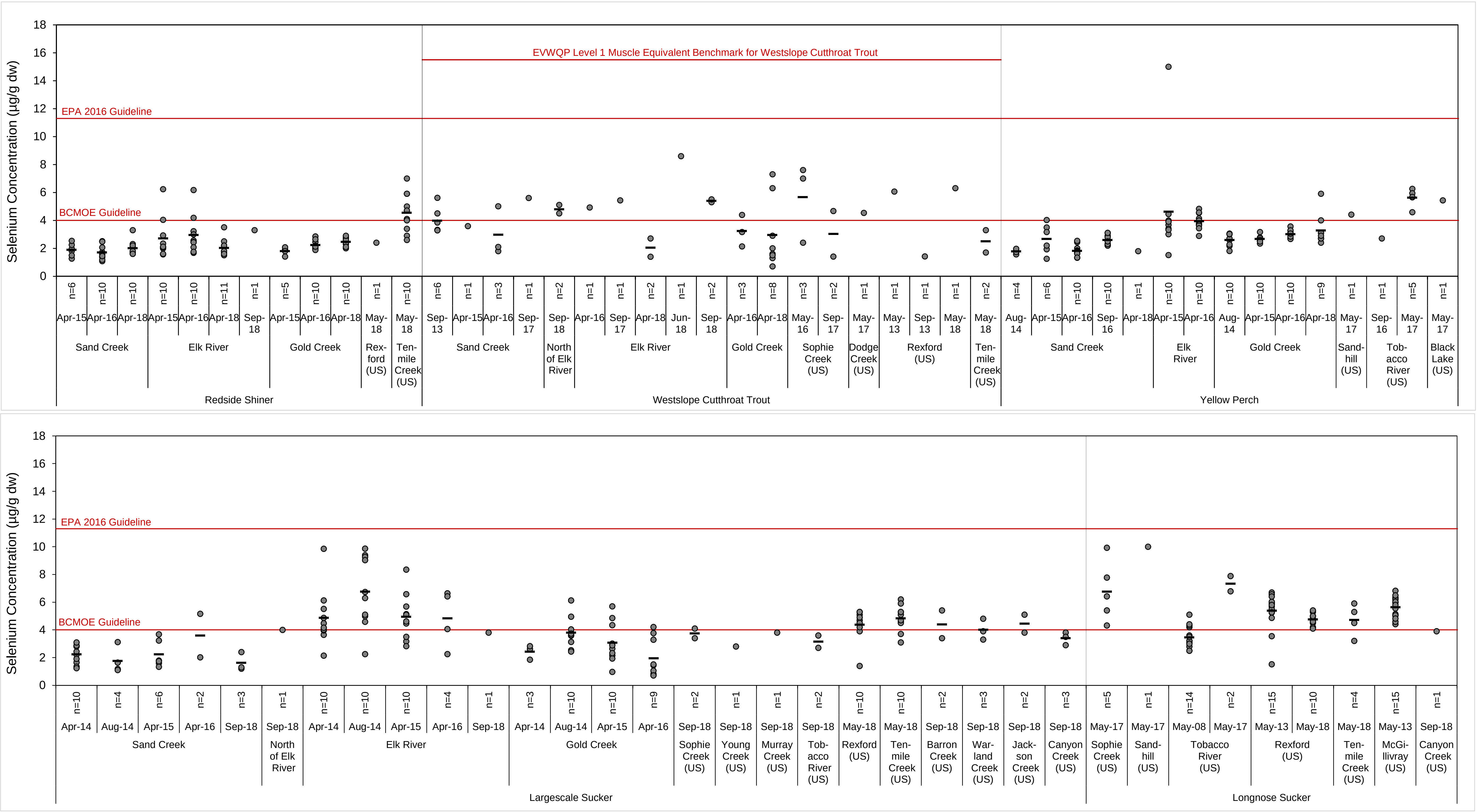

Figure 7.7: Concentrations of Selenium (µg/g dw) in Fish Muscle in Koocanusa Reservoir, 2008 to 2018

Notes: Individual values from muscle or filet are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MT DEQ. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ.

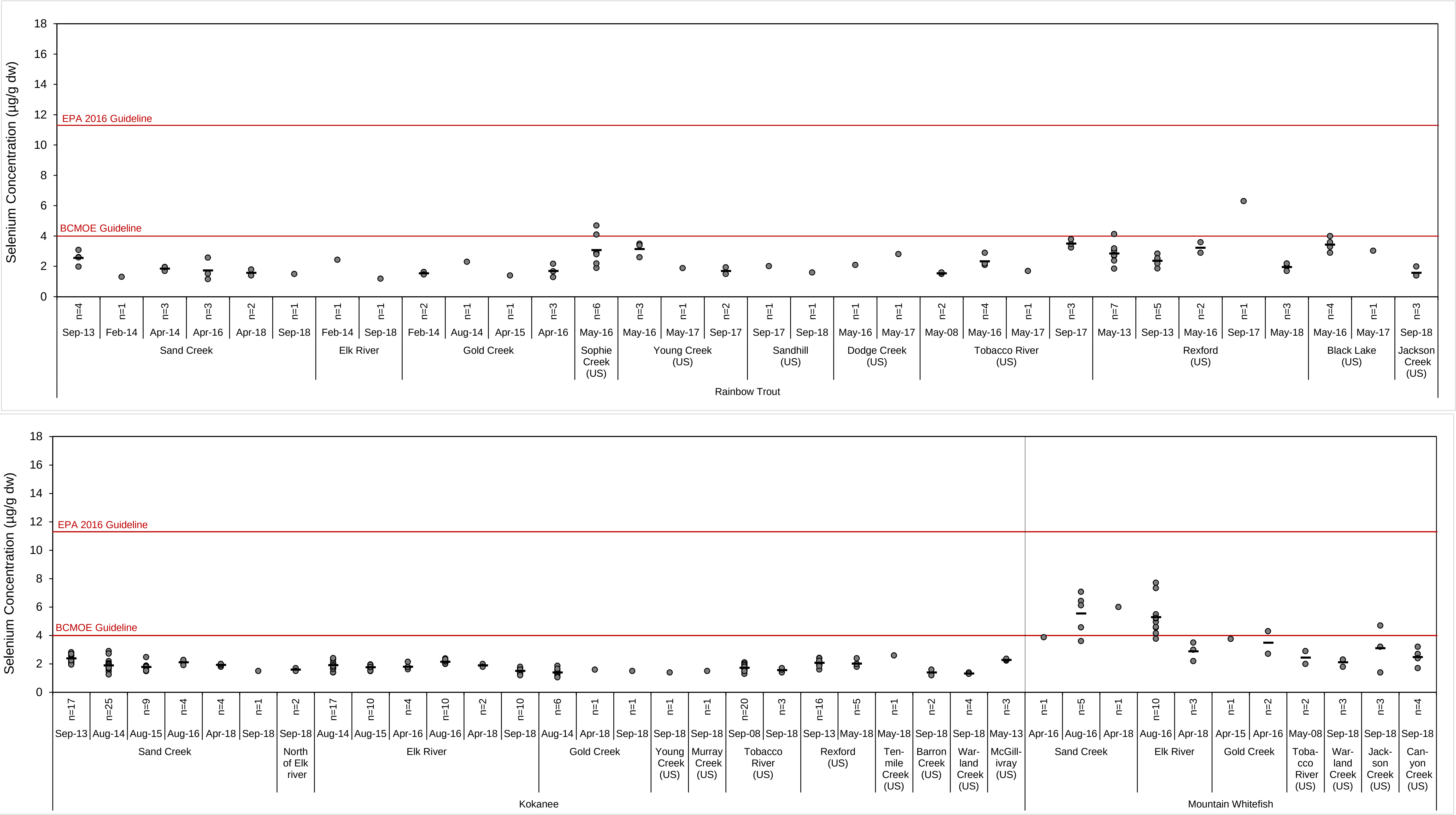

Figure 7.7: Concentrations of Selenium (µg/g dw) in Fish Muscle in Koocanusa Reservoir, 2008 to 2018

Notes: Individual values from muscle or filet are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MT DEQ. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ.

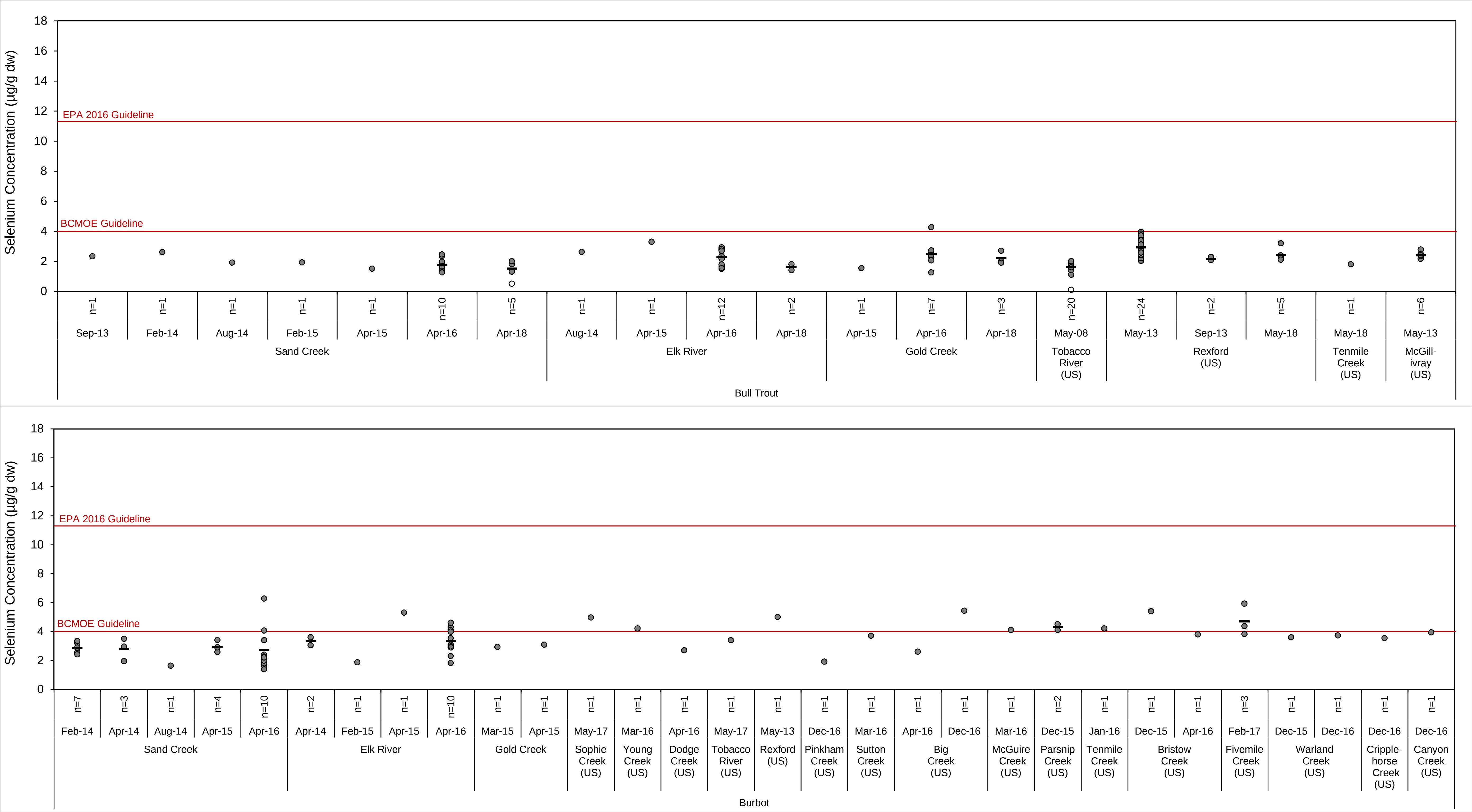

Figure 7.7: Concentrations of Selenium (µg/g dw) in Fish Muscle in Koocanusa Reservoir, 2008 to 2018

Notes: Individual values from muscle or filet are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MT DEQ. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ.

7.3.2 Ovary

Ovary samples for tissue selenium concentration determination were collected from PCC, RSC, and NSC at all three study areas within the Canadian portion of the reservoir in 2018. Ovary samples were also collected opportunistically from yellow perch at the Sand Creek and Gold Creek areas in April 2018. Mean selenium concentrations were above the BCMOE guideline (11 µg/g) in some PCC, RSC, and NSC ovaries collected at both of the downstream areas as well as the upstream area in the Canadian portion of the reservoir in 2018 (Figure 7.8). Mean selenium concentrations in RSC (21 µg/g) and NSC (21 µg/g) ovaries collected at the Elk River area, as well as in RSC (16 µg/g) ovaries collected at the Sand Creek upstream area, were also above the US EPA guideline of 15.1 µg/g (Figure 7.8). Mean selenium concentrations in yellow perch ovaries sampled from the Sand Creek and Gold Creek areas were below both the BCMOE guideline and US EPA criterion. Ovary selenium concentrations in yellow perch collected at Sand Creek and Gold Creek areas, as well as largescale and longnose sucker, and sport fish (Kokanee and mountain whitefish) collected within the Montana portion of the reservoir were all below the BCMOE guideline and US EPA criterion in 2018 (Figure 7.8).

Selenium concentrations in PCC ovaries collected at the Elk River and Gold Creek areas, and in RSC ovaries collected at the Elk River area, did not differ significantly from those collected at the Sand Creek upstream area (Table 7.6). In addition, selenium concentrations in RSC ovaries collected at the Gold Creek area were significantly lower than at the upstream area (Table 7.6). Selenium concentrations in ovaries of both species were similar at stations in both Canadian and Montana portions of the reservoir (Figure 7.8)

Selenium concentrations in ovary tissues of PCC, RSC, and Kokanee captured in 2018 were similar to those reported in previous years for like-species and areas for both Canadian and Montana portions of the reservoir where more than one year of data were available. NSC ovaries collected at the Elk River area showed higher selenium concentrations in 2018 than observed previously in 2015 and 2016 (Figure 7.8).

7.4 **Mercury Concentrations in Muscle**

No significant differences in relative mercury concentrations in muscle tissue (i.e., mercury concentration at length relationship) were indicated in PCC or RSC between downstream and upstream areas within the Canadian portion of the reservoir (Table 7.7). Mercury concentrations in muscle tissue of bull trout, Kokanee, mountain whitefish, NSC, PCC, rainbow trout, RSC, and yellow perch were greater than the BC guideline for protection of wildlife (0.165 µg/g dw[12]) at each

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[12] The BC guideline for the protection of wildlife (0.033 µg/g ww) was converted to a dry weight basis using the average moisture content in fish muscle in Koocanusa Reservoir of approximately 80%.

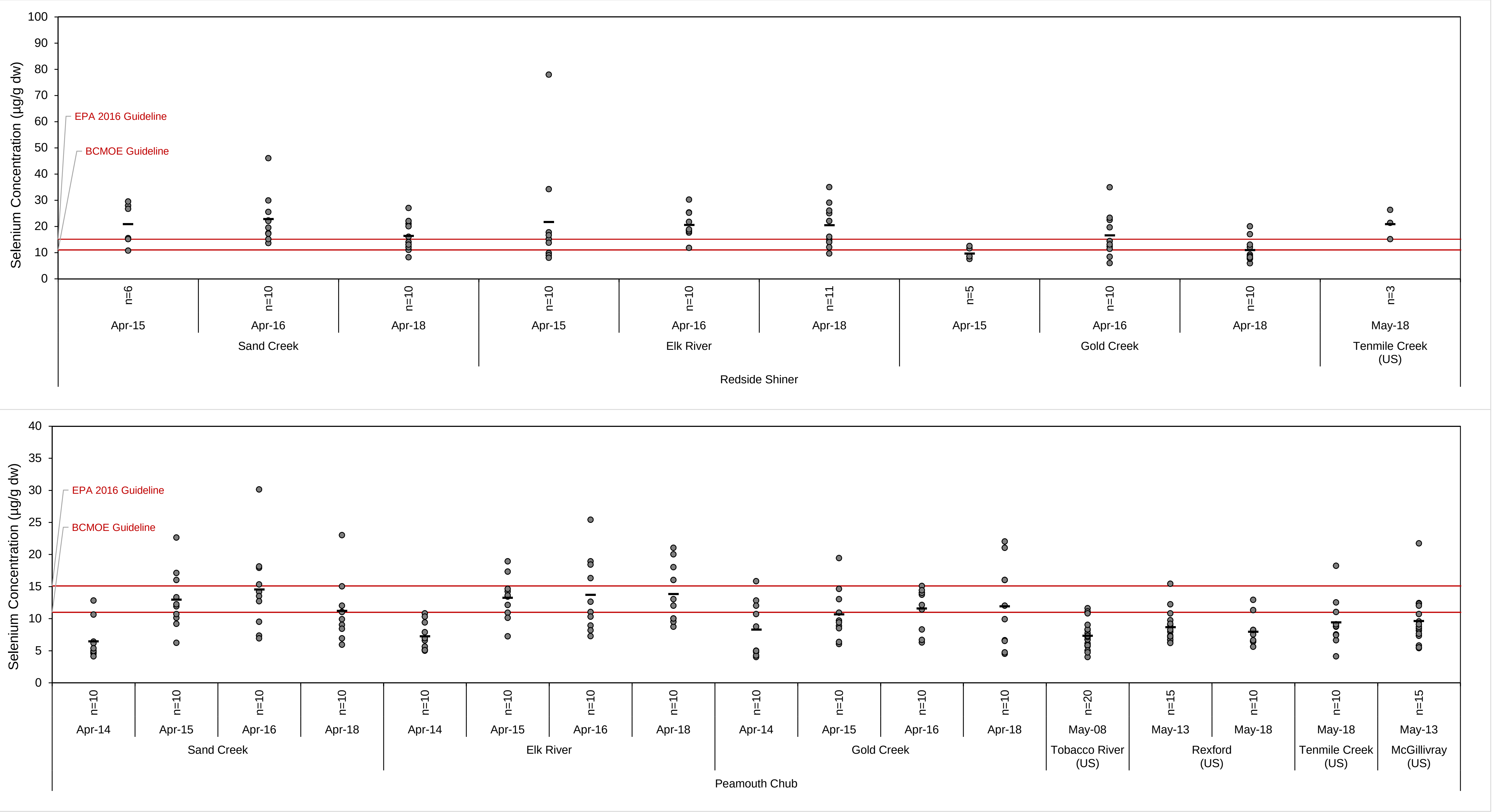

Figure 7.8: **Concentrations of Selenium (µg/g dw) in Fish Gonads or Ovary, Koocanusa Reservoir, 2008 to 2018**

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ. MT DEQ also collected some samples in Sand Creek (2013 samples). All samples collected by Teck were ovary samples. All samples collected by MT DEQ were labelled as gonads or ovary samples.

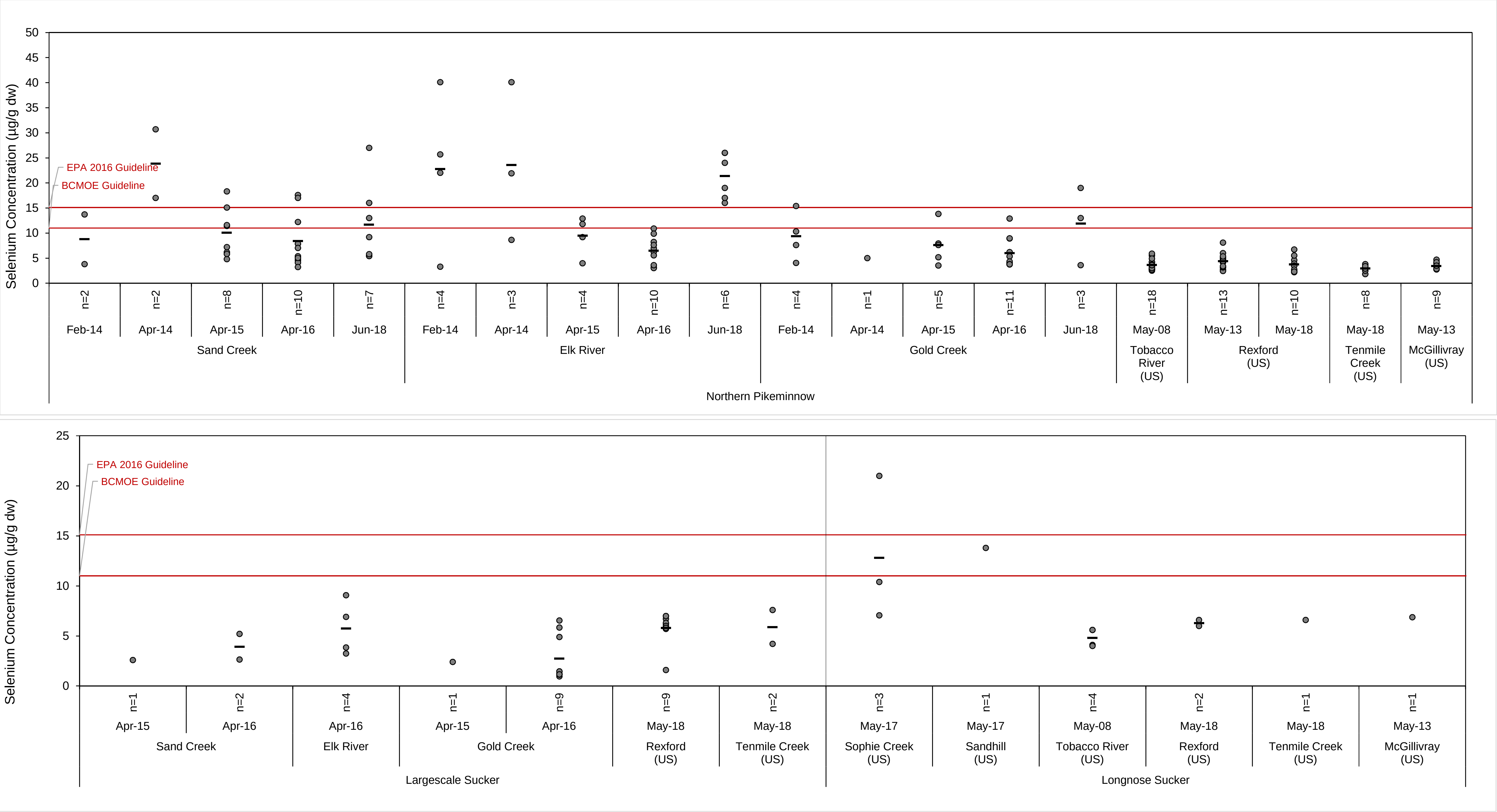

Figure 7.8: **Concentrations of Selenium (µg/g dw) in Fish Gonads or Ovary, Koocanusa Reservoir, 2008 to 2018**

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ. MT DEQ also collected some samples in Sand Creek (2013 samples). All samples collected by Teck were ovary samples. All samples collected by MT DEQ were labelled as gonads or ovary samples.

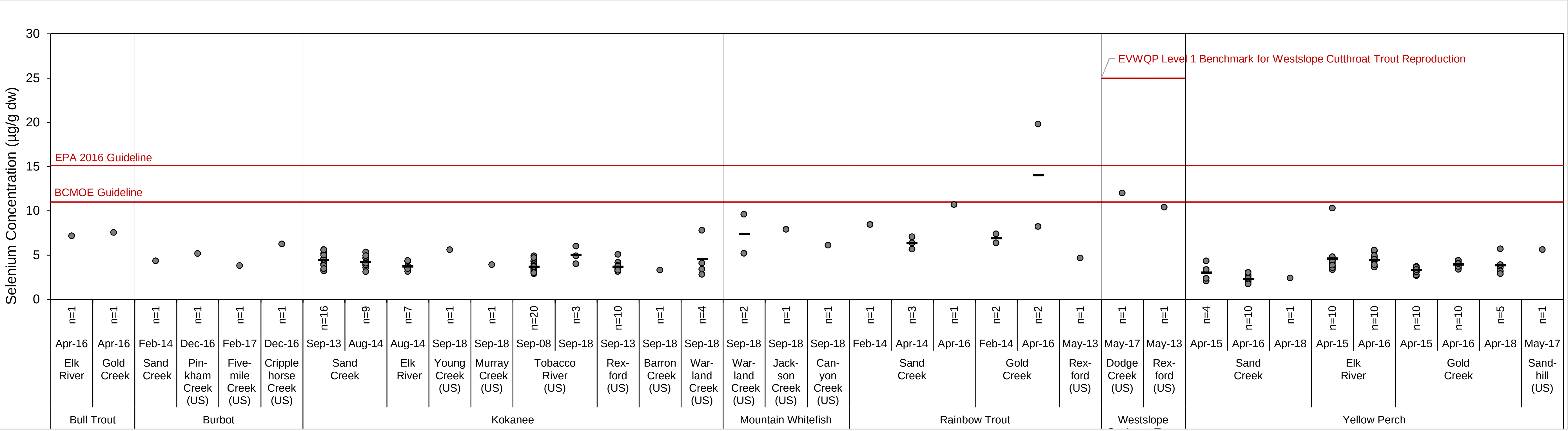

Figure 7.8: **Concentrations of Selenium (µg/g dw) in Fish Gonads or Ovary, Koocanusa Reservoir, 2008 to 2018**

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MT DEQ. MT DEQ also collected some samples in Sand Creek (2013 samples). All samples collected by Teck were ovary samples. All samples collected by MT DEQ were labelled as gonads or ovary samples.

Table 7.7: Statistical Comparisons of Redside Shiner (RSC) and Peamouth Chub (PCC) Muscle Mercury Concentrations (mg/kg dw) Relative to Fork Length (cm) between Downstream (Elk River and Gold Creek) and Upstream (Sand Creek) Areas, Koocanusa Reservoir Monitoring Program, 2018

Species	Sample Size			ANCOVA Model Statistics			Measure of Central Tendancy[b]				Overall Test P-value (Area)	Pairwise Comparisons[c]			
				Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]						Elk River vs. Sand Creek		Gold Creek vs. Sand Creek	
	Sand Creek	Elk River	Gold Creek	Interaction P-value	Covariate P-value		Statistic	Sand Creek	Elk River	Gold Creek		P-value	Magnitude of Difference (%)[d]	P-value	Magnitude of Difference (%)[d]
RSC	10	11	10	0.002	-	8.50	Predicted Mean	0.399	0.289	0.322	-	<0.001	-28	0.591	-19
						10.5		0.454	0.785	0.432			73		-4.8
	10	9[e]	10	0.358	0.006	9.34	Adjusted Mean	0.429	0.388	0.375	0.224	0.414	-9.5	0.234	-13
PCC	10	10	10	0.049	-	21.1	Predicted Mean	0.472	0.344	0.531	-	0.377	-27	0.520	12
						24.6		0.720	0.764	0.614			6.1		-15
	10	9[f]	10	0.189	0.009	22.7	Adjusted Mean	0.579	0.523	0.584	0.600	0.664	-9.8	0.998	0.77

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Magnitude of Difference > 25%

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The geometric mean. The predicted means of the regression line equations are reported for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVA when a significant interaction is observed.

[c] Pairwise comparisons conducted using Tukey's Honestly Significant Differences (differences in means for parallel slope models; differences in slopes for interaction models).

[d] Calculated as the difference in Measure of Central Tendency (MCT) between areas (downstream minus upstream), expressed as a percentage of the upstream area MCT.

[e] Two fish with high tissue mercury concentrations (Hg > 0.8 mg/kg dw) were removed from the analysis.

[f] One fish with a high tissue mercury concentration (Hg > 1 mg/kg dw) was removed from the analysis.

of the downstream (Elk River and Gold Creek) and upstream (Sand Creek) areas in 2018 (Figure 7.9), mirroring similar findings from previous monitoring (Minnow 2018a). Investigations by Teck regarding human health and water quality identified that mercury is not a mine-related constituent (Teck 2018c).

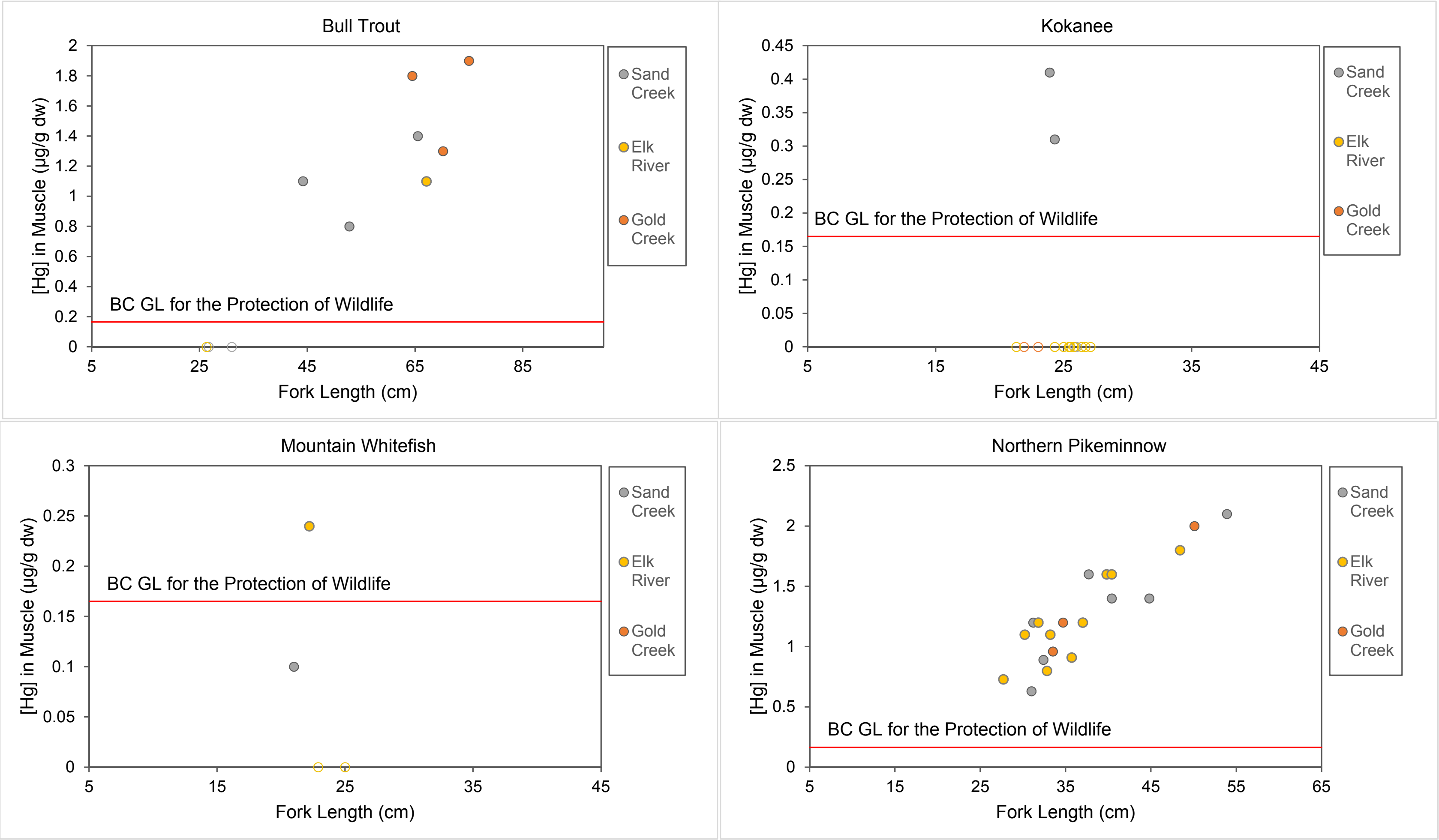

Figure 7.9: Mercury Concentrations (µg/g dw) in Fish Muscle Tissue Relative to Fork Length (cm) for all Species, Koocanusa Reservoir Monitoring Program, 2018

Notes: Sand Creek (SC) study area is located upstream of the Elk River, while Elk River (ER) and Gold Creek (GC) study areas are located downstream of the Elk River confluence. Assuming all mercury is present as methyl-mercury (CCME 2000). The BC guideline for the protection of wildlife (0.033 µg/g ww) was converted to dry weight based on an average moisture content in fish muscle in Koocanusa Reservoir of approximately 80%. Non-detect values are presented as an open symbol.

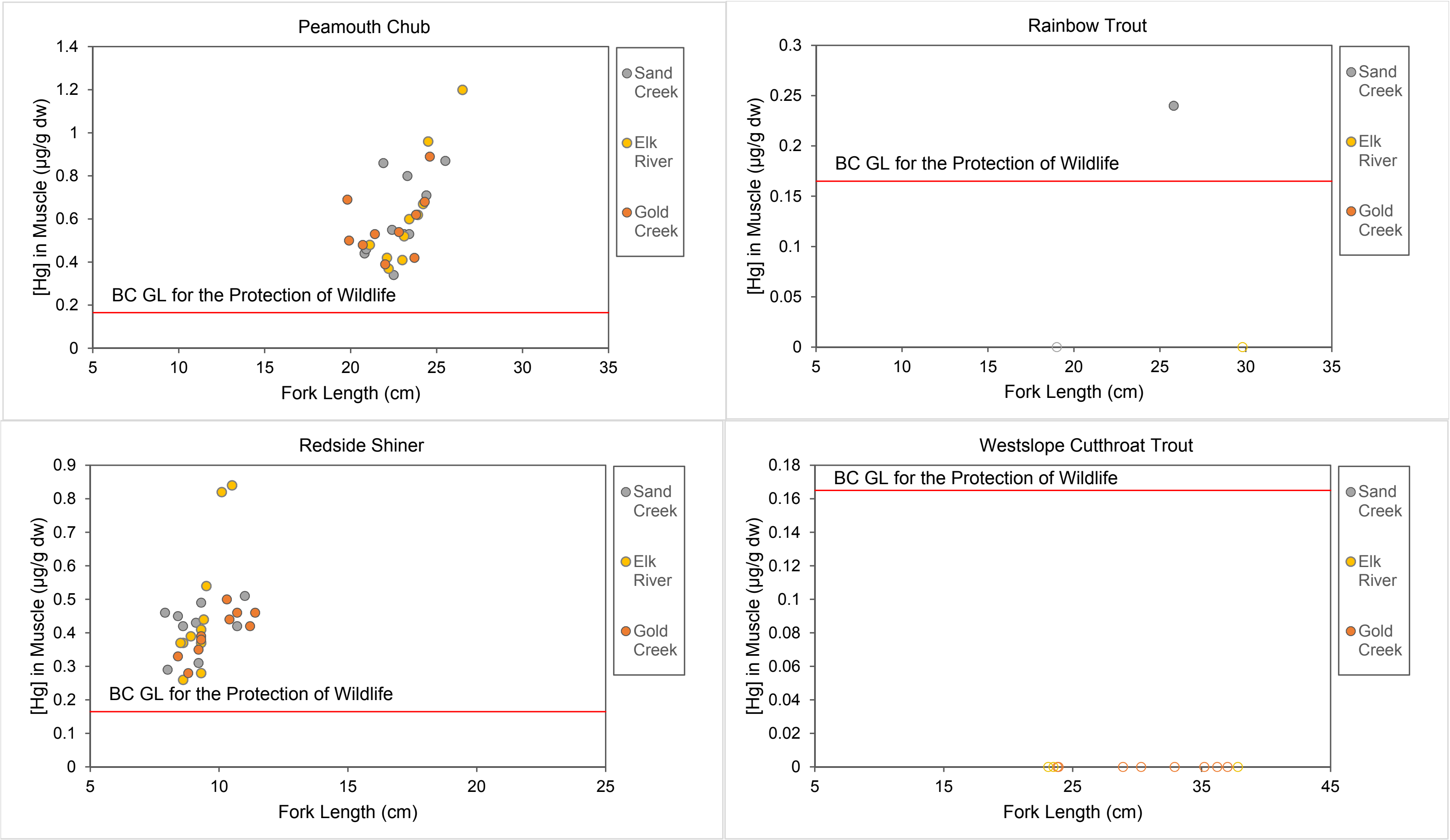

Figure 7.9: Mercury Concentrations (µg/g dw) in Fish Muscle Tissue Relative to Fork Length (cm) for all Species, Koocanusa Reservoir Monitoring Program, 2018

Notes: Sand Creek (SC) study area is located upstream of the Elk River, while Elk River (ER) and Gold Creek (GC) study areas are located downstream of the Elk River confluence. Assuming all mercury is present as methyl-mercury (CCME 2000). The BC guideline for the protection of wildlife (0.033 µg/g ww) was converted to dry weight based on an average moisture content in fish muscle in Koocanusa Reservoir of approximately 80%. Non-detect values are presented as an open symbol.

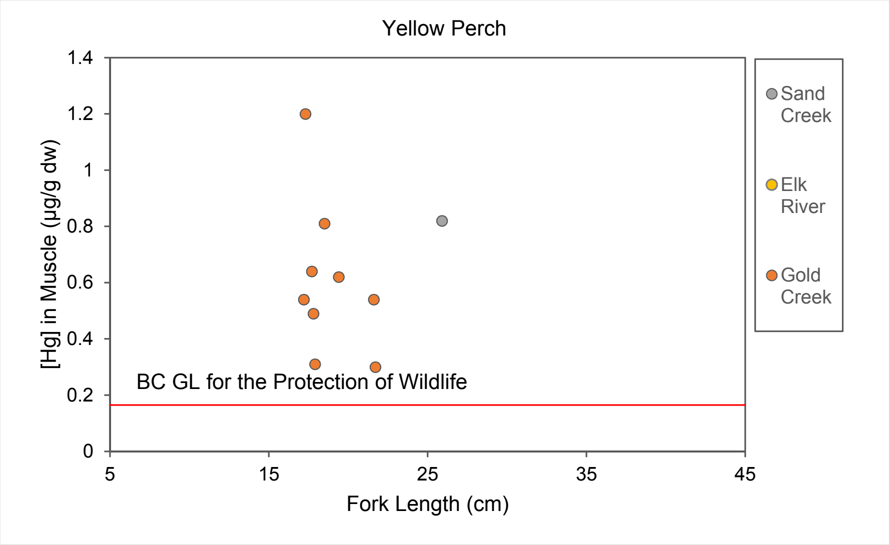

Figure 7.9: **Mercury Concentrations (µg/g dw) in Fish Muscle Tissue Relative to Fork Length (cm) for all Species, Koocanusa Reservoir Monitoring Program, 2018**

Notes: Sand Creek (SC) study area is located upstream of the Elk River, while Elk River (ER) and Gold Creek (GC) study areas are located downstream of the Elk River confluence. Assuming all mercury is present as methyl-mercury (CCME 2000). The BC guideline for the protection of wildlife (0.033 µg/g ww) was converted to dry weight based on an average moisture content in fish muscle in Koocanusa Reservoir of approximately 80%. Non-detect values are presented as an open symbol.

8 SUMMARY

In 2018, the Koocanusa Reservoir Monitoring Program was conducted to assess spatial and temporal changes in physico-chemical and biological conditions in Koocanusa Reservoir. In accordance with this monitoring program and conditions of ENV Permit 107517 (Section 10.8), this annual report provides an overview of the environmental monitoring activities conducted in the Canadian portion of Koocanusa Reservoir, together with a summary of the associated results for 2018. Principal findings from Koocanusa Reservoir monitoring in 2018 are summarized below.

Water Quality

Water quality data indicated that concentrations of the Order constituents dissolved cadmium, nitrate, total selenium, and sulphate, were below respective guidelines at all Koocanusa Reservoir permitted stations in 2018, including at Order Station RG_DSELK, except for selenium concentrations in April 2018. In April 2018, the monthly sample was taken from the shoreline (not from the permitted location) due to safety concerns and insufficient water depth of the reservoir. The average selenium concentration at this Order Station in April 2018 was 2.7 µg/L, which exceeded the permit limit of 2 µg/L. Of the remaining water quality constituents analyzed, total zinc concentrations were above BC water quality guidelines in April and May. These exceedances were also observed upstream of the Elk River confluence, and as such, do not appear to be mining related. Assessment of water quality-based productivity indicators showed that the reservoir is generally oligotrophic to mesotrophic, with short periods of eutrophication occurring in the spring (April to June), and that phosphorus was continually limiting in 2018. Water chemistry and productivity indicators at individual Koocanusa Reservoir monitoring stations in 2018 were within respective ranges observed during previous years of monitoring, suggesting no substantial changes since 2014.

Assessment of Elk River mixing in Koocanusa Reservoir indicated that under low pool and riverine conditions present in April 2018, flow from the Elk River was confined to the eastern half of the reservoir (channel) until becoming substantially mixed approximately 4 to 5 km downstream of the Elk River confluence. Under intermediate to full pool conditions in June and August, Elk River flow appeared mainly confined to the lower third of the water column across the entire width of the reservoir with substantial mixing not occurring within approximately 14 to 15 km downstream of the Elk River.

Sediment Quality

Concentrations of all metals and polycyclic aromatic hydrocarbons (PAHs) in sediment at all profundal and littoral stations located downstream and upstream of the Elk River were well below applicable provincial severe effects level (SEL) sediment quality guidelines. Sediment collected at both profundal and littoral stations located downstream of the Elk River showed elevated concentrations of several metals and PAHs compared to respective profundal and littoral stations located upstream of the Elk River. Of the elevated parameters, concentrations of cadmium, 2 methylnaphthalene, and phenanthrene were elevated above applicable lowest effect level (LEL) sediment quality guidelines only downstream of the Elk River. Arsenic, iron, manganese, and nickel occurred at concentrations above applicable LEL sediment quality guidelines at profundal and/or littoral stations upstream and downstream of the Elk River. Sediment chemistry at Koocanusa Reservoir downstream and upstream areas in 2018 showed parameter concentrations that were generally within respective ranges observed during previous years of monitoring, suggesting no substantial changes since 2013.

Selenium concentrations in particulate material filtered from reservoir water at Station RG_DSELK, and at Montana stations (International Boundary, Tenmile Creek, and Forebay) in 2018 were above the applicable sediment quality guideline for selenium. Selenium concentrations in particulate material were higher at RG_DSELK than at stations in the Montana portion of the reservoir in July and September 2018.

Plankton Community and Tissue Chemistry

Plankton community data showed no significant differences in phytoplankton or zooplankton total density, total richness, or total biomass between areas located downstream and upstream of the Elk River in August 2018. Phytoplankton and zooplankton community metrics at the Koocanusa Reservoir downstream and upstream areas in late-summer 2018, were within respective ranges observed during previous years of monitoring, suggesting no changes since 2014. Zooplankton community total richness, total density, and total biomass were significantly higher downstream compared to upstream of the Elk River confluence in June 2018 suggesting potential seasonality differences in plankton community response between June and late summer.

Comparison of two zooplankton community sampling techniques was completed in 2018 between surficial (top 10 m) and entire water column samples collected in late summer (August and September, respectively). The surface (top 10 m) community results indicated lower zooplankton richness, but higher total density and total biomass (as well as community composition differences) suggesting that sampling methodology is an important consideration in comparing data between the Canadian and Montana portions of the reservoir.

Selenium concentrations in zooplankton tissue were significantly higher downstream compared to upstream of the Elk River in June and September 2018. The concentrations of selenium in zooplankton tissue were above the applicable BC interim chronic dietary guideline for invertebrate tissues, but below the EVWQP Level 1 benchmarks at both the downstream and upstream areas in September 2018. Zooplankton tissue selenium concentrations within the Montana portion of the reservoir for 2017 and 2018 were lower than observed for both areas in the Canadian portion of the reservoir. With the exception of the mean tissue selenium concentration from International Boundary in October 2018, all data from Montana were below the BC chronic interim guideline and EVWQP benchmarks. In general, zooplankton tissue selenium concentrations observed at areas within the Canadian portion of the reservoir downstream and upstream areas of the Elk River in 2018 were similar to concentrations reported in previous years, suggesting no changes over time.

Benthic Invertebrate Community and Tissue Chemistry

Benthic invertebrate community data indicated significantly lower richness, total density of nematodes, and total and relative density of Ostracoda downstream compared to upstream of the Elk River in August 2018. Benthic invertebrate tissue selenium concentrations were higher downstream relative to upstream in April, but similar between these areas in August. Benthic invertebrate tissue selenium concentrations were above the interim BCMOE selenium guideline of 4 µg/g dw at profundal areas both upstream and downstream of the Elk River in 2018. Mean tissue selenium concentrations were above the interim BCMOE selenium guideline as well, but below the EVWQP Level 1 benchmarks. Benthic invertebrate community metrics and tissue selenium concentrations at downstream and upstream areas in 2018 were within respective ranges observed since 2014.

Fish Health and Tissue Chemistry

Fish health assessment focused on peamouth chub and redside shiner because these species are abundant at all study areas, have relatively small home range size, and are not an important sport fish. Fish health endpoint comparisons for these species indicated no consistent differences and/or direction of differences between areas located downstream and upstream of the Elk River over the period from 2014 to 2018. Heavier relative liver weight was consistently shown in female redside shiner at the Elk River area, and in male redside shiner at the Gold Creek area, compared to the Sand Creek upstream area in 2016 and 2018. A greater proportion of YOY were observed in redside shiner populations downstream of the Elk River compared to upstream in 2018, which suggests no adverse influences on recruitment.

Selenium concentrations in peamouth chub, redside shiner, and northern pikeminnow muscle tissue were below applicable BC tissue guidelines and US EPA criterion at all study areas. Tissue selenium concentrations in peamouth chub muscle were higher at downstream areas, while those in redside shiner muscle were higher at the Gold Creek area, compared to the upstream area in the Canadian portion of the reservoir. Mean selenium concentrations in westslope cutthroat trout muscle tissue were above the BC tissue guidelines in samples collected from just north of the mouth, and at the mouth of, the Elk River, but all were lower than the US EPA criterion and

EVWQP Level 1 benchmark. Selenium concentrations in muscle tissue of sport fish and sucker species were generally similar downstream and upstream of the Elk River, and similar between the Canadian and Montana portions of the reservoir, in 2018. Selenium concentrations in muscle tissues collected from all fish species at the Koocanusa Reservoir downstream and upstream areas in 2018 were generally within respective ranges observed at the same respective study areas for each species during previous years of monitoring.

Selenium concentrations in ovaries of northern pikeminnow, peamouth, and redside shiners were above the BC guideline in all areas. Northern pikeminnow and redside shiners were above both the criteria and benchmark at the Elk River. Selenium concentrations in ovaries of peamouth chub and redside shiner at downstream areas of the Canadian portion of the reservoir were similar to, or lower than, concentrations observed in ovaries of these species at the area upstream of the Elk River in 2018. Selenium concentrations in ovary tissues collected from all fish species at the Koocanusa Reservoir downstream and upstream areas in 2018 were generally within respective ranges observed at the same respective study areas for each species during previous years of monitoring.

Similar to previous years, mercury concentrations in muscle tissue of peamouth chub, redside shiner, northern pikeminnow, and various sport fish (including bull trout, Kokanee, mountain whitefish, rainbow trout, and yellow perch) were above the BC guideline for protection of wildlife in 2018. However, similar mercury concentrations were indicated in muscle tissue of all of these fish species downstream compared to upstream of the Elk River, and investigations completed by Teck for water quality and human consumption indicate mercury it not a mine-related constituent (Teck 2018c).

9 REFERENCES

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APPENDIX A
WATER QUALITY

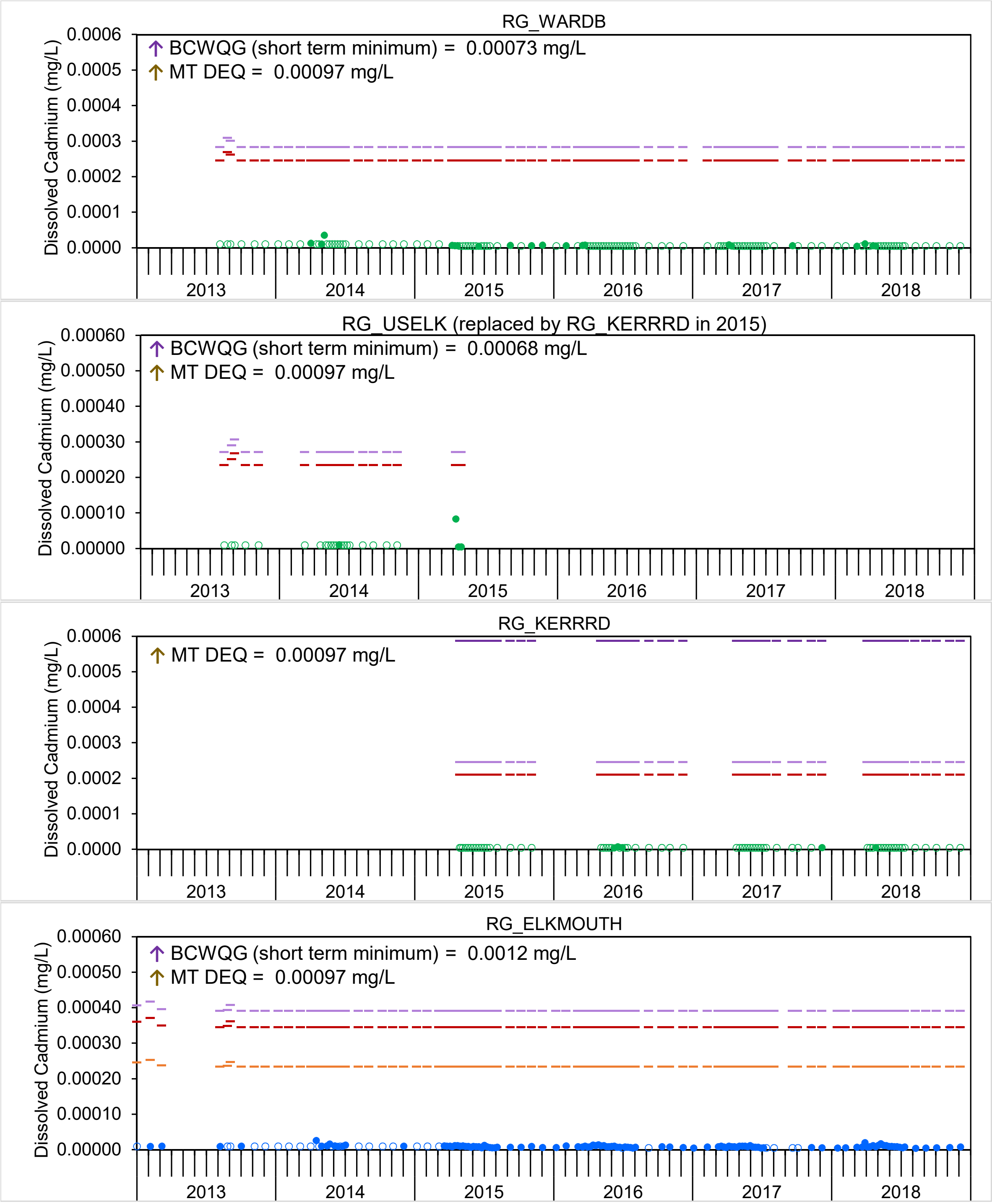


Figure A.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

- - = BCWQG (long term); - - = BCWQG (short term); - - = * EVWQP Level 1 Benchmark; - - = EPA WQG; - - = MT DEQ

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. * Elk Valley Water Quality Plan (Teck, 2014).

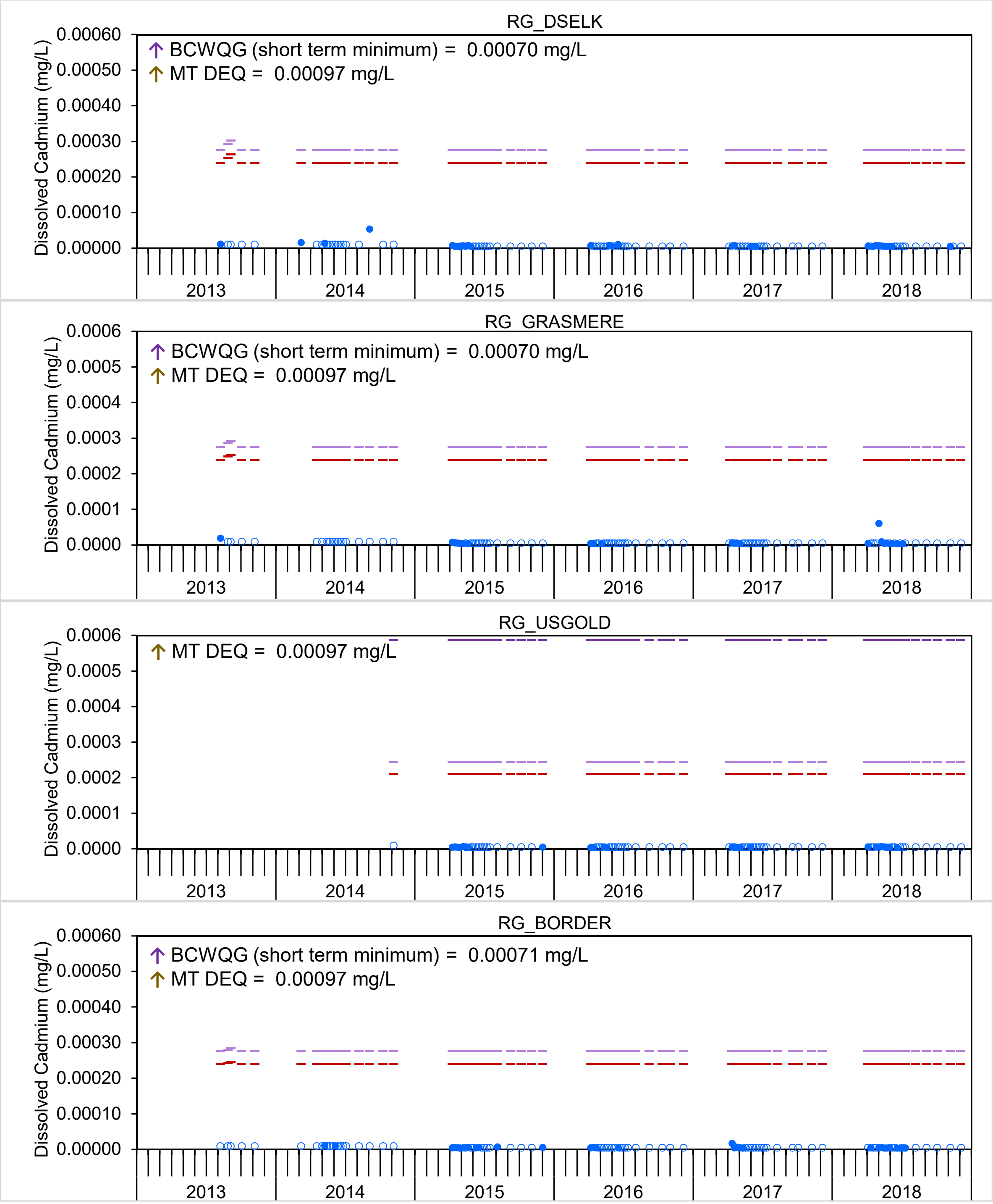


Figure A.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = EPA WQG; – – = MT DEQ

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

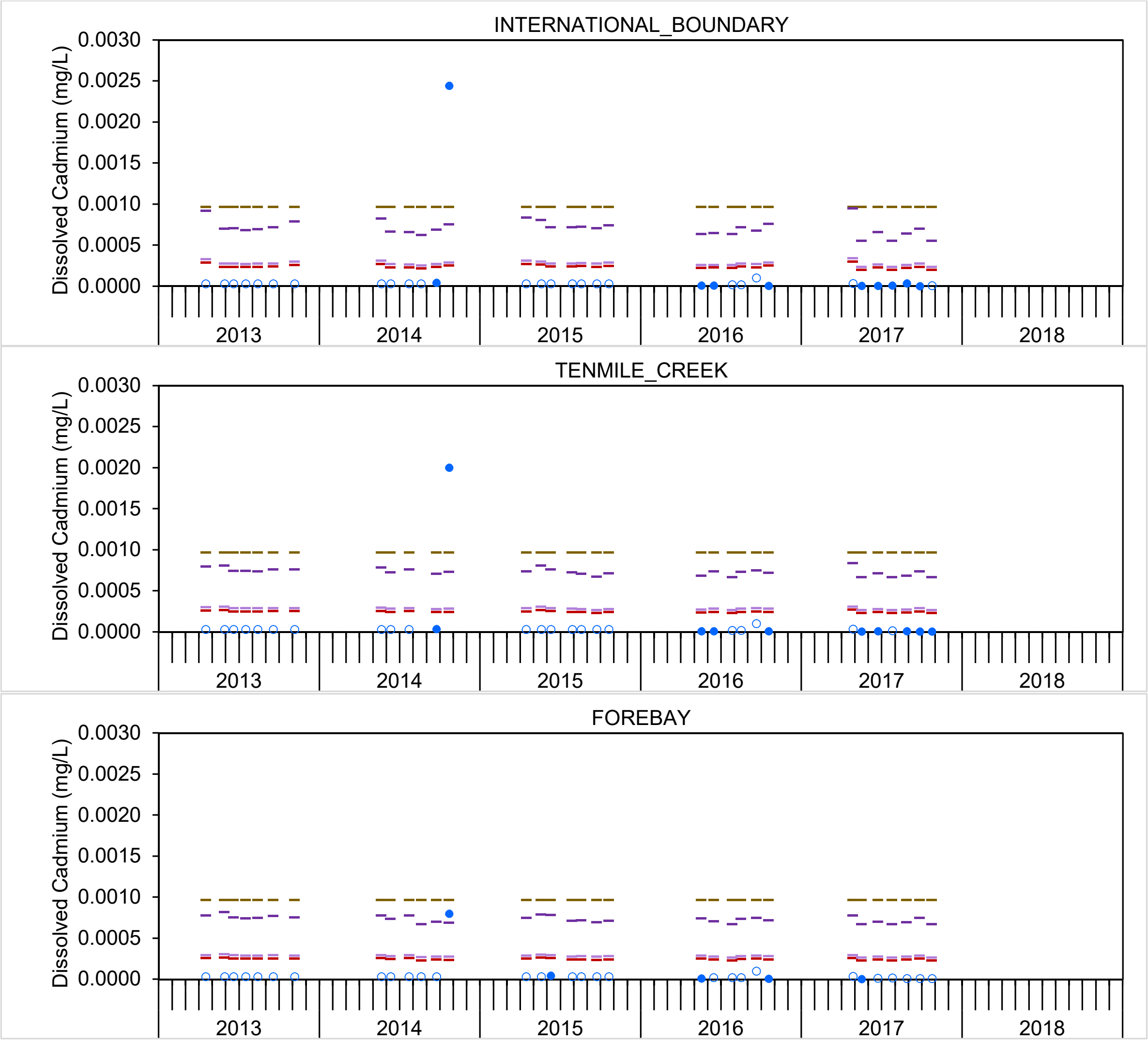


Figure A.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = EPA WQG; – – = MT DEQ

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

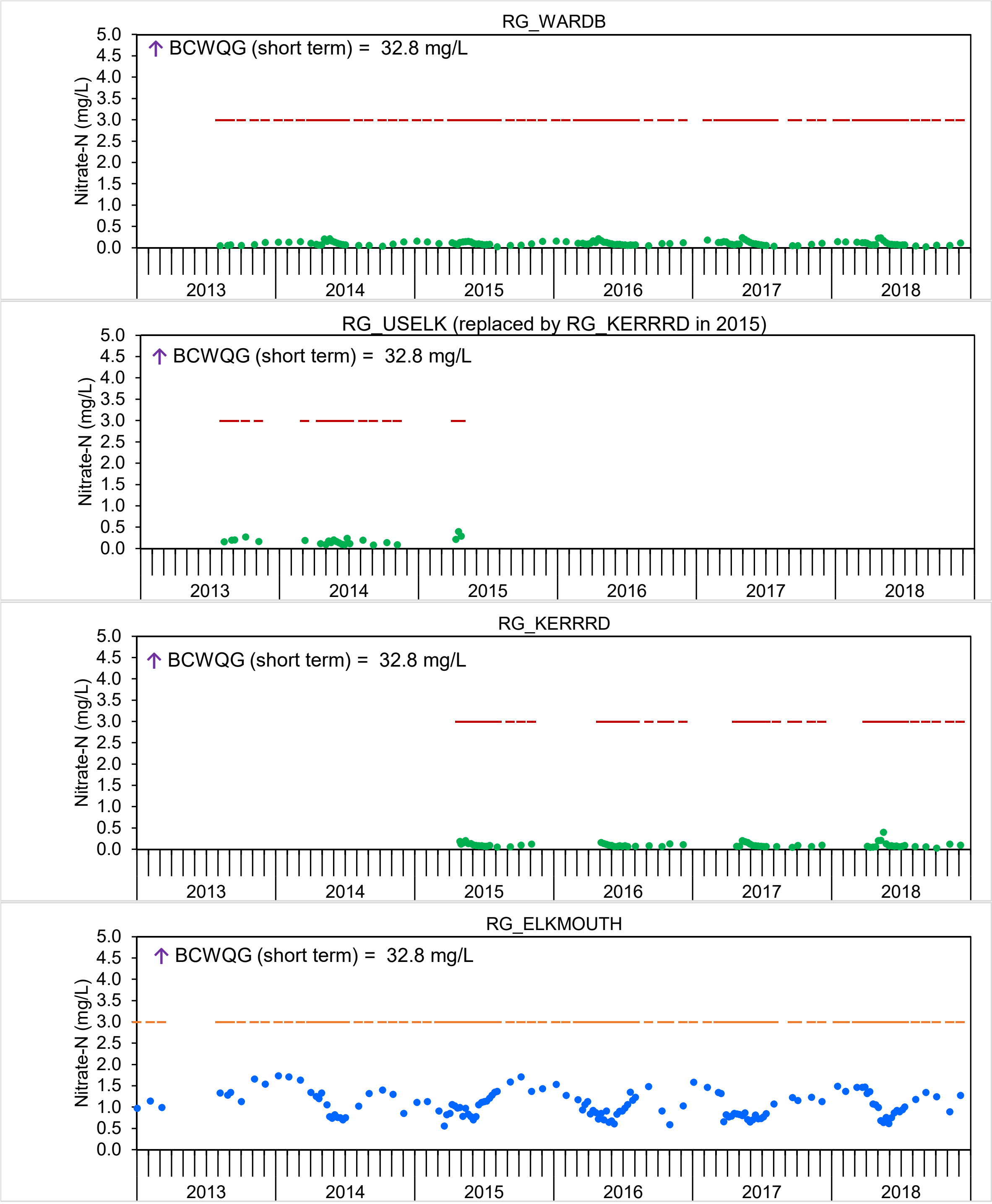


Figure A.2: Time Series Plots for Aqueous Nitrate-N Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

- - = BCWQG (long term); - - = BCWQG (short term); - - = * EVWQP Level 1 Benchmark.

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. * Elk Valley Water Quality Plan (Teck, 2014) and overlaps with BCWQGL (long term). No data for US stations.

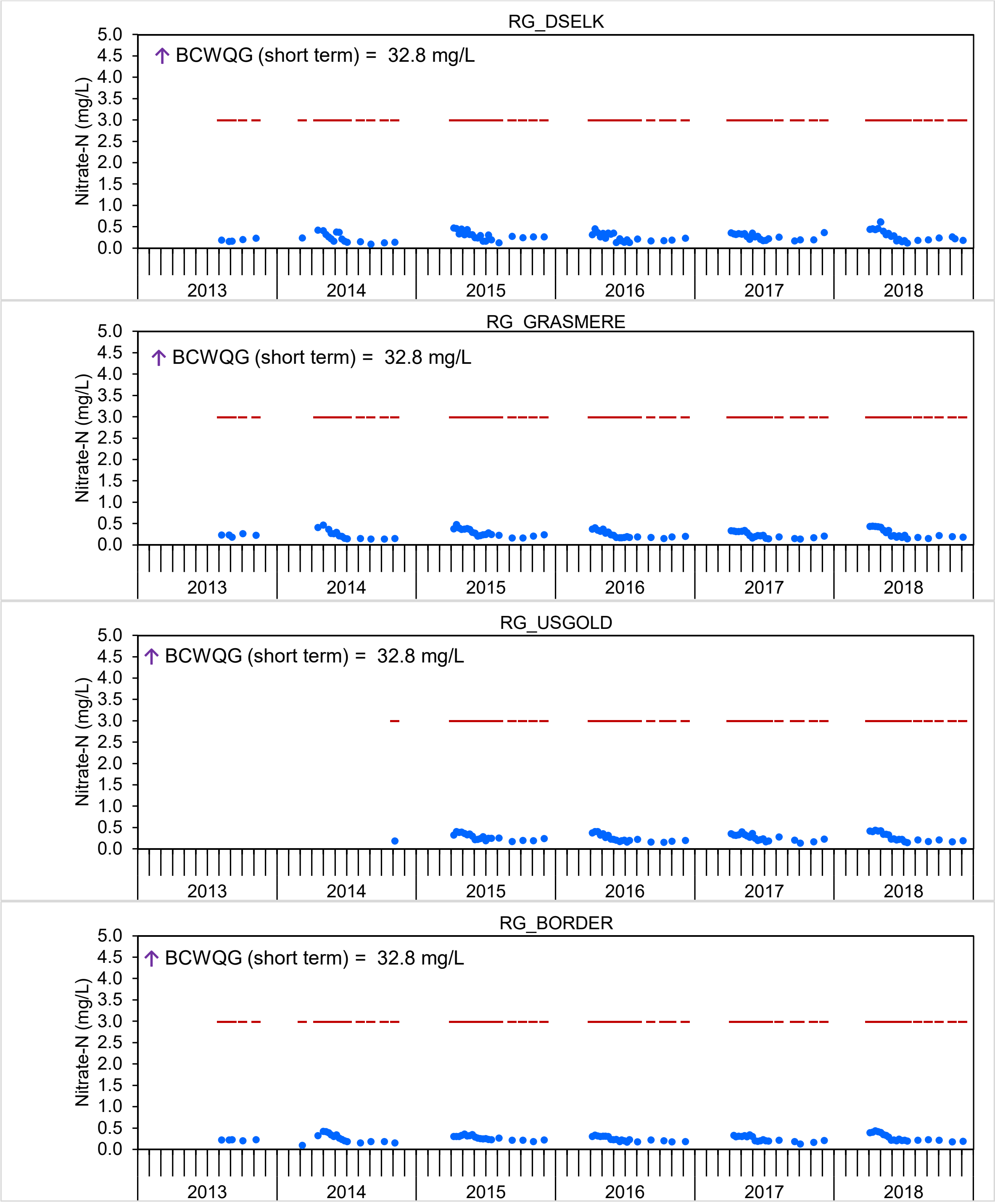


Figure A.2: Time Series Plots for Aqueous Nitrate-N Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

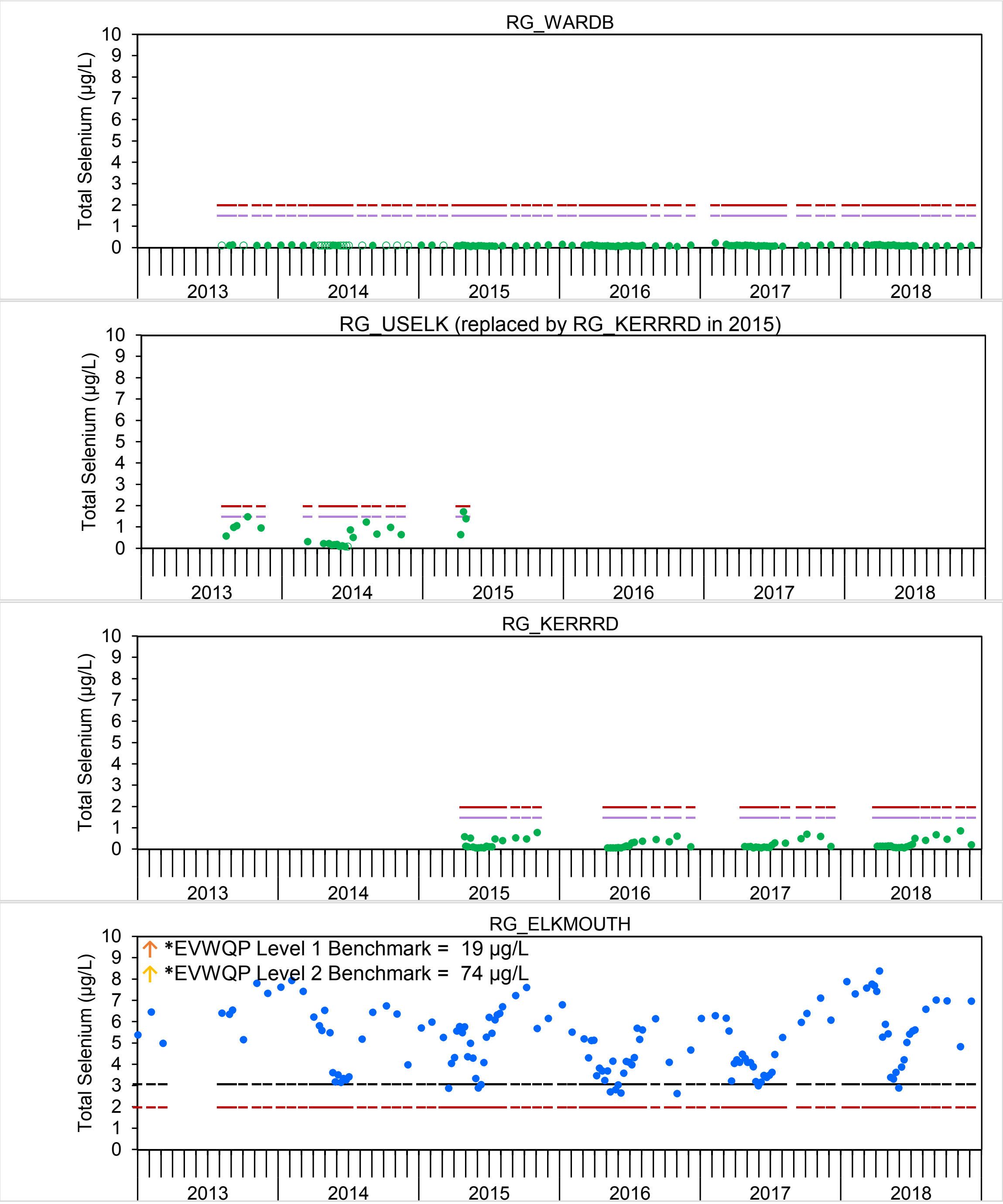


Figure A.3: Time Series Plots for Aqueous Total Selenium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = * EVWQP Level 1 Benchmark; – – = * EVWQP Level 2 Benchmark;

– – = EPA WQG River; – – = EPA WQG Lake.

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. * Elk Valley Water Quality Plan (Teck, 2014).

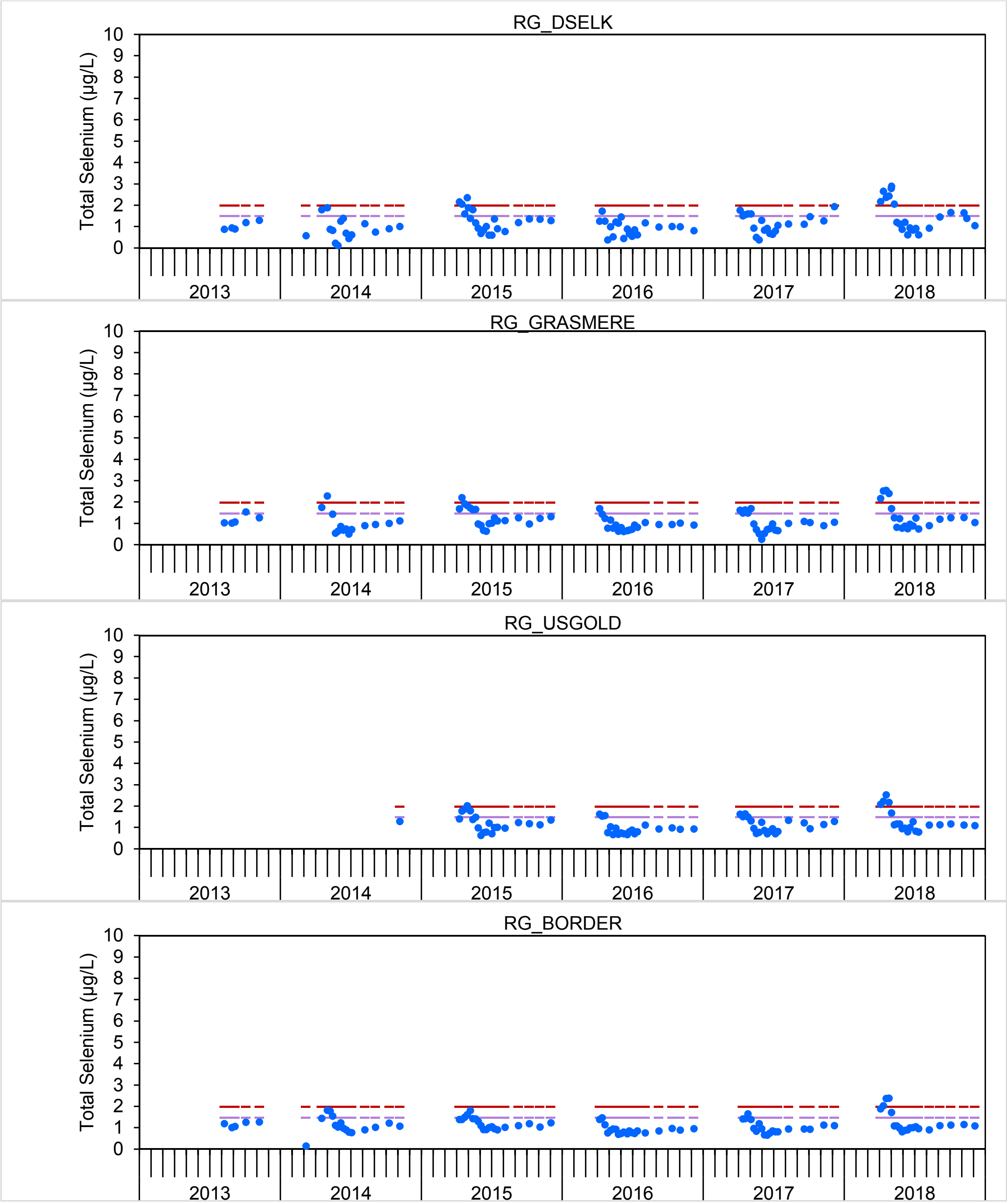


Figure A.3: Time Series Plots for Aqueous Total Selenium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = EPA WQG Lake

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

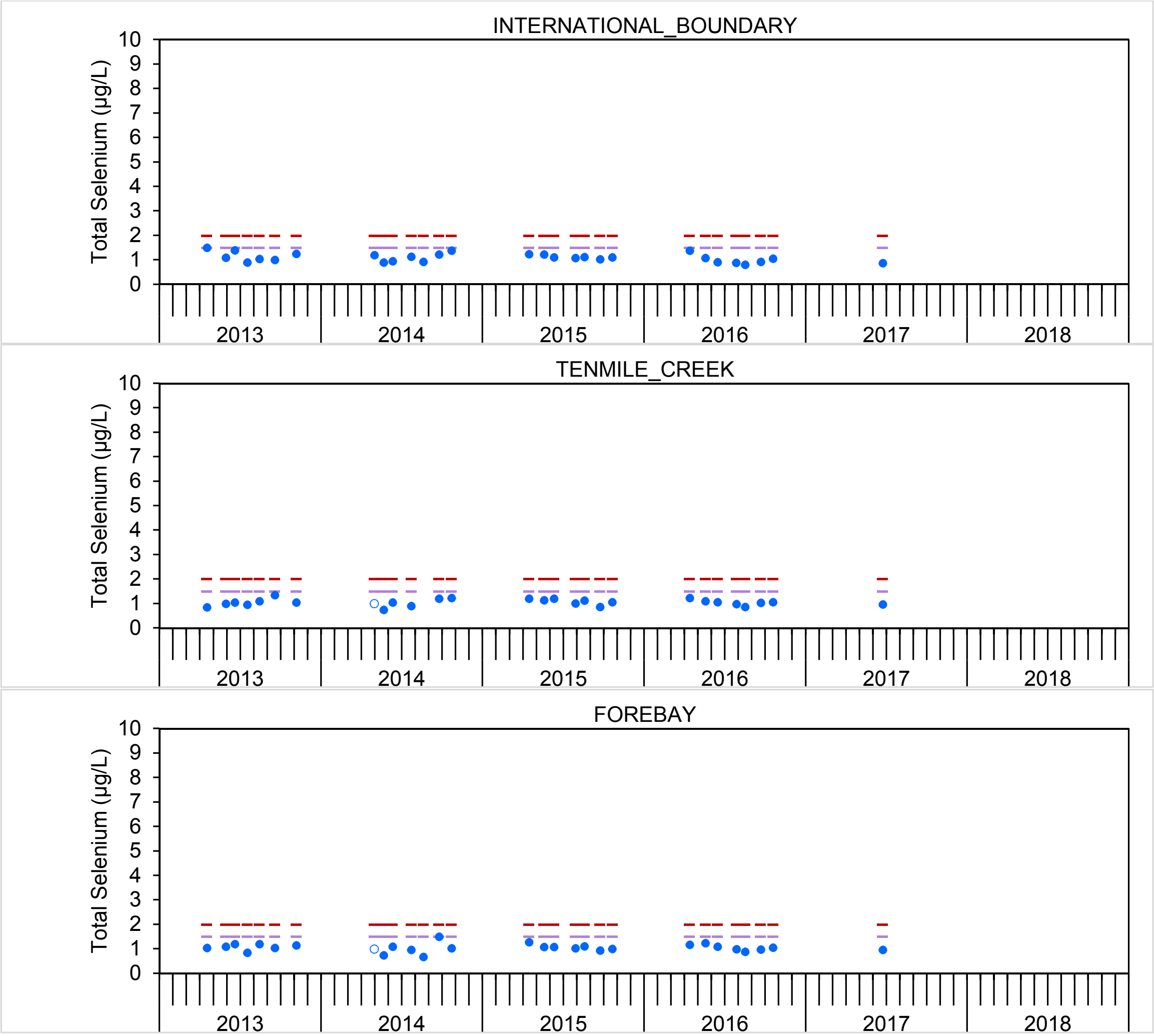


Figure A.3: **Time Series Plots for Aqueous Total Selenium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

– – = BCWQG (long term); – – = EPA WQG Lake
● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. * Elk Valley Water Quality Plan (Teck, 2014).

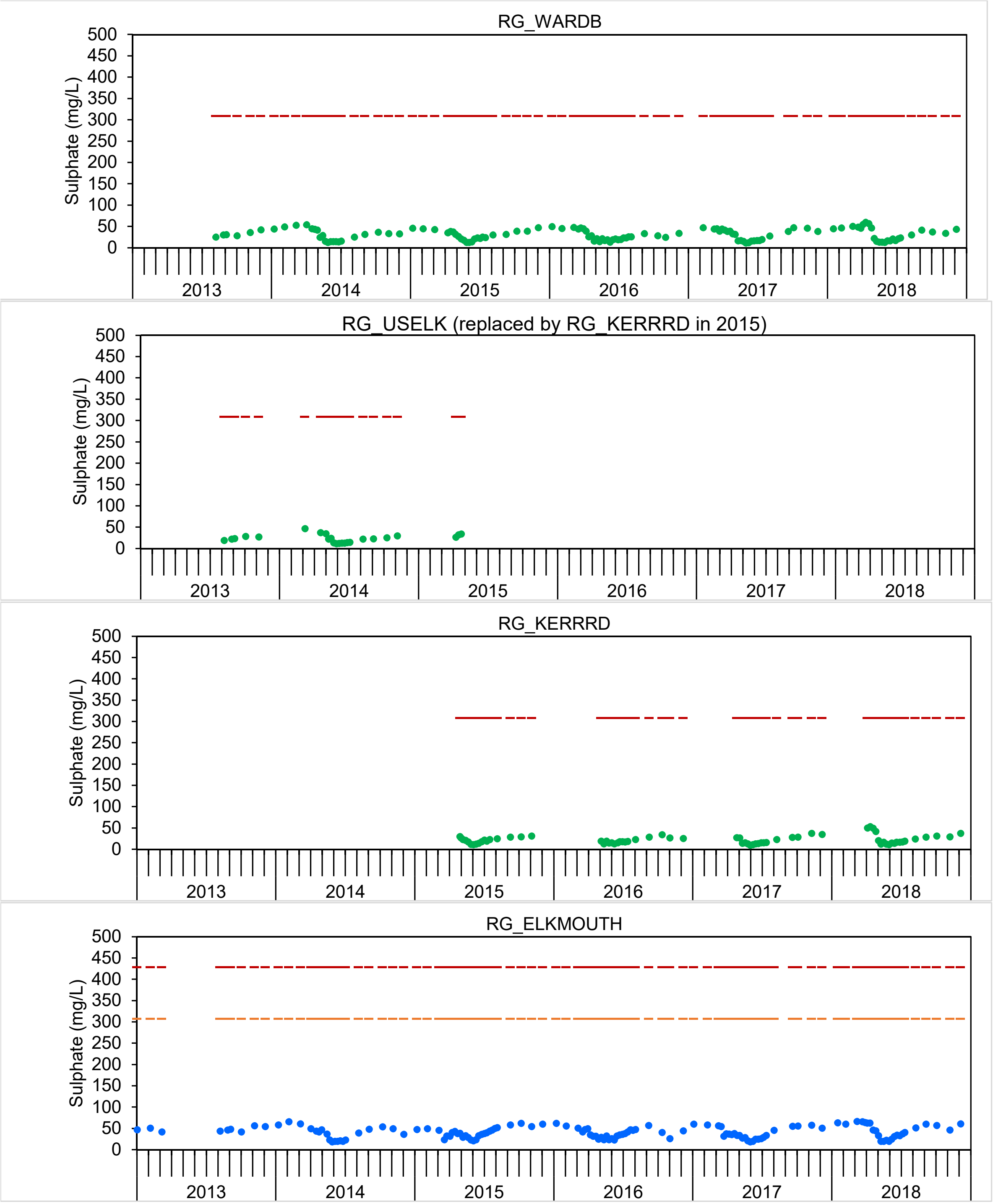
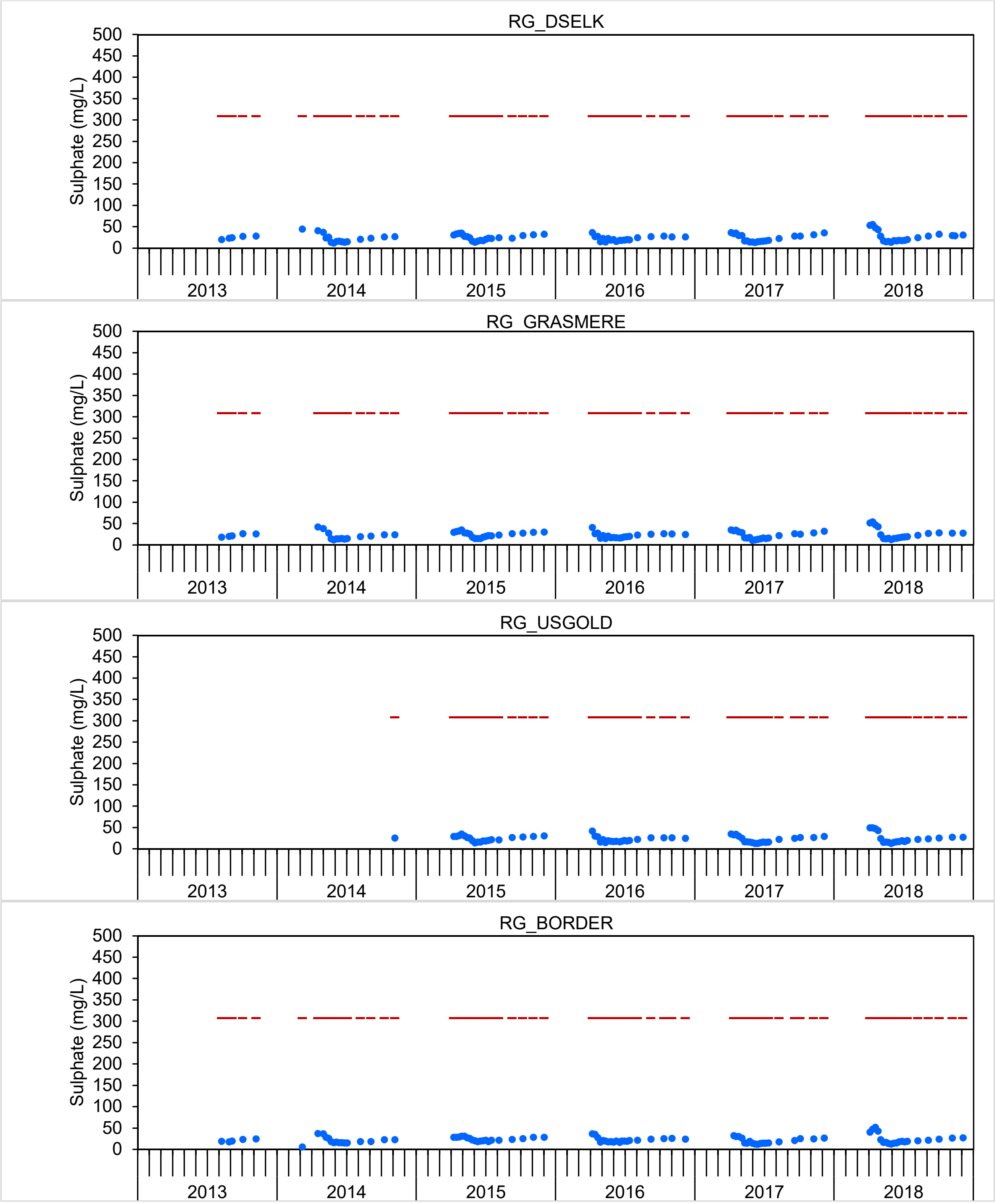


Figure A.4: Time Series Plots for Aqueous Sulphate Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = * EVWQP Level 1 Benchmark.

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. * Elk Valley Water Quality Plan (Teck, 2014).



RG_DSELK

RG_GRASMERE

RG_USGOLD

RG_BORDER

Figure A.4: Time Series Plots for Aqueous Sulphate Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

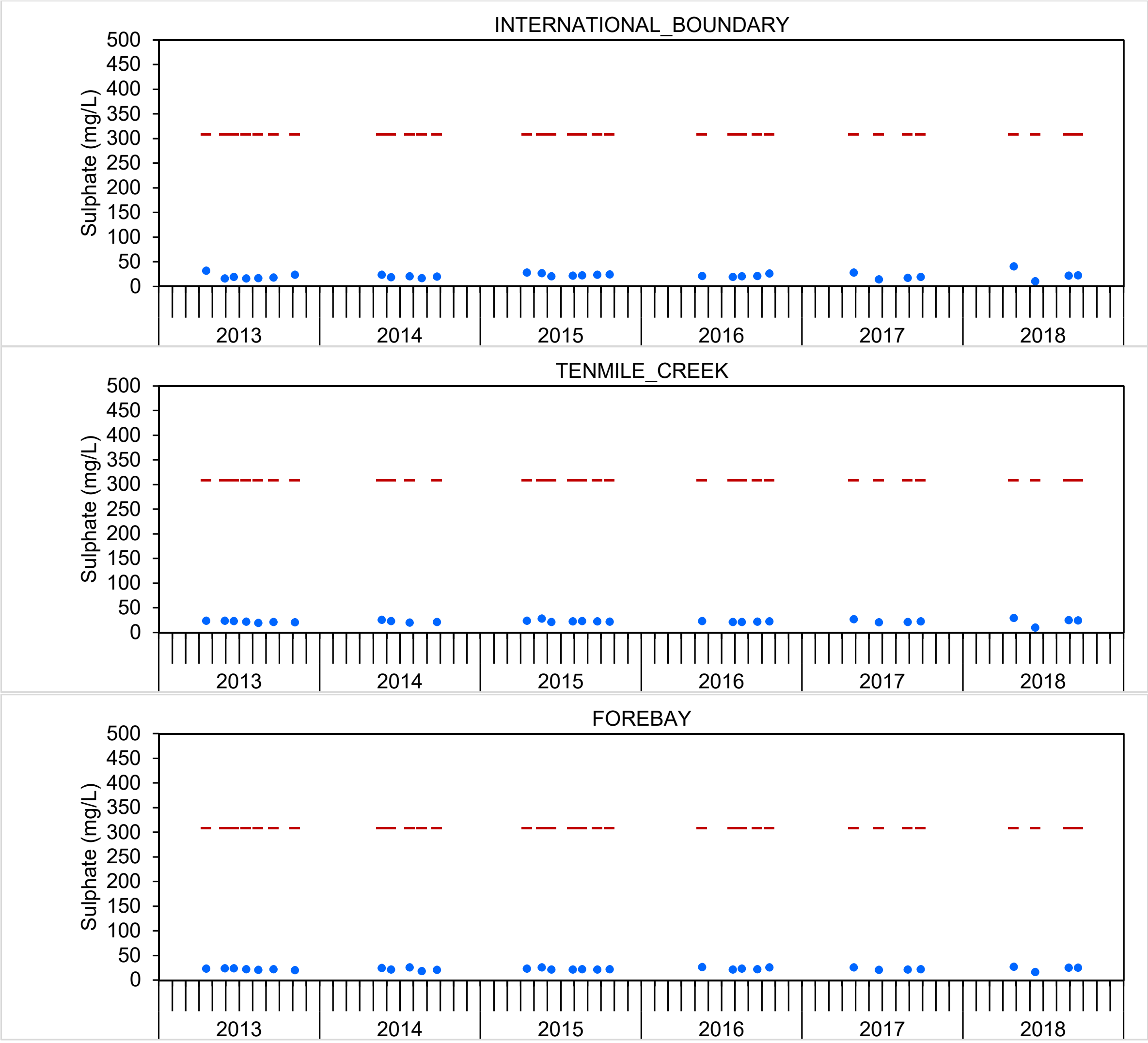


Figure A.4: **Time Series Plots for Aqueous Sulphate Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

– – = BCWQG (long term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

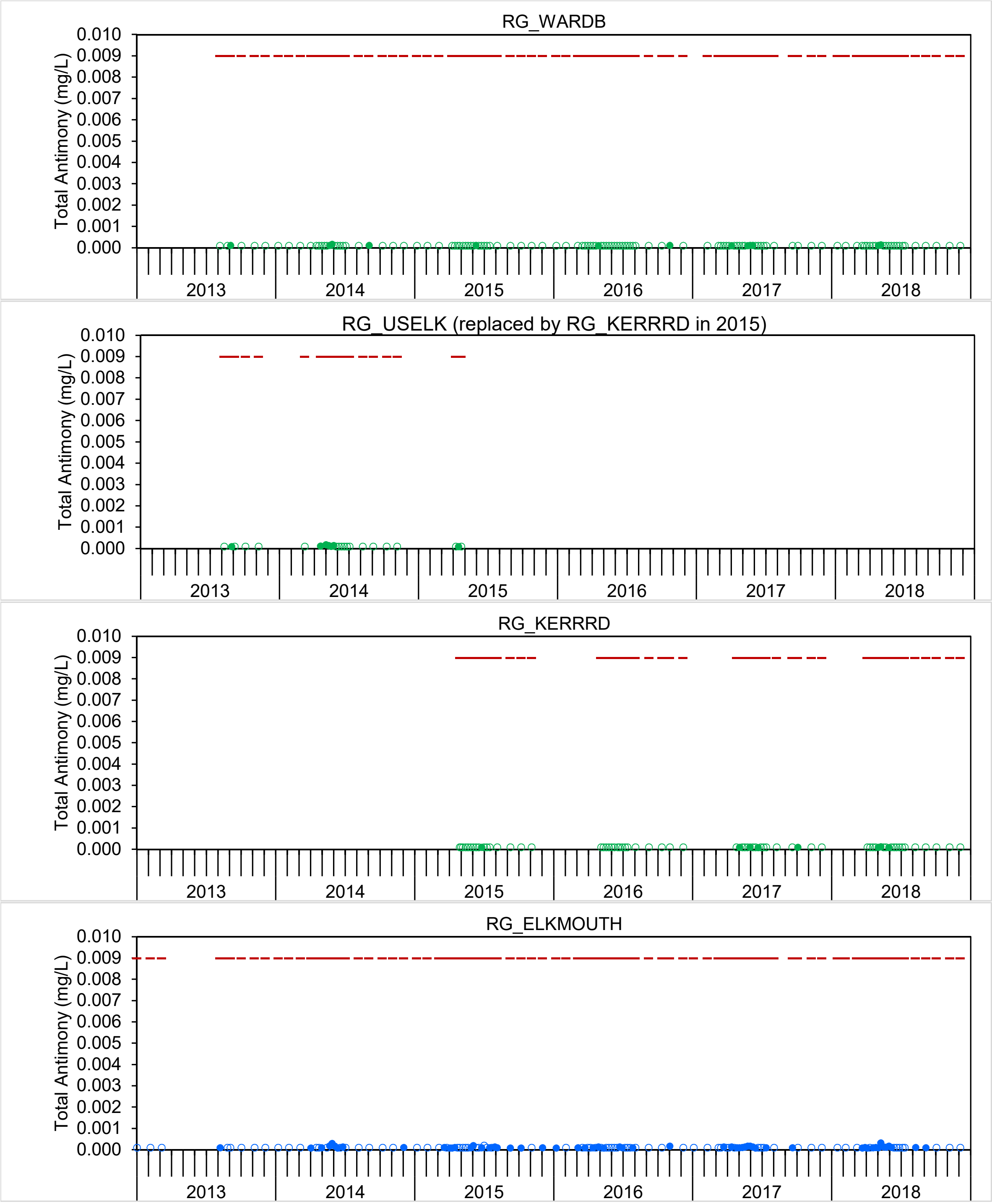


Figure A.5: Time Series Plots for Aqueous Total Antimony Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

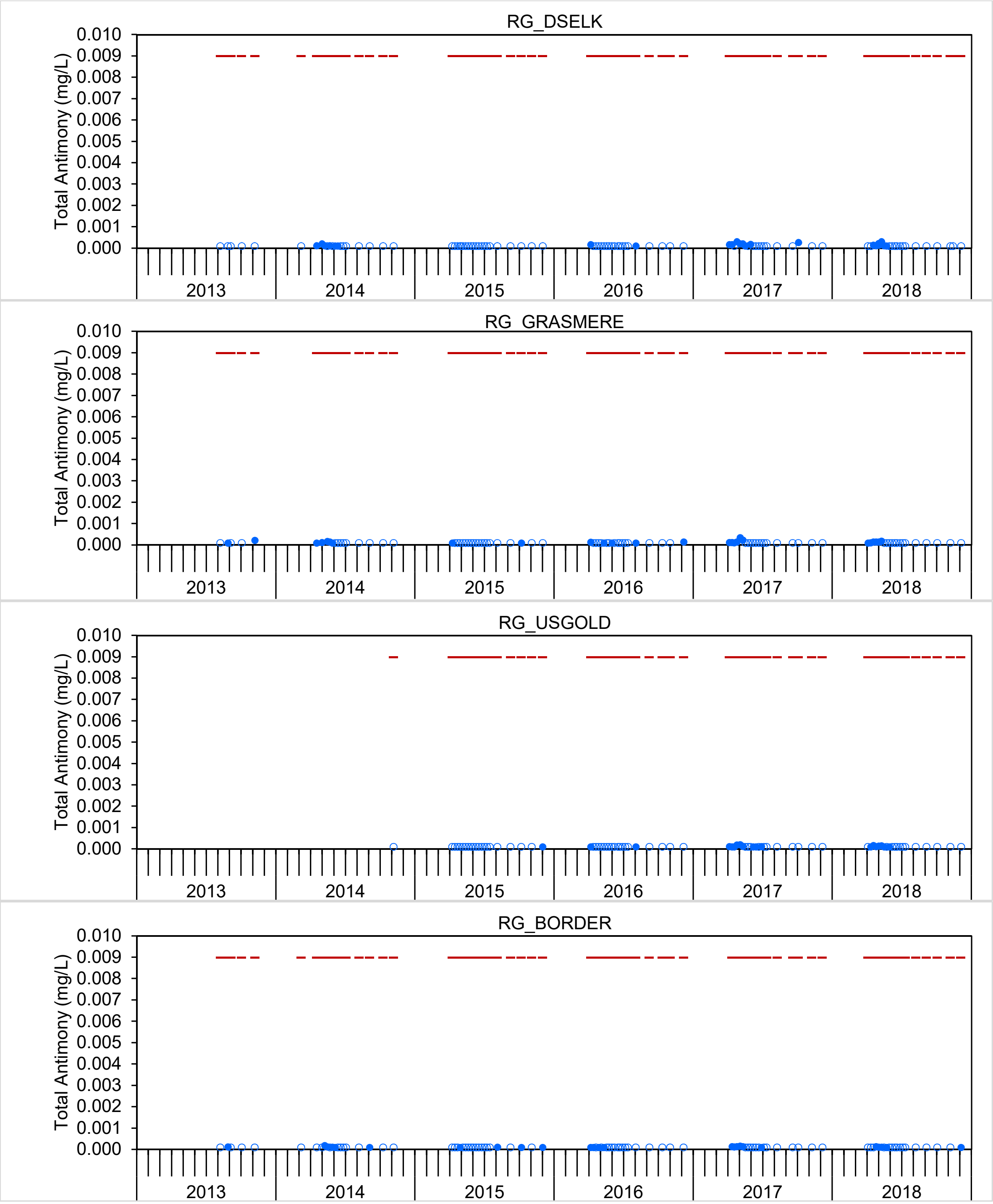


Figure A.5: Time Series Plots for Aqueous Total Antimony Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

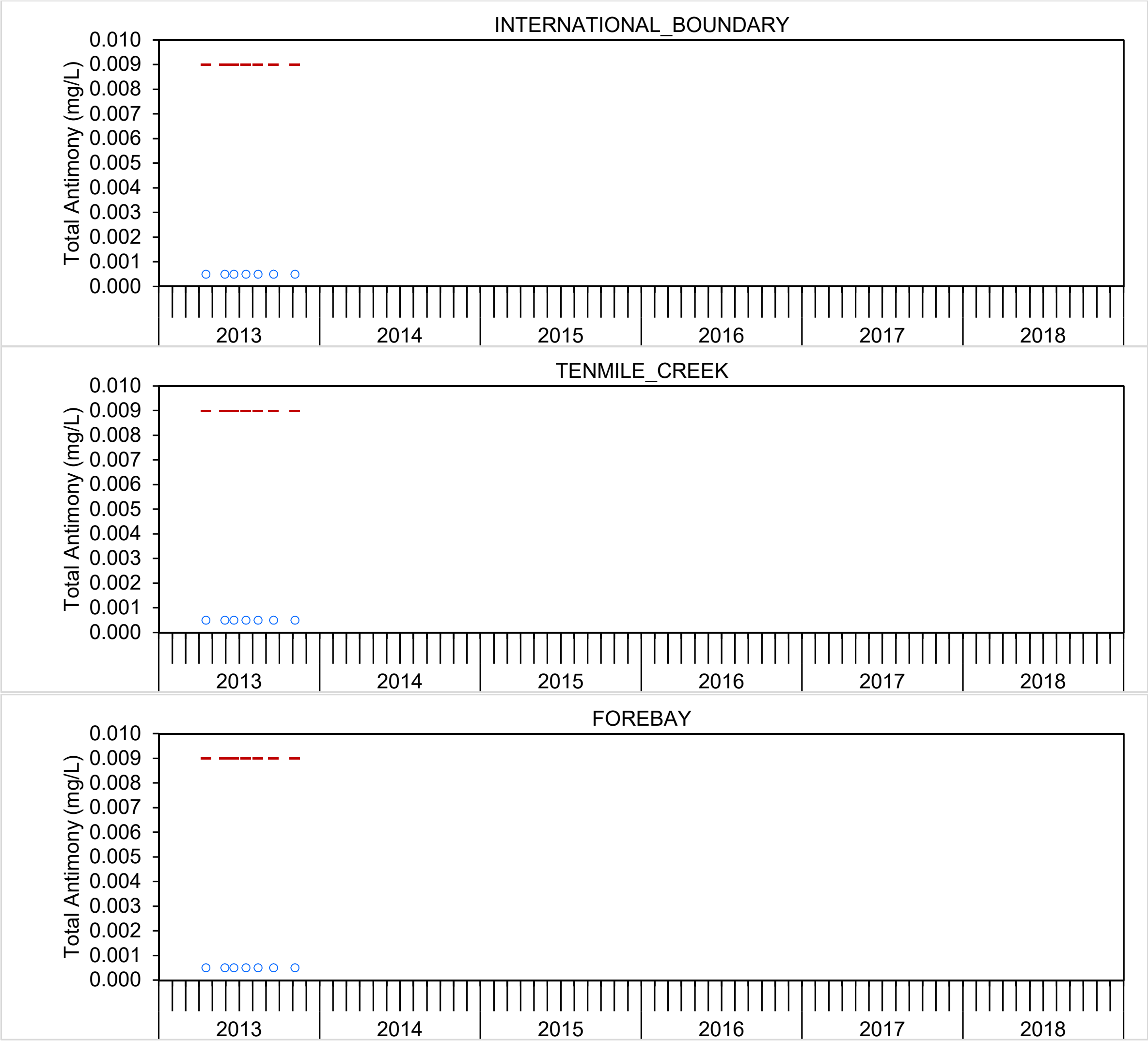


Figure A.5: Time Series Plots for Aqueous Total Antimony Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term).

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

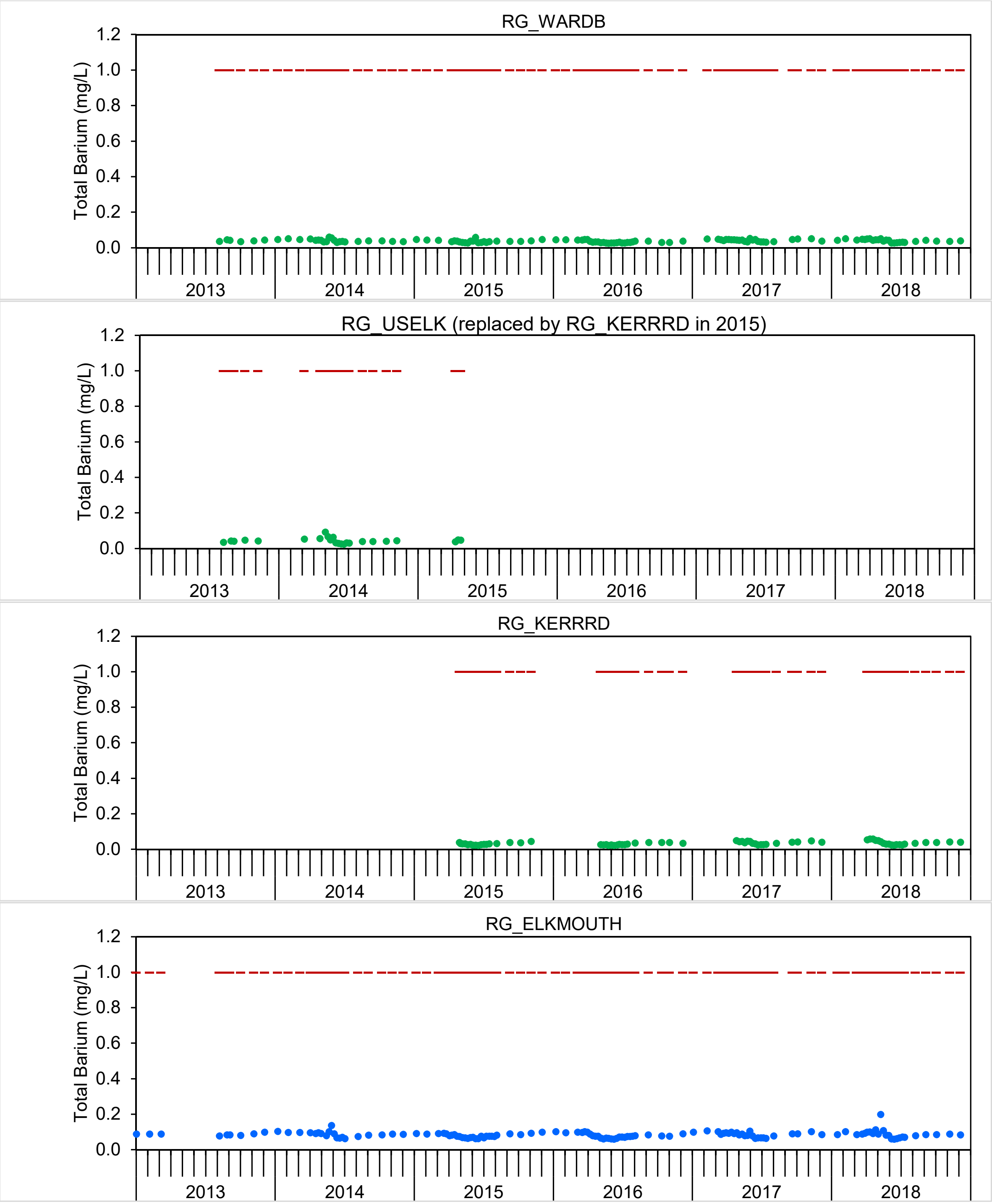


Figure A.6: Time Series Plots for Aqueous Total Barium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

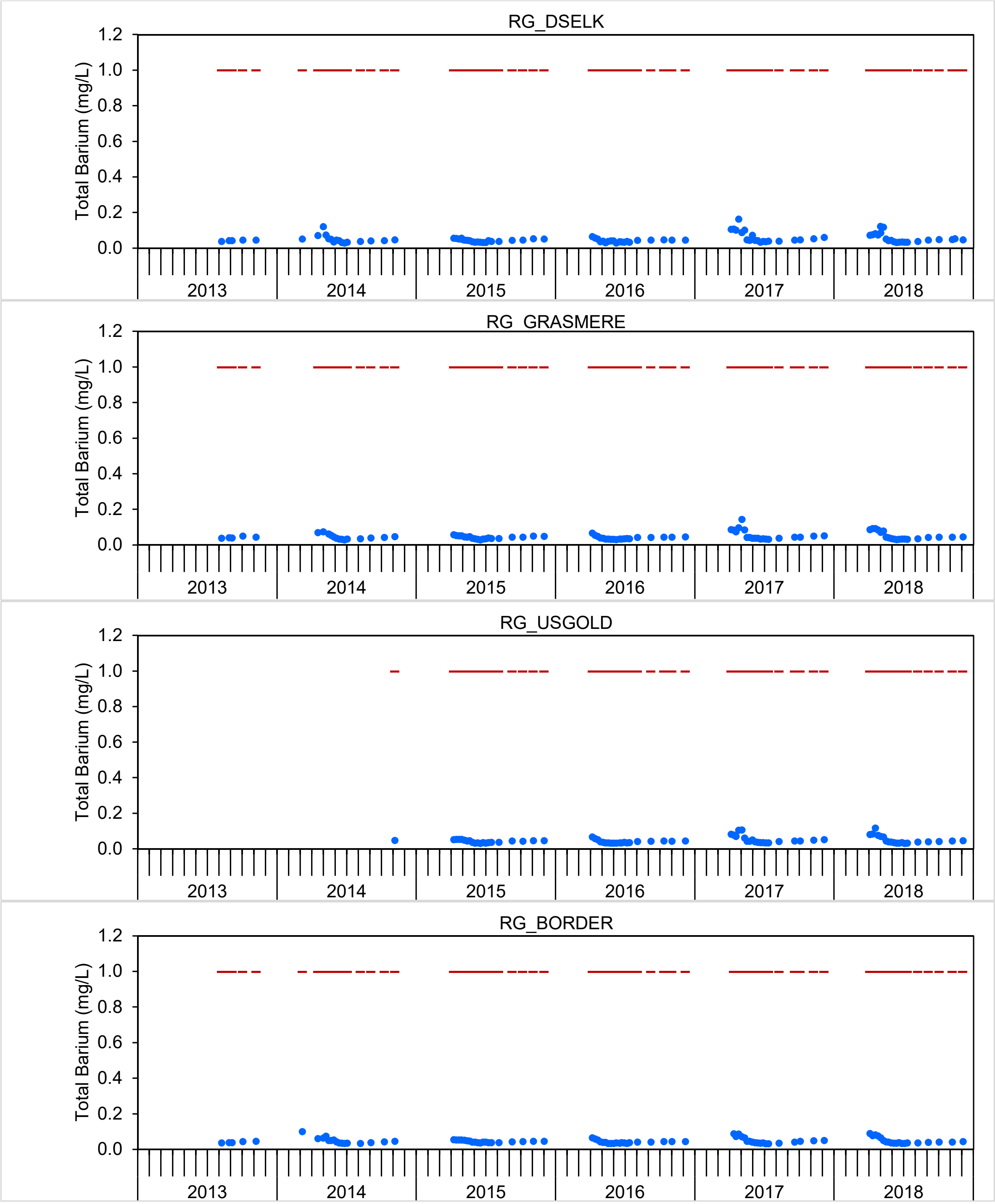


Figure A.6: Time Series Plots for Aqueous Total Barium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

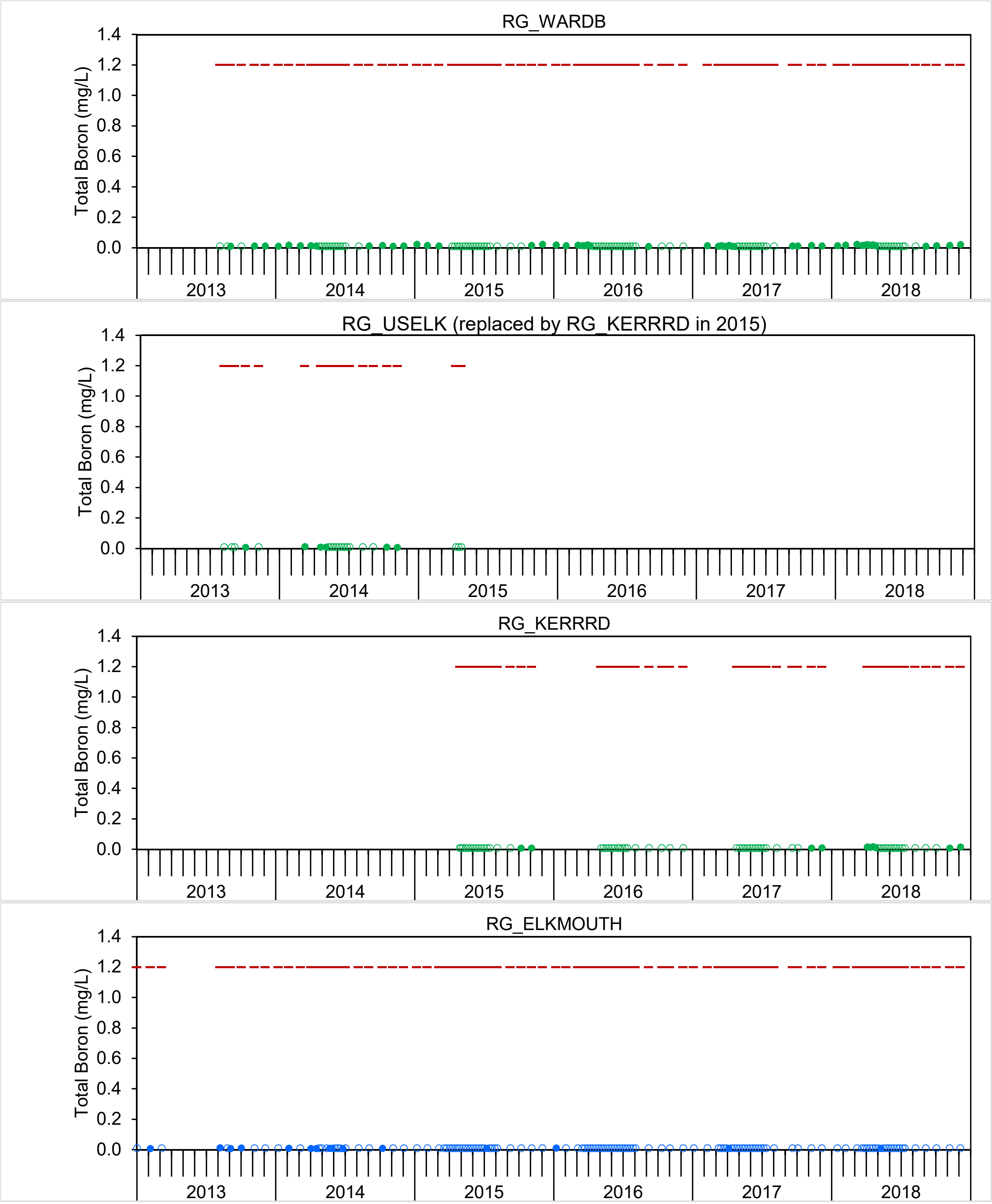


Figure A.7: Time Series Plots for Aqueous Total Boron Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

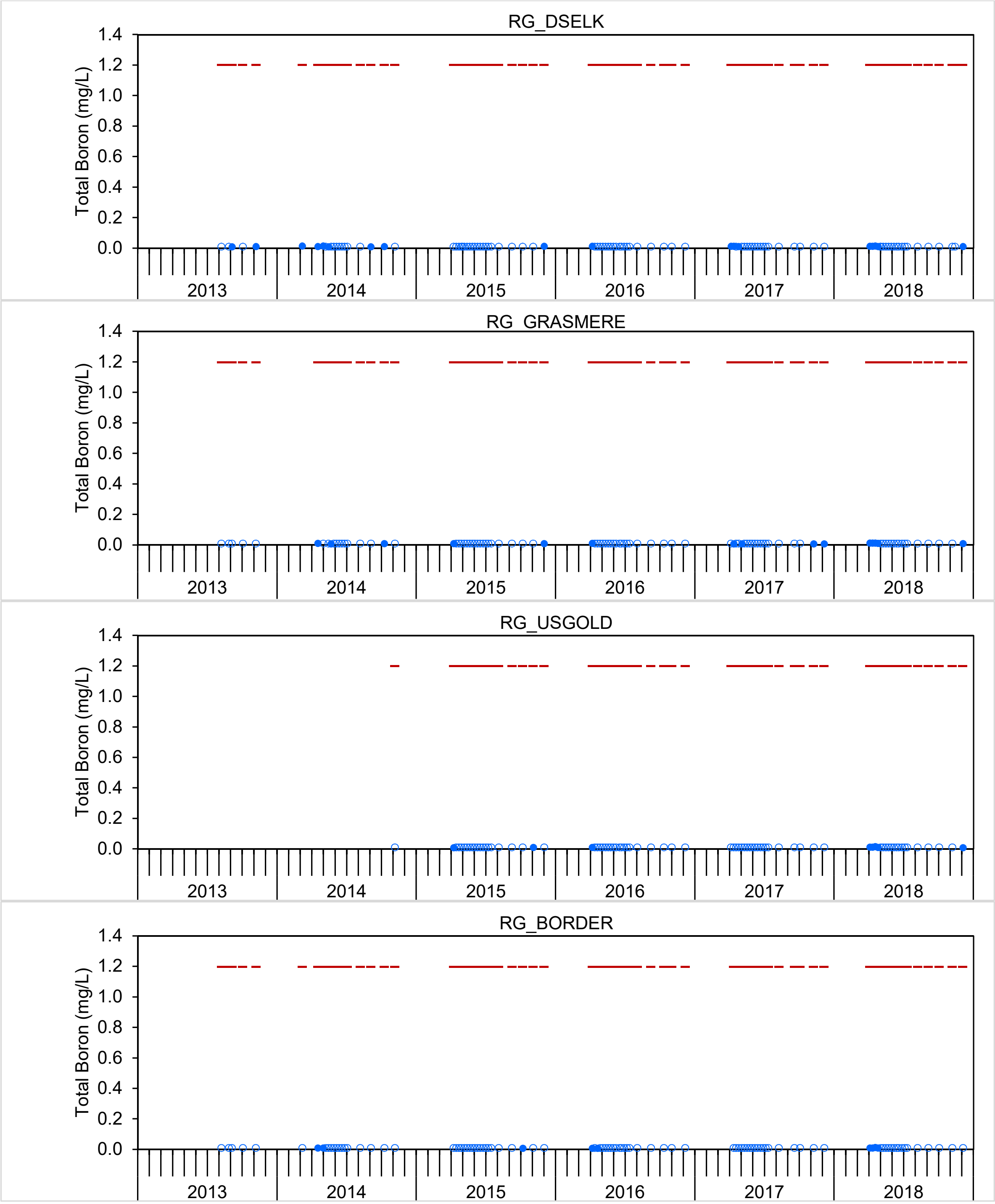


Figure A.7: Time Series Plots for Aqueous Total Boron Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

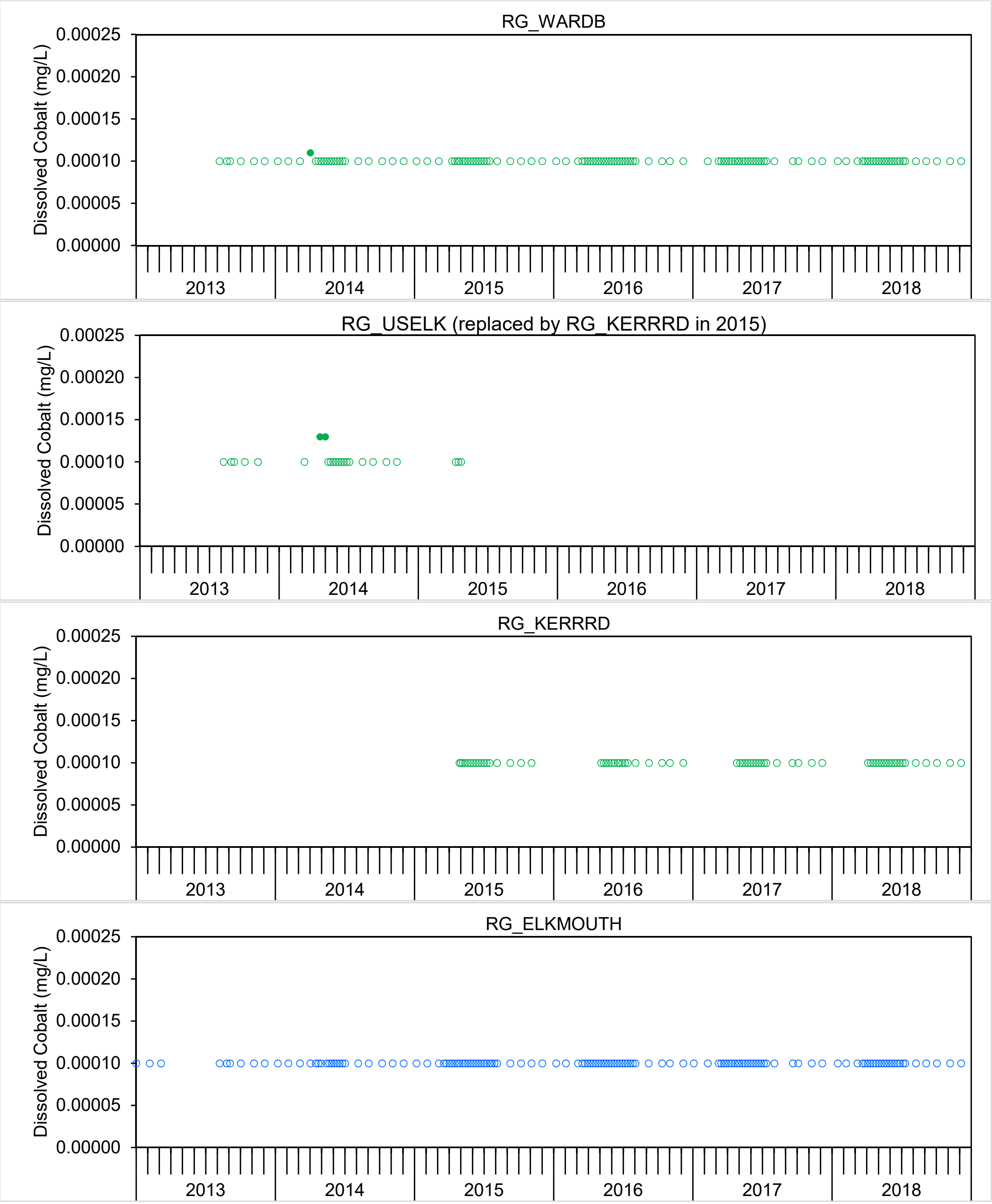


Figure A.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

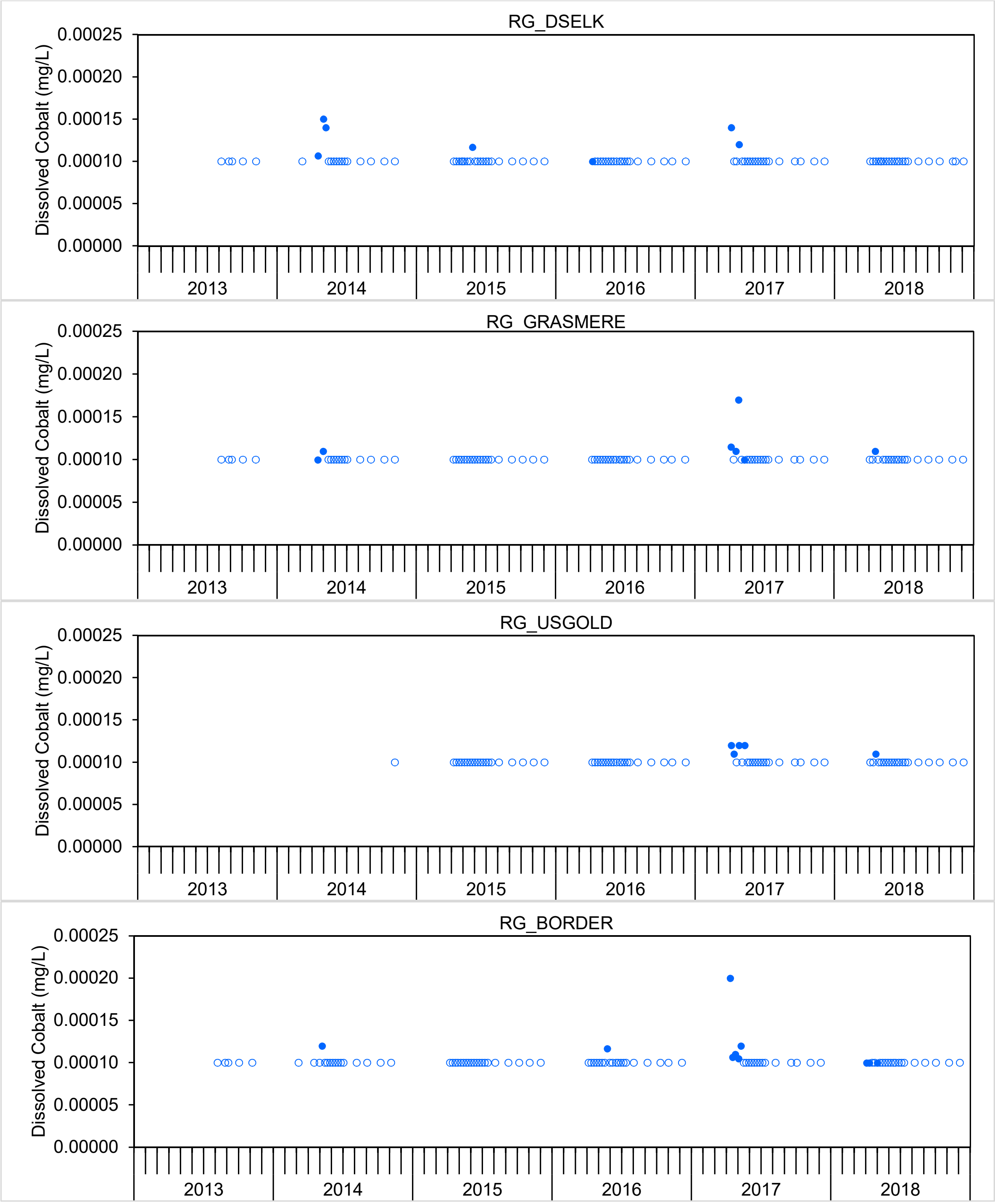


Figure A.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

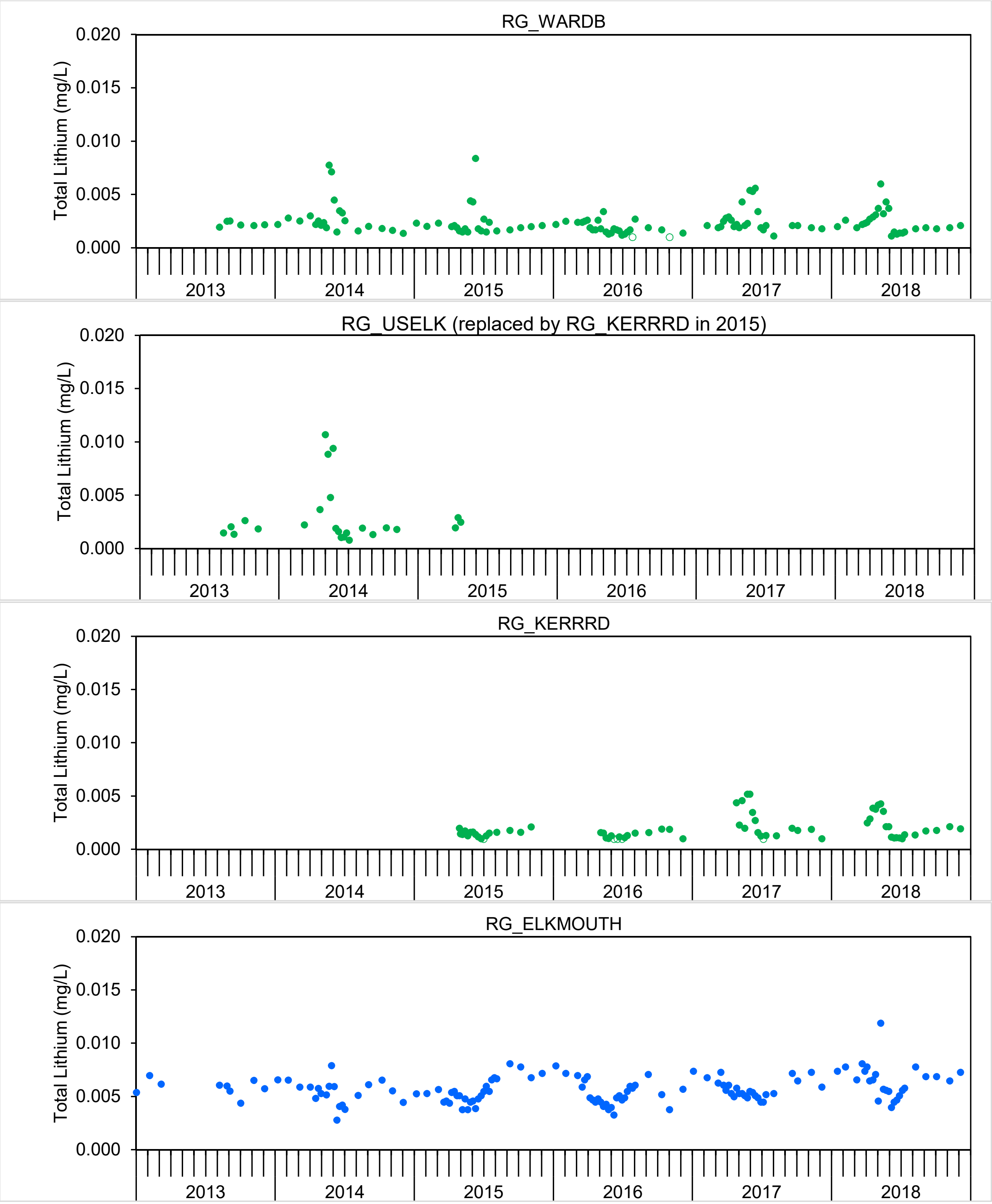


Figure A.9: Time Series Plots for Aqueous Total Lithium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

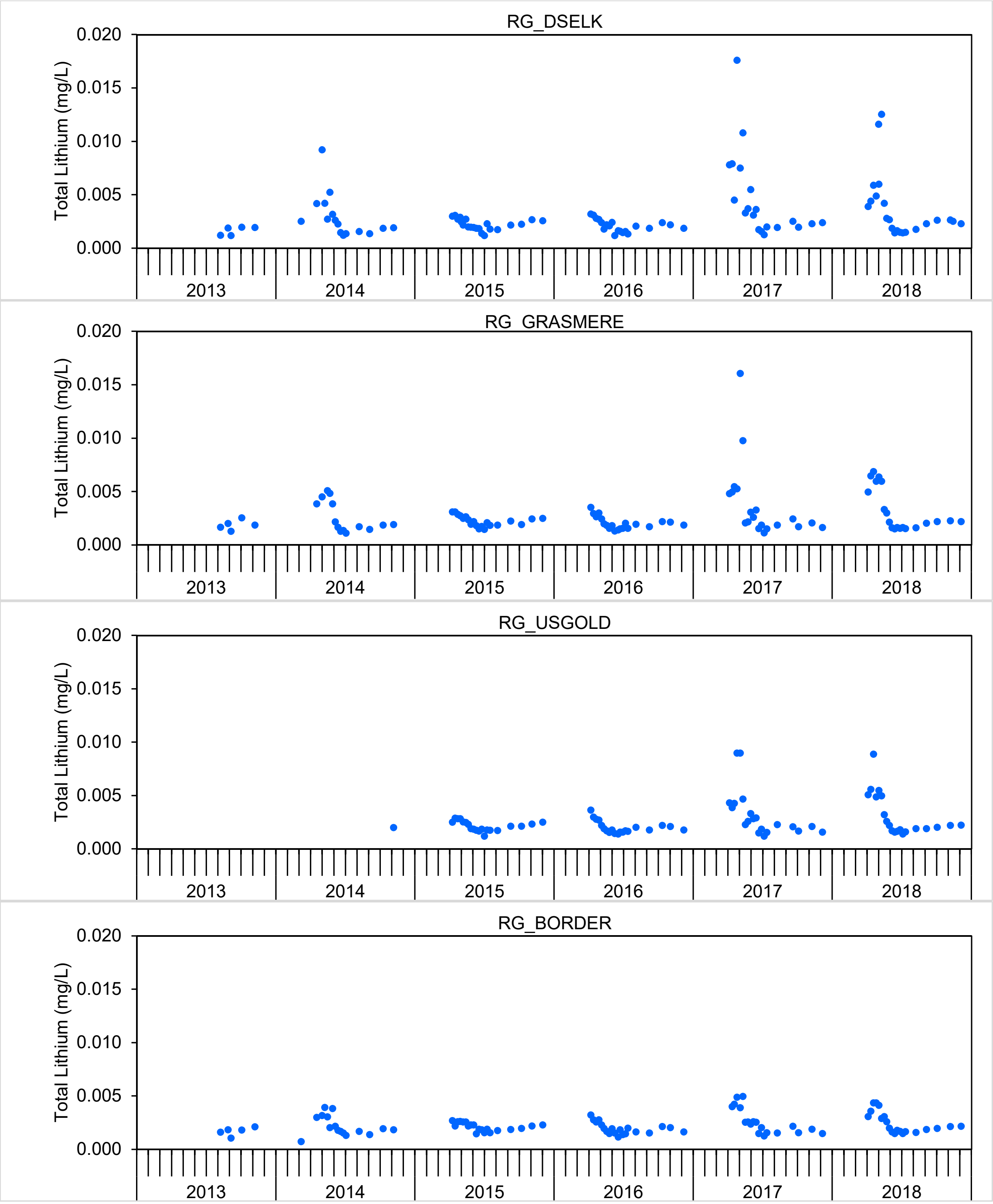


Figure A.9: Time Series Plots for Aqueous Total Lithium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

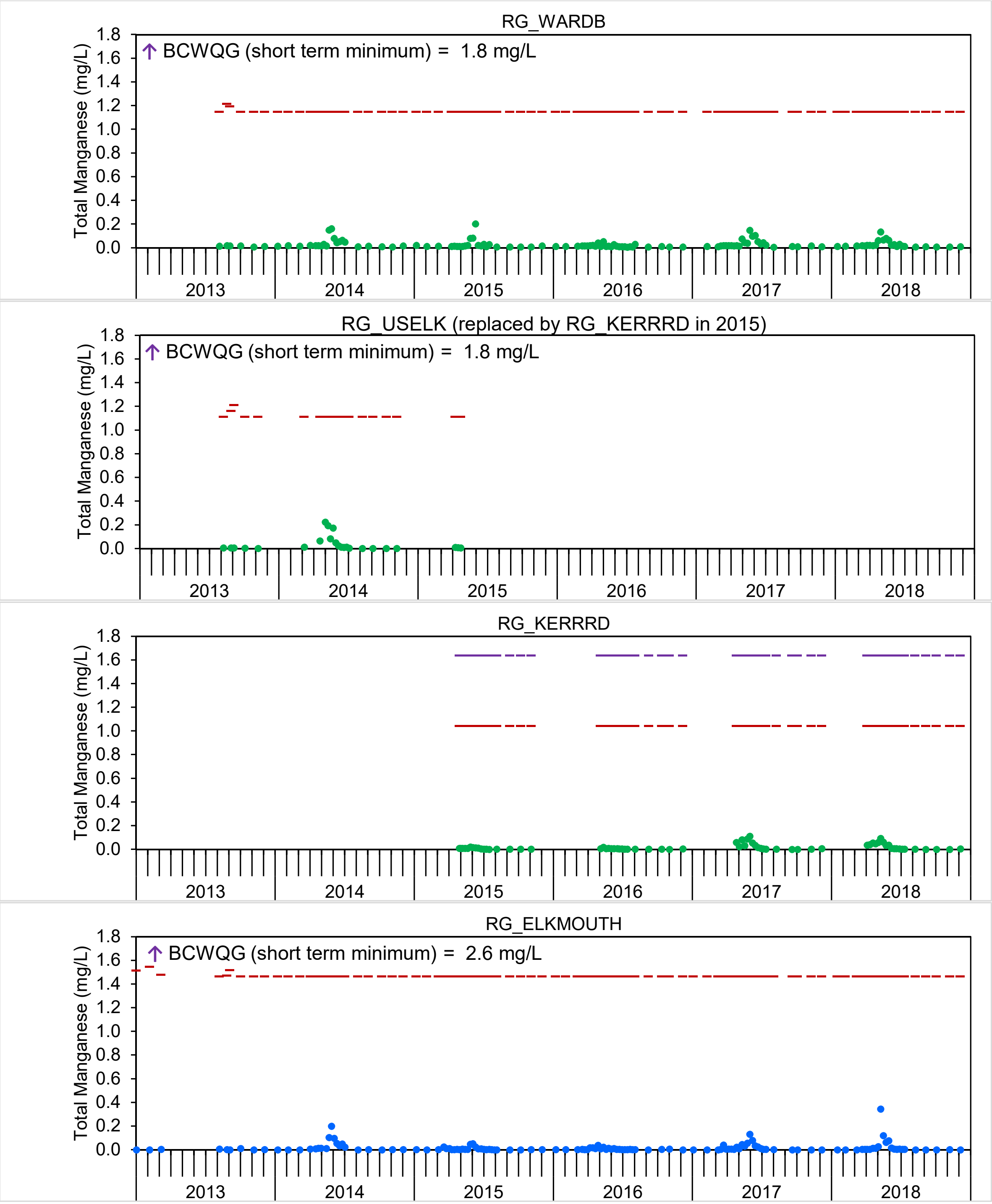


Figure A.10: Time Series Plots for Aqueous Total Manganese Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. No data for US stations.

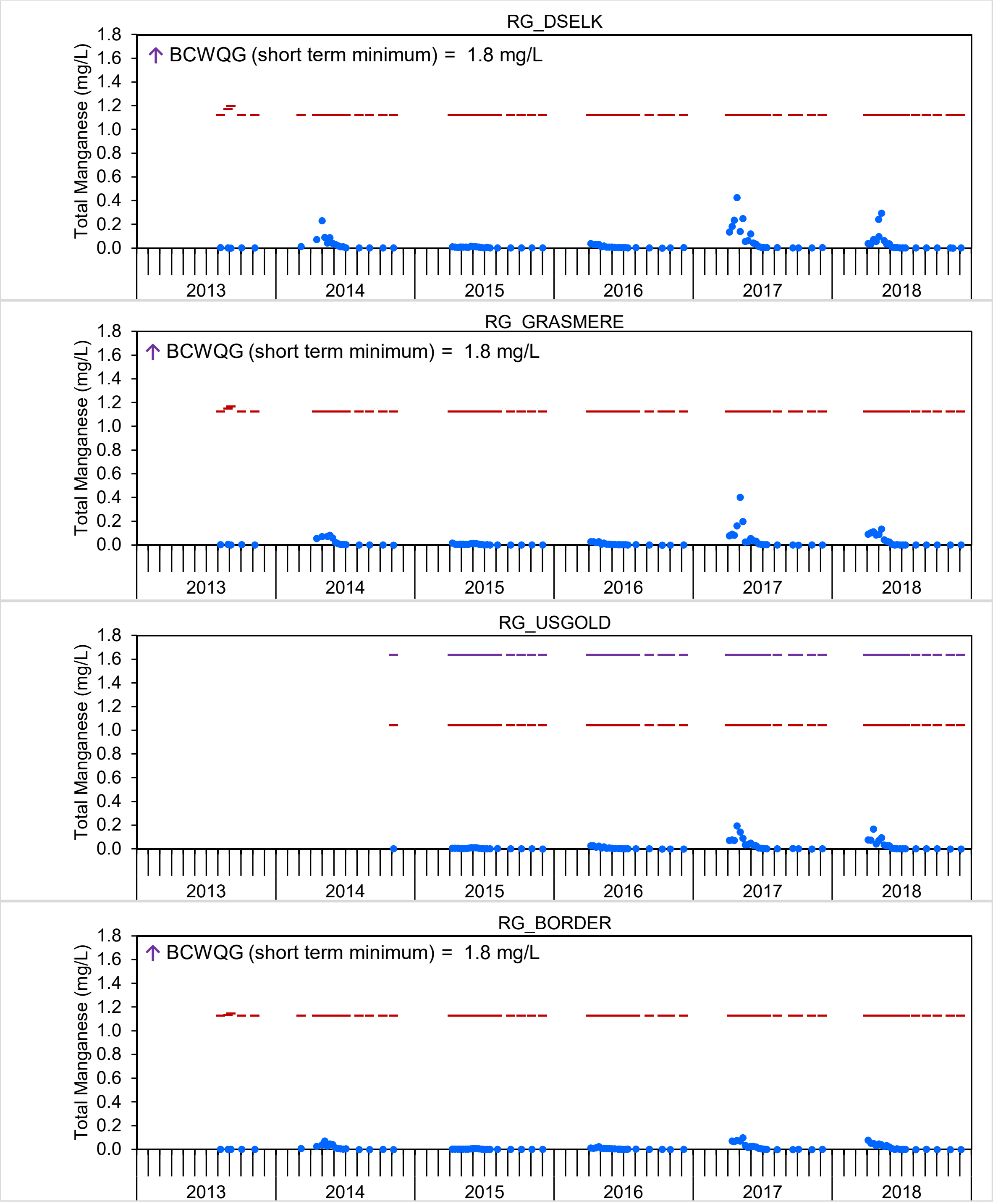


Figure A.10: Time Series Plots for Aqueous Total Manganese Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. No data for US stations.

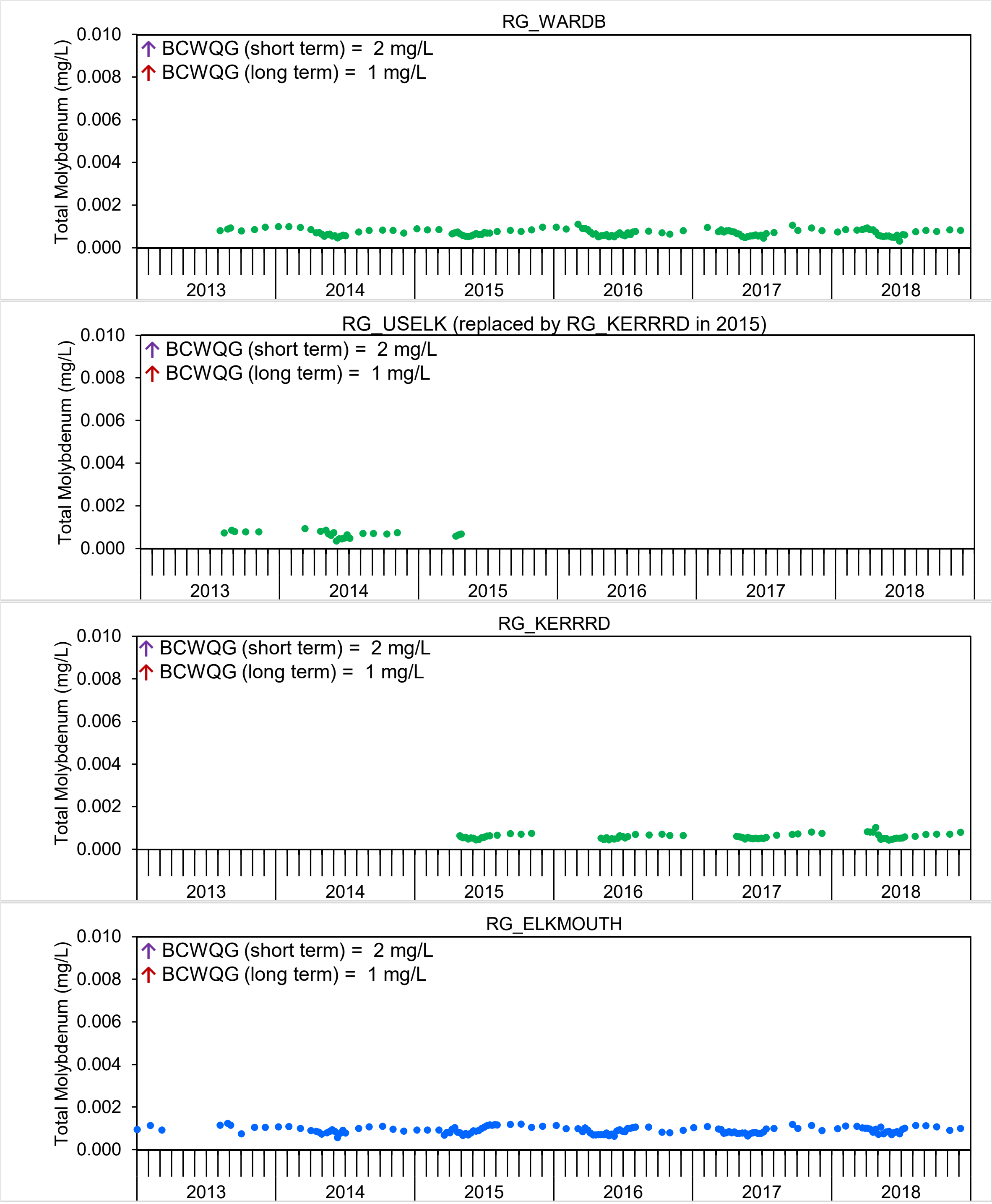


Figure A.11: Time Series Plots for Aqueous Total Molybdenum Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

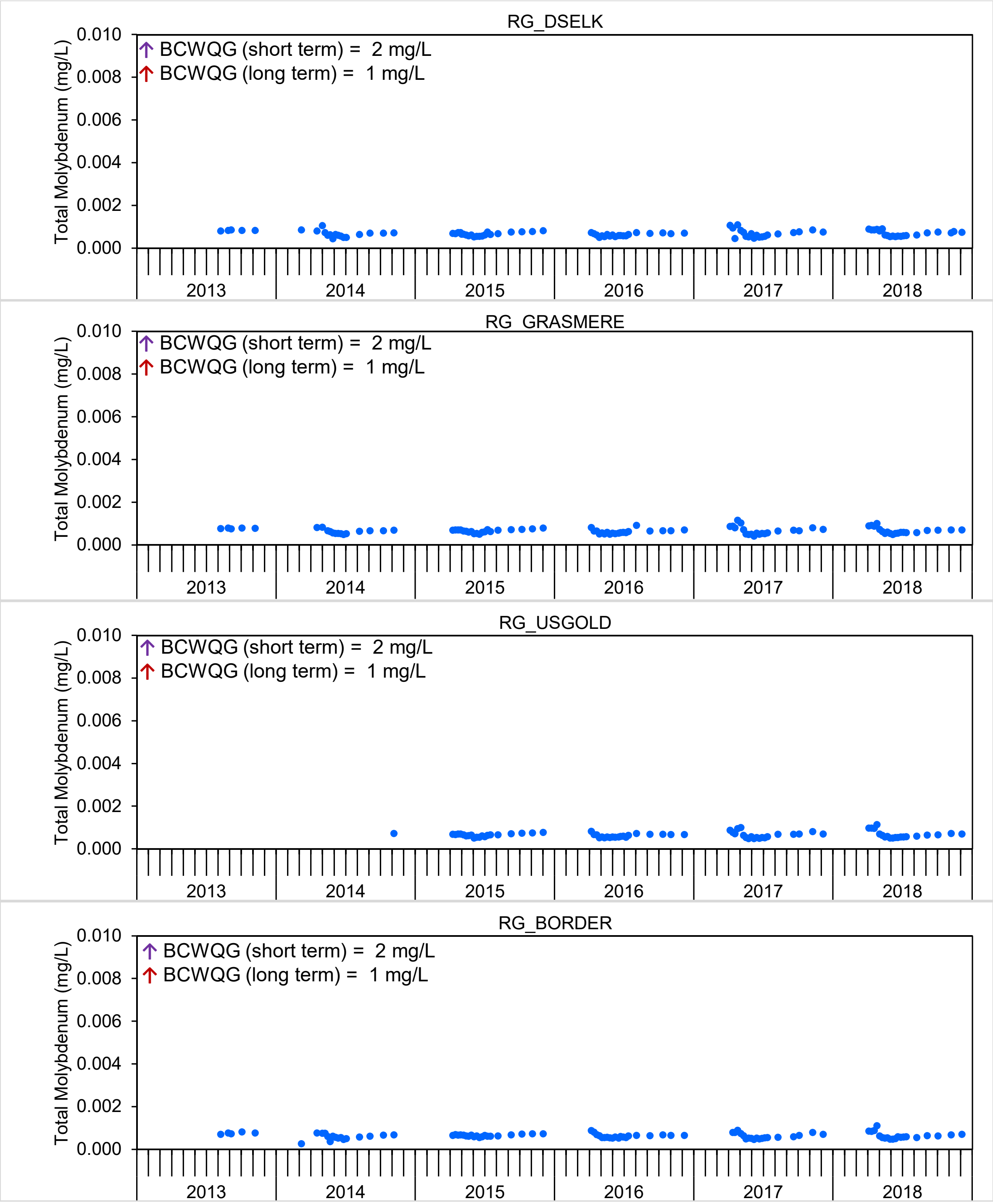


Figure A.11: **Time Series Plots for Aqueous Total Molybdenum Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

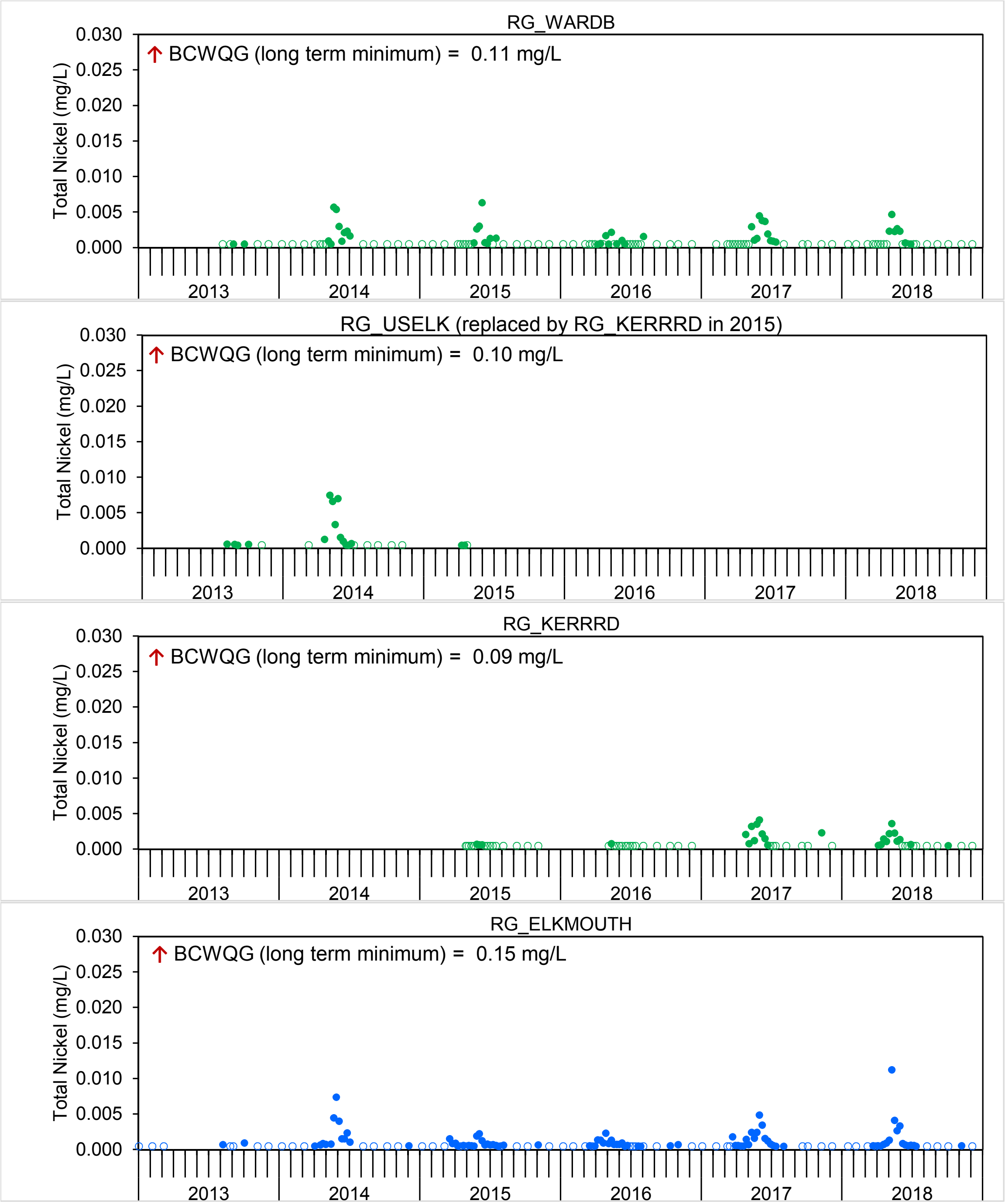


Figure A.12: Time Series Plots for Aqueous Total Nickel Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. No data for US stations.

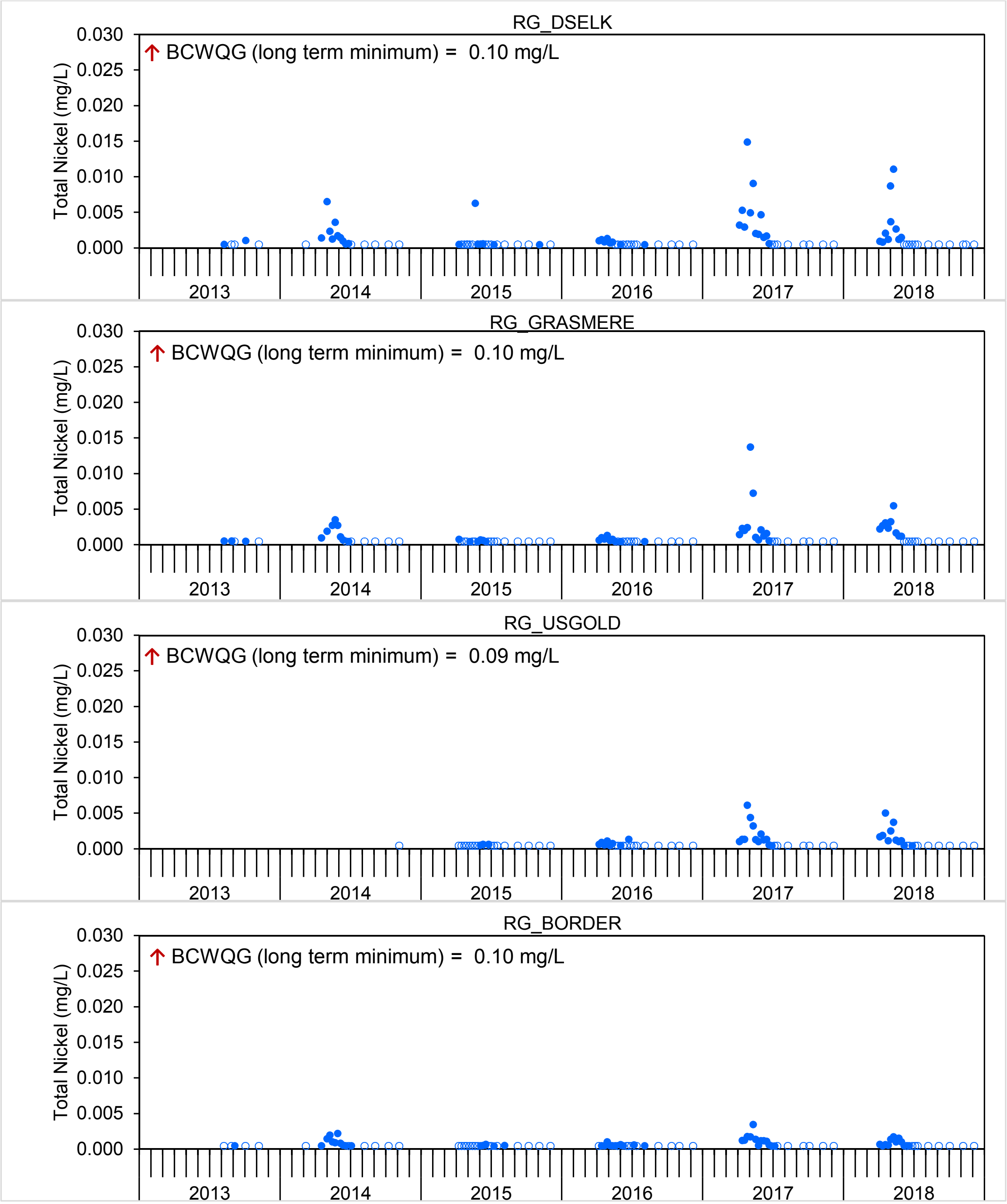


Figure A.12: Time Series Plots for Aqueous Total Nickel Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness. No data for US stations.

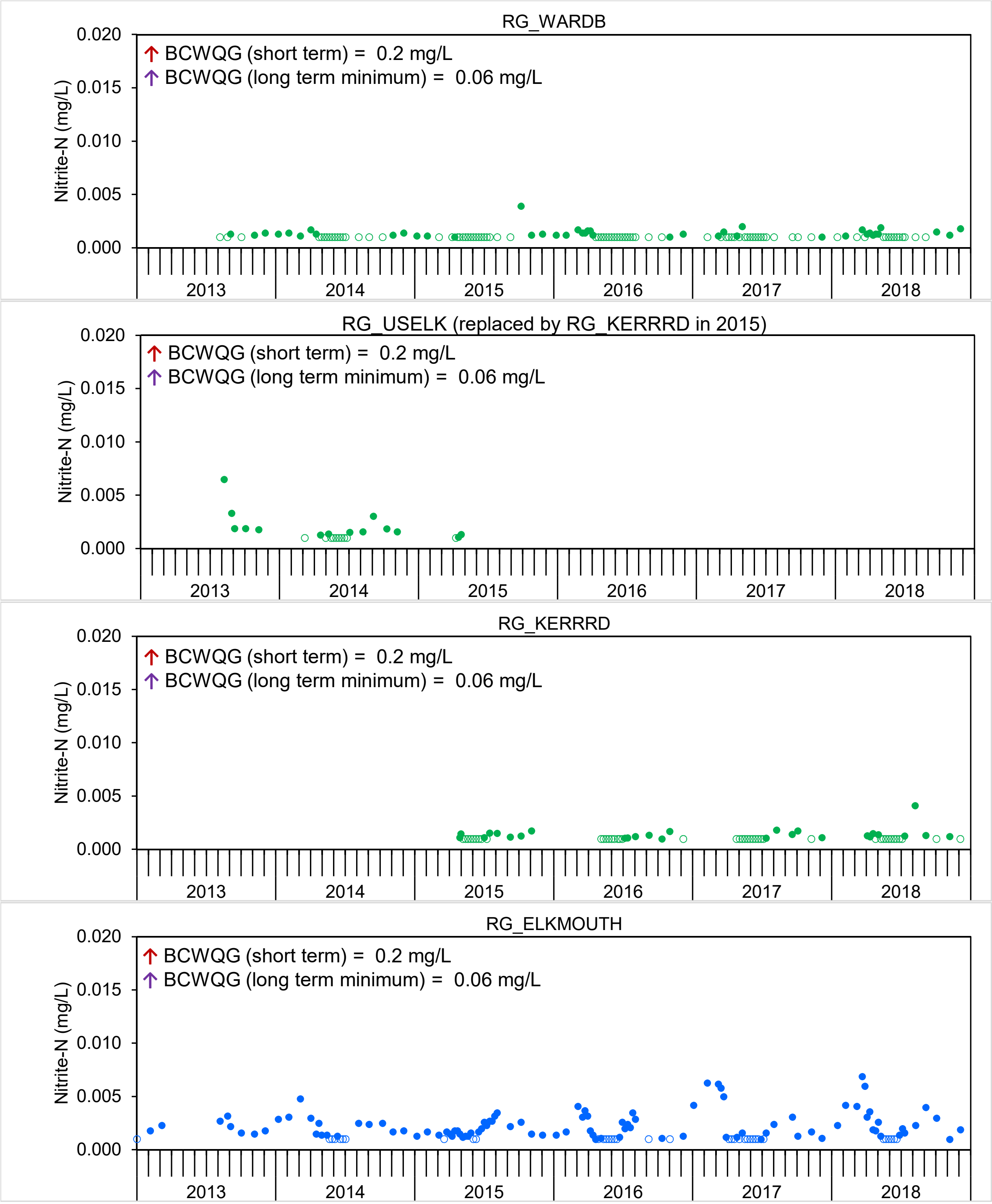


Figure A.13: Time Series Plots for Aqueous Nitrite-N Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

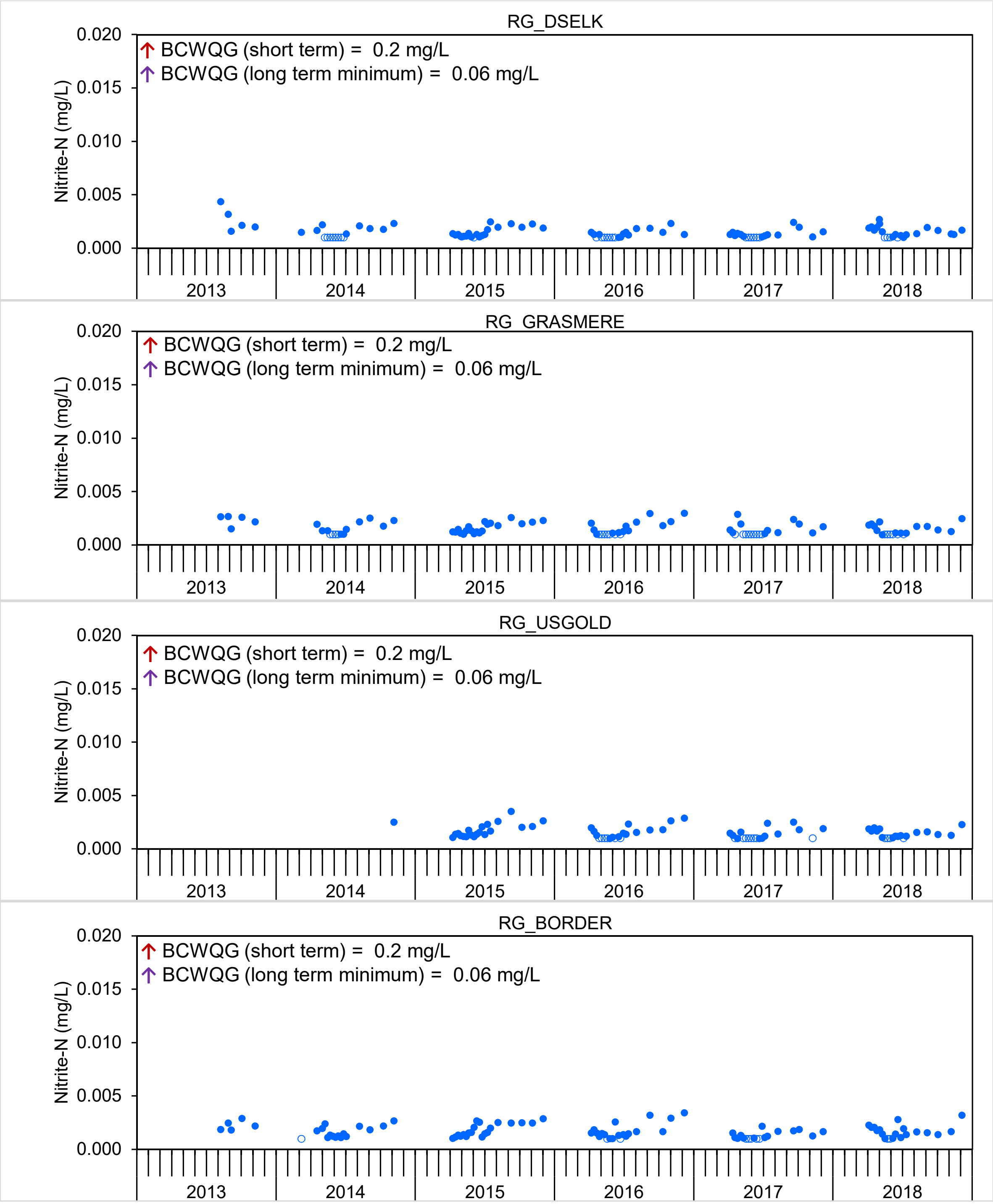


Figure A.13: Time Series Plots for Aqueous Nitrite-N Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

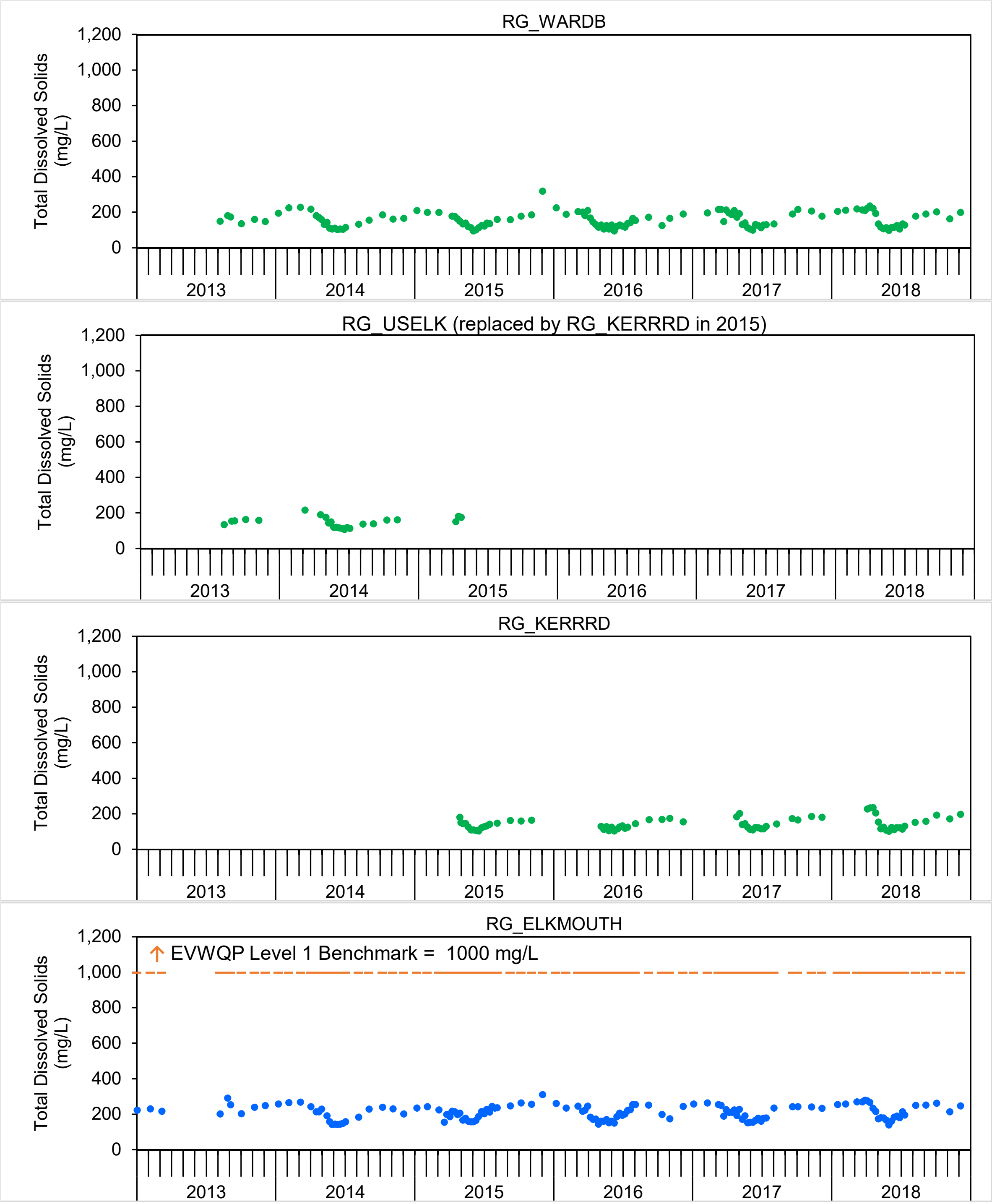


Figure A.14: Time Series Plots for Aqueous Total Dissolved Solids Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = * EVWQP Level 1 Benchmark

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. * Elk Valley Water Quality Plan (Teck, 2014).

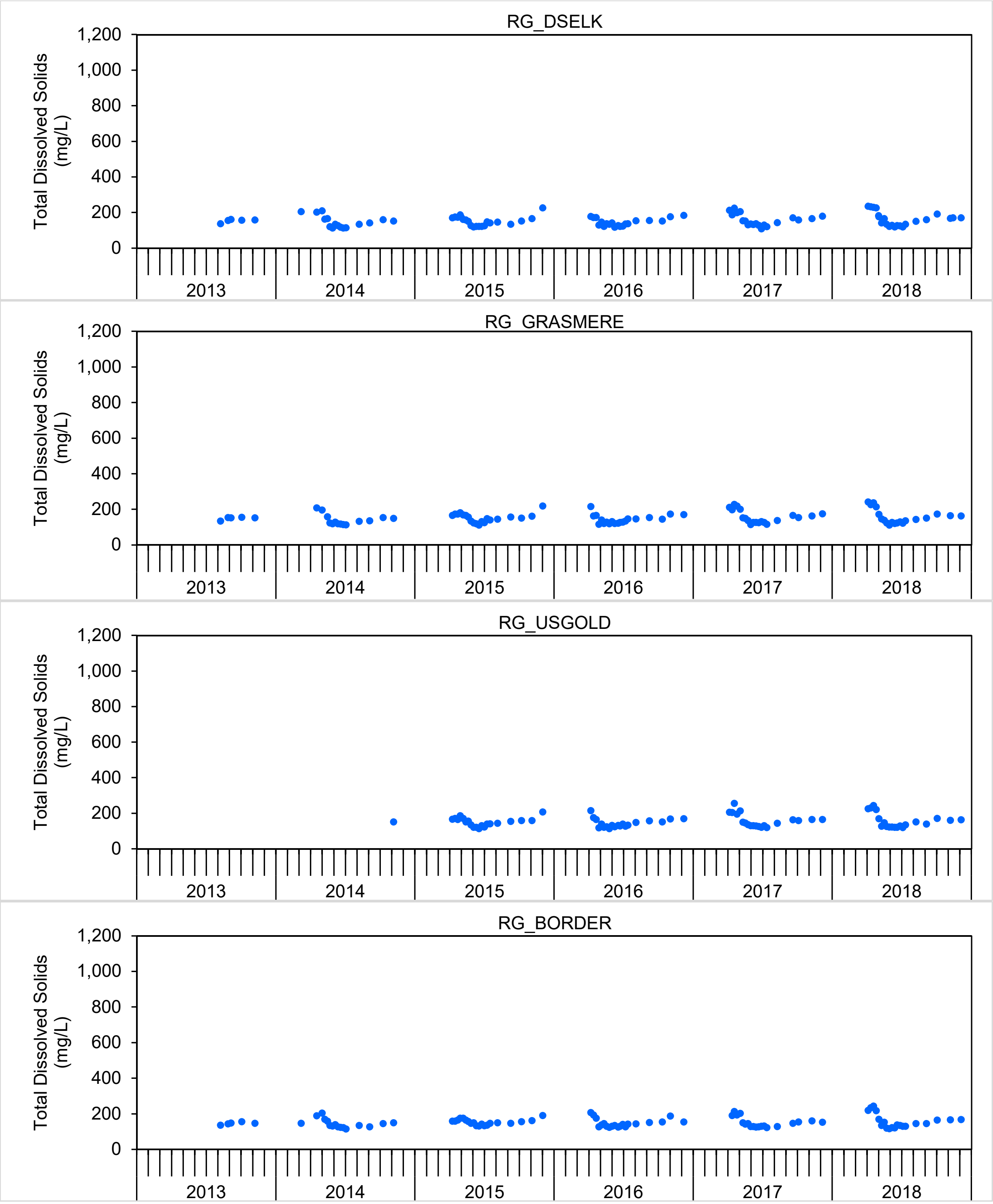


Figure A.14: Time Series Plots for Aqueous Total Dissolved Solids Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

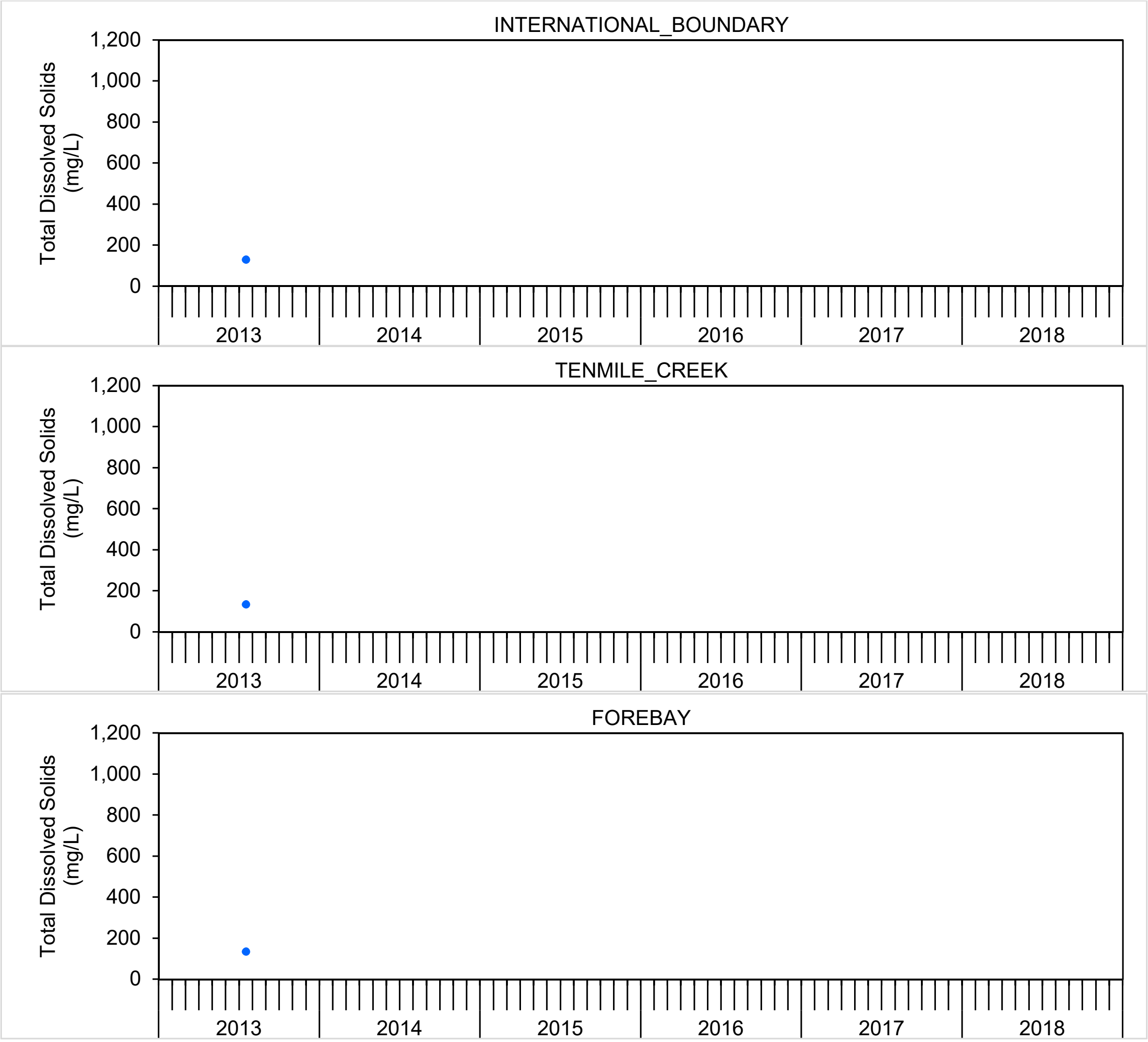


Figure A.14: **Time Series Plots for Aqueous Total Dissolved Solids Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

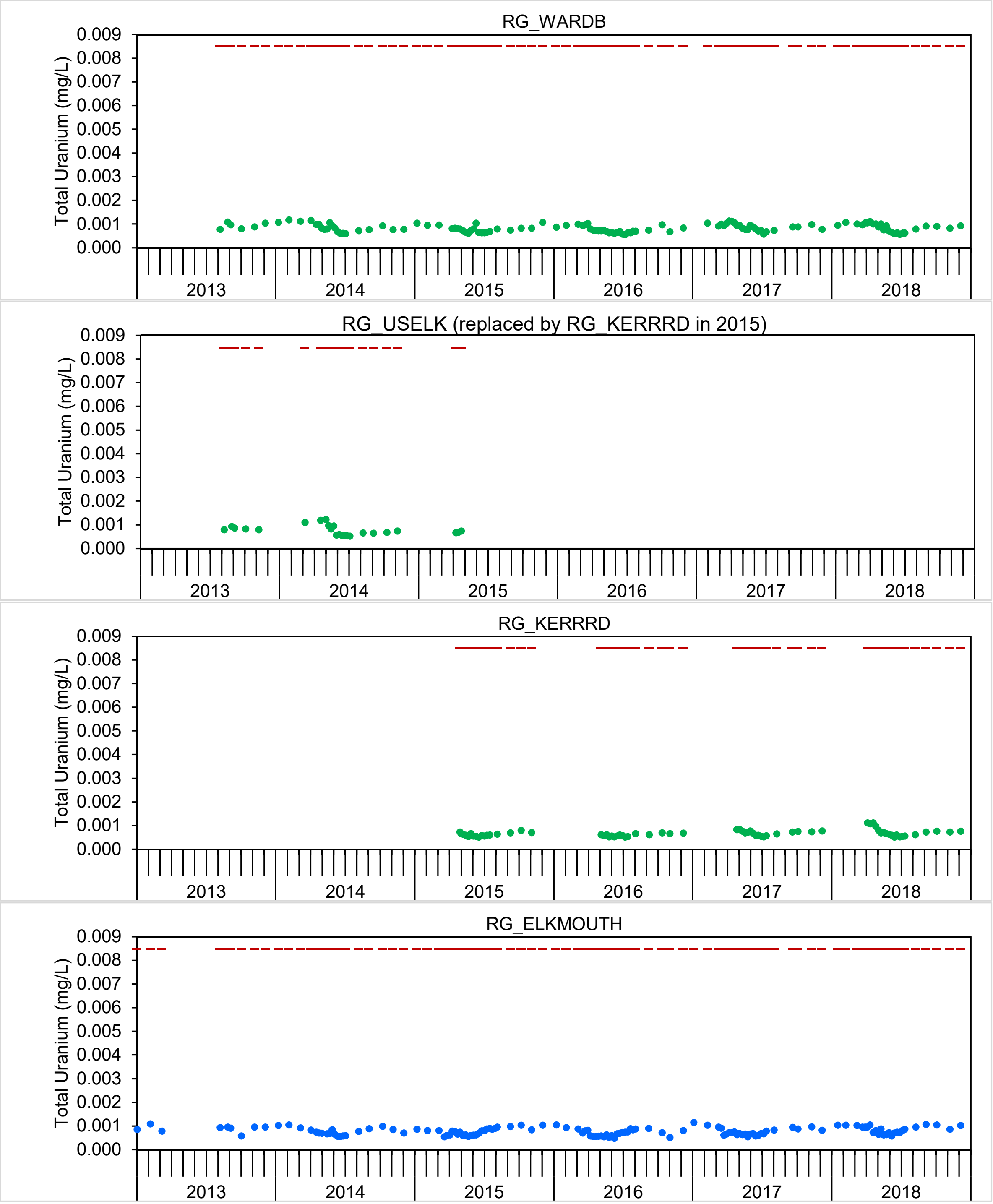


Figure A.15: Time Series Plots for Aqueous Total Uranium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

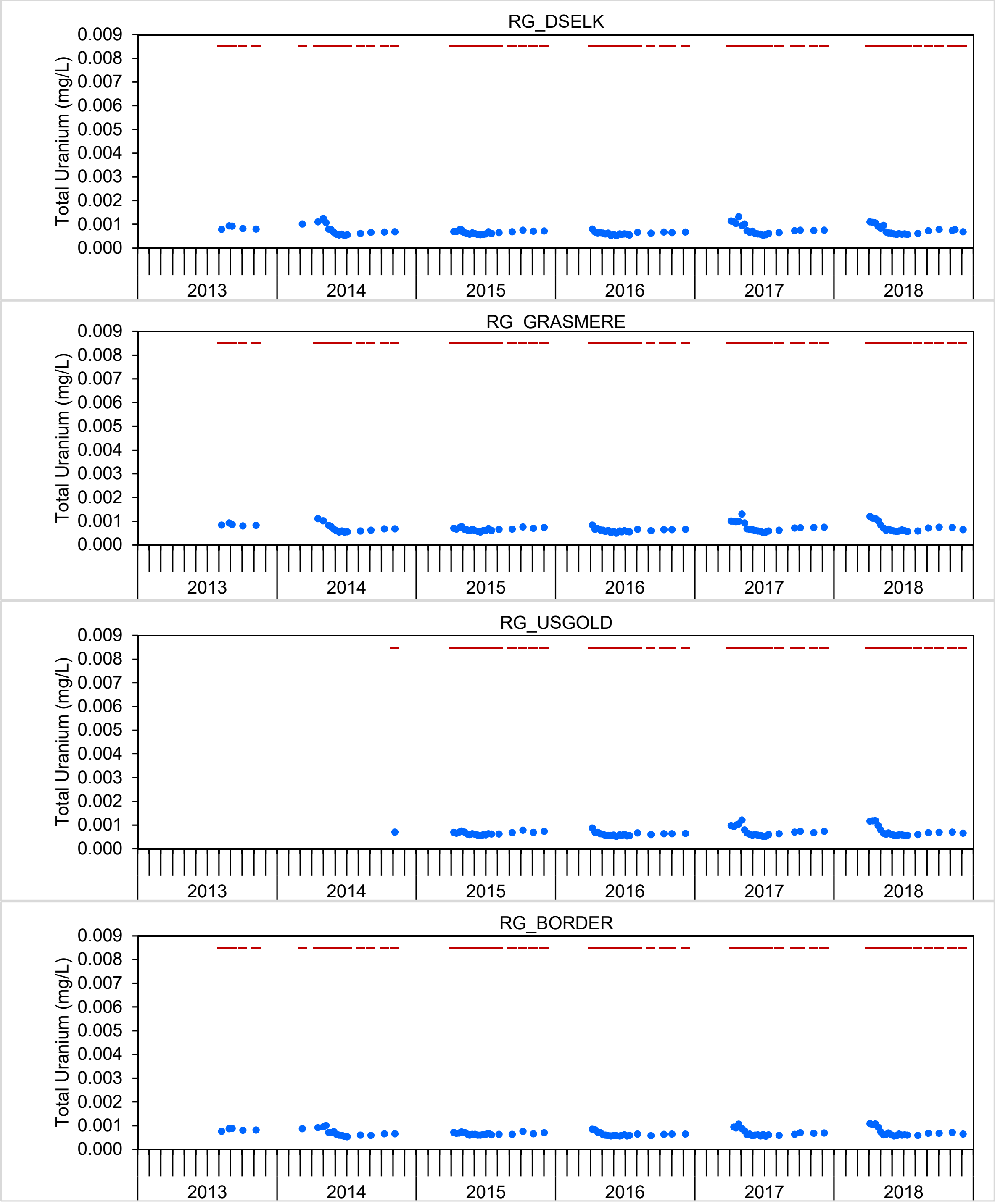


Figure A.15: Time Series Plots for Aqueous Total Uranium Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term)

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. No data for US stations.

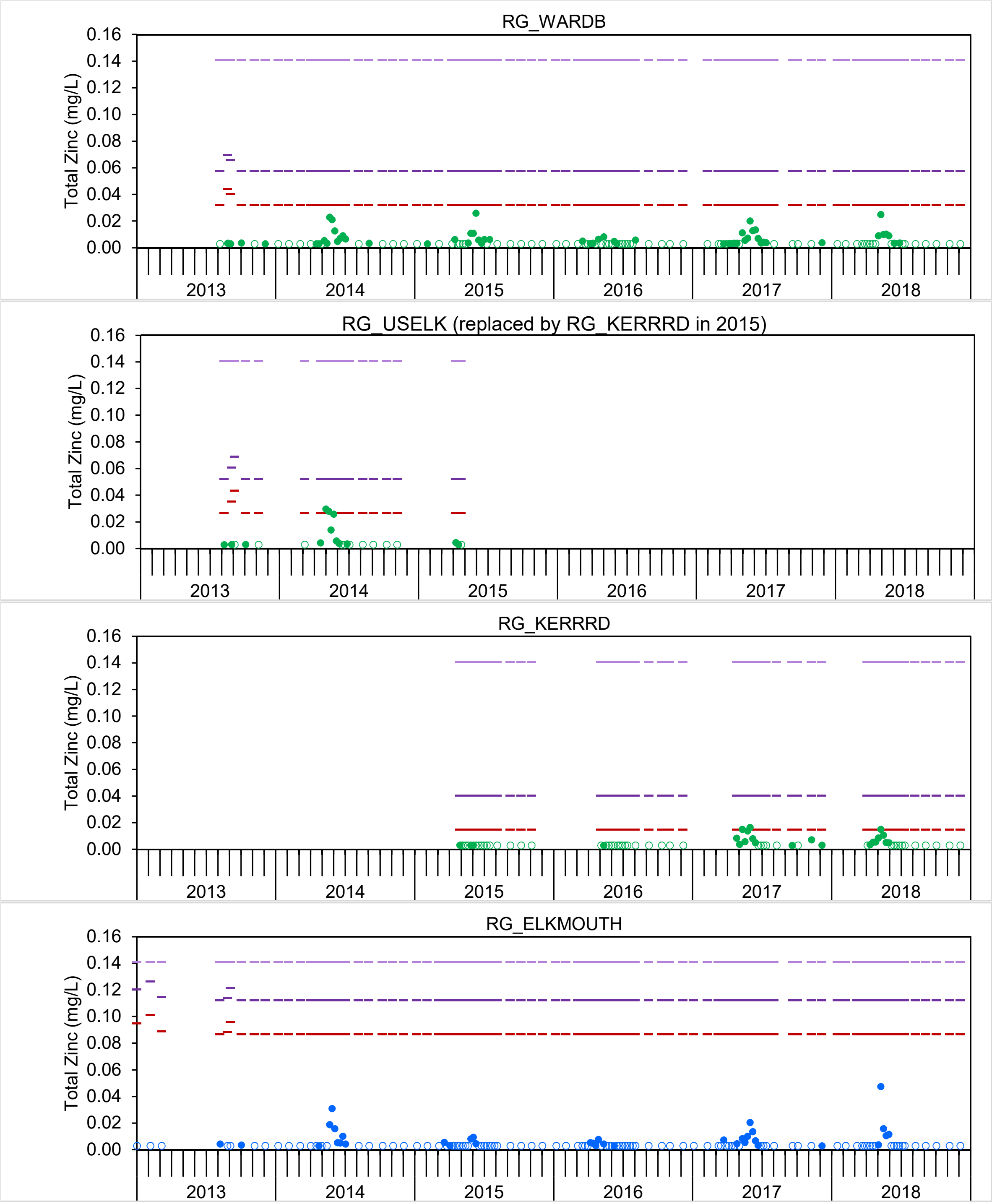


Figure A.16: Time Series Plots for Aqueous Total Zinc Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = EPA WQG

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

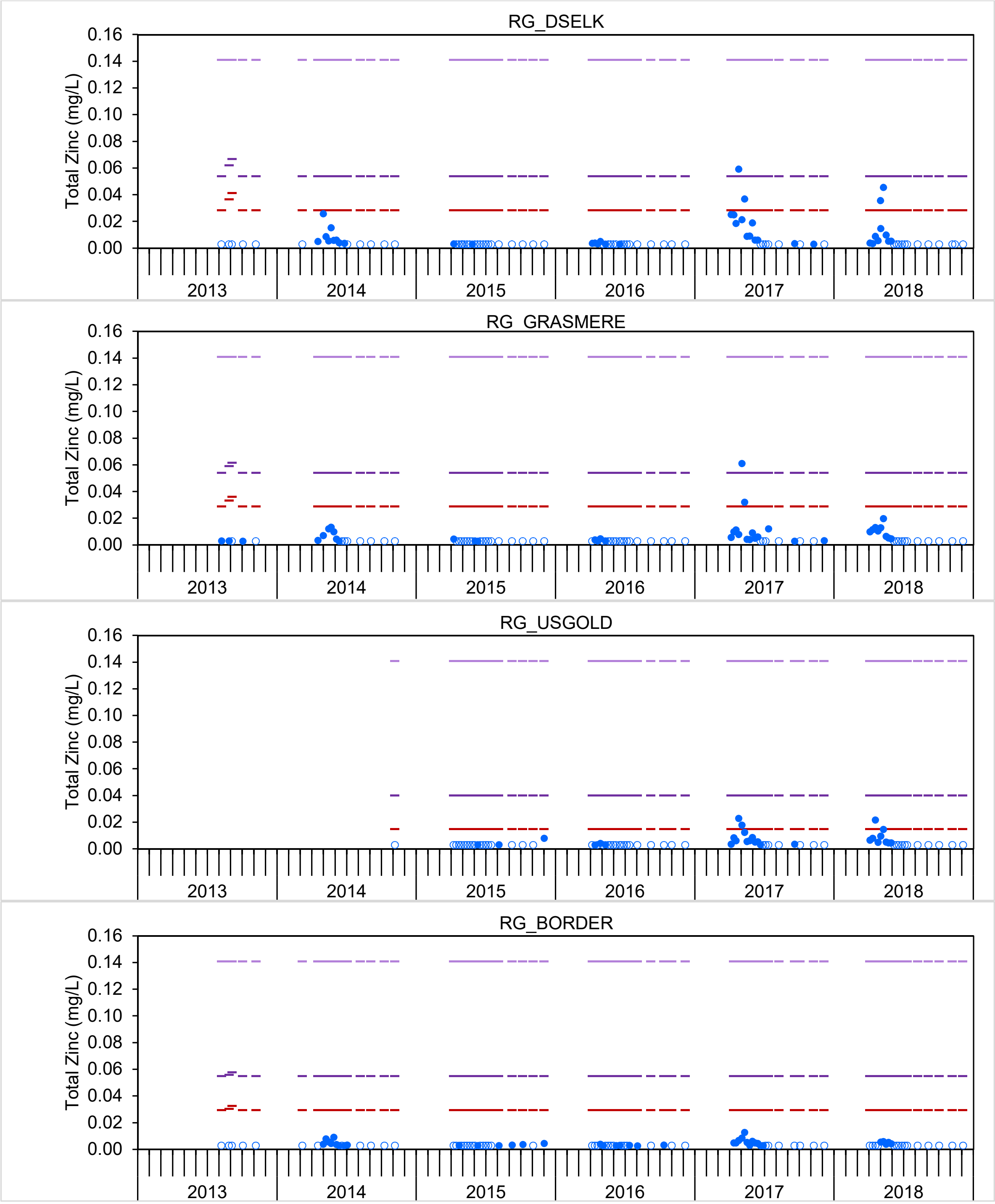


Figure A.16: **Time Series Plots for Aqueous Total Zinc Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

– – = BCWQG (long term); – – = BCWQG (short term); – – = EPA WQG

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

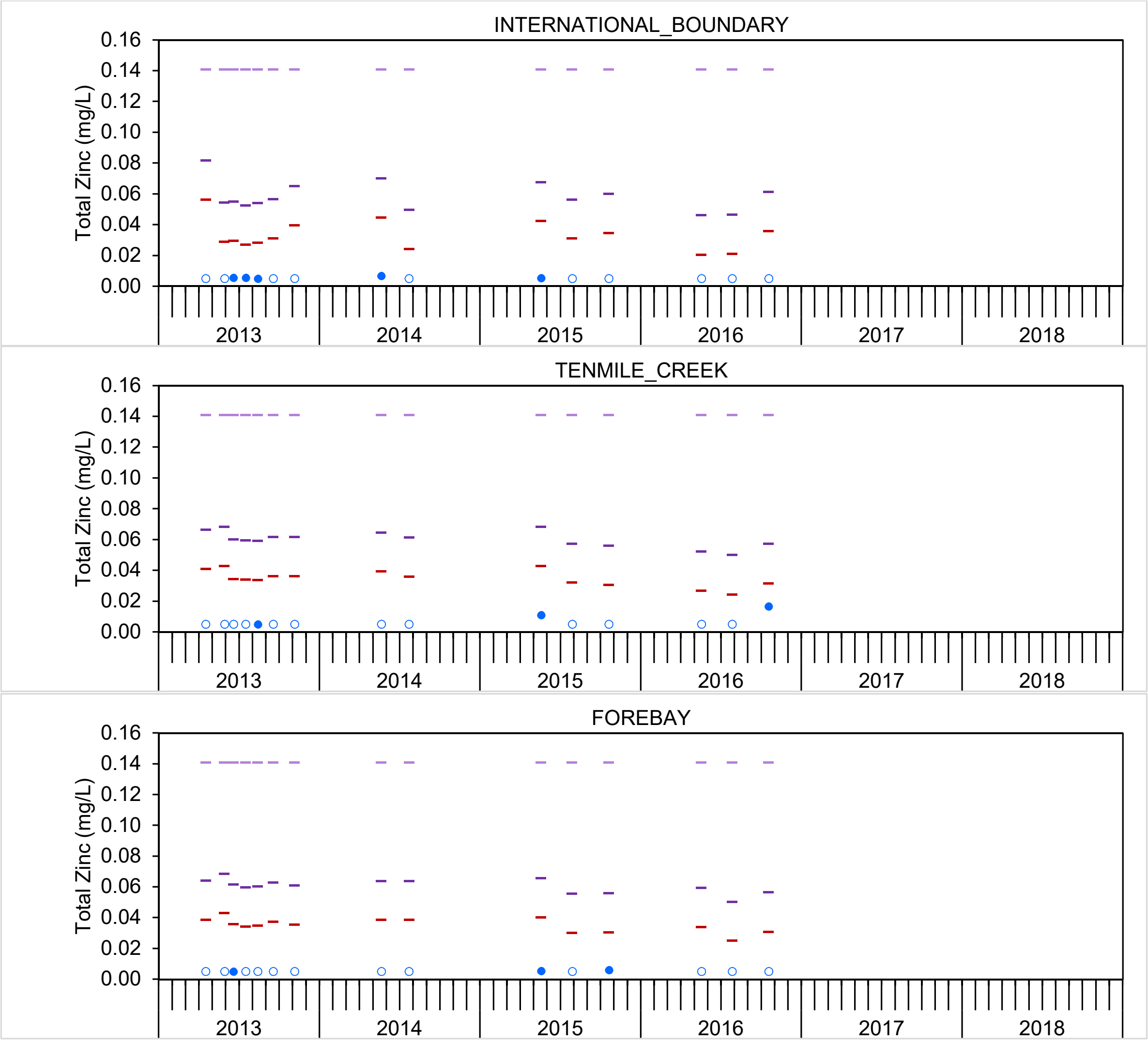


Figure A.16: **Time Series Plots for Aqueous Total Zinc Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

– – = BCWQG (long term); – – = BCWQG (short term); – – = EPA WQG

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines are dependent on water hardness.

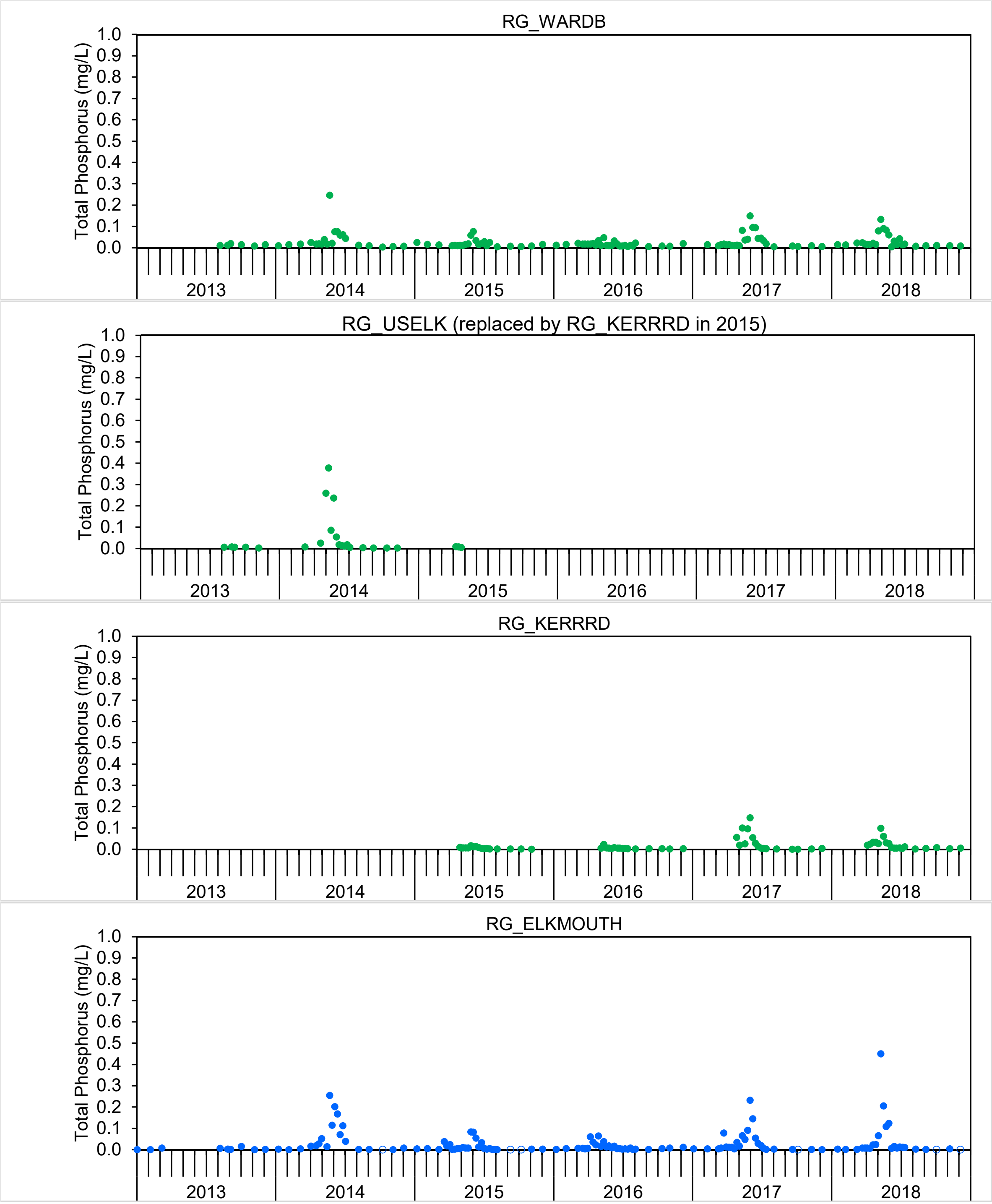


Figure A.17: Time Series Plots for Aqueous Total Phosphorus Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

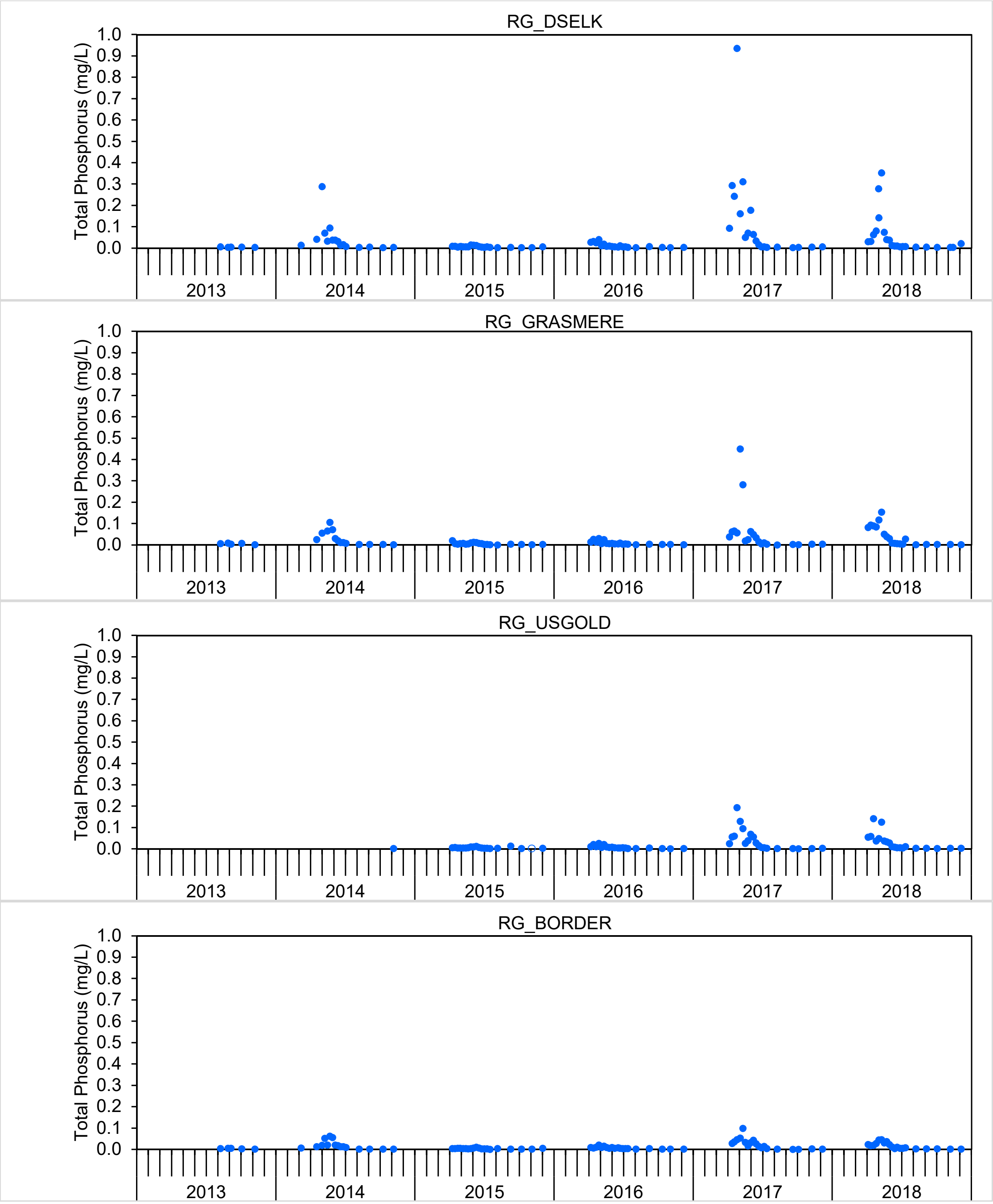


Figure A.17: **Time Series Plots for Aqueous Total Phosphorus Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

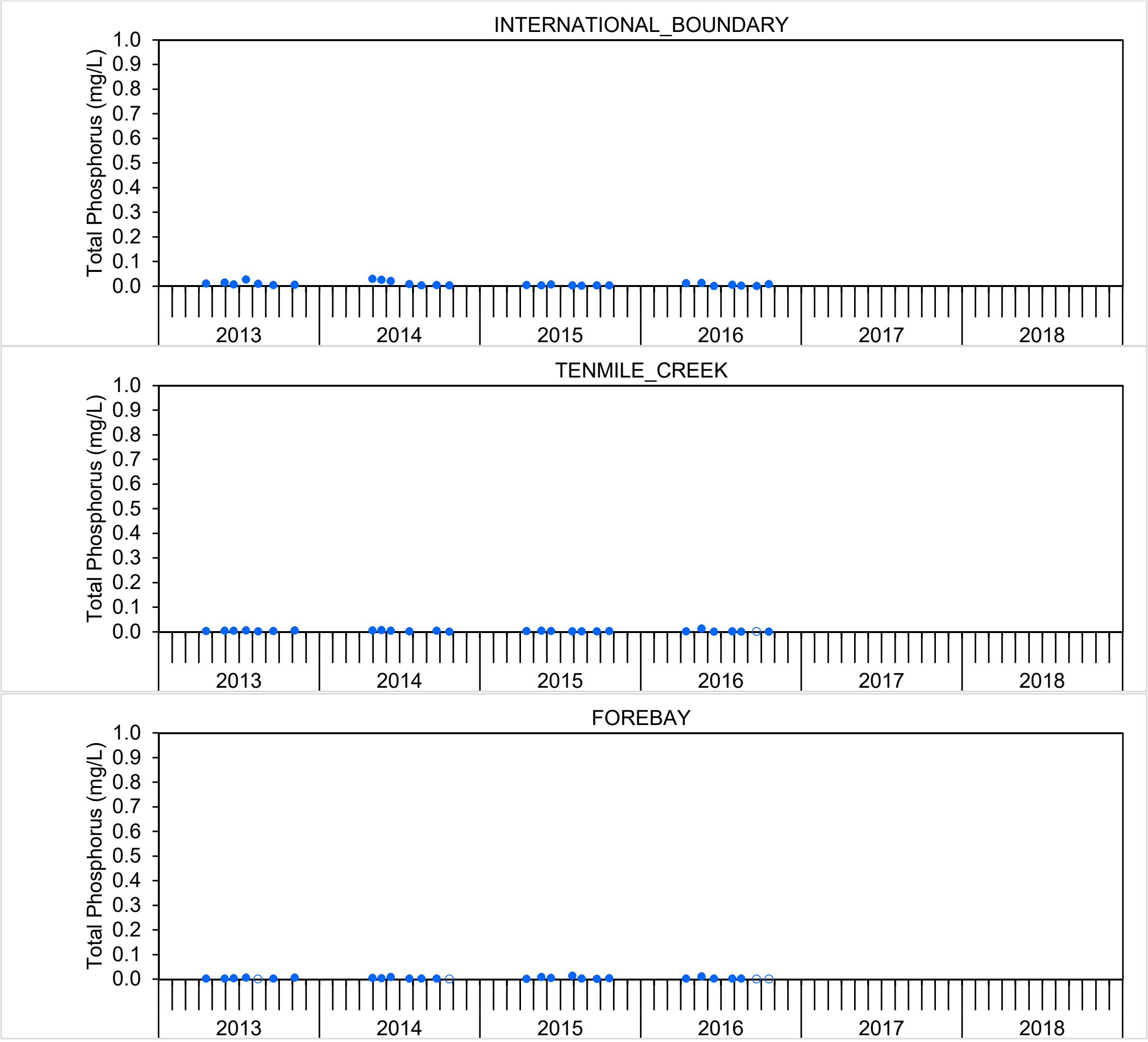


Figure A.17: Time Series Plots for Aqueous Total Phosphorus Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

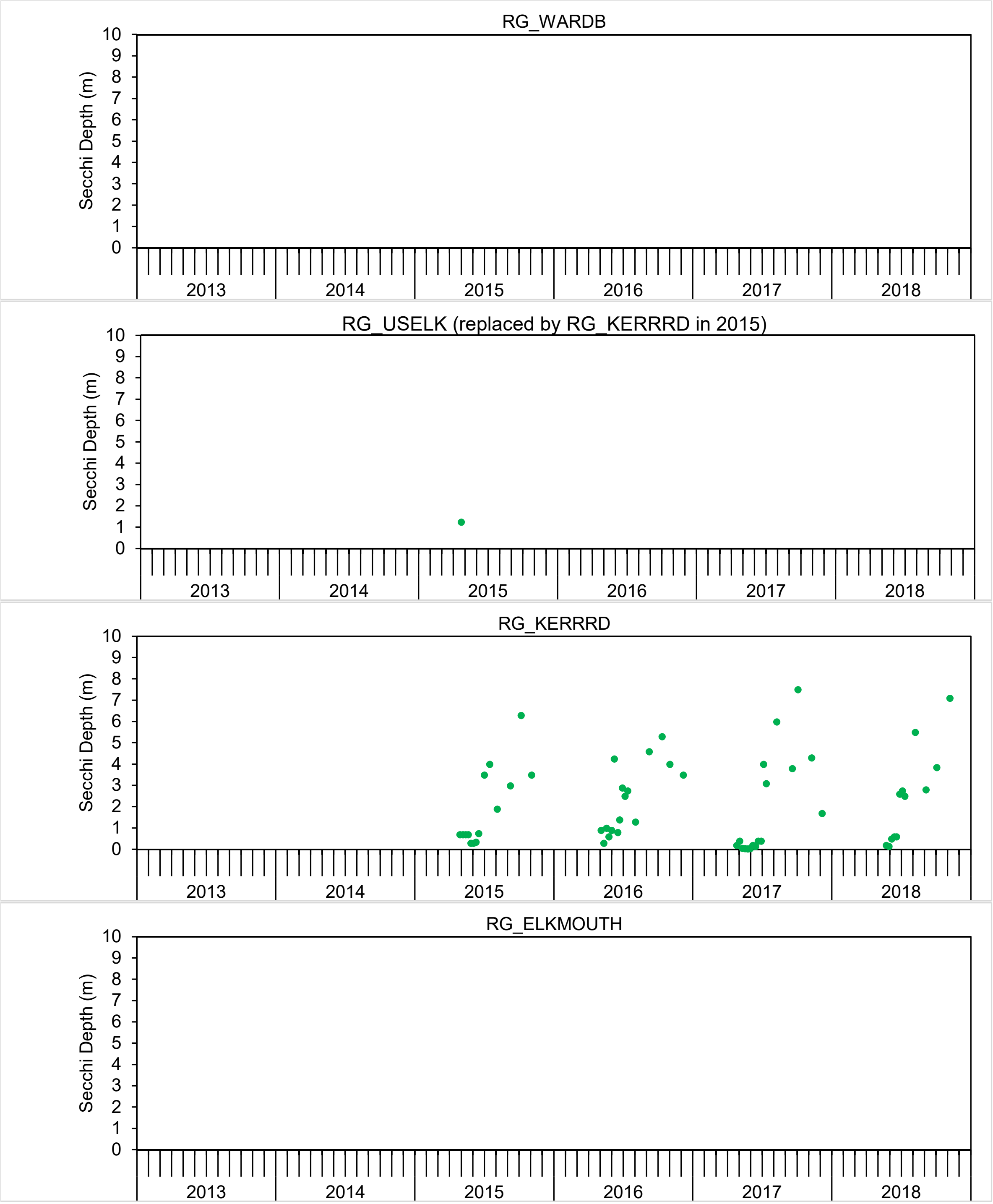


Figure A.18: **Time Series Plots for Secchi Depth from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

● = Downstream; ● = Upstream.

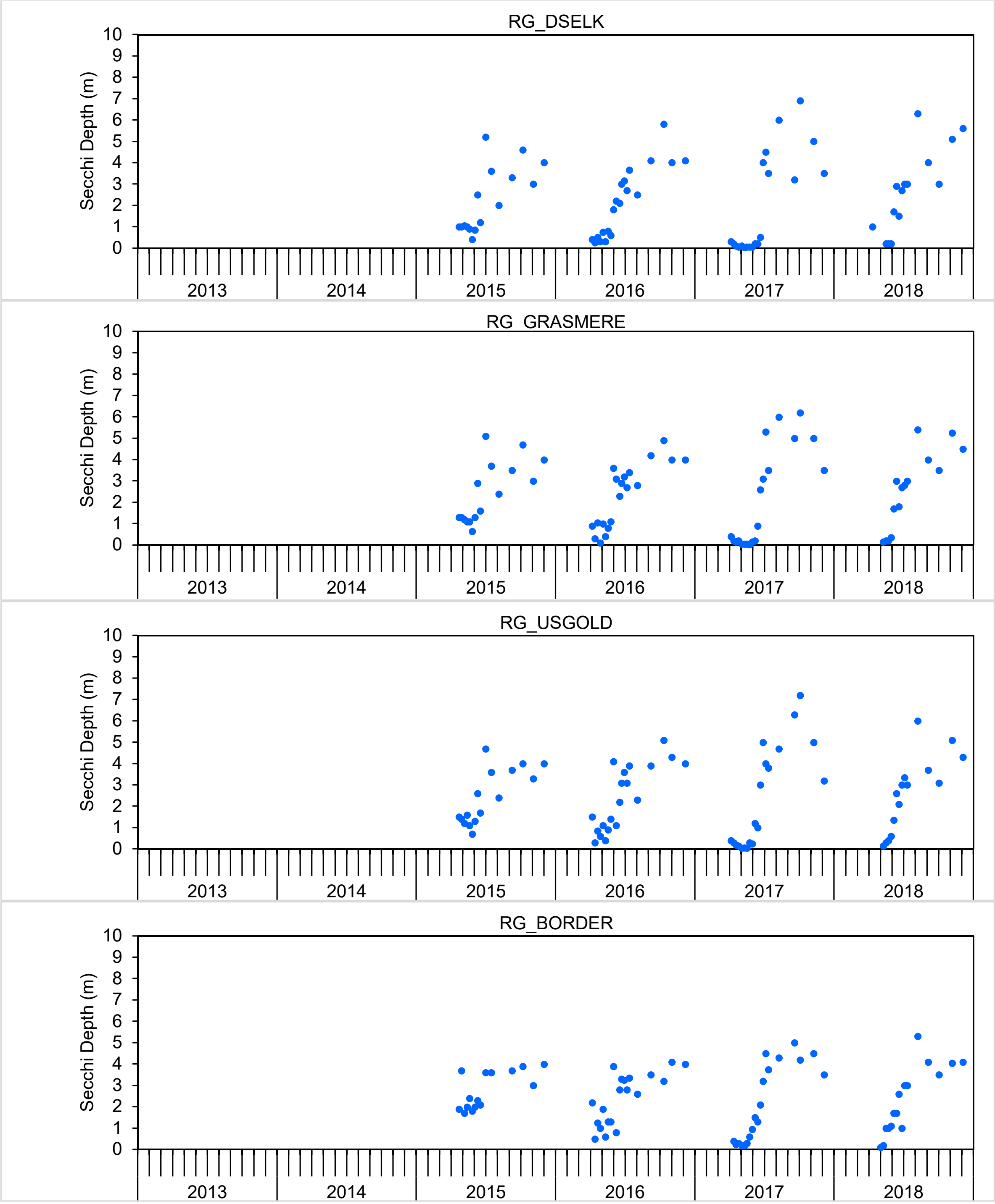


Figure A.18: Time Series Plots for Secchi Depth from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

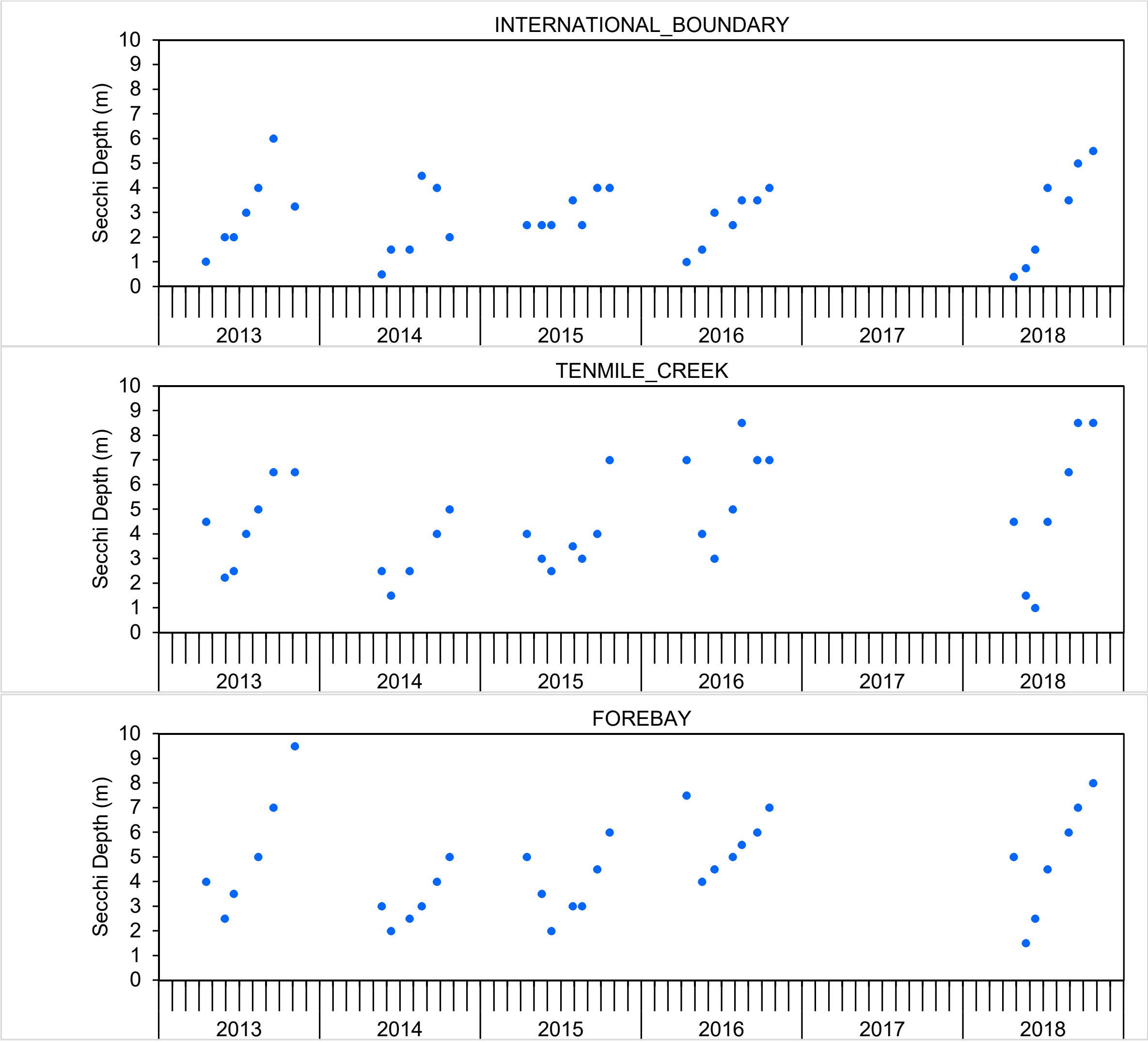


Figure A.18: Time Series Plots for Secchi Depth from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

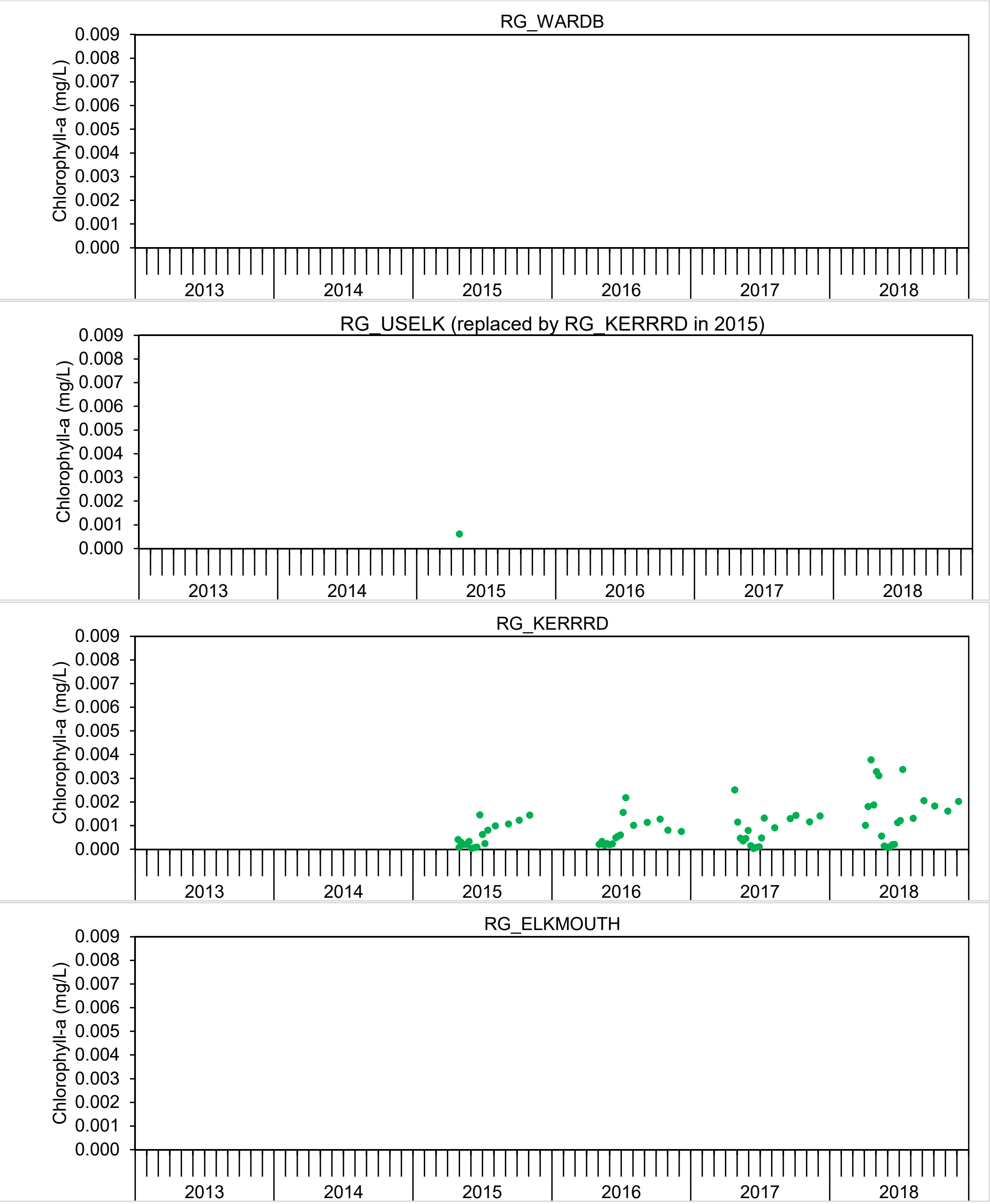


Figure A.19: Time Series Plots for Chlorophyll-a Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

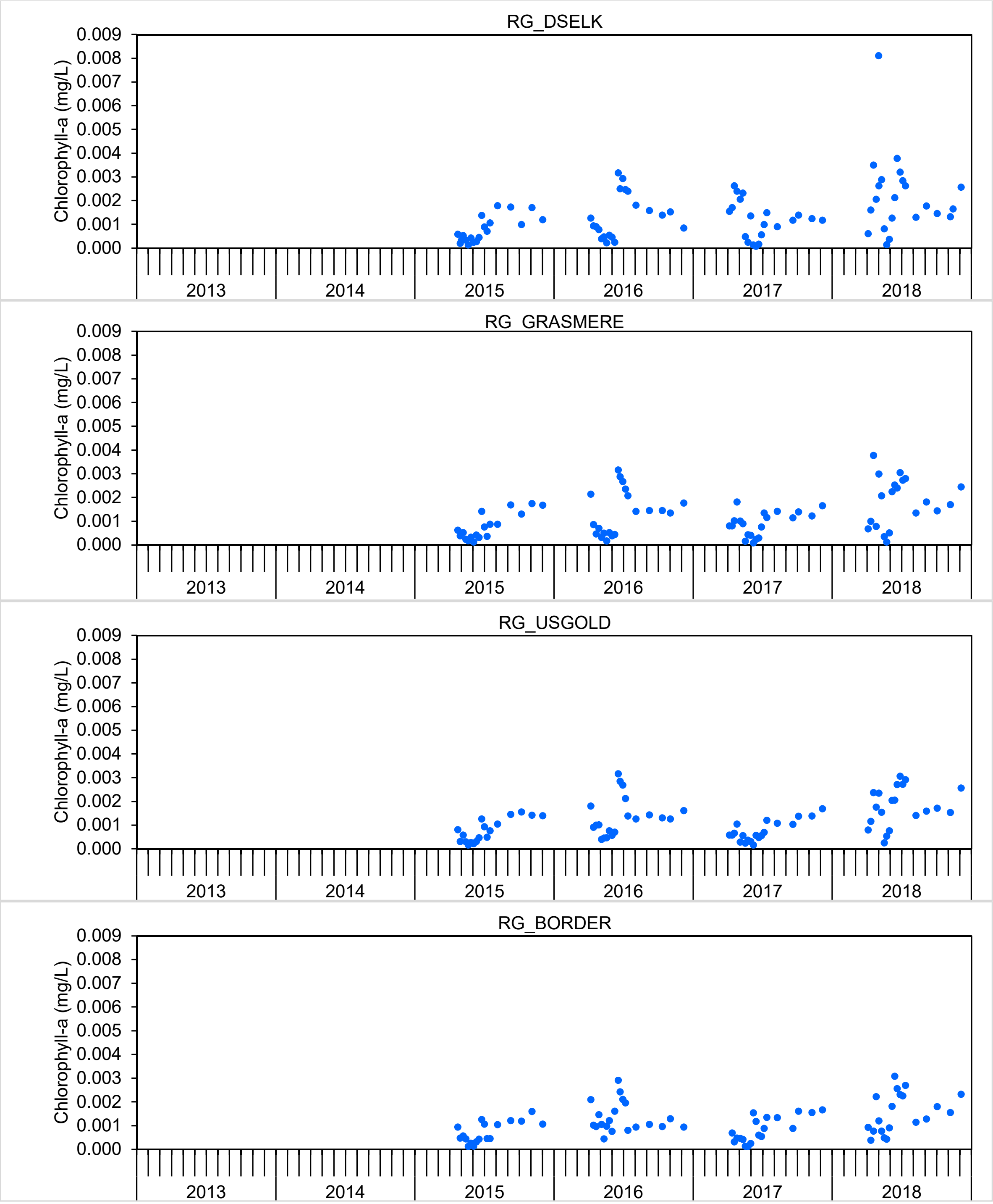


Figure A.19: Time Series Plots for Chlorophyll-a Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

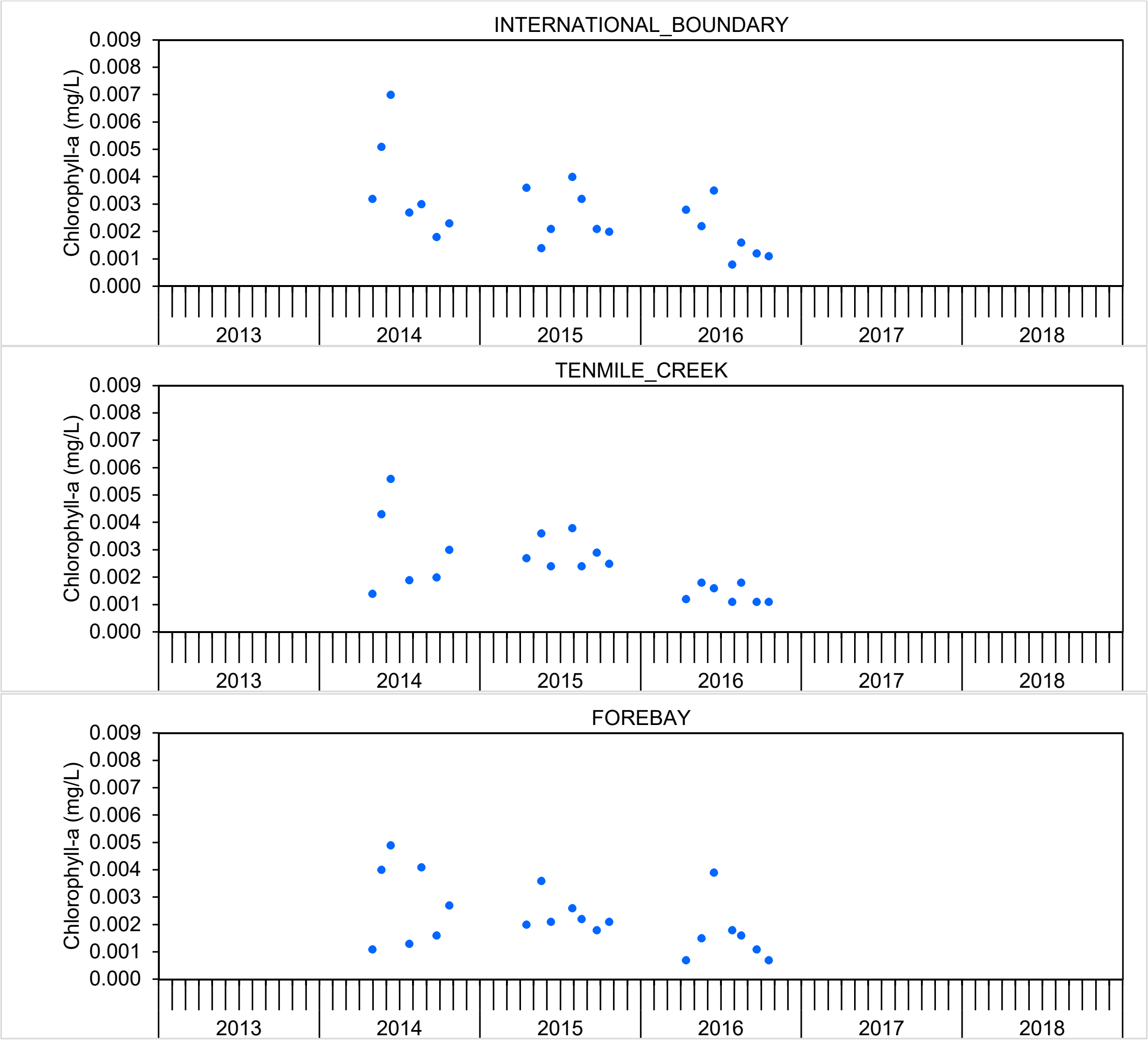


Figure A.19: **Time Series Plots for Chlorophyll-a Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

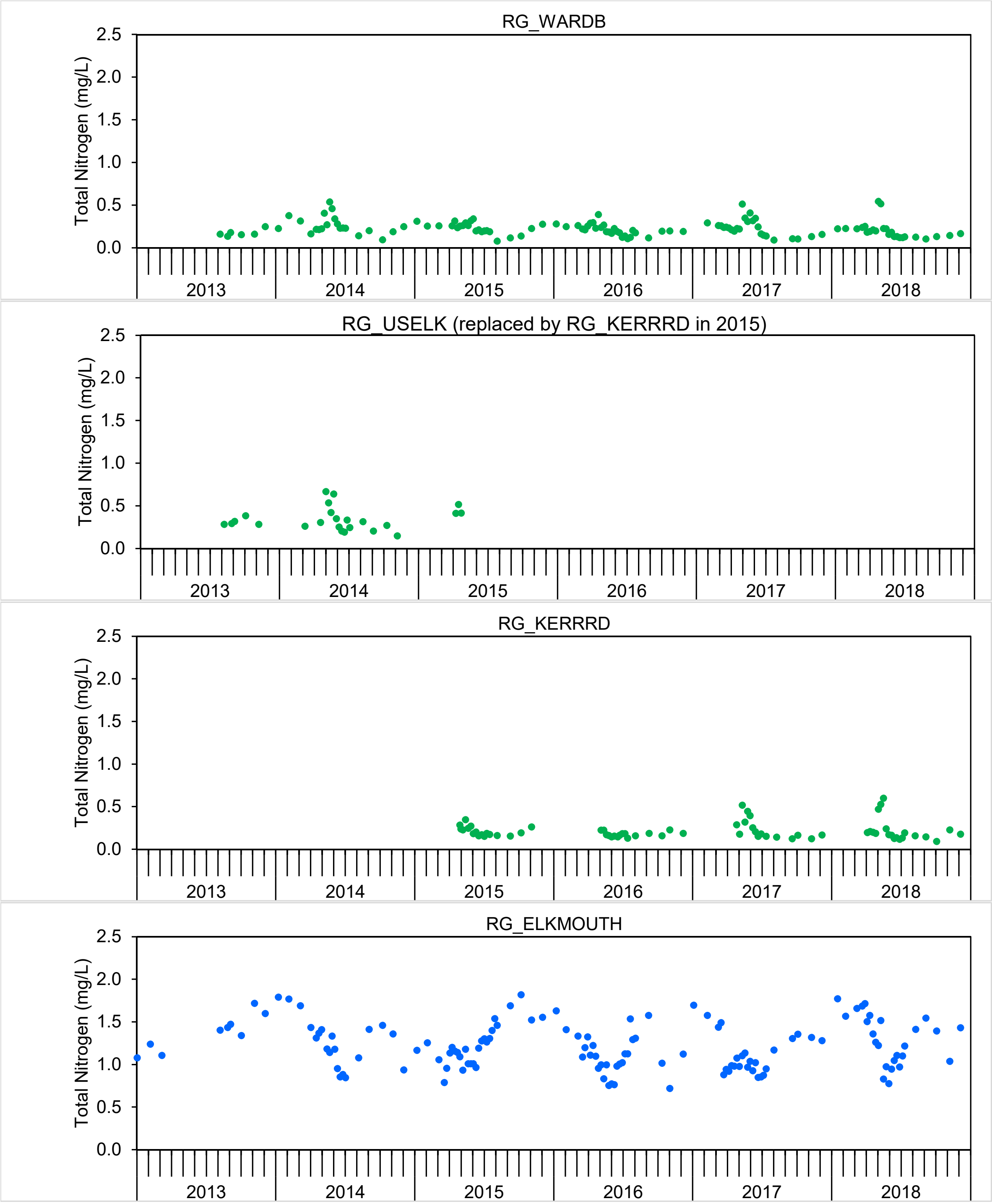


Figure A.20: Time Series Plots for Aqueous Total Nitrogen Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

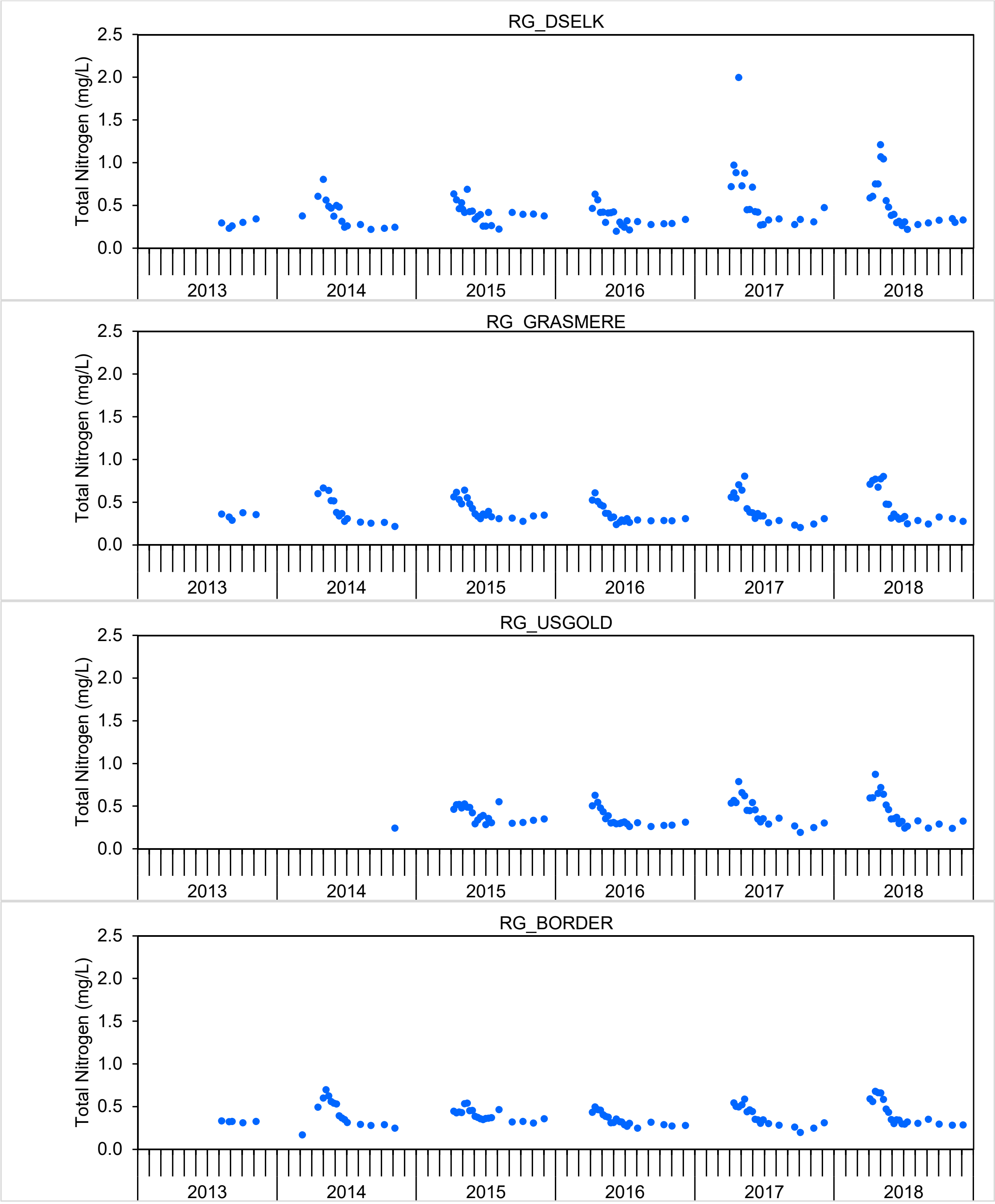


Figure A.20: **Time Series Plots for Aqueous Total Nitrogen Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018**

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

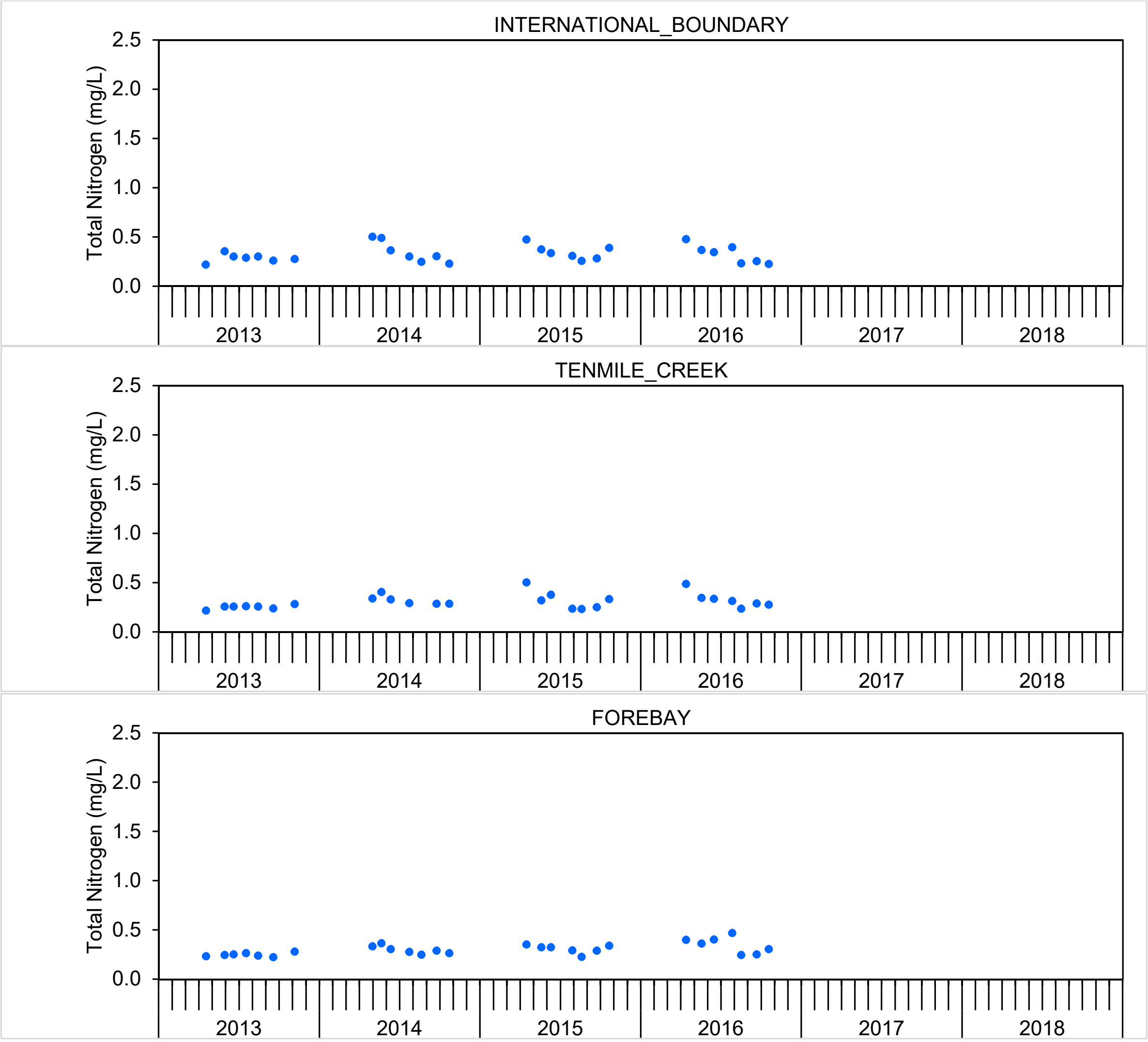


Figure A.20: Time Series Plots for Aqueous Total Nitrogen Concentrations from Sampling Stations in the Koocanusa Reservoir Study Area, 2013 to 2018

● = Downstream; ● = Upstream.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

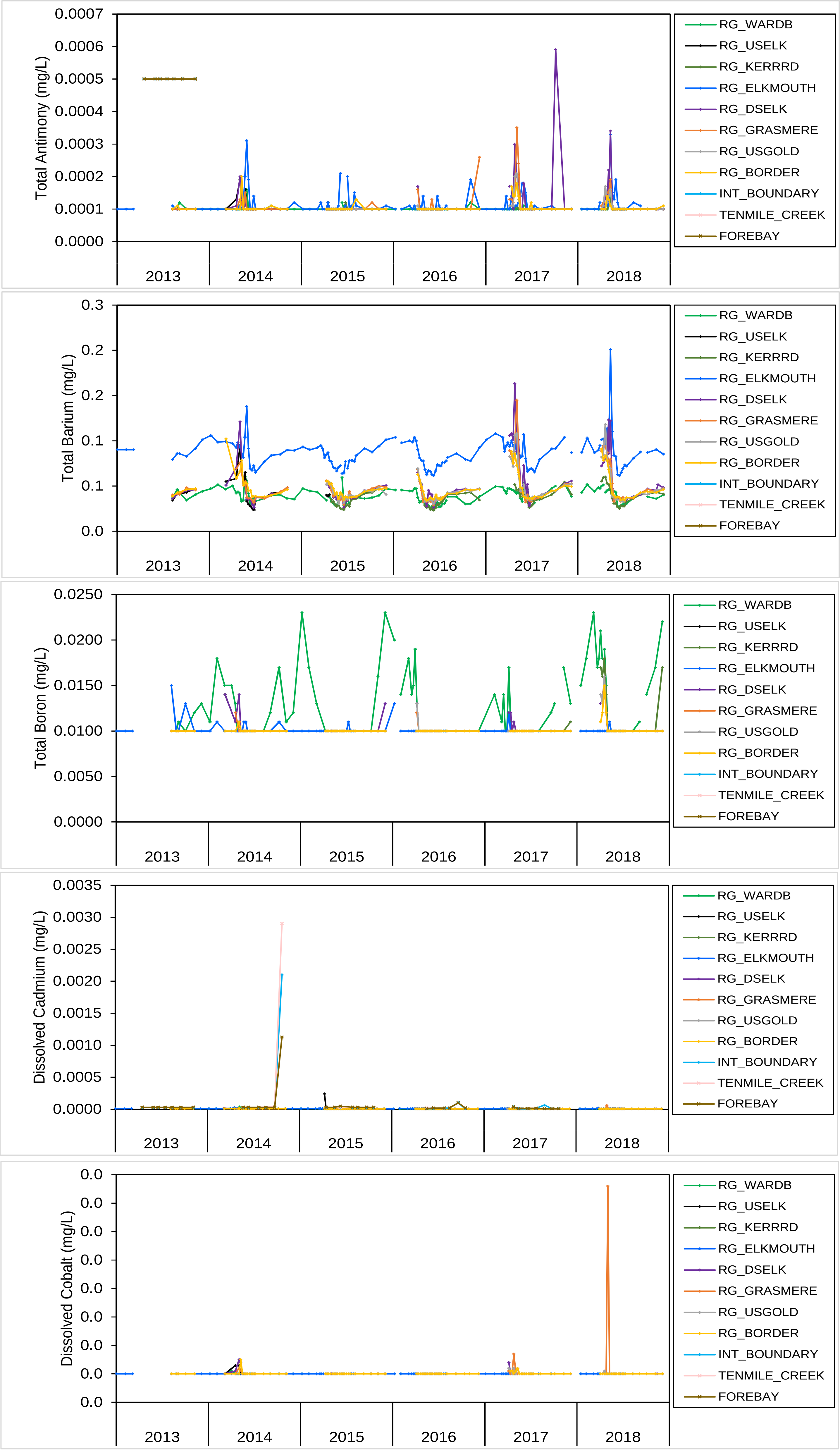


Figure A.21: Times Series Plots for Constituents with Early Warning Triggers from the Permitted Water Quality Stations, and from Montana Stations, Koocanusa Reservoir Monitoring Program 2013 to 2018

Notes:
Data represents averages of depths for each sample.
Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL.
No Nitrate-N data for US stations (International Boundary, Forebay, Tenmile Creek).

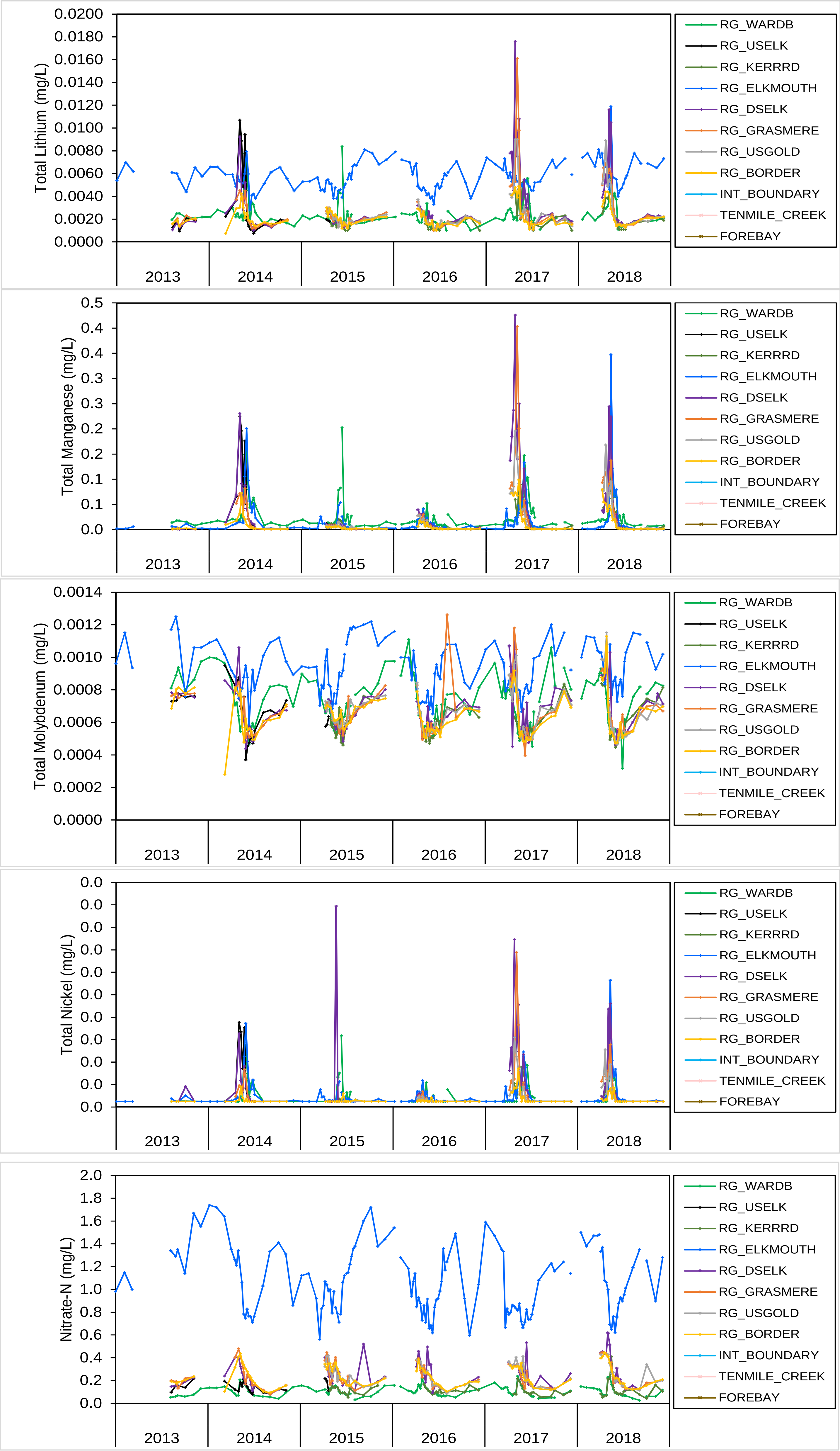


Figure A.21: Times Series Plots for Constituents with Early Warning Triggers from the Permitted Water Quality Stations, and from Montana Stations, Koocanusa Reservoir Monitoring Program 2013 to 2018

Notes:

Data represents averages of depths for each sample.

Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL.

No Nitrate-N data for US stations (International Boundary, Forebay, Tenmile Creek).

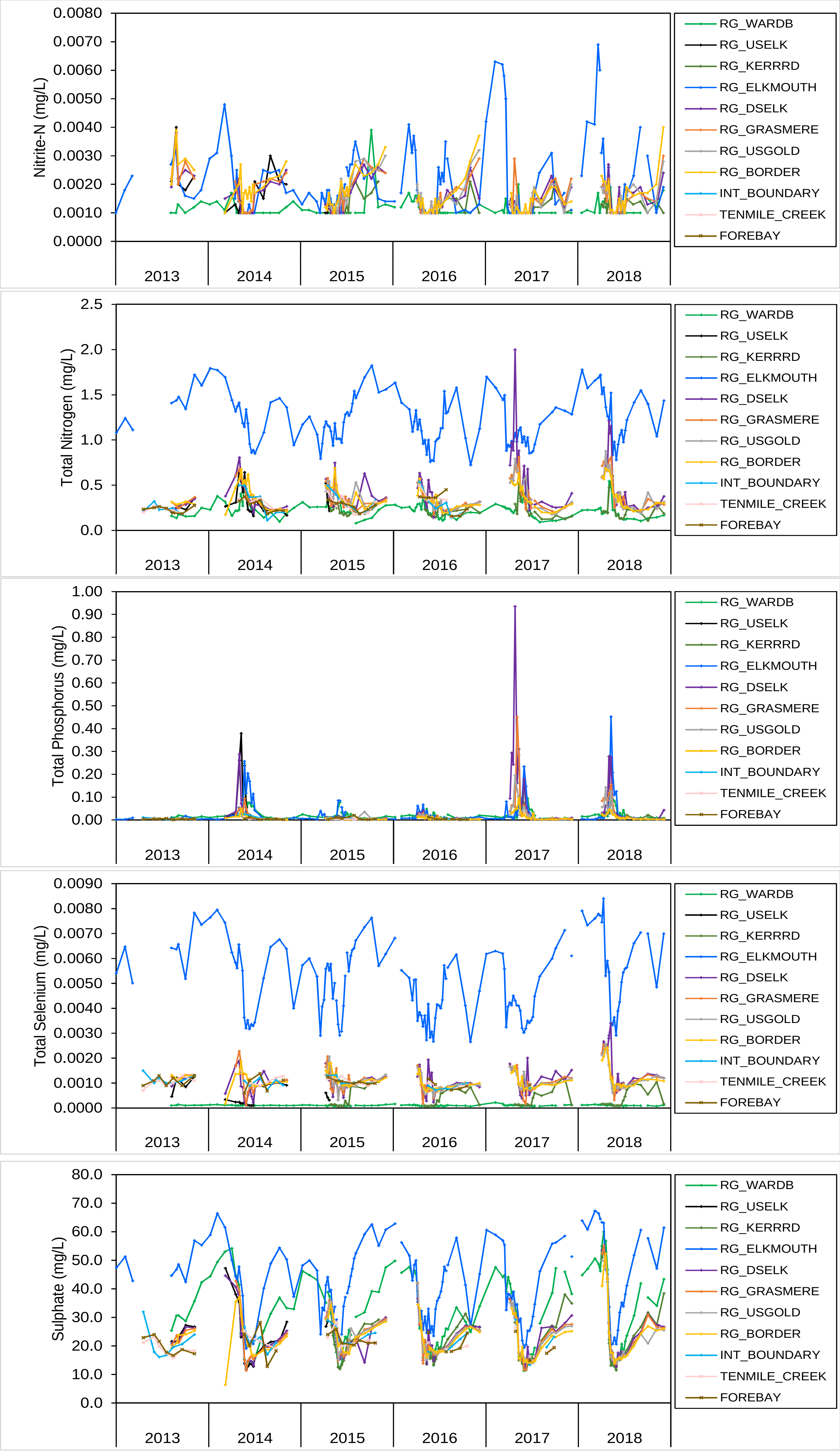


Figure A.21: **Times Series Plots for Constituents with Early Warning Triggers from the Permitted Water Quality Stations, and from Montana Stations, Koocanusa Reservoir Monitoring Program 2013 to 2018**

Notes:

Data represents averages of depths for each sample.

Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL.

No Nitrate-N data for US stations (International Boundary, Forebay, Tenmile Creek).

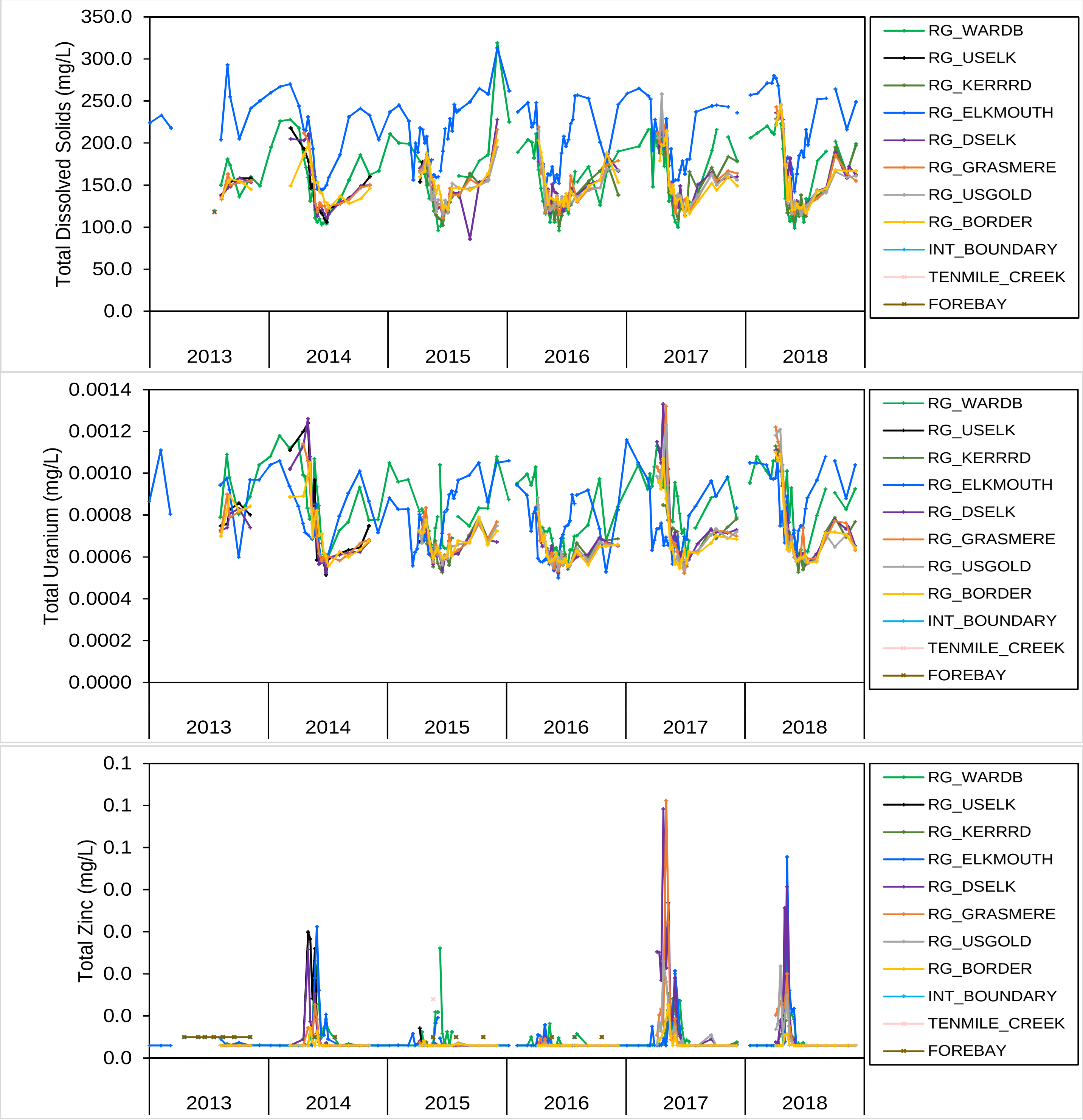


Figure A.21: Times Series Plots for Constituents with Early Warning Triggers from the Permitted Water Quality Stations, and from Montana Stations, Koocanusa Reservoir Monitoring Program 2013 to 2018

Notes:
Data represents averages of depths for each sample.
Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL.
No Nitrate-N data for US stations (International Boundary, Forebay, Tenmile Creek).

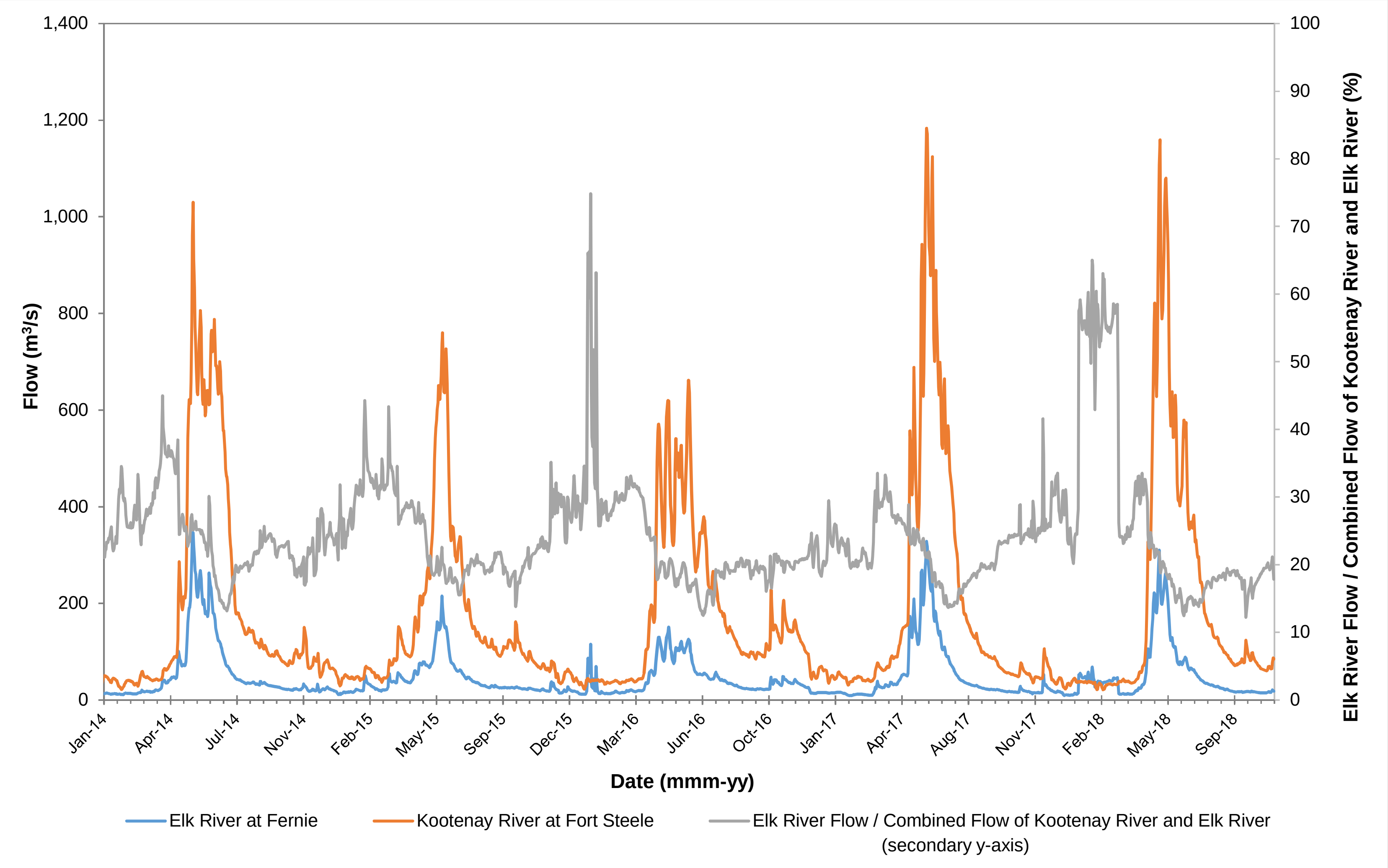


Figure A.22: **Flow Measurements at the Elk River (Station No. 08NK002) and Kootenay River (Station No. 08NG065) Water Survey of Canada Stations, 2014 to 2018**

Note: Values for the Elk River in 2018 and the Kootenay River from 2017 to 2018 are preliminary data from Environment Canada.

Table A.1: *In situ* Water Quality Measurements in Koocanusa Reservoir, 2018

Station	Date	Location (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Specific Conductivity	ORP	Secchi Depth
		Easting	Northing	m	°C		mg/L	%	µS/cm	mV	m
RG_SC	30-Apr-18	625624	5457296	Surface	11.1	7.38	13.7	135	310	-74.4	-
				0.5	11.0	7.63	13.7	135	310	-31.6	
				1.0	11.1	7.37	13.5	122	310	-28.4	
				1.5	11.0	7.41	13.3	120	309	-25.5	
RG_ER	27-Apr-18	627959	5447572	Surface	9.29	8.26	9.95	86.9	303	157.7	0.1
				0.5	8.97	8.15	9.92	86.3	302	160.5	
				1.0	8.90	8.07	9.87	85.5	302	160.1	
RG_T4	29-Apr-18	629235	5441654	Surface	6.73	7.57	12.5	103	262	-89.5	0.1
				0.5	6.75	7.55	12.5	102	266	-92.2	
				1.0	6.73	7.44	12.4	102	261	-87.5	
				1.5	6.73	7.40	12.3	101	263	-90.0	
				2.0	6.73	7.35	12.3	101	265	-90.1	
				2.5	6.77	7.40	12.5	103	260	-91.5	
				3.0	6.74	7.41	12.4	102	265	-91.3	
RG_GC	27-Apr-18	630926	5436344	Surface	11.2	7.59	12.8	113	327	-9.60	-
				0.5	7.81	7.49	12.6	106	256	2.20	
				1.0	7.91	7.33	12.6	106	264	3.70	
				1.5	8.16	7.32	12.6	107	214	6.10	
				2.0	8.05	7.27	12.3	104	248	5.50	

Note:
A profile was not collected at RG_TN due to insufficient depth.

Table A.2: **Depth Profiles from the Koocanusa Reservoir, June 2018**

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	Turbidity
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	NTU
RG_SC	13-Jun-18	625691	5457986	Surface	11.6	7.98	10.6	104	131	175	13.2
				1.5	11.9	7.90	10.6	104	130	173	13.1
RG_TN-1	11-Jun-18	627369	5453492	1	12.2	8.19	10.7	108	143	190	10.1
				2	12.1	8.19	10.3	103	143	190	10.7
				3	12.1	8.19	10.0	100	143	190	10.2
				4	12.1	8.18	9.83	98.2	143	190	10.0
				5	12.1	8.16	9.82	98.0	143	190	10.4
				6	12.2	8.17	9.65	96.3	143	190	9.90
				7	12.1	8.16	9.71	96.6	144	190	9.60
				8	12.0	8.16	9.72	96.6	143	190	10.6
				9	11.9	8.16	9.66	95.4	142	189	12.7
				10	11.8	8.13	9.69	95.7	141	189	13.2
				11	11.8	8.11	9.64	95.4	141	189	13.2
RG_TN-2	11-Jun-18	627256	5453672	1	12.3	8.22	10.1	101	144	190	9.60
				2	12.3	8.21	9.74	97.3	144	190	9.40
				3	12.2	8.19	9.76	97.9	144	190	9.50
				4	12.0	8.18	9.59	95.5	143	190	10.2
				5	11.9	8.15	9.74	96.7	142	189	10.5
				6	11.8	8.14	9.71	96.2	141	188	10.9
				7	11.7	8.11	9.66	95.3	140	188	11.6
				8	11.7	8.08	9.68	95.3	140	188	11.8
				9	11.6	8.05	9.59	94.7	140	188	12.3
				10	11.6	8.04	9.61	94.6	140	188	12.8
RG_TN-3	11-Jun-18	627367	5453710	1	12.3	8.03	10.3	103	144	191	9.00
				2	12.4	8.10	10.1	101	145	190	9.00
				3	12.4	8.13	9.99	100	145	191	8.90
				4	12.3	8.15	9.96	99.7	144	191	9.70
				5	12.3	8.15	9.92	99.3	144	190	9.60
				6	12.2	8.16	9.86	98.5	144	190	10.3
				7	12.2	8.16	9.86	98.5	144	190	10.5
				8	12.0	8.18	9.82	97.5	143	190	12.3
				9	11.9	8.18	9.77	97.3	142	190	13.2
				10	11.9	8.15	9.81	97.5	142	190	13.5
				11	11.8	8.12	9.78	96.8	142	190	13.8
RG_TN-4	11-Jun-18	627333	5453882	1	12.4	8.16	10.2	103	145	191	9.30
				2	12.4	8.16	9.95	99.7	145	191	9.30
				3	12.5	8.16	9.75	97.9	145	191	9.30
				4	12.4	8.15	9.80	98.2	145	191	9.30
				5	12.4	8.14	9.74	97.6	145	191	9.40
				6	12.4	8.13	9.62	96.4	144	190	9.90
				7	12.1	8.12	9.67	96.2	143	189	9.80
				8	11.9	8.10	9.63	95.6	141	189	10.6
				9	11.7	8.08	9.62	95.1	140	188	12.0
				10	11.7	8.06	9.61	94.7	140	188	12.1
RG_TN-5	11-Jun-18	627200	5454005	1	12.5	8.21	9.98	99.7	145	190	9.60
				2	12.5	8.22	9.77	98.1	144	190	9.10
				3	12.4	8.21	9.60	96.1	144	190	9.00
				4	12.3	8.19	9.67	96.6	144	190	9.20
				5	12.1	8.18	9.68	96.2	142	189	10.0
				6	12.1	8.16	9.57	95.6	142	189	10.1
				7	12.0	8.13	9.54	94.2	141	188	10.2
				8	11.8	8.11	9.53	94.4	141	188	10.7
				9	11.7	8.09	9.58	94.2	140	188	11.9
				10	11.7	8.08	9.47	93.3	140	188	12.4
RG_ER	9-Jun-18	633598	5449060	Surface	10.3	-	-	-	196	273	14.7
	13-Jun-18	627959	5447572	Surface	13.1	8.02	9.50	102	145	189	10.2
				1.9	12.7	7.97	8.90	96.8	145	190	9.74
RG_DSELK	13-Jun-18	627017	5445677	1	15.4	8.34	9.59	103	165	203	3.00
				2	14.7	8.31	9.76	104	164	203	3.30
				3	14.7	8.25	9.88	105	163	202	3.90
				4	13.1	8.06	10.0	102	149	193	7.80
				5	12.9	8.00	9.92	101	148	193	7.60
				6	12.9	7.94	9.93	99.7	148	193	7.30
				7	13.0	7.85	10.0	100	147	192	7.60
				8	12.2	7.84	9.98	99.7	147	194	9.10
				9	12.2	7.86	9.81	97.7	146	193	8.80
				10	12.2	7.86	9.80	97.8	146	193	9.00
				11	12.1	7.85	9.76	97.5	145	192	9.00
				12	12.1	7.85	9.80	97.6	146	193	8.60
				13	12.1	-	-	-	144	192	8.70
				14	11.6	-	-	-	155	205	9.50
				15	11.1	-	-	-	155	211	12.5

Table A.2: Depth Profiles from the Koocanusa Reservoir, June 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	Turbidity
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	NTU
RG_T4-1	9-Jun-18	630115	5441812	Surface	16.1	8.20	9.67	105	166	202	2.90
				1	16.1	8.23	9.62	105	166	201	3.30
				2	16.1	8.22	9.54	104	166	200	3.10
				3	16.1	8.23	8.98	97.6	166	200	3.10
				4	16.1	8.22	8.88	97.2	166	200	3.10
				5	16.1	8.20	8.97	97.8	166	201	3.20
				6	16.0	8.18	9.29	107	166	200	3.40
				7	15.8	8.15	9.37	103	165	201	3.70
				8	15.6	8.12	9.12	98.5	165	201	3.90
				9	15.5	8.07	9.43	102	165	201	4.20
				10	15.4	8.03	9.47	102	165	202	4.20
				11	15.3	8.00	9.35	102	165	202	7.20
				12	14.8	7.98	9.25	99.5	165	205	4.90
				13	13.6	7.98	9.35	100	164	210	7.20
				14	12.2	-	-	-	162	215	10.1
				15	11.8	-	-	-	162	216	12.7
				16	11.5	-	-	-	162	219	14.1
				17	11.3	-	-	-	162	220	13.4
				18	11.2	-	-	-	165	223	12.6
				19	11.2	-	-	-	165	224	13.7
				20	10.8	-	-	-	163	224	14.6
				21	10.8	-	-	-	163	224	14.8
RG_T4-2	8-Jun-18	629831	5442006	1	16.6	7.97	8.44	92.2	170	202	2.70
				2	16.6	7.98	8.43	92.2	170	202	2.70
				3	16.5	8.00	8.46	92.4	170	203	2.70
				4	16.5	8.04	8.36	91.2	170	203	2.60
				5	16.3	8.05	8.43	92.2	169	203	2.70
				6	15.7	8.06	8.43	92.5	166	202	3.20
				7	15.2	8.07	8.32	91.3	164	201	3.20
				8	14.3	8.06	8.28	90.6	160	201	3.60
				9	14.1	8.05	8.30	89.9	159	201	4.30
				10	13.8	8.03	8.34	89.4	159	202	4.60
				11	13.3	7.97	8.19	85.5	158	204	6.00
				12	12.2	7.88	8.08	84.7	160	211	8.40
				13	11.5	7.86	8.03	83.6	171	230	10.5
				14	11.2	-	-	-	173	235	12.1
				15	11.2	-	-	-	173	236	14.0
				16	11.1	-	-	-	174	236	13.6
				17	11.1	-	-	-	175	238	13.6
				18	11.0	-	-	-	172	236	14.3
				19	11.0	-	-	-	171	235	14.8
RG_T4-3	9-Jun-18	629695	5441699	Surface	16.0	8.23	10.1	109	168	203	3.20
				1	16.0	8.29	9.89	108	168	203	3.20
				2	16.0	8.30	9.88	108	168	203	3.40
				3	16.1	8.29	9.55	105	168	203	3.40
				4	16.0	8.28	9.61	106	168	203	3.40
				5	16.0	8.28	9.48	103	168	203	3.30
				6	15.9	8.27	9.45	103	167	202	3.60
				7	15.7	8.27	9.37	102	166	202	3.80
				8	15.6	8.24	9.49	104	165	202	3.80
				9	15.4	8.20	9.37	102	165	202	4.10
				10	15.3	8.17	9.39	102	164	202	3.60
				11	14.5	8.13	9.22	99.4	163	203	4.00
				12	14.1	8.09	9.37	101	164	207	5.80
				13	13.0	8.04	9.34	101	166	216	8.90
				14	11.8	-	-	-	160	215	12.9
				15	11.6	-	-	-	161	217	12.9
				16	11.5	-	-	-	161	218	13.6
				17	11.5	-	-	-	162	218	14.1
				18	11.5	-	-	-	162	219	14.2
				19	11.5	-	-	-	162	219	14.8

Table A.2: Depth Profiles from the Koocanusa Reservoir, June 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	Turbidity
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	NTU
RG_T4-4	9-Jun-18	629494	5441783	Surface	16.0	8.36	10.1	112	170	206	2.90
				1	16.2	8.43	9.51	104	170	204	3.10
				2	16.1	8.45	9.48	106	169	203	3.00
				3	16.1	8.45	9.46	104	169	203	3.30
				4	16.1	8.47	9.62	105	169	203	3.20
				5	16.1	8.42	9.32	101	169	203	3.40
				6	16.1	8.40	9.43	103	169	203	3.20
				7	16.1	8.38	9.56	105	169	203	3.40
				8	15.7	8.37	9.18	100	166	202	3.80
				9	15.3	8.32	9.56	103	165	203	4.10
				10	15.0	8.27	9.03	98.2	166	205	4.90
				11	14.7	8.22	9.10	97.2	167	208	5.80
				12	14.3	8.17	9.04	98.1	165	208	6.90
				13	13.2	-	-	-	171	221	8.80
				14	11.9	-	-	-	156	209	13.6
				15	11.7	-	-	-	155	207	13.8
				16	11.6	-	-	-	155	208	13.4
				17	11.6	-	-	-	155	209	14.0
				18	11.6	-	-	-	156	210	15.9
				19	11.5	-	-	-	157	211	15.6
RG_T4-5	9-Jun-18	629430	5441547	Surface	16.5	8.45	9.81	109	171	204	2.60
				1	16.5	8.47	9.59	106	170	203	2.80
				2	16.5	8.47	9.47	104	170	203	2.70
				3	16.4	8.47	9.31	103	170	203	2.80
				4	16.4	8.46	9.45	104	170	203	2.80
				5	16.2	8.45	9.44	104	169	203	3.10
				6	16.1	8.43	9.60	105	168	203	3.40
				7	15.8	8.38	9.52	103	166	202	3.60
				8	15.4	8.33	9.00	97.0	169	208	5.00
				9	14.7	8.28	9.43	101	164	205	6.90
				10	14.3	8.24	9.53	101	160	201	6.90
				11	14.1	8.16	9.71	102	159	202	6.90
				12	13.8	-	-	-	162	206	8.20
				13	12.7	-	-	-	173	224	11.4
				14	12.0	-	-	-	145	195	14.0
				15	11.9	-	-	-	145	193	13.1
				16	11.8	-	-	-	145	193	14.0
				17	11.8	-	-	-	145	193	14.6
				18	11.7	-	-	-	149	199	15.1
				19	11.6	-	-	-	152	204	14.9
				20	11.6	-	-	-	153	205	14.5
RG_GC	8-Jun-18	630302	5436933	Surface	17.2	7.95	8.97	99.6	161	179	2.50
				1	16.7	7.97	9.03	99.4	165	187	2.80
				2	15.8	7.99	9.17	99.6	163	187	3.20
				3	14.8	7.95	9.13	96.4	154	188	3.70
				4	14.6	7.90	8.92	94.0	152	188	3.90
				5	14.3	7.88	8.84	92.4	151	188	3.90
				6	14.0	7.82	8.57	88.0	150	189	4.10

Table A.3: Depth Profile for RG_DSELK in July 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	Turbidity
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	NTU
RG_DSELK	31-Jul-18	627017	5445677	Surface	22.2	8.64	8.73	109	210	222	1.52
				1	22.1	8.64	8.76	109	210	223	1.45
				2	22.0	8.64	8.75	109	210	223	1.48
				3	21.3	8.64	8.97	110	210	226	1.67
				4	21.2	8.63	9.06	111	210	227	1.61
				5	20.7	8.64	9.28	113	212	231	1.59
				6	19.5	8.60	9.50	113	218	244	1.64
				7	18.9	8.58	9.39	110	228	259	1.60
				8	18.3	8.54	9.24	107	235	269	1.92
				9	17.7	8.46	9.01	103	208	242	2.13
				10	17.6	8.45	8.97	102	207	241	2.10
				11	17.4	8.41	8.86	101	200	234	2.37
				12	17.3	8.40	8.82	99.9	202	236	2.39
				13	16.6	8.28	8.36	93.3	190	227	2.96
				14	16.5	8.26	8.22	91.8	190	227	3.05
				15	16.1	8.20	7.83	86.4	190	229	2.09
				16	15.3	8.09	7.19	77.5	186	230	3.45
				17	14.0	8.04	7.02	74.0	178	224	3.80
				18	13.0	8.07	7.43	76.0	170	221	3.30
				19	13.0	8.07	7.43	75.9	170	221	3.30

Table A.4: Depth Profile for RG_DSELK in August 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	TDS
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	mg/L
RG_SC	29-Aug-18	625624	5457296	Surface	19.1	8.53	8.95	108	217	244	159
				1	19.1	8.54	8.97	106	217	244	159
				2	19.1	8.54	8.98	107	217	244	159
				3	19.1	8.54	8.99	107	216	244	158
				4	19.0	8.55	8.99	107	216	244	158
				5	19.0	8.54	8.99	106	216	244	158
				6	19.0	8.54	8.99	106	216	244	158
				7	18.9	8.53	8.98	106	216	244	159
				8	18.8	8.52	8.97	106	216	244	159
				9	18.6	8.51	8.97	105	216	245	160
				10	18.4	8.48	8.97	105	217	249	161
				11	18.1	8.46	8.99	104	218	252	163
				12	16.0	8.26	8.72	97.2	225	272	176
				13	15.8	8.24	8.65	95.9	226	274	178
				14	15.8	8.24	8.62	95.4	226	248	178
				15	15.7	8.24	8.60	95.2	226	248	179
				16	15.7	8.23	8.59	95.0	226	275	179
RG_TN-1	31-Aug-18	627369	5453492	Surface	19.1	8.85	9.04	97.6	214	242	157
				1	19.1	8.86	9.04	97.6	214	242	157
				2	19.1	8.86	9.04	97.7	214	242	157
				3	19.1	8.85	9.04	97.6	214	242	157
				4	19.1	8.85	9.04	97.6	214	242	157
				5	19.1	8.83	9.03	97.6	214	242	157
				6	19.1	8.82	9.03	97.5	214	242	157
				7	19.1	8.82	9.03	97.5	214	242	157
				8	19.1	8.82	9.04	97.5	214	242	157
				9	18.9	8.81	9.04	97.3	214	243	158
				10	18.7	8.79	9.02	96.7	215	245	159
				11	15.9	8.66	8.96	90.8	225	272	177
				12	15.9	8.56	8.72	88.2	225	272	177
				13	15.8	8.50	8.60	87.0	225	272	177
				14	15.8	8.50	8.58	86.8	225	272	177
				15	15.7	8.48	8.44	85.0	225	274	178
RG_TN-2	31-Aug-18	627256	5453672	Surface	19.1	8.85	9.06	97.8	214	242	157
				1	19.1	8.85	9.07	97.9	214	242	157
				2	19.1	8.85	9.07	97.9	214	242	157
				3	19.1	8.85	9.07	97.9	214	242	157
				4	19.1	8.85	9.06	97.8	214	242	157
				5	19.1	8.85	9.06	97.8	214	242	157
				6	19.0	8.84	9.06	97.7	214	242	157
				7	19.0	8.84	9.05	97.7	214	242	157
				8	18.9	8.84	9.05	97.6	214	242	157
				9	18.9	8.83	9.05	97.5	214	242	157
				10	18.7	8.81	9.03	96.9	215	244	159
				11	17.5	8.67	8.87	92.8	218	254	165
				12	15.7	8.50	8.68	87.4	225	273	178
				13	15.7	8.50	8.65	87.1	225	273	178
RG_TN-3	31-Aug-18	627367	5453710	Surface	19.1	8.86	8.88	96.0	215	242	157
				1	19.1	8.86	9.03	97.7	215	242	157
				2	19.1	8.85	9.05	97.8	215	242	157
				3	19.1	8.85	9.05	97.8	214	242	157
				4	19.1	8.85	9.05	97.8	214	242	157
				5	19.1	8.85	9.05	97.8	214	242	157
				6	19.1	8.85	9.05	97.7	214	242	157
				7	19.0	8.84	9.06	97.7	214	242	157
				8	18.9	8.84	9.06	97.6	214	242	157
				9	18.9	8.83	9.05	97.4	214	242	158
				10	18.4	8.80	9.00	96.1	216	247	160
				11	16.6	8.71	8.93	91.6	222	265	172
				12	15.7	8.53	8.66	87.2	225	274	178
				13	15.6	8.50	8.62	86.7	225	274	178
				14	15.6	8.48	8.58	86.3	225	274	178
RG_TN-4	31-Aug-18	627333	5453882	Surface	19.3	8.84	9.07	98.4	216	242	157
				1	19.2	8.84	9.07	98.3	215	242	157
				2	19.2	8.85	9.08	98.3	215	242	157
				3	19.1	8.85	9.08	98.2	215	242	157
				4	19.1	8.85	9.08	98.1	214	242	157
				5	19.1	8.84	9.08	98.0	214	242	157
				6	19.0	8.84	9.08	98.0	214	242	157
				7	19.0	8.84	9.08	97.9	214	242	157
				8	18.9	8.83	9.08	97.8	214	242	157
				9	18.9	8.83	9.07	97.8	214	242	157
				10	18.6	8.79	9.03	96.6	216	246	160
				11	17.6	8.69	8.92	93.4	217	253	164
				12	15.6	8.60	8.88	89.3	225	275	179
				13	15.5	8.49	8.69	87.2	225	275	179
RG_TN-5	31-Aug-18	627200	5454005	Surface	19.4	8.84	9.05	98.5	216	242	157
				1	19.3	8.84	9.08	98.5	216	242	157
				2	19.2	8.84	9.10	98.5	215	242	157
				3	19.1	8.84	9.11	98.5	215	242	157
				4	19.1	8.84	9.11	98.5	215	242	157
				5	19.1	8.84	9.11	98.4	214	242	157
				6	19.0	8.83	9.11	98.3	214	242	157
				7	19.0	8.83	9.11	98.3	214	242	157
				8	19.0	8.83	9.11	98.2	214	242	157
				9	18.9	8.83	9.10	98.1	214	242	157
				10	18.9	8.82	9.09	97.9	214	242	158
				11	16.6	8.71	9.06	92.9	223	266	173
				12	15.5	8.53	8.78	88.0	225	275	178
				13	15.5	8.48	8.71	87.3	225	275	178

Table A.4: Depth Profile for RG_DSELK in August 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	TDS
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	mg/L
RG_ER	30-Aug-18	627959	5447572	Surface	19.7	8.58	8.89	107	212	236	153
				1	19.7	8.56	8.90	107	212	236	153
				2	19.7	8.57	8.90	107	212	236	154
				3	19.6	8.56	8.92	107	212	237	154
				4	19.5	8.56	8.94	107	213	238	155
				5	19.4	8.55	8.95	107	213	238	155
				6	19.4	8.55	8.95	107	213	239	155
				7	19.3	8.53	8.96	107	213	239	155
				8	19.2	8.52	8.96	107	214	241	156
				9	19.1	8.51	8.96	106	215	242	158
				10	18.9	8.49	8.93	106	216	245	159
				11	18.6	8.46	8.92	105	217	246	161
				12	17.7	8.37	8.86	102	220	255	165
RG_ER	30-Aug-18	627959	5447572	13	16.6	8.22	8.54	96.6	222	265	172
				14	16.5	8.21	8.44	95.2	223	266	173
				15	16.5	8.21	8.39	94.5	224	267	174
				16	16.4	8.29	8.23	93.1	223	266	173
				17	16.1	8.19	8.19	91.7	227	274	178
RG_DSELK	4-Sep-18	627017	5445677	Surface	18.7	8.60	8.89	103	208	236	-
				1	18.7	8.60	8.89	103	208	236	-
				2	18.7	8.60	8.88	103	208	236	-
				3	18.7	8.60	8.88	103	208	236	-
				4	18.7	8.60	8.88	103	208	236	-
				5	18.7	8.59	8.87	103	208	236	-
				6	18.7	8.59	8.87	103	208	236	-
				7	18.7	8.58	8.86	103	208	236	-
				8	18.7	8.59	8.86	103	208	236	-
				9	18.7	8.58	8.86	103	208	236	-
				10	18.7	8.58	8.85	103	208	236	-
				11	18.7	8.58	8.85	103	208	236	-
				12	18.7	8.58	8.85	103	208	236	-
				13	18.7	8.58	8.84	103	208	236	-
				14	18.7	8.58	8.84	103	208	237	-
				15	18.7	8.58	8.84	103	208	237	-
				16	18.3	8.53	8.80	101	215	246	-
				17	16.6	8.36	8.57	95.1	234	279	-
				18	16.0	8.27	8.29	91.0	230	278	-
				19	15.8	8.23	8.16	89.1	230	279	-
				20	15.8	8.23	8.14	88.9	231	280	-
				21	15.7	8.23	8.12	88.5	234	285	-
				22	15.6	8.21	8.01	87.2	236	287	-
RG_T4-1	30-Aug-18	630115	5441812	Surface	19.4	8.27	8.49	92.4	-	-	-
				1	19.3	8.82	8.89	96.5	205	230	149
				2	19.3	8.82	8.90	96.5	205	230	149
				3	19.3	8.82	8.91	96.5	204	230	149
				4	19.3	8.81	8.90	96.5	204	230	149
				5	19.2	8.81	8.90	96.4	204	230	149
				6	19.2	8.81	8.89	96.4	204	229	149
				7	19.2	8.81	8.89	96.3	204	229	149
				8	19.2	8.81	8.89	96.2	204	229	149
				9	19.2	8.81	8.88	96.2	204	229	149
				10	19.2	8.81	8.88	96.1	204	229	-
				11	19.2	8.81	8.88	96.1	204	229	149
				12	19.2	8.80	8.88	96.0	204	230	149
				13	19.2	8.80	8.87	96.0	204	230	149
				14	19.1	8.79	8.87	95.9	205	230	150
				15	19.1	8.79	8.84	95.6	205	231	150
				16	19.1	8.77	8.79	94.9	207	233	152
				17	18.8	8.72	8.67	93.1	212	241	157
				18	18.1	8.54	8.22	86.9	224	258	168
				19	17.2	8.50	8.12	84.5	228	268	174
				20	16.5	8.38	7.60	77.9	227	271	176
				21	15.8	8.29	7.04	71.2	221	268	174
				22	15.3	8.21	6.71	67.1	208	255	166
				23	15.0	8.10	6.26	62.1	203	251	163
RG_T4-2	30-Aug-18	629831	5442006	Surface	19.7	8.81	8.88	97.1	206	230	149
				1	19.3	8.82	8.94	97.2	205	230	149
				2	19.3	8.82	8.94	97.1	205	230	149
				3	19.3	8.82	8.94	97.0	205	230	149
				4	19.3	8.81	8.94	97.0	205	230	149
				5	19.3	8.81	8.94	96.9	204	230	149
				6	19.2	8.80	8.93	96.8	204	230	149
				7	19.2	8.80	8.93	96.7	204	229	149
				8	19.2	8.79	8.93	96.7	204	230	149
				9	19.2	8.79	8.92	96.6	204	230	149
				10	19.2	8.78	8.91	96.4	204	230	149
				11	19.2	8.78	8.89	96.2	204	230	150
				12	19.2	8.78	8.87	96.0	204	230	150
				13	19.2	8.78	8.87	96.0	204	230	150
				14	19.1	8.78	8.85	95.7	205	230	150
				15	19.1	8.77	8.83	95.4	206	232	151
				16	19.0	8.75	8.78	94.7	208	235	153
				17	18.9	8.73	8.71	93.8	210	238	155
				18	18.2	8.57	8.29	88.0	220	253	164
				19	16.8	8.43	7.82	80.6	229	271	176
				20	16.2	8.32	7.32	74.5	223	268	174
				21	15.8	8.30	7.06	71.4	222	269	175
				22	15.5	8.21	6.49	65.1	210	257	167
				23	14.0	8.11	5.87	57.0	191	242	157

Table A.4: Depth Profile for RG_DSELK in August 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	TDS
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	mg/L
RG_T4-3	29-Aug-18	629695	5441699	Surface	19.2	8.77	8.90	96.5	205	231	-
				1	19.2	8.77	8.91	96.5	206	231	-
				2	19.2	8.77	8.90	96.5	205	231	-
				3	19.2	8.76	8.90	96.4	206	231	-
				4	19.2	8.78	8.89	96.4	205	231	-
				5	19.2	8.78	8.89	96.3	205	231	-
				6	19.2	8.77	8.88	96.2	206	231	-
				7	19.2	8.78	8.88	96.2	205	231	-
				8	19.2	8.77	8.87	96.1	205	231	-
				9	19.2	8.76	8.86	96.0	206	231	-
				10	19.2	8.77	8.85	95.9	206	231	-
				11	19.2	8.77	8.84	95.8	206	231	-
				12	19.2	8.77	8.82	95.5	206	231	-
				13	19.1	8.71	8.67	93.5	210	237	-
				14	18.6	8.61	8.47	90.5	218	248	-
				15	17.7	8.57	8.48	88.8	227	265	-
				16	17.1	8.50	8.24	85.6	227	267	-
				17	16.8	8.49	8.18	84.2	233	277	-
				18	16.4	8.46	8.03	82.2	236	281	-
				19	16.3	8.46	8.02	81.7	237	284	-
				20	16.2	8.43	7.78	78.5	236	284	-
				21	15.7	8.25	6.82	68.5	219	269	-
				22	15.4	8.21	6.62	66.2	215	264	-
				23	14.7	8.06	5.99	58.8	196	246	-
				24	14.2	8.10	5.95	57.5	187	244	-
RG_T4-4	31-Aug-18	629494	5441783	Surface	19.8	8.85	8.89	97.6	207	230	149
				1	19.4	8.85	8.95	97.4	205	229	149
				2	19.4	8.86	8.97	97.5	204	229	149
				3	19.3	8.85	8.97	97.4	204	229	149
				4	19.3	8.85	8.98	97.4	204	229	149
				5	19.2	8.84	9.00	97.4	204	230	149
				6	19.2	8.84	8.99	97.3	204	230	149
				7	19.1	8.82	8.94	96.7	204	230	149
				8	19.1	8.81	8.94	96.6	204	230	149
				9	19.1	8.81	8.91	96.3	205	231	150
				10	19.1	8.80	8.89	96.1	207	233	151
				11	19.1	8.79	8.87	95.8	208	234	152
				12	19.1	8.79	8.87	95.8	207	234	152
				13	19.1	8.79	8.86	95.7	207	233	152
				14	19.1	8.79	8.86	95.6	207	234	152
				15	19.0	8.78	8.84	95.3	210	237	154
				16	18.6	8.75	8.83	94.5	215	245	159
				17	18.3	8.69	8.68	92.2	218	250	163
				18	17.0	8.61	8.49	87.9	231	272	177
				19	16.5	8.52	8.25	84.6	230	274	178
				20	16.4	8.50	8.20	83.9	229	274	178
				21	16.2	8.46	8.03	81.8	224	270	175
				22	15.8	8.41	7.62	76.9	219	265	173
RG_T4-5	31-Aug-18	629430	5441547	Surface	19.9	8.84	8.63	94.7	208	230	150
				1	19.8	8.85	8.90	97.5	207	230	149
				2	19.7	8.85	8.96	98.0	206	230	149
				3	19.5	8.85	8.99	97.9	205	229	149
				4	19.4	8.86	9.02	98.1	205	229	149
				5	19.3	8.86	9.03	98.1	205	229	149
				6	19.3	8.85	9.03	97.9	205	230	150
				7	19.2	8.85	9.01	97.6	205	230	150
				8	19.2	8.83	8.98	97.1	206	232	151
				9	19.1	8.83	8.96	96.9	206	233	151
				10	19.1	8.82	8.94	96.7	206	232	150
				11	19.1	8.82	8.94	96.6	205	231	150
				12	19.1	8.81	8.91	96.2	205	232	151
				13	19.1	8.80	8.89	96.0	207	233	152
				14	18.8	8.75	8.88	95.4	214	242	157
				15	18.7	8.74	8.87	95.2	214	243	158
				16	18.5	8.72	8.86	94.6	217	248	161
				17	18.2	8.69	8.81	93.4	219	252	164
				18	17.2	8.60	8.63	89.7	228	268	174
				19	16.6	8.51	8.37	86.0	227	271	176
				20	16.5	8.48	8.13	83.3	228	272	177
				21	16.2	8.45	7.94	80.9	229	275	179
				22	15.7	8.35	7.30	73.5	217	264	172
				23	15.5	8.34	7.20	72.3	215	263	171

Table A.4: Depth Profile for RG_DSELK in August 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductivity	TDS
		Easting	Northing	m	°C		mg/L	%	µS/cm	µS/cm	mg/L
RG_GC	30-Aug-18	630926	5436344	0	19.0	8.79	8.94	96.4	202	228	-
				1	19.0	8.80	8.91	96.2	202	228	-
				2	19.0	8.80	8.88	95.8	202	228	-
				3	19.0	8.80	8.88	95.7	202	228	-
				4	19.0	8.80	8.87	95.7	202	228	-
				5	19.0	8.80	8.86	95.6	202	228	-
				6	19.0	8.79	8.85	95.5	202	228	-
				7	19.0	8.79	8.85	95.4	202	228	-
				8	19.0	8.79	8.84	95.4	202	228	-
				9	19.0	8.79	8.84	95.4	202	228	-
				10	19.0	8.79	8.84	95.3	202	228	-
				11	19.0	8.79	8.83	95.3	202	228	-
				12	19.0	8.79	8.83	95.2	202	228	-
				13	19.0	8.79	8.82	95.1	202	228	-
				14	19.0	8.78	8.79	94.8	203	229	-
				15	18.9	8.75	8.72	93.9	207	235	-
				16	18.8	8.74	8.68	93.3	208	236	-
				17	18.6	8.69	8.60	92.1	212	242	-
				18	18.5	8.66	8.51	90.7	212	243	-
				19	18.0	8.60	8.40	88.8	220	254	-
				20	17.4	8.50	7.98	83.2	219	257	-
				21	17.1	8.43	7.76	80.7	221	261	-
				22	16.6	8.35	7.40	76.1	222	264	-
				23	16.4	8.30	7.22	73.8	221	264	-
				24	16.2	8.26	6.99	71.3	220	264	-
				25	15.4	8.12	6.01	60.5	212	260	-
				26	13.4	8.01	5.52	53.0	182	234	-
				27	13.2	7.97	5.35	51.1	139	231	-

Table A.5: Depth Profile for RG_T4 in October 2018

Station	Date	UTM (11U, NAD83)		Depth	Temperature	pH	Dissolved Oxygen		Conductivity	Specific Conductance	TDS	Turbidity
		Easting	Northing	m	˚C		mg/L	%	µS/cm	µS/cm	mg/L	NTU
RG_T4-3	9-Oct-18	629695	5441699	0	12.9	8.06	9.25	87.6	207	269	175	0.37
				1	12.9	8.13	9.22	87.4	207	270	175	0.35
				2	12.9	8.15	9.21	87.3	207	270	175	0.36
				3	12.9	8.16	9.20	87.2	208	270	175	0.36
				4	12.9	8.17	9.20	87.1	208	270	175	0.34
				5	12.9	8.18	9.19	87.1	208	270	175	0.34
				6	12.9	8.18	9.19	87.1	208	270	175	0.33
				7	12.9	8.19	9.18	87.0	208	270	175	0.36
				8	12.9	8.20	9.18	87.0	208	270	176	0.36
				9	12.9	8.27	9.18	86.9	208	270	176	0.36
				10	12.9	8.21	9.18	86.9	208	270	175	0.37
				11	12.9	8.22	9.18	86.9	208	270	176	0.34
				12	12.9	8.23	9.18	86.8	208	270	176	0.35
				13	12.8	8.23	9.17	86.8	208	271	176	0.37
				14	12.8	8.23	9.17	86.8	208	271	176	0.38
				15	12.8	8.24	9.18	86.8	208	271	176	0.33
				16	12.8	8.24	9.19	86.6	208	273	176	0.35
				17	12.2	8.24	9.31	86.8	212	281	182	0.56
				18	12.2	8.22	9.33	86.9	213	282	182	0.48
				19	11.9	8.21	9.38	86.4	218	293	188	0.81
				20	11.5	8.16	9.41	86.5	219	294	191	0.23
				21	11.6	8.16	9.41	86.5	220	297	193	2.59
				22	11.4	8.14	9.33	85.5	221	298	194	2.69

Table A.6: Turbidity Measurements from the Elk River Plume Delineation, June 2018

Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
					1 (right bank - looking d/s [B])	2 [C]	3 [D]	4 [E]	5 (left bank looking d/s [F])
Within Elk River Outlet Arm	9-Jun-2018	outlet (T1)	0.5	483	14.8	14.1	13.2	14.8	14.8
			1.0		14.0	-	14.2	14.7	15.2
			1.5		14.1	-	13.9	14.9	15.5
			2.0		-	-	-	14.9	15.7
		250 m downstream (T2)	0.5	500	13.6	14.4	13.1	14.0	14.9
			1.0		13.7	14.8	15.6	14.0	14.9
		500 m downstream (T3)	0.5	500	12.5	12.1	11.3	12.9	14.7
			1.0		13.0	12.7	12.6	13.1	14.8
			1.5		13.1	12.4	-	-	14.9
			2.0		12.6	-	-	-	15.0
			2.5		-	-	-	-	15.1
			3.0		-	-	-	-	15.0
			3.5		-	-	-	-	15.4
			4.0		-	-	-	-	15.5
			4.5		-	-	-	-	15.4
			5.0		-	-	-	-	15.1
			5.5		-	-	-	-	15.7
		750 m downstream (T4)	0.5	500	5.2	4.7	4.9	5.4	8.7
			1.0		10.3	9.7	9.7	10.7	10.8
			1.5		11.4	11.3	11.6	11.8	11.1
			2.0		12.4	-	12.1	12.8	12.7
			2.5		12.5	-	12.1	13.7	12.7
			3.0		-	-	-	-	14.9
		1,000 m downstream (T5)	0.5	530	5.1	3.0	4.7	-	5.6
			1.0		5.5	5.6	5.8	7.2	8.9
			1.5		7.9	8.3	8.7	-	9.9
			2.0		11.1	10.3	11.3	13.2	11.4
			2.5		11.6	11.7	11.7	-	12.3
			3.0		12.2	11.5	12.7	14.0	13.3
			3.5		12.2	11.8	-	-	14.7
			4.0		-	12.1	-	14.3	-
			4.5		-	-	-	-	-
			5.0		-	-	-	14.1	-
		1,250 m downstream (T6)	0.5	550	-	-	-	2.6	-
			1.0		4.4	3.4	3.0	3.0	3.8
			1.5		-	-	-	3.7	-
			2.0		7.3	5.9	4.5	5.1	8.7
			2.5		-	-	-	5.9	-
			3.0		9.2	9.6	6.7	6.0	10.0
			3.5		-	-	-	6.7	-
			4.0		10.3	10.7	13.7	9.9	11.1
			4.5		-	-	-	10.6	-
			5.0		12.2	11.5	14.6	-	12.1
			5.5		-		-	-	-
			6.0		-		-	-	12.9
		1,500 m downstream (T7)	1.0	1,200	2.7	3.2	3.7	2.9	2.6
			2.0		3.0	3.7	4.1	3.1	9.2
			3.0		6.7	4.0	5.3	5.1	15.8
			4.0		10.4	9.1	5.4	6.3	13.0
			5.0		11.4	12.5	8.3	12.5	11.8
			6.0		-	-	12.1	14.2	-
	10-Jun-2018	mouth of Elk River Outlet Arm (T8)	1.0	1,300	2.7	3.0	3.5	3.4	3.2
			2.0		2.7	3.3	3.5	3.5	3.6
			3.0		3.0	7.3	5.5	4.6	4.4
			4.0		6.3	7.8	6.0	4.7	5.3
			5.0		6.9	8.0	6.2	4.7	5.7
			6.0		8.3	8.1	6.6	6.9	6.4
			7.0		8.8	8.3	6.9	7.1	7.5
			8.0		9.4	8.8	7.8	8.3	8.4
			9.0		9.7	10.5	10.0	9.5	9.4
Upstream of the Elk River Outlet Arm	10-Jun-2018	3,000 m upstream (T23)	1.0	1,100	11.4	13.4	10.7	10.6	6.0
			2.0		11.6	11.7	11.7	10.6	6.0
			3.0		11.4	11.8	11.9	10.5	6.0
			4.0		11.4	11.7	12.1	10.7	7.1
			5.0		11.4	11.7	12.1	10.7	9.5
			6.0		11.4	12.1	12.1	10.9	10.1
			7.0		11.7	12.9	12.2	10.9	10.5
			8.0		11.6	13.4	12.2	12.2	11.2
			9.0		12.0	13.7	12.3	12.4	11.2
			10.0		12.9	13.9	12.9	13.9	11.1
			11.0		14.1	14.6	14.7	-	13.7
			12.0		-	-	-	-	-
		2,000 m upstream (T22)	1.0	1,400	11.7	10.5	8.5	7.0	4.7
			2.0		11.6	10.7	8.7	6.9	4.7
			3.0		11.6	10.9	9.8	7.3	4.9
			4.0		11.6	10.9	9.9	9.1	4.8
			5.0		11.7	10.9	10.3	10.6	4.8
			6.0		11.6	11.2	10.8	11.8	5.7

Table A.6: Turbidity Measurements from the Elk River Plume Delineation, June 2018

Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
					1 (right bank - looking d/s [B])	2 [C]	3 [D]	4 [E]	5 (left bank looking d/s [F])
Upstream of the Elk River Outlet Arm	10-Jun-2018	2,000 m upstream (T22)	7.0	1,400	12.0	11.3	11.1	12.8	9.6
			8.0		13.2	11.2	12.7	13.6	-
			9.0		13.8	11.7	13.4	13.8	-
			10.0		13.7	13.3	14.4	14.1	-
			11.0		14.1	13.9	16.4	14.6	-
			12.0		-	-	16.3	14.6	-
			13.0		-	-	17.2	-	-
			14.0		-	-	17.0	-	-
			15.0		-	-	17.5	-	-
		1,000 m upstream (T21)	1.0	1,300	10.5	7.8	6.9	5.9	5.5
			2.0		10.7	8.9	7.4	6.1	5.6
			3.0		11.5	10.2	8.5	7.7	5.5
			4.0		13.8	10.1	8.5	8.3	5.7
			5.0		13.9	11.1	10.3	8.8	5.6
			6.0		-	10.9	10.6	9.0	5.9
			7.0		-	10.8	11.3	10.6	6.6
			8.0		-	11.2	12.8	11.2	7.4
			9.0		-	11.8	13.4	13.3	9.2
			10.0		-	12.6	14.2	13.6	10.3
			11.0		-	12.9	15.4	14.1	12.0
			12.0		-	13.4	-	14.4	13.5
			13.0		-	-	-	14.8	14.5
			14.0		-	-	-	15.1	-
			15.0		-	-	-	16.7	-
			16.0		-	-	-	17.3	-
Upstream of the Elk River Outlet Arm	10-Jun-2018	directly upstream of Outlet Arm (T20)	1.0	800	6.5	5.2	5.4	5.3	3.2
			2.0		7.5	5.3	4.5	4.7	3.8
			3.0		10.2	7.6	5.5	4.8	5.1
			4.0		12.5	8.2	6.6	5.5	5.1
			5.0		12.6	9.3	8.1	6.0	6.3
			6.0		12.8	10.7	8.8	6.7	6.8
			7.0		13.1	12.5	10.3	7.8	10.6
			8.0		13.1	12.9	10.9	9.3	10.7
			9.0		13.4	13.4	12.2	9.6	11.2
			10.0		13.8	13.7	13.3	15.4	12.5
			11.0		14.6	14.4	14.5	14.7	13.4
			12.0		15.9	-	-	-	-
			13.0		16.5	-	-	-	-
			14.0		16.8	-	-	-	-
			15.0		17.1	-	-	-	-
Downstream of the Elk River Outlet Arm	10-Jun-2018	directly downstream of Outlet Arm (T9)	1.0	1,000	8.7	4.8	3.4	3.2	3.0
			2.0		9.2	5.8	3.8	3.1	3.3
			3.0		11.2	6.7	4.4	3.5	3.6
			4.0		13.3	9.2	7.6	4.1	5.0
			5.0		13.3	7.7	8.5	4.1	5.2
			6.0		13.4	12.4	11.5	4.7	7.9
			7.0		13.6	13.8	12.4	7.4	8.6
			8.0		14.1	13.7	13.2	8.2	11.8
			9.0		14.9	13.2	13.1	9.6	11.6
			10.0		15.1	13.6	12.5	10.0	12.2
			11.0		15.2	13.4	12.0	-	-
			12.0		15.1	13.7	12.1	-	-
			13.0		15.4	-	-	-	-
			14.0		14.2	-	-	-	-
			15.0		15.1	-	-	-	-
			16.0		14.1	-	-	-	-
	12-Jun-2018	1,000 m downstream (T10)	1.0	1,100	4.1	4.5	3.7	3.4	3.5
			2.0		4.9	5.4	4.1	3.8	4.2
			3.0		5.6	5.4	4.5	4.6	6.3
			4.0		6.1	5.6	4.9	5.1	6.3
			5.0		6.6	5.9	5.4	5.4	6.4
			6.0		6.9	6.7	6.1	5.8	6.4
			7.0		7.1	7.5	6.5	6.1	6.6
			8.0		7.4	7.8	7.1	6.3	6.7
			9.0		7.7	8.7	7.4	6.5	6.9
			10.0		7.9	9.0	7.6	6.8	7.5
			11.0		8.1	9.1	8.0	7.9	8.8
			12.0		9.5	9.2	8.7	8.9	11.9
			13.0		10.1	9.7	9.6	11.3	12.1
			14.0		13.7	10.7	11.9	12.1	12.6
			15.0		-	14.4	13.4	12.9	-
			16.0		-	-	-	13.4	-
	12-Jun-2018	2,000 m downstream (T11)	1.0	900	6.2	4.1	4.2	3.7	3.5
			2.0		6.1	4.3	4.3	3.9	3.7
			3.0		6.2	4.8	4.5	4.2	3.9
			4.0		6.3	5.1	4.6	4.6	4.5
			5.0		6.6	5.4	4.9	5.1	4.9
			6.0		7.4	5.9	4.9	5.4	5.5
			7.0		8.1	6.5	4.9	5.8	6.0
			8.0		8.5	7.3	4.9	6.1	6.8

Table A.6: **Turbidity Measurements from the Elk River Plume Delineation, June 2018**

Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
					1 (right bank - looking d/s [B])	2 [C]	3 [D]	4 [E]	5 (left bank looking d/s [F])
Downstream of the Elk River Outlet Arm	12-Jun-2018	2,000 m downstream (T11)	9.0	900	8.6	7.7	8.8	6.7	7.2
			10.0		9.1	8.4	8.9	7.9	7.7
			11.0		9.1	9.1	9.5	8.6	8.1
			12.0		9.1	9.7	9.9	9.8	8.6
			13.0		9.5	10.2	10.7	10.3	9.1
			14.0		9.5	10.6	11.7	12.6	10.7
			15.0		9.6	-	-	-	11.2
			16.0		-	-	-	-	11.8
	12-Jun-2018	3,000 m downstream (T12)	1.0	800	4.3	4.0	3.4	3.3	3.7
			2.0		4.8	5.2	3.6	3.5	3.6
			3.0		5.8	5.1	3.6	3.7	4.3
			4.0		6.2	4.7	3.7	3.7	4.2
			5.0		6.7	5.0	3.9	3.7	4.4
			6.0		6.9	5.3	4.2	3.9	4.5
			7.0		7.4	5.5	4.5	4.1	4.7
			8.0		7.7	6.0	4.7	4.4	5.0
			9.0		8.1	6.6	5.4	4.7	5.1
			10.0		8.7	6.6	5.7	4.9	5.1
			11.0		9.1	6.9	6.5	5.4	5.4
			12.0		9.5	7.6	6.7	5.6	5.7
			13.0		9.8	8.1	7.7	5.9	6.2
			14.0		9.9	8.8	8.6	7.5	6.7
			15.0		10.7	10.1	10.7	10.6	7.8
			16.0		11.4	-	13.8	11.2	8.5
			17.0		-	-	-	12.0	-
			18.0		-	-	-	12.2	-
	12-Jun-2018	4,000 m downstream (T13)	1.0	800	2.9	3.2	3.6	3.0	3.3
			2.0		2.9	3.2	3.7	3.1	3.4
			3.0		2.9	3.1	3.5	3.1	3.5
			4.0		3.0	3.6	3.6	3.1	3.4
			5.0		3.0	3.8	3.6	3.1	3.6
			6.0		3.5	3.8	3.5	3.1	3.5
			7.0		3.9	3.8	3.6	3.1	3.4
			8.0		5.1	4.5	3.8	3.3	3.4
			9.0		5.8	5.3	4.1	3.7	3.4
			10.0		6.7	5.9	4.3	3.8	3.6
			11.0		7.5	6.1	4.9	4.0	3.7
			12.0		8.3	6.3	5.1	5.5	3.8
			13.0		8.9	7.1	5.4	5.6	4.1
			14.0		9.8	7.8	5.9	6.7	4.7
			15.0		10.0	9.3	8.2	9.2	5.5
			16.0		10.6	10.5	8.3	9.9	6.7
			17.0		11.3	-	8.2	-	7.1
			18.0		11.8	-	8.2	-	12.5
			19.0		*	-	11.3	-	-
	12-Jun-2018	5,000 m downstream (T14)	1.0	800	3.0	2.9	3.1	2.8	2.8
			2.0		3.1	3.1	2.9	2.7	2.8
			3.0		3.0	3.3	3.0	2.8	2.8
			4.0		3.0	3.2	3.0	2.9	2.8
			5.0		3.0	3.1	3.0	2.9	2.9
			6.0		3.2	3.2	3.0	3.1	3.0
			7.0		3.5	3.3	3.3	3.1	2.8
			8.0		4.6	3.7	3.5	3.0	2.8
			9.0		4.7	3.8	3.5	3.1	2.9
			10.0		5.2	3.7	3.6	3.1	2.8
			11.0		5.3	4.1	3.9	3.2	2.8
			12.0		5.7	4.4	4.2	3.3	2.9
			13.0		6.5	4.6	4.6	3.4	2.9
			14.0		6.9	4.9	5.1	3.6	3.2
			15.0		9.7	5.2	5.5	3.9	3.6
			16.0		-	5.4	6.1	4.6	4.3
			17.0		-	6.8	8.2	8.1	5.0
			18.0		-	7.3	*	11.1	7.8
			19.0		-	8.1	-	-	9.9
			20.0		-	-	-	-	11.9
	12-Jun-2018	6,000 m downstream (T15)	0.5	1,400	-	-	-	3.9	4.0
			1.0		3.2	3.1	3.0	3.7	4.1
			1.5		-	-	-	3.7	4.1
			2.0		3.0	3.3	2.9	3.8	4.1
			2.5		-	-	-	4.6	4.6
			3.0		3.1	3.2	3.0	-	5.4
			3.5		-	-	-	-	6.4
			4.0		3.2	3.1	3.0	-	-
			4.5		-	-	-	-	-
			5.0		3.4	3.1	3.2	-	-
			6.0		3.4	3.1	3.2	-	-
			7.0		3.5	3.2	3.1	-	-
			8.0		3.8	3.2	3.2	-	-
			9.0		4.2	3.3	3.1	-	-
			10.0		4.5	3.6	3.3	-	-

Table A.6: **Turbidity Measurements from the Elk River Plume Delineation, June 2018**

Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
					1 (right bank - looking d/s [B])	2 [C]	3 [D]	4 [E]	5 (left bank looking d/s [F])
Downstream of the Elk River Outlet Arm	12-Jun-2018	6,000 m downstream (T15)	11.0	1,400	4.6	3.8	3.3	-	-
			12.0		4.8	4.1	3.3	-	-
			13.0		5.1	4.2	3.5	-	-
			14.0		5.6	4.8	5.2	-	-
			15.0		6.0	4.8	6.0	-	-
			16.0		7.2	8.2	6.7	-	-
			17.0		8.1	9.9	8.0	-	-
			18.0		8.7	10.9	11.1	-	-
			19.0		8.6	11.1	12.5	-	-
			20.0		9.5	12.3	13.8	-	-
			21.0		-	12.1	-	-	-
			22.0		-	-	-	-	-
	12-Jun-2018	7,000 m downstream (T16)	1.0	1,300	3.4	3.4	2.3	3.1	2.9
			2.0		3.6	3.4	2.9	3.0	2.8
			3.0		3.6	3.2	2.9	3.0	2.8
			4.0		3.6	3.1	3.0	3.0	2.9
			5.0		3.5	3.0	3.1	3.2	2.9
			6.0		3.4	3.0	3.1	3.2	2.0
			7.0		3.6	3.1	3.0	3.1	3.1
			8.0		3.5	3.3	2.9	0.2	3.1
			9.0		3.6	3.4	3.0	3.2	3.2
			10.0		3.6	3.4	2.9	3.2	3.4
			11.0		3.7	3.6	3.2	3.3	3.6
			12.0		3.8	4.0	3.4	3.3	3.7
			13.0		3.9	4.3	3.5	3.4	3.7
			14.0		4.5	4.4	3.9	3.6	5.3
			15.0		4.9	5.2	4.7	4.7	6.4
			16.0		5.6	6.3	5.4	7.2	7.6
			17.0		6.2	10.8	9.4	9.4	8.6
			18.0		6.7	10.9	9.8	10.5	9.3
			19.0		7.5	11.2	10.8	12.5	10.0
			20.0		8.4	11.7	11.7	-	10.5
			21.0		9.3	-	-	-	10.8
	12-Jun-2018	9,000 m downstream (T17)	1.0	700	3.5	3.6	3.1	3.0	2.7
			2.0		3.5	3.5	3.2	3.4	2.8
			3.0		3.8	3.5	3.2	3.3	2.8
			4.0		3.9	3.5	3.1	3.0	2.8
			5.0		3.8	3.6	3.2	3.1	2.8
			6.0		3.8	3.7	3.5	3.2	3.8
			7.0		3.8	3.7	3.5	3.2	3.5
			8.0		3.9	3.7	3.7	3.2	3.6
			9.0		4.4	3.8	3.7	3.3	3.7
			10.0		4.3	4.3	3.8	3.4	4.0
			11.0		4.2	4.3	3.9	3.5	4.1
			12.0		4.3	4.2	4.1	3.9	4.1
			13.0		4.9	4.3	4.4	4.2	4.3
			14.0		4.9	4.3	4.5	4.3	4.4
			15.0		5.3	5.6	4.5	4.3	4.9
			16.0		5.7	6.1	5.2	4.3	5.3
			17.0		6.8	7.2	8.1	8.1	5.9
			18.0		7.3	7.1	8.9	9.0	6.6
			19.0		7.9	8.6	9.3	9.1	6.9
			20.0		8.7	9.1	*	9.1	7.3
			21.0		9.8	9.9	-	9.8	8.6
			22.0		10.4	*	-	*	8.9
			23.0		10.8	-	-	-	9.7
	12-Jun-2018	11,000 m downstream (T18)	1.0	900	2.9	3.2	3.1	2.9	2.8
			2.0		3.1	3.2	3.1	2.9	2.8
			3.0		3.2	3.2	3.2	3.0	2.9
			4.0		3.3	3.2	3.3	3.1	2.9
			5.0		3.4	3.3	3.3	3.1	2.9
			6.0		3.5	3.3	3.3	3.1	2.9
			7.0		3.6	3.4	3.6	3.1	2.8
			8.0		3.6	3.4	3.6	3.1	2.9
			9.0		3.6	3.5	3.7	3.1	2.9
			10.0		3.6	3.6	3.6	3.1	3.0
			11.0		3.6	3.6	3.6	3.3	3.2
			12.0		3.7	3.6	3.5	3.7	3.3
			13.0		3.8	3.7	3.7	3.6	3.3
			14.0		3.9	3.7	3.8	3.6	3.2
			15.0		4.2	3.8	3.8	3.6	3.2
			16.0		4.5	3.8	4.0	3.6	3.3
			17.0		4.6	3.9	4.0	3.8	3.7
			18.0		4.9	4.0	4.6	3.8	3.8
			19.0		5.3	4.2	4.7	3.9	3.9
			20.0		6.7	4.3	6.8	4.1	4.1
			21.0		7.3	4.7	9.3	5.1	4.2
			22.0		8.2	5.1	10.0	8.3	4.7
			23.0		9.7	6.3	*	10.3	6.2
			24.0		12.0	6.6	-	*	8.9

Table A.6: **Turbidity Measurements from the Elk River Plume Delineation, June 2018**

Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
					1 (right bank - looking d/s [B])	2 [C]	3 [D]	4 [E]	5 (left bank looking d/s [F])
Downstream of the Elk River Outlet Arm	12-Jun-2018	11,000 m downstream (T18)	25.0	900	12.5	7.9	-	-	10.5
			26.0		*	9.2	-	-	12.3
			27.0		-	10.7	-	-	-
	12-Jun-2018	13,000 m downstream (T19)	1.0	1,100	2.9	3.1	2.9	3.0	3.3
			2.0		2.9	3.1	3.0	3.0	3.1
			3.0		2.9	3.2	3.1	3.1	3.0
			4.0		4.0	3.2	3.3	3.1	3.0
			5.0		4.0	3.2	3.3	3.1	3.1
			6.0		4.0	3.2	3.3	3.3	3.2
			7.0		4.0	3.4	3.3	3.3	3.2
			8.0		4.2	3.4	3.3	3.4	3.2
			9.0		4.5	3.5	3.5	3.4	3.2
			10.0		4.5	4.0	3.7	3.4	3.3
			11.0		4.5	3.8	3.7	3.5	3.3
			12.0		4.6	3.8	3.7	3.7	3.4
			13.0		4.5	3.9	3.7	3.7	3.4
			14.0		4.8	4.0	3.7	3.7	3.5
			15.0		5.0	4.1	3.7	3.7	3.7
			16.0		5.4	4.1	3.7	3.7	3.7
			17.0		5.6	4.3	10.3	3.9	3.8
			18.0		5.8	4.5	11.4	4.2	4.6
			19.0		6.0	4.9	11.6	5.1	12.3
			20.0		6.1	5.6	12.0	6.7	14.4
			21.0		6.8	7.9	12.5	7.8	14.4
			22.0		7.2	9.3	13.5	8.7	14.2
			23.0		8.0	9.7	14.4	9.7	14.2
			24.0		8.8	10.7	14.8	12.9	14.3
			25.0		-	11.4	15.3	12.9	14.7
			26.0		-	11.8	-	12.9	*
			27.0		-	12.8	-	-	-
			28.0		-	13.4	-	-	-
			29.0		-	13.3	-	-	-
			30.0		-	15.1	-	-	-

* Cable was maxed out, so complete turbidity profile was not completed. "-" indicates maximum depth reached.

Table A.7: **Turbidity Measurements from the Elk River Plume Delineation, August 2018**

Date	Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
	ID	Start Shore UTM (NAD83, 11U)								
		Easting	Northing			1 (B)	2 (C)	3 (D)	4 (E)	5 (F)
30-Aug-18	A (T21)	628001	5451931	0.0	1,200	1.90	1.95	2.02	2.12	2.16
				1.0		1.92	2.00	2.01	2.15	2.19
				2.0		1.95	2.02	2.01	2.16	2.22
				3.0		1.91	1.98	2.00	2.16	2.20
				4.0		1.95	1.97	2.04	2.18	2.16
				5.0		1.96	1.99	2.02	2.22	2.17
				6.0		1.94	1.98	2.01	2.23	2.15
				7.0		2.00	1.99	2.00	2.21	2.16
				8.0		2.00	1.98	1.97	2.19	2.15
				9.0		2.03	2.00	1.98	2.16	2.16
				10.0		2.05	2.08	2.00	2.14	2.20
				11.0		2.13	2.15	2.11	2.30	2.35
				12.0		2.26	2.50	2.58	2.50	2.97
				13.0		3.50	3.12	3.40	3.59	3.98
				14.0		-	-	4.38	4.50	4.60
				15.0		-	-	-	-	5.85
30-Aug-18	B (T20)	628497	5451065	0.0	1,100	1.91	1.99	1.98	2.02	2.10
				1.0		1.92	2.02	2.00	2.02	2.10
				2.0		1.95	2.05	1.97	2.06	2.15
				3.0		2.00	2.07	1.95	2.05	2.20
				4.0		1.96	2.11	1.98	2.05	2.25
				5.0		1.92	2.09	2.00	2.02	2.30
				6.0		1.95	2.04	1.98	2.02	2.32
				7.0		1.98	2.02	1.99	2.07	2.32
				8.0		1.99	2.01	1.89	2.03	2.33
				9.0		1.99	2.01	2.00	2.04	2.45
				10.0		2.05	2.00	2.02	1.99	2.44
				11.0		2.15	2.16	2.06	2.09	2.54
				12.0		2.62	2.84	2.58	2.45	2.78
				13.0		2.96	3.59	3.15	3.50	3.64
				14.0		-	4.08	-	4.76	5.08
				15.0		-	5.25	-	6.50	6.13
				16.0		-	5.76	-	-	-
				17.0		-	6.10	-	-	-
30-Aug-18	C (T19)	628671	5450236	0.0	1,400	2.00	2.10	2.07	2.08	2.10
				1.0		2.09	2.10	2.02	2.07	2.07
				2.0		2.06	2.17	2.06	2.10	2.08
				3.0		2.09	2.16	2.10	2.11	2.12
				4.0		2.12	2.20	2.12	2.10	2.11
				5.0		2.14	2.16	2.13	2.08	2.13
				6.0		2.14	2.16	2.11	2.09	2.13
				7.0		2.13	2.13	2.08	2.10	2.15
				8.0		2.10	2.12	2.05	2.10	2.17
				9.0		2.08	2.11	2.08	2.07	2.18
				10.0		2.09	2.14	2.11	2.08	2.18
				11.0		2.22	2.18	2.13	2.12	2.20
				12.0		2.52	2.56	2.55	2.46	2.55
				13.0		3.78	3.38	3.45	3.09	4.40
				14.0		4.20	4.20	4.61	4.24	4.75
				15.0		4.45	4.46	-	4.75	-
				16.0		-	-	-	5.30	-
				17.0		-	-	-	8.04	-
30-Aug-18	D (T18)	628858	5449338	0.0	1,000	2.01	2.04	2.03	2.03	2.03
				1.0		2.02	2.06	2.11	2.07	2.07
				2.0		2.04	2.07	2.13	2.09	2.12
				3.0		2.07	2.06	2.14	2.11	2.20
				4.0		2.07	2.08	2.12	2.10	2.25
				5.0		2.10	2.09	2.13	2.11	2.19
				6.0		2.11	2.07	2.10	2.08	2.13
				7.0		2.11	2.10	2.11	2.09	2.15
				8.0		2.12	2.12	2.07	2.12	2.20
				9.0		2.16	2.17	2.15	2.13	2.20
				10.0		2.21	2.25	2.23	2.12	2.18
				11.0		2.45	2.83	2.53	2.14	2.19
				12.0		2.65	3.09	2.60	2.16	2.33
				13.0		3.54	3.25	2.74	2.98	2.85
				14.0		4.07	3.71	5.30	4.88	4.26
				15.0		4.65	-	5.37	-	5.36
				16.0		6.85	-	-	-	-
30-Aug-18	E (T17)	628875	5449086	0.0	800	2.07	2.08	2.00	2.02	2.02
				1.0		2.10	2.07	2.04	2.17	2.04
				2.0		2.15	2.08	2.08	2.25	2.12
				3.0		2.20	2.09	2.13	2.28	2.13
				4.0		2.26	2.06	2.18	2.15	2.14
				5.0		2.28	2.11	2.16	2.17	2.13
				6.0		2.30	2.13	2.12	2.18	2.12
				7.0		2.24	2.15	2.11	2.16	2.17
				8.0		2.37	2.17	2.13	2.15	2.18
				9.0		2.71	2.18	2.19	2.17	2.19
				10.0		2.67	2.19	2.21	2.26	2.23
				11.0		2.50	2.33	2.26	2.32	2.22

Table A.7: **Turbidity Measurements from the Elk River Plume Delineation, August 2018**

Date	Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
	ID	Start Shore UTM (NAD83, 11U)								
		Easting	Northing			1 (B)	2 (C)	3 (D)	4 (E)	5 (F)
30-Aug-18	E (T17)	628875	5449086	12.0	800	2.87	2.45	2.33	2.41	2.28
				13.0		3.75	3.05	2.68	2.56	3.44
				14.0		4.22	2.63	4.07	5.99	4.56
				15.0		4.85	4.65	-	-	-
				16.0		5.56	5.27	-	-	-
				17.0		6.31	-	-	-	-
				18.0		7.02	-	-	-	-
30-Aug-18	F (T16)	628850	5448842	0.0	700	2.03	2.04	2.01	2.08	2.09
				1.0		2.06	2.10	2.08	2.12	2.11
				2.0		2.09	2.11	2.11	2.11	2.10
				3.0		2.14	2.09	2.16	2.10	2.11
				4.0		2.16	2.11	2.16	2.11	2.17
				5.0		2.13	2.12	2.15	2.14	2.15
				6.0		2.18	2.18	2.19	2.15	2.14
				7.0		2.26	2.20	2.20	2.15	2.24
				8.0		2.25	2.16	2.18	2.17	2.32
				9.0		2.20	2.23	2.20	2.25	2.30
				10.0		2.26	2.25	2.20	2.22	2.28
				11.0		2.32	2.22	2.26	2.25	2.55
				12.0		2.37	2.30	2.30	2.88	4.07
				13.0		3.02	2.65	2.97	3.45	5.15
				14.0		3.84	2.86	-	-	-
				15.0		4.85	-	-	-	-
				16.0		5.18	-	-	-	-
30-Aug-18	G (T1)	632264	5448456	0.0	1,450	2.60	2.68	2.77	3.63	3.18
				0.5		2.68	2.71	2.92	4.21	3.03
				1.0		2.95	-	4.78	-	-
				1.5		3.06	-	5.65	-	-
				2.0		3.30	-	-	-	-
				2.5		3.55	-	-	-	-
				3.0		3.92	-	-	-	-
				3.5		5.33	-	-	-	-
30-Aug-18	H (T2)	632038	5447358	0.0	400	2.52	2.47	2.45	2.77	2.65
				0.5		2.47	2.65	2.51	2.86	2.66
				1.0		2.84	3.71	2.83	2.84	3.96
				1.5		3.24	4.10	2.95	2.83	-
				2.0		3.60	5.22	-	5.20	-
				2.5		4.38	5.85	-	7.65	-
				3.0		4.64	6.85	-	-	-
31-Aug-18	I (T3)	631927	5447154	0.0	400	2.57	2.58	2.76	2.76	3.71
				0.5		2.54	2.56	2.77	2.73	3.65
				1.0		2.63	4.21	2.78	2.70	3.63
				1.5		2.66	-	4.95	3.56	3.65
				2.0		4.37	-	-	-	-
				2.5		5.58	-	-	-	-
31-Aug-18	J (T4)	631655	5447125	0.0	500	2.18	2.30	2.26	2.30	2.77
				0.5		2.20	2.29	2.25	2.34	2.83
				1.0		2.20	2.32	2.29	2.36	2.85
				1.5		2.20	2.33	2.26	2.34	2.86
				2.0		2.15	2.32	2.26	2.37	2.83
				2.5		2.24	2.28	2.31	2.45	2.86
				3.0		2.22	2.49	-	2.54	2.88
				3.5		-	-	-	2.65	2.81
				4.0		-	-	-	4.08	2.95
				4.5		-	-	-	-	3.25
31-Aug-18	K (T5)	630821	5447615	0.0	550	2.26	2.20	2.20	2.16	2.13
				1.0		2.27	2.22	2.18	2.15	2.20
				2.0		2.25	2.24	2.19	2.13	2.19
				3.0		2.27	2.26	2.26	2.15	2.17
				4.0		2.28	2.25	2.27	2.18	2.20
				5.0		2.29	2.24	2.26	2.19	2.23
				6.0		2.56	2.27	2.59	2.20	2.25
				7.0		-	4.96	-	2.28	6.04
				8.0		-	-	-	4.84	-
31-Aug-18	L (T6)	629992	5448136	0.0	1,200	2.26	2.16	2.11	2.15	2.24
				1.0		2.30	2.12	2.20	2.14	2.22
				2.0		2.32	2.16	2.21	2.17	2.26
				3.0		2.29	2.14	2.19	2.19	2.27
				4.0		2.31	2.16	2.18	2.22	2.29
				5.0		2.33	2.18	2.21	2.19	7.28
				6.0		2.30	2.19	2.21	2.20	2.28
				7.0		2.34	2.20	2.19	2.15	2.31
				8.0		2.35	2.18	2.15	2.12	2.32
				9.0		3.71	2.30	2.19	-	2.35
				10.0		-	7.20	7.20	-	-
				11.0		-	7.50	-	-	-
31-Aug-18	M (T7)	629626	5448595	0.0	1,400	2.34	2.14	2.48	2.45	2.34
				1.0		2.41	2.15	2.47	2.50	2.35
				2.0		2.23	2.18	2.50	2.48	2.37
				3.0		2.23	2.15	2.56	2.55	2.28

Table A.7: **Turbidity Measurements from the Elk River Plume Delineation, August 2018**

Date	Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
	ID	Start Shore UTM (NAD83, 11U)								
		Easting	Northing			1 (B)	2 (C)	3 (D)	4 (E)	5 (F)
31-Aug-18	M (T7)	629626	5448595	4.0	1,400	2.18	2.18	2.58	2.60	2.36
				5.0		2.21	2.15	2.65	2.57	2.44
				6.0		2.17	2.16	2.66	2.56	2.47
				7.0		2.14	2.16	2.43	2.60	2.48
				8.0		2.15	2.13	2.32	2.64	2.50
				9.0		2.17	2.20	2.22	2.63	2.53
				10.0		2.43	2.22	2.25	2.66	2.68
				11.0		3.20	2.85	2.41	2.64	2.75
				12.0		4.38	5.44	3.76	4.01	-
				13.0		-	-	4.85	-	-
31-Aug-18	N (T8)	627909	5447968	0.0	1,000	2.14	2.15	2.16	2.13	2.08
				1.0		2.22	2.13	2.15	2.14	2.13
				2.0		2.21	2.18	2.20	2.21	2.17
				3.0		2.21	2.20	2.21	2.26	2.21
				4.0		2.18	2.23	2.20	2.24	2.22
				5.0		2.19	2.25	2.18	2.25	2.23
				6.0		2.23	2.25	2.14	2.20	2.27
				7.0		2.24	2.20	2.17	2.15	2.26
				8.0		2.20	2.19	2.19	2.16	2.25
				9.0		2.23	2.24	2.25	2.21	2.26
				10.0		2.45	2.28	2.26	2.26	2.22
				11.0		2.72	2.35	2.28	2.32	2.25
				12.0		3.15	2.40	2.34	2.38	2.24
				13.0		2.99	2.52	2.81	-	2.57
				14.0		3.16	2.77	3.98	-	-
				15.0		4.10	5.66	-	-	-
				16.0		4.86	5.88	-	-	-
				17.0		4.99	-	-	-	-
				18.0		5.22	-	-	-	-
				19.0		6.27	-	-	-	-
31-Aug-18	O (T9)	627411	5447137	0.0	1,100	2.10	2.11	2.15	2.15	2.12
				1.0		2.10	2.13	2.18	2.16	2.11
				2.0		2.14	2.11	2.21	2.17	2.13
				3.0		2.16	2.13	2.23	2.20	2.23
				4.0		2.15	2.12	2.20	2.19	2.25
				5.0		2.18	2.14	2.19	2.21	2.24
				6.0		2.16	2.13	2.17	2.19	2.22
				7.0		2.17	2.15	2.18	2.21	2.23
				8.0		2.14	2.17	2.19	2.23	2.22
				9.0		2.16	2.18	2.17	2.23	2.23
				10.0		2.16	2.19	2.19	2.22	2.23
				11.0		2.15	2.22	2.16	2.21	2.20
				12.0		2.18	2.26	2.14	2.22	2.17
				13.0		2.41	2.33	2.15	2.24	2.21
				14.0		2.56	2.46	2.29	2.25	2.67
				15.0		2.91	2.60	2.95	2.86	-
				16.0		-	2.64	4.04	3.87	-
				17.0		-	-	-	5.69	-
				18.0		-	-	-	6.40	-
31-Aug-18	P (T10)	626734	5446480	0.0	1,200	2.00	2.03	2.08	2.00	2.01
				1.0		2.03	2.06	2.15	2.04	2.07
				2.0		2.08	2.09	2.14	2.09	2.13
				3.0		2.08	2.12	2.15	2.13	2.19
				4.0		2.04	2.14	2.18	2.16	2.24
				5.0		2.05	2.16	2.17	2.15	2.20
				6.0		2.04	2.14	2.18	2.14	2.22
				7.0		2.10	2.17	2.19	2.11	2.19
				8.0		2.12	2.16	2.18	2.18	2.21
				9.0		2.11	2.16	2.19	2.20	2.19
				10.0		2.13	2.15	2.19	2.25	2.19
				11.0		2.14	2.14	2.22	2.23	2.23
				12.0		2.21	2.14	2.25	2.22	2.30
				13.0		2.33	2.20	2.76	2.24	2.36
				14.0		2.79	2.36	2.33	2.23	2.38
				15.0		3.20	2.52	2.70	2.86	2.77
				16.0		3.65	3.06	3.39	3.59	-
				17.0		-	3.77	-	-	-
				18.0		-	4.30	-	-	-
				19.0		-	4.95	-	-	-
				20.0		-	5.57	-	-	-
31-Aug-18	Q (T11)	626700	5445513	0.0	900	2.04	2.11	2.05	2.12	2.12
				1.0		2.04	2.13	2.15	2.13	2.12
				2.0		2.08	2.16	2.19	2.20	2.18
				3.0		2.11	2.18	2.24	2.21	2.20
				4.0		2.15	2.17	2.24	2.24	2.23
				5.0		2.16	2.22	2.22	2.27	2.24
				6.0		2.12	2.21	2.23	2.26	2.25
				7.0		2.13	2.23	2.24	2.22	2.29
				8.0		2.17	2.24	2.23	2.27	2.30
				9.0		2.16	2.25	2.22	2.24	2.28

Table A.7: **Turbidity Measurements from the Elk River Plume Delineation, August 2018**

Date	Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
	ID	Start Shore UTM (NAD83, 11U)								
		Easting	Northing			1 (B)	2 (C)	3 (D)	4 (E)	5 (F)
31-Aug-18	Q (T11)	626700	5445513	10.0	900	2.16	2.20	2.23	2.25	2.26
				11.0		2.14	2.22	2.21	2.25	2.25
				12.0		2.17	2.22	2.20	2.26	2.26
				13.0		2.30	2.23	2.24	2.23	2.26
				14.0		2.40	2.24	2.25	2.23	2.25
				15.0		2.47	2.30	2.26	2.30	2.42
				16.0		2.87	2.57	2.66	2.35	2.75
				17.0		3.46	3.07	3.69	3.45	4.15
				18.0		5.25	5.28	4.67	3.79	-
				19.0		-	8.85	5.48	5.26	-
				20.0		-	-	5.92	-	-
				21.0		-	-	6.36	-	-
				22.0		-	-	6.83	-	-
31-Aug-18	R (T12)	627153	5443517	0.0	900	2.11	2.11	2.13	2.18	2.18
				1.0		2.20	2.15	2.16	2.17	2.22
				2.0		2.22	2.20	2.23	2.21	2.28
				3.0		2.23	2.23	2.33	2.22	2.34
				4.0		2.25	2.28	2.36	2.27	2.40
				5.0		2.22	2.34	2.34	2.33	2.39
				6.0		2.26	2.39	2.35	2.32	2.40
				7.0		2.24	2.39	2.40	2.33	2.39
				8.0		2.21	2.37	2.38	2.32	2.37
				9.0		2.18	2.33	2.40	2.30	2.34
				10.0		2.13	2.29	2.35	2.30	2.29
				11.0		2.16	2.27	2.33	2.31	2.26
				12.0		2.17	2.25	2.27	2.34	2.27
				13.0		2.22	2.25	2.20	2.30	2.24
				14.0		2.24	2.26	2.22	2.25	2.25
				15.0		2.27	2.27	2.22	2.23	2.27
				16.0		2.36	2.94	2.34	2.27	2.26
				17.0		2.96	3.07	4.79	2.96	2.42
				18.0		3.64	3.96	4.96	3.69	2.75
				19.0		4.37	4.74	5.65	4.87	4.88
				20.0		5.07	5.52	6.28	-	-
				21.0		5.66	-	-	-	-
				22.0		6.01	-	-	-	-
31-Aug-18	S (T13)	628457	5441951	0.0	1,100	2.02	2.02	2.06	2.42	2.66
				1.0		2.08	2.08	2.12	2.45	2.69
				2.0		2.11	2.17	2.19	2.41	7.64
				3.0		2.14	2.18	2.20	2.30	2.53
				4.0		2.15	2.19	2.19	2.26	2.41
				5.0		2.18	2.20	2.16	2.26	2.28
				6.0		2.20	2.24	2.19	2.27	2.30
				7.0		2.22	2.24	2.23	2.27	2.33
				8.0		2.21	2.32	2.24	2.27	2.35
				9.0		2.24	2.21	2.23	2.28	2.34
				10.0		2.32	2.19	2.17	2.29	2.29
				11.0		2.36	2.22	2.16	2.26	2.29
				12.0		2.38	2.23	2.19	2.26	2.26
				13.0		2.42	2.26	2.20	2.22	2.33
				14.0		2.55	2.24	2.18	2.21	2.38
				15.0		2.91	2.27	2.22	2.18	2.43
				16.0		3.00	2.30	2.30	2.22	2.40
				17.0		3.46	2.55	2.42	2.21	2.42
				18.0		4.07	3.08	2.95	2.26	2.82
				19.0		4.95	4.12	3.97	2.68	3.07
				20.0		5.30	5.20	4.83	3.69	2.54
				21.0		-	6.10	5.54	5.50	4.07
				22.0		-	6.64	6.73	5.62	4.25
				23.0		-	6.75	-	-	-
				24.0		-	7.45	-	-	-
				25.0		-	7.75	-	-	-
				26.0		-	7.75	-	-	-
31-Aug-18	T (T14)	630369	5439711	0.0	600	2.06	2.37	2.45	2.61	2.50
				1.0		2.03	2.41	2.44	2.63	2.44
				2.0		2.09	2.51	2.47	2.62	2.41
				3.0		2.12	2.54	2.57	2.61	2.46
				4.0		2.18	2.53	2.59	2.66	2.48
				5.0		2.16	2.54	2.58	2.65	2.50
				6.0		2.18	2.56	2.56	2.64	2.49
				7.0		2.17	2.55	2.53	2.62	2.35
				8.0		2.19	2.58	2.52	2.60	2.60
				9.0		2.20	2.59	2.55	2.61	2.60
				10.0		2.22	2.60	2.56	2.58	2.55
				11.0		2.21	2.61	2.57	2.52	2.44
				12.0		2.25	2.59	2.55	2.55	2.42
				13.0		2.30	2.58	2.55	2.54	2.50
				14.0		2.38	2.60	2.56	2.52	2.54
				15.0		2.41	2.64	2.55	2.55	2.58
				16.0		2.44	2.68	2.57	2.58	2.60

Table A.7: Turbidity Measurements from the Elk River Plume Delineation, August 2018

Date	Location			Depth (m)	Total Transect Distance (m)	Turbidity at Transect Sampling Location				
	ID	Start Shore UTM (NAD83, 11U)								
		Easting	Northing			1 (B)	2 (C)	3 (D)	4 (E)	5 (F)
31-Aug-18	T (T14)	630369	5439711	17.0	600	2.52	2.76	2.65	2.63	2.60
				18.0		2.64	2.89	2.73	2.75	2.67
				19.0		2.86	3.28	3.28	2.85	2.70
				20.0		3.16	3.76	3.84	3.25	2.87
				21.0		3.75	4.08	4.37	4.07	3.30
				22.0		4.02	4.65	4.58	4.57	3.81
				23.0		4.70	4.79	4.95	4.75	4.06
				24.0		4.89	4.90	4.74	4.56	4.05
				25.0		5.02	5.09	5.88	4.94	4.29
				26.0		-	7.22	7.18	-	4.29
				27.0		-	-	-	-	5.15
31-Aug-18	U (T15)	630450	5436631	0.0	1,400	2.25	2.37	2.28	2.28	2.23
				1.0		2.26	2.31	2.29	2.28	2.25
				2.0		2.33	2.32	2.29	2.27	2.27
				3.0		2.38	2.35	2.28	2.29	2.30
				4.0		2.43	2.36	2.30	2.32	2.35
				5.0		2.41	2.36	2.32	2.36	2.34
				6.0		2.41	2.40	2.35	2.39	2.35
				7.0		2.41	2.41	2.37	2.40	2.36
				8.0		2.41	2.42	2.39	2.42	2.37
				9.0		2.43	2.42	2.40	2.41	2.41
				10.0		2.50	2.43	2.41	2.43	2.43
				11.0		2.49	2.44	2.44	2.42	2.40
				12.0		2.60	2.45	2.50	2.41	2.38
				13.0		2.71	2.48	2.54	2.44	2.35
				14.0		3.00	2.20	2.59	2.45	2.32
				15.0		3.44	3.35	2.62	2.53	2.39
				16.0		3.36	3.69	2.63	2.60	2.40
				17.0		3.32	4.33	2.72	2.56	2.47
				18.0		3.59	3.92	2.84	2.56	2.67
				19.0		3.71	4.50	3.06	2.62	2.82
				20.0		4.96	4.68	2.46	3.02	2.97
				21.0		5.86	5.08	2.95	3.55	3.50
				22.0		6.89	5.10	4.25	3.96	3.77
				23.0		-	-	4.36	3.69	3.79
				24.0		-	-	*	*	3.80
				25.0		-	-	-	-	3.97
				26.0		-	-	-	-	4.28
				27.0		-	-	-	-	5.15

* Cable was maxed out, so complete turbidity profile was not completed. "-" indicates maximum depth reached.

Table A.8: Pairwise Comparisons of Water Quality Parameters Among Depths at Each Sampling Station in the Koocanusa Reservoir Study Area, 2018

Station	Total Barium (mg/L)						Total Lithium (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3		1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.249	-	0.242	-	0.946	-	0.137	-	0.030	-	0.222	-
RG_USELK	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	0.527	-	0.717	-	0.686	-	0.173	-	0.910	-	0.200	-
RG_GRASMERE	0.071	-	0.909	-	0.197	-	0.394	-	0.459	-	0.060	-
RG_USGOLD	0.925	-	0.542	-	0.724	-	0.590	-	0.021	-	0.055	-
RG_BORDER	0.048	-	0.189	-	0.152	-	0.446	-	0.083	-	0.130	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-	-	-	-	-	-	-

Station	Total Manganese (mg/L)						Total Molybdenum (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3		1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.242	-	0.104	-	0.038	-	0.010	1	0.830	-	0.125	-
RG_USELK	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	0.031	-	0.257	-	0.081	-	0.239	-	0.661	-	0.173	-
RG_GRASMERE	0.242	-	0.081	-	0.020	-	0.113	-	0.034	-	0.335	-
RG_USGOLD	0.390	-	0.475	-	0.004	-71.2	0.225	-	<0.001	-7.5	0.156	-
RG_BORDER	0.013	-31	0.035	-	0.002	-27	0.300	-	0.148	-	0.357	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-	-	-	-	-	-	-

Station	Nitrate-N (mg/L)						Nitrite-N (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3		1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.009	23	0.034	-	0.463	-	0.395	-	0.250	-	-	-
RG_USELK	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	0.193	-	0.028	-	0.012	-36	0.107	-	0.217	-	0.471	-
RG_GRASMERE	0.598	-	0.006	-32	0.009	-30	0.368	-	0.009	45.0	0.066	-
RG_USGOLD	0.946	-	0.347	-	0.123	-	0.672	-	0.059	-	0.056	-
RG_BORDER	0.013	-15	0.052	-	0.065	-	0.163	-	0.586	-	0.665	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-	-	-	-	-	-	-

Station	Total Phosphorus (mg/L)[a]						Total Selenium (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3		1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.018	-	0.131	-	0.377	-	0.104	-	0.035	-	0.097	-
RG_USELK	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	0.900	-	0.107	-	0.368	-	0.020	-	0.387	-	0.033	-
RG_GRASMERE	0.337	-	0.444	-	0.118	-	0.012	16.1	0.256	-	0.071	-
RG_USGOLD	0.315	-	0.500	-	0.440	-	0.544	-	0.360	-	0.495	-
RG_BORDER	0.390	-	0.009	-35	0.039	-	0.606	-	0.108	-	0.178	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-	-	-	-	-	-	-

Station	Sulphate (mg/L)						Total Dissolved Solids (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3		1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.681	-	0.242	-	0.247	-	0.534	-	0.259	-	0.118	-
RG_USELK	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	0.203	-	0.031	-	0.103	-	0.903	-	0.061	-	0.090	-
RG_GRASMERE	0.374	-	0.091	-	0.237	-	0.831	-	0.141	-	0.179	-
RG_USGOLD	0.119	-	0.016	-14.9	0.428	-	0.172	-	0.008	-2.7	0.903	-
RG_BORDER	0.654	-	0.304	-	0.590	-	0.305	-	0.110	-	0.133	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-	-	-	-	-	-	-

Station	Total Uranium (mg/L)					
	1 vs. 2		1 vs. 3		2 vs. 3	
	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
RG_KERRRD	0.705	-	0.186	-	0.083	-
RG_USELK	-	-	-	-	-	-
RG_DSELK	0.104	-	0.616	-	0.827	-
RG_GRASMERE	0.625	-	0.549	-	0.432	-
RG_USGOLD	0.377	-	0.073	-	0.397	-
RG_BORDER	0.670	-	0.021	-	0.031	-
INTERNATIONAL_BOUNDARY	-	-	-	-	-	-
TENMILE	-	-	-	-	-	-
FOREBAY	-	-	-	-	-	-

▨ P-value < 0.05
🟦 Magnitude of difference is positive (concentration is higher in shallower sample)
🟩 Magnitude of difference is negative (concentration is lower in shallower sample)

Notes:
1 = surface, 2 = middle, 3 =bottom
"-" = not enough data with detectable concentrations (< 5 values) for statistical comparison.
Antimony boron, dissolved cadmium and cobalt, nickel and zinc were excluded from the comparisons because not enough data with detectable concentrations was available.
Comparisons conducted as a one-sample t-test or Wilcoxon signed rank test on the difference in monthly mean concentration (higher depth - lower depth). Magnitude of difference (MOD) calculated as (MCThigher depth - MCTlower depth)/MCTlower depth × 100%. MCT = mean for t-test and median for Wilcoxon signed rank test.
Sampling was not conducted at mid-depth, nor for many of the parameters for US stations (International Boundary, Tenmile and Forebay) .
[a] Phosphorus at US stations was measured as total phosphate-phosphorus.

Table A.9: Water Quality Analytes in Comparison to Guidelines, 2018

	Analyte	Units	Long term Guidelines [1]		Short Term Guidelines [1]		RG_SC	RG_SC	RG_SCU1	RG_SCU2
							Surface	Surface	Surface	Middle
			min	max	min	max	27-Apr-2018	13-Jun-2018	29-Aug-2018	29-Aug-2018
Physical Characteristics	Hardness (as CaCO3)	mg/L	-		-		172	93.2	124	119
	pH, Field	pH	< 6.5 or > 9		-		7.38	7.98	8.54	8.52
	Total Suspended Solids, Lab	mg/L	-		-		265	9.8	<1.0	1.5
	Total Dissolved Solids	mg/L	-		-		176	104	146	143
	Dissolved Oxygen-Field [2]	mg/L	< 8		< 5		13.74	10.60	8.99	8.97
	Dissolved Oxygen-Field	%	-		-		135.3	104.3	106.5	105.7
	Temperature-Field	C	-		-		11.09	11.62	19.1	18.8
Anions and Nutrients	Ammonia as N [3]	mg/L	0.15	1.95	1.06	13.30	0.0130	<0.0050	0.0107	0.0146
	Bromide (Br)	mg/L	-		-		<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	150		600		4.33	1.08	2.54	2.65
	Fluoride (F) [5]	mg/L	-		1.31	1.58	0.088	0.057	0.093	0.092
	Nitrate (as N)	mg/L	3		32.8		0.104	0.0756	0.0703	0.0590
	Nitrite (as N) [4]	mg/L	-		0.02	0.06	0.0010	<0.0010	0.0014	<0.0010
	Phosphorus (P)-Total	mg/L	-		-		0.0651	0.0061	0.0023	<0.0020
	Sulphate (SO_4) [5]	mg/L	429		-		33.0	13.7	26.4	26.5
Total Metals	Aluminum (Al)	mg/L	-		-		1.70	0.132	0.0100	0.0100
	Antimony (Sb)	mg/L	0.009		-		<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005		-		0.00126	0.00038	0.00038	0.00037
	Barium (Ba)	mg/L	1		-		0.0584	0.0242	0.0376	0.0373
	Beryllium (Be)	mg/L	0.0013		-		0.000084	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	-		-		<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	1.2		-		<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	-		-		0.0000335	0.0000057	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	-		-		59.6	25.3	33.1	33.5
	Chromium (Cr) [6]	mg/L	0.001		-		0.00248	0.00022	<0.00010	0.00016
	Cobalt (Co)	mg/L	0.004		0.011		0.00136	0.00011	<0.00010	<0.00010
	Copper (Cu) [5]	mg/L	0.01		0.04		0.00263	<0.00050	<0.00050	0.00067
	Iron (Fe)	mg/L	-		1		2.95	0.187	0.011	0.044
	Lead (Pb) [5]	mg/L	0.02		0.42		0.00257	0.000229	<0.000050	<0.000050
	Lithium (Li)	mg/L	-		-		0.0053	0.0011	0.0018	0.0017
	Magnesium (Mg) [5]	mg/L	-		-		14.5	6.96	9.70	9.86
	Manganese (Mn)	mg/L	1.02	1.41	3.39		0.0820	0.00813	0.00125	0.00176
	Mercury (Hg) [7]	mg/L	0.00000125		-		0.00288	0.00080	<0.00050	<0.00050
	Molybdenum (Mo)	mg/L	1		2		0.000639	0.000522	0.000667	0.000777
	Nickel (Ni) [5]	mg/L	0.15		-		0.00276	<0.00050	<0.00050	0.00133
	Potassium (K)	mg/L	-		-		0.875	0.442	0.503	0.501
	Selenium (Se)	mg/L	0.07		-		0.000191	0.000081	0.000837	0.000712
	Silicon (Si)-Total	mg/L	-		-		4.77	2.31	1.12	1.14
	Silver (Ag) [5]	mg/L	0.0015		0.003		<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-		-		5.16	1.96	3.11	3.21
	Strontium (Sr)	mg/L	-		-		0.200	0.0961	0.130	0.132
	Thallium (Tl)	mg/L	0.0008		-		0.000020	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	-		-		<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-		-		0.015	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0085		-		0.000872	0.000554	0.000679	0.000693
	Vanadium (V)	mg/L	-		-		0.00201	0.00052	<0.00050	<0.00050
	Zinc (Zn) [5]	mg/L	0.19		0.34		0.0102	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	-		0.05		0.0083	0.0165	0.0039	0.0040
	Antimony (Sb)	mg/L	-		-		<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	-		-		0.00045	0.00031	0.00037	0.00038
	Barium (Ba)	mg/L	-		-		0.0502	0.0253	0.0373	0.0372
	Beryllium (Be)	mg/L	-		-		<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	-		-		<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	-		-		<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd) [5]	mg/L	0.00046		0.0028		<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	-		-		46.3	25.4	32.9	31.2
	Chromium (Cr)	mg/L	-		-		<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)	mg/L	-		-		<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	-		-		<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	-		0.35		0.017	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	-		-		0.000051	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-		-		0.0019	<0.0010	0.0017	0.0017
	Magnesium (Mg)	mg/L	-		-		13.6	7.24	10.1	9.85
	Manganese (Mn)	mg/L	-		-		0.00098	0.00246	<0.00010	<0.00010
	Mercury (Hg)	mg/L	-		-		<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	-		-		0.000603	0.000508	0.000684	0.000652
	Nickel (Ni)	mg/L	-		-		<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-		-		0.790	0.456	0.530	0.539
	Selenium (Se)	mg/L	-		-		0.000238	0.000102	0.000807	0.000690
	Silicon (Si)	mg/L	-		-		2.56	2.08	1.09	1.14
	Silver (Ag)	mg/L	-		-		<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-		-		5.90	2.05	3.46	3.53
	Strontium (Sr)	mg/L	-		-		0.168	0.100	0.129	0.127
	Thallium (Tl)	mg/L	-		-		<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	-		-		<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-		-		<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	-		-		0.000838	0.000566	0.000670	0.000687
	Vanadium (V)	mg/L	-		-		<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	-		-		<0.0010	<0.0010	<0.0010	<0.0010

▨	Exceeds BCMOE Long term Guideline
🟦	Exceeds BCMOE Short term Guideline

Notes: "-" = no data

[1] British Columbia Working (BCMOE 2017a) or Accepted (BCMOE 2017b) Water Quality Guidelines for the Protection of Aquatic Life were used. For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.

[2] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.

[3] Temperature and pH dependent; range of minimum and maximum values.

[4] Dependent on concurrent chloride, range of values reported (BCMOE 2017a)

[5] 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. Mimimum and maximum calculated guideline values presented if applicable.

[6] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[7] The most conservative guideline (0.00000125 mg/L) was applied.

Table A.9: Water Quality Analytes in Comparison to Guidelines, 2018

Analyte		Units	RG_SCU3	RG_TN	RG_TNU1	RG_TNU2	RG_TNU3	RG_TNS1
			Bottom	**Surface**	**Surface**	**Middle**	**Bottom**	**Middle**
			29-Aug-2018	30-Apr-2018	11-Jun-2018	11-Jun-2018	11-Jun-2018	29-Aug-2018
Physical Characteristics	Hardness (as CaCO3)	mg/L	132	120	97.0	95.7	94.8	121
	pH, Field	pH	8.24	7.74	8.13	8.15	8.18	8.75
	Total Suspended Solids, Lab	mg/L	2.9	544	6.5	6.9	3.3	1.5
	Total Dissolved Solids	mg/L	168	151	120	119	115	222
	Dissolved Oxygen-Field [2]	mg/L	8.65	15.21	9.99	9.92	9.82	9.05
	Dissolved Oxygen-Field	%	95.9	120.1	100.2	99.3	97.5	97.7
	Temperature-Field	C	15.8	5.5	12.39	12.3	11.95	19
Anions and Nutrients	Ammonia as N [3]	mg/L	0.0173	0.031	0.0067	0.0080	0.0073	0.0073
	Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	4.25	3.22	1.54	1.51	1.48	2.39
	Fluoride (F) [5]	mg/L	0.094	0.079	0.063	0.067	0.063	0.095
	Nitrate (as N)	mg/L	0.0345	0.192	0.0879	0.0880	0.0880	0.102
	Nitrite (as N) [4]	mg/L	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	0.0022
	Phosphorus (P)-Total	mg/L	0.0037	0.139	0.0066	0.0066	0.0069	<0.0020
	Sulphate (SO_4) [5]	mg/L	31.9	22.2	15.9	15.8	15.9	26.5
Total Metals	Aluminum (Al)	mg/L	0.0349	3.26	0.0944	0.0917	0.0854	0.0100
	Antimony (Sb)	mg/L	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00048	0.00238	0.00036	0.00035	0.00040	0.00037
	Barium (Ba)	mg/L	0.0392	0.0594	0.0272	0.0264	0.0259	0.0383
	Beryllium (Be)	mg/L	<0.000020	0.000137	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.0000050	0.000074	0.0000056	0.0000079	0.0000160	<0.0000050
	Calcium (Ca)	mg/L	37.0	82.9	27.9	27.0	28.2	32.6
	Chromium (Cr) [6]	mg/L	0.00012	0.00466	0.00016	0.00017	0.00021	0.00011
	Cobalt (Co)	mg/L	<0.00010	0.00285	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu) [5]	mg/L	<0.00050	0.0060	<0.00050	0.00052	0.00102	<0.00050
	Iron (Fe)	mg/L	0.057	6.17	0.123	0.121	0.117	<0.010
	Lead (Pb) [5]	mg/L	0.000096	0.00629	0.000176	0.000195	0.00134	<0.000050
	Lithium (Li)	mg/L	0.0016	0.0083	0.0010	0.0010	<0.0010	0.0020
	Magnesium (Mg) [5]	mg/L	11.3	17.5	7.80	7.69	7.74	10.1
	Manganese (Mn)	mg/L	0.00475	0.172	0.00728	0.00686	0.00792	0.00099
	Mercury (Hg) [7]	mg/L	<0.00050	0.00442	0.00070	0.00065	0.00063	<0.00050
	Molybdenum (Mo)	mg/L	0.000764	0.00072	0.000504	0.000494	0.000547	0.000652
	Nickel (Ni) [5]	mg/L	<0.00050	0.0059	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.597	0.97	0.474	0.464	0.470	0.506
	Selenium (Se)	mg/L	0.000180	0.00020	0.000135	0.000138	0.000124	0.00107
	Silicon (Si)-Total	mg/L	1.86	6.71	2.30	2.29	2.21	1.14
	Silver (Ag) [5]	mg/L	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	5.26	4.04	2.03	1.99	2.03	3.06
	Strontium (Sr)	mg/L	0.156	0.242	0.101	0.101	0.0982	0.131
	Thallium (Tl)	mg/L	<0.000010	0.000035	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	0.00019	<0.00020	0.00015	0.00012	0.00013	<0.00010
	Titanium (Ti)	mg/L	<0.010	0.033	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000786	0.000939	0.000572	0.000555	0.000532	0.000689
	Vanadium (V)	mg/L	<0.00050	0.0040	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn) [5]	mg/L	<0.0030	0.0226	<0.0030	<0.0030	0.0803	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0042	0.0119	0.0135	0.0142	0.0137	0.0037
	Antimony (Sb)	mg/L	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00043	0.00048	0.00032	0.00027	0.00031	0.00034
	Barium (Ba)	mg/L	0.0385	0.0332	0.0266	0.0268	0.0265	0.0390
	Beryllium (Be)	mg/L	<0.000020	<0.000040	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd) [5]	mg/L	<0.0000050	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	34.7	32.6	26.3	25.8	25.6	32.0
	Chromium (Cr)	mg/L	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	<0.010	0.022	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	<0.000050	<0.00010	<0.000050	<0.000050	0.000144	<0.000050
	Lithium (Li)	mg/L	0.0015	0.0012	<0.0010	<0.0010	<0.0010	0.0018
	Magnesium (Mg)	mg/L	11.0	9.43	7.62	7.59	7.48	9.84
	Manganese (Mn)	mg/L	0.00010	0.00060	0.00259	0.00237	0.00244	<0.00010
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000725	0.00048	0.000536	0.000526	0.000528	0.000655
	Nickel (Ni)	mg/L	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.591	0.53	0.476	0.469	0.476	0.535
	Selenium (Se)	mg/L	0.000140	0.00014	0.000130	0.000110	0.000110	0.00104
	Silicon (Si)	mg/L	1.81	2.86	2.16	2.21	2.15	1.06
	Silver (Ag)	mg/L	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	5.54	3.58	2.10	2.09	2.07	3.22
	Strontium (Sr)	mg/L	0.151	0.124	0.100	0.100	0.0997	0.126
	Thallium (Tl)	mg/L	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	0.00018	<0.00020	0.00014	0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000788	0.000673	0.000560	0.000547	0.000545	0.000700
	Vanadium (V)	mg/L	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010

▨ Exceeds BCMOE Long term Guideline
🟦 Exceeds BCMOE Short term Guideline

Notes: "-" = no data

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[6] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[7] The most conservative guideline (0.00000125 mg/L) was applied.

Table A.9: Water Quality Analytes in Comparison to Guidelines, 2018

Analyte		Units	RG_TNS2	RG_ER	RG_ER	RG_ERU1	RG_ERU2	RG_ERU3
			Bottom	**Surface**	**Surface**	**Surface**	**Middle**	**Bottom**
			29-Aug-2018	27-Apr-2018	13-Jun-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018
Physical Characteristics	Hardness (as CaCO3)	mg/L	128	175	103	119	116	131
	pH, Field	pH	8.42	8.26	8.02	8.56	8.51	8.21
	Total Suspended Solids, Lab	mg/L	3.1	50.1	2.5	2.2	1.3	2.6
	Total Dissolved Solids	mg/L	231	193	111	151	152	178
	Dissolved Oxygen-Field [2]	mg/L	8.66	9.95	10.16	8.92	8.96	8.39
	Dissolved Oxygen-Field	%	87.7	86.9	102.3	107	106.4	94.5
	Temperature-Field	C	18	8.9	13.05	19.6	18.9	16.5
Anions and Nutrients	Ammonia as N [3]	mg/L	0.0198	0.0106	0.0073	0.0201	0.0179	0.0204
	Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	4.10	4.20	<0.50	2.13	2.13	3.87
	Fluoride (F) [5]	mg/L	0.096	0.100	<0.020	0.092	0.092	0.092
	Nitrate (as N)	mg/L	0.0368	0.284	<0.0050	0.118	0.117	0.0463
	Nitrite (as N) [4]	mg/L	0.0012	0.0016	<0.0010	0.0018	0.0018	0.0014
	Phosphorus (P)-Total	mg/L	0.0041	0.0261	0.0118	<0.0020	<0.0020	<0.0020
	Sulphate (SO_4) [5]	mg/L	31.5	36.5	<0.30	24.9	25.0	31.5
Total Metals	Aluminum (Al)	mg/L	0.0329	0.564	0.0772	0.0103	0.0113	0.0220
	Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00049	0.00079	0.00039	0.00034	0.00036	0.00047
	Barium (Ba)	mg/L	0.0381	0.0608	0.0279	0.0396	0.0400	0.0385
	Beryllium (Be)	mg/L	<0.000020	0.000031	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<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	<0.010
	Cadmium (Cd)	mg/L	<0.0000050	0.0000267	0.0000269	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	35.2	46.0	27.1	33.2	33.5	35.9
	Chromium (Cr) [6]	mg/L	0.00011	0.00086	0.00023	<0.00010	<0.00010	0.00011
	Cobalt (Co)	mg/L	<0.00010	0.00043	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu) [5]	mg/L	<0.00050	0.00115	0.00100	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.051	0.838	0.094	<0.010	<0.010	0.032
	Lead (Pb) [5]	mg/L	0.000090	0.000893	0.00382	<0.000050	<0.000050	0.000065
	Lithium (Li)	mg/L	0.0017	0.0038	0.0012	0.0019	0.0019	0.0016
	Magnesium (Mg) [5]	mg/L	11.0	13.7	7.71	9.42	9.65	10.7
	Manganese (Mn)	mg/L	0.00392	0.0313	0.00642	0.00125	0.00119	0.00372
	Mercury (Hg) [7]	mg/L	<0.00050	0.00199	0.00056	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)	mg/L	0.000679	0.000678	0.000521	0.000671	0.000687	0.000756
	Nickel (Ni) [5]	mg/L	<0.00050	0.00112	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.569	0.819	0.510	0.493	0.501	0.564
	Selenium (Se)	mg/L	0.000229	0.00116	0.000319	0.00116	0.00113	0.000309
	Silicon (Si)-Total	mg/L	1.85	3.29	2.31	1.16	1.10	1.74
	Silver (Ag) [5]	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	5.17	5.12	2.14	2.65	2.69	4.61
	Strontium (Sr)	mg/L	0.156	0.159	0.0998	0.123	0.123	0.151
	Thallium (Tl)	mg/L	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000777	0.000840	0.000561	0.000686	0.000675	0.000766
	Vanadium (V)	mg/L	<0.00050	0.00103	0.00053	<0.00050	<0.00050	<0.00050
	Zinc (Zn) [5]	mg/L	<0.0030	0.0041	0.0049	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0041	0.0080	0.0172	0.0042	0.0040	0.0040
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00044	0.00050	0.00034	0.00036	0.00031	0.00045
	Barium (Ba)	mg/L	0.0371	0.0632	0.0306	0.0404	0.0404	0.0385
	Beryllium (Be)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<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	<0.010
	Cadmium (Cd) [5]	mg/L	<0.0000050	<0.0000050	0.0000116	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	33.6	46.6	27.7	31.9	30.7	34.7
	Chromium (Cr)	mg/L	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	<0.010	0.015	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	<0.000050	<0.000050	0.000533	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0015	0.0027	0.0011	0.0018	0.0018	0.0015
	Magnesium (Mg)	mg/L	10.8	14.3	8.14	9.63	9.61	10.8
	Manganese (Mn)	mg/L	<0.00010	0.00083	0.00033	<0.00010	<0.00010	0.00013
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000691	0.000679	0.000543	0.000655	0.000630	0.000897
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.575	0.792	0.507	0.511	0.507	0.593
	Selenium (Se)	mg/L	0.000204	0.00126	0.000326	0.00117	0.00116	0.000316
	Silicon (Si)	mg/L	1.86	2.48	2.19	1.16	1.08	1.68
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	5.12	5.73	2.18	2.88	2.83	4.85
	Strontium (Sr)	mg/L	0.151	0.171	0.103	0.121	0.119	0.147
	Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	0.00012	0.00014	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000760	0.000877	0.000587	0.000700	0.000669	0.000772
	Vanadium (V)	mg/L	<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

▨	Exceeds BCMOE Long term Guideline
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Notes: "-" = no data

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[7] The most conservative guideline (0.00000125 mg/L) was applied.

Table A.9: Water Quality Analytes in Comparison to Guidelines, 2018

Analyte		Units	RG_T4	RG_T4U1	RG_T4U2	RG_T4U3	RG_T4U1	RG_T4U2
			Surface	Surface	Middle	Bottom	Surface	Surface
			29-Apr-2018	08-Jun-2018	08-Jun-2018	08-Jun-2018	29-Aug-2018	29-Aug-2018
Physical Characteristics	Hardness (as CaCO3)	mg/L	137	103	107	122	116	118
	pH, Field	pH	7.57	8.00	8.03	-	8.76	8.77
	Total Suspended Solids, Lab	mg/L	879	2.3	2.1	10.1	1.3	1.1
	Total Dissolved Solids	mg/L	165	129	126	145	140	111
	Dissolved Oxygen-Field [2]	mg/L	12.53	8.46	8.34	-	8.9	8.82
	Dissolved Oxygen-Field	%	102.6	92.4	89.4	-	96.4	95.5
	Temperature-Field	C	6.73	16.53	13.76	11.09	19.2	19.2
Anions and Nutrients	Ammonia as N [3]	mg/L	0.045	0.0094	0.0134	0.0087	0.0127	0.0181
	Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	2.87	3.16	2.49	1.41	2.00	2.11
	Fluoride (F) [5]	mg/L	0.103	0.071	0.069	0.097	0.093	0.093
	Nitrate (as N)	mg/L	0.463	0.187	0.212	0.462	0.116	0.124
	Nitrite (as N) [4]	mg/L	0.0025	0.0016	0.0012	<0.0010	0.0022	0.0019
	Phosphorus (P)-Total	mg/L	0.370	0.0116	0.0074	0.0138	<0.0020	<0.0020
	Sulphate (SO_4) [5]	mg/L	28.8	15.1	15.4	22.2	23.9	24.7
Total Metals	Aluminum (Al)	mg/L	5.64	0.0472	0.0549	0.176	0.0138	0.0122
	Antimony (Sb)	mg/L	0.00026	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00381	0.00040	0.00037	0.00039	0.00036	0.00039
	Barium (Ba)	mg/L	0.121	0.0363	0.0334	0.0464	0.0408	0.0400
	Beryllium (Be)	mg/L	0.000267	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	0.00012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.000268	0.0000075	0.0000066	0.0000200	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	99.3	28.9	28.3	34.2	31.1	31.8
	Chromium (Cr) [6]	mg/L	0.00820	0.00013	0.00013	0.00038	<0.00010	<0.00010
	Cobalt (Co)	mg/L	0.00441	<0.00010	<0.00010	0.00014	<0.00010	<0.00010
	Copper (Cu) [5]	mg/L	0.0095	0.00065	<0.00050	0.00055	<0.00050	<0.00050
	Iron (Fe)	mg/L	9.99	0.043	0.053	0.212	<0.010	<0.010
	Lead (Pb) [5]	mg/L	0.0101	0.000170	0.000114	0.000235	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0136	0.0016	0.0015	0.0028	0.0019	0.0020
	Magnesium (Mg) [5]	mg/L	21.4	8.38	7.67	10.0	9.38	9.70
	Manganese (Mn)	mg/L	0.291	0.00263	0.00320	0.0107	0.00123	0.00138
	Mercury (Hg) [7]	mg/L	0.0196	0.00067	0.00068	0.00086	<0.00050	<0.00050
	Molybdenum (Mo)	mg/L	0.00103	0.000536	0.000506	0.000681	0.000677	0.000648
	Nickel (Ni) [5]	mg/L	0.0103	<0.00050	<0.00050	0.00055	<0.00050	<0.00050
	Potassium (K)	mg/L	1.50	0.595	0.492	0.517	0.484	0.489
	Selenium (Se)	mg/L	0.00246	0.000880	0.000752	0.00223	0.00115	0.00115
	Silicon (Si)-Total	mg/L	9.81	2.47	2.40	2.49	1.15	1.23
	Silver (Ag) [5]	mg/L	0.000065	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	3.72	4.47	2.40	1.64	2.66	2.74
	Strontium (Sr)	mg/L	0.270	0.0993	0.0980	0.114	0.122	0.124
	Thallium (Tl)	mg/L	0.000093	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<0.00020	0.00057	0.00012	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.043	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00112	0.000612	0.000612	0.000657	0.000726	0.000665
	Vanadium (V)	mg/L	0.0088	<0.00050	<0.00050	0.00061	<0.00050	<0.00050
	Zinc (Zn) [5]	mg/L	0.0424	0.0032	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0147	0.0154	0.0183	0.0130	0.0044	0.0045
	Antimony (Sb)	mg/L	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00060	0.00036	0.00036	0.00030	0.00032	0.00033
	Barium (Ba)	mg/L	0.0579	0.0375	0.0365	0.0455	0.0398	0.0388
	Beryllium (Be)	mg/L	<0.000040	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd) [5]	mg/L	<0.000010	<0.0000050	<0.0000050	0.0000153	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	36.9	27.6	29.0	32.5	31.1	31.7
	Chromium (Cr)	mg/L	<0.00020	<0.00010	<0.00010	0.00012	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00060	<0.00050	<0.00050	0.00077	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.022	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0026	0.0014	0.0015	0.0025	0.0019	0.0018
	Magnesium (Mg)	mg/L	10.9	8.27	8.29	9.85	9.33	9.42
	Manganese (Mn)	mg/L	0.00072	0.00026	0.00068	0.00058	<0.00010	<0.00010
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.00065	0.000483	0.000533	0.000652	0.000623	0.000609
	Nickel (Ni)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.56	0.603	0.556	0.510	0.520	0.514
	Selenium (Se)	mg/L	0.00206	0.000816	0.000777	0.00226	0.00101	0.00100
	Silicon (Si)	mg/L	2.67	2.33	2.28	2.14	1.16	1.20
	Silver (Ag)	mg/L	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	3.25	3.28	2.24	1.69	2.67	2.83
	Strontium (Sr)	mg/L	0.124	0.0921	0.0983	0.104	0.118	0.117
	Thallium (Tl)	mg/L	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<0.00020	0.00046	0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000749	0.000573	0.000583	0.000588	0.000663	0.000670
	Vanadium (V)	mg/L	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	<0.0020	0.0019	<0.0010	<0.0010	<0.0010	<0.0010

▨ Exceeds BCMOE Long term Guideline

🟦 Exceeds BCMOE Short term Guideline

Notes: "-" = no data

[1] British Columbia Working (BCMOE 2017a) or Accepted (BCMOE 2017b) Water Quality Guidelines for the Protection of Aquatic Life were used. For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.

[2] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.

[3] Temperature and pH dependent; range of minimum and maximum values.

[4] Dependent on concurrent chloride, range of values reported (BCMOE 2017a)

[5] 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. Mimimum and maximum calculated guideline values presented if applicable.

[6] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[7] The most conservative guideline (0.00000125 mg/L) was applied.

Table A.9: Water Quality Analytes in Comparison to Guidelines, 2018

Analyte		Units	RG_T4U3	RG_GC	RG_GC	RG_GCU1	RG_GCU2	RG_GCU3
			Middle	Surface	Surface	Surface	Middle	Bottom
			29-Aug-2018	27-Apr-2018	08-Jun-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018
Physical Characteristics	Hardness (as CaCO3)	mg/L	143	184	100	114	117	132
	pH, Field	pH	8.25	7.59	7.95	8.8	8.79	8.26
	Total Suspended Solids, Lab	mg/L	3.1	43.1	1.9	1.5	1.3	1.3
	Total Dissolved Solids	mg/L	212	196	117	149	152	169
	Dissolved Oxygen-Field [2]	mg/L	6.82	12.83	8.97	8.88	8.82	6.99
	Dissolved Oxygen-Field	%	68.2	113.3	99.6	95.7	95.1	71.3
	Temperature-Field	C	15.7	11.87	17.2	19	19	16.2
Anions and Nutrients	Ammonia as N [3]	mg/L	0.0259	0.0258	0.0060	0.0229	0.0166	0.0216
	Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	2.56	3.71	1.18	1.92	1.96	2.93
	Fluoride (F) [5]	mg/L	0.114	0.108	0.066	0.090	0.090	0.103
	Nitrate (as N)	mg/L	0.386	0.457	0.168	0.114	0.117	0.222
	Nitrite (as N) [4]	mg/L	0.0052	0.0020	0.0018	0.0022	0.0022	0.0044
	Phosphorus (P)-Total	mg/L	0.0035	0.0333	0.0053	0.0028	<0.0020	0.0032
	Sulphate (SO_4) [5]	mg/L	33.4	37.7	13.7	23.0	23.4	30.4
Total Metals	Aluminum (Al)	mg/L	0.0262	0.853	0.0367	0.0104	0.0113	0.0225
	Antimony (Sb)	mg/L	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00041	0.00109	0.00037	0.00036	0.00034	0.00043
	Barium (Ba)	mg/L	0.0514	0.0767	0.0374	0.0405	0.0391	0.0437
	Beryllium (Be)	mg/L	<0.000020	0.000050	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<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	<0.010
	Cadmium (Cd)	mg/L	0.0000056	0.0000378	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	37.3	45.6	28.1	31.6	31.7	37.1
	Chromium (Cr) [6]	mg/L	0.00016	0.00112	0.00023	0.00014	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	0.00061	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu) [5]	mg/L	<0.00050	0.00172	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.040	1.19	0.031	0.013	<0.010	0.026
	Lead (Pb) [5]	mg/L	0.000080	0.00124	<0.000050	<0.000050	<0.000050	0.000106
	Lithium (Li)	mg/L	0.0031	0.0044	0.0014	0.0018	0.0018	0.0022
	Magnesium (Mg) [5]	mg/L	11.6	13.0	8.04	9.26	9.09	10.9
	Manganese (Mn)	mg/L	0.00778	0.0548	0.00230	0.00115	0.00117	0.00400
	Mercury (Hg) [7]	mg/L	<0.00050	0.00146	0.00057	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)	mg/L	0.000798	0.000740	0.000477	0.000641	0.000647	0.000735
	Nickel (Ni) [5]	mg/L	<0.00050	0.00170	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.545	0.860	0.530	0.491	0.477	0.545
	Selenium (Se)	mg/L	0.00216	0.00183	0.000765	0.00106	0.00110	0.00111
	Silicon (Si)-Total	mg/L	1.96	4.00	2.62	1.22	1.21	1.85
	Silver (Ag) [5]	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	3.23	4.27	1.82	2.43	2.43	3.59
	Strontium (Sr)	mg/L	0.149	0.145	0.0917	0.116	0.115	0.142
	Thallium (Tl)	mg/L	<0.000010	0.000016	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<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
	Uranium (U)	mg/L	0.000789	0.000849	0.000593	0.000666	0.000673	0.000763
	Vanadium (V)	mg/L	<0.00050	0.00161	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn) [5]	mg/L	0.0035	0.0045	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0034	0.0154	0.0144	0.0043	0.0042	0.0031
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00040	0.00062	0.00033	0.00037	0.00035	0.00043
	Barium (Ba)	mg/L	0.0502	0.0831	0.0382	0.0406	0.0408	0.0441
	Beryllium (Be)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)	mg/L	<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	<0.010
	Cadmium (Cd) [5]	mg/L	<0.0000050	0.0000061	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	37.9	49.0	27.1	30.5	31.8	34.9
	Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	0.00057	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	<0.010	0.023	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	<0.000050	0.000054	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0029	0.0031	0.0013	0.0017	0.0017	0.0021
	Magnesium (Mg)	mg/L	11.8	15.1	7.90	9.19	9.24	11.0
	Manganese (Mn)	mg/L	<0.00010	0.0141	0.00027	<0.00010	<0.00010	<0.00010
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000819	0.000667	0.000465	0.000642	0.000632	0.000762
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.590	0.835	0.538	0.505	0.505	0.567
	Selenium (Se)	mg/L	0.00211	0.00182	0.000807	0.000920	0.00109	0.00106
	Silicon (Si)	mg/L	1.84	2.70	2.50	1.22	1.18	1.95
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	3.45	4.86	1.79	2.63	2.62	3.81
	Strontium (Sr)	mg/L	0.151	0.165	0.0870	0.113	0.114	0.141
	Thallium (Tl)	mg/L	<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
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000809	0.000877	0.000571	0.000662	0.000671	0.000756
	Vanadium (V)	mg/L	<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

▨ Exceeds BCMOE Long term Guideline

🟦 Exceeds BCMOE Short term Guideline

Notes: "-" = no data

[1] British Columbia Working (BCMOE 2017a) or Accepted (BCMOE 2017b) Water Quality Guidelines for the Protection of Aquatic Life were used. For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.

[2] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.

[3] Temperature and pH dependent; range of minimum and maximum values.

[4] Dependent on concurrent chloride, range of values reported (BCMOE 2017a)

[5] 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. Mimimum and maximum calculated guideline values presented if applicable.

[6] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[7] The most conservative guideline (0.00000125 mg/L) was applied.

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	pH[a]	Temp (°C)	TDS (mg/L)	TSS (mg/L)	Secchi Depth (m)	Chlorophyll a (mg/L)	Total Nitrogen (mg/L)	Dissolved Organic Carbon (mg/L)	Total Organic Carbon (mg/L)
International Boundary	4/26/2017	Bottom	7.9	8.4	-	-	-	-	-	-	-
	4/26/2017	Surface	7.9	8.9	-	-	-	-	-	-	-
	5/16/2017	Bottom	8.1	7.4	-	-	-	-	-	-	-
	5/16/2017	Surface	8.2	10	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	-
	6/22/2017	Surface	-	-	-	-	-	-	-	-	-
	7/25/2017	Bottom	7.9	9.1	-	-	-	-	-	-	-
	7/25/2017	Surface	8.7	22	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2017	Surface	-	-	-	-	-	-	-	-	-
	9/26/2017	Bottom	7.9	9.2	-	-	-	-	-	-	-
	9/26/2017	Surface	8.5	16	-	-	-	-	-	-	-
	10/24/2017	Bottom	8.3	12	-	-	-	-	-	-	-
	10/24/2017	Surface	8.5	12	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-
	4/24/2018	Surface	-	-	-	-	0.40	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	0.75	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-
	6/12/2018	Surface	-	-	-	-	1.5	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	4.0	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2018	Surface	-	-	-	-	3.5	-	-	-	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-
	9/18/2018	Surface	-	-	-	-	5.0	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	5.5	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	8.0	4.0	-	-	-	-	-	-	-
	4/26/2017	Surface	8.2	4.6	-	-	-	-	-	-	-
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	-
	6/22/2017	Surface	-	-	-	-	-	-	-	-	-
	7/25/2017	Bottom	7.8	5.0	-	-	-	-	-	-	-
	7/25/2017	Surface	8.6	20	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2017	Surface	-	-	-	-	-	-	-	-	-
	9/26/2017	Bottom	7.8	5.3	-	-	-	-	-	-	-
	9/26/2017	Surface	8.6	16	-	-	-	-	-	-	-
	10/24/2017	Bottom	7.7	5.2	-	-	-	-	-	-	-
	10/24/2017	Surface	8.3	12	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-
	4/24/2018	Surface	-	-	-	-	4.5	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	1.5	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-
	6/12/2018	Surface	-	-	-	-	1.0	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	4.5	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2018	Surface	-	-	-	-	6.5	-	-	-	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-
	9/18/2018	Surface	-	-	-	-	8.5	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	8.5	-	-	-	-
Forebary	4/26/2017	Bottom	-	-	-	-	-	-	-	-	-
	4/26/2017	Surface	8.2	5.1	-	-	-	-	-	-	-
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	-
	5/16/2017	Surface	8.2	9.5	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	-
	6/22/2017	Surface	-	-	-	-	-	-	-	-	-
	7/25/2017	Bottom	7.8	4.4	-	-	-	-	-	-	-
	7/25/2017	Surface	8.7	21	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2017	Surface	-	-	-	-	-	-	-	-	-
	9/26/2017	Bottom	7.8	4.6	-	-	-	-	-	-	-
	9/26/2017	Surface	8.6	16	-	-	-	-	-	-	-
	10/24/2017	Bottom	7.7	4.7	-	-	-	-	-	-	-
	10/24/2017	Surface	8.2	12	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-
	4/24/2018	Surface	-	-	-	-	5.0	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	1.5	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-
	6/12/2018	Surface	-	-	-	-	2.5	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	4.5	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-
	8/28/2018	Surface	-	-	-	-	6.0	-	-	-	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-
	9/18/2018	Surface	-	-	-	-	7.0	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	8.0	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.

[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).

"-" indicates no data available

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	Dissolved Oxygen (mg/L)	Orthophosphate (mg/L)	Phosphate-Phosphorus (mg/L)	Dissolved Ammonia (mg/L)	Total Ammonia (mg/L)	Dissolved Nitrate +Nitrite (mg/L)	Total Nitrate +Nitrite (mg/L)	Hardness (mg/L) [b]	Alkalinity (mg/L)
International Boundary	4/26/2017	Bottom	9.5	-	-	-	-	-	-	167	-
	4/26/2017	Surface	9.6	-	-	-	-	-	-	152	-
	5/16/2017	Bottom	11	-	-	-	-	-	-	-	-
	5/16/2017	Surface	10	-	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	121	-
	6/22/2017	Surface	-	-	-	-	-	-	-	104	-
	7/25/2017	Bottom	8.5	-	-	-	-	-	-	-	-
	7/25/2017	Surface	9.1	-	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	105	-
	8/28/2017	Surface	-	-	-	-	-	-	-	113	-
	9/26/2017	Bottom	7.0	-	-	-	-	-	-	117	-
	9/26/2017	Surface	8.7	-	-	-	-	-	-	119	-
	10/24/2017	Bottom	9.4	-	-	-	-	-	-	-	-
	10/24/2017	Surface	9.8	-	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	166	-
	4/24/2018	Surface	-	-	-	-	-	-	-	166	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	102	-
	6/12/2018	Surface	-	-	-	-	-	-	-	88	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	119	-
	8/28/2018	Surface	-	-	-	-	-	-	-	111	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	120	-
	9/18/2018	Surface	-	-	-	-	-	-	-	119	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	11	-	-	-	-	-	-	147	-
	4/26/2017	Surface	12	-	-	-	-	-	-	136	-
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	135	-
	6/22/2017	Surface	-	-	-	-	-	-	-	108	-
	7/25/2017	Bottom	9.5	-	-	-	-	-	-	-	-
	7/25/2017	Surface	9.0	-	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	129	-
	8/28/2017	Surface	-	-	-	-	-	-	-	104	-
	9/26/2017	Bottom	8.3	-	-	-	-	-	-	139	-
	9/26/2017	Surface	9.1	-	-	-	-	-	-	111	-
	10/24/2017	Bottom	7.9	-	-	-	-	-	-	-	-
	10/24/2017	Surface	9.4	-	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	140	-
	4/24/2018	Surface	-	-	-	-	-	-	-	136	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	140	-
	6/12/2018	Surface	-	-	-	-	-	-	-	89	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	137	-
	8/28/2018	Surface	-	-	-	-	-	-	-	101	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	137	-
	9/18/2018	Surface	-	-	-	-	-	-	-	111	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-
Forebary	4/26/2017	Bottom	-	-	-	-	-	-	-	134	-
	4/26/2017	Surface	12	-	-	-	-	-	-	129	-
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	-
	5/16/2017	Surface	12	-	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	133	-
	6/22/2017	Surface	-	-	-	-	-	-	-	106	-
	7/25/2017	Bottom	10	-	-	-	-	-	-	-	-
	7/25/2017	Surface	9.6	-	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	133	-
	8/28/2017	Surface	-	-	-	-	-	-	-	103	-
	9/26/2017	Bottom	8.6	-	-	-	-	-	-	141	-
	9/26/2017	Surface	9.2	-	-	-	-	-	-	112	-
	10/24/2017	Bottom	8.3	-	-	-	-	-	-	-	-
	10/24/2017	Surface	9.4	-	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	151	-
	4/24/2018	Surface	-	-	-	-	-	-	-	126	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	140	-
	6/12/2018	Surface	-	-	-	-	-	-	-	93	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	146	-
	8/28/2018	Surface	-	-	-	-	-	-	-	108	-
	9/18/2018	Bottom	-	-	-	-	-	-	-	141	-
	9/18/2018	Surface	-	-	-	-	-	-	-	109	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.

[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).

"-" indicates no data available

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	Bicarbonate (mg/L)	Carbonate (mg/L)	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)	Dissolved Antimony (mg/L)	Total Antimony (mg/L)	Dissolved Arsenic (mg/L)	Total Arsenic (mg/L)	Dissolved Cadmium (mg/L)	Total Cadmium (mg/L)	Total Calcium (mg/L)
International Boundary	4/26/2017	Bottom	-	-	-	-	-	-	-	-	<0.000035	0.000039	45
	4/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000035	0.000045	41
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	0.0000060	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-	-	0.0000040	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	<0.000012	0.000027	33
	6/22/2017	Surface	-	-	-	-	-	-	-	-	0.0000070	<0.000012	28
	7/25/2017	Bottom	-	-	-	-	-	-	-	-	0.000011	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-	-	<0.000016	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	0.0000090	0.0000090	28
	8/28/2017	Surface	-	-	-	-	-	-	-	-	0.000066	<0.000051	29
	9/26/2017	Bottom	-	-	-	-	-	-	-	-	0.0000030	0.0000070	33
	9/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	0.0000030	32
	10/24/2017	Bottom	-	-	-	-	-	-	-	-	<0.000008	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	44
	4/24/2018	Surface	-	-	-	-	-	-	-	-	-	0.000022	44
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-	0.000012	28
	6/12/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	24
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	32
	8/28/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	29
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	33
	9/18/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	32
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	-	-	-	-	-	-	-	-	<0.000035	<0.000035	38
	4/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000035	<0.000035	36
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	0.0000050	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	0.0000080	0.000011	35
	6/22/2017	Surface	-	-	-	-	-	-	-	-	<0.000012	<0.000012	29
	7/25/2017	Bottom	-	-	-	-	-	-	-	-	<0.000016	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-	-	<0.000016	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	0.000010	<0.000051	33
	8/28/2017	Surface	-	-	-	-	-	-	-	-	<0.00001	<0.00001	27
	9/26/2017	Bottom	-	-	-	-	-	-	-	-	0.0000060	0.0000080	37
	9/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	<0.000008	30
	10/24/2017	Bottom	-	-	-	-	-	-	-	-	0.0000060	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-	-	<0.00001	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	37
	4/24/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	36
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-	0.000014	37
	6/12/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	24
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	36
	8/28/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	26
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	36
	9/18/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	30
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
Forebary	4/26/2017	Bottom	-	-	-	-	-	-	-	-	<0.000035	<0.000035	35
	4/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000035	<0.000035	34
	5/16/2017	Bottom	-	-	-	-	-	-	-	-	0.0000040	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	-	-
	6/22/2017	Bottom	-	-	-	-	-	-	-	-	<0.000012	<0.000012	34
	6/22/2017	Surface	-	-	-	-	-	-	-	-	<0.000012	<0.000012	29
	7/25/2017	Bottom	-	-	-	-	-	-	-	-	<0.000016	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-	-	<0.000016	-	-
	8/28/2017	Bottom	-	-	-	-	-	-	-	-	<0.00001	0.0000060	34
	8/28/2017	Surface	-	-	-	-	-	-	-	-	<0.00001	<0.00001	27
	9/26/2017	Bottom	-	-	-	-	-	-	-	-	<0.000008	0.0000040	37
	9/26/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	<0.000008	30
	10/24/2017	Bottom	-	-	-	-	-	-	-	-	<0.000008	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-	-	<0.000008	-	-
	4/24/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	44
	4/24/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	34
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	37
	6/12/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	25
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	38
	8/28/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	29
	9/18/2018	Bottom	-	-	-	-	-	-	-	-	-	<0.00003	37
	9/18/2018	Surface	-	-	-	-	-	-	-	-	-	<0.00003	29
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.

[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).

"-" indicates no data available

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	Total Chloride (mg/L)	Dissolved Chromium (mg/L)	Total Chromium (mg/L)	Dissolved Copper (mg/L)	Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Dissolved Lead (mg/L)	Total Lead (mg/L)	Total Magnesium (mg/L)	Total Mercury (mg/L)
International Boundary	4/26/2017	Bottom	3.0	-	-	-	-	-	-	0.00016	0.0018	13	0.0000031
	4/26/2017	Surface	3.0	-	-	-	-	-	-	0.00011	0.0013	12	0.0000026
	5/16/2017	Bottom	-	-	-	-	-	-	-	0.000065	-	-	0.0000035
	5/16/2017	Surface	-	-	-	-	-	-	-	0.000035	-	-	0.0000022
	6/22/2017	Bottom	1.1	-	-	-	-	-	-	0.000028	0.00084	9.1	0.0000016
	6/22/2017	Surface	1.1	-	-	-	-	-	-	0.000033	0.000077	8.3	0.00000074
	7/25/2017	Bottom	-	-	-	-	-	-	-	0.000075	-	-	0.0000011
	7/25/2017	Surface	-	-	-	-	-	-	-	0.000012	-	-	0.00000047
	8/28/2017	Bottom	1.3	-	-	-	-	-	-	0.000036	0.00013	8.4	0.00000088
	8/28/2017	Surface	1.7	-	-	-	-	-	-	0.000012	<0.000091	9.6	0.00000038
	9/26/2017	Bottom	1.2	-	-	-	-	-	-	0.000023	0.000072	8.7	0.00000053
	9/26/2017	Surface	2.3	-	-	-	-	-	-	0.000012	0.000018	9.6	0.00000020
	10/24/2017	Bottom	-	-	-	-	-	-	-	<0.000022	-	-	0.00000034
	10/24/2017	Surface	-	-	-	-	-	-	-	<0.000022	-	-	0.00000032
	4/24/2018	Bottom	4.9	-	-	-	-	-	-	-	0.00039	14	-
	4/24/2018	Surface	4.9	-	-	-	-	-	-	-	0.00070	13	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.0000029
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.0000016
	6/12/2018	Bottom	1.0	-	-	-	-	-	-	-	0.00036	8.0	-
	6/12/2018	Surface	1.2	-	-	-	-	-	-	-	0.00011	6.8	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.00000075
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.00000058
	8/28/2018	Bottom	2.0	-	-	-	-	-	-	-	0.000098	9.5	-
	8/28/2018	Surface	1.8	-	-	-	-	-	-	-	0.000026	9.1	-
	9/18/2018	Bottom	1.9	-	-	-	-	-	-	-	0.000059	9.2	-
	9/18/2018	Surface	2.1	-	-	-	-	-	-	-	<0.000073	9.3	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	3.5	-	-	-	-	-	-	<0.000061	0.00011	12	0.00000089
	4/26/2017	Surface	3.2	-	-	-	-	-	-	<0.000061	0.000031	12	0.00000073
	5/16/2017	Bottom	-	-	-	-	-	-	-	0.000011	-	-	0.0000013
	5/16/2017	Surface	-	-	-	-	-	-	-	0.000012	-	-	0.0000018
	6/22/2017	Bottom	3.1	-	-	-	-	-	-	0.00014	0.00030	12	0.0000012
	6/22/2017	Surface	1.5	-	-	-	-	-	-	0.000033	0.000063	8.8	0.00000083
	7/25/2017	Bottom	-	-	-	-	-	-	-	0.000028	-	-	0.0000011
	7/25/2017	Surface	-	-	-	-	-	-	-	<0.000016	-	-	0.00000044
	8/28/2017	Bottom	2.9	-	-	-	-	-	-	0.000021	0.000083	11	0.00000072
	8/28/2017	Surface	1.5	-	-	-	-	-	-	<0.000018	0.000010	8.8	0.00000037
	9/26/2017	Bottom	3.3	-	-	-	-	-	-	0.000012	0.000051	11	0.00000057
	9/26/2017	Surface	1.6	-	-	-	-	-	-	0.000049	<0.00002	8.9	0.00000018
	10/24/2017	Bottom	-	-	-	-	-	-	-	<0.000033	-	-	0.00000057
	10/24/2017	Surface	-	-	-	-	-	-	-	<0.000027	-	-	0.00000022
	4/24/2018	Bottom	3.8	-	-	-	-	-	-	-	0.000073	12	-
	4/24/2018	Surface	3.3	-	-	-	-	-	-	-	0.000031	11	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.00000075
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.0000014
	6/12/2018	Bottom	3.3	-	-	-	-	-	-	-	0.00044	12	-
	6/12/2018	Surface	1.1	-	-	-	-	-	-	-	0.00013	6.9	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.00000084
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.00000046
	8/28/2018	Bottom	3.3	-	-	-	-	-	-	-	0.000038	11	-
	8/28/2018	Surface	1.6	-	-	-	-	-	-	-	<0.000073	8.4	-
	9/18/2018	Bottom	3.0	-	-	-	-	-	-	-	0.000039	12	-
	9/18/2018	Surface	1.7	-	-	-	-	-	-	-	<0.000073	8.9	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-
Forebary	4/26/2017	Bottom	3.2	-	-	-	-	-	-	<0.000061	0.000035	11	0.00000077
	4/26/2017	Surface	2.7	-	-	-	-	-	-	<0.000061	0.000032	11	0.00000097
	5/16/2017	Bottom	-	-	-	-	-	-	-	0.0000080	-	-	0.0000012
	5/16/2017	Surface	-	-	-	-	-	-	-	0.0000090	-	-	0.0000017
	6/22/2017	Bottom	3.3	-	-	-	-	-	-	0.000024	0.000051	12	0.00000063
	6/22/2017	Surface	1.3	-	-	-	-	-	-	0.000047	0.000095	8.5	0.00000088
	7/25/2017	Bottom	-	-	-	-	-	-	-	0.000021	-	-	0.00000097
	7/25/2017	Surface	-	-	-	-	-	-	-	<0.000016	-	-	0.00000050
	8/28/2017	Bottom	3.0	-	-	-	-	-	-	0.000027	0.000033	12	0.00000062
	8/28/2017	Surface	1.4	-	-	-	-	-	-	<0.000018	0.000011	8.4	0.00000081
	9/26/2017	Bottom	3.4	-	-	-	-	-	-	<0.00002	0.000034	12	0.00000059
	9/26/2017	Surface	1.6	-	-	-	-	-	-	<0.00002	0.000012	8.9	0.00000025
	10/24/2017	Bottom	-	-	-	-	-	-	-	<0.000022	-	-	0.00000067
	10/24/2017	Surface	-	-	-	-	-	-	-	<0.000022	-	-	0.00000028
	4/24/2018	Bottom	3.1	-	-	-	-	-	-	-	0.000043	10	-
	4/24/2018	Surface	2.9	-	-	-	-	-	-	-	0.000032	10	-
	5/22/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.00000047
	5/22/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.0000013
	6/12/2018	Bottom	3.1	-	-	-	-	-	-	-	0.00010	12	-
	6/12/2018	Surface	1.3	-	-	-	-	-	-	-	0.000080	7.2	-
	7/10/2018	Bottom	-	-	-	-	-	-	-	-	-	-	0.00000045
	7/10/2018	Surface	-	-	-	-	-	-	-	-	-	-	0.00000049
	8/28/2018	Bottom	3.3	-	-	-	-	-	-	-	<0.000073	12	-
	8/28/2018	Surface	1.6	-	-	-	-	-	-	-	<0.000073	8.7	-
	9/18/2018	Bottom	3.4	-	-	-	-	-	-	-	<0.000073	12	-
	9/18/2018	Surface	1.6	-	-	-	-	-	-	-	<0.000073	8.6	-
	10/23/2018	Bottom	-	-	-	-	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.

[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).

"-" indicates no data available

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	Total Potassium (mg/L)	Dissolved Methylseleninic Acid (mg/L)	Dissolved Selenate (mg/L)	Dissolved Selenite (mg/L)	Dissolved Selenium (mg/L)	Total Selenium (mg/L)	Dissolved Selenocyanate (mg/L)	Dissolved Selenomethionine (mg/L)	Dissolved Silver (mg/L)
International Boundary	4/26/2017	Bottom	0.87	-	-	-	0.0013	-	-	-	-
	4/26/2017	Surface	0.75	-	-	-	0.0014	-	-	-	-
	5/16/2017	Bottom	-	-	-	-	0.00096	-	-	-	-
	5/16/2017	Surface	-	-	-	-	0.0010	-	-	-	-
	6/22/2017	Bottom	0.48	-	-	-	0.00095	0.00095	-	-	-
	6/22/2017	Surface	0.42	-	-	-	0.00084	0.00080	-	-	-
	7/25/2017	Bottom	-	-	-	-	0.00093	-	-	-	-
	7/25/2017	Surface	-	-	-	-	0.00087	-	-	-	-
	8/28/2017	Bottom	0.47	-	-	-	0.00088	-	-	-	-
	8/28/2017	Surface	0.46	-	-	-	0.00093	-	-	-	-
	9/26/2017	Bottom	1.1	-	-	-	0.00078	-	-	-	-
	9/26/2017	Surface	0.85	-	-	-	0.00090	-	-	-	-
	10/24/2017	Bottom	-	-	-	-	0.0011	-	-	-	-
	10/24/2017	Surface	-	-	-	-	0.0011	-	-	-	-
	4/24/2018	Bottom	0.72	-	-	-	0.0018	-	-	-	-
	4/24/2018	Surface	0.76	-	-	-	0.0023	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	0.0010	-	-	-	-
	5/22/2018	Surface	-	-	-	-	0.00098	-	-	-	-
	6/12/2018	Bottom	0.41	-	-	-	0.0012	-	-	-	-
	6/12/2018	Surface	0.37	-	-	-	0.00085	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	0.0013	-	-	-	-
	7/10/2018	Surface	-	-	-	-	0.00075	-	-	-	-
	8/28/2018	Bottom	0.52	-	-	-	0.0010	-	-	-	-
	8/28/2018	Surface	0.45	-	-	-	0.00094	-	-	-	-
	9/18/2018	Bottom	0.54	-	-	-	0.00099	-	-	-	-
	9/18/2018	Surface	0.49	-	-	-	0.0010	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	0.0011	-	-	-	-
	10/23/2018	Surface	-	-	-	-	0.0011	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	0.67	-	-	-	0.0010	-	-	-	-
	4/26/2017	Surface	0.60	-	-	-	0.00087	-	-	-	-
	5/16/2017	Bottom	-	-	-	-	0.0010	-	-	-	-
	5/16/2017	Surface	-	-	-	-	0.0010	-	-	-	-
	6/22/2017	Bottom	0.62	-	-	-	0.00097	0.00095	-	-	-
	6/22/2017	Surface	0.46	-	-	-	0.00090	0.00098	-	-	-
	7/25/2017	Bottom	-	-	-	-	0.0011	-	-	-	-
	7/25/2017	Surface	-	-	-	-	0.00091	-	-	-	-
	8/28/2017	Bottom	0.61	-	-	-	0.0010	-	-	-	-
	8/28/2017	Surface	0.46	-	-	-	0.00086	-	-	-	-
	9/26/2017	Bottom	0.91	-	-	-	0.00088	-	-	-	-
	9/26/2017	Surface	0.82	-	-	-	0.00078	-	-	-	-
	10/24/2017	Bottom	-	-	-	-	0.00035	-	-	-	-
	10/24/2017	Surface	-	-	-	-	0.0011	-	-	-	-
	4/24/2018	Bottom	0.61	-	-	-	0.0012	-	-	-	-
	4/24/2018	Surface	0.58	-	-	-	0.0012	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	0.0013	-	-	-	-
	5/22/2018	Surface	-	-	-	-	0.0013	-	-	-	-
	6/12/2018	Bottom	0.58	-	-	-	0.0012	-	-	-	-
	6/12/2018	Surface	0.40	-	-	-	0.00091	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	0.0011	-	-	-	-
	7/10/2018	Surface	-	-	-	-	0.00094	-	-	-	-
	8/28/2018	Bottom	0.60	-	-	-	0.0011	-	-	-	-
	8/28/2018	Surface	0.44	-	-	-	0.00094	-	-	-	-
	9/18/2018	Bottom	0.62	-	-	-	0.0011	-	-	-	-
	9/18/2018	Surface	0.49	-	-	-	0.00095	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	0.0011	-	-	-	-
	10/23/2018	Surface	-	-	-	-	0.0010	-	-	-	-
Forebary	4/26/2017	Bottom	0.59	-	-	-	0.00088	-	-	-	-
	4/26/2017	Surface	0.60	-	-	-	0.00084	-	-	-	-
	5/16/2017	Bottom	-	-	-	-	0.00099	-	-	-	-
	5/16/2017	Surface	-	-	-	-	0.00090	-	-	-	-
	6/22/2017	Bottom	0.57	-	-	-	0.00097	0.00099	-	-	-
	6/22/2017	Surface	0.45	-	-	-	0.00089	0.00093	-	-	-
	7/25/2017	Bottom	-	-	-	-	0.0010	-	-	-	-
	7/25/2017	Surface	-	-	-	-	0.00087	-	-	-	-
	8/28/2017	Bottom	0.65	-	-	-	0.0010	-	-	-	-
	8/28/2017	Surface	0.45	-	-	-	0.00084	-	-	-	-
	9/26/2017	Bottom	0.93	-	-	-	0.00090	-	-	-	-
	9/26/2017	Surface	0.76	-	-	-	0.00080	-	-	-	-
	10/24/2017	Bottom	-	-	-	-	0.00091	-	-	-	-
	10/24/2017	Surface	-	-	-	-	0.00099	-	-	-	-
	4/24/2018	Bottom	0.56	-	-	-	0.0012	-	-	-	-
	4/24/2018	Surface	0.55	-	-	-	0.0011	-	-	-	-
	5/22/2018	Bottom	-	-	-	-	0.0012	-	-	-	-
	5/22/2018	Surface	-	-	-	-	0.0013	-	-	-	-
	6/12/2018	Bottom	0.55	-	-	-	0.0011	-	-	-	-
	6/12/2018	Surface	0.41	-	-	-	0.00097	-	-	-	-
	7/10/2018	Bottom	-	-	-	-	0.0011	-	-	-	-
	7/10/2018	Surface	-	-	-	-	0.00091	-	-	-	-
	8/28/2018	Bottom	0.62	-	-	-	0.0011	-	-	-	-
	8/28/2018	Surface	0.45	-	-	-	0.00091	-	-	-	-
	9/18/2018	Bottom	0.63	-	-	-	0.0010	-	-	-	-
	9/18/2018	Surface	0.48	-	-	-	0.00091	-	-	-	-
	10/23/2018	Bottom	-	-	-	-	0.0011	-	-	-	-
	10/23/2018	Surface	-	-	-	-	0.00098	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.
[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).
"-" indicates no data available

Table A.10: Water Quality Data for Montana in the Koocanusa Reservoir, 2017 to 2018

Station	Date	Depth	Total Silver (mg/L)	Sodium Adsorption Ratio	Total Sodium (mg/L)	Total Sulfate (mg/L)	Total Sulfide (mg/L)	Dissolved Zinc (mg/L)	Total Zinc (mg/L)
International Boundary	4/26/2017	Bottom	-	-	3.6	28	-	-	-
	4/26/2017	Surface	-	-	3.5	29	-	-	-
	5/16/2017	Bottom	-	-	-	-	-	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	1.5	16	-	-	-
	6/22/2017	Surface	-	-	1.5	13	-	-	-
	7/25/2017	Bottom	-	-	-	-	-	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	1.5	16	-	-	-
	8/28/2017	Surface	-	-	1.9	20	-	-	-
	9/26/2017	Bottom	-	-	1.9	16	-	-	-
	9/26/2017	Surface	-	-	2.7	23	-	-	-
	10/24/2017	Bottom	-	-	-	-	-	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	5.5	41	-	-	-
	4/24/2018	Surface	-	-	5.3	41	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	1.6	11	-	-	-
	6/12/2018	Surface	-	-	1.5	12	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	2.5	22	-	-	-
	8/28/2018	Surface	-	-	2.2	22	-	-	-
	9/18/2018	Bottom	-	-	2.4	22	-	-	-
	9/18/2018	Surface	-	-	2.5	25	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-
Tenmile Creek	4/26/2017	Bottom	-	-	4.4	29	-	-	-
	4/26/2017	Surface	-	-	4.0	27	-	-	-
	5/16/2017	Bottom	-	-	-	-	-	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	3.9	26	-	-	-
	6/22/2017	Surface	-	-	1.9	16	-	-	-
	7/25/2017	Bottom	-	-	-	-	-	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	3.4	26	-	-	-
	8/28/2017	Surface	-	-	1.8	18	-	-	-
	9/26/2017	Bottom	-	-	3.9	26	-	-	-
	9/26/2017	Surface	-	-	2.1	20	-	-	-
	10/24/2017	Bottom	-	-	-	-	-	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	4.3	32	-	-	-
	4/24/2018	Surface	-	-	3.7	28	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	4.1	11	-	-	-
	6/12/2018	Surface	-	-	1.5	9.7	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	4.1	30	-	-	-
	8/28/2018	Surface	-	-	2.0	21	-	-	-
	9/18/2018	Bottom	-	-	4.0	29	-	-	-
	9/18/2018	Surface	-	-	2.1	21	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-
Forebary	4/26/2017	Bottom	-	-	4.0	28	-	-	-
	4/26/2017	Surface	-	-	4.8	25	-	-	-
	5/16/2017	Bottom	-	-	-	-	-	-	-
	5/16/2017	Surface	-	-	-	-	-	-	-
	6/22/2017	Bottom	-	-	4.1	28	-	-	-
	6/22/2017	Surface	-	-	1.7	15	-	-	-
	7/25/2017	Bottom	-	-	-	-	-	-	-
	7/25/2017	Surface	-	-	-	-	-	-	-
	8/28/2017	Bottom	-	-	3.9	27	-	-	-
	8/28/2017	Surface	-	-	1.7	17	-	-	-
	9/26/2017	Bottom	-	-	4.1	26	-	-	-
	9/26/2017	Surface	-	-	2.1	19	-	-	-
	10/24/2017	Bottom	-	-	-	-	-	-	-
	10/24/2017	Surface	-	-	-	-	-	-	-
	4/24/2018	Bottom	-	-	3.4	28	-	-	-
	4/24/2018	Surface	-	-	3.2	27	-	-	-
	5/22/2018	Bottom	-	-	-	-	-	-	-
	5/22/2018	Surface	-	-	-	-	-	-	-
	6/12/2018	Bottom	-	-	4.2	22	-	-	-
	6/12/2018	Surface	-	-	1.7	12	-	-	-
	7/10/2018	Bottom	-	-	-	-	-	-	-
	7/10/2018	Surface	-	-	-	-	-	-	-
	8/28/2018	Bottom	-	-	4.3	31	-	-	-
	8/28/2018	Surface	-	-	2.0	20	-	-	-
	9/18/2018	Bottom	-	-	4.3	31	-	-	-
	9/18/2018	Surface	-	-	2.0	21	-	-	-
	10/23/2018	Bottom	-	-	-	-	-	-	-
	10/23/2018	Surface	-	-	-	-	-	-	-

Notes: [a] When depth gradient of pH was present in the dataset, the values closest to the top and bottom depths of the other parameters was selected.

[b] Hardness was calculated as (2.5 × Total Calcium) + (4.1 × Total Magnesium).

"-" indicates no data available

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

August 29, 2018

Teck Coal Ltd.
Cait Good
P.O. Box 3000
Sparwood, B.C. CANADA V0B2G0
Cait.Good@Teck.com

Re: TCL-SW1801

Ms. Good,

On August 6, 2018, Brooks Applied Labs (BAL) received four (4) aqueous samples that were logged-in for the analyses of dissolved selenium (Se) according to the chain-of-custody (COC) form. All samples had been filtered and preserved in the field prior to receipt at BAL. All samples were received and stored in accordance with BAL SOPs.

Dissolved Se in Waters by ICP-QQQ-MS

Each aqueous sample fraction for 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.

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.

All data was reported without qualification and 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 me if you have any questions regarding this report.

Sincerely,

Jacki Aitken
Project Manager
Jacki@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/>. 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**	standard 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 9/23/09)

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.

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.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_DSELKU1_WS_20180731-1030	1832002-01	Water	Sample	07/31/2018	08/06/2018
RG_DSELKU3_WS_20180731-1030	1832002-02	Water	Sample	07/31/2018	08/06/2018
RG_DSELKU1_WS_20180731-1100	1832002-03	Water	Sample	07/31/2018	08/06/2018
RG_DSELKU3_WS_20180731-1100	1832002-04	Water	Sample	07/31/2018	08/06/2018

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Se	Water	EPA 200.8 Mod	08/08/2018	08/11/2018	B181998	1801070

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_DSELKU1_WS_20180731-1030										
1832002-01	Se	Water	D	0.842		0.030	0.167	µg/L	B181998	1801070
RG_DSELKU3_WS_20180731-1030										
1832002-02	Se	Water	D	0.881		0.030	0.167	µg/L	B181998	1801070
RG_DSELKU1_WS_20180731-1100										
1832002-03	Se	Water	D	0.786		0.030	0.167	µg/L	B181998	1801070
RG_DSELKU3_WS_20180731-1100										
1832002-04	Se	Water	D	0.831		0.030	0.167	µg/L	B181998	1801070

Accuracy & Precision Summary

Batch: B181998
Lab Matrix: Water
Method: EPA 200.8 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B181998-BS1	**Blank Spike, (1806052)**						
	Se		100.0	84.61	µg/L	85% 75-125	
B181998-SRM1	**Standard Reference Material (1803061, TMDA 70.2 Reference Standard - Bottle4)**						
	Se		27.70	21.71	µg/L	78% 75-125	
B181998-DUP1	**Duplicate, (1832002-01)**						
	Se	0.842		0.894	µg/L		6% 20
B181998-MS1	**Matrix Spike, (1832002-01)**						
	Se	0.842	101.0	85.59	µg/L	84% 75-125	
B181998-MSD1	**Matrix Spike Duplicate, (1832002-01)**						
	Se	0.842	101.0	86.02	µg/L	84% 75-125	0.5% 20

Method Blanks & Reporting Limits

Batch: B181998
Matrix: Water
Method: EPA 200.8 Mod
Analyte: Se

Sample	Result	Units
B181998-BLK1	0.008	µg/L
B181998-BLK2	0.016	µg/L
B181998-BLK3	0.017	µg/L
B181998-BLK4	0.020	µg/L

Average: 0.015
Limit: 0.165

MDL: 0.030
MRL: 0.165

Sample Containers

Lab ID: 1832002-01
Sample: RG_DSELKU1_WS_20180731-1030
Report Matrix: Water
Sample Type: Sample
Collected: 07/31/2018
Received: 08/06/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	HNO3 (Client)	n/a	<2	Cooler - 1832002

Lab ID: 1832002-02
Sample: RG_DSELKU3_WS_20180731-1030
Report Matrix: Water
Sample Type: Sample
Collected: 07/31/2018
Received: 08/06/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	HNO3 (Client)	n/a	<2	Cooler - 1832002

Lab ID: 1832002-03
Sample: RG_DSELKU1_WS_20180731-1100
Report Matrix: Water
Sample Type: Sample
Collected: 07/31/2018
Received: 08/06/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	HNO3 (Client)	n/a	<2	Cooler - 1832002

Lab ID: 1832002-04
Sample: RG_DSELKU3_WS_20180731-1100
Report Matrix: Water
Sample Type: Sample
Collected: 07/31/2018
Received: 08/06/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	HNO3 (Client)	n/a	<2	Cooler - 1832002

Shipping Containers

Cooler - 1832002

Received: August 6, 2018 9:30
Tracking No: 772865158808 via FedEx
Coolant Type: Ice (melted)
Temperature: 22.0 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: IR#15

Custody seals present? No
Custody seals intact? No
COC present? Yes

BROOKS APPLIED LABS

Chain -of-Custody Form

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only
Received by:
Date: 8/6/18
Work Order ID: 1832002
Time: 9:30
Project ID:

Client: Teck
Contact: Cait Good / Justin Wilson
Client Project ID: 18-07
Samples Collected By: Tyrell Worrall

PO Number: VPO 0056 3596
Phone: 905-873-3371
Email: Cait.good@teck.com

Mailing Address: Mirrow Environmental - 2 Lamb st
Georgetown, ON, L7G 3M9
Email Receipt Confirmation? [✓ Yes]/No)
BAL PM:

Requested TAT (business days)
- ☐ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection Date	Collection Time	Matrix Type	Number of Containers	Field Filtered? (Yes/No)	Preservation Type HCl/HNO$_3$/Other	Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify) InOrg, III, V, MMA, DMA	Se Species (specify) Se(IV), Se(VI), SeCN, Unknown	Filtration	Other (specify) Dissolved SE	Other (specify)	Comments Specify Here
1	RG-DSELK41_WS-	20180731	1030	Water	1	Y	HNO3							✓		
2	RG-DSELK42-WS-	20180731	1035	"	1	Y	"							✓		
3	RG-DSELK43_WS-	20180731	1100	"	1	Y	"							✓		
4	RG-DSELK44-WS-	20180731	1105	"	1	Y	"							✓		
5																
6																
7																
8																
9																
10																
	Trip Blank															

Relinquished By: T. Worrall	Date: 31-Jul-18	Time: 15:00	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page____of____ List Hazardous Contaminants: ________

samples@brooksapplied.com | brooksapplied.com

ORIGIN ID:YRME (905) 873-3371
TYRELL WORRALL
MINNOW ENVIRONMENTAL
1474 THEATRE RD

CRANBROOK, BC V1C7G1
CANADA CA

SHIP DATE: 31JUL18
ACTWGT: 5.00 LB
CAD: 102308985/INET4040
DIMS: 8x10x5 IN

BILL SENDER

TO SAMPLE LAB
BROOKS APPLIED LABS
18804 NORTH CREEK PARKWAY
SUITE 100
BOTHELL WA 98011 (US)
(206) 632-6206 REF:
INV:
PO: DEPT:

552J1/3309/DCA5

FedEx Express

E

J182018072202uv

4:30P

TRK# 0430 7728 6515 8808

INTL ** 2DAY **

ASR

98011

WA-US SEA

SH PAEA

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2. Place label in shipping pouch and affix it to your shipment.

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The Warsaw Convention, as amended, will then govern and in most cases limit FedEx's liability for loss, delay of, or damage to your shipment. The Warsaw Convention, as amended, limits FedEx's liability. For example in the U.S. liability is limited to $9.07 per pound (20$ per kilogram), unless a higher value for carriage is declared as described below and you pay any applicable supplementary charges. The interpretation and operation of the Warsaw Convention's liability limits may vary in each country. There are no specific stopping places which are agreed to and FedEx reserves the right to route the shipment in any way FedEx deems appropriate. ROAD TRANSPORT NOTICE. Shipments transported solely by road to or from a country which is a party to the Warsaw Convention or the Contract for the International Carriage of Goods by Road (the "CMR") are subject to the terms and conditions of the CMR, notwithstanding any other provision of this Air Waybill to the contrary. For those shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill, the terms of the CMR shall prevail. LIMITATION OF LIABILITY. If not governed by the Warsaw Convention, the CMR, or other international treaties, laws, other government regulations, orders, or requirements, FedEx's maximum liability for damage, loss, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment is limited by this Agreement and as set out in the terms and conditions of the contract of carriage. Please refer to the contract of carriage set forth in the applicable FedEx Service Guide or its equivalent to determine the contractual limitation. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge for each additional U.S. $100 (or equivalent local currency for the country of origin) of declared value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx's maximum liability will be the lesser of the declared value for carriage or your actual damages. LIABILITIES NOT ASSUMED. IN ANY EVENT, FEDEX WON'T BE LIABLE FOR ANY DAMAGES, WHETHER DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL IN EXCESS OF THE DECLARED VALUE FOR CARRIAGE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) OR THE ACTUAL VALUE OF THE SHIPMENT, IF LOWER, WHETHER OR NOT FEDEX HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIGHT BE INCURRED. FedEx won't be liable for your acts or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packaging, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment or violations by any party of the terms of this agreement. FedEx won't be liable for damage, loss, delay, shortage, mis-delivery, non-delivery, misinformation or failure to provide information in connection with shipments of cash, currency or other prohibited items or in instances beyond our control, such as acts of God, perils of the air, weather conditions, mechanical delays, acts of public enemies, war, strike, civil commotion, or acts or omissions of public authorities(including customs and health officials) with actual or apparent authority. NO WARRANTY. We make no warranties, express or implied. CLAIMS FOR LOSS, DAMAGE OR DELAY. ALL CLAIMS MUST BE MADE IN WRITING AND WITHIN STRICT TIME LIMITS. SEE OUR TARIFF, APPLICABLE FEDEX SERVICE GUIDE, OR STANDARD CONDITIONS OF CARRIAGE FOR DETAILS. The Warsaw Convention provides specific written claims procedures for damage, delay or non-delivery of your shipment. Moreover, the interpretation and operation of the Warsaw Convention's claims provisions may vary in each country. Refer to the Convention to determine the claims period for your shipment. The right to damages against us shall be extinguished unless an action is brought within two years, as set forth in the Convention. FedEx is not obligated to act on any claim until all transportation charges have been paid. The claim amount may not be deducted from the transportation charges. If the recipient accepts the shipment without noting any damage on the delivery record, FedEx will assume the shipment was delivered in good condition. In order for us to consider a claim for damage, the contents, original shipping carton and packing must be made available to us for inspection. MANDATORY LAW. Insofar as any provision contained or referred to in this Air Waybill may be contrary to any applicable international treaties, laws, government regulations, orders or requirements such provisions shall remain in effect as a part of our agreement to the extent that it is not overridden. The invalidity or unenforceability of any provisions shall not affect any other part of this Air Waybill. Unless otherwise indicated, FEDERAL EXPRESS CORPORATION, 2005 Corporate Avenue, Memphis, TN 38132, USA, is the first carrier of this shipment. Email address located at www.fedex.com.

cardboard box | lunchbox
No CS
CoC
125 mL glass 17-0182
22°C TR#15
melted ice

BAL Report 1832002 1/6

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 10, 2018

Teck Coal Ltd.
Cait Good
P.O. Box 3000
Sparwood, B.C. CANADA V0B2G0
Cait.Good@Teck.com

Re: TCL-SW1801

Ms. Good,

On September 7, 2018, Brooks Applied Labs (BAL) received five (5) aqueous samples in a sealed cooler at 17.5°C. The samples were logged-in for dissolved selenium (Se) quantitation.

Brooks Applied Labs strongly recommends that all samples submitted for dissolved metals quantitation remain at a temperature of ≤6°C to maintain sample integrity prior to analysis. The client was notified of the temperature exceedance upon receipt but did not request that the analyses be cancelled. All samples were filtered and acidified upon receipt at BAL All samples submitted were collected on September 4, 2018. The samples were not filtered within 48 hours from the time of collection and were received at an elevated temperature, thus the results are qualified **H**. The samples were stored in accordance with BAL SOPs.

Dissolved Se in Waters by ICP-QQQ-MS

Each aqueous sample fraction for 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.

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.

All data was reported without further qualification and 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,

Jacki Aitken
Project Manager
Brooks Applied Labs
Jacki@brooksapplied.com

Betty Vordahl
Project Manager
Brooks Applied Labs
Betty@brooksapplied.com

Report Information

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MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 9/23/09)

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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.

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.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG_DSELK_U1_WS_20180904-1015	1836044-01	Water	Sample	09/04/2018	09/07/2018
RG_DSELK_U1_WS_20180904-1020	1836044-02	Water	Sample	09/04/2018	09/07/2018
RG_DSELK_U3_WS_20180904-1030	1836044-03	Water	Sample	09/04/2018	09/07/2018
RG_DSELK_U3_WS_20180904-1035	1836044-04	Water	Sample	09/04/2018	09/07/2018
RG_FBLANK_WQ_20180904-1035	1836044-05	Water	Field Blank	09/04/2018	09/07/2018

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Se	Water	EPA 200.8 Mod	09/18/2018	09/21/2018	B182393	1801279

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG_DSELK_U1_WS_20180904-1015										
1836044-01	Se	Water	D	0.989	H	0.136	0.273	µg/L	B182393	1801279
RG_DSELK_U1_WS_20180904-1020										
1836044-02	Se	Water	D	1.10	H	0.136	0.273	µg/L	B182393	1801279
RG_DSELK_U3_WS_20180904-1030										
1836044-03	Se	Water	D	1.00	H	0.136	0.273	µg/L	B182393	1801279
RG_DSELK_U3_WS_20180904-1035										
1836044-04	Se	Water	D	1.12	H	0.136	0.273	µg/L	B182393	1801279
RG_FBLANK_WQ_20180904-1035										
1836044-05	Se	Water	D	≤ 0.136	U H	0.136	0.273	µg/L	B182393	1801279

Accuracy & Precision Summary

Batch: B182393
Lab Matrix: Water
Method: EPA 200.8 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B182393-BS1	**Blank Spike, (1806052)**						
	Se		500.0	534.9	µg/L	107% 75-125	
B182393-BS2	**Blank Spike, (1806038)**						
	Se		100.0	108.1	µg/L	108% 75-125	
B182393-SRM1	**Standard Reference Material (1803062, TMDA 70.2 Reference Standard - Bottle5)**						
	Se		27.70	28.71	µg/L	104% 75-125	
B182393-DUP1	**Duplicate, (1836032-07)**						
	Se	176.0		176.1	µg/L		0.05% 20
B182393-MS1	**Matrix Spike, (1836032-07)**						
	Se	176.0	500.0	667.6	µg/L	98% 75-125	
B182393-MSD1	**Matrix Spike Duplicate, (1836032-07)**						
	Se	176.0	500.0	659.2	µg/L	97% 75-125	1% 20

Method Blanks & Reporting Limits

Batch: B182393
Matrix: Water
Method: EPA 200.8 Mod
Analyte: Se

Sample	Result	Units
B182393-BLK1	0.097	µg/L
B182393-BLK2	0.082	µg/L
B182393-BLK3	0.064	µg/L
B182393-BLK4	0.052	µg/L
Average:	0.074	
Limit:	0.270	

MDL: 0.135
MRL: 0.270

Sample Containers

Lab ID: 1836044-01
Sample: RG_DSELK_U1_WS_20180904-1015
Report Matrix: Water
Sample Type: Sample
Collected: 09/04/2018
Received: 09/07/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	1% HNO3 (BAL)	1814035	<2	Cooler - 1836044
B	Cent Tube 15mL Se-Sp	15 mL	n/a	none	n/a		Cooler - 1836044
C	EXTRA_VOL	15 mL	n/a	none	n/a		Cooler - 1836044

Lab ID: 1836044-02
Sample: RG_DSELK_U1_WS_20180904-1020
Report Matrix: Water
Sample Type: Sample
Collected: 09/04/2018
Received: 09/07/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	1% HNO3 (BAL)	1814035	<2	Cooler - 1836044
B	Cent Tube 15mL Se-Sp	15 mL	n/a	none	n/a		Cooler - 1836044
C	EXTRA_VOL	15 mL	n/a	none	n/a		Cooler - 1836044

Lab ID: 1836044-03
Sample: RG_DSELK_U3_WS_20180904-1030
Report Matrix: Water
Sample Type: Sample
Collected: 09/04/2018
Received: 09/07/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	1% HNO3 (BAL)	1814035	<2	Cooler - 1836044
B	Cent Tube 15mL Se-Sp	15 mL	n/a	none	n/a		Cooler - 1836044
C	EXTRA_VOL	15 mL	n/a	none	n/a		Cooler - 1836044

Sample Containers

Lab ID: 1836044-04
Sample: RG_DSELK_U3_WS_20180904-1035
Report Matrix: Water
Sample Type: Sample
Collected: 09/04/2018
Received: 09/07/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	1% HNO3 (BAL)	1814035	<2	Cooler - 1836044
B	Cent Tube 15mL Se-Sp	15 mL	n/a	none	n/a		Cooler - 1836044
C	EXTRA_VOL	15 mL	n/a	none	n/a		Cooler - 1836044

Lab ID: 1836044-05
Sample: RG_FBLANK_WQ_20180904-1035
Report Matrix: Water
Sample Type: Field Blank
Collected: 09/04/2018
Received: 09/07/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Glass - Bottle TM	125 mL	17-0182	1% HNO3 (BAL)	1814035	<2	Cooler - 1836044
B	Cent Tube 15mL Se-Sp	15 mL	n/a	none	n/a		Cooler - 1836044
C	EXTRA_VOL	15 mL	n/a	none	n/a		Cooler - 1836044

Shipping Containers

Cooler - 1836044

Received: September 7, 2018 12:16
Tracking No: 773132979023 via
Coolant Type: Blue Ice
Temperature: 17.5 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: IR#18

Custody seals present? No
Custody seals intact? No
COC present? Yes

BROOKS APPLIED LABS

Chain-of-Custody Form

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only

Received by: ________ *Date:* 9/7/18

Work Order ID: 1836044 *Time:* 9:30

Project ID: ________

Client: Minnow Environmental / Teck

Contact: Cait Good / JUSTIN WILSON

Client Project ID: 1807

Samples Collected By: JW, SW

PO Number: 1807

Phone: 905-873-3371 x 233

Email: jwilson@minnow.ca
cait.good@teck.com

Mailing Address: ________

Email Receipt Confirmation? (Yes/No)

BAL PM: ________

Requested TAT (business days)

☐ 20 (standard)
☐ 15*
☐ 10*
☐ 5*
☐ Other ____

**Surcharges may apply to expedited TATs*

	Sample ID	Date	Time	Matrix Type	Number of Containers	Field Filtered? (Yes/No)	Preservation Type HCl /HNO$_3$/Other	Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify) InOrg, III, V, MMA, DMA	Se Species (specify) Se(IV), Se(VI), SeCN, Uknown	Filtration	Other (specify) Dissolved Selenium	Other (specify)	*Specify Here*
	Collection			**Client Sample Info**				**BAL Analyses Required**								**Comments**
1	RG-DSELK-U1-WS-20180904-1015	Sept 04/18	1015	WS	1	NO	NO							✓		
2	RG-DSELK-U1-WS-20180904-1020	↓	1020	↓	1	↓	↓							✓		
3	RG-DSELK-U3-WS-20180904-1030	↓	1030	↓	1	↓	↓							✓		
4	RG-DSELK-U3-WS-20180904-1035	↓	1035	↓	1	↓	↓							✓		
5	RG-FBLANK-WQ-20180904-1035	↓	1035	WQ	1	↓	↓							✓		
6																
7																
8																
9																
10																
	Trip Blank															

PLEASE FILTER + PRESERVE
(FILTERS WERE NOT WORKING)

Relinquished By: JW	Date: Sept 4.18	Time: 1400	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page_____of_____

List Hazardous Contaminants: ________

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

December 7, 2018

Teck Coal Ltd.
Cait Good
P.O. Box 3000
Sparwood, B.C. CANADA V0B2G0
Cait.Good@Teck.com

Re: TCL-SW1801

Ms. Good,

On November 8, 2018, Brooks Applied Labs (BAL) received four (4) solid samples that were logged-in for the analyses of total recoverable selenium (Se) according to the chain-of-custody (COC) form. All samples were freeze dried prior to receipt at BAL. They were received and stored in accordance with BAL SOPs.

The client had provided sample IDs by email prior to shipment which were used to compare against the submitted COC and bottle IDs upon receipt. The samples identified as *RG_DSELK_WS_20180731-1030* and *RG_DSELK_WS_20180731-1100* in the email were identified on the COC and on the bottle IDs as *RG-DSELK WS-1000* and *RG-DSELK WS-1005*. As per communication with the client, the samples were logged in according to the COC and bottle IDs.

Total Recoverable Se in Solids by ICP-QQQ-MS

Each sample for total recoverable Se quantitation was digested via modified EPA Method 3050B with a mix of concentrated nitric acid, hydrochloric acid, and hydrogen peroxide. All resulting digests were analyzed using inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). The ICP-QQQ-MS determinative method 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.

It was noted by the analyst that samples *RG-DSELK WS-1000* and *RG-DSELK WS-1005* contained a thin plastic material that ranged in size from a pin-head to approximately ½ of a dime. These plastic pieces were excluded from the subsample taken for the digestion. The BAL project manager was not made aware of this until after digestion and a sample had already been exhausted so no further corrective action or redigestion was possible.

Due to an analyst oversight, five times more 50% HNO_3 was added to the samples at the initial step of the EPA 3050B Mod. digestion. To compensate for this additional acid, the subsequent additions of concentrated HNO_3 called for in the method were skipped and the samples were heated for the standard amount of time before the required peroxide additions. Due to the limited mass of sample submitted, repreparation of the samples was not possible. All quality control parameters performed acceptably, demonstrating the accuracy of the applied methods and suggesting that the inadvertent method deviation had no significant impact on the reported sample results. No further corrective actions were warranted.

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.

All data was reported without qualification and 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 me if you have any questions regarding this report.

Sincerely,

Jacki Aitken
Project Manager
Jacki@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/>. 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**	standard 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 9/23/09)

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.

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.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
RG-DSELK WS-1000	1845024-01	Biota	Sample	07/31/2018	11/08/2018
RG-DSELK WS-1005	1845024-02	Biota	QC Sample	07/31/2018	11/08/2018
RG-DSELK WS-1030	1845024-03	Biota	Sample	09/04/2018	11/08/2018
RG-DSELK WS-1035	1845024-04	Biota	Sample	09/04/2018	11/08/2018

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Se	Biota	EPA 6020B Mod	11/16/2018	11/25/2018	B183104	1801589

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
RG-DSELK WS-1000										
1845024-01	Se	Biota	AR	6.31		0.012	0.040	mg/kg	B183104	1801589
RG-DSELK WS-1005										
1845024-02	Se	Biota	AR	6.46		0.012	0.040	mg/kg	B183104	1801589
RG-DSELK WS-1030										
1845024-03	Se	Biota	AR	6.96		0.012	0.039	mg/kg	B183104	1801589
RG-DSELK WS-1035										
1845024-04	Se	Biota	AR	7.49		0.012	0.040	mg/kg	B183104	1801589

Accuracy & Precision Summary

Batch: B183104
Lab Matrix: Biota
Method: EPA 6020B Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B183104-BS1	**Blank Spike, (1847006)**						
	Se		20.00	22.41	mg/kg	112% 75-125	
B183104-SRM1	**Standard Reference Material (1817067, NIST 1568b TM/SP)**						
	Se		0.3650	0.367	mg/kg	101% 75-125	
B183104-DUP1	**Duplicate, (1845024-02)**						
	Se	6.462		6.482	mg/kg		0.3% 30
B183104-MS1	**Matrix Spike, (1845024-02)**						
	Se	6.462	31.55	42.56	mg/kg	114% 70-130	

Method Blanks & Reporting Limits

Batch: B183104
Matrix: Biota
Method: EPA 6020B Mod
Analyte: Se

Sample	Result	Units
B183104-BLK1	0.009	mg/kg
B183104-BLK2	0.004	mg/kg
B183104-BLK3	0.005	mg/kg
B183104-BLK4	0.005	mg/kg

Average: 0.006
Limit: 0.040

MDL: 0.012
MRL: 0.040

Sample Containers

Lab ID: 1845024-01
Sample: RG-DSELK WS-1000
Report Matrix: Biota
Sample Type: Sample
Collected: 07/31/2018
Received: 11/08/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	20mL	n/a	none	n/a		Envelope - 1845024

Lab ID: 1845024-02
Sample: RG-DSELK WS-1005
Report Matrix: Biota
Sample Type: QC Sample
Collected: 07/31/2018
Received: 11/08/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	20mL	n/a	none	n/a		Envelope - 1845024

Lab ID: 1845024-03
Sample: RG-DSELK WS-1030
Report Matrix: Biota
Sample Type: Sample
Collected: 09/04/2018
Received: 11/08/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	20mL	n/a	none	n/a		Envelope - 1845024

Lab ID: 1845024-04
Sample: RG-DSELK WS-1035
Report Matrix: Biota
Sample Type: Sample
Collected: 09/04/2018
Received: 11/08/2018

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	20mL	n/a	none	n/a		Envelope - 1845024

Shipping Containers

Envelope - 1845024

Received: November 8, 2018 10:00
Tracking No: 1ZA562150396458571 via UPS
Coolant Type: None
Temperature: Ambient

Description: Envelope
Damaged in transit? No
Returned to client? No
Comments: ambient

Custody seals present? No
Custody seals intact? No
COC present? Yes

Georgia State University: Geoscience

Suspended Sediment Sample preparation: Inforamtion

Koocanusa 31- July 2018

Sample ID	Sample Date	Date Dewatered	y/Bottle Weight (kg)		Sample Weight (g)			
			Filled	Empty	Sample Vol (L	Vial (Empty)	Vial (Sample)	Sample (Dry)
RG-DSELK WS -1000	7/31/2018	8/16/2018	17.08	0.62	16.46	6.50	6.60	0.099
RG-DSELK WS -1005	7/31/2018	8/16/2018	19.24	0.64	18.60	6.50	7.95	1.450

Koocanusa 4- September 2018

Sample ID	Sample Date	Date Dewatered	y/Bottle Weight (kg)		Sample Weight (g)			
			Filled	Empty	Sample Vol (L	Vial (Empty)	Vial (Sample)	Sample (Dry)
RG-DSELK WS -1030	9/4/2018	9/7/2018	16.21	0.32	15.89	6.50	6.80	0.30
RG-DSELK WS -1035	9/4/2018	9/7/2018	18.47	0.31	18.16	6.50	6.62	0.12

Received Matt Clare 11/8/18 @ 1000

JULIA KIRN
4044135760
GSU DEPT OF GEOSCIENCES
24 PEACHTREE CENTER
ATLANTA GA 30303

1 LBS

1 OF 1

DWT: 13,10,1

SHIP TO:
AMANDA ROYAL
BROOKS APPLIED LABS
SUITE 100
18804 NORTH CREEK PARKWAY
BOTHELL WA 98011-8024

WA 982 9-36

UPS GROUND

TRACKING #: 1Z A56 215 03 9645 8571

BILLING: P/P

Campus Locations: Geosciences Department

CS 20.5.25 WNTNV50 06.0A 10/2018

329

envelope
no CS
COC✓
ambient
Client provided
20mL

low mass

Teck Coal Ltd.
ATTN: Lee Wilm
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 28-APR-18
Report Date: 08-MAY-18 11:58 (MT)
Version: FINAL

Client Phone: 250-425-5289

Certificate of Analysis

Lab Work Order #: L2086365

Project P.O. #:	VPO00563596
Job Reference:	REGIONAL EFFECTS PROGRAM
C of C Numbers:	REP-2018-04-27
Legal Site Desc:	

Lyudmyla Shvets, B.Sc.
Account Manager

	Sample ID	L2086365-1	L2086365-2	L2086365-3	L2086365-4	L2086365-5
	Description	WS	WQ	WS	WQ	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	09:40	09:40	09:40	09:40	14:00
	Client ID	RG_ER_WS_20180427-940	RG_DUP__ER_WQ_20180427-940	RG_ER_WS_20180427-940_FB-HG	RG_DUP_ER_WQ_20180427-940_FB-HG	RG_GC_WS_20180427-1400
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	325	323			337
	Hardness (as CaCO3) (mg/L)	175	169			184
	pH (pH)	8.29	8.27			8.22
	ORP (mV)	318	320			293
	Total Suspended Solids (mg/L)	50.1	64.9			43.1
	Total Dissolved Solids (mg/L)	193 DLHC	191 DLHC			196 DLHC
	Turbidity (NTU)	34.2	45.1			39.2
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0 DLM	<1.0 DLM			<1.0 DLM
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	120	135			131
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.6	<1.0			<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	122	135			131
	Ammonia as N (mg/L)	0.0106	0.0115			0.0258
	Bromide (Br) (mg/L)	<0.050	<0.050			<0.050
	Chloride (Cl) (mg/L)	4.20	4.20			3.71
	Fluoride (F) (mg/L)	0.100	0.099			0.108
	Ion Balance (%)	113	101			111
	Nitrate (as N) (mg/L)	0.284	0.282			0.457
	Nitrite (as N) (mg/L)	0.0016	0.0015			0.0020
	Total Kjeldahl Nitrogen (mg/L)	0.270	0.245			0.274
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			<0.0010
	Phosphorus (P)-Total (mg/L)	0.0261	0.0235			0.0333
	Sulfate (SO4) (mg/L)	36.5	36.6			37.7
	Anion Sum (meq/L)	3.35	3.60			3.54
	Cation Sum (meq/L)	3.77	3.64			3.92
	Cation - Anion Balance (%)	6.0	0.5			5.1
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.25	2.08			2.83
	Total Organic Carbon (mg/L)	2.32	2.30			2.98
Total Metals	Aluminum (Al)-Total (mg/L)	0.564	0.633			0.853
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012			0.00011
	Arsenic (As)-Total (mg/L)	0.00079	0.00083			0.00109
	Barium (Ba)-Total (mg/L)	0.0608	0.0610			0.0767
	Beryllium (Be)-Total (ug/L)	0.031	0.033			0.051
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			<0.000050
	Boron (B)-Total (mg/L)	0.010	<0.010			<0.010
	Cadmium (Cd)-Total (ug/L)	0.0267	0.0249			0.0378

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

	Sample ID	L2086365-6	L2086365-7	L2086365-8	L2086365-9	L2086365-10
	Description	WS	WQ	WQ	WS	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	14:00	15:30	15:30	14:30	14:30
	Client ID	RG_GC_WS_20180427-1400_FB-HG	RG_FBLANK_WQ_20180427-1530	RG_FBLANK_WQ_20180427-1530_FB-HG	RG_SC_WS_20180427-1430	RG_SC_WS_20180427-1430_FB-HG
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)		<2.0		311	
	Hardness (as CaCO3) (mg/L)		<0.50		172	
	pH (pH)		5.08		8.24	
	ORP (mV)		468		328	
	Total Suspended Solids (mg/L)		<1.0		265	
	Total Dissolved Solids (mg/L)		<10		176 DLHC	
	Turbidity (NTU)		<0.10		88.6	
Anions and Nutrients	Acidity (as CaCO3) (mg/L)		2.0		<1.0 DLM	
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		<1.0		121	
	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)		<1.0		121	
	Ammonia as N (mg/L)		<0.0050		0.0130	
	Bromide (Br) (mg/L)		<0.050		<0.050	
	Chloride (Cl) (mg/L)		<0.50		4.33	
	Fluoride (F) (mg/L)		<0.020		0.088	
	Ion Balance (%)		0.0		115	
	Nitrate (as N) (mg/L)		<0.0050		0.104	
	Nitrite (as N) (mg/L)		<0.0010		0.0010	
	Total Kjeldahl Nitrogen (mg/L)		<0.050		0.373	
	Orthophosphate-Dissolved (as P) (mg/L)		<0.0010		<0.0010	
	Phosphorus (P)-Total (mg/L)		<0.0010		0.0651	
	Sulfate (SO4) (mg/L)		<0.30		33.0	
	Anion Sum (meq/L)		<0.10		3.23	
	Cation Sum (meq/L)		<0.10		3.71	
	Cation - Anion Balance (%)		0.0		6.9	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		<0.50		2.90	
	Total Organic Carbon (mg/L)		<0.50		3.08	
Total Metals	Aluminum (Al)-Total (mg/L)		<0.0030		1.70	
	Antimony (Sb)-Total (mg/L)		<0.00010		<0.00010	
	Arsenic (As)-Total (mg/L)		<0.00010		0.00126	
	Barium (Ba)-Total (mg/L)		<0.00010		0.0584	
	Beryllium (Be)-Total (ug/L)		<0.020		0.084	
	Bismuth (Bi)-Total (mg/L)		<0.000050		<0.000050	
	Boron (B)-Total (mg/L)		<0.010		<0.010	
	Cadmium (Cd)-Total (ug/L)		<0.0050		0.0335	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

	Sample ID	L2086365-11	L2086365-12			
	Description	WQ	WQ			
	Sampled Date	27-APR-18	27-APR-18			
	Sampled Time	14:30	14:30			
	Client ID	RG_TRIP_WQ_20180427	RG_TRIP_WQ_20180427-1430_FB-HG			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)					
	pH (pH)	5.51				
	ORP (mV)	435				
	Total Suspended Solids (mg/L)	1.5				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	1.9 DLM				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0				
	Ammonia as N (mg/L)	0.0133				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Ion Balance (%)	0.0				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	<0.30				
	Anion Sum (meq/L)	<0.10				
	Cation Sum (meq/L)	<0.10				
	Cation - Anion Balance (%)	0.0				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.00010				
	Beryllium (Be)-Total (ug/L)	<0.020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (ug/L)	<0.0050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

	Sample ID	L2086365-1	L2086365-2	L2086365-3	L2086365-4	L2086365-5
	Description	WS	WQ	WS	WQ	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	09:40	09:40	09:40	09:40	14:00
	Client ID	RG_ER_WS_20180427-940	RG_DUP__ER_WQ_20180427-940	RG_ER_WS_20180427-940_FB-HG	RG_DUP_ER_WQ_20180427-940_FB-HG	RG_GC_WS_20180427-1400
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	46.0	45.7			45.6
	Chromium (Cr)-Total (mg/L)	0.00086	0.00094			0.00112
	Cobalt (Co)-Total (ug/L)	0.43	0.48			0.61
	Copper (Cu)-Total (mg/L)	0.00115	0.00123			0.00172
	Iron (Fe)-Total (mg/L)	0.838	0.993			1.19
	Lead (Pb)-Total (mg/L)	0.000893	0.000983			0.00124
	Lithium (Li)-Total (mg/L)	0.0038	0.0040			0.0044
	Magnesium (Mg)-Total (mg/L)	13.7	13.3			13.0
	Manganese (Mn)-Total (mg/L)	0.0313	0.0346			0.0548
	Mercury (Hg)-Total (ug/L)	0.00199	0.00196	<0.00050	<0.00050	0.00146
	Molybdenum (Mo)-Total (mg/L)	0.000678	0.000695			0.000740
	Nickel (Ni)-Total (mg/L)	0.00112	0.00119			0.00170
	Potassium (K)-Total (mg/L)	0.819	0.812			0.860
	Selenium (Se)-Total (ug/L)	1.16	1.19			1.83
	Silicon (Si)-Total (mg/L)	3.29	3.43			4.00
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			<0.000010
	Sodium (Na)-Total (mg/L)	5.12	5.25			4.27
	Strontium (Sr)-Total (mg/L)	0.159	0.165			0.145
	Thallium (Tl)-Total (mg/L)	0.000013	0.000013			0.000016
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			<0.010
	Uranium (U)-Total (mg/L)	0.000840	0.000843			0.000849
	Vanadium (V)-Total (mg/L)	0.00103	0.00114			0.00161
	Zinc (Zn)-Total (mg/L)	0.0041	0.0043			0.0045
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB			LAB
	Dissolved Metals Filtration Location	LAB	LAB			LAB
	Aluminum (Al)-Dissolved (mg/L)	0.0080	0.0112			0.0154
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00050	0.00046			0.00062
	Barium (Ba)-Dissolved (mg/L)	0.0632	0.0603			0.0831
	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)	<0.0050	0.0059			0.0061
	Calcium (Ca)-Dissolved (mg/L)	46.6	44.4			49.0
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00012			<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.

	Sample ID	L2086365-6	L2086365-7	L2086365-8	L2086365-9	L2086365-10
	Description	WS	WQ	WQ	WS	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	14:00	15:30	15:30	14:30	14:30
	Client ID	RG_GC_WS_20180427-1400_FB-HG	RG_FBLANK_WQ_20180427-1530	RG_FBLANK_WQ_20180427-1530_FB-HG	RG_SC_WS_20180427-1430	RG_SC_WS_20180427-1430_FB-HG
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)		<0.050		59.6	
	Chromium (Cr)-Total (mg/L)		<0.00010		0.00248	
	Cobalt (Co)-Total (ug/L)		<0.10		1.36	
	Copper (Cu)-Total (mg/L)		<0.00050		0.00263	
	Iron (Fe)-Total (mg/L)		<0.010		2.95	
	Lead (Pb)-Total (mg/L)		<0.000050		0.00257	
	Lithium (Li)-Total (mg/L)		<0.0010		0.0053	
	Magnesium (Mg)-Total (mg/L)		<0.10		14.5	
	Manganese (Mn)-Total (mg/L)		<0.00010		0.0820	
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	0.00288	<0.00050
	Molybdenum (Mo)-Total (mg/L)		<0.000050		0.000639	
	Nickel (Ni)-Total (mg/L)		<0.00050		0.00276	
	Potassium (K)-Total (mg/L)		<0.050		0.875	
	Selenium (Se)-Total (ug/L)		<0.050		0.191	
	Silicon (Si)-Total (mg/L)		<0.10		4.77	
	Silver (Ag)-Total (mg/L)		<0.000010		<0.000010	
	Sodium (Na)-Total (mg/L)		<0.050		5.16	
	Strontium (Sr)-Total (mg/L)		<0.00020		0.200	
	Thallium (Tl)-Total (mg/L)		<0.000010		0.000020	
	Tin (Sn)-Total (mg/L)		<0.00010		<0.00010	
	Titanium (Ti)-Total (mg/L)		<0.010		0.015	
	Uranium (U)-Total (mg/L)		<0.000010		0.000872	
	Vanadium (V)-Total (mg/L)		<0.00050		0.00201	
	Zinc (Zn)-Total (mg/L)		<0.0030		0.0102	
Dissolved Metals	Dissolved Mercury Filtration Location		LAB		LAB	
	Dissolved Metals Filtration Location		LAB		LAB	
	Aluminum (Al)-Dissolved (mg/L)		<0.0030		0.0083	
	Antimony (Sb)-Dissolved (mg/L)		<0.00010		<0.00010	
	Arsenic (As)-Dissolved (mg/L)		<0.00010		0.00045	
	Barium (Ba)-Dissolved (mg/L)		<0.00010		0.0502	
	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)		<0.0050		<0.0050	
	Calcium (Ca)-Dissolved (mg/L)		<0.050		46.3	
	Chromium (Cr)-Dissolved (mg/L)		<0.00010		<0.00010	
	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	L2086365-11	L2086365-12			
	Description	WQ	WQ			
	Sampled Date	27-APR-18	27-APR-18			
	Sampled Time	14:30	14:30			
	Client ID	RG_TRIP_WQ_20180427	RG_TRIP_WQ_20180427-1430_FB-HG			
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	<0.050				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (ug/L)	<0.10				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.10				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050			
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Potassium (K)-Total (mg/L)	<0.050				
	Selenium (Se)-Total (ug/L)	<0.050				
	Silicon (Si)-Total (mg/L)	<0.10				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (ug/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (ug/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (ug/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2086365-1	L2086365-2	L2086365-3	L2086365-4	L2086365-5
	Description	WS	WQ	WS	WQ	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	09:40	09:40	09:40	09:40	14:00
	Client ID	RG_ER_WS_20180427-940	RG_DUP__ER_WQ_20180427-940	RG_ER_WS_20180427-940_FB-HG	RG_DUP_ER_WQ_20180427-940_FB-HG	RG_GC_WS_20180427-1400
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050			0.00057
	Iron (Fe)-Dissolved (mg/L)	0.015	0.018			0.023
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000056			0.000054
	Lithium (Li)-Dissolved (mg/L)	0.0027	0.0026			0.0031
	Magnesium (Mg)-Dissolved (mg/L)	14.3	14.0			15.1
	Manganese (Mn)-Dissolved (mg/L)	0.00083	0.00080			0.0141
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000679	0.000655			0.000667
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050			<0.00050
	Potassium (K)-Dissolved (mg/L)	0.792	0.762			0.835
	Selenium (Se)-Dissolved (ug/L)	1.26	1.29			1.82
	Silicon (Si)-Dissolved (mg/L)	2.48	2.48			2.70
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			<0.000010
	Sodium (Na)-Dissolved (mg/L)	5.73	5.56			4.86
	Strontium (Sr)-Dissolved (mg/L)	0.171	0.165			0.165
	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)	0.000877	0.000843			0.000877
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			<0.0010

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2086365-6	L2086365-7	L2086365-8	L2086365-9	L2086365-10
	Description	WS	WQ	WQ	WS	WS
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	14:00	15:30	15:30	14:30	14:30
	Client ID	RG_GC_WS_20180427-1400_FB-HG	RG_FBLANK_WQ_20180427-1530	RG_FBLANK_WQ_20180427-1530_FB-HG	RG_SC_WS_20180427-1430	RG_SC_WS_20180427-1430_FB-HG
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)		<0.00050		<0.00050	
	Iron (Fe)-Dissolved (mg/L)		<0.010		0.017	
	Lead (Pb)-Dissolved (mg/L)		<0.000050		0.000051	
	Lithium (Li)-Dissolved (mg/L)		<0.0010		0.0019	
	Magnesium (Mg)-Dissolved (mg/L)		<0.10		13.6	
	Manganese (Mn)-Dissolved (mg/L)		<0.00010		0.00098	
	Mercury (Hg)-Dissolved (mg/L)		<0.0000050		<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)		<0.000050		0.000603	
	Nickel (Ni)-Dissolved (mg/L)		<0.00050		<0.00050	
	Potassium (K)-Dissolved (mg/L)		<0.050		0.790	
	Selenium (Se)-Dissolved (ug/L)		<0.050		0.238	
	Silicon (Si)-Dissolved (mg/L)		<0.050		2.56	
	Silver (Ag)-Dissolved (mg/L)		<0.000010		<0.000010	
	Sodium (Na)-Dissolved (mg/L)		<0.050		5.90	
	Strontium (Sr)-Dissolved (mg/L)		<0.00020		0.168	
	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)		<0.000010		0.000838	
	Vanadium (V)-Dissolved (mg/L)		<0.00050		<0.00050	
	Zinc (Zn)-Dissolved (mg/L)		<0.0010		<0.0010	

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2086365-11 WQ 27-APR-18 14:30 RG_TRIP_WQ_20180427	L2086365-12 WQ 27-APR-18 14:30 RG_TRIP_WQ_20180427-1430_FB-HG			
Grouping	**Analyte**						
WATER							
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)						
	Iron (Fe)-Dissolved (mg/L)						
	Lead (Pb)-Dissolved (mg/L)						
	Lithium (Li)-Dissolved (mg/L)						
	Magnesium (Mg)-Dissolved (mg/L)						
	Manganese (Mn)-Dissolved (mg/L)						
	Mercury (Hg)-Dissolved (mg/L)						
	Molybdenum (Mo)-Dissolved (mg/L)						
	Nickel (Ni)-Dissolved (mg/L)						
	Potassium (K)-Dissolved (mg/L)						
	Selenium (Se)-Dissolved (ug/L)						
	Silicon (Si)-Dissolved (mg/L)						
	Silver (Ag)-Dissolved (mg/L)						
	Sodium (Na)-Dissolved (mg/L)						
	Strontium (Sr)-Dissolved (mg/L)						
	Thallium (Tl)-Dissolved (mg/L)						
	Tin (Sn)-Dissolved (mg/L)						
	Titanium (Ti)-Dissolved (mg/L)						
	Uranium (U)-Dissolved (mg/L)						
	Vanadium (V)-Dissolved (mg/L)						
	Zinc (Zn)-Dissolved (mg/L)						

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
EXTEMP10	Samples Received with temperature >10 Degrees C - 15C
SFPL	Sample was Filtered and Preserved at the laboratory - DOC, Diss-Metals/Hg

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2086365-11
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2086365-1, -2, -5, -7, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2086365-1, -2, -5, -7, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2086365-1, -2, -5, -7, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2086365-1, -2, -5, -7, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2086365-1, -2, -5, -7, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Arsenic (As)-Total	MS-B	L2086365-11
Matrix Spike	Barium (Ba)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2086365-11
Matrix Spike	Boron (B)-Total	MS-B	L2086365-11
Matrix Spike	Calcium (Ca)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2086365-11
Matrix Spike	Cobalt (Co)-Total	MS-B	L2086365-11
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2086365-11
Matrix Spike	Manganese (Mn)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2086365-11
Matrix Spike	Potassium (K)-Total	MS-B	L2086365-11
Matrix Spike	Sodium (Na)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2086365-11
Matrix Spike	Strontium (Sr)-Total	MS-B	L2086365-1, -11, -2, -5, -7, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2086365-11
Matrix Spike	Ammonia as N	MS-B	L2086365-1, -11, -2, -5, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

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.

Reference Information

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 subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-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.

Reference Information

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-ED Water Total P in Water by Colour 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-ED Water Diss. Orthophosphate in Water by Colour 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
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

Chain of Custody Numbers:

REP-2018-04-27

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: L2086365 Report Date: 08-MAY-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Lee Wilm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R4033052								
WG2764828-12 DUP		**L2086365-7**						
Acidity (as CaCO3)		2.0	1.9		mg/L	4.1	20	03-MAY-18
WG2764828-11 LCS								
Acidity (as CaCO3)			102.9		%		85-115	03-MAY-18
WG2764828-10 MB								
Acidity (as CaCO3)			1.8		mg/L		2	03-MAY-18
ALK-MAN-CL	**Water**							
Batch R4032387								
WG2764074-8 LCS								
Alkalinity, Total (as CaCO3)			98.5		%		85-115	02-MAY-18
WG2764074-7 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	02-MAY-18
BE-D-L-CCMS-VA	**Water**							
Batch R4035791								
WG2764413-3 DUP		**L2086365-5**						
Beryllium (Be)-Dissolved		<0.000020	<0.000020	RPD-NA	mg/L	N/A	20	06-MAY-18
WG2764413-2 LCS								
Beryllium (Be)-Dissolved			92.7		%		80-120	06-MAY-18
WG2764413-1 MB		**LF**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	06-MAY-18
WG2764413-4 MS		**L2086365-1**						
Beryllium (Be)-Dissolved			92.6		%		70-130	06-MAY-18
BE-T-L-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-3 DUP		**L2086365-2**						
Beryllium (Be)-Total		0.000032	0.000034		mg/L	5.2	20	05-MAY-18
WG2764124-2 LCS								
Beryllium (Be)-Total			102.1		%		80-120	05-MAY-18
WG2764124-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	05-MAY-18
WG2764124-4 MS		**L2086365-1**						
Beryllium (Be)-Total			98.3		%		70-130	05-MAY-18
BR-L-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-31 DUP		**L2086365-11**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30 LCS								

Quality Control Report

Workorder: L2086365 Report Date: 08-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BR-L-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-30 LCS								
Bromide (Br)			100.3		%		85-115	28-APR-18
WG2763499-29 MB								
Bromide (Br)			<0.050		mg/L		0.05	28-APR-18
WG2763499-32 MS		**L2086365-11**						
Bromide (Br)			87.9		%		75-125	28-APR-18
C-DIS-ORG-LOW-CL	**Water**							
Batch R4034471								
WG2765468-7 DUP		**L2086365-9**						
Dissolved Organic Carbon		2.90	1.94	J	mg/L	0.96	1	05-MAY-18
WG2765468-2 LCS								
Dissolved Organic Carbon			104.1		%		80-120	05-MAY-18
WG2765468-6 LCS								
Dissolved Organic Carbon			101.3		%		80-120	05-MAY-18
WG2765468-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
WG2765468-5 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
WG2765468-8 MS		**L2086365-9**						
Dissolved Organic Carbon			106.5		%		70-130	05-MAY-18
C-TOT-ORG-LOW-CL	**Water**							
Batch R4034471								
WG2765468-7 DUP		**L2086365-9**						
Total Organic Carbon		3.08	3.24		mg/L	5.1	20	05-MAY-18
WG2765468-2 LCS								
Total Organic Carbon			107.8		%		80-120	05-MAY-18
WG2765468-6 LCS								
Total Organic Carbon			104.1		%		80-120	05-MAY-18
WG2765468-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
WG2765468-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
WG2765468-8 MS		**L2086365-9**						
Total Organic Carbon			108.9		%		70-130	05-MAY-18
CL-IC-N-CL	**Water**							

Quality Control Report

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-IC-N-CL		**Water**							
Batch	**R4031083**								
WG2763499-31	**DUP**		**L2086365-11**						
Chloride (Cl)			<0.50	<0.50	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30	**LCS**								
Chloride (Cl)				101.0		%		90-110	28-APR-18
WG2763499-29	**MB**								
Chloride (Cl)				<0.50		mg/L		0.5	28-APR-18
WG2763499-32	**MS**		**L2086365-11**						
Chloride (Cl)				88.7		%		75-125	28-APR-18
EC-L-PCT-CL		**Water**							
Batch	**R4032387**								
WG2764074-8	**LCS**								
Conductivity (@ 25C)				100.4		%		90-110	02-MAY-18
WG2764074-7	**MB**								
Conductivity (@ 25C)				<2.0		uS/cm		2	02-MAY-18
F-IC-N-CL		**Water**							
Batch	**R4031083**								
WG2763499-31	**DUP**		**L2086365-11**						
Fluoride (F)			<0.020	<0.020	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30	**LCS**								
Fluoride (F)				104.2		%		90-110	28-APR-18
WG2763499-29	**MB**								
Fluoride (F)				<0.020		mg/L		0.02	28-APR-18
WG2763499-32	**MS**		**L2086365-11**						
Fluoride (F)				91.9		%		75-125	28-APR-18
HG-D-CVAA-VA		**Water**							
Batch	**R4033477**								
WG2764909-3	**DUP**		**L2086365-2**						
Mercury (Hg)-Dissolved			<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	04-MAY-18
WG2764909-2	**LCS**								
Mercury (Hg)-Dissolved				102.4		%		80-120	04-MAY-18
WG2764909-1	**MB**		**LF**						
Mercury (Hg)-Dissolved				<0.0000050		mg/L		0.000005	04-MAY-18
WG2764909-4	**MS**		**L2086365-1**						
Mercury (Hg)-Dissolved				102.6		%		70-130	04-MAY-18
HG-T-U-CVAF-VA		**Water**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-T-U-CVAF-VA	**Water**							
Batch R4032847								
WG2764547-2 LCS								
Mercury (Hg)-Total			106.1		%		80-120	03-MAY-18
WG2764547-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	03-MAY-18
WG2764547-4 MS		**L2086365-1**						
Mercury (Hg)-Total			93.0		%		70-130	03-MAY-18
MET-D-CCMS-VA	**Water**							
Batch R4035791								
WG2764413-3 DUP		**L2086365-5**						
Aluminum (Al)-Dissolved		0.0154	0.0156		mg/L	1.5	20	06-MAY-18
Antimony (Sb)-Dissolved		<0.00010	0.00010	RPD-NA	mg/L	N/A	20	06-MAY-18
Arsenic (As)-Dissolved		0.00062	0.00059		mg/L	5.2	20	06-MAY-18
Barium (Ba)-Dissolved		0.0831	0.0775		mg/L	7.0	20	06-MAY-18
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	06-MAY-18
Boron (B)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	06-MAY-18
Cadmium (Cd)-Dissolved		0.0000061	<0.0000050	RPD-NA	mg/L	N/A	20	06-MAY-18
Calcium (Ca)-Dissolved		49.0	45.0		mg/L	8.5	20	06-MAY-18
Chromium (Cr)-Dissolved		<0.00010	0.00010	RPD-NA	mg/L	N/A	20	06-MAY-18
Cobalt (Co)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	06-MAY-18
Copper (Cu)-Dissolved		0.00057	0.00053		mg/L	7.4	20	06-MAY-18
Iron (Fe)-Dissolved		0.023	0.024		mg/L	4.5	20	06-MAY-18
Lead (Pb)-Dissolved		0.000054	<0.000050	RPD-NA	mg/L	N/A	20	06-MAY-18
Lithium (Li)-Dissolved		0.0031	0.0030		mg/L	3.2	20	06-MAY-18
Magnesium (Mg)-Dissolved		15.1	14.5		mg/L	4.1	20	06-MAY-18
Manganese (Mn)-Dissolved		0.0141	0.0132		mg/L	6.7	20	06-MAY-18
Molybdenum (Mo)-Dissolved		0.000667	0.000690		mg/L	3.4	20	06-MAY-18
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-18
Potassium (K)-Dissolved		0.835	0.793		mg/L	5.1	20	06-MAY-18
Selenium (Se)-Dissolved		0.00182	0.00219		mg/L	18	20	06-MAY-18
Silicon (Si)-Dissolved		2.70	2.75		mg/L	2.0	20	06-MAY-18
Silver (Ag)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	06-MAY-18
Sodium (Na)-Dissolved		4.86	4.69		mg/L	3.6	20	06-MAY-18
Strontium (Sr)-Dissolved		0.165	0.155		mg/L	6.5	20	06-MAY-18
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	06-MAY-18
Tin (Sn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	06-MAY-18
Titanium (Ti)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	06-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4035791								
WG2764413-3 DUP		**L2086365-5**						
Uranium (U)-Dissolved		0.000877	0.000886		mg/L	0.9	20	06-MAY-18
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	06-MAY-18
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	06-MAY-18
WG2764413-2 LCS								
Aluminum (Al)-Dissolved			109.5		%		80-120	06-MAY-18
Antimony (Sb)-Dissolved			98.0		%		80-120	06-MAY-18
Arsenic (As)-Dissolved			100.8		%		80-120	06-MAY-18
Barium (Ba)-Dissolved			106.5		%		80-120	06-MAY-18
Bismuth (Bi)-Dissolved			97.3		%		80-120	06-MAY-18
Boron (B)-Dissolved			87.9		%		80-120	06-MAY-18
Cadmium (Cd)-Dissolved			100.2		%		80-120	06-MAY-18
Calcium (Ca)-Dissolved			103.4		%		80-120	06-MAY-18
Chromium (Cr)-Dissolved			102.4		%		80-120	06-MAY-18
Cobalt (Co)-Dissolved			104.7		%		80-120	06-MAY-18
Copper (Cu)-Dissolved			98.9		%		80-120	06-MAY-18
Iron (Fe)-Dissolved			105.0		%		80-120	06-MAY-18
Lead (Pb)-Dissolved			98.9		%		80-120	06-MAY-18
Lithium (Li)-Dissolved			95.3		%		80-120	06-MAY-18
Magnesium (Mg)-Dissolved			105.7		%		80-120	06-MAY-18
Manganese (Mn)-Dissolved			102.0		%		80-120	06-MAY-18
Molybdenum (Mo)-Dissolved			101.7		%		80-120	06-MAY-18
Nickel (Ni)-Dissolved			101.3		%		80-120	06-MAY-18
Potassium (K)-Dissolved			103.6		%		80-120	06-MAY-18
Selenium (Se)-Dissolved			95.5		%		80-120	06-MAY-18
Silicon (Si)-Dissolved			102.9		%		80-120	06-MAY-18
Silver (Ag)-Dissolved			103.7		%		80-120	06-MAY-18
Sodium (Na)-Dissolved			106.0		%		80-120	06-MAY-18
Strontium (Sr)-Dissolved			104.1		%		80-120	06-MAY-18
Thallium (Tl)-Dissolved			100.6		%		80-120	06-MAY-18
Tin (Sn)-Dissolved			98.6		%		80-120	06-MAY-18
Titanium (Ti)-Dissolved			98.4		%		80-120	06-MAY-18
Uranium (U)-Dissolved			99.0		%		80-120	06-MAY-18
Vanadium (V)-Dissolved			103.1		%		80-120	06-MAY-18
Zinc (Zn)-Dissolved			103.9		%		80-120	06-MAY-18
WG2764413-1 MB		**LF**						

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4035791								
WG2764413-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	06-MAY-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	06-MAY-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	06-MAY-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	06-MAY-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	06-MAY-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	06-MAY-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	06-MAY-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	06-MAY-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	06-MAY-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	06-MAY-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	06-MAY-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	06-MAY-18
WG2764413-4 MS		**L2086365-1**						
Aluminum (Al)-Dissolved			104.1		%		70-130	06-MAY-18
Antimony (Sb)-Dissolved			101.7		%		70-130	06-MAY-18
Arsenic (As)-Dissolved			101.9		%		70-130	06-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4035791								
WG2764413-4 MS		**L2086365-1**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	06-MAY-18
Bismuth (Bi)-Dissolved			90.4		%		70-130	06-MAY-18
Boron (B)-Dissolved			87.1		%		70-130	06-MAY-18
Cadmium (Cd)-Dissolved			105.6		%		70-130	06-MAY-18
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	06-MAY-18
Chromium (Cr)-Dissolved			102.2		%		70-130	06-MAY-18
Cobalt (Co)-Dissolved			102.1		%		70-130	06-MAY-18
Copper (Cu)-Dissolved			100.7		%		70-130	06-MAY-18
Iron (Fe)-Dissolved			100.4		%		70-130	06-MAY-18
Lead (Pb)-Dissolved			96.2		%		70-130	06-MAY-18
Lithium (Li)-Dissolved			91.5		%		70-130	06-MAY-18
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	06-MAY-18
Manganese (Mn)-Dissolved			97.3		%		70-130	06-MAY-18
Molybdenum (Mo)-Dissolved			99.6		%		70-130	06-MAY-18
Nickel (Ni)-Dissolved			97.5		%		70-130	06-MAY-18
Potassium (K)-Dissolved			99.2		%		70-130	06-MAY-18
Selenium (Se)-Dissolved			101.0		%		70-130	06-MAY-18
Silicon (Si)-Dissolved			89.5		%		70-130	06-MAY-18
Silver (Ag)-Dissolved			101.9		%		70-130	06-MAY-18
Sodium (Na)-Dissolved			N/A	MS-B	%		-	06-MAY-18
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	06-MAY-18
Thallium (Tl)-Dissolved			95.6		%		70-130	06-MAY-18
Tin (Sn)-Dissolved			99.4		%		70-130	06-MAY-18
Titanium (Ti)-Dissolved			101.2		%		70-130	06-MAY-18
Uranium (U)-Dissolved			95.1		%		70-130	06-MAY-18
Vanadium (V)-Dissolved			103.1		%		70-130	06-MAY-18
Zinc (Zn)-Dissolved			93.8		%		70-130	06-MAY-18
MET-T-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-3 DUP		**L2086365-2**						
Aluminum (Al)-Total		0.633	0.642		mg/L	1.3	20	05-MAY-18
Antimony (Sb)-Total		0.00012	<0.00010	RPD-NA	mg/L	N/A	20	05-MAY-18
Arsenic (As)-Total		0.00083	0.00085		mg/L	2.6	20	05-MAY-18
Barium (Ba)-Total		0.0610	0.0606		mg/L	0.7	20	05-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-3 DUP		**L2086365-2**						
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-MAY-18
Boron (B)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	05-MAY-18
Cadmium (Cd)-Total		0.0000249	0.0000309	J	mg/L	0.000006	0.00001	05-MAY-18
Calcium (Ca)-Total		45.7	44.2		mg/L	3.2	20	05-MAY-18
Chromium (Cr)-Total		0.00094	0.00092		mg/L	1.8	20	05-MAY-18
Cobalt (Co)-Total		0.00048	0.00049		mg/L	2.4	20	05-MAY-18
Copper (Cu)-Total		0.00123	0.00131		mg/L	6.4	20	05-MAY-18
Iron (Fe)-Total		0.993	0.980		mg/L	1.4	20	05-MAY-18
Lead (Pb)-Total		0.000983	0.000954		mg/L	3.0	20	05-MAY-18
Lithium (Li)-Total		0.0040	0.0038		mg/L	4.2	20	05-MAY-18
Magnesium (Mg)-Total		13.3	13.0		mg/L	2.1	20	05-MAY-18
Manganese (Mn)-Total		0.0346	0.0344		mg/L	0.5	20	05-MAY-18
Molybdenum (Mo)-Total		0.000695	0.000676		mg/L	2.7	20	05-MAY-18
Nickel (Ni)-Total		0.00119	0.00126		mg/L	5.2	20	05-MAY-18
Potassium (K)-Total		0.812	0.825		mg/L	1.6	20	05-MAY-18
Selenium (Se)-Total		0.00119	0.00124		mg/L	4.6	20	05-MAY-18
Silicon (Si)-Total		3.43	3.39		mg/L	1.2	20	05-MAY-18
Silver (Ag)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	05-MAY-18
Sodium (Na)-Total		5.25	5.17		mg/L	1.5	20	05-MAY-18
Strontium (Sr)-Total		0.165	0.157		mg/L	4.8	20	05-MAY-18
Thallium (Tl)-Total		0.000013	0.000011		mg/L	16	20	05-MAY-18
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	05-MAY-18
Titanium (Ti)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	05-MAY-18
Uranium (U)-Total		0.000843	0.000811		mg/L	3.8	20	05-MAY-18
Vanadium (V)-Total		0.00114	0.00113		mg/L	0.7	20	05-MAY-18
Zinc (Zn)-Total		0.0043	0.0040		mg/L	6.5	20	05-MAY-18
WG2764124-2 LCS								
Aluminum (Al)-Total			101.2		%		80-120	05-MAY-18
Antimony (Sb)-Total			100.2		%		80-120	05-MAY-18
Arsenic (As)-Total			97.2		%		80-120	05-MAY-18
Barium (Ba)-Total			100.2		%		80-120	05-MAY-18
Bismuth (Bi)-Total			98.0		%		80-120	05-MAY-18
Boron (B)-Total			93.5		%		80-120	05-MAY-18
Cadmium (Cd)-Total			101.9		%		80-120	05-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-2 LCS								
Calcium (Ca)-Total			97.3		%		80-120	05-MAY-18
Chromium (Cr)-Total			100.3		%		80-120	05-MAY-18
Cobalt (Co)-Total			99.4		%		80-120	05-MAY-18
Copper (Cu)-Total			100.6		%		80-120	05-MAY-18
Iron (Fe)-Total			94.5		%		80-120	05-MAY-18
Lead (Pb)-Total			100.6		%		80-120	05-MAY-18
Lithium (Li)-Total			99.5		%		80-120	05-MAY-18
Magnesium (Mg)-Total			98.6		%		80-120	05-MAY-18
Manganese (Mn)-Total			94.6		%		80-120	05-MAY-18
Molybdenum (Mo)-Total			98.9		%		80-120	05-MAY-18
Nickel (Ni)-Total			98.8		%		80-120	05-MAY-18
Potassium (K)-Total			98.6		%		80-120	05-MAY-18
Selenium (Se)-Total			95.6		%		80-120	05-MAY-18
Silicon (Si)-Total			100.9		%		80-120	05-MAY-18
Silver (Ag)-Total			94.1		%		80-120	05-MAY-18
Sodium (Na)-Total			99.3		%		80-120	05-MAY-18
Strontium (Sr)-Total			99.3		%		80-120	05-MAY-18
Thallium (Tl)-Total			97.3		%		80-120	05-MAY-18
Tin (Sn)-Total			99.5		%		80-120	05-MAY-18
Titanium (Ti)-Total			96.2		%		80-120	05-MAY-18
Uranium (U)-Total			101.6		%		80-120	05-MAY-18
Vanadium (V)-Total			99.4		%		80-120	05-MAY-18
Zinc (Zn)-Total			95.4		%		80-120	05-MAY-18
WG2764124-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	05-MAY-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	05-MAY-18
Boron (B)-Total			<0.010		mg/L		0.01	05-MAY-18
Cadmium (Cd)-Total			<0.000005		mg/L		0.000005	05-MAY-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	05-MAY-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	05-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-1 MB								
Copper (Cu)-Total			<0.00050		mg/L		0.0005	05-MAY-18
Iron (Fe)-Total			<0.010		mg/L		0.01	05-MAY-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	05-MAY-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	05-MAY-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	05-MAY-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	05-MAY-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	05-MAY-18
Potassium (K)-Total			<0.050		mg/L		0.05	05-MAY-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	05-MAY-18
Silicon (Si)-Total			<0.10		mg/L		0.1	05-MAY-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	05-MAY-18
Sodium (Na)-Total			<0.050		mg/L		0.05	05-MAY-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	05-MAY-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	05-MAY-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	05-MAY-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	05-MAY-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	05-MAY-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	05-MAY-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	05-MAY-18
WG2764124-4 MS		**L2086365-1**						
Aluminum (Al)-Total			N/A	MS-B	%		-	05-MAY-18
Antimony (Sb)-Total			92.8		%		70-130	05-MAY-18
Arsenic (As)-Total			97.5		%		70-130	05-MAY-18
Barium (Ba)-Total			N/A	MS-B	%		-	05-MAY-18
Bismuth (Bi)-Total			94.1		%		70-130	05-MAY-18
Boron (B)-Total			96.2		%		70-130	05-MAY-18
Cadmium (Cd)-Total			98.6		%		70-130	05-MAY-18
Calcium (Ca)-Total			N/A	MS-B	%		-	05-MAY-18
Chromium (Cr)-Total			98.2		%		70-130	05-MAY-18
Cobalt (Co)-Total			95.2		%		70-130	05-MAY-18
Copper (Cu)-Total			93.9		%		70-130	05-MAY-18
Iron (Fe)-Total			91.5		%		70-130	05-MAY-18
Lead (Pb)-Total			94.2		%		70-130	05-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4033943								
WG2764124-4 MS		**L2086365-1**						
Lithium (Li)-Total			95.8		%		70-130	05-MAY-18
Magnesium (Mg)-Total			N/A	MS-B	%		-	05-MAY-18
Manganese (Mn)-Total			N/A	MS-B	%		-	05-MAY-18
Molybdenum (Mo)-Total			94.8		%		70-130	05-MAY-18
Nickel (Ni)-Total			92.5		%		70-130	05-MAY-18
Potassium (K)-Total			93.0		%		70-130	05-MAY-18
Selenium (Se)-Total			90.2		%		70-130	05-MAY-18
Silicon (Si)-Total			92.8		%		70-130	05-MAY-18
Silver (Ag)-Total			92.3		%		70-130	05-MAY-18
Sodium (Na)-Total			N/A	MS-B	%		-	05-MAY-18
Strontium (Sr)-Total			N/A	MS-B	%		-	05-MAY-18
Thallium (Tl)-Total			92.0		%		70-130	05-MAY-18
Tin (Sn)-Total			96.9		%		70-130	05-MAY-18
Titanium (Ti)-Total			106.9		%		70-130	05-MAY-18
Uranium (U)-Total			96.3		%		70-130	05-MAY-18
Vanadium (V)-Total			96.4		%		70-130	05-MAY-18
Zinc (Zn)-Total			87.9		%		70-130	05-MAY-18
Batch R4036052								
WG2765995-2 LCS								
Aluminum (Al)-Total			104.8		%		80-120	07-MAY-18
Antimony (Sb)-Total			107.7		%		80-120	07-MAY-18
Arsenic (As)-Total			106.8		%		80-120	07-MAY-18
Barium (Ba)-Total			105.9		%		80-120	07-MAY-18
Bismuth (Bi)-Total			101.7		%		80-120	07-MAY-18
Boron (B)-Total			86.4		%		80-120	07-MAY-18
Cadmium (Cd)-Total			112.1		%		80-120	07-MAY-18
Calcium (Ca)-Total			101.7		%		80-120	07-MAY-18
Chromium (Cr)-Total			101.5		%		80-120	07-MAY-18
Cobalt (Co)-Total			105.8		%		80-120	07-MAY-18
Copper (Cu)-Total			107.0		%		80-120	07-MAY-18
Iron (Fe)-Total			101.8		%		80-120	07-MAY-18
Lead (Pb)-Total			104.5		%		80-120	07-MAY-18
Lithium (Li)-Total			95.0		%		80-120	07-MAY-18
Magnesium (Mg)-Total			97.2		%		80-120	07-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4036052								
WG2765995-2 LCS								
Manganese (Mn)-Total			101.9		%		80-120	07-MAY-18
Molybdenum (Mo)-Total			102.1		%		80-120	07-MAY-18
Nickel (Ni)-Total			106.1		%		80-120	07-MAY-18
Potassium (K)-Total			108.9		%		80-120	07-MAY-18
Selenium (Se)-Total			108.0		%		80-120	07-MAY-18
Silicon (Si)-Total			109.3		%		80-120	07-MAY-18
Silver (Ag)-Total			100.5		%		80-120	07-MAY-18
Sodium (Na)-Total			103.7		%		80-120	07-MAY-18
Strontium (Sr)-Total			96.7		%		80-120	07-MAY-18
Thallium (Tl)-Total			102.6		%		80-120	07-MAY-18
Tin (Sn)-Total			98.2		%		80-120	07-MAY-18
Titanium (Ti)-Total			104.3		%		80-120	07-MAY-18
Uranium (U)-Total			101.8		%		80-120	07-MAY-18
Vanadium (V)-Total			107.3		%		80-120	07-MAY-18
Zinc (Zn)-Total			100.8		%		80-120	07-MAY-18
WG2765995-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	07-MAY-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Boron (B)-Total			<0.010		mg/L		0.01	07-MAY-18
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	07-MAY-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	07-MAY-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Copper (Cu)-Total			<0.00050		mg/L		0.0005	07-MAY-18
Iron (Fe)-Total			<0.010		mg/L		0.01	07-MAY-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	07-MAY-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	07-MAY-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Molybdenum (Mo)-Total			0.000205	MB-LOR	mg/L		0.00005	07-MAY-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	07-MAY-18

Quality Control Report

Workorder: L2086365 Report Date: 08-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4036052								
WG2765995-1 MB								
Potassium (K)-Total			<0.050		mg/L		0.05	07-MAY-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Silicon (Si)-Total			<0.10		mg/L		0.1	07-MAY-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Sodium (Na)-Total			<0.050		mg/L		0.05	07-MAY-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	07-MAY-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	07-MAY-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	07-MAY-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	07-MAY-18
NH3-L-F-CL	**Water**							
Batch R4033330								
WG2765118-6 LCS								
Ammonia as N			103.9		%		85-115	04-MAY-18
WG2765118-5 MB								
Ammonia as N			<0.0050		mg/L		0.005	04-MAY-18
NO2-L-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-31 DUP		**L2086365-11**						
Nitrite (as N)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30 LCS								
Nitrite (as N)			105.4		%		90-110	28-APR-18
WG2763499-29 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	28-APR-18
WG2763499-32 MS		**L2086365-11**						
Nitrite (as N)			92.8		%		75-125	28-APR-18
NO3-L-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-31 DUP		**L2086365-11**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30 LCS								
Nitrate (as N)			101.4		%		90-110	28-APR-18
WG2763499-29 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	28-APR-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-32 MS		**L2086365-11**						
Nitrate (as N)			89.1		%		75-125	28-APR-18
ORP-CL	**Water**							
Batch R4035889								
WG2765339-1 CRM		**CL-ORP**						
ORP			221		mV		210-230	04-MAY-18
WG2765339-2 CRM		**CL-ORP**						
ORP			221		mV		210-230	04-MAY-18
P-T-L-COL-ED	**Water**							
Batch R4036287								
WG2766259-14 LCS								
Phosphorus (P)-Total			105.4		%		80-120	07-MAY-18
WG2766259-16 LCS								
Phosphorus (P)-Total			103.4		%		80-120	07-MAY-18
WG2766259-18 LCS								
Phosphorus (P)-Total			103.8		%		80-120	07-MAY-18
WG2766259-2 LCS								
Phosphorus (P)-Total			105.2		%		80-120	07-MAY-18
WG2766259-1 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-13 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-15 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-17 MB								
Phosphorus (P)-Total			0.0010		mg/L		0.001	07-MAY-18
PH-CL	**Water**							
Batch R4032387								
WG2764074-8 LCS								
pH			7.02		pH		6.9-7.1	02-MAY-18
PO4-DO-L-COL-ED	**Water**							
Batch R4025111								
WG2760976-2 LCS								
Orthophosphate-Dissolved (as P)			95.2		%		80-120	29-APR-18
WG2760976-6 LCS								
Orthophosphate-Dissolved (as P)			103.8		%		80-120	29-APR-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-L-COL-ED	**Water**							
Batch R4025111								
WG2760976-1 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	29-APR-18
WG2760976-5 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	29-APR-18
SO4-IC-N-CL	**Water**							
Batch R4031083								
WG2763499-31 DUP		**L2086365-11**						
Sulfate (SO4)		<0.30	<0.30	RPD-NA	mg/L	N/A	20	28-APR-18
WG2763499-30 LCS								
Sulfate (SO4)			101.6		%		90-110	28-APR-18
WG2763499-29 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	28-APR-18
WG2763499-32 MS		**L2086365-11**						
Sulfate (SO4)			89.6		%		75-125	28-APR-18
SOLIDS-TDS-CL	**Water**							
Batch R4033264								
WG2763855-5 LCS								
Total Dissolved Solids			99.6		%		85-115	03-MAY-18
WG2763855-4 MB								
Total Dissolved Solids			<10		mg/L		10	03-MAY-18
TKN-L-F-CL	**Water**							
Batch R4029812								
WG2762325-15 DUP		**L2086365-2**						
Total Kjeldahl Nitrogen		0.245	0.223		mg/L	9.4	20	01-MAY-18
WG2762325-10 LCS								
Total Kjeldahl Nitrogen			111.5		%		75-125	01-MAY-18
WG2762325-14 LCS								
Total Kjeldahl Nitrogen			107.8		%		75-125	01-MAY-18
WG2762325-13 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	01-MAY-18
WG2762325-9 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	01-MAY-18
WG2762325-16 MS		**L2086365-5**						
Total Kjeldahl Nitrogen			102.8		%		70-130	01-MAY-18
TSS-L-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TSS-L-CL	**Water**							
Batch R4033361								
WG2764537-8 LCS								
Total Suspended Solids			92.7		%		85-115	03-MAY-18
WG2764537-7 MB								
Total Suspended Solids			<1.0		mg/L		1	03-MAY-18
TURBIDITY-CL	**Water**							
Batch R4025066								
WG2760902-11 LCS								
Turbidity			98.5		%		85-115	28-APR-18
WG2760902-10 MB								
Turbidity			<0.10		NTU		0.1	28-APR-18

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.
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							
pH							
	1	27-APR-18 09:40	02-MAY-18 11:00	0.25	121	hours	EHTR-FM
	2	27-APR-18 09:40	02-MAY-18 11:00	0.25	121	hours	EHTR-FM
	5	27-APR-18 14:00	02-MAY-18 11:00	0.25	117	hours	EHTR-FM
	7	27-APR-18 15:30	02-MAY-18 11:00	0.25	115	hours	EHTR-FM
	9	27-APR-18 14:30	02-MAY-18 11:00	0.25	116	hours	EHTR-FM
	11	27-APR-18 14:30	02-MAY-18 11:00	0.25	116	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 L2086365 were received on 28-APR-18 13:00.

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

Page 1 of 1

COC ID: REP-2018-04-27 **TURNAROUND TIME:**

L2086365-COFC

PROJECT/CLIENT INFO

Facility Name / Job# Regional Effects Program
Project Manager Lee Wilm
Email lee.wilm@teck.com
Address PO Box 1777, 124B Aspen Drive
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Postal Code V0B 2G0 Country Canada
Phone Number 250-865-5289

LABORATORY

Lab Name ALS Calgary
Lab Contact Lyudmyla Shvets
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Postal Code T1Y 7B5 Country Canada
Phone Number 1 403 407 1794

		DF	EDD
teckcoal@equisonline.com			
carla.fraser@teck.com	x	x	x
andrew.wight@teck.com	x	x	x
jwilson@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.	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
1	RG_ER_WS_20180427-940	~~[illegible]~~ RG-ER	WS	NO	April 27.18	0940	G	7	/	/	/	/	/	/	/
2	RG_DUP_ER_WQ_20180427-940	RG_ER	WQ	NO	April 27.18	0940	G	7	/	/	/	/	/	/	/
3	RG_ER_WS_20180427-940 FB-Hg	RG_ER	WS	NO	April 27.18	0940	G	1				/			
4	RG-DUP_ER-WQ-20180427-940 -FB-Hg	RG_ER	WQ	NO	April 27.18	0940	G	1				/			
5	RG-GC-WS_20180427-1400	RG_GC	WS	NO	April 27.18	1400	G	7	/	/	/	/	/	/	/
6	RG-GC-WS-20180427-1400-FB-Hg	RG_GC	WS	NO	April 27.18	1400	G	1				/			
7	RG_FBLANK-WQ-20180427-1530	RG-FBLANK	WQ	NO	April 27.18	15:30	G	7	/	/	/	/	/	/	/
8	RG_FBLANK-WQ-20180427-1530-FB-Hg	RG_FBLANK	WQ	NO	April 27.18	15:30	G	1				/			
9	RG_SC-WS-20180427-1430	RG_SC	WS	NO	April 27.18	1430	G	7	/	/	/	/	/	/	/
10	RG-SC-WS-20180427-1430-FB-Hg	RG_SC	WS	NO	April 27.18	1430	G	1				/			
11	RG_TRIP-WQ-20180427-	RG_TRIP	WQ	NO	April 27.18	1430	-	4	/		/	/		/	

Id (RG_FBLANK_WQ 2018.... 1430 FB-Hg -wm 28/Apr/18.

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

12) RG_TRIP_WQ -FB-Hg

*HG-T-U rec'd-wm 28/4

All metals samples must be shipped to ALS Burnaby for analysis

RELINQUISHED BY/AFFILIATION | **DATE/TIME** | **ACCEPTED BY/AFFILIATION**

28Apr/18 15°C 13:00.

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 JUSTIN WILSON **Mobile #** 519-803-3923
Sampler's Signature **Date/Time** Apr.27.18 / 1700.

Teck Coal Ltd.
ATTN: Lee Wilm
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 01-MAY-18
Report Date: 09-MAY-18 14:37 (MT)
Version: FINAL

Client Phone: 250-425-5289

Certificate of Analysis

Lab Work Order #: L2087338
Project P.O. #: VPO00563596
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: REP-2018-04-29
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2087338-1	L2087338-2	L2087338-3	L2087338-4	
	Description	Water	Water	Water	Water	
	Sampled Date	29-APR-18	29-APR-18	30-APR-18	30-APR-18	
	Sampled Time	11:30	11:30	12:30	12:30	
	Client ID	RG_T4_WS_20180429-1130	RG_T4_WS_20180429-1130-FB-HG	RG_TN_WS_20180430-1230	RG_TN_WS_20180430-1230-FB-HG	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	284		253		
	Hardness (as CaCO3) (mg/L)	137		120		
	pH (pH)	8.20		8.21		
	ORP (mV)	242		288		
	Total Suspended Solids (mg/L)	879		544		
	Total Dissolved Solids (mg/L)	165		151		
	Turbidity (NTU)	19.8		206		
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0		<1.0		
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	117		105		
	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)	117		105		
	Ammonia as N (mg/L)	0.045 DLM		0.031 DLM		
	Bromide (Br) (mg/L)	<0.050		<0.050		
	Chloride (Cl) (mg/L)	2.87		3.22		
	Fluoride (F) (mg/L)	0.103		0.079		
	Ion Balance (%)	94.8		96.7		
	Nitrate (as N) (mg/L)	0.463		0.192		
	Nitrite (as N) (mg/L)	0.0025		0.0013		
	Total Kjeldahl Nitrogen (mg/L)	0.603		0.320		
	Orthophosphate-Dissolved (as P) (mg/L)	0.0017		<0.0010		
	Phosphorus (P)-Total (mg/L)	0.370 DLHC		0.139 DLHC		
	Sulfate (SO4) (mg/L)	28.8		22.2		
	Anion Sum (meq/L)	3.06		2.67		
	Cation Sum (meq/L)	2.90		2.58		
	Cation - Anion Balance (%)	-2.7		-1.7		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.59		2.79		
	Total Organic Carbon (mg/L)	2.84		2.46		
Total Metals	Aluminum (Al)-Total (mg/L)	5.64		3.26		
	Antimony (Sb)-Total (mg/L)	0.00026		<0.00020 DLA		
	Arsenic (As)-Total (mg/L)	0.00381		0.00238		
	Barium (Ba)-Total (mg/L)	0.121		0.0594		
	Beryllium (Be)-Total (ug/L)	0.267		0.137		
	Bismuth (Bi)-Total (mg/L)	0.00012		<0.00010 DLA		
	Boron (B)-Total (mg/L)	<0.020		<0.020 DLA		
	Cadmium (Cd)-Total (ug/L)	0.268		0.074		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

	Sample ID	L2087338-1	L2087338-2	L2087338-3	L2087338-4	
	Description	Water	Water	Water	Water	
	Sampled Date	29-APR-18	29-APR-18	30-APR-18	30-APR-18	
	Sampled Time	11:30	11:30	12:30	12:30	
	Client ID	RG_T4_WS_20180429-1130	RG_T4_WS_20180429-1130-FB-HG	RG_TN_WS_20180430-1230	RG_TN_WS_20180430-1230-FB-HG	
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	99.3		82.9		
	Chromium (Cr)-Total (mg/L)	0.00820		0.00466		
	Cobalt (Co)-Total (ug/L)	4.41		2.85		
	Copper (Cu)-Total (mg/L)	0.0095		0.0060		
	Iron (Fe)-Total (mg/L)	9.99		6.17		
	Lead (Pb)-Total (mg/L)	0.0101		0.00629		
	Lithium (Li)-Total (mg/L)	0.0136		0.0083		
	Magnesium (Mg)-Total (mg/L)	21.4		17.5		
	Manganese (Mn)-Total (mg/L)	0.291		0.172		
	Mercury (Hg)-Total (ug/L)	0.0196	<0.00050	0.00442	<0.00050	
	Molybdenum (Mo)-Total (mg/L)	0.00103		0.00072		
	Nickel (Ni)-Total (mg/L)	0.0103		0.0059		
	Potassium (K)-Total (mg/L)	1.50		0.97		
	Selenium (Se)-Total (ug/L)	2.46		0.20		
	Silicon (Si)-Total (mg/L)	9.81		6.71		
	Silver (Ag)-Total (mg/L)	0.000065		DLA <0.000020		
	Sodium (Na)-Total (mg/L)	3.72		4.04		
	Strontium (Sr)-Total (mg/L)	0.270		0.242		
	Thallium (Tl)-Total (mg/L)	0.000093		0.000035		
	Tin (Sn)-Total (mg/L)	DLA <0.00020		DLA <0.00020		
	Titanium (Ti)-Total (mg/L)	0.043		0.033		
	Uranium (U)-Total (mg/L)	0.00112		0.000939		
	Vanadium (V)-Total (mg/L)	0.0088		0.0040		
	Zinc (Zn)-Total (mg/L)	0.0424		0.0226		
Dissolved Metals	Dissolved Mercury Filtration Location	LAB		LAB		
	Dissolved Metals Filtration Location	LAB		LAB		
	Aluminum (Al)-Dissolved (mg/L)	0.0147		0.0119		
	Antimony (Sb)-Dissolved (mg/L)	DLA <0.00020		DLA <0.00020		
	Arsenic (As)-Dissolved (mg/L)	0.00060		0.00048		
	Barium (Ba)-Dissolved (mg/L)	0.0579		0.0332		
	Beryllium (Be)-Dissolved (ug/L)	DLA <0.040		DLA <0.040		
	Bismuth (Bi)-Dissolved (mg/L)	DLA <0.00010		DLA <0.00010		
	Boron (B)-Dissolved (mg/L)	DLA <0.020		DLA <0.020		
	Cadmium (Cd)-Dissolved (ug/L)	DLA <0.010		DLA <0.010		
	Calcium (Ca)-Dissolved (mg/L)	36.9		32.6		
	Chromium (Cr)-Dissolved (mg/L)	DLA <0.00020		DLA <0.00020		
	Cobalt (Co)-Dissolved (ug/L)	DLA <0.20		DLA <0.20		

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2087338-1	L2087338-2	L2087338-3	L2087338-4	
	Description	Water	Water	Water	Water	
	Sampled Date	29-APR-18	29-APR-18	30-APR-18	30-APR-18	
	Sampled Time	11:30	11:30	12:30	12:30	
	Client ID	RG_T4_WS_20180429-1130	RG_T4_WS_20180429-1130-FB-HG	RG_TN_WS_20180430-1230	RG_TN_WS_20180430-1230-FB-HG	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	0.00060		<0.00050		
	Iron (Fe)-Dissolved (mg/L)	0.022		0.022		
	Lead (Pb)-Dissolved (mg/L)	DLA <0.00010		DLA <0.00010		
	Lithium (Li)-Dissolved (mg/L)	0.0026		0.0012		
	Magnesium (Mg)-Dissolved (mg/L)	10.9		9.43		
	Manganese (Mn)-Dissolved (mg/L)	0.00072		0.00060		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050		<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00065		0.00048		
	Nickel (Ni)-Dissolved (mg/L)	DLA <0.0010		DLA <0.0010		
	Potassium (K)-Dissolved (mg/L)	0.56		0.53		
	Selenium (Se)-Dissolved (ug/L)	2.06		0.14		
	Silicon (Si)-Dissolved (mg/L)	2.67		2.86		
	Silver (Ag)-Dissolved (mg/L)	DLA <0.000020		DLA <0.000020		
	Sodium (Na)-Dissolved (mg/L)	3.25		3.58		
	Strontium (Sr)-Dissolved (mg/L)	0.124		0.124		
	Thallium (Tl)-Dissolved (mg/L)	DLA <0.000020		DLA <0.000020		
	Tin (Sn)-Dissolved (mg/L)	DLA <0.00020		DLA <0.00020		
	Titanium (Ti)-Dissolved (mg/L)	<0.010		<0.010		
	Uranium (U)-Dissolved (mg/L)	0.000749		0.000673		
	Vanadium (V)-Dissolved (mg/L)	DLA <0.0010		DLA <0.0010		
	Zinc (Zn)-Dissolved (mg/L)	DLA <0.0020		DLA <0.0020		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - DOC and dissolved metals to filtered and preserved in lab; filter code added
UCM	Unknown sample container (non-ALS) submitted for metals analysis (excluding Hg). ALS cannot verify container cleanliness or suitability for trace metals tests.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Molybdenum (Mo)-Dissolved	MB-LOR	L2087338-1, -3
Method Blank	Total Dissolved Solids	MB-LOR	L2087338-1, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2087338-1, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2087338-1, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2087338-1, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2087338-1, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2087338-1, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

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.

Reference Information

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 subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-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)

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-ED Water Total P in Water by Colour 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-ED Water Diss. Orthophosphate in Water by Colour 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**
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

REP-2018-04-29

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: L2087338 Report Date: 09-MAY-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0

Contact: Lee Wilm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R4037712								
WG2767019-2 LCS								
Acidity (as CaCO3)			103.2		%		85-115	07-MAY-18
WG2767019-1 MB								
Acidity (as CaCO3)			2.0		mg/L		2	07-MAY-18
ALK-MAN-CL	**Water**							
Batch R4035147								
WG2766144-11 LCS								
Alkalinity, Total (as CaCO3)			101.5		%		85-115	04-MAY-18
WG2766144-20 LCS								
Alkalinity, Total (as CaCO3)			99.0		%		85-115	04-MAY-18
WG2766144-10 MB								
Alkalinity, Total (as CaCO3)			1.0		mg/L		1	04-MAY-18
WG2766144-19 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	04-MAY-18
BE-D-L-CCMS-VA	**Water**							
Batch R4034954								
WG2765591-2 LCS								
Beryllium (Be)-Dissolved			100.5		%		80-120	06-MAY-18
WG2765591-1 MB		**LF**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	06-MAY-18
BE-T-L-CCMS-VA	**Water**							
Batch R4036388								
WG2765501-2 LCS								
Beryllium (Be)-Total			108.0		%		80-120	07-MAY-18
WG2765501-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	07-MAY-18
BR-L-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Bromide (Br)			103.0		%		85-115	01-MAY-18
WG2763063-9 MB								
Bromide (Br)			<0.050		mg/L		0.05	01-MAY-18
C-DIS-ORG-LOW-CL	**Water**							
Batch R4034471								
WG2765468-6 LCS								
Dissolved Organic Carbon			101.3		%		80-120	05-MAY-18
WG2765468-5 MB								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-LOW-CL	**Water**							
Batch R4034471								
WG2765468-5 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
C-TOT-ORG-LOW-CL	**Water**							
Batch R4034471								
WG2765468-6 LCS								
Total Organic Carbon			104.1		%		80-120	05-MAY-18
WG2765468-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-MAY-18
CL-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Chloride (Cl)			100.8		%		90-110	01-MAY-18
WG2763063-9 MB								
Chloride (Cl)			<0.50		mg/L		0.5	01-MAY-18
EC-L-PCT-CL	**Water**							
Batch R4035147								
WG2766144-11 LCS								
Conductivity (@ 25C)			99.4		%		90-110	04-MAY-18
WG2766144-20 LCS								
Conductivity (@ 25C)			105.2		%		90-110	04-MAY-18
WG2766144-10 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	04-MAY-18
WG2766144-19 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	04-MAY-18
F-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Fluoride (F)			107.1		%		90-110	01-MAY-18
WG2763063-9 MB								
Fluoride (F)			<0.020		mg/L		0.02	01-MAY-18
HG-D-CVAA-VA	**Water**							
Batch R4033477								
WG2764912-3 DUP		**L2087338-3**						
Mercury (Hg)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	04-MAY-18
WG2764912-2 LCS								
Mercury (Hg)-Dissolved			103.4		%		80-120	04-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-D-CVAA-VA	**Water**							
Batch R4033477								
WG2764912-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	04-MAY-18
WG2764912-4 MS		**L2087338-1**						
Mercury (Hg)-Dissolved			98.3		%		70-130	04-MAY-18
HG-T-U-CVAF-VA	**Water**							
Batch R4033793								
WG2765618-2 LCS								
Mercury (Hg)-Total			101.6		%		80-120	05-MAY-18
WG2765618-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	05-MAY-18
MET-D-CCMS-VA	**Water**							
Batch R4034954								
WG2765591-2 LCS								
Aluminum (Al)-Dissolved			103.1		%		80-120	06-MAY-18
Antimony (Sb)-Dissolved			98.6		%		80-120	06-MAY-18
Arsenic (As)-Dissolved			99.9		%		80-120	06-MAY-18
Barium (Ba)-Dissolved			97.6		%		80-120	06-MAY-18
Bismuth (Bi)-Dissolved			104.6		%		80-120	06-MAY-18
Boron (B)-Dissolved			92.6		%		80-120	06-MAY-18
Cadmium (Cd)-Dissolved			104.1		%		80-120	06-MAY-18
Calcium (Ca)-Dissolved			101.3		%		80-120	06-MAY-18
Chromium (Cr)-Dissolved			99.3		%		80-120	06-MAY-18
Cobalt (Co)-Dissolved			102.0		%		80-120	06-MAY-18
Copper (Cu)-Dissolved			101.3		%		80-120	06-MAY-18
Iron (Fe)-Dissolved			94.3		%		80-120	06-MAY-18
Lead (Pb)-Dissolved			98.4		%		80-120	06-MAY-18
Magnesium (Mg)-Dissolved			106.8		%		80-120	06-MAY-18
Manganese (Mn)-Dissolved			102.2		%		80-120	06-MAY-18
Molybdenum (Mo)-Dissolved			98.8		%		80-120	06-MAY-18
Nickel (Ni)-Dissolved			102.3		%		80-120	06-MAY-18
Potassium (K)-Dissolved			103.8		%		80-120	06-MAY-18
Selenium (Se)-Dissolved			101.4		%		80-120	06-MAY-18
Silicon (Si)-Dissolved			99.1		%		80-120	06-MAY-18
Silver (Ag)-Dissolved			96.2		%		80-120	06-MAY-18
Sodium (Na)-Dissolved			105.4		%		80-120	06-MAY-18
Strontium (Sr)-Dissolved			95.4		%		80-120	06-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4034954								
WG2765591-2 LCS								
Thallium (Tl)-Dissolved			100.2		%		80-120	06-MAY-18
Tin (Sn)-Dissolved			99.0		%		80-120	06-MAY-18
Titanium (Ti)-Dissolved			102.7		%		80-120	06-MAY-18
Uranium (U)-Dissolved			104.6		%		80-120	06-MAY-18
Vanadium (V)-Dissolved			103.6		%		80-120	06-MAY-18
Zinc (Zn)-Dissolved			97.9		%		80-120	06-MAY-18
WG2765591-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	06-MAY-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	06-MAY-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	06-MAY-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	06-MAY-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	06-MAY-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	06-MAY-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	06-MAY-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	06-MAY-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	06-MAY-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	06-MAY-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	06-MAY-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	06-MAY-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	06-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4034954								
WG2765591-1 MB		**LF**						
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	06-MAY-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	06-MAY-18
Batch R4038294								
WG2767160-2 LCS								
Aluminum (Al)-Dissolved			96.8		%		80-120	08-MAY-18
Antimony (Sb)-Dissolved			93.5		%		80-120	08-MAY-18
Arsenic (As)-Dissolved			91.6		%		80-120	08-MAY-18
Barium (Ba)-Dissolved			99.3		%		80-120	08-MAY-18
Bismuth (Bi)-Dissolved			93.4		%		80-120	08-MAY-18
Boron (B)-Dissolved			81.8		%		80-120	08-MAY-18
Cadmium (Cd)-Dissolved			99.4		%		80-120	08-MAY-18
Calcium (Ca)-Dissolved			93.1		%		80-120	08-MAY-18
Chromium (Cr)-Dissolved			95.7		%		80-120	08-MAY-18
Cobalt (Co)-Dissolved			93.9		%		80-120	08-MAY-18
Copper (Cu)-Dissolved			94.0		%		80-120	08-MAY-18
Iron (Fe)-Dissolved			88.8		%		80-120	08-MAY-18
Lead (Pb)-Dissolved			93.6		%		80-120	08-MAY-18
Lithium (Li)-Dissolved			94.7		%		80-120	08-MAY-18
Magnesium (Mg)-Dissolved			102.5		%		80-120	08-MAY-18
Manganese (Mn)-Dissolved			97.9		%		80-120	08-MAY-18
Molybdenum (Mo)-Dissolved			95.7		%		80-120	08-MAY-18
Nickel (Ni)-Dissolved			94.1		%		80-120	08-MAY-18
Potassium (K)-Dissolved			99.6		%		80-120	08-MAY-18
Selenium (Se)-Dissolved			89.0		%		80-120	08-MAY-18
Silicon (Si)-Dissolved			92.1		%		80-120	08-MAY-18
Silver (Ag)-Dissolved			95.0		%		80-120	08-MAY-18
Sodium (Na)-Dissolved			100.9		%		80-120	08-MAY-18
Strontium (Sr)-Dissolved			93.2		%		80-120	08-MAY-18
Thallium (Tl)-Dissolved			92.2		%		80-120	08-MAY-18
Tin (Sn)-Dissolved			95.1		%		80-120	08-MAY-18
Titanium (Ti)-Dissolved			93.7		%		80-120	08-MAY-18
Uranium (U)-Dissolved			89.7		%		80-120	08-MAY-18
Vanadium (V)-Dissolved			96.1		%		80-120	08-MAY-18
Zinc (Zn)-Dissolved			92.9		%		80-120	08-MAY-18
WG2767160-1		**LF**						

Quality Control Report

Workorder: L2087338 Report Date: 09-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch **R4038294**								
WG2767160-1 **MB**		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	08-MAY-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	08-MAY-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	08-MAY-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	08-MAY-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	08-MAY-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	08-MAY-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	08-MAY-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	08-MAY-18
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	08-MAY-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	08-MAY-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Molybdenum (Mo)-Dissolved			0.000056	MB-LOR	mg/L		0.00005	08-MAY-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	08-MAY-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	08-MAY-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	08-MAY-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	08-MAY-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	08-MAY-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	08-MAY-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	08-MAY-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	08-MAY-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	08-MAY-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	08-MAY-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	08-MAY-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	08-MAY-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	08-MAY-18
MET-T-CCMS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4036388								
WG2765501-2 LCS								
Aluminum (Al)-Total			105.8		%		80-120	07-MAY-18
Antimony (Sb)-Total			105.4		%		80-120	07-MAY-18
Arsenic (As)-Total			101.9		%		80-120	07-MAY-18
Barium (Ba)-Total			102.8		%		80-120	07-MAY-18
Bismuth (Bi)-Total			95.7		%		80-120	07-MAY-18
Boron (B)-Total			100.5		%		80-120	07-MAY-18
Cadmium (Cd)-Total			103.3		%		80-120	07-MAY-18
Calcium (Ca)-Total			105.2		%		80-120	07-MAY-18
Chromium (Cr)-Total			99.2		%		80-120	07-MAY-18
Cobalt (Co)-Total			102.8		%		80-120	07-MAY-18
Copper (Cu)-Total			102.7		%		80-120	07-MAY-18
Iron (Fe)-Total			106.9		%		80-120	07-MAY-18
Lead (Pb)-Total			99.4		%		80-120	07-MAY-18
Lithium (Li)-Total			107.6		%		80-120	07-MAY-18
Magnesium (Mg)-Total			99.0		%		80-120	07-MAY-18
Manganese (Mn)-Total			104.9		%		80-120	07-MAY-18
Molybdenum (Mo)-Total			103.6		%		80-120	07-MAY-18
Nickel (Ni)-Total			103.1		%		80-120	07-MAY-18
Potassium (K)-Total			99.0		%		80-120	07-MAY-18
Selenium (Se)-Total			100.7		%		80-120	07-MAY-18
Silicon (Si)-Total			101.2		%		80-120	07-MAY-18
Silver (Ag)-Total			106.7		%		80-120	07-MAY-18
Sodium (Na)-Total			103.4		%		80-120	07-MAY-18
Strontium (Sr)-Total			103.4		%		80-120	07-MAY-18
Thallium (Tl)-Total			94.2		%		80-120	07-MAY-18
Tin (Sn)-Total			102.9		%		80-120	07-MAY-18
Titanium (Ti)-Total			92.7		%		80-120	07-MAY-18
Uranium (U)-Total			102.7		%		80-120	07-MAY-18
Vanadium (V)-Total			105.4		%		80-120	07-MAY-18
Zinc (Zn)-Total			101.5		%		80-120	07-MAY-18
WG2765501-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	07-MAY-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	07-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4036388								
WG2765501-1 MB								
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Boron (B)-Total			<0.010		mg/L		0.01	07-MAY-18
Cadmium (Cd)-Total			<0.000005		mg/L		0.000005	07-MAY-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	07-MAY-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Copper (Cu)-Total			<0.00050		mg/L		0.0005	07-MAY-18
Iron (Fe)-Total			<0.010		mg/L		0.01	07-MAY-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	07-MAY-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	07-MAY-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	07-MAY-18
Potassium (K)-Total			<0.050		mg/L		0.05	07-MAY-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	07-MAY-18
Silicon (Si)-Total			<0.10		mg/L		0.1	07-MAY-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Sodium (Na)-Total			<0.050		mg/L		0.05	07-MAY-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	07-MAY-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	07-MAY-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	07-MAY-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	07-MAY-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	07-MAY-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	07-MAY-18
Batch R4036551								
WG2765501-1 MB								
Arsenic (As)-Total			<0.00010		mg/L		0.0001	07-MAY-18
NH3-L-F-CL	**Water**							
Batch R4035468								
WG2766462-16 DUP		**L2087338-1**						
Ammonia as N		0.045	0.0446		mg/L	0.0	20	08-MAY-18
WG2766462-14 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-L-F-CL	**Water**							
Batch R4035468								
WG2766462-14 LCS								
Ammonia as N			101.9		%		85-115	07-MAY-18
WG2766462-13 MB								
Ammonia as N			<0.0050		mg/L		0.005	07-MAY-18
WG2766462-15 MS		**L2087338-1**						
Ammonia as N			103.0		%		75-125	07-MAY-18
Ammonia as N			89.7		%		75-125	08-MAY-18
NO2-L-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Nitrite (as N)			106.1		%		90-110	01-MAY-18
WG2763063-9 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	01-MAY-18
NO3-L-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Nitrate (as N)			100.9		%		90-110	01-MAY-18
WG2763063-9 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	01-MAY-18
ORP-CL	**Water**							
Batch R4038204								
WG2767635-7 CRM		**CL-ORP**						
ORP			215		mV		210-230	08-MAY-18
WG2767635-8 CRM		**CL-ORP**						
ORP			223		mV		210-230	08-MAY-18
P-T-L-COL-ED	**Water**							
Batch R4036287								
WG2766259-14 LCS								
Phosphorus (P)-Total			105.4		%		80-120	07-MAY-18
WG2766259-16 LCS								
Phosphorus (P)-Total			103.4		%		80-120	07-MAY-18
WG2766259-18 LCS								
Phosphorus (P)-Total			103.8		%		80-120	07-MAY-18
WG2766259-2 LCS								
Phosphorus (P)-Total			105.2		%		80-120	07-MAY-18
WG2766259-1 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-13								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-T-L-COL-ED	**Water**							
Batch R4036287								
WG2766259-13 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-15 MB								
Phosphorus (P)-Total			<0.0010		mg/L		0.001	07-MAY-18
WG2766259-17 MB								
Phosphorus (P)-Total			0.0010		mg/L		0.001	07-MAY-18
PH-CL	**Water**							
Batch R4035147								
WG2766144-11 LCS								
pH			7.03		pH		6.9-7.1	04-MAY-18
WG2766144-20 LCS								
pH			7.00		pH		6.9-7.1	04-MAY-18
PO4-DO-L-COL-ED	**Water**							
Batch R4030926								
WG2762964-10 LCS								
Orthophosphate-Dissolved (as P)			98.2		%		80-120	02-MAY-18
WG2762964-14 LCS								
Orthophosphate-Dissolved (as P)			99.8		%		80-120	02-MAY-18
WG2762964-2 LCS								
Orthophosphate-Dissolved (as P)			98.0		%		80-120	02-MAY-18
WG2762964-6 LCS								
Orthophosphate-Dissolved (as P)			100.2		%		80-120	02-MAY-18
WG2762964-1 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	02-MAY-18
WG2762964-13 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	02-MAY-18
WG2762964-5 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	02-MAY-18
WG2762964-9 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	02-MAY-18
SO4-IC-N-CL	**Water**							
Batch R4030617								
WG2763063-10 LCS								
Sulfate (SO4)			101.8		%		90-110	01-MAY-18
WG2763063-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	01-MAY-18
SOLIDS-TDS-CL	**Water**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TDS-CL	**Water**							
Batch R4035306								
WG2764840-8 LCS								
Total Dissolved Solids			94.6		%		85-115	04-MAY-18
WG2764840-7 MB								
Total Dissolved Solids			19	MB-LOR	mg/L		10	04-MAY-18
TKN-L-F-CL	**Water**							
Batch R4037088								
WG2766927-2 LCS								
Total Kjeldahl Nitrogen			99.9		%		75-125	04-MAY-18
WG2766927-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	04-MAY-18
TSS-L-CL	**Water**							
Batch R4035648								
WG2765188-8 LCS								
Total Suspended Solids			96.4		%		85-115	04-MAY-18
WG2765188-7 MB								
Total Suspended Solids			<1.0		mg/L		1	04-MAY-18
TURBIDITY-CL	**Water**							
Batch R4032594								
WG2762597-8 LCS								
Turbidity			100.0		%		85-115	01-MAY-18
WG2762597-7 MB								
Turbidity			<0.10		NTU		0.1	01-MAY-18

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
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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							
pH							
	1	29-APR-18 11:30	04-MAY-18 15:00	0.25	124	hours	EHTR-FM
	3	30-APR-18 12:30	04-MAY-18 15:00	0.25	98	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 L2087338 were received on 01-MAY-18 09:20.

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

Page 1 of 1

COC ID: REP-2018-04-29

TURNAROUND T

L2087338-COFC

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program	Lab Name	ALS
Project Manager	Lee Wilm	Lab Contact	Lyudmyla Shvets
Email	lee.wilm@teck.com	Email	lyudmyla.shvets@alsglobal.com
Address	PO Box 1777, 124B Aspen Drive	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	250-865-5289	Phone Number	1 403 407 1794

	Excel	PDF	EDD
lee.wilm@teck.com	x	x	x
teckcoal@equisonline.com			x
carla.fraser@teck.com	x	x	x
andrew.wight@teck.com	x	x	x
jwilson@minnow.ca	x	+	x

SAMPLE DETAILS / **ANALYSIS REQUESTED**

Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

	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				
FIL											
PRESERV			x			x					

	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				
1	RG_T4_WS_20180429-1130	RG_T4	Water	NO	April 29,18	11:30	G	7	1	1	1	1	1	1	1				
2	RG-T4-WS-20180429-1130-FB-Hg	RG_T4	Water	NO	April 29,18	11:30	G	1				1							
3	RG_TN_WS_20180430-1230	RG_TN	Water	No	April 30/18	12:30	G	7	1	1	1	1	1	1	1				
4	RG_TN-WQ-20180430-1230-FB-Hg	RG_TN	Water	No	April 30/18	12:30	G	1				1							

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

All metals samples must be shipped to ALS Burnaby for analysis

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
			5/1 9:20

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	JUSTIN WILSON	Mobile #	519-803-3923
Sampler's Signature		Date/Time	April 29.18 / 10:30pm

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 31-AUG-18
Report Date: 11-SEP-18 13:59 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2157301
Project P.O. #: VPO00563596
Job Reference: REGIONAL KOOCANUSA
C of C Numbers: Regional Koocanusa
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18
	Sampled Time	15:15	14:45	11:30	12:30	14:00
	Client ID	RG_TN_1_SED_20 180829-1515	RG_TN_2_SED_20 180829-1445	RG_TN_3_SED_20 180829-1130	RG_TN_4_SED_20 180829-1230	RG_TN_5_SED_20 180829-1400
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	41.5	38.7	41.6	33.2	35.8
	pH (1:2 soil:water) (pH)	8.40	8.59	8.35	8.83	8.77
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	<1.0	<1.0	<1.0	15.3	2.7
	% Sand (0.125mm - 0.063mm) (%)	<1.0	6.7	2.0	29.6	28.0
	% Silt (0.063mm - 0.0312mm) (%)	30.1	29.5	34.1	19.4	26.8
	% Silt (0.0312mm - 0.004mm) (%)	57.1	52.1	53.8	28.0	35.0
	% Clay (<4um) (%)	12.5	11.6	10.1	7.4	7.4
	Texture	Silt	Silt	Silt	Sandy loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.00	1.99	2.4	1.83	1.91
Metals	Aluminum (Al) (mg/kg)	12100	12300	12100	9220	9860
	Antimony (Sb) (mg/kg)	0.29	0.30	0.34	0.26	0.29
	Arsenic (As) (mg/kg)	7.13	6.77	7.23	6.33	6.76
	Barium (Ba) (mg/kg)	71.1	71.7	73.8	57.3	59.5
	Beryllium (Be) (mg/kg)	0.37	0.35	0.37	0.27	0.32
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.176	0.171	0.202	0.144	0.138
	Calcium (Ca) (mg/kg)	106000	115000	103000	111000	114000
	Chromium (Cr) (mg/kg)	17.1	16.8	18.0	15.1	15.9
	Cobalt (Co) (mg/kg)	8.98	8.88	9.52	7.98	8.40
	Copper (Cu) (mg/kg)	16.3	15.2	17.5	12.1	13.1
	Iron (Fe) (mg/kg)	22000	21900	22500	19700	20900
	Lead (Pb) (mg/kg)	16.5	15.5	18.0	14.2	14.7
	Lithium (Li) (mg/kg)	25.1	24.5	24.5	20.1	22.5
	Magnesium (Mg) (mg/kg)	22200	24600	23500	24900	26100
	Manganese (Mn) (mg/kg)	423	430	429	382	402
	Mercury (Hg) (mg/kg)	0.0196	0.0150	0.0202	0.0141	0.0126
	Molybdenum (Mo) (mg/kg)	0.58	0.61	0.65	0.55	0.59
	Nickel (Ni) (mg/kg)	18.9	19.0	20.2	16.8	17.9
	Phosphorus (P) (mg/kg)	617	641	675	633	682
	Potassium (K) (mg/kg)	800	740	800	610	630
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.23	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20180828-1000	RG_T4_2_SED_20180828-1200	RG_T4_3_SED_20180828-1330	RG_T4_4_SED_20180828-1430	RG_T4_5_SED_20180828-1530
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	40.0	42.3	41.0	43.3	39.2
	pH (1:2 soil:water) (pH)	8.53	8.42	8.42	8.43	8.49
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.125mm - 0.063mm) (%)	<1.0	<1.0	2.2	1.9	2.9
	% Silt (0.063mm - 0.0312mm) (%)	19.4	18.5	21.6	14.8	16.0
	% Silt (0.0312mm - 0.004mm) (%)	60.8	62.2	58.8	62.8	61.2
	% Clay (<4um) (%)	19.7	19.1	17.2	20.5	19.8
	Texture	Silt	Silt	Silt	Silt	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.15	2.19	2.20	2.2	1.94
Metals	Aluminum (Al) (mg/kg)	10500	13200	12000	13500	13400
	Antimony (Sb) (mg/kg)	0.46	0.48	0.41	0.42	0.42
	Arsenic (As) (mg/kg)	7.25	7.69	7.17	7.59	7.14
	Barium (Ba) (mg/kg)	161	166	135	141	116
	Beryllium (Be) (mg/kg)	0.50	0.55	0.47	0.48	0.45
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.586	0.573	0.486	0.462	0.336
	Calcium (Ca) (mg/kg)	117000	119000	115000	122000	120000
	Chromium (Cr) (mg/kg)	17.6	20.0	18.7	20.4	19.6
	Cobalt (Co) (mg/kg)	9.08	10.3	9.45	10.2	9.83
	Copper (Cu) (mg/kg)	16.4	18.0	16.4	17.5	16.1
	Iron (Fe) (mg/kg)	22200	24500	22800	24700	23900
	Lead (Pb) (mg/kg)	14.0	15.4	15.0	15.9	15.8
	Lithium (Li) (mg/kg)	24.1	26.1	24.2	25.6	24.8
	Magnesium (Mg) (mg/kg)	24100	26700	24000	26200	24300
	Manganese (Mn) (mg/kg)	589	596	539	568	528
	Mercury (Hg) (mg/kg)	0.0323	0.0336	0.0286	0.0291	0.0208
	Molybdenum (Mo) (mg/kg)	1.03	1.01	0.94	0.94	0.85
	Nickel (Ni) (mg/kg)	22.4	24.8	22.5	23.9	22.0
	Phosphorus (P) (mg/kg)	912	979	812	830	734
	Potassium (K) (mg/kg)	950	1110	1020	1160	1010
	Selenium (Se) (mg/kg)	0.61	0.53	0.47	0.51	0.40
	Silver (Ag) (mg/kg)	0.11	0.11	<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	L2157301-11				
	Description	Sediment				
	Sampled Date	28-AUG-18				
	Sampled Time	14:35				
	Client ID	RG_T4_4_SED_20180828-1435				
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	42.3				
	pH (1:2 soil:water) (pH)	8.45				
Particle Size	% Gravel (>2mm) (%)	<1.0				
	% Sand (2.00mm - 1.00mm) (%)	<1.0				
	% Sand (1.00mm - 0.50mm) (%)	<1.0				
	% Sand (0.50mm - 0.25mm) (%)	<1.0				
	% Sand (0.25mm - 0.125mm) (%)	<1.0				
	% Sand (0.125mm - 0.063mm) (%)	1.4				
	% Silt (0.063mm - 0.0312mm) (%)	17.4				
	% Silt (0.0312mm - 0.004mm) (%)	61.6				
	% Clay (<4um) (%)	19.6				
	Texture	Silt				
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.3				
Metals	Aluminum (Al) (mg/kg)	14700				
	Antimony (Sb) (mg/kg)	0.44				
	Arsenic (As) (mg/kg)	8.24				
	Barium (Ba) (mg/kg)	142				
	Beryllium (Be) (mg/kg)	0.50				
	Bismuth (Bi) (mg/kg)	0.21				
	Boron (B) (mg/kg)	<5.0				
	Cadmium (Cd) (mg/kg)	0.454				
	Calcium (Ca) (mg/kg)	140000				
	Chromium (Cr) (mg/kg)	21.8				
	Cobalt (Co) (mg/kg)	11.2				
	Copper (Cu) (mg/kg)	19.2				
	Iron (Fe) (mg/kg)	26900				
	Lead (Pb) (mg/kg)	17.8				
	Lithium (Li) (mg/kg)	27.7				
	Magnesium (Mg) (mg/kg)	28400				
	Manganese (Mn) (mg/kg)	629				
	Mercury (Hg) (mg/kg)	0.0462				
	Molybdenum (Mo) (mg/kg)	1.05				
	Nickel (Ni) (mg/kg)	25.6				
	Phosphorus (P) (mg/kg)	876				
	Potassium (K) (mg/kg)	1110				
	Selenium (Se) (mg/kg)	0.52				
	Silver (Ag) (mg/kg)	<0.10				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Grouping	Analyte	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Sample ID	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18
	Sampled Time	15:15	14:45	11:30	12:30	14:00
	Client ID	RG_TN_1_SED_20180829-1515	RG_TN_2_SED_20180829-1445	RG_TN_3_SED_20180829-1130	RG_TN_4_SED_20180829-1230	RG_TN_5_SED_20180829-1400
SOIL						
Metals	Sodium (Na) (mg/kg)	81	84	89	81	82
	Strontium (Sr) (mg/kg)	238	250	229	231	237
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.087	0.078	0.085	0.066	0.067
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	142	140	143	129	123
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.794	0.729	0.881	0.582	0.576
	Vanadium (V) (mg/kg)	13.4	13.4	13.9	12.0	12.5
	Zinc (Zn) (mg/kg)	69.4	66.9	73.6	61.8	64.0
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	1.5	1.3	1.4
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	<0.010	<0.010
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	0.022	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	0.011	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	94.4	91.6	85.2	73.8	82.5
	Surrogate: d12-Chrysene (%)	103.9	104.2	105.8	101.4	104.4
	Surrogate: d8-Naphthalene (%)	92.6	88.9	80.5	69.6	79.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20180828-1000	RG_T4_2_SED_20180828-1200	RG_T4_3_SED_20180828-1330	RG_T4_4_SED_20180828-1430	RG_T4_5_SED_20180828-1530
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	92	100	91	100	103
	Strontium (Sr) (mg/kg)	216	227	226	250	263
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.136	0.144	0.128	0.131	0.113
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	54.8	76.9	84.1	99.6	102
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.758	0.788	0.850	0.811	0.784
	Vanadium (V) (mg/kg)	18.0	20.2	17.9	19.3	17.2
	Zinc (Zn) (mg/kg)	81.6	88.7	79.8	84.4	77.2
	Zirconium (Zr) (mg/kg)	1.7	1.7	1.5	1.3	1.4
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)	0.012	0.013	<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)	0.020	0.020	0.014	0.015	<0.010
	Benzo(e)pyrene (mg/kg)	0.013	0.013	<0.010	0.010	<0.010
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	0.014	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	0.025	0.026	0.018	0.018	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	0.0057	<0.0050
	Fluoranthene (mg/kg)	0.017	0.019	0.014	0.014	<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)	0.026	0.023	0.025	0.016	<0.010
	2-Methylnaphthalene (mg/kg)	0.047	0.041	0.040	0.030	0.016
	Naphthalene (mg/kg)	0.019	0.016	0.014	0.010	<0.010
	Perylene (mg/kg)	0.015	0.015	<0.010	0.011	<0.010
	Phenanthrene (mg/kg)	0.045	0.039	0.041	0.027	0.017
	Pyrene (mg/kg)	0.013	0.014	0.011	0.011	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	87.8	88.0	87.2	84.2	79.8
	Surrogate: d12-Chrysene (%)	106.7	116.9	104.8	104.9	104.2
	Surrogate: d8-Naphthalene (%)	84.1	84.5	84.9	81.4	75.3

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-11				
	Description	Sediment				
	Sampled Date	28-AUG-18				
	Sampled Time	14:35				
	Client ID	RG_T4_4_SED_20180828-1435				
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	105				
	Strontium (Sr) (mg/kg)	288				
	Sulfur (S) (mg/kg)	<1000				
	Thallium (Tl) (mg/kg)	0.132				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	101				
	Tungsten (W) (mg/kg)	<0.50				
	Uranium (U) (mg/kg)	0.907				
	Vanadium (V) (mg/kg)	19.6				
	Zinc (Zn) (mg/kg)	88.7				
	Zirconium (Zr) (mg/kg)	1.8				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050				
	Acenaphthylene (mg/kg)	<0.0050				
	Acridine (mg/kg)	<0.010				
	Anthracene (mg/kg)	<0.0040				
	Benz(a)anthracene (mg/kg)	<0.010				
	Benzo(a)pyrene (mg/kg)	<0.010				
	Benzo(b&j)fluoranthene (mg/kg)	0.015				
	Benzo(e)pyrene (mg/kg)	<0.010				
	Benzo(g,h,i)perylene (mg/kg)	<0.010				
	Benzo(k)fluoranthene (mg/kg)	<0.010				
	Chrysene (mg/kg)	0.015				
	Dibenz(a,h)anthracene (mg/kg)	<0.0050				
	Fluoranthene (mg/kg)	0.013				
	Fluorene (mg/kg)	<0.010				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010				
	1-Methylnaphthalene (mg/kg)	0.019				
	2-Methylnaphthalene (mg/kg)	0.029				
	Naphthalene (mg/kg)	0.013				
	Perylene (mg/kg)	0.011				
	Phenanthrene (mg/kg)	0.028				
	Pyrene (mg/kg)	<0.010				
	Quinoline (mg/kg)	<0.010				
	Surrogate: d10-Acenaphthene (%)	90.4				
	Surrogate: d12-Chrysene (%)	109.9				
	Surrogate: d8-Naphthalene (%)	89.5				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2157301-1 Sediment 29-AUG-18 15:15 RG_TN_1_SED_20180829-1515	L2157301-2 Sediment 29-AUG-18 14:45 RG_TN_2_SED_20180829-1445	L2157301-3 Sediment 29-AUG-18 11:30 RG_TN_3_SED_20180829-1130	L2157301-4 Sediment 29-AUG-18 12:30 RG_TN_4_SED_20180829-1230	L2157301-5 Sediment 29-AUG-18 14:00 RG_TN_5_SED_20180829-1400
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	95.9	93.9	92.5	84.5	88.6
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20180828-1000	RG_T4_2_SED_20180828-1200	RG_T4_3_SED_20180828-1330	RG_T4_4_SED_20180828-1430	RG_T4_5_SED_20180828-1530
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	94.7	94.7	91.4	90.2	87.7
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	0.23	0.23	0.17	0.19	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-11				
	Description	Sediment				
	Sampled Date	28-AUG-18				
	Sampled Time	14:35				
	Client ID	RG_T4_4_SED_20180828-1435				
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	94.6				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME) (mg/kg)	0.17				

* 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)
Certified Reference Material	Phosphorus (P)	MES	L2157301-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

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).

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.

ALS Test Code	Matrix	Test Description	Method Reference**
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)

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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 samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-CL	Soil	% Moisture	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C

ALS Test Code	Matrix	Test Description	Method Reference**
PAH-TMB-D/A-MS-CL	Soil	PAH by Tumbler Extraction (DCM/Acetone)	EPA 3570/8270

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 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 DCM 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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** 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

Reference Information

CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

Regional Koocanusa

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: L2157301 Report Date: 11-SEP-18

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 R4207675								
WG2869426-2 LCS								
Inorganic Carbon			97.8		%		80-120	10-SEP-18
WG2869426-3 MB								
Inorganic Carbon			<0.050		%		0.05	10-SEP-18
Batch R4210968								
WG2869424-1 DUP		**L2157301-6**						
Inorganic Carbon		2.73	2.69		%	1.4	20	11-SEP-18
WG2869424-2 LCS								
Inorganic Carbon			96.9		%		80-120	11-SEP-18
WG2869424-3 MB								
Inorganic Carbon			<0.050		%		0.05	11-SEP-18
C-TOT-LECO-SK	**Soil**							
Batch R4205562								
WG2867622-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			106.5		%		80-120	07-SEP-18
WG2867622-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			101.0		%		90-110	07-SEP-18
WG2867622-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	07-SEP-18
Batch R4205816								
WG2868854-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			97.8		%		80-120	08-SEP-18
WG2868854-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			100.0		%		90-110	08-SEP-18
WG2868854-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	08-SEP-18
HG-200.2-CVAA-CL	**Soil**							
Batch R4204124								
WG2869457-9 CRM		**TILL-1**						
Mercury (Hg)			109.2		%		70-130	07-SEP-18
WG2869457-8 LCS								
Mercury (Hg)			103.0		%		80-120	07-SEP-18
WG2869457-6 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	07-SEP-18
MET-200.2-CCMS-CL	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4204992								
WG2869457-9 CRM		**TILL-1**						
Aluminum (Al)			129.0		%		70-130	07-SEP-18
Antimony (Sb)			120.4		%		70-130	07-SEP-18
Arsenic (As)			122.1		%		70-130	07-SEP-18
Barium (Ba)			114.7		%		70-130	07-SEP-18
Beryllium (Be)			117.4		%		70-130	07-SEP-18
Bismuth (Bi)			98.6		%		70-130	07-SEP-18
Boron (B)			3.4		mg/kg		0-8.2	07-SEP-18
Cadmium (Cd)			121.6		%		70-130	07-SEP-18
Calcium (Ca)			122.7		%		70-130	07-SEP-18
Chromium (Cr)			118.6		%		70-130	07-SEP-18
Cobalt (Co)			119.5		%		70-130	07-SEP-18
Copper (Cu)			114.1		%		70-130	07-SEP-18
Iron (Fe)			120.0		%		70-130	07-SEP-18
Lead (Pb)			117.5		%		70-130	07-SEP-18
Lithium (Li)			120.3		%		70-130	07-SEP-18
Magnesium (Mg)			127.0		%		70-130	07-SEP-18
Manganese (Mn)			127.8		%		70-130	07-SEP-18
Molybdenum (Mo)			128.8		%		70-130	07-SEP-18
Nickel (Ni)			117.3		%		70-130	07-SEP-18
Phosphorus (P)			130.2	MES	%		70-130	07-SEP-18
Potassium (K)			110.0		%		70-130	07-SEP-18
Selenium (Se)			0.36		mg/kg		0.11-0.51	07-SEP-18
Silver (Ag)			0.24		mg/kg		0.13-0.33	07-SEP-18
Sodium (Na)			109.4		%		70-130	07-SEP-18
Strontium (Sr)			109.1		%		70-130	07-SEP-18
Thallium (Tl)			0.131		mg/kg		0.077-0.18	07-SEP-18
Tin (Sn)			1.2		mg/kg		0-3.1	07-SEP-18
Titanium (Ti)			121.8		%		70-130	07-SEP-18
Tungsten (W)			0.18		mg/kg		0-0.66	07-SEP-18
Uranium (U)			103.2		%		70-130	07-SEP-18
Vanadium (V)			116.7		%		70-130	07-SEP-18
Zinc (Zn)			116.2		%		70-130	07-SEP-18
Zirconium (Zr)			0.8		mg/kg		0-1.8	07-SEP-18
WG2869457-6 MB								

Quality Control Report

Workorder: L2157301 Report Date: 11-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch **R4204992**								
WG2869457-6 **MB**								
Aluminum (Al)			<50		mg/kg		50	07-SEP-18
Antimony (Sb)			<0.10		mg/kg		0.1	07-SEP-18
Arsenic (As)			<0.10		mg/kg		0.1	07-SEP-18
Barium (Ba)			<0.50		mg/kg		0.5	07-SEP-18
Beryllium (Be)			<0.10		mg/kg		0.1	07-SEP-18
Bismuth (Bi)			<0.20		mg/kg		0.2	07-SEP-18
Boron (B)			<5.0		mg/kg		5	07-SEP-18
Cadmium (Cd)			<0.020		mg/kg		0.02	07-SEP-18
Calcium (Ca)			<50		mg/kg		50	07-SEP-18
Chromium (Cr)			<0.50		mg/kg		0.5	07-SEP-18
Cobalt (Co)			<0.10		mg/kg		0.1	07-SEP-18
Copper (Cu)			<0.50		mg/kg		0.5	07-SEP-18
Iron (Fe)			<50		mg/kg		50	07-SEP-18
Lead (Pb)			<0.50		mg/kg		0.5	07-SEP-18
Lithium (Li)			<2.0		mg/kg		2	07-SEP-18
Magnesium (Mg)			<20		mg/kg		20	07-SEP-18
Manganese (Mn)			<1.0		mg/kg		1	07-SEP-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	07-SEP-18
Nickel (Ni)			<0.50		mg/kg		0.5	07-SEP-18
Phosphorus (P)			<50		mg/kg		50	07-SEP-18
Potassium (K)			<100		mg/kg		100	07-SEP-18
Selenium (Se)			<0.20		mg/kg		0.2	07-SEP-18
Silver (Ag)			<0.10		mg/kg		0.1	07-SEP-18
Sodium (Na)			<50		mg/kg		50	07-SEP-18
Strontium (Sr)			<0.50		mg/kg		0.5	07-SEP-18
Sulfur (S)			<1000		mg/kg		1000	07-SEP-18
Thallium (Tl)			<0.050		mg/kg		0.05	07-SEP-18
Tin (Sn)			<2.0		mg/kg		2	07-SEP-18
Titanium (Ti)			<1.0		mg/kg		1	07-SEP-18
Tungsten (W)			<0.50		mg/kg		0.5	07-SEP-18
Uranium (U)			<0.050		mg/kg		0.05	07-SEP-18
Vanadium (V)			<0.20		mg/kg		0.2	07-SEP-18
Zinc (Zn)			<2.0		mg/kg		2	07-SEP-18
Zirconium (Zr)			<1.0		mg/kg		1	07-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-CL	**Soil**							
Batch R4201553								
WG2867497-2 LCS								
Moisture			105.3		%		90-110	04-SEP-18
WG2867497-1 MB								
Moisture			<0.25		%		0.25	04-SEP-18
Batch R4203606								
WG2868175-3 DUP		**L2157301-3**						
Moisture		41.6	43.5		%	4.4	20	05-SEP-18
WG2868175-2 LCS								
Moisture			104.8		%		90-110	05-SEP-18
WG2868175-1 MB								
Moisture			<0.25		%		0.25	05-SEP-18
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-3 DUP		**L2157301-3**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Acridine		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(e)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
1-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Quinoline		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-1 LCS								
Acenaphthene			95.2		%		60-130	06-SEP-18
Acenaphthylene			91.4		%		60-130	06-SEP-18
Acridine			103.3		%		60-130	06-SEP-18
Anthracene			92.6		%		60-130	06-SEP-18
Benz(a)anthracene			95.2		%		60-130	06-SEP-18
Benzo(a)pyrene			93.6		%		60-130	06-SEP-18
Benzo(b&j)fluoranthene			95.9		%		60-130	06-SEP-18
Benzo(g,h,i)perylene			103.3		%		60-130	06-SEP-18
Benzo(k)fluoranthene			99.1		%		60-130	06-SEP-18
Benzo(e)pyrene			104.9		%		60-130	06-SEP-18
Chrysene			101.1		%		60-130	06-SEP-18
Dibenz(a,h)anthracene			101.4		%		60-130	06-SEP-18
Fluoranthene			90.1		%		60-130	06-SEP-18
Fluorene			95.2		%		60-130	06-SEP-18
Indeno(1,2,3-c,d)pyrene			100.4		%		60-130	06-SEP-18
1-Methylnaphthalene			105.7		%		60-130	06-SEP-18
2-Methylnaphthalene			95.7		%		60-130	06-SEP-18
Naphthalene			95.7		%		50-130	06-SEP-18
Perylene			107.1		%		60-130	06-SEP-18
Phenanthrene			94.5		%		60-130	06-SEP-18
Pyrene			91.3		%		60-130	06-SEP-18
Quinoline			97.4		%		60-130	06-SEP-18
WG2870492-5 LCS								
Acenaphthene			83.0		%		60-130	06-SEP-18
Acenaphthylene			82.3		%		60-130	06-SEP-18
Acridine			99.9		%		60-130	06-SEP-18
Anthracene			85.0		%		60-130	06-SEP-18
Benz(a)anthracene			100.4		%		60-130	06-SEP-18
Benzo(a)pyrene			98.9		%		60-130	06-SEP-18
Benzo(b&j)fluoranthene			100.7		%		60-130	06-SEP-18
Benzo(g,h,i)perylene			100.6		%		60-130	06-SEP-18
Benzo(k)fluoranthene			105.4		%		60-130	06-SEP-18
Benzo(e)pyrene			113.0		%		60-130	06-SEP-18
Chrysene			110.8		%		60-130	06-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-5 LCS								
Dibenz(a,h)anthracene			97.7		%		60-130	06-SEP-18
Fluoranthene			96.6		%		60-130	06-SEP-18
Fluorene			83.8		%		60-130	06-SEP-18
Indeno(1,2,3-c,d)pyrene			100.0		%		60-130	06-SEP-18
1-Methylnaphthalene			91.8		%		60-130	06-SEP-18
2-Methylnaphthalene			82.9		%		60-130	06-SEP-18
Naphthalene			83.7		%		50-130	06-SEP-18
Perylene			113.3		%		60-130	06-SEP-18
Phenanthrene			85.9		%		60-130	06-SEP-18
Pyrene			98.1		%		60-130	06-SEP-18
Quinoline			84.8		%		60-130	06-SEP-18
WG2870492-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	06-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	06-SEP-18
Acridine			<0.010		mg/kg		0.01	06-SEP-18
Anthracene			<0.0040		mg/kg		0.004	06-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Chrysene			<0.010		mg/kg		0.01	06-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	06-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Fluorene			<0.010		mg/kg		0.01	06-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	06-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
Naphthalene			<0.010		mg/kg		0.01	06-SEP-18
Perylene			<0.010		mg/kg		0.01	06-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	06-SEP-18
Pyrene			<0.010		mg/kg		0.01	06-SEP-18
Quinoline			<0.010		mg/kg		0.01	06-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-2 MB								
Surrogate: d8-Naphthalene			102.6		%		50-130	06-SEP-18
Surrogate: d10-Acenaphthene			106.0		%		60-130	06-SEP-18
Surrogate: d10-Phenanthrene			102.4		%		60-130	06-SEP-18
Surrogate: d12-Chrysene			123.2		%		60-130	06-SEP-18
WG2870492-6 MB								
Acenaphthene			<0.0050		mg/kg		0.005	06-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	06-SEP-18
Acridine			<0.010		mg/kg		0.01	06-SEP-18
Anthracene			<0.0040		mg/kg		0.004	06-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Chrysene			<0.010		mg/kg		0.01	06-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	06-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Fluorene			<0.010		mg/kg		0.01	06-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	06-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
Naphthalene			<0.010		mg/kg		0.01	06-SEP-18
Perylene			<0.010		mg/kg		0.01	06-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	06-SEP-18
Pyrene			<0.010		mg/kg		0.01	06-SEP-18
Quinoline			<0.010		mg/kg		0.01	06-SEP-18
Surrogate: d8-Naphthalene			82.5		%		50-130	06-SEP-18
Surrogate: d10-Acenaphthene			84.7		%		60-130	06-SEP-18
Surrogate: d10-Phenanthrene			83.1		%		60-130	06-SEP-18
Surrogate: d12-Chrysene			113.0		%		60-130	06-SEP-18
WG2870492-4 MS		**L2157301-4**						
Acenaphthene			81.0		%		50-150	06-SEP-18
Acenaphthylene			77.0		%		50-150	06-SEP-18
Acridine			100.9		%		50-150	06-SEP-18

Quality Control Report

Workorder: L2157301 Report Date: 11-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-4 MS		**L2157301-4**						
Anthracene			88.7		%		50-150	06-SEP-18
Benz(a)anthracene			103.1		%		50-150	06-SEP-18
Benzo(a)pyrene			98.3		%		50-150	06-SEP-18
Benzo(b&j)fluoranthene			102.0		%		50-150	06-SEP-18
Benzo(g,h,i)perylene			97.4		%		50-150	06-SEP-18
Benzo(k)fluoranthene			106.5		%		50-150	06-SEP-18
Benzo(e)pyrene			112.9		%		50-150	06-SEP-18
Chrysene			109.1		%		50-150	06-SEP-18
Dibenz(a,h)anthracene			100.1		%		50-150	06-SEP-18
Fluoranthene			100.9		%		50-150	06-SEP-18
Fluorene			85.5		%		50-150	06-SEP-18
Indeno(1,2,3-c,d)pyrene			97.9		%		50-150	06-SEP-18
1-Methylnaphthalene			87.3		%		50-150	06-SEP-18
2-Methylnaphthalene			79.8		%		50-150	06-SEP-18
Naphthalene			78.2		%		50-150	06-SEP-18
Perylene			107.5		%		50-150	06-SEP-18
Phenanthrene			92.4		%		50-150	06-SEP-18
Pyrene			102.5		%		50-150	06-SEP-18
Quinoline			79.3		%		50-150	06-SEP-18
PH-1:2-CL	**Soil**							
Batch R4205885								
WG2871863-2 DUP		**L2157301-1**						
pH (1:2 soil:water)		8.40	8.37	J	pH	0.03	0.2	09-SEP-18
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4205718								
WG2869283-1 DUP		**L2157301-6**						
% Gravel (>2mm)		<1.0	<1.0	RPD-NA	%	N/A	25	08-SEP-18
% Sand (2.00mm - 1.00mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (1.00mm - 0.50mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.50mm - 0.25mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.25mm - 0.125mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.125mm - 0.063mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Silt (0.063mm - 0.0312mm)		19.4	18.9	J	%	0.5	5	08-SEP-18
% Silt (0.0312mm - 0.004mm)		60.8	60.5	J	%	0.4	5	08-SEP-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4205718								
WG2869283-1 DUP		**L2157301-6**						
% Clay (<4um)		19.7	20.4	J	%	0.7	5	08-SEP-18
WG2869283-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			3.0		%		0-7.6	08-SEP-18
% Sand (1.00mm - 0.50mm)			3.8		%		0-8.9	08-SEP-18
% Sand (0.50mm - 0.25mm)			9.0		%		5.3-15.3	08-SEP-18
% Sand (0.25mm - 0.125mm)			14.7		%		10-20	08-SEP-18
% Sand (0.125mm - 0.063mm)			14.7		%		7.3-17.3	08-SEP-18
% Silt (0.063mm - 0.0312mm)			13.5		%		9.9-19.9	08-SEP-18
% Silt (0.0312mm - 0.004mm)			22.5		%		17.6-27.6	08-SEP-18
% Clay (<4um)			18.9		%		13.4-23.4	08-SEP-18

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.
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).
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

Page 1 of 1

COC ID:	REGIONAL Koocanusa Reservoir	TURNAROUND TIME:	Regular

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Koocanusa		
Project Manager	Cait Good		
Email	[illegible]		
Address	421 Pine Avenue		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

LABORATORY

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OTHER INFO

Report Format / Distribution		Excel	PDF	EDD
Email 1:	[illegible]	X	X	X
Email 2:	carla.fraser@teck.com	X	X	X
Email 3:				
Email 4:	teckcoal@equisonline.com			X
Email 5:	jwilson@minnow.ca	X	X	X
PO number	VPO00563596			

L2157301-COFC

SAMPLE DETAILS / **ANALYSIS REQUESTED** Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

								Particle Size	TOC	PAH	Total Metals (including Hg)	Moisture		
FILT								N	N	N	N	N	N	N
PRESERV								NONE	NONE	NONE	NONE	NONE	HNO3	NONE
Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.							
RG_TN_1_SED_20180829-1515	RG_TN_1	Sediment		29-Aug-18	3:15:00 PM	G	2	X	X	X	X	X		
RG_TN_2_SED_20180829-1445	RG_TN_2	Sediment		29-Aug-18	2:45:00 PM	G	2	X	X	X	X	X		
RG_TN_3_SED_20180829-1130	RG_TN_3	Sediment		29-Aug-18	11:30:00 AM	G	2	X	X	X	X	X		
RG_TN_4_SED_20180829-1230	RG_TN_4	Sediment		29-Aug-18	12:30:00 PM	G	2	X	X	X	X	X		
RG_TN_5_SED_20180829-1400	RG_TN_5	Sediment		29-Aug-18	2:00:00 PM	G	2	X	X	X	X	X		
RG_T4_1_SED_20180828-1000	RG_T4_1	Sediment		28-Aug-18	10:00:00 AM	G	2	X	X	X	X	X		
RG_T4_2_SED_20180828-1200	RG_T4_2	Sediment		28-Aug-18	12:00:00 PM	G	2	X	X	X	X	X		
RG_T4_3_SED_20180828-1330	RG_T4_3	Sediment		28-Aug-18	1:30:00 PM	G	2	X	X	X	X	X		
RG_T4_4_SED_20180828-1430	RG_T4_4	Sediment		28-Aug-18	2:30:00 PM	G	2	X	X	X	X	X		
RG_T4_5_SED_20180828-1530	RG_T4_5	Sediment		28-Aug-18	3:30:00 PM	G	2	X	X	X	X	X		
RG_T4_4_SED_20180828-1435	RG_T4_4	Sediment		28-Aug-18	2:35:00 PM	G	2	X	X	X	X	X		

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
Koocanusa - VPO00563596 1 jar for PAHs and 1 bag for everything else				8/31 10:10

SERVICE REQUEST (rush - subject to availability)

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	Justin Wilson	Mobile #	519-803-3923
Sampler's Signature		Date/Time	August 30, 2018

5°

APPENDIX B

SEDIMENT QUALITY

Table B.1: Profundal Sediment Sampling Locations in Koocanusa Reservoir, August 2018

Station Identifier		UTM (NAD 83, Zone 11U)		Station Depth (m)	Average Ponar Fullness (%)	Sample Texture	Macrophytes in Sample	Algae in Sample
		Easting	Northing					
Upstream of Elk River	RG_TN-1	627394	5453542	14.0	75% - 100%	95% sand and finer, 5% organics	No	No
	RG_TN-2	627291	5453642	13.3	75%	90% sand and finer, 10% organics	No	No
	RG_TN-3	627343	5456370	14.6	75%	90% sand and finer, 10% organics	No	No
	RG_TN-4	627344	5453854	14.0	100%	95% sand and finer, 5% organics	No	No
	RG_TN-5	627175	5453986	14.3	100%	100% sand and finer, minimal organics	No	No
Downstream of Elk River	RG_T4-1	630074	5441765	25.1	75%	100% sand and finer	No	No
	RG_T4-2	629838	5442106	24.3	75%	100% sand and finer	No	No
	RG_T4-3	629706	5441670	24.4	100%	100% sand and finer	No	No
	RG_T4-4	629512	5441745	23.9	100%	100% sand and finer, minimal organics	No	No
	RG_T4-5	629460	5441543	24.8	100%	100% sand and finer	No	No

Table B.2: **Littoral Sediment Sampling Locations in Koocanusa Reservoir, April 2018**

Station Identifier		Comment	UTM (NAD 83, Zone 11U)		Station Depth (m)	Sample Texture	Macrophytes in Sample	Algae in Sample	Dominant Taxa
			Easting	Northing					
Sand Creek	RG_SC_01	-	625489	5458292	1.5	silty sand	no	no	chironomid
	RG_SC_02	-	625467	5458231	-	silty sand	no	no	chironomid, mayfly
	RG_SC_03	-	625577	5457631	1.0	silty sand	no	no	chironomid
	RG_SC_04	-	625652	5457353	1.3	silty sand	no	no	chironomid
	RG_SC_05	-	625680	5458260	1.5	silty sand	no	no	chironomid, mayfly
Elk River	RG_ER_01	downstream of mouth of Elk River	628309	5448218	< 0.5	100% sand and finer, minimal organics	no	no	mayfly, chironomid
	RG_ER_02	northern most braid at mouth of the Elk River	628475	5448196	0.4	100% sand and finer, minimal organics	no	no	stonefly, mayfly, chironomid
	RG_ER_03	southern most braid at mouth of the Elk River	628280	5448086	< 0.5	100% sand and finer, 10% organics	no	no	mayfly
	RG_ER_04	in sheltered bay downstream of the mouth	627989	5447672	< 0.5	100% sand and finer, minimal organics	no	no	chironomid
	RG_ER_05	in sheltered bay downstream of the mouth	627950	5447580	< 0.5	100% sand and finer, minimal organics	no	no	mayfly
Gold Creek	RG_GC_01	spooned at sediment-water interface	630805	5436307	0.1	100% sand and finer, minimal organics	no	no	chironomid, mayfly
	RG_GC_02	-	630906	5436212	0.1	100% sand and finer, minimal organics	no	no	mayfly, chironomid
	RG_GC_03	texture slightly coarser than -01 and -02	630825	5436436	0.1	100% sand and finer, minimal organics	no	no	stonefly, chironomid
	RG_GC_04	superfine, sticky material, from shoreline water interface	631158	5436077	0.1	100% sand and finer, minimal organics	no	no	chironomid, stonefly, mayfly
	RG_GC_05	very fine, less clay, less sticky than -04	631068	5436163	0.1	100% sand and finer, minimal organics	no	no	stonefly, mayfly, chironomid

Table B.3: Profundal Sediment Quality in Koocanusa Reservoir, August 2018

Analytes	Units	BC Sediment Quality Guidelines [a]	Upstream of Elk River (RG_TN)				
			TN-1	TN-2	TN-3	TN-4	TN-5
Non-metals							
Moisture	%	-	41.5	38.7	41.6	33.2	35.8
pH (1:2 soil:water)	pH	-	8.40	8.59	8.35	8.83	8.77
Particle size[d]							
% Gravel	%	-	<1.0	<1.0	<1.0	<1.0	<1.0
% Sand	%	-	<1.0	6.70	2.00	44.9	30.7
% Silt	%	-	87.2	81.6	87.9	47.4	61.8
% Clay	%	-	12.5	11.6	10.1	7.4	7.4
Carbon							
TOC[e]	%	-	2.00	1.99	2.40	1.83	1.91
Metals (< 1mm fraction)							
Aluminum (Al)	mg/kg dw	-	12,100	12,300	12,100	9,220	9,860
Antimony (Sb)	mg/kg dw	-	0.29	0.30	0.34	0.26	0.29
Arsenic (As)	mg/kg dw	5.9/17 [b]	7.13	6.77	7.23	6.33	6.76
Barium (Ba)	mg/kg dw	-	71.1	71.7	73.8	57.3	59.5
Beryllium (Be)	mg/kg dw	-	0.37	0.35	0.37	0.27	0.32
Bismuth (Bi)	mg/kg dw	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	mg/kg dw	-	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg dw	0.6/3.5 [b]	0.176	0.171	0.202	0.144	0.138
Calcium (Ca)	mg/kg dw	-	106,000	115,000	103,000	111,000	114,000
Chromium (Cr)	mg/kg dw	37.3/90 [b]	17.1	16.8	18.0	15.1	15.9
Cobalt (Co)	mg/kg dw	-	8.98	8.88	9.52	7.98	8.40
Copper (Cu)	mg/kg dw	35.7/197 [b]	16.3	15.2	17.5	12.1	13.1
Iron (Fe)	mg/kg dw	21,200/43,766 [c]	22,000	21,900	22,500	19,700	20,900
Lead (Pb)	mg/kg dw	35/91 [b]	16.5	15.5	18.0	14.2	14.7
Lithium (Li)	mg/kg dw	-	25.1	24.5	24.5	20.1	22.5
Magnesium (Mg)	mg/kg dw	-	22,200	24,600	23,500	24,900	26,100
Manganese (Mn)	mg/kg dw	460/1,100 [c]	423	430	429	382	402
Mercury (Hg)	mg/kg dw	0.170/0.486 [b]	0.0196	0.0150	0.0202	0.0141	0.0126
Molybdenum (Mo)	mg/kg dw	-	0.58	0.61	0.65	0.55	0.59
Nickel (Ni)	mg/kg dw	16/75 [c]	18.9	19.0	20.2	16.8	17.9
Phosphorus (P)	mg/kg dw	-	617	641	675	633	682
Potassium (K)	mg/kg dw	-	800	740	800	610	630
Selenium (Se)	mg/kg dw	2	<0.20	<0.20	0.23	<0.20	<0.20
Silver (Ag)	mg/kg dw	0.5	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg dw	-	81	84	89	81	82
Strontium (Sr)	mg/kg dw	-	238	250	229	231	237
Sulfur (S)	mg/kg dw	-	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	mg/kg dw	-	0.087	0.078	0.085	0.066	0.067
Tin (Sn)	mg/kg dw	-	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg dw	-	142	140	143	129	123
Tungsten (W)	mg/kg dw	-	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	mg/kg dw	-	0.794	0.729	0.881	0.582	0.576
Vanadium (V)	mg/kg dw	-	13.4	13.4	13.9	12.0	12.5
Zinc (Zn)	mg/kg dw	123/315 [b]	69.4	66.9	73.6	61.8	64.0
Zirconium (Zr)	mg/kg dw	-	<1.0	<1.0	1.5	1.3	1.4
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg dw	0.00671/0.0889 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg dw	0.00587/0.128 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acridine	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg dw	0.0469/0.245 [b]	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg dw	0.0317/0.385 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg dw	0.0319/0.782 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(e)pyrene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg dw	0.17/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg dw	0.24/13.4 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg dw	0.0571/0.862 [b]	0.022	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg dw	0.00622/0.135 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg dw	0.111/2.355 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg dw	0.021/0.144 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg dw	0.2/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg dw	0.0202/0.201 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg dw	0.0346/0.391 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Perylene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg dw	0.0419/0.515 [b]	<0.010	0.011	<0.010	<0.010	<0.010
Pyrene	mg/kg dw	0.053/0.875 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
d10-Acenaphthene	%	-	94.4	91.6	85.2	73.8	82.5
d12-Chrysene	%	-	103.9	104.2	105.8	101.4	104.4
d8-Naphthalene	%	-	92.6	88.9	80.5	69.6	79.5
d10-Phenanthrene	%	-	95.9	93.9	92.5	84.5	88.6
B(a)P Total Potency Equivalent	mg/kg dw	-	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	mg/kg dw	-	<0.15	<0.15	<0.15	<0.15	<0.15

Note: Shaded values were above the lower guidelines (ISQG[b] or LEL[c]). No values exceeded the upper (PEL[b] or SEL[c]) guidelines.

[a] Working sediment quality guidelines (BC MOE 2015).

[b] Interim Sediment Quality Guideline (ISQG; or Threshold Effect Level [LEL])/ Probable Effect Level (PEL).

[c] Lowest Effect Level (LEL)/ Severe Effect Level (SEL).

[d] Gravel = >2.0 mm; Sand = 0.063 to 2.0 mm; Silt = 0.004 to 0.063 mm; Clay = <0.004 mm.

[e] TOC = Total Organic Carbon.

Table B.3: Profundal Sediment Quality in Koocanusa Reservoir, August 2018

Analytes	Units	BC Sediment Quality Guidelines [a]	Downstream of Elk River (RG_T4)				
			T4-1	T4-2	T4-3	T4-4	T4-5
Non-metals							
Moisture	%	-	40.0	42.3	41.0	42.8	39.2
pH (1:2 soil:water)	pH	-	8.53	8.42	8.42	8.44	8.49
Particle size[d]							
% Gravel	%	-	<1.0	<1.0	<1.0	<1.0	<1.0
% Sand	%	-	<1.0	<1.0	2.20	1.65	2.90
% Silt	%	-	80.2	80.7	80.4	78.3	77.2
% Clay	%	-	19.7	19.1	17.2	20.1	19.8
Carbon							
TOC[e]	%	-	2.15	2.19	2.20	2.25	1.94
Metals (< 1mm fraction)							
Aluminum (Al)	mg/kg dw	-	10,500	13,200	12,000	14,100	13,400
Antimony (Sb)	mg/kg dw	-	0.46	0.48	0.41	0.43	0.42
Arsenic (As)	mg/kg dw	5.9/17 [b]	7.25	7.69	7.17	7.92	7.14
Barium (Ba)	mg/kg dw	-	161	166	135	142	116
Beryllium (Be)	mg/kg dw	-	0.50	0.55	0.47	0.49	0.45
Bismuth (Bi)	mg/kg dw	-	<0.20	<0.20	<0.20	0.21	<0.20
Boron (B)	mg/kg dw	-	5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg dw	0.6/3.5 [b]	0.586	0.573	0.486	0.458	0.336
Calcium (Ca)	mg/kg dw	-	117,000	119,000	115,000	131,000	120,000
Chromium (Cr)	mg/kg dw	37.3/90 [b]	17.6	20.0	18.7	21.1	19.6
Cobalt (Co)	mg/kg dw	-	9.08	10.3	9.45	10.7	9.83
Copper (Cu)	mg/kg dw	35.7/197 [b]	16.4	18.0	16.4	18.4	16.1
Iron (Fe)	mg/kg dw	21,200/43,766 [c]	22,200	24,500	22,800	25,800	23,900
Lead (Pb)	mg/kg dw	35/91 [b]	14.0	15.4	15.0	16.9	15.8
Lithium (Li)	mg/kg dw	-	24.1	26.1	24.2	26.7	24.8
Magnesium (Mg)	mg/kg dw	-	24,100	26,700	24,000	27,300	24,300
Manganese (Mn)	mg/kg dw	460/1,100 [c]	589	596	539	599	528
Mercury (Hg)	mg/kg dw	0.170/0.486 [b]	0.0323	0.0336	0.0286	0.0377	0.0208
Molybdenum (Mo)	mg/kg dw	-	1.03	1.01	0.94	1.00	0.85
Nickel (Ni)	mg/kg dw	16/75 [c]	22.4	24.8	22.5	24.8	22.0
Phosphorus (P)	mg/kg dw	-	912	979	812	853	734
Potassium (K)	mg/kg dw	-	950	1,110	1,020	1,135	1,010
Selenium (Se)	mg/kg dw	2	0.61	0.53	0.47	0.52	0.40
Silver (Ag)	mg/kg dw	0.5	0.11	0.11	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg dw	-	92	100	91	103	103
Strontium (Sr)	mg/kg dw	-	216	227.0	226.0	269	263
Sulfur (S)	mg/kg dw	-	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	mg/kg dw	-	0.136	0.144	0.128	0.132	0.113
Tin (Sn)	mg/kg dw	-	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg dw	-	54.8	76.9	84.1	100.3	102.0
Tungsten (W)	mg/kg dw	-	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	mg/kg dw	-	0.758	0.788	0.850	0.859	0.784
Vanadium (V)	mg/kg dw	-	18.0	20.2	17.9	19.5	17.2
Zinc (Zn)	mg/kg dw	123/315 [b]	81.6	88.7	79.8	86.6	77.2
Zirconium (Zr)	mg/kg dw	-	1.7	1.7	1.5	1.6	1.4
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg dw	0.00671/0.0889 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg dw	0.00587/0.128 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acridine	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg dw	0.0469/0.245 [b]	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg dw	0.0317/0.385 [b]	0.012	0.013	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg dw	0.0319/0.782 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	mg/kg dw	-	0.020	0.020	0.014	0.015	<0.010
Benzo(e)pyrene	mg/kg dw	-	0.013	0.013	<0.010	0.01	<0.010
Benzo(g,h,i)perylene	mg/kg dw	0.17/3.2 [b]	<0.010	<0.010	<0.010	0.014	<0.010
Benzo(k)fluoranthene	mg/kg dw	0.24/13.4 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg dw	0.0571/0.862 [b]	0.025	0.026	0.018	0.017	<0.010
Dibenz(a,h)anthracene	mg/kg dw	0.00622/0.135 [b]	<0.0050	<0.0050	<0.0050	0.0054	<0.0050
Fluoranthene	mg/kg dw	0.111/2.355 [b]	0.017	0.019	0.014	0.0135	<0.010
Fluorene	mg/kg dw	0.021/0.144 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg dw	0.2/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	mg/kg dw	-	0.026	0.023	0.025	0.018	<0.010
2-Methylnaphthalene	mg/kg dw	0.0202/0.201 [b]	0.047	0.041	0.040	0.030	0.016
Naphthalene	mg/kg dw	0.0346/0.391 [b]	0.019	0.016	0.014	0.012	<0.010
Perylene	mg/kg dw	-	0.015	0.015	<0.010	0.011	<0.010
Phenanthrene	mg/kg dw	0.0419/0.515 [b]	0.045	0.039	0.041	0.028	0.017
Pyrene	mg/kg dw	0.053/0.875 [b]	0.013	0.014	0.011	0.011	<0.010
Quinoline	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
d10-Acenaphthene	%	-	87.8	88	87.2	87.3	79.8
d12-Chrysene	%	-	106.7	116.9	104.8	107.4	104.2
d8-Naphthalene	%	-	84.1	84.5	84.9	85.45	75.3
d10-Phenanthrene	%	-	94.7	94.7	91.4	92.4	87.7
B(a)P Total Potency Equivalent	mg/kg dw	-	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	mg/kg dw	-	0.23	0.23	0.17	0.18	<0.15

Note: Shaded values were above the lower guidelines (ISQG[b] or LEL[c]). No values exceeded the upper (PEL[b] or SEL[c]) guidelines.

[a] Working sediment quality guidelines (BC MOE 2015).

[b] Interim Sediment Quality Guideline (ISQG; or Threshold Effect Level [LEL])/ Probable Effect Level (PEL).

[c] Lowest Effect Level (LEL)/ Severe Effect Level (SEL).

[d] Gravel = >2.0 mm; Sand = 0.063 to 2.0 mm; Silt = 0.004 to 0.063 mm; Clay = <0.004 mm.

[e] TOC = Total Organic Carbon.

Table B.4: Littoral Sediment Quality in Koocanusa Reservoir, April 2018

Analytes	Units	BC Sediment Quality Guidelines [a]	Upstream of Elk River (RG_SC)					Downstream of Elk River (RG_ER)				
			SC-1	SC-2	SC-3	SC-0	SC-5	ER-1	ER-2	ER-3	ER-4	ER-5
Non-metals												
Moisture	%	-	29.6	31.9	37.1	42.6	40.9	49.9	40.5	39.4	41.3	39.9
pH (1:2 soil:water)	pH	-	8.45	8.31	8.05	8.25	8.16	8.19	8.49	8.35	8.17	8.21
Particle size[d]												
% Gravel	%	-	<1.0	1.3	2.8	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
% Sand	%	-	43.2	29.6	27.3	47.2	5.8	9.2	72.8	53.5	10.8	3.8
% Silt	%	-	46.1	55.6	59.7	42.9	73.4	73.4	23.8	41.9	69.0	75.9
% Clay	%	-	10.6	13.2	9.8	8.6	19.7	15.7	3.2	4.6	19.2	18.0
Carbon												
TOC[e]	%	-	1.76	1.07	1.67	1.18	1.10	1.83	1.98	1.99	1.90	1.70
Metals (< 1mm fraction)												
Aluminum (Al)	mg/kg dw	-	9,820	9,760	10,500	10,500	13,000	11,000	8,260	7,440	9,830	12,100
Antimony (Sb)	mg/kg dw	-	0.23	0.24	0.36	0.29	0.30	0.46	0.40	0.41	0.36	0.39
Arsenic (As)	mg/kg dw	5.9/17 [b]	4.73	4.53	6.09	5.70	5.68	5.64	4.62	4.59	4.82	5.55
Barium (Ba)	mg/kg dw	-	61.3	70.5	68.9	71.5	97.0	206	131	166	137	151
Beryllium (Be)	mg/kg dw	-	0.33	0.34	0.38	0.41	0.46	0.61	0.47	0.47	0.48	0.51
Bismuth (Bi)	mg/kg dw	-	<0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	mg/kg dw	-	<5.0	<5.0	<5.0	<5.0	<5.0	6.9	5.8	5.4	<5.0	5.1
Cadmium (Cd)	mg/kg dw	0.6/3.5 [b]	0.136	0.147	0.198	0.187	0.196	0.688	0.457	0.516	0.438	0.447
Calcium (Ca)	mg/kg dw	-	105,000	107,000	102,000	105,000	122,000	84,200	55,600	57,700	91,400	102,000
Chromium (Cr)	mg/kg dw	37.3/90 [b]	14.0	14.6	15.3	16.0	18.0	16.3	11.5	11.8	14.9	16.6
Cobalt (Co)	mg/kg dw	-	6.97	6.97	7.63	7.98	9.09	7.33	4.46	4.75	7.07	7.97
Copper (Cu)	mg/kg dw	35.7/197 [b]	10.9	10.6	13.4	13.2	14.7	15.1	8.91	9.94	13.4	14.9
Iron (Fe)	mg/kg dw	21,200/43,766 [c]	18,100	17,900	19,900	19,200	22,300	17,600	12,900	12,600	16,900	19,100
Lead (Pb)	mg/kg dw	35/91 [b]	10.9	13.2	22.1	14.0	15.1	11.5	7.15	7.43	12.1	12.8
Lithium (Li)	mg/kg dw	-	20.5	20.4	21.8	22.0	26.9	20.0	14.4	13.4	20.1	23.3
Magnesium (Mg)	mg/kg dw	-	20,300	20,400	21,700	20,500	24,000	21,100	13,200	14,600	19,600	22,000
Manganese (Mn)	mg/kg dw	460/1,100 [c]	376	422	447	435	530	502	264	310	457	525
Mercury (Hg)	mg/kg dw	0.170/0.486 [b]	0.0110	0.0120	0.0140	0.0148	0.0151	0.0330	0.0214	0.0221	0.0265	0.0238
Molybdenum (Mo)	mg/kg dw	-	0.51	0.54	0.56	0.59	0.63	0.87	0.70	0.78	0.69	0.77
Nickel (Ni)	mg/kg dw	16/75 [c]	15.7	15.9	17.1	17.5	20.5	19.2	13.2	14.0	17.4	19.5
Phosphorus (P)	mg/kg dw	-	468	406	534	528	515	922	874	967	619	690
Potassium (K)	mg/kg dw	-	660	770	800	890	1,150	1,650	1,170	1,160	1,210	1,390
Selenium (Se)	mg/kg dw	2	<0.20	<0.20	0.22	0.20	0.21	0.96	0.56	0.65	0.52	0.64
Silver (Ag)	mg/kg dw	0.5	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	0.10
Sodium (Na)	mg/kg dw	-	100	152	97	108	118	129	144	87	140	120
Strontium (Sr)	mg/kg dw	-	257	252	220	204	306	151	74.2	78.8	185	216
Sulfur (S)	mg/kg dw	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Thallium (Tl)	mg/kg dw	-	0.067	0.066	0.080	0.089	0.086	0.179	0.122	0.141	0.129	0.137
Tin (Sn)	mg/kg dw	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg dw	-	102	100	109	188	135	65.8	33.6	39.1	72.6	76.7
Tungsten (W)	mg/kg dw	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	mg/kg dw	-	0.552	0.519	0.586	0.679	0.731	0.820	0.708	0.718	0.698	0.671
Vanadium (V)	mg/kg dw	-	11.5	11.5	12.9	13.6	14.6	22.1	18.3	19.6	16.8	18.0
Zinc (Zn)	mg/kg dw	123/315 [b]	47.7	52.4	61.7	59.5	63.6	67.3	50.1	54.4	62.5	66.7
Zirconium (Zr)	mg/kg dw	-	1.5	1.6	1.7	1.6	1.9	1.5	1.5	1.4	1.6	1.2
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	mg/kg dw	0.00671/0.0889 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg dw	0.00587/0.128 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0054	<0.0050	<0.0050	<0.0050
Acridine	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg dw	0.0469/0.245 [b]	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0057	0.0071	0.0064	<0.0040	<0.0040
Benz(a)anthracene	mg/kg dw	0.0317/0.385 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.028	0.073	0.027	<0.010	<0.010
Benzo(a)pyrene	mg/kg dw	0.0319/0.782 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.026	0.089	0.025	<0.010	<0.010
Benzo(b&j)fluoranthene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.044	0.131	0.043	0.012	0.014
Benzo(e)pyrene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.022	0.061	0.022	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg dw	0.17/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	0.038	0.012	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg dw	0.24/13.4 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	0.040	0.012	<0.010	<0.010
Chrysene	mg/kg dw	0.0571/0.862 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.037	0.077	0.034	0.012	0.012
Dibenz(a,h)anthracene	mg/kg dw	0.00622/0.135 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0143	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg dw	0.111/2.355 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.033	0.040	0.029	<0.010	0.011
Fluorene	mg/kg dw	0.021/0.144 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg dw	0.2/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	0.040	0.012	<0.010	<0.010
1-Methylnaphthalene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.030	0.032	0.036	0.014	0.013
2-Methylnaphthalene	mg/kg dw	0.0202/0.201 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.051	0.054	0.060	0.026	0.025
Naphthalene	mg/kg dw	0.0346/0.391 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.021	0.027	0.025	0.011	0.011
Perylene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	0.037	0.018	0.013	<0.010
Phenanthrene	mg/kg dw	0.0419/0.515 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.054	0.047	0.058	0.020	0.023
Pyrene	mg/kg dw	0.053/0.875 [b]	<0.010	<0.010	<0.010	<0.010	<0.010	0.029	0.040	0.024	<0.010	<0.010
Quinoline	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
d10-Acenaphthene	%	-	67.4	63.4	72.6	64.5	70.4	64	62	66.6	84.7	69.6
d12-Chrysene	%	-	86.2	88.3	85.6	76.7	93.2	88.5	79.3	92.5	95.5	84.5
d8-Naphthalene	%	-	63.8	61	69.3	60.4	66.4	57.6	57.3	62	83.3	65.4
d10-Phenanthrene	%	-	77	76	77.3	66.1	82.4	79	67.2	81.9	80.8	77.3
B(a)P Total Potency Equivalent	mg/kg dw	-	<0.020	<0.020	<0.020	<0.020	<0.020	0.039	0.133	0.037	<0.020	<0.020
IACR (CCME)	mg/kg dw	-	<0.15	<0.15	<0.15	<0.15	<0.15	0.56	1.65	0.52	0.15	0.16

Note: Shaded values were above the lower guidelines (ISQG[b] or LEL[c]). No values exceeded the upper (PEL[b] or SEL[c]) guidelines.

[a] Working sediment quality guidelines (BC MOE 2015).

[b] Interim Sediment Quality Guideline (ISQG; or Threshold Effect Level [LEL])/ Probable Effect Level (PEL).

[c] Lowest Effect Level (LEL)/ Severe Effect Level (SEL).

[d] Gravel = >2.0 mm; Sand = 0.063 to 2.0 mm; Silt = 0.004 to 0.063 mm; Clay = <0.004 mm.

[e] TOC = Total Organic Carbon.

Table B.4: Littoral Sediment Quality in Koocanusa Reservoir, April 2018

Analytes	Units	BC Sediment Quality Guidelines [a]	Downstream of Elk River (RG_GC)				
			GC-1	GC-2	GC-3	GC-4	GC-5
Non-metals							
Moisture	%	-	40.3	41.8	44.3	38.6	43.2
pH (1:2 soil:water)	pH	-	8.08	8.04	8.18	8.23	8.12
Particle size[d]							
% Gravel	%	-	<1.0	<1.0	<1.0	<1.0	<1.0
% Sand	%	-	7.40	1.60	18.7	29.8	6.10
% Silt	%	-	77.3	77.6	65.1	63.0	75.3
% Clay	%	-	15.1	20.1	15.6	6.3	17.9
Carbon							
TOC[e]	%	-	1.76	1.69	1.24	1.66	1.90
Metals (< 1mm fraction)							
Aluminum (Al)	mg/kg dw	-	11,100	14,200	9,870	14,000	12,900
Antimony (Sb)	mg/kg dw	-	0.28	0.34	0.27	0.36	0.31
Arsenic (As)	mg/kg dw	5.9/17 [b]	4.09	5.52	2.68	5.40	5.20
Barium (Ba)	mg/kg dw	-	117	157	105	138	135
Beryllium (Be)	mg/kg dw	-	0.48	0.57	0.36	0.53	0.51
Bismuth (Bi)	mg/kg dw	-	<0.20	0.21	<0.20	0.21	<0.20
Boron (B)	mg/kg dw	-	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg dw	0.6/3.5 [b]	0.145	0.216	0.088	0.270	0.164
Calcium (Ca)	mg/kg dw	-	48,300	76,200	26,400	106,000	51,500
Chromium (Cr)	mg/kg dw	37.3/90 [b]	12.8	16.9	10.5	18.5	14.1
Cobalt (Co)	mg/kg dw	-	7.51	8.74	6.73	9.28	8.43
Copper (Cu)	mg/kg dw	35.7/197 [b]	12.5	15.2	10.19	15.3	13.7
Iron (Fe)	mg/kg dw	21,200/43,766 [c]	17,700	20,700	14,950	22,500	19,900
Lead (Pb)	mg/kg dw	35/91 [b]	7.90	10.9	6.08	13.3	8.93
Lithium (Li)	mg/kg dw	-	17.2	22.0	13.7	25.9	19.0
Magnesium (Mg)	mg/kg dw	-	14,100	17,900	12,050	21,100	16,100
Manganese (Mn)	mg/kg dw	460/1,100 [c]	460	601	250	556	455
Mercury (Hg)	mg/kg dw	0.170/0.486 [b]	0.0412	0.0347	0.0623	0.0257	0.0388
Molybdenum (Mo)	mg/kg dw	-	0.33	0.51	0.18	0.68	0.35
Nickel (Ni)	mg/kg dw	16/75 [c]	13.7	17.8	11.3	20.8	15.6
Phosphorus (P)	mg/kg dw	-	546	696	531	567	637
Potassium (K)	mg/kg dw	-	1,170	1,560	880	1,640	1,290
Selenium (Se)	mg/kg dw	2	0.38	0.38	0.21	0.38	0.40
Silver (Ag)	mg/kg dw	0.5	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg dw	-	103	157	61	157	109
Strontium (Sr)	mg/kg dw	-	151	141	35.9	233	93.6
Sulfur (S)	mg/kg dw	-	<1,000	<1,000	<1,000	<1,000	<1,000
Thallium (Tl)	mg/kg dw	-	0.077	0.112	0.058	0.122	0.084
Tin (Sn)	mg/kg dw	-	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg dw	-	190	191	204	152	180
Tungsten (W)	mg/kg dw	-	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	mg/kg dw	-	0.623	0.769	0.595	0.766	0.641
Vanadium (V)	mg/kg dw	-	14.5	18.4	12.8	18.1	15.5
Zinc (Zn)	mg/kg dw	123/315 [b]	32.9	47.3	22.4	62.6	37.9
Zirconium (Zr)	mg/kg dw	-	1.5	2.2	1.8	2.2	1.8
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg dw	0.00671/0.0889 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg dw	0.00587/0.128 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acridine	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg dw	0.0469/0.245 [b]	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg dw	0.0317/0.385 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg dw	0.0319/0.782 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(e)pyrene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg dw	0.17/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg dw	0.24/13.4 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg dw	0.0571/0.862 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg dw	0.00622/0.135 [b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg dw	0.111/2.355 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg dw	0.021/0.144 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg dw	0.2/3.2 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg dw	0.0202/0.201 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg dw	0.0346/0.391 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Perylene	mg/kg dw	-	<0.010	<0.010	0.014	<0.010	<0.010
Phenanthrene	mg/kg dw	0.0419/0.515 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg dw	0.053/0.875 [b]	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	mg/kg dw	-	<0.010	<0.010	<0.010	<0.010	<0.010
d10-Acenaphthene	%	-	68.6	64.8	67.5	65.7	76.6
d12-Chrysene	%	-	89.4	80.9	90.4	89.2	90.4
d8-Naphthalene	%	-	64.4	61.5	63.9	62.7	73.8
d10-Phenanthrene	%	-	82.4	68.9	78.15	71.5	86.7
B(a)P Total Potency Equivalent	mg/kg dw	-	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	mg/kg dw	-	<0.15	<0.15	<0.15	<0.15	<0.15

Note: Shaded values were above the lower guidelines (ISQG[b] or LEL[c]). No values exceeded the upper (PEL[b] or SEL[c]) guidelines.

[a] Working sediment quality guidelines (BC MOE 2015).

[b] Interim Sediment Quality Guideline (ISQG; or Threshold Effect Level [LEL])/ Probable Effect Level (PEL).

[c] Lowest Effect Level (LEL)/ Severe Effect Level (SEL).

[d] Gravel = >2.0 mm; Sand = 0.063 to 2.0 mm; Silt = 0.004 to 0.063 mm; Clay = <0.004 mm.

[e] TOC = Total Organic Carbon.

Table B.5: Statistical Comparisons of Concentrations of Metals and PAHs in Sediment Among Areas for Area Downstream (RG_T4) Relative to Upstream (RG_TN) of the Elk River, August 2018

Parameter	Test[a]	P-value	Magnitude of Difference for RG_T4 Relative to RG_TN (%)[b]
% Moisture	t	0.140	-
pH (1:2 soil:water)	t_{log}	0.260	-
% Gravel	nt	-	-
% Sand	Wilcoxon	0.163	-
% Silt	t	0.463	-
% Clay	t_{log}	0.002	100
TOC	t_{log}	0.286	-
Aluminum	t	0.132	-
Antimony	t_{log}	<0.001	49
Arsenic	t	0.030	8.6
Barium	t	<0.001	116
Beryllium	t	<0.001	46
Bismuth	Wilcoxon	0.317	-
Boron	nt	-	-
Cadmium	t_{log}	<0.001	191
Calcium	t_{log}	0.018	10
Chromium	t	0.007	17
Cobalt	t_{log}	0.021	13
Copper	t_{log}	0.081	-
Iron	t_{log}	0.016	11
Lead	t_{log}	0.684	-
Lithium	t	0.121	-
Magnesium	t_{log}	0.323	-
Manganese	t	<0.001	38
Mercury	t	0.002	88
Molybdenum	t_{log}	<0.001	62
Nickel	t_{log}	0.001	26
Phosphorus	t_{log}	0.001	32
Potassium	t_{log}	<0.001	47
Selenium	Wilcoxon	0.004	>158
Silver	Wilcoxon	0.134	-
Sodium	t_{log}	0.001	17
Strontium	t_{log}	0.837	-
Sulfur	nt	-	-
Thallium	t	<0.001	70
Tin	nt	-	-
Titanium	t	0.001	-38
Tungsten	nt	-	-
Uranium	t	0.167	-
Vanadium	t	<0.001	42
Zinc	t_{log}	0.001	23
Zirconium	Wilcoxon	0.020	19
Acenaphthene	nt	-	-
Acenaphthylene	nt	-	-
Acridine	nt	-	-
Anthracene	nt	-	-
Benz(a)anthracene	Wilcoxon	0.136	-
Benzo(a)pyrene	nt	-	-
Benzo(b&j)fluoranthene	Wilcoxon	0.016	>50
Benzo(e)pyrene	Wilcoxon	0.052	-

Table B.5: Statistical Comparisons of Concentrations of Metals and PAHs in Sediment Among Areas for Area Downstream (RG_T4) Relative to Upstream (RG_TN) of the Elk River, August 2018

Parameter	Test[a]	P-value	Magnitude of Difference for RG_T4 Relative to RG_TN (%)[b]
Benzo(g,h,i)perylene	Wilcoxon	0.317	-
Benzo(k)fluoranthene	nt	-	-
Chrysene	Wilcoxon	0.094	-
Dibenz(a,h)anthracene	Wilcoxon	0.317	-
Fluoranthene	Wilcoxon	0.017	>40
Fluorene	nt	-	-
Indeno(1,2,3-c,d)pyrene	nt	-	-
1-Methylnaphthalene	Wilcoxon	0.017	>130
2-Methylnaphthalene	Wilcoxon	0.004	>300
Naphthalene	Wilcoxon	0.017	>40
Perylene	Wilcoxon	0.052	-
Phenanthrene	Wilcoxon	0.004	>290
Pyrene	Wilcoxon	0.017	>10
Quinoline	nt	-	-
d10-Acenaphthene	t	0.898	-
d12-Chrysene	MW	0.075	-
d8-Naphthalene	t	0.891	-
d10-Phenanthrene	t	0.660	-
B(a)P Total Potency Equivalent	nt	-	-
IACR (CCME)	Wilcoxon	0.016	>20

▨ P-value < 0.05

🟦 Comparison to Upstream (RG_TN) is significant ($\alpha = 0.05$) and magnitude of difference is positive

🟩 Comparison to Upstream (RG_TN) is significant ($\alpha = 0.05$) and magnitude of difference is negative

Notes: nt = not tested; ns = not significant, LRL = laboratory reporting limit.

[a] nt = not tested because all values were reported below the LRL; t = two-sample t-test; log = log10-transformation; MW = Mann-Whitney; Wilcoxon = Wilcoxon score test.

[b] Magnitude of difference calculated as $(MCT_{downstream} - MCT_{upstream})/(MCT_{upstream}) \times 100\%$, where MCT is the measure of central tendency = mean (ANOVA), geometric mean ($ANOVA_{log}$), median (Wilcoxon or KW

Table B.6: Statistical Comparisons of Concentrations of Metals and PAHs in Sediment Among Areas for Sand Creek (RG_SC: Upstream), Elk River (RG_ER: Downstream), and Gold Creek (RG_GC: Downstream), April 2018

Parameter	Test[a]	P-value	Pairwise Comparisons Among Areas[b]			Magnitude of Difference Relative to Reference (RG_SC) (%)[c]	
			RG_SC	RG_ER	RG_GC	RG_ER	RG_GC
% Moisture	ANOVA	0.105	A	A	A	-	-
pH (1:2 soil:water)	ANOVA$_{log}$	0.173	A	A	A	-	-
% Gravel	Wilcoxon	0.024	A	A	A	-	-
% Sand	ANOVA	0.353	A	A	A	-	-
% Silt	ANOVA	0.229	A	A	A	-	-
% Clay	ANOVA$_{log}$	0.604	A	A	A	-	-
TOC	ANOVA	0.019	B	A	AB	39	-
Aluminum	ANOVA$_{log}$	0.087	A	A	A	-	-
Antimony	ANOVA$_{log}$	0.004	B	A	B	44	-
Arsenic	ANOVA	0.385	A	A	A	-	-
Barium	ANOVA	<0.001	B	A	A	114	76
Beryllium	ANOVA	0.024	B	A	AB	32	-
Bismuth	Wilcoxon	0.377	A	A	A	-	-
Boron	Wilcoxon	0.003	A	A	A	-	-
Cadmium	ANOVA$_{log}$	<0.001	B	A	B	194	-
Calcium	ANOVA	0.016	A	AB	B	-	-43
Chromium	ANOVA$_{log}$	0.634	A	A	A	-	-
Cobalt	ANOVA$_{log}$	0.077	A	A	A	-	-
Copper	ANOVA$_{log}$	0.774	A	A	A	-	-
Iron	ANOVA	0.085	A	A	A	-	-
Lead	ANOVA$_{log}$	0.044	A	AB	B	-	-38
Lithium	ANOVA	0.284	A	A	A	-	-
Magnesium	ANOVA	0.070	A	A	A	-	-
Manganese	ANOVA	0.748	A	A	A	-	-
Mercury	ANOVA$_{log}$	<0.001	C	B	A	89	193
Molybdenum	KW	0.006	AB	A	B	-	-
Nickel	ANOVA	0.723	A	A	A	-	-
Phosphorus	ANOVA	0.001	B	A	B	66	-
Potassium	ANOVA$_{log}$	0.009	B	A	A	55	52
Selenium	Wilcoxon	<0.001	C	A	B	220	90
Silver	Wilcoxon	0.108	A	A	A	-	-
Sodium	ANOVA	0.886	A	A	A	-	-
Strontium	ANOVA	0.017	A	B	B	-43	-47
Sulfur	nt	-	A	A	A	-	-
Thallium	ANOVA$_{log}$	0.002	B	A	B	82	-
Tin	nt	-	A	A	A	-	-
Titanium	ANOVA$_{log}$	<0.001	A	B	A	-56	-
Tungsten	nt	-	A	A	A	-	-
Uranium	ANOVA$_{log}$	0.107	A	A	A	-	-
Vanadium	ANOVA	0.001	B	A	AB	48	-
Zinc	ANOVA	0.027	AB	A	B	-	-
Zirconium	ANOVA	0.021	AB	B	A	-	-
Acenaphthene	nt	-	A	A	A	-	-
Acenaphthylene	Wilcoxon	0.368	A	A	A	-	-
Acridine	nt	-	A	A	A	-	-
Anthracene	Wilcoxon	0.024	A	A	A	-	-
Benz(a)anthracene	Wilcoxon	0.024	A	A	A	-	-
Benzo(a)pyrene	Wilcoxon	0.024	A	A	A	-	-
Benzo(b&j)fluoranthene	Wilcoxon	<0.001	B	A	B	>330	-
Benzo(e)pyrene	Wilcoxon	0.026	A	A	A	-	-
Benzo(g,h,i)perylene	Wilcoxon	0.024	A	A	A	-	-

Table B.6: Statistical Comparisons of Concentrations of Metals and PAHs in Sediment Among Areas for Sand Creek (RG_SC: Upstream), Elk River (RG_ER: Downstream), and Gold Creek (RG_GC: Downstream), April 2018

Parameter	Test[a]	P-value	Pairwise Comparisons Among Areas[b]			Magnitude of Difference Relative to Reference (RG_SC) (%)[c]	
			RG_SC	RG_ER	RG_GC	RG_ER	RG_GC
Benzo(k)fluoranthene	Wilcoxon	0.024	A	A	A	-	-
Chrysene	Wilcoxon	<0.001	B	A	B	>240	-
Dibenz(a,h)anthracene	Wilcoxon	0.368	A	A	A	-	-
Fluoranthene	Wilcoxon	0.003	A	A	A	-	-
Fluorene	nt	-	A	A	A	-	-
Indeno(1,2,3-c,d)pyrene	Wilcoxon	0.024	A	A	A	-	-
1-Methylnaphthalene	Wilcoxon	<0.001	B	A	B	>200	-
2-Methylnaphthalene	Wilcoxon	<0.001	B	A	B	>410	-
Naphthalene	Wilcoxon	<0.001	B	A	B	>110	-
Perylene	Wilcoxon	0.012	A	A	A	-	-
Phenanthrene	Wilcoxon	<0.001	B	A	B	>370	-
Pyrene	Wilcoxon	0.024	A	A	A	-	-
Quinoline	nt	-	A	A	A	-	-
d10-Acenaphthene	$\text{ANOVA}_{\text{log}}$	0.933	A	A	A	-	-
d12-Chrysene	ANOVA	0.800	A	A	A	-	-
d8-Naphthalene	KW	0.779	A	A	A	-	-
d10-Phenanthrene	ANOVA	0.898	A	A	A	-	-
B(a)P Total Potency Equivalent	Wilcoxon	0.024	A	A	A	-	-
IACR (CCME)	Wilcoxon	<0.001	B	A	B	>247	-

▨ P-value < 0.05

🟦 Comparison to Upstream (RG_SC) is significant (α = 0.05) and magnitude of difference is positive

🟩 Comparison to Upstream (RG_SC) is significant (α = 0.05) and magnitude of difference is negative

Notes: nt = not tested; ns = not significant, LRL = laboratory reporting limit.

[a] nt = not tested because all values were reported below the LRL; ANOVA = analysis of variance; log = log10-transformation; KW = Kruskal-Wallis test; Wilcoxon = Wilcoxon score test.

[b] Areas that share a letter (e.g., A,B,C) do not differ significantly among areas. Letters are assigned such that A is assigned to the area with the highest concentration.

[c] Magnitude of difference calculated as $(\text{MCT}_{\text{downstream}} - \text{MCT}_{\text{upstream}})/(\text{MCT}_{\text{upstream}})\times 100\%$, where MCT is the measure of central tendency = mean (ANOVA), geometric mean ($\text{ANOVA}_{\text{log}}$), median (Wilcoxon or KW tests).

Teck Coal Ltd.
ATTN: Lee Wilm
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 02-MAY-18
Report Date: 11-MAY-18 12:48 (MT)
Version: FINAL

Client Phone: 250-425-5289

Certificate of Analysis

Lab Work Order #: L2089149
Project P.O. #: VPO00563596
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: REP-2018-05-01
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2089149-1	L2089149-2	L2089149-3	L2089149-4	L2089149-5
	Description	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	28-APR-18
	Sampled Time	13:00	13:45	14:30	15:45	12:30
	Client ID	RG_SC_01_SS_20 180427-1300	RG_SC_02_SS_20 180427-1345	RG_SC_03_SS_20 180427-1430	RG_SC_04_SS_20 180427-1545	RG_SC_05_SS_20 180428-1230
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	29.6	31.9	37.1	42.6	40.9
	pH (1:2 soil:water) (pH)	8.45	8.31	8.05	8.25	8.16
Particle Size	% Gravel (>2mm) (%)	<1.0	1.3	2.8	1.4	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	1.8	<1.0
	% Sand (1.00mm - 0.50mm) (%)	1.3	6.6	1.6	9.3	<1.0
	% Sand (0.50mm - 0.25mm) (%)	3.7	11.1	5.2	22.7	3.0
	% Sand (0.25mm - 0.125mm) (%)	25.0	2.6	8.1	7.7	<1.0
	% Sand (0.125mm - 0.063mm) (%)	13.2	9.3	12.4	5.7	2.8
	% Silt (0.063mm - 0.0312mm) (%)	14.0	15.1	22.4	14.3	16.2
	% Silt (0.0312mm - 0.004mm) (%)	32.1	40.5	37.3	28.6	57.2
	% Clay (<4um) (%)	10.6	13.2	9.8	8.6	19.7
	Texture	Sandy loam	Silt loam	Silt loam	Sandy loam	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.76	1.07	1.67	1.18	1.1
Metals	Aluminum (Al) (mg/kg)	9820	9760	10500	10500	13000
	Antimony (Sb) (mg/kg)	0.23	0.24	0.36	0.29	0.30
	Arsenic (As) (mg/kg)	4.73	4.53	6.09	5.70	5.68
	Barium (Ba) (mg/kg)	61.3	70.5	68.9	71.5	97.0
	Beryllium (Be) (mg/kg)	0.33	0.34	0.38	0.41	0.46
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	0.22	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.136	0.147	0.198	0.187	0.196
	Calcium (Ca) (mg/kg)	105000	107000	102000	105000	122000
	Chromium (Cr) (mg/kg)	14.0	14.6	15.3	16.0	18.0
	Cobalt (Co) (mg/kg)	6.97	6.97	7.63	7.98	9.09
	Copper (Cu) (mg/kg)	10.9	10.6	13.4	13.2	14.7
	Iron (Fe) (mg/kg)	18100	17900	19900	19200	22300
	Lead (Pb) (mg/kg)	10.9	13.2	22.1	14.0	15.1
	Lithium (Li) (mg/kg)	20.5	20.4	21.8	22.0	26.9
	Magnesium (Mg) (mg/kg)	20300	20400	21700	20500	24000
	Manganese (Mn) (mg/kg)	376	422	447	435	530
	Mercury (Hg) (mg/kg)	0.0110	0.0120	0.0140	0.0148	0.0151
	Molybdenum (Mo) (mg/kg)	0.51	0.54	0.56	0.59	0.63
	Nickel (Ni) (mg/kg)	15.7	15.9	17.1	17.5	20.5
	Phosphorus (P) (mg/kg)	468	406	534	528	515
	Potassium (K) (mg/kg)	660	770	800	890	1150
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.22	0.20	0.21
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10

	Sample ID	L2089149-6	L2089149-7	L2089149-8	L2089149-9	L2089149-10
	Description	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	12:00	13:00	13:10	14:30	15:30
	Client ID	RG_ER_01_SS_20180427-1200	RG_ER_02_SS_20180427-1300	RG_ER_03_SS_20180427-1310	RG_ER_04_SS_20180427-1430	RG_ER_05_SS_20180427-1530
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	49.9	40.5	39.4	41.3	39.9
	pH (1:2 soil:water) (pH)	8.19	8.49	8.35	8.17	8.21
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	1.9	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	4.0	<1.0	1.3	1.2
	% Sand (0.50mm - 0.25mm) (%)	<1.0	25.5	3.1	2.0	1.2
	% Sand (0.25mm - 0.125mm) (%)	1.5	24.9	22.3	3.6	<1.0
	% Sand (0.125mm - 0.063mm) (%)	7.7	16.5	28.1	3.9	1.4
	% Silt (0.063mm - 0.0312mm) (%)	22.6	11.8	20.8	16.3	19.7
	% Silt (0.0312mm - 0.004mm) (%)	50.8	12.0	21.1	52.7	56.2
	% Clay (<4um) (%)	15.7	3.2	4.6	19.2	18.0
	Texture	Silt loam / Silt	Loamy sand	Sandy loam	Silt loam	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.83	1.98	1.99	1.90	1.7
Metals	Aluminum (Al) (mg/kg)	11000	8260	7440	9830	12100
	Antimony (Sb) (mg/kg)	0.46	0.40	0.41	0.36	0.39
	Arsenic (As) (mg/kg)	5.64	4.62	4.59	4.82	5.55
	Barium (Ba) (mg/kg)	206	131	166	137	151
	Beryllium (Be) (mg/kg)	0.61	0.47	0.47	0.48	0.51
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	6.9	5.8	5.4	<5.0	5.1
	Cadmium (Cd) (mg/kg)	0.688	0.457	0.516	0.438	0.447
	Calcium (Ca) (mg/kg)	84200	55600	57700	91400	102000
	Chromium (Cr) (mg/kg)	16.3	11.5	11.8	14.9	16.6
	Cobalt (Co) (mg/kg)	7.33	4.46	4.75	7.07	7.97
	Copper (Cu) (mg/kg)	15.1	8.91	9.94	13.4	14.9
	Iron (Fe) (mg/kg)	17600	12900	12600	16900	19100
	Lead (Pb) (mg/kg)	11.5	7.15	7.43	12.1	12.8
	Lithium (Li) (mg/kg)	20.0	14.4	13.4	20.1	23.3
	Magnesium (Mg) (mg/kg)	21100	13200	14600	19600	22000
	Manganese (Mn) (mg/kg)	502	264	310	457	525
	Mercury (Hg) (mg/kg)	0.0330	0.0214	0.0221	0.0265	0.0238
	Molybdenum (Mo) (mg/kg)	0.87	0.70	0.78	0.69	0.77
	Nickel (Ni) (mg/kg)	19.2	13.2	14.0	17.4	19.5
	Phosphorus (P) (mg/kg)	922	874	967	619	690
	Potassium (K) (mg/kg)	1650	1170	1160	1210	1390
	Selenium (Se) (mg/kg)	0.96	0.56	0.65	0.52	0.64
	Silver (Ag) (mg/kg)	0.13	<0.10	<0.10	<0.10	0.10

	Sample ID	L2089149-11	L2089149-12	L2089149-13	L2089149-14	L2089149-15
	Description	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	28-APR-18
	Sampled Time	12:45	13:00	13:15	13:16	13:30
	Client ID	RG_GC_01_SS_20180427-1245	RG_GC_02_SS_20180427-1300	RG_GC_03_SS_20180427-1315	RG_GC_03_SS_20180427-1316	RG_GC_04_SS_20180428-1330
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	40.3	41.8	44.1	44.5	38.6
	pH (1:2 soil:water) (pH)	8.08	8.04	8.17	8.18	8.23
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	1.4	<1.0	<1.0	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	1.6	<1.0	4.7	<1.0	4.6
	% Sand (0.125mm - 0.063mm) (%)	4.4	1.6	31.7	<1.0	25.2
	% Silt (0.063mm - 0.0312mm) (%)	25.6	20.4	27.5	11.5	29.8
	% Silt (0.0312mm - 0.004mm) (%)	51.7	57.2	28.0	63.1	33.2
	% Clay (<4um) (%)	15.1	20.1	6.3	24.9	6.3
	Texture	Silt	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.76	1.69	1.28	1.20	1.66
Metals	Aluminum (Al) (mg/kg)	11100	14200	9640	10100	14000
	Antimony (Sb) (mg/kg)	0.28	0.34	0.28	0.26	0.36
	Arsenic (As) (mg/kg)	4.09	5.52	2.63	2.73	5.40
	Barium (Ba) (mg/kg)	117	157	103	106	138
	Beryllium (Be) (mg/kg)	0.48	0.57	0.34	0.37	0.53
	Bismuth (Bi) (mg/kg)	<0.20	0.21	<0.20	<0.20	0.21
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.145	0.216	0.087	0.088	0.270
	Calcium (Ca) (mg/kg)	48300	76200	24900	27900	106000
	Chromium (Cr) (mg/kg)	12.8	16.9	10.3	10.7	18.5
	Cobalt (Co) (mg/kg)	7.51	8.74	6.81	6.65	9.28
	Copper (Cu) (mg/kg)	12.5	15.2	10.4	9.98	15.3
	Iron (Fe) (mg/kg)	17700	20700	15000	14900	22500
	Lead (Pb) (mg/kg)	7.90	10.9	6.05	6.11	13.3
	Lithium (Li) (mg/kg)	17.2	22.0	13.5	13.8	25.9
	Magnesium (Mg) (mg/kg)	14100	17900	11800	12300	21100
	Manganese (Mn) (mg/kg)	460	601	246	253	556
	Mercury (Hg) (mg/kg)	0.0412	0.0347	0.0960	0.0286	0.0257
	Molybdenum (Mo) (mg/kg)	0.33	0.51	0.17	0.19	0.68
	Nickel (Ni) (mg/kg)	13.7	17.8	11.2	11.3	20.8
	Phosphorus (P) (mg/kg)	546	696	528	534	567
	Potassium (K) (mg/kg)	1170	1560	840	920	1640
	Selenium (Se) (mg/kg)	0.38	0.38	0.22	<0.20	0.38
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10

	Sample ID	L2089149-16
	Description	SEDIMENT
	Sampled Date	28-APR-18
	Sampled Time	13:45
	Client ID	RG_GC_05_SS_20 180428-1345
Grouping	**Analyte**	
SOIL		
Physical Tests	Moisture (%)	43.2
	pH (1:2 soil:water) (pH)	8.12
Particle Size	% Gravel (>2mm) (%)	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0
	% Sand (0.25mm - 0.125mm) (%)	1.6
	% Sand (0.125mm - 0.063mm) (%)	4.5
	% Silt (0.063mm - 0.0312mm) (%)	19.6
	% Silt (0.0312mm - 0.004mm) (%)	55.7
	% Clay (<4um) (%)	17.9
	Texture	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.90
Metals	Aluminum (Al) (mg/kg)	12900
	Antimony (Sb) (mg/kg)	0.31
	Arsenic (As) (mg/kg)	5.20
	Barium (Ba) (mg/kg)	135
	Beryllium (Be) (mg/kg)	0.51
	Bismuth (Bi) (mg/kg)	<0.20
	Boron (B) (mg/kg)	<5.0
	Cadmium (Cd) (mg/kg)	0.164
	Calcium (Ca) (mg/kg)	51500
	Chromium (Cr) (mg/kg)	14.1
	Cobalt (Co) (mg/kg)	8.43
	Copper (Cu) (mg/kg)	13.7
	Iron (Fe) (mg/kg)	19900
	Lead (Pb) (mg/kg)	8.93
	Lithium (Li) (mg/kg)	19.0
	Magnesium (Mg) (mg/kg)	16100
	Manganese (Mn) (mg/kg)	455
	Mercury (Hg) (mg/kg)	0.0388
	Molybdenum (Mo) (mg/kg)	0.35
	Nickel (Ni) (mg/kg)	15.6
	Phosphorus (P) (mg/kg)	637
	Potassium (K) (mg/kg)	1290
	Selenium (Se) (mg/kg)	0.40
	Silver (Ag) (mg/kg)	<0.10

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**	L2089149-1 SEDIMENT 27-APR-18 13:00 RG_SC_01_SS_20 180427-1300	L2089149-2 SEDIMENT 27-APR-18 13:45 RG_SC_02_SS_20 180427-1345	L2089149-3 SEDIMENT 27-APR-18 14:30 RG_SC_03_SS_20 180427-1430	L2089149-4 SEDIMENT 27-APR-18 15:45 RG_SC_04_SS_20 180427-1545	L2089149-5 SEDIMENT 28-APR-18 12:30 RG_SC_05_SS_20 180428-1230
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	100	152	97	108	118
	Strontium (Sr) (mg/kg)	257	252	220	204	306
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.067	0.066	0.080	0.089	0.086
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	102	100	109	188	135
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.552	0.519	0.586	0.679	0.731
	Vanadium (V) (mg/kg)	11.5	11.5	12.9	13.6	14.6
	Zinc (Zn) (mg/kg)	47.7	52.4	61.7	59.5	63.6
	Zirconium (Zr) (mg/kg)	1.5	1.6	1.7	1.6	1.9
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	<0.010	<0.010
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	67.4	63.4	72.6	64.5	70.4
	Surrogate: d12-Chrysene (%)	86.2	88.3	85.6	76.7	93.2
	Surrogate: d8-Naphthalene (%)	63.8	61.0	69.3	60.4	66.4

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2089149-6	L2089149-7	L2089149-8	L2089149-9	L2089149-10
	Description	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	12:00	13:00	13:10	14:30	15:30
	Client ID	RG_ER_01_SS_20180427-1200	RG_ER_02_SS_20180427-1300	RG_ER_03_SS_20180427-1310	RG_ER_04_SS_20180427-1430	RG_ER_05_SS_20180427-1530
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	129	144	87	140	120
	Strontium (Sr) (mg/kg)	151	74.2	78.8	185	216
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.179	0.122	0.141	0.129	0.137
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	65.8	33.6	39.1	72.6	76.7
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.820	0.708	0.718	0.698	0.671
	Vanadium (V) (mg/kg)	22.1	18.3	19.6	16.8	18.0
	Zinc (Zn) (mg/kg)	67.3	50.1	54.4	62.5	66.7
	Zirconium (Zr) (mg/kg)	1.5	1.5	1.4	1.6	1.2
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	0.0054	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Anthracene (mg/kg)	0.0057	0.0071	0.0064	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	0.028	0.073	0.027	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	0.026	0.089	0.025	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	0.044	0.131	0.043	0.012	0.014
	Benzo(e)pyrene (mg/kg)	0.022	0.061	0.022	<0.010	<0.010
	Benzo(g,h,i)perylene (mg/kg)	0.014	0.038	0.012	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	0.015	0.040	0.012	<0.010	<0.010
	Chrysene (mg/kg)	0.037	0.077	0.034	0.012	0.012
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	0.0143	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	0.033	0.040	0.029	<0.010	0.011
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	0.013	0.040	0.012	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	0.030	0.032	0.036	0.014	0.013
	2-Methylnaphthalene (mg/kg)	0.051	0.054	0.060	0.026	0.025
	Naphthalene (mg/kg)	0.021	0.027	0.025	0.011	0.011
	Perylene (mg/kg)	0.019	0.037	0.018	0.013	<0.010
	Phenanthrene (mg/kg)	0.054	0.047	0.058	0.020	0.023
	Pyrene (mg/kg)	0.029	0.040	0.024	<0.010	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	64.0	62.0	66.6	84.7	69.6
	Surrogate: d12-Chrysene (%)	88.5	79.3	92.5	95.5	84.5
	Surrogate: d8-Naphthalene (%)	57.6	57.3	62.0	83.3	65.4

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**	L2089149-11 SEDIMENT 27-APR-18 12:45 RG_GC_01_SS_20 180427-1245	L2089149-12 SEDIMENT 27-APR-18 13:00 RG_GC_02_SS_20 180427-1300	L2089149-13 SEDIMENT 27-APR-18 13:15 RG_GC_03_SS_20 180427-1315	L2089149-14 SEDIMENT 27-APR-18 13:16 RG_GC_03_SS_20 180427-1316	L2089149-15 SEDIMENT 28-APR-18 13:30 RG_GC_04_SS_20 180428-1330
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	103	157	58	64	157
	Strontium (Sr) (mg/kg)	151	141	32.0	39.8	233
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.077	0.112	0.058	0.058	0.122
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	190	191	198	209	152
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.623	0.769	0.596	0.593	0.766
	Vanadium (V) (mg/kg)	14.5	18.4	12.5	13.0	18.1
	Zinc (Zn) (mg/kg)	32.9	47.3	21.7	23.1	62.6
	Zirconium (Zr) (mg/kg)	1.5	2.2	1.8	1.7	2.2
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	<0.010	<0.010
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Perylene (mg/kg)	<0.010	<0.010	0.011	0.016	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	68.6	64.8	67.8	67.2	65.7
	Surrogate: d12-Chrysene (%)	89.4	80.9	91.5	89.3	89.2
	Surrogate: d8-Naphthalene (%)	64.4	61.5	63.9	63.9	62.7

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2089149-16				
	Description	SEDIMENT				
	Sampled Date	28-APR-18				
	Sampled Time	13:45				
	Client ID	RG_GC_05_SS_20 180428-1345				
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	109				
	Strontium (Sr) (mg/kg)	93.6				
	Sulfur (S) (mg/kg)	<1000				
	Thallium (Tl) (mg/kg)	0.084				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	180				
	Tungsten (W) (mg/kg)	<0.50				
	Uranium (U) (mg/kg)	0.641				
	Vanadium (V) (mg/kg)	15.5				
	Zinc (Zn) (mg/kg)	37.9				
	Zirconium (Zr) (mg/kg)	1.8				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050				
	Acenaphthylene (mg/kg)	<0.0050				
	Acridine (mg/kg)	<0.010				
	Anthracene (mg/kg)	<0.0040				
	Benz(a)anthracene (mg/kg)	<0.010				
	Benzo(a)pyrene (mg/kg)	<0.010				
	Benzo(b&j)fluoranthene (mg/kg)	<0.010				
	Benzo(e)pyrene (mg/kg)	<0.010				
	Benzo(g,h,i)perylene (mg/kg)	<0.010				
	Benzo(k)fluoranthene (mg/kg)	<0.010				
	Chrysene (mg/kg)	<0.010				
	Dibenz(a,h)anthracene (mg/kg)	<0.0050				
	Fluoranthene (mg/kg)	<0.010				
	Fluorene (mg/kg)	<0.010				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010				
	1-Methylnaphthalene (mg/kg)	<0.010				
	2-Methylnaphthalene (mg/kg)	<0.010				
	Naphthalene (mg/kg)	<0.010				
	Perylene (mg/kg)	<0.010				
	Phenanthrene (mg/kg)	<0.010				
	Pyrene (mg/kg)	<0.010				
	Quinoline (mg/kg)	<0.010				
	Surrogate: d10-Acenaphthene (%)	76.6				
	Surrogate: d12-Chrysene (%)	90.4				
	Surrogate: d8-Naphthalene (%)	73.8				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**	L2089149-1 SEDIMENT 27-APR-18 13:00 RG_SC_01_SS_20 180427-1300	L2089149-2 SEDIMENT 27-APR-18 13:45 RG_SC_02_SS_20 180427-1345	L2089149-3 SEDIMENT 27-APR-18 14:30 RG_SC_03_SS_20 180427-1430	L2089149-4 SEDIMENT 27-APR-18 15:45 RG_SC_04_SS_20 180427-1545	L2089149-5 SEDIMENT 28-APR-18 12:30 RG_SC_05_SS_20 180428-1230
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	77.0	76.0	77.3	66.1	82.4
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15	<0.15	<0.15

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2089149-6	L2089149-7	L2089149-8	L2089149-9	L2089149-10
	Description	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
	Sampled Date	27-APR-18	27-APR-18	27-APR-18	27-APR-18	27-APR-18
	Sampled Time	12:00	13:00	13:10	14:30	15:30
	Client ID	RG_ER_01_SS_20 180427-1200	RG_ER_02_SS_20 180427-1300	RG_ER_03_SS_20 180427-1310	RG_ER_04_SS_20 180427-1430	RG_ER_05_SS_20 180427-1530
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	79.0	67.2	81.9	80.8	77.3
	B(a)P Total Potency Equivalent (mg/kg)	0.039	0.133	0.037	<0.020	<0.020
	IACR (CCME) (mg/kg)	0.56	1.65	0.52	0.15	0.16

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2089149-11 SEDIMENT 27-APR-18 12:45 RG_GC_01_SS_20 180427-1245	L2089149-12 SEDIMENT 27-APR-18 13:00 RG_GC_02_SS_20 180427-1300	L2089149-13 SEDIMENT 27-APR-18 13:15 RG_GC_03_SS_20 180427-1315	L2089149-14 SEDIMENT 27-APR-18 13:16 RG_GC_03_SS_20 180427-1316	L2089149-15 SEDIMENT 28-APR-18 13:30 RG_GC_04_SS_20 180428-1330
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	82.4	68.9	79.8	76.5	71.5
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15	<0.15	<0.15

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2089149-16				
	Description	SEDIMENT				
	Sampled Date	28-APR-18				
	Sampled Time	13:45				
	Client ID	RG_GC_05_SS_20 180428-1345				
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	86.7				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME) (mg/kg)	<0.15				

Reference Information

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 samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

MOISTURE-CL	Soil	% Moisture	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C

PAH-TMB-D/A-MS-CL	Soil	PAH by Tumbler Extraction (DCM/Acetone)	EPA 3570/8270

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 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 DCM 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.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** 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:

REP-2018-05-01

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: L2089149 Report Date: 11-MAY-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Lee Wilm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4037981								
WG2765607-1 DUP		**L2089149-8**						
Inorganic Carbon		2.02	2.07		%	2.3	20	08-MAY-18
WG2765607-2 LCS								
Inorganic Carbon			95.4		%		80-120	08-MAY-18
WG2765607-3 MB								
Inorganic Carbon			<0.050		%		0.05	08-MAY-18
C-TOT-LECO-SK	**Soil**							
Batch R4038126								
WG2765502-1 DUP		**L2089149-8**						
Total Carbon by Combustion		4.01	3.98		%	0.8	20	08-MAY-18
WG2765502-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			93.8		%		80-120	08-MAY-18
WG2765502-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	08-MAY-18
HG-200.2-CVAA-CL	**Soil**							
Batch R4039234								
WG2768129-4 CRM		**TILL-1**						
Mercury (Hg)			85.5		%		70-130	10-MAY-18
WG2768129-5 DUP		**L2089149-7**						
Mercury (Hg)		0.0214	0.0210		mg/kg	1.7	40	10-MAY-18
WG2768129-3 LCS								
Mercury (Hg)			82.4		%		80-120	10-MAY-18
WG2768129-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	10-MAY-18
MET-200.2-CCMS-CL	**Soil**							
Batch R4039135								
WG2768129-4 CRM		**TILL-1**						
Aluminum (Al)			107.9		%		70-130	09-MAY-18
Antimony (Sb)			107.7		%		70-130	09-MAY-18
Arsenic (As)			102.7		%		70-130	09-MAY-18
Barium (Ba)			106.0		%		70-130	09-MAY-18
Beryllium (Be)			107.2		%		70-130	09-MAY-18
Bismuth (Bi)			102.2		%		70-130	09-MAY-18
Boron (B)			6.4		mg/kg		0-8.2	09-MAY-18
Cadmium (Cd)			115.8		%		70-130	09-MAY-18
Calcium (Ca)			104.5		%		70-130	09-MAY-18
Chromium (Cr)			105.5		%		70-130	09-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4039135								
WG2768129-4 CRM		**TILL-1**						
Cobalt (Co)			103.9		%		70-130	09-MAY-18
Copper (Cu)			105.0		%		70-130	09-MAY-18
Iron (Fe)			104.5		%		70-130	09-MAY-18
Lead (Pb)			106.5		%		70-130	09-MAY-18
Lithium (Li)			108.4		%		70-130	09-MAY-18
Magnesium (Mg)			109.6		%		70-130	09-MAY-18
Manganese (Mn)			108.7		%		70-130	09-MAY-18
Molybdenum (Mo)			107.7		%		70-130	09-MAY-18
Nickel (Ni)			104.2		%		70-130	09-MAY-18
Phosphorus (P)			100.1		%		70-130	09-MAY-18
Potassium (K)			105.5		%		70-130	09-MAY-18
Selenium (Se)			0.31		mg/kg		0.11-0.51	09-MAY-18
Silver (Ag)			0.25		mg/kg		0.13-0.33	09-MAY-18
Sodium (Na)			119.2		%		70-130	09-MAY-18
Strontium (Sr)			124.7		%		70-130	09-MAY-18
Thallium (Tl)			0.133		mg/kg		0.077-0.18	09-MAY-18
Tin (Sn)			1.1		mg/kg		0-3.1	09-MAY-18
Titanium (Ti)			119.4		%		70-130	09-MAY-18
Tungsten (W)			0.15		mg/kg		0-0.66	09-MAY-18
Uranium (U)			106.6		%		70-130	09-MAY-18
Vanadium (V)			105.9		%		70-130	09-MAY-18
Zinc (Zn)			95.5		%		70-130	09-MAY-18
Zirconium (Zr)			0.9		mg/kg		0-1.8	09-MAY-18
WG2768129-5 DUP		**L2089149-7**						
Aluminum (Al)		8260	8190		mg/kg	0.9	40	09-MAY-18
Antimony (Sb)		0.40	0.42		mg/kg	4.9	30	09-MAY-18
Arsenic (As)		4.62	4.98		mg/kg	7.4	30	09-MAY-18
Barium (Ba)		131	145		mg/kg	11	40	09-MAY-18
Beryllium (Be)		0.47	0.48		mg/kg	3.0	30	09-MAY-18
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	09-MAY-18
Boron (B)		5.8	6.1		mg/kg	5.5	30	09-MAY-18
Cadmium (Cd)		0.457	0.464		mg/kg	1.7	30	09-MAY-18
Calcium (Ca)		55600	59100		mg/kg	6.1	30	09-MAY-18
Chromium (Cr)		11.5	12.5		mg/kg	7.9	30	09-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4039135								
WG2768129-5 DUP		**L2089149-7**						
Cobalt (Co)		4.46	4.70		mg/kg	5.4	30	09-MAY-18
Copper (Cu)		8.91	9.45		mg/kg	5.8	30	09-MAY-18
Iron (Fe)		12900	13500		mg/kg	4.4	30	09-MAY-18
Lead (Pb)		7.15	7.46		mg/kg	4.3	40	09-MAY-18
Lithium (Li)		14.4	15.2		mg/kg	5.6	30	09-MAY-18
Magnesium (Mg)		13200	13800		mg/kg	4.5	30	09-MAY-18
Manganese (Mn)		264	296		mg/kg	11	30	09-MAY-18
Molybdenum (Mo)		0.70	0.79		mg/kg	11	40	09-MAY-18
Nickel (Ni)		13.2	14.0		mg/kg	5.7	30	09-MAY-18
Phosphorus (P)		874	899		mg/kg	2.8	30	09-MAY-18
Potassium (K)		1170	1240		mg/kg	5.8	40	09-MAY-18
Selenium (Se)		0.56	0.60		mg/kg	6.2	30	09-MAY-18
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	09-MAY-18
Sodium (Na)		144	109		mg/kg	28	40	09-MAY-18
Strontium (Sr)		74.2	74.4		mg/kg	0.4	40	09-MAY-18
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	09-MAY-18
Thallium (Tl)		0.122	0.129		mg/kg	5.4	30	09-MAY-18
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	09-MAY-18
Titanium (Ti)		33.6	39.9		mg/kg	17	40	09-MAY-18
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	09-MAY-18
Uranium (U)		0.708	0.734		mg/kg	3.6	30	09-MAY-18
Vanadium (V)		18.3	19.4		mg/kg	5.8	30	09-MAY-18
Zinc (Zn)		50.1	53.2		mg/kg	5.8	30	09-MAY-18
Zirconium (Zr)		1.5	1.5		mg/kg	0.7	30	09-MAY-18
WG2768129-3 LCS								
Aluminum (Al)			99.4		%		80-120	09-MAY-18
Antimony (Sb)			102.5		%		80-120	09-MAY-18
Arsenic (As)			98.2		%		80-120	09-MAY-18
Barium (Ba)			104.0		%		80-120	09-MAY-18
Beryllium (Be)			100.6		%		80-120	09-MAY-18
Bismuth (Bi)			95.0		%		80-120	09-MAY-18
Boron (B)			93.0		%		80-120	09-MAY-18
Cadmium (Cd)			103.4		%		80-120	09-MAY-18
Calcium (Ca)			89.1		%		80-120	09-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4039135								
WG2768129-3 LCS								
Chromium (Cr)			96.5		%		80-120	09-MAY-18
Cobalt (Co)			97.8		%		80-120	09-MAY-18
Copper (Cu)			96.7		%		80-120	09-MAY-18
Iron (Fe)			98.5		%		80-120	09-MAY-18
Lead (Pb)			94.0		%		80-120	09-MAY-18
Lithium (Li)			97.8		%		80-120	09-MAY-18
Magnesium (Mg)			102.1		%		80-120	09-MAY-18
Manganese (Mn)			98.4		%		80-120	09-MAY-18
Molybdenum (Mo)			96.8		%		80-120	09-MAY-18
Nickel (Ni)			96.4		%		80-120	09-MAY-18
Potassium (K)			95.9		%		80-120	09-MAY-18
Selenium (Se)			99.4		%		80-120	09-MAY-18
Silver (Ag)			99.96		%		80-120	09-MAY-18
Sodium (Na)			97.4		%		80-120	09-MAY-18
Strontium (Sr)			98.3		%		80-120	09-MAY-18
Sulfur (S)			87.7		%		80-120	09-MAY-18
Thallium (Tl)			91.5		%		80-120	09-MAY-18
Tin (Sn)			100.6		%		80-120	09-MAY-18
Titanium (Ti)			107.0		%		80-120	09-MAY-18
Tungsten (W)			95.5		%		80-120	09-MAY-18
Uranium (U)			96.1		%		80-120	09-MAY-18
Vanadium (V)			100.3		%		80-120	09-MAY-18
Zinc (Zn)			86.6		%		80-120	09-MAY-18
Zirconium (Zr)			94.8		%		80-120	09-MAY-18
WG2768129-1 MB								
Aluminum (Al)			<50		mg/kg		50	09-MAY-18
Antimony (Sb)			<0.10		mg/kg		0.1	09-MAY-18
Arsenic (As)			<0.10		mg/kg		0.1	09-MAY-18
Barium (Ba)			<0.50		mg/kg		0.5	09-MAY-18
Beryllium (Be)			<0.10		mg/kg		0.1	09-MAY-18
Bismuth (Bi)			<0.20		mg/kg		0.2	09-MAY-18
Boron (B)			<5.0		mg/kg		5	09-MAY-18
Cadmium (Cd)			<0.020		mg/kg		0.02	09-MAY-18
Calcium (Ca)			<50		mg/kg		50	09-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4039135								
WG2768129-1 MB								
Chromium (Cr)			<0.50		mg/kg		0.5	09-MAY-18
Cobalt (Co)			<0.10		mg/kg		0.1	09-MAY-18
Copper (Cu)			<0.50		mg/kg		0.5	09-MAY-18
Iron (Fe)			<50		mg/kg		50	09-MAY-18
Lead (Pb)			<0.50		mg/kg		0.5	09-MAY-18
Lithium (Li)			<2.0		mg/kg		2	09-MAY-18
Magnesium (Mg)			<20		mg/kg		20	09-MAY-18
Manganese (Mn)			<1.0		mg/kg		1	09-MAY-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	09-MAY-18
Nickel (Ni)			<0.50		mg/kg		0.5	09-MAY-18
Phosphorus (P)			<50		mg/kg		50	09-MAY-18
Potassium (K)			<100		mg/kg		100	09-MAY-18
Selenium (Se)			<0.20		mg/kg		0.2	09-MAY-18
Silver (Ag)			<0.10		mg/kg		0.1	09-MAY-18
Sodium (Na)			<50		mg/kg		50	09-MAY-18
Strontium (Sr)			<0.50		mg/kg		0.5	09-MAY-18
Sulfur (S)			<1000		mg/kg		1000	09-MAY-18
Thallium (Tl)			<0.050		mg/kg		0.05	09-MAY-18
Tin (Sn)			<2.0		mg/kg		2	09-MAY-18
Titanium (Ti)			<1.0		mg/kg		1	09-MAY-18
Tungsten (W)			<0.50		mg/kg		0.5	09-MAY-18
Uranium (U)			<0.050		mg/kg		0.05	09-MAY-18
Vanadium (V)			<0.20		mg/kg		0.2	09-MAY-18
Zinc (Zn)			<2.0		mg/kg		2	09-MAY-18
Zirconium (Zr)			<1.0		mg/kg		1	09-MAY-18
MOISTURE-CL	**Soil**							
Batch R4038658								
WG2767007-2 LCS								
Moisture			106.9		%		90-110	08-MAY-18
WG2767007-1 MB								
Moisture			<0.25		%		0.25	08-MAY-18
PAH-TMB-D/A-MS-CL	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-13 DUP		**L2089149-1**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-MAY-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-MAY-18
Acridine		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Benzo(e)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-MAY-18
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
1-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
Quinoline		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-MAY-18
WG2766584-1 LCS								
Acenaphthene			71.7		%		60-130	07-MAY-18
Acenaphthylene			75.4		%		60-130	07-MAY-18
Acridine			103.5		%		50-150	07-MAY-18
Anthracene			88.7		%		60-130	07-MAY-18
Benz(a)anthracene			100.8		%		60-130	07-MAY-18
Benzo(a)pyrene			100.1		%		60-130	07-MAY-18
Benzo(b&j)fluoranthene			94.0		%		60-130	07-MAY-18
Benzo(g,h,i)perylene			100.9		%		60-130	07-MAY-18
Benzo(k)fluoranthene			101.5		%		60-130	07-MAY-18
Benzo(e)pyrene			98.6		%		50-150	07-MAY-18
Chrysene			101.7		%		60-130	07-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-1 LCS								
Dibenz(a,h)anthracene			97.7		%		60-130	07-MAY-18
Fluoranthene			94.4		%		60-130	07-MAY-18
Fluorene			77.8		%		60-130	07-MAY-18
Indeno(1,2,3-c,d)pyrene			83.9		%		60-130	07-MAY-18
1-Methylnaphthalene			70.2		%		50-150	07-MAY-18
2-Methylnaphthalene			69.7		%		60-130	07-MAY-18
Naphthalene			71.3		%		50-130	07-MAY-18
Perylene			106.0		%		50-150	07-MAY-18
Phenanthrene			80.4		%		60-130	07-MAY-18
Pyrene			96.8		%		60-130	07-MAY-18
Quinoline			78.7		%		50-150	07-MAY-18
WG2766584-10 LCS								
Acenaphthene			77.7		%		60-130	08-MAY-18
Acenaphthylene			79.0		%		60-130	08-MAY-18
Acridine			104.6		%		50-150	08-MAY-18
Anthracene			95.9		%		60-130	08-MAY-18
Benz(a)anthracene			110.5		%		60-130	08-MAY-18
Benzo(a)pyrene			120.9		%		60-130	08-MAY-18
Benzo(b&j)fluoranthene			112.7		%		60-130	08-MAY-18
Benzo(g,h,i)perylene			97.5		%		60-130	08-MAY-18
Benzo(k)fluoranthene			113.0		%		60-130	08-MAY-18
Benzo(e)pyrene			109.0		%		50-150	08-MAY-18
Chrysene			99.7		%		60-130	08-MAY-18
Dibenz(a,h)anthracene			98.7		%		60-130	08-MAY-18
Fluoranthene			91.6		%		60-130	08-MAY-18
Fluorene			85.6		%		60-130	08-MAY-18
Indeno(1,2,3-c,d)pyrene			94.8		%		60-130	08-MAY-18
1-Methylnaphthalene			75.4		%		50-150	08-MAY-18
2-Methylnaphthalene			75.0		%		60-130	08-MAY-18
Naphthalene			73.8		%		50-130	08-MAY-18
Perylene			116.7		%		50-150	08-MAY-18
Phenanthrene			86.3		%		60-130	08-MAY-18
Pyrene			95.5		%		60-130	08-MAY-18
Quinoline			83.2		%		50-150	08-MAY-18
WG2766584-15 LCS								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-15 LCS								
Acenaphthene			73.1		%		60-130	08-MAY-18
Acenaphthylene			74.4		%		60-130	08-MAY-18
Acridine			94.6		%		50-150	08-MAY-18
Anthracene			78.6		%		60-130	08-MAY-18
Benz(a)anthracene			101.2		%		60-130	08-MAY-18
Benzo(a)pyrene			112.2		%		60-130	08-MAY-18
Benzo(b&j)fluoranthene			103.8		%		60-130	08-MAY-18
Benzo(g,h,i)perylene			87.6		%		60-130	08-MAY-18
Benzo(k)fluoranthene			104.2		%		60-130	08-MAY-18
Benzo(e)pyrene			100.6		%		50-150	08-MAY-18
Chrysene			90.2		%		60-130	08-MAY-18
Dibenz(a,h)anthracene			90.0		%		60-130	08-MAY-18
Fluoranthene			79.3		%		60-130	08-MAY-18
Fluorene			71.2		%		60-130	08-MAY-18
Indeno(1,2,3-c,d)pyrene			86.1		%		60-130	08-MAY-18
1-Methylnaphthalene			68.3		%		50-150	08-MAY-18
2-Methylnaphthalene			71.2		%		60-130	08-MAY-18
Naphthalene			71.6		%		50-130	08-MAY-18
Perylene			110.8		%		50-150	08-MAY-18
Phenanthrene			68.3		%		60-130	08-MAY-18
Pyrene			83.0		%		60-130	08-MAY-18
Quinoline			80.2		%		50-150	08-MAY-18
WG2766584-11 MB								
Acenaphthene			<0.0050		mg/kg		0.005	08-MAY-18
Acenaphthylene			<0.0050		mg/kg		0.005	08-MAY-18
Acridine			<0.010		mg/kg		0.01	08-MAY-18
Anthracene			<0.0040		mg/kg		0.004	08-MAY-18
Benz(a)anthracene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	08-MAY-18
Chrysene			<0.010		mg/kg		0.01	08-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-11 MB								
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	08-MAY-18
Fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Fluorene			<0.010		mg/kg		0.01	08-MAY-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	08-MAY-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	08-MAY-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	08-MAY-18
Naphthalene			<0.010		mg/kg		0.01	08-MAY-18
Perylene			<0.010		mg/kg		0.01	08-MAY-18
Phenanthrene			<0.010		mg/kg		0.01	08-MAY-18
Pyrene			<0.010		mg/kg		0.01	08-MAY-18
Quinoline			<0.010		mg/kg		0.01	08-MAY-18
Surrogate: d8-Naphthalene			67.9		%		50-130	08-MAY-18
Surrogate: d10-Acenaphthene			69.5		%		50-150	08-MAY-18
Surrogate: d10-Phenanthrene			72.1		%		60-130	08-MAY-18
Surrogate: d12-Chrysene			92.0		%		50-150	08-MAY-18
WG2766584-17 MB								
Acenaphthene			<0.0050		mg/kg		0.005	09-MAY-18
Acenaphthylene			<0.0050		mg/kg		0.005	09-MAY-18
Acridine			<0.010		mg/kg		0.01	09-MAY-18
Anthracene			<0.0040		mg/kg		0.004	09-MAY-18
Benz(a)anthracene			<0.010		mg/kg		0.01	09-MAY-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	09-MAY-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	09-MAY-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	09-MAY-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	09-MAY-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	09-MAY-18
Chrysene			<0.010		mg/kg		0.01	09-MAY-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	09-MAY-18
Fluoranthene			<0.010		mg/kg		0.01	09-MAY-18
Fluorene			<0.010		mg/kg		0.01	09-MAY-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	09-MAY-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	09-MAY-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	09-MAY-18
Naphthalene			<0.010		mg/kg		0.01	09-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-17 MB								
Perylene			<0.010		mg/kg		0.01	09-MAY-18
Phenanthrene			<0.010		mg/kg		0.01	09-MAY-18
Pyrene			<0.010		mg/kg		0.01	09-MAY-18
Quinoline			<0.010		mg/kg		0.01	09-MAY-18
Surrogate: d8-Naphthalene			76.0		%		50-130	09-MAY-18
Surrogate: d10-Acenaphthene			76.2		%		50-150	09-MAY-18
Surrogate: d10-Phenanthrene			80.4		%		60-130	09-MAY-18
Surrogate: d12-Chrysene			92.8		%		50-150	09-MAY-18
WG2766584-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	07-MAY-18
Acenaphthylene			<0.0050		mg/kg		0.005	07-MAY-18
Acridine			<0.010		mg/kg		0.01	07-MAY-18
Anthracene			<0.0040		mg/kg		0.004	07-MAY-18
Benz(a)anthracene			<0.010		mg/kg		0.01	07-MAY-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	07-MAY-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	07-MAY-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	07-MAY-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	07-MAY-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	07-MAY-18
Chrysene			<0.010		mg/kg		0.01	07-MAY-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	07-MAY-18
Fluoranthene			<0.010		mg/kg		0.01	07-MAY-18
Fluorene			<0.010		mg/kg		0.01	07-MAY-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	07-MAY-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	07-MAY-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	07-MAY-18
Naphthalene			<0.010		mg/kg		0.01	07-MAY-18
Perylene			<0.010		mg/kg		0.01	07-MAY-18
Phenanthrene			<0.010		mg/kg		0.01	07-MAY-18
Pyrene			<0.010		mg/kg		0.01	07-MAY-18
Quinoline			<0.010		mg/kg		0.01	07-MAY-18
Surrogate: d8-Naphthalene			78.8		%		50-130	07-MAY-18
Surrogate: d10-Acenaphthene			79.9		%		50-150	07-MAY-18
Surrogate: d10-Phenanthrene			86.3		%		60-130	07-MAY-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-2 MB								
Surrogate: d12-Chrysene			87.0		%		50-150	07-MAY-18
WG2766584-7 MB								
Acenaphthene			<0.0050		mg/kg		0.005	08-MAY-18
Acenaphthylene			<0.0050		mg/kg		0.005	08-MAY-18
Acridine			<0.010		mg/kg		0.01	08-MAY-18
Anthracene			<0.0040		mg/kg		0.004	08-MAY-18
Benz(a)anthracene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	08-MAY-18
Chrysene			<0.010		mg/kg		0.01	08-MAY-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	08-MAY-18
Fluoranthene			<0.010		mg/kg		0.01	08-MAY-18
Fluorene			<0.010		mg/kg		0.01	08-MAY-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	08-MAY-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	08-MAY-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	08-MAY-18
Naphthalene			<0.010		mg/kg		0.01	08-MAY-18
Perylene			<0.010		mg/kg		0.01	08-MAY-18
Phenanthrene			<0.010		mg/kg		0.01	08-MAY-18
Pyrene			<0.010		mg/kg		0.01	08-MAY-18
Quinoline			<0.010		mg/kg		0.01	08-MAY-18
Surrogate: d8-Naphthalene			97.9		%		50-130	08-MAY-18
Surrogate: d10-Acenaphthene			97.6		%		50-150	08-MAY-18
Surrogate: d10-Phenanthrene			90.5		%		60-130	08-MAY-18
Surrogate: d12-Chrysene			98.3		%		50-150	08-MAY-18
WG2766584-16 MS		**L2089149-2**						
Acenaphthene			65.4		%		50-150	08-MAY-18
Acenaphthylene			69.1		%		50-150	08-MAY-18
Acridine			90.5		%		50-150	08-MAY-18
Anthracene			78.9		%		50-150	08-MAY-18
Benz(a)anthracene			99.1		%		50-150	08-MAY-18
Benzo(a)pyrene			106.7		%		50-150	08-MAY-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4035894								
WG2766584-16 MS		**L2089149-2**						
Benzo(b&j)fluoranthene			100.6		%		50-150	08-MAY-18
Benzo(g,h,i)perylene			85.4		%		50-150	08-MAY-18
Benzo(k)fluoranthene			99.7		%		50-150	08-MAY-18
Benzo(e)pyrene			97.1		%		50-150	08-MAY-18
Chrysene			90.0		%		50-150	08-MAY-18
Dibenz(a,h)anthracene			86.1		%		50-150	08-MAY-18
Fluoranthene			79.1		%		50-150	08-MAY-18
Fluorene			70.0		%		50-150	08-MAY-18
Indeno(1,2,3-c,d)pyrene			80.3		%		50-150	08-MAY-18
1-Methylnaphthalene			62.9		%		50-150	08-MAY-18
2-Methylnaphthalene			65.6		%		50-150	08-MAY-18
Naphthalene			62.6		%		50-150	08-MAY-18
Perylene			106.4		%		50-150	08-MAY-18
Phenanthrene			71.8		%		50-150	08-MAY-18
Pyrene			83.4		%		50-150	08-MAY-18
Quinoline			69.9		%		50-150	08-MAY-18
PH-1:2-CL	**Soil**							
Batch R4039107								
WG2768503-2 DUP		**L2089149-8**						
pH (1:2 soil:water)		8.35	8.37	J	pH	0.02	0.2	09-MAY-18
WG2768503-1 IRM		**SAL-STD9**						
pH (1:2 soil:water)			7.94		pH		7.7-8.3	09-MAY-18
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4038134								
WG2766112-1 DUP		**L2089149-8**						
% Gravel (>2mm)		<1.0	<1.0	RPD-NA	%	N/A	25	08-MAY-18
% Sand (2.00mm - 1.00mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-MAY-18
% Sand (1.00mm - 0.50mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-MAY-18
% Sand (0.50mm - 0.25mm)		3.1	3.0	J	%	0.1	5	08-MAY-18
% Sand (0.25mm - 0.125mm)		22.3	24.3	J	%	2.0	5	08-MAY-18
% Sand (0.125mm - 0.063mm)		28.1	26.4	J	%	1.7	5	08-MAY-18
% Silt (0.063mm - 0.0312mm)		20.8	20.7	J	%	0.1	5	08-MAY-18
% Silt (0.0312mm - 0.004mm)		21.1	21.1	J	%	0.0	5	08-MAY-18
% Clay (<4um)		4.6	4.4	J	%	0.2	5	08-MAY-18
WG2766112-2 IRM		**2017-PSA**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4038134								
WG2766112-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			2.6		%		0-7.6	08-MAY-18
% Sand (1.00mm - 0.50mm)			3.7		%		0-8.9	08-MAY-18
% Sand (0.50mm - 0.25mm)			10.1		%		5.3-15.3	08-MAY-18
% Sand (0.25mm - 0.125mm)			14.0		%		10-20	08-MAY-18
% Sand (0.125mm - 0.063mm)			12.7		%		7.3-17.3	08-MAY-18
% Silt (0.063mm - 0.0312mm)			14.8		%		9.9-19.9	08-MAY-18
% Silt (0.0312mm - 0.004mm)			23.2		%		17.6-27.6	08-MAY-18
% Clay (<4um)			19.0		%		13.4-23.4	08-MAY-18

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

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COC ID: REP-2018-05-01

TURNAROUND TIME:

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SAMPLE DETAILS — **ANALYSIS REQUESTED** — Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

L2089149-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~~ TOC	PAHs	Metals (incl. Hg)	Moisture	Particle Size
Fil																			
PRESERV											x			x					
1	RG_SC-01-SS-20180427-1300	RG-SC-01	Sediment	NO	Apr. 27.18	1300	G	2							✓	✓	✓	✓	✓
2	RG_SC-02-SS_20180427-1345	RG_SC-02	Sediment	NO	April 27.18	1345	G	2							✓	✓	✓	✓	✓
3	RG-SC-03-SS_20180427-1430	RG-SC-03	Sediment		Apr. 27.18	1430	G	2							✓	✓	✓	✓	✓
4	RG-SC-04-SS-20180427-1545	RG-SC-04	Sediment		April 27.18	1545	G	2							✓	✓	✓	✓	✓
5	RG-SC-05-SS-20180428-1230	RG-SC-05	Sediment		April 28.18	1230	G	2							✓	✓	✓	✓	✓
6	RG_ER-01-SS_20180427-1200	RG_ER-01	Sediment		April 27.18	1200	G	2							✓	✓	✓	✓	✓
7	RG_ER-02-SS_20180427-1300	RG_ER-02	Sediment		April 27.18	1300	G	2							✓	✓	✓	✓	✓
8	RG-ER-03-SS-20180427-1310	RG_ER-03	Sediment		April 27.18	1310	G	2							✓	✓	✓	✓	✓
9	RG-ER-04-SS_20180427-1430	RG-ER-04	Sediment		April 27.18	1430	G	2							✓	✓	✓	✓	✓
10	RG-ER-05-SS-20180427-1530	RG-ER-05	Sediment		April 27.18	1530	G	2							✓	✓	✓	✓	✓
11	RG-GC-01-SS-20180427-1245	RG-GC-01	Sediment		April 27.18	1245	G	2							✓	✓	✓	✓	✓

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

All metals samples must be shipped to ALS Burnaby for analysis

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	
			5/2 9:25

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	JUSTIN WILSON	**Mobile #**	519-803-3923
Sampler's Signature		**Date/Time**	May 1, 2018 / 11:30 am

* 1 jar ~~#2 plastic bag~~. for PAH + 1 plastic bag for everything else.

Teck

Page 1 of 1

Page 2 of 2

COC ID: REP-2018-05-01

TURNAROUND TIME:

PROJECT/CLIENT INFO				LABORATORY			
Facility Name / Job#	Regional Effects Program			Lab Name	ALS Calgary		
Project Manager	Lee Wilm			Lab Contact	Lyudmyla Shvets		
Email	lee.wilm@teck.com			Email	lyudmyla.shvets@alsglobal.com		
Address	PO Box 1777, 124B Aspen Drive			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	250-865-5289			Phone Number	1 403 407 1794		

	Excel	PDF	EDD
lee.wilm@teck.com	x	x	x
teckcoal@equisonline.com			x
carla.fraser@teck.com	x	x	x
andrew.wight@teck.com	x	x	x
jwilson@minnow.ca	x	x	x

L2089149-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~~ TOC	PAHs	Metals (including Hg)	Moisture	Particle Size
PRESERV.											x			x					
12	RG-GC-02-SS-20180427-1300	RG-GC-02	Sediment	NO	April 27.18	1300	G	2							✓	✓	✓	✓	✓
13	RG-GC-03-SS-20180427-1315	RG-GC-03	Sediment	NO	April 27.18	1315	G	2							✓	✓	✓	✓	✓
14	RG-GC-03-SS-20180427-1316	RG-GC-03	Sediment		April 27.18	1316	G	2							✓	✓	✓	✓	✓
15	RG-GC-04-SS-20180428-1330	RG-GC-04	Sediment		April 28.18	1330	G	2							✓	✓	✓	✓	✓
16	RG-GC-05-SS-20180428-1345	RG-GC-05	Sediment		April 28.18	1345	G	2							✓	✓	✓	✓	✓

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

All metals samples must be shipped to ALS Burnaby for analysis

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME

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	Justin Wilson	Mobile #	519-803-3923
Sampler's Signature		Date/Time	~~April~~ May 1, 2018 / 11:30 am

* 1 jar for PAH & 1 plastic bag for everything else

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 31-AUG-18
Report Date: 11-SEP-18 13:59 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2157301

Project P.O. #: VPO00563596
Job Reference: REGIONAL KOOCANUSA
C of C Numbers: Regional Koocanusa
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

	Sample ID	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18
	Sampled Time	15:15	14:45	11:30	12:30	14:00
	Client ID	RG_TN_1_SED_20180829-1515	RG_TN_2_SED_20180829-1445	RG_TN_3_SED_20180829-1130	RG_TN_4_SED_20180829-1230	RG_TN_5_SED_20180829-1400
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	41.5	38.7	41.6	33.2	35.8
	pH (1:2 soil:water) (pH)	8.40	8.59	8.35	8.83	8.77
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	<1.0	<1.0	<1.0	15.3	2.7
	% Sand (0.125mm - 0.063mm) (%)	<1.0	6.7	2.0	29.6	28.0
	% Silt (0.063mm - 0.0312mm) (%)	30.1	29.5	34.1	19.4	26.8
	% Silt (0.0312mm - 0.004mm) (%)	57.1	52.1	53.8	28.0	35.0
	% Clay (<4um) (%)	12.5	11.6	10.1	7.4	7.4
	Texture	Silt	Silt	Silt	Sandy loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.00	1.99	2.4	1.83	1.91
Metals	Aluminum (Al) (mg/kg)	12100	12300	12100	9220	9860
	Antimony (Sb) (mg/kg)	0.29	0.30	0.34	0.26	0.29
	Arsenic (As) (mg/kg)	7.13	6.77	7.23	6.33	6.76
	Barium (Ba) (mg/kg)	71.1	71.7	73.8	57.3	59.5
	Beryllium (Be) (mg/kg)	0.37	0.35	0.37	0.27	0.32
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.176	0.171	0.202	0.144	0.138
	Calcium (Ca) (mg/kg)	106000	115000	103000	111000	114000
	Chromium (Cr) (mg/kg)	17.1	16.8	18.0	15.1	15.9
	Cobalt (Co) (mg/kg)	8.98	8.88	9.52	7.98	8.40
	Copper (Cu) (mg/kg)	16.3	15.2	17.5	12.1	13.1
	Iron (Fe) (mg/kg)	22000	21900	22500	19700	20900
	Lead (Pb) (mg/kg)	16.5	15.5	18.0	14.2	14.7
	Lithium (Li) (mg/kg)	25.1	24.5	24.5	20.1	22.5
	Magnesium (Mg) (mg/kg)	22200	24600	23500	24900	26100
	Manganese (Mn) (mg/kg)	423	430	429	382	402
	Mercury (Hg) (mg/kg)	0.0196	0.0150	0.0202	0.0141	0.0126
	Molybdenum (Mo) (mg/kg)	0.58	0.61	0.65	0.55	0.59
	Nickel (Ni) (mg/kg)	18.9	19.0	20.2	16.8	17.9
	Phosphorus (P) (mg/kg)	617	641	675	633	682
	Potassium (K) (mg/kg)	800	740	800	610	630
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.23	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20180828-1000	RG_T4_2_SED_20180828-1200	RG_T4_3_SED_20180828-1330	RG_T4_4_SED_20180828-1430	RG_T4_5_SED_20180828-1530
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	40.0	42.3	41.0	43.3	39.2
	pH (1:2 soil:water) (pH)	8.53	8.42	8.42	8.43	8.49
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.25mm - 0.125mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.125mm - 0.063mm) (%)	<1.0	<1.0	2.2	1.9	2.9
	% Silt (0.063mm - 0.0312mm) (%)	19.4	18.5	21.6	14.8	16.0
	% Silt (0.0312mm - 0.004mm) (%)	60.8	62.2	58.8	62.8	61.2
	% Clay (<4um) (%)	19.7	19.1	17.2	20.5	19.8
	Texture	Silt	Silt	Silt	Silt	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.15	2.19	2.20	2.2	1.94
Metals	Aluminum (Al) (mg/kg)	10500	13200	12000	13500	13400
	Antimony (Sb) (mg/kg)	0.46	0.48	0.41	0.42	0.42
	Arsenic (As) (mg/kg)	7.25	7.69	7.17	7.59	7.14
	Barium (Ba) (mg/kg)	161	166	135	141	116
	Beryllium (Be) (mg/kg)	0.50	0.55	0.47	0.48	0.45
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.586	0.573	0.486	0.462	0.336
	Calcium (Ca) (mg/kg)	117000	119000	115000	122000	120000
	Chromium (Cr) (mg/kg)	17.6	20.0	18.7	20.4	19.6
	Cobalt (Co) (mg/kg)	9.08	10.3	9.45	10.2	9.83
	Copper (Cu) (mg/kg)	16.4	18.0	16.4	17.5	16.1
	Iron (Fe) (mg/kg)	22200	24500	22800	24700	23900
	Lead (Pb) (mg/kg)	14.0	15.4	15.0	15.9	15.8
	Lithium (Li) (mg/kg)	24.1	26.1	24.2	25.6	24.8
	Magnesium (Mg) (mg/kg)	24100	26700	24000	26200	24300
	Manganese (Mn) (mg/kg)	589	596	539	568	528
	Mercury (Hg) (mg/kg)	0.0323	0.0336	0.0286	0.0291	0.0208
	Molybdenum (Mo) (mg/kg)	1.03	1.01	0.94	0.94	0.85
	Nickel (Ni) (mg/kg)	22.4	24.8	22.5	23.9	22.0
	Phosphorus (P) (mg/kg)	912	979	812	830	734
	Potassium (K) (mg/kg)	950	1110	1020	1160	1010
	Selenium (Se) (mg/kg)	0.61	0.53	0.47	0.51	0.40
	Silver (Ag) (mg/kg)	0.11	0.11	<0.10	<0.10	<0.10

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-11				
	Description	Sediment				
	Sampled Date	28-AUG-18				
	Sampled Time	14:35				
	Client ID	RG_T4_4_SED_20180828-1435				
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	42.3				
	pH (1:2 soil:water) (pH)	8.45				
Particle Size	% Gravel (>2mm) (%)	<1.0				
	% Sand (2.00mm - 1.00mm) (%)	<1.0				
	% Sand (1.00mm - 0.50mm) (%)	<1.0				
	% Sand (0.50mm - 0.25mm) (%)	<1.0				
	% Sand (0.25mm - 0.125mm) (%)	<1.0				
	% Sand (0.125mm - 0.063mm) (%)	1.4				
	% Silt (0.063mm - 0.0312mm) (%)	17.4				
	% Silt (0.0312mm - 0.004mm) (%)	61.6				
	% Clay (<4um) (%)	19.6				
	Texture	Silt				
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.3				
Metals	Aluminum (Al) (mg/kg)	14700				
	Antimony (Sb) (mg/kg)	0.44				
	Arsenic (As) (mg/kg)	8.24				
	Barium (Ba) (mg/kg)	142				
	Beryllium (Be) (mg/kg)	0.50				
	Bismuth (Bi) (mg/kg)	0.21				
	Boron (B) (mg/kg)	<5.0				
	Cadmium (Cd) (mg/kg)	0.454				
	Calcium (Ca) (mg/kg)	140000				
	Chromium (Cr) (mg/kg)	21.8				
	Cobalt (Co) (mg/kg)	11.2				
	Copper (Cu) (mg/kg)	19.2				
	Iron (Fe) (mg/kg)	26900				
	Lead (Pb) (mg/kg)	17.8				
	Lithium (Li) (mg/kg)	27.7				
	Magnesium (Mg) (mg/kg)	28400				
	Manganese (Mn) (mg/kg)	629				
	Mercury (Hg) (mg/kg)	0.0462				
	Molybdenum (Mo) (mg/kg)	1.05				
	Nickel (Ni) (mg/kg)	25.6				
	Phosphorus (P) (mg/kg)	876				
	Potassium (K) (mg/kg)	1110				
	Selenium (Se) (mg/kg)	0.52				
	Silver (Ag) (mg/kg)	<0.10				

	Sample ID	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18
	Sampled Time	15:15	14:45	11:30	12:30	14:00
	Client ID	RG_TN_1_SED_20180829-1515	RG_TN_2_SED_20180829-1445	RG_TN_3_SED_20180829-1130	RG_TN_4_SED_20180829-1230	RG_TN_5_SED_20180829-1400
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	81	84	89	81	82
	Strontium (Sr) (mg/kg)	238	250	229	231	237
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.087	0.078	0.085	0.066	0.067
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	142	140	143	129	123
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.794	0.729	0.881	0.582	0.576
	Vanadium (V) (mg/kg)	13.4	13.4	13.9	12.0	12.5
	Zinc (Zn) (mg/kg)	69.4	66.9	73.6	61.8	64.0
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	1.5	1.3	1.4
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	<0.010	<0.010
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	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)	0.022	<0.010	<0.010	<0.010	<0.010
	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)	<0.010	<0.010	<0.010	<0.010	<0.010
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	0.011	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	94.4	91.6	85.2	73.8	82.5
	Surrogate: d12-Chrysene (%)	103.9	104.2	105.8	101.4	104.4
	Surrogate: d8-Naphthalene (%)	92.6	88.9	80.5	69.6	79.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20 180828-1000	RG_T4_2_SED_20 180828-1200	RG_T4_3_SED_20 180828-1330	RG_T4_4_SED_20 180828-1430	RG_T4_5_SED_20 180828-1530
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	92	100	91	100	103
	Strontium (Sr) (mg/kg)	216	227	226	250	263
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.136	0.144	0.128	0.131	0.113
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	54.8	76.9	84.1	99.6	102
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.758	0.788	0.850	0.811	0.784
	Vanadium (V) (mg/kg)	18.0	20.2	17.9	19.3	17.2
	Zinc (Zn) (mg/kg)	81.6	88.7	79.8	84.4	77.2
	Zirconium (Zr) (mg/kg)	1.7	1.7	1.5	1.3	1.4
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)	0.012	0.013	<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)	0.020	0.020	0.014	0.015	<0.010
	Benzo(e)pyrene (mg/kg)	0.013	0.013	<0.010	0.010	<0.010
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	0.014	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	0.025	0.026	0.018	0.018	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	0.0057	<0.0050
	Fluoranthene (mg/kg)	0.017	0.019	0.014	0.014	<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)	0.026	0.023	0.025	0.016	<0.010
	2-Methylnaphthalene (mg/kg)	0.047	0.041	0.040	0.030	0.016
	Naphthalene (mg/kg)	0.019	0.016	0.014	0.010	<0.010
	Perylene (mg/kg)	0.015	0.015	<0.010	0.011	<0.010
	Phenanthrene (mg/kg)	0.045	0.039	0.041	0.027	0.017
	Pyrene (mg/kg)	0.013	0.014	0.011	0.011	<0.010
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	87.8	88.0	87.2	84.2	79.8
	Surrogate: d12-Chrysene (%)	106.7	116.9	104.8	104.9	104.2
	Surrogate: d8-Naphthalene (%)	84.1	84.5	84.9	81.4	75.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-11				
	Description	Sediment				
	Sampled Date	28-AUG-18				
	Sampled Time	14:35				
	Client ID	RG_T4_4_SED_20 180828-1435				
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	105				
	Strontium (Sr) (mg/kg)	288				
	Sulfur (S) (mg/kg)	<1000				
	Thallium (Tl) (mg/kg)	0.132				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	101				
	Tungsten (W) (mg/kg)	<0.50				
	Uranium (U) (mg/kg)	0.907				
	Vanadium (V) (mg/kg)	19.6				
	Zinc (Zn) (mg/kg)	88.7				
	Zirconium (Zr) (mg/kg)	1.8				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050				
	Acenaphthylene (mg/kg)	<0.0050				
	Acridine (mg/kg)	<0.010				
	Anthracene (mg/kg)	<0.0040				
	Benz(a)anthracene (mg/kg)	<0.010				
	Benzo(a)pyrene (mg/kg)	<0.010				
	Benzo(b&j)fluoranthene (mg/kg)	0.015				
	Benzo(e)pyrene (mg/kg)	<0.010				
	Benzo(g,h,i)perylene (mg/kg)	<0.010				
	Benzo(k)fluoranthene (mg/kg)	<0.010				
	Chrysene (mg/kg)	0.015				
	Dibenz(a,h)anthracene (mg/kg)	<0.0050				
	Fluoranthene (mg/kg)	0.013				
	Fluorene (mg/kg)	<0.010				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010				
	1-Methylnaphthalene (mg/kg)	0.019				
	2-Methylnaphthalene (mg/kg)	0.029				
	Naphthalene (mg/kg)	0.013				
	Perylene (mg/kg)	0.011				
	Phenanthrene (mg/kg)	0.028				
	Pyrene (mg/kg)	<0.010				
	Quinoline (mg/kg)	<0.010				
	Surrogate: d10-Acenaphthene (%)	90.4				
	Surrogate: d12-Chrysene (%)	109.9				
	Surrogate: d8-Naphthalene (%)	89.5				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-1	L2157301-2	L2157301-3	L2157301-4	L2157301-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18	29-AUG-18
	Sampled Time	15:15	14:45	11:30	12:30	14:00
	Client ID	RG_TN_1_SED_20180829-1515	RG_TN_2_SED_20180829-1445	RG_TN_3_SED_20180829-1130	RG_TN_4_SED_20180829-1230	RG_TN_5_SED_20180829-1400
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	95.9	93.9	92.5	84.5	88.6
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2157301-6	L2157301-7	L2157301-8	L2157301-9	L2157301-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18	28-AUG-18
	Sampled Time	10:00	12:00	13:30	14:30	15:30
	Client ID	RG_T4_1_SED_20180828-1000	RG_T4_2_SED_20180828-1200	RG_T4_3_SED_20180828-1330	RG_T4_4_SED_20180828-1430	RG_T4_5_SED_20180828-1530
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	94.7	94.7	91.4	90.2	87.7
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	0.23	0.23	0.17	0.19	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2157301-11 Sediment 28-AUG-18 14:35 RG_T4_4_SED_20180828-1435				
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	94.6				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME) (mg/kg)	0.17				

* 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)
Certified Reference Material	Phosphorus (P)	MES	L2157301-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

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).

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.

ALS Test Code	Matrix	Test Description	Method Reference**
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)

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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 samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-CL	Soil	% Moisture	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C

ALS Test Code	Matrix	Test Description	Method Reference**
PAH-TMB-D/A-MS-CL	Soil	PAH by Tumbler Extraction (DCM/Acetone)	EPA 3570/8270

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 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 DCM 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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** 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

Reference Information

CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

Regional Koocanusa

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: L2157301　　Report Date: 11-SEP-18

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 R4207675								
WG2869426-2 LCS								
Inorganic Carbon			97.8		%		80-120	10-SEP-18
WG2869426-3 MB								
Inorganic Carbon			<0.050		%		0.05	10-SEP-18
Batch R4210968								
WG2869424-1 DUP		**L2157301-6**						
Inorganic Carbon		2.73	2.69		%	1.4	20	11-SEP-18
WG2869424-2 LCS								
Inorganic Carbon			96.9		%		80-120	11-SEP-18
WG2869424-3 MB								
Inorganic Carbon			<0.050		%		0.05	11-SEP-18
C-TOT-LECO-SK	**Soil**							
Batch R4205562								
WG2867622-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			106.5		%		80-120	07-SEP-18
WG2867622-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			101.0		%		90-110	07-SEP-18
WG2867622-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	07-SEP-18
Batch R4205816								
WG2868854-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			97.8		%		80-120	08-SEP-18
WG2868854-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			100.0		%		90-110	08-SEP-18
WG2868854-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	08-SEP-18
HG-200.2-CVAA-CL	**Soil**							
Batch R4204124								
WG2869457-9 CRM		**TILL-1**						
Mercury (Hg)			109.2		%		70-130	07-SEP-18
WG2869457-8 LCS								
Mercury (Hg)			103.0		%		80-120	07-SEP-18
WG2869457-6 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	07-SEP-18
MET-200.2-CCMS-CL	**Soil**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4204992								
WG2869457-9 CRM		**TILL-1**						
Aluminum (Al)			129.0		%		70-130	07-SEP-18
Antimony (Sb)			120.4		%		70-130	07-SEP-18
Arsenic (As)			122.1		%		70-130	07-SEP-18
Barium (Ba)			114.7		%		70-130	07-SEP-18
Beryllium (Be)			117.4		%		70-130	07-SEP-18
Bismuth (Bi)			98.6		%		70-130	07-SEP-18
Boron (B)			3.4		mg/kg		0-8.2	07-SEP-18
Cadmium (Cd)			121.6		%		70-130	07-SEP-18
Calcium (Ca)			122.7		%		70-130	07-SEP-18
Chromium (Cr)			118.6		%		70-130	07-SEP-18
Cobalt (Co)			119.5		%		70-130	07-SEP-18
Copper (Cu)			114.1		%		70-130	07-SEP-18
Iron (Fe)			120.0		%		70-130	07-SEP-18
Lead (Pb)			117.5		%		70-130	07-SEP-18
Lithium (Li)			120.3		%		70-130	07-SEP-18
Magnesium (Mg)			127.0		%		70-130	07-SEP-18
Manganese (Mn)			127.8		%		70-130	07-SEP-18
Molybdenum (Mo)			128.8		%		70-130	07-SEP-18
Nickel (Ni)			117.3		%		70-130	07-SEP-18
Phosphorus (P)			130.2	MES	%		70-130	07-SEP-18
Potassium (K)			110.0		%		70-130	07-SEP-18
Selenium (Se)			0.36		mg/kg		0.11-0.51	07-SEP-18
Silver (Ag)			0.24		mg/kg		0.13-0.33	07-SEP-18
Sodium (Na)			109.4		%		70-130	07-SEP-18
Strontium (Sr)			109.1		%		70-130	07-SEP-18
Thallium (Tl)			0.131		mg/kg		0.077-0.18	07-SEP-18
Tin (Sn)			1.2		mg/kg		0-3.1	07-SEP-18
Titanium (Ti)			121.8		%		70-130	07-SEP-18
Tungsten (W)			0.18		mg/kg		0-0.66	07-SEP-18
Uranium (U)			103.2		%		70-130	07-SEP-18
Vanadium (V)			116.7		%		70-130	07-SEP-18
Zinc (Zn)			116.2		%		70-130	07-SEP-18
Zirconium (Zr)			0.8		mg/kg		0-1.8	07-SEP-18
WG2869457-6 MB								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4204992								
WG2869457-6 MB								
Aluminum (Al)			<50		mg/kg		50	07-SEP-18
Antimony (Sb)			<0.10		mg/kg		0.1	07-SEP-18
Arsenic (As)			<0.10		mg/kg		0.1	07-SEP-18
Barium (Ba)			<0.50		mg/kg		0.5	07-SEP-18
Beryllium (Be)			<0.10		mg/kg		0.1	07-SEP-18
Bismuth (Bi)			<0.20		mg/kg		0.2	07-SEP-18
Boron (B)			<5.0		mg/kg		5	07-SEP-18
Cadmium (Cd)			<0.020		mg/kg		0.02	07-SEP-18
Calcium (Ca)			<50		mg/kg		50	07-SEP-18
Chromium (Cr)			<0.50		mg/kg		0.5	07-SEP-18
Cobalt (Co)			<0.10		mg/kg		0.1	07-SEP-18
Copper (Cu)			<0.50		mg/kg		0.5	07-SEP-18
Iron (Fe)			<50		mg/kg		50	07-SEP-18
Lead (Pb)			<0.50		mg/kg		0.5	07-SEP-18
Lithium (Li)			<2.0		mg/kg		2	07-SEP-18
Magnesium (Mg)			<20		mg/kg		20	07-SEP-18
Manganese (Mn)			<1.0		mg/kg		1	07-SEP-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	07-SEP-18
Nickel (Ni)			<0.50		mg/kg		0.5	07-SEP-18
Phosphorus (P)			<50		mg/kg		50	07-SEP-18
Potassium (K)			<100		mg/kg		100	07-SEP-18
Selenium (Se)			<0.20		mg/kg		0.2	07-SEP-18
Silver (Ag)			<0.10		mg/kg		0.1	07-SEP-18
Sodium (Na)			<50		mg/kg		50	07-SEP-18
Strontium (Sr)			<0.50		mg/kg		0.5	07-SEP-18
Sulfur (S)			<1000		mg/kg		1000	07-SEP-18
Thallium (Tl)			<0.050		mg/kg		0.05	07-SEP-18
Tin (Sn)			<2.0		mg/kg		2	07-SEP-18
Titanium (Ti)			<1.0		mg/kg		1	07-SEP-18
Tungsten (W)			<0.50		mg/kg		0.5	07-SEP-18
Uranium (U)			<0.050		mg/kg		0.05	07-SEP-18
Vanadium (V)			<0.20		mg/kg		0.2	07-SEP-18
Zinc (Zn)			<2.0		mg/kg		2	07-SEP-18
Zirconium (Zr)			<1.0		mg/kg		1	07-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-CL	**Soil**							
Batch R4201553								
WG2867497-2 LCS								
Moisture			105.3		%		90-110	04-SEP-18
WG2867497-1 MB								
Moisture			<0.25		%		0.25	04-SEP-18
Batch R4203606								
WG2868175-3 DUP		**L2157301-3**						
Moisture		41.6	43.5		%	4.4	20	05-SEP-18
WG2868175-2 LCS								
Moisture			104.8		%		90-110	05-SEP-18
WG2868175-1 MB								
Moisture			<0.25		%		0.25	05-SEP-18
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-3 DUP		**L2157301-3**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Acridine		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Benzo(e)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	06-SEP-18
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
1-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18
Quinoline		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	06-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-1 LCS								
Acenaphthene			95.2		%		60-130	06-SEP-18
Acenaphthylene			91.4		%		60-130	06-SEP-18
Acridine			103.3		%		60-130	06-SEP-18
Anthracene			92.6		%		60-130	06-SEP-18
Benz(a)anthracene			95.2		%		60-130	06-SEP-18
Benzo(a)pyrene			93.6		%		60-130	06-SEP-18
Benzo(b&j)fluoranthene			95.9		%		60-130	06-SEP-18
Benzo(g,h,i)perylene			103.3		%		60-130	06-SEP-18
Benzo(k)fluoranthene			99.1		%		60-130	06-SEP-18
Benzo(e)pyrene			104.9		%		60-130	06-SEP-18
Chrysene			101.1		%		60-130	06-SEP-18
Dibenz(a,h)anthracene			101.4		%		60-130	06-SEP-18
Fluoranthene			90.1		%		60-130	06-SEP-18
Fluorene			95.2		%		60-130	06-SEP-18
Indeno(1,2,3-c,d)pyrene			100.4		%		60-130	06-SEP-18
1-Methylnaphthalene			105.7		%		60-130	06-SEP-18
2-Methylnaphthalene			95.7		%		60-130	06-SEP-18
Naphthalene			95.7		%		50-130	06-SEP-18
Perylene			107.1		%		60-130	06-SEP-18
Phenanthrene			94.5		%		60-130	06-SEP-18
Pyrene			91.3		%		60-130	06-SEP-18
Quinoline			97.4		%		60-130	06-SEP-18
WG2870492-5 LCS								
Acenaphthene			83.0		%		60-130	06-SEP-18
Acenaphthylene			82.3		%		60-130	06-SEP-18
Acridine			99.9		%		60-130	06-SEP-18
Anthracene			85.0		%		60-130	06-SEP-18
Benz(a)anthracene			100.4		%		60-130	06-SEP-18
Benzo(a)pyrene			98.9		%		60-130	06-SEP-18
Benzo(b&j)fluoranthene			100.7		%		60-130	06-SEP-18
Benzo(g,h,i)perylene			100.6		%		60-130	06-SEP-18
Benzo(k)fluoranthene			105.4		%		60-130	06-SEP-18
Benzo(e)pyrene			113.0		%		60-130	06-SEP-18
Chrysene			110.8		%		60-130	06-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-5 LCS								
Dibenz(a,h)anthracene			97.7		%		60-130	06-SEP-18
Fluoranthene			96.6		%		60-130	06-SEP-18
Fluorene			83.8		%		60-130	06-SEP-18
Indeno(1,2,3-c,d)pyrene			100.0		%		60-130	06-SEP-18
1-Methylnaphthalene			91.8		%		60-130	06-SEP-18
2-Methylnaphthalene			82.9		%		60-130	06-SEP-18
Naphthalene			83.7		%		50-130	06-SEP-18
Perylene			113.3		%		60-130	06-SEP-18
Phenanthrene			85.9		%		60-130	06-SEP-18
Pyrene			98.1		%		60-130	06-SEP-18
Quinoline			84.8		%		60-130	06-SEP-18
WG2870492-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	06-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	06-SEP-18
Acridine			<0.010		mg/kg		0.01	06-SEP-18
Anthracene			<0.0040		mg/kg		0.004	06-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Chrysene			<0.010		mg/kg		0.01	06-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	06-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Fluorene			<0.010		mg/kg		0.01	06-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	06-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
Naphthalene			<0.010		mg/kg		0.01	06-SEP-18
Perylene			<0.010		mg/kg		0.01	06-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	06-SEP-18
Pyrene			<0.010		mg/kg		0.01	06-SEP-18
Quinoline			<0.010		mg/kg		0.01	06-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-2 MB								
Surrogate: d8-Naphthalene			102.6		%		50-130	06-SEP-18
Surrogate: d10-Acenaphthene			106.0		%		60-130	06-SEP-18
Surrogate: d10-Phenanthrene			102.4		%		60-130	06-SEP-18
Surrogate: d12-Chrysene			123.2		%		60-130	06-SEP-18
WG2870492-6 MB								
Acenaphthene			<0.0050		mg/kg		0.005	06-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	06-SEP-18
Acridine			<0.010		mg/kg		0.01	06-SEP-18
Anthracene			<0.0040		mg/kg		0.004	06-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	06-SEP-18
Chrysene			<0.010		mg/kg		0.01	06-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	06-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	06-SEP-18
Fluorene			<0.010		mg/kg		0.01	06-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	06-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	06-SEP-18
Naphthalene			<0.010		mg/kg		0.01	06-SEP-18
Perylene			<0.010		mg/kg		0.01	06-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	06-SEP-18
Pyrene			<0.010		mg/kg		0.01	06-SEP-18
Quinoline			<0.010		mg/kg		0.01	06-SEP-18
Surrogate: d8-Naphthalene			82.5		%		50-130	06-SEP-18
Surrogate: d10-Acenaphthene			84.7		%		60-130	06-SEP-18
Surrogate: d10-Phenanthrene			83.1		%		60-130	06-SEP-18
Surrogate: d12-Chrysene			113.0		%		60-130	06-SEP-18
WG2870492-4 MS		**L2157301-4**						
Acenaphthene			81.0		%		50-150	06-SEP-18
Acenaphthylene			77.0		%		50-150	06-SEP-18
Acridine			100.9		%		50-150	06-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4204772								
WG2870492-4 MS		**L2157301-4**						
Anthracene			88.7		%		50-150	06-SEP-18
Benz(a)anthracene			103.1		%		50-150	06-SEP-18
Benzo(a)pyrene			98.3		%		50-150	06-SEP-18
Benzo(b&j)fluoranthene			102.0		%		50-150	06-SEP-18
Benzo(g,h,i)perylene			97.4		%		50-150	06-SEP-18
Benzo(k)fluoranthene			106.5		%		50-150	06-SEP-18
Benzo(e)pyrene			112.9		%		50-150	06-SEP-18
Chrysene			109.1		%		50-150	06-SEP-18
Dibenz(a,h)anthracene			100.1		%		50-150	06-SEP-18
Fluoranthene			100.9		%		50-150	06-SEP-18
Fluorene			85.5		%		50-150	06-SEP-18
Indeno(1,2,3-c,d)pyrene			97.9		%		50-150	06-SEP-18
1-Methylnaphthalene			87.3		%		50-150	06-SEP-18
2-Methylnaphthalene			79.8		%		50-150	06-SEP-18
Naphthalene			78.2		%		50-150	06-SEP-18
Perylene			107.5		%		50-150	06-SEP-18
Phenanthrene			92.4		%		50-150	06-SEP-18
Pyrene			102.5		%		50-150	06-SEP-18
Quinoline			79.3		%		50-150	06-SEP-18
PH-1:2-CL	**Soil**							
Batch R4205885								
WG2871863-2 DUP		**L2157301-1**						
pH (1:2 soil:water)		8.40	8.37	J	pH	0.03	0.2	09-SEP-18
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4205718								
WG2869283-1 DUP		**L2157301-6**						
% Gravel (>2mm)		<1.0	<1.0	RPD-NA	%	N/A	25	08-SEP-18
% Sand (2.00mm - 1.00mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (1.00mm - 0.50mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.50mm - 0.25mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.25mm - 0.125mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Sand (0.125mm - 0.063mm)		<1.0	<1.0	RPD-NA	%	N/A	5	08-SEP-18
% Silt (0.063mm - 0.0312mm)		19.4	18.9	J	%	0.5	5	08-SEP-18
% Silt (0.0312mm - 0.004mm)		60.8	60.5	J	%	0.4	5	08-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4205718								
WG2869283-1 DUP		**L2157301-6**						
% Clay (<4um)		19.7	20.4	J	%	0.7	5	08-SEP-18
WG2869283-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			3.0		%		0-7.6	08-SEP-18
% Sand (1.00mm - 0.50mm)			3.8		%		0-8.9	08-SEP-18
% Sand (0.50mm - 0.25mm)			9.0		%		5.3-15.3	08-SEP-18
% Sand (0.25mm - 0.125mm)			14.7		%		10-20	08-SEP-18
% Sand (0.125mm - 0.063mm)			14.7		%		7.3-17.3	08-SEP-18
% Silt (0.063mm - 0.0312mm)			13.5		%		9.9-19.9	08-SEP-18
% Silt (0.0312mm - 0.004mm)			22.5		%		17.6-27.6	08-SEP-18
% Clay (<4um)			18.9		%		13.4-23.4	08-SEP-18

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.
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).
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

Page 1 of 1

COC ID: **REGIONAL Koocanusa Reservoir**

TURNAROUND TIME: Regular

PROJECT/CLIENT INFO			
Facility Name / Job#	Regional Koocanusa		
Project Manager	Cait Good		
Email	[illegible]		
Address	421 Pine Avenue		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

LABORATORY			
Lab Name	ALS Burnaby		
Lab Contact	Lyudmyla Shvets		
Email	Lyudmyla.Shvets@ALSGlobal.com		
Address	2559 29 Street NE		
City	Calgary	Province	AB
Postal Code	T1Y7B5	Country	Canndn
Phone Number	14034071794		

OTHER INFO				
Report Format / Distribution		Excel	PDF	EDD
Email 1:	[illegible]	X	X	X
Email 2:	carla.fraser@teck.com	X	X	X
Email 3:				
Email 4:	teckcoal@equisonline.com			X
Email 5:	jwilson@minnow.ca	X	X	X
PO number	*VPO00563596*			

L2157301-COFC

SAMPLE DETAILS / **ANALYSIS REQUESTED** Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	Particle Size	TOC	PAH	Total Metals (including Hg)	Moisture							
							FILT	N	N	N	N	N	N	N					
							PRESERV	NONE	NONE	NONE	NONE	NONE	HNO3	NONE					
RG_TN_1_SED_20180829-1515	RG_TN_1	Sediment		29-Aug-18	3:15:00 PM	G	2	X	X	X	X	X							
RG_TN_2_SED_20180829-1445	RG_TN_2	Sediment		29-Aug-18	2:45:00 PM	G	2	X	X	X	X	X							
RG_TN_3_SED_20180829-1130	RG_TN_3	Sediment		29-Aug-18	11:30:00 AM	G	2	X	X	X	X	X							
RG_TN_4_SED_20180829-1230	RG_TN_4	Sediment		29-Aug-18	12:30:00 PM	G	2	X	X	X	X	X							
RG_TN_5_SED_20180829-1400	RG_TN_5	Sediment		29-Aug-18	2:00:00 PM	G	2	X	X	X	X	X							
RG_T4_1_SED_20180828-1000	RG_T4_1	Sediment		28-Aug-18	10:00:00 AM	G	2	X	X	X	X	X							
RG_T4_2_SED_20180828-1200	RG_T4_2	Sediment		28-Aug-18	12:00:00 PM	G	2	X	X	X	X	X							
RG_T4_3_SED_20180828-1330	RG_T4_3	Sediment		28-Aug-18	1:30:00 PM	G	2	X	X	X	X	X							
RG_T4_4_SED_20180828-1430	RG_T4_4	Sediment		28-Aug-18	2:30:00 PM	G	2	X	X	X	X	X							
RG_T4_5_SED_20180828-1530	RG_T4_5	Sediment		28-Aug-18	3:30:00 PM	G	2	X	X	X	X	X							
RG_T4_4_SED_20180828-1435	RG_T4_4	Sediment		28-Aug-18	2:35:00 PM	G	2	X	X	X	X	X							

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS

Koocanusa - VPO00563596

1 jar for PAHs and 1 bag for everything else

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
			8/31 10:10

SERVICE REQUEST (rush - subject to availability)

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	**Justin Wilson**	**Mobile #**	**519-803-3923**
Sampler's Signature		**Date/Time**	**August 30, 2018**

5°

Montana Department
of Environmental Quality

Quality Assurance Project Plan for the collection of data to support the development of partition coefficients (K_d)

Project Period: May 20th- October 2018

Project Number: WQSMQAP-03

Approval Signatures:

5/18/18

Eric Urban, Water Quality Planning Bureau Chief Date
Montana DEQ

5/18/18

Myla Kelly, Standards supervisor Date
Montana DEQ

5/18/18

Darrin Kron, Monitoring and Assessment Supervisor Date
Montana DEQ

Michael Pipp 5/18/18

Michael Pipp, Information Management and Technical Services Section Date
Montana DEQ

Michelle Hauer 5/18/18

Michelle Hauer, QA/QC Officer Date
Montana DEQ

5/18/2018

Terri Mavencamp, Project Manager, Co-chair LKMRWG Date
Montana DEQ

5/18/2018

Mike Sokal, Co-Chair LKMRWG Date
MOE

Note: The latest controlled version of this document is located on the DEQ website. Printed copies are not controlled. Document users are responsible for ensuring printed copies are valid prior to use.

REVISION HISTORY

Revision No.	Date	Modified By	Sections Modified	Description of Changes

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DISTRIBUTION LIST

All persons on the distribution list will receive electronic copies of the final QAPP and any subsequent revisions.

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Mike Sokal, Ministry of Environment and Climate Change, BC, Biologist, mike.sokal@gov.bc.ca

Selenium Technical Subcommittee (SeTSC)
Monitoring and Research Committee (MRC)

1.0 PROJECT ORGANIZATION

Partners: Montana Department of Environmental Quality (MT DEQ) and the U.S. Army Corps of Engineers (USACE) are partnering together to fund and conduct a study in 2018 to monitor selenium concentrations in Lake Koocanusa and develop a partition coefficient to support the development of a site-specific criterion/objective for Lake Koocanusa.

Kent Easthouse, USACE, **field lead**, has the responsibility of physically collecting the samples and ensuring that sampling procedures comply with this QAPP and reporting any deviations to Terri Mavencamp, who will inform the QA/QC officer, Michelle Hauer.

Terri Mavencamp, MT DEQ, Project manager has the responsibility for writing and implementing the QAPP for this project (in collaboration with the SeTSC and USACE) managing day-to-day project activities and coordination of laboratory services and data management.

Darrin Kron, MT DEQ, Monitoring and Assessment has the responsibility of supplying field support for USACE to ensure the samples follow the DEQ quality assurance/quality control process for data flow and shipping the samples to Georgia State.

Dr. Theresa Presser, **USGS,** technical advisor, technical consulting and data interpretation.

Dr. David Naftz, USGS, technical advisor, technical consulting and data interpretation

Dr. Dan Deocampo, Georgia State University Sediment Laboratory will extract particulates from large volume water samples using continuous centrifuge equipment.

Amanda Royal, Brooks Applied Labs, Seattle, WA has the responsibility of receiving the samples from Georgia State, logging them in, analyzing them for selenium and reporting the data as outlined in this QAPP. Amanda will report any discrepancies or laboratory problems to Terri Mavencamp who will inform the DEQ QA/QC manager.

Brooks Applied Laboratories, Washington State will analyze the selenium concentration in particulate samples extracted from the large volume samples.

Michael Pipp and Jolene McQuillan, MT DEQ Information Management and Technical Services (IMTS), are responsible for data validation of received data from the lab and entering the data into DEQ's Montana EQuIS Water Quality Exchange database (MT-eWQX) and subsequently sending the data to EPA's National WQX Warehouse where the data will be available for use by the public and other agencies through EPA's Water Quality Portal.

Michele Hauer, MT DEQ QA/QC officer has the responsibility of reviewing and approving this QAPP and of overseeing project quality assurance and control, including the documentation of field deviations and determining when the QAPP will need to be revised/re-submitted for signatures.

Eric Urban Water Quality Protection Bureau Chief has the responsibility of securing funding for the laboratory analyses.

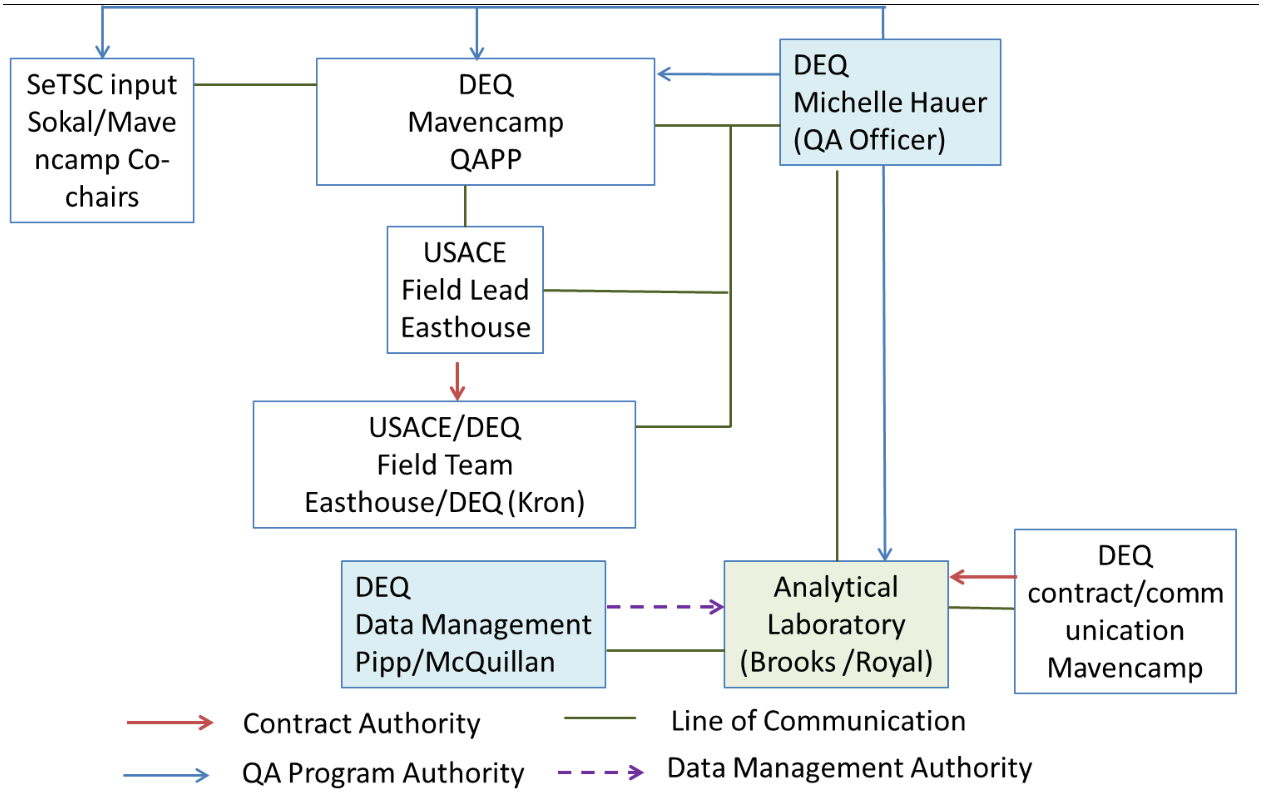

Figure 1: Project Organization. Green lines indicate lines of communication, which flow both ways.

2.0 PROJECT BACKGROUND & DESCRIPTION

Project Objectives: The objective of the proposed sampling program is to measure suspended particulate selenium concentrations at the Forebay, Tenmile and International Border in Lake Koocanusa in May, June and September 2018 to continue the development of a partition coefficient, K_d as per recommendations by the Selenium Technical Subcommittee (SeTSC, February 15, 2018).

For details on the SeTSC and the working structure of the Lake Koocanusa Monitoring and Research Committee, please see the committee governance documents: http://lakekoocanusaconservation.pbworks.com/w/browse/#view=ViewFolder&param=Commitee_Governance_Docs

The partition coefficient describes the process of phase transformation at the base of the food web, specifically the partitioning of selenium from the dissolved to the particulate phase. The determination of instantaneous K_d values is necessary to support the development of a site-specific selenium water criterion/objective for Lake Koocanusa.

Environmental partitioning between dissolved and particulate phases, K_d, is defined as the ratio of the Se concentration of particulate material (in dry weight (dw)) to the dissolved Se concentration (covered in the USACE 2018 SAP) observed at any instant in simultaneously collected samples (Presser and Luoma, 2013b):

Equation 1: $K_d = (C_{\text{particulate material}}, \mu g/kg\ dw) \div (C_{\text{water}}, \mu g/L)$

The magnitude of K_d varies with particulate-material type, hydrology and Se speciation, among other factors. The K_d links the dissolved selenium value (for permitting and monitoring activities) to a final selenium toxicity guideline, for example in aquatic life. "Passage through the food web becomes predictable once concentrations of Se at the base of the food web are known" (Luoma and Presser, 2009).

For the greatest reduction in uncertainty associated with K_d, it is necessary to measure selenium values across multiple years and multiple seasons. Furthermore, to model the bioaccumulation of selenium in a system, data from the same site is needed within a 12-month window (EPA, 2016) and ideally within the same month (SeTSC, April, 2018).

2018 is the fourth year of Lake Koocanusa K_d sampling and will occur at three locations in the reservoir: the International Border, Tenmile and the Forebay. In 2015-2017, the Tenmile location was not sampled for particulate matter, but is a long-term monitoring site on the reservoir and data for selenium has been collected at this site since 2012. Therefore, having data at Tenmile in 2018 may provide a third model location in the reservoir (in addition to International Border and Forebay). To develop a site-specific selenium water criterion/objective for Lake Koocanusa we need spatially and temporally matched data for water, particulates, invertebrates and fish. For QAPPs covering the water, invertebrates and fish see USACE, 2018; DEQ/FWP 2018a, DEQ/FWP, 2018b. See Table 1 for a graphic of 2018 planned field activities.

The sampling in 2018 will focus on the epilimnion instead of the epilimnion and hypolimnion as significant differences in the suspended particulate selenium dry weight results between the epilimnion and hypolimnion were not been noted in 2016 ($p > .05$) and most of the fish identified for modeling selenium bioaccumulation spend most of their time in the shallow water, littoral zones of the reservoir (Baranowska, K. and M.D. Robinson, 2017).

Border Station							
	apr	**may**	**jun**	**jul**	**aug**	**sep**	**oct**
lake profiling pH, SC, DO and temp.	X	X	X	X	X	X	X
dissolved selenium 2 depths	X	X	X	X	X	X	X
selenium in suspended sediment- epi- 2 depths		X	X			X	
zooplankton selenium tows 64 um mesh size and community analyses	X	X	X	X	X	X	X
surface macro-invert Se and community to order		X				X	
benthic invert dredge Se and community to order, 0.5 mm		X				X	
selenium in fish tissue: eggs, muscle, whole body (prioritized in that order)		X				X	
Tenmile							
lake profiling pH, SC, DO and temp.	X	X	X	X	X	X	X
dissolved selenium 2 depths	X	X	X	X	X	X	X
selenium in suspended sediment 2 depths		X	X			X	
zooplankton selenium tows 64 um mesh size and community analyses	X	X	X	X	X	X	X
surface macro-invert Se and community		X				X	
benthic invert dredge Se and community, 0.5mm		X				X	
selenium in fish tissue: eggs, muscle, whole body (prioritized in that order)		X				X^t	
Forebay							
lake profiling pH, SC, DO and temp.	X	X	X	X	X	X	X
dissolved selenium 2 depths	X	X	X	X	X	X	X
selenium in suspended sediment 2 depths		X	X			X	
zooplankton selenium tows 64 um mesh size and community analyses	X	X	X	X	X	X	X
surface macro-invert Se and community		X				X	
benthic invert dredge Se and community, 0.5mm		X				X	
selenium in fish tissue: eggs, muscle, whole body (prioritized in that order)		X				X^t	

Table 1: 2018 Planned field activities on Lake Koocanusa in the U.S. $\overset{t}{X}$ indicated that the event is tentative.

3.0 PROJECT TASK/DESCRIPTION

3.1 PROJECT SCHEDULE

The USACE will collect matched water and suspended sediment samples in May, June and September of 2018 (see Table 1). This QAPP details the collection of the suspended sediment samples only. The matched dissolved selenium water samples and zooplankton selenium analyses are described in the 2018 USACE SAP. Suspended sediment samples will be delivered to the Georgia State University sediment laboratory using overnight mail services. After particle extraction at Georgia State, the dried particulate samples will be shipped to Brooks Analytical Laboratories (BAL) for total selenium analysis.

The Georgia State laboratory and BAL will report the analytical results to MT DEQ within 30 days of sample receipt. Data collected for this project will be validated (see Attachment B) and entered into MT-eWQX and subsequently entered into EPA's National WQX Warehouse where it can be publicly accessed via the USGS/EPA Water Quality PORTAL (https://www.waterqualitydata.us//).

Once the annual data are validated by MT DEQ, the data will be made available to the Lake Koocanusa Monitoring and Research Committee and the Lake Koocanusa Selenium Subcommittee for review and incorporation into modeling efforts and other applications.

Table 2. Sampling location coordinates.

Site Name	Latitude	Longitude
Forebay	48.41194	-115.30917
Ten Mile	48.58500	-115.23111
International Boundary	48.99556	-115.17861

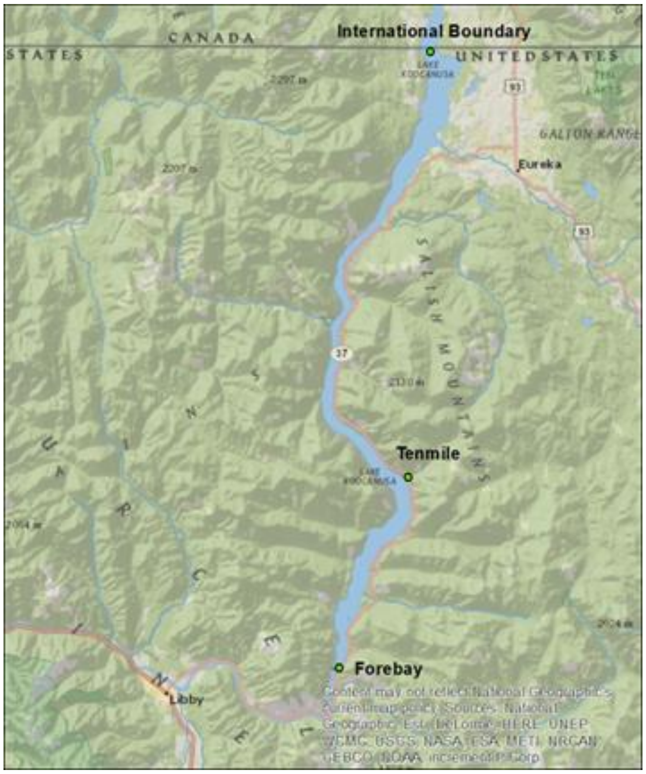

Figure 2. Map of the sampling locations: the Forebay, Tenmile and International Border.

3.2 TASK 1. COLLECTION OF WATER FOR SUSPENDED PARTICULATE SE FROM THE EPILIMNION.

Selenium (µg/kg) dry weight (dw) in particulate from the large volume water samples and the dissolved Se (µg/L) are needed to determine the K_d values (Equation 1).

Large volume water samples for particulate total Se will be collected in pre-cleaned ~19 Liter high density polyethylene carboys at the surface (3 m below the water surface) using a 3.0 liter polycarbonate van dorn sampler with ultra-clean seals at three locations in the reservoir (Table 2).

A designated van dorn sampler is used at each sampling location and will be decontaminated between each sample event via a 0.2% liquinox wash, deionized water rinse, 5% hydrochloric (HCl) acid rinse and 5x DI rinse. Large volume samples will be collected for particulate analysis rather than by using field filtration because large volume samples are the most efficient way to get a large enough mass of sediment to achieve a reproducible and defensible chemical concentration for sediment-associated constituents (Horowitz, 2001).

In May and June, one sample (~19 L) will be collected from the epilimnion at the International Border, Tenmile and Forebay stations as well as one duplicate and one blank. For the September sampling, because of lower suspended sediment concentrations, two samples will be collected from the epilimnion at each of the three stations along with a blank and duplicate (Table 4).

After collection, each sample will be placed in a large plastic bag on ice in a cooler. The samples will be kept cold on ice (less than four degrees Celsius) until receipt by Georgia State University (GSU).

Once at GSU, Daniel Gebregiorgis, a post doc for Dan Decampo will measure or oversee the measurement of the water volume contained in each carboy, and suspended particulates will be concentrated using a high volume, continuous centrifuge at the GSU sediment laboratory in Atlanta, Georgia (Horowitz et al., 2001). The particulate mass will be freeze dried, weighed, and sent to Brooks Applied Laboratories in Washington for digestion and total selenium analysis.

Particulates from the high-volume water samples will be digested according to EPA method 3050B-modified and analyzed by inductively coupled plasma triple quadrupole mass spectrometry (ICP QQQ MS). The samples will be submitted as dry weight masses and will be reported as dry weight.

Water samples for the analysis of dissolved (<0.45 µm pore size) Se will be collected from the International Boundary, Tenmile and Forebay sites from April-October (Table 1- details of collection and analyses are included in the USACE 2018 SAP). Briefly, water samples will be collected using a 2.2 liter polycarbonate van-dorn style sampler. Samples will be collected from 3 m below the reservoir surface and 3 m above the reservoir bottom. Sample containers will be rinsed three times prior to filling by two field technicians wearing powder-free vinyl gloves. The May, June and September dissolved selenium water samples will be filtered by filling a 60 ml syringe with a 0.45 µm disposable filter with water and rinsing the sample bottle three times with at least 20 ml of filtered water. After rinsing, a new filter will be placed onto the syringe, 5 – 10 ml wasted through the filter before filling the sample bottle with at least 50 ml of filtered water. The samples will be preserved with ultra pure 7.7 N nitric acid, placed on ice and sent to Brooks Applied Laboratories in Washington State for the analysis of total dissolved selenium using ICP-QQQ-MS.

A designated van-dorn sampler will be used at each water quality station (International Border, Tenmile and Forebay.

3.3 DEVIATIONS FROM QAPP

Any deviations from the QAPP will be reported to the field lead as soon as the deviation is identified. The field lead will inform the project manager, T. Mavencamp, who will notify the MT DEQ QA officer, M. Hauer. The deviations will be recorded in writing and appended to the QAPP file (hard copy and on-line). If the deviations will affect laboratory processes and data, the appropriate lab (Brooks or Georgia), the MT DEQ data manager, Jolene McQuillan, and the MT DEQ QA officer, Michelle Hauer, will be notified. A plan to address the deviation will be sent to the appropriate individuals.

If changes to the QAPP are needed, the QA officer will determine if they significantly impact the technical and quality objectives of the project. If they do, Terri Mavencamp will modify the QAPP to document the change and submit the revision for approval. Following approval, the changes may be implemented.

4.0 DATA QUALITY OBJECTIVES AND CRITERIA

4.1 PRECISION AND ACCURACY

4.1.1 PRECISION

Laboratory precision will be assessed using a laboratory duplicate that will be analyzed at random with every sample batch (i.e., sampling event) and a field duplicate that will be analyzed with every sampling event. For particulate selenium analysis, the relative percent difference (RPD) of the laboratory duplicates will be less than or equal to 30 % for values that are greater than 5 times the detection limit and less than or equal to 40 % for values that are less than or equal to 5 times the detection limit.

Table 3. QC requirements for particulate selenium analysis

particulate Se analysis			
Measurement	Precision	Accuracy	Measurement Range
Particulate analysis	≤ 30%	≤ 25%	Reporting limit = .1 mg/kg

4.1.2 ACCURACY

Accuracy will be assessed using laboratory standard reference materials. These quality control analyses will be performed for every sample batch at a frequency of at least 5 percent of the total number of samples submitted and must be within 25 percent of the certified value. Field blanks will also be submitted (silica in large volume water sample) to determine recovery of the centrifugation step and background for the selenium analyses. The recovery must be within 30 percent. The selenium values for blanks will not exceed 2 times the minimum detection limit. If a field blank exceeds the control limits, all of the values from the batch will be flagged (see Attachment B).

For particulate selenium analysis, the percent recovery of matrix spikes must be between 75 and 125 percent.

4.2 REPRESENTATIVENESS

Sample representativeness will be ensured by employing consistent and standard sampling procedures.

4.3 COMPLETENESS

The completeness goal is that a minimum of 90 percent of the sample analysis results reported by the laboratory will be judged acceptable. It is anticipated that all planned field samples will be collected. An equipment checklist will be used to prevent loss of data resulting from missing containers or inoperable instruments prior to embarking on field sampling trips.

Completeness will be assessed by comparing valid sample data with this quality assurance project plan and the chain-of-custody records. Samples that have been collected, but found to contain insufficient sediment mass to complete a selenium analysis will be considered incomplete, and the volume or method for collecting sediment for that site will be modified in future QAPPs. Completeness will be calculated by dividing the number of valid values by the total number of values.

4.4 COMPARABILITY

Data comparability will be ensured through the application of standard sampling procedures, analytical methods, units of measurement, and detection limits. The results will be tabulated in standard spreadsheets for comparison with threshold limits and background data.

4.5 SENSITIVITY

To determine the K_d, the suspended particulate value must be measured with a reasonable amount of certainty. Therefore, the measurement must be above the minimum detection limit (MDL), and ideally to increase confidence in the number, above the practicable quantitation limit (PQL). In previous years, the concentration of Se in the suspended sediment were approximately 3-4 mg/kg dw (Presser and Naftz, 2017). For particulate selenium analyses, Brooks regularly achieves a minimum detection limit (MDL) of .035 and a minimum reporting limit (MRL) of approximately 0.1 mg/kg. For this study, a MRL of 0.1 mg/kg is the required sensitivity.

5.0 TRAINING REQUIREMENTS AND CERTIFICATION

Training for MT DEQ field personnel is described in the MT DEQ Field Manual, 2012.

6.0 DOCUMENTATION AND RECORDS

6.1 SAMPLE HANDLING AND CUSTODY

Field crews are responsible for the integrity of samples from the time of collection until shipment. This responsibility includes proper labeling, packaging of the samples and sample custody documentation packaged in a zip lock baggie.

The day after sampling, the samples will be taken to Libby or Kalispell and shipped overnight (Libby, 918 Idaho Ave, Libby, MT, 59923, 406293-4181) to Georgia State University by DEQ or USACE staff (Daniel M. Deocampo, Professor and Associate Dean,
Kell Hall 390B, College of Arts and Sciences, Georgia State University). Once in Georgia, the chain of custody section of the Site Visit Form (SVF) will be updated and the SVFs and samples will be sent to Brooks Laboratory in Seattle for sediment selenium analyses. The SVF's COC section will be updated by Brooks upon receipt and the original SVFs will be sent to MT DEQ for data processing.

6.2 SAMPLE HANDLING PROCEDURES

After samples are collected and labeled, samples are wrapped in bubble wrap and placed in a clean cooler on ice, two carboys per cooler. A temperature of ≤4°C will be maintained until received by Georgia State. Georgia State will keep the samples cold during processing and dewater them within 1 week of the sample collection date. After processing, Georgia State will send the samples to Brooks for Se analyses.

6.3 SAMPLE LABELING

All samples must have MT DEQ site visit stickers, unique Sample IDs, and should be clearly linked to the information on the SVF (attachment A).

6.4 SAMPLE CUSTODY

Custody documentation (SVF) will accompany all samples from the field to the laboratory (see Attachment A for the SVF with chain of custody information at the bottom). Field personnel will initiate custody documentation before samples are placed in the cooler and maintain the custody forms until the samples are shipped. The field technician will sign the custody documentation and inspect the integrity of the samples and documentation before shipment. Any missing information or discrepancies will be communicated to the project lead. Once Georgia State receives the samples, they will sign the custody documentation. The custody will be tracked until the sample reaches Brooks Lab and is analyzed for selenium. Each handler of the samples will inspect the integrity of the samples and documentation during the sample receipt. Any issues or discrepancies identified by the laboratory will be communicated to the project lead and QA/QC officer.

6.5 DATA MANAGEMENT

MT DEQ-funded data are entered into MT-eWQX where it is subsequently entered into the USGS/EPA Water Quality Portal for public access https://www.waterqualitydata.us// This project is to follow the WQPB quality assurance/quality control process. This internal process consists of writing a quality assurance project plan (QAPP) and submitting it to the MT DEQ QA officer. Once the sampling plan has been approved and filed, and the sampling is being undertaken, appropriate SVFs need to be filled out so that laboratory results can be processed by WQPB staff. One SVF will be filled out for each sample and a unique Site Visit Code sticker will be affixed to the SVF.

When samples are shipped, each SVF is signed and included with the carboys. When the samples arrive at Georgia State, the lab personal will take the temperature of the sample and sign the sample in. The SVFs will be included with the samples when they are sent to Brooks and Brooks lab will sign the samples in and make copies of the SVFs for their records and will return the original SVFs to MT DEQ.

The SVF copies need to be filed with WQPB Data Tech (currently Deanna Tarum), who will enter the forms into the MT DEQ electronic records system.

7.0 SAMPLING PROCESS DESIGN

7.1 LARGE VOLUME PARTICULATE SAMPLES

Suspended particulate will be collected for Se suspended particulate analysis via large volume water samples. Sampling will be scheduled when it is safe to be on the lake in a boat (depending on weather) in May, June and September, typically towards the end of the month on a Tuesday.

Large volume samples will be collected at 3 meters below the surface at the Forebay, Tenmile and International Boundary sites (Table 2). In May and June, one sample (~19 L) will be taken from each location along with a blank and duplicate. In September, due to lower predicted suspended sediment, two samples will be taken at each location along with a duplicate and blank (Table 4).

Dissolved water samples for dissolved selenium analysis will be collected at the same locations/depths and time as the large volume particulate analysis by the USACE. The total dissolved selenium sample will be filtered into a 60 ml HDPE bottle and placed on ice in a cooler (sampling details covered under the 2018 USACE SAP).

Table 4: Table of Samples to be collected during each sampling event.

Activity	MAY	JUN	SEP	LAB
Large volume suspended sediment collection	19 L samples from 1 depth, 3 locations + 1 QC blank + 1 replicate (total = 5 samples)	19 L samples from 1 depth, 3 locations + 1 QC blank + 1 replicate (total = 5 samples)	38 liter samples from 1 depth, 3 locations (2 samples/depth due to low particulates in Sep) + 1 QC blank + 1 replicate (total = 9 samples)	Georgia State Univ. = centrifugation and Brooks Applied Lab for particle analysis
Dissolved selenium in water collection (field filtered)*	2 depths, 2 locations + 1 SRWS + 1 duplicate + 1 blank (total = 7 samples)	2 depths, 2 locations + 1 SRWS + 1 duplicate + 1 blank (total = 7 samples)	2 depths, 2 locations + 1 SRWS + 1 duplicate + 1 blank (total = 7 samples)	Brooks Applied Lab

*This activity is covered in the USACE 2018 SAP.

Table 5. Sample Methods

Sample	Suspended Sediment	Dissolved selenium analysis
Sample Method	Large-Volume Water Samples (Horowitz et al., 2001)	3.0 liter van-dorn style sampler to depth and filling
How sample is taken/ equipment	The 19 Liter polyethylene carboys will be filled by a pre-cleaned van dorn sampler.	Sample will be filtered in the field using syringe filters supplied by Brooks lab
Container	19 Liter pre-cleaned polyethylene carboys. Sample will be place on ice and shipped over night to the lab for analysis.	60 ml lab-supplied HDPE bottle sample will be placed on ice and shipped overnight to the lab.
Sample Preservation	acid preservation is inappropriate for sediment analysis, will cause analytes to dissociate from sediment.	Yes, nitric acid

	0-4°C during shipment <4° C in lab.	
Holding Time	Lab processed w/in 1 week to dryness and then sent to Brooks	Not to exceed 6 months

8.0 SAMPLING METHODS

USACE follows field sampling methods as outlined in the USGS field manual found at http://water.usgs.gov/owq/FieldManual/

9.0 ANALYTICAL METHODS

The samples will be sent to Georgia State University where they will be dewatered to dry sediment and then sent to Brooks Applied Lab in Washington State. Brooks will analyze the samples and report their results to MT DEQ within 30 days. Sample and QC data will be reported in MT-eWQX EDD standard format, including any problems encountered during the analyses.

Table 6. Analytical Methods

Measurement	method	lab
Particulates (large volume)	ICP-QQQ-MS w EPA 1638-modified	Brooks Applied Laboratories, WA
Dissolved total Se *	ICP-QQQ-MS EPA 1638 mod with in bottle digestion	Brooks Applied Laboratories, WA

*Collection/analyses is covered in the USACE 2018 SAP.

10.0 QUALITY CONTROL REQUIREMENTS

Quality Assurance/Quality Control (QA/QC) procedures will consist of following this QAPP and collecting field QC samples.

10.1 FIELD DUPLICATE SAMPLES

One field duplicate will be taken per sampling event. The sites will be randomly selected for duplicate sampling and will be collected following the same methodology as for the original sample.

10.2 PRECISION

The relative percent difference (RPD) of duplicates (analyzed with every sampling event) will be calculated as follows:

$$RPD = ((C_1-C_2) / ((C_1+C_2)/2)) \times 100\%$$

where
C_1 is the larger of the 2 values, and
C_2 is the smaller of the 2 values.

Duplicates that exceed the precision outlined in Table 4 will be flagged (attachment B).

10.3 METHOD ACCURACY

The accuracy of the method in the presence of a specific matrix (matrix spike) will be calculated as follows. Blank spikes, matrix spikes and duplicate spikes will be performed with every sample event.

$\%R = ((S-U) / C_{sa}) \times 100$

where
%R is the percent recovery,
S is the measured concentration in the spiked sample,
U is the measured concentration in the unspiked sample, and
C_{sa} is the actual concentration of spike added.

The method accuracy will be analyzed at a frequency of at least 5%
Results exceeding the objectives outlined in Table 4 will be flagged (attachment B).

10.4 ACCURACY OF LABORATORY CONTROLS

Accuracy of laboratory standard reference materials will be measured as

$\% R = (M-T) \times 100\%$
where
%R is the % recovery,
M is the measured value, and
T is the true value.

Results exceeding the objectives outlined in Table 4 will be flagged (attachment B).

10.5 BLANK/RECOVERY STANDARD

Blank/Recovery standards will be taken every time routine water samples are delivered to the lab. They will be prepared using certified blank water, clean polypropylene bottles and Powdered Weisner Quartzite from Rome, Georgia (obtained from GSU sediment laboratory). The blank/recovery standards will be used to determine the recovery of suspended sediment during the large volume centrifugation and will indicate if there is contamination in the bottles/shipping/handling/centrifugation by comparing the selenium results in the Quartzite recovered via large volume centrifugation to the selenium results of the quartzite alone (dry, not subjected to large volume centrifugation).

11.0 EQUIPMENT DECONTAMINATION

Sampling equipment (large volume carboys, van dorn sampler, etc.) used during the project will be decontaminated prior to sample collection using the following procedure.

- Wash with phosphate-free detergent.

- Rinse thoroughly with potable water.

- Rinse with a dilute HCl solution.

- Rinse thoroughly with deionized water

12.0 ASSESSMENT & RESPONSE

12.1 LABORATORIES AND CONTRACTORS

Georgia State University will concentrate the large volume samples down to dry sediment.

Brooks Applied Laboratory in Bothell Washington will analyze the dissolved selenium (under a different contract with the USACE see USACE 2018 SAP), and total selenium in particulates. Brooks is accredited by the National Environmental Laboratory Accreditation Program and has multiple certifications for non-potable water and solids in Washington and New Jersey, including Se speciation analysis and trace metal analysis. They participate in the bi-annual USGS laboratory round-robin program for trace elements, including selenium.

12.2 FIELD ACTIVITY ASSESSMENTS AND CORRECTIVE ACTIONS

Assessment of field sampling procedures will be provided by the USACE field lead, Kent Easthouse. The field lead or his/her representative will observe field sampling procedures and assess their conformity with this QAPP. A summary report will be prepared and submitted within 20 days to MT DEQ outlining any corrective actions that are needed.

13.0 DATA REVIEW, VERIFICATION & VALIDATION

MT DEQ will do the QA/QC assessment of data before it is uploaded into MT-eWQX. After receipt of data from Brooks, Data Management and the QA officer at MT DEQ will review the sample and control data.

Data will be accepted if the samples were collected and analyzed in accord with this QAPP and the results from the lab fall within the acceptable precision/accuracy/data measurement ranges. If the values are outside of these ranges, the data will be qualified as appropriate.

13.1 DATA ANALYSIS

After a QC review and validation of the data by MT DEQ, the data will be released to the SeTSC for analysis and discussion. The data that is available will be presented in draft form to the SeTSC and MRC at the October 2018 meeting. For more details on the data analysis of this project, please refer to the 2018 Benthic and Surface Macroinvertebrate Selenium Concentrations in Lake Koocanusa QAPP data analysis section.

17.0 REFERENCES

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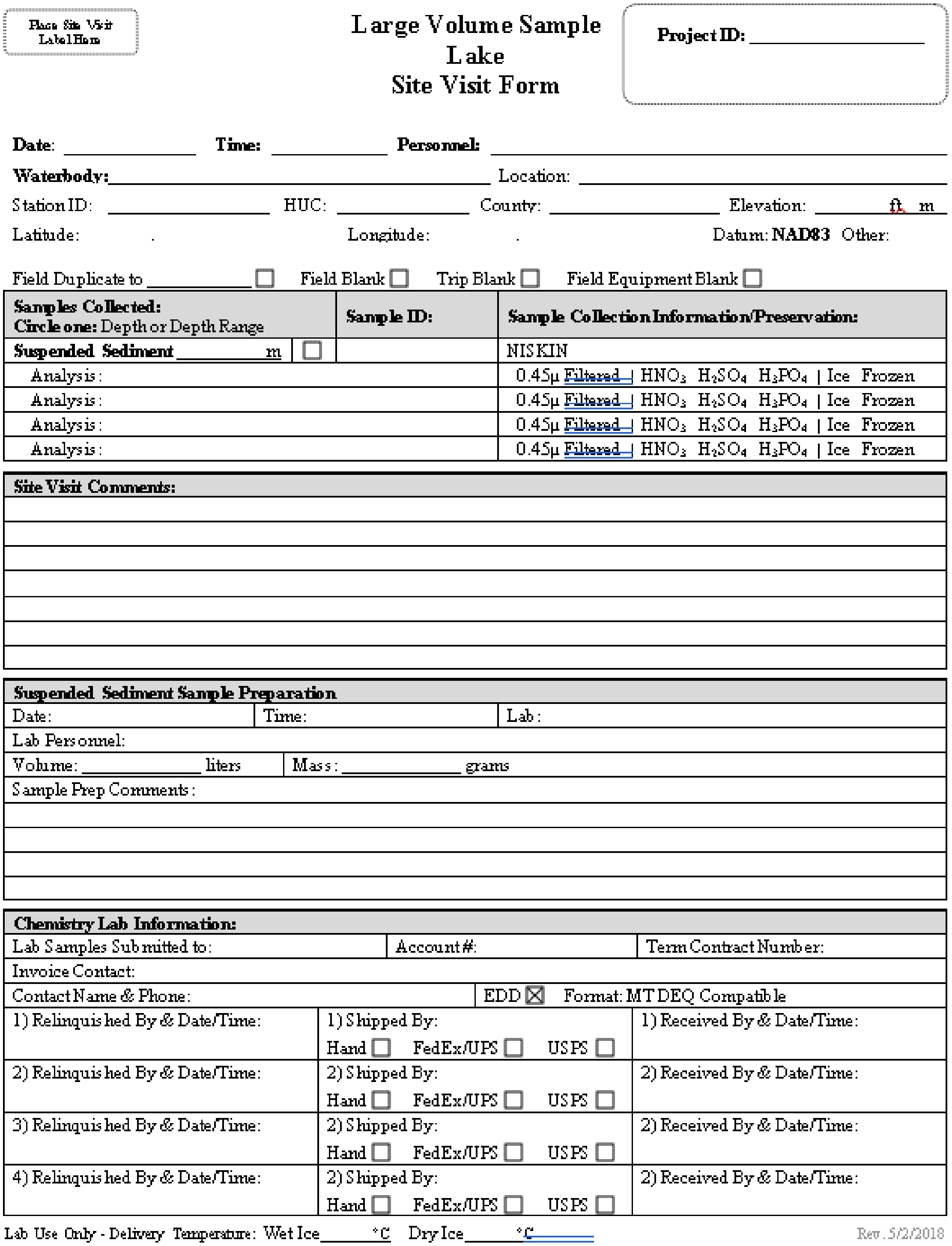
18.0 ATTACHMENT A: DEQ SITE VISIT FORM



Place Site Visit Label Here

Large Volume Sample
Lake
Site Visit Form

Project ID: ____________________

Date: ______________ **Time:** ____________ **Personnel:** ____

Waterbody:____ Location: ____

Station ID: _________________ HUC: ______________ County: __________________ Elevation: __________ft m

Latitude: . Longitude: . Datum: **NAD83** Other:

Field Duplicate to ___________ ☐ Field Blank ☐ Trip Blank ☐ Field Equipment Blank ☐

Samples Collected: **Circle one:** Depth or Depth Range	**Sample ID:**	**Sample Collection Information/Preservation:**
Suspended Sediment _________m ☐		NISKIN
Analysis:		0.45μ Filtered | HNO_3 H_2SO_4 H_3PO_4 | Ice Frozen
Analysis:		0.45μ Filtered | HNO_3 H_2SO_4 H_3PO_4 | Ice Frozen
Analysis:		0.45μ Filtered | HNO_3 H_2SO_4 H_3PO_4 | Ice Frozen
Analysis:		0.45μ Filtered | HNO_3 H_2SO_4 H_3PO_4 | Ice Frozen

Site Visit Comments:

Suspended Sediment Sample Preparation

Date:	Time:	Lab:
Lab Personnel:		
Volume: ___________ liters	Mass: ___________ grams	
Sample Prep Comments:		

Chemistry Lab Information:

Lab Samples Submitted to:	Account #:	Term Contract Number:
Invoice Contact:		
Contact Name & Phone:	EDD ☒ Format: MT DEQ Compatible	
1) Relinquished By & Date/Time:	1) Shipped By: Hand ☐ FedEx/UPS ☐ USPS ☐	1) Received By & Date/Time:
2) Relinquished By & Date/Time:	2) Shipped By: Hand ☐ FedEx/UPS ☐ USPS ☐	2) Received By & Date/Time:
3) Relinquished By & Date/Time:	2) Shipped By: Hand ☐ FedEx/UPS ☐ USPS ☐	2) Received By & Date/Time:
4) Relinquished By & Date/Time:	2) Shipped By: Hand ☐ FedEx/UPS ☐ USPS ☐	2) Received By & Date/Time:

Lab Use Only - Delivery Temperature: Wet Ice______°C Dry Ice______°C

Rev. 5/2/2018

ATTACHMENT B: QUALITY CONTROL CHECKLIST

Electronic Data Deliverable (EDD) - Activity

__ Lab EDD Activity IDs match the SVF/SUDS Activity IDs.

__ Lab EDD Activity Start Date and Time match the date/time the samples were collected.

__ Field duplicates and field blanks are clearly identified by an Activity Comment, Result Comment, and appropriate Activity Type.

Lab Report

__ Reporting detection limits meet the project-required detection limit defined in SAP.

__ Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the SAP/QAPP. If any samples exceeded the control limits, the associated data is "J" flagged.

  - Lab Qualifier "S" (Spike recovery outside of advisory limits) = apply "J" flag with Result Comment "MS/MSD failed [high or low] (xx/xx%), expect [high or low] bias." Apply flag and comment to all associated results (in the same batch) that were detected above the LRL.

__ All method blanks are less than the project-required detection limit. If a method blank has a detect level at or above the reporting limit (LRL), then samples up to or equal 10x the detected value are "B" flagged with a Result Comment "Method blank contamination, results <[x.xx] mg/l are B flagged." The actual blank is not "B" flagged. Non-detects are not flagged.

EDD - Results

__ Holding times met. If any data exceeds the holding time, an "H" flag and Result Comment are added (such as "Sample exceeded EPA 7 day holding time.")

__ Ensure the Analytical Method ID matches the laboratory report and followed the method defined in the SAP.

__ Ensure approriate Result Value Units are used. Ensure that the Result Values and the Result Value Units correlate.

__ Ensure Characteristic ID, Characteristic Name, Method Speciation Name, and Sample Fraction are entered approriately and correctly. Refer to Appendix C in the data manager desk manual.

__ If the result value is between the MDL and the LRL, the result is "J" flagged and has a Result Comment "Result between MDL and LRL, J flagged as estimate."

__ All field blanks are less than the project-required detection limit. If a field blank has a detect level at or above the reporting limit (LRL), then samples up to or equal 10x the detected value are "B" flagged with a Result Comment "Field blank contamination, results <[x.xx] mg/l are B flagged." The actual blank is not "B" flagged. Non-detects are not flagged.

__ Field duplicates were all within the required control limits specified in the SAP/QAPP (usually if result value >5x LRL, then duplicates should be within 25% of each other). If any field duplicates exceeded the project-required control limits, all associated results are "J" flagged with a Result Comment "Field duplicate RPD >25% (xx%)." Or "Associated field duplicate RPD >25% (xx%)."

__ All samples requiring dilutions have a "D" result qualifier and the associated detection/reporting limits have the dilution factor applied.

__ For STREFPRO State Lab cations with a sample fraction of "Free Avail", add a Result Comment: "Analyzed directly from acid-preserved bottle without digestion." Only project allowed to have Free Avail sample fraction is STREFPRO.

__ All samples that have result qualifiers in the laboratory report have the appropriate qualifier, or equivilent qualifier, in the Result Qualifier field.

__ Ensure that Total Nitrogen results are greater than both Nitrate+Nitrite and Ammonia (within 10% is ok). If TN is less than the total, apply "J" flag and Result Comment describing why the Result Value is estimated.

__ Ensure that Total Phosphorus results are greater than SRP/Orthophosphate (within 10% is ok). If TP is less than SRP, apply "J" flag and Result Comment describing why the Result Value is estimated.

__ Ensure that total recoverable metal results for a particular analyte are greater than the dissolved fraction.

  - When detected at normal levels, well above the reporting limit, always go with 10% since that is typical for an RPD limit if you were comparing duplicates. However, when it is a really low level, the 10% rule doesn't work. If they were different by more than the reporting limit for a low-level result, have the lab recheck the results.

__ Look for any unusual outlier data by analyte.

Data Qualifiers and Descriptions

Result Qualifier	Result Qualifier Description
B	Detection in blank.
D	Contract Required Quantitation Limit (CRQL) not met due to sample matrix interference, dilution required.
H	Holding time exceeded.
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
L	Lowest available reporting limit for the analytical method used.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
**Any combination of these qualifiers can be associated with each result value.	

Quality Control Terminology and Descriptions

<table>
<tr><th colspan="3">FIELD QC</th></tr>
<tr><th>Term</th><th>Description</th><th>Purpose/Usage</th></tr>
<tr><td>Trip Blanks</td><td>Prepared at the lab prior to the sampling event and kept with the collected samples throughout the sampling trip.</td><td>To determine if cross contamination occurs between samples and identify contaminants that may be introduced into samples during transit to and from the lab.</td></tr>
<tr><td>Field Blank</td><td>Prepared in the field with lab water and kept with the collected samples throughout the sampling trip.</td><td>Monitors contamination resulting from field activities and or ambient levels of analytes present at time of sampling.</td></tr>
<tr><td>Field Duplicate</td><td>Two independent samples taken under the same conditions. Water samples would be two independent samples taken at the same location at the same time.</td><td>To determine the homogeneity of the samples collected.</td></tr>
<tr><th colspan="3">LABORATORY BATCH QC</th></tr>
<tr><th>Acronym</th><th>Description</th><th>Definition</th></tr>
<tr><td>LRB/Method Blank</td><td>Laboratory Reagent Blank</td><td>An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and internal standards that are used with other samples. The LRB is used to determine if method analytes or other interferences are present.</td></tr>
<tr><td>LFB/LCS</td><td>Laboratory Fortified Blank;
Laboratory Control Sample</td><td>Reagent water spiked with a known amount of analyte. Ideally treated exactly like a MS/LFM. Control used to determine bias in sample spikes.</td></tr>
<tr><td>MS/LFM</td><td>Matrix Spike/Laboratory Fortified Matrix .</td><td>An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations</td></tr>
<tr><td>MSD/LFMD</td><td>Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate</td><td>Determine method precision in sample concentrations are < 5X the RL.</td></tr>
<tr><td>DUP</td><td>Duplicate</td><td>Determine method precision in sample concentrations are > 5X the RL.</td></tr>
<tr><td>QCS</td><td>Quality Control Sample</td><td>A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance</td></tr>
</table>

SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.

LABORATORY ANALYSIS QC

Acronym	Description	Definition
ICB	Initial Calibration Blank	Monitors instrument drift at low end of calibration curve.
CCB	Continuing Calibration Blank	Monitors instrument drift at low end of calibration curve.
ICV	Initial Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of calibration curve.
CCV	Continuing Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of calibration curve.
IPC	Instrument Performance Check	Monitors instrument drift at a defined concentration near the mid range of calibration curve.
MS/LFM	Matrix Spike/Laboratory Fortified Matrix .	An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations
MSD/LFMD	Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate	Determine method precision in sample concentrations are < 5X the RL.
DUP	Duplicate	Determine method precision in sample concentrations are > 5X the RL.
QCS	Quality Control Sample	A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance
SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.
IDL	Instrument detection limit	Signal just above baseline. 3-5x the STD DEV of 7 replicates of a blank. Not used for quantification.
MDL	Method detection limit	Statistical determination of the lowest concentration of an analyte with 95% certainty the analyte is present.
PQL	Practical Quantitation Limit	3-5x the MDL. Lowest level that quantification is determined
RL	Reporting Limit	Value a Laboratory reports results. Usually the PQL.

APPENDIX C
PLANKTON

Table C.1: **Density (no. of cells/L) of Phytoplankton Species, August 2018**

Species		Upstream of Elk River					Downstream of Elk River				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Chlorophyte	*Carteria* spp.	0	0	0	7,184	0	0	0	0	0	0
	Chlamydomonas spp.	0	46,696	14,368	14,368	14,368	21,552	21,552	14,368	28,736	28,736
	Chlorogonium maximum	0	100	0	0	0	0	0	0	0	0
	Sphaerocystis schroeteri	0	17,960	0	0	0	0	0	0	0	0
	Pediastrum duplex	0	0	0	0	0	0	0	0	0	200
	Oocystis lacustris	43,104	0	57,472	7,184	28,736	14,368	0	0	0	0
	Paulschulzia pseudovolvox	0	0	0	0	0	0	0	0	200	0
	Scenedesmus denticulatus	0	28,736	0	0	14,368	0	0	14,368	14,368	14,368
	Coelastrum microporum	0	100	0	0	0	0	0	0	0	0
	Elakatothrix gelatinosa	0	0	0	0	0	0	7,184	7,184	0	0
	Cosmarium sp.	0	100	0	0	0	0	0	0	0	0
	Spondylosium planum	0	7,184	0	0	0	0	0	0	0	0
	Botryococcus braunii	0	0	600	0	1,000	200	0	0	0	0
	Tetraedron caudatum	7,184	0	0	0	0	0	0	0	0	0
	Ankistrodesmus spiralis	0	3,592	0	0	14,368	57,472	0	0	0	0
Chrysophyte	*Small chrysophyceae*	79,024	32,328	43,104	2,341,984	71,840	71,840	129,312	86,208	43,104	79,024
	Large chrysophyceae	14,368	3,592	7,184	28,736	0	7,184	7,184	35,920	7,184	0
	Chrysochromulina parva	43,104	96,984	186,784	301,728	265,808	7,184	57,472	172,416	165,232	193,968
	Chrysococcus sp.	122,128	46,696	71,840	79,024	172,416	100,576	122,128	93,392	93,392	100,576
	Kephyrion sp.	71,840	64,656	71,840	64,656	7,184	71,840	14,368	21,552	100,576	43,104
	Spiniferomonas serrata	0	7,184	7,184	0	0	0	0	0	0	0
	Mallomonas crassisquama	400	0	0	400	0	0	400	200	600	200
	Dinobryon mucronatom	0	0	0	7,184	0	28,736	21,552	14,368	14,368	43,104
	Dinobryon bavaricum	79,024	57,472	114,944	100,576	93,392	136,496	114,944	86,208	194,168	266,608
	Dinobryon sertularia	58,072	46,896	79,024	122,128	43,704	400	21,752	21,552	21,752	28,736
	Chrysolykos skuja	0	0	0	0	0	7,184	0	0	50,288	0
	Ochromonas sp.	0	0	0	0	0	0	0	7,184	0	0
	Bitrichia chodatii	0	10,776	0	14,368	0	7,184	7,184	0	7,184	0
	Chrysochromulina laurentiana	7,184	7,184	0	0	0	14,368	7,184	0	7,184	7,184
	Salpingoeca frequentissima	0	0	0	0	0	21,552	0	0	0	0
Diatom	*Cyclotella stelligera*	3,600	5,400	2,400	8,400	7,200	9,400	12,600	11,600	16,200	14,000
	Cyclotella pseudostelligera	2,485,664	3,254,352	1,803,184	1,975,600	1,185,360	2,500,032	2,370,720	1,479,904	1,278,752	1,343,408
	Rhizosolenia eriense	0	0	0	0	7,184	0	0	7,184	0	0
	Tabellaria fenestrata	200	1,100	0	200	200	400	2,600	0	0	800
	Tabellaria flocculosa	400	0	0	200	400	0	0	0	0	0
	Fragilaria crotonensis	5,400	1,600	10,000	9,400	1,200	10,600	5,200	2,000	8,400	45,600
	Synedra ulna	600	1,800	2,000	1,200	2,400	600	2,200	200	1,400	1,200
	Asterionella formosa	0	0	0	2,000	0	400	400	1,600	0	4,400
	Cyclotella michiganiana	1,875,024	1,422,432	1,975,600	0	1,580,480	1,443,984	1,767,264	2,270,144	2,198,304	1,479,904
	Cyclotella bodanica	200	0	200	200	200	200	600	600	1,400	1,400
	Fragilaria capucina	0	0	0	2,000	0	0	0	0	0	0
Cryptophyte	*Rhodomonas minuta*	215,520	344,832	114,944	258,624	71,840	237,072	316,096	136,496	215,520	172,416
	Cryptomonas erosa	14,600	16,300	10,200	25,200	10,600	8,000	14,000	13,000	22,200	12,800
	Cryptomonas rostratiformis	0	0	200	200	200	0	0	0	0	0
	Katablepharis ovalis	7,184	35,920	0	50,288	0	14,368	0	0	7,184	0
Dinoflagellate	*Gymnodinium* sp.	400	200	0	0	200	0	200	200	200	200
	Peridinium pusillum	800	900	400	400	400	200	400	400	600	2,000
	Ceratium hirundinella	200	200	200	0	400	0	200	600	200	1,400
Total number of cells		**5,135,224**	**5,563,272**	**4,573,672**	**5,423,432**	**3,595,448**	**4,793,392**	**5,024,696**	**4,498,848**	**4,498,696**	**3,885,336**
Total number of taxa		**25**	**30**	**22**	**27**	**26**	**28**	**26**	**26**	**27**	**25**

Table C.2: Density (no. of cells/L) of Phytoplankton Species by Major Groups, August 2018

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Chlorophyte	50,288	104,468	72,440	28,736	72,840	93,592	28,736	35,920	43,304	43,304
Chrysophyte	475,144	373,768	581,904	3,060,784	654,344	474,544	503,480	539,000	705,032	762,504
Diatom	4,371,088	4,686,684	3,793,384	1,999,200	2,784,624	3,965,616	4,161,584	3,773,232	3,504,456	2,890,712
Cryptophyte	237,304	397,052	125,344	334,312	82,640	259,440	330,096	149,496	244,904	185,216
Dinoflagellate	1,400	1,300	600	400	1,000	200	800	1,200	1,000	3,600
Total number of cells	**5,135,224**	**5,563,272**	**4,573,672**	**5,423,432**	**3,595,448**	**4,793,392**	**5,024,696**	**4,498,848**	**4,498,696**	**3,885,336**
Total number of groups	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**

Table C.3: **Percent Composition of Phytoplankton Species Based on Total Density (no. of cells/L), August 2018**

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Chlorophyte	*Carteria* spp.	0	0	0	0.1	0	0	0	0	0	0
	Chlamydomonas spp.	0	0.8	0.3	0.3	0.4	0.4	0.4	0.3	0.6	0.7
	Chlorogonium maximum	0	0.0	0	0	0	0	0	0	0	0
	Sphaerocystis schroeteri	0	0.3	0	0	0	0	0	0	0	0
	Pediastrum duplex	0	0	0	0	0	0	0	0	0	0.0
	Oocystis lacustris	0.8	0	1.3	0.1	0.8	0.3	0	0	0	0
	Paulschulzia pseudovolvox	0	0	0	0	0	0	0	0	0.0	0
	Scenedesmus denticulatus	0	0.5	0	0	0.4	0	0	0.3	0.3	0.4
	Coelastrum microporum	0	0.0	0	0	0	0	0	0	0	0
	Elakatothrix gelatinosa	0	0	0	0	0	0	0.1	0.2	0	0
	Cosmarium sp.	0	0.0	0	0	0	0	0	0	0	0
	Spondylosium planum	0	0.13	0	0	0	0	0	0	0	0
	Botryococcus braunii	0	0	0.0	0	0.0	0.0	0	0	0	0
	Tetraedron caudatum	0.1	0	0	0	0	0	0	0	0	0
	Ankistrodesmus spiralis	0	0.065	0	0	0.4	1.2	0	0	0	0
Chrysophyte	*Small chrysophyceae*	1.5	0.58	0.9	43.2	2.0	1.5	2.6	1.9	1.0	2.0
	Large chrysophyceae	0.3	0.065	0.2	0.5	0	0.1	0.1	0.8	0.2	0
	Chrysochromulina parva	0.8	1.7	4.1	5.6	7.4	0.1	1.1	3.8	3.7	5.0
	Chrysococcus sp.	2.4	0.84	1.6	1.5	4.8	2.1	2.4	2.1	2.1	2.6
	Kephyrion sp.	1.4	1.2	1.6	1.2	0.2	1.5	0.3	0.5	2.2	1.1
	Spiniferomonas serrata	0	0.1	0.2	0	0	0	0	0	0	0
	Mallomonas crassisquama	0.0	0	0	0.0	0	0	0.0	0.0	0.0	0.0
	Dinobryon mucronatom	0	0	0	0.1	0	0.6	0.4	0.3	0.3	1.1
	Dinobryon bavaricum	1.5	1.0	2.5	1.9	2.6	2.8	2.3	1.9	4.3	6.9
	Dinobryon sertularia	1.1	0.84	1.7	2.3	1.2	0.0	0.4	0.5	0.5	0.7
	Chrysolykos skuja	0	0	0	0	0	0.1	0	0	1.1	0
	Ochromonas sp.	0	0	0	0	0	0	0	0.2	0	0
	Bitrichia chodatii	0	0.19	0	0.3	0	0.1	0.1	0	0.2	0
	Chrysochromulina laurentiana	0.1	0.13	0	0	0	0.3	0.1	0	0.2	0.2
	Salpingoeca frequentissima	0	0	0	0	0	0.4	0	0	0	0
Diatoms	*Cyclotella stelligera*	0.1	0.10	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4
	Cyclotella pseudostelligera	48.4	58.5	39.4	36.4	33.0	52.2	47.2	32.9	28.4	34.6
	Rhizosolenia eriense	0	0	0	0	0.2	0	0	0.2	0	0
	Tabellaria fenestrata	0.0	0.020	0	0.0	0.0	0.0	0.1	0	0	0.0
	Tabellaria flocculosa	0.0	0	0	0.0	0.0	0	0	0	0	0
	Fragilaria crotonensis	0.1	0.029	0.2	0.2	0.0	0.2	0.1	0.0	0.2	1.2
	Synedra ulna	0.0	0.032	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	Asterionella formosa	0	0	0	0.0	0	0.0	0.0	0.0	0	0.1
	Cyclotella michiganiana	36.5	25.6	43.2	0	44.0	30.1	35.2	50.5	48.9	38.1
	Cyclotella bodanica	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fragilaria capucina	0	0	0	0.0	0	0	0	0	0	0
Cryptophyte	*Rhodomonas minuta*	4.2	6.2	2.5	4.8	2.0	4.9	6.3	3.0	4.8	4.4
	Cryptomonas erosa	0.3	0.3	0.2	0.5	0.3	0.2	0.3	0.3	0.5	0.3
	Cryptomonas rostratiformis	0	0	0.0	0.0	0.0	0	0	0	0	0
	Katablepharis ovalis	0.1	0.65	0	0.9	0	0.3	0	0	0.2	0
Dinoflagellates	*Gymnodinium* sp.	0.0	0.0036	0	0	0.0	0	0.0	0.0	0.0	0.0
	Peridinium pusillum	0.0	0.016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Ceratium hirundinella	0.0	0.0036	0.0	0	0.0	0	0.0	0.0	0.0	0.0
Total number of cells		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total number of taxa		**25**	**30**	**22**	**27**	**26**	**28**	**26**	**26**	**27**	**25**

Table C.4: **Biomass (µg/L dw) of Phytoplankton Species, August 2018**

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Chlorophyte	*Carteria* spp.	0	0	0	0.66	0	0	0	0	0	0
	Chlamydomonas spp.	0	2.2	0.72	0.72	0.64	0.92	1.1	0.72	1.4	1.4
	Chlorogonium maximum	0	0.23	0	0	0	0	0	0	0	0
	Sphaerocystis schroeteri	0	0.28	0	0	0	0	0	0	0	0
	Pediastrum duplex	0	0	0	0	0	0	0	0	0	0.75
	Oocystis lacustris	1.2	0	1.6	0.36	1.4	0.41	0	0	0	0
	Paulschulzia pseudovolvox	0	0	0	0	0	0	0	0	0.54	0
	Scenedesmus denticulatus	0	2.0	0	0	0.67	0	0	1.1	0.65	0.67
	Coelastrum microporum	0	0.27	0	0	0	0	0	0	0	0
	Elakatothrix gelatinosa	0	0	0	0	0	0	0.16	0.16	0	0
	Cosmarium sp.	0	0.19	0	0	0	0	0	0	0	0
	Spondylosium planum	0	0.27	0	0	0	0	0	0	0	0
	Botryococcus braunii	0	0	0.31	0	0.52	0.10	0	0	0	0
	Tetraedron caudatum	0.03	0	0	0	0	0	0	0	0	0
	Ankistrodesmus spiralis	0	0.22	0	0	0.90	4.1	0	0	0	0
Chrysophyte	*Small chrysophyceae*	0.81	0.14	0.44	147	0.83	0.92	1.2	0.79	0.55	0.44
	Large chrysophyceae	2.6	0.65	1.3	5.2	0	1.3	1.3	6.5	1.3	0
	Chrysochromulina parva	2.8	6.3	12.2	19.7	17.4	0.47	3.8	11.3	10.8	12.7
	Chrysococcus sp.	8.0	2.4	4.7	5.2	11.3	6.6	8.0	6.1	6.1	6.6
	Kephyrion sp.	1.8	2.7	1.4	1.6	0.11	1.1	0.27	0.53	1.7	0.81
	Spiniferomonas serrata	0	0.94	0.66	0	0	0	0	0	0	0
	Mallomonas crassisquama	0.41	0	0	0.41	0	0	0.42	0.21	0.63	0.21
	Dinobryon mucronatom	0	0	0	0.94	0	3.8	2.8	1.9	1.8	5.1
	Dinobryon bavaricum	17.9	13	26.0	22.8	21.1	30.9	26.0	19.5	44.6	61.1
	Dinobryon sertularia	14.2	11	17.9	27.6	10.5	0.50	5.1	4.9	5.1	6.5
	Chrysolykos skuja	0	0	0	0	0	0.20	0	0	1.4	0
	Ochromonas sp.	0	0	0	0	0	0	0	0.70	0	0
	Bitrichia chodatii	0	0.54	0	0.72	0	0.36	0.36	0	1.0	0
	Chrysochromulina laurentiana	3.1	2.8	0	0	0	5.7	2.8	0	3.1	2.8
	Salpingoeca frequentissima	0	0	0	0	0	0.74	0	0	0	0
Diatom	*Cyclotella stelligera*	7.7	11	5.7	18.8	16.3	18.6	24.9	26.3	35.3	33.0
	Cyclotella pseudostelligera	704	997	387	436	277	506	555	376	282	280
	Rhizosolenia eriense	0	0	0	0	0.46	0	0	0.46	0	0
	Tabellaria fenestrata	0.17	0.84	0	0.17	0.15	0.30	2.0	0	0	0.60
	Tabellaria flocculosa	0.51	0	0	0.24	0.51	0	0	0	0	0
	Fragilaria crotonensis	2.3	0.65	4.2	3.9	0.51	4.4	2.2	0.85	3.7	19.7
	Synedra ulna	3.8	12	13.6	8.2	15.4	3.7	16.4	1.4	8.8	9.9
	Asterionella formosa	0	0	0	0.20	0	0.03	0.04	0.15	0	0.47
	Cyclotella michiganiana	48.8	35	48.4	0	32.2	29.5	43.3	62.7	57.2	38.5
	Cyclotella bodanica	1.5	0	1.2	1.4	1.2	1.5	4.6	3.8	9.9	8.2
	Fragilaria capucina	0	0	0	0.34	0	0	0	0	0	0
Cryptophyte	*Rhodomonas minuta*	32.5	52	17.3	39.0	10.8	35.8	47.7	20.6	32.5	26.0
	Cryptomonas erosa	25.4	28	17.2	43.1	18.3	14.2	24.3	22.5	38.9	22.7
	Cryptomonas rostratiformis	0	0.0	0.45	0.45	0.42	0	0	0	0	0
	Katablepharis ovalis	0.46	2.6	0	2.4	0	0.74	0	0	0.37	0
Dinoflagellate	*Gymnodinium* sp.	6.2	3.1	0	0	3.1	0	2.3	2.3	2.8	3.4
	Peridinium pusillum	3.2	3.8	1.6	1.7	1.7	0.76	1.6	1.6	2.3	7.6
	Ceratium hirundinella	10.1	9.2	9.4	0	19.8	0	10.1	28.6	10.1	70.4
Total biomass of cells		**900**	**1,202**	**573**	**789**	**464**	**673**	**787**	**602**	**565**	**620**
Total number of taxa		**25**	**30**	**22**	**27**	**26**	**28**	**26**	**26**	**27**	**25**

Table C.5: Biomass (μg/L dw) of Phytoplankton Species by Group, August 2018

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Chlorophyte	1.3	5.7	2.7	1.7	4.2	5.5	1.2	2.0	2.6	2.9
Chrysophyte	52	41	65	231	61	52	52	52	78	96
Diatom	769	1,057	460	470	344	564	648	472	397	390
Cryptophyte	58	83	35	85	30	51	72	43	72	49
Dinoflagellate	19	16	11	1.7	25	0.76	14	32	15	81
Total biomass of cells	**900**	**1,202**	**573**	**789**	**464**	**673**	**787**	**602**	**565**	**620**
Total number of groups	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**

Table C.6: Percent Composition of Phytoplankton Species Based on Total Biomass (µg/L dw), August 2018

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Chlorophyte	*Carteria* spp.	0	0	0	0.083	0	0	0	0	0	0	0.083	0	0.083	0	0.083	0	0.083	0	0	0.059
	Chlamydomonas spp.	0	0.36	0.13	0.092	0.14	0.14	0.14	0.12	0.26	0.23	0.092	0.12	0.13	0.14	0.36	0.26	0.18	0.18	0.12	0.075
	Chlorogonium maximum	0	0.038	0	0	0	0	0	0	0	0	0.038	0	0.038	0	0.038	0	0.038	0	0	0.027
	Sphaerocystis schroeteri	0	0.046	0	0	0	0	0	0	0	0	0.046	0	0.046	0	0.046	0	0.046	0	0	0.033
	Pediastrum duplex	0	0	0	0	0	0	0	0	0	0.12	0	0.12	0	0.12	0	0.12	0	0.12	0	0.070
	Oocystis lacustris	0.14	0	0.28	0.046	0.31	0.060	0	0	0	0	0.046	0.060	0.21	0.060	0.31	0.060	0.19	0.060	0.13	0.010
	Paulschulzia pseudovolvox	0	0	0	0	0	0	0	0	0.095	0	0	0.095	0	0.095	0	0.095	0	0.095	0	0.055
	Scenedesmus denticulatus	0	0.17	0	0	0.14	0	0	0.18	0.11	0.11	0.14	0.11	0.16	0.11	0.17	0.18	0.16	0.13	0.017	0.031
	Coelastrum microporum	0	0.044	0	0	0	0	0	0	0	0	0.044	0	0.044	0	0.044	0	0.044	0	0	0.031
	Elakatothrix gelatinosa	0	0	0	0	0	0	0.020	0.026	0	0	0	0.020	0	0.023	0	0.026	0	0.023	0	0.014
	Cosmarium sp.	0	0.031	0	0	0	0	0	0	0	0	0.031	0	0.031	0	0.031	0	0.031	0	0	0.022
	Spondylosium planum	0	0.045	0	0	0	0	0	0	0	0	0.045	0	0.045	0	0.045	0	0.045	0	0	0.032
	Botryococcus braunii	0	0	0.055	0	0.11	0.016	0	0	0	0	0.055	0.016	0.084	0.016	0.11	0.016	0.084	0.016	0.041	0.028
	Tetraedron caudatum	0.0038	0	0	0	0	0	0	0	0	0	0.0038	0	0.0038	0	0.0038	0	0.0038	0	0	0.0027
	Ankistrodesmus spiralis	0	0.037	0	0	0.19	0.61	0	0	0	0	0.037	0.61	0.12	0.61	0.19	0.61	0.12	0.61	0.11	0.40
Chrysophyte	*Small chrysophyceae*	0.090	0.011	0.077	19	0.18	0.14	0.15	0.13	0.10	0.071	0.011	0.071	0.090	0.13	19	0.15	3.8	0.12	8.3	0.044
	Large chrysophyceae	0.29	0.11	0.23	0.65	0	0.19	0.16	1.1	0.23	0	0.11	0.16	0.26	0.21	0.65	1.1	0.32	0.41	0.24	0.46
	Chrysochromulina parva	0.31	0.53	2.1	2.5	3.8	0.070	0.48	1.9	1.9	2.0	0.31	0.070	2.1	1.9	3.8	2.0	1.8	1.3	1.4	0.97
	Chrysococcus sp.	0.89	0.20	0.82	0.66	2.4	0.98	1.0	1.0	1.1	1.1	0.20	0.98	0.82	1.0	2.4	1.1	1.0	1.0	0.85	0.38
	Kephyrion sp.	0.19	0.23	0.24	0.20	0.024	0.17	0.034	0.087	0.31	0.13	0.024	0.034	0.20	0.13	0.24	0.31	0.18	0.15	0.087	0.11
	Spiniferomonas serrata	0	0.16	0.12	0	0	0	0	0	0	0	0.12	0	0.14	0	0.16	0	0.14	0	0.029	0.082
	Mallomonas crassisquama	0.046	0	0	0.052	0	0	0.053	0.035	0.11	0.034	0.046	0.034	0.049	0.044	0.052	0.11	0.049	0.058	0.0045	0.034
	Dinobryon mucronatom	0	0	0	0.12	0	0.56	0.36	0.31	0.32	0.83	0.12	0.31	0.12	0.36	0.12	0.83	0.12	0.48	0	0.27
	Dinobryon bavaricum	2.0	1.1	4.5	2.9	4.6	4.6	3.3	3.2	7.9	9.9	1.1	3.2	2.9	4.6	4.6	9.9	3.0	5.8	1.5	3.7
	Dinobryon sertularia	1.6	0.91	3.1	3.5	2.3	0.074	0.65	0.81	0.91	1.0	0.91	0.074	2.3	0.81	3.5	1.0	2.3	0.70	1.1	0.39
	Chrysolykos skuja	0	0	0	0	0	0.030	0	0	0.25	0	0	0.030	0	0.14	0	0.25	0	0.14	0	0.14
	Ochromonas sp.	0	0	0	0	0	0	0	0.12	0	0	0	0.12	0	0.12	0	0.12	0	0.12	0	0.067
	Bitrichia chodatii	0	0.045	0	0.092	0	0.054	0.046	0	0.18	0	0.045	0.046	0.068	0.054	0.092	0.18	0.068	0.093	0.033	0.078
	Chrysochromulina laurentia	0.35	0.23	0	0	0	0.84	0.36	0	0.55	0.46	0.23	0.36	0.29	0.51	0.35	0.84	0.29	0.55	0.080	0.14
	Salpingoeca frequentissima	0	0	0	0	0	0.11	0	0	0	0	0	0.11	0	0.11	0	0.11	0	0.11	0	0.077
Diatoms	*Cyclotella stelligera*	0.86	0.95	0.99	2.4	3.5	2.8	3.2	4.4	6.2	5.3	0.86	2.8	0.99	4.4	3.5	6.2	1.7	4.4	1.2	2.1
	Cyclotella pseudostelligera	78	83	68	55	60	75	70	63	50	45	55	45	68	63	83	75	69	61	12	7.4
	Rhizosolenia eriense	0	0	0	0	0.10	0	0	0.076	0	0	0.10	0.076	0.10	0.076	0.10	0.076	0.10	0.076	0	0.013
	Tabellaria fenestrata	0.018	0.070	0	0.021	0.033	0.045	0.26	0	0	0.10	0.018	0.045	0.027	0.10	0.070	0.26	0.036	0.13	0.024	0.040
	Tabellaria flocculosa	0.057	0	0	0.030	0.11	0	0	0	0	0	0.030	0	0.057	0	0.11	0	0.066	0	0.041	0.021
	Fragilaria crotonensis	0.25	0.054	0.73	0.50	0.11	0.66	0.28	0.14	0.66	3.2	0.054	0.14	0.25	0.66	0.73	3.2	0.33	0.98	0.28	1.3
	Synedra ulna	0.42	0.96	2.4	1.0	3.3	0.55	2.1	0.23	1.6	1.6	0.42	0.23	1.0	1.6	3.3	2.1	1.6	1.2	1.2	0.71
	Asterionella formosa	0	0	0	0.025	0	0.0049	0.0048	0.025	0	0.075	0.025	0.0048	0.025	0.015	0.025	0.075	0.025	0.028	0	0.030
	Cyclotella michiganiana	5.4	2.9	8.4	0	7.0	4.4	5.5	10	10	6.2	2.9	4.4	6.2	6.2	8.4	10	5.9	7.3	2.4	3.4
	Cyclotella bodanica	0.17	0	0.22	0.18	0.25	0.23	0.59	0.64	1.7	1.3	0.17	0.23	0.20	0.64	0.25	1.7	0.20	0.90	0.037	0.69
	Fragilaria capucina	0	0	0	0.044	0	0	0	0	0	0	0.044	0	0.044	0	0.044	0	0.044	0	0	0.031
Cryptophyte	*Rhodomonas minuta*	3.6	4.3	3.0	4.9	2.3	5.3	6.1	3.4	5.8	4.2	2.3	3.4	3.6	5.3	4.9	6.1	3.6	4.9	1.0	1.3
	Cryptomonas erosa	2.8	2.3	3.0	5.5	3.9	2.1	3.1	3.7	6.9	3.7	2.3	2.1	3.0	3.7	5.5	6.9	3.5	3.9	1.2	1.9
	Cryptomonas rostratiformis	0	0	0.079	0.057	0.092	0	0	0	0	0	0.057	0	0.079	0	0.092	0	0.076	0.0	0.017	0.040
	Katablepharis ovalis	0.051	0.21	0	0.31	0	0.11	0	0	0.066	0	0.051	0.066	0.21	0.088	0.31	0.11	0.19	0.088	0.13	0.0082
Dinoflagellates	*Gymnodinium* sp.	0.69	0.26	0	0	0.67	0	0.29	0.38	0.50	0.55	0.26	0.29	0.67	0.44	0.69	0.55	0.54	0.43	0.25	0.13
	Peridinium pusillum	0.35	0.31	0.28	0.21	0.36	0.11	0.20	0.26	0.40	1.2	0.21	0.11	0.31	0.26	0.36	1.2	0.30	0.44	0.061	0.45
	Ceratium hirundinella	1.1	0.76	1.6	0	4.3	0	1.3	4.8	1.8	11	0.76	1.3	1.4	3.3	4.3	11	1.9	4.8	1.6	4.4

Table C.7: Zooplankton Community and Biomass Results as Provided by the Analytical Laboratory, June 2018 [a]

Species			Life Stage [b]	Upstream of Elk River (RG_TN)										Downstream of Elk River (RG_T4)									
				TN-1		TN-2		TN-3		TN-4		TN-5		T4-1		T4-2		T4-3		T4-4		T4-5	
				Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
				#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw
Copepoda	Calanoid	*Epischura nevadensis*	AF	0.11	21.7	0.02	4.0	0.03	5.5	0.06	11.5	0.05	9.6	0	0	0.01	1.9	0	0.38	0	0.38	0	0.36
			AM	0.04	6.1	0.02	4.1	0.06	9.9	0.09	14.8	0.04	6.8	0	0.58	0	0.32	0	0.32	0.02	3.4	0	0.31
			IM	0	0	0	0	0	0	0.08	4.0	0.08	4.0	0	0	0	0.10	0	0	0	0	0	0.09
		Diaptomus pallidus	AF	0.15	10.7	0.09	6.3	0.07	5.1	0.12	8.9	0.16	11.9	0	0.13	0.02	1.5	0.31	22.7	0.06	4.5	0.04	2.8
			GF	0	0	0	0	0.04	3.1	0.03	2.0	0.03	2.0	0	0	0	0	0	0.14	0	0	0	0
			AM	0.11	5.0	0.13	5.9	0.35	15.9	0.16	7.4	0.21	9.3	0	0	0.10	4.6	0	0	0	0	0	0
			IM 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			IM 1.0	0.19	6.9	0.04	1.6	0	0	0.08	2.9	0.12	4.4	0	0	0	0	0.31	11.6	0.31	11.6	0	0
			IM 0.75	0	0	0.08	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0.31	5.7	0.30	5.4
			IM 0.5	0.04	0.24	0.08	0.54	0.07	0.46	0	0	0	0	0	0	0	0	0.31	2.1	0	0	0	0
		Diaptomus tyrrelli	AF	0	0	0	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	0	0	0
			GF	0.01	1.3	0	0.37	0.14	12.6	0	0	0	0	0.02	1.7	0.04	3.7	0.01	0.87	0.06	5.5	0.01	0.50
			AM	0.01	0.43	0	0	0	0.21	0	0.24	0.06	3.4	0	0.11	0.02	1.2	0	0.12	0	0	0	0
			IM 2.0	0.11	6.4	0.13	7.6	0.07	4.1	0.04	2.4	0	0	0.04	2.1	0.06	3.6	0	0.11	0.04	2.4	0.02	0.97
			IM 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.30	11.0
			IM 0.75	0	0	0.17	3.0	0.21	3.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			IM 0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Calanoid nauplius	Small	0.56	1.7	0.66	1.9	0.01	0.03	0.78	2.3	0.39	1.1	0.56	1.7	1.3	3.7	0.31	0.92	0	0	0.30	0.87
			Large	0.07	0.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.30	1.1
	Cylcopoid	*Cyclops bicuspidatus thomasi*	AF	0.07	1.4	0	0	0.21	4.1	0	0	0.08	1.5	2.5	49.1	0.63	12.1	3.8	72.8	1.9	36.4	4.2	80.4
			GF	0	0	0	0	0	0.07	0	0.08	0.02	0.44	0.28	5.5	0.16	3.2	0.25	4.8	0.12	2.4	0.08	1.5
			AM	0.07	0.70	0	0	0.14	1.4	0.08	0.78	0	0	3.0	29.3	0.63	6.2	1.9	18.6	1.3	12.4	1.5	14.7
			IM 1.0	0	0	0.08	2.8	0.07	2.4	0.08	2.7	0	0	2.8	96.8	0.94	32.3	2.2	75.3	0.94	32.3	0.89	30.6
			IM 0.75	1.1	17.0	0.25	4.0	1.8	28.3	0.24	3.8	0.51	8.2	24.0	385	9.4	151	11.9	191	28.5	458	16.9	272
			IM 0.5	0.28	1.5	0.08	0.44	2.5	13.1	0.86	4.6	0.71	3.7	38.7	205	12.9	68.3	32.6	173	38.6	205	36.0	191
		Acanthocyclops vernalis	IM 0.5	0.14	0.78	0.08	0.46	0.07	0.39	0	0	0	0	0.28	1.6	0.94	5.2	0.31	1.7	0.31	1.7	0	0
		Cyclopoid nauplius	-	0	0	0.08	0.23	0.07	0.19	0.16	0.43	0.04	0.11	8.2	22.5	6.6	18.1	13.2	36.2	10.7	29.3	2.4	6.5
Cladocera		*Daphnia schoedleri*	2	0	0	0	0	0	0	0.24	109	0.12	54.6	0.56	262	0.31	146	0.63	291	0.63	291	0.30	138
		Daphnia schoedleri	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Daphnia schoedleri	1	0	0	0	0	0	0	0.24	13.1	0.20	10.9	0.28	15.8	0.63	35.0	1.6	87.6	3.5	193	1.2	66.4
		Daphnia schoedleri	0.5	0	0	0	0	0	0	0	0	0	0	0	0	1.3	9.0	1.3	9.0	1.3	9.0	2.1	14.8
		Daphnia galeata mendotae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Daphnia galeata mendotae	1.5	0.14	47.4	0.25	83.6	1.3	450	0.94	316	0.47	158	0.99	332	0	0	0	0	0.63	211	1.2	399
		Daphnia galeata mendotae	1	1.8	76.3	1.8	79.0	3.6	156	3.4	146	1.7	74.6	2.5	110	1.3	54.3	2.2	94.9	1.9	81.4	4.2	180
		Daphnia galeata mendotae	0.5	0.49	1.4	1.2	3.3	3.7	10.6	2.0	5.5	1.2	3.4	2.4	6.8	0.63	1.8	1.9	5.3	3.1	8.9	5.3	15.1
		Daphnia retrocurva Forbes	2	0	0	0	0	0.07	20.6	0	0	0	0	0	0	0	0	0	0	0	0	0.30	86.5
		Daphnia retrocurva	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Daphnia retrocurva	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Holopedium gibberum	-	0	0	0	0	0	0	0	0	0	0	0	0	0.63	11.5	0	0	0	0	0	0
		Bosmina longirostris	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.30	48.8
		Bosmina longirostris	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Bosmina longirostris	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.31	5.2	0.31	5.2	1.3	20.7	0.89	14.7
		Bosmina longirostris	0.25	0	0	0	0	1.1	1.7	0	0	0	0	5.5	8.8	3.8	6.0	4.4	7.1	11.9	19.2	11.9	19.1
		Scapholeberis kingii	-	0	7.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Leptodora kindtii	-	0.04	0.60	0	0	0	0.60	0	0.67	0	0.67	0	0	0.01	1.3	0	0.34	0.02	3.0	0	0
		Diaphanosoma leuchtenbergianum	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotifera		*Kellicottia* spp.	-	1.6	0.33	0.75	0.16	2.1	0.45	1.2	0.25	0.98	0.21	49.4	10.6	17.9	3.8	24.8	5.3	32.6	7.0	12.8	2.7
		Keratella spp.	-	0.78	0.12	0.33	0.05	1.3	0.21	0.08	0.01	0.67	0.10	170	26.7	104	16.4	213	33.4	151	23.7	106	16.7
		Polyarthra spp.	-	0	0	0	0	0	0	0.08	0.05	0	0	1.7	0.99	7.2	4.2	11.3	6.6	5.6	3.3	4.5	2.6
		Conochilus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.63	0.38	0.94	0.56	0.59	0.36
		Gastropus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Synchaeta spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0.31	0.31	1.9	1.9	0.63	0.63	0	0
		Brachionus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled entire water column (1.5 m from the bottom to the surface).

[b] AF: adult female; AM: adult male; GF: gravid female; IM: immature followed by body size in millimetres (mm) when available; numbers represent body size in mm.

Table C.8: Zooplankton Community and Biomass Results as Provided by the Analytical Laboratory, August 2018 [a]

Species			Life Stage [b]	Upstream of Elk River (RG_TN)										Downstream of Elk River (RG_T4)									
				TN-1		TN-2		TN-3		TN-4		TN-5		T4-1		T4-2		T4-3		T4-4		T4-5	
				Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
				#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw
Copepoda	Calanoid	*Epischura nevadensis*	AF	0.15	28.9	0.15	28.9	0.22	28.9	0.15	28.9	0	0.69	0.07	14.4	0.07	14.4	0.04	7.2	0.04	7.2	0.04	7.2
			AM	0.22	36.6	0.14	23.2	0.26	42.7	0.11	18.3	0	0	0	0	0.07	12.2	0.07	12.2	0.04	6.1	0.19	30.5
			IM	0.85	43.1	0.28	21.5	0.42	14.4	0.28	14.4	0	0.18	0	0	0.14	7.2	0	0	0.14	7.2	0.56	28.7
		Diaptomus pallidus	AF	0.28	20.4	0	10.2	0.14	0	0.07	5.1	0	0	0	0	0	0	0	0	0	0	0.28	20.4
			GF	0	0	0	5.4	0.01	0	0.01	0.89	0	0	0	0.26	0	0	0	0	0.01	0.51	0.04	2.7
			AM	0.28	12.7	0	19.1	0.07	0	0.11	5.0	0	0	0.14	6.4	0.14	6.4	0.14	6.4	0.28	12.7	0.14	6.4
			IM 2.0	0	0	0	0	0	0	0.07	3.0	0	0	0	0	0	0	0	0	0	0	0.14	5.9
			IM 1.0	0	0	0	10.4	0.14	0	0.14	5.2	0	0	0	0	0	0	0	0	0	0	0.56	20.9
			IM 0.75	0.14	2.6	0.14	12.9	0.28	2.6	0.14	2.6	0	0	0.28	5.2	0.85	15.5	0.28	5.2	0	0	0	0
			IM 0.5	0.28	1.8	0	3.7	0	0	0.07	0.46	0	0	0.28	1.8	0.14	0.92	0.28	1.8	0.28	1.8	0.14	0.92
		Diaptomus tyrrelli	AF	0	0	0.14	12.6	0.11	12.6	0.13	11.6	0	0	0.14	12.6	0.04	3.3	0.42	37.8	0.14	12.6	0	0
			GF	0	0	0.01	3.5	0.02	1.3	0.02	1.9	0	0	0.05	4.7	0.06	5.3	0.07	6.6	0.04	3.1	0.04	3.3
			AM	0	0.21	0.14	0	0.19	8.5	0.17	10.1	0	0	1.1	68.1	1.1	68.1	0.85	51.1	0.85	51.1	0.56	34.0
			IM 2.0	0.04	2.1	0	16.3	0.14	0	0.28	16.3	0	0	0.28	16.3	0.14	8.2	0.14	8.2	0.14	8.2	0	0
			IM 1.0	0	0	0.14	5.2	0.14	5.2	0.07	2.6	0	0	0	0	1.1	41.8	0.42	15.7	0	0	0	0
			IM 0.75	0.28	5.2	0	0	0	0	0	0	0	0	0.28	5.2	0	0	0	0	0	0	0	0
			IM 0.5	0	0	0	0	0	0	0.06	0.36	0	0	0	0	0	0	0	0	0	0	0	0
		Calanoid nauplius	Small	0.14	0.41	0.56	2.9	0.28	1.7	0.56	1.7	0	0	1.3	3.7	0.14	0.41	0.71	2.1	0.99	2.9	0.99	2.9
			Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cylcopoid	*Cyclops bicuspidatus thomasi*	AF	0.14	2.7	0.56	16.4	0.42	10.9	0.49	9.6	0.01	0.14	1.6	30.0	1.3	24.6	2.7	51.8	1.3	24.6	1.4	27.3
			GF	0	0	0	2.7	0	0	0	0.03	0	0	0	0.07	0.01	0.20	0.07	1.4	0	0.07	0.14	2.7
			AM	0.42	4.2	0.28	8.4	0.85	2.8	0.71	7.0	0	0	1.3	12.6	0.99	9.8	2.8	27.9	0.28	2.8	0.85	8.4
			IM 1.0	0.28	9.7	0	0	0	0	0.07	2.4	0	0	0	0	0	0	0	0	0	0	0	0
			IM 0.75	5.2	83.8	3.1	43.1	3.5	49.9	2.8	45.3	0	0.06	7.5	120	7.5	120	9.2	147	6.1	97.4	11.7	188
			IM 0.5	6.5	34.5	4.0	21.7	3.8	21.0	3.2	17.2	0	0	12.8	68.2	12.3	65.2	13.7	72.7	17.2	91.5	28.4	151
		Acanthocyclops vernalis	IM 0.5	0.71	3.9	0.14	1.6	0.14	0.78	0.14	0.78	0	0	0.28	1.6	0	0	0	0	0.28	1.6	0.28	1.6
		Cyclopoid nauplius	-	1.7	4.7	3.5	6.6	2.3	9.7	2.5	7.0	0.07	0.19	1.1	3.1	2.3	6.2	2.5	7.0	3.2	8.9	2.5	7.0
Cladocera		*Daphnia schoedleri*	2	0.71	327	0.07	17.2	0.42	34.4	0.28	131	0	0	0.14	65.5	0.04	17.2	0	0	0	0	0	0
			1.5	0	0	0.11	7.2	0	21.7	0.07	13.8	0	0.69	0	0	0.14	27.5	0	0	0	0	0	0
			1	0.14	7.9	0.14	0	0.14	7.9	0.07	3.9	0	0	0	0	0	0	0	0	0	0	0	0
			0.5	0	0	0.42	0.26	0	3.0	0	0	0	0	0.42	3.0	0	0	0.14	1.0	0	0	0	0
		Daphnia galeata mendotae	2	0.28	126	0.28	503	0.56	126	0.85	377	0.01	3.1	0	0	0	0	0.28	126	0.42	189	0.28	126
			1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			1	0	0	0.14	0	0.56	6.1	0.49	21.4	0	0	0.56	24.4	1.1	48.8	1.3	54.9	0.42	18.3	0.42	18.3
			0.5	0	0	0.14	0.40	0.28	0.40	0.42	1.2	0	0	0.56	1.6	0.85	2.4	1.8	5.2	0.85	2.4	0.85	2.4
		Daphnia retrocurva	2	0.28	82.2	0.02	43.2	0.28	5.1	0.21	61.7	0	0	0.28	82.2	0.11	32.4	0	0	0.14	41.1	0.14	41.1
			1	0.14	2.4	0	0	0	0	0	0	0	0	0.28	4.8	0	0	0.14	2.4	0	0	0.14	2.4
			0.5	0.14	0.55	0	0.55	0	0	0	0	0	0	0.14	0.55	0	0	0.28	1.1	0.14	0.55	0.14	0.55
		Holopedium gibberum	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Bosmina longirostris	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Scapholeberis kingii	-	0	0	0	0	0	0	0	0	0	0	0.01	1.5	0	0.75	0	0	0.01	1.5	0	0
		Leptodora kindtii	-	0.02	3.6	0	1.8	0	0	0	0	0	0	0.01	1.8	0	0	0.01	1.8	0	0	0.01	1.2
		Diaphanosoma leuchtenbergianum	-	0.01	0.13	0.28	2.0	0.07	5.2	0.18	3.3	0	0	0	0	0.71	13.0	0.99	18.2	0.22	4.1	0.19	3.4
Rotifera		*Kellicottia* spp.	-	1.3	0.27	0.85	0.15	0.85	0.18	0.92	0.20	0.14	0.03	1.8	0.39	1.8	0.39	3.2	0.70	4.2	0.91	2.8	0.60
		Keratella spp.	-	1.1	0.18	1.6	0.18	2.0	0.24	1.8	0.28	0.07	0.01	4.2	0.67	3.1	0.49	5.4	0.84	6.2	0.98	7.1	1.1
		Polyarthra spp.	-	0.28	0.17	1.6	0.50	2.1	0.91	1.6	0.95	0	0	0.42	0.25	0.28	0.17	0	0	0.99	0.58	0.71	0.41
		Conochilus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gastropus spp.	-	2.5	0.54	4.0	0.79	3.0	0.85	3.3	0.71	0	0	6.2	1.3	6.4	1.4	6.9	1.5	3.2	0.70	4.0	0.85
		Synchaeta spp.	-	0	0	0	0.14	0.07	0	0.18	0.18	0	0	0	0	0	0	0	0	0.14	0.14	0	0
		Brachionus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled from a depth of 10 m to the surface

[b] AF: adult female; AM: adult male; GF: gravid female; IM: immature followed by body size in millimetres (mm) when available; numbers represent body size in mm.

Table C.9: **Zooplankton Community and Biomass Results as Provided by the Analytical Laboratory, September 2018**[a]

Species			Life Stage [b]	Upstream of Elk River (RG_TN)										Downstream of Elk River (RG_T4)									
				TN-1		TN-2		TN-3		TN-4		TN-5		T4-1		T4-2		T4-3		T4-4		T4-5	
				Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
				#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw	#/L	µg/L dw
Copepoda	Calanoid	*Epischura nevadensis*	AF	0.053	10	0.055	11	0.089	17	0.25	48	0.25	48	0.035	6.9	0.10	20	0.034	6.6	0.034	6.6	0.067	13
			AM	0.040	6.5	0.071	12	0.18	29	0.37	61	0.19	30	0.018	2.9	0.017	2.8	0.034	5.5	0.017	2.8	0.051	8.3
			IM	0.25	13	0.12	6.2	0.23	11	0.12	6.0	0.24	12	0.20	10	0.064	3.3	0.064	3.3	0.064	3.3	0.32	16
		Diaptomus pallidus	AF	0.25	18	0.25	18	0.11	8.2	0.031	2.2	0.12	8.5	0	0	0	0	0	0	0	0	0	0
			GF	0.0076	0.55	0.0092	0.67	0.0028	0.20	0.0029	0.21	0.0029	0.21	0.0034	0.24	0	0	0	0	0	0	0	0
			AM	0.013	0.60	0.12	5.5	0	0	0.031	1.4	0	0	0	0	0.19	8.7	0	0	0	0	0	0
			IM 2.0	0.050	2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0016	0.067
			IM 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			IM 0.75	0.10	1.8	0	0	0	0	0	0	0	0	0.067	1.2	0	0	0	0	0.064	1.2	0.064	1.2
			IM 0.5	0	0	0	0	0	0	0	0	0	0	0.067	0.44	0.064	0.42	0.064	0.42	0	0	0.064	0.42
		Diaptomus tyrrelli	AF	0.066	5.9	0.12	11	0.059	5.3	0.031	2.8	0.12	10	0.053	4.7	0	0	0.064	5.7	0.13	11	0.32	29
			GF	0.018	1.6	0.0061	0.55	0.0085	0.76	0.0029	0.26	0.0088	0.79	0.013	1.2	0.011	1.0	0.0032	0.29	0.0096	0.86	0.030	2.7
			AM	0.11	6.4	0.12	7.4	0.11	6.8	0.71	43	0.24	14	0.21	13	0.45	27	0.064	3.9	0.19	12	0.26	15
			IM 2.0	0	0	0.12	7.1	0	0	0	0	0	0	0	0	0.13	7.4	0	0	0	0	0.064	3.7
			IM 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0.064	2.4	0.064	2.4	0	0	0.13	4.7
			IM 0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.064	1.2
			IM 0.5	0	0	0	0	0.059	0.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Calanoid nauplius	Small	0.81	2.4	1.4	4.0	0.34	1.0	0.71	2.1	0.82	2.4	0.81	2.4	2.1	6.0	1.0	3.0	2.0	5.8	1.2	3.4
			Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.064	0.24	0	0	0	0
	Cylcopoid	*Cyclops bicuspidatus thomasi*	AF	0.15	2.9	0.37	7.1	0.11	2.2	0	0	0	0	0.94	18	0.90	17	0.38	7.4	0.19	3.7	0.38	7.4
			GF	0.0063	0.12	0	0	0	0	0	0	0.031	0.60	0.035	0.68	0.0016	0.031	0.051	1.0	0.0048	0.093	0.19	3.7
			AM	0.20	2.0	0.12	1.2	0.34	3.4	0.12	1.2	0.12	1.2	0.13	1.3	1.0	10	0.13	1.3	0.13	1.3	0.64	6.4
			IM 1.0	0.15	5.2	0	0	0	0	0	0	0.12	4.0	0	0	0.064	2.2	0	0	0	0	0	0
			IM 0.75	1.7	27	0.12	2.0	0.34	5.4	0.47	7.6	0.47	7.6	3.1	50	3.6	58	1.7	27	1.2	20	2.9	46
			IM 0.5	0.35	1.9	1.2	6.5	0.11	0.60	0.47	2.5	0.47	2.5	3.6	19	4.1	22	2.8	15	3.3	17	3.8	20
		Acanthocyclops vernalis	IM 0.5	0.10	0.56	0.74	4.1	0.11	0.62	0.24	1.3	0.12	0.65	0.27	1.5	0.13	0.71	0.064	0.35	0.19	1.1	0.19	1.1
		Cyclopoid nauplius	-	2.8	7.6	3.1	8.4	2.9	8.1	3.4	9.4	2.0	5.5	3.3	9.0	4.0	11	3.1	8.6	4.2	11	4.6	13
Cladocera		*Daphnia schoedleri*	2	0.11	49	0.032	15	0.089	41	0	0	0.0029	1.4	0.13	62	0	0	0.0064	3.0	0.0016	0.74	0	0
			1.5	0.040	7.7	0	0	0.089	17	0.031	6.0	0.031	6.0	0.067	13	0	0	0.0032	0.63	0.0032	0.63	0.0080	1.6
			1	0.013	0.74	0.064	3.6	0.059	3.3	0	0	0.031	1.7	0	0	0.064	3.6	0	0	0	0	0	0
			0.5	0	0	0	0	0.030	0.21	0	0	0	0	0	0	0.064	0.46	0.017	0.12	0.19	1.4	0	0
		Daphnia galeata mendotae	2	0.066	29	0.13	57	0.27	119	0.25	110	0.22	96	0	0	0.064	29	0.064	29	0.064	29	0.19	86
			1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			1	0.12	5.1	0.064	2.8	0.12	5.1	0.062	2.7	0.031	1.3	0.067	2.9	0.064	2.8	0	0	0.19	8.3	0.064	2.8
			0.5	0.30	0.86	0.12	0.35	0.11	0.32	0.24	0.67	0.24	0.67	0	0	0.26	0.73	0.13	0.36	0.064	0.18	0.064	0.18
		Daphnia retrocurva	2	0.093	27	0.064	19	0.24	69	0.22	63	0.19	54	0.27	78	0.19	56	0.064	19	0.064	19	0.13	37
			1	0.013	0.22	0	0	0.059	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0.064	1.1
			0.5	0.064	0.25	0	0	0.11	0.44	0	0	0.062	0.24	0	0	0.064	0.25	0.064	0.25	0	0	0.064	0.25
		Holopedium gibberum	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Bosmina longirostris	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0.75	0	0	0	0	0	0	0	0	**0**	0	0.067	4.3	0	0	0	0	0	0	**0**	**0**
			0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Scapholeberis kingii	-	0	0	0	0	0	0	0.0029	0.62	0.0029	0.62	0	0	0	0	0	0	0	0	0	0
		Leptodora kindtii	-	0.019	3.2	0.018	3.2	0.014	2.4	0.0029	0.50	0.0059	1.0	0.0017	0.29	0	0	0	0	0	0	0	0
		Diaphanosoma leuchtenbergianum	-	0.36	6.6	0.13	2.4	0.059	1.1	0.19	3.4	0.12	2.3	0.13	2.5	0.45	8.3	0.51	9.4	0.26	4.7	0.19	3.5
Rotifera		*Kellicottia* spp.	-	0.45	0.10	0.74	0.16	0.90	0.19	0.94	0.20	0.71	0.15	2.4	0.52	3.0	0.63	1.8	0.38	2.0	0.43	1.9	0.41
		Keratella spp.	-	1.2	0.19	1.5	0.23	1.0	0.16	1.5	0.24	2.4	0.37	3.1	0.49	2.8	0.44	2.4	0.37	1.9	0.30	2.4	0.37
		Polyarthra spp.	-	0.55	0.32	8.8	5.2	1.9	1.1	1.4	0.83	0.94	0.55	0.74	0.43	1.4	0.83	1.0	0.60	1.8	1.1	1.0	0.60
		Conochilus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gastropus spp.	-	2.1	0.44	2.1	0.45	2.5	0.53	1.4	0.30	1.3	0.28	1.6	0.35	1.5	0.32	0.58	0.12	0.90	0.19	1.9	0.40
		Synchaeta spp.	-	0.10	0.050	0.37	0.37	0	0	0.12	0.12	0.12	0.12	0	0	0	0	0	0	0.13	0.13	0.064	0.064
		Brachionus spp.	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.064	0.040	0	0

[a] Sampled entire water column (1.5 m from the bottom to the surface).

[b] AF: adult female; AM: adult male; GF: gravid female; IM: immature followed by body size in millimetres (mm) when available; numbers represent body size in mm.

Table C.10: Zooplankton Community Density Data (no. of organisms/L), June 2018[a]

		Species	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
			TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Copepoda	**Calanoid**	*Epischura nevadensis*	0.15	0.046	0.088	0.23	0.17	0	0.014	0	0.023	0.0056
		Diaptomus pallidus	0.48	0.43	0.54	0.39	0.52	0	0.12	0.94	0.69	0.34
		Diaptomus tyrrelli	0.13	0.30	0.43	0.045	0.071	0.057	0.12	0.014	0.10	0.32
		Calanoid nauplius	0.64	0.66	0.011	0.78	0.39	0.56	1.3	0.31	0	0.59
	Cyclopoid	*Cyclops bicuspidatus thomasi*	1.5	0.42	4.7	1.3	1.3	0	25	53	71	60
		Acanthocyclops vernalis	0.14	0.083	0.071	0	0	0.28	0.94	0.31	0.31	0
		Cyclopoid nauplius	0	0.083	0.071	0.16	0.039	8.2	6.6	13	11	2.4
Cladocera		*Daphnia schoedleri*	0	0	0	0.47	0.31	0.85	2.2	3.5	5.3	3.6
		Daphnia galeata mendotae	2.4	3.2	8.7	6.3	3.4	5.9	1.9	4.1	5.6	11
		Daphnia retrocurva	0	0	0.071	0	0	0	0	0	0	0.30
		Holopedium gibberum	0	0	0	0	0	0	0.63	0	0	0
		Bosmina longirostris	0	0	1.1	0	0	5.5	4.1	4.7	13	13
		Scapholeberis kingii	0	0	0	0	0	0	0	0	0	0
		Leptodora kindtii	0.037	0	0	0	0	0	0.0078	0	0.018	0
		Diaphanosoma leuchtenbergianum	0	0	0	0	0	0	0	0	0	0
Rotifera		*Kellicottia* spp.	1.6	0.75	2.1	1.2	0.98	49	18	25	33	13
		Keratella spp.	0.78	0.33	1.3	0.078	0.67	170	104	213	151	106
		Polyarthra spp.	0	0	0	0.078	0	1.7	7.2	11	5.6	4.5
		Conochilus spp.	0	0	0	0	0	0	0	0.63	0.94	0.59
		Gastropus spp.	0	0	0	0	0	0	0	0	0	0
		Synchaeta spp.	0	0	0	0	0	0	0.31	1.9	0.63	0
		Brachionus spp.	0	0	0	0	0	0	0	0	0	0
Total number of organisms/L			**7.8**	**6.3**	**19**	**11**	**7.9**	**243**	**172**	**331**	**298**	**215**
Total number of taxa			**11**	**10**	**13**	**12**	**11**	**12**	**16**	**16**	**15**	**14**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.11: Zooplankton Community Density Data (no. of organisms/L), August 2018[a]

		Species	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
			TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Copepoda	Calanoid	*Epischura nevadensis*	1.2	0.69	0.79	0.54	0.0071	0.074	0.29	0.11	0.22	0.79
		Diaptomus pallidus	0.99	0.14	0.65	0.62	0	0.71	1.1	0.71	0.57	1.3
		Diaptomus tyrrelli	0.32	0.44	0.60	0.73	0	1.9	2.5	1.9	1.2	0.60
		Calanoid nauplius	0.14	0.56	0.28	0.56	0	1.3	0.14	0.71	0.99	0.99
	Cylopoid	*Cyclops bicuspidatus thomasi*	12.6	7.9	8.6	7.3	0.011	23	22	28	25	42
		Acanthocyclops vernalis	0.71	0.14	0.14	0.14	0	0.28	0	0	0.28	0.28
		Cyclopoid nauplius	1.7	3.5	2.3	2.5	0.071	1.1	2.3	2.5	3.2	2.5
Cladocera		*Daphnia schoedleri*	0.85	0.75	0.56	0.42	0	0.56	0.18	0.14	0	0
		Daphnia galeata mendotae	0.28	0.56	1.4	1.8	0.0071	1.1	2.0	3.4	1.7	1.6
		Daphnia retrocurva	0.56	0.018	0.28	0.21	0	0.71	0.11	0.42	0.28	0.42
		Holopedium gibberum	0	0	0	0	0	0	0	0	0	0
		Bosmina longirostris	0	0	0	0	0	0	0	0	0	0
		Scapholeberis kingii	0	0	0	0	0	0.0071	0	0	0.0071	0
		Leptodora kindtii	0.021	0	0	0	0	0.011	0	0.011	0	0.0071
		Diaphanosoma leuchtenbergianum	0.0071	0.28	0.074	0.18	0	0	0.71	0.99	0.22	0.19
Rotifera		*Kellicottia* spp.	1.3	0.85	0.85	0.92	0.14	1.8	1.8	3.2	4.2	2.8
		Keratella spp.	1.1	1.6	2.0	1.8	0.071	4.2	3.1	5.4	6.2	7.1
		Polyarthra spp.	0.28	1.6	2.1	1.6	0	0.42	0.28	0	0.99	0.71
		Conochilus spp.	0	0	0	0	0	0	0	0	0	0
		Gastropus spp.	2.5	4.0	3.0	3.3	0	6.2	6.4	6.9	3.2	4.0
		Synchaeta spp.	0	0	0.074	0.18	0	0	0	0	0.14	0
		Brachionus spp.	0	0	0	0	0	0	0	0	0	0
Total number of organisms/L			**25**	**23**	**24**	**23**	**0.31**	**44**	**43**	**55**	**48**	**66**
Total number of taxa			**16**	**15**	**16**	**16**	**7**	**16**	**15**	**14**	**16**	**15**

[a] Sampled from a depth of 10m to the surface

Table C.12: Zooplankton Community Density Data (no. of organisms/L), September 2018[a]

Species			Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
			TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Copepoda	Calanoid	*Epischura nevadensis*	0.34	0.25	0.49	0.74	0.67	0.25	0.18	0.13	0.11	0.44
		Diaptomus pallidus	0.42	0.38	0.12	0.065	0.12	0.14	0.26	0.064	0.064	0.13
		Diaptomus tyrrelli	0.19	0.37	0.24	0.74	0.36	0.28	0.65	0.20	0.33	0.86
		Calanoid nauplius	0.81	1.4	0.34	0.71	0.82	0.81	2.1	1.1	2.0	1.2
	Cylopoid	*Cyclops bicuspidatus thomasi*	2.5	1.8	0.90	1.1	1.2	7.8	9.7	5.0	4.8	7.9
		Acanthocyclops vernalis	0.10	0.74	0.11	0.24	0.12	0.27	0.13	0.064	0.19	0.19
		Cyclopoid nauplius	2.8	3.1	2.9	3.4	2.0	3.3	4.0	3.1	4.2	4.6
Cladocera		*Daphnia schoedleri*	0.16	0.10	0.27	0	0.065	0.20	0.13	0	0.20	0
		Daphnia galeata mendotae	0.49	0.32	0.50	0.54	0.48	0.067	0.38	0.19	0.32	0.32
		Daphnia retrocurva	0.17	0.064	0.41	0.22	0.25	0.27	0.26	0.13	0.064	0.26
		Holopedium gibberum	0	0	0	0	0	0	0	0	0	0
		Bosmina longirostris	0	0	0	0	0	0.067	0	0	0	0
		Scapholeberis kingii	0	0	0	0	0	0	0	0	0	0
		Leptodora kindtii	0	0	0	0	0	0	0	0	0	0
		Diaphanosoma leuchtenbergianum	0.36	0.13	0.059	0.19	0.12	0.13	0.45	0.51	0.26	0.19
Rotifera		*Kellicottia* spp.	0.45	0.74	0.90	0.94	0.71	2.4	3.0	1.8	2.0	1.9
		Keratella spp.	1.2	1.5	1.0	1.5	2.4	3.1	2.8	2.4	1.9	2.4
		Polyarthra spp.	0.55	8.8	1.9	1.4	0.94	0.74	1.4	1.0	1.8	1.0
		Conochilus spp.	0	0	0	0	0	0	0	0	0	0
		Gastropus spp.	2.1	2.1	2.5	1.4	1.3	1.6	1.5	0.58	0.90	1.9
		Synchaeta spp.	0.10	0.37	0	0.12	0.12	0	0	0	0.13	0.064
		Brachionus spp.	0	0	0	0	0	0	0	0	0.064	0
Total number of organisms/L			**13**	**22**	**13**	**13**	**12**	**21**	**27**	**16**	**19**	**23**
Total number of taxa			**17**	**17**	**16**	**18**	**18**	**17**	**15**	**15**	**17**	**16**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.13: Zooplankton Density (no. of organisms/L) Organized by Major Groups, June 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Copepoda	3.0	2.0	5.9	2.9	2.5	9.1	34	67	83	63
Cladocera	2.4	3.2	9.8	6.7	3.7	12	8.8	12	24	28
Rotifera	2.3	1.1	3.5	1.3	1.6	221	130	251	190	124
Total number of organisms/L	**8**	**6**	**19**	**11**	**8**	**243**	**172**	**331**	**298**	**215**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.14: Zooplankton Density (no. of organisms/L) Organized by Major Groups, August 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Copepoda	18	13	13	12	0.088	29	28	34	31	49
Cladocera	1.7	1.6	2.3	2.6	0.011	2.4	3.0	5.0	2.2	2.2
Rotifera	5.2	7.9	8.0	7.8	0.21	13	12	16	15	15
Total number of organisms/L	**25**	**23**	**24**	**23**	**0.31**	**44**	**43**	**55**	**48**	**66**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled from a depth of 10m to the surface

Table C.15: Zooplankton Density (no. of organisms/L) Organized by Major Groups, September 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Copepoda	7.2	8.0	5.1	6.9	5.3	13	17	9.7	12	15
Cladocera	1.2	0.62	1.2	0.98	0.93	0.74	1.2	0.86	0.84	0.78
Rotifera	4.4	14	6.3	5.4	5.4	7.9	8.7	5.8	6.8	7.2
Total number of organisms/L	**13**	**22**	**13**	**13**	**12**	**21**	**27**	**16**	**19**	**23**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.16: Relative Density (%) of Zooplankton Species, June 2018[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	1.9	0.72	0.46	2.1	2.1	0	0.0080	0	0.0076	0	0.46	0	1.9	0	2.1	0.0080	1.5	0	0.80	0
	Diaptomus pallidus	6.2	6.7	2.8	3.6	6.5	0	0.072	0.28	0.23	0.16	2.8	0	6.2	0.16	6.7	0.28	5.2	0.15	1.8	0.12
	Diaptomus tyrrelli	1.7	4.7	2.2	0.41	0.90	0.024	0.072	0	0.035	0.15	0.41	0	1.7	0.035	4.7	0.15	2.0	0.057	1.7	0.057
	Calanoid nauplius	8.2	10	0.055	7.2	5.0	0.23	0.73	0.095	0	0.28	0.055	0	7.2	0.23	10	0.73	6.2	0.27	3.9	0.28
	Cyclops bicuspidatus thomasi	19	6.6	24	11	17	0	14	16	24	28	6.6	0	17	16	24	28	16	16	6.9	11
	Acanthocyclops vernalis	1.8	1.3	0.37	0	0	0.12	0.55	0.095	0.11	0	0	0	0.37	0.11	1.8	0.55	0.70	0.17	0.82	0.21
	Cyclopoid nauplius	0	1.3	0.37	1.4	0.50	3.4	3.8	4.0	3.6	1.1	0	1.1	0.50	3.6	1.4	4.0	0.72	3.2	0.62	1.2
Cladocera	*Daphnia schoedleri*	0	0	0	4.3	4.0	0.35	1.3	1.0	1.8	1.7	0	0.35	0	1.3	4.3	1.8	1.7	1.2	2.3	0.57
	Daphnia galeata mendotae	31	51	45	57	43	2.4	1.1	1.2	1.9	5.0	31	1.1	45	1.9	57	5.0	46	2.3	9.9	1.6
	Daphnia retrocurva	0	0	0.37	0	0	0	0	0	0	0.14	0	0	0	0	0.37	0.14	0.074	0.028	0.16	0.062
	Holopedium gibberum	0	0	0	0	0	0	0.36	0	0	0	0	0	0	0	0	0.36	0	0.073	0	0.16
	Bosmina longirostris	0	0	5.5	0	0	2.3	2.4	1.4	4.4	6.1	0	1.4	0	2.4	5.5	6.1	1.1	3.3	2.5	1.9
	Scapholeberis kingii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leptodora kindtii	0.48	0	0.018	0.036	0.050	0	0	0	0.0059	0	0	0	0.036	0	0.48	0.0059	0.12	0	0.20	0
	Diaphanosoma leuchtenbergianum	0.045	0	0	0	0	0	0	0	0	0	0	0	0	0	0.045	0	0.0091	0	0.020	0
Rotifera	*Kellicottia* spp.	20	12	11	11	12	20	10	7.5	11	5.9	11	5.9	12	10	20	20	13	11	3.8	5.6
	Keratella spp.	10	5.2	7.0	0.72	8.5	70	61	64	51	49	0.72	49	7.0	61	10	70	6.3	59	3.6	8.9
	Polyarthra spp.	0	0	0	0.72	0	0.70	4.2	3.4	1.9	2.1	0	0.70	0	2.1	0.72	4.2	0.14	2.5	0.32	1.4
	Conochilus spp.	0	0	0	0	0	0	0	0.19	0.32	0.28	0	0	0	0.19	0	0.32	0	0.16	0	0.15
	Gastropus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Synchaeta spp.	0	0	0	0	0	0	0.18	0.57	0.21	0	0	0	0	0.18	0	0.57	0	0.19	0	0.23
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.17: **Relative Density (%) of Zooplankton Species, August 2018**[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	5.0	3.0	3.4	2.4	2.3	0.17	0.67	0.20	0.45	1.2	2.3	0.17	3.0	0.45	5.0	1.2	3.2	0.54	1.1	0.42
	Diaptomus pallidus	4.0	0.62	2.7	2.7	0	1.6	2.6	1.3	1.2	2.0	0	1.2	2.7	1.6	4.0	2.6	2.0	1.7	1.7	0.59
	Diaptomus tyrrelli	1.3	1.9	2.5	3.2	0	4.3	5.8	3.5	2.4	0.92	0	0.92	1.9	3.5	3.2	5.8	1.8	3.4	1.2	1.9
	Calanoid nauplius	0.57	2.5	1.2	2.5	0	2.9	0.33	1.3	2.0	1.5	0	0.33	1.2	1.5	2.5	2.9	1.3	1.6	1.1	0.95
	Cyclops bicuspidatus thomasi	51	34	36	32	3.4	53	51	52	51	65	3.4	51	34	52	51	65	32	54	17	5.7
	Acanthocyclops vernalis	2.9	0.62	0.60	0.62	0	0.65	0	0	0.58	0.43	0	0	0.62	0.43	2.9	0.65	0.94	0.33	1.1	0.31
	Cyclopoid nauplius	6.9	15	9.6	11	23	2.6	5.3	4.6	6.7	3.9	6.9	2.6	11	4.6	23	6.7	13	4.6	6.2	1.5
Cladocera	*Daphnia schoedleri*	3.4	3.3	2.4	1.9	1.1	1.3	0.42	0.26	0	0	1.1	0	2.4	0.26	3.4	1.3	2.4	0.39	0.97	0.53
	Daphnia galeata mendotae	1.1	2.5	6.0	7.7	2.3	2.6	4.6	6.2	3.5	2.4	1.1	2.4	2.5	3.5	7.7	6.2	3.9	3.8	2.8	1.6
	Daphnia retrocurva	2.3	0.077	1.2	0.93	0	1.6	0.26	0.77	0.58	0.64	0	0.26	0.93	0.64	2.3	1.6	0.90	0.78	0.94	0.51
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Scapholeberis kingii	0	0	0	0	0	0.016	0.0082	0	0.015	0	0	0	0	0.0082	0	0.016	0	0.0078	0	0.0077
	Leptodora kindtii	0.086	0	0	0	0	0.024	0	0.019	0	0.011	0	0	0	0.011	0.086	0.024	0.017	0.011	0.039	0.011
	Diaphanosoma leuchtenbergianum	0.029	1.2	0.31	0.78	0	0	1.6	1.8	0.46	0.28	0	0	0.31	0.46	1.2	1.8	0.47	0.84	0.53	0.83
Rotifera	*Kellicottia* spp.	5.2	3.7	3.6	4.0	45	4.2	4.3	5.9	8.8	4.3	3.6	4.2	4.0	4.3	45	8.8	12	5.5	18	2.0
	Keratella spp.	4.6	6.8	8.4	7.7	23	9.7	7.2	9.8	13	11	4.6	7.2	7.7	9.8	23	13	10	10	7.2	2.0
	Polyarthra spp.	1.1	6.8	9.0	7.1	0	0.97	0.66	0	2.0	1.1	0	0	6.8	0.97	9.0	2.0	4.8	0.95	4.0	0.74
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	10	17	13	15	0	14	15	13	6.7	6.0	0	6.0	13	13	17	15	11	11	6.6	4.2
	Synchaeta spp.	0	0	0.31	0.78	0	0	0	0	0.29	0	0	0	0	0	0.78	0.29	0.22	0.058	0.34	0.13
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled from a depth of 10m to the surface

Table C.18: Relative Density (%) of Zooplankton Species, September 2018[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	2.7	1.1	3.9	5.5	5.7	1.2	0.68	0.81	0.59	1.9	1.1	0.59	3.9	0.81	5.7	1.9	3.8	1.0	1.9	0.53
	Diaptomus pallidus	3.3	1.7	0.91	0.48	1.0	0.64	0.96	0.39	0.33	0.56	0.48	0.33	1.0	0.56	3.3	0.96	1.5	0.58	1.1	0.25
	Diaptomus tyrrelli	1.5	1.7	1.9	5.5	3.1	1.3	2.4	1.2	1.7	3.7	1.5	1.2	1.9	1.7	5.5	3.7	2.7	2.1	1.7	1.0
	Calanoid nauplius	6.3	6.1	2.7	5.3	7.1	3.8	7.7	6.7	10	5.0	2.7	3.8	6.1	6.7	7.1	10	5.5	6.7	1.7	2.5
	Cyclops bicuspidatus thomasi	20	8.3	7.1	7.9	10	36	36	31	25	34	7.1	25	8.3	34	20	36	11	32	5.2	4.8
	Acanthocyclops vernalis	0.79	3.3	0.89	1.8	1.0	1.3	0.48	0.39	1.0	0.83	0.79	0.39	1.0	0.83	3.3	1.3	1.6	0.79	1.1	0.36
	Cyclopoid nauplius	22	14	23	26	17	15	15	19	22	20	14	15	22	19	26	22	20	18	4.7	2.9
Cladocera	*Daphnia schoedleri*	1.2	0.44	2.1	0.23	0.56	0.94	0.48	0.16	1.0	0.034	0.23	0.034	0.56	0.48	2.1	1.0	0.91	0.53	0.76	0.44
	Daphnia galeata mendotae	3.8	1.4	3.9	4.1	4.1	0.31	1.4	1.2	1.7	1.4	1.4	0.31	3.9	1.4	4.1	1.7	3.5	1.2	1.2	0.52
	Daphnia retrocurva	1.3	0.29	3.2	1.6	2.1	1.3	0.96	0.79	0.33	1.1	0.29	0.33	1.6	0.96	3.2	1.3	1.7	0.89	1.1	0.35
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	0.31	0	0	0	0	0	0	0	0	0	0.31	0	0.063	0	0.14
	Scapholeberis kingii	0	0	0	0.022	0.025	0	0	0	0	0	0	0	0	0	0.025	0	0.0095	0	0.013	0
	Leptodora kindtii	0.15	0.083	0.11	0.022	0.051	0.0078	0	0	0	0	0.022	0	0.083	0	0.15	0.0078	0.083	0	0.050	0
	Diaphanosoma leuchtenbergianum	2.8	0.58	0.47	1.4	1.1	0.63	1.7	3.1	1.3	0.83	0.47	0.63	1.1	1.3	2.8	3.1	1.3	1.5	0.94	1.0
Rotifera	*Kellicottia* spp.	3.6	3.3	7.1	7.1	6.1	11	11	11	10	8.3	3.3	8.3	6.1	11	7.1	11	5.4	10	1.9	1.2
	Keratella spp.	9.5	6.7	8.0	11	20	14	11	15	10	10	6.7	10	9.5	11	20	15	11	12	5.4	2.3
	Polyarthra spp.	4.4	40	15	11	8.1	3.4	5.3	6.3	9.3	4.4	4.4	3.4	11	5.3	40	9.3	16	5.7	14	2.3
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	16	9.4	20	11	11	7.5	5.5	3.5	4.6	8.0	9.4	3.5	11	5.5	20	8.0	13	5.8	4.3	1.9
	Synchaeta spp.	0.79	1.7	0	0.88	1.0	0	0	0	0.66	0.28	0	0	0.88	0	1.7	0.66	0.87	0.19	0.59	0.29
	Brachionus spp.	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0.33	0	0.066	0	0.15

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.19: Zooplankton Community Biomass Data (µg/L dw), June 2018[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Copepoda	*Epischura nevadensis*	28	8.1	15	30	20	0.58	2.3	0.70	3.8	0.76
	Diaptomus pallidus	23	16	25	21	28	0.13	6.1	37	22	8.3
	Diaptomus tyrrelli	8.1	11	21	2.6	4.7	3.9	8.5	1.1	7.9	12
	Calanoid nauplius	1.9	1.9	0.031	2.3	1.1	1.7	3.7	0.92	0	2.0
	Cyclops bicuspidatus thomasi	21	7.3	49	12	14	771	273	536	747	590
	Acanthocyclops vernalis	0.78	0.46	0.39	0	0	1.6	5.2	1.7	1.7	0
	Cyclopoid nauplius	0	0.23	0.19	0.43	0.11	22	18	36	29	6.5
Cladocera	*Daphnia schoedleri*	0	0	0	122	66	278	190	388	493	219
	Daphnia galeata mendotae	125	166	616	467	236	448	56	100	301	594
	Daphnia retrocurva	0	0	21	0	0	0	0	0	0	87
	Holopedium gibberum	0	0	0	0	0	0	11	0	0	0
	Bosmina longirostris	0	0	1.7	0	0	8.8	11	12	40	83
	Scapholeberis kingii	7.8	0	0	0	0	0	0	0	0	0
	Leptodora kindtii	0.60	0	0.60	0.67	0.67	0	1.3	0.34	3.0	0
	Diaphanosoma leuchtenbergianum	0	0	0	0	0	0	0	0	0	0
Rotifera	*Kellicottia* spp.	0.33	0.16	0.45	0.25	0.21	11	3.8	5.3	7.0	2.7
	Keratella spp.	0.12	0.052	0.21	0.012	0.10	27	16	33	24	17
	Polyarthra spp.	0	0	0	0.046	0	0.99	4.2	6.6	3.3	2.6
	Conochilus spp.	0	0	0	0	0	0	0	0.38	0.56	0.36
	Gastropus spp.	0	0	0	0	0	0	0	0	0	0
	Synchaeta spp.	0	0	0	0	0	0	0.31	1.9	0.63	0
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0
Total biomass of organisms		**216**	**211**	**750**	**659**	**370**	**1,575**	**611**	**1,161**	**1,683**	**1,625**
Total number of taxa		**11**	**10**	**13**	**12**	**11**	**13**	**16**	**16**	**15**	**14**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.20: Zooplankton Community Biomass Data (µg/L dw), August 2018[a]

Species		**Upstream of Elk River (RG_TN)**					**Downstream of Elk River (RG_T4)**				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Copepoda	*Epischura nevadensis*	109	74	86	62	0.87	14	34	19	20	66
	Diaptomus pallidus	38	62	2.6	22	0	14	23	13	15	57
	Diaptomus tyrrelli	7.5	38	28	43	0	107	127	119	75	37
	Calanoid nauplius	0.41	2.9	1.7	1.7	0	3.7	0.41	2.1	2.9	2.9
	Cyclops bicuspidatus thomasi	135	92	85	82	0.19	231	220	301	216	377
	Acanthocyclops vernalis	3.9	1.6	0.78	0.78	0	1.6	0	0	1.6	1.6
	Cyclopoid nauplius	4.7	6.6	9.7	7.0	0.19	3.1	6.2	7.0	8.9	7.0
Cladocera	*Daphnia schoedleri*	335	25	67	149	0.69	69	45	1.0	0	0
	Daphnia galeata mendotae	126	503	132	400	3.1	26	51	186	209	146
	Daphnia retrocurva	85	44	5.1	62	0	88	32	3.5	42	44
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	0	0	0	0	0
	Scapholeberis kingii	0	0	0	0	0	1.5	0.75	0	1.5	0
	Leptodora kindtii	3.6	1.8	0	0	0	1.8	0	1.8	0	1.2
	Diaphanosoma leuchtenbergianum	0.13	2.0	5.2	3.3	0	0	13	18	4.1	3.4
Rotifera	*Kellicottia* spp.	0.27	0.15	0.18	0.20	0.030	0.39	0.39	0.70	0.91	0.60
	Keratella spp.	0.18	0.18	0.24	0.28	0.011	0.67	0.49	0.84	0.98	1.1
	Polyarthra spp.	0.17	0.50	0.91	0.95	0	0.25	0.17	0	0.58	0.41
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	0.54	0.79	0.85	0.71	0	1.3	1.4	1.5	0.70	0.85
	Synchaeta spp.	0	0.14	0	0.18	0	0	0	0	0.14	0
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0
Total biomass of organisms		**849**	**854**	**425**	**833**	**5.1**	**562**	**554**	**676**	**600**	**748**
Total number of taxa		**16**	**17**	**15**	**16**	**7**	**16**	**15**	**14**	**16**	**15**

[a] Sampled from a depth of 10m to the surface

Table C.21: Zooplankton Community Biomass Data (µg/L dw), September 2018[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Copepoda	*Epischura nevadensis*	30	29	58	115	91	20	26	15	13	38
	Diaptomus pallidus	23	24	8.4	3.8	8.7	1.9	9.1	0.42	1.2	1.7
	Diaptomus tyrrelli	14	26	13	46	25	19	38	12	24	56
	Calanoid nauplius	2.4	4.0	0.99	2.1	2.4	2.4	6.0	3.2	5.8	3.4
	Cyclops bicuspidatus thomasi	39	17	12	11	16	89	109	51	42	84
	Acanthocyclops vernalis	0.56	4.1	0.62	1.3	0.65	1.5	0.71	0.35	1.1	1.1
	Cyclopoid nauplius	7.6	8.4	8.1	9.4	5.5	9.0	11	8.6	11	13
Cladocera	*Daphnia schoedleri*	58	19	62	6.0	9.1	75	4.0	3.7	2.7	1.6
	Daphnia galeata mendotae	35	61	124	113	98	2.9	32	29	37	89
	Daphnia retrocurva	27	19	71	63	54	78	56	19	19	39
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	4.3	0	0	0	0
	Scapholeberis kingii	0	0	0	0.62	0.62	0	0	0	0	0
	Leptodora kindtii	3.2	3.2	2.4	0.50	1.0	0.29	0	0	0	0
	Diaphanosoma leuchtenbergianum	6.6	2.4	1.1	3.4	2.3	2.5	8.3	9.4	4.7	3.5
Rotifera	*Kellicottia* spp.	0.10	0.16	0.19	0.20	0.15	0.52	0.63	0.38	0.43	0.41
	Keratella spp.	0.19	0.23	0.16	0.24	0.37	0.49	0.44	0.37	0.30	0.37
	Polyarthra spp.	0.32	5.2	1.1	0.83	0.55	0.43	0.83	0.60	1.1	0.60
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	0.44	0.45	0.53	0.30	0.28	0.35	0.32	0.12	0.19	0.40
	Synchaeta spp.	0.050	0.37	0	0.12	0.12	0	0	0	0.13	0.064
	Brachionus spp.	0	0	0	0	0	0	0	0	0.040	0
Total biomass of organisms		**248**	**222**	**363**	**377**	**316**	**308**	**303**	**154**	**163**	**331**
Total number of taxa		**17**	**17**	**16**	**18**	**18**	**17**	**15**	**15**	**17**	**16**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.22: Biomass (µg/L dw) of Zooplankton by Group, June 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-3	TN-4	TN-5	T4-2	T4-3	T4-4	T4-5	T4-6
Copepoda	82	45	111	69	68	802	317	613	811	620
Cladocera	133	166	639	590	302	735	270	500	836	982
Rotifera	0.45	0.21	0.66	0.31	0.31	38	25	48	35	22
Total biomass of organisms	**216**	**211**	**750**	**659**	**370**	**1,575**	**611**	**1,161**	**1,683**	**1,625**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.23: Biomass (µg/L dw) of Zooplankton by Group, August 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-2**	**T4-3**	**T4-4**	**T4-5**	**T4-6**
Copepoda	298	276	213	218	1.3	374	410	462	340	550
Cladocera	550	576	210	613	3.8	185	142	210	257	195
Rotifera	1.2	1.8	2.2	2.3	0.041	2.6	2.4	3.0	3.3	3.0
Total biomass of organisms	**849**	**854**	**425**	**833**	**5**	**562**	**554**	**676**	**600**	**748**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled from a depth of 10m to the surface

Table C.24: Biomass (µg/L dw) of Zooplankton by Group, September 2018[a]

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-2**	**T4-3**	**T4-4**	**T4-5**	**T4-6**
Copepoda	116	112	101	188	149	143	200	91	98	197
Cladocera	130	103	260	187	165	164	101	61	63	133
Rotifera	1.1	6.4	2.0	1.7	1.5	1.8	2.2	1.5	2.1	1.8
Total biomass of organisms	**248**	**222**	**363**	**377**	**316**	**308**	**303**	**154**	**163**	**331**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.25: Relative Biomass (%) of Zooplankton Species, June 2018[a]

	Species	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	13	3.9	2.0	4.6	5.5	0.037	0.38	0.061	0.22	0.047	2.0	0.037	4.6	0.061	13	0.38	5.8	0.15	4.2	0.15
	Diaptomus pallidus	11	7.5	3.3	3.2	7.4	0.0081	1.0	3.1	1.3	0.51	3.2	0.0081	7.4	1.0	11	3.1	6.4	1.2	3.2	1.2
	Diaptomus tyrrelli	3.8	5.2	2.8	0.40	1.3	0.25	1.4	0.10	0.47	0.77	0.40	0.10	2.8	0.47	5.2	1.4	2.7	0.59	1.9	0.51
	Calanoid nauplius	0.89	0.92	0	0.35	0.31	0.10	0.60	0.079	0	0.12	0	0	0.35	0.10	0.92	0.60	0.49	0.18	0.40	0.24
	Cyclops bicuspidatus thomasi	9.5	3.5	6.6	1.8	3.8	49	45	46	44	36	1.8	36	3.8	45	9.5	49	5.0	44	3.0	4.7
	Acanthocyclops vernalis	0.36	0.22	0.052	0	0	0.10	0.85	0.15	0.10	0	0	0	0.052	0.10	0.36	0.85	0.13	0.24	0.16	0.34
	Cyclopoid nauplius	0	0.11	0.026	0.065	0.029	1.4	3.0	3.1	1.7	0.40	0	0.40	0.029	1.7	0.11	3.1	0.046	1.9	0.042	1.1
Cladocera	*Daphnia schoedleri*	0	0	0	19	18	18	31	33	29	13	0	13	0	29	19	33	7.3	25	9.9	8.8
	Daphnia galeata mendotae	58	79	82	71	64	28	9.2	8.6	18	37	58	8.6	71	18	82	37	71	20	10	12
	Daphnia retrocurva	0	0	2.7	0	0	0	0	0	0	5.3	0	0	0	0	2.7	5.3	0.55	1.1	1.2	2.4
	Holopedium gibberum	0	0	0	0	0	0	1.9	0	0	0	0	0	0	0	0	1.9	0	0.38	0	0.84
	Bosmina longirostris	0	0	0.23	0	0	0.56	1.8	1.1	2.4	5.1	0	0.56	0	1.8	0.23	5.1	0.045	2.2	0.10	1.8
	Scapholeberis kingii	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	3.6	0	0.73	0	1.6	0
	Leptodora kindtii	0.28	0	0.081	0.10	0.18	0	0.22	0.029	0.18	0	0	0	0.10	0.029	0.28	0.22	0.13	0.086	0.11	0.11
	Diaphanosoma leuchtenbergianum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotifera	*Kellicottia* spp.	0.15	0.076	0.060	0.038	0.057	0.67	0.63	0.46	0.42	0.17	0.038	0.17	0.060	0.46	0.15	0.67	0.077	0.47	0.045	0.20
	Keratella spp.	0.056	0.025	0.028	0	0.028	1.7	2.7	2.9	1.4	1.0	0	1.0	0.028	1.7	0.056	2.9	0.028	1.9	0.019	0.81
	Polyarthra spp.	0	0	0	0.0070	0	0.063	0.69	0.57	0.20	0.16	0	0.063	0	0.20	0.0070	0.69	0	0.34	0	0.28
	Conochilus spp.	0	0	0	0	0	0	0	0.032	0.034	0.022	0	0	0	0.022	0	0.034	0	0.018	0	0.017
	Gastropus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Synchaeta sp.	0	0	0	0	0	0	0.051	0.16	0.037	0	0	0	0	0.037	0	0.16	0	0.050	0	0.067
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.26: **Relative Biomass (%) of Zooplankton Species, August 2018**[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	13	8.6	20	7.4	17	2.6	6.1	2.9	3.4	8.9	7.4	2.6	13	3.4	20	8.9	13	4.8	5.4	2.7
	Diaptomus pallidus	4.4	7.2	0.61	2.7	0	2.4	4.1	2.0	2.5	7.7	0	2.0	2.7	2.5	7.2	7.7	3.0	3.7	2.9	2.3
	Diaptomus tyrrelli	0.89	4.4	6.5	5.1	0	19	23	18	12	5.0	0	5.0	4.4	18	6.5	23	3.4	15	2.8	6.9
	Calanoid nauplius	0.049	0.34	0.39	0.20	0	0.66	0.075	0.31	0.48	0.39	0	0.075	0.20	0.39	0.39	0.66	0.20	0.38	0.17	0.22
	Cyclops bicuspidatus thomasi	16	11	20	9.8	3.8	41	40	45	36	50	3.8	36	11	41	20	50	12	42	6.2	5.5
	Acanthocyclops vernalis	0.46	0.18	0.18	0.093	0	0.28	0	0	0.26	0.21	0	0	0.18	0.21	0.46	0.28	0.18	0.15	0.17	0.14
	Cyclopoid nauplius	0.55	0.77	2.3	0.84	3.8	0.55	1.1	1.0	1.5	0.93	0.55	0.55	0.84	1.0	3.8	1.5	1.6	1.0	1.4	0.34
Cladocera	*Daphnia schoedleri*	40	2.9	16	18	13	12	8.1	0.15	0	0	2.9	0	16	0.15	40	12	18	4.1	13	5.7
	Daphnia galeata mendotae	15	59	31	48	61	4.6	9.2	28	35	20	15	4.6	48	20	61	35	43	19	20	13
	Daphnia retrocurva	10	5.1	1.2	7.4	0	16	5.8	0.51	6.9	5.9	0	0.51	5.1	5.9	10	16	4.8	7.0	4.2	5.4
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Scapholeberis kingii	0	0	0	0	0	0.27	0.13	0	0.25	0	0	0	0	0.13	0	0.27	0	0.13	0	0.13
	Leptodora kindtii	0.43	0.21	0	0	0	0.32	0	0.27	0	0.16	0	0	0	0.16	0.43	0.32	0.13	0.15	0.19	0.15
	Diaphanosoma leuchtenbergianum	0.015	0.24	1.2	0.39	0	0	2.3	2.7	0.68	0.46	0	0	0.24	0.68	1.2	2.7	0.37	1.2	0.50	1.2
Rotifera	*Kellicottia* spp.	0.032	0.018	0.043	0.024	0.59	0.070	0.071	0.10	0.15	0.081	0.018	0.070	0.032	0.081	0.59	0.15	0.14	0.10	0.25	0.034
	Keratella spp.	0.021	0.021	0.057	0.033	0.22	0.12	0.088	0.12	0.16	0.15	0.021	0.088	0.033	0.12	0.22	0.16	0.070	0.13	0.083	0.029
	Polyarthra spp.	0.019	0.058	0.21	0.11	0	0.044	0.030	0	0.10	0.055	0	0	0.058	0.044	0.21	0.10	0.081	0.045	0.086	0.035
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	0.064	0.092	0.20	0.085	0	0.24	0.25	0.22	0.12	0.11	0	0.11	0.085	0.22	0.20	0.25	0.088	0.19	0.072	0.066
	Synchaeta sp.	0	0.017	0	0.021	0	0	0	0	0.024	0	0	0	0	0	0.021	0.024	0.0076	0	0.011	0.011
	Brachionus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Sampled from a depth of 10m to the surface

Table C.27: **Relative Biomass (%) of Zooplankton Species, September 2018**[a]

Species		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Copepoda	*Epischura nevadensis*	12	13	16	31	29	6.5	8.5	10	7.7	11	12	6.5	16	8.5	31	11	20	8.8	8.9	1.9
	Diaptomus pallidus	9.4	11	2.3	1.0	2.8	0.62	3.0	0.27	0.72	0.50	1.0	0.27	2.8	0.62	11	3.0	5.3	1.0	4.5	1.1
	Diaptomus tyrrelli	5.6	12	3.6	12	8.1	6.1	13	8.0	15	17	3.6	6.1	8.1	13	12	17	8.2	12	3.7	4.6
	Calanoid nauplius	0.95	1.8	0.27	0.55	0.76	0.77	2.0	2.1	3.6	1.0	0.27	0.77	0.76	2.0	1.8	3.6	0.86	1.9	0.57	1.1
	Cyclops bicuspidatus thomasi	16	7.6	3.2	3.0	5.0	29	36	33	26	25	3.0	25	5.0	29	16	36	6.9	30	5.2	4.7
	Acanthocyclops vernalis	0.22	1.8	0.17	0.34	0.21	0.48	0.23	0.23	0.65	0.32	0.17	0.23	0.22	0.32	1.8	0.65	0.56	0.38	0.72	0.18
	Cyclopoid nauplius	3.1	3.8	2.2	2.5	1.7	2.9	3.6	5.6	7.0	3.8	1.7	2.9	2.5	3.8	3.8	7.0	2.7	4.6	0.80	1.7
Cladocera	*Daphnia schoedleri*	23	8.4	17	1.6	2.9	24	1.3	2.4	1.7	0.47	1.6	0.47	8.4	1.7	23	24	11	6.1	9.3	10
	Daphnia galeata mendotae	14	27	34	30	31	0.94	11	19	23	27	14	0.94	30	19	34	27	27	16	7.7	10
	Daphnia retrocurva	11	8.5	19	17	17	25	19	12	11	12	8.5	11	17	12	19	25	15	16	4.6	6.1
	Holopedium gibberum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosmina longirostris	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0	1.4	0	0.28	0	0.63
	Scapholeberis kingii	0	0	0	0.16	0.20	0	0	0	0	0	0	0	0	0	0.20	0	0.072	0	0.10	0
	Leptodora kindtii	1.3	1.4	0.67	0.13	0.32	0.093	0	0	0	0	0.13	0	0.67	0	1.4	0.093	0.77	0.019	0.58	0.042
	Diaphanosoma leuchtenbergianum	2.7	1.1	0.30	0.90	0.72	0.80	2.7	6.1	2.9	1.1	0.30	0.80	0.90	2.7	2.7	6.1	1.1	2.7	0.90	2.1
Rotifera	*Kellicottia* spp.	0.039	0.071	0.053	0.053	0.048	0.17	0.21	0.25	0.26	0.12	0.039	0.12	0.053	0.21	0.071	0.26	0.053	0.20	0.012	0.057
	Keratella spp.	0.077	0.10	0.044	0.064	0.12	0.16	0.15	0.24	0.19	0.11	0.044	0.11	0.077	0.16	0.12	0.24	0.081	0.17	0.030	0.049
	Polyarthra spp.	0.13	2.3	0.31	0.22	0.17	0.14	0.27	0.39	0.64	0.18	0.13	0.14	0.22	0.27	2.3	0.64	0.63	0.33	0.95	0.20
	Conochilus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gastropus spp.	0.18	0.20	0.15	0.080	0.088	0.11	0.10	0.080	0.12	0.12	0.080	0.080	0.15	0.11	0.20	0.12	0.14	0.11	0.054	0.016
	Synchaeta sp.	0.020	0.17	0	0.031	0.037	0	0	0	0.079	0.019	0	0	0.031	0	0.17	0.079	0.051	0.020	0.066	0.034
	Brachionus spp.	0	0	0	0	0	0	0	0	0.025	0	0	0	0	0	0	0.025	0	0	0	0.011

[a] Sampled entire water column (1.5m from the bottom to the surface).

Table C.28: Summary of Phytoplankton Community Metrics and Statistical Comparisons for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Biological Monitoring 2018

Endpoint	Units	Data Transformation	Test	Test P-value	Mean or Median [a]		Observed Effect Size (RG_T4 - RG_TN)/SD
					RG_T4	RG_TN	
Richness	-	rank	MW	0.676	26.00	25.00	-
Total Density	1,000 cells/L	none	T	0.428	4,893.33	4,540.19	0.53
Chlorophyte	1,000 cells/L	$\log_{10}$	T	0.307	64.29	44.83	0.69
Chrysophyte	1,000 cells/L	rank	MW	0.917	581.90	539.00	0.32
Diatom	1,000 cells/L	none	T	0.854	3,552.60	3,659.12	-0.12
Cryptophyte	1,000 cells/L	square-root	T	0.851	216.51	229.59	-0.12
Dinoflagellate	1,000 cells/L	$\log_{10}$	T	0.721	0.77	0.93	-0.23
Total Biomass	mg/m^3	$\log_{10}$	T	0.460	743.97	645.02	0.49
Chlorophyte	mg/m^3	$\log_{10}$	T	0.800	64.29	44.83	0.17
Chrysophyte	mg/m^3	rank	MW	0.754	581.90	52.49	0.91
Diatom	mg/m^3	$\log_{10}$	T	0.481	3,385.02	3,630.63	0.47
Cryptophyte	mg/m^3	$\log_{10}$	T	0.827	199.44	225.32	-0.14
Dinoflagellate	mg/m^3	square-root	T	0.393	0.80	1.14	-0.57
NMDS Axis 1	Density	rank	MW	0.347	0.06	0.02	0.52
NMDS Axis 2	Density	none	T	0.779	0.01	-0.01	0.18
NMDS Axis 3	Density	none	T	0.006	-0.06	0.06	-2.3
NMDS Axis 1	Biomass	none	T	0.772	0.01	-0.01	-0.19
NMDS Axis 2	Biomass	none	T	0.099	0.01	-0.01	-1.2
NMDS Axis 3	Biomass	none	T	0.057	-0.06	0.06	1.4

▨ P-value < 0.1

🟦 Effect size magnitude > 2

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

Note: (Downstream-Upstream)/ Standard Deviation (SD) for trans data; SD for all data

Table C.29: Phytoplankton Community Endpoint Summaries for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa 2018

Site	Endpoint	Units	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
RG_TN	Richness	-	5	25.60	0.89	0.40	25.00	25.00	27.00
	Total Density	1,000 cells/L	5	4540.19	427.53	191.20	3885.34	4498.85	5024.70
	Chlorophyte	1,000 cells/L	5	48.97	25.67	11.48	28.74	43.30	93.59
	Chrysophyte	1,000 cells/L	5	596.91	128.62	57.52	474.54	539.00	762.50
	Diatom	1,000 cells/L	5	3659.12	493.41	220.66	2890.71	3773.23	4161.58
	Cryptophyte	1,000 cells/L	5	233.83	69.86	31.24	149.50	244.90	330.10
	Dinoflagellate	1,000 cells/L	5	1.36	1.31	0.58	0.20	1.00	3.60
	Total Biomass	mg/m^3	5	649.37	86.39	38.63	564.99	619.60	787.24
	Chlorophyte	mg/m^3	5	2.84	1.62	0.73	1.24	2.63	5.51
	Chrysophyte	mg/m^3	5	66.27	20.19	9.03	52.06	52.49	96.32
	Diatom	mg/m^3	5	494.27	110.89	49.59	390.28	471.93	648.01
	Cryptophyte	mg/m^3	5	57.24	13.65	6.10	43.09	50.67	72.00
	Dinoflagellate	mg/m^3	5	28.75	31.54	14.11	0.76	15.14	81.45
	NMDS Axis 1	Density	5	-0.01	0.04	0.02	-0.06	0.02	0.02
	NMDS Axis 2	Density	5	-0.01	0.11	0.05	-0.19	0.02	0.11
	NMDS Axis 3	Density	5	0.06	0.04	0.02	-0.01	0.08	0.10
	NMDS Axis 1	Biomass	5	0.01	0.05	0.02	-0.07	0.03	0.05
	NMDS Axis 2	Biomass	5	0.06	0.08	0.04	-0.05	0.03	0.18
	NMDS Axis 3	Biomass	5	-0.06	0.11	0.05	-0.14	-0.08	0.12
RG_T4	Richness	-	5	24.60	2.19	0.98	21.00	26.00	26.00
	Total Density	1,000 cells/L	5	4893.33	842.91	376.96	3595.25	5135.22	5739.08
	Chlorophyte	1,000 cells/L	5	73.68	43.37	19.40	28.74	72.44	144.08
	Chrysophyte	1,000 cells/L	5	1033.50	1137.61	508.75	395.32	581.90	3060.78
	Diatom	1,000 cells/L	5	3552.60	1153.65	515.93	1999.20	3793.38	4814.70
	Cryptophyte	1,000 cells/L	5	232.72	129.69	58.00	82.64	237.30	383.98
	Dinoflagellate	1,000 cells/L	5	0.84	0.38	0.17	0.40	0.80	1.40
	Total Biomass	mg/m^3	5	790.10	304.35	136.11	453.62	788.67	1235.40
	Chlorophyte	mg/m^3	5	73.68	43.37	19.40	28.74	72.44	144.08
	Chrysophyte	mg/m^3	5	1033.50	1137.61	508.75	395.32	581.90	3060.78
	Diatom	mg/m^3	5	3552.60	1153.65	515.93	1999.20	3793.38	4814.70
	Cryptophyte	mg/m^3	5	232.72	129.69	58.00	82.64	237.30	383.98
	Dinoflagellate	mg/m^3	5	0.84	0.38	0.17	0.40	0.80	1.40
	NMDS Axis 1	Density	5	0.01	0.18	0.08	-0.30	0.06	0.15
	NMDS Axis 2	Density	5	0.01	0.09	0.04	-0.11	0.04	0.11
	NMDS Axis 3	Density	5	-0.06	0.06	0.03	-0.12	-0.08	0.03
	NMDS Axis 1	Biomass	5	0.01	0.18	0.08	-0.30	0.06	0.15
	NMDS Axis 2	Biomass	5	0.01	0.09	0.04	-0.11	0.04	0.11
	NMDS Axis 3	Biomass	5	-0.06	0.06	0.03	-0.12	-0.08	0.03

Table C.30: **Phytoplankton Community Density and Biomass Endpoints Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, August 2018**

Area	Richness	Total Density (cells/L)	Total Biomass (mg/m^3)	Chlorophyte (cells/L)	Chrysophyte (cells/L)	Diatom (cells/L)	Cryptophyte (cells/L)	Dinoflagellate (cells/L)	Chlorophyte (mg/m3)	Chrysophyte (mg/m3)	Diatom (mg/m3)	Cryptophyte (mg/m3)	Dinoflagellate (mg/m3)
T4-1	27	4,793,392	673	93,592	474,544	3,965,616	259,440	200	5.51	52.49	563.82	50.67	0.76
T4-2	25	5,024,696	787	28,736	503,480	4,161,584	330,096	800	1.24	52.06	648.01	72.00	13.93
T4-3	25	4,498,848	602	35,920	539,000	3,773,232	149,496	1,200	1.96	52.31	471.93	43.09	32.48
T4-4	26	4,498,696	565	43,304	705,032	3,504,456	244,904	1,000	2.63	78.16	397.31	71.75	15.14
T4-5	25	3,885,336	620	43,304	762,504	2,890,712	185,216	3,600	2.87	96.32	390.28	48.68	81.45
TN-1	24	5,135,224	900	50,288	475,144	4,371,088	237,304	1,400	1.25	51.56	768.95	58.33	19.45
TN-2	26	5,739,080	1,235	144,080	395,320	4,814,696	383,984	1,000	6.95	45.30	1,086.73	81.58	14.85
TN-3	21	4,573,672	573	72,440	581,904	3,793,384	125,344	600	2.66	64.54	460.07	35.02	10.98
TN-4	26	5,423,432	789	28,736	3,060,784	1,999,200	334,312	400	1.74	230.62	469.66	84.97	1.68
TN-5	26	3,595,248	454	72,840	654,344	2,784,624	82,640	800	4.17	61.22	344.01	29.53	14.68

Table C.31: **Station Scores for a Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Phytoplankton Density and Biomass at the Lowest Practical Level of Identification for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, August 2018**

Area	Replicate	Density			Biomass		
		NMDS Axis 1	NMDS Axis 2	NMDS Axis 3	NMDS Axis 1	NMDS Axis 2	NMDS Axis 3
RG_TN	1	-0.063	-0.192	-0.009	-0.068	0.176	0.118
	2	-0.051	0.022	0.054	0.032	0.031	-0.045
	3	0.023	0.109	0.078	0.020	-0.050	-0.132
	4	0.017	-0.009	0.098	0.053	0.096	-0.085
	5	0.020	0.025	0.095	0.028	0.026	-0.142
RG_T4	1	0.015	-0.047	-0.121	0.079	0.003	0.102
	2	0.146	-0.109	0.033	0.233	0.013	0.079
	3	0.061	0.038	-0.115	-0.048	-0.148	0.092
	4	-0.304	0.049	-0.037	-0.292	0.039	0.003
	5	0.136	0.115	-0.075	-0.038	-0.186	0.010

Table C.32: Spearman Correlations of Fourth-Root Transformed Relative Densities with Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Phytoplankton Relative Densities for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018

Taxa	Density					
	NMDS Axis 1		NMDS Axis 2		NMDS Axis 3	
	r_s	P-value	r_s	P-value	r_s	P-value
Ankistrodesmus spiralis	-0.061	0.868	0.078	0.831	0.242	0.500
Asterionella formosa	-0.485	0.155	-0.213	0.554	-0.394	0.259
Bitrichia chodatii	-0.369	0.295	0.394	0.259	-0.226	0.530
Botryococcus braunii	0.291	0.415	-0.246	0.493	0.515	0.128
Ceratium hirundinella	0.498	0.143	-0.547	0.102	-0.438	0.206
Chlamydomonas spp	0.321	0.368	0.406	0.247	-0.697	0.031
Chrysochromulina laurentiana	-0.388	0.268	0.732	0.016	-0.450	0.192
Chrysochromulina parva	0.321	0.368	-0.855	0.004	0.006	1.000
Chrysococcus sp	-0.042	0.919	-0.224	0.537	-0.018	0.973
Chrysolykos skuja	-0.320	0.367	0.493	0.148	-0.389	0.266
Chrysophyceae	-0.491	0.154	-0.576	0.088	-0.139	0.707
Cryptomonas erosa	0.079	0.838	-0.224	0.537	-0.479	0.166
Cryptomonas rostratiformis	0.231	0.521	-0.664	0.036	0.574	0.083
Cyclotella bodanica	0.067	0.865	-0.321	0.368	-0.673	0.039
Cyclotella michiganiana	0.430	0.218	-0.467	0.178	-0.285	0.427
Cyclotella pseudostelligera	-0.103	0.785	0.685	0.035	0.455	0.191
Cyclotella stelligera	-0.079	0.838	-0.200	0.584	-0.867	0.003
Dinobryon bavaricum	-0.079	0.838	-0.079	0.838	-0.455	0.191
Dinobryon mucronatom	-0.488	0.153	0.144	0.692	-0.682	0.030
Dinobryon sertularia	0.224	0.537	-0.455	0.191	0.600	0.073
Elakatothrix gelatinosa	-0.052	0.887	-0.294	0.409	-0.355	0.315
Fragilaria crotonensis	-0.467	0.178	0.212	0.560	-0.139	0.707
Gymnodinium sp	0.276	0.440	-0.215	0.551	-0.043	0.906
Katablepharis ovalis	-0.369	0.295	0.511	0.131	0.071	0.845
Kephyrion	-0.297	0.407	0.455	0.191	0.042	0.919
Mallomonas crassisquama	-0.538	0.109	0.081	0.823	-0.381	0.277
Oocystis lacustris	-0.019	0.958	-0.097	0.790	0.912	<0.001
Peridinium pusillum	0.442	0.204	-0.042	0.919	-0.188	0.608
Rhizosolenia eriense	0.450	0.192	-0.701	0.024	0.043	0.906
Rhodomonas minuta	-0.406	0.247	0.697	0.031	-0.430	0.218
Scenedesmus denticulatus	0.601	0.066	-0.459	0.182	-0.459	0.182
Spiniferomonas serrata	0.623	0.054	0.216	0.548	0.225	0.532
Synedra ulna	0.406	0.247	-0.200	0.584	0.067	0.865
Tabellaria fenestrata	-0.080	0.827	0.350	0.322	-0.129	0.723
Tabellaria flocculosa	-0.067	0.854	-0.365	0.299	0.649	0.042

▨ P-value < 0.05
🟦 $|r_s| > 0.5$

Table C.33: Summary of Zooplankton Community Metrics and Statistical Comparisons From Entire Column Samples for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, June 2018

Endpoint	Units	Data Transformation	Test	Test P-value	Mean or Median [a]		Observed Effect Size (RG_T4 - RG_TN)/SD
					RG_T4	RG_TN	
Richness	-	square-root	T	0.010	12.7	9.57	2.1
Total Density	ind/L	fourth-root	T	<0.001	260	9.91	9.3
Total Calanoida	ind/L	$\log_{10}$	T	0.248	1.04	1.30	-0.79
Total Cyclopoida	ind/L	fourth-root	T	<0.001	62.1	1.61	7.1
Total Cladocera	ind/L	none	T	0.018	17.0	5.33	1.9
Total Rotifera	ind/L	fourth-root	T	<0.001	178	1.83	11
NMDS1	Density	rank	MW	0.009	-0.159	0.097	-3138
NMDS2	Density	rank	MW	0.076	-0.048	-0.051	27
Total Biomass	µg/L	none	T	0.005	1,314	459	2.4
Total Calanoida	µg/L	square-root	T	0.009	1.07	1.30	-2.2
Total Cyclopoida	µg/L	fourth-root	T	<0.001	62.1	1.61	6.7
Total Cladocera	µg/L	none	T	0.131	17.0	5.33	1.1
Total Rotifera	µg/L	fourth-root	T	<0.001	178	1.83	11
Tissue Selenium	µg/g dw	none	T	0.007	2.50	1.90	2.3

▨	P-value < 0.1
🟦	Effect size magnitude > 2

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

Note: (Downstream-Upstream)/Standard Deviation [SD] for transformed data; SD for all other data.

Table C.34: Summary of Zooplankton Community Metrics and Statistical Comparisons From 10m Depth Samples for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, August 2018

Endpoint	Units	Data Transformation	Test	Test P-value	Mean or Median [a]		Observed Effect Size (RG_T4 - RG_TN)/SD
					RG_T4	RG_TN	
Richness	-	rank	MW	0.602	13.0	14.0	-0.67
Total Density	ind/L	none	T	<0.001	51.1	19.1	3.2
Total Calanoida	ind/L	none	T	0.111	3.61	2.27	1.1
Total Cyclopoida	ind/L	none	T	0.002	30.7	9.78	2.9
Total Cladocera	ind/L	none	T	0.056	2.94	1.49	1.4
Total Rotifera	ind/L	none	T	<0.001	13.8	5.56	3.3
NMDS1	Density	none	T	0.496	0.0475	-0.0475	0.45
NMDS2	Density	none	T	0.606	0.0000	0.0000	0.34
Total Biomass	µg/L	none	T	0.802	589	548	0.16
Total Calanoida	µg/L	none	T	0.381	3.61	2.27	0.59
Total Cyclopoida	µg/L	none	T	0.001	30.7	9.78	3
Total Cladocera	µg/L	none	T	0.160	2.94	1.49	-0.98
Total Rotifera	µg/L	none	T	0.018	13.8	5.56	1.9
Tissue Selenium	µg/g dw	none	T	0.009	4.18	3.04	2.2

▒ P-value < 0.1

🟦 Effect size magnitude > 2

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

Note: (Downstream-Upstream)/Standard Deviation [SD] for transformed data; SD for all other data.

Table C.35: Summary of Zooplankton Community Metrics and Statistical Comparisons From Entire Column Samples for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, September 2018

Endpoint	Units	Data Transformation	Test	Test P-value	Mean or Median [a]		Observed Effect Size (RG_T4 - RG_TN)/SD
					RG_T4	RG_TN	
Richness	-	rank	MW	0.175	14.0	15.0	-0.67
Total Density	ind/L	fourth root	T	0.022	21.2	13.9	1.8
Total Calanoida	ind/L	none	T	0.374	2.24	1.87	0.6
Total Cyclopoida	ind/L	none	T	<0.001	11.1	4.43	3.7
Total Cladocera	ind/L	log	T	0.400	0.87	1.03	-0.56
Total Rotifera	ind/L	log	T	0.549	7.20	6.29	0.4
NMDS1	Density	none	T	0.010	-0.0672	0.0672	-2.1
NMDS2	Density	none	T	0.290	-0.01858	0.01858	-0.72
Total Biomass	µg/L	fourth root	T	0.210	203	256	-0.86
Total Calanoida	µg/L	log	T	0.062	2.14	1.81	-1.4
Total Cyclopoida	µg/L	square root	T	<0.001	11.0	4.40	3.5
Total Cladocera	µg/L	none	T	0.080	0.888	1.08	-1.3
Total Rotifera	µg/L	log	T	0.890	7.20	6.29	-0.09
Tissue Selenium	µg/g dw	none	T	<0.001	4.32	2.52	4.5

▨	P-value < 0.1
🟦	Effect size magnitude > 2

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

Note: (Downstream-Upstream)/Standard Deviation [SD] for transformed data; SD for all other data.

Table C.36: Zooplankton Community Summary Statistics for Entire Column Samples, June 2018

Site	Endpoint	Units	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
RG_TN	Richness	-	5	9.6	1.14	0.51	8	10	11
	Total Density	ind/L	5	10.5	5.10	2.28	6.3	8.4	19.1
	Total Calanoida	ind/L	5	1.3	0.17	0.08	1.1	1.4	1.5
	Total Cyclopoida	ind/L	5	1.9	1.65	0.74	0.6	1.4	4.8
	Total Cladocera	ind/L	5	5.3	2.99	1.34	2.4	4.4	9.8
	Total Rotifera	ind/L	5	2.0	0.96	0.43	1.1	1.6	3.5
	NMDS1	Density	5	0.1	0.08	0.04	0.1	0.1	0.3
	NMDS2	Density	5	0.0	0.03	0.01	-0.1	-0.1	0.0
	Total Biomass	µg/L	5	459	242.10	108.27	211	479	730
	Total Calanoida	µg/L	5	53	9.86	4.41	37	56	61
	Total Cyclopoida	µg/L	5	21	17.10	7.65	8	12	50
	Total Cladocera	µg/L	5	389	233.83	104.57	134	415	639
	Total Rotifera	µg/L	5	0.4	0.18	0.08	0.2	0.3	0.7
	Tissue Selenium	µg/g dw	5	1.9	0.31	0.14	1.5	2.0	2.3
RG_T4	Richness	-	5	12.8	1.79	0.80	10	14	14
	Total Density	ind/L	5	265.9	68.83	30.78	172.0	297.7	330.9
	Total Calanoida	ind/L	5	1.1	0.37	0.16	0.6	1.3	1.5
	Total Cyclopoida	ind/L	5	64.4	20.03	8.96	32.2	66.1	82.3
	Total Cladocera	ind/L	5	17.0	8.32	3.72	8.8	12.3	27.6
	Total Rotifera	ind/L	5	183.3	55.89	24.99	124.2	190.4	251.2
	NMDS1	Density	5	-0.1	0.05	0.02	-0.2	-0.2	0.0
	NMDS2	Density	5	0.0	0.19	0.09	0.0	0.0	0.4
	Total Biomass	µg/L	5	1,313.7	439.06	196.35	611.4	1538.1	1682.6
	Total Calanoida	µg/L	5	1.1	0.37	0.16	0.6	1.3	1.5
	Total Cyclopoida	µg/L	5	64.4	20.03	8.96	32.2	66.1	82.3
	Total Cladocera	µg/L	5	17.0	8.32	3.72	8.8	12.3	27.6
	Total Rotifera	µg/L	5	183.3	55.89	24.99	124.2	190.4	251.2
	Tissue Selenium	µg/g dw	5	2.5	0.21	0.09	2.2	2.5	2.7

Table C.37: Zooplankton Community Summary Statistics for 10m Samples, August 2018

Site	Endpoint	Units	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
RG_TN	Richness	-	5	12.4	3.65	1.63	6	14	15
	Total Density	ind/L	5	19.1	10.52	4.71	0.3	23.6	24.6
	Total Calanoida	ind/L	5	2.3	1.62	0.72	0.0	2.3	4.5
	Total Cyclopoida	ind/L	5	9.8	5.66	2.53	0.1	11.3	15.0
	Total Cladocera	ind/L	5	1.5	0.87	0.39	0.0	1.7	2.3
	Total Rotifera	ind/L	5	5.6	3.20	1.43	0.2	6.5	8.0
	NMDS1	Density	5	0.0	0.27	0.12	-0.3	-0.1	0.4
	NMDS2	Density	5	0.0	0.00	0.00	0.0	0.0	0.0
	Total Biomass	µg/L	5	547.5	340.33	152.20	5.1	736.1	810.5
	Total Calanoida	µg/L	5	119.9	69.69	31.17	0.9	150.8	175.9
	Total Cyclopoida	µg/L	5	88.0	52.71	23.57	0.4	100.4	143.5
	Total Cladocera	µg/L	5	380.7	260.68	116.58	3.8	550.0	575.7
	Total Rotifera	µg/L	5	1.5	0.96	0.43	0.0	1.8	2.4
	Tissue Selenium	µg/g dw	5	3.0	0.32	0.14	2.6	3.2	3.3
RG_T4	Richness	-	5	13.2	0.84	0.37	12	13	14
	Total Density	ind/L	5	51.1	9.47	4.23	42.9	48.3	65.7
	Total Calanoida	ind/L	5	3.6	0.45	0.20	2.9	3.7	4.1
	Total Cyclopoida	ind/L	5	30.7	8.63	3.86	24.3	28.4	45.3
	Total Cladocera	ind/L	5	2.9	1.17	0.52	2.2	2.4	5.0
	Total Rotifera	ind/L	5	13.8	1.64	0.73	11.6	14.5	15.5
	NMDS1	Density	5	0.0	0.12	0.06	-0.1	0.0	0.2
	NMDS2	Density	5	0.0	0.00	0.00	0.0	0.0	0.0
	Total Biomass	µg/L	5	588.7	98.26	43.94	480.1	559.0	706.6
	Total Calanoida	µg/L	5	3.6	0.45	0.20	2.9	3.7	4.1
	Total Cyclopoida	µg/L	5	30.7	8.63	3.86	24.3	28.4	45.3
	Total Cladocera	µg/L	5	2.9	1.17	0.52	2.2	2.4	5.0
	Total Rotifera	µg/L	5	13.8	1.64	0.73	11.6	14.5	15.5
	Tissue Selenium	µg/g dw	5	4.2	0.68	0.30	3.2	4.2	4.9

Table C.38: Zooplankton Community Summary Statistics for Entire Column Samples, August 2018

Site	Endpoint	Units	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
RG_TN	Richness	-	5	15.0	1.00	0.45	14	15	16
	Total Density	ind/L	5	14.3	4.43	1.98	11.6	12.7	22.1
	Total Calanoida	ind/L	5	1.9	0.48	0.22	1.2	2.0	2.4
	Total Cyclopoida	ind/L	5	4.4	0.87	0.39	3.3	4.5	5.7
	Total Cladocera	ind/L	5	1.1	0.38	0.17	0.6	1.0	1.6
	Total Rotifera	ind/L	5	6.9	3.78	1.69	3.9	5.4	13.5
	NMDS1	Density	5	0.1	0.08	0.04	0.0	0.1	0.2
	NMDS2	Density	5	0.0	0.07	0.03	-0.1	0.0	0.1
	Total Biomass	µg/L	5	258.8	47.21	21.11	202.9	262.2	314.1
	Total Calanoida	µg/L	5	104.1	42.08	18.82	63.7	82.5	166.6
	Total Cyclopoida	µg/L	5	25.6	6.13	2.74	20.3	22.0	34.6
	Total Cladocera	µg/L	5	170.6	59.20	26.48	103.4	165.5	260.4
	Total Rotifera	µg/L	5	2.5	2.21	0.99	0.9	1.7	6.4
	Tissue Selenium	µg/g dw	5	2.5	0.25	0.11	2.1	2.6	2.7
RG_T4	Richness	-	5	14.0	1.00	0.45	13	14	15
	Total Density	ind/L	5	21.5	3.98	1.78	16.3	21.5	26.8
	Total Calanoida	ind/L	5	2.2	0.73	0.33	1.5	2.5	3.1
	Total Cyclopoida	ind/L	5	11.1	2.35	1.05	8.2	11.4	13.8
	Total Cladocera	ind/L	5	0.9	0.19	0.09	0.7	0.8	1.2
	Total Rotifera	ind/L	5	7.3	1.09	0.49	5.8	7.3	8.7
	NMDS1	Density	5	-0.1	0.04	0.02	-0.1	-0.1	0.0
	NMDS2	Density	5	0.0	0.02	0.01	0.0	0.0	0.0
	Total Biomass	µg/L	5	210.1	68.22	30.51	135.2	229.9	293.9
	Total Calanoida	µg/L	5	2.2	0.73	0.33	1.5	2.5	3.1
	Total Cyclopoida	µg/L	5	11.1	2.35	1.05	8.2	11.4	13.8
	Total Cladocera	µg/L	5	0.9	0.19	0.09	0.7	0.8	1.2
	Total Rotifera	µg/L	5	7.3	1.09	0.49	5.8	7.3	8.7
	Tissue Selenium	µg/g dw	5	4.3	0.51	0.23	3.8	4.4	4.9

Table C.39: Statistical Comparisons Between June (Spring) and September (Summer) Entire Column Zooplankton Community Endpoints, Koocanusa Reservoir Monitoring Program, 2018

Endpoint	Transformation	ANOVA P-Values			Magnitude of Difference[a]	
		Season x Area Interaction	Season	Area	RG_TN	RG_T4
Richness	fourth-root	0.002	-	-	-	-36
Total Density (ind/L)	fourth-root	<0.001	-	-	1126	-29
Total Calanoida (ind/L)	none	0.199	<0.001	0.722	-51	-30
Total Cyclopoida (ind/L)	fourth-root	<0.001	-	-	470	-
Total Cladocera (ind/L)	$\log_{10}$	0.003	-	-	1662	356
Total Rotifera (ind/L)	fourth-root	<0.001	-	-	2365	-72
Total Biomass (µg/L)	fourth-root	0.001	-	-	520	-
Total Calanoida (µg/L)	fourth-root	0.717	<0.001	0.002	-60	-47
Total Cyclopoida (µg/L)	fourth-root	<0.001	-	-	598	-
Total Cladocera (µg/L)	none	0.057	<0.001	0.266	539	127
Total Rotifera (µg/L)	$\log_{10}$	<0.001	-	-	1633	-82
Selenium (ug/g dw)	none	0.001	-	-	-42	-25

▨ P-value < 0.05

Notes:

[a] Magnitude of difference are shown only when pairwise differences between Spring and Summer samples differed, and was calculated as (Spring-Summer)/Summer*100

Table C.40: Statistical Comparisons Between 10m (August) and Entire Column (September) Depth Zooplankton Community Sampling Methods, Koocanusa Reservoir Monitoring Program, 2018

Endpoint	Transformation	ANOVA P-Values			Magnitude of Difference[a]	
		Method x Area Interaction	Method	Area	RG_TN	RG_T4
Richness	rank	0.576	0.034	0.146	-7.1	-6.7
Total Density (ind/L)	none	0.002	-	-	139	-
Total Calanoida (ind/L)	none	0.267	0.054	0.082	-	-
Total Cyclopoida (ind/L)	rank	0.498	<0.001	<0.001	149	149
Total Cladocera (ind/L)	none	0.028	-	-	231	-
Total Rotifera (ind/L)	none	0.004	-	-	90	-
Total Biomass (µg/L)	rank	0.443	<0.001	0.769	143	181
Total Calanoida (µg/L)	none	0.078	0.020	0.748	155	15
Total Cyclopoida (µg/L)	none	0.007	-	-	220	-
Total Cladocera (µg/L)	rank	0.435	0.019	0.124	93	233
Total Rotifera (µg/L)	square-root	0.089	0.927	0.255	-	-
Selenium (ug/g dw)	none	0.135	0.397	<0.001	-	-

▨ P-value < 0.05

Notes:

[a] Magnitude of difference are shown only when pairwise differences between 10m and Entire Column (EC) samples differed, and was calculated as (10m-EC)/EC*100

Table C.41: Zooplankton Community Density and Biomass Endpoints for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018

Sample Depth	Date	Area	Richness	Total Density (ind/L)	Total Calanoida (ind/L)	Total Cyclopoida (ind/L)	Total Cladocera (ind/L)	Total Rotifera (ind/L)	Total Zooplankton (µg/L)	Total Calanoida (µg/L)	Total Cyclopoida (µg/L)	Total Cladocera (µg/L)	Total Rotifera (µg/L)
Entire Column	June, 2018	TN-1	10	7.79	1.40	1.62	2.44	2.33	215.92	60.63	21.34	133.50	0.45
		TN-2	8	6.34	1.44	0.58	3.24	1.08	210.98	36.94	7.97	165.86	0.21
		TN-3	11	19.14	1.06	4.80	9.81	3.46	729.87	60.71	50.01	639.04	0.66
		TN-4	10	10.95	1.45	1.42	6.75	1.33	659.18	56.47	12.33	590.07	0.31
		TN-5	9	8.41	1.19	1.26	4.40	1.57	479.00	51.74	11.85	415.11	0.30
		T4-1	10	313.97	0.63	79.75	12.28	221.31	1574.84	6.26	795.48	734.77	38.33
		T4-2	14	172.00	1.52	32.16	8.79	129.54	611.42	20.62	296.47	269.59	24.74
		T4-3	14	330.86	1.27	66.11	12.23	251.24	1161.33	39.25	574.06	500.42	47.60
		T4-4	14	297.67	0.81	82.30	24.17	190.39	1682.63	33.47	777.70	836.31	35.15
		T4-5	12	214.98	1.26	61.88	27.63	124.21	1538.13	23.46	596.69	982.10	22.42
10 m	August, 2018	TN-1	14	24.57	2.67	14.96	1.72	5.22	766.50	154.07	143.49	549.99	1.16
		TN-2	15	24.07	4.50	11.29	1.79	6.49	810.52	175.85	100.44	575.65	1.75
		TN-3	13	22.93	1.83	11.57	1.61	7.90	419.36	117.73	95.03	209.55	2.18
		TN-4	14	23.64	2.32	11.01	2.33	7.98	736.14	150.82	100.45	564.65	2.44
		TN-5	6	0.31	0.01	0.08	0.01	0.21	5.13	0.87	0.39	3.83	0.04
		T4-1	14	43.62	3.94	24.56	2.42	12.70	480.09	138.65	235.66	185.36	2.64
		T4-2	13	42.89	4.06	24.29	2.97	11.57	521.84	183.66	226.09	142.05	2.41
		T4-3	12	54.89	3.43	30.98	4.95	15.53	675.70	154.10	308.23	210.34	3.02
		T4-4	14	48.34	2.94	28.37	2.21	14.82	559.01	113.43	226.82	256.57	3.30
		T4-5	13	65.70	3.68	45.31	2.17	14.54	706.61	163.89	385.74	195.11	2.97
Entire Column	September, 2018	TN-1	14	11.67	1.58	4.54	1.62	3.93	220.62	63.69	34.62	136.81	0.92
		TN-2	15	22.12	2.35	5.65	0.62	13.50	202.86	82.54	29.32	103.38	6.38
		TN-3	14	12.71	1.19	3.95	1.25	6.32	294.33	80.70	20.26	260.42	2.01
		TN-4	16	13.34	2.25	4.70	0.98	5.41	314.07	166.58	21.89	186.87	1.69
		TN-5	16	11.63	1.97	3.32	0.93	5.41	262.18	127.19	21.99	165.49	1.47
		T4-1	15	21.48	1.48	11.39	0.74	7.86	229.92	42.99	99.66	163.79	1.78
		T4-2	13	26.82	3.14	13.80	1.22	8.66	246.44	78.71	120.89	100.69	2.22
		T4-3	13	16.31	1.48	8.20	0.86	5.77	135.24	31.29	60.12	61.04	1.48
		T4-4	15	19.32	2.50	9.18	0.84	6.80	144.75	43.50	54.56	63.23	2.14
		T4-5	14	23.32	2.59	12.70	0.78	7.25	293.93	99.22	97.73	132.50	1.85

Table C.42: Station Scores for a Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Zooplankton Communities for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018

Attribute	Month	Area	Replicate	NMDS1	NMDS2
Density	June (Entire Column)	RG_TN	1	0.0970	-0.0510
			2	0.285	0.0131
			3	0.0970	-0.0512
			4	0.0970	-0.0509
			5	0.0970	-0.0511
		RG_T4	1	-0.159	-0.0482
			2	-0.159	-0.0481
			3	-0.159	-0.0481
			4	-0.159	-0.0480
			5	-0.0378	0.383
	August (10 m)	RG_TN	1	0.380	0.0719
			2	-0.242	0.0787
			3	-0.132	-0.0401
			4	-0.287	-0.0243
			5	0.0436	-0.264
		RG_T4	1	0.210	-0.000325
			2	0.149	-0.401
			3	-0.0111	0.128
			4	-0.0675	0.191
			5	-0.0429	0.259
	September (Entire Column)	RG_TN	1	0.0231	0.0988
			2	0.0806	0.0504
			3	0.113	0.0200
			4	0.165	-0.0944
			5	-0.0457	0.0181
		RG_T4	1	-0.0707	-0.0322
			2	-0.0109	0.00159
			3	-0.0657	-0.00179
			4	-0.0788	-0.0396
			5	-0.110	-0.0209

Table C.43: **Station Scores for a Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Zooplankton Relative Densities at the LPL Level of Indentification for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018**

Area	Replicate	NMDS Axis 1	NMDS Axis 2	NMDS Axis 3
RG_TN	1	-0.030	0.401	0.131
	2	0.273	0.050	0.017
	3	0.281	0.048	0.041
	4	-0.017	-0.039	0.145
	5	0.247	0.197	-0.210
RG_T4	1	0.066	-0.281	-0.223
	2	-0.168	0.125	-0.220
	3	0.203	-0.374	0.252
	4	-0.437	0.123	0.181
	5	-0.419	-0.250	-0.114

Table C.44: Spearman Correlations of Fourth-Root Transformed Relative Densities with Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Zooplankton Relative Densities at the LPL Level of Identification for Downstream (RG_T4) and Upstream RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018

Sampling Period	Taxa	NMDS Axis 1		NMDS Axis 2		NMDS Axis 3	
		r_s	P-value	r_s	P-value	r_s	P-value
June (Enitre Column)	Nematoda	0.669	0.035	-0.128	0.725	0.073	0.841
	Aulodrilus limnobius	0.782	0.008	-0.106	0.770	0.031	0.932
	Limnodrilus hoffmeisteri	-0.455	0.187	-0.172	0.636	-0.693	0.026
	Limnodrilus udekemianus	0.588	0.074	0.265	0.459	0.162	0.656
	Tubifex tubifex	0.166	0.647	-0.485	0.156	0.399	0.254
	Tubificinae	-0.491	0.154	-0.624	0.060	0.503	0.143
	Candona	0.313	0.379	0.816	0.004	0.117	0.748
	Cytherissa lacustris	0.031	0.932	-0.344	0.331	-0.425	0.221
	Chironomus	0.310	0.383	0.736	0.015	-0.486	0.154
	Harnischia	-0.157	0.666	0.738	0.015	0.097	0.790
	Phaenopsectra	0.144	0.692	0.169	0.641	-0.500	0.141
	Tanytarsus	0.006	1.000	0.309	0.387	-0.273	0.448
	Monodiamesa	0.276	0.440	0.440	0.203	-0.455	0.187
	Procladius	-0.309	0.387	-0.067	0.865	-0.539	0.113
	Pisidium/Neopisidium	-0.821	0.004	0.511	0.131	0.110	0.762
	Cyprididae	0.524	0.120	-0.110	0.762	-0.058	0.873
September (Entire Column)	Nematoda	0.669	0.035	-0.128	0.725	0.073	0.841
	Aulodrilus limnobius	0.782	0.008	-0.106	0.770	0.031	0.932
	Limnodrilus hoffmeisteri	-0.455	0.187	-0.172	0.636	-0.693	0.026
	Limnodrilus udekemianus	0.588	0.074	0.265	0.459	0.162	0.656
	Tubifex tubifex	0.166	0.647	-0.485	0.156	0.399	0.254
	Tubificinae	-0.491	0.154	-0.624	0.060	0.503	0.143
	Candona	0.313	0.379	0.816	0.004	0.117	0.748
	Cytherissa lacustris	0.031	0.932	-0.344	0.331	-0.425	0.221
	Chironomus	0.310	0.383	0.736	0.015	-0.486	0.154
	Harnischia	-0.157	0.666	0.738	0.015	0.097	0.790
	Phaenopsectra	0.144	0.692	0.169	0.641	-0.500	0.141
	Tanytarsus	0.006	1.000	0.309	0.387	-0.273	0.448
	Monodiamesa	0.276	0.440	0.440	0.203	-0.455	0.187
	Procladius	-0.309	0.387	-0.067	0.865	-0.539	0.113
	Pisidium/Neopisidium	-0.821	0.004	0.511	0.131	0.110	0.762
	Cyprididae	0.524	0.120	-0.110	0.762	-0.058	0.873

▨ P-value < 0.05

🟦 $|r_s| > 0.5$

APPENDIX D
BENTHIC INVERTEBRATE

Table D.1: Benthic Invertebrate Community and Tissue Sampling Locations in Koocanusa Reservoir, August 2018

Station Identifier		UTM (NAD 83, Zone 11U)		Station Depth (m)	Average Ponar Fullness (%)	Sample Texture	Macrophytes in Sample	Algae in Sample
		Easting	Northing					
Upstream of Elk River (RG_TN)	RG_TN-1	627394	5453542	14.0	75% - 100%	95% sand and finer, 5% organics	No	No
	RG_TN-2	627291	5453642	13.3	75%	90% sand and finer, 10% organics	No	No
	RG_TN-3	627343	5456370	14.6	75%	90% sand and finer, 10% organics	No	No
	RG_TN-4	627344	5453854	14.0	100%	95% sand and finer, 5% organics	No	No
	RG_TN-5	627175	5453986	14.3	100%	100% sand and finer, minimal organics	No	No
Downstream of Elk River (RG_T4)	RG_T4-1	630074	5441765	25.1	75%	100% sand and finer	No	No
	RG_T4-2	629838	5442106	24.3	75%	100% sand and finer	No	No
	RG_T4-3	629706	5441670	24.4	100%	100% sand and finer	No	No
	RG_T4-4	629512	5441745	23.9	100%	100% sand and finer, minimal organics	No	No
	RG_T4-5	629460	5441543	24.8	100%	100% sand and finer	No	No

Table D.2: Benthic Invertebrate Tissue Locations in Koocanusa Reservoir, April 2018

Station Identifier		Comment	UTM (NAD 83, Zone 11U)		Station Depth (m)	Sample Texture	Macrophytes in Sample	Algae in Sample	Dominant Taxa
			Easting	Northing					
Sand Creek (RG_SC)	RG_SC_01	-	625489	5458292	1.5	silty sand	no	no	chironomid
	RG_SC_02	-	625467	5458231	-	silty sand	no	no	chironomid, mayfly
	RG_SC_03	-	625577	5457631	1.0	silty sand	no	no	chironomid
	RG_SC_04	-	625652	5457353	1.3	silty sand	no	no	chironomid
	RG_SC_05	-	625680	5458260	1.5	silty sand	no	no	chironomid, mayfly
RG_TN	RG_TN	very strong current, sandy half grabs	677112	5453388	1.5	100% sand and finer, minimal organics	no	no	chironomid
Elk River (RG_ER)	RG_ER_01	downstream of mouth of Elk River	628309	5448218	< 0.5	100% sand and finer, minimal organics	no	no	mayfly, chironomid
	RG_ER_02	northern most braid at mouth of the Elk River	628475	5448196	0.4	100% sand and finer, minimal organics	no	no	stonefly, mayfly, chironomid
	RG_ER_03	southern most braid at mouth of the Elk River	628280	5448086	< 0.5	100% sand and finer, 10% organics	no	no	mayfly
	RG_ER_04	in sheltered bay downstream of the mouth	627989	5447672	< 0.5	100% sand and finer, minimal organics	no	no	chironomid
	RG_ER_05	in sheltered bay downstream of the mouth	627950	5447580	< 0.5	100% sand and finer, minimal organics	no	no	mayfly
RG_T4	RG_T4	some flow in area, moved behind bar to hold in place	629235	5441654	0.75	100% sand and finer, minimal organics	no	no	chironomid
Gold Creek (RG_GC)	RG_GC_01	spooned at sediment-water interface	630805	5436307	0.1	100% sand and finer, minimal organics	no	no	chironomid, mayfly
	RG_GC_02	-	630906	5436212	0.1	100% sand and finer, minimal organics	no	no	mayfly, chironomid
	RG_GC_03	texture slightly coarser than -01 and -02	630825	5436436	0.1	100% sand and finer, minimal organics	no	no	stonefly, chironomid
	RG_GC_04	superfine, sticky material, from shoreline water interface	631158	5436077	0.1	100% sand and finer, minimal organics	no	no	chironomid, stonefly, mayfly
	RG_GC_05	very fine, less clay, less sticky than -04	631068	5436163	0.1	100% sand and finer, minimal organics	no	no	stonefly, mayfly, chironomid

Table D.3: **Benthic Invertebrate Density (No. of Organisms per m^2) Reported to the Lowest Practical Level, August 2018**

Organism		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
		TN-1	**TN-2**	**TN-3**	**TN-4**	**TN-5**	**T4-1**	**T4-2**	**T4-3**	**T4-4**	**T4-5**
Nematode	P. Nemata	34	34	69	17	34	8.6	8.6	69	0	0
Oligochaete	S.F. Naidinae										
	Dero	0	0	0	0	0	0	0	121	0	0
	S.F. Tubificinae										
	Aulodrilus limnobius	0	379	388	784	1,405	17	0	621	0	0
	Limnodrilus hoffmeisteri	0	0	0	0	0	8.6	17	0	0	26
	Limnodrilus udekemianus	103	379	112	284	69	0	0	0	0	0
	Tubifex tubifex	0	112	164	69	0	0	8.6	250	112	78
	immatures with hair chaetae[a]	241	164	276	422	129	138	43	1,121	1,595	78
	immatures without hair chaetae	138	52	164	147	0	43	86	371	569	319
Ostracod	Cl. Ostracoda										
	Indeterminate	0	0	0	0	0	0	0	0	0	8.6
	F. Candonidae										
	Candona	103	69	69	43	103	0	8.6	0	69	0
	F. Cyprididae										
	Isocypris	0	34	34	17	17	0	0	0	0	8.6
	F. Cytherideidae										
	Cytherissa lacustris	0	52	0	34	34	17	0	0	34	17
Insect	F. Chaoboridae										
	Chaoborus flavicans	0	0	0	0	0	0	8.6	0	0	0
	F. Chironomidae										
	chironomid pupae[b]	**0**	**0**	**34**	**17**	**0**	**0**	**8.6**	**0**	**0**	**17**
	S.F. Chironominae										
	Chironomus	207	121	103	60	241	17	43	0	0	8.6
	Harnischia	34	0	0	0	52	0	0	0	34	0
	Phaenopsectra	0	17	69	0	17	17	26	0	34	0
	Tanytarsus	172	103	34	17	86	43	60	207	69	0
	S.F. Prodiamesinae										
	Monodiamesa	0	34	0	0	17	0	8.6	0	0	0
	S.F. Tanypodinae										
	Procladius	690	569	345	310	397	190	293	897	586	448
Bivalve Mollusc	F. Sphaeriidae										
	Pisidium (Cyclocalyx)	0	0	0	0	0	0	0	0	0	8.6
	Pisidium (Cyclocalyx)/Neopisidi	103	0	0	17	0	0	34	0	34	0
Total Number of Organisms		**1,828**	**2,121**	**1,862**	**2,241**	**2,603**	**500**	**655**	**3,655**	**3,138**	**1,017**
Total Number of Taxa		**10**	**14**	**12**	**13**	**13**	**10**	**13**	**8**	**10**	**10**

[a] Immature Tubificinae were combined for data analyses

[b] Bold entries excluded from taxon count

Table D.4: Densities (No. of Organisms per m^2) of Major Benthic Invertebrate Groups, August 2018

Group	Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Nemata	34	34	69	17	34	8.6	8.6	69	0	0
Oligochaeta	483	1,086	1,103	1,707	1,603	207	155	2,483	2,276	500
Ostracoda	103	155	103	95	155	17	8.6	0	103	34
Insect	1,103	845	586	405	845	267	448	1,103	724	474
Bivalvia	103	0	0	17	0	0	34	0	34	8.6
Total Number of Organisms	**1,828**	**2,121**	**1,862**	**2,241**	**2,638**	**500**	**655**	**3,655**	**3,138**	**1,017**
Total Number of Groups	**5**	**4**	**4**	**5**	**4**	**4**	**5**	**3**	**4**	**4**

Table D.5: **Relative Densities (%) of Benthic Invertebrates Reported to the Lowest Practical Level, August 2018**

Organism		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)					Summary Statistics									
												Minimum		Median		Maximum		Mean		Standard Deviation	
		TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Nematode	P. Nemata	1.9	1.6	3.7	0.77	1.3	1.7	1.3	1.9	0	0	0.77	0	1.6	1.3	3.7	1.9	1.9	0.99	1.1	0.92
Oligochaete	S.F. Naidinae																				
	Dero	0	0	0	0	0	0	0	3.3	0	0	0	0	0	0	0	3.3	0	0.66	0	1.5
	S.F. Tubificinae																				
	Aulodrilus limnobius	0	18	21	35	54	3.4	0	17	0	0	0	0	21	0	54	17	26	4.1	20	7.4
	Limnodrilus hoffmeisteri	0	0	0	0	0	1.7	2.6	0	0	2.5	0	0	0	1.7	0	2.6	0	1.4	0	1.3
	Limnodrilus udekemianus	5.7	18	6.0	13	2.6	0	0	0	0	0	2.6	0	6.0	0	18	0	9.0	0	6.2	0
	Tubifex tubifex	0	5.3	8.8	3.1	0	0	1.3	6.8	3.6	7.6	0	0	3.1	3.6	8.8	7.6	3.4	3.9	3.7	3.3
	immatures with hair chaetae[a]	13	7.7	15	19	5.0	28	6.6	31	51	7.6	5.0	6.6	13	28	19	51	12	25	5.6	18
	immatures without hair chaetae[a]	7.5	2.4	8.8	6.5	0	8.6	13	10	18	31	0	8.6	6.5	13	8.8	31	5.1	16	3.7	9.2
Ostracod	Cl. Ostracoda																				
	Indeterminate	0	0	0	0	0	0	0	0	0	0.85	0	0	0	0	0	0.85	0	0.17	0	0.38
	F. Candonidae																				
	Candona	5.7	3.3	3.7	1.9	4.0	0	1.3	0	2.2	0	1.9	0	3.7	0	5.7	2.2	3.7	0.70	1.3	1.0
	F. Cyprididae																				
	Isocypris	0	1.6	1.9	0.77	0.66	0	0	0	0	0.85	0	0	0.77	0	1.9	0.85	0.98	0.17	0.76	0.38
	F. Cytherideidae																				
	Cytherissa lacustris	0	2.4	0	1.5	1.3	3.4	0	0	1.1	1.7	0	0	1.3	1.1	2.4	3.4	1.1	1.2	1.1	1.4
Insect	F. Chaoboridae																				
	Chaoborus flavicans	0	0	0	0	0	0	1.3	0	0	0	0	0	0	0	0	1.3	0	0.26	0	0.59
	F. Chironomidae																				
	chironomid pupae[b]	0	0	1.9	0.77	0	0	1.3	0	0	1.7	0	0	0	0	1.9	1.7	0.52	0.60	0.81	0.84
	S.F. Chironominae																				
	Chironomus	11	5.7	5.6	2.7	9.3	3.4	6.6	0	0	0.85	2.7	0	5.7	0.85	11	6.6	6.9	2.2	3.4	2.8
	Harnischia	1.9	0	0	0	2.0	0	0	0	1.1	0	0	0	0	0	2.0	1.1	0.77	0.22	1.1	0.49
	Phaenopsectra	0	0.81	3.7	0	0.66	3.4	3.9	0	1.1	0	0	0	0.66	1.1	3.7	3.9	1.0	1.7	1.5	1.9
	Tanytarsus	9.4	4.9	1.9	0.77	3.3	8.6	9.2	5.7	2.2	0	0.77	0	3.3	5.7	9.4	9.2	4.0	5.1	3.4	4.0
	S.F. Prodiamesinae																				
	Monodiamesa	0	1.6	0	0	0.66	0	1.3	0	0	0	0	0	0	0	1.6	1.3	0.46	0.26	0.71	0.59
	S.F. Tanypodinae																				
	Procladius	38	27	19	14	15	38	45	25	19	44	14	19	19	38	38	45	22	34	9.9	12
Bivalve Mollusc	F. Sphaeriidae																				
	Pisidium (Cyclocalyx)	0	0	0	0	0	0	0	0	0	0.85	0	0	0	0	0	0.85	0	0.17	0	0.38
	Pisidium (Cyclocalyx)/Neopisidium	5.7	0	0	0.77	0	0	5.3	0	1.1	0	0	0	0	0	5.7	5.3	1.3	1.3	2.5	2.3

[a] Immature Tubificinae were combined for data analyses

Note: Summary statistics were provided to determine taxa (bolded) that comprise at least 5% of the total number of organisms at one or more stations within an area (as shown in Figure 6.3).

Table D.6: Summary of Benthic Invertebrate Community Metrics and Statistical Comparisons for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program 2018

Endpoint	Units	Data Transformation	Test P-value	Mean or Median [a]		Observed Effect Size (RG_T4 - RG_TN)/ Standard Deviation
				RG_T4	RG_TN	
Richness	-	none	0.049	9	12	-1.50
Total Density	ind/m2	square root	0.424	1,548	2,131	-0.53
Nemata	ind/m2	fourth root	0.074	3	35	-1.30
Oligochaeta	ind/m2	log	0.386	621	1,101	-0.58
Ostracoda	ind/m2	square root	0.007	21	121	-2.30
Chironomidae	ind/m2	log	0.373	539	712	-0.60
Bivalvia	ind/m2	log(X+1)	0.776	7	5	0.19
Nemata	%	none	0.212	1.0	1.9	-0.86
Oligochaeta	%	none	0.750	50.9	54.9	-0.21
Ostracoda	%	none	0.004	2.3	5.7	-2.60
Chironomidae	%	log	0.487	41.0	33.6	0.46
Bivalvia	%	fourth root	0.654	0.2	0.1	0.29
NMDS Axis 1	-	none	0.073	-0.151	0.151	-1.30
NMDS Axis 2	-	none	0.080	-0.131	0.131	-1.30
NMDS Axis 3	-	none	0.689	-0.025	0.025	-0.26

▨ P-value < 0.1

🟦 Effect size magnitude > 2

Notes:

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

Note: (Downstream-Upstream)/Standard Deviation for transformed data; Standard Deviation for other data.

Table D.7: Benthic Invertebrate Community Summary Statistics, Koocanusa Reservoir Monitoring Program 2018

Site	Endpoint	Units	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Upstream of the Elk River (RG_TN)	Richness	-	5	11.6	1.7	0.7	9	12	13
	Total Density	ind/m^2	5	2,139.9	317.5	142.0	1,835	2,130	2,614
	Nemata	ind/m^2	5	38.1	19.0	8.5	17	35	69
	Oligochaeta	ind/m^2	5	1,201.5	491.0	219.6	485	1,108	1,714
	Ostracoda	ind/m^2	5	122.9	30.2	13.5	95	104	156
	Chironomidae	ind/m^2	5	753.1	267.2	119.5	407	814	1,108
	Bivalvia	ind/m^2	5	24.2	45.1	20.2	0	0	104
	Nemata	%	5	1.9	1.1	0.5	1	2	4
	Oligochaeta	%	5	54.9	18.3	8.2	26	59	76
	Ostracoda	%	5	5.7	1.1	0.5	4	6	7
	Chironomidae	%	5	36.2	15.6	7.0	18	31	60
	Bivalvia	%	5	1.3	2.5	1.1	0	0	6
	NMDS Axis 1	-	5	0.2	0.2	0.1	0	0	0
	NMDS Axis 2	-	5	0.1	0.2	0.1	0	0	0
	NMDS Axis 3	-	5	0.0	0.1	0.1	0	0	0
Downstream of the Elk River (RG_T4)	Richness	-	5	9.0	1.9	0.8	7	9	12
	Total Density	ind/m^2	5	1,800.6	1,493.2	667.8	502	1,021	3,670
	Nemata	ind/m^2	5	17.3	29.4	13.1	0	9	69
	Oligochaeta	ind/m^2	5	1,128.8	1,160.5	519.0	156	502	2,493
	Ostracoda	ind/m^2	5	32.9	41.7	18.6	0	17	104
	Chironomidae	ind/m^2	5	604.2	325.8	145.7	268	476	1,108
	Bivalvia	ind/m^2	5	15.6	17.7	7.9	0	9	35
	Nemata	%	5	17.3	29.4	13.1	0	9	69
	Oligochaeta	%	5	1,128.8	1,160.5	519.0	156	502	2,493
	Ostracoda	%	5	32.9	41.7	18.6	0	17	104
	Chironomidae	%	5	604.2	325.8	145.7	268	476	1,108
	Bivalvia	%	5	15.6	17.7	7.9	0	9	35
	NMDS Axis 1	-	5	-0.2	0.3	0.1	0	0	0
	NMDS Axis 2	-	5	-0.1	0.2	0.1	0	0	0
	NMDS Axis 3	-	5	0.0	0.2	0.1	0	0	0

Table D.8: **Station Scores for a Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Benthic Invertebrate Relative Densities at the LPL Level of Identification for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, August 2018**

Area	Replicate	NMDS Axis 1	NMDS Axis 2	NMDS Axis 3
RG_TN	1	-0.030	0.401	0.131
	2	0.273	0.050	0.017
	3	0.281	0.048	0.041
	4	-0.017	-0.039	0.145
	5	0.247	0.197	-0.210
RG_T4	1	0.066	-0.281	-0.223
	2	-0.168	0.125	-0.220
	3	0.203	-0.374	0.252
	4	-0.437	0.123	0.181
	5	-0.419	-0.250	-0.114

Table D.9: Spearman Correlations of Fourth-Root Transformed Relative Densities with Non-Metric Multidimensional Scaling of Bray-Curtis Dissimilarities Calculated for Benthic Invertebrate Relative Densities at the LPL Level of Identification for Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Monitoring Program 2018

Taxa	NMDS Axis 1		NMDS Axis 2		NMDS Axis 3	
	r_s	P-value	r_s	P-value	r_s	P-value
Nematoda	0.669	0.035	-0.128	0.725	0.073	0.841
Aulodrilus limnobius	0.782	0.008	-0.106	0.770	0.031	0.932
Limnodrilus hoffmeisteri	-0.455	0.187	-0.172	0.636	-0.693	0.026
Limnodrilus udekemianus	0.588	0.074	0.265	0.459	0.162	0.656
Tubifex tubifex	0.166	0.647	-0.485	0.156	0.399	0.254
Tubificinae	-0.491	0.154	-0.624	0.060	0.503	0.143
Candona	0.313	0.379	0.816	0.004	0.117	0.748
Cytherissa lacustris	0.031	0.932	-0.344	0.331	-0.425	0.221
Chironomus	0.310	0.383	0.736	0.015	-0.486	0.154
Harnischia	-0.157	0.666	0.738	0.015	0.097	0.790
Phaenopsectra	0.144	0.692	0.169	0.641	-0.500	0.141
Tanytarsus	0.006	1.000	0.309	0.387	-0.273	0.448
Monodiamesa	0.276	0.440	0.440	0.203	-0.455	0.187
Procladius	-0.309	0.387	-0.067	0.865	-0.539	0.113
Pisidium/Neopisidium	-0.821	0.004	0.511	0.131	0.110	0.762
Cyprididae	0.524	0.120	-0.110	0.762	-0.058	0.873

▨ P-value < 0.05

🟦 $|r_s| > 0.5$

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www.src.sk.ca/analytical

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Jul-10-2018 Client P.O.: VPO00555477 Ref# 18-07

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  - * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  - * Environment Canada
  - * US EPA
  - * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SRC Group # 2018-8314
Aug 10, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Jul-10-2018

Client P.O.: VPO00555477 Ref# 18-07

26965 **04/25/2018 RG_GC_BT01M_20180425 *TISSUE***
26966 **04/27/2018 RG_GC_BT02M_20180427 *TISSUE***
26967 **04/28/2018 RG_GC_BT03M_20180428 *TISSUE***

Analyte	Units	26965	26966	26967
Lab Section 2 (ICP)				
Aluminum	ug/g	200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	<5	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	<5	<5	<5
Iron	ug/g	200	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	1.3	1.9	1.8
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	2.7	2.0	1.9
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	<5	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	79.02	75.25	76.97

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26968 **04/25/2018 RG_GC_WCT01M_20180425 *TISSUE***
26969 **04/25/2018 RG_GC_WCT02M_20180425 *TISSUE***
26970 **04/25/2018 RG_GC_WCT03M_20180425 *TISSUE***

Analyte	Units	26968	26969	26970
Lab Section 2 (ICP)				
Aluminum	ug/g	300	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	<5	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	20	<5	<5
Iron	ug/g	300	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	1.6	1.3	1.5
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	6	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	74.92	76.95	66.83

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26971 **04/25/2018 RG_GC_WCT04M_20180425 *TISSUE***
26972 **04/25/2018 RG_GC_WCT05M_20180425 *TISSUE***
26973 **04/25/2018 RG_GC_WCT06M_20180425 *TISSUE***

Analyte	Units	26971	26972	26973
Lab Section 2 (ICP)				
Aluminum	ug/g	200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	<5	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	6	<5	<5
Iron	ug/g	200	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	2.0	7.3	6.3
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	6	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	75.00	14.60	21.13

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26974 **04/25/2018 RG_GC_WCT07M_20180425 *TISSUE***
26975 **04/25/2018 RG_GC_WCT08M_20180425 *TISSUE***
26976 **04/27/2018 RG_GC_KO01M_20180427 *TISSUE***

Analyte	Units	26974	26975	26976
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	6	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	<5	<5	<5
Iron	ug/g	<200	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	0.7	2.9	1.6
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	<5	5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	20.75	12.92	61.33

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26977 **04/25/2018 RG_GC_PCC01M_20180425 *TISSUE***
26978 **04/25/2018 RG_GC_PCC01O_20180427 *TISSUE***
26979 **04/25/2018 RG_GC_PCC02M_20180425 *TISSUE***

Analyte	Units	26977	26978	26979
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	0.7	1.0	1.1
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.1	3.6	0.8
Iron	ug/g	<20	40	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	<1	5	1
Mercury	ug/g	0.53	<0.05	0.54
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	1.6	4.5	2.1
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	2	<1	3
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	30	90	30
Lab Section 6 (SPTP)				
Moisture	%	76.73	62.19	76.78

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26980	**04/25/2018 RG_GC_PCC02O_20180425 *TISSUE***
26981	**04/25/2018 RG_GC_PCC04M_20180425 *TISSUE***
26982	**04/25/2018 RG_GC_PCC04O_20180425 *TISSUE***

Analyte	Units	26980	26981	26982
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	70
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	3.3	0.9	2.1
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	4.1	1.6	2.5
Iron	ug/g	120	20	120
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	19	<1	10
Mercury	ug/g	0.05	0.69	0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	1.5	<0.5	<0.5
Selenium	ug/g	21	4.5	16
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	<1	1	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	1.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	200	26	120
Lab Section 6 (SPTP)				
Moisture	%	75.27	77.15	68.53

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26983 **04/25/2018 RG_GC_PCC08M_20180425 *TISSUE***
26984 **04/25/2018 RG_GC_PCC08O_20180425 *TISSUE***
26985 **04/26/2018 RG_GC_PCC09M_20180426 *TISSUE***

Analyte	Units	26983	26984	26985
Lab Section 2 (ICP)				
Aluminum	ug/g	40	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	1.4	0.9	1.0
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.2	2.6	0.7
Iron	ug/g	40	40	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	1	5	1
Mercury	ug/g	0.39	<0.05	0.42
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	2.3	4.7	3.3
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	3	<1	3
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	32	80	21
Lab Section 6 (SPTP)				
Moisture	%	75.09	62.66	77.78

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26986 **04/26/2018 RG_GC_PCC09O_20180426 *TISSUE***
26987 **04/26/2018 RG_GC_PCC11M_20180426 *TISSUE***
26988 **04/26/2018 RG_GC_PCC11O_20180426 *TISSUE***

Analyte	Units	26986	26987	26988
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	0.9	1.4	1.2
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	0.1	<0.1	<0.1
Copper	ug/g	2.8	0.9	3.1
Iron	ug/g	90	20	60
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	10	1	6
Mercury	ug/g	<0.05	0.48	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	22	3.4	9.9
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	<1	3	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	0.6	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	120	49	110
Lab Section 6 (SPTP)				
Moisture	%	68.00	76.94	67.06

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26989	**04/26/2018 RG_GC_PCC14M_20180426 *TISSUE***
26990	**04/26/2018 RG_GC_PCC14O_20180426 *TISSUE***
26991	**04/26/2018 RG_GC_PCC15M_20180426 *TISSUE***

Analyte	Units	26989	26990	26991
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	0.8	0.9	1.3
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	0.9	3.7	0.8
Iron	ug/g	20	70	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	<1	8	1
Mercury	ug/g	0.89	<0.05	0.62
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	1.8	12	2.0
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	2	<1	4
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	23	100	43
Lab Section 6 (SPTP)				
Moisture	%	74.40	62.05	78.69

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Results are reported on a dry basis.

SRC Group # 2018-8314
Aug 10, 2018

Minnow Environmental Inc.

26992 **04/26/2018 RG_GC_PCC15O_20180426 *TISSUE***
26993 **04/26/2018 RG_GC_PCC17M_20180426 *TISSUE***
26994 **04/26/2018 RG_GC_PCC17O_20180426 *TISSUE***

Analyte	Units	26992	26993	26994
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<50	<20
Antimony	ug/g	<1	<2	<1
Arsenic	ug/g	<0.5	<1	<0.5
Barium	ug/g	1.0	1	1.5
Beryllium	ug/g	<0.1	<0.2	<0.1
Boron	ug/g	<10	<20	<10
Cadmium	ug/g	<0.1	<0.2	<0.1
Chromium	ug/g	<5	<10	<5
Cobalt	ug/g	<0.1	<0.2	<0.1
Copper	ug/g	3.0	1	4.0
Iron	ug/g	60	<50	70
Lead	ug/g	<0.1	<0.2	<0.1
Manganese	ug/g	5	<2	15
Mercury	ug/g	<0.05	0.5	<0.05
Molybdenum	ug/g	<1	<2	<1
Nickel	ug/g	<0.5	<1	<0.5
Selenium	ug/g	6.6	4.2	16
Silver	ug/g	<0.1	<0.2	<0.1
Strontium	ug/g	<1	2	<1
Thallium	ug/g	<0.5	<1	<0.5
Tin	ug/g	<0.5	<1	<0.5
Titanium	ug/g	<0.5	<1	<0.5
Uranium	ug/g	<0.05	<0.1	<0.05
Vanadium	ug/g	<1	<2	<1
Zinc	ug/g	100	20	140
Lab Section 6 (SPTP)				
Moisture	%	65.13	74.77	67.97

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Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26995 **04/26/2018 RG_GC_PCC18M_20180426 *TISSUE***
26996 **04/26/2018 RG_GC_PCC18O_20180426 *TISSUE***
26997 **04/24/2018 RG_GC_RSC02M_20180424 *TISSUE***

Analyte	Units	26995	26996	26997
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	10	<20
Antimony	ug/g	<1	<0.1	<1
Arsenic	ug/g	<0.5	0.34	<0.5
Barium	ug/g	0.8	0.53	1.2
Beryllium	ug/g	<0.1	<0.01	<0.1
Boron	ug/g	<10	<1	<10
Cadmium	ug/g	<0.1	<0.01	<0.1
Chromium	ug/g	<5	<0.5	<5
Cobalt	ug/g	<0.1	0.04	<0.1
Copper	ug/g	1.0	3.0	1.6
Iron	ug/g	20	59	30
Lead	ug/g	<0.1	0.02	<0.1
Manganese	ug/g	1	4.7	1
Mercury	ug/g	0.68	0.025	0.39
Molybdenum	ug/g	<1	<0.1	<1
Nickel	ug/g	<0.5	<0.05	<0.5
Selenium	ug/g	1.5	6.5	2.3
Silver	ug/g	<0.1	0.01	<0.1
Strontium	ug/g	3	0.3	2
Thallium	ug/g	<0.5	<0.05	<0.5
Tin	ug/g	<0.5	<0.05	<0.5
Titanium	ug/g	<0.5	0.31	<0.5
Uranium	ug/g	<0.05	<0.005	<0.05
Vanadium	ug/g	<1	<0.1	<1
Zinc	ug/g	29	99	81
Lab Section 6 (SPTP)				
Moisture	%	75.18	61.96	68.96

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

26998 **04/24/2018 RG_GC_RSC02O_20180424 *TISSUE***
26999 **04/24/2018 RG_GC_RSC04M_20180424 *TISSUE***
27000 **04/24/2018 RG_GC_RSC04O_20180424 *TISSUE***

Analyte	Units	26998	26999	27000
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<200
Antimony	ug/g	<1	<1	<10
Arsenic	ug/g	<0.5	<0.5	<5
Barium	ug/g	1.1	1.9	<5
Beryllium	ug/g	<0.1	<0.1	<1
Boron	ug/g	<10	<10	<100
Cadmium	ug/g	<0.1	<0.1	<1
Chromium	ug/g	<5	<5	<50
Cobalt	ug/g	<0.1	<0.1	<1
Copper	ug/g	5.7	1.8	6
Iron	ug/g	120	20	<200
Lead	ug/g	<0.1	<0.1	<1
Manganese	ug/g	9	1	<10
Mercury	ug/g	<0.05	0.33	<0.5
Molybdenum	ug/g	<1	<1	<10
Nickel	ug/g	<0.5	<0.5	<5
Selenium	ug/g	5.9	2.0	9.2
Silver	ug/g	<0.1	<0.1	<1
Strontium	ug/g	1	2	<10
Thallium	ug/g	<0.5	<0.5	<5
Tin	ug/g	<0.5	<0.5	<5
Titanium	ug/g	<0.5	<0.5	<5
Uranium	ug/g	<0.05	<0.05	<0.5
Vanadium	ug/g	<1	<1	<10
Zinc	ug/g	220	86	270
Lab Section 6 (SPTP)				
Moisture	%	67.81	69.38	67.93

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Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27001 **04/26/2018 RG_GC_RSC09M_20180426 *TISSUE***
27002 **04/26/2018 RG_GC_RSC09O_20180426 *TISSUE***
27003 **04/26/2018 RG_GC_RSC16O_20180426 *TISSUE***

Analyte	Units	27001	27002	27003
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	80	20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	0.9	1.4	1.3
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	0.2	<0.1
Copper	ug/g	2.1	8.3	4.2
Iron	ug/g	30	200	130
Lead	ug/g	<0.1	0.1	<0.1
Manganese	ug/g	1	11	9
Mercury	ug/g	0.44	0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	2.4	7.6	8.6
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	1	2	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	1.6	0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	60	240	220
Lab Section 6 (SPTP)				
Moisture	%	76.89	72.13	68.19

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Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27004 **04/26/2018 RG_GC_RSC16M_20180426 *TISSUE***
27005 **04/27/2018 RG_GC_RSC17M_20180427 *TISSUE***
27006 **04/27/2018 RG_GC_RSC17O_20180427 *TISSUE***

Analyte	Units	27004	27005	27006
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	1.9	1.2	<0.5
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.8	1.7	7.3
Iron	ug/g	30	20	120
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	2	2	8
Mercury	ug/g	0.28	0.46	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	2.5	2.7	12
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	7	4	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	59	33	210
Lab Section 6 (SPTP)				
Moisture	%	70.41	76.55	65.63

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27007 **04/27/2018 RG_GC_RSC18M_20180427 *TISSUE***
27008 **04/27/2018 RG_GC_RSC18O_20180427 *TISSUE***
27009 **04/27/2018 RG_GC_RSC19M_20180427 *TISSUE***

Analyte	Units	27007	27008	27009
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	1.1	1.1	<0.5
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.3	5.4	1.0
Iron	ug/g	30	140	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	2	11	1
Mercury	ug/g	0.38	<0.05	0.46
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	2.4	13	2.8
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	5	1	1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	64	200	25
Lab Section 6 (SPTP)				
Moisture	%	74.69	72.72	76.27

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27010 **04/27/2018 RG_GC_RSC19O_20180427 *TISSUE***
27011 **04/27/2018 RG_GC_RSC20M_20180427 *TISSUE***
27012 **04/27/2018 RG_GC_RSC20O_20180427 *TISSUE***

Analyte	Units	27010	27011	27012
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	9	<20
Antimony	ug/g	<1	<0.2	<1
Arsenic	ug/g	<0.5	0.1	<0.5
Barium	ug/g	1.2	1.0	0.6
Beryllium	ug/g	<0.1	<0.02	<0.1
Boron	ug/g	<10	<2	<10
Cadmium	ug/g	0.2	<0.02	<0.1
Chromium	ug/g	<5	<1	<5
Cobalt	ug/g	<0.1	0.02	<0.1
Copper	ug/g	6.6	1.6	6.4
Iron	ug/g	180	28	150
Lead	ug/g	<0.1	0.03	<0.1
Manganese	ug/g	11	1.7	8
Mercury	ug/g	<0.05	0.42	<0.05
Molybdenum	ug/g	<1	<0.2	<1
Nickel	ug/g	<0.5	<0.1	<0.5
Selenium	ug/g	7.8	2.6	8.2
Silver	ug/g	<0.1	<0.02	<0.1
Strontium	ug/g	<1	1.9	<1
Thallium	ug/g	<0.5	<0.1	<0.5
Tin	ug/g	<0.5	<0.1	<0.5
Titanium	ug/g	<0.5	0.6	<0.5
Uranium	ug/g	<0.05	<0.01	<0.05
Vanadium	ug/g	<1	<0.2	<1
Zinc	ug/g	190	56	170
Lab Section 6 (SPTP)				
Moisture	%	73.44	77.81	69.32

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27013 04/27/2018 RG_GC_RSC21M_20180427 *TISSUE*
27014 04/27/2018 RG_GC_RSC21O_20180427 *TISSUE*
27015 04/27/2018 RG_GC_RSC24M_20180427 *TISSUE*

Analyte	Units	27013	27014	27015
Lab Section 2 (ICP)				
Aluminum	ug/g	<5	<20	<20
Antimony	ug/g	<0.2	<1	<1
Arsenic	ug/g	<0.1	<0.5	<0.5
Barium	ug/g	2.2	<0.5	1.2
Beryllium	ug/g	<0.02	<0.1	<0.1
Boron	ug/g	<2	<10	<10
Cadmium	ug/g	<0.02	<0.1	<0.1
Chromium	ug/g	<1	<5	<5
Cobalt	ug/g	0.04	0.1	<0.1
Copper	ug/g	2.6	5.9	1.6
Iron	ug/g	29	130	30
Lead	ug/g	0.04	<0.1	<0.1
Manganese	ug/g	1.7	12	2
Mercury	ug/g	0.50	<0.05	0.35
Molybdenum	ug/g	<0.2	<1	<1
Nickel	ug/g	<0.1	<0.5	<0.5
Selenium	ug/g	2.1	20	2.9
Silver	ug/g	<0.02	<0.1	<0.1
Strontium	ug/g	3.6	<1	3
Thallium	ug/g	<0.1	<0.5	<0.5
Tin	ug/g	<0.1	<0.5	<0.5
Titanium	ug/g	0.2	<0.5	<0.5
Uranium	ug/g	<0.01	<0.05	<0.05
Vanadium	ug/g	<0.2	<1	<1
Zinc	ug/g	110	200	66
Lab Section 6 (SPTP)				
Moisture	%	76.82	72.45	67.22

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27016 **04/27/2018 RG_GC_RSC24O_20180427 *TISSUE***
27017 **04/25/2018 RG_GC_YP01M_20180425 *TISSUE***
27018 **04/25/2018 RG_GC_YP01O_20180425 *TISSUE***

Analyte	Units	27016	27017	27018
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	5	3
Antimony	ug/g	<1	<0.1	<0.1
Arsenic	ug/g	<0.5	<0.05	<0.05
Barium	ug/g	<0.5	0.10	0.26
Beryllium	ug/g	<0.1	<0.01	<0.01
Boron	ug/g	<10	<1	<1
Cadmium	ug/g	<0.1	<0.01	<0.01
Chromium	ug/g	<5	<0.5	<0.5
Cobalt	ug/g	<0.1	0.02	0.04
Copper	ug/g	6.3	0.93	2.1
Iron	ug/g	120	14	34
Lead	ug/g	<0.1	<0.01	<0.01
Manganese	ug/g	13	0.8	2.1
Mercury	ug/g	<0.05	0.54	0.018
Molybdenum	ug/g	<1	<0.1	<0.1
Nickel	ug/g	<0.5	<0.05	<0.05
Selenium	ug/g	17	3.1	3.6
Silver	ug/g	<0.1	<0.01	<0.01
Strontium	ug/g	<1	0.5	1.4
Thallium	ug/g	<0.5	<0.05	<0.05
Tin	ug/g	<0.5	<0.05	<0.05
Titanium	ug/g	<0.5	0.14	0.07
Uranium	ug/g	<0.05	<0.005	<0.005
Vanadium	ug/g	<1	<0.1	<0.1
Zinc	ug/g	180	24	74
Lab Section 6 (SPTP)				
Moisture	%	72.78	80.16	81.39

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27019 **04/25/2018 RG_GC_YP02M_20180425 *TISSUE***
27020 **04/25/2018 RG_GC_YP02O_20180425 *TISSUE***
27021 **04/25/2018 RG_GC_YP03M_20180425 *TISSUE***

Analyte	Units	27019	27020	27021
Lab Section 2 (ICP)				
Aluminum	ug/g	2	<2	<20
Antimony	ug/g	<0.1	<0.1	<1
Arsenic	ug/g	<0.05	<0.05	<0.5
Barium	ug/g	0.24	0.28	0.5
Beryllium	ug/g	<0.01	<0.01	<0.1
Boron	ug/g	<1	<1	<10
Cadmium	ug/g	<0.01	<0.01	<0.1
Chromium	ug/g	<0.5	<0.5	<5
Cobalt	ug/g	0.03	0.10	<0.1
Copper	ug/g	0.80	2.2	0.7
Iron	ug/g	12	37	20
Lead	ug/g	<0.01	<0.01	<0.1
Manganese	ug/g	1.4	2.7	2
Mercury	ug/g	0.81	0.038	1.2
Molybdenum	ug/g	<0.1	<0.1	<1
Nickel	ug/g	<0.05	<0.05	<0.5
Selenium	ug/g	5.9	5.7	4.0
Silver	ug/g	<0.01	<0.01	<0.1
Strontium	ug/g	1.1	1.4	2
Thallium	ug/g	<0.05	<0.05	<0.5
Tin	ug/g	<0.05	<0.05	<0.5
Titanium	ug/g	0.14	0.06	<0.5
Uranium	ug/g	<0.005	<0.005	<0.05
Vanadium	ug/g	<0.1	<0.1	<1
Zinc	ug/g	24	76	41
Lab Section 6 (SPTP)				
Moisture	%	74.14	80.89	65.82

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27022 **04/25/2018 RG_GC_YP03O_20180425 *TISSUE***
27023 **04/25/2018 RG_GC_YP04M_20180425 *TISSUE***
27024 **04/25/2018 RG_GC_YP04O_20180425 *TISSUE***

Analyte	Units	27022	27023	27024
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	13	<2
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	<0.05	<0.05	0.06
Barium	ug/g	0.34	0.36	0.30
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.08	0.02	0.05
Copper	ug/g	2.3	1.2	2.5
Iron	ug/g	38	23	33
Lead	ug/g	<0.01	0.01	<0.01
Manganese	ug/g	4.4	1.2	2.3
Mercury	ug/g	0.061	0.54	0.025
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	3.9	2.7	3.2
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	1.5	1.3	1.4
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	<0.05	0.35	<0.05
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	85	34	85
Lab Section 6 (SPTP)				
Moisture	%	81.84	79.27	82.50

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27025 **04/25/2018 RG_GC_YP05M_20180425 *TISSUE***
27026 **04/25/2018 RG_GC_YP05O_20180425 *TISSUE***
27027 **04/25/2018 RG_GC_YP06M_20180425 *TISSUE***

Analyte	Units	27025	27026	27027
Lab Section 2 (ICP)				
Aluminum	ug/g	3	<2	4
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	<0.05	<0.05	<0.05
Barium	ug/g	0.59	0.33	0.30
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.02	0.06	0.02
Copper	ug/g	1.0	2.2	0.86
Iron	ug/g	12	33	13
Lead	ug/g	<0.01	<0.01	<0.01
Manganese	ug/g	1.6	4.1	0.9
Mercury	ug/g	0.30	0.011	0.49
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	2.4	2.9	2.7
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	4.1	1.5	1.6
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.10	<0.05	0.10
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	40	81	27
Lab Section 6 (SPTP)				
Moisture	%	74.06	83.75	77.86

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27028 **04/25/2018 RG_GC_YP07M_20180425 *TISSUE***
27029 **04/25/2018 RG_GC_YP08M_20180425 *TISSUE***
27030 **04/25/2018 RG_GC_YP09M_20180425 *TISSUE***

Analyte	Units	27028	27029	27030
Lab Section 2 (ICP)				
Aluminum	ug/g	<5	<5	5
Antimony	ug/g	<0.2	<0.2	<0.1
Arsenic	ug/g	<0.1	<0.1	<0.05
Barium	ug/g	0.2	<0.1	0.20
Beryllium	ug/g	<0.02	<0.02	<0.01
Boron	ug/g	<2	<2	<1
Cadmium	ug/g	<0.02	<0.02	<0.01
Chromium	ug/g	<1	<1	<0.5
Cobalt	ug/g	<0.02	<0.02	0.02
Copper	ug/g	1.2	0.8	0.93
Iron	ug/g	13	14	14
Lead	ug/g	<0.02	<0.02	0.01
Manganese	ug/g	1.0	0.6	1.0
Mercury	ug/g	0.64	0.31	0.62
Molybdenum	ug/g	<0.2	<0.2	<0.1
Nickel	ug/g	<0.1	<0.1	<0.05
Selenium	ug/g	3.1	2.7	2.9
Silver	ug/g	<0.02	<0.02	<0.01
Strontium	ug/g	1.1	<0.2	0.7
Thallium	ug/g	<0.1	<0.1	<0.05
Tin	ug/g	<0.1	<0.1	<0.05
Titanium	ug/g	0.1	0.1	0.12
Uranium	ug/g	<0.01	<0.01	<0.005
Vanadium	ug/g	<0.2	<0.2	<0.1
Zinc	ug/g	34	21	29
Lab Section 6 (SPTP)				
Moisture	%	76.50	74.92	79.18

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

Minnow Environmental Inc.

27031 **04/25/2018 RG_ER_WCT01M_20180425 *TISSUE***
27032 **04/30/2018 RG_ER_WCT02M_20180430 *TISSUE***
27033 **04/25/2018 RG_ER_MW01M_20180425 *TISSUE***

Analyte	Units	27031	27032	27033
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	<5	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	<5	<5	<5
Iron	ug/g	<200	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	2.7	1.4	3.5
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	<5	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	61.19	54.49	57.94

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27034 **04/28/2018 RG_ER_MW02M_20180428 *TISSUE***
27035 **04/29/2018 RG_ER_MW03M_20180429 *TISSUE***
27036 **04/27/2018 RG_ER_BT01M_20180427 *TISSUE***

Analyte	Units	27034	27035	27036
Lab Section 2 (ICP)				
Aluminum	ug/g	7	<200	<200
Antimony	ug/g	<0.1	<10	<10
Arsenic	ug/g	0.45	<5	<5
Barium	ug/g	0.10	<5	<5
Beryllium	ug/g	<0.01	<1	<1
Boron	ug/g	<1	<100	<100
Cadmium	ug/g	<0.01	<1	<1
Chromium	ug/g	<0.5	<50	<50
Cobalt	ug/g	0.04	<1	<1
Copper	ug/g	1.4	<5	<5
Iron	ug/g	17	<200	<200
Lead	ug/g	<0.01	<1	<1
Manganese	ug/g	0.8	<10	<10
Mercury	ug/g	0.24	<0.5	1.1
Molybdenum	ug/g	<0.1	<10	<10
Nickel	ug/g	<0.05	<5	<5
Selenium	ug/g	2.2	3.0	1.8
Silver	ug/g	<0.01	<1	<1
Strontium	ug/g	0.7	<10	<10
Thallium	ug/g	<0.05	<5	<5
Tin	ug/g	<0.05	<5	<5
Titanium	ug/g	0.10	<5	<5
Uranium	ug/g	<0.005	<0.5	<0.5
Vanadium	ug/g	<0.1	<10	<10
Zinc	ug/g	17	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	74.77	41.05	19.34

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27037 **04/29/2018 RG_ER_BT02M_20180429 *TISSUE***
27038 **04/28/2018 RG_ER_KO01M_20180428 *TISSUE***
27039 **04/29/2018 RG_ER_KO02M_20180429 *TISSUE***

Analyte	Units	27037	27038	27039
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	<5	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	<5	<5	<5
Iron	ug/g	<200	<200	<200
Lead	ug/g	<1	<1	<1
Manganese	ug/g	<10	<10	<10
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	1.4	2.0	1.8
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	<5	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	73.82	56.16	20.70

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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Aug 10, 2018

Minnow Environmental Inc.

27040 **04/25/2018 RG_ER_PCC01M_20180425 *TISSUE***
27041 **04/25/2018 RG_ER_PCC01O_20180425 *TISSUE***
27042 **04/25/2018 RG_ER_PCC02M_20180425 *TISSUE***

Analyte	Units	27040	27041	27042
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	2	5
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.12	0.13	0.08
Barium	ug/g	1.3	0.91	1.1
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	0.04	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.02	0.06	0.02
Copper	ug/g	0.67	4.1	0.68
Iron	ug/g	15	100	10
Lead	ug/g	0.04	0.02	0.01
Manganese	ug/g	1.5	8.3	1.0
Mercury	ug/g	0.62	0.041	0.41
Molybdenum	ug/g	<0.1	0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	2.1	8.7	2.8
Silver	ug/g	<0.01	0.01	<0.01
Strontium	ug/g	5.7	0.4	4.4
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.10	0.08	0.19
Uranium	ug/g	<0.005	0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	19	110	36
Lab Section 6 (SPTP)				
Moisture	%	78.71	66.13	76.98

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27043 **04/25/2018 RG_ER_PCC02O_20180425 *TISSUE***
27044 **04/25/2018 RG_ER_PCC03M_20180425 *TISSUE***
27045 **04/25/2018 RG_ER_PCC03O_20180425 *TISSUE***

Analyte	Units	27043	27044	27045
Lab Section 2 (ICP)				
Aluminum	ug/g	5	<2	<2
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.24	0.15	0.18
Barium	ug/g	2.5	1.0	1.4
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.02	<0.01	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.07	0.02	0.06
Copper	ug/g	4.6	1.4	3.8
Iron	ug/g	110	18	54
Lead	ug/g	0.01	<0.01	0.03
Manganese	ug/g	16	0.8	4.4
Mercury	ug/g	0.034	0.42	0.024
Molybdenum	ug/g	0.2	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	16	4.4	18
Silver	ug/g	0.02	<0.01	0.01
Strontium	ug/g	0.7	2.5	0.3
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.09	0.05	0.06
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	160	42	120
Lab Section 6 (SPTP)				
Moisture	%	72.36	77.81	64.24

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27046 **04/25/2018 RG_ER_PCC06M_20180425 *TISSUE***
27047 **04/25/2018 RG_ER_PCC06O_20180425 *TISSUE***
27048 **04/26/2018 RG_ER_PCC08M_20180426 *TISSUE***

Analyte	Units	27046	27047	27048
Lab Section 2 (ICP)				
Aluminum	ug/g	3	4	3
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.15	0.37	0.10
Barium	ug/g	0.96	0.57	1.1
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.01	0.05	0.01
Copper	ug/g	1.5	4.3	0.92
Iron	ug/g	17	63	12
Lead	ug/g	0.01	<0.01	0.01
Manganese	ug/g	0.8	11	0.9
Mercury	ug/g	0.48	0.035	0.52
Molybdenum	ug/g	<0.1	0.2	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	2.0	10	2.6
Silver	ug/g	<0.01	0.02	<0.01
Strontium	ug/g	2.7	0.3	3.7
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.48	0.10	0.16
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	41	140	27
Lab Section 6 (SPTP)				
Moisture	%	78.57	67.87	79.63

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27049 04/26/2018 RG_ER_PCC08O_20180426 *TISSUE*
27050 04/26/2018 RG_ER_PCC09M_20180426 *TISSUE*
27051 04/26/2018 RG_ER_PCC09O_20180426 *TISSUE*

Analyte	Units	27049	27050	27051
Lab Section 2 (ICP)				
Aluminum	ug/g	8	<2	8
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.12	0.10	0.08
Barium	ug/g	2.2	1.2	0.75
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.02	<0.01	0.02
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.05	0.01	0.07
Copper	ug/g	2.8	1.2	2.8
Iron	ug/g	110	13	120
Lead	ug/g	0.04	0.03	0.02
Manganese	ug/g	14	1.0	6.5
Mercury	ug/g	0.060	0.67	0.035
Molybdenum	ug/g	0.2	<0.1	0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	20	2.7	12
Silver	ug/g	0.01	0.14	<0.01
Strontium	ug/g	0.5	4.0	0.3
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.25	0.07	0.20
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	160	28	110
Lab Section 6 (SPTP)				
Moisture	%	76.89	79.32	66.94

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27050
There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

Results are reported on a dry basis.

SRC Group # 2018-8314
Aug 10, 2018

Minnow Environmental Inc.

27052 **04/26/2018 RG_ER_PCC11M_20180426 *TISSUE***
27053 **04/26/2018 RG_ER_PCC11O_20180426 *TISSUE***
27054 **04/26/2018 RG_ER_PCC12M_20180426 *TISSUE***

Analyte	Units	27052	27053	27054
Lab Section 2 (ICP)				
Aluminum	ug/g	<5	3	3
Antimony	ug/g	<0.2	<0.1	<0.1
Arsenic	ug/g	0.1	0.13	0.12
Barium	ug/g	0.5	0.59	1.1
Beryllium	ug/g	<0.02	<0.01	<0.01
Boron	ug/g	<2	<1	<1
Cadmium	ug/g	<0.02	0.02	<0.01
Chromium	ug/g	<1	<0.5	<0.5
Cobalt	ug/g	<0.02	0.06	0.01
Copper	ug/g	1.3	4.2	1.2
Iron	ug/g	21	73	20
Lead	ug/g	0.03	0.01	0.02
Manganese	ug/g	0.4	10	0.8
Mercury	ug/g	0.6	0.036	0.96
Molybdenum	ug/g	<0.2	0.1	<0.1
Nickel	ug/g	<0.1	<0.05	<0.05
Selenium	ug/g	2.4	9.5	2.2
Silver	ug/g	<0.02	0.02	<0.01
Strontium	ug/g	0.4	0.3	1.8
Thallium	ug/g	<0.1	<0.05	<0.05
Tin	ug/g	<0.1	<0.05	<0.05
Titanium	ug/g	<0.1	0.08	0.10
Uranium	ug/g	<0.01	<0.005	<0.005
Vanadium	ug/g	<0.2	<0.1	<0.1
Zinc	ug/g	28	120	28
Lab Section 6 (SPTP)				
Moisture	%	75.70	66.57	80.66

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27055 **04/26/2018 RG_ER_PCC12O_20180426 *TISSUE***
27056 **04/26/2018 RG_ER_PCC16M_20180426 *TISSUE***
27057 **04/26/2018 RG_ER_PCC16O_20180426 *TISSUE***

Analyte	Units	27055	27056	27057
Lab Section 2 (ICP)				
Aluminum	ug/g	3	6	6
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.08	0.21	0.18
Barium	ug/g	0.54	1.7	0.86
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.03	0.02	0.06
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.08	0.02	0.06
Copper	ug/g	4.6	1.0	4.5
Iron	ug/g	98	23	94
Lead	ug/g	0.02	0.03	0.01
Manganese	ug/g	13	1.3	9.7
Mercury	ug/g	0.077	1.2	0.10
Molybdenum	ug/g	0.2	<0.1	0.2
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	10	5.0	21
Silver	ug/g	0.01	<0.01	0.02
Strontium	ug/g	0.7	6.7	0.4
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.10	0.16	0.10
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	150	35	120
Lab Section 6 (SPTP)				
Moisture	%	71.47	79.36	67.79

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27058 **04/26/2018 RG_ER_PCC17M_20180426 *TISSUE***
27059 **04/26/2018 RG_ER_PCC17O_20180426 *TISSUE***
27060 **04/25/2018 RG_ER_RSC01O_20180425 *TISSUE***

Analyte	Units	27058	27059	27060
Lab Section 2 (ICP)				
Aluminum	ug/g	6	6	<5
Antimony	ug/g	<0.1	<0.1	<0.2
Arsenic	ug/g	0.27	0.42	0.4
Barium	ug/g	1.1	1.7	0.9
Beryllium	ug/g	<0.01	<0.01	<0.02
Boron	ug/g	<1	<1	<2
Cadmium	ug/g	<0.01	0.02	<0.02
Chromium	ug/g	<0.5	<0.5	<1
Cobalt	ug/g	0.02	0.07	0.09
Copper	ug/g	2.8	4.5	5.4
Iron	ug/g	33	75	120
Lead	ug/g	0.02	0.02	<0.02
Manganese	ug/g	0.9	12	7.4
Mercury	ug/g	0.37	0.043	0.04
Molybdenum	ug/g	<0.1	0.2	<0.2
Nickel	ug/g	<0.05	<0.05	<0.1
Selenium	ug/g	1.9	13	22
Silver	ug/g	<0.01	0.02	<0.02
Strontium	ug/g	1.8	0.4	0.6
Thallium	ug/g	<0.05	<0.05	<0.1
Tin	ug/g	<0.05	<0.05	<0.1
Titanium	ug/g	0.32	0.15	<0.1
Uranium	ug/g	<0.005	<0.005	<0.01
Vanadium	ug/g	<0.1	<0.1	<0.2
Zinc	ug/g	49	160	220
Lab Section 6 (SPTP)				
Moisture	%	76.65	69.40	70.08

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27061 **04/25/2018 RG_ER_RSC01M_20180425 *TISSUE***
27062 **04/25/2018 RG_ER_RSC07O_20180425 *TISSUE***
27063 **04/25/2018 RG_ER_RSC07M_20180425 *TISSUE***

Analyte	Units	27061	27062	27063
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	<0.5	0.8	<0.5
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.1	6.7	1.0
Iron	ug/g	<20	130	<20
Lead	ug/g	<0.1	0.3	<0.1
Manganese	ug/g	1	6	1
Mercury	ug/g	0.82	<0.05	0.44
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	1.5	35	2.5
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	2	<1	2
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	26	240	24
Lab Section 6 (SPTP)				
Moisture	%	76.30	70.29	74.87

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27064 **04/25/2018 RG_ER_RSC08O_20180425 *TISSUE***
27065 **04/25/2018 RG_ER_RSC08M_20180425 *TISSUE***
27066 **04/25/2018 RG_ER_RSC09O_20180425 *TISSUE***

Analyte	Units	27064	27065	27066
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	0.7	<0.5	2.2
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	0.1
Copper	ug/g	8.1	1.1	7.4
Iron	ug/g	140	<20	130
Lead	ug/g	<0.1	<0.1	0.1
Manganese	ug/g	6	1	6
Mercury	ug/g	0.08	0.84	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	29	1.7	25
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	<1	3	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	1.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	240	23	270
Lab Section 6 (SPTP)				
Moisture	%	71.43	77.14	73.49

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27067 **04/25/2018 RG_ER_RSC09M_20180425 *TISSUE***
27068 **04/25/2018 RG_ER_RSC10O_20180425 *TISSUE***
27069 **04/25/2018 RG_ER_RSC10M_20180425 *TISSUE***

Analyte	Units	27067	27068	27069
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<200	<20
Antimony	ug/g	<1	<10	<1
Arsenic	ug/g	<0.5	<5	<0.5
Barium	ug/g	<0.5	<5	0.7
Beryllium	ug/g	<0.1	<1	<0.1
Boron	ug/g	<10	<100	<10
Cadmium	ug/g	<0.1	<1	<0.1
Chromium	ug/g	<5	<50	<5
Cobalt	ug/g	<0.1	<1	<0.1
Copper	ug/g	2.5	6	1.7
Iron	ug/g	<20	<200	<20
Lead	ug/g	<0.1	<1	<0.1
Manganese	ug/g	1	<10	1
Mercury	ug/g	0.39	<0.5	0.28
Molybdenum	ug/g	<1	<10	<1
Nickel	ug/g	<0.5	<5	<0.5
Selenium	ug/g	2.2	15	1.8
Silver	ug/g	<0.1	<1	<0.1
Strontium	ug/g	2	<10	2
Thallium	ug/g	<0.5	<5	<0.5
Tin	ug/g	<0.5	<5	<0.5
Titanium	ug/g	<0.5	<5	<0.5
Uranium	ug/g	<0.05	<0.5	<0.05
Vanadium	ug/g	<1	<10	<1
Zinc	ug/g	30	290	63
Lab Section 6 (SPTP)				
Moisture	%	77.58	54.60	76.40

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27070 **04/25/2018 RG_ER_RSC11O_20180425 *TISSUE***
27071 **04/25/2018 RG_ER_RSC11M_20180425 *TISSUE***
27072 **04/25/2018 RG_ER_RSC12O_20180425 *TISSUE***

Analyte	Units	27070	27071	27072
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	1.1	<0.5	1.2
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	0.2
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	6.3	1.4	7.1
Iron	ug/g	110	20	140
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	7	1	6
Mercury	ug/g	<0.05	0.54	0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	14	1.8	26
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	1	2	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	220	22	240
Lab Section 6 (SPTP)				
Moisture	%	73.96	71.25	72.33

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27073 **04/25/2018 RG_ER_RSC12M_20180425 *TISSUE***
27074 **04/25/2018 RG_ER_RSC14O_20180425 *TISSUE***
27075 **04/25/2018 RG_ER_RSC14M_20180425 *TISSUE***

Analyte	Units	27073	27074	27075
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	<0.5	1.2	<0.5
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	0.9	7.8	1.2
Iron	ug/g	<20	130	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	1	7	1
Mercury	ug/g	0.41	<0.05	0.37
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	1.8	12	2.2
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	3	<1	2
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	23	230	26
Lab Section 6 (SPTP)				
Moisture	%	74.76	74.62	78.01

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27076 **04/25/2018 RG_ER_RSC15O_20180425 *TISSUE***
27077 **04/25/2018 RG_ER_RSC15M_20180425 *TISSUE***
27078 **04/25/2018 RG_ER_RSC16O_20180425 *TISSUE***

Analyte	Units	27076	27077	27078
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<200
Antimony	ug/g	<1	<1	<10
Arsenic	ug/g	<0.5	<0.5	<5
Barium	ug/g	1.3	1.1	<5
Beryllium	ug/g	<0.1	<0.1	<1
Boron	ug/g	<10	<10	<100
Cadmium	ug/g	<0.1	<0.1	<1
Chromium	ug/g	<5	<5	<50
Cobalt	ug/g	<0.1	<0.1	<1
Copper	ug/g	5.1	2.4	<5
Iron	ug/g	120	30	<200
Lead	ug/g	<0.1	<0.1	<1
Manganese	ug/g	10	1	<10
Mercury	ug/g	<0.05	0.26	<0.5
Molybdenum	ug/g	<1	<1	<10
Nickel	ug/g	<0.5	<0.5	<5
Selenium	ug/g	22	3.5	16
Silver	ug/g	<0.1	<0.1	<1
Strontium	ug/g	<1	<1	<10
Thallium	ug/g	<0.5	<0.5	<5
Tin	ug/g	<0.5	<0.5	<5
Titanium	ug/g	<0.5	<0.5	<5
Uranium	ug/g	<0.05	<0.05	<0.5
Vanadium	ug/g	<1	<1	<10
Zinc	ug/g	210	85	350
Lab Section 6 (SPTP)				
Moisture	%	69.92	76.27	82.15

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27079 **04/25/2018 RG_ER_RSC16M_20180425 *TISSUE***
27080 **04/25/2018 RG_ER_RSC19O_20180425 *TISSUE***
27081 **04/25/2018 RG_ER_RSC19M_20180425 *TISSUE***

Analyte	Units	27079	27080	27081
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	<0.5	0.9	<0.5
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	1.2	7.0	1.1
Iron	ug/g	<20	150	<20
Lead	ug/g	<0.1	<0.1	<0.1
Manganese	ug/g	1	10	<1
Mercury	ug/g	0.37	<0.05	0.37
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	1.8	9.6	1.6
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	3	<1	2
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	26	210	23
Lab Section 6 (SPTP)				
Moisture	%	78.14	75.19	77.23

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27082 04/25/2018 RG_SC_KO01M_20180425 *TISSUE*
27083 04/25/2018 RG_SC_KO02M_20180425 *TISSUE*
27084 04/26/2018 RG_SC_KO03M_20180426 *TISSUE*

Analyte	Units	27082	27083	27084
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	8	<200
Antimony	ug/g	<1	<0.1	<10
Arsenic	ug/g	<0.5	0.08	<5
Barium	ug/g	1.2	0.07	<5
Beryllium	ug/g	<0.1	<0.01	<1
Boron	ug/g	<10	<1	<100
Cadmium	ug/g	<0.1	<0.01	<1
Chromium	ug/g	<5	<0.5	<50
Cobalt	ug/g	<0.1	<0.01	<1
Copper	ug/g	1.0	1.1	<5
Iron	ug/g	<20	19	<200
Lead	ug/g	<0.1	0.02	<1
Manganese	ug/g	<1	0.5	<10
Mercury	ug/g	0.41	0.31	<0.5
Molybdenum	ug/g	<1	<0.1	<10
Nickel	ug/g	<0.5	<0.05	<5
Selenium	ug/g	1.8	2.0	1.9
Silver	ug/g	<0.1	<0.01	<1
Strontium	ug/g	<1	0.3	<10
Thallium	ug/g	<0.5	0.08	<5
Tin	ug/g	<0.5	<0.05	<5
Titanium	ug/g	<0.5	0.46	<5
Uranium	ug/g	<0.05	<0.005	<0.5
Vanadium	ug/g	<1	<0.1	<10
Zinc	ug/g	13	16	<50
Lab Section 6 (SPTP)				
Moisture	%	72.32	75.03	71.47

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27083
There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27085 04/26/2018 RG_SC_KO04M_20180426 *TISSUE*
27086 04/25/2018 RG_SC_BT01M_20180425 *TISSUE*
27087 04/25/2018 RG_SC_BT03M_20180425 *TISSUE*

Analyte	Units	27085	27086	27087
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	<1000	<200
Antimony	ug/g	<10	<50	<10
Arsenic	ug/g	<5	<20	<5
Barium	ug/g	<5	<20	<5
Beryllium	ug/g	<1	<5	<1
Boron	ug/g	<100	<500	<100
Cadmium	ug/g	<1	<5	<1
Chromium	ug/g	<50	<200	<50
Cobalt	ug/g	<1	<5	<1
Copper	ug/g	<5	<20	<5
Iron	ug/g	<200	<1000	<200
Lead	ug/g	<1	<5	<1
Manganese	ug/g	<10	<50	<10
Mercury	ug/g	<0.5	<2	0.8
Molybdenum	ug/g	<10	<50	<10
Nickel	ug/g	<5	<20	<5
Selenium	ug/g	2.0	2	1.8
Silver	ug/g	<1	<5	<1
Strontium	ug/g	<10	<50	<10
Thallium	ug/g	<5	<20	<5
Tin	ug/g	<5	<20	<5
Titanium	ug/g	<5	<20	<5
Uranium	ug/g	<0.5	<2	<0.5
Vanadium	ug/g	<10	<50	<10
Zinc	ug/g	<50	<200	<50
Lab Section 6 (SPTP)				
Moisture	%	74.93	83.64	74.10

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27086
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27088 **04/27/2018 RG_SC_BT04M_20180427 *TISSUE***
27089 **04/28/2018 RG_SC_BT05M_20180428 *TISSUE***
27090 **04/28/2018 RG_SC_BT06M_20180428 *TISSUE***

Analyte	Units	27088	27089	27090
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	<200	<200
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	24	<5	<5
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	<1	<1	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	<1	<1	<1
Copper	ug/g	<5	<5	<5
Iron	ug/g	300	<200	<200
Lead	ug/g	4	<1	<1
Manganese	ug/g	20	<10	<10
Mercury	ug/g	<0.5	1.1	1.4
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	<5	<5	<5
Selenium	ug/g	<0.5	2.0	1.3
Silver	ug/g	<1	<1	<1
Strontium	ug/g	<10	<10	<10
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	6	<5	<5
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	<50	<50	<50
Lab Section 6 (SPTP)				
Moisture	%	39.41	78.74	76.11

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27091 **04/27/2018 RG_SC_RT01M_20180427 *TISSUE***
27092 **04/27/2018 RG_SC_RT02M_20180427 *TISSUE***
27093 **04/27/2018 RG_SC_MW01M_20180427 *TISSUE***

Analyte	Units	27091	27092	27093
Lab Section 2 (ICP)				
Aluminum	ug/g	<200	10	<5
Antimony	ug/g	<10	<0.1	<0.2
Arsenic	ug/g	<5	<0.05	0.2
Barium	ug/g	<5	0.17	0.1
Beryllium	ug/g	<1	<0.01	<0.02
Boron	ug/g	<100	<1	<2
Cadmium	ug/g	<1	<0.01	<0.02
Chromium	ug/g	<50	<0.5	<1
Cobalt	ug/g	<1	0.02	0.03
Copper	ug/g	<5	1.2	1.6
Iron	ug/g	<200	23	18
Lead	ug/g	<1	<0.01	<0.02
Manganese	ug/g	<10	0.8	1.0
Mercury	ug/g	<0.5	0.24	0.1
Molybdenum	ug/g	<10	<0.1	<0.2
Nickel	ug/g	<5	<0.05	<0.1
Selenium	ug/g	1.8	1.4	6.0
Silver	ug/g	<1	<0.01	<0.02
Strontium	ug/g	<10	1.0	0.8
Thallium	ug/g	<5	<0.05	<0.1
Tin	ug/g	<5	<0.05	<0.1
Titanium	ug/g	<5	0.20	0.1
Uranium	ug/g	<0.5	<0.005	<0.01
Vanadium	ug/g	<10	<0.1	<0.2
Zinc	ug/g	<50	16	18
Lab Section 6 (SPTP)				
Moisture	%	81.54	75.87	77.68

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27094 **04/27/2018 RG_SC_YP01M_20180427 *TISSUE***
27095 **04/27/2018 RG_SC_YP01O_20180427 *TISSUE***
27096 **04/24/2018 RG_SC_PCC01M_20180424 *TISSUE***

Analyte	Units	27094	27095	27096
Lab Section 2 (ICP)				
Aluminum	ug/g	4	<2	5
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	<0.05	<0.05	0.16
Barium	ug/g	0.22	0.14	1.6
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.02	0.04	0.02
Copper	ug/g	0.77	2.1	0.99
Iron	ug/g	11	29	23
Lead	ug/g	0.01	<0.01	0.05
Manganese	ug/g	1.2	2.8	1.1
Mercury	ug/g	0.82	0.042	0.71
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	1.8	2.4	2.2
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	2.5	1.8	3.4
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.09	0.06	0.42
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	32	79	32
Lab Section 6 (SPTP)				
Moisture	%	79.90	83.37	80.39

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27097 **04/24/2018 RG_SC_PCC01O_20180424 *TISSUE***
27098 **04/24/2018 RG_SC_PCC02M_20180424 *TISSUE***
27099 **04/24/2018 RG_SC_PCC02O_20180424 *TISSUE***

Analyte	Units	27097	27098	27099
Lab Section 2 (ICP)				
Aluminum	ug/g	23	12	24
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.15	0.10	0.08
Barium	ug/g	1.7	1.0	2.2
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.01	<0.01	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.10	0.02	0.06
Copper	ug/g	4.5	1.1	3.4
Iron	ug/g	110	25	69
Lead	ug/g	0.09	0.09	0.05
Manganese	ug/g	6.7	1.3	11
Mercury	ug/g	0.032	0.80	0.041
Molybdenum	ug/g	0.1	<0.1	0.2
Nickel	ug/g	0.07	0.16	<0.05
Selenium	ug/g	11	1.4	11
Silver	ug/g	0.01	<0.01	<0.01
Strontium	ug/g	0.6	3.2	0.6
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.45	0.40	0.47
Uranium	ug/g	0.007	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	100	22	120
Lab Section 6 (SPTP)				
Moisture	%	66.39	79.17	67.38

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27100 **04/24/2018 RG_SC_PCC03M_20180424 *TISSUE***
27101 **04/24/2018 RG_SC_PCC03O_20180424 *TISSUE***
27102 **04/24/2018 RG_SC_PCC06M_20180424 *TISSUE***

Analyte	Units	27100	27101	27102
Lab Section 2 (ICP)				
Aluminum	ug/g	18	17	19
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.27	0.22	0.13
Barium	ug/g	1.4	1.0	1.5
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	0.02	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.04	0.08	0.03
Copper	ug/g	2.4	3.8	1.1
Iron	ug/g	53	100	36
Lead	ug/g	0.06	0.04	0.08
Manganese	ug/g	1.3	6.6	1.6
Mercury	ug/g	0.87	0.044	0.53
Molybdenum	ug/g	<0.1	0.1	<0.1
Nickel	ug/g	<0.05	<0.05	0.06
Selenium	ug/g	2.0	9.0	2.2
Silver	ug/g	<0.01	0.02	<0.01
Strontium	ug/g	1.8	0.5	4.3
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.25	0.26	0.32
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	47	110	34
Lab Section 6 (SPTP)				
Moisture	%	79.25	66.31	79.38

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27103 **04/24/2018 RG_SC_PCC06O_20180424 *TISSUE***
27104 **04/24/2018 RG_SC_PCC07M_20180424 *TISSUE***
27105 **04/24/2018 RG_SC_PCC07O_20180424 *TISSUE***

Analyte	Units	27103	27104	27105
Lab Section 2 (ICP)				
Aluminum	ug/g	10	4	7
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.10	0.09	0.23
Barium	ug/g	1.4	0.56	1.4
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.02	<0.01	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.07	0.01	0.08
Copper	ug/g	4.7	1.1	4.1
Iron	ug/g	65	13	80
Lead	ug/g	0.04	0.06	0.06
Manganese	ug/g	14	0.9	14
Mercury	ug/g	0.030	0.44	0.038
Molybdenum	ug/g	0.1	<0.1	0.2
Nickel	ug/g	0.05	<0.05	<0.05
Selenium	ug/g	15	1.9	12
Silver	ug/g	0.02	<0.01	0.02
Strontium	ug/g	0.6	2.4	0.5
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.22	0.11	0.12
Uranium	ug/g	0.008	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	130	22	150
Lab Section 6 (SPTP)				
Moisture	%	68.68	78.55	72.05

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27106 **04/24/2018 RG_SC_PCC08M_20180424 *TISSUE***
27107 **04/24/2018 RG_SC_PCC08O_20180424 *TISSUE***
27108 **04/24/2018 RG_SC_PCC10M_20180424 *TISSUE***

Analyte	Units	27106	27107	27108
Lab Section 2 (ICP)				
Aluminum	ug/g	8	4	4
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.19	0.11	0.19
Barium	ug/g	1.2	0.93	0.60
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.02	0.07	0.02
Copper	ug/g	0.80	2.1	1.8
Iron	ug/g	25	76	18
Lead	ug/g	0.08	0.05	0.03
Manganese	ug/g	1.3	7.1	0.6
Mercury	ug/g	0.86	0.059	0.55
Molybdenum	ug/g	<0.1	0.1	<0.1
Nickel	ug/g	0.06	<0.05	<0.05
Selenium	ug/g	2.0	23	1.7
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	3.0	0.3	0.6
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.12	0.11	0.09
Uranium	ug/g	<0.005	0.006	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	34	130	33
Lab Section 6 (SPTP)				
Moisture	%	79.32	67.82	78.63

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27109 04/24/2018 RG_SC_PCC10O_20180424 *TISSUE*
27110 04/24/2018 RG_SC_PCC11M_20180424 *TISSUE*
27111 04/24/2018 RG_SC_PCC11O_20180424 *TISSUE*

Analyte	Units	27109	27110	27111
Lab Section 2 (ICP)				
Aluminum	ug/g	6	7	5
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.39	0.10	0.12
Barium	ug/g	2.0	1.0	1.5
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.02	<0.01	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.06	0.02	0.08
Copper	ug/g	3.9	1.1	3.9
Iron	ug/g	54	22	56
Lead	ug/g	0.06	0.04	0.03
Manganese	ug/g	6.9	1.2	12
Mercury	ug/g	0.030	0.53	0.027
Molybdenum	ug/g	0.1	<0.1	0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	8.4	1.9	9.9
Silver	ug/g	0.02	<0.01	0.02
Strontium	ug/g	0.3	3.2	0.4
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.12	0.12	0.07
Uranium	ug/g	<0.005	<0.005	0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	160	24	120
Lab Section 6 (SPTP)				
Moisture	%	66.74	79.00	65.36

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27112 **04/24/2018 RG_SC_PCC13M_20180424 *TISSUE***
27113 **04/24/2018 RG_SC_PCC13O_20180424 *TISSUE***
27114 **04/24/2018 RG_SC_PCC14M_20180424 *TISSUE***

Analyte	Units	27112	27113	27114
Lab Section 2 (ICP)				
Aluminum	ug/g	2	4	6
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.27	0.36	0.11
Barium	ug/g	0.78	0.95	0.60
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.02	0.04	0.01
Copper	ug/g	2.6	3.4	0.83
Iron	ug/g	46	43	14
Lead	ug/g	0.02	0.02	0.06
Manganese	ug/g	0.7	4.9	1.0
Mercury	ug/g	0.34	0.022	0.46
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	1.4	5.9	1.7
Silver	ug/g	<0.01	0.02	<0.01
Strontium	ug/g	0.6	0.2	3.2
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.06	0.07	0.12
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	47	100	23
Lab Section 6 (SPTP)				
Moisture	%	75.22	60.54	77.91

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27115 04/24/2018 RG_SC_PCC14O_20180424 *TISSUE*
27116 04/24/2018 RG_SC_RSC02M_20180424 *TISSUE*
27117 04/24/2018 RG_SC_RSC02O_20180424 *TISSUE*

Analyte	Units	27115	27116	27117
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<20	<20
Antimony	ug/g	<0.1	<1	<1
Arsenic	ug/g	0.24	<0.5	<0.5
Barium	ug/g	0.40	<0.5	1.8
Beryllium	ug/g	<0.01	<0.1	<0.1
Boron	ug/g	<1	<10	<10
Cadmium	ug/g	<0.01	<0.1	<0.1
Chromium	ug/g	<0.5	<5	<5
Cobalt	ug/g	0.05	<0.1	<0.1
Copper	ug/g	3.2	1.2	6.4
Iron	ug/g	52	<20	120
Lead	ug/g	0.02	<0.1	<0.1
Manganese	ug/g	6.3	1	7
Mercury	ug/g	0.022	0.44	<0.05
Molybdenum	ug/g	0.1	<1	<1
Nickel	ug/g	<0.05	<0.5	<0.5
Selenium	ug/g	6.9	1.7	11
Silver	ug/g	0.01	<0.1	<0.1
Strontium	ug/g	0.3	1	<1
Thallium	ug/g	<0.05	<0.5	<0.5
Tin	ug/g	<0.05	<0.5	<0.5
Titanium	ug/g	0.06	1.0	1.2
Uranium	ug/g	<0.005	<0.05	<0.05
Vanadium	ug/g	<0.1	<1	<1
Zinc	ug/g	100	50	280
Lab Section 6 (SPTP)				
Moisture	%	63.05	74.98	73.09

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27118 **04/24/2018 RG_SC_RSC04M_20180424 *TISSUE***
27119 **04/24/2018 RG_SC_RSC04O_20180424 *TISSUE***
27120 **04/24/2018 RG_SC_RSC05M_20180424 *TISSUE***

Analyte	Units	27118	27119	27120
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<200	20
Antimony	ug/g	<1	<10	<1
Arsenic	ug/g	<0.5	<5	<0.5
Barium	ug/g	1.3	<5	1.8
Beryllium	ug/g	<0.1	<1	<0.1
Boron	ug/g	<10	<100	<10
Cadmium	ug/g	<0.1	<1	<0.1
Chromium	ug/g	<5	<50	<5
Cobalt	ug/g	<0.1	<1	<0.1
Copper	ug/g	2.5	6	1.7
Iron	ug/g	30	<200	40
Lead	ug/g	<0.1	<1	<0.1
Manganese	ug/g	1	<10	3
Mercury	ug/g	0.46	<0.5	0.31
Molybdenum	ug/g	<1	<10	<1
Nickel	ug/g	<0.5	<5	<0.5
Selenium	ug/g	1.7	21	2.1
Silver	ug/g	<0.1	<1	<0.1
Strontium	ug/g	1	<10	9
Thallium	ug/g	<0.5	<5	<0.5
Tin	ug/g	<0.5	<5	<0.5
Titanium	ug/g	1.3	<5	<0.5
Uranium	ug/g	<0.05	<0.5	<0.05
Vanadium	ug/g	<1	<10	<1
Zinc	ug/g	82	360	74
Lab Section 6 (SPTP)				
Moisture	%	74.87	73.65	76.89

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27121 **04/24/2018 RG_SC_RSC05O_20180424 *TISSUE***
27122 **04/24/2018 RG_SC_RSC06M_20180424 *TISSUE***
27123 **04/24/2018 RG_SC_RSC06O_20180424 *TISSUE***

Analyte	Units	27121	27122	27123
Lab Section 2 (ICP)				
Aluminum	ug/g	20	<20	<20
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	1.9	1.0	1.6
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	7.2	2.6	3.9
Iron	ug/g	140	20	120
Lead	ug/g	0.2	<0.1	<0.1
Manganese	ug/g	9	1	12
Mercury	ug/g	<0.05	0.45	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	16	2.3	8.2
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	2	1	<1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	<0.5	<0.5	<0.5
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	270	70	300
Lab Section 6 (SPTP)				
Moisture	%	73.55	78.66	77.13

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27124 **04/24/2018 RG_SC_RSC09M_20180424 *TISSUE***
27125 **04/24/2018 RG_SC_RSC09O_20180424 *TISSUE***
27126 **04/24/2018 RG_SC_RSC10M_20180424 *TISSUE***

Analyte	Units	27124	27125	27126
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<200	<20
Antimony	ug/g	<1	<10	<1
Arsenic	ug/g	<0.5	<5	<0.5
Barium	ug/g	1.7	<5	1.6
Beryllium	ug/g	<0.1	<1	<0.1
Boron	ug/g	<10	<100	<10
Cadmium	ug/g	<0.1	<1	<0.1
Chromium	ug/g	<5	<50	<5
Cobalt	ug/g	<0.1	<1	<0.1
Copper	ug/g	2.5	6	1.4
Iron	ug/g	30	<200	20
Lead	ug/g	<0.1	<1	<0.1
Manganese	ug/g	1	<10	2
Mercury	ug/g	0.29	<0.5	0.42
Molybdenum	ug/g	<1	<10	<1
Nickel	ug/g	<0.5	<5	<0.5
Selenium	ug/g	3.3	14	1.8
Silver	ug/g	<0.1	<1	<0.1
Strontium	ug/g	2	<10	1
Thallium	ug/g	<0.5	<5	<0.5
Tin	ug/g	<0.5	<5	<0.5
Titanium	ug/g	<0.5	<5	0.7
Uranium	ug/g	<0.05	<0.5	<0.05
Vanadium	ug/g	<1	<10	<1
Zinc	ug/g	78	250	60
Lab Section 6 (SPTP)				
Moisture	%	76.41	75.48	76.75

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27127 **04/24/2018 RG_SC_RSC10O_20180424 *TISSUE***
27128 **04/26/2018 RG_SC_RSC11M_20180426 *TISSUE***
27129 **04/26/2018 RG_SC_RSC11O_20180426 *TISSUE***

Analyte	Units	27127	27128	27129
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	<20	30
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	<0.5	<0.5
Barium	ug/g	<0.5	0.6	1.3
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	<0.1	<0.1	<0.1
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	<0.1	<0.1	<0.1
Copper	ug/g	5.8	1.9	6.8
Iron	ug/g	140	30	150
Lead	ug/g	<0.1	0.1	<0.1
Manganese	ug/g	7	2	9
Mercury	ug/g	<0.05	0.43	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	<0.5	<0.5	<0.5
Selenium	ug/g	12	1.8	27
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	<1	2	1
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	3.2	<0.5	1.0
Uranium	ug/g	<0.05	<0.05	<0.05
Vanadium	ug/g	<1	<1	<1
Zinc	ug/g	240	71	250
Lab Section 6 (SPTP)				
Moisture	%	75.73	75.67	73.54

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27130 **04/26/2018 RG_SC_RSC13M_20180426 *TISSUE***
27131 **04/26/2018 RG_SC_RSC13O_20180426 *TISSUE***
27132 **04/27/2018 RG_SC_RSC17M_20180427 *TISSUE***

Analyte	Units	27130	27131	27132
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	6	<20
Antimony	ug/g	<1	<0.2	<1
Arsenic	ug/g	<0.5	0.5	<0.5
Barium	ug/g	0.6	1.2	1.4
Beryllium	ug/g	<0.1	<0.02	<0.1
Boron	ug/g	<10	<2	<10
Cadmium	ug/g	<0.1	0.38	<0.1
Chromium	ug/g	<5	<1	<5
Cobalt	ug/g	<0.1	0.12	<0.1
Copper	ug/g	1.2	6.1	1.2
Iron	ug/g	<20	130	<20
Lead	ug/g	<0.1	0.05	<0.1
Manganese	ug/g	2	8.3	3
Mercury	ug/g	0.42	0.04	0.49
Molybdenum	ug/g	<1	<0.2	<1
Nickel	ug/g	<0.5	<0.1	<0.5
Selenium	ug/g	2.2	22	1.6
Silver	ug/g	<0.1	<0.02	<0.1
Strontium	ug/g	3	0.6	12
Thallium	ug/g	<0.5	<0.1	<0.5
Tin	ug/g	<0.5	<0.1	<0.5
Titanium	ug/g	0.7	<0.1	0.6
Uranium	ug/g	<0.05	<0.01	<0.05
Vanadium	ug/g	<1	<0.2	<1
Zinc	ug/g	38	240	55
Lab Section 6 (SPTP)				
Moisture	%	76.01	71.34	74.70

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27133 04/27/2018 RG_SC_RSC17O_20180427 *TISSUE*
27134 04/27/2018 RG_SC_RSC18M_20180427 *TISSUE*
27135 04/27/2018 RG_SC_RSC18O_20180427 *TISSUE*

Analyte	Units	27133	27134	27135
Lab Section 2 (ICP)				
Aluminum	ug/g	<20	6	<20
Antimony	ug/g	<1	<0.2	<1
Arsenic	ug/g	<0.5	<0.1	<0.5
Barium	ug/g	0.8	2.0	2.2
Beryllium	ug/g	<0.1	<0.02	<0.1
Boron	ug/g	<10	<2	<10
Cadmium	ug/g	<0.1	<0.02	<0.1
Chromium	ug/g	<5	<1	<5
Cobalt	ug/g	<0.1	<0.02	<0.1
Copper	ug/g	6.2	2.2	5.1
Iron	ug/g	130	24	190
Lead	ug/g	<0.1	<0.02	<0.1
Manganese	ug/g	14	2.0	6
Mercury	ug/g	0.05	0.51	<0.05
Molybdenum	ug/g	<1	<0.2	<1
Nickel	ug/g	<0.5	<0.1	<0.5
Selenium	ug/g	13	1.6	20
Silver	ug/g	<0.1	<0.02	<0.1
Strontium	ug/g	<1	4.4	<1
Thallium	ug/g	<0.5	<0.1	<0.5
Tin	ug/g	<0.5	<0.1	<0.5
Titanium	ug/g	<0.5	<0.1	1.2
Uranium	ug/g	<0.05	<0.01	<0.05
Vanadium	ug/g	<1	<0.2	<1
Zinc	ug/g	240	51	280
Lab Section 6 (SPTP)				
Moisture	%	75.65	77.56	74.62

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27136 **04/27/2018 RG_ER_BI01_20180427 *TISSUE***
27137 **04/27/2018 RG_ER_BI02_20180427 *TISSUE***
27138 **04/27/2018 RG_ER_BI03_20180427 *TISSUE***

Analyte	Units	27136	27137	27138
Lab Section 2 (ICP)				
Aluminum	ug/g	<1000	900	2800
Antimony	ug/g	<50	<10	<10
Arsenic	ug/g	<20	<5	<5
Barium	ug/g	20	12	32
Beryllium	ug/g	<5	<1	<1
Boron	ug/g	<500	<100	<100
Cadmium	ug/g	<5	<1	1
Chromium	ug/g	<200	<50	<50
Cobalt	ug/g	<5	<1	2
Copper	ug/g	20	20	15
Iron	ug/g	<1000	700	2100
Lead	ug/g	<5	<1	1
Manganese	ug/g	<50	50	80
Mercury	ug/g	<2	<0.5	<0.5
Molybdenum	ug/g	<50	<10	<10
Nickel	ug/g	<20	<5	<5
Selenium	ug/g	6	5.4	5.0
Silver	ug/g	<5	<1	<1
Strontium	ug/g	<50	<10	10
Thallium	ug/g	<20	<5	<5
Tin	ug/g	<20	<5	<5
Titanium	ug/g	<20	12	34
Uranium	ug/g	<2	<0.5	<0.5
Vanadium	ug/g	<50	<10	<10
Zinc	ug/g	<200	150	100
Lab Section 6 (SPTP)				
Moisture	%	66.38	71.29	70.68

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27136
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27139 **04/27/2018 RG_ER_BI04_20180427 *TISSUE***
27140 **04/27/2018 RG_ER_BI05_20180427 *TISSUE***
27141 **04/27/2018 RG_GC_BI01_20180427 *TISSUE***

Analyte	Units	27139	27140	27141
Lab Section 2 (ICP)				
Aluminum	ug/g	3000	9000	5000
Antimony	ug/g	<50	<50	<50
Arsenic	ug/g	<20	<20	<20
Barium	ug/g	80	90	30
Beryllium	ug/g	<5	<5	<5
Boron	ug/g	<500	<500	<500
Cadmium	ug/g	7	9	<5
Chromium	ug/g	<200	<200	<200
Cobalt	ug/g	<5	<5	<5
Copper	ug/g	40	<20	30
Iron	ug/g	2000	6000	6000
Lead	ug/g	<5	<5	<5
Manganese	ug/g	140	220	230
Mercury	ug/g	<2	<2	<2
Molybdenum	ug/g	<50	<50	<50
Nickel	ug/g	<20	<20	<20
Selenium	ug/g	10	12	4
Silver	ug/g	<5	<5	<5
Strontium	ug/g	<50	70	<50
Thallium	ug/g	<20	<20	<20
Tin	ug/g	<20	<20	<20
Titanium	ug/g	60	180	80
Uranium	ug/g	<2	<2	<2
Vanadium	ug/g	<50	<50	<50
Zinc	ug/g	<200	<200	<200
Lab Section 6 (SPTP)				
Moisture	%	91.11	73.15	75.81

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27139
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Note for Sample # 27140
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

Note for Sample # 27141
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27142 **04/27/2018 RG_GC_BI02_20180427 *TISSUE***
27143 **04/27/2018 RG_GC_BI03_20180427 *TISSUE***
27144 **04/28/2018 RG_GC_BI04_20180428 *TISSUE***

Analyte	Units	27142	27143	27144
Lab Section 2 (ICP)				
Aluminum	ug/g	2200	<200	6000
Antimony	ug/g	<10	<10	<50
Arsenic	ug/g	<5	<5	<20
Barium	ug/g	34	<5	90
Beryllium	ug/g	<1	<1	<5
Boron	ug/g	<100	<100	<500
Cadmium	ug/g	<1	<1	<5
Chromium	ug/g	<50	<50	<200
Cobalt	ug/g	2	<1	<5
Copper	ug/g	14	21	20
Iron	ug/g	1900	300	5000
Lead	ug/g	<1	<1	<5
Manganese	ug/g	40	10	120
Mercury	ug/g	<0.5	<0.5	<2
Molybdenum	ug/g	<10	<10	<50
Nickel	ug/g	<5	<5	<20
Selenium	ug/g	2.8	3.9	2
Silver	ug/g	<1	<1	<5
Strontium	ug/g	<10	<10	<50
Thallium	ug/g	<5	<5	<20
Tin	ug/g	<5	<5	<20
Titanium	ug/g	55	<5	450
Uranium	ug/g	<0.5	<0.5	<2
Vanadium	ug/g	<10	<10	<50
Zinc	ug/g	90	80	<200
Lab Section 6 (SPTP)				
Moisture	%	49.01	72.85	94.02

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27144
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27145 **04/28/2018 RG_GC_BI05_20180428 *TISSUE***
27146 **04/27/2018 RG_SC_BI01_20180427 *TISSUE***
27147 **04/27/2018 RG_SC_BI02_20180427 *TISSUE***

Analyte	Units	27145	27146	27147
Lab Section 2 (ICP)				
Aluminum	ug/g	2700	1000	15300
Antimony	ug/g	<1	<50	<10
Arsenic	ug/g	1.0	<20	<5
Barium	ug/g	40	<20	120
Beryllium	ug/g	0.1	<5	<1
Boron	ug/g	<10	<500	<100
Cadmium	ug/g	0.4	6	<1
Chromium	ug/g	<5	<200	<50
Cobalt	ug/g	2.1	<5	6
Copper	ug/g	15	30	12
Iron	ug/g	2300	2000	14400
Lead	ug/g	1.2	<5	10
Manganese	ug/g	110	<50	330
Mercury	ug/g	<0.05	<2	<0.5
Molybdenum	ug/g	<1	<50	<10
Nickel	ug/g	2.0	<20	14
Selenium	ug/g	2.3	9	<0.5
Silver	ug/g	<0.1	<5	<1
Strontium	ug/g	6	<50	180
Thallium	ug/g	<0.5	<20	<5
Tin	ug/g	<0.5	<20	<5
Titanium	ug/g	46	80	250
Uranium	ug/g	0.20	<2	0.6
Vanadium	ug/g	3	<50	20
Zinc	ug/g	100	<200	80
Lab Section 6 (SPTP)				
Moisture	%	83.79	73.91	52.63

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27146
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27148 **04/27/2018 RG_SC_BI03_20180427 *TISSUE***
27149 **04/27/2018 RG_SC_BI04_20180427 *TISSUE***
27150 **04/28/2018 RG_SC_BI05_20180428 *TISSUE***

Analyte	Units	27148	27149	27150
Lab Section 2 (ICP)				
Aluminum	ug/g	5200	5600	5100
Antimony	ug/g	<10	<10	<10
Arsenic	ug/g	<5	<5	<5
Barium	ug/g	36	42	40
Beryllium	ug/g	<1	<1	<1
Boron	ug/g	<100	<100	<100
Cadmium	ug/g	3	3	<1
Chromium	ug/g	<50	<50	<50
Cobalt	ug/g	2	3	3
Copper	ug/g	19	16	16
Iron	ug/g	6300	6300	5500
Lead	ug/g	5	5	4
Manganese	ug/g	120	170	120
Mercury	ug/g	<0.5	<0.5	<0.5
Molybdenum	ug/g	<10	<10	<10
Nickel	ug/g	5	5	6
Selenium	ug/g	3.8	3.5	6.3
Silver	ug/g	<1	<1	<1
Strontium	ug/g	60	80	70
Thallium	ug/g	<5	<5	<5
Tin	ug/g	<5	<5	<5
Titanium	ug/g	100	81	80
Uranium	ug/g	<0.5	<0.5	<0.5
Vanadium	ug/g	<10	<10	<10
Zinc	ug/g	130	100	120
Lab Section 6 (SPTP)				
Moisture	%	71.87	57.30	62.54

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8314

Aug 10, 2018

Minnow Environmental Inc.

27151 **04/29/2018 RG_T4_BI_20180429 *TISSUE***
27152 **04/30/2018 RG_TN_BI_20180430 *TISSUE***

Analyte	Units	27151	27152
Lab Section 2 (ICP)			
Aluminum	ug/g	6900	8000
Antimony	ug/g	<10	<50
Arsenic	ug/g	<5	<20
Barium	ug/g	75	40
Beryllium	ug/g	<1	<5
Boron	ug/g	<100	<500
Cadmium	ug/g	3	<5
Chromium	ug/g	<50	<200
Cobalt	ug/g	2	<5
Copper	ug/g	22	<20
Iron	ug/g	6700	11600
Lead	ug/g	6	14
Manganese	ug/g	140	190
Mercury	ug/g	<0.5	<2
Molybdenum	ug/g	<10	<50
Nickel	ug/g	6	<20
Selenium	ug/g	8.5	<2
Silver	ug/g	<1	<5
Strontium	ug/g	60	70
Thallium	ug/g	<5	<20
Tin	ug/g	<5	<20
Titanium	ug/g	97	100
Uranium	ug/g	0.5	<2
Vanadium	ug/g	10	<50
Zinc	ug/g	160	<200
Lab Section 6 (SPTP)			
Moisture	%	91.57	85.28

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27152
Detection limits are influenced by several factors. "Less than" values reported above represent the lowest detection limits achievable for the sample due to insufficient sample size.

Results are reported on a dry basis.

SASKATCHEWAN RESEARCH COUNCIL

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SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Jul-10-2018 Client P.O.: VPO00555477 Ref# 18-07

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

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* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  - * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  - * Environment Canada
  - * US EPA
  - * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SRC Group # 2018-8318
Aug 16, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Jul-10-2018 Client P.O.: VPO00555477 Ref# 18-07

27156 **06/05/2018 RG_SC_NSC01M_20180605 *TISSUE***
27157 **06/05/2018 RG_SC_NSC01O_20180605 *TISSUE***
27158 **06/05/2018 RG_SC_NSC02M_20180605 *TISSUE***

Analyte	Units	27156	27157	27158
Lab Section 2 (ICP)				
Aluminum	ug/g	5	7	<2
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	<0.05	0.12	<0.05
Barium	ug/g	0.17	0.18	0.07
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	<0.01	0.06	<0.01
Copper	ug/g	0.80	3.4	0.68
Iron	ug/g	13	110	7
Lead	ug/g	0.05	0.07	0.01
Manganese	ug/g	0.5	1.7	0.2
Mercury	ug/g	1.4	0.11	1.4
Molybdenum	ug/g	<0.1	0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	1.7	16	1.3
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	0.2	0.2	0.1
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.15	0.20	<0.05
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	20	330	18
Lab Section 6 (SPTP)				
Moisture	%	77.93	76.39	77.47

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27159 06/05/2018 RG_SC_NSC02O_20180605 *TISSUE*
27160 06/05/2018 RG_SC_NSC03M_20180605 *TISSUE*
27161 06/05/2018 RG_SC_NSC03O_20180605 *TISSUE*

Analyte	Units	27159	27160	27161
Lab Section 2 (ICP)				
Aluminum	ug/g	2	2	5
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.08	0.05	0.08
Barium	ug/g	0.13	0.17	0.25
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.04	<0.01	0.05
Copper	ug/g	3.9	0.82	4.2
Iron	ug/g	90	13	120
Lead	ug/g	0.05	0.03	0.02
Manganese	ug/g	1.5	0.6	5.3
Mercury	ug/g	0.17	1.2	0.076
Molybdenum	ug/g	<0.1	<0.1	0.2
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	5.4	2.4	9.2
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	0.3	0.4	1.1
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	0.06	0.19	0.08
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	130	32	210
Lab Section 6 (SPTP)				
Moisture	%	74.75	78.87	75.02

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27162 **06/05/2018 RG_SC_NSC04M_20180605 *TISSUE***
27163 **06/05/2018 RG_SC_NSC04O_20180605 *TISSUE***
27164 **06/05/2018 RG_SC_NSC05M_20180605 *TISSUE***

Analyte	Units	27162	27163	27164
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	7	3
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	<0.05	0.17	0.06
Barium	ug/g	0.20	0.14	0.55
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	<0.01	0.04	<0.01
Copper	ug/g	0.75	2.9	0.72
Iron	ug/g	9	100	10
Lead	ug/g	<0.01	0.03	0.02
Manganese	ug/g	0.7	6.0	1.1
Mercury	ug/g	0.89	0.053	0.63
Molybdenum	ug/g	<0.1	0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	1.6	5.4	2.7
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	0.6	0.3	1.6
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	<0.05	0.16	0.10
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	25	190	21
Lab Section 6 (SPTP)				
Moisture	%	79.13	73.98	78.10

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

Aug 16, 2018

Minnow Environmental Inc.

27165 06/05/2018 RG_SC_NSC05O_20180605 *TISSUE*
27166 06/10/2018 RG_SC_NSC06M_20180610 *TISSUE*
27167 06/10/2018 RG_SC_NSC06O_20180610 *TISSUE*

Analyte	Units	27165	27166	27167
Lab Section 2 (ICP)				
Aluminum	ug/g	4	2	3
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.18	<0.05	0.09
Barium	ug/g	0.41	0.15	0.38
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	0.01	<0.01	0.02
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.05	<0.01	0.06
Copper	ug/g	3.8	0.63	3.5
Iron	ug/g	120	8	190
Lead	ug/g	0.02	0.04	0.14
Manganese	ug/g	2.2	0.4	1.4
Mercury	ug/g	0.033	1.6	0.12
Molybdenum	ug/g	0.1	<0.1	0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	13	2.0	27
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	0.3	0.2	0.6
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	0.06
Titanium	ug/g	0.07	0.11	0.08
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	350	20	320
Lab Section 6 (SPTP)				
Moisture	%	74.63	78.76	77.89

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27168 **06/10/2018 RG_SC_NSC07M_20180610 *TISSUE***
27169 **06/10/2018 RG_SC_NSC07O_20180610 *TISSUE***
27170 **06/06/2018 RG_ER_NSC01M_20180606 *TISSUE***

Analyte	Units	27168	27169	27170
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<2	<2
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.06	<0.05	0.07
Barium	ug/g	0.06	0.14	0.14
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	<0.01
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	<0.01	0.03	<0.01
Copper	ug/g	0.64	2.5	0.58
Iron	ug/g	8	68	8
Lead	ug/g	0.03	0.02	0.04
Manganese	ug/g	0.2	1.1	0.5
Mercury	ug/g	2.1	0.12	1.2
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	<0.05	<0.05
Selenium	ug/g	1.6	5.8	4.0
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	<0.1	0.2	0.3
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	<0.05	<0.05	<0.05
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	16	130	18
Lab Section 6 (SPTP)				
Moisture	%	77.19	70.90	78.85

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

Minnow Environmental Inc.

27171 **06/06/2018 RG_ER_NSC01O_20180606 *TISSUE***
27172 **06/06/2018 RG_ER_NSC02M_20180606 *TISSUE***
27173 **06/06/2018 RG_ER_NSC02O_20180606 *TISSUE***

Analyte	Units	27171	27172	27173
Lab Section 2 (ICP)				
Aluminum	ug/g	2	<2	<5
Antimony	ug/g	<0.1	<0.1	<0.2
Arsenic	ug/g	0.13	0.06	0.2
Barium	ug/g	0.36	0.32	0.4
Beryllium	ug/g	<0.01	<0.01	<0.02
Boron	ug/g	<1	<1	<2
Cadmium	ug/g	0.02	<0.01	0.02
Chromium	ug/g	<0.5	<0.5	<1
Cobalt	ug/g	0.04	<0.01	0.02
Copper	ug/g	2.7	0.69	4.2
Iron	ug/g	140	13	130
Lead	ug/g	0.19	0.05	0.11
Manganese	ug/g	1.7	0.7	0.8
Mercury	ug/g	0.065	1.2	0.07
Molybdenum	ug/g	<0.1	<0.1	<0.2
Nickel	ug/g	<0.05	<0.05	<0.1
Selenium	ug/g	16	3.1	19
Silver	ug/g	<0.01	<0.01	<0.02
Strontium	ug/g	0.2	1.0	<0.2
Thallium	ug/g	0.06	<0.05	<0.1
Tin	ug/g	<0.05	<0.05	<0.1
Titanium	ug/g	0.06	0.07	<0.1
Uranium	ug/g	<0.005	<0.005	<0.01
Vanadium	ug/g	<0.1	<0.1	<0.2
Zinc	ug/g	310	20	520
Lab Section 6 (SPTP)				
Moisture	%	73.74	79.56	74.22

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27174 **06/07/2018 RG_ER_NSC03M_20180607 *TISSUE***
27175 **06/07/2018 RG_ER_NSC03O_20180607 *TISSUE***
27176 **06/07/2018 RG_ER_NSC04M_20180607 *TISSUE***

Analyte	Units	27174	27175	27176
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<20	<2
Antimony	ug/g	<0.1	<1	<0.1
Arsenic	ug/g	0.09	<0.5	0.05
Barium	ug/g	0.46	1.8	0.18
Beryllium	ug/g	<0.01	<0.1	<0.01
Boron	ug/g	<1	<10	<1
Cadmium	ug/g	<0.01	<0.1	<0.01
Chromium	ug/g	<0.5	<5	<0.5
Cobalt	ug/g	<0.01	<0.1	<0.01
Copper	ug/g	0.56	5.2	0.62
Iron	ug/g	10	190	7
Lead	ug/g	<0.01	0.3	0.02
Manganese	ug/g	0.8	2	0.4
Mercury	ug/g	1.1	0.08	1.6
Molybdenum	ug/g	<0.1	<1	<0.1
Nickel	ug/g	<0.05	<0.5	<0.05
Selenium	ug/g	2.5	17	4.8
Silver	ug/g	<0.01	<0.1	<0.01
Strontium	ug/g	1.1	<1	0.2
Thallium	ug/g	<0.05	<0.5	<0.05
Tin	ug/g	<0.05	<0.5	<0.05
Titanium	ug/g	0.06	<0.5	0.05
Uranium	ug/g	<0.005	<0.05	<0.005
Vanadium	ug/g	<0.1	<1	<0.1
Zinc	ug/g	20	670	18
Lab Section 6 (SPTP)				
Moisture	%	79.31	79.67	77.85

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

Minnow Environmental Inc.

27177 **06/07/2018 RG_ER_NSC04O_20180607 *TISSUE***
27178 **06/07/2018 RG_ER_NSC05M_20180607 *TISSUE***
27179 **06/07/2018 RG_ER_NSC05O_20180607 *TISSUE***

Analyte	Units	27177	27178	27179
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<2	4
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	0.12	0.07	0.06
Barium	ug/g	0.11	1.9	1.4
Beryllium	ug/g	<0.01	<0.01	<0.01
Boron	ug/g	<1	<1	<1
Cadmium	ug/g	<0.01	<0.01	0.02
Chromium	ug/g	<0.5	<0.5	<0.5
Cobalt	ug/g	0.04	<0.01	0.07
Copper	ug/g	2.8	0.72	4.3
Iron	ug/g	67	9	280
Lead	ug/g	0.01	0.02	0.08
Manganese	ug/g	1.3	0.5	1.6
Mercury	ug/g	0.11	0.91	0.18
Molybdenum	ug/g	<0.1	<0.1	<0.1
Nickel	ug/g	<0.05	0.11	0.05
Selenium	ug/g	24	2.5	26
Silver	ug/g	<0.01	<0.01	<0.01
Strontium	ug/g	0.2	0.2	0.9
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	<0.05	<0.05	<0.05
Titanium	ug/g	<0.05	0.06	0.14
Uranium	ug/g	<0.005	<0.005	<0.005
Vanadium	ug/g	<0.1	<0.1	<0.1
Zinc	ug/g	130	21	640
Lab Section 6 (SPTP)				
Moisture	%	67.68	80.22	82.36

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27180 **06/07/2018 RG_ER_NSC06M_20180607 *TISSUE***
27181 **06/07/2018 RG_ER_NSC06O_20180607 *TISSUE***
27182 **06/07/2018 RG_GC_NSC01M_20180607 *TISSUE***

Analyte	Units	27180	27181	27182
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<5	<2
Antimony	ug/g	<0.1	<0.2	<0.1
Arsenic	ug/g	0.10	0.2	0.07
Barium	ug/g	0.71	9.3	0.65
Beryllium	ug/g	<0.01	<0.02	<0.01
Boron	ug/g	<1	<2	<1
Cadmium	ug/g	<0.01	<0.02	<0.01
Chromium	ug/g	<0.5	<1	<0.5
Cobalt	ug/g	<0.01	0.03	<0.01
Copper	ug/g	0.76	3.4	0.65
Iron	ug/g	8	84	8
Lead	ug/g	0.01	0.04	<0.01
Manganese	ug/g	0.9	1.0	0.6
Mercury	ug/g	0.73	0.04	1.2
Molybdenum	ug/g	<0.1	<0.2	<0.1
Nickel	ug/g	<0.05	<0.1	<0.05
Selenium	ug/g	4.4	26	2.9
Silver	ug/g	<0.01	<0.02	<0.01
Strontium	ug/g	0.8	<0.2	0.3
Thallium	ug/g	<0.05	<0.1	<0.05
Tin	ug/g	<0.05	<0.1	<0.05
Titanium	ug/g	<0.05	<0.1	<0.05
Uranium	ug/g	<0.005	<0.01	<0.005
Vanadium	ug/g	<0.1	<0.2	<0.1
Zinc	ug/g	26	500	22
Lab Section 6 (SPTP)				
Moisture	%	78.93	71.15	78.92

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27183 **06/07/2018 RG_GC_NSC01O_20180607 *TISSUE***
27184 **06/07/2018 RG_GC_NSC02M_20180607 *TISSUE***
27185 **06/07/2018 RG_GC_NSC02O_20180607 *TISSUE***

Analyte	Units	27183	27184	27185
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<2	<5
Antimony	ug/g	<0.1	<0.1	<0.2
Arsenic	ug/g	0.10	0.11	0.2
Barium	ug/g	0.87	0.44	0.8
Beryllium	ug/g	<0.01	<0.01	<0.02
Boron	ug/g	<1	<1	<2
Cadmium	ug/g	<0.01	<0.01	<0.02
Chromium	ug/g	<0.5	<0.5	<1
Cobalt	ug/g	0.05	<0.01	0.03
Copper	ug/g	3.1	0.73	3.4
Iron	ug/g	130	8	150
Lead	ug/g	0.04	0.04	0.06
Manganese	ug/g	2.0	0.5	1.1
Mercury	ug/g	0.10	0.96	0.12
Molybdenum	ug/g	0.1	<0.1	<0.2
Nickel	ug/g	<0.05	<0.05	<0.1
Selenium	ug/g	13	2.7	19
Silver	ug/g	<0.01	<0.01	<0.02
Strontium	ug/g	0.1	0.5	<0.2
Thallium	ug/g	<0.05	<0.05	<0.1
Tin	ug/g	<0.05	<0.05	<0.1
Titanium	ug/g	<0.05	0.06	<0.1
Uranium	ug/g	<0.005	<0.005	<0.01
Vanadium	ug/g	<0.1	<0.1	<0.2
Zinc	ug/g	230	24	470
Lab Section 6 (SPTP)				
Moisture	%	75.18	78.85	76.94

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27186 **06/07/2018 RG_GC_NSC03M_20180607 *TISSUE***
27187 **06/07/2018 RG_GC_NSC03O_20180607 *TISSUE***
27188 **06/07/2018 RG_ER_WCT01M_20180607 *TISSUE***

Analyte	Units	27186	27187	27188
Lab Section 2 (ICP)				
Aluminum	ug/g	<2	<2	<200
Antimony	ug/g	<0.1	<0.1	<10
Arsenic	ug/g	0.07	0.07	<5
Barium	ug/g	2.1	0.25	14
Beryllium	ug/g	<0.01	<0.01	<1
Boron	ug/g	<1	<1	<100
Cadmium	ug/g	<0.01	<0.01	<1
Chromium	ug/g	<0.5	<0.5	<50
Cobalt	ug/g	<0.01	0.03	<1
Copper	ug/g	0.79	2.8	<5
Iron	ug/g	8	31	<200
Lead	ug/g	0.06	0.01	<1
Manganese	ug/g	0.3	1.9	<10
Mercury	ug/g	2.0	0.078	<0.5
Molybdenum	ug/g	<0.1	<0.1	<10
Nickel	ug/g	<0.05	<0.05	<5
Selenium	ug/g	1.7	3.6	8.6
Silver	ug/g	<0.01	<0.01	<1
Strontium	ug/g	0.2	0.2	<10
Thallium	ug/g	<0.05	<0.05	<5
Tin	ug/g	<0.05	<0.05	<5
Titanium	ug/g	0.06	<0.05	<5
Uranium	ug/g	<0.005	<0.005	<0.5
Vanadium	ug/g	<0.1	<0.1	<10
Zinc	ug/g	18	88	<50
Lab Section 6 (SPTP)				
Moisture	%	76.66	63.78	77.98

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27189 **06/11/2018 RG_TN_1_20180611 *TISSUE***
27190 **06/11/2018 RG_TN_2_20180611 *TISSUE***
27191 **06/11/2018 RG_TN_3_20180611 *TISSUE***

Analyte	Units	27189	27190	27191
Lab Section 2 (ICP)				
Aluminum	ug/g	6200	4700	6000
Antimony	ug/g	2	<1	<0.2
Arsenic	ug/g	7.0	4.0	5.3
Barium	ug/g	92	86	90
Beryllium	ug/g	0.2	0.2	0.25
Boron	ug/g	<10	<10	5
Cadmium	ug/g	1.8	1.3	1.6
Chromium	ug/g	6	5	6
Cobalt	ug/g	2.2	2.1	2.3
Copper	ug/g	11	11	13
Iron	ug/g	4600	4400	4600
Lead	ug/g	6.7	9.0	7.1
Manganese	ug/g	130	120	140
Mercury	ug/g	<0.05	<0.05	0.05
Molybdenum	ug/g	<1	<1	0.5
Nickel	ug/g	5.0	20	17
Selenium	ug/g	2.0	1.5	2.3
Silver	ug/g	<0.1	<0.1	0.04
Strontium	ug/g	150	160	160
Thallium	ug/g	<0.5	<0.5	0.1
Tin	ug/g	1.1	<0.5	1.3
Titanium	ug/g	64	60	59
Uranium	ug/g	0.61	0.97	0.48
Vanadium	ug/g	6	6	6.1
Zinc	ug/g	120	110	120
Lab Section 6 (SPTP)				
Moisture	%	99.78	99.90	99.73

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27192 **06/11/2018 RG_TN_4_20180611 *TISSUE***
27193 **06/11/2018 RG_TN_5_20180611 *TISSUE***
27194 **06/09/2018 RG_T4_2_20180609 *TISSUE***

Analyte	Units	27192	27193	27194
Lab Section 2 (ICP)				
Aluminum	ug/g	6200	3900	1500
Antimony	ug/g	<0.2	<1	<0.1
Arsenic	ug/g	4.7	4.3	5.0
Barium	ug/g	90	68	27
Beryllium	ug/g	0.26	0.2	0.08
Boron	ug/g	6	<10	2
Cadmium	ug/g	1.3	1.3	0.95
Chromium	ug/g	6	<5	1.3
Cobalt	ug/g	2.2	2.0	1.2
Copper	ug/g	12	12	8.9
Iron	ug/g	4600	3900	750
Lead	ug/g	7.7	6.2	2.0
Manganese	ug/g	140	130	106
Mercury	ug/g	0.04	<0.05	0.037
Molybdenum	ug/g	0.5	<1	0.3
Nickel	ug/g	4.8	4.2	3.0
Selenium	ug/g	2.0	1.7	2.2
Silver	ug/g	0.03	<0.1	0.03
Strontium	ug/g	160	140	32
Thallium	ug/g	0.1	<0.5	<0.05
Tin	ug/g	0.3	<0.5	0.37
Titanium	ug/g	59	47	14
Uranium	ug/g	0.55	0.62	0.090
Vanadium	ug/g	6.1	4	1.7
Zinc	ug/g	110	100	78
Lab Section 6 (SPTP)				
Moisture	%	99.79	99.83	97.90

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC Group # 2018-8318
Aug 16, 2018

Minnow Environmental Inc.

27195 **06/08/2018 RG_T4_3_20180608 *TISSUE***
27196 **06/09/2018 RG_T4_4_20180609 *TISSUE***
27197 **06/09/2018 RG_T4_5_20180609 *TISSUE***

Analyte	Units	27195	27196	27197
Lab Section 2 (ICP)				
Aluminum	ug/g	1200	1200	1300
Antimony	ug/g	<0.1	<0.1	<0.1
Arsenic	ug/g	6.0	6.0	6.0
Barium	ug/g	26	25	28
Beryllium	ug/g	0.06	0.08	0.08
Boron	ug/g	2	1	2
Cadmium	ug/g	0.94	0.97	0.96
Chromium	ug/g	1.4	1.0	1.0
Cobalt	ug/g	1.2	1.1	1.3
Copper	ug/g	9.5	9.0	8.5
Iron	ug/g	700	640	780
Lead	ug/g	6.6	1.7	1.6
Manganese	ug/g	104	107	114
Mercury	ug/g	0.039	0.037	0.039
Molybdenum	ug/g	0.4	0.3	0.3
Nickel	ug/g	2.0	1.6	2.0
Selenium	ug/g	2.7	2.5	2.7
Silver	ug/g	0.02	0.02	0.02
Strontium	ug/g	33	28	34
Thallium	ug/g	<0.05	<0.05	<0.05
Tin	ug/g	0.76	0.21	0.11
Titanium	ug/g	12	10	12
Uranium	ug/g	0.11	0.094	0.092
Vanadium	ug/g	1.4	1.4	1.5
Zinc	ug/g	100	86	85
Lab Section 6 (SPTP)				
Moisture	%	97.73	97.83	97.78

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 27195
This sample was reanalyzed for Lead. Reanalysis confirms original results are within the expected measurement uncertainty.

Results are reported on a dry basis.

SRC Group # 2018-8318

Aug 16, 2018

Minnow Environmental Inc.

27198 **06/09/2018 RG_T4_6_20180609 *TISSUE***

Analyte	Units	27198
Lab Section 2 (ICP)		
Aluminum	ug/g	1300
Antimony	ug/g	<0.1
Arsenic	ug/g	5.1
Barium	ug/g	26
Beryllium	ug/g	0.07
Boron	ug/g	1
Cadmium	ug/g	0.74
Chromium	ug/g	1.1
Cobalt	ug/g	1.1
Copper	ug/g	6.8
Iron	ug/g	840
Lead	ug/g	1.3
Manganese	ug/g	90
Mercury	ug/g	0.035
Molybdenum	ug/g	0.3
Nickel	ug/g	1.8
Selenium	ug/g	2.4
Silver	ug/g	0.02
Strontium	ug/g	37
Thallium	ug/g	<0.05
Tin	ug/g	0.10
Titanium	ug/g	12
Uranium	ug/g	0.082
Vanadium	ug/g	1.5
Zinc	ug/g	70
Lab Section 6 (SPTP)		
Moisture	%	97.53

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SASKATCHEWAN RESEARCH COUNCIL
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SRC Group # 2018-13833

Nov 19, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Nov-02-2018 Client P.O.: VPO00555477 Ref# 18-07

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

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* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  - * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  - * Environment Canada
  - * US EPA
  - * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SRC Group # 2018-13833
Nov 19, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Justin Wilson

Date Samples Received: Nov-02-2018

Client P.O.: VPO00555477 Ref# 18-07

45644 **10/10/2018 RG_T4-BIT_20181009-1555 *TISSUE***

Analyte	Units	45644
Lab Section 2 (ICP)		
Aluminum	ug/g	12100
Antimony	ug/g	<1
Arsenic	ug/g	9.3
Barium	ug/g	110
Beryllium	ug/g	0.4
Boron	ug/g	10
Cadmium	ug/g	1.1
Chromium	ug/g	16
Cobalt	ug/g	5.4
Copper	ug/g	22
Iron	ug/g	16300
Lead	ug/g	11
Manganese	ug/g	310
Mercury	ug/g	0.06
Molybdenum	ug/g	<1
Nickel	ug/g	13
Selenium	ug/g	4.7
Silver	ug/g	<0.1
Strontium	ug/g	130
Thallium	ug/g	<0.5
Tin	ug/g	<0.5
Titanium	ug/g	170
Uranium	ug/g	0.56
Vanadium	ug/g	19
Zinc	ug/g	94
Lab Section 6 (SPTP)		
Moisture	%	86.26

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

APPENDIX E
FISH

Table E.1: Hoop Net Records for Fish Caught in Koocanusa Reservoir, April 2018

Area	Station	Size	Location (11U, NAD83)		Set Date	Removal Date	Set Time	Removal Time	Fishing Hours (hrs)	Depth Range (m)		Effort (Fishing days)	Brook Trout			Bull Trout			Burbot			Largescale Sucker			Northern Pikeminnow			Peamouth Chub			Redside Shiner			Westslope Cutthroat Trout			Yellow Perch		
			Easting	Northing									Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE*	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}	Catch	Mortalities/ Sacrificed	CPUE ^{a}
Sand Creek	RG_SC_HN_01_20180424	medium	623775	5461216	24-Apr-18	25-Apr-18	12:23	9:30	21.1	1.3	1.5	0.880	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_HN_02_20180424	medium	625743	5458191	24-Apr-18	25-Apr-18	13:45	10:45	21.0	1.5	2.0	0.875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_HN_03_20180425	medium	625706	5457684	25-Apr-18	26-Apr-18	10:30	9:30	23.0	1.0	1.5	0.958	0	0	0	0	0	0	0	0	0	1	0	1.14	2	1	2.09	1	1	1.04	0	0	0	0	0	0	0	0	0
	RG_SC_HN_04_20180425	medium	625628	5457337	25-Apr-18	26-Apr-18	11:20	9:50	22.5	1.3	1.8	0.938	0	0	0	0	0	0	0	0	0	2	0	2.09	4	0	4.27	3	3	3.20	0	0	0	0	0	0	0	0	0
	RG_SC_HN_05_20180426	medium	625706	5457684	26-Apr-18	27-Apr-18	9:43	9:25	23.7	1.2	1.7	0.987	0	0	0	1	0	1.01	0	0	0	4	0	4.27	2	0	2.03	0	0	0	1	1	0.042	0	0	0	1	0	1
	RG_SC_HN_06_20180426	medium	625628	5457337	26-Apr-18	27-Apr-18	10:00	10:46	24.8	1.2	1.7	1.03	0	0	0	0	0	0	0	0	0	34	0	34.4	9	0	8.72	12	12	11.6	0	0	0	0	0	0	0	0	0
	RG_SC_HN_07_20180427	medium	625476	5458232	27-Apr-18	28-Apr-18	10:30	9:15	22.7	1.0	1.5	0.948	0	0	0	0	0	0	0	0	0	16	0	15.5	0	0	0	7	7	7.38	0	0	0	0	0	0	0	0	0
	RG_SC_HN_08_20180427	medium	625621	5457346	27-Apr-18	28-Apr-18	11:10	10:30	23.3	1.0	1.3	0.972	0	0	0	1	0	1.03	0	0	0	37	0	39.0	4	0	4.11	4	4	4.11	0	0	0	0	0	0	0	0	0
	RG_SC_HN_09_20180428	medium	625666	5458230	28-Apr-18	29-Apr-18	9:35	9:30	23.9	0.0	1.5	1.00	0	0	0	0	0	0	0	0	0	13	0	13.4	5	0	5.02	1	1	1.00	0	0	0	0	0	0	0	0	0
	RG_SC_HN_10_20180428	medium	625621	5457346	28-Apr-18	29-Apr-18	10:00	9:00	23.0	1.0	1.5	0.958	0	0	0	0	0	0	0	0	0	7	0	7.02	4	0	4.17	3	3	3.13	0	0	0	0	0	0	0	0	0
	Total								**208**	**-**	**-**	**9.55**	**0**	**0**	**0**	**2**	**0**	**0.210**	**0**	**0**	**0**	**114**	**0**	**11.9**	**30**	**1**	**3.14**	**31**	**31**	**3.25**	**1**	**1**	**0.105**	**0**	**0**	**0**	**1**	**0**	**0.105**
Elk River	RG_ER_HN_01_20180425	medium	627997	5447625	25-Apr-18	26-Apr-18	9:15	10:08	24.9	0.5	1.0	1.04	0	0	0	0	0	0	0	0	0	4	0	3.86	0	0	0	25	25	24.1	2	2	1.93	0	0	0	0	0	0
	RG_ER_HN_02_20180425	medium	628268	5448201	25-Apr-18	26-Apr-18	9:50	9:35	23.8	0.1	0.7	0.990	0	0	0	0	0	0	0	0	0	37	0	37.4	1	0	1.01	21	21	21.2	1	1	1.01	0	0	0	0	0	0
	RG_ER_HN_03_20180426	medium	628268	5448201	26-Apr-18	27-Apr-18	9:45	11:25	25.7	0.5	1.0	0.990	0	0	0	0	0	0	0	0	0	38	0	35.5	1	0	0.935	5	2	4.68	0	0	0	0	0	0	0	0	0
	RG_ER_HN_04_20180426	medium	627997	5447625	26-Apr-18	27-Apr-18	10:12	10:15	24.0	0.1	0.7	1.07	0	0	0	1	0	0.935	0	0	0	2	0	1.87	1	0	0.935	3	1	2.81	0	0	0	0	0	0	0	0	0
	RG_ER_HN_05_20180427	medium	628268	5448201	27-Apr-18	28-Apr-18	10:30	12:05	25.6	0.5	1.0	1.07	0	0	0	0	0	0	0	0	0	2	0	1.88	1	0	0.938	19	9	17.8	0	0	0	0	0	0	0	0	0
	RG_ER_HN_06_20180427	medium	627997	5447625	27-Apr-18	28-Apr-18	11:40	9:15	21.6	0.1	0.7	0.899	0	0	0	0	0	0	0	0	0	16	0	17.8	1	0	1.11	14	9	15.6	7	7	7.78	0	0	0	0	0	0
	RG_ER_HN_07_20180428	medium	627997	5447625	28-Apr-18	29-Apr-18	10:00	9:03	23.1	0.1	0.7	0.960	1	0	1.04	0	0	0	0	0	0	2	0	2.08	0	0	0	0	0	0	2	2	2.08	0	0	0	0	0	0
	RG_ER_HN_08_20180428	medium	628268	5448201	28-Apr-18	29-Apr-18	12:25	9:40	21.3	0.5	1.0	0.885	0	0	0	0	0	0	1	0	1.13	17	0	19.2	7	0	7.91	16	16	18.1	2	2	2.26	0	0	0	0	0	0
	RG_ER_HN_09_20180429	medium	628268	5448201	29-Apr-18	29-Apr-18	9:45	13:15	3.5	0.5	1.0	0.146	0	0	0	0	0	0	0	0	0	1	0	6.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total								**193.3**	**-**	**-**	**8.04**	**1**	**0**	**0.124**	**1**	**0**	**0.124**	**1**	**0**	**0.124**	**119**	**0**	**14.8**	**12**	**0**	**1.49**	**103**	**83**	**12.8**	**14**	**14**	**1.74**	**0**	**0**	**0**	**0**	**0**	**0**
Gold Creek	RG_GC_HN_01_20180424	medium	630804	5436413	24-Apr-18	25-Apr-18	12:45	9:45	21.0	1.0	1.0	0.875	0	0	0	1	0	1.14	0	0	0	11	0	13	2	0	2.29	0	0	0	0	0	0	6	0	6.86	1	0	1.14
	RG_GC_HN_02_20180424	medium	630920	5436384	24-Apr-18	25-Apr-18	13:18	11:48	22.5	1.4	1.6	0.938	0	0	0	0	0	0	1	0	1.07	1	0	1.07	4	0	4.27	0	0	0	0	0	0	0	0	0	8	8	8.53
	Total								**43.5**	**-**	**-**	**1.81**	**0**	**0**	**0**	**1**	**0**	**0.552**	**1**	**0**	**0.552**	**12**	**0**	**6.62**	**6**	**0**	**3.31**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**3.31**	**9**	**8**	**4.97**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the hoop net sets in one area.

Table E.2: **Gill Netting Catch Record and Catch-Per-Unit-Effort (CPUE) Data for Fish Sampling Conducted in April 2018**

Area	Station ID	Location (11U, NAD83)		Length (m)	Mesh (inches)	Depth Range (m)		Set Date	Removal Date	Set Time	Removal Time	Time (hours)	Effort (m*hours/ 100 m)	Bull Trout			Kokanee			Largescale Sucker			Mountain Whitefish			Northern Pikeminnow			Peamouth Chub			Rainbow Trout			Redside Shiner			Westslope Cutthroat Trout			Yellow Perch		
		Easting	Northing											Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]
Sand Creek	RG_SC_GN_01_20180424	625656	5458178	15.2	2	1.5	2.0	24-Apr-18	24-Apr-18	14:20	14:35	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	2	0	52.5	7	6	184	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_02_20180424	625656	5458178	15.2	2	1.5	2.0	24-Apr-18	24-Apr-18	14:45	15:00	0.250	0.0381	0	0	0	0	0	0	1	0	26.2	0	0	0	2	0	52.5	4	4	105	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_03_20180424	625682	5458216	22.9	1	0.5	1.0	24-Apr-18	24-Apr-18	15:40	15:55	0.250	0.0571	0	0	0	0	0	0	1	0	17.5	0	0	0	2	0	35.0	0	0	0	0	0	0	10	10	175	0	0	0	0	0	0
	RG_SC_GN_04_20180424	625685	5458175	15.2	2	0.5	1.5	24-Apr-18	24-Apr-18	15:45	16:00	0.250	0.0381	0	0	0	0	0	0	1	0	26.2	0	0	0	0	0	0	5	5	131	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_05_20180424	625696	5458147	15.2	2	1.0	2.0	24-Apr-18	24-Apr-18	16:15	16:30	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	105	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_06_20180424	625708	5458166	22.9	1	1.5	2.0	24-Apr-18	24-Apr-18	16:20	16:35	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_07_20180425	625678	5458207	15.2	1	0.8	1.0	25-Apr-18	25-Apr-18	11:35	11:50	0.250	0.0381	0	0	0	0	0	0	1	0	26.2	0	0	0	3	0	78.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_08_20180425	625690	5458173	22.9	2	1.0	1.5	25-Apr-18	25-Apr-18	11:40	11:55	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	35.0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_09_20180425	625642	5457311	15.2	2	1.3	2.0	25-Apr-18	25-Apr-18	12:30	12:45	0.250	0.0381	0	0	0	0	0	0	2	0	52.5	0	0	0	0	0	0	18	18	472	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_10_20180425	625642	5457311	22.9	1	1.0	1.2	25-Apr-18	25-Apr-18	12:40	12:55	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_11_20180425	625642	5457311	15.2	2	1.0	1.4	25-Apr-18	25-Apr-18	12:55	13:10	0.250	0.0381	2	0	52.5	2	0	52.5	2	0	52.5	0	0	0	1	0	26.2	4	2	105	2	0	52.5	0	0	0	0	0	0	0	0	0
	RG_SC_GN_12_20180425	625640	5457309	22.9	1	1.0	1.2	25-Apr-18	25-Apr-18	13:00	13:20	0.333	0.0762	1	0	13	0	0	0	0	0	0	0	0	0	2	0	26.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_13_20180425	625642	5457302	15.2	2	1.2	1.8	25-Apr-18	25-Apr-18	13:40	14:00	0.333	0.0508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	98.4	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_14_20180425	625649	5457301	15.2	2	1.0	1.4	25-Apr-18	25-Apr-18	14:00	14:15	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_15_20180425	625618	5457343	15.2	2	1.5	2.0	25-Apr-18	25-Apr-18	14:15	14:35	0.333	0.0508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_16_20180425	625618	5457343	15.2	2	1.5	2.0	25-Apr-18	25-Apr-18	14:35	14:55	0.333	0.0508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_17_20180426	625642	5457302	15.2	2	0.5	1.5	26-Apr-18	26-Apr-18	10:10	10:25	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	52.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_18_20180426	625498	5457218	22.9	1	0.5	0.8	26-Apr-18	26-Apr-18	10:15	10:30	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	4	0	70.0	1	1	17.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_19_20180426	625255	5457944	22.9	1	0.5	1.0	26-Apr-18	26-Apr-18	11:15	11:30	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	17.5	0	0	0	2	2	35.0	0	0	0	0	0	0
	RG_SC_GN_20_20180426	625553	5458050	15.2	2	1.2	1.7	26-Apr-18	26-Apr-18	11:25	11:40	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	26.2	0	0	0	1	1	26.2	0	0	0	0	0	0
	RG_SC_GN_21_20180426	625255	5457944	22.9	1	0.5	1.0	26-Apr-18	26-Apr-18	12:00	12:20	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_22_20180426	625553	5458050	15.2	2	1.2	1.7	26-Apr-18	26-Apr-18	11:45	12:00	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	1	0	26.2	0	0	0	0	0	0	1	1	26.2	0	0	0	0	0	0
	RG_SC_GN_23_20180426	625263	5457898	22.9	1	0.5	1.2	26-Apr-18	26-Apr-18	12:40	12:55	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	17.5	0	0	0	0	0	0
	RG_SC_GN_24_20180426	625366	5458018	15.2	2	0.5	1.0	26-Apr-18	26-Apr-18	12:55	13:10	0.250	0.0381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	26.2	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_25_20180426	625341	5458030	22.9	1	0.5	1.0	26-Apr-18	26-Apr-18	13:00	13:15	0.250	0.0571	0	0	0	0	0	0	1	0	17.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_26_20180426	625646	5457319	22.9	1	1.0	1.2	26-Apr-18	26-Apr-18	13:30	13:45	0.250	0.0571	1	0	17.5	2	0	35.0	1	0	17.5	0	0	0	0	0	0	1	1	17.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_27_20180427	625619	5457347	15.2	2	1.5	1.7	27-Apr-18	27-Apr-18	11:15	11:30	0.250	0.0381	0	0	0	0	0	0	1	0	26.2	0	0	0	0	0	0	0	0	0	2	2	52.5	0	0	0	0	0	0	0	0	0
	RG_SC_GN_28_20180427	625475	5458205	15.2	2	0.5	1.0	27-Apr-18	27-Apr-18	11:50	12:05	0.250	0.0381	0	0	0	0	0	0	5	0	131	1	1	26	6	0	157	7	7	184	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_29_20180427	625476	5458197	22.9	1	0.5	0.8	27-Apr-18	27-Apr-18	11:55	12:15	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_30_20180427	625706	5457684	22.9	1	0.5	1.2	27-Apr-18	27-Apr-18	15:00	15:15	0.250	0.0571	0	0	0	0	0	0	3	0	52.5	0	0	0	0	0	0	2	0	35.0	0	0	0	2	2	35.0	0	0	0	0	0	0
	RG_SC_GN_31_20180427	625649	5457351	22.9	1	0.5	1.5	27-Apr-18	27-Apr-18	15:40	15:55	0.250	0.0571	0	0	0	0	0	0	3	0	52.5	0	0	0	1	0	17.5	1	0	17.5	0	0	0	3	3	52.5	0	0	0	0	0	0
	RG_SC_GN_32_20180428	625464	5458223	22.9	1	1.2	1.5	28-Apr-18	28-Apr-18	9:30	9:45	0.250	0.0571	0	0	0	0	0	0	1	0	17.5	0	0	0	0	0	0	1	0	17.5	0	0	0	1	1	17.5	0	0	0	0	0	0
	RG_SC_GN_33_20180428	625487	5458198	22.9	1	1.0	1.5	28-Apr-18	28-Apr-18	9:35	9:50	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	17.5	0	0	0	0	0	0
	RG_SC_GN_34_20180428	625686	5458247	22.9	1	0.0	1.0	28-Apr-18	28-Apr-18	10:05	10:20	0.250	0.0571	0	0	0	0	0	0	2	0	35.0	0	0	0	3	0	52.5	1	1	17.5	0	0	0	7	7	122	0	0	0	0	0	0
	RG_SC_GN_35_20180428	625686	5458247	22.9	1	0.0	1.0	28-Apr-18	28-Apr-18	10:10	10:25	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	2	0	35.0	0	0	0	0	0	0	3	3	52.5	0	0	0	0	0	0
	RG_SC_GN_36_20180428	625686	5458247	22.9	1	0.0	1.0	28-Apr-18	28-Apr-18	10:15	10:30	0.250	0.0571	0	0	0	0	0	0	2	0	35.0	0	0	0	2	0	35.0	3	0	52.5	0	0	0	5	5	87.5	0	0	0	0	0	0
	RG_SC_GN_37_20180428	625680	5458260	22.9	1	0.5	1.2	28-Apr-18	28-Apr-18	12:00	12:22	0.367	0.0838	0	0	0	0	0	0	10	0	119	0	0	0	8	0	95.4	4	3	47.7	0	0	0	9	9	107	0	0	0	0	0	0
	RG_SC_GN_38_20180428	625279	5457941	22.9	1	1.0	1.2	28-Apr-18	28-Apr-18	13:30	13:50	0.333	0.0762	0	0	0	0	0	0	6	0	78.7	0	0	0	3	0	39.4	4	0	52.5	0	0	0	11	11	144	0	0	0	0	0	0
	RG_SC_GN_39_20180428	625302	5457948	45.7	1	1.0	1.4	28-Apr-18	28-Apr-18	14:20	14:40	0.333	0.152	1	0	6.56	0	0	0	1	0	6.56	0	0	0	0	0	0	1	0	6.56	0	0	0	3	3	19.7	0	0	0	0	0	0
	RG_SC_GN_40_20180429	625668	5458208	68.6	1	0.5	1.2	29-Apr-18	29-Apr-18	9:40	10:00	0.333	0.229	0	0	0	0	0	0	8	0	35.0	0	0	0	11	0	48.1	5	5	21.9	0	0	0	15	15	65.6	0	0	0	0	0	0
	RG_SC_GN_41_20180429	625667	5458214	15.2	2	1.2	1.5	29-Apr-18	29-Apr-18	9:50	10:05	0.250	0.0381	0	0	0	0	0	0	2	0	52.5	0	0	0	0	0	0	6	6	157	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_42_20180429	625667	5458214	15.2	2	1.0	1.5	29-Apr-18	29-Apr-18	10:15	10:30	0.250	0.0381	0	0	0	0	0	0	3	3	78.7	0	0	0	2	0	52.5	1	1	26.2	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_43_20180429	625662	5458246	68.6	1	1.0	1.5	29-Apr-18	29-Apr-18	11:10	11:30	0.333	0.229	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_44_20180429	625663	5458244	15.2	2	1.5	2.0	29-Apr-18	29-Apr-18	11:15	11:30	0.250	0.0381	0	0	0	0	0	0	14	0	367	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_45_20180429	625302	5457948	68.6	1	1.0	1.2	29-Apr-18	29-Apr-18	13:00	13:20	0.333	0.229	0	0	0	0	0	0	2	0	8.75	0	0	0	0	0	0	4	3	17.5	0	0	0	7	7	30.6	0	0	0	0	0	0
	RG_SC_GN_46_20180429	625548	5458144	15.2	2	1.5	2.0	29-Apr-18	29-Apr-18	13:05	13:25	0.333	0.0508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_47_20180429	625292	5457949	68.6	1	1.0	1.5	29-Apr-18	29-Apr-18	14:00	14:20	0.333	0.229	0	0	0	0	0	0	2	0	8.75	0	0	0	1	0	4.37	1	1	4.37	0	0	0	2	2	8.75	0	0	0	0	0	0
	RG_SC_GN_48_20180429	625295	5457951	15.2	2	1.5	2.0	29-Apr-18	29-Apr-18	14:05	14:25	0.333	0.0508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_49_20180429	625657	5457346	68.6	1	0.5	1.2	29-Apr-18	29-Apr-18	15:00	15:30	0.500	0.343	0	0	0	0	0	0	4	0	11.7	0	0	0	6	0	17.5	2	2	5.83	0	0	0	15	15	43.7	0	0	0	0	0	0
	RG_SC_GN_50_20180429	625658	5457344	15.2	2	1.0	1.5	29-Apr-18	29-Apr-18	15:05	15:35	0.500	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	4	0	52.5	1	1	13.1	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_GN_51_20180430	625646	5457350	30.5	2	1.5	2.0	30-Apr-18	30-Apr-18	9:30	9:52	0.367	0.112	0	0	0	0	0	0	5	0	45	0	0	0	3	0	27	6	6	54	0	0	0	0	0	0	0	0	0	1	1	9
	RG_SC_GN_52_20180430	625646	5457350	30.5	2	1.5	2.0	30-Apr-18	30-Apr-18	10:15	10:35	0.333	0.102	1	0	9.84	0	0	0	0	0	0	0	0	0	2	0	19.7	5	5	49.2	0	0	0	0	0	0	0	0	0	0	0	0
											Total	**15.0**	**3.90**	**6**	**0**	**1.54**	**4**	**0**	**1.02**	**84**	**3**	**21.5**	**1**	**1**	**0.256**	**71**	**0**	**18.2**	**111**	**94**	**28.4**	**4**	**2**	**1.02**	**99**	**99**	**25.4**	**0**	**0**	**0**	**1**	**1**	**0.256**

Table E.2: Gill Netting Catch Record and Catch-Per-Unit-Effort (CPUE) Data for Fish Sampling Conducted in April 2018

Area	Station ID	Location (11U, NAD83)		Length (m)	Mesh (inches)	Depth Range (m)		Set Date	Removal Date	Set Time	Removal Time	Time (hours)	Effort (m*hours/ 100 m)	Bull Trout			Kokanee			Largescale Sucker			Mountain Whitefish			Northern Pikeminnow			Peamouth Chub			Rainbow Trout			Redside Shiner			Westslope Cutthroat Trout			Yellow Perch		
		Easting	Northing											Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE[a]
Elk River	RG_ER_GN_01_20180425	628097	5447705	22.9	2	0.5	2.3	25-Apr-18	25-Apr-18	10:15	10:30	0.250	0.0571	0	0	0	0	0	0	5	0	87.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_02_20180425	628002	5447599	22.9	1	0.2	1.0	25-Apr-18	25-Apr-18	10:27	10:45	0.300	0.0686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	14.6	0	0	0	0	0	0
	RG_ER_GN_03a_20180425	628092	5447738	22.9	2	0.5	2.2	25-Apr-18	25-Apr-18	10:37	11:10	0.550	0.126	0	0	0	0	0	0	2	0	15.9	0	0	0	0	0	0	2	2	15.9	0	0	0	0	0	0	1	0	7.95	0	0	0
	RG_ER_GN_03b_20180425			22.9				25-Apr-18	25-Apr-18	11:15	11:35	0.333	0.0762	0	0	0	0	0	0	1	0	13.1	0	0	0	2	0	26.2	4	4	52.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_03c_20180425			22.9				25-Apr-18	25-Apr-18	11:35	12:00	0.417	0.0952	0	0	0	0	0	0	1	0	10.5	1	0	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_04a_20180425	627994	5447591	22.9	1	0.2	0.9	25-Apr-18	25-Apr-18	10:52	11:15	0.383	0.0876	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	57.1	0	0	0	0	0	0
	RG_ER_GN_04b_20180425			22.9				25-Apr-18	25-Apr-18	11:24	11:55	0.517	0.118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	50.8	0	0	0	2	2	16.9	0	0	0	0	0	0
	RG_ER_GN_05_20180425	628325	5448260	22.9	2	1.2	0.8	25-Apr-18	25-Apr-18	13:18	13:35	0.283	0.0648	0	0	0	0	0	0	1	0	15.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_06a_20180425	628231	5448177	22.9	1	0.5	1.2	25-Apr-18	25-Apr-18	13:23	13:35	0.200	0.0457	0	0	0	0	0	0	1	0	21.9	1	0	21.9	0	0	0	0	0	0	0	0	0	5	5	109	0	0	0	0	0	0
	RG_ER_GN_06b_20180425			22.9				25-Apr-18	25-Apr-18	13:52	14:13	0.350	0.0800	0	0	0	0	0	0	0	0	0	0	0	0	1	0	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_06c_20180425			22.9				25-Apr-18	25-Apr-18	14:19	16:45	2.43	0.556	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1.80	0	0	0	0	0	0
	RG_ER_GN_07_20180425	628314	5448248	22.9	2	0.5	0.5	25-Apr-18	25-Apr-18	13:40	13:55	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_08_20180425	628636	5448484	22.9	2	0.9	1.5	25-Apr-18	25-Apr-18	14:10	14:30	0.333	0.0762	0	0	0	0	0	0	2	0	26.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_09_20180425	627996	5447709	22.9	1	1.1	1.6	25-Apr-18	25-Apr-18	14:45	15:00	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	52.5	0	0	0	9	9	157	0	0	0	0	0	0
	RG_ER_GN_10_20180425	628121	5447376	22.9	2	0.8	2.0	25-Apr-18	25-Apr-18	14:55	15:10	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_11_20180426	627914	5447150	22.9	1	0.4	0.6	26-Apr-18	26-Apr-18	10:45	11:00	0.250	0.0572	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	87.5	0	0	0	4	4	70.0	0	0	0	0	0	0
	RG_ER_GN_12_20180426	627997	5447625	22.9	1	0.6	0.8	26-Apr-18	26-Apr-18	11:13	11:35	0.367	0.0838	0	0	0	0	0	0	0	0	0	1	0	11.9	0	0	0	0	0	0	0	0	0	1	1	11.9	0	0	0	0	0	0
	RG_ER_GN_13_20180426	627905	5447460	22.9	1	0.4	0.6	26-Apr-18	26-Apr-18	11:40	11:58	0.300	0.0686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	58.3	0	0	0	0	0	0
	RG_ER_GN_14_20180426	627975	5447566	22.9	1	0.2	1.0	26-Apr-18	26-Apr-18	12:03	12:23	0.333	0.0762	0	0	0	0	0	0	1	0	13.1	0	0	0	1	0	13.1	2	0	26.2	0	0	0	2	2	26.2	0	0	0	0	0	0
	RG_ER_GN_15_20180426	627975	5447566	22.9	1	0.2	1.0	26-Apr-18	26-Apr-18	12:28	12:48	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	1	0	13.1	3	3	39.4	0	0	0	2	2	26.2	0	0	0	0	0	0
	RG_ER_GN_16_20180426	627975	5447566	22.9	1	0.2	1.0	26-Apr-18	26-Apr-18	12:56	13:10	0.233	0.0533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	75.0	0	0	0	3	3	56.2	0	0	0	0	0	0
	RG_ER_GN_17_20180426	627975	5447566	22.9	1	0.2	1.0	26-Apr-18	26-Apr-18	13:15	13:30	0.250	0.0571	0	0	0	0	0	0	1	0	17.5	0	0	0	0	0	0	1	0	17.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_18_20180427	628299	5448226	22.9	1	1.0	1.0	27-Apr-18	27-Apr-18	11:45	12:00	0.250	0.0571	0	0	0	0	0	0	2	0	35.0	0	0	0	0	0	0	3	2	52.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_19_20180427	628299	5448226	22.9	1	1.0	1.0	27-Apr-18	27-Apr-18	12:15	12:45	0.500	0.114	0	0	0	0	0	0	1	0	8.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_20_20180427	628299	5448226	22.9	1	1.0	1.0	27-Apr-18	27-Apr-18	12:55	13:10	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_21_20180427	627989	5447672	22.9	1	0.5	1.5	27-Apr-18	27-Apr-18	14:20	14:40	0.333	0.0762	0	0	0	0	0	0	1	0	13.1	0	0	0	0	0	0	0	0	0	0	0	0	5	5	65.6	0	0	0	0	0	0
	RG_ER_GN_22_20180427	627950	5447580	22.9	1	0.8	1.0	27-Apr-18	27-Apr-18	15:30	15:48	0.300	0.0686	0	0	0	0	0	0	3	0	43.7	0	0	0	1	0	14.6	3	0	43.7	0	0	0	3	3	43.7	0	0	0	0	0	0
	RG_ER_GN_23_20180427	627950	5447580	22.9	1	1.0	1.0	27-Apr-18	27-Apr-18	15:55	16:25	0.500	0.114	0	0	0	0	0	0	4	0	35.0	0	0	0	0	0	0	6	0	52.5	0	0	0	1	1	8.75	0	0	0	0	0	0
	RG_ER_GN_24_20180428	628291	5448202	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	9:05	9:23	0.300	0.0686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	14.6	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_25_20180428	628291	5448702	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	9:25	9:45	0.333	0.0762	0	0	0	1	0	13.1	1	0	13.1	1	0	13.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_26_20180428	628271	5448196	22.9	1	1.0	1.0	28-Apr-18	28-Apr-18	9:30	10:00	0.500	0.114	0	0	0	0	0	0	2	0	17.5	0	0	0	0	0	0	1	0	8.75	0	0	0	1	1	8.75	0	0	0	0	0	0
	RG_ER_GN_27_20180428	628291	5448702	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	10:10	10:35	0.417	0.0952	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	1	1	10.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_28_20180428	628246	5448175	22.9	1	1.0	1.0	28-Apr-18	28-Apr-18	10:20	10:45	0.417	0.0952	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_29_20180428	628291	5448702	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	10:40	11:05	0.417	0.0952	0	0	0	0	0	0	1	0	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_30_20180428	628246	5448175	22.9	1	1.0	1.0	28-Apr-18	28-Apr-18	10:55	11:20	0.417	0.0952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_31_20180428	627947	5447561	22.9	1	1.0	1.0	28-Apr-18	28-Apr-18	12:00	12:25	0.417	0.0952	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	2	1	21.0	0	0	0	14	14	147	0	0	0	0	0	0
	RG_ER_GN_32_20180428	627947	5447561	22.9	1	1.0	1.0	28-Apr-18	28-Apr-18	12:35	13:00	0.417	0.0952	0	0	0	0	0	0	1	0	10.5	0	0	0	1	0	10.5	1	0	10.5	0	0	0	3	3	31.5	0	0	0	0	0	0
	RG_ER_GN_33_20180428	627978	5447571	22.9	2	1.0	1.5	28-Apr-18	28-Apr-18	12:45	13:05	0.333	0.0762	0	0	0	0	0	0	1	0	13.1	1	0	13.1	0	0	0	1	1	13.1	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_34_20180428	627947	5447561	22.9	1	1.0	1.5	28-Apr-18	28-Apr-18	13:15	13:40	0.417	0.0952	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	1	0	10.5	0	0	0	2	2	21.0	0	0	0	0	0	0
	RG_ER_GN_35_20180428	627978	5447571	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	13:20	13:43	0.383	0.0876	0	0	0	0	0	0	8	0	91.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_36_20180428	627947	5447561	22.9	1	1.0	1.5	28-Apr-18	28-Apr-18	13:45	14:10	0.417	0.0953	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	31.5	0	0	0	0	0	0
	RG_ER_GN_37_20180428	627978	5447571	22.9	2	1.0	1.0	28-Apr-18	28-Apr-18	14:06	14:30	0.400	0.0914	0	0	0	0	0	0	2	0	21.9	0	0	0	0	0	0	1	1	10.9	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_38_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	9:55	10:10	0.250	0.0571	0	0	0	1	0	17.5	0	0	0	0	0	0	1	0	17.5	1	0	17.5	0	0	0	6	6	105	0	0	0	0	0	0
	RG_ER_GN_39_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	10:00	10:30	0.500	0.114	1	0	8.75	0	0	0	27	0	236	0	0	0	1	0	8.75	3	3	26.2	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_40_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	10:30	11:00	0.500	0.114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	61.2	0	0	0	0	0	0
	RG_ER_GN_41_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	11:10	11:45	0.583	0.133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_42_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	11:40	12:15	0.583	0.133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	7.50	0	0	0	4	4	30.0	0	0	0	0	0	0
	RG_ER_GN_43_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	11:45	12:20	0.583	0.133	0	0	0	0	0	0	4	0	30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_44_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	12:40	13:00	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	26.2	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_45_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	12:45	13:05	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	13.1	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_46_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	13:05	13:45	0.667	0.152	0	0	0	0	0	0	3	0	19.7	1	0	6.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_47_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	13:10	13:40	0.500	0.114	0	0	0	0	0	0	2	0	17.5	0	0	0	0	0	0	3	3	26.2	0	0	0	4	4	35.0	0	0	0	0	0	0
	RG_ER_GN_48_20180429	627945	5447545	22.9	1	1.0	1.0	29-Apr-18	29-Apr-18	13:25	14:00	0.583	0.133	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7.50	0	0	0	0	0	0	2	2	15.0	0	0	0	0	0	0
	RG_ER_GN_49_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	13:45	14:05	0.333	0.0762	0	0	0	0	0	0	2	0	26.2	0	0	0	0	0	0	2	2	26.2	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_50_20180429	627945	5447569	22.9	1	1.2	1.2	29-Apr-18	29-Apr-18	13:40	14:05	0.417	0.0952	0	0	0	0	0	0	2	0	21.0	0	0	0	0	0	0	1	1	10.5	0	0	0	1	1	10.5	0	0	0	0	0	0
	RG_ER_GN_51_20180429	627945	5447545	22.9	1	1.0	1.0	29-Apr-18	29-Apr-18	14:00	14:30	0.500	0.114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	17.5	0	0	0	1	1	8.75	0	0	0	0	0	0

Table E.2: Gill Netting Catch Record and Catch-Per-Unit-Effort (CPUE) Data for Fish Sampling Conducted in April 2018

Area	Station ID	Location (11U, NAD83)		Length (m)	Mesh (inches)	Depth Range (m)		Set Date	Removal Date	Set Time	Removal Time	Time (hours)	Effort (m*hours/ 100 m)	Bull Trout			Kokanee			Largescale Sucker			Mountain Whitefish			Northern Pikeminnow			Peamouth Chub			Rainbow Trout			Redside Shiner			Westslope Cutthroat Trout			Yellow Perch		
		Easting	Northing											Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]
Elk River	RG_ER_GN_52_20180429	627949	5447559	22.9	2	1.0	1.0	29-Apr-18	29-Apr-18	14:05	14:40	0.583	0.133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	15.0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_53_20180430	627945	5447569	22.9	1	1.2	1.2	30-Apr-18	30-Apr-18	14:05	14:45	0.667	0.152	0	0	0	0	0	0	2	0	13.1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6.56	0	0	0	0	0	0
	RG_ER_GN_54_20180430	627941	5447551	15.2	2	1.0	1.0	30-Apr-18	30-Apr-18	10:30	11:00	0.500	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_55_20180430	627951	5447557	22.9	2	1.0	1.0	30-Apr-18	30-Apr-18	10:35	11:05	0.500	0.114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_56_20180430	627941	5447551	15.2	2	1.0	1.0	30-Apr-18	30-Apr-18	11:05	11:45	0.667	0.101	0	0	0	0	0	0	2	0	19.7	0	0	0	0	0	0	1	1	9.9	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_57_20180430	627951	5447557	22.9	2	1.0	1.0	30-Apr-18	30-Apr-18	11:10	11:50	0.667	0.152	0	0	0	0	0	0	2	0	13.1	0	0	0	0	0	0	2	2	13.1	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_58_20180430	627941	5447551	15.2	2	1.0	1.0	30-Apr-18	30-Apr-18	11:55	12:35	0.667	0.101	0	0	0	0	0	0	1	0	9.87	0	0	0	0	0	0	2	2	19.7	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_59_20180430	627951	5447557	22.9	2	1.0	1.0	30-Apr-18	30-Apr-18	12:10	12:45	0.583	0.133	0	0	0	0	0	0	2	0	15.0	0	0	0	0	0	0	1	1	7.50	0	0	0	0	0	0	1	0	7.50	0	0	0
	RG_ER_GN_60_20180430	627941	5447551	15.2	2	1.0	1.0	30-Apr-18	30-Apr-18	13:15	13:55	0.667	0.101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_GN_61_20180430	627951	5447557	22.9	2	1.0	1.0	30-Apr-18	30-Apr-18	13:25	14:05	0.667	0.152	0	0	0	0	0	0	2	0	13.1	0	0	0	0	0	0	4	4	26.2	0	0	0	0	0	0	0	0	0	0	0	0
											Total	**29.7**	**6.60**	**1**	**0**	**0.151**	**2**	**0**	**0.303**	**103**	**0**	**15.6**	**6**	**0**	**0.909**	**10**	**0**	**1.51**	**79**	**43**	**12.0**	**0**	**0**	**0**	**97**	**95**	**14.7**	**2**	**0**	**0.303**	**0**	**0**	**0**
Gold Creek	RG_GC_GN_01_20180424	630930	5436332	22.9	1	1.8	2.0	24-Apr-18	24-Apr-18	13:39	13:50	0.183	0.0419	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	23.9	0	0	0	1	1	23.9	0	0	0	0	0	0
	RG_GC_GN_02_20180424	630392	5436392	22.9	1	1.4	2.3	24-Apr-18	24-Apr-18	14:05	14:29	0.400	0.0914	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	10.9	0	0	0	0	0	0
	RG_GC_GN_03_20180424	630820	5436416	22.9	1	1.0	1.0	24-Apr-18	24-Apr-18	14:38	15:02	0.400	0.0914	0	0	0	0	0	0	2	0	21.9	0	0	0	0	0	0	0	0	0	0	0	0	2	2	21.9	0	0	0	0	0	0
	RG_GC_GN_04_20180425	630816	5436404	22.9	1	1.0	1.0	25-Apr-18	25-Apr-18	12:16	12:39	0.383	0.0876	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_05_20180425	630841	5436362	15.2	2	1.0	1.0	25-Apr-18	25-Apr-18	12:22	13:01	0.650	0.0991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	30.3	0	0	0	0	0	0	1	0	10.1	0	0	0
	RG_GC_GN_06_20180425	630828	5436368	22.9	1	1.0	1.0	25-Apr-18	25-Apr-18	12:41	13:16	0.583	0.133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	15.0	0	0	0	0	0	0
	RG_GC_GN_07_20180425	630838	5436402	15.2	2	1.0	1.0	25-Apr-18	25-Apr-18	13:05	13:24	0.317	0.0483	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_08_20180425	630844	5436312	22.9	1	1.0	1.0	25-Apr-18	25-Apr-18	13:21	13:48	0.450	0.103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_09_20180425	630839	5436403	22.9	1	1.0	1.0	25-Apr-18	25-Apr-18	14:05	14:20	0.250	0.0571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	17.5	0	0	0	0	0	0
	RG_GC_GN_10_20180425	630908	5436382	15.2	2	1.0	1.0	25-Apr-18	25-Apr-18	14:08	14:30	0.367	0.0559	0	0	0	0	0	0	0	0	0	0	0	0	2	0	35.8	5	5	89.5	0	0	0	0	0	0	1	0	17.9	0	0	0
	RG_GC_GN_11_20180426	630970	5436354	22.9	1	1.0	2.8	26-Apr-18	26-Apr-18	9:02	9:20	0.300	0.0686	0	0	0	0	0	0	0	0	0	0	0	0	1	0	14.6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	14.6
	RG_GC_GN_12_20180426	630822	5436416	15.2	2	0.7	0.9	26-Apr-18	26-Apr-18	9:06	9:30	0.400	0.0610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_13a_20180426	630865	5436351	61.0	2	0.8	1.4	26-Apr-18	26-Apr-18	10:24	10:40	0.267	0.163	0	0	0	0	0	0	3	0	18.5	0	0	0	0	0	0	2	2	12.3	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_13b_20180426			61.0				26-Apr-18	26-Apr-18	10:50	11:05	0.250	0.152	0	0	0	0	0	0	3	0	19.7	0	0	0	0	0	0	19	19	125	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_13c_20180426			61.0				26-Apr-18	26-Apr-18	11:40	12:05	0.417	0.254	0	0	0	0	0	0	8	0	31.5	0	0	0	8	0	31.5	57	57	224	0	0	0	0	0	0	2	0	7.87	0	0	0
	RG_GC_GN_14_20180426	630867	5436467	22.6	1	0.9	1.2	26-Apr-18	26-Apr-18	10:36	11:00	0.400	0.0902	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	22.2	0	0	0	3	3	33.2	0	0	0	1	0	11.1
	RG_GC_GN_15_20180426	630810	5436325	22.9	1	0.5	0.8	26-Apr-18	26-Apr-18	11:30	11:55	0.417	0.0953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	10.5	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_16a_20180426	630864	5436345	22.9	1	1.1	1.2	26-Apr-18	26-Apr-18	13:08	13:25	0.283	0.0648	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	30.9	0	0	0	0	0	0
	RG_GC_GN_16b_20180426			22.9				26-Apr-18	26-Apr-18	13:34	13:50	0.267	0.0610	0	0	0	0	0	0	2	0	32.8	0	0	0	0	0	0	0	0	0	0	0	0	1	1	16.4	0	0	0	0	0	0
	RG_GC_GN_17_20180426	630846	5436426	15.2	1	0.3	1.1	26-Apr-18	26-Apr-18	13:18	13:45	0.450	0.0686	0	0	0	0	0	0	0	0	0	2	0	29.2	0	0	0	7	0	102	0	0	0	3	3	43.7	0	0	0	0	0	0
	RG_GC_GN_18_20180427	630940	5436318	61.0	2	1.6	1.9	27-Apr-18	27-Apr-18	10:30	10:50	0.333	0.203	0	0	0	1	0	4.92	6	0	29.5	0	0	0	10	0	49.2	59	59	290	0	0	0	0	0	0	1	0	4.92	0	0	0
	RG_GC_GN_19_20180427	631168	5436072	22.9	1	2.3	2.0	27-Apr-18	27-Apr-18	10:35	10:55	0.333	0.0762	0	0	0	0	0	0	1	0	13.1	1	0	13.1	1	0	13.1	3	0	39.4	0	0	0	10	10	131	0	0	0	0	0	0
	RG_GC_GN_20_20180427	631193	5436049	15.2	1	2.3	2.3	27-Apr-18	27-Apr-18	10:40	11:05	0.417	0.0635	1	0	15.7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	31.5	0	0	0	12	12	189	0	0	0	0	0	0
	RG_GC_GN_21_20180428	631166	5436079	15.2	1	0.8	2.2	28-Apr-18	28-Apr-18	9:30	10:00	0.500	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	13.1	0	0	0	0	0	0
	RG_GC_GN_22_20180428	631212	5436344	22.9	1	1.0	0.9	28-Apr-18	28-Apr-18	9:35	10:05	0.500	0.114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_23_20180428	631240	5436005	22.9	1	1.1	1.3	28-Apr-18	28-Apr-18	10:20	10:40	0.333	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_GN_24a_20180428	631262	5435969	15.2	1	1.1	1.2	28-Apr-18	28-Apr-18	10:25	10:45	0.333	0.0508	1	0	19.7	0	0	0	1	0	19.7	0	0	0	0	0	0	0	0	0	0	0	0	15	15	295	0	0	0	0	0	0
	RG_GC_GN_24b_20180428			15.2				28-Apr-18	28-Apr-18	11:35	12:00	0.417	0.0635	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	252	0	0	0	0	0	0
	RG_GC_GN_24c_20180428			15.2				28-Apr-18	28-Apr-18	12:40	13:05	0.417	0.0635	0	0	0	0	0	0	1	0	15.7	0	0	0	0	0	0	1	0	15.7	0	0	0	11	11	173	0	0	0	0	0	0
	RG_GC_GN_25a_20180428	631279	5435946	15.2	1	1.2	1.5	28-Apr-18	28-Apr-18	11:40	12:10	0.500	0.0762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22	289	0	0	0	0	0	0
	RG_GC_GN_25b_20180428			15.2				28-Apr-18	28-Apr-18	12:35	13:09	0.567	0.0864	0	0	0	0	0	0	1	0	11.6	0	0	0	2	0	23.2	1	0	11.6	0	0	0	7	7	81.1	0	0	0	0	0	0
	RG_GC_GN_25c_20180428			15.2				28-Apr-18	28-Apr-18	13:25	14:10	0.750	0.114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8.75	0	0	0	2	2	17.5	0	0	0	0	0	0
	RG_GC_GN_26_20180428	631305	5435916	22.9	1	1.7	2.3	28-Apr-18	28-Apr-18	13:15	13:50	0.583	0.133	0	0	0	0	0	0	0	0	0	1	0	7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
											Total	**13.4**	**3.08**	**2**	**0**	**0.648**	**1**	**0**	**0.324**	**28**	**0**	**9.08**	**4**	**0**	**1.30**	**24**	**0**	**7.78**	**164**	**146**	**53.2**	**0**	**0**	**0**	**112**	**112**	**36.3**	**5**	**0**	**1.62**	**2**	**0**	**0.648**

[a] CPUE denotes catch per unit effort (#fish/100 m hour)

Table E.3: Angling Records for Fish Caught in Koocanusa Reservoir, April 2018

Area	Station ID	Location (11U, NAD83)		Set Date	Date of Removal	Set Time	Removal Time	Angling Hours (hours)	Depth Range (m)		# of Lines	Effort (angling lines*days)	Bull Trout			Kokanee			Rainbow Trout			Westslope Cutthroat Trout			Yellow Perch		
		Easting	Northing										Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE[a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]
Sand Creek	RG_SC_AN_01_20180424	625553	5458223	24-Apr-18	24-Apr-18	12:30	12:45	0.250	1.5	2.0	2	0.0208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_AN_02_20180424	625440	5458201	24-Apr-18	24-Apr-18	14:35	14:55	0.333	0.8	2.5	2	0.0278	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Total	**0.583**	**-**	**-**	**-**	**0.0486**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Gold Creek	RG_GC_AN_01_20180424	630840	5436312	24-Apr-18	24-Apr-18	14:12	14:25	0.217	1.0	-	2	0.0181	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_AN_02_20180424	630823	5436415	24-Apr-18	24-Apr-18	14:40	14:55	0.250	1.0	-	2	0.0208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_AN_03_20180424	630693	5436448	24-Apr-18	24-Apr-18	15:20	15:26	0.100	1.0	-	2	0.0083	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Total	**0.57**	**-**	**-**	**-**	**0.05**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total angling effort in one area.

Table E.4: **Angling Records for Fish Caught in the Koocanusa Reservoir, June 2018**

Area	Station ID	UTM (NAD83, 11U)		Set Date	Removal Date	Start Time	End Time	Angling Hours (hours)	Depth Range (m)		# of Lines	Effort (angling lines*days)	Largescale Sucker			Northern Pikeminnow			Peamouth Chub			Westslope Cutthroat Trout		
		Easting	Northing										Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]
Sand Creek	RG_SC_AN_01_20180605	625691	5457986	5-Jun-18	5-Jun-18	11:30	13:30	2.00	3.0	5.2	2	0.167	1	0	6.00	13	12	78.0	5	0	30.0	0	0	0
	RG_SC_AN_02_20180605	625691	5457986	5-Jun-18	5-Jun-18	14:35	16:40	2.08	3.2	5.5	2	0.174	0	0	0	9	9	51.8	3	0	17.3	0	0	0
	RG_SC_AN_03_20180610	625691	5457986	10-Jun-18	10-Jun-18	15:00	17:30	2.50	5.4	6.0	2	0.208	0	0	0	11	6	52.8	4	0	19.2	0	0	0
	Total							**6.6**	**-**	**-**	**-**	**0.549**	**1**	**0**	**1.82**	**33**	**27**	**60.2**	**12**	**0**	**21.9**	**0**	**0**	**0**
Elk River	RG_ER_AN_01_20180606	627989	5447721	6-Jun-18	6-Jun-18	13:00	15:00	2.00	7.4	9.6	2	0.167	0	0	0	4	4	24.0	2	0	12.0	0	0	0
	RG_ER_AN_02_20180606	628669	5447426	6-Jun-18	6-Jun-18	15:05	16:20	1.25	1.8	5.5	2	0.104	0	0	0	9	9	86.4	1	0	9.60	0	0	0
	RG_ER_AN_03_20180607	628624	5447338	7-Jun-18	7-Jun-18	9:30	12:30	3.00	0.5	5.8	2	0.250	0	0	0	11	6	44.0	9	0	36.0	1	0	4.00
	Total							**6.3**	**-**	**-**	**-**	**0.521**	**0**	**0**	**0**	**24**	**19**	**46.1**	**12**	**0**	**23.0**	**1**	**0**	**1.92**
Gold Creek	RG_GC_AN_01_20180606	630351	5436952	6-Jun-18	6-Jun-18	9:30	9:50	0.33	1.2	1.8	2	0.0278	0	0	0	1	0	36.0	0	0	0	0	0	0
	RG_GC_AN_02_20180606	628977	5436935	6-Jun-18	6-Jun-18	9:55	12:30	2.58	1.5	4.5	2	0.215	0	0	0	9	9	41.8	5	0	23.2	0	0	0
	RG_GC_AN_03_20180607	632685	5434375	7-Jun-18	7-Jun-18	13:00	17:30	4.50	3.5	9.2	2	0.375	0	0	0	9	5	24.0	6	0	16.0	0	0	0
	Total							**7.4**	**-**	**-**	**-**	**0.618**	**0**	**0**	**0**	**19**	**14**	**30.7**	**11**	**0**	**17.8**	**0**	**0**	**0**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total angling effort in one area.

Table E.5: **Angling Records for Fish Caught in the Koocanusa Reservoir, August 2018**

Area	Station ID	UTM (NAD83, 11U)		Set Date	Removal Date	Start Time	End Time	Angling Hours (hours)	Depth Range (m)		# of Lines	Effort (angling lines*days)	Kokanee			Largescale Sucker			Northern Pikeminnow			Peamouth Chub			Westslope Cutthroat Trout			Rainbow Trout		
		Start Easting	Start Northing										Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]
Sand Creek	RG_SC_AN_01_20180901	626492	5458292	1-Sep-18	1-Sep-18	10:10	11:00	0.833	2.0	10	2	0.0694	0	0	0	0	0	0	1	0	14.4	0	0	0	0	0	0	0	0	0
	RG_SC_AN_02_20180901	623648	5463055	1-Sep-18	1-Sep-18	11:20	12:30	1.17	1.0	2.0	2	0.0972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_SC_AN_03_20180901	626380	5455295	1-Sep-18	1-Sep-18	13:15	14:00	0.750	-	-	2	0.0625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Total	**2.75**	**-**	**-**	**-**	**0.229**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**4.36**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Elk River	RG_ER_AN_01_20180901	632162	5447353	1-Sep-18	1-Sep-18	9:45	11:00	1.25	3.5	-	2	0.104	0	0	0	0	0	0	1	0	9.6	0	0	0	0	0	0	0	0	0
	RG_ER_AN_02_20180901	627921	5446733	1-Sep-18	1-Sep-18	11:00	12:55	1.9167	20	-	2	0.1597	4	4	25.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_AN_03_20180901	627084	5446722	1-Sep-18	1-Sep-18	12:05	12:30	0.417	22	-	2	0.0347	1	0	28.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_AN_04_20180901	626902	5446710	1-Sep-18	1-Sep-18	12:45	13:15	0.500	8.3	-	2	0.0417	0	0	0	0	0	0	1	0	24.0	0	0	0	0	0	0	0	0	0
	RG_ER_AN_05_20180901	626772	5445605	1-Sep-18	1-Sep-18	13:30	14:00	0.500	15	-	2	0.0417	1	0	24.0	0	0	0	1	0	24.0	0	0	0	0	0	0	1	0	24
	RG_ER_AN_06_20180901	629084	5442539	1-Sep-18	1-Sep-18	14:25	15:00	0.583	20	-	2	0.0486	1	0	20.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_ER_AN_07_20180901	628571	5447340	1-Sep-18	1-Sep-18	14:30	15:30	1.00	-	-	2	0.0833	0	0	0	0	0	0	3	0	36.0	0	0	0	0	0	0	0	0	0
							Total	**6.17**	**-**	**-**	**-**	**0.514**	**7**	**4**	**13.6**	**0**	**0**	**0**	**6**	**0**	**11.7**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1.95**
Gold Creek	RG_GC_AN_01_20180901	630498	5436738	1-Sep-18	1-Sep-18	15:20	16:45	1.42	15	-	2	0.118	1	1	8.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RG_GC_AN_02_20180901	630612	5437886	1-Sep-18	1-Sep-18	15:45	16:25	0.667	-	-	2	0.0556	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Total	**2.08**	**-**	**-**	**-**	**0.174**	**1**	**1**	**5.76**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total angling effort in one area.

Table E.6: **Seine Catch Records for Fish Caught in Koocanusa Reservoir, August 2018**[a]

Area	Station ID	Location (NAD 83, Zone 11U)		Date	Time	Length (m)	Distance (m)	# of Hauls	Effort [Area Seined (m^2)]	Largemouth Bass (juvenile)			Largescale Sucker (juvenile)			Redside Shiner (juvenile)			Yellow Perch (juvenile)		
		Easting	Northing							Catch	Mortalities/ Sacrificed	CPUE[b]	Catch	Mortalities/ Sacrificed	CPUE[b]	Catch	Mortalities/ Sacrificed	CPUE[b]	Catch	Mortalities/ Sacrificed	CPUE[b]
Sand Creek	RG_SC_SN_01_20180829	625982	5457457	29-Aug-18	9:30	15	25	1	375	0	0	0	18	0	0.05	380	170	1.01	0	0	0
Elk River	RG_ER_SN_01_20180828	632704	5447704	28-Aug-18	13:09	15	20	1	300	0	0	0	336	0	1.12	40	4	0.133	1	0	0
	RG_ER_SN_02_20180828	632754	5447700	28-Aug-18	15:15	15	25	1	375	0	0	0	156	0	0.42	271	123	0.723	4	0	0.01
	Total					**-**	**-**	**2**	**675**	**0**	**0**	**0**	**492**	**0**	**0.73**	**311**	**127**	**0.461**	**5**	**0**	**0.01**
Gold Creek	RG_GC_SN_01_20180828	628388	5436933	28-Aug-18	9:30	15	40	1	600	1	0	0	43	0	0.07	293	5	0.49	2	0	0.00

[a] Fish collected were all juveniles.

[b] Total catch-per-unit-effort (CPUE; number of fish / m^2) calculated as the number of fish caught over the area seined.

Table E.7: Summary of Fish Catches at the Sand Creek, Elk River, and Gold Creek Study Areas in Koocanusa Reservoir, April 2018

Study Area	Fishing Method	Summary Statistic	Fish Species												Total by Fishing Method	Total No. Species (all methods)
			Brook Trout	**Bull Trout**	**Burbot**	**Kokanee**	**Largescale Sucker**	**Mountain Whitefish**	**Northern Pikeminnow**	**Peamouth Chub**	**Rainbow Trout**	**Redside Shiner**	**Westslope Cutthroat Trout**	**Yellow Perch**		
Sand Creek	Angling	Total Caught	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**9**
		CPUE[a]	0	0	0	0	0	0	0	0	0	0	0	0	**0**	
	Gill Netting	Total Caught	0	6	0	4	84	1	71	111	4	99	0	1	**381**	
		CPUE[a]	0	1.54	0	1.02	21.5	0.256	18.2	28.4	1.03	25.4	0	0.260	**97.6**	
	Hoop Netting	Total Caught	0	2	0	0	114	0	30	31	0	1	0	1	**179**	
		CPUE[a]	0	0.210	0	0	11.9	0	3.14	3.25	0	0.105	0	0.105	**18.8**	
Elk River	Angling	Total Caught	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**10**
		CPUE[a]	-	-	-	-	-	-	-	-	-	-	-	-	**-**	
	Gill Netting	Total Caught	0	1	0	2	103	6	10	79	0	97	2	0	**300**	
		CPUE[a]	0	0.151	0	0.303	15.6	0.909	1.51	12.0	0	14.7	0.303	0	**45.5**	
	Hoop Netting	Total Caught	1	1	1	0	119	0	12	103	0	14	0	0	**251**	
		CPUE[a]	0.124	0.124	0.124	0	14.8	0	1.49	12.8	0	1.74	0	0	**31.2**	
Gold Creek	Angling	Total Caught	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**10**
		CPUE[a]	0	0	0	0	0	0	0	0	0	0	0	0	**0**	
	Gill Netting	Total Caught	0	2	0	1	28	4	24	164	0	112	5	2	**342**	
		CPUE[a]	0	0.648	0	0.324	9.08	1.30	7.78	53.2	0	36.3	1.62	0.648	**111**	
	Hoop Netting	Total Caught	0	1	1	0	12	0	6	0	0	0	6	9	**35**	
		CPUE[a]	0	0.552	0.552	0	6.62	0	3.31	0	0	0	3.31	4.97	**19.3**	

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for a fishing method in a study area (i.e., number of fish per angler per 24 hour period, number of fish per gill or hoop net per 24 hour period).

Table E.8: **Summary of Fish Catches at the Sand Creek, Elk River, and Gold Creek Study Areas in Koocanusa Reservoir, June 2018**

Study Area	Fishing Method	Summary Statistic	Fish Species				Total by Fishing Method	Total No. Species (all methods)
			Largescale Sucker	Northern Pikeminnow	Peamouth Chub	Westslope Cutthroat Trout		
Sand Creek	Angling	Total Caught	1	33	12	0	**46**	**3**
		CPUE[a]	1.82	60.2	21.9	0	**83.9**	
Elk River	Angling	Total Caught	0	24	12	1	**37**	**3**
		CPUE[a]	0	46.1	23.0	1.92	**71.0**	
Gold Creek	Angling	Total Caught	0	19	11	0	**30**	**2**
		CPUE[a]	0	30.7	17.8	0	**48.5**	

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for a fishing method in a study area (i.e., number of fish per angler per 24 hour period).

Table E.9: **Summary of Fish Catches at Sand Creek, Elk River, and Gold Creek Fishing Areas in Koocanusa Reservoir, August 2018**

Study Area	Fishing Method	Summary Statistic	Fish Species							Total by Fishing Method	Total No. Species (all methods)
			Kokanee	Largemouth Bass (juvenile)	Largescale Sucker (juvenile)	Northern Pikeminnow	Rainbow Trout	Redside Shiner (juvenile)	Yellow Perch (juvenile)		
Sand Creek	Angling	Total Caught	0	0	0	1	0	0	0	**1**	**1**
		CPUE[a]	0	0	0	4.36	0	0	0	**4.36**	
	Seine Netting	Total Caught	0	0	18	0	0	380	0	**398**	**2**
		CPUE[a]	0	0	0.05	0	0	1.01	0	**1.06**	
Elk River	Angling	Total Caught	7	0	0	6	1	0	0	**14**	**3**
		CPUE[a]	13.6	0	0	11.7	1.95	0	0	**27.2**	
	Seine Netting	Total Caught	0	0	492	0	0	311	5	**808**	**3**
		CPUE[a]	0	0	0.73	0	0	0.46	0.01	**1.20**	
Gold Creek	Angling	Total Caught	1	0	0	0	0	0	0	**1**	**1**
		CPUE[a]	5.76	0	0	0	0	0	0	**5.76**	
	Seine Netting	Total Caught	0	1	43	0	0	293	2	**339**	**4**
		CPUE[a]	0	0.002	0.07	0	0	0.49	0.003	**0.565**	

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for a fishing method in a study area (i.e., number of fish per angler per 24 hour period, number of fish caught over the area seined).

Table E.10: Summary Statistics for Bull Trout Meristic Data Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Tissue Collected
						D	**E**	**L**	**T**		
Sand Creek	25-Apr-18	RG_SC_BT_01_20180425	33.0	31.0	280	M	A	A	A	missing top third of caudal fin	muscle plug
	25-Apr-18	RG_SC_BT_02_20180425	26.4	25.2	150	A	A	A	A	no muscle plug taken, as fish was small and stressed	-
	25-Apr-18	RG_SC_BT_03_20180425	55.9	52.8	1,480	A	A	A	A	-	muscle plug
	27-Apr-18	RG_SC_BT_04_20180427	28.3	26.7	185	A	A	A	A	muscle plug includes hard orange structure	muscle plug
	28-Apr-18	RG_SC_BT_05_20180428	47.2	44.2	750	A	A	A	A	-	muscle plug
	28-Apr-18	RG_SC_BT_06_20180428	68.9	65.5	2,700	A	M	A	A	-	muscle plug
	total sample size		**6**	**6**	**6**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**43.3**	**40.9**	**924**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**40.1**	**37.6**	**515**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**17.0**	**16.1**	**1,005**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**6.94**	**6.59**	**410**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**26.4**	**25.2**	**150**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**68.9**	**65.5**	**2,700**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	27-Apr-18	RG_ER_BT_01_20180427	70.2	67.1	3,280	A	A	A	A	-	muscle plug
	29-Apr-18	RG_ER_BT_02_20180429	27.9	26.3	159	A	M	A	A	minor erosion	muscle plug
	total sample size		**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**49.1**	**46.7**	**1,720**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**49.1**	**46.7**	**1,720**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**29.9**	**28.8**	**2,207**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**21.2**	**20.4**	**1,561**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**27.9**	**26.3**	**159**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**70.2**	**67.1**	**3,280**	**-**	**-**	**-**	**-**	**-**	**-**
Gold Creek	25-Apr-18	RG_GC_BT_01_20180425	71.7	70.2	3,300	A	A	M	A	minor lesions	muscle plug
	27-Apr-18	RG_GC_BT_02_20180427	77.9	75.0	3,550	A	A	A	A	worm in left pectoral, clipped adipose	muscle plug
	28-Apr-18	RG_GC_BT_03_20180428	67.4	64.5	2,450	A	A	A	A	fishing line in throat	muscle plug
	total sample size		**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**72.3**	**69.9**	**3,100**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**71.7**	**70.2**	**3,300**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**5.28**	**5.26**	**577**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**3.05**	**3.03**	**333**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**67.4**	**64.5**	**2,450**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**77.9**	**75.0**	**3,550**	**-**	**-**	**-**	**-**	**-**	**-**

Table E.11: **Summary Statistics for Kokanee Meristic Data Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	**Processing Date**	**Fish ID**	**Total Length (cm)**	**Fork Length (cm)**	**Body Weight (g)**	**DELT (Severe[S]/ Minor[M]/ Absent[A])**				**Comment**	**Tissue Collected**
						D	**E**	**L**	**T**		
Sand Creek	25-Apr-18	RG_SC_KO_01_20180425	26.1	23.9	138	A	A	A	A	-	muscle
	25-Apr-18	RG_SC_KO_02_20180425	26.8	24.3	143	A	A	A	A	-	muscle
	26-Apr-18	RG_SC_KO_03_20180426	28.5	25.9	152	A	A	A	A	-	muscle
	26-Apr-18	RG_SC_KO_04_20180426	28.6	26.0	150	A	A	A	A	-	muscle
	total sample size		**4**	**4**	**4**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**27.5**	**25.0**	**146**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**27.7**	**25.1**	**147**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**1.25**	**1.08**	**6.45**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.623**	**0.541**	**3.22**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**26.1**	**23.9**	**138**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**28.6**	**26.0**	**152**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	28-Apr-18	RG_ER_KO_01_20180428	27.7	25.4	280	A	A	A	A	-	muscle plug
	29-Apr-18	RG_ER_KO_02_20180429	26.8	24.3	126	A	M	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_01_20180901	29.4	26.7	220	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_02_20180901	28.4	26.4	205	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_03_20180901	28.2	25.5	180	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_04_20180901	23.6	21.3	130	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_05_20180901	28.1	25.8	185	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_06_20180901	29.6	27.1	235	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_07_20180901	27.3	25.0	190	A	A	A	A	-	muscle plug
	1-Sep-18	RG_ER_KO_08_20180901	28.0	25.5	208	A	A	A	A	-	muscle plug
	total sample size		**10**	**10**	**10**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**27.7**	**25.3**	**196**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**28.1**	**25.5**	**198**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**1.68**	**1.63**	**46.0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.530**	**0.515**	**14.5**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**23.6**	**21.3**	**126**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**29.6**	**27.1**	**280**	**-**	**-**	**-**	**-**	**-**	**-**
Gold Creek	27-Apr-18	RG_GC_KO_01_20180427	25.8	23.0	188	A	A	A	A	-	muscle plug
	1-Sep-18	RG_GC_KO_01_20180901	24.3	21.9	122	A	A	A	A	-	muscle plug
	total sample size		**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**25.1**	**22.5**	**155**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**25.1**	**22.5**	**155**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**1.06**	**0.778**	**46.7**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.750**	**0.550**	**33.0**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**24.3**	**21.9**	**122**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**25.8**	**23.0**	**188**	**-**	**-**	**-**	**-**	**-**	**-**

Table E.12: **Summary Statistics for Mountain Whitefish Meristic Data Collected near Sand Creek and Elk River in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Tissue Collected
						D	**E**	**L**	**T**		
Sand Creek	27-Apr-18	RG_SC_MW_01_20180427	23.0	21.0	95.0	A	A	A	A	-	muscle
	total sample size		**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**23.0**	**21.0**	**95.0**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**23.0**	**21.0**	**95.0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**23.0**	**21.0**	**95.0**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**23.0**	**21.0**	**95.0**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	25-Apr-18	RG_ER_MW_01_20180425	25.1	22.9	160	A	A	A	A	-	muscle plug
	28-Apr-18	RG_ER_MW_02_20180428	24.7	22.2	120	A	A	A	A	-	muscle plug
	29-Apr-18	RG_ER_MW_03_20180429	27.1	25.0	174	A	A	A	A	-	muscle plug
	total sample size		**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**25.6**	**23.4**	**151**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**25.1**	**22.9**	**160**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**1.29**	**1.46**	**28.3**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.742**	**0.841**	**16.3**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**24.7**	**22.2**	**120**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**27.1**	**25.0**	**174**	**-**	**-**	**-**	**-**	**-**	**-**

Table E.13: Summary Statistics for Northern Pikeminnow Meristic Data Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structures Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Sand Creek	5-Jun-18	RG_SC_NSC_01_20180605	44.3	40.4	685	oto	12	F	5.85	10.5	669	0.015	0.009	A	A	A	A	-	-	muscle, ovaries
	5-Jun-18	RG_SC_NSC_02_20180605	48.8	44.8	1,140	oto	13	F	52.1	24.0	1,064	0.021	0.046	A	A	A	A	-	-	muscle, ovaries
	5-Jun-18	RG_SC_NSC_03_20180605	34.5	31.2	330	oto	10	F	4.87	2.93	322	0.009	0.015	A	A	A	A	crayfish in gut	-	muscle, ovaries
	5-Jun-18	RG_SC_NSC_04_20180605	35.6	32.4	340	oto	9	F	7.24	3.65	329	0.011	0.021	A	A	A	A	-	-	muscle, ovaries
	5-Jun-18	RG_SC_NSC_05_20180605	34.0	31.0	280	oto	8	F	2.80	2.76	274	0.010	0.010	A	A	A	A	-	-	muscle, ovaries
	10-Jun-18	RG_SC_NSC_06_20180610	41.6	37.7	530	oto	11	F	6.82	4.65	519	0.009	0.013	A	A	A	A	-	-	muscle, ovaries
	10-Jun-18	RG_SC_NSC_07_20180610	58.9	53.9	1,690	oto	17	F	96.2	29.2	1,565	0.017	0.057	A	A	A	A	-	-	muscle, ovaries
	total sample size		**7**	**7**	**7**	**-**	**7**	**-**	**7**	**7**	**7**	**7**	**7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**42.5**	**38.8**	**714**	**-**	**11.4**	**-**	**25.1**	**11.1**	**677**	**0.013**	**0.024**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**41.6**	**37.7**	**530**	**-**	**11.0**	**-**	**6.82**	**4.65**	**519**	**0.011**	**0.015**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**9.10**	**8.44**	**524**	**-**	**2.99**	**-**	**35.9**	**11.0**	**478**	**0.005**	**0.019**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**3.44**	**3.19**	**198**	**-**	**1.13**	**-**	**13.6**	**4.16**	**181**	**0.002**	**0.007**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**34.0**	**31.0**	**280**	**-**	**8**	**-**	**2.80**	**2.76**	**274**	**0.009**	**0.009**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**58.9**	**53.9**	**1,690**	**-**	**17**	**-**	**96.2**	**29.2**	**1,565**	**0.021**	**0.057**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	6-Jun-18	RG_ER_NSC_01_20180606	41.4	37.0	545	oto	10	F	3.56	6.42	535	0.012	0.007	A	A	A	A	-	-	muscle, ovaries
	6-Jun-18	RG_ER_NSC_02_20180606	35.5	31.8	315	oto	9	F	1.92	2.70	310	0.009	0.006	A	A	A	A	scar on right side	-	muscle, ovaries
	7-Jun-18	RG_ER_NSC_03_20180607	33.9	30.2	275	oto	10	F	1.63	2.06	271	0.008	0.006	A	A	A	A	-	-	muscle, ovaries
	7-Jun-18	RG_ER_NSC_04_20180607	44.0	39.8	755	oto	12	F	26.4	4.40	724	0.006	0.035	A	A	A	A	-	-	muscle, ovaries
	7-Jun-18	RG_ER_NSC_05_20180607	39.9	35.7	445	oto	11	F	2.69	5.16	437	0.012	0.006	A	A	A	A	-	-	muscle, ovaries
	7-Jun-18	RG_ER_NSC_06_20180607	30.9	27.7	205	oto	6	F	1.05	2.93	201	0.014	0.005	A	A	A	A	intestinal worm	0.213	muscle, ovaries
	1-Sep-18	RG_ER_NSC_01_20180901	53.5	48.4	1,220	-	-	-	-	-	-	-	-	A	A	A	A	-	-	muscle plug
	1-Sep-18	RG_ER_NSC_02_20180901	44.7	40.4	650	-	-	-	-	-	-	-	-	A	A	A	A	-	-	muscle plug
	1-Sep-18	RG_ER_NSC_03_20180901	36.8	33.2	360	-	-	-	-	-	-	-	-	A	A	A	A	-	-	muscle plug
	1-Sep-18	RG_ER_NSC_04_20180901	36.4	32.8	350	-	-	-	-	-	-	-	-	A	A	A	A	-	-	muscle plug
	total sample size		**10**	**10**	**10**	**-**	**6**	**-**	**6**	**6**	**6**	**6**	**6**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
	average		**39.7**	**35.7**	**512**	**-**	**9.67**	**-**	**6.21**	**3.94**	**413**	**0.010**	**0.011**	**-**	**-**	**-**	**-**	**-**	**0.213**	**-**
	median		**38.4**	**34.5**	**403**	**-**	**10.0**	**-**	**2.30**	**3.66**	**374**	**0.010**	**0.006**	**-**	**-**	**-**	**-**	**-**	**0.213**	**-**
	standard deviation		**6.54**	**6.02**	**302**	**-**	**2.07**	**-**	**9.95**	**1.67**	**194**	**0.003**	**0.012**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**2.07**	**1.90**	**95.7**	**-**	**0.843**	**-**	**4.06**	**0.681**	**79.1**	**0.001**	**0.005**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**30.9**	**27.7**	**205**	**-**	**6**	**-**	**1.05**	**2.06**	**201**	**0.006**	**0.005**	**-**	**-**	**-**	**-**	**-**	**0.213**	**-**
	maximum		**53.5**	**48.4**	**1,220.0**	**-**	**12**	**-**	**26.4**	**6.42**	**724**	**0.014**	**0.035**	**-**	**-**	**-**	**-**	**-**	**0.213**	**-**
Gold Creek	7-Jun-18	RG_GC_NSC_01_20180607	38.5	34.7	475	oto	9	F	6.12	8.25	461	0.017	0.013	A	A	A	A	-	-	muscle, ovaries
	7-Jun-18	RG_GC_NSC_02_20180607	37.1	33.5	350	oto	9	F	1.91	4.32	344	0.012	0.005	A	A	A	A	-	-	muscle, ovaries
	7-Jun-18	RG_GC_NSC_03_20180607	54.5	50.1	1,800	oto	15	F	192	47.8	1,561	0.027	0.106	A	A	A	A	gonad sub-sampled for tissue sample	-	muscle, ovaries
	total sample size		**3**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**43.4**	**39.4**	**875**	**-**	**11.0**	**-**	**66.6**	**20.1**	**788**	**0.019**	**0.042**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**38.5**	**34.7**	**475**	**-**	**9.00**	**-**	**6.12**	**8.25**	**461**	**0.017**	**0.013**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**9.67**	**9.26**	**804**	**-**	**3.46**	**-**	**108**	**24.1**	**671**	**0.007**	**0.056**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**5.58**	**5.34**	**464**	**-**	**2.00**	**-**	**62.6**	**13.9**	**388**	**0.004**	**0.033**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**37.1**	**33.5**	**350**	**-**	**9**	**-**	**1.91**	**4.32**	**344**	**0.012**	**0.005**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**54.5**	**50.1**	**1,800**	**-**	**15**	**-**	**192**	**47.8**	**1,561**	**0.027**	**0.106**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

[a] Age structures collected: oto - otoliths

[b] Adjusted body weight represents whole body weight less the liver weight and gonad weight and used for statistical analyses.

Table E.14: **Summary Statistics for Peamouth Chub Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structures Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Sand Creek	24-Apr-18	RG_SC_PCC_01_20180424	27.3	24.4	156	oto	12	F	10.6	2.92	142	0.019	0.068	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_02_20180424	25.9	23.3	147	oto	11	F	10.2	2.48	134	0.017	0.069	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_03_20180424	28.0	25.5	178	oto	11	F	15.5	3.12	159	0.018	0.087	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_04_20180424	24.8	22.4	91.5	oto	9	M	1.17	1.44	88.9	0.016	0.013	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_05_20180424	23.5	20.9	92.0	oto	5	M	3.72	1.31	87.0	0.014	0.040	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_06_20180424	25.6	23.1	136	oto	8	F	7.53	2.39	126	0.018	0.055	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_07_20180424	23.4	20.8	108	oto	6	F	4.26	1.63	102	0.015	0.039	A	A	A	A	worms	4.41	muscle, ovaries
	24-Apr-18	RG_SC_PCC_08_20180424	24.4	21.9	118	oto	14	F	7.93	1.72	108	0.015	0.067	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_09_20180424	22.5	20.3	89.5	oto	5	M	2.96	1.59	85.0	0.018	0.033	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_10_20180424	24.7	22.4	130	oto	6	F	8.00	1.87	120	0.014	0.062	A	A	M	A	small cut	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_11_20180424	25.9	23.4	147	oto	7	F	9.24	2.71	135	0.018	0.063	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_12_20180424	23.3	20.8	103	oto	6	M	3.40	1.63	98.0	0.016	0.033	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_13_20180424	25.0	22.5	135	oto	7	F	12.4	2.28	120	0.017	0.092	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_14_20180424	23.2	20.9	113	oto	5	F	7.83	2.20	103	0.019	0.069	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_PCC_15_20180424	22.4	20.1	99.5	-	-	U	-	1.56	-	0.016	-	A	A	A	A	worms	15.6	-
	24-Apr-18	RG_SC_PCC_16_20180424	22.7	20.5	89.5	oto	5	M	3.89	0.98	84.6	0.011	0.043	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_17_20180424	24.4	21.9	125	oto	6	F	10.3	2.00	113	0.016	0.082	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_PCC_18_20180424	24.8	22.6	144	oto	7	F	9.86	1.49	133	0.010	0.068	A	A	A	A	worms	13.5	-
	24-Apr-18	RG_SC_PCC_19_20180424	23.1	20.5	90.2	oto	5	F	3.27	1.67	85.3	0.019	0.036	A	A	A	A	worms	2.96	-
	25-Apr-18	RG_SC_PCC_20_20180425	26.7	24.4	144	oto	10	F	6.08	1.78	136	0.012	0.042	A	A	A	A	worms	3.05	-
	25-Apr-18	RG_SC_PCC_21_20180425	29.3	26.5	217	oto	18	F	14.2	3.56	199	0.016	0.065	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_22_20180425	27.6	25.2	164	oto	15	F	12.4	3.19	148	0.019	0.076	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_23_20180425	24.9	22.4	122	oto	5	M	0.616	1.75	120	0.014	0.0050	A	A	A	A	worms	6.94	-
	25-Apr-18	RG_SC_PCC_24_20180425	24.4	21.9	115	oto	6	M	1.42	1.48	112	0.013	0.012	A	A	A	A	worms	12.0	-
	25-Apr-18	RG_SC_PCC_25_20180425	26.3	24.1	139	oto	9	F	10.5	1.85	127	0.013	0.076	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_26_20180425	24.5	22.2	115	oto	7	M	1.21	1.60	112	0.014	0.011	A	A	A	A	1x oto, worms	12.0	-
	25-Apr-18	RG_SC_PCC_27_20180425	25.9	23.5	150	oto	5	F	4.96	2.26	143	0.015	0.033	A	A	A	A	worms	25.2	-
	25-Apr-18	RG_SC_PCC_28_20180425	26.1	23.6	124	oto	11	F	6.81	1.70	115	0.014	0.055	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_29_20180425	24.0	21.4	115	oto	7	F	7.96	2.18	105	0.019	0.069	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_30_20180425	22.9	20.7	104	oto	4	F	7.95	1.80	94.3	0.017	0.076	A	A	A	A	-	-	-
	25-Apr-18	RG_SC_PCC_31_20180425	25.2	22.8	151	oto	6	F	3.14	2.26	146	0.015	0.021	A	A	A	A	worms	22.0	-
	25-Apr-18	RG_SC_PCC_32_20180425	22.0	19.8	89.0	-	-	U	-	1.17	-	0.013	-	A	A	A	A	1x oto, worms	14.4	-
	25-Apr-18	RG_SC_PCC_33_20180425	24.0	21.5	122	oto	5	M	0.987	1.63	119	0.013	0.008	A	A	A	A	worms	22.9	-
	25-Apr-18	RG_SC_PCC_34_20180425	22.4	20.0	98.0	oto	5	M	0.496	1.19	96.3	0.012	0.005	A	A	A	A	worms	15.7	-
	25-Apr-18	RG_SC_PCC_35_20180425	23.2	20.9	105	oto	5	M	0.979	1.71	102	0.016	0.009	A	A	A	A	1x oto, worms	16.5	-
	25-Apr-18	RG_SC_PCC_36_20180425	22.5	20.3	98.0	oto	5	M	0.440	1.17	96.4	0.012	0.004	A	A	A	A	worms	16.4	-
	25-Apr-18	RG_SC_PCC_37_20180425	25.0	22.5	130	oto	7	M	1.09	2.15	127	0.017	0.008	A	A	A	A	worms	8.90	-
	25-Apr-18	RG_SC_PCC_38_20180425	24.6	22.0	120	oto	5	F	1.23	1.10	118	0.009	0.010	A	M	A	A	worms	20.4	-
	26-Apr-18	RG_SC_PCC_39_20180426	25.7	23.5	145	oto	6	M	1.38	1.30	142	0.009	0.010	A	A	A	A	worms	20.9	-
	26-Apr-18	RG_SC_PCC_40_20180426	24.6	22.1	133	oto	5	F	1.02	0.96	131	0.007	0.008	A	A	A	A	worms	17.1	-
	26-Apr-18	RG_SC_PCC_41_20180426	20.2	19.1	70.0	oto	4	M	3.09	0.63	66.3	0.009	0.044	A	A	A	A	-	-	-
	26-Apr-18	RG_SC_PCC_42_20180426	22.5	20.2	95.0	oto	5	M	0.296	0.93	93.8	0.010	0.003	A	M	A	A	worms	11.5	-
	26-Apr-18	RG_SC_PCC_43_20180426	19.3	17.5	53.4	oto	5	M	1.76	0.91	50.7	0.017	0.033	A	A	A	A	-	-	-
	27-Apr-18	RG_SC_PCC_44_20180427	24.7	22.3	130	oto	11	M	5.36	1.76	123	0.014	0.041	A	A	A	A	-	-	-
	27-Apr-18	RG_SC_PCC_45_20180427	24.1	21.5	111	oto	7	M	1.41	1.40	108	0.013	0.013	A	A	A	A	worms	10.3	-
	27-Apr-18	RG_SC_PCC_46_20180427	24.5	22.0	125	oto	6	M	6.32	1.53	117	0.012	0.051	A	A	A	A	-	-	-
	27-Apr-18	RG_SC_PCC_47_20180427	22.0	19.5	77.5	oto	7	M	2.97	0.92	73.6	0.012	0.038	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_48_20180428	21.2	19.0	77.0	oto	5	M	2.84	1.00	73.2	0.013	0.037	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_49_20180428	24.3	21.7	125	oto	6	M	5.71	0.86	118	0.007	0.046	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_50_20180428	22.4	20.0	82.5	oto	6	M	0.682	0.88	80.9	0.011	0.008	A	A	A	A	worms	6.19	-
	28-Apr-18	RG_SC_PCC_51_20180428	23.2	20.5	98.5	oto	5	F	0.833	1.31	96.4	0.013	0.008	A	A	A	A	worms	0.257	-
	28-Apr-18	RG_SC_PCC_52_20180428	21.5	19.3	73.5	oto	6	M	2.32	0.77	70.4	0.011	0.032	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_53_20180428	19.7	17.5	51.5	oto	4	M	0.198	0.90	50.4	0.017	0.004	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_54_20180428	19.8	17.7	53.0	oto	5	M	0.434	0.95	51.6	0.018	0.008	A	M	A	A	-	-	-
	28-Apr-18	RG_SC_PCC_55_20180428	23.4	20.9	115	oto	5	M	0.533	1.15	113	0.010	0.005	A	A	A	A	1x oto, worms	21.8	-
	29-Apr-18	RG_SC_PCC_56_20180429	21.2	19.0	71.0	oto	5	M	2.29	0.83	67.9	0.012	0.032	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_PCC_57_20180429	20.3	18.0	60.0	oto	-	M	2.13	0.64	57.2	0.011	0.035	A	A	A	A	-	-	-
	30-Apr-18	RG_SC_PCC_58_20180430	24.1	21.9	102	oto	6	M	5.30	1.55	95.2	0.015	0.052	A	A	A	A	-	-	-
	30-Apr-18	RG_SC_PCC_59_20180430	24.4	21.9	102	oto	11	M	4.21	1.16	96.6	0.011	0.041	A	A	A	A	-	-	-
	30-Apr-18	RG_SC_PCC_60_20180430	23.4	20.9	105	oto	6	M	0.741	1.59	103	0.015	0.007	A	A	A	A	worms	20.7	-
	total sample size		**60**	**60**	**60**	**-**	**57**	**-**	**58**	**60**	**58**	**60**	**58**	-	-	-	-	**-**	**25**	**-**
	average		**23.9**	**21.5**	**113**	**-**	**6.95**	**-**	**4.59**	**1.61**	**107**	**0.014**	**0.037**	-	-	-	-	**-**	**13.7**	**-**
	median		**24.1**	**21.6**	**114**	**-**	**6.00**	**-**	**3.20**	**1.58**	**108**	**0.014**	**0.037**	-	-	-	-	**-**	**14.4**	**-**
	standard deviation		**2.05**	**1.92**	**31.5**	**-**	**2.92**	**-**	**4.01**	**0.65**	**28.8**	**0.003**	**0.026**	-	-	-	-	**-**	**6.99**	**-**
	standard error		**0.264**	**0.247**	**4.07**	**-**	**0.387**	**-**	**0.527**	**0.08**	**3.78**	**0.000**	**0.003**	-	-	-	-	**-**	**1.40**	**-**
	minimum		**19.3**	**17.5**	**51.5**	**-**	**4**	**-**	**0.198**	**0.63**	**50.4**	**0.007**	**0.003**	-	-	-	-	**-**	**0.257**	**-**
	maximum		**29.3**	**26.5**	**217**	**-**	**18**	**-**	**15.5**	**3.56**	**199**	**0.019**	**0.092**	-	-	-	-	**-**	**25.2**	**-**

Table E.14: Summary Statistics for Peamouth Chub Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structures Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Elk River	25-Apr-18	RG_ER_PCC_01_20180425	26.6	23.9	155	oto	12	F	10.6	2.89	142	0.019	0.068	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_PCC_02_20180425	25.1	23.0	151	oto	5	F	3.40	2.40	145	0.016	0.022	A	A	A	A	worms	22.1	muscle, ovaries
	25-Apr-18	RG_ER_PCC_03_20180425	24.4	22.1	119	oto	7	F	8.62	1.83	109	0.015	0.072	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_PCC_04_20180425	23.7	21.4	128	oto	5	M	0.109	1.14	127	0.009	0.001	A	A	A	A	worms	27.3	-
	25-Apr-18	RG_ER_PCC_05_20180425	23.5	20.9	105	oto	5	M	0.680	1.22	103	0.012	0.006	A	A	A	A	worms	5.13	-
	25-Apr-18	RG_ER_PCC_06_20180425	22.3	21.1	92.0	oto	5	F	4.55	1.22	86.2	0.013	0.049	A	A	A	A	worms	0.0390	muscle, ovaries
	26-Apr-18	RG_ER_PCC_07_20180426	25.6	22.8	136	oto	7	M	6.44	1.51	128	0.011	0.047	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_08_20180426	26.0	23.1	145	oto	6	F	2.85	1.86	140	0.013	0.020	A	A	A	A	worms	32.2	muscle, ovaries
	26-Apr-18	RG_ER_PCC_09_20180426	26.6	24.2	142	oto	11	F	9.07	2.46	130	0.017	0.064	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_ER_PCC_10_20180426	20.2	17.9	52.0	oto	-	U	-	0.44	-	0.009	-	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_11_20180426	26.0	23.4	137	oto	11	F	8.84	1.96	126	0.014	0.065	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_ER_PCC_12_20180426	27.2	24.5	138	oto	13	F	6.16	1.40	130	0.010	0.045	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_ER_PCC_13_20180426	20.6	18.4	58.0	oto	4	M	0.675	0.82	56.5	0.014	0.012	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_14_20180426	20.9	18.7	66.0	oto	5	M	1.34	0.53	64.1	0.008	0.020	A	M	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_15_20180426	21.8	19.5	78.0	oto	5	M	2.17	0.77	75.1	0.010	0.028	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_16_20180426	29.4	26.5	172	oto	15	F	10.3	3.06	159	0.018	0.060	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_ER_PCC_17_20180426	24.7	22.2	117	oto	5	F	3.90	1.61	111	0.014	0.033	A	A	A	A	worms	6.24	muscle, ovaries
	26-Apr-18	RG_ER_PCC_18_20180426	22.9	20.4	84.5	oto	7	M	2.53	0.40	81.6	0.005	0.030	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_19_20180426	21.8	19.5	60.5	oto	4	F	0.634	0.76	59.1	0.012	0.010	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_20_20180426	21.5	19.2	75.0	oto	6	F	4.79	1.04	69.2	0.014	0.064	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_21_20180426	21.5	19.4	82.0	oto	4	M	3.26	0.99	77.8	0.012	0.040	A	A	A	A	-		-
	26-Apr-18	RG_ER_PCC_22_20180426	20.9	18.8	58.5	oto	6	M	1.07	0.54	56.9	0.009	0.018	A	A	A	A	-		-
	26-Apr-18	RG_ER_PCC_23_20180426	23.4	21.1	105	oto	6	M	1.08	1.46	102	0.014	0.010	A	A	A	A	worms	16.7	-
	26-Apr-18	RG_ER_PCC_24_20180426	21.7	19.5	65.0	oto	5	M	2.49	0.63	61.9	0.010	0.038	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_25_20180426	21.3	19.0	71.0	oto	5	F	3.77	1.57	65.7	0.022	0.053	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_25_20180426	23.5	21.2	88.5	oto	5	M	0.356	1.29	86.9	0.015	0.004	A	A	A	A	worms	11.1	-
	26-Apr-18	RG_ER_PCC_27_20180426	27.7	25.4	150	oto	15	F	7.57	2.28	140	0.015	0.050	M	A	A	A		-	-
	26-Apr-18	RG_ER_PCC_28_20180426	21.4	19.1	64.5	oto	5	F	0.665	1.09	62.7	0.017	0.010	A	A	A	A	worms	5.29	-
	26-Apr-18	RG_ER_PCC_29_20180426	21.5	19.1	71.0	oto	5	F	4.47	1.38	65.2	0.019	0.063	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_PCC_30_20180426	24.1	21.8	97.0	oto	12	F	4.83	1.34	90.8	0.014	0.050	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_PCC_31_20180427	24.2	21.6	115	oto	5	M	0.622	1.99	112	0.017	0.005	A	A	A	A	worms	21.7	-
	27-Apr-18	RG_ER_PCC_32_20180427	27.3	24.6	154	oto	14	F	9.19	2.85	142	0.018	0.060	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_PCC_33_20180427	26.6	23.7	165	oto	6	F	6.60	2.40	156	0.015	0.040	A	A	A	A	worms	19.0	-
	27-Apr-18	RG_ER_PCC_34_20180427	27.2	24.1	129	oto	15	F	6.27	1.28	121	0.010	0.049	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_PCC_35_20180427	20.7	18.5	60.0	oto	5	M	1.87	0.71	57.4	0.012	0.031	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_PCC_36_20180427	29.2	26.3	178	oto	14	F	9.70	3.53	165	0.020	0.054	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_PCC_37_20180428	22.0	19.7	83.0	oto	6	M	4.80	1.05	77.2	0.013	0.058	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_PCC_38_20180428	24.7	22.0	112	oto	5	M	5.32	0.86	106	0.008	0.048	M	A	A	A	-	-	-
	28-Apr-18	RG_ER_PCC_39_20180428	25.5	22.9	146	oto	7	M	1.12	1.08	144	0.007	0.008	A	A	A	A	worms	25.9	-
	28-Apr-18	RG_ER_PCC_40_20180428	24.4	22.0	118	oto	6	M	4.67	0.21	113	0.002	0.040	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_PCC_41_20180428	24.2	21.7	101	oto	5	F	0.542	1.04	99.4	0.010	0.005	A	A	A	A	-	17.9	-
	28-Apr-18	RG_ER_PCC_42_20180428	20.0	18.0	58.0	oto	6	M	0.691	0.75	56.6	0.013	0.012	A	M	A	A	minor erosion		-
	28-Apr-18	RG_ER_PCC_43_20180428	23.3	20.9	110	oto	5	M	0.743	1.34	108	0.012	0.007	A	A	A	A	worms	20.3	-
	28-Apr-18	RG_ER_PCC_44_20180428	20.9	18.7	68.0	oto	4	M	0.311	1.06	66.6	0.016	0.005	A	A	A	A	worms	3.08	-
	28-Apr-18	RG_ER_PCC_45_20180428	20.6	18.5	65.0	oto	4	M	1.26	0.71	63.0	0.011	0.019	A	A	A	A	worms	0.133	-
	28-Apr-18	RG_ER_PCC_46_20180428	20.7	18.4	63.0	oto	4	M	0.334	0.80	61.9	0.013	0.005	A	A	A	A	worms	4.60	-
	29-Apr-18	RG_ER_PCC_47_20180429	24.3	21.8	124	oto	6	M	1.15	2.09	121	0.017	0.009	A	A	A	A	worms	16.4	-
	29-Apr-18	RG_ER_PCC_48_20180429	24.0	21.5	118	oto	5	M	0.458	1.60	116	0.014	0.004	A	A	A	A	worms	20.0	-
	29-Apr-18	RG_ER_PCC_49_20180429	21.0	18.7	68.5	oto	4	M	1.40	0.91	66.2	0.013	0.020	A	M	A	A	-	-	-
	29-Apr-18	RG_ER_PCC_50_20180429	19.1	16.8	42.5	oto	4	M	0.192	0.35	42.0	0.008	0.005	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_PCC_51_20180429	20.5	18.3	57.0	oto	5	M	0.419	0.74	55.8	0.013	0.007	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_PCC_52_20180429	20.4	18.0	62.0	oto	5	M	1.71	0.69	59.6	0.011	0.028	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_PCC_53_20180429	21.0	18.8	73.0	oto	5	M	3.76	1.32	67.9	0.018	0.051	A	A	A	A	-	-	-
	30-Apr-18	RG_ER_PCC_54_20180430	23.7	21.4	113	oto	5	M	1.52	1.35	110	0.012	0.013	A	A	A	A	worms	9.84	-
	30-Apr-18	RG_ER_PCC_55_20180430	24.1	21.8	119	oto	5	M	1.50	1.75	116	0.015	0.013	A	M	A	A	worms	12.8	-
	30-Apr-18	RG_ER_PCC_56_20180430	23.0	20.8	105	oto	5	M	0.541	0.95	103	0.009	0.005	A	A	A	A	worms	20.5	-
	30-Apr-18	RG_ER_PCC_57_20180430	22.4	20.1	92.0	oto	5	M	0.786	1.46	89.8	0.016	0.009	A	A	A	A	worms	10.1	-
	30-Apr-18	RG_ER_PCC_58_20180430	23.4	20.9	103	oto	5	M	0.933	1.32	101	0.013	0.009	A	A	A	A	worms	16.4	-
	total sample size		**58**	**58**	**58**	**-**	**57**	**-**	**57**	**58**	**57**	**58**	**57**	-	-	-	-	**-**	**24**	**-**
	average		**23.4**	**21.0**	**101**	**-**	**6.60**	**-**	**3.26**	**1.35**	**97.4**	**0.013**	**0.029**	-	-	-	-	**-**	**14.4**	**-**
	median		**23.4**	**21.0**	**102**	**-**	**5.00**	**-**	**1.87**	**1.25**	**101**	**0.013**	**0.022**	-	-	-	-	**-**	**16.4**	**-**
	standard deviation		**2.47**	**2.29**	**35.4**	**-**	**3.23**	**-**	**3.06**	**0.72**	**32.6**	**0.0038**	**0.022**	-	-	-	-	**-**	**8.85**	**-**
	standard error		**0.324**	**0.300**	**4.64**	**-**	**0.428**	**-**	**0.406**	**0.09**	**4.31**	**0.0005**	**0.0029**	-	-	-	-	**-**	**1.81**	**-**
	minimum		**19.1**	**16.8**	**42.5**	**-**	**4**	**-**	**0.109**	**0.21**	**42.0**	**0.0018**	**0.0009**	-	-	-	-	**-**	**0.0390**	**-**
	maximum		**29.4**	**26.5**	**178**	**-**	**15**	**-**	**10.6**	**3.53**	**165**	**0.022**	**0.072**	-	-	-	-		**32.2**	**-**

Table E.14: **Summary Statistics for Peamouth Chub Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structures Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/ Minor[M]/ Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Gold Creek	25-Apr-18	RG_GC_PCC_01_20180425	23.9	21.4	108	oto	8	F	10.64	2.04	95.3	0.019	0.099	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_GC_PCC_02_20180425	25.0	22.8	128	oto	6	F	2.38	1.53	124	0.012	0.019	A	A	A	A	worms	20.6	muscle, ovaries
	25-Apr-18	RG_GC_PCC_03_20180425	22.4	19.9	96.0	oto	6	M	0.72	1.84	93.4	0.019	0.0075	A	A	A	A	worms	3.85	-
	25-Apr-18	RG_GC_PCC_04_20180425	21.9	19.8	87.0	oto	7	F	4.75	2.57	79.7	0.030	0.055	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_GC_PCC_05_20180425	23.4	20.9	96.0	oto	7	M	0.61	1.07	94.3	0.011	0.0064	A	A	A	A	worms	12.0	-
	25-Apr-18	RG_GC_PCC_06_20180425	23.2	20.9	98.0	oto	4	M	1.09	1.48	95.4	0.015	0.011	A	A	A	A	worms	6.24	-
	25-Apr-18	RG_GC_PCC_07_20180425	23.1	20.5	99.0	oto	4	M	0.40	1.33	97.3	0.013	0.0041	A	A	A	A	worms	15.3	-
	25-Apr-18	RG_GC_PCC_08_20180425	24.2	22.0	118	oto	5	F	8.67	2.13	107	0.018	0.073	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_09_20180426	26.4	23.7	134	oto	9	F	8.90	2.51	123	0.019	0.066	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_10_20180426	24.2	22.1	123	oto	5	M	0.45	1.56	121	0.013	0.0037	A	A	A	A	worms	20.3	-
	26-Apr-18	RG_GC_PCC_11_20180426	23.4	20.7	105	oto	6	F	7.66	3.48	93.9	0.033	0.073	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_12_20180426	22.8	20.3	92.0	oto	5	M	0.93	1.55	89.5	0.017	0.010	A	A	A	A	worms	10.5	-
	26-Apr-18	RG_GC_PCC_13_20180426	25.1	22.5	121	oto	8	M	0.39	1.89	119	0.016	0.0032	A	A	A	A	worms	20.6	-
	26-Apr-18	RG_GC_PCC_14_20180426	27.1	24.6	154	oto	11	F	12.30	3.04	139	0.020	0.080	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_15_20180426	26.5	23.8	148	oto	7	F	12.67	2.77	133	0.019	0.086	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_16_20180426	22.3	19.8	81.0	oto	7	M	2.88	1.39	76.7	0.017	0.036	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_17_20180426	22.1	19.9	74.5	oto	5	F	4.22	1.13	69.2	0.015	0.057	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_18_20180426	26.6	24.3	154	oto	7	F	16.01	3.90	134	0.025	0.10	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_GC_PCC_19_20180426	22.7	20.5	104	oto	5	M	0.36	1.43	102	0.014	0.0035	A	A	A	A	worms	10.9	-
	26-Apr-18	RG_GC_PCC_20_20180426	26.4	23.7	160	oto	6	F	12.66	2.91	144	0.018	0.079	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_21_20180426	23.2	20.9	90.0	oto	6	F	5.92	2.21	81.9	0.025	0.066	A	A	A	A	worms	3.06	-
	26-Apr-18	RG_GC_PCC_22_20180426	23.2	20.9	102	oto	7	F	4.46	1.39	96.2	0.014	0.044	A	A	A	A	worms	9.49	-
	26-Apr-18	RG_GC_PCC_23_20180426	22.4	19.8	81.5	oto	5	M	0.39	1.09	80.0	0.013	0.0048	A	A	A	A	worms	19.5	-
	26-Apr-18	RG_GC_PCC_24_20180426	24.0	21.3	119	oto	7	M	3.76	2.23	113	0.019	0.032	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_25_20180426	26.9	24.5	153	oto	11	F	10.23	3.06	140	0.020	0.067	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_26_20180426	22.1	19.7	73.5	oto	5	F	2.35	1.08	70.1	0.015	0.032	A	A	A	A	worms	5.44	-
	26-Apr-18	RG_GC_PCC_27_20180426	26.0	23.5	148	oto	7	F	6.25	2.62	139	0.018	0.042	A	A	A	A	worms	16.4	-
	26-Apr-18	RG_GC_PCC_28_20180426	23.9	21.5	111	oto	7	F	9.76	2.00	99.2	0.018	0.088	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_29_20180426	24.9	22.4	127	oto	5	F	11.01	2.64	113	0.021	0.087	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_30_20180426	25.9	23.4	138	oto	11	F	9.40	1.80	127	0.013	0.068	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_31_20180426	23.5	21.1	80.0	oto	7	F	3.77	1.03	75.2	0.013	0.047	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_32_20180426	22.9	21.6	99.0	oto	5	F	7.49	2.02	89.5	0.020	0.076	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_33_20180426	23.9	21.5	115	oto	6	F	1.38	1.69	112	0.015	0.012	A	A	A	A	worms	19.3	-
	26-Apr-18	RG_GC_PCC_34_20180426	25.4	22.5	130	oto	6	F	1.61	0.99	127	0.008	0.012	A	A	A	A	worms	23.8	-
	26-Apr-18	RG_GC_PCC_35_20180426	24.2	21.8	118	oto	7	F	1.33	1.48	115	0.013	0.011	A	A	A	A	worms	22.3	-
	26-Apr-18	RG_GC_PCC_36_20180426	21.5	19.3	70.5	oto	5	M	2.09	1.06	67.3	0.015	0.030	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_37_20180426	21.3	19.1	82.0	oto	4	M	0.30	1.31	80.4	0.016	0.004	A	A	A	A	worms	9.46	-
	26-Apr-18	RG_GC_PCC_38_20180426	23.1	20.5	86.5	oto	6	M	2.97	1.37	82.2	0.016	0.034	A	A	A	A	fatty liver	-	-
	26-Apr-18	RG_GC_PCC_39_20180426	23.1	20.8	84.5	oto	6	M	3.03	1.53	79.9	0.018	0.036	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_40_20180426	21.9	19.5	94.0	oto	6	M	0.20	1.27	92.5	0.013	0.002	A	A	A	A	worms	23.1	-
	26-Apr-18	RG_GC_PCC_41_20180426	22.1	20.0	83.0	oto	6	M	0.53	1.29	81.2	0.016	0.006	A	A	A	A	worms	10.9	-
	26-Apr-18	RG_GC_PCC_42_20180426	22.8	20.2	99.0	oto	7	M	1.14	1.28	96.6	0.013	0.011	A	A	A	A	worms	9.99	-
	26-Apr-18	RG_GC_PCC_43_20180426	20.9	18.5	69.0	oto	4	M	2.22	0.85	65.9	0.012	0.032	A	A	A	A	-	-	-
	26-Apr-18	RG_GC_PCC_44_20180426	22.4	20.2	90.5	oto	5	M	1.78	1.52	87.2	0.017	0.020	A	A	A	A	worms	0.238	-
	26-Apr-18	RG_GC_PCC_45_20180426	22.1	19.6	98.0	oto	5	M	0.63	1.30	96.1	0.013	0.006	A	A	A	A	worms	24.6	-
	26-Apr-18	RG_GC_PCC_46_20180426	22.7	19.5	79.0	oto	4	M	0.51	1.17	77.3	0.015	0.006	A	A	A	A	worms	5.24	-
	26-Apr-18	RG_GC_PCC_47_20180426	24.9	22.5	119	oto	11	M	0.80	1.28	117	0.011	0.007	A	A	A	A	worms	7.27	-
	27-Apr-18	RG_GC_PCC_48_20180427	24.6	22.0	123	oto	9	M	1.37	1.79	120	0.015	0.011	A	A	A	A	worms	13.2	-
	27-Apr-18	RG_GC_PCC_49_20180427	22.7	20.5	95.0	oto	5	M	1.89	1.44	91.7	0.015	0.020	A	A	A	A	worms	11.6	-
	27-Apr-18	RG_GC_PCC_50_20180427	21.5	19.4	78.0	oto	5	M	0.36	0.77	76.9	0.010	0.005	A	A	A	A	worms	12.0	-
	27-Apr-18	RG_GC_PCC_51_20180427	25.1	22.5	130	oto	4	M	2.38	1.06	127	0.008	0.018	A	A	A	A	-	-	-
	27-Apr-18	RG_GC_PCC_52_20180427	23.6	21.1	125	oto	8	M	5.22	2.20	118	0.018	0.042	A	A	A	A	-	-	-
	27-Apr-18	RG_GC_PCC_53_20180427	22.3	19.8	78.0	oto	5	M	0.59	0.86	76.6	0.011	0.008	A	A	A	A	worms	11.2	-
	27-Apr-18	RG_GC_PCC_54_20180427	23.1	21.2	112	oto	6	M	0.25	1.03	111	0.009	0.002	A	A	A	A	worms	12.9	-
	27-Apr-18	RG_GC_PCC_55_20180427	23.5	21.2	109	oto	6	M	0.68	1.27	107	0.012	0.006	A	A	A	A	worms	19.4	-
	27-Apr-18	RG_GC_PCC_56_20180427	24.6	22.3	112	oto	10	M	5.03	1.34	106	0.012	0.045	A	A	A	A	-	-	-
	27-Apr-18	RG_GC_PCC_57_20180427	25.0	22.4	132	oto	6	F	1.67	1.27	129	0.010	0.013	A	A	A	A	worms	23.0	
	27-Apr-18	RG_GC_PCC_58_20180427	24.0	21.1	91.0	oto	6	M	1.37	0.72	88.9	0.008	0.015	A	A	A	A	-	-	-
	27-Apr-18	RG_GC_PCC_59_20180427	23.8	21.5	123	oto	5	M	0.56	1.12	121	0.009	0.005	A	A	A	A	worms	26.7	-
	27-Apr-18	RG_GC_PCC_60_20180427	23.9	21.8	112	oto	8	M	6.09	1.87	104	0.017	0.054	A	A	A	A	-	-	-
	27-Apr-18	RG_GC_PCC_61_20180427	22.9	20.7	104	oto	5	M	0.50	1.20	102	0.012	0.005	A	A	A	A	worms	16.8	-
	total sample size		**61**	**61**	**61**	**-**	**61**	**-**	**61**	**61**	**61**	**61**	**61**	-	-	-	-	**-**	**34**	**-**
	average		**23.7**	**21.3**	**107**	**-**	**6.34**	**-**	**3.80**	**1.67**	**102**	**0.015**	**0.033**	-	-	-	-	**-**	**14.0**	**-**
	median		**23.4**	**21.1**	**104**	**-**	**6.00**	**-**	**2.09**	**1.44**	**97.3**	**0.015**	**0.020**	-	-	-	-	**-**	**12.4**	**-**
	standard deviation		**1.50**	**1.45**	**23.4**	**-**	**1.81**	**-**	**4.02**	**0.69**	**20.9**	**0.005**	**0.030**	-	-	-	-	**-**	**6.99**	**-**
	standard error		**0.19**	**0.19**	**3.00**	**-**	**0.23**	**-**	**0.52**	**0.09**	**2.68**	**0.001**	**0.004**	-	-	-	-	**-**	**1.20**	**-**
	minimum		**20.9**	**18.5**	**69.0**	**-**	**4**	**-**	**0.20**	**0.72**	**65.9**	**0.008**	**0.002**	-	-	-	-	**-**	**0.24**	**-**
	maximum		**27.1**	**24.6**	**160**	**-**	**11**	**-**	**16.0**	**3.90**	**144**	**0.033**	**0.104**	-	-	-	-	**-**	**26.7**	**-**

[a] Age structures collected: oto - otoliths.

[b] Adjusted body weight represents whole body weight less the liver weight and gonad weight and used for statistical analyses.

Table E.15: **Summary Statistics for Redside Shiner Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Sand Creek	24-Apr-18	RG_SC_RSC_01_20180424	10.0	8.90	7.67	oto	-	U	-	0.066	-	0.009	-	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_RSC_02_20180424	10.8	9.40	9.80	oto	4	F	0.334	0.168	9.30	0.017	0.034	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_RSC_03_20180424	10.1	8.70	7.71	oto	-	U	-	0.104	-	0.013	-	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_RSC_04_20180424	9.10	7.90	6.78	oto	2	F	0.188	0.182	6.41	0.027	0.028	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_RSC_05_20180424	10.7	9.20	8.54	oto	3	F	0.251	0.082	8.20	0.010	0.029	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_RSC_06_20180424	9.60	8.40	6.78	oto	3	F	0.228	0.025	6.52	0.004	0.034	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_RSC_07_20180424	10.2	8.80	7.96	oto	-	U	-	0.105	-	0.013	-	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_RSC_08_20180424	11.5	10.0	13.1	oto	4	M	0.153	0.123	12.9	0.009	0.012	A	A	A	A	-	-	-
	24-Apr-18	RG_SC_RSC_09_20180424	9.20	8.00	6.04	oto	3	F	0.092	0.103	5.85	0.017	0.015	A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_SC_RSC_10_20180424	10.0	8.60	7.28	oto	2	F	0.261	0.037	6.98	0.005	0.036	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_SC_RSC_11_20180426	10.5	9.10	9.59	oto	3	F	0.499	0.183	8.91	0.019	0.052	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_SC_RSC_12_20180426	10.2	8.90	8.14	oto	3	M	0.029	0.062	8.05	0.008	0.004	A	M	A	A	-	-	-
	26-Apr-18	RG_SC_RSC_13_20180426	12.3	10.7	15.8	oto	3	F	0.627	0.192	15.0	0.012	0.040	A	A	A	A	-	-	muscle, ovaries
	26-Apr-18	RG_SC_RSC_14_20180426	10.5	9.00	8.65	oto	3	M	0.092	0.052	8.51	0.006	0.011	A	A	A	A	-	-	-
	26-Apr-18	RG_SC_RSC_15_20180426	9.60	8.10	7.22	oto	3	M	0.065	0.096	7.06	0.013	0.009	A	A	A	A	worms	0.704	-
	27-Apr-18	RG_SC_RSC_16_20180427	10.1	8.60	7.60	oto	2	M	0.045	0.190	7.37	0.025	0.006	A	A	A	A	-	-	-
	27-Apr-18	RG_SC_RSC_17_20180427	11.2	9.30	10.1	oto	3	F	0.379	0.153	9.58	0.015	0.037	A	A	A	A	worms	0.136	muscle, ovaries
	27-Apr-18	RG_SC_RSC_18_20180427	12.6	11.0	20.3	oto	4	F	0.561	0.285	19.4	0.014	0.028	A	M	A	A	worms	2.72	muscle, ovaries
	27-Apr-18	RG_SC_RSC_19_20180427	10.7	9.60	11.8	oto	3	M	0.434	0.144	11.3	0.012	0.037	A	M	A	A	-	-	-
	27-Apr-18	RG_SC_RSC_20_20180427	11.9	10.5	12.9	oto	4	F	0.597	0.130	12.1	0.010	0.046	A	A	A	A	-	-	-
	27-Apr-18	RG_SC_RSC_21_20180427	11.3	9.60	10.9	oto	3	M	0.202	0.040	10.7	0.004	0.019	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_22_20180428	11.0	9.40	10.4	oto	3	M	0.137	0.207	10.1	0.020	0.013	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_23_20180428	9.80	8.50	7.33	oto	3	M	0.079	0.082	7.16	0.011	0.011	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_24_20180428	10.3	9.00	9.32	oto	4	F	0.358	0.099	8.86	0.011	0.038	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_25_20180428	11.3	10.0	11.8	oto	3	M	0.072	0.123	11.6	0.010	0.006	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_26_20180428	10.0	8.90	8.62	oto	3	F	0.296	0.199	8.13	0.023	0.034	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_27_20180428	10.9	9.50	10.3	oto	3	M	0.082	0.159	10.1	0.015	0.008	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_28_20180428	10.3	9.00	8.69	oto	3	M	0.063	0.084	8.55	0.010	0.007	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_29_20180428	10.7	9.30	10.6	oto	4	F	0.574	0.258	9.77	0.024	0.054	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_30_20180428	11.6	10.0	10.9	oto	5	M	0.098	0.031	10.7	0.003	0.009	A	A	A	A	worms	0.0390	-
	28-Apr-18	RG_SC_RSC_31_20180428	11.7	10.2	13.7	oto	4	F	0.611	0.203	12.9	0.015	0.045	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_32_20180428	11.5	10.2	13.1	oto	3	F	0.687	0.348	12.1	0.027	0.052	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_33_20180428	12.4	10.6	16.6	oto	3	F	0.524	0.349	15.7	0.021	0.032	A	A	A	A	worms	0.196	-
	28-Apr-18	RG_SC_RSC_34_20180428	11.0	9.50	11.6	oto	4	F	0.715	0.190	10.7	0.016	0.062	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_35_20180428	10.0	8.90	8.70	oto	3	M	0.047	0.086	8.56	0.010	0.005	A	A	A	A	worms	0.453	-
	28-Apr-18	RG_SC_RSC_36_20180428	11.1	9.40	9.67	oto	3	M	0.214	0.144	9.31	0.015	0.022	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_37_20180428	11.2	9.80	10.9	oto	3	M	0.019	0.102	10.8	0.009	0.002	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_38_20180428	10.3	9.00	9.23	oto	3	M	0.117	0.053	9.06	0.006	0.013	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_39_20180428	11.4	9.90	11.8	oto	4	M	0.118	0.330	11.3	0.028	0.010	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_40_20180428	12.3	10.7	15.2	oto	5	F	0.688	0.176	14.3	0.012	0.045	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_41_20180428	11.4	9.90	12.2	oto	3	F	0.487	0.084	11.6	0.007	0.040	A	A	A	A	worms	0.720	-
	28-Apr-18	RG_SC_RSC_42_20180428	11.6	10.2	12.3	oto	4	F	0.667	0.155	11.5	0.013	0.054	A	M	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_43_20180428	11.9	10.3	12.5	oto	5	M	0.147	0.260	12.1	0.021	0.012	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_44_20180428	9.50	8.30	6.75	oto	3	M	0.070	0.014	6.67	0.002	0.010	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_45_20180428	12.1	10.5	15.1	oto	6	F	0.330	0.154	14.6	0.010	0.022	A	A	A	A	worms	1.46	-
	28-Apr-18	RG_SC_RSC_46_20180428	12.3	10.9	16.6	oto	4	F	0.795	0.370	15.5	0.022	0.048	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_47_20180428	12.1	10.7	14.1	oto	5	F	0.710	0.159	13.3	0.011	0.050	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_48_20180428	10.0	8.70	8.58	oto	[c]	M	0.057	0.168	8.36	0.020	0.007	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_49_20180428	11.6	9.90	11.8	oto	4	M	0.123	0.166	11.5	0.014	0.010	A	M	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_50_20180428	10.0	8.90	8.27	oto	3	F	0.295	0.090	7.89	0.011	0.036	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_51_20180428	8.70	7.50	4.82	oto	3	F	0.177	0.093	4.55	0.019	0.037	A	M	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_52_20180428	11.5	7.10	12.6	oto	4	M	0.179	0.169	12.2	0.013	0.014	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_53_20180428	11.0	9.50	11.4	oto	3	M	0.163	0.111	11.2	0.010	0.014	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_54_20180428	11.1	8.50	11.5	oto	3	M	0.158	0.117	11.2	0.010	0.014	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_55_20180428	11.1	9.50	10.6	oto	3	M	0.111	0.159	10.3	0.015	0.011	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_56_20180428	10.0	8.60	8.46	oto	2	F	0.066	0.071	8.32	0.008	0.008	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_57_20180428	10.5	9.10	9.14	oto	4	F	0.400	0.126	8.61	0.014	0.044	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_58_20180428	9.70	8.60	7.14	oto	4	M	0.035	0.083	7.03	0.012	0.005	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_59_20180428	10.6	9.10	9.16	oto	3	M	0.044	0.076	9.04	0.008	0.005	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_60_20180428	10.1	8.90	9.18	oto	3	F	0.078	0.164	8.94	0.018	0.008	A	M	A	A	worms	0.948	-
	28-Apr-18	RG_SC_RSC_61_20180428	11.1	9.60	11.5	oto	5	F	0.102	0.203	11.2	0.018	0.009	A	A	A	A	worms	0.298	-
	29-Apr-18	RG_SC_RSC_62_20180429	13.3	11.6	19.2	oto	6	F	1.257	0.293	17.7	0.015	0.065	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_63_20180429	10.2	8.90	9.14	oto	2	M	0.040	0.119	8.98	0.013	0.004	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_64_20180429	11.4	9.70	11.3	oto	3	M	0.198	0.133	11.0	0.012	0.017	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_65_20180428	11.7	10.1	12.1	oto	3	F	0.582	0.213	11.3	0.018	0.048	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_66_20180429	13.5	11.8	20.3	oto	5	F	0.808	0.473	19.0	0.023	0.040	A	A	A	A	worms	0.237	-
	29-Apr-18	RG_SC_RSC_67_20180429	9.90	8.60	8.42	oto	3	M	0.085	0.158	8.18	0.019	0.010	A	M	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_68_20180429	11.0	9.50	11.2	oto	4	M	0.120	0.180	10.9	0.016	0.011	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_69_20180428	10.5	9.10	9.07	oto	3	F	0.389	0.052	8.63	0.006	0.043	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_70_20180429	9.70	8.40	7.45	oto	3	M	0.131	0.110	7.21	0.015	0.018	A	A	A	A	-	-	-
	28-Apr-18	RG_SC_RSC_71_20180428	11.5	10.0	12.2	oto	4	F	0.577	0.172	11.5	0.014	0.047	A	M	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_72_20180429	12.9	11.3	17.4	oto	5	M	0.180	0.211	17.0	0.012	0.010	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_73_20180429	10.4	9.00	8.98	oto	3	M	0.093	0.052	8.84	0.006	0.010	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_74_20180429	10.5	9.00	9.11	oto	2	M	0.137	0.126	8.85	0.014	0.015	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_75_20180429	11.6	10.1	12.6	oto	4	F	0.179	0.220	12.2	0.017	0.014	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_76_20180429	11.8	10.2	14.0	oto	3	M	0.179	0.220	13.6	0.016	0.013	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_77_20180429	10.5	9.40	9.22	oto	3	M	0.061	0.117	9.04	0.013	0.007	A	M	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_78_20180429	10.9	9.50	9.68	oto	3	M	0.062	0.147	9.47	0.015	0.006	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_79_20180429	11.8	10.3	12.4	oto	4	M	0.154	0.114	12.1	0.009	0.012	A	M	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_80_20180429	11.2	9.50	10.8	oto	3	M	0.108	0.099	10.6	0.009	0.010	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_81_20180429	11.7	10.3	14.2	oto	4	M	0.295	0.220	13.6	0.016	0.021	A	A	A	A	-	-	-

Table E.15: **Summary Statistics for Redside Shiner Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Sand Creek	29-Apr-18	RG_SC_RSC_82_20180429	11.1	9.50	10.7	oto	5	M	0.126	0.107	10.5	0.010	0.012	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_83_20180429	10.2	8.80	8.49	oto	3	M	0.140	0.145	8.21	0.017	0.016	A	A	A	A	worms	0.0200	-
	29-Apr-18	RG_SC_RSC_84_20180429	10.7	9.30	9.96	oto	3	M	0.152	0.138	9.67	0.014	0.015	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_85_20180429	9.90	8.50	8.22	oto	3	M	0.077	0.091	8.05	0.011	0.009	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_86_20180429	10.7	9.50	9.89	oto	3	M	0.119	0.119	9.65	0.012	0.012	A	A	A	A	-	-	-
	29-Apr-18	RG_SC_RSC_87_20180429	11.1	9.70	11.2	oto	4	M	0.168	0.233	10.8	0.021	0.015	A	A	A	A	-	-	-
	total sample size		**87**	**87**	**87**	**-**	**83**	**-**	**84**	**87**	**84**	**87**	**84**	**-**	**-**	**-**	**-**	**-**	**12**	**-**
	average		**10.9**	**9.43**	**10.7**	**-**	**3.45**	**-**	**0.264**	**0.149**	**10.4**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.661**	**-**
	median		**10.9**	**9.40**	**10.3**	**-**	**3.00**	**-**	**0.161**	**0.138**	**10.1**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.376**	**-**
	standard deviation		**0.937**	**0.870**	**3.08**	**-**	**0.859**	**-**	**0.242**	**0.082**	**2.87**	**0.01**	**0.02**	**-**	**-**	**-**	**-**	**-**	**0.776**	**-**
	standard error		**0.100**	**0.0933**	**0.330**	**-**	**0.0943**	**-**	**0.026**	**0.009**	**0.313**	**0.001**	**0.002**	**-**	**-**	**-**	**-**	**-**	**0.224**	**-**
	minimum		**8.70**	**7.10**	**4.82**	**-**	**2.00**	**-**	**0.019**	**0.014**	**4.55**	**0.00**	**0.00**	**-**	**-**	**-**	**-**	**-**	**0.0200**	**-**
	maximum		**13.5**	**11.8**	**20.3**	**-**	**6.00**	**-**	**1.26**	**0.473**	**19.4**	**0.0**	**0.1**	**-**	**-**	**-**	**-**	**-**	**2.72**	**-**
Elk River	25-Apr-18	RG_ER_RSC_01_20180425	11.2	10.1	13.3	oto	4	F	0.735	0.265	12.3	0.020	0.055	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_02_20180425	10.6	9.20	9.96	oto	3	M	0.066	0.154	9.74	0.015	0.007	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_03_20180425	10.5	9.10	8.32	oto	-	U	-	0.090	-	0.011	-	A	A	A	A	worms	0.797	-
	25-Apr-18	RG_ER_RSC_04_20180425	9.80	8.70	6.91	oto	3	M	0.042	0.041	6.83	0.006	0.006	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_05_20180425	10.8	9.50	11.1	oto	3	M	2.888	0.155	8.04	0.014	0.261	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_06_20180425	10.9	9.50	10.3	oto	3	M	0.112	0.147	10.0	0.014	0.011	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_07_20180425	10.9	9.40	10.3	oto	4	F	0.459	0.103	9.78	0.010	0.044	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_08_20180425	12.1	10.5	13.4	oto	5	F	0.584	0.343	12.5	0.026	0.044	A	A	A	A	worms	0.0960	muscle, ovaries
	25-Apr-18	RG_ER_RSC_09_20180425	10.1	8.90	7.90	oto	3	F	0.271	0.197	7.43	0.025	0.034	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_10_20180425	10.6	9.30	8.77	oto	3	F	0.039	0.140	8.59	0.016	0.004	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_11_20180425	10.7	9.50	10.7	oto	3	F	0.478	0.173	10.1	0.016	0.045	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_12_20180425	10.5	9.30	9.03	oto	4	F	0.263	0.202	8.56	0.022	0.029	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_13_20180425	9.80	8.50	8.03	oto	3	M	0.061	0.176	7.80	0.022	0.008	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_14_20180425	9.90	8.60	7.40	oto	3	F	0.238	0.150	7.01	0.020	0.032	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_15_20180425	9.70	8.60	7.27	oto	3	F	0.213	0.135	6.92	0.019	0.029	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_16_20180425	9.70	8.50	8.24	oto	3	F	0.086	0.192	7.96	0.023	0.010	A	A	A	A	worms	1.40	muscle, ovaries
	25-Apr-18	RG_ER_RSC_17_20180425	10.6	9.20	8.52	oto	3	M	0.143	0.063	8.31	0.007	0.017	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_18_20180425	10.0	8.70	8.73	oto	-	U	0.025	0.065	8.64	0.007	0.003	A	A	A	A	worms	1.07	-
	25-Apr-18	RG_ER_RSC_19_20180425	10.5	9.30	9.03	oto	3	F	0.347	0.148	8.54	0.016	0.038	A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_ER_RSC_20_20180425	9.40	8.50	6.77	oto	-	U	0.024	0.123	6.62	0.018	0.004	A	A	A	A	worms	0.476	-
	25-Apr-18	RG_ER_RSC_21_20180425	10.0	8.60	7.82	oto	3	F	0.198	0.083	7.54	0.011	0.025	A	A	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_22_20180425	10.8	9.30	9.65	oto	3	F	0.290	0.243	9.12	0.025	0.030	A	M	A	A	-	-	-
	25-Apr-18	RG_ER_RSC_23_20180425	10.3	8.90	9.32	oto	3	M	0.090	0.128	9.10	0.014	0.010	A	A	A	A	cut tail fin	-	-
	26-Apr-18	RG_ER_RSC_24_20180426	12.1	10.4	15.2	oto	4	M	0.144	0.234	14.8	0.015	0.010	A	M	A	A	worms	0.0930	-
	26-Apr-18	RG_ER_RSC_25_20180426	12.1	10.5	14.6	oto	5	F	0.692	0.169	13.7	0.012	0.048	A	A	A	A	missing half of caudal fin	-	-
	26-Apr-18	RG_ER_RSC_26_20180426	12.2	10.3	13.8	oto	4	F	0.353	0.336	13.1	0.024	0.026	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_27_20180426	10.5	9.20	9.12	oto	3	F	0.155	0.167	8.80	0.018	0.017	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_28_20180426	11.9	10.5	13.9	oto	3	F	0.417	0.096	13.4	0.007	0.030	M	A	A	A	worms, broken operculum	0.200	-
	26-Apr-18	RG_ER_RSC_29_20180426	11.0	9.11	11.8	oto	3	F	0.681	0.188	10.9	0.016	0.058	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_30_20180426	11.2	9.80	10.9	oto	3	M	0.083	0.160	10.6	0.015	0.008	A	A	A	A	worms	0.00600	-
	26-Apr-18	RG_ER_RSC_31_20180426	11.0	9.70	10.3	oto	3	M	0.124	0.029	10.2	0.003	0.012	A	M	A	A	worms, missing half of caudal fin	0.309	-
	26-Apr-18	RG_ER_RSC_32_20180426	10.1	8.90	8.26	oto	3	F	0.137	0.140	7.99	0.017	0.017	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_33_20180426	10.2	8.90	7.96	oto	3	M	0.084	0.149	7.73	0.019	0.011	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_34_20180426	11.8	10.5	13.3	oto	4	M	0.071	0.119	13.2	0.009	0.005	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_35_20180426	11.9	10.5	14.6	oto	4	F	0.566	0.248	13.8	0.017	0.039	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_36_20180426	11.5	9.90	11.7	oto	4	M	0.088	0.195	11.4	0.017	0.008	A	A	A	A	worms	0.711	-
	26-Apr-18	RG_ER_RSC_37_20180426	10.0	8.50	7.63	oto	4	M	0.064	0.175	7.39	0.023	0.008	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_38_20180426	9.80	8.40	7.53	oto	2	M	0.017	0.146	7.37	0.019	0.002	A	A	A	A	worms	0.0400	-
	26-Apr-18	RG_ER_RSC_39_20180426	10.0	8.60	8.08	oto	3	M	0.032	0.110	7.94	0.014	0.004	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_40_20180426	10.5	9.10	8.61	oto	3	M	0.083	0.113	8.41	0.013	0.010	A	A	A	A	-	-	-
	26-Apr-18	RG_ER_RSC_41_20180426	10.0	8.60	7.87	oto	3	M	0.096	0.075	7.70	0.010	0.012	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_42_20180427	11.6	10.5	15.2	oto	3	M	0.181	0.156	14.9	0.010	0.012	A	A	A	A	worms	1.11	-
	27-Apr-18	RG_ER_RSC_43_20180427	11.7	10.3	12.9	oto	3	M	0.093	0.115	12.7	0.009	0.007	A	M	A	A	missing half of caudal fin	-	-
	27-Apr-18	RG_ER_RSC_44_20180427	10.4	9.00	7.85	oto	3	F	0.296	0.103	7.45	0.013	0.038	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_45_20180427	11.1	9.70	10.0	oto	5	M	0.051	0.101	9.86	0.010	0.005	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_46_20180427	9.90	8.50	8.94	oto	3	F	0.496	0.192	8.25	0.021	0.055	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_47_20180427	10.5	9.30	9.12	oto	2	M	0.122	0.211	8.79	0.023	0.013	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_48_20180427	12.0	10.4	13.7	oto	5	F	0.444	0.218	13.0	0.016	0.032	A	A	A	A	worms	0.282	-
	27-Apr-18	RG_ER_RSC_49_20180427	11.4	10.5	11.3	oto	4	M	0.077	0.280	11.0	0.025	0.007	A	A	A	A	-	-	-
	27-Apr-18	RG_ER_RSC_50_20180427	10.4	8.90	9.31	oto	3	M	0.061	0.077	9.17	0.008	0.007	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_51_20180428	12.5	10.8	17.5	oto	4	M	0.560	0.364	16.5	0.021	0.032	A	A	A	A	worms	0.561	-
	28-Apr-18	RG_ER_RSC_52_20180428	10.8	9.30	10.0	oto	4	F	0.420	0.214	9.40	0.021	0.042	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_53_20180428	12.3	10.6	14.2	oto	4	M	0.247	0.244	13.7	0.017	0.017	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_54_20180428	11.2	9.70	11.3	oto	3	F	0.940	0.198	10.2	0.017	0.083	A	A	A	A	worms	0.0390	-
	28-Apr-18	RG_ER_RSC_55_20180428	10.1	8.50	8.45	oto	4	M	0.044	0.157	8.25	0.019	0.005	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_56_20180428	12.6	11.1	16.5	oto	4	F	0.802	0.276	15.5	0.017	0.049	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_57_20180428	12.2	10.6	14.7	oto	8	M	0.074	0.322	14.3	0.022	0.005	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_58_20180428	10.4	9.10	9.17	oto	-	M	0.109	0.174	8.89	0.019	0.012	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_59_20180428	12.9	11.3	18.6	oto	4	F	0.880	0.272	17.5	0.015	0.047	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_60_20180428	13.3	11.7	18.6	oto	5	F	0.978	0.321	17.3	0.017	0.053	A	A	A	A	worms	2.78	-

Table E.15: **Summary Statistics for Redside Shiner Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S] /Minor[M]/ Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Elk River	28-Apr-18	RG_ER_RSC_61_20180428	13.1	11.5	17.5	oto	5	F	0.906	0.272	16.3	0.016	0.052	A	M	A	A	worms	0.936	-
	28-Apr-18	RG_ER_RSC_62_20180428	13.0	11.5	20.9	oto	5	F	0.314	0.367	20.2	0.018	0.015	A	A	A	A	worms	1.39	-
	28-Apr-18	RG_ER_RSC_63_20180428	12.3	10.7	16.2	oto	5	M	0.079	0.263	15.9	0.016	0.005	A	A	A	A	worms	1.45	-
	28-Apr-18	RG_ER_RSC_64_20180428	11.5	9.70	12.2	oto	4	F	0.096	0.116	12.0	0.009	0.008	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_65_20180428	11.8	10.4	14.3	oto	-	U	-	0.215	-	0.015	-	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_66_20180428	13.5	11.7	20.8	oto	5	F	1.361	0.375	19.1	0.018	0.065	A	A	A	A	worms	0.288	-
	28-Apr-18	RG_ER_RSC_67_20180428	11.5	10.2	13.8	oto	4	M	0.170	0.123	13.5	0.009	0.012	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_68_20180428	12.2	10.5	14.4	oto	4	F	0.583	0.195	13.6	0.014	0.040	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_69_20180428	11.2	9.70	10.7	oto	3	F	0.487	0.130	10.1	0.012	0.046	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_70_20180428	12.5	10.8	17.1	oto	3	M	0.194	0.169	16.7	0.010	0.011	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_71_20180428	11.7	10.4	13.2	oto	4	F	0.321	0.347	12.6	0.026	0.024	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_72_20180428	10.2	8.90	8.36	oto	3	F	0.272	0.173	7.92	0.021	0.033	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_73_20180428	10.5	9.00	9.75	oto	3	M	0.052	0.122	9.57	0.013	0.005	A	A	A	A	-	-	-
	28-Apr-18	RG_ER_RSC_74_20180428	11.1	9.60	11.6	oto	3	M	0.102	0.081	11.5	0.007	0.009	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_75_20180429	11.4	10.0	12.9	oto	4	M	0.115	0.187	12.6	0.014	0.009	A	M	A	A	caudal fin erosion	-	-
	29-Apr-18	RG_ER_RSC_76_20180429	12.5	10.8	16.1	oto	7	M	0.295	0.253	15.5	0.016	0.018	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_77_20180429	10.6	9.10	9.78	oto	4	F	0.356	0.190	9.23	0.019	0.036	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_78_20180429	11.9	10.4	13.0	oto	4	M	0.118	0.169	12.8	0.013	0.009	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_79_20180429	11.3	9.90	11.3	oto	4	M	0.105	0.196	11.0	0.017	0.009	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_80_20180429	12.0	10.6	14.6	oto	6	M	0.167	0.221	14.2	0.015	0.011	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_81_20180429	11.2	10.0	11.6	oto	4	M	0.128	0.126	11.4	0.011	0.011	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_82_20180429	10.7	9.50	10.6	oto	4	M	0.147	0.145	10.3	0.014	0.014	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_83_20180429	11.2	10.0	13.0	oto	4	M	0.114	0.346	12.5	0.027	0.009	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_84_20180429	11.4	10.0	11.4	oto	3	M	0.062	0.174	11.2	0.015	0.005	A	A	A	A	worms	0.0890	-
	29-Apr-18	RG_ER_RSC_85_20180429	11.2	9.60	10.5	oto	3	M	0.040	0.208	10.2	0.020	0.004	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_86_20180429	10.5	9.20	8.68	oto	3	M	0.088	0.260	8.34	0.030	0.010	A	A	A	A	-	-	-
	29-Apr-18	RG_ER_RSC_87_20180429	10.7	9.20	9.38	oto	3	M	0.105	0.074	9.20	0.008	0.011	A	A	A	A	-	-	-
	total sample size		**87**	**87**	**87**	**-**	**82**	**-**	**85**	**87**	**85**	**87**	**85**	**-**	**-**	**-**	**-**	**-**	**21**	**-**
	average		**11.1**	**9.70**	**11.5**	**-**	**3.67**	**-**	**0.296**	**0.182**	**11.0**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.673**	**-**
	median		**11.0**	**9.60**	**10.7**	**-**	**3.00**	**-**	**0.144**	**0.173**	**10.2**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**0.476**	**-**
	standard deviation		**0.950**	**0.854**	**3.31**	**-**	**0.982**	**-**	**0.391**	**0.080**	**3.13**	**0.01**	**0.03**	**-**	**-**	**-**	**-**	**-**	**0.689**	**-**
	standard error		**0.102**	**0.0915**	**0.355**	**-**	**0.108**	**-**	**0.042**	**0.009**	**0.340**	**0.001**	**0.003**	**-**	**-**	**-**	**-**	**-**	**0.150**	**-**
	minimum		**9.40**	**8.40**	**6.77**	**-**	**2.00**	**-**	**0.017**	**0.029**	**6.62**	**0.00**	**0.00**	**-**	**-**	**-**	**-**	**-**	**0.00600**	**-**
	maximum		**13.5**	**11.7**	**20.9**	**-**	**8.00**	**-**	**2.89**	**0.375**	**20.2**	**0.0**	**0.3**	**-**	**-**	**-**	**-**	**-**	**2.78**	**-**
Gold Creek	24-Apr-18	RG_GC_RSC_01_20180424	10.5	9.10	8.73	oto	3	M	0.056	0.067	8.61			A	A	A	A	-	-	-
	24-Apr-18	RG_GC_RSC_02_20180424	10.4	9.30	9.25	oto	3	F	0.421	0.072	8.76			A	A	A	A	-	-	muscle, ovaries
	24-Apr-18	RG_GC_RSC_03_20180424	10.0	8.60	7.91	oto	-	U	0.048	0.137	7.72			A	A	A	A	worms	0.249	-
	24-Apr-18	RG_GC_RSC_04_20180424	9.80	8.40	7.19	oto	3	F	0.061	0.117	7.01			A	A	A	A	-	-	muscle, ovaries
	25-Apr-18	RG_GC_RSC_05_20180425	11.1	9.80	10.3	oto	3	M	0.038	0.182	10.1			A	A	A	A	-	-	-
	25-Apr-18	RG_GC_RSC_06_20180425	10.4	8.90	8.73	oto	2	M	0.099	0.131	8.50			A	A	A	A	-	-	-
	25-Apr-18	RG_GC_RSC_07_20180425	10.3	8.90	8.00	oto	3	M	0.047	0.085	7.87			A	A	A	A	-	-	-
	26-Apr-18	RG_GC_RSC_08_20180426	9.70	8.40	7.02	oto	3	M	0.045	0.107	6.87			A	A	A	A	-	-	-
	26-Apr-18	RG_GC_RSC_09_20180426	11.9	10.4	14.6	oto	4	F	0.388	0.196	14.0			A	A	A	A	worms	1.04	muscle, ovaries
	26-Apr-18	RG_GC_RSC_10_20180426	9.90	8.50	7.82	oto	3	M	0.043	0.182	7.59			A	A	A	A	-	-	-
	26-Apr-18	RG_GC_RSC_11_20180426	9.70	8.40	8.27	oto	-	U	0.024	0.150	8.10			A	A	A	A	worms	0.0120	-
	26-Apr-18	RG_GC_RSC_12_20180426	9.90	8.50	8.31	oto	3	M	0.083	0.179	8.05			A	A	A	A	-	-	-
	26-Apr-18	RG_GC_RSC_13_20180426	9.80	8.50	7.54	oto	2	M	0.077	0.098	7.36			A	A	A	A	worms	0.0520	-
	26-Apr-18	RG_GC_RSC_14_20180426	9.20	8.10	6.86	oto	3	M	0.118	0.152	6.59			A	A	A	A	-	-	-
	26-Apr-18	RG_GC_RSC_15_20180426	10.1	8.90	8.44	oto	4	M	0.068	0.050	8.32			A	A	A	A	worms	0.0170	-
	26-Apr-18	RG_GC_RSC_16_20180426	9.90	8.80	8.88	oto	3	F	0.373	0.105	8.40			A	A	A	A	-	-	muscle, ovaries
	27-Apr-18	RG_GC_RSC_17_20180427	12.5	10.7	15.5	oto	5	F	0.494	0.103	14.9			A	A	A	A	worms	0.452	muscle, ovaries
	27-Apr-18	RG_GC_RSC_18_20180427	10.1	9.30	9.66	oto	3	F	0.385	0.190	9.08			A	A	A	A	-	-	muscle, ovaries
	27-Apr-18	RG_GC_RSC_19_20180427	12.5	11.4	15.7	oto	4	F	0.660	0.359	14.7			A	A	A	A	-	-	muscle, ovaries
	27-Apr-18	RG_GC_RSC_20_20180427	12.8	11.2	16.0	oto	3	F	0.700	0.222	15.1			A	M	A	A	worms	0.229	muscle, ovaries
	27-Apr-18	RG_GC_RSC_21_20180427	11.5	10.3	14.6	oto	4	F	0.715	0.274	13.6			A	A	A	A	-	-	muscle, ovaries
	27-Apr-18	RG_GC_RSC_22_20180427	10.6	9.20	9.17	oto	3	M	0.108	0.061	9.00			A	A	A	A	worms	0.668	-
	27-Apr-18	RG_GC_RSC_23_20180427	10.4	8.90	7.97	oto	3	F	0.322	0.125	7.52			A	A	A	A	worms	0.0490	-
	27-Apr-18	RG_GC_RSC_24_20180427	10.6	9.20	9.63	oto	3	F	0.380	0.215	9.04			A	A	A	A	-	-	muscle, ovaries
	27-Apr-18	RG_GC_RSC_25_20180427	12.2	10.6	15.1	oto	4	F	0.418	0.273	14.4			-	-	-	-	worms	0.554	-
	27-Apr-18	RG_GC_RSC_26_20180427	10.2	8.80	8.17	oto	2	F	0.217	0.081	7.87			A	A	A	A	worms	0.00900	-
	27-Apr-18	RG_GC_RSC_27_20180427	10.4	9.00	9.71	oto	3	M	0.049	0.143	9.52			A	M	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_28_20180427	10.9	9.40	8.61	oto	3	F	0.063	0.108	8.44			A	A	A	A	worms	1.37	-
	27-Apr-18	RG_GC_RSC_29_20180427	10.9	8.60	11.4	oto	3	M	0.075	0.113	11.2			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_30_20180427	10.9	9.50	11.8	oto	3	F	0.527	0.160	11.1			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_31_20180427	11.1	10.5	10.1	oto	3	M	0.062	0.291	9.75			A	A	A	A	worms	0.004	-
	27-Apr-18	RG_GC_RSC_32_20180427	9.60	8.50	8.31	oto	3	F	0.380	0.098	7.83			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_33_20180427	10.4	9.10	8.92	oto	3	M	0.080	0.156	8.69			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_34_20180427	9.70	8.60	8.60	oto	3	M	0.041	0.054	8.50			A	A	A	A	worms, upturned snout	0.581	-
	27-Apr-18	RG_GC_RSC_35_20180427	9.70	8.50	7.62	oto	2	M	0.029	0.133	7.46			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_36_20180427	11.6	10.2	13.2	oto	3	F	0.620	0.136	12.5			A	A	A	A	worms	0.660	-
	27-Apr-18	RG_GC_RSC_37_20180427	12.5	10.9	15.6	oto	4	M	0.533	0.237	14.9			A	A	A	A	-	-	-
	27-Apr-18	RG_GC_RSC_38_20180427	9.70	8.50	7.90	oto	2	M	0.048	0.130	7.72			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_39_20180428	12.3	10.6	14.8	oto	3	F	0.414	0.225	14.2			A	A	A	A	worms	0.435	-
	28-Apr-18	RG_GC_RSC_40_20180428	12.2	10.5	15.5	oto	3	F	0.579	0.340	14.6			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_41_20180428	11.6	10.2	14.6	oto	3	M	0.290	0.154	14.1			A	M	A	A	worms	1.01	-
	28-Apr-18	RG_GC_RSC_42_20180428	10.5	8.90	9.44	oto	3	F	0.318	0.184	8.94			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_43_20180428	10.4	9.10	8.17	oto	3	M	0.071	0.121	7.98			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_44_20180428	11.5	10.1	12.5	oto	4	F	0.585	0.160	11.7			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_45_20180428	10.4	9.10	8.71	oto	3	F	0.362	0.125	8.22			A	A	A	A	-	-	-

Table E.15: **Summary Statistics for Redside Shiner Meristic Data Used for the Fish Health Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age (years)	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Worm Weight (g)	Tissue Collected
														D	E	L	T			
Gold Creek	28-Apr-18	RG_GC_RSC_46_20180428	11.1	9.50	10.8	oto	3	F	0.683	0.147	9.95			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_47_20180428	12.8	10.9	15.9	oto	4	F	0.813	0.406	14.7			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_48_20180428	10.2	8.90	10.9	oto	-	U	0.026	0.169	10.7			A	M	A	A	worms	2.49	-
	28-Apr-18	RG_GC_RSC_49_20180428	10.2	8.60	8.00	oto	3	M	0.130	0.104	7.77			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_50_20180428	11.4	9.90	11.3	oto	3	F	0.556	0.162	10.6			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_51_20180428	11.2	9.50	13.1	oto	3	M	0.106	0.125	12.8			A	A	A	A	worms	1.79	-
	28-Apr-18	RG_GC_RSC_52_20180428	12.6	11.0	16.9	oto	4	F	0.323	0.230	16.3			A	A	A	A	worms	0.392	-
	28-Apr-18	RG_GC_RSC_53_20180428	11.9	10.4	13.8	oto	3	F	0.257	0.255	13.3			A	A	A	A	worms	0.0170	-
	28-Apr-18	RG_GC_RSC_54_20180428	10.0	8.70	8.22	oto	3	M	0.093	0.064	8.06			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_55_20180428	10.4	9.10	8.74	oto	3	M	0.038	0.026	8.68			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_56_20180428	10.6	9.20	9.50	oto	3	M	0.038	0.220	9.24			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_57_20180428	10.8	9.40	9.49	oto	3	M	0.103	0.155	9.23			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_58_20180428	10.4	9.10	8.34	oto	3	M	0.096	0.155	8.09			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_59_20180428	10.2	9.00	8.99	oto	3	M	0.130	0.204	8.66			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_60_20180428	11.2	9.70	9.37	oto	4	F	0.406	0.120	8.85			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_61_20180428	10.4	9.10	9.09	oto	-	U	0.037	0.070	8.98			A	A	A	A	worms	0.622	-
	28-Apr-18	RG_GC_RSC_62_20180428	10.9	9.50	10.3	oto	3	M	0.180	0.166	9.92			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_63_20180428	10.4	9.10	9.08	oto	3	F	0.286	0.238	8.55			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_64_20180428	11.3	9.70	10.8	oto	3	M	0.092	0.248	10.5			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_65_20180428	12.3	10.6	14.8	oto	4	F	0.683	0.227	13.9			A	A	A	A	worms	0.0180	-
	28-Apr-18	RG_GC_RSC_66_20180428	11.9	10.5	14.1	oto	4	M	0.174	0.239	13.7			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_67_20180428	10.7	9.30	9.00	oto	3	M	0.155	0.083	8.77			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_68_20180428	11.0	9.60	10.4	oto	4	M	0.144	0.098	10.2			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_69_20180428	10.6	9.10	10.7	oto	3	M	0.122	0.233	10.3			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_70_20180428	10.3	9.00	9.16	oto	4	M	0.099	0.220	8.84			A	A	A	A	worms	0.0680	-
	28-Apr-18	RG_GC_RSC_71_20180428	10.1	8.60	8.29	oto	-	U	0.004	0.053	8.23			A	A	A	A	worms	0.0230	-
	28-Apr-18	RG_GC_RSC_72_20180428	11.6	10.2	13.2	oto	4	F	0.634	0.161	12.4			A	A	A	A	worms	0.299	-
	28-Apr-18	RG_GC_RSC_73_20180428	10.0	8.70	8.28	oto	3	M	0.050	0.272	7.96			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_74_20180428	10.1	8.90	8.82	oto	3	M	0.029	0.112	8.68			A	A	A	A	worms	1.37	-
	28-Apr-18	RG_GC_RSC_75_20180428	12.5	11.0	17.9	oto	4	F	0.344	0.218	17.3			A	A	A	A	worms	2.79	-
	28-Apr-18	RG_GC_RSC_76_20180428	10.5	9.00	8.95	oto	3	M	0.126	0.141	8.68			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_77_20180428	11.3	9.90	11.4	oto	5	M	0.079	0.167	11.1			A	A	A	A	worms	0.0330	-
	28-Apr-18	RG_GC_RSC_78_20180428	10.7	9.00	8.79	oto	4	M	0.120	0.139	8.53			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_79_20180428	10.4	8.90	8.09	oto	2	M	0.125	0.122	7.84			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_80_20180428	10.4	9.10	9.17	oto	3	F	0.292	0.209	8.66			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_81_20180428	7.50	9.00	8.69	oto	3	M	0.027	0.207	8.46			A	A	A	A	worms	0.0290	-
	28-Apr-18	RG_GC_RSC_82_20180428	12.1	10.6	14.8	oto	4	F	0.547	0.227	14.0			A	A	A	A	worms	0.133	-
	28-Apr-18	RG_GC_RSC_83_20180428	11.6	10.0	12.0	oto	4	F	0.602	0.162	11.2			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_84_20180428	10.4	9.20	9.37	oto	3	F	0.226	0.209	8.93			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_85_20180428	11.0	10.0	9.09	oto	3	F	0.527	0.198	8.36			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_86_20180428	9.90	8.70	7.91	oto	3	M	0.069	0.126	7.72			A	A	A	A	worm	-	-
	28-Apr-18	RG_GC_RSC_87_20180428	12.4	11.0	15.3	oto	3	M	0.251	0.164	14.9			A	A	A	A	-	-	-
	28-Apr-18	RG_GC_RSC_88_20180428	10.5	9.20	7.78	oto	3	M	0.086	0.136	7.55			A	M	A	A	-	-	-
		total sample size	**88**	**88**	**88**	**-**	**83**	**-**	**88**	**88**	**88**			**-**	**-**	**-**	**-**	**-**	**31**	**-**
		average	**10.8**	**9.44**	**10.5**	**-**	**3.20**	**-**	**0.243**	**0.163**	**10.1**			**-**	**-**	**-**	**-**	**-**	**0.563**	**-**
		median	**10.5**	**9.15**	**9.21**	**-**	**3.00**	**-**	**0.128**	**0.155**	**8.89**			**-**	**-**	**-**	**-**	**-**	**0.299**	**-**
		standard deviation	**0.953**	**0.804**	**2.81**	**-**	**0.600**	**-**	**0.219**	**0.0711**	**2.63**			**-**	**-**	**-**	**-**	**-**	**0.727**	**-**
		standard error	**0.102**	**0.0857**	**0.300**	**-**	**0.0659**	**-**	**0.0234**	**0.00758**	**0.280**			**-**	**-**	**-**	**-**	**-**	**0.131**	**-**
		minimum	**7.50**	**8.10**	**6.86**	**-**	**2.00**	**-**	**0.00400**	**0.0260**	**6.59**			**-**	**-**	**-**	**-**	**-**	**0.004**	**-**
		maximum	**12.8**	**11.4**	**17.9**	**-**	**5.00**	**-**	**0.813**	**0.406**	**17.3**			**-**	**-**	**-**	**-**	**-**	**2.79**	**-**

[a] Age structures collected: oto - otoliths.

[b] Adjusted body weight represents whole body weight less the liver weight and gonad weight and used for statistical analyses.

[c] otoliths were crystalized.

Table E.16: **Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Sand Creek	29-Aug-18	RG_SC_RSC_01_20180829	22.0	20.4	0.075	whole body	0	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_02_20180829	22.9	21.1	0.115	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_03_20180829	26.3	23.7	0.130	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_04_20180829	32.6	30.5	0.263	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_05_20180829	28.6	25.6	0.172	whole body	0	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_06_20180829	32.6	29.0	0.262	whole body	0	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_07_20180829	34.3	32.2	0.311	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_08_20180829	25.2	22.7	0.125	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_09_20180829	27.5	24.4	0.155	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_10_20180829	20.4	18.1	0.083	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_11_20180829	23.9	22.2	0.121	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_12_20180829	25.5	24.0	0.153	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_13_20180829	24.0	22.9	0.135	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_14_20180829	23.8	22.2	0.132	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_15_20180829	23.0	21.2	0.103	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_16_20180829	29.4	27.0	0.188	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_17_20180829	30.0	27.7	0.238	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_18_20180829	26.3	24.1	0.151	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_19_20180829	28.0	26.1	0.185	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_20_20180829	21.9	20.1	0.106	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_21_20180829	23.2	20.6	0.117	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_22_20180829	28.8	25.8	0.203	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_23_20180829	24.5	22.3	0.129	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_24_20180829	23.5	21.4	0.139	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_25_20180829	31.1	28.4	0.220	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_26_20180829	39.5	37.0	0.488	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_27_20180829	31.1	28.2	0.209	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_28_20180829	22.8	21.1	0.094	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_29_20180829	36.7	33.2	0.377	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_30_20180829	37.8	34.2	0.351	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_31_20180829	30.1	26.8	0.201	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_32_20180829	33.0	29.8	0.304	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_33_20180829	23.6	21.5	0.116	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_34_20180829	33.6	31.0	0.338	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_35_20180829	25.1	23.2	0.135	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_36_20180829	33.7	29.7	0.313	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_37_20180829	30.6	27.5	0.232	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_38_20180829	34.4	32.7	0.345	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_39_20180829	24.1	22.5	0.131	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_40_20180829	25.7	23.0	0.150	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_41_20180829	29.6	26.2	0.171	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_42_20180829	34.2	30.7	0.304	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_43_20180829	38.1	33.9	0.388	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_44_20180829	42.1	37.4	0.502	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_45_20180829	29.9	26.7	0.207	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_46_20180829	34.1	31.5	0.296	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_47_20180829	34.2	30.4	0.275	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_48_20180829	24.7	22.7	0.124	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_49_20180829	36.2	32.9	0.395	whole body	0	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_50_20180829	30.8	27.6	0.121	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_51_20180829	31.9	29.5	0.223	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_52_20180829	24.1	22.0	0.263	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_53_20180829	23.5	21.5	0.091	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_54_20180829	25.0	22.5	0.114	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_55_20180829	28.3	25.5	0.161	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_56_20180829	30.8	28.3	0.221	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_57_20180829	24.8	22.9	0.126	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_58_20180829	25.3	22.4	0.115	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_59_20180829	21.7	19.0	0.073	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_60_20180829	30.4	27.5	0.227	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_61_20180829	31.9	27.1	0.210	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_62_20180829	28.5	25.5	0.148	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_63_20180829	29.7	26.1	0.157	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_64_20180829	31.3	28.9	0.214	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_65_20180829	31.5	28.6	0.207	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_66_20180829	33.5	29.6	0.253	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_67_20180829	26.0	24.1	0.120	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_68_20180829	22.9	21.6	0.091	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_69_20180829	23.0	21.2	0.090	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_70_20180829	22.6	20.5	0.073	-	-	A	A	A	A	-	-

Table E.16: Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Sand Creek	29-Aug-18	RG_SC_RSC_71_20180829	26.5	24.7	0.138	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_72_20180829	22.9	20.5	0.089	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_73_20180829	22.5	20.5	0.083	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_74_20180829	23.2	21.5	0.104	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_75_20180829	22.6	20.5	0.091	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_76_20180829	28.3	25.8	0.164	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_77_20180829	35.1	31.7	0.317	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_78_20180829	38.6	34.5	0.394	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_79_20180829	34.5	31.4	0.276	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_80_20180829	30.7	27.8	0.212	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_81_20180829	25.2	22.2	0.122	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_82_20180829	35.7	32.2	0.288	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_83_20180829	46.9	41.9	0.726	whole body	1	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_84_20180829	35.6	33.4	0.299	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_85_20180829	38.9	36.2	0.409	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_86_20180829	30.7	28.0	0.227	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_87_20180829	33.6	31.3	0.240	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_88_20180829	32.4	30.2	0.260	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_89_20180829	32.2	29.6	0.242	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_90_20180829	37.2	34.1	0.395	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_91_20180829	27.4	25.3	0.172	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_92_20180829	37.4	34.0	0.352	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_93_20180829	27.9	24.7	0.158	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_94_20180829	29.0	26.6	0.156	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_95_20180829	23.8	22.2	0.103	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_96_20180829	23.4	21.6	0.093	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_97_20180829	21.5	18.9	0.059	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_98_20180829	26.6	23.3	0.291	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_99_20180829	32.4	29.8	0.287	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_100_20180829	36.1	33.3	0.387	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_101_20180829	34.2	31.2	0.279	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_102_20180829	27.4	24.6	0.141	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_103_20180829	21.7	19.8	0.080	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_104_20180829	26.2	23.4	0.112	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_105_20180829	24.6	21.8	0.098	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_106_20180829	26.6	23.9	0.137	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_107_20180829	33.3	30.3	0.259	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_108_20180829	30.4	26.7	0.222	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_109_20180829	33.9	29.6	0.308	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_110_20180829	26.9	24.8	0.159	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_111_20180829	33.2	29.5	0.315	-	-	A	A	A	A	-	-
	29-Aug-18	RG_SC_RSC_112_20180829	33.0	29.6	0.281	-	-	A	A	A	A	-	-
		total sample size	**112**	**112**	**112**	**-**	**5**	**-**	**-**	**-**	**-**	**-**	**-**
		average	**29.2**	**26.5**	**0.208**	**-**	**0.200**	**-**	**-**	**-**	**-**	**-**	**-**
		median	**28.9**	**26.1**	**0.179**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
		standard deviation	**5.30**	**4.80**	**0.111**	**-**	**0.447**	**-**	**-**	**-**	**-**	**-**	**-**
		standard error	**0.501**	**0.454**	**0.0105**	**-**	**0.200**	**-**	**-**	**-**	**-**	**-**	**-**
		minimum	**20.4**	**18.1**	**0.0590**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
		maximum	**46.9**	**41.9**	**0.726**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	28-Aug-18	RG_ER_RSC_01_20180828	38.9	34.4	0.402	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_02_20180828	36.9	33.6	0.390	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_03_20180828	30.1	28.2	0.230	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_04_20180828	37.0	32.9	0.362	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_05_20180828	31.5	28.6	0.223	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_06_20180828	34.2	32.1	0.294	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_07_20180828	39.0	35.1	0.444	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_08_20180828	29.2	27.1	0.212	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_09_20180828	31.4	29.2	0.237	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_10_20180828	34.0	30.8	0.275	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_11_20180828	30.1	27.7	0.206	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_12_20180828	32.8	30.6	0.249	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_13_20180828	33.2	29.8	0.262	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_14_20180828	36.6	34.1	0.372	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_15_20180828	38.3	34.5	0.430	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_16_20180828	31.0	28.0	0.210	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_17_20180828	22.0	18.9	0.074	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_18_20180828	49.0	45.2	0.869	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_19_20180828	27.2	25.4	0.143	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_20_20180828	41.8	37.5	0.606	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_21_20180828	41.6	35.5	0.572	-	-	A	A	A	A	-	-

Table E.16: **Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Elk River	28-Aug-18	RG_ER_RSC_22_20180828	30.7	29.4	0.231	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_23_20180828	32.4	30.4	0.277	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_24_20180828	39.9	36.1	0.487	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_25_20180828	30.5	28.6	0.248	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_26_20180828	27.4	25.0	0.168	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_27_20180828	33.4	30.3	0.259	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_28_20180828	28.3	26.1	0.178	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_29_20180828	31.5	26.5	0.238	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_30_20180828	30.1	27.8	0.212	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_31_20180828	37.0	33.3	0.381	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_32_20180828	31.5	28.8	0.235	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_33_20180828	43.4	39.9	0.622	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_34_20180828	34.9	31.4	0.299	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_35_20180828	38.2	34.1	0.368	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_36_20180828	34.6	31.8	0.271	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_37_20180828	32.3	29.0	0.218	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_38_20180828	37.0	33.5	0.363	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_39_20180828	41.3	36.9	0.569	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_40_20180828	31.4	28.5	0.233	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_41_20180828	29.1	27.6	0.195	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_42_20180828	33.0	29.6	0.264	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_43_20180828	31.4	29.4	0.241	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_44_20180828	30.0	27.6	0.173	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_45_20180828	31.6	28.8	0.223	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_46_20180828	33.4	30.2	0.264	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_47_20180828	33.5	31.6	0.255	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_48_20180828	34.6	32.8	0.315	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_49_20180828	26.3	25.2	0.130	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_50_20180828	30.7	28.1	0.202	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_51_20180828	26.5	25.4	0.181	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_52_20180828	35.0	32.7	0.337	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_53_20180828	31.6	29.0	0.231	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_54_20180828	33.2	29.3	0.287	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_55_20180828	26.9	25.1	0.156	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_56_20180828	33.1	29.5	0.269	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_57_20180828	31.0	28.0	0.209	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_58_20180828	31.0	28.4	0.221	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_59_20180828	30.0	27.6	0.206	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_60_20180828	32.3	29.7	0.235	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_61_20180828	29.4	28.0	0.227	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_62_20180828	33.5	30.5	0.272	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_63_20180828	32.0	29.0	0.234	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_64_20180828	26.2	24.7	0.148	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_65_20180828	30.2	27.9	0.225	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_66_20180828	32.9	29.8	0.288	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_67_20180828	29.4	26.6	0.173	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_68_20180828	28.5	25.8	0.183	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_69_20180828	34.8	31.3	0.337	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_70_20180828	37.6	33.1	0.424	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_71_20180828	30.3	28.1	0.205	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_72_20180828	31.8	29.2	0.275	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_73_20180828	30.0	27.5	0.217	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_74_20180828	31.9	28.9	0.285	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_75_20180828	28.5	26.0	0.169	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_76_20180828	29.9	26.8	0.192	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_77_20180828	29.3	27.3	0.188	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_78_20180828	28.8	27.4	0.199	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_79_20180828	27.4	26.1	0.149	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_80_20180828	27.4	26.7	0.210	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_81_20180828	28.4	27.1	0.158	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_82_20180828	26.3	24.2	0.149	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_83_20180828	31.3	28.8	0.248	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_84_20180828	31.1	27.5	0.202	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_85_20180828	28.2	25.6	0.165	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_86_20180828	32.1	29.0	0.264	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_87_20180828	30.6	28.3	0.237	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_88_20180828	25.4	24.0	0.131	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_89_20180828	36.8	34.2	0.372	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_90_20180828	35.0	31.4	0.285	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_91_20180828	30.6	27.7	0.224	-	-	A	A	A	A	-	-

Table E.16: **Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Elk River	28-Aug-18	RG_ER_RSC_92_20180828	26.9	24.0	0.157	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_93_20180828	25.4	23.0	0.128	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_94_20180828	30.3	27.9	0.190	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_95_20180828	25.4	23.4	0.120	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_96_20180828	28.3	25.4	0.151	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_97_20180828	29.7	26.2	0.166	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_98_20180828	30.2	27.5	0.192	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_99_20180828	28.6	25.8	0.159	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_100_20180828	27.7	24.9	0.164	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_101_20180828	26.9	24.3	0.139	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_102_20180828	36.8	27.4	0.193	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_103_20180828	28.3	25.2	0.169	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_104_20180828	27.4	25.5	0.151	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_105_20180828	28.8	25.8	0.172	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_106_20180828	28.2	25.6	0.129	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_107_20180828	28.9	26.5	0.197	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_108_20180828	27.1	23.6	0.135	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_109_20180828	32.8	29.9	0.237	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_110_20180828	28.7	26.9	0.156	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_111_20180828	33.6	31.4	0.277	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_112_20180828	24.4	22.4	0.118	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_113_20180828	23.0	21.6	0.075	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_114_20180828	32.1	29.7	0.281	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_115_20180828	30.7	28.1	0.197	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_116_20180828	30.3	26.7	0.183	-	-	A	A	A	A	-	-
	28-Aug-18	RG_ER_RSC_117_20180828	32.0	29.3	0.219	-	-	A	A	A	A	-	-
	total sample size		**117**	**117**	**117**	**-**	**5**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**31.6**	**28.8**	**0.248**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**31.0**	**28.2**	**0.223**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**4.32**	**3.79**	**0.117**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.400**	**0.351**	**0.0108**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**22.0**	**18.9**	**0.0740**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**49.0**	**45.2**	**0.869**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
Gold Creek	28-Aug-18	RG_GC_RSC_01_20180828	40.2	35.2	0.491	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_02_20180828	24.4	22.7	0.148	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_03_20180828	25.7	23.7	0.146	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_04_20180828	29.6	27.6	0.194	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_05_20180828	24.0	22.1	0.115	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_06_20180828	31.1	29.3	0.227	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_07_20180828	24.4	22.7	0.124	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_08_20180828	29.0	26.1	0.168	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_09_20180828	28.8	25.8	0.158	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_10_20180828	34.7	32.0	0.294	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_11_20180828	31.5	29.1	0.193	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_12_20180828	28.4	26.8	0.149	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_13_20180828	26.6	24.7	0.143	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_14_20180828	34.1	31.5	0.293	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_15_20180828	34.4	31.9	0.305	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_16_20180828	27.6	25.6	0.145	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_17_20180828	29.4	27.4	0.161	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_18_20180828	32.4	28.9	0.239	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_19_20180828	27.5	25.5	0.144	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_20_20180828	42.4	38.8	0.550	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_21_20180828	35.1	32.9	0.325	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_22_20180828	27.4	24.7	0.133	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_23_20180828	35.7	33.3	0.340	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_24_20180828	33.8	30.7	0.281	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_25_20180828	36.6	32.9	0.327	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_26_20180828	27.9	26.2	0.146	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_27_20180828	42.7	39.3	0.583	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_28_20180828	26.8	25.0	0.142	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_29_20180828	32.5	29.9	0.220	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_30_20180828	30.5	28.7	0.206	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_31_20180828	29.6	27.7	0.217	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_32_20180828	33.8	31.0	0.322	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_33_20180828	30.2	28.2	0.208	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_34_20180828	32.6	29.7	0.262	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_35_20180828	41.7	37.4	0.521	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_36_20180828	34.0	31.6	0.296	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_37_20180828	29.9	28.5	0.184	-	-	A	A	A	A	-	-

Table E.16: **Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Gold Creek	28-Aug-18	RG_GC_RSC_38_20180828	27.6	26.2	0.171	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_39_20180828	37.5	33.9	0.397	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_40_20180828	26.5	23.0	0.138	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_41_20180828	40.7	38.3	0.480	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_42_20180828	38.7	35.7	0.387	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_43_20180828	27.4	24.7	0.115	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_44_20180828	29.9	27.6	0.195	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_45_20180828	31.2	27.8	0.202	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_46_20180828	32.8	31.5	0.301	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_47_20180828	35.5	34.3	0.438	whole body	0	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_48_20180828	28.6	25.3	0.152	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_49_20180828	27.0	25.5	0.147	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_50_20180828	32.8	30.1	0.296	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_51_20180828	27.5	26.8	0.172	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_52_20180828	26.9	25.5	0.200	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_53_20180828	30.9	29.1	0.237	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_54_20180828	27.8	26.3	0.166	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_55_20180828	28.5	26.1	0.147	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_56_20180828	36.8	34.0	0.375	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_57_20180828	29.6	26.8	0.196	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_58_20180828	29.9	26.7	0.184	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_59_20180828	36.4	32.4	0.349	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_60_20180828	29.5	27.3	0.211	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_61_20180828	36.0	32.0	0.347	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_62_20180828	30.0	27.2	0.196	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_63_20180828	27.3	25.0	0.159	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_64_20180828	33.3	30.4	0.299	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_65_20180828	32.3	29.1	0.240	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_66_20180828	35.8	33.4	0.355	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_67_20180828	33.4	30.6	0.293	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_68_20180828	37.3	34.2	0.407	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_69_20180828	33.6	31.6	0.314	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_70_20180828	34.8	32.3	0.389	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_71_20180828	34.6	30.8	0.253	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_72_20180828	32.7	30.7	0.268	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_73_20180828	34.5	32.5	0.347	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_74_20180828	36.8	34.0	0.359	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_75_20180828	37.9	34.2	0.408	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_76_20180828	41.1	38.0	0.513	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_77_20180828	37.5	34.8	0.408	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_78_20180828	30.2	28.4	0.199	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_79_20180828	46.4	42.9	0.706	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_80_20180828	32.4	31.0	0.268	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_81_20180828	36.0	34.0	0.303	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_82_20180828	37.8	35.5	0.427	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_83_20180828	36.5	34.0	0.331	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_84_20180828	41.1	37.2	0.442	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_85_20180828	27.4	24.1	0.123	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_86_20180828	40.0	37.1	0.526	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_87_20180828	38.1	34.7	0.368	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_88_20180828	25.5	24.0	0.135	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_89_20180828	39.2	35.3	0.399	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_90_20180828	33.9	31.7	0.275	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_91_20180828	42.1	37.2	0.538	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_92_20180828	39.2	36.5	0.442	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_93_20180828	37.0	34.5	0.363	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_94_20180828	38.0	34.0	0.405	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_95_20180828	28.9	26.8	0.138	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_96_20180828	39.3	34.5	0.433	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_97_20180828	31.9	29.8	0.271	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_98_20180828	31.9	29.1	0.257	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_99_20180828	34.9	31.6	0.275	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_100_20180828	34.2	31.0	0.286	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_101_20180828	34.6	33.3	0.353	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_102_20180828	32.7	31.4	0.278	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_103_20180828	34.4	33.3	0.304	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_104_20180828	42.1	38.6	0.582	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_105_20180828	33.2	29.7	0.246	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_106_20180828	29.0	27.3	0.182	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_107_20180828	25.6	23.6	0.109	-	-	A	A	A	A	-	-

Table E.16: **Summary Statistics for Juvenile Redside Shiner Meristic Data Used for the Recruitment Assessment and Collected near Sand Creek, Elk River, and Gold Creek in Koocanusa Reservoir, 2018**

Area	Processing Date	Fish ID	Total Length (mm)	Fork Length (mm)	Body Weight (g)	Age Structure Collected	Age	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
								D	E	L	T		
Gold Creek	28-Aug-18	RG_GC_RSC_108_20180828	22.6	20.3	0.081	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_109_20180828	31.9	29.6	0.229	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_110_20180828	35.7	30.9	0.281	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_111_20180828	40.1	35.4	0.478	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_112_20180828	41.9	38.7	0.542	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_113_20180828	33.9	31.0	0.281	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_114_20180828	35.4	32.4	0.298	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_115_20180828	34.4	32.5	0.281	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_116_20180828	35.9	33.0	0.326	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_130_20180828	34.9	32.0	0.293	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_117_20180828	32.7	29.0	0.234	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_118_20180828	34.0	31.1	0.274	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_119_20180828	34.0	31.2	0.248	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_120_20180828	35.1	32.2	0.287	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_121_20180828	36.6	24.6	0.116	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_122_20180828	36.9	33.4	0.331	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_123_20180828	27.3	24.7	0.137	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_124_20180828	27.4	24.7	0.126	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_125_20180828	30.1	27.5	0.188	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_126_20180828	33.2	31.0	0.227	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_127_20180828	33.2	29.3	0.225	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_128_20180828	35.5	33.1	0.287	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_129_20180828	35.1	32.6	0.290	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_131_20180828	38.2	35.0	0.405	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_132_20180828	37.6	33.6	0.385	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_133_20180828	36.1	32.4	0.323	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_134_20180828	34.1	31.1	0.306	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_135_20180828	35.7	31.5	0.322	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_136_20180828	35.1	31.7	0.296	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_137_20180828	28.9	26.8	0.174	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_138_20180828	34.4	29.9	0.291	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_139_20180828	34.9	30.8	0.267	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_140_20180828	35.4	30.0	0.269	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_141_20180828	34.2	31.2	0.297	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_142_20180828	23.7	21.2	0.092	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_143_20180828	37.1	33.9	0.346	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_144_20180828	33.2	31.1	0.241	-	-	A	A	A	A	-	-
	28-Aug-18	RG_GC_RSC_145_20180828	25.4	23.0	0.109	-	-	A	A	A	A	-	-
	total sample size		**145**	**145**	**145**	**-**	**5**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**33.2**	**30.4**	**0.279**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**33.8**	**31.0**	**0.275**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**4.68**	**4.25**	**0.119**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**0.388**	**0.353**	**0.00991**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**22.6**	**20.3**	**0.0810**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**46.4**	**42.9**	**0.706**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**

Table E.17: Summary Statistics for Rainbow Trout Meristic Data Collected near Sand Creek and Elk River in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structures Collected [a]	Age	Sex	DELT (Severe[S]/Minor[M]/Absent[A])				Comment	Tissue Collected
									D	E	L	T		
Sand Creek	27-Apr-18	RG_SC_RT_01_20180427	21.1	19.0	65	-	-	-	A	A	A	A	-	muscle
	27-Apr-18	RG_SC_RT_02_20180427	27.7	25.8	174	oto	3	U	A	A	A	A	-	muscle
	total sample size		**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**24.4**	**22.4**	**120**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**24.4**	**22.4**	**120**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**4.67**	**4.81**	**77.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**3.30**	**3.40**	**54.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**21.1**	**19.0**	**65.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**27.7**	**25.8**	**174**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Elk River	1-Sep-18	RG_ER_RT_01_20180901	32.2	29.8	270	-	-	-	A	A	A	A	-	muscle plug
	total sample size		**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**32.2**	**29.8**	**270**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**32.2**	**29.8**	**270**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**32.2**	**29.8**	**270**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**32.2**	**29.8**	**270**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

[a] Age structures collected: oto - otoliths

Table E.18: Summary Statistics for Westslope Cutthroat Trout Meristic Data Collected near Elk River and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Sex	DELT (Severe[S]/Minor[M]/Absent[A])				Comments	Tissue Collected
							D	E	L	T		
Elk River	25-Apr-18	RG_ER_WCT_01_20180425	24.2	23.1	140	-	A	A	A	A	-	muscle plug
	30-Apr-18	RG_ER_WCT_02_20180430	24.3	23.5	100	-	A	M	A	A	-	muscle plug
	7-Jun-18	RG_ER_WCT_01_20180607	39.5	37.8	535	F	A	A	A	A	-	muscle plug
	total sample size		**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**29.3**	**28.1**	**258**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**24.3**	**23.5**	**140**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**8.80**	**8.37**	**240**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**5.08**	**4.83**	**139**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**24.2**	**23.1**	**100**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**39.5**	**37.8**	**535**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gold Creek	25-Apr-18	RG_GC_WCT_01_20180425	38.9	37.0	600	-	A	A	A	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_02_20180425	25.2	23.8	134	-	A	A	M	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_03_20180425	34.8	32.9	410	-	A	A	A	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_04_20180425	38.8	36.2	560	-	A	A	A	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_05_20180425	36.9	35.2	455	-	A	A	A	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_06_20180425	32.6	30.3	320	-	A	A	M	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_07_20180425	25.4	23.9	144	-	A	A	A	A	-	muscle plug
	25-Apr-18	RG_GC_WCT_08_20180425	29.7	28.9	250	-	A	A	M	A	minor lesion	muscle plug
	total sample size		**8**	**8**	**8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**32.8**	**31.0**	**359**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**33.7**	**31.6**	**365**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**5.56**	**5.23**	**178**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**1.96**	**1.85**	**62.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**25.2**	**23.8**	**134**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**38.9**	**37.0**	**600**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table E.19: Summary Statistics for Yellow Perch Meristic Data Collected near Sand Creek and Gold Creek in Koocanusa Reservoir, 2018

Area	Processing Date	Fish ID	Sex	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Hepato-somatic Index	Gonado-somatic Index	DELT (Severe[S]/Minor[M]/Absent[A])				Comments	Tissue Collected
														D	E	L	T		
Sand Creek	27-Apr-18	RG_SC_YP_01_20180427	F	27.2	25.9	305	oto	5	82.4	4.05	219	0.013	0.270	A	A	A	A	-	muscle, ovaries
	30-Apr-18	RG_SC_YP_02_20180430	M	17.8	17.1	65.0	oto	3	0.77	0.70	63.5	0.011	0.012	A	A	A	A	-	-
	total sample size		**-**	**2**	**2**	**2**	**-**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
	average		**-**	**22.5**	**21.5**	**185**	**-**	**4.00**	**41.6**	**2.37**	**141**	**0.0120**	**0.141**	**-**	**-**	**-**	**-**	**-**	**-**
	median		**-**	**22.5**	**21.5**	**185**	**-**	**4.00**	**41.6**	**2.37**	**141**	**0.0120**	**0.141**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation		**-**	**6.65**	**6.22**	**170**	**-**	**1.41**	**57.7**	**2.37**	**110**	**0.00175**	**0.183**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error		**-**	**4.70**	**4.40**	**120**	**-**	**1.00**	**40.8**	**1.67**	**77.5**	**0.00124**	**0.129**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum		**-**	**17.8**	**17.1**	**65.0**	**-**	**3.00**	**0.768**	**0.701**	**63.5**	**0.0108**	**0.0118**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum		**-**	**27.2**	**25.9**	**305**	**-**	**5.00**	**82.4**	**4.05**	**219**	**0.0133**	**0.270**	**-**	**-**	**-**	**-**	**-**	**-**
Gold Creek	25-Apr-18	RG_GC_YP_01_20180425	F	22.5	21.6	151	oto, ds	6	39.3	2.16	110	0.10	1.8	A	A	A	A	-	muscle, ovaries
	25-Apr-18	RG_GC_YP_02_20180425	F	19.5	18.5	99.0	oto, ds	6	25.7	1.64	71.7	0.089	1.4	A	A	A	A	-	muscle, ovaries
	25-Apr-18	RG_GC_YP_03_20180425	F	18.2	17.3	74.0	oto, ds	4	18.7	0.99	54.3	0.057	1.1	A	A	A	A	-	muscle, ovaries
	25-Apr-18	RG_GC_YP_04_20180425	F	18.1	17.2	77.0	oto, ds	3	18.5	0.70	57.8	0.041	1.1	A	A	A	A	-	muscle, ovaries
	25-Apr-18	RG_GC_YP_05_20180425	F	22.5	21.7	155	oto, ds	3	39.9	1.72	113	0.079	1.8	A	A	A	A	-	muscle, ovaries
	25-Apr-18	RG_GC_YP_06_20180425	M	18.7	17.8	70.0	oto, ds	5	3.34	1.28	65.4	0.072	0.19	A	A	A	A	some milt loss	muscle
	25-Apr-18	RG_GC_YP_07_20180425	M	18.6	17.7	78.0	oto, ds	5	3.32	0.68	74.0	0.038	0.19	A	A	A	A	-	muscle
	25-Apr-18	RG_GC_YP_08_20180425	M	18.8	17.9	74.0	oto, ds	3	2.74	0.78	70.5	0.043	0.15	A	A	A	A	some milt loss	muscle
	25-Apr-18	RG_GC_YP_09_20180425	M	20.3	19.4	96.0	oto, ds	4	4.74	0.94	90.3	0.048	0.24	A	A	A	A	some milt loss	muscle
	total sample size			**9**	**9**	**9**	**-**	**9**	**9**	**9**	**9**	**9**	**9**	**-**	**-**	**-**	**-**	**-**	**-**
	average			**19.7**	**18.8**	**97.1**	**-**	**4.33**	**17.4**	**1.21**	**78.5**	**0.0631**	**0.886**	**-**	**-**	**-**	**-**	**-**	**-**
	median			**18.8**	**17.9**	**78.0**	**-**	**4.00**	**18.5**	**0.993**	**71.7**	**0.0574**	**1.08**	**-**	**-**	**-**	**-**	**-**	**-**
	standard deviation			**1.73**	**1.75**	**33.2**	**-**	**1.22**	**15.1**	**0.524**	**21.3**	**0.0226**	**0.710**	**-**	**-**	**-**	**-**	**-**	**-**
	standard error			**0.576**	**0.584**	**11.1**	**-**	**0.408**	**5.04**	**0.175**	**7.10**	**0.00754**	**0.237**	**-**	**-**	**-**	**-**	**-**	**-**
	minimum			**18.1**	**17.2**	**70.0**	**-**	**3.00**	**2.74**	**0.680**	**54.3**	**0.0384**	**0.153**	**-**	**-**	**-**	**-**	**-**	**-**
	maximum			**22.5**	**21.7**	**155**	**-**	**6.00**	**39.9**	**2.16**	**113**	**0.10**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**

[a] Age structures collected: oto - otoliths, ds- dorsal spines

[b] Adjusted body weight represents whole body weight less the liver weight and gonad weight and used for statistical analyses.

Table E.20: Summary of Externally and Internally Observed Fish Abnormalities at Sand Creek, Elk River, and Gold Creek Study Areas in Koocanusa Reservoir, 2018

Fish Species	Study Area	External				Total Proportion of Fish with Internal Abnormalities	Internal			Total Proportion of Fish with External Abnormalities
		Sample Size	Deformities	Erosion	Lesions		Sample Size	Parasites[a]	Irregular Size or Discolouration of Liver or Gonads	
Bull Trout (April)	Sand Creek	6	17%	17%	0%	33%	-	-	-	-
	Elk River	2	0%	50%	0%	50%	-	-	-	-
	Gold Creek	3	0%	0.0%	33%	33%	-	-	-	-
Kokanee (April)	Sand Creek	4	0%	0%	0%	0%	-	-	-	-
	Elk River	10	0%	10%	0%	10%	-	-	-	-
	Gold Creek	2	0%	0%	0%	0%	-	-	-	-
Peamouth Chub (April)	Sand Creek	60	0%	0%	0%	0%	60	42%	0%	42%
	Elk River	58	3.4%	6.9%	0%	10%	58	41%	0%	41%
	Gold Creek	61	0%	0%	0%	0%	61	56%	1.6%	57%
Redside Shiner (April)	Sand Creek	87	0%	11%	0%	11%	87	14%	0%	14%
	Elk River	87	1.1%	6.9%	0%	8%	87	24%	0%	24%
	Gold Creek	88	0%	5.7%	0%	6%	88	35%	0%	35%
Westslope Cutthroat Trout (April)	Sand Creek	-	-	-	-	-	-	-	-	-
	Elk River	2	0%	50%	0%	50%	-	-	-	-
	Gold Creek	8	0%	0%	38%	38%	-	-	-	-
Northern Pikeminnow (June)	Sand Creek	7	0%	0%	0%	0%	7	0%	0%	0%
	Elk River	6	0%	0%	0%	0%	6	17%	0%	17%
	Gold Creek	3	0%	0%	0%	0%	3	0%	0%	0%

[a] Parasites found were exclusively tapeworms; almost all tapeworms were found in body cavity

APPENDIX F

TISSUE CHEMISTRY

Table F.1: Metal Concentrations (µg/g Dry Weight) in Zooplankton and Benthic Invertebrates Collected in Koocanusa Reservoir, 2018

Tissue Type	Area	Month	Sample ID	Moisture	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
				%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Zooplankton [a]	TN	June	RG_TN_ZOOT01_20180611	99.78	6,200	2	7	92	0.2	<10	1.8	6	2.2	11	4,600	6.7
		June	RG_TN_ZOOT02_20180611	99.90	4,700	<1	4	86	0.2	<10	1.3	5	2.1	11	4,400	9
		June	RG_TN_ZOOT03_20180611	99.73	6,000	<0.2	5.3	90	0.25	5	1.6	6	2.3	13	4,600	7.1
		June	RG_TN_ZOOT04_20180611	99.79	6,200	<0.2	4.7	90	0.26	6	1.3	6	2.2	12	4,600	7.7
		June	RG_TN_ZOOT05_20180611	99.83	3,900	<1	4.3	68	0.2	<10	1.3	<5	2	12	3,900	6.2
		August	RG_TN_ZOOT01_20180831	99.87	5,700	0.8	3.8	78	0.26	8	0.93	7	2.3	10	4,400	50
		August	RG_TN_ZOOT02_20180831	99.89	6,700	1.1	4	93	0.29	9	0.85	8	2.5	11	5,100	16
		August	RG_TN_ZOOT03_20180831	99.62	7,400	0.4	3.8	85	0.32	8	0.9	9	2.8	12	6,200	27
		August	RG_TN_ZOOT04_20180831	99.81	6,500	0.5	3.6	94	0.28	8	0.89	8	2.4	10	5,400	12
		August	RG_TN_ZOOT05_20180831	99.83	7,000	0.4	3.1	93	0.29	9	0.86	9	2.5	9.9	5,000	14
		August	RG_TN_ZOOTX01_20180831	99.88	2,800	2	3.8	72	0.1	<10	1	<5	1.4	13	2,500	93
		August	RG_TN_ZOOTX02_20180831	99.93	2,200	1	2.7	96	<0.1	<10	0.8	<5	1.1	9.5	1,900	20
		August	RG_TN_ZOOTX03_20180831	99.92	3,200	2	3.6	86	0.1	<10	0.9	<5	1.4	10	2,900	29
		August	RG_TN_ZOOTX04_20180831	99.94	7,400	3	4.4	130	0.3	10	0.9	10	3.1	14	6,400	52
		August	RG_TN_ZOOTX05_20180831	99.91	7,000	2	3.9	120	0.3	10	1	10	3.1	15	6,000	40
	T4	June	RG_T4_ZOOT02_20180609	97.90	1,500	<0.1	5	27	0.08	2	0.95	1.3	1.2	8.9	750	2
		June	RG_T4_ZOOT03_20180608	97.73	1,200	<0.1	6	26	0.06	2	0.94	1.4	1.2	9.5	700	6.6
		June	RG_T4_ZOOT04_20180609	97.83	1,200	<0.1	6	25	0.08	1	0.97	1	1.1	9	640	1.7
		June	RG_T4_ZOOT05_20180609	97.78	1,300	<0.1	6	28	0.08	2	0.96	1	1.3	8.5	780	1.6
		June	RG_T4_ZOOT06_20180609	97.53	1,300	<0.1	5.1	26	0.07	1	0.74	1.1	1.1	6.8	840	1.3
		August	RG_T4_ZOOT01_20180830	99.81	1,900	3	4.4	53	<0.1	<10	1.8	<5	1.1	16	1,800	8.2
		August	RG_T4_ZOOT02_20180830	99.84	2,600	2	5.8	65	0.1	<10	1.8	<5	1.2	14	1,900	6.4
		August	RG_T4_ZOOT03_20180830	99.80	3,000	1	5.4	65	0.12	5	1.8	4	2	14	2,700	8.6
		August	RG_T4_ZOOT04_20180831	99.87	3,200	1	5.5	70	0.1	<10	1.7	<5	1.8	17	3,200	14
		August	RG_T4_ZOOT05_20180831	99.79	3,400	1.1	4.7	64	0.13	6	1.9	5	1.5	20	2,600	260
		August	RG_T4_ZOOTX01_20180830	99.86	1,200	6	4.4	56	<0.1	<10	1.9	<5	1	17	1,200	14
		August	RG_T4_ZOOTX02_20180830	99.78	1,600	4	6.4	54	<0.1	<10	2	<5	1.2	17	1,600	8.9
		August	RG_T4_ZOOTX03_20180830	99.86	1,500	2	4.9	57	<0.1	<10	1.6	<5	1	16	1,400	330
		August	RG_T4_ZOOTX04_20180831	99.93	2,900	2	3.4	85	0.1	<10	1.8	<5	1.2	15	2,200	14
		August	RG_T4_ZOOTX05_20180831	99.91	2,800	3	5.1	78	0.1	<10	1.6	<5	1.6	17	3,000	140
Benthic Invertebrate	Sand Creek	April	RG_SC_BIT01_20180427	73.91	1,000	<50	<20	<20	<5	<500	6	<200	<5	30	2,000	<5
		April	RG_SC_BIT02_20180427	52.63	15,300	<10	<5	120	<1	<100	<1	<50	6	12	14,400	10
		April	RG_SC_BIT03_20180427	71.87	5,200	<10	<5	36	<1	<100	3	<50	2	19	6,300	5
		April	RG_SC_BIT04_20180427	57.30	5,600	<10	<5	42	<1	<100	3	<50	3	16	6,300	5
		April	RG_SC_BIT05_20180428	62.54	5,100	<10	<5	40	<1	<100	<1	<50	3	16	5,500	4
	TN	April	RG_TN_BIT_20180430	85.28	8,000	<50	<20	40	<5	<500	<5	<200	<5	<20	11,600	14
		August	RG_TN_BIT_20180829	88.07	5,600	<10	<5	47	<1	<100	1	<50	7	22	8,800	11
	Elk River	April	RG_ER_BIT01_20180427	66.38	<1,000	<50	<20	20	<5	<500	<5	<200	<5	20	<1,000	<5
		April	RG_ER_BIT02_20180427	71.29	900	<10	<5	12	<1	<100	<1	<50	<1	20	700	<1
		April	RG_ER_BIT03_20180427	70.68	2,800	<10	<5	32	<1	<100	1	<50	2	15	2,100	1
		April	RG_ER_BIT04_20180427	91.11	3,000	<50	<20	80	<5	<500	7	<200	<5	40	2,000	<5
		April	RG_ER_BIT05_20180427	73.15	9,000	<50	<20	90	<5	<500	9	<200	<5	<20	6,000	<5
	T4	April	RG_T4_BIT_20180429	91.57	6,900	<10	<5	75	<1	<100	3	<50	2	22	6,700	6
		August	RG_T4_BIT_20180828 [b]	79.80	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R
		October	RG_T4_BIT_20181009	86.26	12,100	<1	9.3	110	0.40	10	1.1	16	5.4	22	16,300	11
	Gold Creek	April	RG_GC_BIT01_20180427	75.81	5,000	<50	<20	30	<5	<500	<5	<200	<5	30	6,000	<5
		April	RG_GC_BIT02_20180427	49.01	2,200	<10	<5	34	<1	<100	<1	<50	2	14	1,900	<1
		April	RG_GC_BIT03_20180427	72.85	<200	<10	<5	<5	<1	<100	<1	<50	<1	21	300	<1
		April	RG_GC_BIT04_20180428	94.02	6,000	<50	<20	90	<5	<500	<5	<200	<5	20	5,000	<5
		April	RG_GC_BIT05_20180428	83.79	2,700	<1	1	40	0.1	<10	0.4	<5	2.1	15	2,300	1.2

[a] ZOOT and ZOOTX samples were collected from the entire water column and from the top 10 m of the water column, respectively.

[b] Sample was inadvertently contaminated in the analytical testing process (resampled October 9, 2018).

N/R indiates that no results was recorded.

Table F.1: Metal Concentrations (µg/g Dry Weight) in Zooplankton and Benthic Invertebrates Collected in Koocanusa Reservoir, 2018

Tissue Type	Area	Month	Sample ID	Moisture	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
				%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Zooplankton [a]	TN	June	RG_TN_ZOOT01_20180611	99.78	130	<0.05	<1	5	2	<0.1	150	<0.5	1.1	64	0.61	6	120
		June	RG_TN_ZOOT02_20180611	99.90	120	<0.05	<1	20	1.5	<0.1	160	<0.5	<0.5	60	0.97	6	110
		June	RG_TN_ZOOT03_20180611	99.73	140	0.05	0.5	17	2.3	0.04	160	0.1	1.3	59	0.48	6.1	120
		June	RG_TN_ZOOT04_20180611	99.79	140	0.04	0.5	4.8	2	0.03	160	0.1	0.3	59	0.55	6.1	110
		June	RG_TN_ZOOT05_20180611	99.83	130	<0.05	<1	4.2	1.7	<0.1	140	<0.5	<0.5	47	0.62	4	100
		August	RG_TN_ZOOT01_20180831	99.87	220	0.04	0.5	6	2.7	0.04	100	0.1	1.6	91	0.42	8.2	87
		August	RG_TN_ZOOT02_20180831	99.89	240	0.04	0.6	6.2	2.7	0.04	120	0.1	2.8	107	0.5	9.4	100
		August	RG_TN_ZOOT03_20180831	99.62	270	0.04	0.5	7.3	2.6	0.06	100	0.1	0.7	117	0.43	11	100
		August	RG_TN_ZOOT04_20180831	99.81	250	0.04	0.6	5.9	2.5	0.04	110	0.1	2.3	102	0.53	9.5	96
		August	RG_TN_ZOOT05_20180831	99.83	240	0.04	0.6	6.2	2.1	0.04	120	0.1	1.4	110	0.51	10	94
		August	RG_TN_ZOOTX01_20180831	99.88	120	<0.05	<1	4.5	3.2	<0.1	120	<0.5	5.6	58	0.68	4	120
		August	RG_TN_ZOOTX02_20180831	99.93	95	<0.05	<1	7.6	2.6	<0.1	170	<0.5	1.8	37	0.76	3	100
		August	RG_TN_ZOOTX03_20180831	99.92	130	<0.05	<1	4.2	3.3	<0.1	160	<0.5	1.6	52	0.82	5	100
		August	RG_TN_ZOOTX04_20180831	99.94	220	<0.05	1	8.2	3.3	<0.1	210	<0.5	2.2	130	1.2	11	120
		August	RG_TN_ZOOTX05_20180831	99.91	270	<0.05	1	8	2.8	<0.1	220	<0.5	1.4	120	1	11	120
	T4	June	RG_T4_ZOOT02_20180609	97.90	106	0.037	0.3	3	2.2	0.03	32	<0.05	0.37	14	0.09	1.7	78
		June	RG_T4_ZOOT03_20180608	97.73	104	0.039	0.4	2	2.7	0.02	33	<0.05	0.76	12	0.11	1.4	100
		June	RG_T4_ZOOT04_20180609	97.83	107	0.037	0.3	1.6	2.5	0.02	28	<0.05	0.21	10	0.094	1.4	86
		June	RG_T4_ZOOT05_20180609	97.78	114	0.039	0.3	2	2.7	0.02	34	<0.05	0.11	12	0.092	1.5	85
		June	RG_T4_ZOOT06_20180609	97.53	90	0.035	0.3	1.8	2.4	0.02	37	<0.05	0.1	12	0.082	1.5	70
		August	RG_T4_ZOOT01_20180830	99.81	94	0.05	<1	3.3	3.8	<0.1	91	<0.5	3.3	38	0.45	3	150
		August	RG_T4_ZOOT02_20180830	99.84	120	0.05	<1	3.8	4.9	<0.1	110	<0.5	3.8	47	0.48	4	150
		August	RG_T4_ZOOT03_20180830	99.80	160	0.05	0.8	5.1	4.7	0.05	110	<0.1	1.1	55	0.42	4.2	140
		August	RG_T4_ZOOT04_20180831	99.87	160	0.05	<1	5.9	4.4	<0.1	120	<0.5	3.1	59	0.59	5	130
		August	RG_T4_ZOOT05_20180831	99.79	140	0.06	0.8	6.9	3.8	0.06	94	0.2	4.3	66	0.43	5.3	130
		August	RG_T4_ZOOTX01_20180830	99.86	83	0.06	<1	3	3.9	<0.1	110	<0.5	4.8	27	0.81	2	150
		August	RG_T4_ZOOTX02_20180830	99.78	100	0.06	<1	4.1	4.9	<0.1	100	<0.5	2.3	34	0.48	2	160
		August	RG_T4_ZOOTX03_20180830	99.86	83	<0.05	<1	3.3	4.7	<0.1	110	<0.5	1.1	34	0.68	2	170
		August	RG_T4_ZOOTX04_20180831	99.93	120	0.06	1	4.7	3.2	<0.1	140	<0.5	2.5	46	0.94	4	130
		August	RG_T4_ZOOTX05_20180831	99.91	130	<0.05	1	4.5	4.2	<0.1	140	<0.5	3.2	69	0.81	4	140
Benthic Invertebrate	Sand Creek	April	RG_SC_BIT01_20180427	73.91	<50	<2	<50	<20	9	<5	<50	<20	<20	80	<2	<50	<200
		April	RG_SC_BIT02_20180427	52.63	330	<0.5	<10	14	<0.5	<1	180	<5	<5	250	0.6	20	80
		April	RG_SC_BIT03_20180427	71.87	120	<0.5	<10	5	3.8	<1	60	<5	<5	100	<0.5	<10	130
		April	RG_SC_BIT04_20180427	57.30	170	<0.5	<10	5	3.5	<1	80	<5	<5	81	<0.5	<10	100
		April	RG_SC_BIT05_20180428	62.54	120	<0.5	<10	6	6.3	<1	70	<5	<5	80	<0.5	<10	120
	TN	April	RG_TN_BIT_20180430	85.28	190	<2	<50	<20	<2	<5	70	<20	<20	100	<2	<50	<200
		August	RG_TN_BIT_20180829	88.07	170	<0.5	<10	10	4.7	<1	80	<5	<5	140	0.7	<10	100
	Elk River	April	RG_ER_BIT01_20180427	66.38	<50	<2	<50	<20	6	<5	<50	<20	<20	<20	<2	<50	<200
		April	RG_ER_BIT02_20180427	71.29	50	<0.5	<10	<5	5.4	<1	<10	<5	<5	12	<0.5	<10	150
		April	RG_ER_BIT03_20180427	70.68	80	<0.5	<10	<5	5	<1	10	<5	<5	34	<0.5	<10	100
		April	RG_ER_BIT04_20180427	91.11	140	<2	<50	<20	10	<5	<50	<20	<20	60	<2	<50	<200
		April	RG_ER_BIT05_20180427	73.15	220	<2	<50	<20	12	<5	70	<20	<20	180	<2	<50	<200
	T4	April	RG_T4_BIT_20180429	91.57	140	<0.5	<10	6	8.5	<1	60	<5	<5	97	0.5	10	160
		August	RG_T4_BIT_20180828 [b]	79.80	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R
		October	RG_T4_BIT_20181009	86.26	310	0.06	<1	13	4.7	<0.1	130	<0.5	<0.5	170	0.56	19	94
	Gold Creek	April	RG_GC_BIT01_20180427	75.81	230	<2	<50	<20	4	<5	<50	<20	<20	80	<2	<50	<200
		April	RG_GC_BIT02_20180427	49.01	40	<0.5	<10	<5	2.8	<1	<10	<5	<5	55	<0.5	<10	90
		April	RG_GC_BIT03_20180427	72.85	10	<0.5	<10	<5	3.9	<1	<10	<5	<5	<5	<0.5	<10	80
		April	RG_GC_BIT04_20180428	94.02	120	<2	<50	<20	2	<5	<50	<20	<20	450	<2	<50	<200
		April	RG_GC_BIT05_20180428	83.79	110	<0.05	<1	2	2.3	<0.1	6	<0.5	<0.5	46	0.2	3	100

[a] ZOOT and ZOOTX samples were collected from the entire water column and from the top 10 m of the water column, respectively.

[b] Sample was inadvertently contaminated in the analytical testing process (resampled October 9, 2018).

N/R indiates that no results was recorded.

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Bull Trout	Sand Creek	April	RG_SC_BT01M_20180425	83.64	<1000	<50	<20	<20	<5	<500	<5	<200	<5	<20	<1000	<5
			April	RG_SC_BT03M_20180425	74.10	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_SC_BT04M_20180427	39.41	<200	<10	<5	24	<1	<100	<1	<50	<1	<5	300	4
			April	RG_SC_BT05M_20180428	78.74	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_SC_BT06M_20180428	76.11	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
		Elk River	April	RG_ER_BT01M_20180427	19.34	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_ER_BT02M_20180429	73.82	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
		Gold Creek	April	RG_GC_BT01M_20180425	79.02	200	<10	<5	<5	<1	<100	<1	<50	<1	<5	200	<1
			April	RG_GC_BT02M_20180427	75.25	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_GC_BT03M_20180428	76.97	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
	Kokanee	Sand Creek	April	RG_SC_KO01M_20180425	72.32	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	1	<20	<0.1
			April	RG_SC_KO02M_20180425	75.03	8	<0.1	0.08	0.07	<0.01	<1	<0.01	<0.5	<0.01	1.1	19	0.02
			April	RG_SC_KO03M_20180426	71.47	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_SC_KO04M_20180426	74.93	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
		Elk River	April	RG_ER_KO01M_20180428	56.16	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_ER_KO02M_20180429	20.70	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO01M_20180901	70.63	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO02M_20180901	71.93	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO03M_20180901	72.67	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO04M_20180901	69.87	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO05M_20180901	70.43	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO06M_20180901	70.82	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO07M_20180901	69.85	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_KO08M_20180901	70.57	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
		Gold Creek	April	RG_GC_KO01M_20180427	61.33	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_GC_KO01M_20180901	67.42	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
	Mountain Whitefish	Sand Creek	April	RG_SC_MW01M_20180427	77.68	<5	<0.2	0.2	0.1	<0.02	<2	<0.02	<1	0.03	1.6	18	<0.02
		Elk River	April	RG_ER_MW01M_20180425	57.94	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_ER_MW02M_20180428	74.77	7	<0.1	0.45	0.1	<0.01	<1	<0.01	<0.5	0.04	1.4	17	<0.01
			April	RG_ER_MW03M_20180429	41.05	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
	Northern Pikeminnow	Sand Creek	June	RG_SC_NSC01M_20180605	77.93	5	<0.1	<0.05	0.17	<0.01	<1	<0.01	<0.5	<0.01	0.8	13	0.05
			June	RG_SC_NSC02M_20180605	77.47	<2	<0.1	<0.05	0.07	<0.01	<1	<0.01	<0.5	<0.01	0.68	7	0.01
			June	RG_SC_NSC03M_20180605	78.87	2	<0.1	0.05	0.17	<0.01	<1	<0.01	<0.5	<0.01	0.82	13	0.03
			June	RG_SC_NSC04M_20180605	79.13	<2	<0.1	<0.05	0.2	<0.01	<1	<0.01	<0.5	<0.01	0.75	9	<0.01
			June	RG_SC_NSC05M_20180605	78.10	3	<0.1	0.06	0.55	<0.01	<1	<0.01	<0.5	<0.01	0.72	10	0.02
			June	RG_SC_NSC06M_20180610	78.76	2	<0.1	<0.05	0.15	<0.01	<1	<0.01	<0.5	<0.01	0.63	8	0.04
			June	RG_SC_NSC07M_20180610	77.19	<2	<0.1	0.06	0.06	<0.01	<1	<0.01	<0.5	<0.01	0.64	8	0.03
		Elk River	June	RG_ER_NSC01M_20180606	78.85	<2	<0.1	0.07	0.14	<0.01	<1	<0.01	<0.5	<0.01	0.58	8	0.04
			June	RG_ER_NSC02M_20180606	79.56	<2	<0.1	0.06	0.32	<0.01	<1	<0.01	<0.5	<0.01	0.69	13	0.05
			June	RG_ER_NSC03M_20180607	79.31	<2	<0.1	0.09	0.46	<0.01	<1	<0.01	<0.5	<0.01	0.56	10	<0.01
			June	RG_ER_NSC04M_20180607	77.85	<2	<0.1	0.05	0.18	<0.01	<1	<0.01	<0.5	<0.01	0.62	7	0.02
			June	RG_ER_NSC05M_20180607	80.22	<2	<0.1	0.07	1.9	<0.01	<1	<0.01	<0.5	<0.01	0.72	9	0.02
			June	RG_ER_NSC06M_20180607	78.93	<2	<0.1	0.1	0.71	<0.01	<1	<0.01	<0.5	<0.01	0.76	8	0.01
			September	RG_ER_NSC01M_20180901	75.32	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_NSC02M_20180901	71.3	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_NSC03M_20180901	77.42	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			September	RG_ER_NSC04M_20180901	76.65	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
		Gold Creek	June	RG_GC_NSC01M_20180607	78.92	<2	<0.1	0.07	0.65	<0.01	<1	<0.01	<0.5	<0.01	0.65	8	<0.01
			June	RG_GC_NSC02M_20180607	78.85	<2	<0.1	0.11	0.44	<0.01	<1	<0.01	<0.5	<0.01	0.73	8	0.04
			June	RG_GC_NSC03M_20180607	76.66	<2	<0.1	0.07	2.1	<0.01	<1	<0.01	<0.5	<0.01	0.79	8	0.06
	Peamouth Chub	Sand Creek	April	RG_SC_PCC01M_20180424	80.39	5	<0.1	0.16	1.6	<0.01	<1	<0.01	<0.5	0.02	0.99	23	0.05
			April	RG_SC_PCC02M_20180424	79.17	12	<0.1	0.1	1	<0.01	<1	<0.01	<0.5	0.02	1.1	25	0.09
			April	RG_SC_PCC03M_20180424	79.25	18	<0.1	0.27	1.4	<0.01	<1	<0.01	<0.5	0.04	2.4	53	0.06
			April	RG_SC_PCC06M_20180424	79.38	19	<0.1	0.13	1.5	<0.01	<1	0.01	<0.5	0.03	1.1	36	0.08
			April	RG_SC_PCC07M_20180424	78.55	4	<0.1	0.09	0.56	<0.01	<1	<0.01	<0.5	0.01	1.1	13	0.06
			April	RG_SC_PCC08M_20180424	79.32	8	<0.1	0.19	1.2	<0.01	<1	<0.01	<0.5	0.02	0.8	25	0.08
			April	RG_SC_PCC10M_20180424	78.63	4	<0.1	0.19	0.6	<0.01	<1	<0.01	<0.5	0.02	1.8	18	0.03
			April	RG_SC_PCC11M_20180424	79.00	7	<0.1	0.1	1	<0.01	<1	<0.01	<0.5	0.02	1.1	22	0.04
			April	RG_SC_PCC13M_20180424	75.22	2	<0.1	0.27	0.78	<0.01	<1	<0.01	<0.5	0.02	2.6	46	0.02
			April	RG_SC_PCC14M_20180424	77.91	6	<0.1	0.11	0.6	<0.01	<1	<0.01	<0.5	0.01	0.83	14	0.06

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Bull Trout	Sand Creek	April	RG_SC_BT01M_20180425	83.64	<50	<2	<50	<20	2	<5	<50	<20	<20	<20	<2	<50	<200
			April	RG_SC_BT03M_20180425	74.10	<10	0.8	<10	<5	1.8	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_SC_BT04M_20180427	39.41	20	<0.5	<10	<5	<0.5	<1	<10	<5	<5	6	<0.5	<10	<50
			April	RG_SC_BT05M_20180428	78.74	<10	1.1	<10	<5	2	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_SC_BT06M_20180428	76.11	<10	1.4	<10	<5	1.3	<1	<10	<5	<5	<5	<0.5	<10	<50
		Elk River	April	RG_ER_BT01M_20180427	19.34	<10	1.1	<10	<5	1.8	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_ER_BT02M_20180429	73.82	<10	<0.5	<10	<5	1.4	<1	<10	<5	<5	<5	<0.5	<10	<50
		Gold Creek	April	RG_GC_BT01M_20180425	79.02	<10	1.3	<10	<5	2.7	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_BT02M_20180427	75.25	<10	1.9	<10	<5	2	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_BT03M_20180428	76.97	<10	1.8	<10	<5	1.9	<1	<10	<5	<5	<5	<0.5	<10	<50
	Kokanee	Sand Creek	April	RG_SC_KO01M_20180425	72.32	<1	0.41	<1	<0.5	1.8	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	13
			April	RG_SC_KO02M_20180425	75.03	0.5	0.31	<0.1	<0.05	2	<0.01	0.3	0.08	<0.05	0.46	<0.005	<0.1	16
			April	RG_SC_KO03M_20180426	71.47	<10	<0.5	<10	<5	1.9	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_SC_KO04M_20180426	74.93	<10	<0.5	<10	<5	2	<1	<10	<5	<5	<5	<0.5	<10	<50
		Elk River	April	RG_ER_KO01M_20180428	56.16	<10	<0.5	<10	<5	2	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_ER_KO02M_20180429	20.70	<10	<0.5	<10	<5	1.8	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO01M_20180901	70.63	<10	<0.5	<10	<5	1.6	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO02M_20180901	71.93	<10	<0.5	<10	<5	1.5	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO03M_20180901	72.67	<10	<0.5	<10	<5	1.6	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO04M_20180901	69.87	<10	<0.5	<10	<5	1.4	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO05M_20180901	70.43	<10	<0.5	<10	<5	1.7	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO06M_20180901	70.82	<10	<0.5	<10	<5	1.8	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO07M_20180901	69.85	<10	<0.5	<10	<5	1.2	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_KO08M_20180901	70.57	<10	<0.5	<10	<5	1.6	<1	<10	<5	<5	<5	<0.5	<10	<50
		Gold Creek	April	RG_GC_KO01M_20180427	61.33	<10	<0.5	<10	<5	1.6	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_GC_KO01M_20180901	67.42	<10	<0.5	<10	<5	1.5	<1	<10	<5	<5	<5	<0.5	<10	<50
	Mountain Whitefish	Sand Creek	April	RG_SC_MW01M_20180427	77.68	1	0.1	<0.2	<0.1	6	<0.02	0.8	<0.1	<0.1	0.1	<0.01	<0.2	18
		Elk River	April	RG_ER_MW01M_20180425	57.94	<10	<0.5	<10	<5	3.5	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_ER_MW02M_20180428	74.77	0.8	0.24	<0.1	<0.05	2.2	<0.01	0.7	<0.05	<0.05	0.1	<0.005	<0.1	17
			April	RG_ER_MW03M_20180429	41.05	<10	<0.5	<10	<5	3	<1	<10	<5	<5	<5	<0.5	<10	<50
	Northern Pikeminnow	Sand Creek	June	RG_SC_NSC01M_20180605	77.93	0.5	1.4	<0.1	<0.05	1.7	<0.01	0.2	<0.05	<0.05	0.15	<0.005	<0.1	20
			June	RG_SC_NSC02M_20180605	77.47	0.2	1.4	<0.1	<0.05	1.3	<0.01	0.1	<0.05	<0.05	<0.05	<0.005	<0.1	18
			June	RG_SC_NSC03M_20180605	78.87	0.6	1.2	<0.1	<0.05	2.4	<0.01	0.4	<0.05	<0.05	0.19	<0.005	<0.1	32
			June	RG_SC_NSC04M_20180605	79.13	0.7	0.89	<0.1	<0.05	1.6	<0.01	0.6	<0.05	<0.05	<0.05	<0.005	<0.1	25
			June	RG_SC_NSC05M_20180605	78.10	1.1	0.63	<0.1	<0.05	2.7	<0.01	1.6	<0.05	<0.05	0.1	<0.005	<0.1	21
			June	RG_SC_NSC06M_20180610	78.76	0.4	1.6	<0.1	<0.05	2	<0.01	0.2	<0.05	<0.05	0.11	<0.005	<0.1	20
			June	RG_SC_NSC07M_20180610	77.19	0.2	2.1	<0.1	<0.05	1.6	<0.01	<0.1	<0.05	<0.05	<0.05	<0.005	<0.1	16
		Elk River	June	RG_ER_NSC01M_20180606	78.85	0.5	1.2	<0.1	<0.05	4	<0.01	0.3	<0.05	<0.05	<0.05	<0.005	<0.1	18
			June	RG_ER_NSC02M_20180606	79.56	0.7	1.2	<0.1	<0.05	3.1	<0.01	1	<0.05	<0.05	0.07	<0.005	<0.1	20
			June	RG_ER_NSC03M_20180607	79.31	0.8	1.1	<0.1	<0.05	2.5	<0.01	1.1	<0.05	<0.05	0.06	<0.005	<0.1	20
			June	RG_ER_NSC04M_20180607	77.85	0.4	1.6	<0.1	<0.05	4.8	<0.01	0.2	<0.05	<0.05	0.05	<0.005	<0.1	18
			June	RG_ER_NSC05M_20180607	80.22	0.5	0.91	<0.1	0.11	2.5	<0.01	0.2	<0.05	<0.05	0.06	<0.005	<0.1	21
			June	RG_ER_NSC06M_20180607	78.93	0.9	0.73	<0.1	<0.05	4.4	<0.01	0.8	<0.05	<0.05	<0.05	<0.005	<0.1	26
			September	RG_ER_NSC01M_20180901	75.32	<10	1.8	<10	<5	1.6	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_NSC02M_20180901	71.3	<10	1.6	<10	<5	2.2	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_NSC03M_20180901	77.42	<10	1.1	<10	<5	2.5	<1	<10	<5	<5	<5	<0.5	<10	<50
			September	RG_ER_NSC04M_20180901	76.65	<10	0.8	<10	<5	1.4	<1	<10	<5	<5	<5	<0.5	<10	<50
		Gold Creek	June	RG_GC_NSC01M_20180607	78.92	0.6	1.2	<0.1	<0.05	2.9	<0.01	0.3	<0.05	<0.05	<0.05	<0.005	<0.1	22
			June	RG_GC_NSC02M_20180607	78.85	0.5	0.96	<0.1	<0.05	2.7	<0.01	0.5	<0.05	<0.05	0.06	<0.005	<0.1	24
			June	RG_GC_NSC03M_20180607	76.66	0.3	2	<0.1	<0.05	1.7	<0.01	0.2	<0.05	<0.05	0.06	<0.005	<0.1	18
	Peamouth Chub	Sand Creek	April	RG_SC_PCC01M_20180424	80.39	1.1	0.71	<0.1	<0.05	2.2	<0.01	3.4	<0.05	<0.05	0.42	<0.005	<0.1	32
			April	RG_SC_PCC02M_20180424	79.17	1.3	0.8	<0.1	0.16	1.4	<0.01	3.2	<0.05	<0.05	0.4	<0.005	<0.1	22
			April	RG_SC_PCC03M_20180424	79.25	1.3	0.87	<0.1	<0.05	2	<0.01	1.8	<0.05	<0.05	0.25	<0.005	<0.1	47
			April	RG_SC_PCC06M_20180424	79.38	1.6	0.53	<0.1	0.06	2.2	<0.01	4.3	<0.05	<0.05	0.32	<0.005	<0.1	34
			April	RG_SC_PCC07M_20180424	78.55	0.9	0.44	<0.1	<0.05	1.9	<0.01	2.4	<0.05	<0.05	0.11	<0.005	<0.1	22
			April	RG_SC_PCC08M_20180424	79.32	1.3	0.86	<0.1	0.06	2	<0.01	3	<0.05	<0.05	0.12	<0.005	<0.1	34
			April	RG_SC_PCC10M_20180424	78.63	0.6	0.55	<0.1	<0.05	1.7	<0.01	0.6	<0.05	<0.05	0.09	<0.005	<0.1	33
			April	RG_SC_PCC11M_20180424	79.00	1.2	0.53	<0.1	<0.05	1.9	<0.01	3.2	<0.05	<0.05	0.12	<0.005	<0.1	24
			April	RG_SC_PCC13M_20180424	75.22	0.7	0.34	<0.1	<0.05	1.4	<0.01	0.6	<0.05	<0.05	0.06	<0.005	<0.1	47
			April	RG_SC_PCC14M_20180424	77.91	1	0.46	<0.1	<0.05	1.7	<0.01	3.2	<0.05	<0.05	0.12	<0.005	<0.1	23

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Peamouth Chub	Elk River	April	RG_ER_PCC01M_20180425	78.71	<2	<0.1	0.12	1.3	<0.01	<1	<0.01	<0.5	0.02	0.67	15	0.04
			April	RG_ER_PCC02M_20180425	76.98	5	<0.1	0.08	1.1	<0.01	<1	<0.01	<0.5	0.02	0.68	10	0.01
			April	RG_ER_PCC03M_20180425	77.81	<2	<0.1	0.15	1	<0.01	<1	<0.01	<0.5	0.02	1.4	18	<0.01
			April	RG_ER_PCC06M_20180425	78.57	3	<0.1	0.15	0.96	<0.01	<1	<0.01	<0.5	0.01	1.5	17	0.01
			April	RG_ER_PCC08M_20180426	79.63	3	<0.1	0.1	1.1	<0.01	<1	<0.01	<0.5	0.01	0.92	12	0.01
			April	RG_ER_PCC09M_20180426	79.32	<2	<0.1	0.1	1.2	<0.01	<1	<0.01	<0.5	0.01	1.2	13	0.03
			April	RG_ER_PCC11M_20180426	75.70	<5	<0.2	0.1	0.5	<0.02	<2	<0.02	<1	<0.02	1.3	21	0.03
			April	RG_ER_PCC12M_20180426	80.66	3	<0.1	0.12	1.1	<0.01	<1	<0.01	<0.5	0.01	1.2	20	0.02
			April	RG_ER_PCC16M_20180426	79.36	6	<0.1	0.21	1.7	<0.01	<1	0.02	<0.5	0.02	1	23	0.03
			April	RG_ER_PCC17M_20180426	76.65	6	<0.1	0.27	1.1	<0.01	<1	<0.01	<0.5	0.02	2.8	33	0.02
		Gold Creek	April	RG_GC_PCC01M_20180425	76.73	<20	<1	<0.5	0.7	<0.1	<10	<0.1	<5	<0.1	1.1	<20	<0.1
			April	RG_GC_PCC02M_20180425	76.78	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	0.8	<20	<0.1
			April	RG_GC_PCC04M_20180425	77.15	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	<0.1	1.6	20	<0.1
			April	RG_GC_PCC08M_20180425	75.09	40	<1	<0.5	1.4	<0.1	<10	<0.1	<5	<0.1	1.2	40	<0.1
			April	RG_GC_PCC09M_20180426	77.78	<20	<1	<0.5	1	<0.1	<10	<0.1	<5	<0.1	0.7	<20	<0.1
			April	RG_GC_PCC11M_20180426	76.94	<20	<1	<0.5	1.4	<0.1	<10	<0.1	<5	<0.1	0.9	20	<0.1
			April	RG_GC_PCC14M_20180426	74.40	<20	<1	<0.5	0.8	<0.1	<10	<0.1	<5	<0.1	0.9	20	<0.1
			April	RG_GC_PCC15M_20180426	78.69	<20	<1	<0.5	1.3	<0.1	<10	<0.1	<5	<0.1	0.8	<20	<0.1
			April	RG_GC_PCC17M_20180426	74.77	<50	<2	<1	1	<0.2	<20	<0.2	<10	<0.2	1	<50	<0.2
			April	RG_GC_PCC18M_20180426	75.18	<20	<1	<0.5	0.8	<0.1	<10	<0.1	<5	<0.1	1	20	<0.1
	Rainbow Trout	Sand Creek	April	RG_SC_RT01M_20180427	81.54	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_SC_RT02M_20180427	75.87	10	<0.1	<0.05	0.17	<0.01	<1	<0.01	<0.5	0.02	1.2	23	<0.01
		Elk River	September	RG_ER_RT01M_20180901	75.06	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
	Redside Shiner	Sand Creek	April	RG_SC_RSC02M_20180424	74.98	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.2	<20	<0.1
			April	RG_SC_RSC04M_20180424	74.87	<20	<1	<0.5	1.3	<0.1	<10	<0.1	<5	<0.1	2.5	30	<0.1
			April	RG_SC_RSC05M_20180424	76.89	20	<1	<0.5	1.8	<0.1	<10	<0.1	<5	<0.1	1.7	40	<0.1
			April	RG_SC_RSC06M_20180424	78.66	<20	<1	<0.5	1	<0.1	<10	<0.1	<5	<0.1	2.6	20	<0.1
			April	RG_SC_RSC09M_20180424	76.41	<20	<1	<0.5	1.7	<0.1	<10	<0.1	<5	<0.1	2.5	30	<0.1
			April	RG_SC_RSC10M_20180424	76.75	<20	<1	<0.5	1.6	<0.1	<10	<0.1	<5	<0.1	1.4	20	<0.1
			April	RG_SC_RSC11M_20180426	75.67	<20	<1	<0.5	0.6	<0.1	<10	<0.1	<5	<0.1	1.9	30	0.1
			April	RG_SC_RSC13M_20180426	76.01	<20	<1	<0.5	0.6	<0.1	<10	<0.1	<5	<0.1	1.2	<20	<0.1
			April	RG_SC_RSC17M_20180427	74.70	<20	<1	<0.5	1.4	<0.1	<10	<0.1	<5	<0.1	1.2	<20	<0.1
			April	RG_SC_RSC18M_20180427	77.56	6	<0.2	<0.1	2	<0.02	<2	<0.02	<1	<0.02	2.2	24	<0.02
		Elk River	April	RG_ER_RSC01M_20180425	76.30	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.1	<20	<0.1
			April	RG_ER_RSC07M_20180425	74.87	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1	<20	<0.1
			April	RG_ER_RSC08M_20180425	77.14	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.1	<20	<0.1
			April	RG_ER_RSC09M_20180425	77.58	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	2.5	<20	<0.1
			April	RG_ER_RSC10M_20180425	76.40	<20	<1	<0.5	0.7	<0.1	<10	<0.1	<5	<0.1	1.7	<20	<0.1
			April	RG_ER_RSC11M_20180425	71.25	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.4	20	<0.1
			April	RG_ER_RSC12M_20180425	74.76	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	0.9	<20	<0.1
			April	RG_ER_RSC14M_20180425	78.01	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.2	<20	<0.1
			April	RG_ER_RSC15M_20180425	76.27	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	2.4	30	<0.1
			April	RG_ER_RSC16M_20180425	78.14	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.2	<20	<0.1
			April	RG_ER_RSC19M_20180425	77.23	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1.1	<20	<0.1
		Gold Creek	April	RG_GC_RSC02M_20180424	68.96	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	1.6	30	<0.1
			April	RG_GC_RSC04M_20180424	69.38	<20	<1	<0.5	1.9	<0.1	<10	<0.1	<5	<0.1	1.8	20	<0.1
			April	RG_GC_RSC09M_20180426	76.89	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	<0.1	2.1	30	<0.1
			April	RG_GC_RSC16M_20180426	70.41	<20	<1	<0.5	1.9	<0.1	<10	<0.1	<5	<0.1	1.8	30	<0.1
			April	RG_GC_RSC17M_20180427	76.55	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	1.7	20	<0.1
			April	RG_GC_RSC18M_20180427	74.69	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	1.3	30	<0.1
			April	RG_GC_RSC19M_20180427	76.27	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	1	<20	<0.1
			April	RG_GC_RSC20M_20180427	77.81	9	<0.2	0.1	1	<0.02	<2	<0.02	<1	0.02	1.6	28	0.03
			April	RG_GC_RSC21M_20180427	76.82	<5	<0.2	<0.1	2.2	<0.02	<2	<0.02	<1	0.04	2.6	29	0.04
			April	RG_GC_RSC24M_20180427	67.22	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	1.6	30	<0.1
	Westslope Cutthroat Trout	Elk River	April	RG_ER_WCT01M_20180425	61.19	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_ER_WCT02M_20180430	54.49	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			June	RG_ER_WCT01M_20180607	77.98	<200	<10	<5	14	<1	<100	<1	<50	<1	<5	<200	<1
		Gold Creek	April	RG_GC_WCT01M_20180425	74.92	300	<10	<5	<5	<1	<100	<1	<50	<1	20	300	<1
			April	RG_GC_WCT02M_20180425	76.95	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_GC_WCT03M_20180425	66.83	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Peamouth Chub	Elk River	April	RG_ER_PCC01M_20180425	78.71	1.5	0.62	<0.1	<0.05	2.1	<0.01	5.7	<0.05	<0.05	0.1	<0.005	<0.1	19
			April	RG_ER_PCC02M_20180425	76.98	1	0.41	<0.1	<0.05	2.8	<0.01	4.4	<0.05	<0.05	0.19	<0.005	<0.1	36
			April	RG_ER_PCC03M_20180425	77.81	0.8	0.42	<0.1	<0.05	4.4	<0.01	2.5	<0.05	<0.05	0.05	<0.005	<0.1	42
			April	RG_ER_PCC06M_20180425	78.57	0.8	0.48	<0.1	<0.05	2	<0.01	2.7	<0.05	<0.05	0.48	<0.005	<0.1	41
			April	RG_ER_PCC08M_20180426	79.63	0.9	0.52	<0.1	<0.05	2.6	<0.01	3.7	<0.05	<0.05	0.16	<0.005	<0.1	27
			April	RG_ER_PCC09M_20180426	79.32	1	0.67	<0.1	<0.05	2.7	0.14	4	<0.05	<0.05	0.07	<0.005	<0.1	28
			April	RG_ER_PCC11M_20180426	75.70	0.4	0.6	<0.2	<0.1	2.4	<0.02	0.4	<0.1	<0.1	<0.1	<0.01	<0.2	28
			April	RG_ER_PCC12M_20180426	80.66	0.8	0.96	<0.1	<0.05	2.2	<0.01	1.8	<0.05	<0.05	0.1	<0.005	<0.1	28
			April	RG_ER_PCC16M_20180426	79.36	1.3	1.2	<0.1	<0.05	5	<0.01	6.7	<0.05	<0.05	0.16	<0.005	<0.1	35
			April	RG_ER_PCC17M_20180426	76.65	0.9	0.37	<0.1	<0.05	1.9	<0.01	1.8	<0.05	<0.05	0.32	<0.005	<0.1	49
		Gold Creek	April	RG_GC_PCC01M_20180425	76.73	<1	0.53	<1	<0.5	1.6	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	30
			April	RG_GC_PCC02M_20180425	76.78	1	0.54	<1	<0.5	2.1	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	30
			April	RG_GC_PCC04M_20180425	77.15	<1	0.69	<1	<0.5	4.5	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	26
			April	RG_GC_PCC08M_20180425	75.09	1	0.39	<1	<0.5	2.3	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	32
			April	RG_GC_PCC09M_20180426	77.78	1	0.42	<1	<0.5	3.3	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	21
			April	RG_GC_PCC11M_20180426	76.94	1	0.48	<1	<0.5	3.4	<0.1	3	<0.5	<0.5	0.6	<0.05	<1	49
			April	RG_GC_PCC14M_20180426	74.40	<1	0.89	<1	<0.5	1.8	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	23
			April	RG_GC_PCC15M_20180426	78.69	1	0.62	<1	<0.5	2	<0.1	4	<0.5	<0.5	<0.5	<0.05	<1	43
			April	RG_GC_PCC17M_20180426	74.77	<2	0.5	<2	<1	4.2	<0.2	2	<1	<1	<1	<0.1	<2	20
			April	RG_GC_PCC18M_20180426	75.18	1	0.68	<1	<0.5	1.5	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	29
	Rainbow Trout	Sand Creek	April	RG_SC_RT01M_20180427	81.54	<10	<0.5	<10	<5	1.8	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_SC_RT02M_20180427	75.87	0.8	0.24	<0.1	<0.05	1.4	<0.01	1	<0.05	<0.05	0.2	<0.005	<0.1	16
		Elk River	September	RG_ER_RT01M_20180901	75.06	<10	<0.5	<10	<5	1.2	<1	<10	<5	<5	<5	<0.5	<10	<50
	Redside Shiner	Sand Creek	April	RG_SC_RSC02M_20180424	74.98	1	0.44	<1	<0.5	1.7	<0.1	1	<0.5	<0.5	1	<0.05	<1	50
			April	RG_SC_RSC04M_20180424	74.87	1	0.46	<1	<0.5	1.7	<0.1	1	<0.5	<0.5	1.3	<0.05	<1	82
			April	RG_SC_RSC05M_20180424	76.89	3	0.31	<1	<0.5	2.1	<0.1	9	<0.5	<0.5	<0.5	<0.05	<1	74
			April	RG_SC_RSC06M_20180424	78.66	1	0.45	<1	<0.5	2.3	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	70
			April	RG_SC_RSC09M_20180424	76.41	1	0.29	<1	<0.5	3.3	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	78
			April	RG_SC_RSC10M_20180424	76.75	2	0.42	<1	<0.5	1.8	<0.1	1	<0.5	<0.5	0.7	<0.05	<1	60
			April	RG_SC_RSC11M_20180426	75.67	2	0.43	<1	<0.5	1.8	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	71
			April	RG_SC_RSC13M_20180426	76.01	2	0.42	<1	<0.5	2.2	<0.1	3	<0.5	<0.5	0.7	<0.05	<1	38
			April	RG_SC_RSC17M_20180427	74.70	3	0.49	<1	<0.5	1.6	<0.1	12	<0.5	<0.5	0.6	<0.05	<1	55
			April	RG_SC_RSC18M_20180427	77.56	2	0.51	<0.2	<0.1	1.6	<0.02	4.4	<0.1	<0.1	<0.1	<0.01	<0.2	51
		Elk River	April	RG_ER_RSC01M_20180425	76.30	1	0.82	<1	<0.5	1.5	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	26
			April	RG_ER_RSC07M_20180425	74.87	1	0.44	<1	<0.5	2.5	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	24
			April	RG_ER_RSC08M_20180425	77.14	1	0.84	<1	<0.5	1.7	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	23
			April	RG_ER_RSC09M_20180425	77.58	1	0.39	<1	<0.5	2.2	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	30
			April	RG_ER_RSC10M_20180425	76.40	1	0.28	<1	<0.5	1.8	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	63
			April	RG_ER_RSC11M_20180425	71.25	1	0.54	<1	<0.5	1.8	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	22
			April	RG_ER_RSC12M_20180425	74.76	1	0.41	<1	<0.5	1.8	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	23
			April	RG_ER_RSC14M_20180425	78.01	1	0.37	<1	<0.5	2.2	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	26
			April	RG_ER_RSC15M_20180425	76.27	1	0.26	<1	<0.5	3.5	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	85
			April	RG_ER_RSC16M_20180425	78.14	1	0.37	<1	<0.5	1.8	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	26
			April	RG_ER_RSC19M_20180425	77.23	<1	0.37	<1	<0.5	1.6	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	23
		Gold Creek	April	RG_GC_RSC02M_20180424	68.96	1	0.39	<1	<0.5	2.3	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	81
			April	RG_GC_RSC04M_20180424	69.38	1	0.33	<1	<0.5	2	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	86
			April	RG_GC_RSC09M_20180426	76.89	1	0.44	<1	<0.5	2.4	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	60
			April	RG_GC_RSC16M_20180426	70.41	2	0.28	<1	<0.5	2.5	<0.1	7	<0.5	<0.5	<0.5	<0.05	<1	59
			April	RG_GC_RSC17M_20180427	76.55	2	0.46	<1	<0.5	2.7	<0.1	4	<0.5	<0.5	<0.5	<0.05	<1	33
			April	RG_GC_RSC18M_20180427	74.69	2	0.38	<1	<0.5	2.4	<0.1	5	<0.5	<0.5	<0.5	<0.05	<1	64
			April	RG_GC_RSC19M_20180427	76.27	1	0.46	<1	<0.5	2.8	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	25
			April	RG_GC_RSC20M_20180427	77.81	1.7	0.42	<0.2	<0.1	2.6	<0.02	1.9	<0.1	<0.1	0.6	<0.01	<0.2	56
			April	RG_GC_RSC21M_20180427	76.82	1.7	0.5	<0.2	<0.1	2.1	<0.02	3.6	<0.1	<0.1	0.2	<0.01	<0.2	110
			April	RG_GC_RSC24M_20180427	67.22	2	0.35	<1	<0.5	2.9	<0.1	3	<0.5	<0.5	<0.5	<0.05	<1	66
	Westslope Cutthroat Trout	Elk River	April	RG_ER_WCT01M_20180425	61.19	<10	<0.5	<10	<5	2.7	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_ER_WCT02M_20180430	54.49	<10	<0.5	<10	<5	1.4	<1	<10	<5	<5	<5	<0.5	<10	<50
			June	RG_ER_WCT01M_20180607	77.98	<10	<0.5	<10	<5	8.6	<1	<10	<5	<5	<5	<0.5	<10	<50
		Gold Creek	April	RG_GC_WCT01M_20180425	74.92	<10	<0.5	<10	<5	1.6	<1	<10	<5	<5	6	<0.5	<10	<50
			April	RG_GC_WCT02M_20180425	76.95	<10	<0.5	<10	<5	1.3	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_WCT03M_20180425	66.83	<10	<0.5	<10	<5	1.5	<1	<10	<5	<5	<5	<0.5	<10	<50

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Westslope Cutthroat Trout	Gold Creek	April	RG_GC_WCT04M_20180425	75.00	200	<10	<5	<5	<1	<100	<1	<50	<1	6	200	<1
			April	RG_GC_WCT05M_20180425	14.60	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_GC_WCT06M_20180425	21.13	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_GC_WCT07M_20180425	20.75	<200	<10	<5	6	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_GC_WCT08M_20180425	12.92	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
	Yellow Perch	Sand Creek	April	RG_SC_YP01M_20180427	79.90	4	<0.1	<0.05	0.22	<0.01	<1	<0.01	<0.5	0.02	0.77	11	0.01
		Gold Creek	April	RG_GC_YP01M_20180425	80.16	5	<0.1	<0.05	0.1	<0.01	<1	<0.01	<0.5	0.02	0.93	14	<0.01
			April	RG_GC_YP02M_20180425	74.14	2	<0.1	<0.05	0.24	<0.01	<1	<0.01	<0.5	0.03	0.8	12	<0.01
			April	RG_GC_YP03M_20180425	65.82	<20	<1	<0.5	0.5	<0.1	<10	<0.1	<5	<0.1	0.7	20	<0.1
			April	RG_GC_YP04M_20180425	79.27	13	<0.1	<0.05	0.36	<0.01	<1	<0.01	<0.5	0.02	1.2	23	0.01
			April	RG_GC_YP05M_20180425	74.06	3	<0.1	<0.05	0.59	<0.01	<1	<0.01	<0.5	0.02	1	12	<0.01
			April	RG_GC_YP06M_20180425	77.86	4	<0.1	<0.05	0.3	<0.01	<1	<0.01	<0.5	0.02	0.86	13	<0.01
			April	RG_GC_YP07M_20180425	76.50	<5	<0.2	<0.1	0.2	<0.02	<2	<0.02	<1	<0.02	1.2	13	<0.02
			April	RG_GC_YP08M_20180425	74.92	<5	<0.2	<0.1	<0.1	<0.02	<2	<0.02	<1	<0.02	0.8	14	<0.02
			April	RG_GC_YP09M_20180425	79.18	5	<0.1	<0.05	0.2	<0.01	<1	<0.01	<0.5	0.02	0.93	14	0.01
Ovary	Northern Pikeminnow	Sand Creek	June	RG_SC_NSC01O_20180605	76.39	7	<0.1	0.12	0.18	<0.01	<1	0.01	<0.5	0.06	3.4	110	0.07
			June	RG_SC_NSC02O_20180605	74.75	2	<0.1	0.08	0.13	<0.01	<1	<0.01	<0.5	0.04	3.9	90	0.05
			June	RG_SC_NSC03O_20180605	75.02	5	<0.1	0.08	0.25	<0.01	<1	0.01	<0.5	0.05	4.2	120	0.02
			June	RG_SC_NSC04O_20180605	73.98	7	<0.1	0.17	0.14	<0.01	<1	<0.01	<0.5	0.04	2.9	100	0.03
			June	RG_SC_NSC05O_20180605	74.63	4	<0.1	0.18	0.41	<0.01	<1	0.01	<0.5	0.05	3.8	120	0.02
			June	RG_SC_NSC06O_20180610	77.89	3	<0.1	0.09	0.38	<0.01	<1	0.02	<0.5	0.06	3.5	190	0.14
			June	RG_SC_NSC07O_20180610	70.90	<2	<0.1	<0.05	0.14	<0.01	<1	<0.01	<0.5	0.03	2.5	68	0.02
		Elk River	June	RG_ER_NSC01O_20180606	73.74	2	<0.1	0.13	0.36	<0.01	<1	0.02	<0.5	0.04	2.7	140	0.19
			June	RG_ER_NSC02O_20180606	74.22	<5	<0.2	0.2	0.4	<0.02	<2	0.02	<1	0.02	4.2	130	0.11
			June	RG_ER_NSC03O_20180607	79.67	<20	<1	<0.5	1.8	<0.1	<10	<0.1	<5	<0.1	5.2	190	0.3
			June	RG_ER_NSC04O_20180607	67.68	<2	<0.1	0.12	0.11	<0.01	<1	<0.01	<0.5	0.04	2.8	67	0.01
			June	RG_ER_NSC05O_20180607	82.36	4	<0.1	0.06	1.4	<0.01	<1	0.02	<0.5	0.07	4.3	280	0.08
			June	RG_ER_NSC06O_20180607	71.15	<5	<0.2	0.2	9.3	<0.02	<2	<0.02	<1	0.03	3.4	84	0.04
		Gold Creek	June	RG_GC_NSC01O_20180607	75.18	<2	<0.1	0.1	0.87	<0.01	<1	<0.01	<0.5	0.05	3.1	130	0.04
			June	RG_GC_NSC02O_20180607	76.94	<5	<0.2	0.2	0.8	<0.02	<2	<0.02	<1	0.03	3.4	150	0.06
			June	RG_GC_NSC03O_20180607	63.78	<2	<0.1	0.07	0.25	<0.01	<1	<0.01	<0.5	0.03	2.8	31	0.01
	Peamouth Chub	Sand Creek	April	RG_SC_PCC01O_20180424	66.39	23	<0.1	0.15	1.7	<0.01	<1	0.01	<0.5	0.1	4.5	110	0.09
			April	RG_SC_PCC02O_20180424	67.38	24	<0.1	0.08	2.2	<0.01	<1	0.01	<0.5	0.06	3.4	69	0.05
			April	RG_SC_PCC03O_20180424	66.31	17	<0.1	0.22	1	<0.01	<1	0.02	<0.5	0.08	3.8	100	0.04
			April	RG_SC_PCC06O_20180424	68.68	10	<0.1	0.1	1.4	<0.01	<1	0.02	<0.5	0.07	4.7	65	0.04
			April	RG_SC_PCC07O_20180424	72.05	7	<0.1	0.23	1.4	<0.01	<1	0.01	<0.5	0.08	4.1	80	0.06
			April	RG_SC_PCC08O_20180424	67.82	4	<0.1	0.11	0.93	<0.01	<1	0.01	<0.5	0.07	2.1	76	0.05
			April	RG_SC_PCC10O_20180424	66.74	6	<0.1	0.39	2	<0.01	<1	0.02	<0.5	0.06	3.9	54	0.06
			April	RG_SC_PCC11O_20180424	65.36	5	<0.1	0.12	1.5	<0.01	<1	0.01	<0.5	0.08	3.9	56	0.03
			April	RG_SC_PCC13O_20180424	60.54	4	<0.1	0.36	0.95	<0.01	<1	<0.01	<0.5	0.04	3.4	43	0.02
			April	RG_SC_PCC14O_20180424	63.05	<2	<0.1	0.24	0.4	<0.01	<1	<0.01	<0.5	0.05	3.2	52	0.02
		Elk River	April	RG_ER_PCC01O_20180425	66.13	2	<0.1	0.13	0.91	<0.01	<1	0.04	<0.5	0.06	4.1	100	0.02

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Muscle	Westslope Cutthroat Trout	Gold Creek	April	RG_GC_WCT04M_20180425	75.00	<10	<0.5	<10	<5	2	<1	<10	<5	<5	6	<0.5	<10	<50
			April	RG_GC_WCT05M_20180425	14.60	<10	<0.5	<10	<5	7.3	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_WCT06M_20180425	21.13	<10	<0.5	<10	<5	6.3	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_WCT07M_20180425	20.75	<10	<0.5	<10	<5	0.7	<1	<10	<5	<5	<5	<0.5	<10	<50
			April	RG_GC_WCT08M_20180425	12.92	<10	<0.5	<10	<5	2.9	<1	<10	<5	<5	5	<0.5	<10	<50
	Yellow Perch	Sand Creek	April	RG_SC_YP01M_20180427	79.90	1.2	0.82	<0.1	<0.05	1.8	<0.01	2.5	<0.05	<0.05	0.09	<0.005	<0.1	32
		Gold Creek	April	RG_GC_YP01M_20180425	80.16	0.8	0.54	<0.1	<0.05	3.1	<0.01	0.5	<0.05	<0.05	0.14	<0.005	<0.1	24
			April	RG_GC_YP02M_20180425	74.14	1.4	0.81	<0.1	<0.05	5.9	<0.01	1.1	<0.05	<0.05	0.14	<0.005	<0.1	24
			April	RG_GC_YP03M_20180425	65.82	2	1.2	<1	<0.5	4	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	41
			April	RG_GC_YP04M_20180425	79.27	1.2	0.54	<0.1	<0.05	2.7	<0.01	1.3	<0.05	<0.05	0.35	<0.005	<0.1	34
			April	RG_GC_YP05M_20180425	74.06	1.6	0.3	<0.1	<0.05	2.4	<0.01	4.1	<0.05	<0.05	0.1	<0.005	<0.1	40
			April	RG_GC_YP06M_20180425	77.86	0.9	0.49	<0.1	<0.05	2.7	<0.01	1.6	<0.05	<0.05	0.1	<0.005	<0.1	27
			April	RG_GC_YP07M_20180425	76.50	1	0.64	<0.2	<0.1	3.1	<0.02	1.1	<0.1	<0.1	0.1	<0.01	<0.2	34
			April	RG_GC_YP08M_20180425	74.92	0.6	0.31	<0.2	<0.1	2.7	<0.02	<0.2	<0.1	<0.1	0.1	<0.01	<0.2	21
			April	RG_GC_YP09M_20180425	79.18	1	0.62	<0.1	<0.05	2.9	<0.01	0.7	<0.05	<0.05	0.12	<0.005	<0.1	29
Ovary	Northern Pikeminnow	Sand Creek	June	RG_SC_NSC01O_20180605	76.39	1.7	0.11	0.1	<0.05	16	<0.01	0.2	<0.05	<0.05	0.2	<0.005	<0.1	330
			June	RG_SC_NSC02O_20180605	74.75	1.5	0.17	<0.1	<0.05	5.4	<0.01	0.3	<0.05	<0.05	0.06	<0.005	<0.1	130
			June	RG_SC_NSC03O_20180605	75.02	5.3	0.076	0.2	<0.05	9.2	<0.01	1.1	<0.05	<0.05	0.08	<0.005	<0.1	210
			June	RG_SC_NSC04O_20180605	73.98	6	0.053	0.1	<0.05	5.4	<0.01	0.3	<0.05	<0.05	0.16	<0.005	<0.1	190
			June	RG_SC_NSC05O_20180605	74.63	2.2	0.033	0.1	<0.05	13	<0.01	0.3	<0.05	<0.05	0.07	<0.005	<0.1	350
			June	RG_SC_NSC06O_20180610	77.89	1.4	0.12	0.1	<0.05	27	<0.01	0.6	<0.05	0.06	0.08	<0.005	<0.1	320
			June	RG_SC_NSC07O_20180610	70.90	1.1	0.12	<0.1	<0.05	5.8	<0.01	0.2	<0.05	<0.05	<0.05	<0.005	<0.1	130
		Elk River	June	RG_ER_NSC01O_20180606	73.74	1.7	0.065	<0.1	<0.05	16	<0.01	0.2	0.06	<0.05	0.06	<0.005	<0.1	310
			June	RG_ER_NSC02O_20180606	74.22	0.8	0.07	<0.2	<0.1	19	<0.02	<0.2	<0.1	<0.1	<0.1	<0.01	<0.2	520
			June	RG_ER_NSC03O_20180607	79.67	2	0.08	<1	<0.5	17	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	670
			June	RG_ER_NSC04O_20180607	67.68	1.3	0.11	<0.1	<0.05	24	<0.01	0.2	<0.05	<0.05	<0.05	<0.005	<0.1	130
			June	RG_ER_NSC05O_20180607	82.36	1.6	0.18	<0.1	0.05	26	<0.01	0.9	<0.05	<0.05	0.14	<0.005	<0.1	640
			June	RG_ER_NSC06O_20180607	71.15	1	0.04	<0.2	<0.1	26	<0.02	<0.2	<0.1	<0.1	<0.1	<0.01	<0.2	500
		Gold Creek	June	RG_GC_NSC01O_20180607	75.18	2	0.1	0.1	<0.05	13	<0.01	0.1	<0.05	<0.05	<0.05	<0.005	<0.1	230
			June	RG_GC_NSC02O_20180607	76.94	1.1	0.12	<0.2	<0.1	19	<0.02	<0.2	<0.1	<0.1	<0.1	<0.01	<0.2	470
			June	RG_GC_NSC03O_20180607	63.78	1.9	0.078	<0.1	<0.05	3.6	<0.01	0.2	<0.05	<0.05	<0.05	<0.005	<0.1	88
	Peamouth Chub	Sand Creek	April	RG_SC_PCC01O_20180424	66.39	6.7	0.032	0.1	0.07	11	0.01	0.6	<0.05	<0.05	0.45	0.007	<0.1	100
			April	RG_SC_PCC02O_20180424	67.38	11	0.041	0.2	<0.05	11	<0.01	0.6	<0.05	<0.05	0.47	<0.005	<0.1	120
			April	RG_SC_PCC03O_20180424	66.31	6.6	0.044	0.1	<0.05	9	0.02	0.5	<0.05	<0.05	0.26	<0.005	<0.1	110
			April	RG_SC_PCC06O_20180424	68.68	14	0.03	0.1	0.05	15	0.02	0.6	<0.05	<0.05	0.22	0.008	<0.1	130
			April	RG_SC_PCC07O_20180424	72.05	14	0.038	0.2	<0.05	12	0.02	0.5	<0.05	<0.05	0.12	<0.005	<0.1	150
			April	RG_SC_PCC08O_20180424	67.82	7.1	0.059	0.1	<0.05	23	<0.01	0.3	<0.05	<0.05	0.11	0.006	<0.1	130
			April	RG_SC_PCC10O_20180424	66.74	6.9	0.03	0.1	<0.05	8.4	0.02	0.3	<0.05	<0.05	0.12	<0.005	<0.1	160
			April	RG_SC_PCC11O_20180424	65.36	12	0.027	0.1	<0.05	9.9	0.02	0.4	<0.05	<0.05	0.07	0.005	<0.1	120
			April	RG_SC_PCC13O_20180424	60.54	4.9	0.022	<0.1	<0.05	5.9	0.02	0.2	<0.05	<0.05	0.07	<0.005	<0.1	100
			April	RG_SC_PCC14O_20180424	63.05	6.3	0.022	0.1	<0.05	6.9	0.01	0.3	<0.05	<0.05	0.06	<0.005	<0.1	100
		Elk River	April	RG_ER_PCC01O_20180425	66.13	8.3	0.041	0.1	<0.05	8.7	0.01	0.4	<0.05	<0.05	0.08	0.005	<0.1	110

Table F.2: Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018

Tissue Type	Species	Area	Month	Sample ID	Moisture	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Ovary	Peamouth Chub	Elk River	April	RG_ER_PCC02O_20180425	72.36	5	<0.1	0.24	2.5	<0.01	<1	0.02	<0.5	0.07	4.6	110	0.01
			April	RG_ER_PCC03O_20180425	64.24	<2	<0.1	0.18	1.4	<0.01	<1	0.01	<0.5	0.06	3.8	54	0.03
			April	RG_ER_PCC06O_20180425	67.87	4	<0.1	0.37	0.57	<0.01	<1	<0.01	<0.5	0.05	4.3	63	<0.01
			April	RG_ER_PCC08O_20180426	76.89	8	<0.1	0.12	2.2	<0.01	<1	0.02	<0.5	0.05	2.8	110	0.04
			April	RG_ER_PCC09O_20180426	66.94	8	<0.1	0.08	0.75	<0.01	<1	0.02	<0.5	0.07	2.8	120	0.02
			April	RG_ER_PCC11O_20180426	66.57	3	<0.1	0.13	0.59	<0.01	<1	0.02	<0.5	0.06	4.2	73	0.01
			April	RG_ER_PCC12O_20180426	71.47	3	<0.1	0.08	0.54	<0.01	<1	0.03	<0.5	0.08	4.6	98	0.02
			April	RG_ER_PCC16O_20180426	67.79	6	<0.1	0.18	0.86	<0.01	<1	0.06	<0.5	0.06	4.5	94	0.01
			April	RG_ER_PCC17O_20180426	69.40	6	<0.1	0.42	1.7	<0.01	<1	0.02	<0.5	0.07	4.5	75	0.02
		Gold Creek	April	RG_GC_PCC01O_20180427	62.19	<20	<1	<0.5	1	<0.1	<10	<0.1	<5	<0.1	3.6	40	<0.1
			April	RG_GC_PCC02O_20180425	75.27	<20	<1	<0.5	3.3	<0.1	<10	<0.1	<5	<0.1	4.1	120	<0.1
			April	RG_GC_PCC04O_20180425	68.53	70	<1	<0.5	2.1	<0.1	<10	<0.1	<5	<0.1	2.5	120	<0.1
			April	RG_GC_PCC08O_20180425	62.66	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	<0.1	2.6	40	<0.1
			April	RG_GC_PCC09O_20180426	68.00	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	0.1	2.8	90	<0.1
			April	RG_GC_PCC11O_20180426	67.06	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	3.1	60	<0.1
			April	RG_GC_PCC14O_20180426	62.05	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	<0.1	3.7	70	<0.1
			April	RG_GC_PCC15O_20180426	65.13	<20	<1	<0.5	1	<0.1	<10	<0.1	<5	<0.1	3	60	<0.1
			April	RG_GC_PCC17O_20180426	67.97	<20	<1	<0.5	1.5	<0.1	<10	<0.1	<5	<0.1	4	70	<0.1
			April	RG_GC_PCC18O_20180426	61.96	10	<0.1	0.34	0.53	<0.01	<1	<0.01	<0.5	0.04	3	59	0.02
	Redside Shiner	Sand Creek	April	RG_SC_RSC02O_20180424	73.09	<20	<1	<0.5	1.8	<0.1	<10	<0.1	<5	<0.1	6.4	120	<0.1
			April	RG_SC_RSC04O_20180424	73.65	<200	<10	<5	<5	<1	<100	<1	<50	<1	6	<200	<1
			April	RG_SC_RSC05O_20180424	73.55	20	<1	<0.5	1.9	<0.1	<10	<0.1	<5	<0.1	7.2	140	0.2
			April	RG_SC_RSC06O_20180424	77.13	<20	<1	<0.5	1.6	<0.1	<10	<0.1	<5	<0.1	3.9	120	<0.1
			April	RG_SC_RSC09O_20180424	75.48	<200	<10	<5	<5	<1	<100	<1	<50	<1	6	<200	<1
			April	RG_SC_RSC10O_20180424	75.73	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	5.8	140	<0.1
			April	RG_SC_RSC11O_20180426	73.54	30	<1	<0.5	1.3	<0.1	<10	<0.1	<5	<0.1	6.8	150	<0.1
			April	RG_SC_RSC13O_20180426	71.34	6	<0.2	0.5	1.2	<0.02	<2	0.38	<1	0.12	6.1	130	0.05
			April	RG_SC_RSC17O_20180427	75.65	<20	<1	<0.5	0.8	<0.1	<10	<0.1	<5	<0.1	6.2	130	<0.1
			April	RG_SC_RSC18O_20180427	74.62	<20	<1	<0.5	2.2	<0.1	<10	<0.1	<5	<0.1	5.1	190	<0.1
		Elk River	April	RG_ER_RSC01O_20180425	70.08	<5	<0.2	0.4	0.9	<0.02	<2	<0.02	<1	0.09	5.4	120	<0.02
			April	RG_ER_RSC07O_20180425	70.29	<20	<1	<0.5	0.8	<0.1	<10	<0.1	<5	<0.1	6.7	130	0.3
			April	RG_ER_RSC08O_20180425	71.43	<20	<1	<0.5	0.7	<0.1	<10	<0.1	<5	<0.1	8.1	140	<0.1
			April	RG_ER_RSC09O_20180425	73.49	<20	<1	<0.5	2.2	<0.1	<10	<0.1	<5	0.1	7.4	130	0.1
			April	RG_ER_RSC10O_20180425	54.60	<200	<10	<5	<5	<1	<100	<1	<50	<1	6	<200	<1
			April	RG_ER_RSC11O_20180425	73.96	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	6.3	110	<0.1
			April	RG_ER_RSC12O_20180425	72.33	<20	<1	<0.5	1.2	<0.1	<10	0.2	<5	<0.1	7.1	140	<0.1
			April	RG_ER_RSC14O_20180425	74.62	<20	<1	<0.5	1.2	<0.1	<10	<0.1	<5	<0.1	7.8	130	<0.1
			April	RG_ER_RSC15O_20180425	69.92	<20	<1	<0.5	1.3	<0.1	<10	<0.1	<5	<0.1	5.1	120	<0.1
			April	RG_ER_RSC16O_20180425	82.15	<200	<10	<5	<5	<1	<100	<1	<50	<1	<5	<200	<1
			April	RG_ER_RSC19O_20180425	75.19	<20	<1	<0.5	0.9	<0.1	<10	<0.1	<5	<0.1	7	150	<0.1
		Gold Creek	April	RG_GC_RSC02O_20180424	67.81	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	5.7	120	<0.1
			April	RG_GC_RSC04O_20180424	67.93	<200	<10	<5	<5	<1	<100	<1	<50	<1	6	<200	<1
			April	RG_GC_RSC09O_20180426	72.13	80	<1	<0.5	1.4	<0.1	<10	<0.1	<5	0.2	8.3	200	0.1
			April	RG_GC_RSC16O_20180426	68.19	20	<1	<0.5	1.3	<0.1	<10	<0.1	<5	<0.1	4.2	130	<0.1
			April	RG_GC_RSC17O_20180427	65.63	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	7.3	120	<0.1
			April	RG_GC_RSC18O_20180427	72.72	<20	<1	<0.5	1.1	<0.1	<10	<0.1	<5	<0.1	5.4	140	<0.1
			April	RG_GC_RSC19O_20180427	73.44	<20	<1	<0.5	1.2	<0.1	<10	0.2	<5	<0.1	6.6	180	<0.1
			April	RG_GC_RSC20O_20180427	69.32	<20	<1	<0.5	0.6	<0.1	<10	<0.1	<5	<0.1	6.4	150	<0.1
			April	RG_GC_RSC21O_20180427	72.45	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	0.1	5.9	130	<0.1
			April	RG_GC_RSC24O_20180427	72.78	<20	<1	<0.5	<0.5	<0.1	<10	<0.1	<5	<0.1	6.3	120	<0.1
	Yellow Perch	Sand Creek	April	RG_SC_YP01O_20180427	83.37	<2	<0.1	<0.05	0.14	<0.01	<1	<0.01	<0.5	0.04	2.1	29	<0.01
		Gold Creek	April	RG_GC_YP01O_20180425	81.39	3	<0.1	<0.05	0.26	<0.01	<1	<0.01	<0.5	0.04	2.1	34	<0.01
			April	RG_GC_YP02O_20180425	80.89	<2	<0.1	<0.05	0.28	<0.01	<1	<0.01	<0.5	0.1	2.2	37	<0.01
			April	RG_GC_YP03O_20180425	81.84	<2	<0.1	<0.05	0.34	<0.01	<1	<0.01	<0.5	0.08	2.3	38	<0.01
			April	RG_GC_YP04O_20180425	82.50	<2	<0.1	0.06	0.3	<0.01	<1	<0.01	<0.5	0.05	2.5	33	<0.01
			April	RG_GC_YP05O_20180425	83.75	<2	<0.1	<0.05	0.33	<0.01	<1	<0.01	<0.5	0.06	2.2	33	<0.01

Table F.2: **Metal Concentrations (µg/g Dry Weight) in Fish Tissue Collected in Koocanusa Reservoir, 2018**

Tissue Type	Species	Area	Month	Sample ID	Moisture	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
					%	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw	µg/g dw
Ovary	Peamouth Chub	Elk River	April	RG_ER_PCC02O_20180425	72.36	16	0.034	0.2	<0.05	16	0.02	0.7	<0.05	<0.05	0.09	<0.005	<0.1	160
			April	RG_ER_PCC03O_20180425	64.24	4.4	0.024	<0.1	<0.05	18	0.01	0.3	<0.05	<0.05	0.06	<0.005	<0.1	120
			April	RG_ER_PCC06O_20180425	67.87	11	0.035	0.2	<0.05	10	0.02	0.3	<0.05	<0.05	0.1	<0.005	<0.1	140
			April	RG_ER_PCC08O_20180426	76.89	14	0.06	0.2	<0.05	20	0.01	0.5	<0.05	<0.05	0.25	<0.005	<0.1	160
			April	RG_ER_PCC09O_20180426	66.94	6.5	0.035	0.1	<0.05	12	<0.01	0.3	<0.05	<0.05	0.2	<0.005	<0.1	110
			April	RG_ER_PCC11O_20180426	66.57	10	0.036	0.1	<0.05	9.5	0.02	0.3	<0.05	<0.05	0.08	<0.005	<0.1	120
			April	RG_ER_PCC12O_20180426	71.47	13	0.077	0.2	<0.05	10	0.01	0.7	<0.05	<0.05	0.1	<0.005	<0.1	150
			April	RG_ER_PCC16O_20180426	67.79	9.7	0.1	0.2	<0.05	21	0.02	0.4	<0.05	<0.05	0.1	<0.005	<0.1	120
			April	RG_ER_PCC17O_20180426	69.40	12	0.043	0.2	<0.05	13	0.02	0.4	<0.05	<0.05	0.15	<0.005	<0.1	160
		Gold Creek	April	RG_GC_PCC01O_20180427	62.19	5	<0.05	<1	<0.5	4.5	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	90
			April	RG_GC_PCC02O_20180425	75.27	19	0.05	<1	1.5	21	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	200
			April	RG_GC_PCC04O_20180425	68.53	10	0.05	<1	<0.5	16	<0.1	<1	<0.5	<0.5	1.5	<0.05	<1	120
			April	RG_GC_PCC08O_20180425	62.66	5	<0.05	<1	<0.5	4.7	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	80
			April	RG_GC_PCC09O_20180426	68.00	10	<0.05	<1	<0.5	22	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	120
			April	RG_GC_PCC11O_20180426	67.06	6	<0.05	<1	<0.5	9.9	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	110
			April	RG_GC_PCC14O_20180426	62.05	8	<0.05	<1	<0.5	12	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	100
			April	RG_GC_PCC15O_20180426	65.13	5	<0.05	<1	<0.5	6.6	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	100
			April	RG_GC_PCC17O_20180426	67.97	15	<0.05	<1	<0.5	16	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	140
			April	RG_GC_PCC18O_20180426	61.96	4.7	0.025	<0.1	<0.05	6.5	0.01	0.3	<0.05	<0.05	0.31	<0.005	<0.1	99
	Redside Shiner	Sand Creek	April	RG_SC_RSC02O_20180424	73.09	7	<0.05	<1	<0.5	11	<0.1	<1	<0.5	<0.5	1.2	<0.05	<1	280
			April	RG_SC_RSC04O_20180424	73.65	<10	<0.5	<10	<5	21	<1	<10	<5	<5	<5	<0.5	<10	360
			April	RG_SC_RSC05O_20180424	73.55	9	<0.05	<1	<0.5	16	<0.1	2	<0.5	<0.5	<0.5	<0.05	<1	270
			April	RG_SC_RSC06O_20180424	77.13	12	<0.05	<1	<0.5	8.2	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	300
			April	RG_SC_RSC09O_20180424	75.48	<10	<0.5	<10	<5	14	<1	<10	<5	<5	<5	<0.5	<10	250
			April	RG_SC_RSC10O_20180424	75.73	7	<0.05	<1	<0.5	12	<0.1	<1	<0.5	<0.5	3.2	<0.05	<1	240
			April	RG_SC_RSC11O_20180426	73.54	9	<0.05	<1	<0.5	27	<0.1	1	<0.5	<0.5	1	<0.05	<1	250
			April	RG_SC_RSC13O_20180426	71.34	8.3	0.04	<0.2	<0.1	22	<0.02	0.6	<0.1	<0.1	<0.1	<0.01	<0.2	240
			April	RG_SC_RSC17O_20180427	75.65	14	0.05	<1	<0.5	13	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	240
			April	RG_SC_RSC18O_20180427	74.62	6	<0.05	<1	<0.5	20	<0.1	<1	<0.5	<0.5	1.2	<0.05	<1	280
		Elk River	April	RG_ER_RSC01O_20180425	70.08	7.4	0.04	<0.2	<0.1	22	<0.02	0.6	<0.1	<0.1	<0.1	<0.01	<0.2	220
			April	RG_ER_RSC07O_20180425	70.29	6	<0.05	<1	<0.5	35	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	240
			April	RG_ER_RSC08O_20180425	71.43	6	0.08	<1	<0.5	29	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	240
			April	RG_ER_RSC09O_20180425	73.49	6	<0.05	<1	<0.5	25	<0.1	<1	<0.5	<0.5	1.5	<0.05	<1	270
			April	RG_ER_RSC10O_20180425	54.60	<10	<0.5	<10	<5	15	<1	<10	<5	<5	<5	<0.5	<10	290
			April	RG_ER_RSC11O_20180425	73.96	7	<0.05	<1	<0.5	14	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	220
			April	RG_ER_RSC12O_20180425	72.33	6	0.05	<1	<0.5	26	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	240
			April	RG_ER_RSC14O_20180425	74.62	7	<0.05	<1	<0.5	12	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	230
			April	RG_ER_RSC15O_20180425	69.92	10	<0.05	<1	<0.5	22	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	210
			April	RG_ER_RSC16O_20180425	82.15	<10	<0.5	<10	<5	16	<1	<10	<5	<5	<5	<0.5	<10	350
			April	RG_ER_RSC19O_20180425	75.19	10	<0.05	<1	<0.5	9.6	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	210
		Gold Creek	April	RG_GC_RSC02O_20180424	67.81	9	<0.05	<1	<0.5	5.9	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	220
			April	RG_GC_RSC04O_20180424	67.93	<10	<0.5	<10	<5	9.2	<1	<10	<5	<5	<5	<0.5	<10	270
			April	RG_GC_RSC09O_20180426	72.13	11	0.05	<1	<0.5	7.6	<0.1	2	<0.5	<0.5	1.6	<0.05	<1	240
			April	RG_GC_RSC16O_20180426	68.19	9	<0.05	<1	<0.5	8.6	<0.1	<1	<0.5	<0.5	0.5	<0.05	<1	220
			April	RG_GC_RSC17O_20180427	65.63	8	<0.05	<1	<0.5	12	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	210
			April	RG_GC_RSC18O_20180427	72.72	11	<0.05	<1	<0.5	13	<0.1	1	<0.5	<0.5	<0.5	<0.05	<1	200
			April	RG_GC_RSC19O_20180427	73.44	11	<0.05	<1	<0.5	7.8	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	190
			April	RG_GC_RSC20O_20180427	69.32	8	<0.05	<1	<0.5	8.2	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	170
			April	RG_GC_RSC21O_20180427	72.45	12	<0.05	<1	<0.5	20	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	200
			April	RG_GC_RSC24O_20180427	72.78	13	<0.05	<1	<0.5	17	<0.1	<1	<0.5	<0.5	<0.5	<0.05	<1	180
	Yellow Perch	Sand Creek	April	RG_SC_YP01O_20180427	83.37	2.8	0.042	<0.1	<0.05	2.4	<0.01	1.8	<0.05	<0.05	0.06	<0.005	<0.1	79
		Gold Creek	April	RG_GC_YP01O_20180425	81.39	2.1	0.018	<0.1	<0.05	3.6	<0.01	1.4	<0.05	<0.05	0.07	<0.005	<0.1	74
			April	RG_GC_YP02O_20180425	80.89	2.7	0.038	<0.1	<0.05	5.7	<0.01	1.4	<0.05	<0.05	0.06	<0.005	<0.1	76
			April	RG_GC_YP03O_20180425	81.84	4.4	0.061	<0.1	<0.05	3.9	<0.01	1.5	<0.05	<0.05	<0.05	<0.005	<0.1	85
			April	RG_GC_YP04O_20180425	82.50	2.3	0.025	<0.1	<0.05	3.2	<0.01	1.4	<0.05	<0.05	<0.05	<0.005	<0.1	85
			April	RG_GC_YP05O_20180425	83.75	4.1	0.011	<0.1	<0.05	2.9	<0.01	1.5	<0.05	<0.05	<0.05	<0.005	<0.1	81

Table F.3: **Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018**

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Bull Trout	Tobacco River	5/14/2008	Muscle	1.9
		5/14/2008	Muscle	1.8
		5/14/2008	Muscle	1.4
		5/14/2008	Muscle	1.5
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	1.8
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	<0.1
		5/14/2008	Muscle	2.0
		5/14/2008	Muscle	1.8
		5/14/2008	Muscle	2.0
		5/14/2008	Muscle	1.1
		5/14/2008	Muscle	1.8
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	1.6
		5/14/2008	Muscle	1.4
		5/14/2008	Muscle	2.0
		5/14/2008	Muscle	1.6
		5/14/2008	Muscle	2.0
	Rexford	5/8/2018	Filet	2.3
		5/8/2018	Filet	2.4
		5/8/2018	Filet	2.2
		5/8/2018	Filet	2.1
		5/8/2018	Filet	3.2
		5/14/2013	Muscle	2.9
		5/14/2013	Muscle	2.0
		5/14/2013	Muscle	2.9
		5/14/2013	Muscle	2.2
		5/14/2013	Muscle	3.8
		9/25/2013	Muscle	2.1
		5/14/2013	Muscle	3.5
		5/14/2013	Muscle	2.4
		5/14/2013	Muscle	2.5
		5/14/2013	Muscle	4.0
		5/14/2013	Muscle	3.8
		5/14/2013	Muscle	2.4
		5/14/2013	Muscle	2.9
		5/14/2013	Muscle	2.5
		5/14/2013	Muscle	2.7
		5/14/2013	Muscle	3.0
		5/14/2013	Muscle	3.7
		5/14/2013	Muscle	3.2
		5/14/2013	Muscle	2.5
		5/14/2013	Muscle	3.2
		5/14/2013	Muscle	2.5
		5/14/2013	Muscle	3.4
		5/14/2013	Muscle	2.4
		9/25/2013	Muscle	2.3
		5/14/2013	Muscle	2.6
		5/14/2013	Muscle	3.1
	Tenmile Creek	5/9/2018	Filet	1.8
	McGillivray	5/15/2013	Muscle	2.8
		5/15/2013	Muscle	2.2
		5/15/2013	Muscle	2.2
		5/15/2013	Muscle	2.3
		5/15/2013	Muscle	2.5
		5/15/2013	Muscle	2.4
Burbot	Sophie Creek	5/17/2017	Filet	5.0
	Young Creek	3/23/2016	Muscle	4.2
	Dodge Creek	4/6/2016	Muscle	2.7
	Tobacco River	5/17/2017	Filet	3.4
	Rexford	5/14/2013	Muscle	5.0
	Pinkham Creek	12/2/2016	Filet	1.9
	Sutton Creek	3/9/2016	Muscle	3.7
	Big Creek	12/2/2016	Filet	5.4
		4/1/2016	Muscle	2.6
	McGuire Creek	3/25/2016	Muscle	4.1

Table F.3: Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Burbot	Parsnip Creek	12/23/2015	Muscle	4.1
		12/23/2015	Muscle	4.5
	Tenmile Creek	1/27/2016	Muscle	4.2
	Bristow Creek	12/4/2015	Muscle	5.4
		4/11/2016	Muscle	3.8
	Fivemile Creek	2/8/2017	Filet	5.9
		2/8/2017	Filet	3.8
		2/8/2017	Filet	4.4
	Warland Creek	12/7/2016	Filet	3.7
		12/18/2015	Muscle	3.6
	Cripplehorse Creek	12/29/2016	Filet	3.5
	Canyon Creek	12/29/2016	Filet	3.9
Kokanee	Young Creek	9/20/2018	Filet	1.4
	Murray Creek	9/20/2018	Filet	1.5
	Tobacco River	9/20/2018	Filet	1.4
		9/20/2018	Filet	1.6
		9/20/2018	Filet	1.7
		9/17/2008	Muscle	2.1
		9/17/2008	Muscle	1.3
		9/17/2008	Muscle	1.6
		9/17/2008	Muscle	1.5
		9/17/2008	Muscle	1.5
		9/17/2008	Muscle	2.1
		9/17/2008	Muscle	2.0
		9/17/2008	Muscle	1.9
		9/17/2008	Muscle	2.0
		9/17/2008	Muscle	1.7
		9/17/2008	Muscle	1.8
		9/17/2008	Muscle	2.0
		9/17/2008	Muscle	1.6
		9/17/2008	Muscle	1.9
		9/17/2008	Muscle	1.7
		9/17/2008	Muscle	1.5
		9/17/2008	Muscle	1.5
		9/17/2008	Muscle	1.7
		9/17/2008	Muscle	1.8
		9/17/2008	Muscle	1.5
	Rexford	5/8/2018	Filet	2.0
		5/8/2018	Filet	1.8
		5/8/2018	Filet	2.4
		5/8/2018	Filet	2.0
		5/8/2018	Filet	2.0
		9/25/2013	Muscle	2.0
		9/25/2013	Muscle	2.4
		9/25/2013	Muscle	2.1
		9/25/2013	Muscle	1.9
		9/25/2013	Muscle	2.0
		9/25/2013	Muscle	2.4
		9/25/2013	Muscle	2.0
		9/25/2013	Muscle	1.6
		9/25/2013	Muscle	2.0
		9/25/2013	Muscle	2.1
		9/25/2013	Muscle	2.0
		9/25/2013	Muscle	2.1
		9/25/2013	Muscle	2.4
		9/25/2013	Muscle	1.9
		9/25/2013	Muscle	2.2
		9/25/2013	Muscle	2.2
	Tenmile Creek	5/9/2018	Filet	2.6
	Barron Creek	9/21/2018	Filet	1.6
		9/21/2018	Filet	1.2
	Warland Creek	9/21/2018	Filet	1.3
		9/21/2018	Filet	1.3
		9/21/2018	Filet	1.4
		9/21/2018	Filet	1.3
	McGillivray	5/15/2013	Muscle	2.2
		5/15/2013	Muscle	2.3
		5/15/2013	Muscle	2.4
Largescale Sucker	Sophie Creek	9/20/2018	Filet	3.4
		9/20/2018	Filet	4.1
	Young Creek	9/20/2018	Filet	2.8

Table F.3: **Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018**

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Largescale Sucker	Murray Creek	9/20/2018	Filet	3.8
	Tobacco River	9/20/2018	Filet	3.6
		9/20/2018	Filet	2.7
	Rexford	5/8/2018	Filet	4.4
		5/8/2018	Filet	5.3
		5/8/2018	Filet	4.7
		5/8/2018	Filet	1.4
		5/8/2018	Filet	3.9
		5/8/2018	Filet	5.1
		5/8/2018	Filet	4.9
		5/8/2018	Filet	4.5
		5/8/2018	Filet	4.2
		5/8/2018	Filet	5.3
	Tenmile Creek	5/9/2018	Filet	6.2
		5/9/2018	Filet	5.1
		5/9/2018	Filet	5.3
		5/9/2018	Filet	3.1
		5/9/2018	Filet	5.9
		5/9/2018	Filet	4.6
		5/9/2018	Filet	4.5
		5/9/2018	Filet	3.7
		5/9/2018	Filet	5.3
		5/9/2018	Filet	4.7
	Barron Creek	9/21/2018	Filet	3.4
		9/21/2018	Filet	5.4
	Warland Creek	9/21/2018	Filet	3.3
		9/21/2018	Filet	3.9
		9/21/2018	Filet	4.8
	Jackson Creek	9/21/2018	Filet	3.8
		9/21/2018	Filet	5.1
	Canyon Creek	9/21/2018	Filet	2.9
		9/21/2018	Filet	3.8
		9/21/2018	Filet	3.5
Longnose Sucker	Sophie Creek	5/17/2017	Filet	9.9
		5/17/2017	Filet	4.3
		5/17/2017	Filet	6.4
		5/17/2017	Filet	7.8
		5/17/2017	Filet	5.4
	Sandhill	5/17/2017	Filet	10
	Tobacco River	5/14/2008	Muscle	3.1
		5/14/2008	Muscle	3.2
		5/14/2008	Muscle	4.2
		5/14/2008	Muscle	2.8
		5/14/2008	Muscle	3.6
		5/14/2008	Muscle	4.3
		5/14/2008	Muscle	3.2
		5/14/2008	Muscle	5.1
		5/14/2008	Muscle	2.5
		5/14/2008	Muscle	2.5
		5/14/2008	Muscle	3.2
		5/14/2008	Muscle	3.5
		5/14/2008	Muscle	3.0
		5/14/2008	Muscle	4.4
		5/17/2017	Filet	7.9
		5/17/2017	Filet	6.8
	Rexford	5/14/2013	Muscle	5.9
		5/14/2013	Muscle	5.7
		5/14/2013	Muscle	6.0
		5/14/2013	Muscle	6.7
		5/14/2013	Muscle	3.6
		5/14/2013	Muscle	6.6
		5/14/2013	Muscle	5.3
		5/14/2013	Muscle	5.9
		5/14/2013	Muscle	5.5
		5/14/2013	Muscle	5.3
		5/14/2013	Muscle	6.0
		5/14/2013	Muscle	6.4
		5/14/2013	Muscle	5.8
		5/14/2013	Muscle	1.5
		5/14/2013	Muscle	4.9
		5/8/2018	Filet	4.8

Table F.3: Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Longnose Sucker	Rexford	5/8/2018	Filet	4.5
		5/8/2018	Filet	4.2
		5/8/2018	Filet	4.7
		5/8/2018	Filet	5.0
		5/8/2018	Filet	4.1
		5/8/2018	Filet	5.3
		5/8/2018	Filet	4.6
		5/8/2018	Filet	5.4
		5/8/2018	Filet	5.0
	Tenmile Creek	5/9/2018	Filet	4.5
		5/9/2018	Filet	5.9
		5/9/2018	Filet	3.2
		5/9/2018	Filet	5.3
	McGillivray	5/15/2013	Muscle	5.6
		5/15/2013	Muscle	4.4
		5/15/2013	Muscle	6.3
		5/15/2013	Muscle	5.0
		5/15/2013	Muscle	4.6
		5/15/2013	Muscle	6.4
		5/15/2013	Muscle	6.2
		5/15/2013	Muscle	6.0
		5/15/2013	Muscle	5.1
		5/15/2013	Muscle	5.1
		5/15/2013	Muscle	6.8
		5/15/2013	Muscle	6.0
		5/15/2013	Muscle	4.8
		5/15/2013	Muscle	6.5
		5/15/2013	Muscle	5.8
	Canyon Creek	9/21/2018	Filet	3.9
Mountain Whitefish	Tobacco River	5/14/2008	Muscle	2.0
		5/14/2008	Muscle	2.9
	Warland Creek	9/21/2018	Filet	2.3
		9/21/2018	Filet	1.8
		9/21/2018	Filet	2.3
	Jackson Creek	9/21/2018	Filet	4.7
		9/21/2018	Filet	1.4
		9/21/2018	Filet	3.2
	Canyon Creek	9/21/2018	Filet	2.7
		9/21/2018	Filet	3.2
		9/21/2018	Filet	2.4
		9/21/2018	Filet	1.7
Northern Pikeminnow	Young Creek	9/20/2018	Filet	1.7
		9/20/2018	Filet	2.0
	Sandhill	9/20/2018	Filet	2.5
		9/20/2018	Filet	1.1
	Murray Creek	9/20/2018	Filet	1.8
	Tobacco River	9/20/2018	Filet	1.7
		9/20/2018	Filet	1.3
		9/20/2018	Filet	1.9
		9/20/2018	Filet	2.0
		9/20/2018	Filet	0.90
		5/14/2008	Muscle	1.3
		5/14/2008	Muscle	1.0
		5/14/2008	Muscle	1.4
		5/14/2008	Muscle	1.0
		5/14/2008	Muscle	1.2
		5/14/2008	Muscle	1.1
		5/14/2008	Muscle	1.2
		5/14/2008	Muscle	1.2
		5/14/2008	Muscle	1.9
		5/14/2008	Muscle	1.9
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	1.2
		5/14/2008	Muscle	1.3
		5/14/2008	Muscle	1.3
		5/14/2008	Muscle	1.5
		5/14/2008	Muscle	1.2
		5/14/2008	Muscle	1.3
		5/14/2008	Muscle	1.0
		5/14/2008	Muscle	1.1
		5/14/2008	Muscle	1.6

Table F.3: Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Northern Pikeminnow	Rexford	5/8/2018	Filet	1.4
		5/8/2018	Filet	1.3
		5/8/2018	Filet	1.1
		5/8/2018	Filet	1.9
		5/8/2018	Filet	1.6
		5/8/2018	Filet	1.6
		5/8/2018	Filet	1.4
		5/8/2018	Filet	1.1
		5/8/2018	Filet	1.4
		5/8/2018	Filet	1.4
		5/14/2013	Muscle	1.8
		5/14/2013	Muscle	1.8
		5/14/2013	Muscle	1.3
		5/14/2013	Muscle	1.5
		5/14/2013	Muscle	1.5
		5/14/2013	Muscle	2.3
		5/14/2013	Muscle	2.3
		5/14/2013	Muscle	2.3
		5/14/2013	Muscle	1.9
		5/14/2013	Muscle	2.4
		5/14/2013	Muscle	1.7
		5/14/2013	Muscle	1.5
		5/14/2013	Muscle	1.7
		5/14/2013	Muscle	1.8
		5/14/2013	Muscle	2.0
	Tenmile Creek	5/9/2018	Filet	1.3
		5/9/2018	Filet	1.6
		5/9/2018	Filet	1.3
		5/9/2018	Filet	1.2
		5/9/2018	Filet	1.6
		5/9/2018	Filet	1.7
		5/9/2018	Filet	1.2
		5/9/2018	Filet	1.1
		5/9/2018	Filet	1.1
		5/9/2018	Filet	1.1
	Barron Creek	9/21/2018	Filet	2.2
		9/21/2018	Filet	3.0
		9/21/2018	Filet	2.0
	Warland Creek	9/21/2018	Filet	1.7
		9/21/2018	Filet	1.1
		9/21/2018	Filet	1.7
	McGillivray	5/15/2013	Muscle	1.6
		5/15/2013	Muscle	1.9
		5/15/2013	Muscle	1.5
		5/15/2013	Muscle	1.9
		5/15/2013	Muscle	2.3
		5/15/2013	Muscle	1.5
		5/15/2013	Muscle	1.7
		5/15/2013	Muscle	1.9
		5/15/2013	Muscle	1.7
		5/15/2013	Muscle	1.7
	Jackson Creek	9/21/2018	Filet	2.1
	Canyon Creek	9/21/2018	Filet	2.5
		9/21/2018	Filet	1.1
		9/21/2018	Filet	2.9
Peamouth Chub	Young Creek	9/20/2018	Filet	2.8
		9/20/2018	Filet	1.7
	Sandhill	9/20/2018	Filet	1.5
		9/20/2018	Filet	1.6
	Murray Creek	9/20/2018	Filet	2.0
	Tobacco River	5/14/2008	Muscle	2.3
		5/14/2008	Muscle	1.8
		5/14/2008	Muscle	2.6
		5/14/2008	Muscle	3.5
		5/14/2008	Muscle	2.7
		5/14/2008	Muscle	3.1
		5/14/2008	Muscle	2.7
		5/14/2008	Muscle	1.9
		5/14/2008	Muscle	2.8
		5/14/2008	Muscle	1.9

Table F.3: **Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018**

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Peamouth Chub	Tobacco River	5/14/2008	Muscle	2.9
		5/14/2008	Muscle	4.2
		5/14/2008	Muscle	2.9
		5/14/2008	Muscle	3.2
		5/14/2008	Muscle	4.2
		5/14/2008	Muscle	2.9
		5/14/2008	Muscle	1.7
		5/14/2008	Muscle	3.7
		5/14/2008	Muscle	3.3
		5/14/2008	Muscle	4.6
		9/20/2018	Filet	1.5
		9/20/2018	Filet	1.8
		9/20/2018	Filet	1.5
		9/20/2018	Filet	1.8
		9/20/2018	Filet	1.7
	Rexford	5/14/2013	Muscle	6.7
		5/14/2013	Muscle	3.3
		5/14/2013	Muscle	5.0
		5/14/2013	Muscle	2.8
		5/14/2013	Muscle	6.8
		5/14/2013	Muscle	8.4
		5/14/2013	Muscle	5.4
		5/14/2013	Muscle	3.3
		5/14/2013	Muscle	2.7
		5/14/2013	Muscle	8.0
		5/14/2013	Muscle	4.7
		5/14/2013	Muscle	4.7
		5/14/2013	Muscle	3.0
		5/14/2013	Muscle	4.1
		5/14/2013	Muscle	4.8
		5/8/2018	Filet	2.4
		5/8/2018	Filet	1.9
		5/8/2018	Filet	2.3
		5/8/2018	Filet	2.7
		5/8/2018	Filet	2.2
		5/8/2018	Filet	2.0
		5/8/2018	Filet	2.6
		5/8/2018	Filet	3.5
		5/8/2018	Filet	2.5
		5/8/2018	Filet	3.2
	Tenmile Creek	5/9/2018	Filet	2.0
		5/9/2018	Filet	2.3
		5/9/2018	Filet	2.7
		5/9/2018	Filet	2.8
		5/9/2018	Filet	2.5
		5/9/2018	Filet	2.3
		5/9/2018	Filet	1.9
		5/9/2018	Filet	2.0
		5/9/2018	Filet	2.2
		5/9/2018	Filet	2.2
	Barron Creek	9/21/2018	Filet	1.8
		9/21/2018	Filet	1.9
		9/21/2018	Filet	2.7
	Warland Creek	9/21/2018	Filet	1.8
		9/21/2018	Filet	1.5
		9/21/2018	Filet	1.7
	McGillivray	5/15/2013	Muscle	2.6
		5/15/2013	Muscle	3.3
		5/15/2013	Muscle	3.0
		5/15/2013	Muscle	2.7
		5/15/2013	Muscle	2.7
		5/15/2013	Muscle	3.4
		5/15/2013	Muscle	2.5
		5/15/2013	Muscle	3.3
		5/15/2013	Muscle	2.7
		5/15/2013	Muscle	3.2
		5/15/2013	Muscle	2.1
		5/15/2013	Muscle	3.0
		5/15/2013	Muscle	4.8
		5/15/2013	Muscle	4.3

Table F.3: **Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018**

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Peamouth Chub	McGillivray	5/15/2013	Muscle	3.0
	Jackson Creek	9/21/2018	Filet	1.3
	Canyon Creek	9/21/2018	Filet	1.9
		9/21/2018	Filet	1.7
		9/21/2018	Filet	1.8
Rainbow Trout	Sophie Creek	5/17/2016	Muscle	4.1
		5/17/2016	Muscle	2.9
		5/17/2016	Muscle	4.7
		5/17/2016	Muscle	1.9
		5/17/2016	Muscle	2.2
		5/17/2016	Muscle	2.8
	Young Creek	9/22/2017	Muscle	1.5
		9/22/2017	Muscle	1.9
		5/16/2016	Muscle	2.6
		5/17/2016	Muscle	3.5
		5/17/2016	Muscle	3.4
		5/17/2017	Filet	1.9
	Sandhill	9/22/2017	Filet	2.0
		9/20/2018	Filet	1.6
	Dodge Creek	5/17/2016	Muscle	2.1
		5/17/2017	Filet	2.8
	Tobacco River	9/22/2017	Muscle	3.2
		9/22/2017	Muscle	3.5
		5/16/2016	Muscle	2.9
		5/17/2016	Muscle	2.1
		5/16/2016	Muscle	2.2
		5/17/2016	Muscle	2.2
		5/14/2008	Muscle	1.5
		5/14/2008	Muscle	1.6
		5/17/2017	Filet	1.7
		9/22/2017	Filet	3.8
	Rexford	5/14/2013	Muscle	3.1
		9/25/2013	Muscle	2.9
		5/16/2016	Muscle	2.9
		5/16/2016	Muscle	3.6
		5/14/2013	Muscle	2.7
		5/14/2013	Muscle	1.9
		5/14/2013	Muscle	2.8
		5/14/2013	Muscle	2.4
		9/25/2013	Muscle	2.5
		5/14/2013	Muscle	4.1
		9/25/2013	Muscle	1.9
		9/25/2013	Muscle	2.2
		5/14/2013	Muscle	3.2
		9/25/2013	Muscle	2.5
		9/22/2017	Filet	6.3
		5/8/2018	Filet	2.0
		5/8/2018	Filet	1.7
		5/8/2018	Filet	2.2
	Black Lake	5/17/2016	Muscle	3.3
		5/16/2016	Muscle	4.0
		5/16/2016	Filet	2.9
		5/16/2016	Filet	3.6
		5/17/2017	Filet	3.0
	Jackson Creek	9/21/2018	Filet	1.4
		9/21/2018	Filet	1.4
		9/21/2018	Filet	2.0
Redside Shiner	Rexford	5/8/2018	Filet	2.4
	Tenmile Creek	5/9/2018	Filet	5.0
		5/9/2018	Filet	3.4
		5/9/2018	Filet	4.1
		5/9/2018	Filet	5.9
		5/9/2018	Filet	2.9
		5/9/2018	Filet	4.7
		5/9/2018	Filet	4.0
		5/9/2018	Filet	2.6
		5/9/2018	Filet	7.0
		5/9/2018	Filet	5.9
Westslope Cutthroat Trout	Sophie Creek	9/21/2017	Muscle	4.7
		5/17/2016	Muscle	7.6
		5/17/2016	Muscle	2.4

Table F.3: **Selenium Concentration (mg/kg) in Fish Muscle, Koocanusa Reservoir (Montana), 2008 to 2018**

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Westslope Cutthroat Trout	Sophie Creek	5/17/2016	Muscle	7.0
		9/21/2017	Filet	1.4
	Dodge Creek	5/17/2017	Filet	4.5
	Rexford	9/25/2013	Muscle	1.4
		5/14/2013	Muscle	6.1
		5/8/2018	Filet	6.3
	Tenmile Creek	5/9/2018	Filet	1.7
		5/9/2018	Filet	3.3
Yellow Perch	Sandhill	5/17/2017	Filet	4.4
	Tobacco River	9/15/2016	Filet	2.7
		5/17/2017	Filet	6.3
		5/17/2017	Filet	5.7
		5/17/2017	Filet	5.9
		5/17/2017	Filet	4.6
		5/17/2017	Filet	5.7
	Black Lake	5/17/2017	Filet	5.4

Table F.4: Selenium Concentration (mg/kg) in Fish Gonad, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Burbot	Pinkham Creek	12/2/16	Gonads	5.2
	Fivemile Creek	2/8/17	Gonads	3.8
	Cripplehorse Creek	12/29/16	Gonads	6.3
Kokanee	Young Creek	9/20/18	Gonads	5.6
	Murray Creek	9/20/18	Gonads	3.9
	Tobacco River	9/17/08	Gonads or Ovary	2.9
		9/17/08	Gonads or Ovary	4.9
		9/17/08	Gonads or Ovary	3.0
		9/17/08	Gonads or Ovary	4.3
		9/17/08	Gonads or Ovary	3.4
		9/17/08	Gonads or Ovary	3.1
		9/17/08	Gonads or Ovary	3.5
		9/17/08	Gonads or Ovary	3.6
		9/17/08	Gonads or Ovary	3.5
		9/17/08	Gonads or Ovary	4.3
		9/17/08	Gonads or Ovary	4.4
		9/17/08	Gonads or Ovary	3.3
		9/17/08	Gonads or Ovary	4.0
		9/17/08	Gonads or Ovary	3.6
		9/17/08	Gonads or Ovary	3.4
		9/17/08	Gonads or Ovary	3.8
		9/17/08	Gonads or Ovary	3.1
		9/17/08	Gonads or Ovary	4.7
		9/17/08	Gonads or Ovary	3.0
		9/17/08	Gonads or Ovary	3.7
		9/20/18	Gonads	4.0
		9/20/18	Gonads	4.9
		9/20/18	Gonads	6.0
	Rexford	9/25/13	Gonads or Ovary	3.8
		9/25/13	Gonads or Ovary	4.2
		9/25/13	Gonads or Ovary	3.2
		9/25/13	Gonads or Ovary	5.1
		9/25/13	Gonads or Ovary	3.5
		9/25/13	Gonads or Ovary	3.1
		9/25/13	Gonads or Ovary	3.8
		9/25/13	Gonads or Ovary	3.3
		9/25/13	Gonads or Ovary	3.7
		9/25/13	Gonads or Ovary	3.3
	Barron Creek	9/21/18	Gonads	3.3
	Warland Creek	9/21/18	Gonads	2.8
		9/21/18	Gonads	7.8
		9/21/18	Gonads	3.4
		9/21/18	Gonads	4.1
Largescale Sucker	Rexford	5/8/18	Gonads	6.7
		5/8/18	Gonads	6.2
		5/8/18	Gonads	5.7
		5/8/18	Gonads	1.6
		5/8/18	Gonads	6.3
		5/8/18	Gonads	6.0
		5/8/18	Gonads	7.0
		5/8/18	Gonads	5.8
		5/8/18	Gonads	7.0
	Tenmile Creek	5/9/18	Gonads	7.6
		5/9/18	Gonads	4.2
Longnose Sucker	Sophie Creek	5/17/17	Gonads	7.1
		5/17/17	Gonads	21
		5/17/17	Gonads	10
	Sandhill	5/17/17	Gonads	14
	Tobacco River	5/14/08	Gonads or Ovary	5.6
		5/14/08	Gonads or Ovary	4.1
		5/14/08	Gonads or Ovary	5.6
		5/14/08	Gonads or Ovary	4.0
	Rexford	5/8/18	Gonads	6.0
		5/8/18	Gonads	6.6
	Tenmile Creek	5/9/18	Gonads	6.6
	McGillivray	5/15/13	Gonads or Ovary	6.9
Mountain Whitefish	Warland Creek	9/21/18	Gonads	5.2
		9/21/18	Gonads	9.6
	Jackson Creek	9/21/18	Gonads	7.9
	Canyon Creek	9/21/18	Gonads	6.1

Table F.4: Selenium Concentration (mg/kg) in Fish Gonad, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Northern Pikeminnow	Tobacco River	5/14/08	Gonads or Ovary	2.5
		5/14/08	Gonads or Ovary	3.5
		5/14/08	Gonads or Ovary	2.9
		5/14/08	Gonads or Ovary	5.5
		5/14/08	Gonads or Ovary	3.2
		5/14/08	Gonads or Ovary	2.8
		5/14/08	Gonads or Ovary	4.2
		5/14/08	Gonads or Ovary	3.6
		5/14/08	Gonads or Ovary	4.2
		5/14/08	Gonads or Ovary	3.5
		5/14/08	Gonads or Ovary	2.7
		5/14/08	Gonads or Ovary	5.9
		5/14/08	Gonads or Ovary	2.8
		5/14/08	Gonads or Ovary	2.7
		5/14/08	Gonads or Ovary	3.0
		5/14/08	Gonads or Ovary	3.7
		5/14/08	Gonads or Ovary	3.6
		5/14/08	Gonads or Ovary	4.9
	Rexford	5/14/13	Gonads or Ovary	8.1
		5/14/13	Gonads or Ovary	2.7
		5/14/13	Gonads or Ovary	2.4
		5/14/13	Gonads or Ovary	4.7
		5/14/13	Gonads or Ovary	5.0
		5/14/13	Gonads or Ovary	6.0
		5/14/13	Gonads or Ovary	4.1
		5/14/13	Gonads or Ovary	3.2
		5/14/13	Gonads or Ovary	4.3
		5/14/13	Gonads or Ovary	3.2
		5/14/13	Gonads or Ovary	4.4
		5/14/13	Gonads or Ovary	3.4
		5/14/13	Gonads or Ovary	5.3
		5/8/18	Gonads	4.6
		5/8/18	Gonads	5.5
		5/8/18	Gonads	3.5
		5/8/18	Gonads	3.9
		5/8/18	Gonads	2.4
		5/8/18	Gonads	6.7
		5/8/18	Gonads	3.5
		5/8/18	Gonads	2.2
		5/8/18	Gonads	2.7
		5/8/18	Gonads	2.3
	Tenmile Creek	5/9/18	Gonads	3.0
		5/9/18	Gonads	3.0
		5/9/18	Gonads	3.1
		5/9/18	Gonads	3.8
		5/9/18	Gonads	1.8
		5/9/18	Gonads	2.5
		5/9/18	Gonads	2.9
		5/9/18	Gonads	3.4
	McGillivray	5/15/13	Gonads or Ovary	3.3
		5/15/13	Gonads or Ovary	2.7
		5/15/13	Gonads or Ovary	3.9
		5/15/13	Gonads or Ovary	2.8
		5/15/13	Gonads or Ovary	4.7
		5/15/13	Gonads or Ovary	4.2
		5/15/13	Gonads or Ovary	2.8
		5/15/13	Gonads or Ovary	2.8
		5/15/13	Gonads or Ovary	3.5
Peamouth Chub	Tobacco River	5/14/08	Gonads or Ovary	6.1
		5/14/08	Gonads or Ovary	5.8
		5/14/08	Gonads or Ovary	7.3
		5/14/08	Gonads or Ovary	6.7
		5/14/08	Gonads or Ovary	8.2
		5/14/08	Gonads or Ovary	6.7
		5/14/08	Gonads or Ovary	12
		5/14/08	Gonads or Ovary	11
		5/14/08	Gonads or Ovary	5.7
		5/14/08	Gonads or Ovary	11
		5/14/08	Gonads or Ovary	7.1
		5/14/08	Gonads or Ovary	5.8

Table F.4: Selenium Concentration (mg/kg) in Fish Gonad, Koocanusa Reservoir (Montana), 2008 to 2018

Common Name	Area	Date	Tissue Type	Result (mg/kg dw)
Peamouth Chub	Tobacco River	5/14/08	Gonads or Ovary	7.7
		5/14/08	Gonads or Ovary	4.0
		5/14/08	Gonads or Ovary	5.0
		5/14/08	Gonads or Ovary	8.3
		5/14/08	Gonads or Ovary	9.0
		5/14/08	Gonads or Ovary	7.3
		5/14/08	Gonads or Ovary	4.7
		5/14/08	Gonads or Ovary	7.3
	Rexford	5/14/13	Gonads or Ovary	9.0
		5/14/13	Gonads or Ovary	6.3
		5/14/13	Gonads or Ovary	9.7
		5/14/13	Gonads or Ovary	7.9
		5/14/13	Gonads or Ovary	6.7
		5/14/13	Gonads or Ovary	12
		5/14/13	Gonads or Ovary	8.2
		5/14/13	Gonads or Ovary	9.2
		5/14/13	Gonads or Ovary	7.1
		5/14/13	Gonads or Ovary	6.7
		5/14/13	Gonads or Ovary	7.3
		5/14/13	Gonads or Ovary	11
		5/14/13	Gonads or Ovary	15
		5/14/13	Gonads or Ovary	6.2
		5/14/13	Gonads or Ovary	7.2
		5/8/18	Gonads	7.5
		5/8/18	Gonads	6.4
		5/8/18	Gonads	6.5
		5/8/18	Gonads	6.4
		5/8/18	Gonads	5.6
		5/8/18	Gonads	8.2
		5/8/18	Gonads	13
		5/8/18	Gonads	11
		5/8/18	Gonads	6.6
		5/8/18	Gonads	8.2
	Tenmile Creek	5/9/18	Gonads	7.5
		5/9/18	Gonads	18
		5/9/18	Gonads	11
		5/9/18	Gonads	8.7
		5/9/18	Gonads	8.8
		5/9/18	Gonads	13
		5/9/18	Gonads	6.6
		5/9/18	Gonads	9.1
		5/9/18	Gonads	4.1
		5/9/18	Gonads	7.4
	McGillivray	5/15/13	Gonads or Ovary	11
		5/15/13	Gonads or Ovary	8.1
		5/15/13	Gonads or Ovary	12
		5/15/13	Gonads or Ovary	12
		5/15/13	Gonads or Ovary	8.4
		5/15/13	Gonads or Ovary	22
		5/15/13	Gonads or Ovary	5.4
		5/15/13	Gonads or Ovary	7.3
		5/15/13	Gonads or Ovary	7.6
		5/15/13	Gonads or Ovary	9.6
		5/15/13	Gonads or Ovary	8.7
		5/15/13	Gonads or Ovary	12
		5/15/13	Gonads or Ovary	5.8
		5/15/13	Gonads or Ovary	9.1
		5/15/13	Gonads or Ovary	5.5
Rainbow Trout	Rexford	5/14/13	Gonads or Ovary	4.7
Redside Shiner	Tenmile Creek	5/9/18	Gonads	26
		5/9/18	Gonads	15
		5/9/18	Gonads	21
Westslope Cutthroat Trout	Dodge Creek	5/17/17	Gonads	12
	Rexford	5/14/13	Gonads or Ovary	10
Yellow Perch	Sandhill	5/17/17	Gonads	5.6

Table F.5: Selenium Concentration (mg/kg) in Zooplankton, Koocanusa Reservoir (Montana), 2016 to 2018

Station	Date	Wet/Dry Weight	Selenium (µg/g)
International Boundary	7/26/2016	Wet	0.24
	8/16/2016	Wet	0.282
	9/20/2016	Wet	0.176
	9/20/2016	Wet	0.107
	7/26/2016	Wet	0.2
	8/16/2016	Wet	0.262
	7/25/2017	Dry	0.153
	8/28/2017	Dry	3.26
	9/26/2017	Dry	3.28
	7/25/2017	Dry	0.162
	8/28/2017	Dry	1.96
	9/26/2017	Dry	4.23
	4/24/2018	Dry	0.471
	5/22/2018	Dry	2.57
	6/12/2018	Dry	1.03
	7/10/2018	Dry	1.66
	4/24/2018	Dry	1.05
	5/22/2018	Dry	1.67
	6/12/2018	Dry	0.693
	7/10/2018	Dry	0.942
	8/28/2018	Dry	2.8
	8/28/2018	Dry	2.46
	10/23/2018	Dry	4.38
Tenmile Creek	7/26/2016	Wet	0.17
	8/16/2016	Wet	0.266
	9/20/2016	Wet	0.059
	7/25/2017	Dry	0.178
	8/28/2017	Dry	1.82
	9/26/2017	Dry	3.46
	4/24/2018	Dry	0.978
	5/22/2018	Dry	1.91
	6/12/2018	Dry	0.697
	7/10/2018	Dry	0.924
	8/28/2018	Dry	2
	10/23/2018	Dry	3.15
Forebay	7/26/2016	Wet	0.19
	8/16/2016	Wet	0.241
	9/20/2016	Wet	0.097
	7/25/2017	Dry	0.29
	8/28/2017	Dry	2.33
	9/26/2017	Dry	2.46
	4/24/2018	Dry	1.02
	5/22/2018	Dry	1.5
	6/12/2018	Dry	0.341
	7/10/2018	Dry	1.02
	8/28/2018	Dry	1.82
	10/23/2018	Dry	2.98
	10/23/2018	Dry	3.04

APPENDIX G
SUPPORTING FISH PLOTS

Summary figures showing fish tissue selenium concentrations in Lake Koocanusa

The following is a series of box-&-whisker plots of selenium concentrations in fish collected from sites in Lake Koocanusa in British Columbia and Montana between 2008 and 2018. Data are from the "Koocanusa Reservoir Data Compilation Report" (Lotic Environmental 2018), the Water Quality Portal (https://www.waterqualitydata.us/portal; last accessed November 19,2018), the U.S Fish and Wildlife Service (USFWS Koocanusa Selenium Data MASTER 2008-2018.xlsx), Teck (18-07 Table 2 and 3 Koocanusa Reservoir Tissue Concentrations (Zooplankton, Benthic Invertebrates, Fish) 2018.xlsx), and MTeWQX_LK-KOOCANUSA-BIO_SED_WQ_20190123.xlsx.

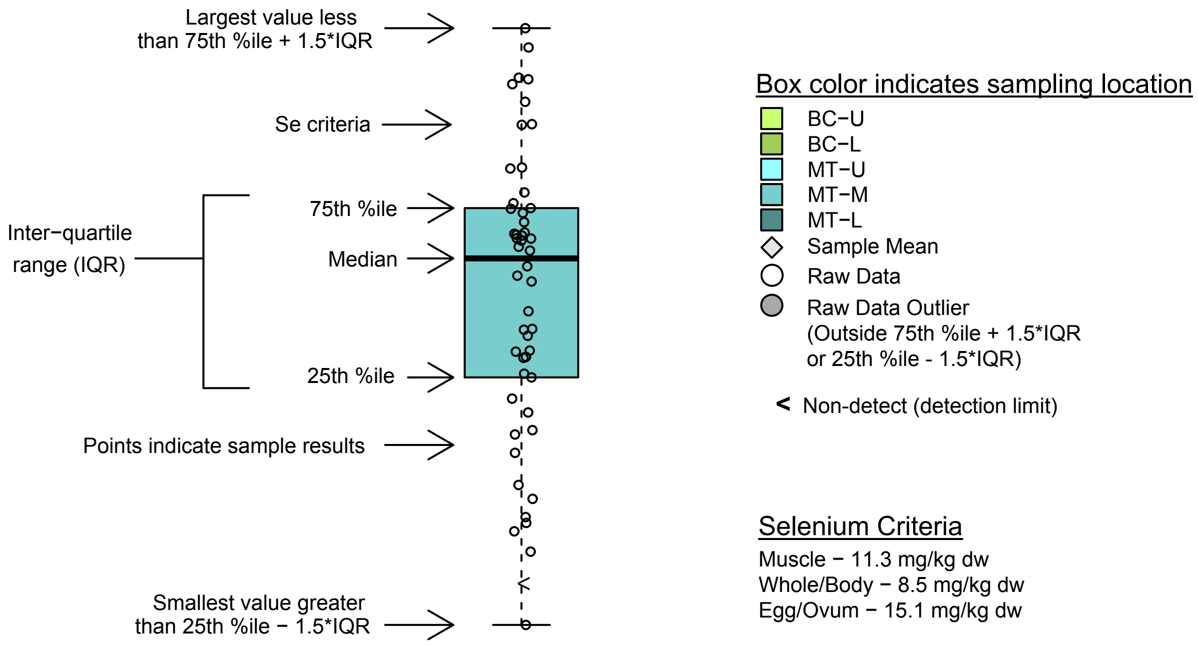
Data shown on the plots are ordered from upper to lower locations within Lake Koocanusa.

BC-Upper – Lake Koocanusa upstream of the mouth of Elk River, British Columbia
    552 samples collected from 12 species and 3 tissue types
BC-Lower – Lake Koocanusa at and downstream of the mouth of Elk River, British Columbia
    868 samples collected from 12 species and 3 tissue types
MT-Upper – Upper third of Lake Koocanusa (>latitude 48.808), Montana
    478 samples collected from 12 species and 3 tissue types MT-
Middle – Middle third of Lake Koocanusa, Montana
    16 samples collected from 1 species and 2 tissue types
MT-Lower – Lower third of Lake Koocanusa (<latitude 48.606), Montana
    257 samples collected from 11 species and 2 tissue types

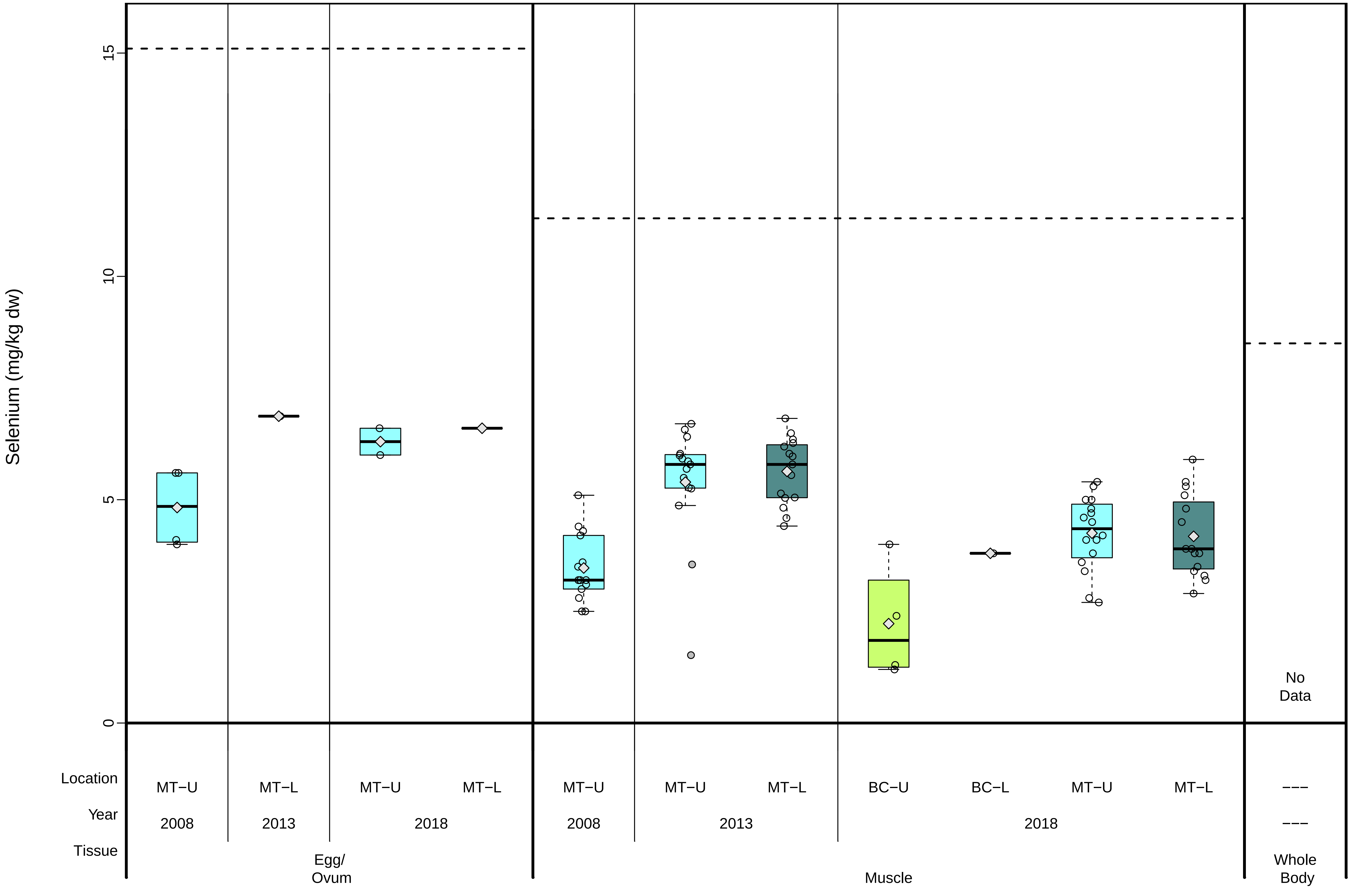
Tissue categories include muscle or muscle plug, egg/ovum, and whole body.

Tissue selenium concentrations are on a dry weight (dw) basis. US EPA's selenium criteria are shown as horizontal dashed lines.

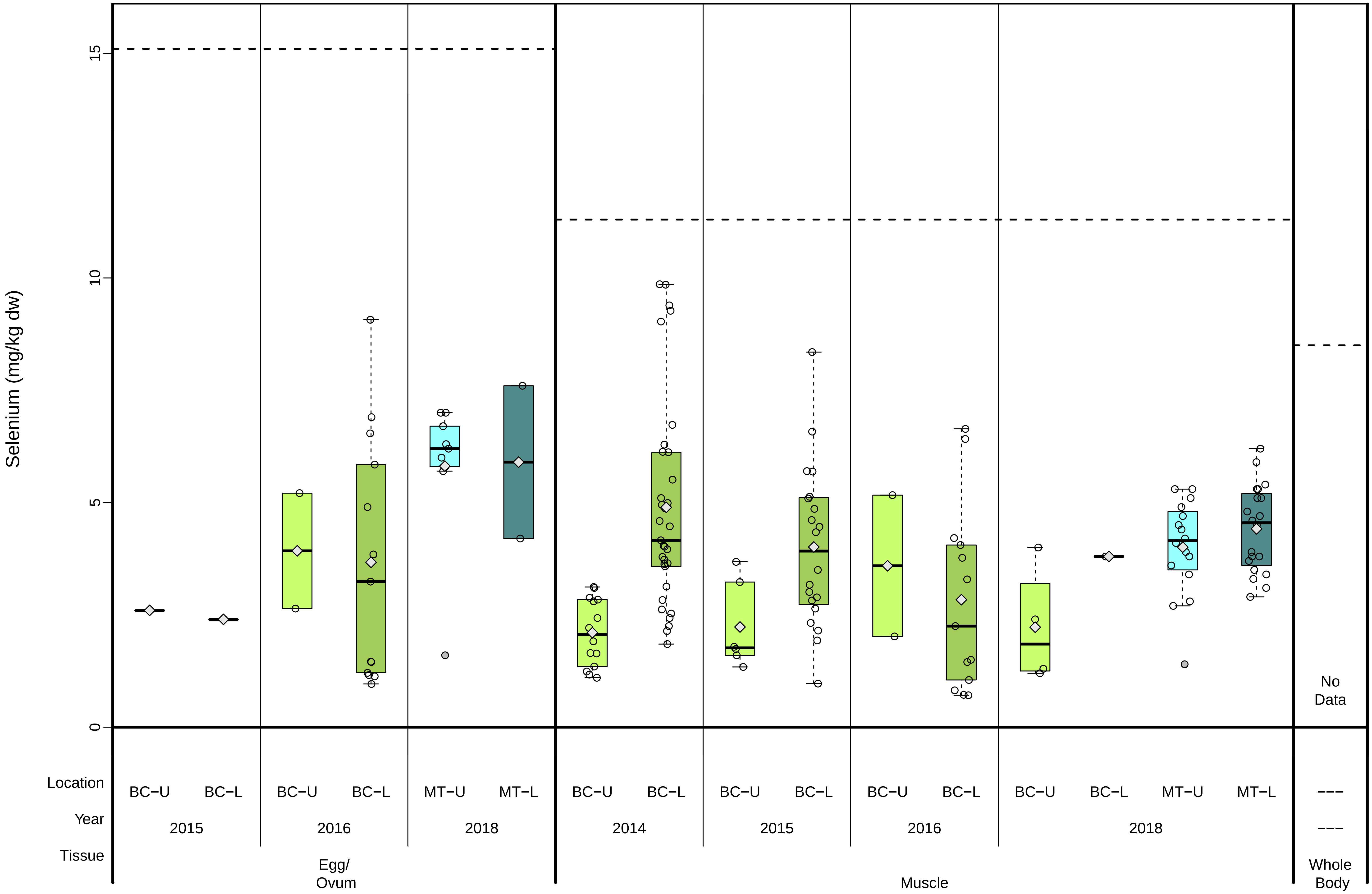
LEGEND



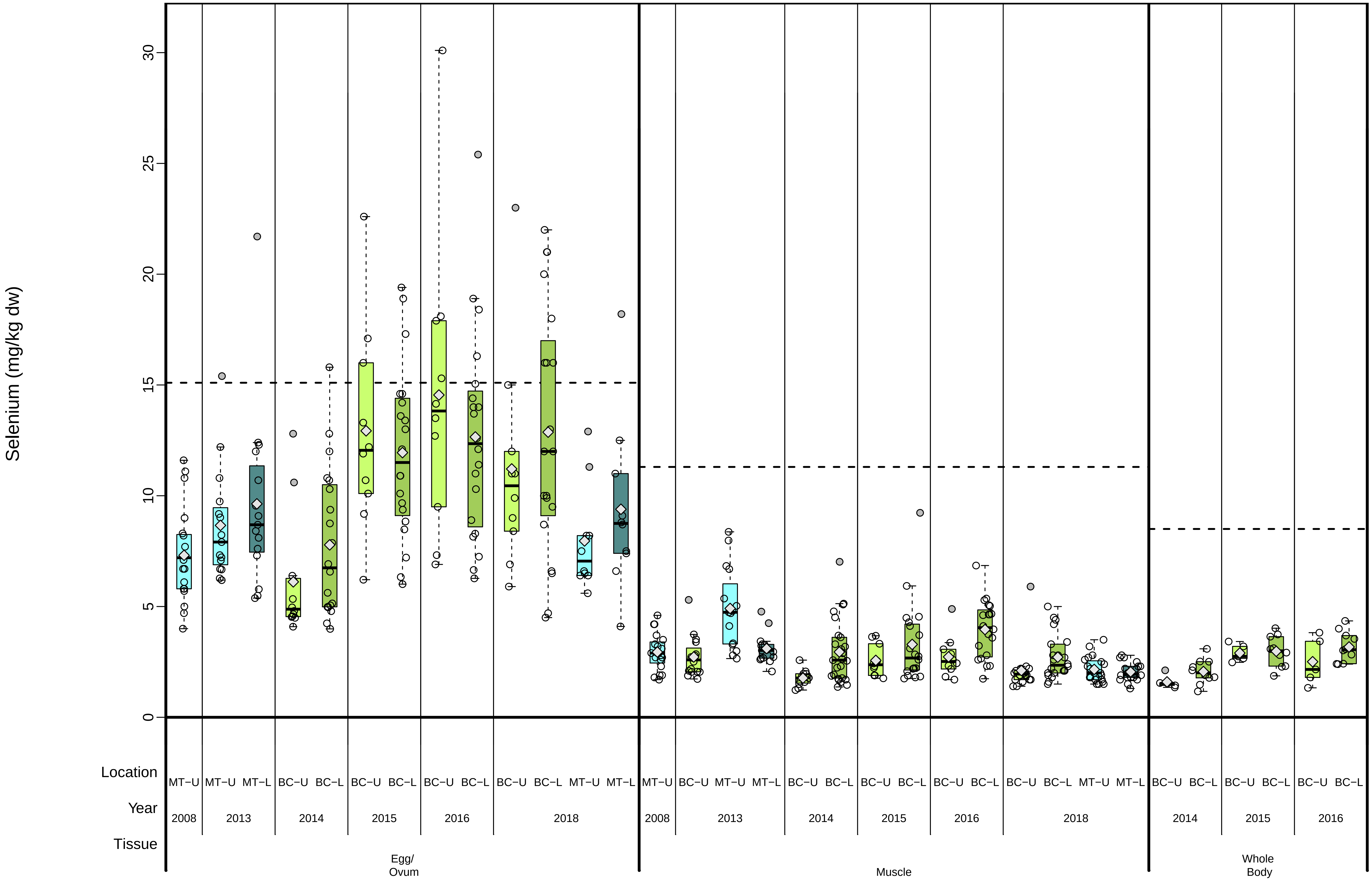
Catostomus catostomus (Longnose sucker)



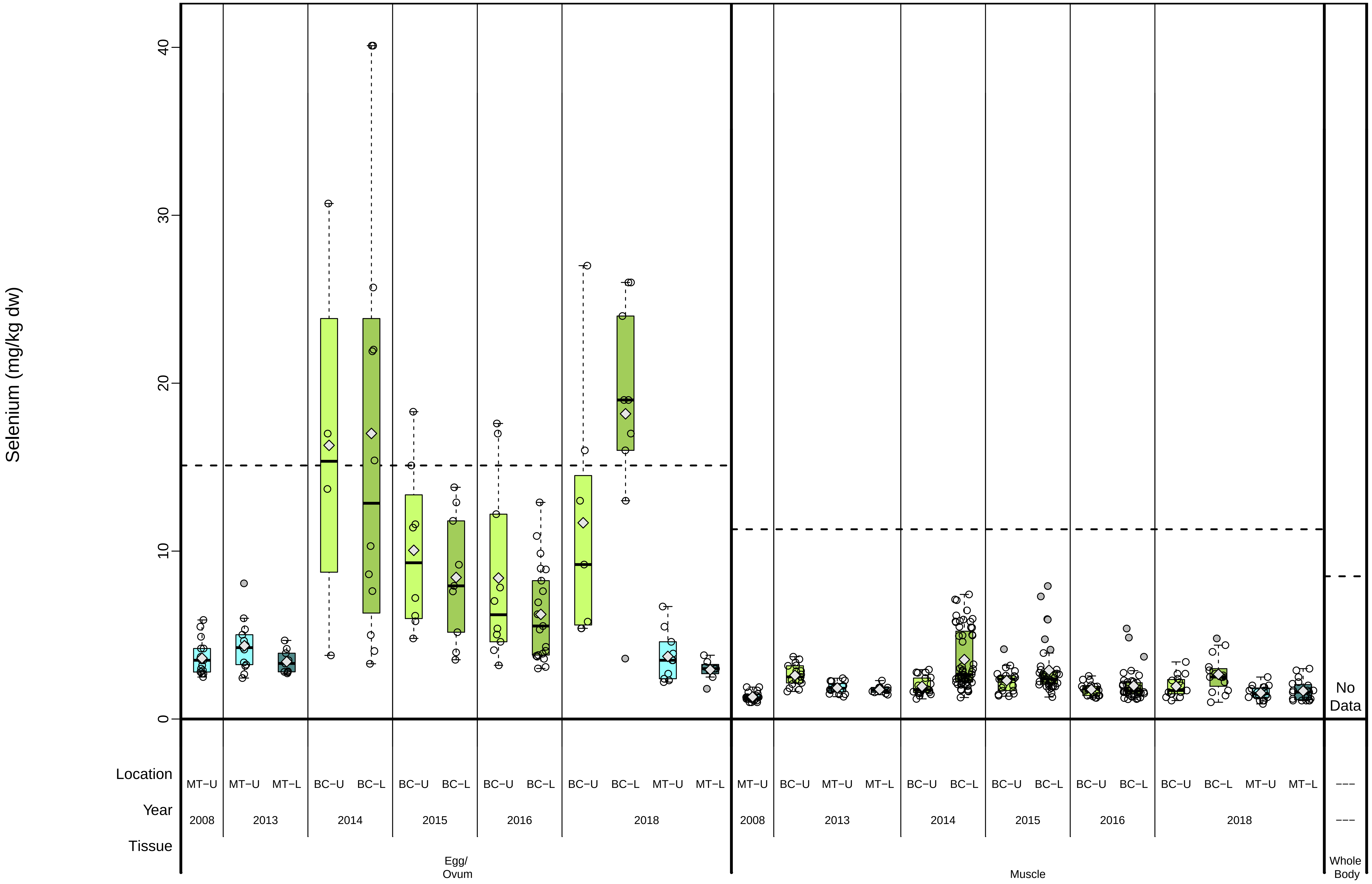
Catostomus macrocheilus (Largescale sucker)



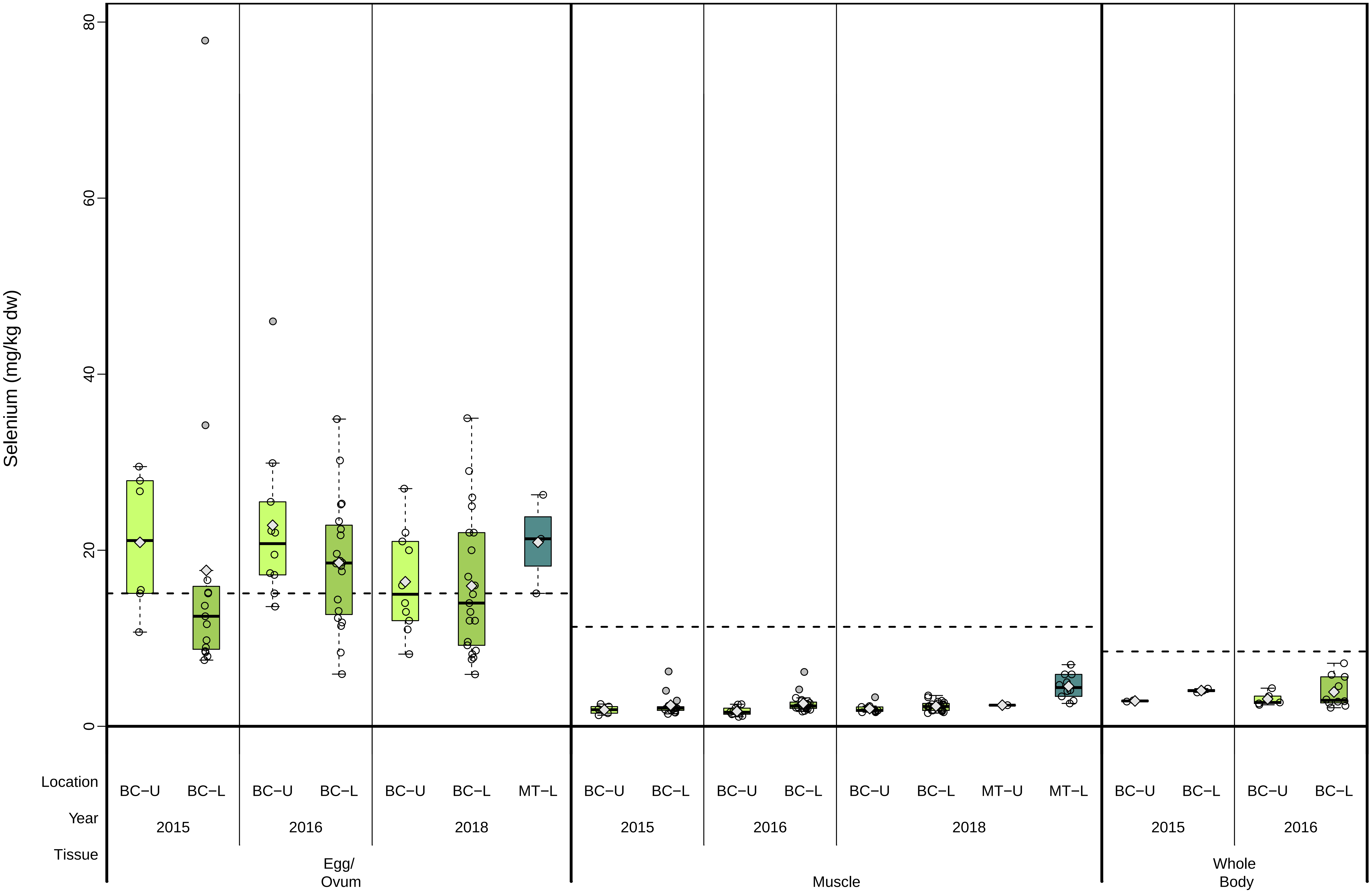
Mylocheilus caurinus (Peamouth chub)



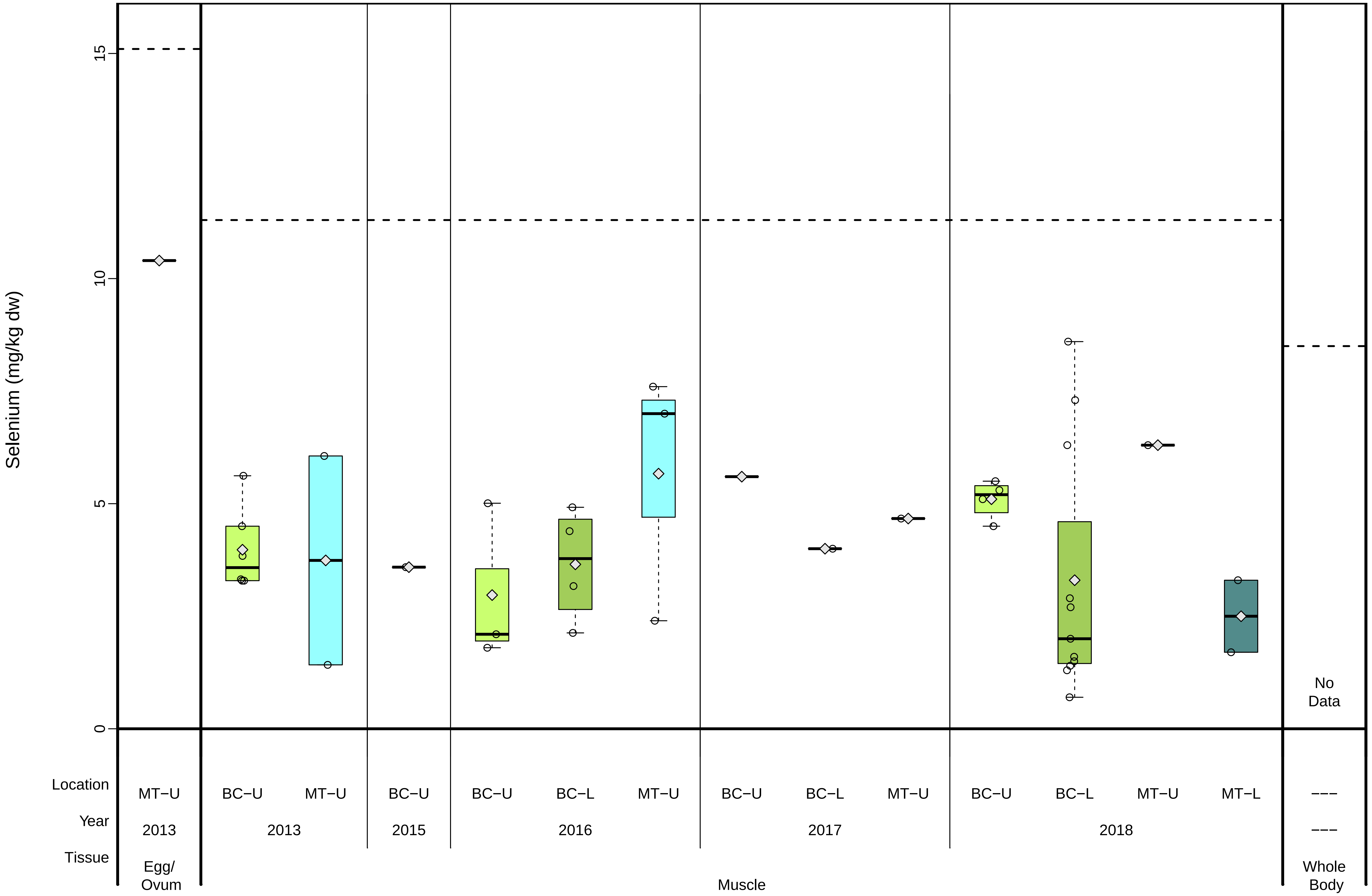
Ptychocheilus oregonensis (Northern pikeminnow)



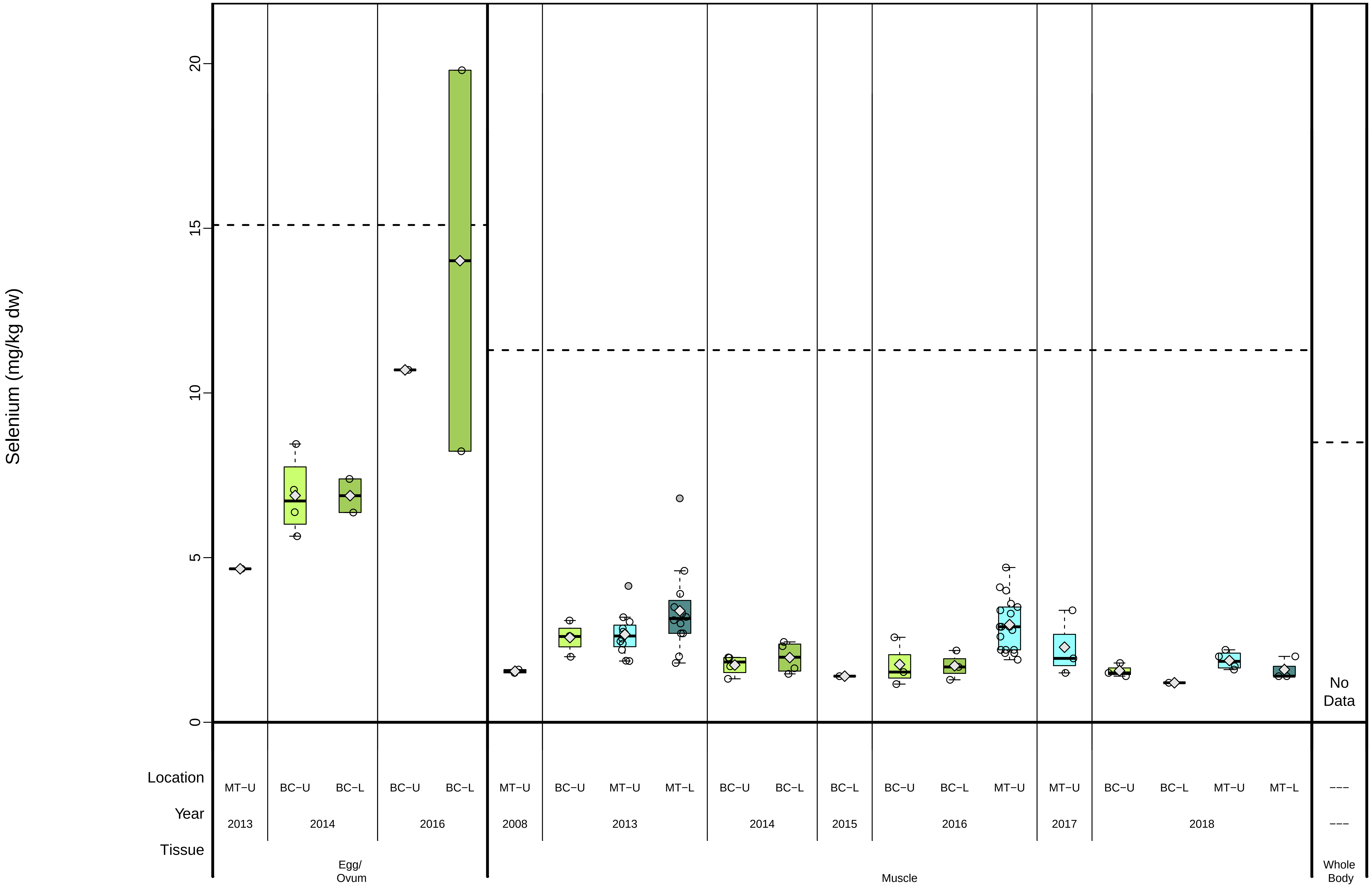
Richardsonius balteatus (Redside shiner)



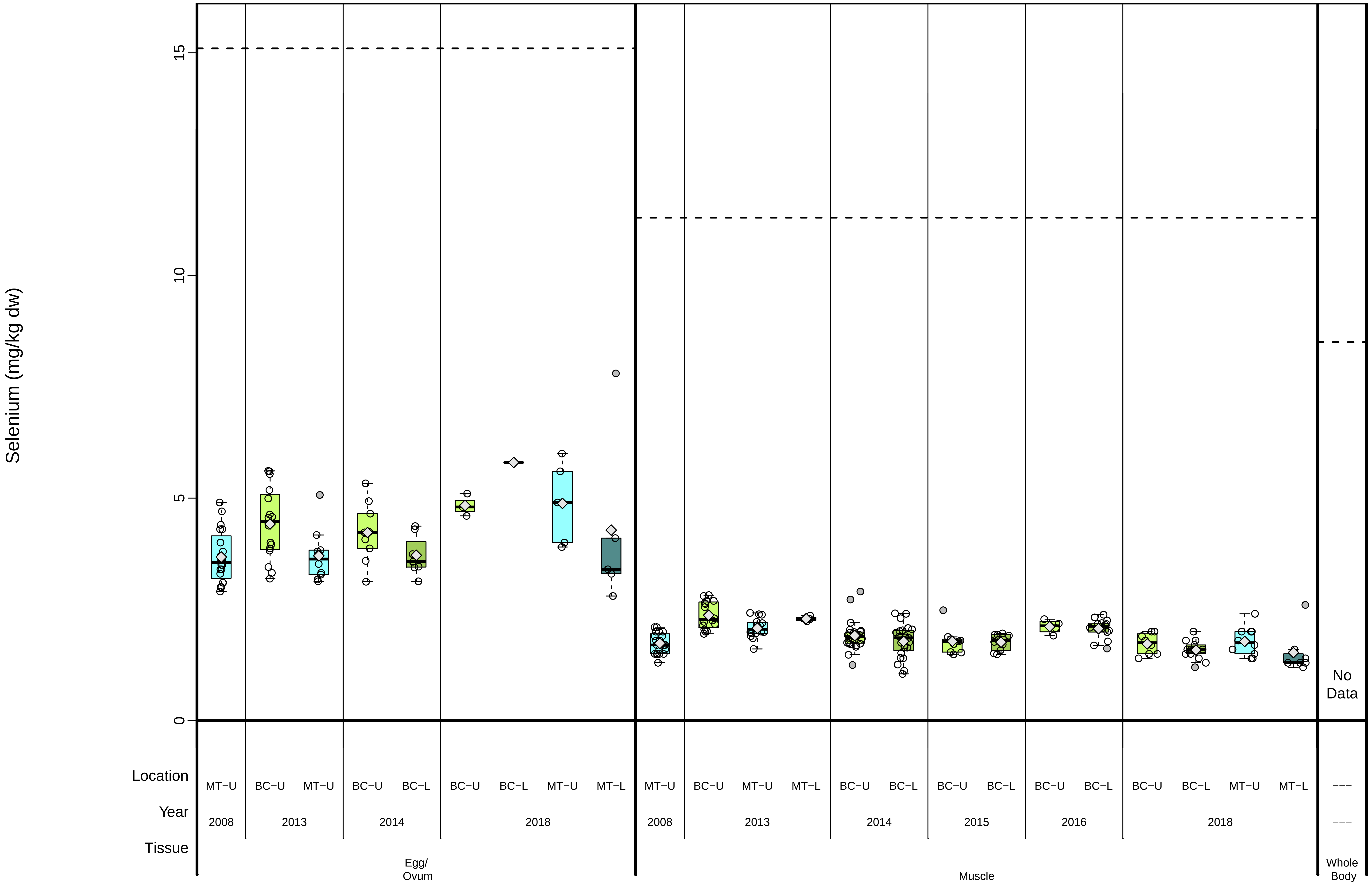
Oncorhynchus clarkii lewisi (Westslope cutthroat trout)



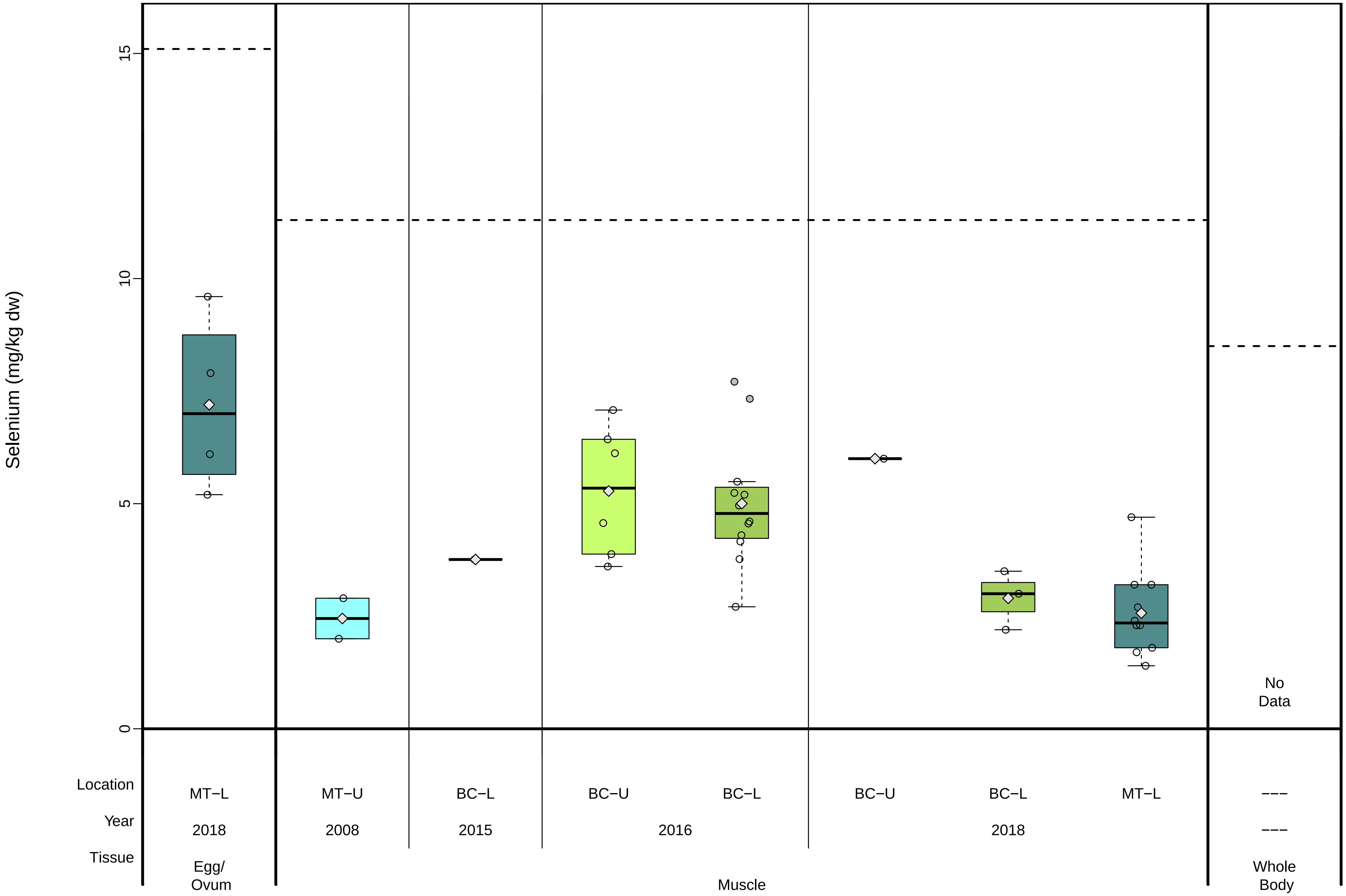
Oncorhynchus mykiss (Rainbow trout)



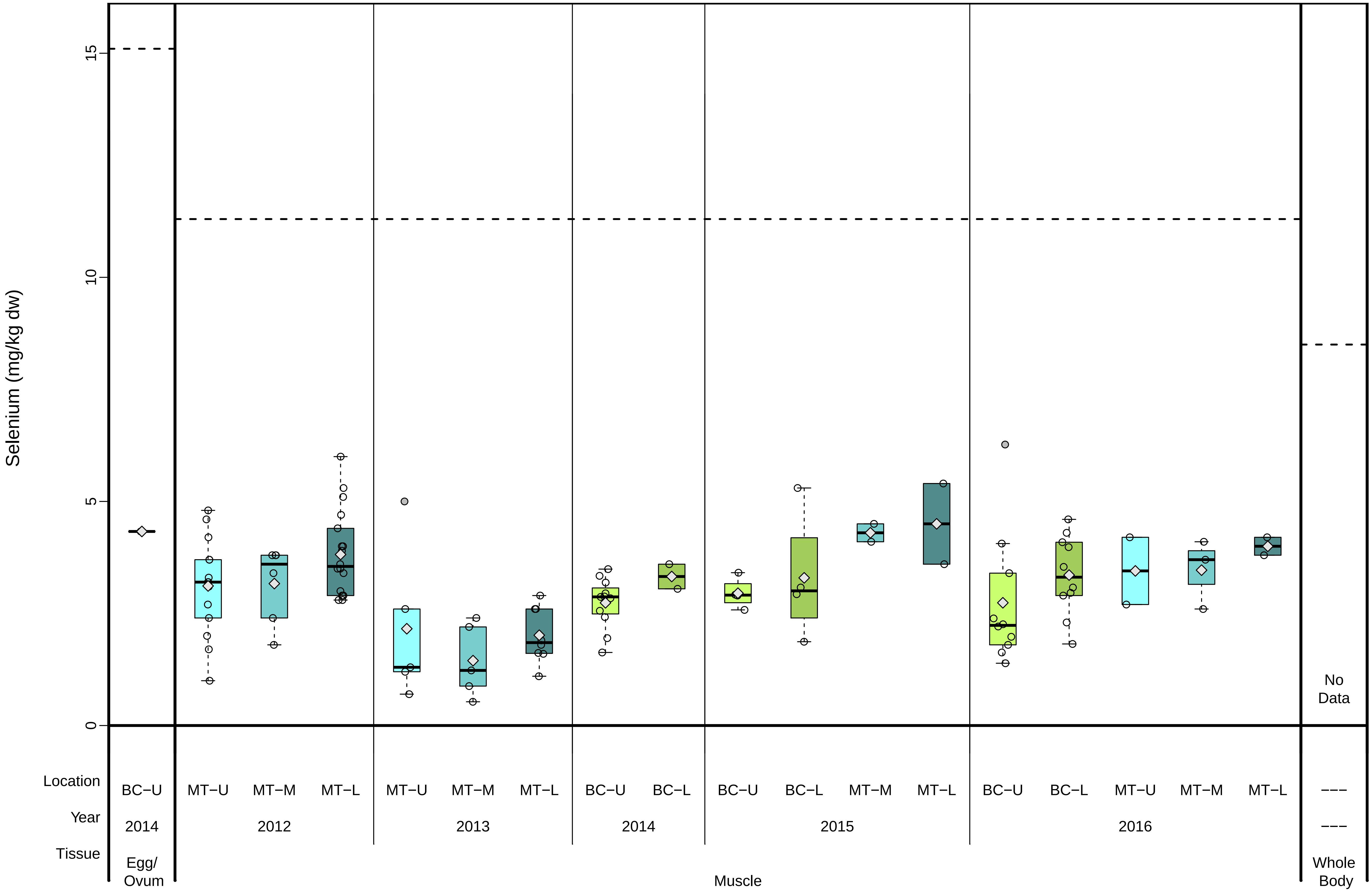
Oncorhynchus nerka (Kokanee)

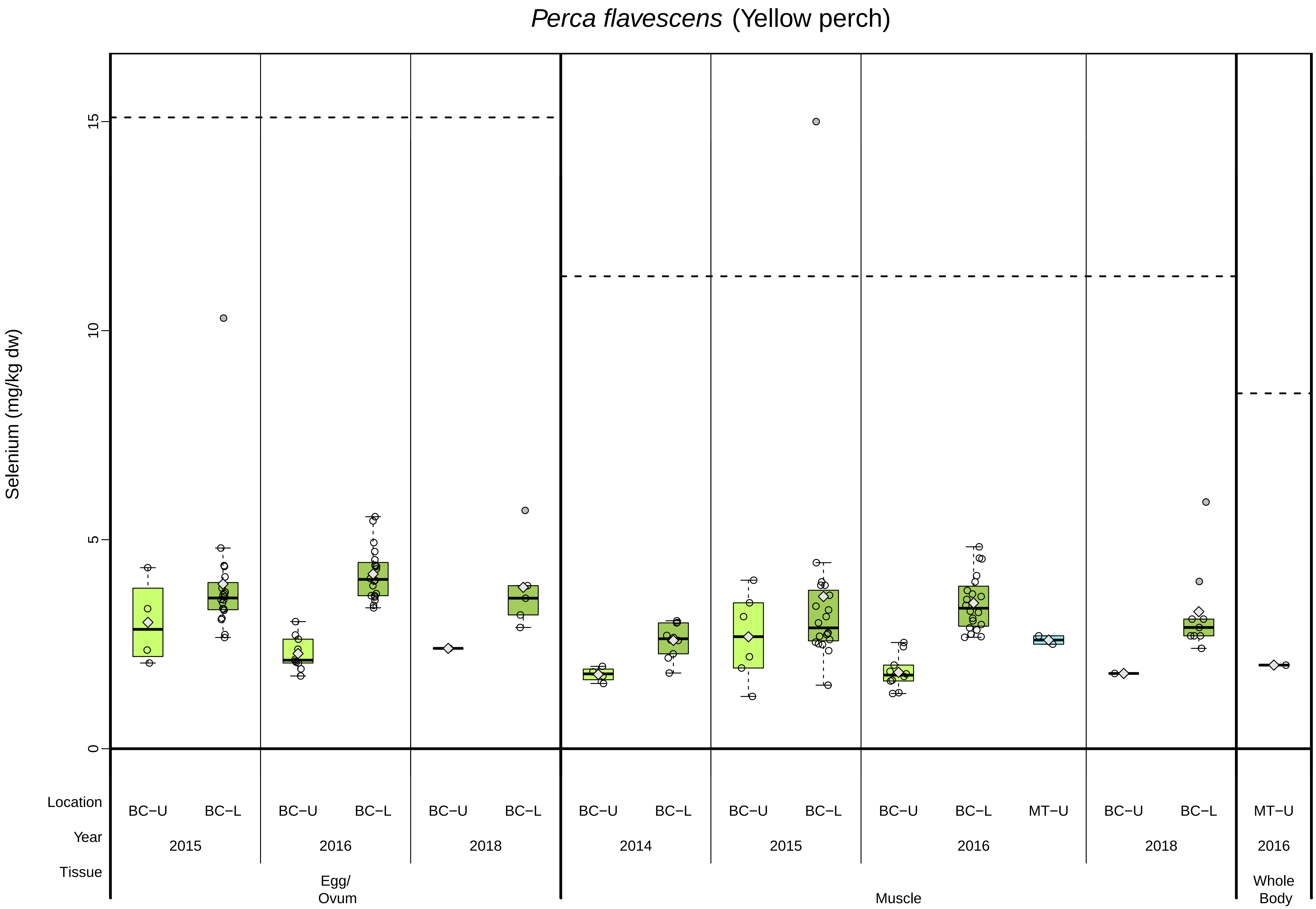


Prosopium williamsoni (Mountain whitefish)



Lota lota (Burbot)





Perca flavescens (Yellow perch)
Selenium (mg/kg dw)
0
5
10
15
Location
Year
Tissue
BC−U
BC−L
BC−U
BC−L
BC−U
BC−L
BC−U
BC−L
BC−U
BC−L
BC−U
BC−L
MT−U
BC−U
BC−L
MT−U
2015
2016
2018
2014
2015
2016
2018
2016
Egg/ Ovum
Muscle
Whole Body

Salvelinus confluentus (Bull trout)