PRELIMINARY WATER QUALITY OBJECTIVES REPORT

KUDZ ZE KAYAH PROJECT

BMC-17-02-1105_003_Preliminary Water Quality Objectives_Rev0_180419

April 19, 2018

Prepared for:

BMC MINERALS (NO.1) LTD.

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EXECUTIVE SUMMARY

BMC Minerals (No.1) Ltd. (BMC) is proposing to develop the Kudz Ze Kayah (KZK) Project (the Project), which is located approximately 110 km southeast of Ross River, Yukon. BMC's Project Proposal for the Project and is currently undergoing a Screening Assessment by the Yukon Environmental and Socio-economic Assessment Board's (YESAB) Executive Committee, under the *Yukon Environmental and Socio-economic Assessment Act (YESAA).* During the Adequacy stage of the Assessment, YESAB requested that BMC submit a number of updated water related reports, prior to YESAB preparing the draft Screening Report. Subsequently, this Preliminary Water Quality Objectives report is an update to the 2016 Preliminary Water Quality Objectives Report (AEG, 2016) that was submitted as Appendix D-8 of the Project Proposal (BMC, 2017).

Preliminary water quality objectives (PWQO) have been developed for a range of contaminants of potential concern (COPC) associated with the KZK Project. The derivation of these PWQO has been performed following the methods outlined by Canadian Council of Ministers of the Environment (CCME) (2003) and is consistent with other permitted mining projects in Yukon. The background concentration procedure (BCP) was used to develop preliminary site-specific water quality objectives (SSWQO) for those COPCs where the 95th percentile concentration exceeded the generic CCME or British Columbia Ministry of Environment (BCMoE) water quality guidelines for protection of aquatic life. This resulted in SSWQOs for aluminum, cadmium, copper, iron, fluoride, and zinc. Where the 95th percentile was lower than the generic CCME or BCMoE water quality guideline, then the most recent of the two guidelines was used.

A different approach was used to develop the preliminary SSWQO for selenium. Selenium uptake by primary producers is a critical step in the accumulation of selenium in higher trophic levels of the freshwater food chain. Sulphate is documented to compete with selenium for uptake by primary producers. Laboratory testing using Finlayson Creek water demonstrated that selenium uptake by two primary producers was diminished in the presence of increasing sulphate concentrations. Therefore, a sulphate-dependent selenium SSWQO was developed. At baseline sulphate concentrations of 60 mg/L or less, the SSWQO was set equivalent to the BCMoE guideline (0.002 mg/L), but at higher sulphate concentrations, the selenium SSWQO is calculated using an equation based on the sulphate concentration.

Alternative approaches to the derivation of SSWQOs for copper, lead, and zinc were also considered since they are COPCs for the Project. Biotic ligand modelling indicated that the time- and resource- intensive water effects ratio procedure (WERP) may not produce higher SSWQO for these elements, however, elevated concentrations of dissolved organic carbon (DOC) present year-round in the downstream reach of Finlayson Creek (site KZ-26) and throughout the watershed during spring freshet may confer some protective effect against these three elements. This may allow the development of a seasonal (i.e., spring), or DOC-threshold based SSWQO using the WERP. In addition, a review of the aquatic species that are resident in the Project receiving environment identified several organisms (or surrogate species) that are particularly sensitive to copper, lead, and zinc chronic exposure. As such, the recalculation procedure, which reviews the resident species and compares them with the species used in toxicity databases that underpin the development of CCME and BCMoE water quality guidelines, is unlikely to produce SSWQO that are substantially different from the generic water quality thresholds for these three metals.

LIST OF ACRONYMS

AEG	Alexco Environmental Group Inc.
BCMoE	British Columbia's Ministry of Environment
BCP	Background Concentration Procedure
BLM	Biotic Ligand Modelling
BMC	BMC Minerals (No.1) Ltd.
CWQG	Canadian Water Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
CCREM	Canadian Council of Resource and Environment Ministers
COPC	Contaminants of Potential Concern
DOC	Dissolved Organic Carbon
DQA	Data Quality Assessment
PWQO	Preliminary Water Quality Objective
RCP	Recalculation Procedure
RSP	Resident Species Procedure
SSWQO	Site Specific Water Quality Objective
WERP	Water Effects Ratio Procedure
WQG	Water Quality Guideline
WQO	Water Quality Objective
YESAA	Yukon Environmental and Socio-economic Assessment Act
YESAB	Yukon Environmental and Socio-economic Assessment Board

GLOSSARY

Background Concentration Procedure: a method that applies a statistical metric (e.g., 95th percentile) to existing baseline water quality data to develop site-specific water quality objectives.

Biotic Ligand Model: a numerical approach that uses the chemical composition of a water sample (e.g., dissolved organic carbon, calcium, magnesium, alkalinity content) alongside toxicological information to predict the toxicity of metals to aquatic biota.

Contaminants of Potential Concern: constituents that may be present at elevated levels in waters that drain Project infrastructure facilities during operations or following closure and may require mitigation measures to ensure that their concentrations can be reduced to an acceptable level.

Dissolved Organic Carbon: the concentration of organic carbon present in a water sample that has been filtered (<0.45 µm) prior to analysis.

Preliminary Water Quality Objectives: constituent concentration thresholds, often developed on a site specific basis, which are designed to be protective of the resident biota. They are subject to refinement as more baseline data is collected for the Project.

Recalculation Procedure: inspects the species toxicological database that was used to prepare the generic regulatory water quality guideline and then removes those species that are not resident at the site. Site-specific water quality objectives are then developed based on this screened toxicological data set using the same protocol that was used to formulate the generic water quality guideline.

Resident Species Procedure: accounts for both the sensitivity of species resident to a site and the influence of site water quality on toxicity. It involves the generation of a complete toxicological data set for constituents of interest using site water and resident species. Such site-specific toxicity data for a range of resident species are then used to derive site-specific water quality objectives.

Water Effects Ratio Procedure: provides a tool to modify generic water quality guidelines based on site-specific water quality characteristics. Toxicity tests are performed with an indicator or resident species using both laboratory water and site water. The results determine the WER, which is the ratio of constituent toxicity in site water compared to that in laboratory water. The calculated WER is then used to directly convert the generic water quality guideline to a site-specific water quality objective.

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1. INTRODUCTION

BMC Minerals (No.1) Ltd. (BMC) is proposing to develop the Kudz Ze Kayah (KZK) Project (the Project), which is located approximately 110 km southeast of Ross River, Yukon. BMC's Project Proposal for the Project and is currently undergoing a Screening Assessment by the Yukon Environmental and Socio-economic Assessment Board's (YESAB) Executive Committee, under the *Yukon Environmental and Socio-economic Assessment Act (YESAA).* During the Adequacy stage of the Assessment, YESAB requested that BMC submit a number of updated water related reports, prior to YESAB preparing the draft Screening Report. Subsequently, this Preliminary Water Quality Objectives report is an update to the 2016 Preliminary Water Quality Objectives Report (AEG, 2016) that was submitted as Appendix D-8 of the Project Proposal (BMC, 2017).

This report presents the preliminary water quality objectives (PWQO) that have been developed for the contaminants of potential concern (COPC) associated with the Project. The derivation of these PWQO has been performed following the methods outlined by Canadian Council of Ministers of the Environment (CCME) (2003) and is consistent with other permitted mining projects in Yukon.

The PWQO have been used to evaluate the Project's performance as part of the Project planning process and to guide development of Project mitigations. Identification of PWQO allows for comparison with water quality predictions for effluent concentrations from the final compliance location. This allows the project design team (mine planners, water treatment, and aquatic scientists) to identify mitigations to their respective Project design elements (e.g. water treatment, discharge rates, covers) as required. The PWQO have been used in the Project Proposal to undertake the effects characterization for surface water quality and aquatic biota. The PWQO will be updated and finalised during the Water Licensing process using additional monitoring data collected during the YESAA process. This report and its appendices present the PWQO for the Kudz Ze Kayah Project.

2. METHODOLOGY

2.1 HISTORIC WORK

The Project underwent environmental assessment and water licensing processes under Cominco in the late 1990s. The supporting work for the Project applications was presented in Cominco's Initial Environmental Evaluation (IEE, 1996). This work included predictions to changes in receiving environment water quality for the study area anticipated with mine operations and in post-closure. Water quality predictions and subsequent assessment focused only on aqueous ammonia, nitrite, copper, lead, and selenium. These predictions were compared with the Canadian Council of Resource and Environment Ministers (CCREM) generic water quality guidelines applicable at the time (CCREM, 1987).

2.2 PROJECT SSWQO DEVELOPMENT

Standard practice is to develop water quality objectives (WQO) for contaminants of potential concern (COPC) in the receiving waters. WQO can be generic (e.g. Canadian Water Quality Guidelines [CWQG] for the protection of aquatic life) or can be site specific water quality objectives (SSWQO) where they take into account background water quality conditions, resident species of aquatic resources, and other conditions present in the receiving environment. Such numerical water quality objectives can be utilized for evaluating potential effects, and as thresholds for further evaluation and action in adaptive management and monitoring programs.

Canadian Council of Ministers of the Environment (CCME) (2003) provides guidance for deriving numerical site specific water quality objectives and includes four procedures, which are the industry standard for establishing SSWQO for Canada and the Yukon. These procedures include the background concentration procedure (BCP), recalculation procedure (RCP), water effects ratio procedure (WERP), and the resident species procedure (RSP). The specific methodologies for evaluating SSWQO options for the primary COPCs are presented in the following Sections 2.2.1 and 2.2.2. Section 2.2.3 presents the methods used to evaluate options for the remaining COPCs, and Section 2.2.4 outlines the methods used to select the preliminary WQOs from the options considered.

The preliminary water quality objectives have been developed utilising the COPCs determined through ongoing surface water monitoring, groundwater monitoring, and waste rock and tailings geochemical characterization. Parameters such as pH and TSS were not included as these will be regulated by established effluent quality standards.

In the preliminary evaluation of options for developing WQO, the available guidelines for the COPCs identified for the Project were compiled for the CCME and British Columbia's Ministry of Environment (BCMoE) guidelines for protection of aquatic life. Although many of the generic CWQG are numerically the same now under the Canadian Council of Ministers of the Environment (CCME) as they were in CCREM in 1987, others have been updated with the results of further toxicity testing and research. In addition, (BCMoE) has published guidelines for the protection of aquatic life (BCMoE, 2017a), with many of them based on more recent testing and research than CCME.

A more in-depth initial focus for consideration of SSWQO development was placed on the 1995 metal/metalloid COPCs (selenium, copper, lead) with the addition of zinc to reflect the economic minerals of the Project.

2.2.1 SELENIUM

After incorporation into the food chain, the biological effects from selenium occur through trophic transfer mechanisms and are highly site-specific. For example, both overall primary productivity and the composition of the food chain play a significant role in determining the assimilation of selenium up the food chain. Dissolved sulphate competes with dissolved selenate (which is likely the dominant form of selenium in flowing watercourses such as Geona Creek and Finlayson Creek) for uptake by aquatic primary producers such that selenium assimilation by primary producers is substantially modified (reduced) with increasing aqueous sulphate concentrations. Therefore, the selenium preliminary SSWQO should consider the local sulphate concentration.

The approach pursued for the development of a sulphate-dependent site specific selenium water quality objective involved characterizing these relationships as a function of sulphate concentrations using both literature data and laboratory test work which employed site water. Relationships between selenium uptake and sulphate concentrations were evaluated using Finlayson Creek water and two primary producers – the alga *Pseudokirchneriella subcapitata* and the plant *Lemna minor*. The uptake of selenium by these organisms was examined in site waters amended with different selenium and sulphate concentrations and statistically significant correlations between the selenium enrichment factor in these primary producers and the dissolved sulphate concentration were identified. This relationship was then applied to a generic selenium guideline to generate a SSWQO formula.

Minnow Environmental was contracted to lead the development of the selenium SSWQO in collaboration with Nautilus Environmental. Further details of this work can be found in Appendix A, which presents the technical memorandum that outlines their methods and findings.

2.2.2 COPPER, LEAD AND ZINC

CCME (2003) indicates that there are four site specific approaches that may be suitable for the development of SSWQO for copper, lead, and zinc (given the status of these three metals as primary COPCs): BCP, WERP, RCP and RSP. The BCP is a statistical desktop exercise and is undertaken with a suitable background water quality dataset (see Section 2.2.3). Minnow Environmental was engaged to assist with evaluating the potential for the WERP and RCP to calculate SSWQOs. Appendix B outlines how Minnow utilized Biotic Ligand Modelling (BLM) as a proxy to evaluate the potential for the WERP to develop a SSWQO. BLM provides an indication of the potential for the toxicity of certain metals to be altered (reduced) in site water due to the presence of modifying factors such as dissolved organic carbon (DOC). This toxicity modification could ultimately be characterized and applied to the generic guideline as a WERP, but this procedure is expensive and time consuming. The BLM gives a good indication of the potential for a useful WERP to be developed before embarking on the protocol.

Likewise, Minnow also investigated the potential to utilize the RCP by comparing the species sensitivities that underpin the toxicity databases utilized for the development of the generic CWQGs with the known species in the Project receiving waters. Similar to the BLM, this desktop comparison provides an indication of the potential for the RCP to result in a meaningful change in the CWQG for use as a SSWQO, prior to investing in the time required to undertake the procedure. Appendix C presents their methods and results for this investigation.

The RSP was not considered at this time as this procedure is most effectively undertaken following the completion of final water quality predictions. The RSP may be undertaken in the future if deemed necessary.

2.2.3 OTHER COPCS

Although not contemplated as COPCs in the 1996 submission, many other metals and aqueous contaminants have the potential to be released from mining activities and to effect the health of local and downstream aquatic ecosystems. For these parameters, the BCP was used to identify SSWQO. This is an evaluation of background water quality concentrations where statistical metrics such as the 95th percentile, maximum, or mean plus two standard deviations may be used to develop a SSWQO for parameters where background concentrations are naturally elevated and routinely exceed the CWQG (CCME, 2003). This condition is not uncommon for proposed mining projects, where runoff drains mineralized areas.

For parameters where background concentrations are not naturally elevated, generic water quality guidelines for the protection of aquatic life have been used for proposed PWQOs. CCME or BCMOE generic guidelines have both been considered for these parameters. Many of these guidelines are hardness or pH dependent and in these cases the dependency has been presented in the summary table. The water quality modelling will predict hardness concentrations for use in developing initial PWQO for these parameters, but in application during mining operations, observed hardness or pH will be used for real-time PWQO determination. For the purposes of evaluation, the lower quartile of the observed hardness/pH has been selected to define a conservative working value for the PWQO, which is observed during the lower streamflow periods when the Creeks are most sensitive. Ammonia PWQOs are based on water temperature and pH. The median observed laboratory pH and field temperature were used to develop the ammonia PWQOs. Laboratory pH was used rather than field pH as it was more alkaline and therefore conservative in establishing the ammonia PWQO.

These statistics were generated using the combined database of water quality data collected by:

- Cominco in 1994 and 1995;
- Cominco, Teck-Cominco, and Teck biannually between 2000 and 2014 for Water Use Licence Monitoring; and
- AEG monthly between April 2015 and March 2018.

These data are included in their entirety as Appendix D. A data quality assessment (DQA) was undertaken prior to statistical calculations, as part of the baseline surface water quality characterization report (AEG, 2018). As part of this assessment, the historic 1994-1995 Cominco data were assessed such that data with relatively poor (i.e., high) detection limits that formed outliers to the entire dataset (defined as values greater than average concentration plus or minus three standard deviations) were examined and removed where appropriate. Similarly, 1994-1995 data associated with high levels of field blank contamination were also examined and removed where appropriate. Further details regarding this DQA are provided by AEG (2018). Overall, the Cominco 1994-1995 dataset was deemed fit for use.

When data were reported by the laboratories as less than a detection limit, the statistical analysis used a value equal to half the detection limit.

2.2.4 PRELIMINARY WATER QUALITY OBJECTIVE SELECTION

The information generated through the methodologies outlined above was compiled where appropriate for Geona Creek (KZ-37), Finlayson Creek – 100 m downstream of confluence with Geona Creek (KZ-15), Finlayson Creek at Robert Campbell Highway (KZ-26), and South Creek (KZ-13). These locations are shown on Figure 2-1 relative to proposed Project infrastructure.

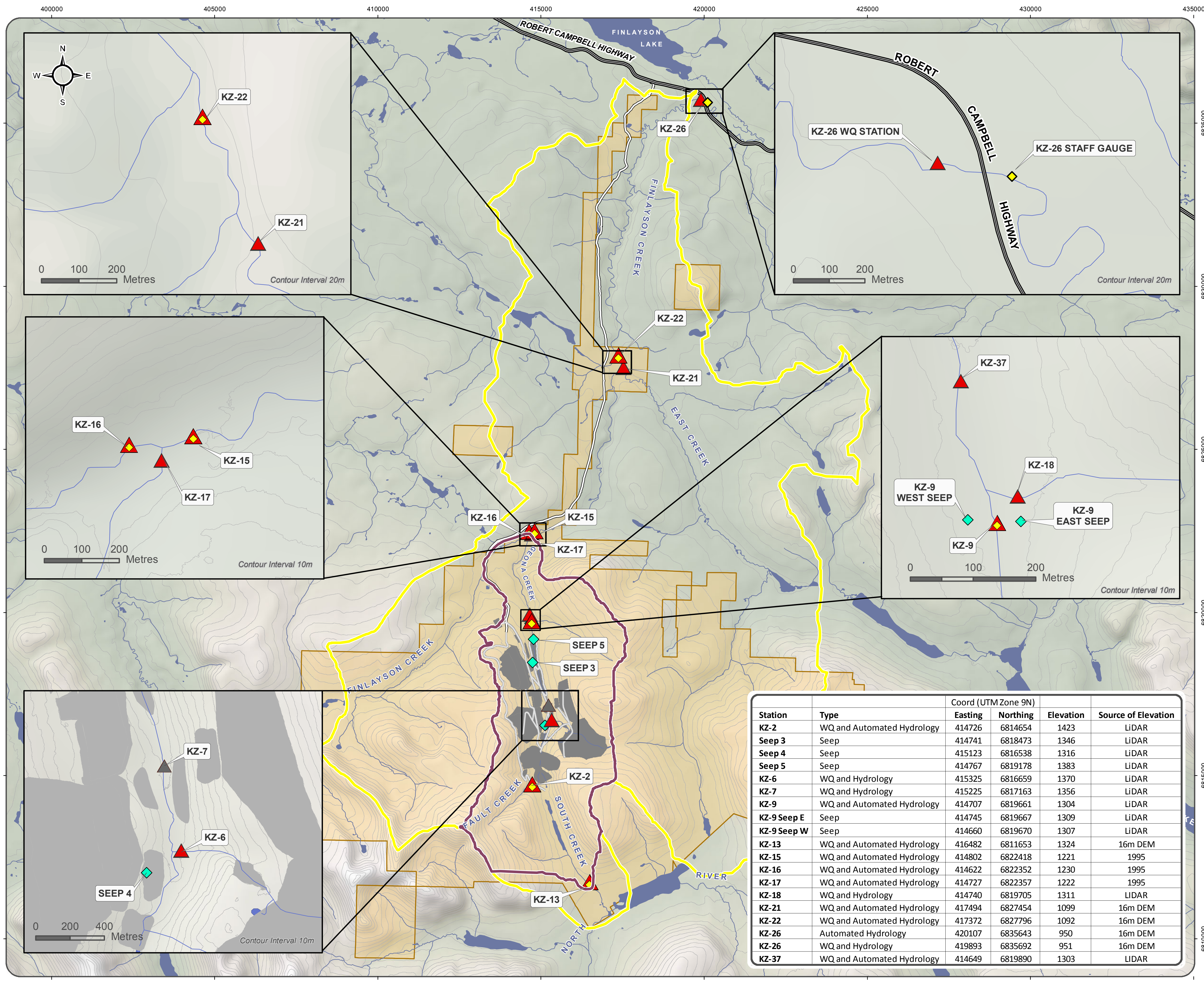
Consistent with CCME (2003) guidelines in developing SSWQO using the BCP, the 95th percentile of background metals concentrations was selected as the statistical basis for the PWQO for parameters whose concentrations exceeded generic guidelines (CCME, 2018 and BCMOE, 2017a). These were calculated on a site by site basis using the data collected to date for each site. CCME (2003) also discuss other statistical approaches to calculating SSWQO using the BCP such as the mean plus two standard deviations. This alternative approach was also investigated; however, the results were typically comparable to, or markedly higher than the 95th percentile. As such, the 95th percentile was preferred in order to increase conservatism in the SSWQO developed using the BCP.

The most recently adopted or developed water quality guideline was selected as the PWQO for parameters where baseline concentrations are lower than generic water quality guidelines (WQGs) (Table 2-1 and Table 2-2; e.g., total silver guideline for CCME established in 2015 was set as the PWQO as BCMOE guideline was developed in 1996). Where final CCME and BCMoE guidelines were published in the same year, BCMoE guidelines were preferred since they are developed for freshwaters of British Columbia, which share many similarities with those of Yukon. In the case of antimony, a final guideline is not available with CCME or BCMOE, therefore the working guideline reported by the BCMOE (2017b) has been used to identified as the PWQO for thoroughness and is to be used for comparison purposes only until a final guideline is reported. This approach was not used for selenium since a sulphate-dependent SSWQO was developed as outlined in Section 2.2.1 and Appendix A. Alternative approaches that used BLM or resident biota to determine SSWQO were also explored for copper, lead, and zinc (discussed in Section 2.2.2 and Appendices B and C).

KUDZ ZE KAYAH PROJECT

FIGURE 2-1
SURFACE WATER QUALITY AND HYDROLOGY MONITORING LOCATIONS

FEBRUARY 2018



Station	Type	Coord (UTM Zone 9N) Easting	Northing	Elevation	Source of Elevation
KZ-2	WQ and Automated Hydrology	414726	6814654	1423	LiDAR
Seep 3	Seep	414741	6818473	1346	LiDAR
Seep 4	Seep	415123	6816538	1316	LiDAR
Seep 5	Seep	414767	6819178	1383	LiDAR
KZ-6	WQ and Hydrology	415325	6816659	1370	LiDAR
KZ-7	WQ and Hydrology	415225	6817163	1356	LiDAR
KZ-9	WQ and Automated Hydrology	414707	6819661	1304	LiDAR
KZ-9 Seep E	Seep	414745	6819667	1309	LiDAR
KZ-9 Seep W	Seep	414660	6819670	1307	LiDAR
KZ-13	WQ and Automated Hydrology	416482	6811653	1324	16m DEM
KZ-15	WQ and Automated Hydrology	414802	6822418	1221	1995
KZ-16	WQ and Automated Hydrology	414622	6822352	1230	1995
KZ-17	WQ and Automated Hydrology	414727	6822357	1222	1995
KZ-18	WQ and Hydrology	414740	6819705	1311	LIDAR
KZ-21	WQ and Automated Hydrology	417494	6827454	1099	16m DEM
KZ-22	WQ and Automated Hydrology	417372	6827796	1092	16m DEM
KZ-26	Automated Hydrology	420107	6835643	950	16m DEM
KZ-26	WQ and Hydrology	419893	6835692	951	16m DEM
KZ-37	WQ and Automated Hydrology	414649	6819890	1303	LIDAR

- Hydrometric Station
- Water Quality and Hydrometric Station
- Water Quality Sampling Location
- Seep
- Water Quality Sampling Location, Discontinued
- Local Study Area
- Regional Study Area
- Tote Road/Proposed Access Road
- Proposed Mine Road
- Contour (40 m interval)
- Watercourse
- Waterbody
- Location of Proposed Mine Infrastructure
- BMC Minerals (No.1) Ltd. Mineral Claim Areas

Digital elevation model created by the Yukon Department of the Environment interpolated from the digital 1:50,000 Canadian National Topographic Database (NTDB Edition 2) contour and watercourse layers. Obtained from Geomatics Yukon.

Datum: NAD 83; Projection UTM Zone 9N

1:115,000 when printed on 11 x 17 inch paper

0 1 2 3 4 5 Kilometres

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(*Last edited by: amatlashevska; 16/02/2018/12:25 PM*)

Table 2-1: BCMoE and CCME Guidelines Considered as PWQO for Total Constituents with 95th Percentile Baseline Concentrations that do not Exceed Canadian Water Quality Guidelines

Constituent	CCME Guideline Date	BCMoE Guideline Date	Long Term Water Quality Guideline
Aluminum, Total	1987 [a]	Not available	0.005 mg/L if pH < 6.5; 0.1 mg/L if pH ≥ 6.5
Ammonia-N	2001	2009	Temperature and pH dependent (see Table 3-2 for values)
Antimony, Total	Not available	No final guideline	0.009 mg/L (British Columbia working water quality guideline for antimony (III))
Arsenic, Total	1997	2002	0.005 mg/L
Cadmium, Total	2014	No guideline for total cadmium	0.00004 mg/L if hardness (as $CaCO_3$) < 17 mg/L 10^{0.83(log[hardness]) – 2.46}/1000 (mg/L) if hardness ≥ 17 mg/L and ≤ 280 mg/L 0.00037 mg/L if hardness > 280 mg/L
Copper, Total	1987	1987	0.002 mg/L if hardness ≤ 50 mg/L; (0.04*(hardness))/1000 (mg/L) if hardness > 50 mg/L and < 187 mg/L
Cyanide, Total	1987	Not available	0.005 mg/L (as free CN)
Cyanide, Weak Acid Dissociable	Not available	1986	0.005 mg/L
Fluoride	1987	No long term guideline	0.12 mg/L
Iron, Total	1987	No long term guideline	0.3 mg/L
Lead, Total	1987	1987	(3.31 + e^[1.273 ln (hardness+D3) - 4.704])/1000 (mg/L) if hardness > 8 mg/L
Manganese, Total	Not available	2001	0.0044*hardness + 0.605 mg/L if hardness ≥ 37 mg/L and ≤ 450 mg/L
Mercury, Total	2003	2001	0.000026 mg/L
Molybdenum, Total	1999	1986	0.073 mg/L
Nickel, Total	1987	Same as CCME	0.025 mg/L if hardness (as CaCO3) ≤ 60 mg/L or unknown, (e^{0.76[ln(hardness)]+1.06})/1000 mg/L if hardness > 60 mg/L and ≤ 180 mg/L, 0.15 mg/L if hardness > 180 mg/L
Nitrate-N	2012	2009	3 mg/L
Nitrite-N	1987	2009	0.02 mg/L if chloride <2 mg/L; Guideline increases by 0.02 mg/L increments for every 2 mg/L chloride increase between 2 and 10 mg/L; 0.2 mg/L if chloride >10 mg/L
Selenium, Total	1987	2014	0.002 mg/L
Silver, Total	2015	1996	0.00025 mg/L
Sulphate	Not available	2013	128 mg/L if hardness ≤ 30 mg/L; 218 mg/L if hardness > 30 mg/L and ≤ 75 mg/L; 309 mg/L if hardness > 75 mg/L and ≤ 180 mg/L; 429 mg/L if hardness > 180 mg/L and ≤ 250 mg/L
Thallium, Total	1999	No final guideline	0.0008 mg/L
Uranium, Total	2011	No final guideline	0.015 mg/L
Zinc, Total	1987	1999	0.0075 mg/L if hardness ≤ 90 mg/L; (7.5 + 0.75*(hardness – 90))/1000 mg/L if hardness > 90 mg/L

[a] Green shading indicates guideline selected for preliminary water quality objective

Table 2-2: BCMoE and CCME Guidelines Considered as PWQO for Dissolved Constituents with 95th Percentile Baseline Concentrations that do not Exceed Canadian Water Quality Guidelines

Constituent	CCME Guideline Date	BCMoE Guideline Date	Long Term Water Quality Guideline
Aluminum, Dissolved	Not available	2001 [a]	e^[1.6–3.327(pH)+0.402(pH)^2] mg/L if pH < 6.5 0.05 mg/L if pH ≥ 6.5
Cadmium, Dissolved	Not available	2015	(e^(0.736*ln(hardness)-4.943))/1000 mg/L for hardness between 3.4 and 285 mg/L

[a] Green shading indicates guideline used for preliminary water quality objective

3. RESULTS

A summary of the results of all investigations and calculations undertaken in this preliminary exercise is presented in Table 3-1 for total and dissolved parameters. Parameter-specific findings are summarized in the sections below. Table 3-1 identifies the recommended PWQO selected from the various methods considered.

3.1 SELENIUM

The results of the site-specific selenium uptake testwork and their application to the development of a SSWQO for selenium are presented in Appendix A. Selenium uptake in two primary producers, *Pseudokirchneriella subcapitata* and *Lemna minor*, was examined at 0.002 mg/L and 0.01 mg/L selenium in the presence of between five and six different sulphate concentrations, which ranged between 60 mg/L and 550 mg/L (Appendix A). The selenium enrichment factor (EF; ratio of the selenium concentration in the primary producer to the selenium concentration in the water) showed a strong positive correlation with dissolved sulphate for *P. subcapitata* at both 0.002 mg/L selenium and 0.01 mg/L selenium, and for *L. minor* at 0.01 mg/L selenium. No relationship could be produced at 0.002 mg/L selenium for *L. minor* since tissue selenium concentrations were below the detection limit in the majority of tests run. The site-specific EFs determined ranged from 32 to 182 L/kg, which is lower than the median EF documented for lotic environments (i.e. running water systems such as streams and rivers) of 400 L/kg reported by the USEPA (2016), suggesting a low site-specific selenium enrichment for Finlayson Creek waters.

The three sets of experiments (*P. subcapitata* at both 0.002 mg/L selenium and 0.01 mg/L selenium, and *L. minor* at 0.01 mg/L selenium) all produced similarly sloped relationships between dissolved sulphate concentration and selenium EF, allowing the data to be combined to produce one relationship (Appendix A). The background sulphate concentration in the Finlayson Creek water used in these experiments was 60 mg/L. Therefore, it was assumed that the generic BCMoE selenium water quality guideline (0.002 mg/L) would apply at sulphate concentrations ≤60 mg/L. For Geona and Finlayson Creek waters with dissolved sulphate concentrations higher than 60 mg/L, the SSWQO is calculated based on the sulphate concentration, since higher sulphate levels ameliorate selenium uptake. Therefore, the selenium SSWQO can be calculated as:

Total Selenium SSWQO (mg/L) = 0.002 mg/L at sulphate ≤60 mg/L; and

Total Selenium SSWQO (mg/L) = $(0.1736*[\text{sulphate}]^{0.597})/1000$ at sulphate >60 mg/L

The baseline sulphate concentrations for Geona Creek at KZ-37 and Finlayson Creek at KZ-15 and KZ-26 range from <0.5 to 34.5 mg/L, <0.5 to 43.0 mg/L, and 13.3 to 61.0 mg/L, respectively. The sulphate concentrations predicted at these sites during operations and closure from the water quality model will be used and are anticipated to be between 130 and 300 mg/L, which corresponds to selenium SSWQO of 0.0032 and 0.0052 mg/L, respectively. It should be noted that the PWQO for sulphate (309 mg/L for KZ-37 and KZ-15, and 429 mg/L for KZ-26, Table 3-1), is hardness-dependent and will be increased for KZ-37 and KZ-15 to 429 mg/L for certain months of the year using preliminary hardness results from the water quality model. No SSWQO for selenium was developed for South Creek (KZ-13) since no effluent discharges to this watercourse are planned during operations or any closure periods.

3.2 COPPER, LEAD AND ZINC

The results of the biotic ligand modelling and the associated implications regarding the utility of the water-effect ratio (WER) Procedure to develop SSWQO for these elements is presented in Appendix B. The Windward, PNEC.pro, and Bio-Met biotic ligand models were used to predict chronic no-effect concentrations for copper and zinc for sampling events performed between April 2015 and December 2015 at water quality stations in Geona Creek (KZ-17) and Finlayson Creek (KZ-15 and KZ-26). Since DOC is a required input for all three models, only datasets that contained DOC could be used, which excluded data collected prior to April 2015. The Windward BLM was also used to predict acute effect concentrations for lead since it is the only model that can be applied to that parameter. The BLM results obtained for each sample dataset were compared to the USEPA standard to produce site-specific WER for copper, zinc, and lead. A WER >2 suggests that the WER Procedure may be potentially useful in deriving a SSWQO.

The predicted WERs for copper, zinc, and lead all showed a strong positive correlation with DOC, with the highest WERs observed during freshet for all three elements (Appendix B). Site KZ-26, located near the mouth of Finlayson Creek, generally returned the highest estimated WERs due to its higher DOC content, however, lower DOC concentrations observed farther upstream on Finlayson Creek, and in Geona Creek appear to limit the application of the WER Procedure. There is the potential to use the WER Procedure to develop a season-specific SSWQO based on the high DOC concentrations observed during freshet, but the WERP would likely be of limited use at other times of the year when DOC levels are lower.

The potential utility of the RCP in developing SSWQO for copper, lead, and zinc was also investigated by Minnow (Appendix C). The aquatic species that are resident in the Project area were reviewed and their sensitivity to copper, lead, or zinc exposure was assessed based on literature data. Numerous species (or a reasonable surrogate species) that are sensitive to copper, lead, and zinc exposure were identified as being resident in the Project receiving environment, including Arctic grayling, cladocerans (water fleas) and green algae. This suggests there is limited potential for the application of the Recalculation Procedure to result in a SSWQO that differs meaningfully from the generic WQG for these parameters.

Given the current evaluation of the WERP or RCP for copper, lead and zinc, these parameters have been treated in a similar fashion to all other remaining metal parameters, in terms of identifying PWQOs (Section 3.3 below).

3.3 OTHER COPCS

The PWQOs for total and dissolved constituents other than selenium have been selected using either the generic WQG or by using the BCP to calculate a SSWQO for parameters that have naturally elevated background concentrations in Project receiving waters (Table 3-1). Using the BCP, the 95th percentile total concentration was used as a SSWQO for the concentration of the following elements (Table 3-1):

- Total aluminum at KZ-37 (0.25 mg/L), KZ-13 (0.32 mg/L), and KZ-26 (0.18 mg/L);
- Fluoride at KZ-15 (0.13) and KZ-26 (0.14 mg/L);
- Total iron at KZ-37 (0.92 mg/L), KZ-15 (0.34 mg/L), KZ-13 (0.36 mg/L), and KZ-26 (1.00 mg/L); and
- Total zinc at KZ-13 (0.0137 mg/L).

Where the 95th percentile concentration was lower than the generic CCME or BCMoE water quality threshold, then the most recent guideline was used.

The ammonia-N guideline is dependent on the temperature and pH of the sample collected, however, for reference purposes, monthly ammonia-N PWQOs are presented in Table 3-2 based on the median monthly temperature and pH of waters observed at each sample location.

Table 3-1: Preliminary Water Quality Objectives (pWQO) for Constituents at Kudz Ze Kayah Project.

Parameter		Lowest Laboratory Detection Limit Available	KZ-37 95th percentile mg/L	KZ-15 95th percentile mg/L	KZ-13 95th percentile mg/L	KZ-26 95th percentile mg/L	CCME Guidelines - Aquatic Life (mg/L) KZ-37[k]	KZ-15[d]	KZ-13[c]	KZ-26[h]	BCMoE Guidelines - Aquatic Life (mg/L) KZ-37[k]	KZ-15[d]	KZ-13[c]	KZ-26[h]	Preliminary Water Quality Objectives KZ-37 (mg/L)	KZ-37 pWQO Rationale	KZ-15 (mg/L)	KZ-15 pWQO Rationale	KZ-13 (mg/L)	KZ-13 pWQO Rationale	KZ-26 (mg/L)	KZ-26 pWQO Rationale
Aluminum, total	mg/L	0.0005	0.25	0.059	0.32	0.18	0.1[a]	0.1[a]	0.1[a]	0.1[a]	-	-	-	-	0.25	95th percentile> generic guidelines	0.10	CCME is most recent guideline	0.32	95th percentile> generic guidelines	0.18	95th percentile> generic guidelines
Ammonia-N	mg/L	0.005	0.062	0.059	0.063	0.069	0.86[b]	0.86[b]	0.86[b]	0.28[i]	1.13[b]	1.13[b]	1.13[b]	0.37[i]	pH and temperature dependent	BCMOE is most recent guideline	pH and temperature dependent	BCMOE is most recent guideline	pH and temperature dependent	BCMOE is most recent guideline	pH and temperature dependent	BCMOE is most recent guideline
Antimony, total	mg/L	0.00002	0.000068	0.000041	0.000054	0.00016	-	-	-	-	0.0090	0.0090	0.0090	0.0090	0.0090	Only a working guideline with BCMOE	0.0090	Only a working guideline with BCMOE	0.0090	Only a working guideline with BCMOE	0.0090	Only a working guideline with BCMOE
Arsenic, total	mg/L	0.00002	0.00074	0.00084	0.0005	0.0023	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	CCME is most recent guideline	0.0050	CCME is most recent guideline	0.0050	CCME is most recent guideline	0.0050	CCME is most recent guideline
Cadmium, total	mg/L	0.000005	0.00014	0.00009	0.000067	0.000084	0.00019	0.00021	0.00011	0.00027	-	-	-	-	hardness dependent	CCME is most recent guideline	hardness dependent	CCME is most recent guideline	hardness dependent	CCME is most recent guideline	hardness dependent	CCME is most recent guideline
Chloride, total	mg/L	0.5	1.12	0.98	0.87	1.20	120	120	120	120	150	150	150	150	120	CCME is most recent guideline	120	CCME is most recent guideline	120	CCME is most recent guideline	120	CCME is most recent guideline
Copper, total	mg/L	0.00005	0.0026	0.0018	0.0024	0.0022	0.0028	0.0031	0.002	0.004	0.0049	0.0056	0.0024	0.0076	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline
Cyanide, Total	mg/L	0.0005	0.00088	0.00080	0.00102	0.00102	0.005[j]	0.005[j]	0.005[j]	0.005[j]	-	-	-	-	0.005	CCME guideline	0.005	CCME guideline	0.005	CCME guideline	0.005	CCME guideline
Cyanide, Weak Acid Dissociable	mg/L	0.0005	0.00125	0.00087	0.00092	0.00091	-	-	-	-	0.005	0.005	0.005	0.005	0.005	Only a guideline with BCMOE	0.005	Only a guideline with BCMOE	0.005	Only a guideline with BCMOE	0.005	Only a guideline with BCMOE
Fluoride	mg/L	0.01	0.110	0.130	0.062	0.140	0.12	0.12	0.12	0.12	-	-	-	-	0.12	CCME guideline	0.13	95th percentile> generic guidelines	0.12	CCME guideline	0.14	95th percentile> generic guidelines
Iron, total	mg/L	0.001	0.92	0.34	0.36	1.00	0.3	0.3	0.3	0.3	-	-	-	-	0.92	95th percentile> generic guidelines	0.34	95th percentile> generic guidelines	0.36	95th percentile> generic guidelines	1.00	95th percentile> generic guidelines
Lead, total	mg/L	0.000005	0.0011	0.00050	0.00030	0.0011	0.0041	0.0048	0.0017	0.0070	0.0075	0.0082	0.0050	0.011	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline
Manganese, total	mg/L	0.00005	0.147	0.085	0.14	0.095	-	-	-	-	1.1	1.2	0.87	1.4	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE
Mercury, total	mg/L	0.000002	0.0000027	0.0000054	0.0000050	0.0000050	0.000026	0.000026	0.000026	0.000026	0.000020	0.000020	0.000020	0.000020	0.000026	CCME is most recent guideline	0.000026	CCME is most recent guideline	0.000026	CCME is most recent guideline	0.000026	CCME is most recent guideline
Molybdenum, total	mg/L	0.00005	0.0010	0.0017	0.0009	0.0012	0.073	0.073	0.073	0.073	1.0	1.0	1.0	1.0	0.073	CCME is most recent guideline	0.073	CCME is most recent guideline	0.073	CCME is most recent guideline	0.073	CCME is most recent guideline
Nickel, total	mg/L	0.00002	0.0014	0.0019	0.0010	0.0030	0.112	0.123	0.066	0.150	-	-	-	-	hardness dependent	CCME guideline	hardness dependent	CCME guideline	hardness dependent	CCME guideline	hardness dependent	CCME guideline
Nitrate-N	mg/L	0.002	0.229	0.236	0.151	0.275	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	CCME is most recent guideline	3.0	CCME is most recent guideline	3.0	CCME is most recent guideline	3.0	CCME is most recent guideline
Nitrite-N	mg/L	0.002	0.0031	0.0025	0.0025	0.0026	0.06	0.06	0.06	0.06	0.02	0.02	0.02	0.02	0.02	BCMOE is most recent guideline	0.02	BCMOE is most recent guideline	0.02	BCMOE is most recent guideline	0.02	BCMOE is most recent guideline
Selenium, total	mg/L	0.00004	0.0013	0.0016	0.0004	0.0011	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002 or equation	BCMOE is most recent guideline	0.002 or equation	BCMOE is most recent guideline	0.002 or equation	BCMOE is most recent guideline	0.002 or equation	BCMOE is most recent guideline
Silver, total	mg/L	0.000005	0.000011	0.000006	0.000010	0.000022	0.00025	0.00025	0.00025	0.00025	0.0015	0.0015	0.000050	0.0015	0.00025	CCME is most recent guideline	0.00025	CCME is most recent guideline	0.00025	CCME is most recent guideline	0.00025	CCME is most recent guideline
Sulphate	mg/L	0.5	33.1	42.5	19.7	55.6	-	-	-	-	309	309	218	429	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE
Thallium, total	mg/L	0.000002	0.000007	0.000003	0.000005	0.000005	0.0008	0.0008	0.0008	0.0008	-	-	-	-	0.0008	CCME guideline	0.0008	CCME guideline	0.0008	CCME guideline	0.0008	CCME guideline
Uranium, total	mg/L	0.000002	0.0021	0.0062	0.0019	0.0038	0.015	0.015	0.015	0.015	-	-	-	-	0.015	CCME guideline	0.015	CCME guideline	0.015	CCME guideline	0.015	CCME guideline
Zinc, total	mg/L	0.0001	0.0281	0.0128	0.0137	0.0091	0.03[g]	0.03[g]	0.03[g]	0.03[g]	0.0322	0.0442	0.0075	0.0818	hardness dependent	BCMOE is most recent guideline	hardness dependent	BCMOE is most recent guideline	0.014	95th percentile> generic guidelines	hardness dependent	BCMOE is most recent guideline

Parameter		Laboratory Detection Limit	KZ-37 95th percentile mg/L	KZ-15 95th percentile mg/L	KZ-13 95th percentile mg/L	KZ-26 95th percentile mg/L	CCME Guidelines - Aquatic Life (mg/L) KZ-37[k]	KZ-15[c]	KZ-13[b]	KZ-26[e]	BCMOE Guidelines - Aquatic Life (mg/L) KZ-37[k]	KZ-15[d]	KZ-13[c]	KZ-26[e]	Preliminary Water Quality Objectives KZ-37 (mg/L)	KZ-37 pWQO Rationale	KZ-15 (mg/L)	KZ-15 pWQO Rationale	KZ-13 (mg/L)	KZ-13 pWQO Rationale	KZ-26 (mg/L)	KZ-26 pWQO Rationale
Aluminum, dissolved	mg/L	0.0005	0.029	0.016	0.031	0.018	-	-	-	-	0.050[a]	0.050[a]	0.050[a]	0.050[a]	0.050	Only a guideline with BCMOE	0.050	Only a guideline with BCMOE	0.050	Only a guideline with BCMOE	0.050	Only a guideline with BCMOE
Cadmium, dissolved	mg/L	0.000005	0.00009	0.00007	0.00005	0.00003	-	-	-	-	0.00025	0.00027	0.00015	0.00034	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE	hardness dependent	Only a guideline with BCMOE
Iron, dissolved	mg/L	0.001	0.247	0.061	0.215	0.108	-	-	-	-	0.35	0.35	0.35	0.35	0.35	Only a guideline with BCMOE	0.35	Only a guideline with BCMOE	0.35	Only a guideline with BCMOE	0.35	Only a guideline with BCMOE

[a]based on pH >6.5
[b]based on pH 8 and temperature 10°C
[c]based on hardness of 61, lower quartile hardness for KZ-13
[d]based on hardness of 139, lower quartile hardness for KZ-15
[e]based on hardness of 141, lower quartile hardness for KZ-9
[f]based on Arsenic (III), but applied for total
[g]this if for current approved guideline, while draft guideline is currently out for review
[h]based on hardness of 189, lower quartile hardness for KZ-26
[i]based on pH 8.5 and temperature 10°C
[j]guideline is for free cyanide
[k]based on hardness of 123, lower quartile hardness for KZ-37
(grey shading) indicates value used for site specific water quality objective

Table 3-2: Preliminary Water Quality Objectives for Ammonia (mg/L as N) by Month at Kudz Ze Kayah Project

Month	Sampling Locations			
	KZ-13 South Creek	KZ-37 Geona Creek	KZ-15 Finlayson Creek	KZ-26 Finlayson Creek
January	6.0	1.9	19	6.0
February	6.0	6.0	6.0	6.0
March	6.0	19	6.0	1.9
April	6.0	1.9	6.0	1.9
May	6.0	1.9	1.9	1.3
June	0.86	4.0	1.3	1.3
July	2.7	4.0	0.86	0.86
August	4.0	1.3	0.86	0.28
September	4.0	6.0	1.3	1.3
October	6.0	1.9	1.9	1.9
November	6.0	1.9	6.0	1.9
December	6.0	19	6.0	6.0

4. SUMMARY

Preliminary water quality objectives have been developed consistent with the procedures outlined by CCME (2003). The background concentration procedure was used to develop SSWQOs for elements that had a 95th percentile concentration which exceeded the generic water quality guideline provided by CCME or BCMoE (whichever is most recent). This comprised:

- Total aluminum and iron at KZ-37;
- Total iron and fluoride at KZ-15;
- Total aluminum, iron and zinc at KZ-13; and
- Total aluminum, iron and fluoride at KZ-26.

Where the 95th percentile concentration was lower than the generic CCME or BCMoE water quality threshold, the most recent guideline was used, with the exception of selenium. Laboratory tests using Finlayson Creek water confirmed literature observations that selenium uptake by primary producers is inhibited by increasing sulphate concentrations. Therefore, a SSWQO for selenium was developed based on the sulphate concentration of the water such that:

- Where sulphate ≤60 mg/L, selenium SSWQO = 0.002 mg/L; and
- Where sulphate >60 mg/L, selenium SSWQO (mg/L) = $(0.1736*[\text{sulphate}]^{0.597})/1000)$.

Given the status of copper, lead, and zinc as primary COPCs, alternative approaches to their SSWQO development were also assessed. Biotic ligand modelling indicated that the resource-intensive water-effects ratio procedure (WERP) may result in alternatively higher SSWQO for copper, lead, or zinc, when elevated concentrations of DOC at site are present throughout the watershed during spring freshet and may modify toxicity of these metals, perhaps allowing for the development of seasonal (i.e., spring), or DOC-threshold based WERP SSWQO. A review of the aquatic biota that are resident in the Project's receiving environment indicates that the Recalculation Procedure is unlikely to result in SSWQO that are different from the generic WQG for these three metals.

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APPENDIX A.

Evaluation of Selenium Uptake in Aquatic Primary Producers and Application of Uptake Relationships to the Development of a Site-Specific Water Quality Objective at BMC Minerals Kudz Ze Kayah Project (Minnow Environmental Inc., Nautilus Environmental)

January 18, 2016

Name REDACTED

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Dear Name REDACTED

Re: Evaluation of Selenium Uptake in Aquatic Primary Producers and Application of Uptake Relationships to the Development of a Site-Specific Water Quality Objective at BMC Minerals Kudz Ze Kayah Project

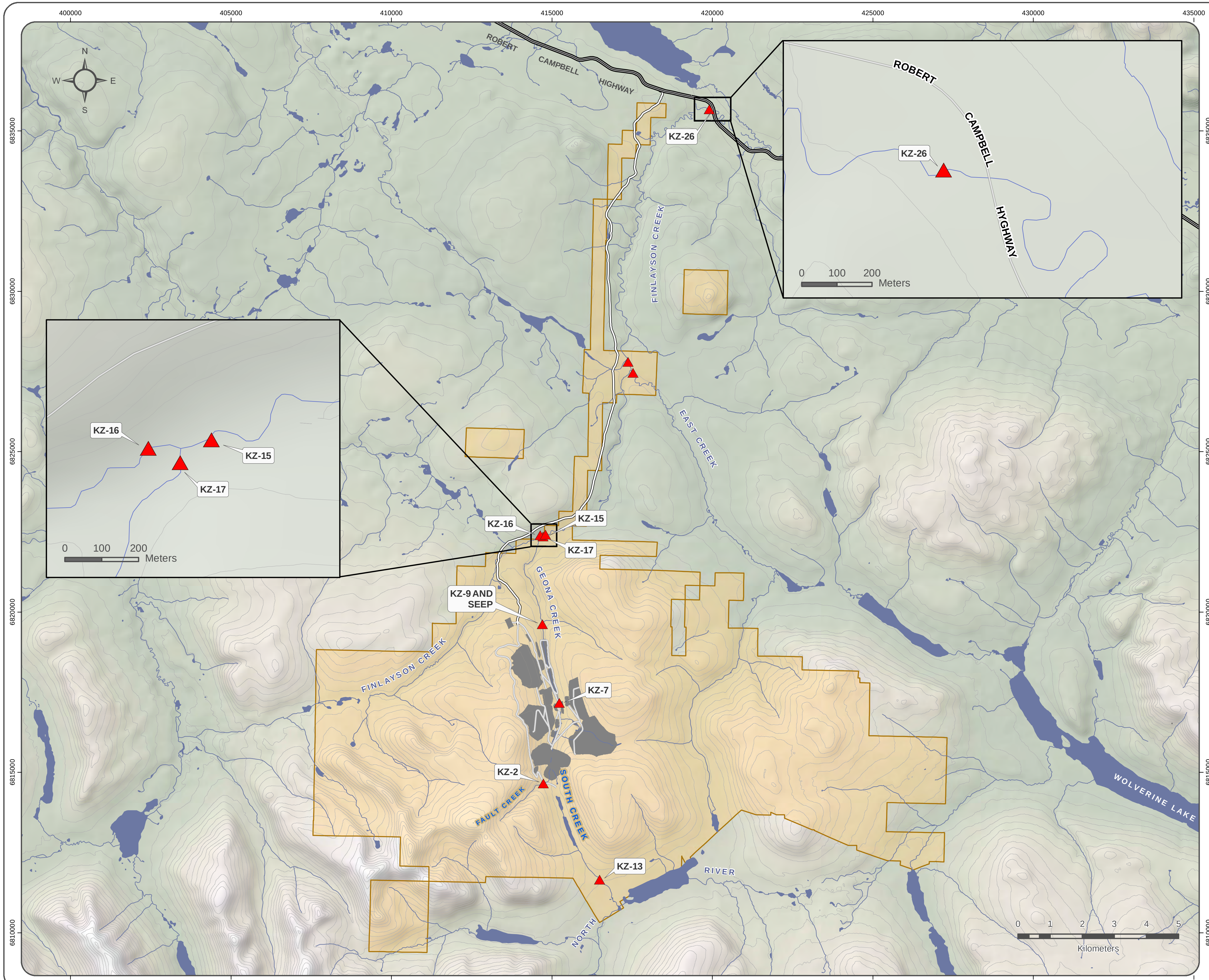
Minnow Environmental Inc. (Minnow) is pleased to provide a brief letter report examining the results of site-specific selenium uptake testing and their utility in deriving a site-specific water quality objective (SSWQO) for selenium at the BMC Minerals Kudz Ze Kayah Project.

Project Background

The BMC Minerals Kudz Ze Kayah Project is located in Yukon Territory, approximately 110 kilometers southeast of the community of Ross River. The project lies primarily within the Geona Creek watershed (Figure 1). Geona Creek flows to Finlayson Creek, which in turn is a tributary to the Finlayson River, and ultimately the Frances, Liard and MacKenzie rivers. An initial environmental evaluation of the project by a previous owner indicated that water quality of Geona and Finlayson creeks would potentially be impacted by mine water discharge, particularly based on concentrations of copper, selenium, zinc, ammonia and nitrite (Cominco 1996). It is expected that this mine water will be treated prior to discharge during the operational period. The evaluation reported herein can contribute to the design criteria for water treatment.

Technical Background

Potential effects associated with selenium in aquatic environments require evaluation that differs from metals such as copper and zinc because chronic effects of selenium occur following incorporation into the food chain, biotransformation to organic forms (seleno-amino acids) and transfer through the food chain (e.g., Janz 2012). Because overall productivity and the



BMC MINERALS

KUDZ ZE KAYAH PROJECT

FIGURE 1
WATER QUALITY MONITORING STATIONS

DECEMBER 2016

- Surface Water Quality Stations
- Robert Campbell Highway
- Tote Road/Proposed Access
- Proposed Mine Road
- Contour (40m interval)
- Watercourse
- Waterbody
- Location of Mine Infrastructure
- BMC Minerals (No.1) Ltd. Claims

ALEXCO ENVIRONMENTAL GROUP

minnow environmental inc.
A Tetra Consultants Company

Digital elevation model created by the Yukon Department of the Environment interpolated from the digital 1:50,000 Canadian National Topographic Database (NTDB Edition 2) contour and watercourse layers. Obtained from Geomatics Yukon.

Datum: NAD 83; Projection UTM Zone 9N

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\01_WaterQuality\01-Surface\Specific\Minnow\SWQ_Minnow_20161212.mxd
(*Last edited by: mducharme; 12/12/2016/11:58 AM*)

characteristics of food chains differ substantially among aquatic systems, incorporation of aqueous selenium into the food chain, and transfer through the food chain, is highly site-specific. In general, low productivity systems with simple food chains are less sensitive to selenium than higher productivity systems with longer food chains (Stewart et al. 2010; Orr et al. 2012; USEPA 2015) and lotic (running water) systems (i.e., creeks and rivers) are less sensitive to selenium than lentic (still water) systems (wetlands, ponds and lakes; Adams et al. 2000; Hamilton and Palace 2001; Orr et al. 2006; USEPA 2015). A recent review by the USEPA (2015) indicated that incorporation of selenium into aquatic food chain is approximately 3.8 times lower in lotic environments (median water-to-primary producer enrichment 360-fold) than in lentic environments (median water-to-primary producer enrichment 1,370-fold).

One means of developing a water quality objective (WQO) for selenium is by food chain modelling (e.g., Presser and Luoma 2010), whereby a tissue quality guideline (e.g., a fish egg/ovary tissue guideline; widely considered to be the most accurate estimate of no-effect concentration; e.g., Janz 2012; DeForest et al. 2012) is used to back-calculate a WQO. This can be done by using the tissue quality guideline as a starting point and applying Trophic Transfer Functions (TTFs; the ratio of selenium in a trophic level to selenium in the level immediately below) and Enrichment Functions (EFs; the ratio of selenium in primary producers [the first trophic level] to selenium in water) based on field or laboratory data to calculate the corresponding water value. Essentially, this involves moving backwards through the typical food chain model of selenium accumulation (e.g., moving backwards through Figure 2). Characterizing the EF and TTFs in a model food chain can be onerous. However, by far the greatest step-increase in selenium concentration occurs at the very base of the food chain (i.e., the EF; Stewart et al. 2010; Presser and Luoma 2010; Orr et al. 2012). Subsequent to incorporation at the base of the food chain, where it is bio-transformed to seleno-amino acids, trophic transfer generally results in similar concentrations at increasing trophic levels (i.e., TTFs are near 1; Figure 2). Therefore, by characterizing the EF (accumulation from water to primary producers), the greatest source of site-specific variability can be addressed.

Recent research has shown that sulphate can substantially reduce the incorporation of selenium into an aquatic food chain by competition with selenate, the dominant form of selenium in flowing aquatic systems such as Geona and Finlayson creeks (Williams et al. 1994; Lo et al. 2012). Such competition is consistent with the chemical similarity of selenate and sulphate. Therefore, it would take more selenium to cause uptake and effects the higher the sulphate concentration present. Relationships between selenium uptake and sulphate concentrations in Finlayson Creek water (Station KZ-15; Figure 1) were evaluated using two primary producers – the alga *Pseudokirchneriella subcapitata* and the plant *Lemna minor* (Nautilus 2016). All methodology and results of the uptake testing are provided in that report (Appendix A). This letter report applies the findings of the uptake study to the derivation of a potential SSWQO for selenium in Finlayson Creek.

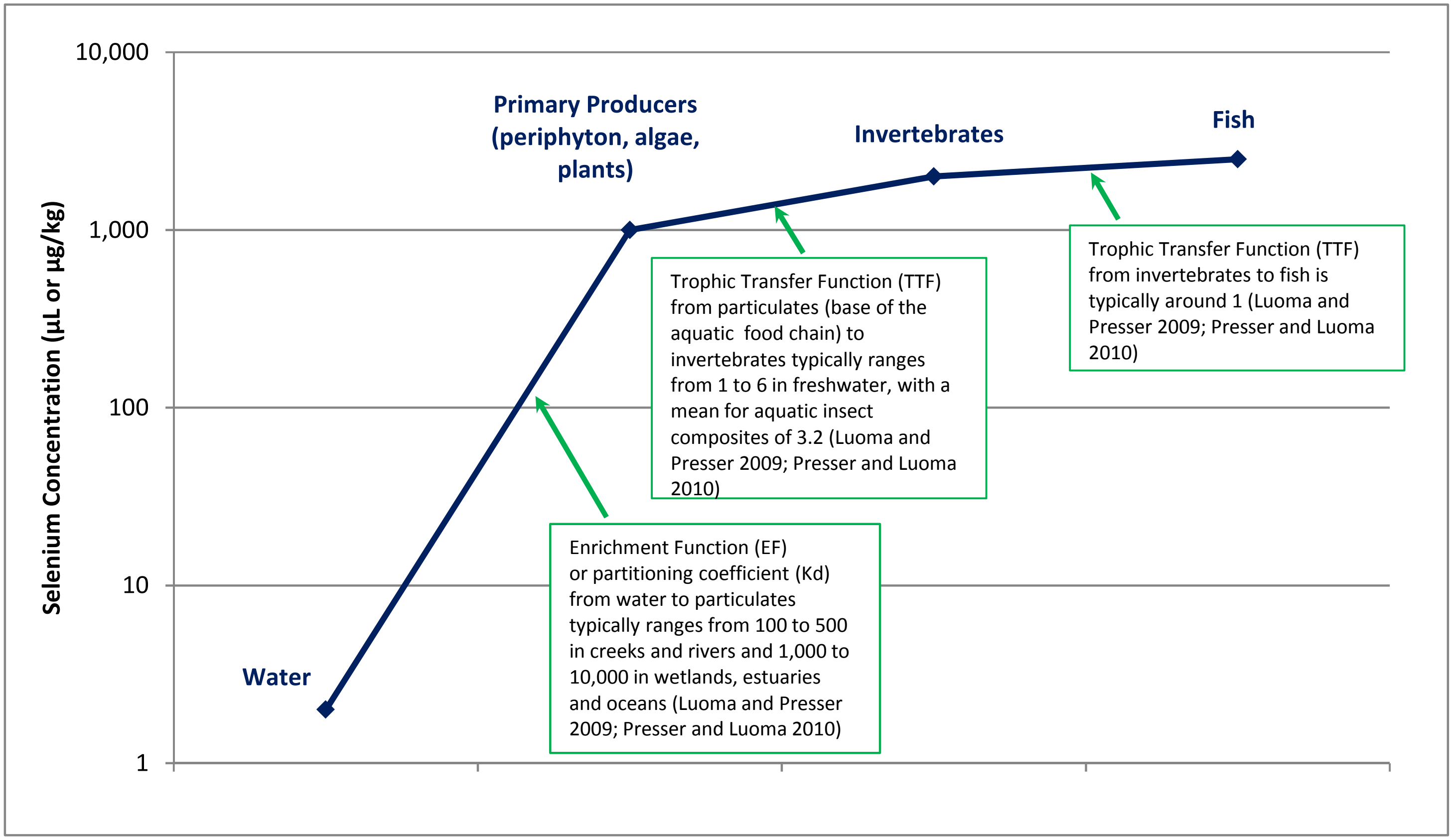


Figure 2: Schematic of selenium incorporation to the aquatic food chain and trophic transfer

SSWQO Derivation

Based on testing conducted in Finlayson Creek and laboratory test waters, Nautilus (2016) reported clear, linear, statistically significant relationships between selenium EFs and sulphate concentrations for *P. subcapitata* at 2 ppb selenium and 10 ppb selenium, and for *L. minor* at 10 ppb selenium (Figure 3). A relationship could not be developed for *L. minor* at 2 ppb selenium as this combination resulted in tissue selenium concentrations below the method detection limit (Nautilus 2016). The site-specific EFs at two different selenium concentrations ranged from 32 (site water amended with 2 µg/L selenium and 250 mg/L sulphate) to 182 (site water amended with 2 µg/L selenium and no additional sulphate). These values are lower than the median water-to-primary producer enrichment function for lotic environments calculated from USEPA (2015) data (360-fold), suggesting low site-specific enrichment. The three relationships appeared to be similar and statistical tests of their slopes using Analysis of Covariance (ANCOVA) indicated that slopes did not differ significantly (Appendix B). Therefore, the data were combined to produce one relationship. The two datasets for *P. subcapitata* were averaged by taking the geometric mean of the EF reported at 2 ppb and 10 ppb selenium, yielding a relationship defined by the equation: Selenium EF = 1,791 * Sulphate$^{-0.597}$ (Figure 4).

The relationship defining the reduction in EF with increasing sulphate concentration can be used to derive a SSWQO for selenium that is based on sulphate concentration. At sulphate concentration equivalent to background (approximately 60 mg/L), it is logical to assume that a generic guideline for selenium would apply at the site. Although some discussion of what this guideline should be is required, one option is the generic British Columbia guideline of 2.0 µg/L selenium (BCMOE 2014). An alternative is the USEPA (2015) chronic criterion for lotic systems (running waters) of 4.8 µg/L selenium. The latter is specific to lotic systems, which have inherently lower EFs and are therefore inherently less sensitive to selenium (than lentic systems [ponded waters]), but should not be applied to any areas of ponded habitat. By making the guideline applicable at 60 mg/L sulphate, it can be adjusted for additional sulphate which ameliorates selenium uptake according to the equation defined above (Table 1). Although it may be desirable to simplify the equations, the relationships result in the following SSWQO for selenium if the BCMOE guideline were to be adopted (Figure 5):

2.0 µg/L selenium at sulphate ≤ 60 mg/L, and
0.1736*(sulphate)$^{0.597}$ µg/L selenium at sulphate > 60 mg/L.

If the USEPA criterion is adopted, the equivalent equations (Figure 5) are:

4.8 µg/L selenium at sulphate ≤ 60 mg/L, and
0.4166*(sulphate)$^{0.597}$ µg/L selenium at sulphate > 60 mg/L

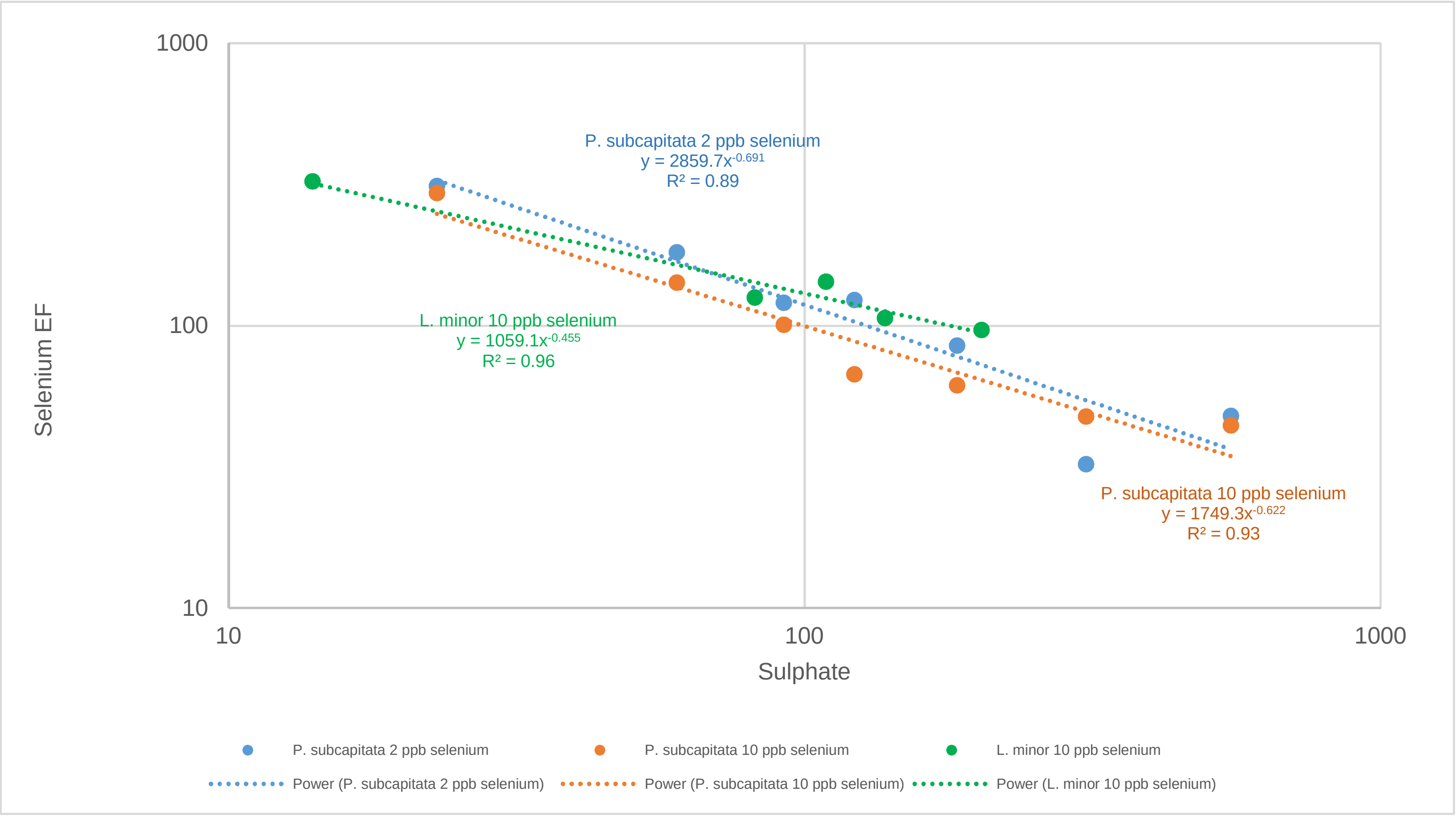


Figure 3: Relationships between selenium enrichment function (EF) and sulphate concentration (Nautilus 2016)

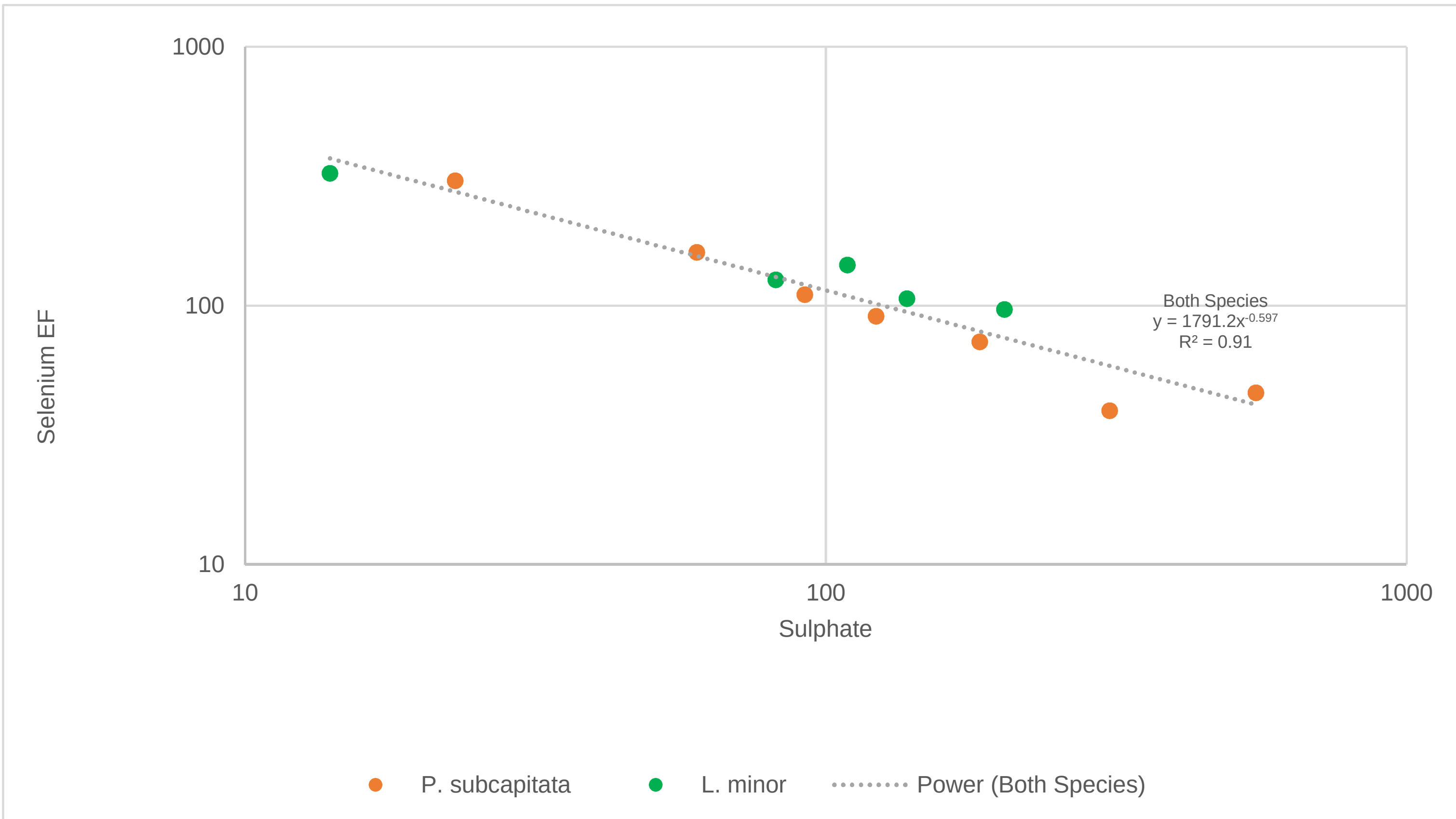


Figure 4: Combined primary producer selenium enrichment function (EF) and sulphate concentration (Nautilus 2016)

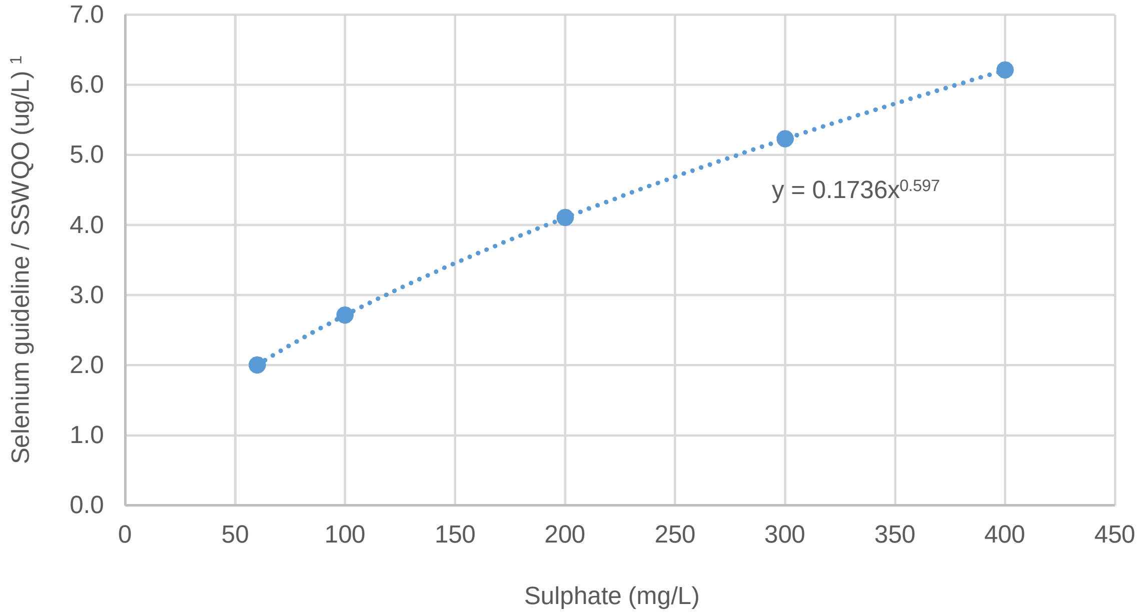
Table 1: Calculations of a preliminary SSWQO for selenium based on sulphate amelioration of selenium uptake

A) Adoption of the BCMOE (2014) generic guideline

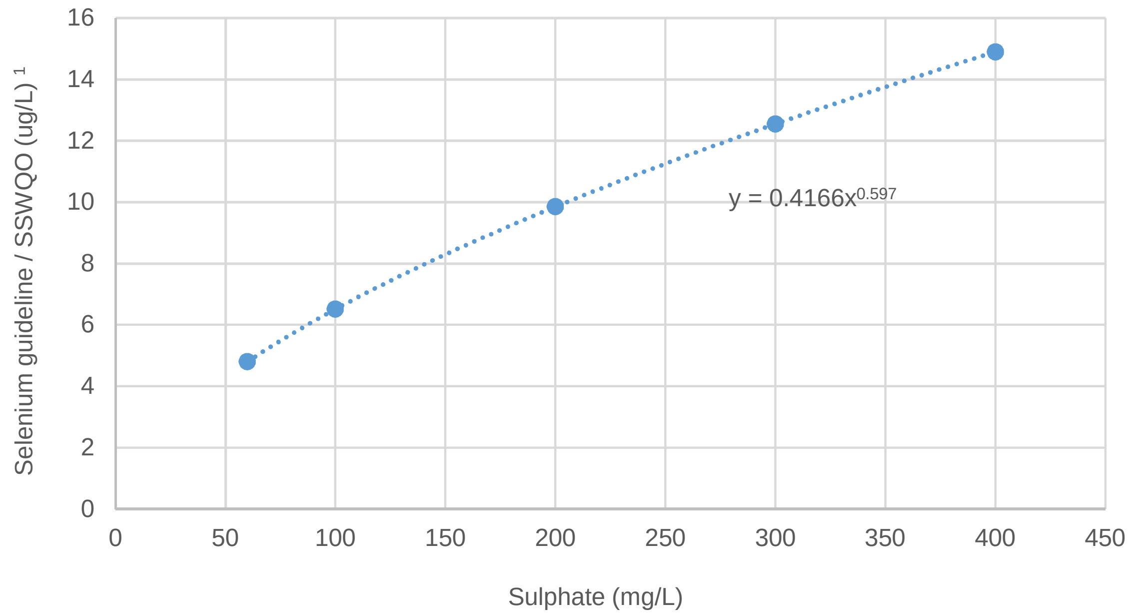
Sulphate	Enrichment Function (EF)	Selenium Guideline / SSWQO
mg/L	unitless	µg/L
60	155	2.0
100	115	2.7
200	76	4.1
300	59	5.2
400	50	6.2

B) Adoption of the USEPA (2015) criterion for lotic environments (running water)

Sulphate	Enrichment Function (EF)	Selenium Guideline / SSWQO
mg/L	unitless	µg/L
60	155	4.8
100	115	6.5
200	76	9.8
300	59	12.5
400	50	14.9



[1] selenium concentration under varying sulphate concentations that results in a selenium concentration in primary producers that is the same as at 2.0 ug/L selenium (the generic BCMOE guideline) and 25 mg/L sulphate



[1] selenium concentration under varying sulphate concentations that results in a selenium concentration in primary producers that is the same as at 4.8 ug/L selenium (the USEPA criterion for running waters) and 25 mg/L sulphate

Figure 5: Potential equations for a selenium SSWQO at the Kudz Ze Kayah Project. top) with application of the generic BCMOE guideline as the base case bottom) with application of the USEPA criterion for running water as the base case.

Summary

Testing of selenium uptake in two aquatic primary producers (the alga *P. subcapitata* and the plant *L. minor*) in water collected from Finlayson Creek and in laboratory water indicated low enrichment functions (EF) and indicated statistically significant, linear reduction in selenium uptake with increasing sulphate concentration. The significant reduction in EF caused by sulphate was used to calculate potential SSWQOs for selenium based on the generic BCMOE guideline and the USEPA criterion for running water. The former is considered to be more generically applicable to Geona and Finlayson creeks (i.e., including ponded habitat), and results in a potential SSWQO for 2.0 µg/L at 60 mg/L sulphate, 2.7 µg/L at 100 mg/L sulphate, 4.1 µg/L at 200 mg/L sulphate, etc., as defined by the equation: selenium SSWQO = $0.1736*(\text{sulphate})^{0.597}$ µg/L.

I trust that this brief letter report meets your requirements and expectations. If you have any questions or would like to discuss any aspect of this report, please do not hesitate to let me know.

Sincerely,

Signature REDACTED

Signature REDACTED

, EP, RPBio

Aquatic Scientist & Principal

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APPENDIX A

EVALUATION OF SELENIUM UPTAKE IN WATER FROM THE KUDZ ZE KAYAH MINE PROJECT BY PRIMARY PRODUCERS

NAUTILUS (2016)

Evaluation of selenium uptake in water from the Kudz Ze Kayah mine project by primary producers

Final Report

Report date:
January 14, 2016

Submitted to:

Minnow Environmental
Victoria, BC

#4, 6125 12 St SE
Calgary, AB
T2H 2K1

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Environmental Scientist

Signature REDACTED

Name REDACTED .
Senior Reviewer

This report has been prepared based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

1.0 INTRODUCTION

It is widely recognized that environmental risk associated with selenium is primarily linked to accumulation of organic selenium (as seleno-amino acids) through the food-chain (Young et al., 2010). Consequently, selenium water quality guideline development efforts have increasingly focused on tissue burdens of selenium, rather than measures in other environmental compartments such as water or sediment. For example, both the BC Ministry of Environment (BCMoE) and the U.S. Environmental Protection Agency (USEPA) have issued draft or finalized water quality benchmarks in which the importance of tissue burdens of selenium was emphasized.

Accumulation of selenium into the food-web is primarily modified at the primary producer level, where the bio-concentration of inorganic selenium from water into tissue commonly comprises two or three orders of magnitude, and varies considerably between sites. The bio-concentration factor (often referred to as an Enrichment Function [EF] or the K_d) is calculated by dividing the selenium concentration in biological tissues associated with the base of the food-web (e.g., primary producers such as plants, algae and periphyton) by the concentration in water. Once selenium is incorporated into the base of the food-chain, where it is transformed into seleno-amino acids, transfer between trophic levels in freshwater environments results in selenium concentrations that are generally similar between trophic levels. Consequently, variations in the uptake rate at the base of the food-chain (i.e., from water into primary producers) dominates the potential for differences in accumulation rates between sites (Presser and Luoma, 2010).

The Kudz Ze Kayah project is located in the Yukon, and is planned to be a base metal mine. Water quality predictions for the site have indicated that selenium may exceed the CCME and BC water quality guidelines of 1 and 2 µg/L, respectively, for the water column. Consequently, there is an interest in understanding whether increased selenium concentrations would be expected to result in accumulation of selenium in the food-web to concentrations that might pose an environmental risk. Sulphate is also expected to increase concurrently with selenium, and this constituent modifies uptake of selenium, when present as selenate (Williams et al, 1994; Lo et al., 2012), which is the expected form of selenium at the site. Consequently, this study was performed to evaluate uptake of selenium across a range of concentrations of sulphate.

The exposures described in this report provide an evaluation of the estimated site-specific uptake rate of selenium into an alga and a vascular plant under conditions that are anticipated to occur at the site. The accumulation rate of selenium was assessed in water collected from the site, and in this water after adding different concentrations of major ions associated with future predicted conditions (in particular, calcium, magnesium and sulphate).

The exposure duration used in these tests was relatively short (i.e., 7 days); however, as a result of encompassing exponential growth phase for the algae, the cell density increased by over 3000-fold during the exposure. Because of the nature of the exposure, it is not possible to measure the cells for reaching "steady-state", since they are continually dividing. Similarly, for duckweed, the fronds multiplied by more than a factor of five relative to the start of the tests. Thus, the vast majority of cells or fronds in the test containers at the end of the exposure were produced using the ionic nutrients (including selenium) that were present in the test solutions. Thus, it is reasonable to assume that the cells are in equilibrium with the surrounding media, including the selenium concentration. Regardless, this test method provides a measure of relative uptake of selenium under differing water quality conditions.

2.0 METHODS

The site water was collected from Finlayson Creek at a water quality monitoring station referred to as KZ-15 (Finlayson Creek downstream of Geona Creek). The sample was transported by courier and was received in good condition.

The methods used here are based on methodology developed by Lo et al. (2012) for evaluation of the effect of water quality characteristics on uptake of selenium. The selenium-spiked waters were evaluated for uptake using 7-day exposures using a green alga (*Pseudokirchneriella subcapitata*) and duckweed (*Lemna minor*). The test waters were supplemented with nutrients required for growth of these species, and the exposures conducted in a constant environment room with lighting and temperature regimes which are suitable for culturing these species (Environment Canada 2007a; 2007b). In the case of *P. subcapitata*, nutrients were added at four-fold over the usual culture water in order to achieve sufficient cell growth for subsequent analysis of selenium in the cells. The test exposures were not replicated.

Selenium uptake was evaluated under current conditions and under conditions of elevated ionic strength that are predicted to occur in the environment. Selenium was introduced using sodium selenate, since selenate is expected to be the predominant form of selenium in lotic systems such as this (BC MoE 2014).

Uptake of selenium into algal cells and duckweed was measured in three water types:

1) A sample from the site was tested to evaluate selenium uptake under current conditions. This sample was amended with 0, 1, 2 and 10 µg/L Se.

2) An amended site water was created by supplementing the water with calcium and magnesium sulphates at a ratio of 6:1 Ca:Mg (on a mass basis) to achieve 500 mg/L sulphate in the water (note that the actual sulphate in this water was higher than 500 mg/L as a result of sulphate in the unamended site water, as well as sulphate present in the nutrients that were added). This water was diluted with unamended site water using a 0.5-times dilution series to achieve nominal concentrations of 31.2, 62.5, 125, 250, and 500 mg/L of supplemented SO_4. These dilutions were then each spiked with 2 and 10 µg/L Se.

3) A laboratory-prepared water was evaluated after supplementing with a range of selenium concentrations in order to benchmark the results against prior uptake studies conducted in the laboratory. This laboratory water was amended with 0, 1, 2 and 10 µg/L Se.

At the end of the exposures, the tissues were rinsed with selenium-free water. For *P. subcapitata*, algal cells were rinsed in deionized water with 15 mg/L sodium bicarbonate to reduce osmotic stress on the cells. The rinsing and centrifugation process was repeated three times. Following the final rinse and decanting of overlaying water, the algal pellet was frozen at -20°C. For *L. minor*, macrophytes were rinsed in deionized water, dabbed dry using Kim-wipes and frozen at -20°C. The concentration of selenium in the tissues was measured by the Analytical Chemistry Group at the University of Missouri after freeze-drying the samples. Concentrations of sulphate and selenium in the exposure waters were measured at test initiation by CARO Analytical (Edmonton, AB) using ion chromatography.

3.0 RESULTS

Pseudokirchneriella subcapitata

Measured selenium and sulphate concentrations in the exposure waters, selenium concentrations in the algal cells and calculated EF values are summarized in Table 1. The average EF values measured in laboratory water and site water were 339 and 185, respectively. The average EF values measured in sulphate-amended site waters ranged from 39 to 110. Uptake in site water was approximately 45% lower relative to laboratory water, while uptake in sulphate-amended site waters ranged from 68 to 88% lower relative to laboratory water.

Results of uptake tests using *P. subcapitata* in lab water and samples collected from the site supplemented with major ions are shown in Figure 1. Selenium uptake into algal cells increased in a very consistent manner with increasing waterborne selenium. Linear regression analyses found that waterborne selenium had a significant effect on tissue selenium concentrations ($p < 0.05$). The relationship between tissue selenium and selenium in water was best explained by a power function, which is linear on a log x-axis, log y-axis scale.

Amending the site water with sulphate resulted in a decrease in uptake of selenium relative to un-amended site water (Figure 1), demonstrating that the higher ionic strength reduced the selenium bioaccumulation. The EF values decreased with increasing sulphate concentration, as shown in Figure 2. With one exception, the EF values also decreased with increasing selenium at each sulphate concentration.

Lemna minor

Measured selenium and sulphate concentrations in the exposure waters, selenium concentrations in *L. minor* tissue, and EF values are summarized in Table 2. The quantity of tissue that was produced in the test (approximately 0.1 to 0.2 g) was not sufficient to result in detectable concentrations of selenium in a number of the samples, indicating that the concentrations of selenium were close to the detection limit in the tissues as a result of the small sample volumes. Regardless, the data for exposure to 10 µg/L Se produced detectable selenium in four of the five site water exposures, as well as in the laboratory water; the EF values for these exposures decreased with increasing sulphate, as shown in Figure 3.

Table 1. Measured tissue concentrations of selenium in *Pseudokirchneriella subcapitata*, exposed to different levels of selenium and sulphate.

Water type	Water Se (µg/L)		Sulphate	Tissue Se	Enrichment function
	Added	Measured	(mg/L)	(mg/kg dw)	
Lab	0	<0.5	23	ND	NC
	1	1.1	23	0.464	421.6
	2	2.1	23	0.656	312.4
	10	10.2	23	3.010	295.1
Site	0	0.6	60	0.143	237.6
	1	1.8	60	0.346	192.4
	2	2.6	60	0.472	181.6
	10	10.4	60	1.476	141.9
Site amended with	2	2.7	92	0.326	120.6
31.2 mg/L SO_4	10	10.2	92	1.026	100.6
Site amended with	2	2.7	122	0.333	123.2
62.5 mg/L SO_4	10	12.3	122	0.826	67.2
Site amended with	2	2.7	184	0.230	85.1
125 mg/L SO_4	10	10.5	184	0.646	61.5
Site amended with	2	2.6	308	0.084	32.3
250 mg/L SO_4	10	10.5	308	0.501	47.7
Site amended with	2	2.8	550	0.134	47.9
500 mg/L SO_4	10	10.6	550	0.470	44.3

ND = Not Detected, NC = Not Calculable

Figure 1. Uptake of selenium into *Pseudokirchneriella subcapitata* in amended site water compared with laboratory water.

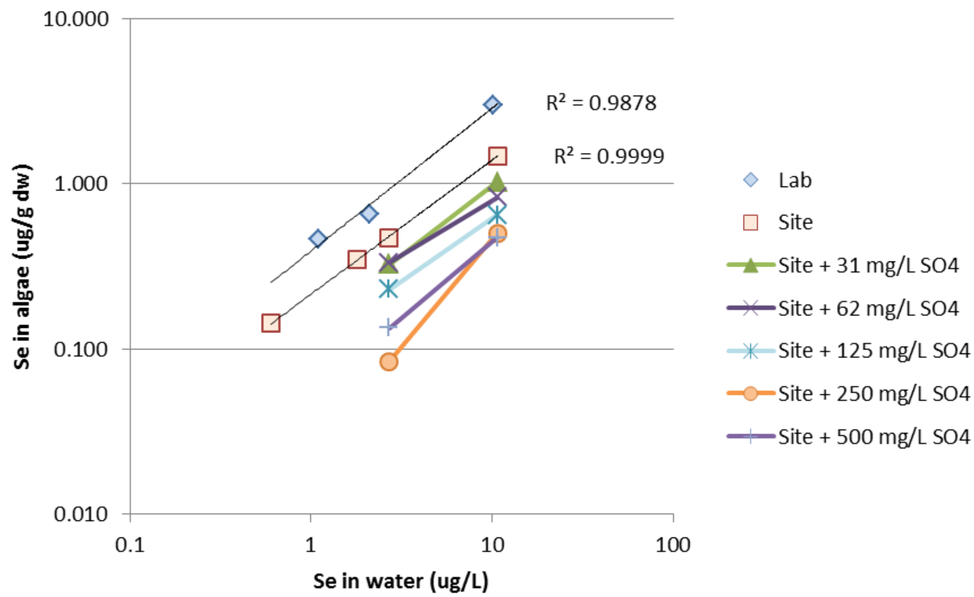


Figure 2. *Pseudokirchneriella subcapitata* enrichment function compared to sulphate concentration in site water amended with magnesium and calcium sulphate. The equation presented is based on the geometric mean data for each sulphate concentration.

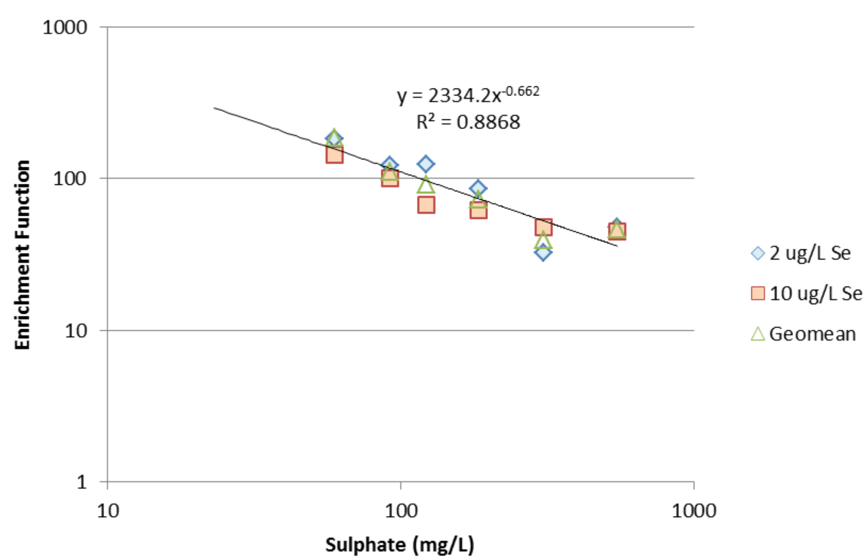
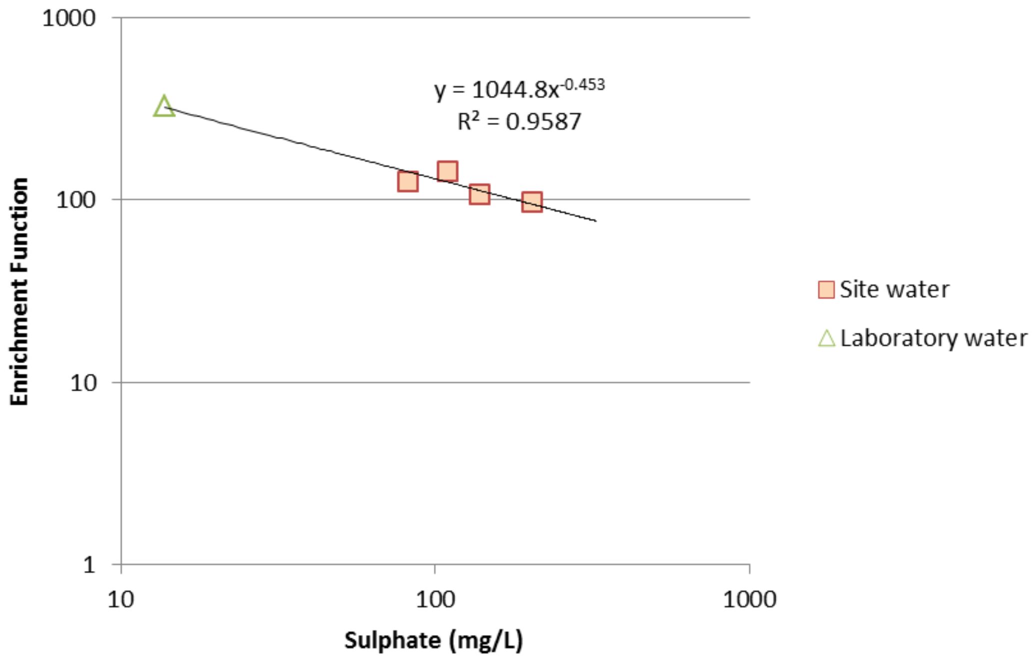


Table 2. Measured tissue concentrations of selenium in *Lemna minor* exposed to different levels of selenium and sulphate.

Water type	Water Se (µg/L) Added	Water Se (µg/L) Measured	Sulphate (mg/L)	Tissue Se (mg/kg dw)	Enrichment function
Lab	0	<0.5	14	0.645	NC
	1	1.1	14	0.472	429.4
	2	2	14	ND	NC
	10	6.8	14	2.207	324.5
Site	0	0.7	82	ND	NC
	1	1.7	82	0.387	227.8
	2	2.6	82	0.188	72.3
	10	10.9	82	1.369	125.6
Site amended with	2	2.6	109	0.404	155.3
31.2 mg/L SO_4	10	10.4	109	1.491	143.3
Site amended with	2	2.6	138	ND	NC
62.5 mg/L SO_4	10	9.6	138	1.022	106.5
Site amended with	2	2.6	203	ND	NC
125 mg/L SO_4	10	9.6	203	0.927	96.6
Site amended with	2	2.7	324	0.357	132.1
250 mg/L SO_4	10	10.1	324	ND	NC

ND = Not Detected, NC = Not Calculable

Figure 3. *Lemna minor* enrichment function compared to sulphate concentration in laboratory water and site water amended with magnesium and calcium sulphate. The equation presented is based on data for 10 µg/L Se exposure at each sulphate concentration, including both laboratory and site waters.



4.0 DISCUSSION

The results for amended site water shown in Figure 2 for *P. subcapitata* and Figure 3 for *L. minor* indicated that higher ionic strength associated with predicted future conditions would be expected to reduce the bioaccumulation rate of selenium relative to current conditions, likely as a result of interaction between sulphate and selenate, since sulphate has been shown to reduce uptake of selenate into primary producers (Lo et al. 2012; Williams et al. 1994). The slopes of these relationships were -0.662 and -0.453, respectively. The data for *L. minor* were confounded by proximity to the detection limit, and may be less accurate than the results presented for *P. subcapitata*.

It should be noted that the actual site-related EF values may differ from the EF values reported here as a result of differing assemblages of species, seasonal fluctuations etc., and there are limitations to the accuracy of the predictions made here for this factor. However, the tissue selenium concentrations would be expected to change in a manner that is similar to that described here, assuming that sulphate exhibits a consistent relationship among species, which appears to be the case (Lo et al. 2015). Presence of selenite or significant depositional areas, where anoxic sediment may occur, in the system would cause a deviation from that described here, since sulphate does not compete with selenite for uptake sites. However, since the receiving environment is a fast-flowing system, these conditions would not be expected.

5.0 REFERENCES

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APPENDIX A – Chemistry

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University of Missouri-Columbia

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Selenium Analysis
by Instrumental Neutron Activation Analysis

TO: Name REDACTED / Name REDACTED
HydroQual Laboratories / Nautilus Environmental
4 – 6125 12 Street SE
Calgary, AB T2H2K1 Canada

RE: Measurement of Selenium in Algae and Lemna
Project #PJ15-005
MURR Project No. 2205 Set 27

DATE: November 10, 2015

We have completed the analyses of the samples received under the above referenced project. Sixty (60) algae and lemna samples were received frozen and deemed viable for accurate determinations of total selenium concentration.

An aliquot of the freeze dried, homogenized samples were taken and analyzed for selenium. The whole sample wet and dry matter content was determined for each sample.

ANALYSIS NOTES:

1. The samples were held in a freezer upon receipt until analysis.

2. Samples were allowed to thaw at room temperature and then weighed as received to obtain a wet mass, re-frozen, and then freeze-dried.

3. Following freeze-drying, dry masses were obtained for all samples. A wet-to-dry ratio was obtained for each sample.

4. A homogenized aliquot of each sample was weighed into a pre-cleaned high-density polyethylene vial and irradiated in a thermal-neutron flux to induce Se-77m, a radioactive excited state of Se-77. This excited state decays by isomeric transition;

emitting a gamma-ray having an energy of 162 keV, which is quantitatively measured by high-resolution gamma-ray spectroscopy.

5. Sample aliquot wet masses were calculated by multiplying the sample aliquot dry mass by the wet-to-dry ratio. “Wet mass Se PPMs” were derived from this calculated aliquot wet mass.

6. Selenium concentrations were determined by standard comparison using certified single-element selenium standards traceable to the U.S. National Institutes of Standards and Technology (NIST).

7. Replicate samples of NIST Standard Reference Material 1577 Bovine Liver, having a certified selenium concentration of 1.1 +/- 0.1 PPM were analyzed with the samples. The average Se concentration of these three QC samples was determined to be 1.169 $\pm$ 0.147 PPM.

8. The abbreviation “ND” in the concentration columns indicates that the presence of a measurable Se peak was Not Detected during analysis.

9. Table Descriptions:
   a. Table 1
      i. Columns 1 & 2 list the MURR IDs and client IDs, respectively.
      ii. Column 3 lists the matrix as described by the client.
      iii. Column 4 lists the calculated wet mass in grams of the sample aliquot.
      iv. Column 5 lists the dry mass in grams of the lyophilized sample aliquot.
      v. Column 6 lists the wet-to-dry ratio as determined from sample aliquot wet and dry mass measurements.
      vi. Column 7 lists the % dry matter, which is the inverse of the wet-to-dry ratio expressed as a percent.
      vii. Column 8a lists the selenium concentration in parts per million (PPM) on a dry mass basis. *[Note: PPM is equivalent to micrograms Se per gram of sample (μg/g)]*.
      viii. Column 8b lists the selenium concentration in parts per million (PPM) on a wet mass basis. These data should be used with caution because the as-received samples had variation in their moisture content.

   b. Table 2
   This table reports the mean and standard deviation for the selenium concentrations measured in the replicate quality control samples (NIST SRM 1577 Bovine Liver). The measured value of 1.169 +/- 0.147 PPM Se is in good agreement with the certified value of 1.1 +/- 0.1 PPM Se.

2205 Set 27 Se Report

Manifest # PJ15-005

10-Nov-15

Table 1. Selenium concentration (PPM) and Dry Matter Content in Biological Samples.

1	2	3	4	5	6	7	8a	8b
MURR ID	**Client ID**	**Matrix**	**Wet Mass (g)**	**Aliquot Dry Mass (g)**	**Wet-to-Dry Ratio**	**% Dry Matter**	**Se PPM Dry Mass**	**Se PPM Wet Mass**
2205-27-1	15-1220 AG CTL 0	ALGAE	1.11301	0.06146	18.11	5.5	ND	ND
2205-27-2	15-1220 AG CTL 1	ALGAE	0.95264	0.04109	23.18	4.3	0.464	0.020
2205-27-3	15-1220 AG CTL 2	ALGAE	0.71832	0.03309	21.71	4.6	0.656	0.030
2205-27-4	15-1220 AG CTL 10	ALGAE	1.08553	0.06322	17.17	5.8	3.010	0.175
2205-27-5	15-1220 AG 0-0	ALGAE	0.95943	0.05934	16.17	6.2	0.143	0.009
2205-27-6	15-1220 AG 0-1	ALGAE	0.78450	0.04312	18.19	5.5	0.346	0.019
2205-27-7	15-1220 AG 0-2	ALGAE	0.67404	0.03784	17.81	5.6	0.472	0.027
2205-27-8	15-1220 AG 0-10	ALGAE	1.00164	0.05954	16.82	5.9	1.476	0.088
2205-27-9	15-1220 AG 31-2	ALGAE	1.09158	0.06448	16.93	5.9	0.326	0.019
2205-27-10	15-1220 AG 31-10	ALGAE	0.89530	0.05280	16.96	5.9	1.026	0.061
2205-27-11	15-1220 AG 62-2	ALGAE	0.91438	0.06675	13.70	7.3	0.333	0.024
2205-27-12	15-1220 AG 62-10	ALGAE	0.85870	0.06340	13.54	7.4	0.826	0.061
2205-27-13	15-1220 AG 125-2	ALGAE	1.14519	0.07077	16.18	6.2	0.230	0.014
2205-27-14	15-1220 AG 125-10	ALGAE	0.94029	0.07316	12.85	7.8	0.646	0.050
2205-27-15	15-1220 AG 250-2	ALGAE	0.96589	0.09075	10.64	9.4	0.084	0.008
2205-27-16	15-1220 AG 250-10	ALGAE	1.04469	0.06894	15.15	6.6	0.501	0.033
2205-27-17	15-1220 AG 500-2	ALGAE	0.93888	0.09537	9.84	10.2	0.134	0.014
2205-27-18	15-1220 AG 500-10	ALGAE	0.59991	0.06407	9.36	10.7	0.470	0.050
2205-27-19	15-1220 LM CTL 0	LEMNA	0.10108	0.00768	13.16	7.6	0.645	0.049
2205-27-20	15-1220 LM CTL 1	LEMNA	0.21777	0.01409	15.46	6.5	0.472	0.031
2205-27-21	15-1220 LM CTL 2	LEMNA	0.22119	0.01509	14.66	6.8	ND	ND
2205-27-22	15-1220 LM CTL 10	LEMNA	0.16374	0.01245	13.15	7.6	2.207	0.168
2205-27-23	15-1220 LM 0-0	LEMNA	0.16357	0.01243	13.16	7.6	ND	ND
2205-27-24	15-1220 LM 0-1	LEMNA	0.13014	0.01129	11.53	8.7	0.387	0.034
2205-27-25	15-1220 LM 0-2	LEMNA	0.14303	0.01256	11.39	8.8	0.188	0.017
2205-27-26	15-1220 LM 0-10	LEMNA	0.14178	0.01365	10.39	9.6	1.369	0.132
2205-27-27	15-1220 LM 31-2	LEMNA	0.10968	0.01000	10.97	9.1	0.404	0.037
2205-27-28	15-1220 LM 31-10	LEMNA	0.17682	0.01438	12.30	8.1	1.491	0.121
2205-27-29	15-1220 LM 62-2	LEMNA	0.13596	0.01242	10.95	9.1	ND	ND
2205-27-30	15-1220 LM 62-10	LEMNA	0.12761	0.01319	9.67	10.3	1.022	0.106
2205-27-31	15-1220 LM 125-2	LEMNA	0.13210	0.01357	9.73	10.3	ND	ND
2205-27-32	15-1220 LM 125-10	LEMNA	0.06147	0.00676	9.09	11.0	0.927	0.102
2205-27-33	15-1220 LM 250-2	LEMNA	0.08846	0.01074	8.24	12.1	0.357	0.043
2205-27-34	15-1220 LM 250-10	LEMNA	0.10834	0.01145	9.46	10.6	ND	ND
2205-27-35	15-1220 LM 500-2	LEMNA	0.11712	0.01331	8.80	11.4	ND	ND
2205-27-36	15-1220 LM 500-10	LEMNA	0.10406	0.01214	8.57	11.7	ND	ND

Table 2. Selenium concentration measured in quality control samples (NIST SRM 1577 Bovine Liver)

QC ID	n	mean Se conc. (PPM)	s.d.	NIST cert. Se conc. PPM (s.d.)
NIST SRM 1577	3	1.69	0.147	1.1 +/- (0.1)

APPENDIX B

STATISTICAL COMPARISON OF THE SLOPES OF SELENIUM ENRICHMENT FUNCTIONS BY ANALYSIS OF COVARIANCE

Appendix Table B.1: Statistical comparison of the slopes of the selenium Enrichment Function versus sulphate concentration relationship for: 1) *Pseudokirchneriella subcapitata* at 2 µg/L selenium; 2) *Pseudokirchneriella subcapitata* at 10 µ/L selenium; and 3) *Lemna minor* at 10 µg/L selenium

A) Descriptive Statistics

Group	Sample size	Mean	Standard Deviation
P. subcapitata at 2 µg/L selenium	7	129.0	95.2
P. subcapitata at 10 µg/L selenium	7	108.3	89.2
L. minor at 10 µg/L selenium	5	159.3	94.1
ALL	19	129.4	89.8

B) Levene's Test of Equality of Error Variances[1]

Dependent Variable = Selenium EF

F statistic	Degrees of Freedom 1	Degrees of Freedom 2	Signficance	Result
0.1790	2	16	0.8378	non-signicant

[1] Tests the null hypothesis that the error variance of the dependent variable is equal across groups (Intercept+Group+Sulphate+Group * Sulphate)

C) Analysis of Covariance (ANCOVA)

Dependent Variable = Selenium EF

Source	Type III Sum of Squares	Degress of Freedom	Mean Square	F statistic	Significance	Result	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Corrected Model	80853.96339	5	16170.7927	3.2735	0.0394		0.5573	16.3674	0.7220
Intercept	291263.2781	1	291263.2781	58.9610	0.0000		0.8193	58.9610	1.0000
Group	12103.70806	2	6051.8540	1.2251	0.3255		0.1586	2.4502	0.2209
Sulphate	54406.24768	1	54406.2477	11.0136	0.0055		0.4586	11.0136	0.8656
Group * Sulphate	12429.6285	2	6214.8143	1.2581	0.3166	non-significant	0.1622	2.5162	0.2259
Error	64219.12082	13	4939.9324						
Total	463034.79	19							
Corrected Total	145073.0842	18							
a	Computed using alpha = .05								
b	R Squared = .557 (Adjusted R Squared = .387)								

D) Estimated Marginal Means[2]

Dependent Variable: Selenium EF

Group	Mean	Standard Error	95% Confidence Intervals	
			Lower	Upper
P. subcapitata at 2 µg/L selenium	137.2	26.8	79.3	195.0
P. subcapitata at 10 µg/L selenium	114.9	26.8	57.1	172.8
L. minor at 10 µg/L selenium	90.2	43.8	-4.4	184.8

[2] Covariates appearing in the model are evaluated at the following values: Sulphate = 169.68.

APPENDIX B.

<u>Biotic Ligand Modelling of Copper, Lead and Zinc to Evaluate the Potential for Derivation of Site-Specific Water Objectives at the BMC Minerals Kudz Ze Kayah Project (Minnow Environmental Inc.)</u>

January 19, 2016

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Dear name REDACTED

Re: Biotic Ligand Modelling of Copper, Lead and Zinc to Evaluate the Potential for Derivation of Site-Specific Water Objectives at the BMC Minerals Kudz Ze Kayah Project

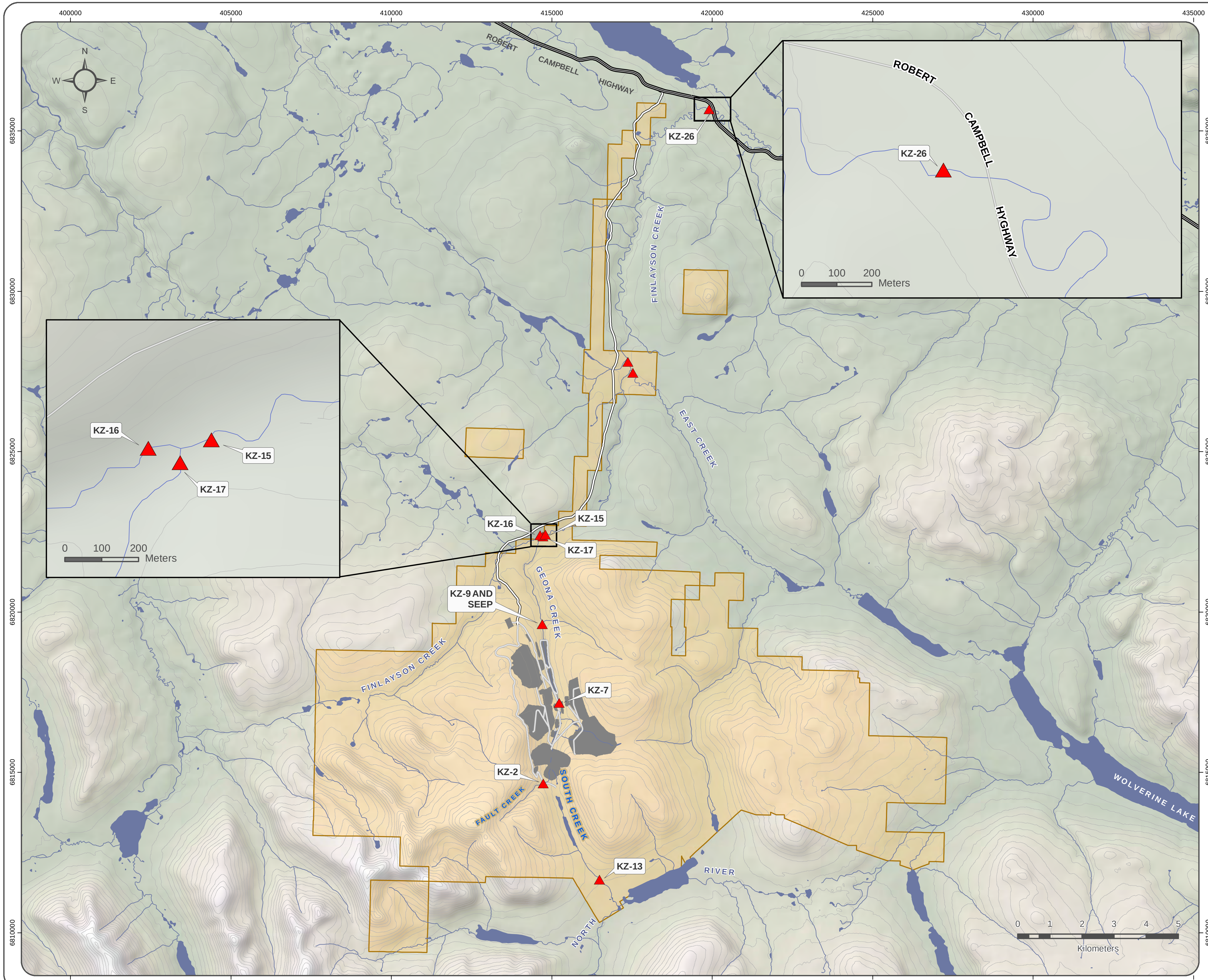
Minnow Environmental Inc. (Minnow) is pleased to provide a brief summary of the application of Biotic Ligand Models (BLMs) to evaluate the potential use of the Water-Effect Ratio Procedure (WERP) to derive Site-Specific Water Quality Objectives (SSWQO) for copper, lead and zinc at the BMC Minerals Kudz Ze Kayah Project.

Project Background

The BMC Minerals Kudz Ze Kayah Project is located in Yukon Territory, approximately 110 kilometers southeast of the community of Ross River. The project lies primarily within the Geona Creek watershed (Figure 1). Geona Creek flows to Finlayson Creek, which in turn is a tributary to the Finlayson River, and ultimately the Frances, Liard and MacKenzie rivers. An initial environmental evaluation of the project by a previous owner indicated that water quality of Geona and Finlayson creeks would potentially be impacted by mine water discharge, particularly based on concentrations of copper, selenium, zinc, ammonia and nitrite (Cominco 1996). It is expected that this mine water will be treated prior to discharge during the operational period. The evaluation reported herein can contribute to the design criteria for water treatment.

Technical Background

Briefly, the WERP is one of several procedures that can be used to develop SSWQOs according to protocols established by the Canadian Council of Ministers of the Environment (CCME 2003). The WERP can be a suitable means of SSWQO derivation in situations where site water



BMC MINERALS

KUDZ ZE KAYAH PROJECT

FIGURE 1
WATER QUALITY MONITORING STATIONS

DECEMBER 2016

- Surface Water Quality Stations
- Robert Campbell Highway
- Tote Road/Proposed Access
- Proposed Mine Road
- Contour (40m interval)
- Watercourse
- Waterbody
- Location of Mine Infrastructure
- BMC Minerals (No.1) Ltd. Claims

ALEXCO ENVIRONMENTAL GROUP

minnow environmental inc.

Digital elevation model created by the Yukon Department of the Environment interpolated from the digital 1:50,000 Canadian National Topographic Database (NTDB Edition 2) contour and watercourse layers. Obtained from Geomatics Yukon.

Datum: NAD 83; Projection UTM Zone 9N

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(*Last edited by: mducharme; 12/12/2016/11:58 AM*)

characteristics enhance or ameliorate toxicity such that toxicity testing demonstrates a different response in the test organisms exposed to site water relative to test water used to formulate the generic guideline. The WER is calculated as the ratio of the effect concentration of a given analyte in site water relative to the effect concentration in reconstituted laboratory water. The WER can then be applied to the generic water quality guideline (by multiplying the guideline by the WER) to develop a SSWQO (CCME 2003).

In order to implement the WERP, site water sampled at various times throughout the year (to capture the range of observed water chemistry) must be tested for toxicity using multiple test organisms, along with laboratory water that is matched for hardness and alkalinity with the site water. This testing may include water from more than one site, and can be an expensive undertaking especially when multiple contaminants are being assessed. In order to avoid wasting resources on cases where a meaningful WER is not likely, Biotic Ligand Modelling (BLM) can be used to examine whether application of the WERP is warranted (i.e., to determine whether a meaningful WER would be expected). Biotic Ligand Models account for key water quality characteristics that influence the bioavailability and toxicity of metals (e.g., DiToro et al. 2001; Niyogi and Wood 2004; De Schamphelaere and Janssen 2004; USEPA 2007; Peters et al. 2011; Erickson 2013). The models treat organisms as "biotic ligands" that are in competition for metal binding (and uptake) with other ligands (such as dissolved organic matter), and also account for competition between metals and major ions for both abiotic and biotic ligands. BLMs can predict the fraction of free bioavailable metal in a given water as well as no-effect and/or effect concentrations. These predicted no-effect or effect concentrations can then be used to calculate estimated WERs by dividing the site water no-effect or effect concentration by the equivalent laboratory water result.

Approach

Based on an assessment of baseline water quality data from the Kudz Ze Kayah Project (e.g. Cominco 1996), it is anticipated that SSWQOs may need to be developed for several metals and metalloids including copper, lead and zinc. Three water quality monitoring stations in the Kudz Ze Kayah Project receiving environment were identified for evaluation of the potential utility of the WERP: KZ-17 (the mouth of Geona Creek), KZ-15 (Finlayson Creek downstream of Geona Creek), and KZ-26 (Finlayson Creek near the mouth), with station KZ-26 being furthest downstream of the Kudz Ze Kayah Project site (Figure 1). The objective of this report is to use BLMs to predict WERs for each metal, and based on the predicted WERs, to evaluate whether proceeding with the WERP to derive SSWQOs is advisable.

Methods

Three BLMs were applied in this assessment: 1) the Windward BLM (USEPA 2007; Windward 2015); 2) the Bio-Met bioavailability tool (ECHA 2008; Bio-Met 2013); and 3) the PNEC.pro BLM (Verschoor et al. 2012; Deltares 2013). Each model requires different inputs with varying validated input ranges as outlined in Table 1, and provide differing outputs as discussed below.

The Windward BLM has been adopted by the USEPA (2007) and provides Ambient Water Quality Criteria, both acute and chronic, that define copper concentrations below which adverse effects would not be expected under the specific water quality that co-occurs with the copper. The model produces a Final Acute Value (FAV) - a concentration of copper that is an estimate of the 5th percentile of a Species Sensitivity Distribution (SSD) represented by average LC50s and EC50s (lethal concentration and effect concentration to 50% of the population, respectively) of the tested genera. The FAV is then used to calculate a Criterion Maximum Concentration (CMC; acute water quality criterion) by dividing the FAV by 2 and a Criterion Continuous Concentration (CCC; chronic water quality criterion) by dividing the FAV by an Acute-Chronic Ratio (ACR). For lead, the Windward BLM software tool uses an acute toxicity endpoint (LA50) to predict effect concentrations for the test organisms rainbow trout, fathead minnow, *Daphnia magna*, and *Ceriodaphnia dubia*. The LA50 represents the lethal accumulation of a metal on a biologically sensitive receptor (biotic ligand) that results in 50% mortality during an acute exposure, and the associated total dissolved concentration of the metal that will result in 50% mortality of the exposed population (LC50) is calculated. For zinc, the Windward BLM output includes both acute and chronic HC5 values. The HC5 is a 5th percentile Hazard Concentration which is calculated from a Species Sensitivity Distribution (SSD) constructed from BLM-normalized data. The Windward BLM incorporates earlier equilibrium models, CHESS (chemical equilibrium of soils and solutions) and WHAM (Windermere Humic Aqueous Model) which include modelling of chemical and electrostatic interactions of organic molecules.

PNEC.pro is a simplified chronic BLM with dissolved organic carbon (DOC) being the only required input, and pH, calcium, magnesium and sodium designated as optional input parameters which help increase the accuracy of the prediction (Verschoor et al. 2012). The PNEC.pro software uses linear equations to simplify biotic ligand modelling for the user, and calculates Predicted No Effect Concentrations (PNECs; 5^{th} percentile Hazard Concentrations) for both copper and zinc by assuming that binding to the biotic ligand has a proportional relationship with metal toxicological effects (Verschoor et al. 2012). These linear equations are based on a large toxicological dataset and a wide variety of water chemistry conditions, and are validated against full biotic ligand models.

Similar to the PNEC.pro BLM, the Bio-Met bioavailability tool is a chronic BLM that is a simplification of a “full” chronic BLM developed by the European Chemicals Agency (ECHA 2008).

Table 1: Biotic Ligand Model input data requirements, and validated upper and lower bounds for specified analytes.

Biotic Ligand Model		Analyte	Requirement	Unit	Lower Bound	Upper Bound
Windward		Dissolved Organic Carbon	Required	mg/L	0.05	29.7
		Humic Acid	Required	%	10	60
		pH	Required	pH	4.9	9.2
		Calcium	Required	mg/L	0.204	120
		Magnesium	Required	mg/L	0.024	51.9
		Sodium	Required	mg/L	0.16	237
		Potassium	Required	mg/L	0.039	156
		Sulphate	Required	mg/L	0.096	278
		Chloride	Required	mg/L	0.32	280
		Alkalinity	Required	as $CaCO_3$ mg/L	1.99	360
		Sulphide	Required	mg/L	0.001	0.006
		Temperature	Required	^{o}C	10	25
PNEC-pro		Dissolved Organic Carbon	Required	mg/L	n/a	n/a
		pH	Optional	pH	5.5	8.8
		Calcium	Optional	mg/L	n/a	n/a
		Magnesium	Optional	mg/L	n/a	n/a
		Sodium	Optional	mg/L	n/a	n/a
Bio-Met	Copper	Dissolved Organic Carbon	Required	mg/L	n/a	n/a
		pH	Required	pH	6.0	8.5
		Calcium	Required	mg/L	3.1	93
	Nickel	Dissolved Organic Carbon	Required	mg/L	n/a	n/a
		pH	Required	pH	6.5	8.7
		Calcium	Required	mg/L	2.0	88
	Zinc	Dissolved Organic Carbon	Required	mg/L	n/a	n/a
		pH	Required	pH	6.0	8.0
		Calcium	Required	mg/L	5.0	160

n/a - not applicable

The Bio-Met tool uses pH, DOC and calcium to calculate "local Environmental Quality Standards" (EQS) for copper and zinc under co-occurring pH and concentrations of DOC and calcium. The EQS is a 5th percentile Hazard Concentration (HC5; similar to a PNEC determined using the PNEC.pro BLM), and is calculated from a SSD according to European Union Water Framework Directive (WFD) methodology (European Communities 2011). The model is based on a database of more than 20,000 simulations of chronic toxicity relationships developed under a variety of water quality conditions, to which the input data are compared, and the EQS is then derived.

The three BLMs (Windward, PNEC.pro and Bio-Met) were used to predict chronic no-effect concentrations for copper and zinc for each sampling event at each of the three water quality monitoring stations (KZ-15, KZ-17, and KZ-26). The Windward BLM is the only model which can be applied to lead, and therefore was used to predict acute effect concentrations for lead (the only prediction currently available in the model) for each sampling event at each site. DOC is required input data for all three BLMs (Table 1). Therefore, only data containing DOC measurements could be used in the BLMs, limiting the useable data to sampling events between April and December 2015 (Table 2). Caution should therefore be applied in deriving conclusions from the limited data. Water quality data were unavailable for humic acid and sulphide, both of which are input parameters for the Windward BLM. A humic acid content of 10% was therefore assumed and the lower bound of the prescribed range for sulphide in the Windward BLM was applied (Table 2; as recommended by Windward [2015]). In addition, all recorded temperature data were equal to or below the lower bound for temperature for which the Windward BLM is validated (10^{o}C; Table 1), therefore all temperatures were adjusted to this lower data limit for the analysis (Table 2).

WERs were calculated for each data point by comparing the site-specific BLM result to the result for USEPA standard reconstituted water (USEPA 2007; Table 2). The USEPA standard reconstituted water is presented for different levels of hardness (USEPA 2007), therefore site water from each sampling event was paired with USEPA standard water of appropriate hardness (Table 3). These pairings were used for WER calculation, with site water BLM predicted no-effect (or effect) concentrations divided by the equivalent USEPA standard reconstituted water no-effect (or effect) concentrations for the appropriate hardness water. A WER of greater than 2 was considered necessary for the WERP to be considered a potentially useful technique for deriving SSWQO.

Results

Copper

The utility of the WERP for copper was evaluated using all three BLMs. However, results of the PNEC.pro BLM were often outside of the validated range of the model (Table 4) and were not used further. WERs calculated from the Bio-Met and the Windward BLM results indicated that

Table 2: Input data for Windward, PNEC.pro, and Bio-Met Biotic Ligand Models for Kudz Ze Kayah site water monitoring stations KZ-15, KZ-17 and KZ-26 [1], and for USEPA laboratory reconstituted water (USEPA 2007).

				PNEC-pro and Windward Inputs					Additional Windward Inputs						
				Bio-Met Inputs											
Station / Sample Name	Station/Sample Description	Sampling Date	Hardness	Dissolved Organic Carbon (DOC)	pH (lab) [2]	Calcium (dissolved)	Magnesium (dissolved)	Sodium (dissolved)	Potassium (dissolved)	Sulphate (dissolved)	Chloride	Alkalinity (total) [2]	Sulphide [3]	Temperature (field) [4]	Humic Acid Content [5]
			mg/L as CaCO3	mg/L	pH units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	%
USEPA	Moderately hard	n/a	80-100	0.50	7.6	14.0	12.0	26.3	2.09	81.5	1.91	65	0.001	10	10
	Hard	n/a	160-180	0.50	7.8	27.9	24.0	52.6	4.19	163	3.81	115	0.001	10	10
	Very hard	n/a	280-320	0.50	8.2	55.8	48.0	105	8.39	326	7.62	235	0.001	10	10
KZ-15	Finlayson Creek downstream of Geona Creek	29-Apr-15	270	0.9	8.4	78.7	17.9	1.58	1.74	35.0	<0.50	224	0.001	10	10
		11-May-15	73	14.9	7.7	22.2	4.3	0.48	2.07	<0.50	0.98	59	0.001	10	10
		22-Jun-15	141	2.3	8.2	46.6	6.1	0.84	1.15	19.5	<0.50	102	0.001	10	10
		28-Jul-15	156	0.9	8.1	48.3	8.7	1.06	1.31	23.1	<0.50	125	0.001	10	10
		22-Aug-15	140	1.4	8.1	43.5	7.6	0.95	1.15	24.4	<0.50	115	0.001	10	10
		9-Sep-15	146	1.7	8.2	46.0	7.4	0.92	1.25	23.9	<0.50	114	0.001	10	10
		11-Sep-15	148	1.8	8.1	46.7	7.5	0.95	1.32	25.3	1.70	112	0.001	10	10
		14-Oct-15	175	1.1	8.2	54.1	9.7	1.00	1.15	29.3	0.55	146	0.001	10	10
		19-Nov-15	212	1.2	8.4	62.9	13.3	1.23	1.37	33.1	<0.50	181	0.001	10	10
		2-Dec-15	224	1.6	8.1	65.1	14.9	1.31	1.35	31.9	0.59	193	0.001	10	10
KZ-17	Mouth of Geona Creek	29-Apr-15	263	1.6	8.3	76.2	17.7	2.54	1.88	32.1	<0.50	214	0.001	10	10
		11-May-15	69	15.6	7.3	20.9	4.1	0.45	2.24	<0.50	1.20	54	0.001	10	10
		22-Jun-15	149	2.9	8.1	46.2	8.2	0.89	1.20	25.8	<0.50	118	0.001	10	10
		28-Jul-15	184	1.8	8.1	55.4	11.0	1.20	1.51	26.7	<0.50	143	0.001	10	10
		22-Aug-15	169	1.7	8.0	51.1	10.0	1.06	1.32	31.2	<0.50	137	0.001	10	10
		9-Sep-15	161	2.2	8.3	50.2	8.8	0.88	1.23	31.4	0.61	136	0.001	10	10
		14-Oct-15	193	1.3	8.3	58.4	11.4	1.01	1.23	31.7	0.60	161	0.001	10	10
		19-Nov-15	212	1.6	8.3	62.2	13.8	1.23	1.40	34.7	0.66	177	0.001	10	10
		2-Dec-15	223	1.9	8.1	65.6	14.5	1.22	1.35	31.6	0.61	187	0.001	10	10
KZ-26	Finlayson Creek near mouth	29-Apr-15	311	1.8	8.4	82.0	25.9	2.31	1.85	47.6	<0.50	252	0.001	10	10
		11-May-15	109	13.9	7.9	28.7	9.1	0.82	1.86	13.3	1.00	86	0.001	10	10
		23-Jun-15	182	5.6	7.9	49.8	13.9	1.30	1.37	27.8	0.97	146	0.001	10	10
		29-Jul-15	222	3.3	8.2	58.9	18.2	1.49	1.41	32.3	0.55	176	0.001	10	10
		22-Aug-15	179	9.1	8.1	47.7	14.5	1.20	0.94	29.9	<0.50	145	0.001	10	10
		8-Sep-15	196	5.6	8.3	52.9	15.6	1.22	1.18	31.1	0.88	158	0.001	10	10
		15-Oct-15	226	4.1	8.3	59.3	18.8	1.47	1.35	36.9	0.73	195	0.001	10	10
		18-Nov-15	268	2.3	8.3	71.4	21.7	1.78	1.63	40.9	<0.50	213	0.001	10	10
		1-Dec-15	263	1.6	8.2	69.1	21.9	1.77	1.48	39.5	0.59	222	0.001	10	10

[1] Only sampling dates from monitoring stations with reported concentrations of DOC are displayed.

[2] pH and alkalinity values displayed for laboratory reconstituted water are the middle of the range reported for these parameters for different USEPA reconstituted water types (USEPA 2007)

[3] Sulphide data were not reported for collected water samples or USEPA laboratory water; therefore lower bound of the prescribed range for sulphide in the Windward BLM (Windward 2015) was used for each sample.

[4] All reported sampling temperatures were at or below the lower bound for temperature within the Windward BLM software. The lower bound (10°C) was therefore used for each sample, including the USEPA labortory water.

[5] Humic Acid Content was not reported for collected water samples or USEPA laboratory water, therefore the lower bound of Humic Acid Content within the Windward BLM software (10%) was used.

n/a = not applicable

Table 3: Input water hardness data for Windward, PNEC.pro, and Bio-Met Biotic Ligand Models for the Kudz Ze Kayah Project water monitoring stations KZ-15, KZ-17 and KZ-26 [1], and for USEPA laboratory reconstituted water (USEPA 2007).

Station / Sample Name	Station/Sample Description	Sampling Date	Measured Hardness	USEPA Hardness Range	Allocated Site-water Hardness [1]
			mg/L as $CaCO_3$	mg/L as $CaCO_3$	
USEPA	Moderately hard	n/a	n/a	80-100	Moderately hard
	Hard	n/a	n/a	160-180	Hard
	Very hard	n/a	n/a	280-320	Very hard
KZ-15	Finlayson Creek downstream of Geona Creek	29-Apr-15	270	n/a	Very hard
		11-May-15	73	n/a	Moderately hard
		22-Jun-15	141	n/a	Hard
		28-Jul-15	156	n/a	Hard
		22-Aug-15	140	n/a	Hard
		9-Sep-15	146	n/a	Hard
		11-Sep-15	148	n/a	Hard
		14-Oct-15	175	n/a	Hard
		19-Nov-15	212	n/a	Hard
		2-Dec-15	224	n/a	Hard
KZ-17	Mouth of Geona Creek	29-Apr-15	263	n/a	Very hard
		11-May-15	69	n/a	Moderately hard
		22-Jun-15	149	n/a	Hard
		28-Jul-15	184	n/a	Hard
		22-Aug-15	169	n/a	Hard
		9-Sep-15	161	n/a	Hard
		14-Oct-15	193	n/a	Hard
		19-Nov-15	212	n/a	Hard
		2-Dec-15	223	n/a	Hard
KZ-26	Finlayson Creek near mouth	29-Apr-15	311	n/a	Very hard
		11-May-15	109	n/a	Moderately hard
		23-Jun-15	182	n/a	Hard
		29-Jul-15	222	n/a	Hard
		22-Aug-15	179	n/a	Hard
		8-Sep-15	196	n/a	Hard
		15-Oct-15	226	n/a	Hard
		18-Nov-15	268	n/a	Very hard
		1-Dec-15	263	n/a	Very hard

[1] The USEPA hardness range for laboratory reconstituted water closest to the measured hardness of each sample was selected.

n/a = not applicable

Table 4: Calculation of the Water Effect Ratio (WER) using Windward, PNEC.pro, and Bio-Met Biotic Ligand Model derived chronic copper no-effect concentrations for sitewater compared to USEPA standard reconstituted water.

Station / Sample Name	Station/Sample Description	Sampling Date	Hardness Value	Hardness Range	Hardness Category	Water Quality Data				Water Quality Guidelines [1]		Windward Output [2]				PNEC.pro Output		Biomet Output	
						Dissolved Organic Carbon (DOC)	pH (lab)	Copper (Total)	Copper (Dissolved)	CCME (Total)	USEPA (Dissolved)	Final Acute Value	CMC	CCC	WER	PNEC [3]	WER	EQS [4]	WER
						mg/L	pH units	µg/L	µg/L	µg/L	µg/L	(FAV), µg/L	(CMC=FAV/2), µg/L	(CCC=FAV/ACR), µg/L		µg/L		µg/L	
USEPA	Moderately hard	n/a	n/a	80-100	Moderately hard	0.50	7.6	n/a	n/a	n/a	1.5	4.9	2.5	1.5	n/a	12.2	n/a	2.5	n/a
	Hard	n/a	n/a	160-180	Hard	0.50	7.8	n/a	n/a	n/a	2.4	7.6	3.8	2.4	n/a	7.7	n/a	1.7	n/a
	Very hard	n/a	n/a	280-320	Very hard	0.50	8.2	n/a	n/a	n/a	4.9	15.7	7.8	4.9	n/a	OD	n/a	1.0	n/a
KZ-15	Finlayson Creek downstream of Geona Creek	29-Apr-15	270	n/a	Very hard	0.85	8.4	0.27	0.22	4.0	6.5	21.0	10.5	6.5	1.3	OD	-	1.0	1.0
		11-May-15	72.9	n/a	Moderately hard	14.9	7.7	3.42	1.75	2.0	41.4	133	66.6	41.4	27.0	49.3	4.0	74.7	30.4
		22-Jun-15	141	n/a	Hard	2.26	8.2	0.53	0.49	3.2	10.8	34.6	17.3	10.8	4.6	5.7	0.7	4.8	2.9
		28-Jul-15	156	n/a	Hard	0.93	8.1	0.43	0.35	3.5	4.4	14.1	7.0	4.4	1.9	2.3	0.3	1.9	1.1
		22-Aug-15	140	n/a	Hard	1.40	8.1	0.72	0.47	3.2	6.1	19.6	9.8	6.1	2.6	4.9	0.6	3.9	2.4
		9-Sep-15	146	n/a	Hard	1.70	8.2	0.44	0.54	3.3	8.1	26.2	13.1	8.1	3.5	4.4	0.6	3.3	2.0
		11-Sep-15	148	n/a	Hard	1.80	8.1	0.42	0.54	3.3	7.9	25.5	12.8	7.9	3.4	5.1	0.7	3.9	2.4
		14-Oct-15	175	n/a	Hard	1.06	8.2	0.42	0.26	3.8	5.7	18.2	9.1	5.7	2.4	0.5	0.1	1.6	1.0
		19-Nov-15	212	n/a	Hard	1.22	8.4	0.33	0.25	4.0	8.1	25.9	13.0	8.1	3.4	OD	-	1.3	0.8
		2-Dec-15	224	n/a	Hard	1.55	8.1	0.28	0.23	4.0	7.7	24.8	12.4	7.7	3.3	0.2	0.02	3.1	1.9
KZ-17	Mouth of Geona Creek	29-Apr-15	263	n/a	Very hard	1.59	8.3	0.27	0.23	4.0	9.9	31.8	15.9	9.9	2.0	OD	-	2.3	2.3
		11-May-15	69.1	n/a	Moderately hard	15.6	7.3	4.67	1.84	2.0	25.8	83.2	41.6	25.8	16.8	54.2	4.4	73.3	29.8
		22-Jun-15	149	n/a	Hard	2.91	8.1	0.64	0.51	3.3	12.6	40.5	20.2	12.6	5.4	8.3	1.1	8.4	5.1
		28-Jul-15	184	n/a	Hard	1.82	8.1	0.49	0.41	4.0	8.4	27.0	13.5	8.4	3.6	3.2	0.4	3.9	2.4
		22-Aug-15	169	n/a	Hard	1.70	8.0	0.52	0.57	3.7	7.5	24.3	12.1	7.5	3.2	4.0	0.5	3.9	2.4
		9-Sep-15	161	n/a	Hard	2.20	8.3	0.66	0.43	3.6	11.4	36.6	18.3	11.4	4.8	4.3	0.6	3.8	2.3
		14-Oct-15	193	n/a	Hard	1.34	8.3	0.45	0.24	4.0	7.5	24.0	12.0	7.5	3.2	OD	-	1.8	1.1
		19-Nov-15	212	n/a	Hard	1.58	8.3	0.43	0.28	4.0	9.0	29.0	14.5	9.0	3.8	OD	-	2.3	1.4
		2-Dec-15	223	n/a	Hard	1.87	8.1	0.33	0.23	4.0	9.2	29.7	14.8	9.2	3.9	0.9	0.1	3.1	1.9
KZ-26	Finlayson Creek near mouth	29-Apr-15	311	n/a	Very hard	1.84	8.4	0.31	0.33	4.0	13.1	42.1	21.0	13.1	2.7	OD	-	1.9	1.9
		11-May-15	109	n/a	Moderately hard	13.9	7.9	1.63	0.99	2.5	49.9	161	80.4	49.9	32.5	43.6	3.6	41.3	16.8
		23-Jun-15	182	n/a	Hard	5.64	7.9	1.62	0.85	4.0	21.8	70.2	35.1	21.8	9.3	16.0	2.1	20.9	12.6
		29-Jul-15	222	n/a	Hard	3.32	8.2	0.68	0.57	4.0	18.1	58.4	29.2	18.1	7.7	5.4	0.7	4.8	2.9
		22-Aug-15	179	n/a	Hard	9.10	8.1	1.83	1.09	3.9	42.1	135	67.7	42.1	17.9	24.6	3.2	26.3	15.9
		8-Sep-15	196	n/a	Hard	5.60	8.3	0.90	0.77	4.0	30.9	99.6	49.8	30.9	13.2	12.6	1.6	12.3	7.4
		15-Oct-15	226	n/a	Hard	4.12	8.3	0.59	0.42	4.0	24.0	77.2	38.6	24.0	10.2	6.9	0.9	6.6	4.0
		18-Nov-15	268	n/a	Very hard	2.30	8.3	0.49	0.44	4.0	14.3	46.0	23.0	14.3	2.9	OD	-	3.1	3.1
		1-Dec-15	263	n/a	Very hard	1.64	8.2	0.34	0.35	4.0	9.5	30.7	15.3	9.5	2.0	OD	-	2.3	2.3

(shaded) WER ≥ 2.0.

[1] See Table A.1 for derivation of hardness-dependent CCME (Canadian Council of Ministers of the Environment) and USEPA (United States Environmental Protection Agency) Water Quality Guidelines. The Windward Biotic Ligand Model for copper calculates the USEPA copper Ambient Water Quality Criteria, therefore the CCC shown is the USEPA chronic criteria for copper.

[2] CMC = Criterion Maximum Concentration; CCC = Criterion Continuous Concentration; ACR = Acute-Chronic Ratio.

[3] PNEC is the Probable No-effect Concentration.

[4] EQS is the Environmental Quality Standard, and is considered to be equivalent to a site-specific PNEC.

OD - Out of Domain (result is outside of the validated range of the model). Water Effect Ratios could not be calculated for samples with an Out of Domain result.

n/a - not applicable.

the WERP may be a useful technique for deriving a SSWQO (i.e., WER > 2). Calculated WERs from both models were greater than 2 in more than half the sampling events at each sampling station (Table 4), and showed similar spatial and temporal trends. Spatial analysis of the WERs focussed on the Windward BLM, since this has been adopted by the USEPA for prediction of Ambient Water Quality Criteria (Figure 2), while temporal analysis considered WERs from the Bio-Met and Windward BLMs. Mean predicted WERs from the Windward BLM were highest at the furthest downstream monitoring station (KZ-26; mean = 10.9), with a lower 95% confidence limit of 3.5 at this station. Mean WERs at the upstream stations (KZ-15 and KZ-17) were lower, with 95% confidence intervals spanning a WER value of 1.0 (i.e., no ratio) at station KZ-15, indicating high variability in the predicted WERs from this monitoring location (Figure 2). Regression analysis of WER results from both the Windward and Bio-Met BLMs indicated that predicted WERs were highly dependent on DOC concentrations ($r^2 = 0.899$, $p<0.001$; Figure 3) with maximum WERs predicted in all three BLMs when DOC concentrations were highest (May 2015; Table 4). Evaluation of the relationship between water pH and predicted WERs yielded a weaker significant relationship ($r^2 = 0.463$, $p<0.001$; Figure A.1); however this is likely due to the co-occurrence of high DOC concentrations with relatively lower pH (Table 4). Due to the dependence of predicted WERs on DOC concentrations, the WERP should only be considered for development of a copper SSWQO in situations where DOC concentrations are high enough to result in a WER greater than 2 (i.e., there is no predicted benefit when DOC is low). As such, the WERP may be of use when DOC concentrations are greater than approximately 1.3 mg/L (as determined by regression analysis; Figure 3) but the WERP is unlikely to yield a SSWQO higher than the generic guideline at lower DOC concentrations.

Overall, the WERP has the potential to yield a beneficial SSWQO only under certain circumstances (DOC concentrations greater than approximately 1.3 mg/L) which, across all monitoring stations, appear to consistently occur only in the spring. In order to accommodate the observed temporal variability in predicted WERs (due to variability in DOC concentrations), the use of a season-specific or DOC threshold-based SSWQO should be considered. This approach could allow for a higher SSWQO at times of the year when DOC is elevated.

Lead

The Windward BLM was used to predict the utility of the WERP for lead based on acute toxicity predictions for four test organisms. Calculated WERs were highest for *Ceriodaphnia dubia* with the WER for the majority of sampling events greater than 2, and lowest for fathead minnow with fewer than half of the calculated WERs greater than 2 at stations KZ-15 or KZ-17 (Table 5). Spatial analysis of WERs considered only fathead minnow results, as these are the most conservative (Figure 2), while temporal analysis considered WERs for all four test organisms. As observed for copper, mean predicted WERs were highest at the furthest downstream monitoring

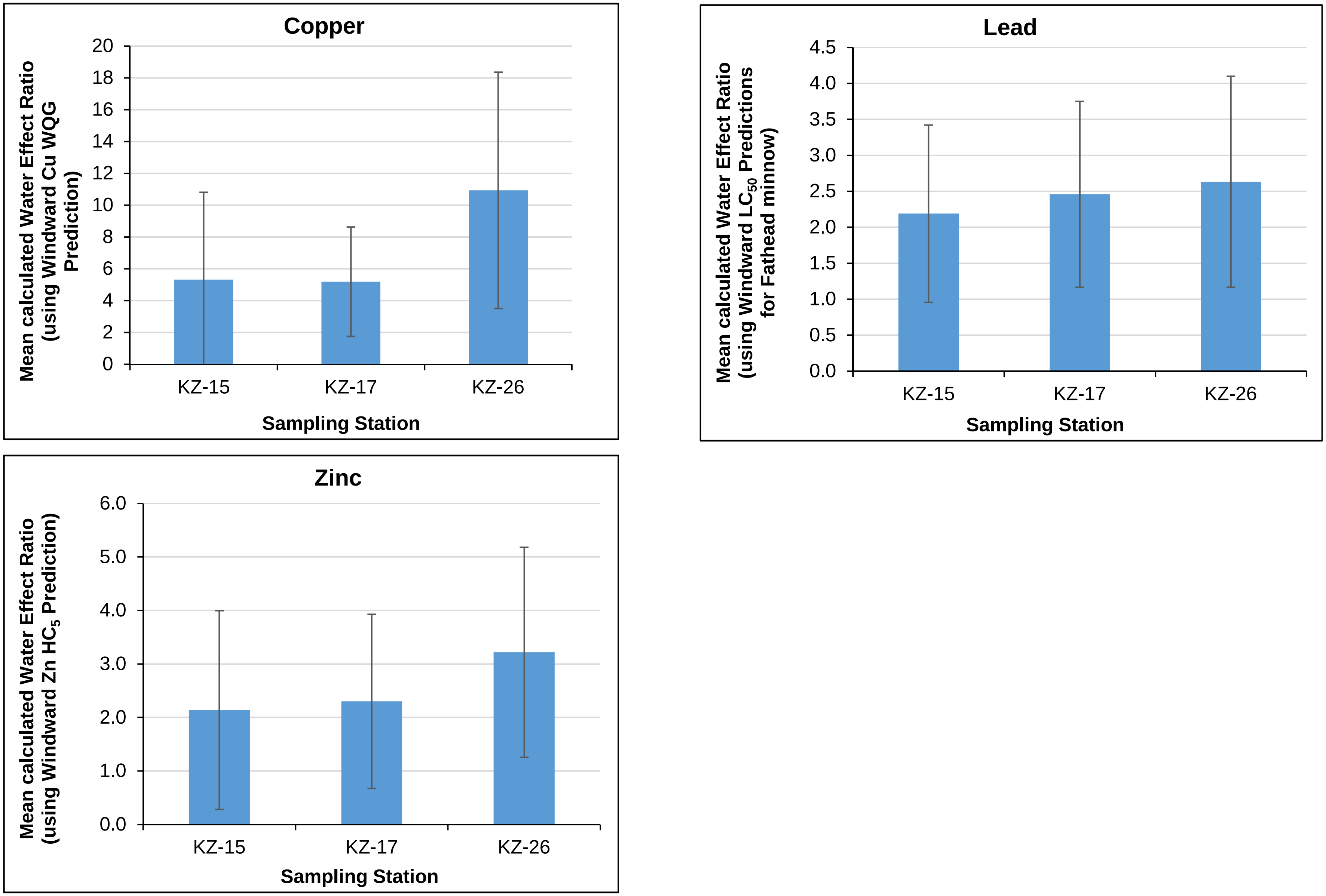

Figure 2: Mean predicted Water Effect Ratios calculated using select Biotic Ligand Model tools for Copper, Lead, and Zinc, for water quality data from monitoring stations KZ-15, KZ-17, and KZ-26 at the Kudz Ze Kayah Project, Yukon. Error bars represent 95% confidence intervals.

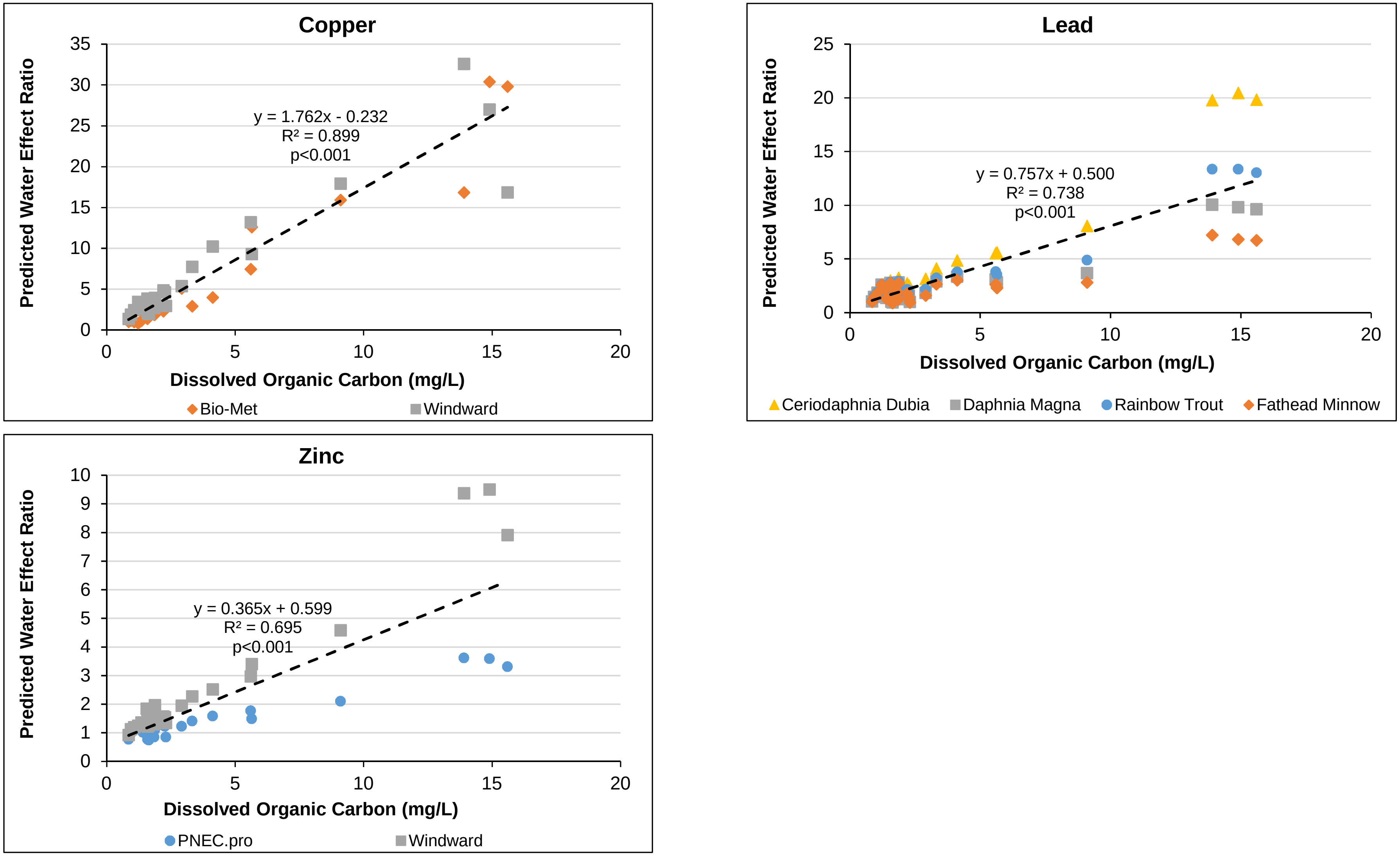

Figure 3: Linear Regression analysis of predicted Water-Effect Ratios relative to measured Dissolved Organic Carbon (mg/L) concentrations in water from monitoring stations KZ-15, KZ-17, and KZ-26 [1] at the Kudz Ze Kayah Project, Yukon.

[1] Linear regression was based on predicted WER results from all three BLM models (Windward, PNEC.pro and Bio-Met) for lead. Regression of predicted WERs for copper included only results from the Windward and Bio-Met BLMs, and for zinc included only results from the Windward and PNEC.pro BLMs due to input data or results outside the validated range of the model.

Table 5: Calculation of the Water Effect Ratio (WER) using Windward Biotic Ligand Model derived acute lead effect concentrations for site water compared to US EPA standard reconstituted water.

Station / Sample Name	Station/Sample Description	Sampling Date	Hardness Value	Hardness Range	Hardness Category	Water Quality Data				Water Quality Guidelines [1]		Windward Output							
						Dissolved Organic Carbon (DOC)	pH (lab)	Lead (Total)	Lead (Dissolved)	CCME (Total)	USEPA (Dissolved)	*Rainbow Trout*	Fathead Minnow	*Daphnia Magna*	*Ceriodaphnia Dubia*	WER			
						mg/L	pH Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	*Rainbow Trout*	Fathead Minnow	*Daphnia Magna*	*Ceriodaphnia Dubia*
USEPA	Moderately hard	n/a	n/a	80-100	Moderately hard	0.50	7.6	n/a	n/a	n/a	n/a	169	505	285	62	n/a	n/a	n/a	n/a
	Hard	n/a	n/a	160-180	Hard	0.50	7.8	n/a	n/a	n/a	n/a	401	1,429	748	118	n/a	n/a	n/a	n/a
	Very hard	n/a	n/a	280-320	Very hard	0.50	8.2	n/a	n/a	n/a	n/a	1,336	5,217	2,633	330	n/a	n/a	n/a	n/a
KZ-15	Finlayson Creek downstream of Geona Creek	29-Apr-15	270	n/a	Very hard	0.85	8.4	0.010	<0.005	7.0	7.3	1,408	5,335	2,724	366	1.1	1.0	1.0	1.1
		11-May-15	72.9	n/a	Moderately hard	14.9	7.7	0.939	0.017	2.1	1.8	2,251	3,449	2,800	1,259	13.3	6.8	9.8	20.4
		22-Jun-15	141	n/a	Hard	2.26	8.2	0.056	0.009	4.9	3.7	736	1,986	1,176	298	1.8	1.4	1.6	2.5
		28-Jul-15	156	n/a	Hard	0.93	8.1	0.023	<0.005	5.6	4.1	602	2,040	1,090	190	1.5	1.4	1.5	1.6
		22-Aug-15	140	n/a	Hard	1.40	8.1	<0.05	<0.005	4.9	3.6	601	1,836	1,027	217	1.5	1.3	1.4	1.8
		9-Sep-15	146	n/a	Hard	1.70	8.2	0.021	0.005	5.2	3.8	676	1,999	1,134	250	1.7	1.4	1.5	2.1
		11-Sep-15	148	n/a	Hard	1.80	8.1	0.014	0.009	5.2	3.8	685	1,986	1,137	261	1.7	1.4	1.5	2.2
		14-Oct-15	175	n/a	Hard	1.06	8.2	0.080	<0.005	6.5	4.6	759	2,618	1,389	233	1.9	1.8	1.9	2.0
		19-Nov-15	212	n/a	Hard	1.22	8.4	2.23	<0.005	7.0	5.6	1,045	3,703	1,943	304	2.6	2.6	2.6	2.6
		2-Dec-15	224	n/a	Hard	1.55	8.1	0.020	<0.005	7.0	6.0	1,134	3,907	2,072	352	2.8	2.7	2.8	3.0
KZ-17	Mouth of Geona Creek	29-Apr-15	263	n/a	Very hard	1.59	8.3	0.025	<0.005	7.0	7.1	1,426	5,061	2,653	419	1.1	1.0	1.0	1.3
		11-May-15	69.1	n/a	Moderately hard	15.6	7.3	1.560	0.023	2.0	1.7	2,196	3,397	2,744	1,220	13.0	6.7	9.6	19.8
		22-Jun-15	149	n/a	Hard	2.91	8.1	0.103	0.008	5.3	3.9	878	2,285	1,376	369	2.2	1.6	1.8	3.1
		28-Jul-15	184	n/a	Hard	1.82	8.1	0.032	<0.005	7.0	4.9	874	2,735	1,512	308	2.2	1.9	2.0	2.6
		22-Aug-15	169	n/a	Hard	1.70	8.0	0.020	<0.005	6.2	4.4	785	2,438	1,353	279	2.0	1.7	1.8	2.4
		9-Sep-15	161	n/a	Hard	2.20	8.3	0.058	0.009	5.8	4.2	870	2,565	1,458	321	2.2	1.8	1.9	2.7
		14-Oct-15	193	n/a	Hard	1.34	8.3	0.092	<0.005	7.0	5.1	911	3,105	1,655	284	2.3	2.2	2.2	2.4
		19-Nov-15	212	n/a	Hard	1.58	8.3	0.115	<0.005	7.0	5.6	1,060	3,597	1,921	332	2.6	2.5	2.6	2.8
		2-Dec-15	223	n/a	Hard	1.87	8.1	0.036	<0.005	7.0	6.0	1,170	3,901	2,098	380	2.9	2.7	2.8	3.2
KZ-26	Finlayson Creek near mouth	29-Apr-15	311	n/a	Very hard	1.84	8.4	0.011	<0.005	7.0	8.4	1,761	6,312	3,296	505	1.3	1.2	1.3	1.5
		11-May-15	109	n/a	Moderately hard	13.9	7.9	0.237	0.009	3.6	2.8	2,254	3,645	2,864	1,216	13.4	7.2	10.0	19.8
		23-Jun-15	182	n/a	Hard	5.64	7.9	0.221	0.011	7.0	4.8	1,422	3,297	2,103	658	3.5	2.3	2.8	5.6
		29-Jul-15	222	n/a	Hard	3.32	8.2	0.027	<0.005	7.0	5.9	1,299	3,798	2,167	483	3.2	2.7	2.9	4.1
		22-Aug-15	179	n/a	Hard	9.10	8.1	0.241	0.008	6.7	4.7	1,957	4,016	2,740	949	4.9	2.8	3.7	8.0
		8-Sep-15	196	n/a	Hard	5.60	8.3	0.058	0.006	7.0	5.2	1,526	3,749	2,328	651	3.8	2.6	3.1	5.5
		15-Oct-15	226	n/a	Hard	4.12	8.3	<0.05	0.006	7.0	6.0	1,515	4,333	2,499	571	3.8	3.0	3.3	4.8
		18-Nov-15	268	n/a	Very hard	2.30	8.3	0.013	0.014	7.0	7.2	1,465	4,907	2,636	465	1.1	0.9	1.0	1.4
		1-Dec-15	263	n/a	Very hard	1.64	8.2	<0.005	<0.005	7.0	7.1	1,347	4,734	2,492	401	1.0	0.9	0.9	1.2

WER ≥ 2.0.

[1] See Table A.1 for derivation of hardness-dependent CCME (Canadian Council of Ministers of the Environment) and USEPA (United States Environmental Protection Agency) Water Quality Guidelines.

n/a - not applicable.

station KZ-26 (mean = 2.6; Figure 2) although the observed difference among means was small. The WERs predicted for all four of the test organisms also varied temporally, with maximum WERs predicted when DOC concentrations were highest (May 2015; Table 5). Regression analysis of DOC concentrations and the predicted WERs demonstrated a significant relationship between the two variables, with 74% of the variance in the predicted WERs explained by DOC concentrations ($r^2 = 0.738$, $p<0.001$; Figure 3). A weaker significant positive relationship also existed between water pH and predicted WERs but is likely due to the co-occurrence of high DOC concentrations with low pH results discussed above. Based on analysis of the limited data available, the development of SSWQO using the WERP for the upstream stations KZ-15 and KZ-17 would likely only be beneficial during the spring (May) when DOC concentrations are high. Concentrations of DOC were higher throughout the year at the downstream monitoring station (KZ-26), and as such the WERP could potentially be applied to a greater portion of the year (e.g., May to October based on 2015 data). Consideration should be given to the development of a season-specific or DOC threshold-based SSWQO similar to the approach discussed above for copper. Based on the linear equation developed between DOC and predicted WERs for lead (Figure 3), there appears to be potential for development of SSWQO when DOC is in excess of approximately 2.0 mg/L, but it is unlikely that a meaningful WER would result at DOC concentrations below this.

Zinc

All three BLM tools were used to assess the potential utility of the WERP for zinc. Input pH data exceeded the validated range for the Bio-Met BLM (Tables 1 and 6) and the Bio-Met BLM results were not used further. WER predictions yielded by the PNEC.pro and Windward BLMs were low (< 2) for the majority of sampling events at stations KZ-15 and KZ-17 (Table 6). Spatial analysis of WERs focussed on the Windward BLM, due to the inclusion of a greater number of parameters in this model (Figure 2), while temporal analysis considered WERs from the Windward and PNEC.pro BLMs. Mean predicted WERs were higher at monitoring station KZ-26 (mean = 3.2) relative to the upstream stations KZ-15 and KZ-17 (mean < 2.3), with both upstream monitoring stations having lower confidence limits of the mean below 1.0 (Figure 2). Similar to the trends observed for copper and lead, maximum predicted WERs in all models coincided with highest DOC concentrations in May 2015. Significant relationships existed between both DOC concentrations and the predicted WERs ($r^2 = 0.695$, $p<0.001$; Figure 3), and between pH and the predicted WERs (Figure A.1), the latter of which was weaker and likely due to the co-occurrence of high DOC and low pH results as discussed above. Based on the linear equation developed for the relationship between DOC concentrations and the predicted WERs (based on all BLM results), WERs greater than 2 are likely to occur when DOC concentrations exceed approximately 3.8 mg/L. Therefore, due to the low predicted WERs observed at stations KZ-15 and KZ-17 and the dependence of predicted WERs on water DOC concentrations, use of the WERP should be

Table 6: Calculation of the Water Effect Ratio (WER) using Windward, PNEC.pro, and Bio-Met Biotic Ligand Model derived chronic zinc no-effect concentrations for sitewater compared to USEPA standard reconstituted water.

Station / Sample Name	Station/Sample Description	Sampling Date	Hardness Value	Hardness Range	Hardness Category	Water Quality Data				Water Quality Guidelines [1]		Windward Output		PNEC.pro Output		Bio-Met Output	
						Dissolved Organic Carbon	pH (lab)	Zinc (Total)	Zinc (Dissolved)	CCME (Total)	USEPA (Dissolved)	Zn Chronic HC_5 [2]	WER	PNEC Output [3]	WER	EQS [4]	WER
						mg/L	pH units	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L		µg/L	
USEPA	Moderately hard	n/a	n/a	80-100	Moderately hard	0.50	7.6	n/a	n/a	n/a	n/a	22.7	n/a	8.0	n/a	11.9	n/a
	Hard	n/a	n/a	160-180	Hard	0.50	7.8	n/a	n/a	n/a	n/a	35.0	n/a	11.2	n/a	11.9	n/a
	Very hard	n/a	n/a	280-320	Very hard	0.50	8.2	n/a	n/a	n/a	n/a	52.2	n/a	17.5	n/a	11.9	n/a
KZ-15	Finlayson Creek downstream of Geona Creek	29-Apr-15	270	n/a	Very hard	0.85	8.4	3.22	2.91	30	274	47.9	0.9	13.4	0.8	14.5	1.2
		11-May-15	72.9	n/a	Moderately hard	14.9	7.7	22.9	5.66	30	90	216	9.5	28.8	3.6	68.2	5.7
		22-Jun-15	141	n/a	Hard	2.26	8.2	2.88	2.55	30	158	53.9	1.5	13.7	1.2	18.3	1.5
		28-Jul-15	156	n/a	Hard	0.93	8.1	2.08	1.25	30	172	39.2	1.1	10.9	1.0	11.9	1.0
		22-Aug-15	140	n/a	Hard	1.40	8.1	3.50	1.29	30	157	43.9	1.3	11.3	1.0	15.3	1.3
		9-Sep-15	146	n/a	Hard	1.70	8.2	2.81	2.27	30	163	46.4	1.3	12.7	1.1	15.3	1.3
		11-Sep-15	148	n/a	Hard	1.80	8.1	2.47	1.99	30	165	50.7	1.4	12.1	1.1	15.3	1.3
		14-Oct-15	175	n/a	Hard	1.06	8.2	4.17	1.93	30	190	41.6	1.2	12.1	1.1	13.1	1.1
		19-Nov-15	212	n/a	Hard	1.22	8.4	5.76	3.90	30	223	43.5	1.2	14.0	1.3	15.9	1.3
		2-Dec-15	224	n/a	Hard	1.55	8.1	4.35	2.26	30	234	64.3	1.8	11.8	1.1	18.0	1.5
KZ-17	Mouth of Geona Creek	29-Apr-15	263	n/a	Very hard	1.59	8.3	5.86	5.32	30	268	63.3	1.2	13.5	0.8	18.0	1.5
		11-May-15	69.1	n/a	Moderately hard	15.6	7.3	42.7	7.49	30	86	179	7.9	26.5	3.3	60.8	5.1
		22-Jun-15	149	n/a	Hard	2.91	8.1	5.45	2.89	30	166	68.0	1.9	13.7	1.2	22.7	1.9
		28-Jul-15	184	n/a	Hard	1.82	8.1	3.45	2.18	30	198	58.5	1.7	12.1	1.1	15.3	1.3
		22-Aug-15	169	n/a	Hard	1.70	8.0	4.10	2.80	30	184	54.4	1.6	11.7	1.1	15.3	1.3
		9-Sep-15	161	n/a	Hard	2.20	8.3	7.54	4.26	30	177	54.7	1.6	14.1	1.3	18.3	1.5
		14-Oct-15	193	n/a	Hard	1.34	8.3	9.89	4.50	30	206	47.6	1.4	12.8	1.1	15.9	1.3
		19-Nov-15	212	n/a	Hard	1.58	8.3	8.20	6.06	30	223	53.9	1.5	13.3	1.2	18.0	1.5
		2-Dec-15	223	n/a	Hard	1.87	8.1	7.24	3.75	30	233	68.5	2.0	12.3	1.1	18.0	1.5
KZ-26	Finlayson Creek near mouth	29-Apr-15	311	n/a	Very hard	1.84	8.4	0.41	0.29	30	309	67.5	1.3	14.8	0.8	18.0	1.5
		11-May-15	109	n/a	Moderately hard	13.9	7.9	4.40	1.27	30	127	213	9.4	29.0	3.6	72.7	6.1
		23-Jun-15	182	n/a	Hard	5.64	7.9	2.40	0.31	30	196	119	3.4	16.6	1.5	38.5	3.2
		29-Jul-15	222	n/a	Hard	3.32	8.2	0.86	0.35	30	232	79.2	2.3	15.8	1.4	24.8	2.1
		22-Aug-15	179	n/a	Hard	9.10	8.1	3.80	0.74	30	193	160	4.6	23.5	2.1	52.3	4.4
		8-Sep-15	196	n/a	Hard	5.60	8.3	1.77	0.81	30	209	104	3.0	19.7	1.8	38.5	3.2
		15-Oct-15	226	n/a	Hard	4.12	8.3	1.10	0.35	30	236	87.8	2.5	17.7	1.6	30.6	2.6
		18-Nov-15	268	n/a	Very hard	2.30	8.3	0.77	0.60	30	272	69.8	1.3	14.9	0.9	20.8	1.7
		1-Dec-15	263	n/a	Very hard	1.64	8.2	0.28	0.23	30	268	65.7	1.3	12.9	0.7	18.0	1.5

(shaded) WER ≥ 2.0.

[1] See Table A.1 for derivation of hardness-dependent CCME (Canadian Council of Ministers of the Environment) and USEPA (United States Environmental Protection Agency) Water Quality Guidelines.

[2] Chronic HC_5 is the chronic hazardous concentration to 5% of the exposed population.

[3] PNEC is the Probable No-effect Concentration.

[4] EQS is the Environmental Quality Standard, and is considered to be equivalent to a site-specific PNEC. The majority of pH values were outside the validated EQS calculation range for zinc (pH >8) and should be interpreted with caution.

n/a - not applicable.

considered for the development of a season-specific of DOC threshold-based SSWQO. This approach could allow for development of a higher SSWQO in the spring when WERs are predicted to be higher (> 2) due to elevated DOC concentrations (above approximately 3.8 mg/L).

Summary

Application of BLMs to predict WERs for copper, lead and zinc using limited available data suggests that use of the WERP to develop SSWQOs for these metals is only likely to be beneficial if season-specific or DOC-based SSWQOs are considered. Higher DOC concentrations in the spring and downstream (at station KZ-26) relative to upstream may support SSWQOs greater than guidelines, but would only be applicable under specific conditions. Such SSWQOs could potentially be useful to the project in evaluating water management options such as seasonal discharge.

We trust that this brief letter report meets your requirements and expectations. If you have any questions or would like to discuss any aspect of this report, please do not hesitate to let us know.

Sincerely,
Minnow Environmental Inc.

Signature REDACTED

Name REDACTED, M.Sc., EP, RPBio
Senior Aquatic Scientist & Principal

Signature REDACTED

Name REDACTED, M.Sc.
Aquatic Scientist

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APPENDIX A

SUPPORTING DATA AND ANALYSES

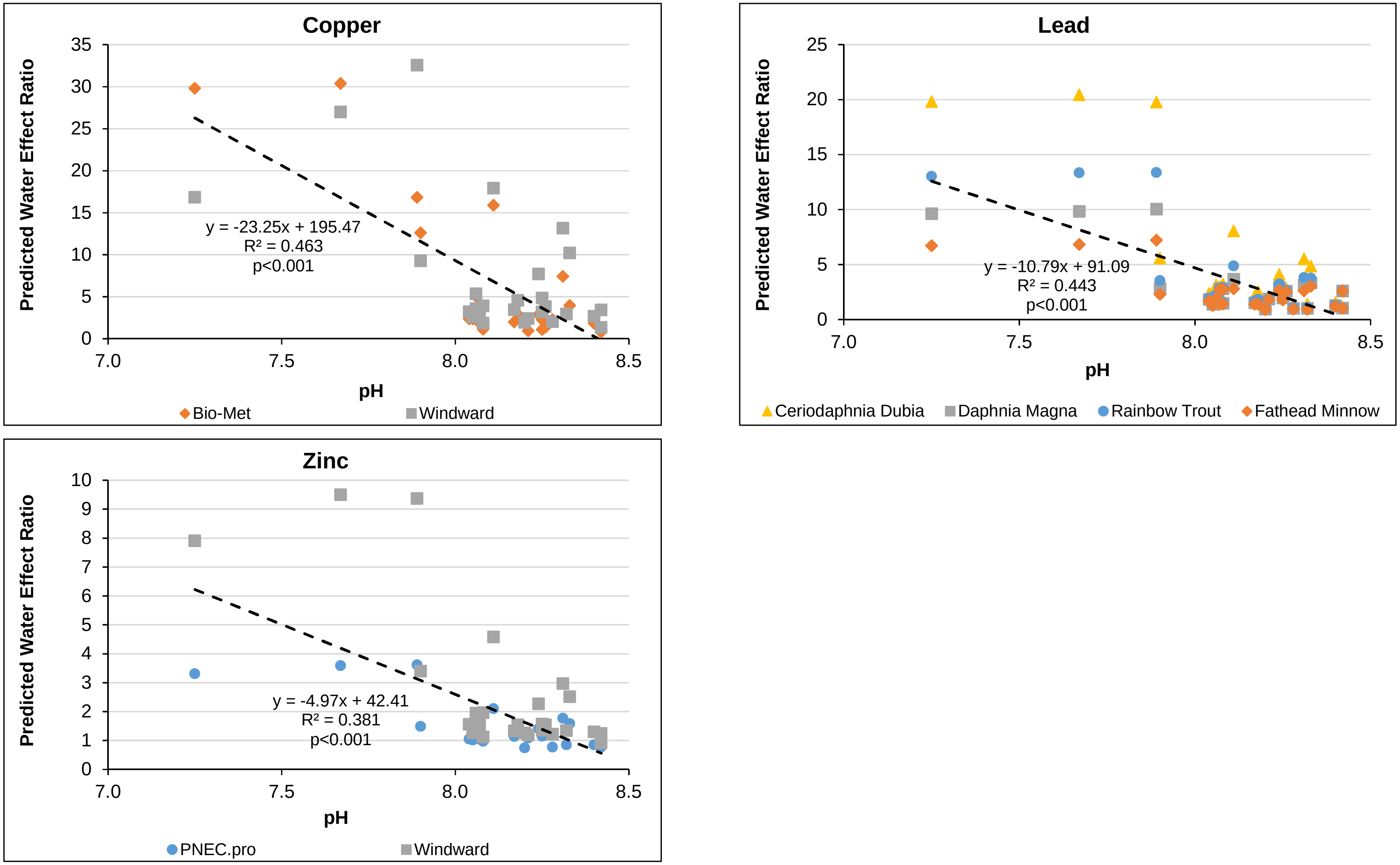


Figure A.1: Predicted Water-Effect Ratios relative to measured pH concentrations in water from monitoring stations KZ-15, KZ-17, and KZ-26 [1] at the Kudz Ze Kayah Project, Yukon.

[1] Linear regression was based on predicted WER results from all three BLM models (Windward, PNEC.pro and Bio-Met) for lead. Regression of predicted WERs for copper included only results from the Windward and Bio-Met BLMs, and for zinc included only results from the Windward and PNEC.pro BLMs due to input data or results outside the validated range of the model.

Table A.1: Explanation of hardness-dependent water quality guidelines.

Guideline Source		Parameter	Units	Guideline Description
Canadian Council for Ministers of the Environment	CCME (2015)[a]	Copper	µg/L	Guideline is hardness-dependent. Below 82 µg/L hardness, guideline is 2 µg/L; between 82 and 180 mg/L hardness, the equation (0.2 x $e^{(0.8545[\ln(hardness)]-1.465)}$) is used; above 180 mg/L hardness, guideline is 4 µg/L.
		Lead	µg/L	Guideline is hardness-dependent. Below 60 mg/L hardness, guideline is 1 µg/L; between 60 and 180 mg/L hardness, the equation ($e^{(1.273\ln(mean\ hardness)-4.704)}$); above 180 mg/L hardness, guideline is 7 µg/L.
		Zinc	µg/L	Guideline is 30 µg/L.
United States Environmental Protection Agency	US EPA (2015)[b]	Copper	µg/L	Freshwater guideline is calculated using the Biotic Ligand Model, and is expressed in terms of dissolved metal in the water column. The Criterion Continuous Concentration (CCC) for dissolved copper in freshwater was used, calculated using the Windward BLM.
		Lead	µg/L	Guideline is hardness-dependent. The equation ([$e^{(1.273[\ln(hardness)]-4.705)]}$*[1.462-(ln(hardness)*(0.146)]) is used to calculate Criterion Continuous Concentration (CCC) for dissolved concentrations in freshwater.
		Zinc	µg/L	Guideline is hardness-dependent. The equation ([$e^{(0.8473[\ln(hardness)]+0.884)]}$*[0.986]) is used to calculate Criterion Continuous Concentration (CCC) for dissolved concentrations in freshwater.

[a] CCME (Canadian Council for Ministers of the Environment). 2014. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Accessed at http://st-ts.ccme.ca/, January 2016.

[b] USEPA (United States Environmental Protection Agency). 2015. National Recommended Water Quality Criteria - Aquatic Life Criteria Table. Accessed at http://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

APPENDIX C.

Kudz Ze Kayah Project Site-Specific Water Quality Objective Recalculation Procedure for Copper, Lead and Zinc (Minnow Environmental Inc.)

February 5, 2016

Name REDACTED
Senior Environmental Manager
Alexco Environmental Group
#3 Calcite Business Centre
151 Industrial Rd.,
Whitehorse, Yukon
Y1A 2V3

Dear Name REDACTED

Re: BMC Minerals Kudz Ze Kayah Project Site-Specific Water Quality Objective Recalculation Procedure for Copper, Lead and Zinc

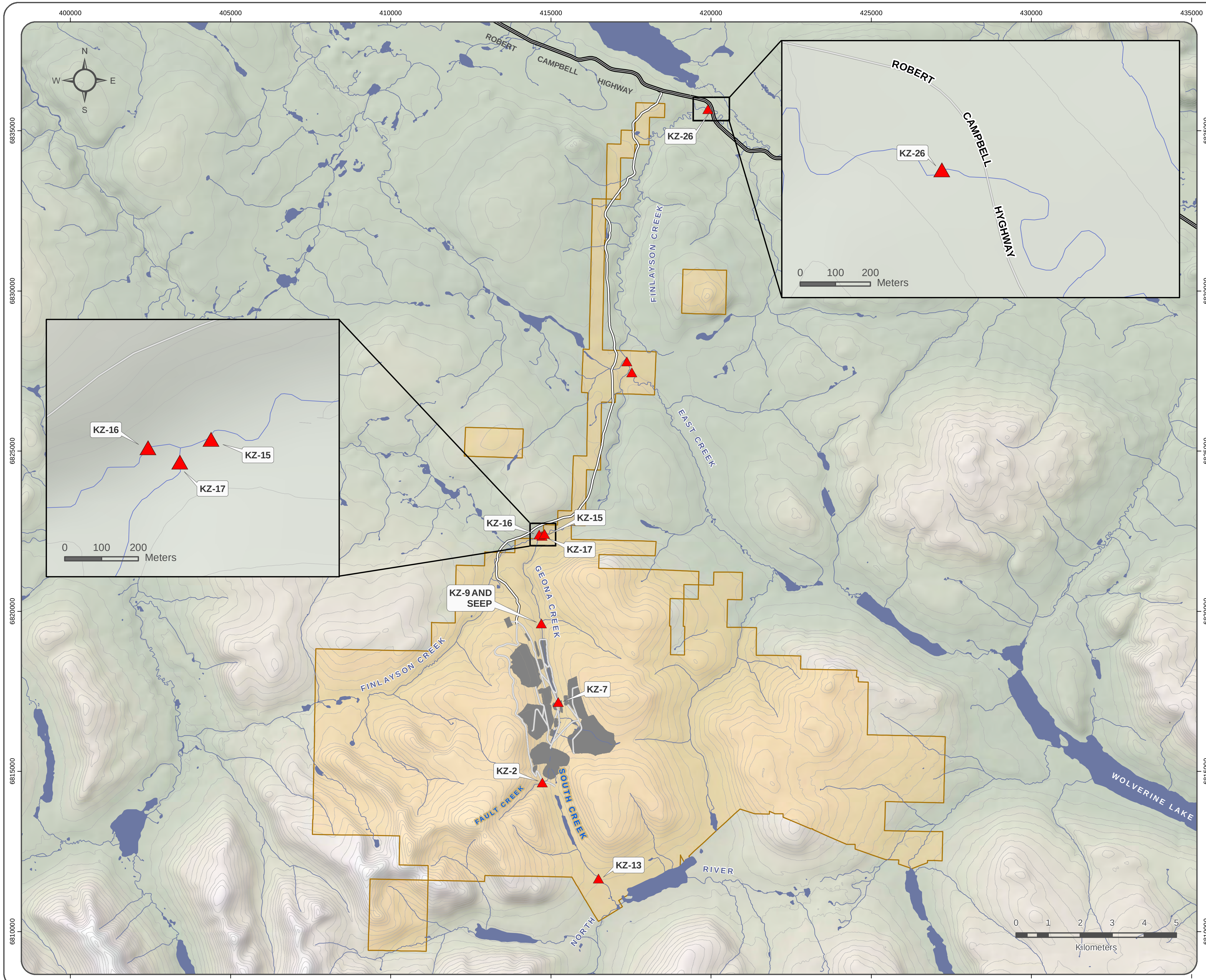
Minnow Environmental Inc. (Minnow) is pleased to provide a brief letter report examining the potential application of the Recalculation Procedure (RCP) to deriving site-specific water quality objectives (SSWQO) for copper, lead and zinc at the BMC Minerals Kudz Ze Kayah Project.

Project Background

The BMC Minerals Kudz Ze Kayah Project is located in Yukon Territory, approximately 110 kilometers southeast of the community of Ross River. The project lies primarily within the Geona Creek watershed (Figure 1). Geona Creek flows to Finlayson Creek, which in turn is a tributary to the Finlayson River, and ultimately the Frances, Liard and MacKenzie rivers. An initial environmental evaluation of the project by a previous owner indicated that water quality of Geona and Finlayson creeks would potentially be impacted by mine water discharge, particularly based on concentrations of copper, selenium, zinc, ammonia and nitrite (Cominco 1996). It is expected that this mine water will be treated prior to discharge during the operational period. The evaluation reported herein can contribute to the design criteria for water treatment.

Technical Background

The Recalculation Procedure (RCP) is one of several accepted approaches for deriving SSWQOs (e.g., CCME 2003). Briefly, the RCP involves the acquisition of an up-to-date toxicological database that includes the data used to derive a generic guideline for a particular parameter. The database is then examined relative to a species list for the area to which the SSWQO will be applied. Data for species that are not resident in the area are identified and are removed from the database. An SSWQO is derived using the same methodology that was originally used to derive the generic guideline, but only considers the reduced data set. If it can be demonstrated that the sensitive species that influenced the derivation of the generic guideline do not occur locally, the recalculation will likely result in a new, higher SSWQO. Conversely, if the most



BMC MINERALS

KUDZ ZE KAYAH PROJECT

FIGURE 1
WATER QUALITY MONITORING STATIONS

DECEMBER 2016

- ▲ Surface Water Quality Stations
- Robert Campbell Highway
- Tote Road/Proposed Access
- Proposed Mine Road
- Contour (40m interval)
- Watercourse
- Waterbody
- Location of Mine Infrastructure
- BMC Minerals (No.1) Ltd. Claims

ALEXCO ENVIRONMENTAL GROUP

minnow environmental inc.
A Tetra Tech Company

Digital elevation model created by the Yukon Department of the Environment interpolated from the digital 1:50,000 Canadian National Topographic Database (NTDB Edition 2) contour and watercourse layers. Obtained from Geomatics Yukon.

Datum: NAD 83; Projection UTM Zone 9N

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\01_WaterQuality\01-Surface\Specific\Minnow\SWQ_Minnow_20161212.mxd
(*Last edited by: mducharme; 12/12/2016/11:58 AM*)

sensitive species are resident in the watershed, then this method would not be expected to result in any difference. In practice, as long as appropriate datasets can be acquired and biological assemblages have been well characterized, it can generally be quickly determined whether or not the approach is likely to result in any difference from the generic guideline.

Methods

Toxicological Data

Toxicological datasets were acquired for copper, lead and zinc to assess species sensitivity. Initial requests for data were submitted to Environment Canada. Environment Canada provided data for zinc and provided further assistance through referral to alternate data sources. Ultimately, toxicological data for copper were collected from the European Union Risk Assessment Report for copper (EURAR 2008). This database evaluated chronic exposure only, and the literature is inclusive up to 2004. Fewer toxicological data were available for lead, so available chronic toxicity reports were compiled to evaluate the range in toxicity for common species (Besser et al. 2005; Borgmann et al. 2005; Brix et al. 2012; Esbaugh et al. 2012; Grosell et al. 2006; Mager et al. 2010; Mager et al. 2011a; Mager et al. 2011b; Wang et al. 2010). These data were considered sufficient for a preliminary examination of the potential for recalculation. Additional data are potentially available through the International Lead Association, but would only be retrieved if the initial assessment is promising. Lastly, toxicological data for zinc were collected from the draft Canadian Water Quality Guideline for the Protection of Aquatic Life for zinc (CCME 2016), and contained a complete literature review up to 2012 for both acute and chronic exposure.

For each metal, toxicity tests (acute and chronic separately when available) were ordered from most to least sensitive based on the species/endpoint effect concentration. The endpoint duration and developmental stage used varied by report due to differences in the optimal conditions required for each species, but overall the lower the measured effect in the endpoint, the more sensitive that species was. Once ordered, the top ten most sensitive species for copper (Table 1), lead (Table 2), zinc (Tables 3 and 4) were selected and reported for initial evaluation. For zinc, only studies used in the CWQG species sensitivity distribution (SSD; CCME 2016) were considered for this report. In the SSD selection process, when more than one study examined the same species, the most sensitive report was selected for inclusion, and if all parameters were the same then the geometic mean was calculated and used in the SSD. This approach was applied for copper and zinc for the current report, where applicable.

Site Biological Data

Site biological data were acquired from the three sources: the Initial Environmental Evaluation report (Cominco 1996), the Kudz Ze Kayah Project – Aquatic Ecosystems and Resources Baseline Report (Alexco 2015), and the 2014 Kudz Ze Kayah Environmental Monitoring Report (Laberge and Can-Nic-a-Nick 2015). The Kudz Ze Kayah Project – Aquatic Ecosystems and Resources Baseline Report (Alexco 2015) report provides data from available baseline environmental studies on fisheries and other aquatic resources in support of the Kudz Ze Kayah project development, as well as includes results from additional studies conducted by Alexco Environmental Group Inc. in 2015.

Fish distribution surveys were primarily conducted in Geona Creek, Finlayson Creek, East Creek, South Creek as well as the North Lakes/River system (Figure 1). Three sites on Finlayson Creek were monitored biennially since 2002 under Water Licence QZ97-026. The sites were:

- KZ-16: Upstream of confluence with Geona Creek, at tote road (reference site).
- KZ-15: 100 m downstream of confluence with Geona Creek.
- KZ-26: Just above the confluence with Finlayson River, at Robert Campbell Highway.

In the project area, the primary fish species captured and identified were Arctic grayling (*Thymallus arcticus*), Burbot (*Lota lota*) and Slimy sculpin (*Cottus cognatus*) (Alexco 2015, Laberge and Can-Nic-a-Nick 2015, Cominco 1996 ; Appendix Table A.1), however it is known that salmonid species other than Arctic grayling are present in the project area (i.e. Lake trout (*Salvelinus namaycush*), Mountain whitefish (*Prosopium williamsoni*); Cominco 1996) although few were captured in any of the surveys (Cominco 1996).

Benthic invertebrate surveys were primarily conducted at Geona Creek, Finlayson Creek, North River and East Creek during baseline studies in September 1995, and under the water licence in 2000, 2004, 2006, 2008, 2010, 2012 and 2014 (KZ-9, KZ-15, KZ-16, KZ-21, KZ-26, KZ-27; Laberge and Can-Nic-A-Nic 2015). Additional benthic invertebrate community sampling was conducted in September 2015 in order to fill in baseline information gaps on Geona Creek (KZ-2, KZ-7, KZ-17; Alexco 2015; Appendix Table A.3). While these data were used to assess the presence and absence of sensitive species within the project area, it is notable that it is difficult to confidently conclude that sensitive species are not present due to the limited spatial coverage and focus on riffle habitat only.

Although periphyton communities were surveyed in 2015 (Alexco 2015), no site biological data exists for aquatic plants. It may be appropriate to augment the baseline data for algae and plants because algae appear to be sensitive to zinc exposure.

RCP Utility Evaluation

Examination of the chronic toxicological dataset for copper (Table 1) indicates that the three most copper sensitive species are cladocerans (small crustaceans commonly known as water fleas). The particular sensitivity of cladocerans has been well characterized (e.g., USEPA 2007). Cladocerans have been documented in the invertebrate data set (Appendix Table A.2). It is also notable that a total of eight of the ten most chronically copper sensitive species-endpoint combinations are for species that are present in the study area (or reasonable surrogate species are present).

Examination of the chronic toxicological dataset for lead (Table 2) indicates that the two most lead sensitive species: *Lymnaea stagnalus* (a pond snail) and the cladoceran *Ceriodaphnia dubia* are present in the study area (or reasonable surrogate species are present). It is also

Table 1: Top ten most sensitive species/endpoints to chronic copper exposure [1]

Rank	Species latin name	Species common name	Life stage	Exposure duration	Endpoint	Observed effect	Measured no effect concentration (µg/L)
1	*Oncorhynchus mykiss*	Rainbow trout	fry (0.12 g; 2.6 cm)	60 d	NOEC	growth	2.2
2	*Ceriodaphnia dubia*	Scud	neonates (< 8 h)	7 d	NOEC	mortality	4
3	*Daphnia pulex*	Water flea	neonates (< 24 h)	42 d	NOEC	mortality	4
4	*Pimephales promelas*	Fathead minnow	embryo-larval	32 d	NOEC	growth	4.8
5	*Juga plicifera*	Snail	mature	30 d	NOEC	mortality	6
6	*Salvelinus fontinalis*	Brook trout	fry	30 d	NOEC	Growth	7
7	*Campeloma decisum*	Snail	11 to 27 mm snail	42 d	NOEC	mortality	8
8	*Brachionus calyciflorus*	Rotifer	neonates (< 2 h)	2 d	NOEC	reproduction	8.2
9	*Clistoronia magnifica*	Caddisfly	larvae 1st generation	240 d	NOEC	Life cycle	8.3
10	*Gammarus pulex*	Amphipod	mixed sizes (1.5-14 mm)	100 d	NOEC	population response	11

[1] data source: European Union Risk Assessment Report (EURAR 2008), European Copper Institute.

- (blue) denotes a species or genus confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)
- (green) denotes a reasonable surrogate species is confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)
- (orange) denotes uncertainty of presence/absence of species or surrogate species in the area.
- (white) absence of colour indicates genus unlikely to occur in the region or distribution unknown

Table 2: Sensitivity ranked toxicity data for chronic exposure to lead [1]

Rank	Species latin name	Species common name	Life stage	Exposure duration	Endpoint	Observed effect	Measured effect concentration (µg/L)
1	*Lymnaea stagnalis*	pond snail	7-10 d	14-d	EC10	Growth	0.9
2	*Ceriodaphnia dubia*	cladoceran	Neonates	7-d	EC10	Reproduction	1.0
3	*Philodina rapida*	rotifer	Adults	4-d	EC10	Population growth	2.4
4	*Hyalella azteca*	amphipod	1.2-1.3 mm (mixed age)	42-d	EC25	Reproduction	2.8
5	*Lampsilis siliquoidea*	fatmucket mussel	Juveniles	28-d	EC10	Length	6.4
6	*Oncorhynchus mykiss*	rainbow trout	Embryo	62-d	EC10	Weight	7.0
7	*Pimephales promelas*	fathead minnow	Larvae (8-d)	21-d	LOEC	Fecundity	31
8	*Chironomus dilutus*	midge	Larvae (8-d)	27-d	MATC	Survival	233
9	*Micropterus dolomieui*	smallmouth bass	Fingerlings	90-d	NOEC	Growth	308

[1] confidential data source

denotes a species or genus confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)

denotes a reasonable surrogate species is confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)

denotes uncertainty of presence/absence of species or surrogate species in the area.

absence of colour indicates genus unlikely to occur in the region or distribution unknown notable that a total of four of nine species-endpoint combinations in the available database are for species that are present in the study area (or reasonable surrogate species are present).

Examination of the acute and chronic toxicological datasets for zinc (Tables 3 and 4) indicate that the green algae *Pseudokirchneriella subcapitata* is particularly sensitive to zinc. *P. subcapitata* is a ubiquitous green alga commonly used in toxicity testing (e.g., Environment Canada 2007). Due to the overall ubiquity of *P. subcapitata* and apparent sensitivity of other green algae (e.g., *Chlorella pyrenoidosa* and *C. vulgaris*; Table 3 and 4), the presence of green algae at the site (Appendix Table A.3) suggests zinc sensitivity. It is also notable that a total of nine of the ten most acutely zinc sensitive species-endpoint combinations and six of ten of the most chronically zinc sensitive species-endpoint combinations are for species that are present in the study area (or reasonable surrogate species are present).

Summary

Evaluation of the potential application of the RCP to derive SSWQOs for copper, lead and zinc in Geona and Finlayson creeks suggests that the approach would not yield SSWQOs that differ meaningfully from generic guidelines. This is due to the presence of sensitive species such as arctic grayling (family Salmonidae), water fleas of the crustacean order Cladocera, and green algae which are among the most sensitive organisms to copper, lead and zinc.

We trust that this brief letter report meets your requirements and expectations. If you have any questions or would like to discuss any aspect of this report, please do not hesitate to let us know.

Sincerely,
Minnow Environmental Inc.

Signature REDACTED

Name REDACTED, M.Sc., EP, RPBio
Senior Aquatic Scientist & Principal

Signature REDACTED

Name REDACTED, PhD.
Aquatic Scientist

Table 3: Top ten most sensitive species/endpoints to acute zinc exposure [1]

Rank	Species latin name	Species common name	Life stage	Exposure duration	Endpoint	Observed effect	Measured effect concentration (µg/L)
1	*Pseudokirchneriella subcapitata*	Green algae	Not reported	24 h	EC50	Growth	15
2	*Chlorella pyrenoidosa*	Green algae	Not reported	24 h	EC50	Growth	57
3	*Oncorhynchus mykiss* [a]	Rainbow trout	Juvenile	5 d	LC50	Mortality	61
4	*Daphnia magna*	Water flea	Juvenile	96 h	LC50	Mortality	68
5	*Ceriodaphnia reticulata*	Water flea	Less than 4h	48 h	LC50	Mortality	76
6	*Oncorhynchus tshawytscha*	Chinook salmon	Juvenile	96 h	LC50	Mortality	84
7	*Salvelinus confluentus* [a]	Bull trout	Juvenile	5 d	LC50	Mortality	89
8	*Daphnia pulex*	Water flea	Less than 24hrs	48 h	LC50	Mortality	107
9	*Ceriodaphnia dubia* [a]	Cladocerans	Less than 48h old	48 h	EC50	Immobility	108
10	*Lampsilis rafinesqueana*	Neosho mucket	Juvenile	48 h	EC50	Survival	134

[1] data source: (Draft Canadian Water Quality Guideline for the Protection of Aquatic Life

[a] Measured effect concentration presented as a geometric mean

(blue)	denotes a species or genus confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)
(green)	denotes a reasonable surrogate species is confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)
(orange)	denotes uncertainty of presence/absence of species or surrogate species in the area.
(white)	absence of colour indicates genus unlikely to occur in the region or distribution unknown

Table 4: Top ten most sensitive species/endpoints to chronic zinc exposure [1]

Rank	Species latin name	Species common name	Life stage	Exposure duration	Endpoint	Observed effect	Measured effect concentration (µg/L)
1	*Pseudokirchneriella subcapitata*	Green algae	Exponential growth phase	72 h	EC20	growth inhibition	10
2	*Epeorus latifolium*	Mayfly	Larva	4 weeks	EC10	emergence	14.4
3	*Ceriodaphnia dubia*	Water flea	Neonate	7 d	MATC	Reproduction	18.1
4	*Chlorella vulgaris*	Green algae	Exponential growth phase	72 h	EC50	biomass	34
5	*Jordanella floridae*	flagfish	Larva	100 d	MATC	Growth	36
6	*Hydra viridissima*	Green hydra	Not reported	7 d	EC10	Population growth inhibition	52.23
7	*Lampsilis siliquoidea*	Fatmucket	Juvenile	28 d	IC10	Length	55
8	*Oncorhynchus tshawytscha*	Chinook salmon	Fry	200 h	LC10	Mortality	68
9	*Brachionus havanaensis*	Rotifer	adults and juveniles	18 d	EC10	Population growth inhibition	78.2
10	*Pimephales promelas*	Fathead minnow	Larva	7 d	IC10	Growth	83.9

[1] data source: (Draft Canadian Water Quality Guideline for the Protection of Aquatic Life

(blue) denotes a species or genus confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)

(green) denotes a reasonable surrogate species is confirmed to be present (based on Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996)

(orange) denotes uncertainty of presence/absence of species or surrogate species in the area.

(white) absence of colour indicates genus unlikely to occur in the region or distribution unknown

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APPENDIX A

BIOLOGICAL DATA

Table A.1: Fish Species in Kudz Ze Kayah Project Vicinity[1] (Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996).

Family	Subfamily	Genus/Species	Common Name
Salmonidae			
	Salmoninae		
		Salvelinus namaycush	Lake trout
	Coregoninae		
		Prosopium williamsoni	Mountain whitefish
	Thaymallinae		
		Thymallus arcticus	Arctic grayling
Gadidae			
		Lota lota	Burbot
Cottidae			
		Cottus cognatus	Slimy sculpin

[1] Fish samples collected from locations at or near KZ-2, KZ-7, KZ-9, KZ-15, KZ16, KZ-21, KZ-26.

Table A.2: Benthic Invertebrate Species in Kudz Ze Kayah Project Vicinity[1] (Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996).

Phylum:	Subphylum	Class	Order	Family	Subfamily	Tribe	Genus/Species
Arthropoda							
	Hexapoda						
		Insecta					
			Ephemeroptera				
				Ameletidae			
							Ameletus
				Baetidae			
							Acentrella parvula
							Acentrella turbida
							Baetis
							Baetis bicaudatus
							Baetis tricaudatus group
				Ephemerellidae			
							Attenella sp.
							Drunella doddsii
							Drunella grandis group
							Drunella sp.
							Drunella spinifera
							Ephemerella
							Ephemerella velmae
				Heptageniidae			
							Cinygmula sp.
							Epeorus deceptivus
							Epeorus longimanus
							Epeorus
							Ironodes sp.
							Rhithrogena
			Plecoptera				
				Capniidae			
				Chloroperlidae			
							Haploperla sp.
							Paraperla sp.
							Suwallia
							Sweltsa sp.
				Leuctridae			
							Perlomyia sp.
				Nemouridae			
							Zapada
							Zapada cinctipes
							Zapada columbiana
							Zapada frigida
							Zapada oregonensis group
				Perlodidae			
				Taeniopterygidae			
							Taenionema
			Trichoptera				
				Brachycentridae			
							Brachycentrus americanus
							Brachycentrus occidentalis
							Micrasema
							Micrasema gelidum
				Glossosomatidae			
							Glossosoma
				Hydropsychidae			
							Parapsyche sp.
				Hydroptilidae			
							Oxyethira sp.
				Limnephilidae			
							Ecclisomyia sp.
				Rhyacophilidae			
							Rhyacophila
							Rhyacophila brunnea/vemna group
							Rhyacophila hyalinata group
							Rhyacophila vofixa group
				Uenoidae			
							Oligophlebodes
			Coleoptera				
				Elmidae			
							Heterlimnius sp.
			Diptera				
				Ceratopogonidae			
							Probezzia
				Chironomidae			
					Chironominae		
						Tanytarsini	
							Micropsectra
							Rheotanytarsus
							Stempellina sp.
							Tanytarsus
					Diamesinae		
						Diamesini	
							Diamesa
							Pagastia
							Potthastia longimana group
							Pseudodiamesa sp.

[1] Benthic invertebrate samples collected from KZ-2, KZ-7, KZ-9, KZ-15, KZ-16, KZ-17, KZ-21, KZ-26, KZ-27.

Table A.2: Benthic Invertebrate Species in Kudz Ze Kayah Project Vicinity[1] (Alexco 2015; Laberge and Can-Nic-a-Nic 2015; Cominco 1996).

Phylum:	Subphylum	Class	Order	Family	Subfamily	Tribe	Genus/Species
					Orthocladiinae		
							Brillia sp.
							Corynoneura
							Cricotopus
							Eukiefferiella
							Eukiefferiella claripennis group
							Eukiefferiella devonica group
							Heleniella sp.
							Hydrobaenus
							Krenosmittia sp.
							Orthocladius
							Parakiefferiella
							Rheocricotopus
							Thienemanniella
							Tvetenia
							Tvetenia bavarica group
							Tvetenia tshernovskii
						Corynoneurini	
							Corynoneura
							Thienemanniella
					Tanypodinae		
						Pentaneuriini	
							Thienemannimyia group
					Podonominae		
						Boreochlini	
							Boreochlus sp.
					Tanypodinae		
						Pentaneurini	
							Thienemannimyia group
				Empididae			
							Chelifera/ Metachela
							Clinocera sp.
							Oreogeton sp.
				Psychodidae			
							Pericoma/Telmatoscopus sp.
				Simuliidae			
							Helodon sp.
							Prosimulium
							Simulium
				Tipulidae			
							Antocha sp.
							Dicranota
							Gonomyodes sp.
	Chelicerata						
		Arachnida					
			Trombidiformes				
				Aturidae			
							Aturus
				Feltriidae			
							Feltria sp.
				Hygrobatidae			
							Atractides
							Hygrobates
				Lebertiidae			
							Lebertia
				Sperchontidae			
							Sperchon
							Sperchonopsis sp.
			Oribatei				
				Oribatidae			
							Oribatida
	Crustacea						
		Ostracoda					
		Branchiopoda					
			Cladocera				
		Maxillipoda					
		Copepoda					
Mullusca		**Bivalvia**					
		Gastropoda					
			Basommatophora				
				Planorbidae			*Gyraulus*
Annelida							
	Clitellata						
		Oligochaeta					
			Lumbriculida				
				Lumbriculidae			
			Tubificida				
				Enchytraeidae			
							Enchytraeus
Nematoda							
Platyhelminthes							
		Turbellaria					
Cnidaria							
		Hydrozoa					
			Anthoathecatae				
				Hydridae			
							Hydra

[1] Benthic invertebrate samples collected from KZ-2, KZ-7, KZ-9, KZ-15, KZ-16, KZ-17, KZ-21, KZ-26, KZ-27.

Table A.3: Periphyton Species in Kudz Ze Kayah Project Vicinity[1] (Alexco 2015).

Genus/Species	Genus/Species
Achnanthes flexella	Gomphonema clevei
Achnanthes hauckiana	Gomphonema gracile
Achnanthes lanceolata	Gomphonema olivaceum
Achnanthes linearis	Gomphonema subclavatum
Achnanthes minutissima	Gomphonema tenellum
Amphipleura pellucida	Hannaea arcus
Amphora ovalis	Melosira italica
Amphora perpusilla	Melosira varians
Anomoeoneis vitrea	Meridion circulare
Caloneis ventricosa	Navicula anglica
Caloneis ventricosa minuta	Navicula cryptocephala
Chlamydomonas sp.	Navicula cryptocephala veneta
Cocconeis placentula	Navicula gregaria
Cymbella affinis	Navicula minuscula
Cymbella cesatii	Navicula mutica
Cymbella cymbiformes	Navicula pupula
Cymbella lunata	Navicula radiosa
Cymbella microcephala	Navicula sp.
Cymbella minuta	Nitzschia acicularis
Cymbella sinuata	Nitzschia amphibia
Cymbella tumida	Nitzschia capitellata
Denticula elegans	Nitzschia constricta
Diatoma hiemale mesodon	Nitzschia dissipata
Diatoma tenue	Nitzschia frustulum
Diatoma tenue elongatum	Nitzschia palea
Diatoma vulgare	Nitzschia paleacea
Didymosphenia geminata	Oscillatoria sp.
Epithemia turgida	Pinnularia sp.
Eunotia pectinalis	Rhoicosphenia curvata
Fragilaria capucina mesolepta	Rhopalodia gibba
Fragilaria construens	Synedra radians
Fragilaria construens venter	Synedra rumpens
Fragilaria leptostauron	Synedra ulna
Fragilaria pinnata	Tabellaria fenestrata
Fragilaria vaucheria	Tabellaria flocculosa
Frustulia rhomboides	Ulothrix sp.
Gomphonema angustatum	

[1] Periphyton samples were collected from KZ-2, KZ-7, KZ- 9, KZ-13, KZ-15, KZ-16, KZ-17, KZ-21, KZ-22, KZ-26.

APPENDIX D.

Kudz Ze Kayah Project Water Quality Data for KZ-13, KZ-15, KZ-37 and KZ-26 (Alexco Environmental Group Inc.)

KZK Surface Water Quality Objectives Data - 1994 to March 2018

Station Name	Description	Sample Date	pH (field)	pH (lab)	Temperature (field)	Hardness (from total)	Hardness (from dissolved)	Chloride	Fluoride	Sulphate, dissolved	Cyanide, total	Cyanide, Weak Acid Dissociable	Ammonia (N)	Nitrite (N)	Nitrate (N)	Aluminum (Al), total	Antimony (Sb), total	Arsenic (As), total	Cadmium (Cd), total	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total
			pH units	pH units	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0	*		0.005	*	*	0.3	*
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0							
BC-MOE - Maximum Guidelines for Aquatic Life										*		0.005		0.02			0.009			*	1.0	*
KZ-13	South Creek near mouth	31-Aug-1994		7.9		252	229			41.3						3.25		0.0069		0.022	9.43	
KZ-13	South Creek near mouth	02-Dec-1994		7.3		69.2	71.1			10.3			0.011		0.11							
KZ-13	South Creek near mouth	07-Apr-1995		8		98.9	98.9			12.1	0.0005	0.0005	0.007	0.0025	0.15	0.021		0.000025	0.000005	0.0004	0.15	0.0003
KZ-13	South Creek near mouth	08-May-1995		7		47.7	46.5			5	0.0005	0.0005	0.008	0.0025	0.03	0.44		0.0004	0.00004	0.0021	0.085	0.00005
KZ-13	South Creek near mouth	11-Jun-1995		7.1		47	46.5			6.6	0.0005	0.0005	0.0025	0.0025	0.04	0.15		0.002	0.00002	0.001	0.25	0.0003
KZ-13	South Creek near mouth	23-Jul-1995		7.4		61.1	61.1			10.3	0.0005	0.0005	0.0025	0.0025	0.01	0.036		0.000025	0.00001	0.0006	0.091	0.0003
KZ-13	South Creek near mouth	15-Aug-1995		7.4		54.9	51.9			7		0.0005	0.0025	0.0025	0.05	0.028		0.000025	0.00001	0.0008	0.082	0.0001
KZ-13	South Creek near mouth	22-Aug-1995		7.6		66.9	69.8			7.6	0.0005	0.0005	0.0025	0.0025	0.01	0.11		0.0001	0.00003	0.0009	0.23	0.0002
KZ-13	South Creek near mouth	30-Aug-1995		7		61.1	61.1			5.9	0.0005	0.0005	0.0025	0.0025	0.03	0.026		0.00011	0.000005	0.0005	0.083	0.0001
KZ-13	South Creek near mouth	06-Sep-1995		7.4		63.6	64			7.5	0.0005	0.0005	0.007	0.0025	0.05	0.034		0.000025	0.00001	0.0005	0.09	0.0002
KZ-13	South Creek near mouth	13-Sep-1995		7		69.8	66.9			7.8	0.0005	0.0005	0.0025	0.0025	0.06	0.037		0.0001	0.00002	0.0008	0.1	0.0002
KZ-13	South Creek near mouth	30-Apr-2015	7.55	8.24	-0.1	113	111	1.2	0.064	13.7	0.0005	0.00025	0.0074	0.0010	0.0935	0.0969	0.000025	0.000291	0.0000359	0.00082	0.258	0.000196
KZ-13	South Creek near mouth	12-May-2015	7.96	7.53	0.4	36.1	35.6	0.85	0.033	0.25	0.00119	0.00116	0.0063		0.035	0.666	0.000025	0.000639	0.000109	0.0026	1.34	0.00106
KZ-13	South Creek near mouth	13-May-2015																				
KZ-13	South Creek near mouth	24-Jun-2015	7.84	7.86	8.1	60.8	61.4	0.73	0.043	10.2	0.00025	0.00025	0.0083	0.0010	0.0175	0.0293	0.000025	0.000226	0.0000197	0.00084	0.0664	0.000025
KZ-13	South Creek near mouth	29-Jul-2015	7.96	7.78	10.3	70.8	70.5	0.25	0.043	11.6	0.00061	0.0007	0.0102	0.0010	0.0198	0.0567	0.000033	0.000276	0.0000275	0.000575	0.141	0.0000698
KZ-13	South Creek near mouth	23-Aug-2015	7.69	7.83	6.8	64.1	64.7	0.25	0.044	14.2	0.00025	0.00056	0.0025	0.0010	0.0378	0.016	0.000025	0.000236	0.000031	0.00103	0.0697	0.000025
KZ-13	South Creek near mouth	11-Sep-2015	7.92	8.02	5.3	68.7	70.9	0.25	0.044	12.4	0.0008	0.00059	0.0025	0.0010	0.0246	0.0262	0.000023	0.000206	0.000031	0.000561	0.0704	0.000045
KZ-13	South Creek near mouth	14-Oct-2015	7.75	7.89	1.5	76	73.4	0.53	0.039	13.6	0.00025	0.00025	0.0134	0.0010	0.0581	0.0273	0.00003	0.000185	0.000026	0.000483	0.0779	0.000047
KZ-13	South Creek near mouth	06-Nov-2015	7.79	8.07	-2	83.4	78.4	0.25	0.044	16	0.00057	0.00025	0.0025	0.0010	0.0793	0.0347	0.000036	0.000218	0.000041	0.000521	0.103	0.000085
KZ-13	South Creek near mouth	02-Dec-2015	7.78	8.05	0.4	89.8	87.6	0.25	0.039	15.4	0.00025	0.00025	0.0025	0.0010	0.0855	0.0273	0.000034	0.000229	0.000034	0.0005	0.132	0.000052
KZ-13	South Creek near mouth	21-Jan-2016	7.6	7.99	0	88.8	89.4	0.57	0.045	13.8	0.00063	0.00072	0.009	0.0010	0.154	0.0149	0.000010	0.000188	0.000041	0.000347	0.171	0.000042
KZ-13	South Creek near mouth	08-Feb-2016	7.51	7.99	0	84.9	87	0.25	0.047	13.5	0.00025	0.00065	0.0066	0.0010	0.159	0.0228	0.000010	0.000307	0.000043	0.00633	0.357	0.000101
KZ-13	South Creek near mouth	21-Mar-2016	6.82	7.83	0.9	91.8	88.4	0.25	0.045	14.6	0.00025	0.00054	0.051	0.0010	0.151	0.0136	0.000010	0.000193	0.000027	0.000269	0.221	0.000023
KZ-13	South Creek near mouth	20-Apr-2016	7.56	8.07	0.2	91	116	0.25	0.053	14.5	0.00025	0.00025	0.0124	0.0010	0.0808	0.0072	0.000025	0.000151	0.000021	0.00056	0.0823	0.000025
KZ-13	South Creek near mouth	16-May-2016	7.53	7.99	2.4	56.5	59.4	0.54	0.044	8.17	0.00053	0.00025	0.0025	0.0010	0.0344	0.02	0.000025	0.00015	0.000015	0.00083	0.0758	0.000025
KZ-13	South Creek near mouth	14-Jun-2016	7.99	7.98	9.7	61.5	61.5	0.54	0.042	11.4	0.00107	0.00065	0.0073	0.0010	0.0404	0.081	0.000055	0.000252	0.000039	0.000779	0.206	0.000204
KZ-13	South Creek near mouth	26-Jul-2016	7.49	7.98	8.6	71.2	72.6	0.25	0.043	12.8	0.00025	0.00055	0.024	0.0010	0.0287	0.0343	0.000028	0.00026	0.000033	0.00088	0.119	0.000065
KZ-13	South Creek near mouth	28-Aug-2016	7.75	7.95	6.1	68	64	0.72	0.042	11.5	0.00025	0.00025	0.03	0.0010	0.0452	0.0261	0.000023	0.000231	0.000034	0.000596	0.0877	0.000056
KZ-13	South Creek near mouth	06-Sep-2016	7.62	7.96	7	60.6	63.4	0.25	0.046	12.8	0.00071	0.00073	0.012	0.0010	0.0412	0.0251	0.000026	0.000199	0.00003	0.000583	0.0675	0.000038
KZ-13	South Creek near mouth	03-Oct-2016	7.7	7.66	1.1	70.9	69	0.57	0.044	13.8	0.00025	0.00025	0.01	0.0010	0.0618	0.0182	0.000028	0.000207	0.000027	0.00196	0.0747	0.000058
KZ-13	South Creek near mouth	16-Nov-2016	7.12	7.96	-0.2	80.2	84.5	0.25	0.05	16	0.00064	0.00071	0.023	0.0010	0.0969	0.015	0.000033	0.000184	0.000031	0.000474	0.108	0.000077
KZ-13	South Creek near mouth	21-Dec-2016	7.19	7.98	0	98.8	103	0.58	0.049	18.1	0.00077	0.00025	0.062	0.0010	0.111	0.0194	0.000035	0.000216	0.000041	0.000484	0.143	0.00005
KZ-13	South Creek near mouth	17-Jan-2017	7.5	8.11	-0.1	105	107	0.88	0.051	17	0.00025	0.00025	0.044	0.0010	0.109	0.00958	0.000035	0.000242	0.000049	0.000364	0.15	0.000028
KZ-13	South Creek near mouth	22-Feb-2017	7.48	8.03	-0.2	110	109	0.54	0.056	17.9	0.00025	0.00025	0.054	0.0022	0.143	0.0211	0.00003	0.000283	0.000042	0.000302	0.197	0.000047
KZ-13	South Creek near mouth	20-Mar-2017	7.76	7.95	-0.2	127	121	0.87	0.058	19.9	0.00025	0.00025	0.067	0.0010	0.15	0.0201	0.000207	0.000318	0.000061	0.000759	0.241	0.000476
KZ-13	South Creek near mouth	30-Apr-2017	8.08	8.2	0	112	112	0.59	0.061	18	0.00068	0.00063	0.042	0.0010	0.142	0.00792	0.000054	0.000212	0.000026	0.00031	0.132	0.000007
KZ-13	South Creek near mouth	17-May-2017	7.63	7.76	1.7	43.3	38.3	0.59	0.036	0.25	0.00105	0.00099	0.039	0.0021	0.0046	0.143	0.000010	0.000339	0.0000683	0.00121	0.358	0.000169
KZ-13	South Creek near mouth	06-Jun-2017	7.48	7.89	9	53.7	52.8	0.57	0.038	8.5	0.00083	0.00025	0.02	0.0010	0.0269	0.0587	0.000031	0.000232	0.000026	0.00084	0.145	0.000073
KZ-13	South Creek near mouth	20-Jul-2017	7.74	7.94	9.7	55.1	55	0.25	0.042	9.01	0.00064	0.00079	0.018	0.0010	0.0187	0.0332	0.000023	0.00021	0.0000255	0.000824	0.0649	0.0000326
KZ-13	South Creek near mouth	09-Aug-2017	7.35	7.91	9.1	56.2	57.5	0.25	0.04	9.08	0.00081	0.00065	0.007	0.0010	0.0186	0.0363	0.00004	0.000227	0.0000326	0.000746	0.0887	0.0000445
KZ-13	South Creek near mouth	14-Sep-2017	7.75	7.95	4	66.3	65.4	0.55	0.046	12.3	0.00025	0.00025	0.012	0.0010	0.0492	0.0196	0.000031	0.000245	0.000028	0.000695	0.0884	0.000042
KZ-13	South Creek near mouth	03-Oct-2017	7.89	7.98	2.5	69.1	65.2	0.7	0.045	13.5	0.00055	0.00025	0.012	0.0010	0.0742	0.0328	0.000033	0.000241	0.000025	0.000501	0.123	0.000064
KZ-13	South Creek near mouth	02-Nov-2017	7.74	7.84	-0.1	67.2	69.5	0.63	0.046	14.9	0.00054	0.00025	0.007	0.0010	0.14	0.00948	0.000010	0.000145	0.000021	0.000323	0.0803	0.000009
KZ-13	South Creek near mouth	06-Dec-2017	7.57	7.95	-0.4	76.9	75.5	0.67	0.044	16.2	0.00025	0.00025	0.0025	0.0010	0.138	0.013	0.000010	0.000153	0.0000306	0.000326	0.0942	0.0000151
KZ-13	South Creek near mouth	31-Jan-2018	7.79	8.16	-0.2	108	115	0.25	0.059	19.5	0.00025	0.00025	0.014	0.0010	0.101	0.0137	0.000043	0.000242	0.000064	0.000464	0.187	0.0000654
KZ-13	South Creek near mouth	15-Feb-2018	7.76	8.03	-0.1	84.4	88.1	0.67	0.055	19.4	0.00065	0.00025	0.016	0.0010	0.14	0.058	0.000039	0.000181	0.000142	0.000719		0.0000659
KZ-13	South Creek near mouth	21-Feb-2018	7.64	8.12	-0.1	121	115	0.74	0.06	20.5	0.00025	0.00025	0.078	0.0010	0.0868	0.0257	0.00004	0.000348	0.0000533	0.000452	0.294	0.000165
KZ-13	South Creek near mouth	01-Mar-2018	7.69	8.19	-0.1	115	113	0.25	0.062	18.4	0.00069	0.00059	0.024	0.0010	0.107	0.00659	0.000042	0.000223	0.0000306	0.000373	0.156	0.0000107
KZ-13	South Creek near mouth	07-Mar-2018	7.66	8.04	-0.3	112	121	0.76	0.062	18.2	0.00096	0.00102	0.063	0.0010	0.109	0.00838	0.000039	0.000276	0.0000595	0.000499	0.143	0.0000377
KZ-13	South Creek near mouth	15-Mar-2018	7.48	8.23	-0.5	107	119	0.25	0.061	18.6	0.00072	0.00025	0.031	0.0010	0.114	0.00649	0.000049	0.000225	0.0000642	0.000576	0.114	0.0000196
Average			7.64	7.84	2.6	81.4	81.6	0.502	0.048	13.217	0.000519	0.000463	0.01845	0.00134	0.0748	0.12109	0.0000341	0.000390	0.0000362	0.001263	0.3587	0.0001144
Count			39	50	39	50	50	39	39	50	47	48	49	47	49	49	39	49	48	49	48	48
Minimum			6.82	7	-2	36.1	35.6	0.25	0.033	0.25	0.00025	0.00025	0.0025	0.0010	0.0046	0.00649	0.000010	0.000025	0.000005	0.000269	0.0649	0.000007
Maximum			8.08	8.24	10.3	252	229	1.2	0.064	41.3	0.00119	0.00116	0.078	0.0025	0.159	3.25	0.000207	0.0069	0.000142	0.022	9.43	0.00106
Geometric Mean			7.64	7.83	3.1	76.6	76.7	0.444	0.047	10.910	0.000459	0.000410	0.01068	0.00123	0.0568	0.03142	0.0000282	0.000208	0.0000299	0.000704	0.1431	0.0000642
Count <DL			0	0	0	0	0	16	0	2	25	31	12	45	2	0	12	4	2	0	0	5
Standard Deviation			0.24	0.32	3.8	33.3	31.7	0.245	0.008	6.259	0.000255	0.000237	0.01986	0.00062	0.0478	0.46956	0.0000307	0.000988	0.0000243	0.003160	1.3504	0.0001697
1st Quartile			7.52	7.79	-0.1	61.2	62.0	0.25	0.043	9.360	0.00025	0.00025	0.0063	0.0010	0.0344	0.016	0.000025	0.000184	0.0000254	0.000483	0.0845	0.0000364
Median			7.69	7.95	0.4	70.8	71.0	0.54	0.045	13.5	0.0005	0.0005	0.0102	0.0010	0.0618	0.0261	0.00003	0.000225	0.0000308	0.000583	0.1210	0.0000570
3rd Quartile			7.77	8.03	5.7	97.0	102.0	0.67	0.054	16.150	0.000665	0.000600	0.024	0.0010	0.11	0.0363	0.0000375	0.00026	0.000041	0.00083	0.1895	0.0001170
95th Percentile			7.963	8.1955	9.7	118	120	0.871	0.06	19.72	0.001023	0.00092	0.0626	0.0025	0.151	0.324	0.0000541	0.0005434	6.687E-05	0.0024	0.358	0.0003
Mean + 2 Standard Deviation			8.12	8.48	10.2	148	145	0.992	0.06	25.74	0.001029	0.000937	0.05817	0.00258	0.17	1.0602	0.0000955	0.002366	0.0000848	0.00758	3.06	0.0004538

Sample Date	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Selenium (Se), total	Silver (Ag), total	Thallium (Tl), total	Uranium (U), total	Zinc (Zn), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Cadmium (Cd), dissolved
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life		0.000026	0.073	*	0.001	0.00025	0.0008	0.015	0.03				
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals										*		0.005	*
BC-MOE - Maximum Guidelines for Aquatic Life	*				0.002				*	*			*
31-Aug-1994	0.258				0.0009				0.07	0.01		0.0016	
02-Dec-1994	0.049												
07-Apr-1995	0.045	0.000005	0.0002	0.0005	0.00016	0.000005			0.008	0.008		0.000025	0.00001
08-May-1995	0.079	0.000005	0.0002	0.002	0.000025	0.000005			0.008	0.07		0.0002	0.00002
11-Jun-1995	0.02		0.0002	0.0005	0.000025	0.000005			0.019	0.026		0.0001	0.00001
23-Jul-1995	0.02	0.000005	0.0011	0.0005	0.00035	0.000005			0.004	0.009		0.000025	0.000005
15-Aug-1995	0.022	0.000005	0.0006	0.0005	0.0001	0.000005			0.003	0.003		0.000025	0.000005
22-Aug-1995	0.039	0.000005	0.0002	0.001	0.000025	0.000005			0.005	0.01		0.00011	0.00001
30-Aug-1995	0.021	0.000005	0.0005	0.0005	0.00006	0.000005			0.004	0.009		0.00009	0.000005
06-Sep-1995	0.019	0.000005	0.0006	0.001	0.000025	0.000005			0.004	0.011		0.000025	0.000005
13-Sep-1995	0.023	0.000005	0.0005	0.0005	0.00009	0.000005			0.003	0.011		0.00006	0.00002
30-Apr-2015	0.0748	0.0000010	0.000953	0.00065	0.000236	0.0000128	0.0000051	0.00259	0.0038	0.00495	0.000046	0.000219	0.00001
12-May-2015	0.196	0.0000025	0.000545	0.00223	0.000133	0.000019	0.0000128	0.000844	0.0114	0.0341	0.000010	0.000253	0.0000107
13-May-2015													
24-Jun-2015	0.016	0.0000010	0.000548	0.00063	0.000138	0.0000258	0.0000049	0.00041	0.0028	0.00784	0.000027	0.000193	0.0000121
29-Jul-2015	0.0455	0.0000010	0.000595	0.0006	0.000152	0.0000025	0.0000023	0.000568	0.00353	0.00715	0.000028	0.000249	0.0000175
23-Aug-2015	0.0197	0.0000010	0.000496	0.00042	0.000123	0.0000025	0.000002	0.000456	0.0045	0.00683	0.000024	0.000193	0.000014
11-Sep-2015	0.0158	0.0000010	0.000488	0.000423	0.000135	0.0000025	0.0000010	0.00054	0.00436	0.00873	0.000029	0.000196	0.000024
14-Oct-2015	0.0233	0.0000010	0.000611	0.000395	0.000198	0.0000025	0.0000010	0.000676	0.00316	0.00592	0.000021	0.000162	0.000015
06-Nov-2015	0.0376	0.0000010	0.000676	0.00043	0.000251	0.0000025	0.0000010	0.000804	0.00421	0.022	0.00003	0.000172	0.000022
02-Dec-2015	0.042	0.0000010	0.000633	0.000398	0.000296	0.0000025	0.0000010	0.00107	0.00377	0.00487	0.00003	0.000156	0.000015
21-Jan-2016	0.0824	0.0000010	0.000737	0.000362	0.000297	0.0000025	0.0000010	0.000861	0.00388	0.00357	0.000010	0.000123	0.000027
08-Feb-2016	0.115	0.0000010	0.000696	0.000408	0.000304	0.0000025	0.0000010	0.000733	0.00509	0.00279	0.000010	0.000132	0.000026
21-Mar-2016	0.0945	0.0000010	0.000755	0.000345	0.000328	0.0000025	0.000002	0.000783	0.00255	0.00485	0.000010	0.000122	0.00002
20-Apr-2016	0.0246	0.0000010	0.000664	0.00037	0.000252	0.0000025	0.0000010	0.00154	0.0018	0.00688	0.000032	0.000196	0.00002
16-May-2016	0.0136	0.0000010	0.0005	0.00044	0.000158	0.0000025	0.000003	0.000402	0.0022	0.0108	0.00002	0.000155	0.000012
14-Jun-2016	0.0398	0.0000010	0.000547	0.000519	0.000142	0.000006	0.0000010	0.000457	0.00502	0.00827	0.00002	0.000161	0.000013
26-Jul-2016	0.0382	0.0000010	0.00057	0.00049	0.000147	0.000005	0.000003	0.000605	0.0038	0.00754	0.000032	0.000226	0.000008
28-Aug-2016	0.0175	0.0000010	0.000462	0.000498	0.000143	0.0000025	0.0000010	0.00049	0.00461	0.00879	0.000028	0.000202	0.000015
06-Sep-2016	0.0144	0.0000010	0.000448	0.000462	0.000142	0.0000025	0.000002	0.000494	0.0049	0.00853	0.000027	0.00016	0.000019
03-Oct-2016	0.0187	0.0000010	0.000552	0.000972	0.000164	0.0000025	0.0000010	0.000606	0.00425	0.00789	0.00003	0.000188	0.000021
16-Nov-2016	0.0411	0.0000010	0.000656	0.000393	0.000242	0.0000025	0.0000010	0.000905	0.00349	0.00446	0.00003	0.00012	0.000019
21-Dec-2016	0.0551	0.0000010	0.000747	0.000454	0.000327	0.0000025	0.000003	0.00114	0.00399	0.00423	0.000029	0.000179	0.000034
17-Jan-2017	0.109	0.0000010	0.000747	0.000373	0.000291	0.0000025	0.000002	0.00139	0.00449	0.00399	0.000035	0.000187	0.00004
22-Feb-2017	0.124	0.0000010	0.000802	0.000394	0.000367	0.0000025	0.000002	0.00163	0.00411	0.00329	0.000027	0.000221	0.000027
20-Mar-2017	0.135	0.0000129	0.000819	0.000531	0.00041	0.0000025	0.000002	0.00174	0.0153	0.00345	0.000101	0.000183	0.00003
30-Apr-2017	0.108	0.0000010	0.000868	0.000403	0.000331	0.0000025	0.000002	0.00191	0.00254	0.00325	0.000029	0.000179	0.00002
17-May-2017	0.093	0.0000032	0.000493	0.00098	0.000175	0.000005	0.0000047	0.000401	0.0075	0.0356	0.000010	0.000209	0.0000342
06-Jun-2017	0.0174	0.0000010	0.000521	0.000622	0.000153	0.0000025	0.000003	0.000433	0.00361	0.018	0.00003	0.000202	0.000013
20-Jul-2017	0.0102	0.0000010	0.000471	0.000555	0.000171	0.0000025	0.0000010	0.000326	0.00335	0.0187	0.000043	0.000207	0.000021
09-Aug-2017	0.0182	0.0000010	0.000486	0.00058	0.000183	0.0000025	0.0000010	0.000327	0.00424	0.0175	0.000054	0.000202	0.0000235
14-Sep-2017	0.0256	0.0000010	0.000621	0.000472	0.000176	0.0000025	0.000002	0.000687	0.00326	0.00915	0.000025	0.000201	0.000022
03-Oct-2017	0.0337	0.0000010	0.000671	0.000484	0.000165	0.0000025	0.000002	0.000733	0.00297	0.00667	0.000027	0.000214	0.000019
02-Nov-2017	0.0476	0.0000010	0.00062	0.000341	0.000199	0.0000025	0.0000010	0.000484	0.00261	0.00548	0.00002	0.00015	0.000021
06-Dec-2017	0.0625	0.0000010	0.000717	0.000358	0.000239	0.0000025	0.0000010	0.000407	0.00375	0.00473	0.000010	0.000134	0.0000347
31-Jan-2018	0.0838	0.0000010	0.000805	0.00044	0.000247	0.0000025	0.0000010	0.00135	0.00384	0.00384	0.000042	0.000199	0.0000472
15-Feb-2018	0.0891	0.0000010	0.000809	0.000547	0.000321	0.0000025	0.0000010	0.000808	0.00534	0.00363	0.000033	0.000122	0.0000766
21-Feb-2018	0.147	0.0000010	0.0009	0.00056	0.000273	0.0000025	0.0000010	0.00193	0.00367	0.00569	0.000053	0.000233	0.000342
01-Mar-2018	0.0849	0.0000010	0.000893	0.000475	0.000268	0.0000025	0.0000021	0.00174	0.00218	0.00346	0.000035	0.000205	0.0000223
07-Mar-2018	0.0926	0.0000010	0.000833	0.000494	0.000324	0.0000025	0.0000010	0.00198	0.00321	0.00329	0.000039	0.000189	0.0000545
15-Mar-2018	0.0745	0.0000010	0.000741	0.000411	0.000316	0.0000025	0.0000010	0.00152	0.00386	0.00313	0.000042	0.00019	0.0000478
Average	0.0595	0.00000201	0.000621	0.000581	0.000218	0.00000419	0.00000210	0.000943	0.00602	0.01022	0.0000302	0.000193	0.0000283
Count	50	47	48	48	49	48	39	39	49	49	39	49	48
Minimum	0.0102	0.0000010	0.0002	0.000341	0.000025	0.0000025	0.0000010	0.000326	0.0018	0.00279	0.000010	0.000025	0.000005
Maximum	0.258	0.0000129	0.0011	0.00223	0.0009	0.0000258	0.0000128	0.00259	0.07	0.07	0.000101	0.0016	0.000342
Geometric Mean	0.0435	0.00000145	0.000583	0.000526	0.000176	0.00000338	0.00000165	0.000797	0.00438	0.00745	0.0000267	0.000152	0.0000192
Count <DL	0	44	4	6	4	44	20	0	0	2	6	4	4
Standard Deviation	0.0506	0.00000223	0.000194	0.000363	0.000139	0.00000429	0.00000209	0.000577	0.00983	0.01141	0.0000161	0.000213	0.0000483
1st Quartile	0.0202	0.0000010	0.0005	0.000410	0.000142	0.0000025	0.0000010	0.000487	0.00326	0.00423	0.0000225	0.000132	0.0000128
Median	0.0416	0.0000010	0.000616	0.000492	0.000183	0.0000025	0.0000010	0.000733	0.00388	0.00715	0.000029	0.000187	0.00002
3rd Quartile	0.0846	0.0000010	0.000747	0.000556	0.000296	0.000005	0.00000205	0.001370	0.00461	0.01	0.0000340	0.000202	0.0000262
95th Percentile	0.1416	0.000005	0.0009	0.001	0.0003602	0.00001042	4.92E-06	0.00194	0.01374	0.03086	5.31E-05	0.0002426	5.216E-05
Mean + 2 Standard Deviation	0.1607	6.47E-06	0.00101	0.00131	0.000496	0.00001277	6.28E-06	0.0021	0.02568	0.03304	6.24E-05	0.000619	0.0001249

Sample Date	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Selenium (Se), dissolved	Silver (Ag), dissolved	Thallium (Tl), dissolved	Uranium (U), dissolved	Zinc (Zn), dissolved
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life												
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals	*	0.3	*		0.000026	0.073	*	0.001	0.00025	0.0008	0.015	0.03
BC-MOE - Maximum Guidelines for Aquatic Life		0.35										
31-Aug-1994	0.0005	0.694		0.051				0.00025				0.001
02-Dec-1994				0.021								
07-Apr-1995	0.0004	0.069	0.0014	0.038	0.000005	0.0002	0.0005	0.00015	0.000005			
08-May-1995		0.29	0.0004	0.046	0.000005	0.0002		0.000025	0.000005			
11-Jun-1995	0.0007	0.047	0.0002	0.0067		0.0006	0.0005	0.000025	0.000005			0.003
23-Jul-1995	0.0006	0.034	0.0002	0.016	0.000005	0.0008	0.0005	0.00032	0.000005			0.004
15-Aug-1995	0.0004	0.03	0.00005	0.013	0.000005	0.0006	0.0005	0.0001	0.000005			0.003
22-Aug-1995	0.0006	0.049	0.00005	0.013	0.000005	0.0002	0.0005	0.000025	0.000005			0.003
30-Aug-1995	0.0005	0.028	0.00005	0.013	0.000005	0.0004		0.00005	0.000005			0.002
06-Sep-1995	0.0005	0.32	0.00005	0.012	0.000005	0.0004	0.0005	0.000025	0.000005			0.002
13-Sep-1995	0.0007	0.035	0.0003	0.013	0.000005	0.0004	0.0005	0.00015	0.000005			0.002
30-Apr-2015	0.000327	0.0271	0.0000051	0.0108	0.0000010	0.000939	0.000427	0.000237	0.0000025	0.0000010	0.00244	0.00099
12-May-2015	0.00086	0.0961	0.0000161	0.000376	0.0000023	0.000403	0.000779	0.000106	0.0000025	0.0000023	0.00033	0.0012
13-May-2015												
24-Jun-2015	0.000775	0.0247	0.000006	0.00601	0.0000010	0.000527	0.000466	0.000124	0.0000025	0.0000010	0.000396	0.00158
29-Jul-2015	0.000435	0.0311	0.0000025	0.0168	0.0000010	0.000566	0.000492	0.000138	0.0000025	0.0000024	0.000565	0.00179
23-Aug-2015	0.000474	0.0198	0.0000025	0.00842	0.0000010	0.000491	0.000392	0.000138	0.0000025	0.0000010	0.000403	0.00233
11-Sep-2015	0.000484	0.0187	0.000006	0.00609	0.0000010	0.000485	0.000412	0.000153	0.0000025	0.0000010	0.000521	0.00297
14-Oct-2015	0.000436	0.0186	0.0000025	0.00972	0.0000010	0.000566	0.000341	0.000176	0.0000025	0.0000010	0.000649	0.00203
06-Nov-2015	0.000571	0.0291	0.000046	0.0226	0.0000010	0.000714	0.000358	0.000248	0.0000025	0.000002	0.000781	0.00261
02-Dec-2015	0.000385	0.0417	0.0000025	0.0226	0.0000010	0.000664	0.000351	0.000306	0.0000025	0.0000010	0.000939	0.00142
21-Jan-2016	0.000272	0.0305	0.000005	0.0575	0.0000010	0.000755	0.000291	0.000277	0.0000025	0.0000010	0.000788	0.00243
08-Feb-2016	0.000282	0.0373	0.000012	0.0636	0.0000010	0.000765	0.000308	0.000311	0.0000025	0.0000010	0.000684	0.00298
21-Mar-2016	0.000238	0.0411	0.000006	0.08	0.0000010	0.000763	0.000318	0.000308	0.0000025	0.000002	0.000784	0.00197
20-Apr-2016	0.000439	0.0677	0.000006	0.0298	0.0000010	0.00077	0.000455	0.000274	0.0000025	0.0000010	0.002	0.00183
16-May-2016	0.000634	0.0369	0.000007	0.00559	0.0000010	0.000499	0.000451	0.000123	0.000005	0.000004	0.000355	0.00165
14-Jun-2016	0.000423	0.0123	0.0000025	0.00136	0.0000010	0.000528	0.000336	0.000115	0.000005	0.000003	0.000418	0.00137
26-Jul-2016	0.000472	0.0171	0.0000025	0.000187	0.0000010	0.000549	0.000358	0.00012	0.0000025	0.000002	0.000593	0.00096
28-Aug-2016	0.000558	0.0215	0.000019	0.00566	0.0000010	0.000463	0.000439	0.000128	0.0000025	0.0000010	0.000473	0.00315
06-Sep-2016	0.000537	0.0153	0.000005	0.00269	0.0000010	0.000457	0.000438	0.000131	0.0000025	0.000002	0.000478	0.00309
03-Oct-2016	0.000455	0.0195	0.000005	0.00288	0.0000010	0.000544	0.00039	0.000148	0.0000025	0.000002	0.000604	0.00277
16-Nov-2016	0.00042	0.0312	0.000016	0.0247	0.0000010	0.000663	0.000359	0.000246	0.0000025	0.000002	0.000827	0.00238
21-Dec-2016	0.000401	0.0653	0.000024	0.0545	0.0000010	0.000697	0.000398	0.000331	0.0000025	0.0000010	0.00112	0.00371
17-Jan-2017	0.000337	0.0594	0.000008	0.108	0.0000010	0.000738	0.00044	0.000313	0.0000025	0.0000010	0.00146	0.00379
22-Feb-2017	0.000261	0.0529	0.0000025	0.112	0.0000010	0.000772	0.000354	0.000363	0.0000025	0.0000010	0.00161	0.00265
20-Mar-2017	0.000507	0.0476	0.000058	0.117	0.0000010	0.000858	0.000419	0.000345	0.0000025	0.000002	0.00188	0.0119
30-Apr-2017	0.000268	0.0644	0.0000025	0.102	0.0000010	0.000854	0.000393	0.000359	0.0000025	0.0000010	0.00184	0.00265
17-May-2017	0.00085	0.103	0.0000158	0.0583	0.0000031	0.000432	0.00074	0.000148	0.0000025	0.000002	0.000326	0.0039
06-Jun-2017	0.000694	0.0541	0.000022	0.00754	0.0000010	0.000502	0.000533	0.000136	0.0000025	0.000002	0.000401	0.00206
20-Jul-2017	0.00075	0.0358	0.000013	0.006	0.0000010	0.000485	0.000536	0.00015	0.0000025	0.000002	0.00031	0.00275
09-Aug-2017	0.000725	0.0495	0.0000154	0.011	0.0000010	0.000594	0.000701	0.000132	0.0000025	0.000002	0.000321	0.00365
14-Sep-2017	0.000492	0.0524	0.000014	0.0222	0.0000010	0.000613	0.000429	0.000163	0.0000025	0.0000010	0.000679	0.00285
03-Oct-2017	0.000437	0.0482	0.000009	0.0283	0.0000010	0.000648	0.000401	0.000174	0.0000025	0.0000010	0.000729	0.00213
02-Nov-2017	0.000327	0.0507	0.00019	0.0443	0.0000010	0.00064	0.000354	0.000191	0.000007	0.0000010	0.000504	0.00241
06-Dec-2017	0.000477	0.0435	0.0000489	0.0579	0.0000010	0.000728	0.000395	0.000241	0.0000025	0.0000010	0.000407	0.00467
31-Jan-2018	0.000378	0.0877	0.0000064	0.083	0.0000010	0.000824	0.000467	0.000273	0.0000025	0.0000010	0.00141	0.00285
15-Feb-2018	0.000647	0.0504	0.0000478	0.0658	0.0000010	0.000804	0.000384	0.000284	0.0000025	0.0000010	0.000806	0.00402
21-Feb-2018	0.000875	0.1	0.0000814	0.133	0.0000010	0.000801	0.000551	0.000247	0.0000025	0.0000010	0.00176	0.00565
01-Mar-2018	0.000025	0.0906	0.0000118	0.0826	0.0000010	0.000795	0.000465	0.000256	0.0000025	0.0000024	0.00188	0.0021
07-Mar-2018	0.000418	0.094	0.0000234	0.0747	0.0000010	0.000847	0.000398	0.000285	0.0000025	0.0000010	0.00166	0.00306
15-Mar-2018	0.000448	0.0703	0.0000122	0.0813	0.0000010	0.00081	0.000432	0.000292	0.0000025	0.0000010	0.0016	0.00375
Average	0.0004936	0.0705	0.00007253	0.037390	0.00000175	0.000612	0.000445	0.000196	0.00000317	0.00000152	0.000916	0.00281
Count	48	49	48	50	47	48	46	49	48	39	39	47
Minimum	0.000025	0.0123	0.0000025	0.000187	0.0000010	0.0002	0.000291	0.000025	0.0000025	0.0000010	0.00031	0.00096
Maximum	0.000875	0.694	0.0014	0.133	0.000005	0.000939	0.000779	0.000363	0.000007	0.000004	0.00244	0.0119
Geometric Mean	0.0004498	0.0469	0.00001685	0.019152	0.00000137	0.000578	0.000435	0.000164	0.00000299	0.00000138	0.000756	0.00251
Count <DL	2	0	12	0	45	3	7	5	45	23	0	1
Standard Deviation	0.0001761	0.1072	0.00021161	0.036203	0.00000153	0.000181	0.000102	0.000096	0.00000120	0.00000071	0.000593	0.00168
1st Quartile	0.0004	0.03	0.00000578	0.008745	0.0000010	0.000490	0.000386	0.000131	0.0000025	0.0000010	0.000446	0.002
Median	0.0004730	0.047	0.00001350	0.022400	0.0000010	0.000606	0.000430	0.000174	0.0000025	0.0000010	0.000684	0.00265
3rd Quartile	0.0006	0.0653	0.00004918	0.058200	0.0000010	0.000766	0.0005	0.000277	0.00000312	0.000002	0.001435	0.00307
95th Percentile	0.0008238	0.2152	0.000265	0.1102	0.000005	0.00085	0.00066	0.0003394	0.000005	2.46E-06	0.00189	0.004475
Mean + 2 Standard Deviation	0.0008458	0.2849	0.00049575	0.1098	4.81E-06	0.00097	0.00065	0.000388	0.00000557	2.94E-06	0.0021	0.00617

KZK Surface Water Quality Objectives Data - 1994 to March 2018

Station Name	Description	Sample Date	pH (field)	pH (lab)	Temperature (field)	Hardness (from total)	Hardness (from dissolved)	Chloride	Fluoride	Sulphate, dissolved	Cyanide, total	Cyanide, Weak Acid Dissociable	Ammonia (N)	Nitrite (N)	Nitrate (N)	Aluminum (Al), total	Antimony (Sb), total	Arsenic (As), total	Cadmium (Cd), total	Copper (Cu), total
			pH units	pH units	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0	*		0.005	*	*
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0					
BC-MOE - Maximum Guidelines for Aquatic Life										*		0.005		0.02			0.009			*
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	03-Dec-1994		7.9		213	214			27.5			0.011		0.19					
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	05-Apr-1995		7.9		271	285			32	0.0005	0.0005	0.0025	0.0025	0.2	0.007		0.00024	0.00002	0.0002
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	08-May-1995		7.3		89.7	29.8			9.8	0.0005	0.0005	0.006	0.0025	0.03	0.1		0.0006	0.00002	0.002
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	11-Jun-1995		7.6		108	92.6			15.8	0.0005	0.0005	0.0025	0.0025	0.03	0.017		0.0003	0.00002	0.001
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	23-Jul-1995		7.8		158	162			24.8	0.0005	0.0005	0.0025	0.0025	0.01	0.009		0.000025	0.00001	0.0004
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	15-Aug-1995		7.8		148	148			25.5	0.0005	0.0005	0.0025	0.0025	0.01	0.003		0.00009	0.00001	0.0018
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	22-Aug-1995		7.7		158	152			19.7	0.0005	0.0005	0.0025	0.0025	0.03	0.02		0.0007	0.00002	0.0009
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	30-Aug-1995		7.7		148	138			24.1	0.0005	0.0005	0.0025	0.0025	0.01	0.01		0.00015	0.000005	0.0004
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	06-Sep-1995		8		150	144			23.8	0.0005	0.0005	0.005	0.0025	0.05	0.009		0.00011	0.00001	0.0004
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	13-Sep-1995		7.9		155	162			21.1	0.0005	0.0005	0.0025	0.0025	0.05	0.011		0.00026	0.00006	0.0008
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	23-Aug-2002				132	143			21.3			0.0025	0.0025	0.01	0.01				
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	19-Aug-2004		8.2		179	185			22.7			0.02	0.0025	0.01	0.035		0.0005	0.00007	0.001
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	24-Aug-2006	8.1	8.1	7.2	140	140			18.6			0.006	0.0025	0.04	0.007		0.0005	0.00002	0.0005
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	14-Aug-2008	8.3	8.2	9.6	177	168			22			0.0025	0.0025	0.06	0.008		0.0003	0.00081	0.0006
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	19-Aug-2010	8.0	8.3	9.7	180	189			29			0.025	0.0025	0.02	0.01		0.0004	0.00002	0.0003
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	16-Aug-2012	8.0	8.18	7.8	147	144			21.5			0.006	0.0025	0.032	0.0183	0.000041	0.000462	0.000028	0.000576
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	21-Aug-2014	7.79	8.22	8.5	163	163			25.8			0.023	0.0025	0.032	0.00363	0.000038	0.000414	0.000022	0.000434
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	29-Apr-2015	7.63	8.42	-0.1	255	270	0.25	0.12	35	0.00025	0.00025	0.0199	0.0010	0.164	0.00204	0.000025	0.000371	0.0000329	0.000265
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	11-May-2015	7.71	7.67	-0.2	70.1	72.9	0.98	0.042	0.25	0.00146	0.00137	0.0025		0.010	0.356	0.000025	0.00318	0.000261	0.00342
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	12-May-2015																		
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	13-May-2015																		
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	22-Jun-2015	7.86	8.18	8.6	120	141	0.25	0.073	19.5	0.00064	0.00055	0.0025	0.0010	0.0093	0.0163	0.000033	0.0004	0.0000287	0.000531
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	23-Jun-2015																		
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	28-Jul-2015	7.94	8.08	10.1	157	156	0.25	0.074	23.1	0.0005	0.00069	0.0025	0.0010	0.0153	0.0169	0.000038	0.000433	0.0000229	0.000425
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	22-Aug-2015	7.81	8.05	7.7	141	140	0.25	0.065	24.4	0.00025	0.00025	0.0059	0.0010	0.0229	0.0057	0.000025	0.00038	0.000026	0.00072
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	09-Sep-2015	8.19	8.17	6.2	140	146	0.25	0.064	23.9	0.00074	0.00062	0.0025	0.0010	0.0429	0.00465	0.000027	0.000398	0.00003	0.00044
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	11-Sep-2015	8.03	8.07	7.2	143	148	1.7	0.067	25.3	0.00074	0.00074	0.0093	0.0010	0.0299	0.00335	0.000029	0.000408	0.000026	0.00042
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	14-Oct-2015	7.76	8.21	0.8	178	175	0.55	0.069	29.3	0.00025	0.00025	0.0101	0.0010	0.135	0.0283	0.000025	0.000561	0.000038	0.000417
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	19-Nov-2015	7.7	8.42	0	219	212	0.25	0.093	33.1	0.00025	0.00025	0.0089	0.0010	0.188	0.0103	0.000041	0.000547	0.000048	0.000331
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	02-Dec-2015	7.29	8.07	0.1	236	224	0.59	0.078	31.9	0.00025	0.00025	0.0084	0.0010	0.194	0.0103	0.000033	0.000505	0.000038	0.000279
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	20-Jan-2016	7.18	8.19	0	271	282	0.82	0.1	36.7	0.0005	0.00062	0.0358	0.0010	0.209	0.00305	0.000026	0.000531	0.000049	0.000305
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	09-Feb-2016	7.35	8.16	0	259	259	0.55	0.1	37.3	0.00025	0.00025	0.0117	0.0010	0.216	0.00964	0.00003	0.000793	0.000054	0.000355
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	20-Mar-2016	7.23	8.02	1	266	263	0.52	0.1	36.5	0.00025	0.0005	0.0058	0.0010	0.217	0.00909	0.000032	0.000563	0.000044	0.000246
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	20-Apr-2016	7.81	8.17	0.5	238	286	0.62	0.11	34	0.00025	0.00025	0.0065	0.0010	0.145	0.005	0.000025	0.000554	0.000036	0.00043
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	04-May-2016	7.43	8.12	0.9	169	170	1.1	0.092	22.3	0.00053	0.00025	0.0025	0.0010	0.0883	0.0125	0.000025	0.000554	0.000031	0.00072
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	15-May-2016	7.85	8.18	3.9	121	118	0.54	0.074	15.8	0.00055	0.00053	0.0025	0.0010	0.0533	0.0158	0.000025	0.000398	0.000027	0.00098
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	13-Jun-2016	8.01	8.09	9.3	131	132	0.74	0.075	22.5	0.00068	0.00053	0.015	0.0010	0.0123	0.0055	0.000025	0.000408	0.000019	0.0007
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	26-Jul-2016	7.84	8.2	8.5	137	135	0.25	0.066	23.2	0.00025	0.00069	0.03	0.0010	0.0119	0.00423	0.00003	0.000338	0.00002	0.000501
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	27-Aug-2016	7.91	8.05	4.9	109	108	0.96	0.052	22.6	0.00025	0.00025	0.11	0.0010	0.0221	0.0271	0.00003	0.000473	0.000036	0.0011
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	07-Sep-2016	7.6	8.13	4.9	140	141	0.7	0.06	26.6	0.00067	0.00069	0.015	0.0010	0.0722	0.0265	0.000031	0.000473	0.000038	0.000657
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	01-Oct-2016	7.86	8.25	-0.1	174	178	0.59	0.078	32.1	0.00054	0.00084	0.099	0.0010	0.164	0.0118	0.000033	0.000481	0.000038	0.000432
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	15-Nov-2016	7.77	8.15	0.2	207	209	0.25	0.094	31.9	0.00055	0.00058	0.022	0.0021	0.228	0.0546	0.000036	0.00113	0.000084	0.000631
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	20-Dec-2016	7.13	8.01	-0.1	255	261	0.74	0.1	40.6	0.00061	0.00025	0.016	0.0025	0.244	0.0196	0.000036	0.000594	0.000063	0.000336
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	16-Jan-2017	7.24	8.16	0.2	256	256	0.78	0.1	36.3	0.00025	0.00025	0.03	0.0010	0.236	0.0145	0.000037	0.000526	0.00006	0.00039
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	23-Feb-2017	7.38	8.13	-0.1		288	0.68	0.12	39.6	0.00025	0.00025	0.031	0.0010	0.255					
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	21-Mar-2017	7.3	7.82	-0.2	285	278	0.72	0.12	38.7	0.00025	0.00025	0.031	0.0010	0.248	0.0068	0.000029	0.000637	0.00007	0.000221
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	28-Apr-2017	7.62	8.4	0.4	243	251	0.61	0.12	37.1	0.00064	0.00058	0.059	0.0010	0.203	0.0111	0.000049	0.000583	0.000052	0.000291
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	16-May-2017	7.93	7.98	1.4	93.2	77.9	0.97	0.051	3.82	0.00129	0.0013	0.039	0.0010	0.0238	0.168	0.000033	0.00118	0.000131	0.00239
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	27-May-2017	7.86	7.99	1.7	93.9	93	0.25	0.051	13.4	0.00081	0.00084	0.0097	0.0010	0.0665	0.0366	0.000041	0.000525	0.00004	0.00146
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	31-May-2017	7.69	7.81	6.4	81.3	79	0.25	0.047	12.6	0.00073	0.00087	0.028	0.0010	0.0274	0.0321	0.000034	0.000479	0.00004	0.00142
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	06-Jun-2017	7.71	8.14	6.1	106	102	0.52	0.054	19	0.0008	0.00025	0.022	0.0010	0.043	0.0165	0.000041	0.000431	0.000027	0.000876
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	14-Jun-2017	7.76	8.14	5.0	92.4	91.5	0.59	0.054	19.7	0.00059	0.00062	0.09	0.0010	0.0237	0.0297	0.000036	0.000458	0.000036	0.00139
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	19-Jul-2017	7.9	8.21	6.4	121	123	0.25	0.056	22.6	0.00054	0.00086	0.055	0.0010	0.0315	0.0166	0.000031	0.00039	0.0000381	0.000785
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	10-Aug-2017	8.01	8.31	6.4	159	161	0.25	0.065	27.9	0.00057	0.0006	0.01	0.0010	0.0815	0.014	0.000051	0.000511	0.0000399	0.00052
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	13-Sep-2017	7.98	8.36	5.3	185	188	0.51	0.086	31.7	0.00054	0.00025	0.0025	0.0010	0.0947	0.00437	0.000035	0.000648	0.000038	0.000378
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	04-Oct-2017	8.01	8.38	4.7	189	189	0.77	0.086	30.7	0.00025	0.00025	0.009	0.0010	0.13	0.00701	0.000031	0.000688	0.000035	0.000335
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	02-Nov-2017	7.56	8.23	-0.1	218	229	0.73	0.1	35.9	0.00025	0.00025	0.005	0.0010	0.18	0.00464	0.000031	0.000433	0.00004	0.000286
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	05-Dec-2017	7.81	8.28	0.2	254	256	0.25	0.1	37.4	0.00025	0.00025	0.0025	0.0010	0.205	0.00457	0.00003	0.000396	0.0000463	0.000263
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	08-Jan-2018	7.41	8.11	0	254	259	0.62	0.11	38.1	0.00025	0.00025	0.029	0.0010	0.23	0.00273	0.000032	0.000406	0.0000535	0.000248
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	14-Feb-2018	7.38	8.45	-0.1	282	290	0.25	0.14	42.5	0.00073	0.00054	0.028	0.0010	0.196	0.00889	0.000035	0.000492	0.000082	0.000243
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	21-Feb-2018	7.8	8.09	-0.1	282	278	0.25	0.13	41.2	0.00025	0.00025	0.007	0.0010	0.213	0.00372	0.000021	0.000501	0.0000762	0.00022
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	01-Mar-2018	7.77	8.39	-0.1	303	313	0.52	0.13	42.9	0.00055	0.00062	0.017	0.0010	0.211	0.00665	0.00003	0.000539	0.0000743	0.000245
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	07-Mar-2018	7.6	8.14	-0.3	321	318	0.75	0.13	42.8	0.00077	0.00088	0.025	0.0010	0.194	0.00369	0.000027	0.000543	0.0000684	0.000238
KZ-15	Finlayson Creek 100 m d/s confluence with Geona Cr	15-Mar-2018	7.16	8.4	-0.3	316	302	0.62	0.13	43	0.00062	0.00025	0.016	0.0010	0.192	0.00413	0.000023	0.000424	0.0000567	0.000219
Average			7.71	8.10	3.3	183.1	185.4	0.565	0.087	27.373	0.000507	0.000498	0.01827	0.00145	0.1048	0.02258	0.0000320	0.000523	0.0000576	0.000662
Count			49	60	49	60	61	44	44	61	53	53	61	59	61	59	45	58	58	58
Minimum			7.13	7.3	-0.3	70.1	29.8	0.25	0.042	0.25	0.00025	0.00025	0.0025	0.0010	0.0093	0.00204	0.000021	0.000025	0.000005	0.0002
Maximum			8.3	8.45	10.1	321	318	1.7	0.14	43	0.00146	0.00137	0.11	0.0025	0.255	0.356	0.000051	0.00318	0.00081	0.00342
Geometric Mean			7.71	8.09	2.8	171.2	170.2	0.492	0.083	24.095	0.000454	0.000439	0.00999	0.00132	0.0632	0.01105	0.0000314	0.000440	0.0000378	0.000513
Count <DL			0	0	0	0	0	15	0	1	27	30	18	57	6	2	6	3	1	0
Standard Deviation			0.29	0.22	3.7	66.2	71.0	0.302	0.027	9.613	0.000252	0.000263	0.02279	0.00069	0.0868	0.05082	0.0000065	0.000404	0.0001070	0.000593
1st Quartile			7.56	8.01	0	139	140	0.25	0.065	22	0.00025	0.00025	0.0025	0.0010	0.0274	0.00525	0.000027	0.000399	0.000026	0.000301
Median			7.77	8.14	1	166.0	168	0.570	0.086	25.8	0.0005	0.0005	0.0097	0.0010	0.0665	0.01	0.000031	0.000476	0.000038	0.000431
3rd Quartile			7.91	8.21	6.4	245.8	256	0.732	0.103	35.9	0.00062	0.00062	0.025	0.0025	0.194	0.01695	0.000036	0.000552	0.0000539	0.000769
95th Percentile			8.072	8.401	9.48	286	290	0.979	0.13	42.5	0.000804	0.000874	0.059	0.0025	0.236	0.0591	0.000041	0.0008435	9.105E-05	0.00183
Mean + 2 Standard Deviation			8.29	8.54	10.7	316	327	1.169	0.14	46.6	0.001011	0.001024	0.06385	0.00283	0.278	0.1242	0.000045	0.001331	0.0002716	0.00185

Station Name	Sample Date	Iron (Fe), total	Lead (Pb), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Selenium (Se), total	Silver (Ag), total	Thallium (Tl), total	Uranium (U), total	Zinc (Zn), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Cadmium (Cd), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Selenium (Se), dissolved	Silver (Ag), dissolved	Thallium (Tl), dissolved	Uranium (U), dissolved	Zinc (Zn), dissolved
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life		0.3	*		0.000026	0.073	*	0.001	0.00025	0.0008	0.015	0.03																
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals													*		0.005	*	*	0.3	*		0.000026	0.073	*	0.001	0.00025	0.0008	0.015	0.03
BC-MOE - Maximum Guidelines for Aquatic Life		1.0	*	*				0.002				*	*			*		0.35										
KZ-15	03-Dec-1994			0.02																0.013								
KZ-15	05-Apr-1995	0.035	0.0005	0.016	0.000005	0.0002	0.0005	0.0011				0.008	0.011		0.000025	0.00003	0.0003	0.018	0.0007	0.0063	0.000005	0.0002	0.001	0.00027				0.009
KZ-15	08-May-1995	0.34	0.00005	0.047		0.0002	0.002	0.0003	0.000005			0.055	0.016		0.0012	0.000005	0.0019	0.0007	0.00005	0.0002		0.0002	0.0005	0.0003	0.000005			0.002
KZ-15	11-Jun-1995	0.059	0.0005	0.01	0.000005	0.0002	0.0005	0.000025	0.000005			0.005	0.01		0.0002	0.00001	0.001	0.026	0.0002	0.0027	0.000005	0.0002	0.0005	0.000025	0.000005			0.005
KZ-15	23-Jul-1995	0.029	0.0002	0.0057	0.000005	0.0002	0.0005	0.00033	0.000005			0.004	0.007		0.000025	0.000005	0.0005	0.024	0.0002	0.0059	0.000005	0.0002	0.0005	0.0003	0.000005			0.004
KZ-15	15-Aug-1995	0.042	0.00005	0.011	0.000005	0.0004	0.002	0.0001	0.000005			0.004	0.003		0.000025	0.000005	0.0005	0.007	0.00005	0.0077	0.000005	0.0002	0.0005	0.0001	0.000005			0.005
KZ-15	22-Aug-1995	0.077	0.0001	0.019	0.000005	0.0002	0.001	0.00047	0.000005			0.006	0.01		0.0004	0.00005	0.0005	0.011	0.0001	0.0081	0.000005	0.0002	0.0005	0.00045	0.000005			0.005
KZ-15	30-Aug-1995	0.052	0.00005	0.015	0.000005	0.0002	0.0005	0.00005	0.000005			0.004	0.003		0.00013	0.000005	0.0004	0.009	0.00005	0.0078	0.000005	0.0002	0.0005	0.00005	0.000005			0.001
KZ-15	06-Sep-1995	0.044	0.00005	0.013		0.0002	0.0005	0.00006	0.000005			0.003	0.01		0.00009	0.00001	0.0005	0.031	0.00005	0.0085		0.0002	0.001	0.00005	0.000005			0.002
KZ-15	13-Sep-1995	0.04	0.0001	0.011	0.000005	0.0005	0.0005	0.00011	0.000005			0.004	0.003		0.00023	0.00006	0.0007	0.018	0.0001	0.01	0.000005	0.0004	0.0005	0.00011	0.000005			0.004
KZ-15	23-Aug-2002	0.131		0.035								0.0025	0.01					0.023		0.017								0.0025
KZ-15	19-Aug-2004	0.186	0.00025	0.082				0.0005			0.00216	0.005	0.002		0.0005	0.00003	0.0006	0.023	0.00025	0.018				0.0005			0.00164	0.0025
KZ-15	24-Aug-2006	0.029	0.00025	0.008	0.000005			0.0005			0.001	0.0025	0.001		0.0005	0.00001	0.0006	0.0025	0.00025	0.005	0.000005			0.0005			0.0011	0.0025
KZ-15	14-Aug-2008	0.012	0.0002	0.003	0.00001	0.0005	0.0005	0.0006			0.0017	0.0025	0.015		0.0004	0.00301	0.001	0.015	0.0004	0.003	0.00001	0.0005	0.0005	0.0007			0.0017	0.008
KZ-15	19-Aug-2010	0.066	0.0001	0.02	0.00001	0.001	0.0005	0.0005			0.0023	0.0025	0.0015		0.0004	0.00002	0.0004	0.01	0.0001	0.012	0.00001	0.001	0.0005	0.0006			0.0027	0.0025
KZ-15	16-Aug-2012	0.0931	0.00006	0.0272		0.000721	0.000483	0.000687	0.0000025	0.0000010	0.00143	0.00202	0.00674	0.000033	0.00043	0.000025	0.000434	0.0272	0.000008	0.0194		0.000859	0.000411	0.000636	0.0000025	0.0000010	0.00146	0.00146
KZ-15	21-Aug-2014	0.0418	0.000011	0.0146	0.0000010	0.00108	0.000501	0.000534	0.0000025	0.0000010	0.00216	0.00216	0.00212	0.00003	0.000362	0.000018	0.000304	0.0179	0.000009	0.012	0.0000038	0.000993	0.000458	0.000529	0.0000025	0.0000010	0.00207	0.00192
KZ-15	29-Apr-2015	0.0357	0.0000102	0.0334	0.0000010	0.00132	0.000946	0.0013	0.0000025	0.0000010	0.00461	0.00322	0.00064	0.000037	0.000359	0.0000305	0.000218	0.0037	0.0000025	0.0138	0.0000010	0.00127	0.00109	0.00127	0.0000025	0.000007	0.00471	0.00291
KZ-15	11-May-2015	2.07	0.000939	0.338	0.0000044	0.000667	0.00314	0.000283	0.0000238	0.0000085	0.000685	0.0229	0.0502	0.000027	0.000437	0.0000584	0.00175	0.145	0.0000173	0.0119	0.0000038	0.000432	0.00146	0.000252	0.0000025	0.0000010	0.000521	0.00566
KZ-15	12-May-2015																											
KZ-15	13-May-2015																											
KZ-15	22-Jun-2015	0.104	0.0000561	0.0279	0.0000010	0.000677	0.00044	0.000434	0.0000025	0.0000010	0.00114	0.00288	0.00307	0.000037	0.000363	0.000017	0.000494	0.0156	0.0000091	0.00741	0.0000010	0.000714	0.000405	0.000465	0.0000025	0.0000010	0.00116	0.00255
KZ-15	23-Jun-2015																											
KZ-15	28-Jul-2015	0.0917	0.0000233	0.023	0.0000010	0.000854	0.000483	0.00047	0.0000025	0.0000010	0.00171	0.00208	0.00168	0.000033	0.000386	0.0000209	0.000353	0.0127	0.0000025	0.0119	0.0000010	0.000839	0.000424	0.000481	0.0000025	0.0000010	0.00174	0.00125
KZ-15	22-Aug-2015	0.0607	0.000025	0.0177	0.0000010	0.000698	0.00043	0.000474	0.0000025	0.0000010	0.00132	0.0035	0.00175	0.000031	0.000349	0.000018	0.000469	0.0174	0.0000025	0.0117	0.0000010	0.000758	0.000524	0.000507	0.0000025	0.0000010	0.00138	0.00129
KZ-15	09-Sep-2015	0.0633	0.000021	0.0193	0.0000010	0.000683	0.000385	0.000657	0.0000025	0.0000010	0.00144	0.00281	0.00806	0.000028	0.000359	0.000022	0.000536	0.0201	0.000005	0.012	0.0000010	0.000672	0.000447	0.000602	0.0000025	0.0000010	0.00142	0.00227
KZ-15	11-Sep-2015	0.0581	0.000014	0.0153	0.0000010	0.000691	0.000401	0.000701	0.0000025	0.0000010	0.00148	0.00247	0.00354	0.000032	0.00035	0.000021	0.00054	0.011	0.000009	0.0103	0.0000010	0.000697	0.000403	0.000598	0.0000025	0.0000010	0.00144	0.00199
KZ-15	14-Oct-2015	0.141	0.00008	0.0335	0.0000010	0.000851	0.000474	0.00117	0.0000025	0.0000010	0.00234	0.00417	0.00128	0.00003	0.000367	0.000022	0.000255	0.0092	0.0000025	0.0129	0.0000010	0.000836	0.000378	0.000984	0.0000025	0.0000010	0.00229	0.00193
KZ-15	19-Nov-2015	0.112	0.00223	0.0473	0.0000010	0.000998	0.00064	0.0013	0.000021	0.0000010	0.00312	0.00576	0.00411	0.000032	0.000344	0.000029	0.000253	0.0076	0.0000025	0.0221	0.0000010	0.00104	0.000589	0.00122	0.0000025	0.0000010	0.00321	0.0039
KZ-15	02-Dec-2015	0.0764	0.00002	0.032	0.0000010	0.00107	0.00065	0.00134	0.0000025	0.0000010	0.0036	0.00435	0.00051	0.000031	0.000412	0.000022	0.000226	0.0102	0.0000025	0.0191	0.0000010	0.00116	0.0006	0.00155	0.0000025	0.0000010	0.00352	0.00226
KZ-15	20-Jan-2016	0.0858	0.000031	0.0468	0.0000010	0.00132	0.00183	0.00156	0.0000025	0.0000010	0.00498	0.00622	0.00185	0.000025	0.000392	0.000042	0.00025	0.0035	0.0000025	0.0306	0.0000010	0.00143	0.000824	0.00151	0.0000025	0.0000010	0.00512	0.0056
KZ-15	09-Feb-2016	0.175	0.000091	0.0559	0.0000010	0.00134	0.001	0.00135	0.0000025	0.0000010	0.00495	0.00755	0.00083	0.000027	0.000308	0.000035	0.000186	0.0031	0.0000025	0.0301	0.0000010	0.00141	0.000859	0.00134	0.0000025	0.0000010	0.00476	0.00518
KZ-15	20-Mar-2016	0.105	0.000033	0.0434	0.0000010	0.0014	0.000942	0.00142	0.0000025	0.0000010	0.00514	0.00485	0.00261	0.000031	0.000341	0.000034	0.000241	0.0028	0.000006	0.028	0.0000010	0.00145	0.000863	0.00143	0.0000025	0.0000010	0.0051	0.00423
KZ-15	20-Apr-2016	0.071	0.000025	0.0234	0.0000010	0.00148	0.00086	0.00115	0.0000025	0.0000010	0.00477	0.0038	0.00124	0.000033	0.0005	0.000031	0.000311	0.0165	0.0000025	0.0185	0.0000010	0.00157	0.000899	0.00119	0.0000025	0.0000010	0.00549	0.00329
KZ-15	04-May-2016	0.146	0.000062	0.0218	0.0000010	0.00101	0.00075	0.000742	0.0000025	0.0000010	0.00255	0.0034	0.00294	0.000033	0.00041	0.000019	0.000492	0.0401	0.000012	0.00842	0.0000010	0.00109	0.000676	0.000765	0.0000025	0.0000010	0.00272	0.00212
KZ-15	15-May-2016	0.108	0.000025	0.015	0.0000010	0.000654	0.00058	0.000434	0.0000025	0.000003	0.00134	0.0018	0.0032	0.000023	0.000261	0.000013	0.000705	0.0156	0.0000025	0.00385	0.0000010	0.000652	0.000552	0.000403	0.000006	0.0000010	0.00128	0.00095
KZ-15	13-Jun-2016	0.0554	0.000025	0.0107	0.0000010	0.000842	0.00038	0.000485	0.000005	0.0000010	0.00132	0.002	0.00164	0.000039	0.000336	0.0000131	0.000465	0.0138	0.0000025	0.00688	0.0000010	0.000826	0.000363	0.000539	0.0000025	0.0000010	0.00141	0.00116
KZ-15	26-Jul-2016	0.0411	0.000016	0.0153	0.0000010	0.000756	0.000364	0.000389	0.0000025	0.0000010	0.00121	0.00165	0.00172	0.00003	0.000288	0.000014	0.000424	0.0077	0.0000025	0.00559	0.0000010	0.000702	0.000358	0.000359	0.0000025	0.0000010	0.00114	0.00005
KZ-15	27-Aug-2016	0.126	0.000324	0.0251	0.0000010	0.000474	0.000614	0.000335	0.0000025	0.0000010	0.000713	0.00341	0.00556	0.000031	0.000316	0.000021	0.000962	0.0208	0.000034	0.00608	0.0000010	0.000496	0.000512	0.000346	0.0000025	0.0000010	0.000682	0.00176
KZ-15	07-Sep-2016	0.149	0.00011	0.036	0.0000010	0.000607	0.000573	0.000643	0.0000025	0.0000010	0.00124	0.00496	0.00199	0.000032	0.000337	0.000016	0.000474	0.0097	0.000005	0.00834	0.0000010	0.000603	0.000386	0.000597	0.0000025	0.0000010	0.00125	0.00222
KZ-15	01-Oct-2016	0.0844	0.000049	0.0292	0.0000010	0.000928	0.000485	0.00131	0.0000025	0.000003	0.0022	0.00563	0.00156	0.00003	0.000458	0.000022	0.000345	0.0127	0.0000025	0.016	0.0000010	0.000944	0.000409	0.00151	0.0000025	0.0000010	0.00222	0.00213
KZ-15	15-Nov-2016	0.357	0.000312	0.0863	0.0000010	0.00115	0.00119	0.00135	0.0000025	0.0000010	0.00348	0.0125	0.0009	0.00003	0.000323	0.000036	0.000208	0.0045	0.0000025	0.0277	0.0000010	0.00118	0.000584	0.00137	0.0000025	0.0000010	0.00316	0.00502
KZ-15	20-Dec-2016	0.118	0.000052	0.055	0.0000010	0.00134	0.00101	0.00155	0.0000025	0.000002	0.00413	0.00856	0.00088	0.000026	0.000354	0.000048	0.000187	0.0106	0.0000025	0.044	0.0000010	0.00128	0.000791	0.00157	0.0000025	0.0000010	0.00422	0.00766
KZ-15	16-Jan-2017	0.117	0.00004	0.0543	0.0000010	0.00127	0.00093	0.00142	0.000005	0.0000010	0.00422	0.0099	0.00127	0.000032	0.000326	0.000043	0.000234	0.0103	0.000033	0.0424	0.0000010	0.00129	0.00088	0.00149	0.0000025	0.0000010	0.00436	0.00737
KZ-15	23-Feb-2017												0.00091	0.000029	0.000408	0.000052	0.000204	0.0076	0.0000025	0.0492	0.0000010	0.0016	0.00105	0.00181	0.0000025	0.0000010	0.00558	0.008
KZ-15	21-Mar-2017	0.107	0.00003	0.0832	0.0000010	0.00166	0.00123	0.00157	0.0000025	0.0000010	0.0056	0.0101	0.00074	0.000044	0.000359	0.000065	0.000191	0.0069	0.0000025	0.0623	0.0000010	0.00157	0.00108	0.00146	0.0000025	0.0000010	0.00555	0.00853
KZ-15	28-Apr-2017	0.0989	0.00003	0.047	0.0000010	0.00136	0.001	0.00119	0.0000025	0.0000010	0.00477	0.0061	0.00086	0.000027	0.000373	0.000045	0.000222	0.0168	0.0000025	0.0356	0.0000010	0.00137	0.000944	0.00134	0.0000025	0.0000010	0.00472	0.00588
KZ-15	16-May-2017	0.612	0.000425	0.0847	0.0000045	0.000559	0.00192	0.000496	0.000005	0.0000037	0.000924	0.0154	0.0702	0.000027	0.000477	0.000061	0.0017	0.139	0.0000424	0.0331	0.0000047	0.000486	0.00138	0.000445	0.0000025	0.0000010	0.000812	0.00823
KZ-15	27-May-2017	0.174	0.000137	0.026	0.0000010	0.000554	0.0009	0.000464	0.000005	0.000002	0.000931	0.0057	0.0157	0.000036	0.00037	0.000029	0.00129	0.0705	0.000038	0.0112	0.0000010	0.000533	0.000851	0.000496	0.0000025	0.0000010	0.000946	0.00372
KZ-15	31-May-2017	0.156	0.000133	0.0198	0.0000010	0.000507	0.0009	0.0004	0.000005	0.0000010	0.000655	0.005	0.0101	0.000033	0.000357	0.000023	0.00118	0.0607	0.000036	0.00693	0.0000010	0.00051	0.000695	0.000442	0.0000025	0.0000010	0.000672	0.00273
KZ-15	06-Jun-2017	0.0949	0.000048	0.0176	0.0000061	0.000622	0.000606	0.000523	0.0000025	0.000002	0.00112	0.00364	0.00661	0.000037	0.000347	0.000019	0.000773	0.0411	0.000014	0.0101	0.0000010	0.000592	0.00056	0.0005	0.0000025	0.0000010	0.00106	0.00273
KZ-15	14-Jun-2017	0.109	0.000107	0.018	0.0000010	0.000525	0.00083	0.000441	0.000007	0.0000010	0.000727	0.00443	0.0107	0.00003	0.000357	0.000021	0.00128	0.0393	0.000014	0.00731	0.0000010	0.000515	0.000733	0.000426	0.0000025	0.0000010	0.000699	0.0028
KZ-15	19-Jul-2017	0.0748	0.0000843	0.0157	0.0000010	0.000589	0.000616	0.000605	0.0000025	0.0000010	0.00109	0.00457	0.006	0.000041	0.00035	0.000027	0.00067	0.0265	0.000017	0.0085	0.0000010	0.000631	0.000477	0.000545	0.0000025	0.0000010	0.00101	0.00292
KZ-15	10-Aug-2017	0.0765	0.0000502	0.0196	0.0000010	0.000825	0.000533	0.00112	0.0000025	0.0000010	0.0017	0.00449	0.0043	0.000052	0.000424	0.0000305	0.000469	0.0292	0.0000025	0.0144	0.0000010	0.000811	0.000424	0.00108	0.0000025	0.0000010	0.00169	0.00348
KZ-15	13-Sep-2017	0.0692	0.00001	0.0313	0.0000010	0.00109	0.000536	0.00123	0.0000025	0.0000010	0.00279	0.00326	0.00183	0.000029	0.000542	0.000033	0.000294	0.0347	0.0000025	0.0282	0.0000010	0.00109	0.000466	0.0012	0.0000025	0.0000010	0.00274	0.0027
KZ-15	04-Oct-2017	0.0934	0.000023	0.0345	0.0000010	0.00109	0.00057	0.00112	0.0000025	0.0000010	0.00274	0.00355	0.00183	0.000031	0.000522	0.000031	0.000298	0.0302	0.000006	0.0286	0.0000027	0.00109	0.000537	0.00108	0.0000025	0.0000010	0.00275	0.00295
KZ-15	02-Nov-2017	0.0472	0.000038	0.031	0.0000010	0.00123	0.00066	0.00125	0.0000025	0.0000010	0.00374	0.00449	0.00122	0.000033	0.000396	0.000034	0.000269	0.0132	0.0000025	0.0278	0.0000010	0.00124	0.000642	0.00131	0.0000025	0.0000010	0.00373	0.00459
KZ-15	05-Dec-2017	0.043	0.0000103	0.0418	0.0000010	0.00118	0.000769	0.00139	0.0000025	0.0000010	0.0038	0.00596	0.00117	0.000033	0.000307	0.0000474	0.000287	0.01	0.0000122	0.0373	0.0000010	0.00117	0.00083	0.00142	0.0000025	0.0000010	0.00385	0.00636
KZ-15	08-Jan-2018	0.0528	0.0000197	0.0473	0.0000010	0.00116	0.000808	0.00152	0.0000025	0.0000010	0.00457	0.00644	0.00975	0.000046	0.0003	0.0000549	0.00039	0.0079	0.000038	0.0395	0.0000010	0.00117	0.000894	0.00158	0.0000025	0.0000010	0.00444	0.00808
KZ-15	14-Feb-2018	0.0907	0.000025	0.0958	0.0000010	0.00174	0.00127	0.0014	0.0000025	0.0000010	0.00678	0.0112	0.00211	0.000033	0.000299	0.0000804	0.000215	0.0082	0.0000025	0.0883	0.0000010	0.00171	0.00139	0.00145	0.0000025	0.0000010	0.00678	0.0107
KZ-15	21-Feb-2018	0.0689	0.0000165	0.0838	0.0000010	0.00172	0.00135	0.00155	0.0000025	0.0000010	0.00631	0.00987	0.00094	0.000024	0.000343	0.0000684	0.000213	0.0086	0.0000025	0.0759	0.0000010	0.00168	0.00121	0.00149	0.0000025	0.0000010	0.00641	0.00908
KZ-15	01-Mar-2018	0.0879	0.0000244	0.0797	0.0000010	0.00165	0.00132	0.00159	0.0000025	0.0000010	0.00602	0.0089	0.00081	0.000028	0.000338	0.0000617	0.000025	0.0089	0.0000061	0.0672	0.0000010	0.00155	0.00128	0.00167	0.0000025	0.0000022	0.0067	0.00897
KZ-15	07-Mar-2018	0.0589	0.0000111	0.0802	0.0000010	0.00145	0.00141	0.00183	0.0000025	0.0000010	0.00667	0.0101	0.00114	0.000039	0.000359	0.0000825	0.0003	0.0099	0.0000209	0.0649	0.0000010	0.00165	0.00123	0.00174	0.0000025	0.0000010	0.00606	0.00955
KZ-15	15-Mar-2018	0.0535	0.0000121	0.0629	0.0000010	0.00122	0.00114	0.0018	0.0000025	0.0000010	0.00484	0.00797	0.00099	0.000037	0.000325	0.0000673	0.000262	0.0077	0.0000025	0.0591	0.0000010	0.00145	0.00114	0.00159	0.0000025	0.0000010	0.00543	0.00816
Average		0.1355	0.0001434	0.0397	0.00000215	0.000882	0.000854	0.000856	0.00000395	0.00000138	0.002862	0.00633	0.00604	0.000032	0.000358	0.0000826	0.0005212	0.0211	0.00005003	0.02167	0.00000211	0.000897	0.000710	0.000857	0.00000294	0.00000116	0.002932	0.004222
Count		59	58	60	54	56	56	58	53	45	49	59	60	46	59	59	59	60	59	61	55	57	57	59	54	46	50	60
Minimum		0.012	0.00001	0.003	0.0000010	0.0002	0.000364	0.000025	0.0000025	0.0000010	0.000655	0.00165	0.00051	0.000023	0.000025	0.000005	0.000025	0.0007	0.0000025	0.0002	0.0000010	0.0002	0.000358	0.000025	0.0000025	0.0000010	0.000521	0.00005
Maximum		2.07	0.00223	0.338	0.00001	0.00174	0.00314	0.00183	0.0000238	0.0000085	0.00678	0.055	0.0702	0.000052	0.0012	0.00301	0.0019	0.145	0.0007	0.0883	0.00001	0.00171	0.00146	0.00181	0.000006	0.000007	0.00678	0.0107
Geometric Mean		0.0855	0.0000567	0.0283	0.00000151	0.000752	0.000746	0.000643	0.00000328	0.00000119	0.002291	0.00484	0.00293	0.000032	0.000311	0.0000283	0.0004099	0.0136	0.00001139	0.01445	0.00000151	0.000751	0.000653	0.000634	0.00000282	0.00000106	0.002314	0.003297
Count <DL		0	11	0	51	8	8	3	50	38	0	4	5	0	5	5	1	1	31	0	51	9	9	3	53	44	0	5
Standard Deviation		0.2721	0.0003219	0.0459	0.00000225	0.000435	0.000523	0.000515	0.00000389	0.00000124	0.001825	0.00743	0.01109	0.000006	0.000156	0.0003882	0.0004035	0.0263	0.00011431	0.01984	0.00000217	0.000460	0.000303	0.000532	0.00000099	0.00000090	0.001895	0.002683
1st Quartile		0.0544	0.0000246	0.0172	0.0000010	0.000558	0.0005	0.000466	0.0000025	0.0000010	0.00132	0.00324	0.00124	0.000029	0.000324	0.000019	0.0002540	0.0085	0.0000025	0.0081	0.0000010	0.000515	0.0005	0.000448	0.0000025	0.0000010	0.001305	0.002198
Median		0.0844	0.00005	0.0276	0.0000010	0.000846	0.000645	0.000672	0.0000025	0.0000010	0.0023	0.00449	0.00211	0.000032	0.000357	0.000029	0.0004	0.0130	0.000008	0.0129	0.0000010	0.000839	0.000584	0.000602	0.0000025	0.0000010	0.002495	0.003120
3rd Quartile		0.1145	0.0001052	0.0471	0.0000010	0.001222	0.001	0.001332	0.000005	0.0000010	0.00457	0.00633	0.00680	0.000033	0.0004	0.0000462	0.0005700	0.0232	0.000038	0.0286	0.00000185	0.00127	0.000894	0.001395	0.0000025	0.0000010	0.004642	0.005715
95th Percentile		0.342	0.0005	0.08478	5.385E-06	0.00165	0.00194	0.001573	0.0000058	0.000003	0.00619	0.01279	0.01572	4.33E-05	0.0005022	6.96E-05	0.001331	0.06119	0.00025	0.0649	0.000005	0.00161	0.0013	0.001598	0.000005	0.000001	0.00625	0.009004
Mean + 2 Standard Deviation		0.68	0.0007872	0.1315	6.65E-06	0.00175	0.0019	0.001886	0.00001173	3.86E-06	0.00651	0.02119	0.02822	0.000044	0.00067	0.000859	0.0013282	0.0737	0.00027865	0.06135	6.45E-06	0.00182	0.00132	0.001921	0.00000492	2.96E-06	0.00672	0.009588

KZK Surface Water Quality Objectives Data - 1994 to March 2018

Station Name	Description	Sample Date	pH (field)	pH (lab)	Temperature (field)	Hardness (from total)	Hardness (from dissolved)	Chloride	Fluoride	Sulphate, dissolved	Cyanide, total	Cyanide, Weak Acid Dissociable	Ammonia (N)	Nitrite (N)	Nitrate (N)	Aluminum (Al), total	Antimony (Sb), total	Arsenic (As), total	Cadmium (Cd), total	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Manganese (Mn), total	Mercury (Hg), total
			pH units	pH units	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0	*		0.005	*	*	0.3	*		0.000026
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals			6.5 - 9	6.5 - 9				120	0.12			0.005	*	0.06	3.0									
BC-MOE - Maximum Guidelines for Aquatic Life										*		0.005		0.02			0.009			*	1.0	*	*	
KZ-26	Finlayson Creek at Robert Campbell Highway	05-Apr-1995		8.2		310	310			42.8	0.0005	0.0005	0.0025	0.0025	0.26	0.011		0.00034	0.00001	0.0003	0.031	0.0008	0.004	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	08-May-1995		7.6		126	29.7			16.3	0.0005	0.0005	0.007	0.0025	0.03	0.11		0.0028	0.000005	0.002	1	0.00005	0.094	
KZ-26	Finlayson Creek at Robert Campbell Highway	11-Jun-1995		8		157	136			19.1	0.0005	0.0005	0.0025	0.0025	0.01	0.11		0.0008	0.00004	0.0019	0.29	0.0007	0.015	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	23-Jul-1995		8.1		226	217			31.6	0.0005	0.0005	0.0025	0.0025	0.04	0.011		0.000025	0.000005	0.0006	0.032	0.0002	0.0037	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	15-Aug-1995		8.1		220	199			33.8	0.0005	0.0005	0.0025		0.05	0.1		0.00032	0.000005	0.0011	0.21	0.0004	0.0053	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	22-Aug-1995		8		220	222			30.8	0.0005	0.0005	0.0025	0.0025	0.01	0.11		0.0004	0.00008	0.0016	0.27	0.0002	0.0077	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	30-Aug-1995		7.9		203	197			27.8	0.001	0.0005	0.0025	0.0025	0.03	0.18		0.00051	0.000005	0.0016	0.47	0.0002	0.014	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	06-Sep-1995		8.2		197	194			25.2	0.0005	0.0005	0.009	0.0025	0.01	0.047		0.00026	0.000005	0.0011	0.16	0.0002	0.0088	
KZ-26	Finlayson Creek at Robert Campbell Highway	13-Sep-1995		8		217	212			30.9	0.0005	0.0005	0.036	0.0025	0.03	0.022		0.00035	0.00001	0.001	0.098	0.00005	0.0041	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	23-Aug-2002				183	197			26.5			0.0025	0.0025	0.01	0.03					0.158		0.014	
KZ-26	Finlayson Creek at Robert Campbell Highway	19-Aug-2004		8.4		241	245			29.9			0.02	0.0025	0.01	0.003		0.0005	0.00001	0.0006	0.01	0.00025	0.003	
KZ-26	Finlayson Creek at Robert Campbell Highway	24-Aug-2006	8.3	8.3	7.1	210	210			29			0.0025	0.0025	0.01	0.009		0.0005	0.00001	0.0007	0.12	0.00025	0.009	0.000005
KZ-26	Finlayson Creek at Robert Campbell Highway	14-Aug-2008	8.5	8.3	9.5	233	222			30			0.0025	0.0025	0.01	0.01		0.0008	0.00002	0.0006	0.09	0.0001	0.007	0.00001
KZ-26	Finlayson Creek at Robert Campbell Highway	18-Aug-2010	8.4	8.47	10.2	219	246			36			0.08	0.0025	0.01	0.006		0.0004	0.000005	0.0005	0.021	0.0001	0.003	0.00001
KZ-26	Finlayson Creek at Robert Campbell Highway	16-Aug-2012	8.3	8.27	9.6	189	193			28.7			0.011	0.0025	0.010	0.0307	0.000096	0.00128	0.000018	0.000693	0.174	0.000051	0.016	
KZ-26	Finlayson Creek at Robert Campbell Highway	22-Aug-2014	8.23	8.31	9.4	230	213			29.8			0.019	0.0025	0.025	0.00532	0.000067	0.000659	0.00001	0.000476	0.0572	0.000008	0.00339	0.0000035
KZ-26	Finlayson Creek at Robert Campbell Highway	29-Apr-2015	8.43	8.4	0.1	302	311	0.25	0.13	47.6	0.00051	0.00025	0.0119	0.0010	0.201	0.00243	0.000063	0.000654	0.0000122	0.000314	0.094	0.0000105	0.00498	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	11-May-2015	7.54	7.89	-0.3	107	109	1	0.057	13.3	0.00108	0.00114	0.0078		0.010	0.144	0.000068	0.00208	0.000058	0.00163	0.994	0.000237	0.0942	0.000003
KZ-26	Finlayson Creek at Robert Campbell Highway	14-May-2015																						
KZ-26	Finlayson Creek at Robert Campbell Highway	23-Jun-2015	8.18	7.9	7	178	182	0.97	0.11	27.8	0.00025	0.00025	0.0086	0.0010	0.0057	0.101	0.00014	0.00119	0.000031	0.00162	0.309	0.000221	0.0174	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	29-Jul-2015	8.24	8.24	8.4	213	222	0.55	0.12	32.3	0.0006	0.00067	0.013	0.0010	0.0079	0.0129	0.000098	0.00106	0.0000149	0.000675	0.134	0.0000272	0.0104	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	22-Aug-2015	8.05	8.11	5.8	176	179	0.25	0.092	29.9	0.00025	0.00025	0.0054	0.0026	0.0168	0.141	0.000156	0.00149	0.00004	0.00183	0.477	0.000241	0.0394	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	08-Sep-2015	8.24	8.31	4	200	196	0.88	0.1	31.1	0.00099	0.00095	0.0025	0.0010	0.009	0.0201	0.000102	0.00114	0.000019	0.000902	0.18	0.000058	0.0245	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	11-Sep-2015																						
KZ-26	Finlayson Creek at Robert Campbell Highway	15-Oct-2015	8.18	8.33	0.7	223	226	0.73	0.11	36.9	0.00025	0.00025	0.0114	0.0010	0.0565	0.0107	0.000076	0.000932	0.000011	0.00059	0.102	0.000025	0.00764	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	18-Nov-2015	8.45	8.32	0	258	268	0.25	0.12	40.9	0.00025	0.00025	0.0025	0.0010	0.101	0.00537	0.000067	0.000509	0.00001	0.00049	0.0425	0.000013	0.00487	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	01-Dec-2015	7.81	8.2	0	273	263	0.59	0.1	39.5	0.00051	0.00025	0.0084	0.0010	0.157	0.0008	0.000064	0.000559	0.000005	0.000341	0.0166	0.0000025	0.000649	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	19-Jan-2016																						
KZ-26	Finlayson Creek at Robert Campbell Highway	08-Feb-2016	7.92	8.35	0	294	300	0.75	0.11	46.1	0.00025	0.00025	0.0099	0.0010	0.252	0.042	0.000074	0.00193	0.000049	0.00107	0.57	0.000443	0.104	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	19-Mar-2016	7.77	8.29	-0.1	376	306	0.55	0.11	44.5	0.00025	0.0006	0.0394	0.0010	0.272	0.00821	0.00006	0.000498	0.000011	0.000339	0.0694	0.000021	0.0071	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	19-Apr-2016	7.82	8.35	1.2	246	288	0.57	0.12	39.8	0.00059	0.00052	0.0025	0.0010	0.115	0.0078	0.000067	0.00104	0.000019	0.00063	0.198	0.000025	0.0125	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	03-May-2016	7.87	8.23	2.0	207	204	1.2	0.12	30.5	0.0007	0.00062	0.01	0.0010	0.0538	0.0139	0.000081	0.00129	0.000021	0.00083	0.27	0.000025	0.0161	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	14-May-2016	8.17	8.48	7.9	215	225	1.2	0.14	37	0.0005	0.00025	0.0025	0.0010	0.028	0.0064	0.000078	0.000725	0.000011	0.00067	0.0937	0.000025	0.00556	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	13-Jun-2016	8.08	8.29	7	201	202	0.8	0.12	30.9	0.00073	0.0006	0.019	0.0022	0.0303	0.0081	0.000067	0.000743	0.000013	0.0007	0.0687	0.000025	0.00667	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	25-Jul-2016	7.85	8.27	8.5	210	201	0.25	0.11	36.4	0.00025	0.00055	0.028	0.0010	0.0166	0.0793	0.000159	0.00139	0.000025	0.00141	0.309	0.000153	0.0219	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	26-Aug-2016	8.2	8.29	8.8	194	202	0.96	0.099	31.9	0.00025	0.00025	0.011	0.0010	0.0124	0.193	0.000125	0.00211	0.000041	0.00182	0.692	0.000338	0.0555	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	06-Sep-2016	7.89	8.25	5.8	186	194	1.1	0.091	32.4	0.00077	0.00083	0.018	0.0010	0.0375	0.0817	0.000103	0.00127	0.000028	0.00109	0.339	0.000199	0.0367	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	30-Sep-2016	8.06	8.36	0.2	199	210	0.59	0.11	36.5	0.00065	0.00079	0.17	0.0010	0.0812	0.036	0.000077	0.00107	0.000022	0.00084	0.229	0.000069	0.0255	0.0000023
KZ-26	Finlayson Creek at Robert Campbell Highway	15-Nov-2016	7.49	8.35	-0.3	245	255	0.54	0.12	41.3	0.00072	0.0008	0.026	0.0010	0.159	0.00328	0.000069	0.000506	0.000013	0.00047	0.0335	0.000041	0.00416	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	19-Dec-2016	7.54	8.14	0	298	290	0.69	0.11	46.9	0.00069	0.00025	0.078	0.0026	0.224		0.000151	0.00227	0.000153	0.00295		0.00189	0.117	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	15-Jan-2017	7.44	8.31	-0.5	301	303	1	0.12	42.1	0.00025	0.00025	0.043	0.0010	0.235	0.00958	0.000104	0.000534	0.000034	0.00088	0.0712	0.00146	0.011	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	22-Feb-2017	7.46	8.31	-0.4	309	322	0.91	0.13	48	0.00025	0.00025	0.039	0.0010	0.299	0.0173	0.000071	0.000537	0.000022	0.00053	0.154	0.000208	0.0112	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	20-Mar-2017	7.91	8.23	-0.4	354	331	0.82	0.13	51	0.00025	0.00025	0.044	0.0010	0.308	0.00158	0.000058	0.000429	0.000015	0.00029	0.0404	0.0000025	0.00711	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	28-Apr-2017	8.16	8.48	0	286	301	1.3	0.13	47.5	0.00059	0.00025	0.021	0.0010	0.267	0.0108	0.000067	0.000693	0.000015	0.000357	0.15	0.000019	0.013	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	16-May-2017	8.31	8.14	0.5	124	115	1.1	0.082	16.9	0.00103	0.00108	0.042	0.0010	0.031	0.0977	0.000071	0.00265	0.0000538	0.00152	0.761	0.000179	0.0969	0.0000029
KZ-26	Finlayson Creek at Robert Campbell Highway	26-May-2017	8.2	8.16	3.7	138	140	0.6	0.089	20.4	0.0008	0.00077	0.012	0.0010	0.0472	0.0414	0.000089	0.00131	0.000021	0.00133	0.311	0.000136	0.021	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	31-May-2017	8.07	8.06	5.4	121	129	0.51	0.082	21.1	0.0007	0.00055	0.034	0.0010	0.0177	0.0318	0.000067	0.00102	0.000019	0.00119	0.218	0.000092	0.0179	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	05-Jun-2017	8.06	8.25	6.1	141	138	0.65	0.086	23.5	0.00067	0.00025	0.02	0.0010	0.0127	0.175	0.000107	0.00125	0.000043	0.00153	0.533	0.000278	0.0261	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	14-Jun-2017	8.03	8.22	3.9	118	119	0.9	0.071	18.6	0.00078	0.00055	0.067	0.0010	0.0203	0.477	0.000178	0.0024	0.000102	0.00402	1.23	0.0012	0.0878	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	18-Jul-2017	8.21	8.34	9	159	167	0.55	0.088	27.9	0.0007	0.00087	0.013	0.0116	0.0095	0.425	0.000194	0.00206	0.0000966	0.00349	1.03	0.00113	0.0627	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	09-Aug-2017	7.7	8.33	7.7	182	186	0.25	0.089	32.3	0.00065	0.00071	0.011	0.0010	0.0265	0.115	0.000126	0.00135	0.0000377	0.00129	0.353	0.000306	0.0354	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	13-Sep-2017	7.87	8.42	2.8	235	233	0.75	0.12	41	0.00051	0.00053	0.0025	0.0010	0.031	0.0283	0.000076	0.00117	0.0000187	0.0006	0.203	0.000053	0.0266	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	04-Oct-2017	7.93	8.44	2.7	246	235	0.87	0.12	41	0.00025	0.00025	0.007	0.0025	0.0752	0.0325	0.000074	0.00135	0.000022	0.000608	0.321	0.00008	0.0345	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	01-Nov-2017	8.03	8.41	-0.4	253	251	1.8	0.13	46.7	0.00056	0.00056	0.007	0.0010	0.148	0.00538	0.000075	0.000634	0.000011	0.000444	0.0578	0.000011	0.0124	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	04-Dec-2017	7.61	8.37	-0.3	308	312	0.71	0.13	43.2	0.00054	0.00025	0.01	0.0010	0.2	0.0523	0.000071	0.000661	0.0000212	0.000587	0.167	0.0000947	0.0223	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	07-Jan-2018	7.77	8.28	-0.4	292	306	0.25	0.12	48.1	0.00025	0.00025	0.026	0.0010	0.272	0.00361	0.000067	0.000389	0.0000179	0.000377	0.03	0.0000208	0.0107	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	13-Feb-2018	8.12	8.43	-0.1	319	323	0.25	0.12	59.4	0.00057	0.00076	0.057	0.0010	0.289	0.00989	0.00007	0.000366	0.0000204	0.000463	0.0346	0.0000711	0.00574	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	21-Feb-2018																						
KZ-26	Finlayson Creek at Robert Campbell Highway	01-Mar-2018	7.99	8.41	-0.2	370	374	0.99	0.14	58.9	0.00073	0.00082	0.012	0.0034	0.105	0.00135	0.000068	0.000793	0.0000491	0.000556	0.0083	0.000019	0.0068	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	07-Mar-2018	7.65	8.34	-0.2	372	364	0.89	0.14	61	0.00162	0.00025	0.022	0.0010	0.0602	0.00621	0.000071	0.000659	0.0000753	0.000567	0.0158	0.0000422	0.00577	0.0000010
KZ-26	Finlayson Creek at Robert Campbell Highway	15-Mar-2018	7.73	8.51	-0.3	306	347	0.6	0.14	54.8	0.00065	0.00025	0.009	0.0010	0.24	0.00066	0.000049	0.000455	0.000015	0.000299	0.0146	0.0000025	0.00578	0.0000010
Average			7.99	8.25	3.3	230	229.3	0.741	0.111	35.5	0.000568	0.000495	0.02086	0.00175	0.0894	0.05813	0.000090	0.000984	0.0000278	0.001016	0.2521	0.00023309	0.023674	0.00000211
Count			46	56	46	57	57	41	41	57	50	50	57	55	57	56	43	56	56	56	56	56	57	52
Minimum			7.44	7.6	-0.5	107	29.7	0.25	0.057	13.3	0.00025	0.00025	0.0025	0.0010	0.0057	0.00066	0.000049	0.000025	0.000005	0.00029	0.0083	0.0000025	0.000649	0.0000010
Maximum			8.5	8.51	10.2	376	374	1.8	0.14	61	0.00162	0.00114	0.17	0.0116	0.308	0.477	0.000194	0.0028	0.000153	0.00402	1.23	0.00189	0.117	0.00001
Geometric Mean			7.99	8.25	3.7	220	215.6	0.658	0.109	33.7	0.000508	0.000438	0.01141	0.00147	0.0436	0.02052	0.000085	0.000782	0.0000193	0.000816	0.1328	0.00008338	0.013226	0.00000152
Count <DL			0	0	0	0	0	7	0	0	21	29	14	49	10	0	0	3	6	0	0	14	0	48
Standard Deviation			0.28	0.17	3.8	66	70.3	0.337	0.020	11.1	0.000272	0.000247	0.02755	0.00155	0.0993	0.09237	0.000035	0.000647	0.0000280	0.000769	0.2860	0.00037734	0.029063	0.00000218
1st Quartile			7.81	8.19	-0.1	189	194	0.55	0.099	29	0.000312	0.00025	0.0054	0.0010	0.0124	0.00745	0.000067	0.000505	0.000011	0.000522	0.0576	0.000025	0.00578	0.0000010
Median			8.04	8.29	1.6	220	222	0.73	0.12	32.4	0.000525	0.0005	0.011	0.0010	0.031	0.01870	0.000074	0.000768	0.000019	0.000697	0.1590	0.00009335	0.0124	0.0000010
3rd Quartile			8.2	8.35	7	286	290	0.96	0.12	42.8	0.0007	0.000615	0.026	0.0025	0.157	0.08570	0.000102	0.001282	0.0000349	0.001350	0.3095	0.00023800	0.0255	0.00000245
95th Percentile			8.4225	8.4725	9.48	357	334	1.2	0.14	55.62	0.001017	0.000914	0.0692	0.0026	0.275	0.1833	0.0001587	0.0023025	8.415E-05	0.00224	0.996	0.0011475	0.09474	0.000005
Mean + 2 Standard Deviation			8.55	8.59	10.9	362	370	1.415	0.15	57.7	0.001112	0.000989	0.07596	0.00485	0.288	0.2429	0.00016	0.002278	0.0000838	0.00255	0.824	0.00098777	0.0818	6.47E-06
KZ-37	Lower Geona Creek d/s east-side trib	23-Feb-2017	7.31	7.9	-0.1	218	217	0.25	0.099	30.9	0.00025	0.00025	0.037	0.0010	0.232	0.00764	0.000028	0.000497	0.000056	0.000151	0.331	0.000016	0.0923	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	21-Mar-2017	6.96	7.44	0	223	222	0.6	0.098	30.3	0.00025	0.00025	0.06	0.0010	0.229	0.00605	0.000032	0.000582	0.000063	0.000145	0.398	0.000016	0.113	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	29-Apr-2017	8.16	8.27	0.1	196	202	0.85	0.096	31.7	0.00059	0.00052	0.03	0.0027	0.187	0.0101	0.000048	0.000455	0.000064	0.000307	0.388	0.000025	0.0957	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	17-May-2017	8.71	7.73	0.5	59	50.5	1.4	0.034	0.25	0.00182	0.00163	0.049	0.010	0.010	0.503	0.00005	0.00105	0.000323	0.00346	1.74	0.00161	0.108	0.0000064
KZ-37	Lower Geona Creek d/s east-side trib	27-May-2017	7.41	7.99	3.8	95.6	98	0.59	0.047	15.6	0.00075	0.00085	0.012	0.0010	0.0706	0.0914	0.000063	0.000533	0.00009	0.00185	0.45	0.000486	0.0331	0.0000025
KZ-37	Lower Geona Creek d/s east-side trib	01-Jun-2017	7.40	7.72	4.3	85.9	84.5	0.52	0.044	17.4	0.0007	0.00025	0.019	0.0010	0.0452	0.234	0.000068	0.000719	0.000131	0.00253	0.88	0.0011	0.0375	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	07-Jun-2017	7.87	8.16	4.6	118	121	0.6	0.049	25.1	0.00083	0.0006	0.018	0.0010	0.0737	0.0712	0.000072	0.000358	0.000062	0.00114	0.316	0.000271	0.0235	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	13-Jun-2017	7.43	8.08	6.2	89.7	88.8	0.73	0.053	20.6	0.00073	0.00089	0.097	0.0025	0.0252	0.114	0.00006	0.000482	0.00009	0.00205	0.407	0.000464	0.0217	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	19-Jul-2017	7.65	8.24	7	125	134	0.25	0.054	25.8	0.00067	0.00123	0.015	0.0010	0.037	0.0568	0.00004	0.000292	0.0000795	0.00107	0.241	0.000374	0.0147	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	10-Aug-2017	7.92	8.31	7.3	156	162	0.25	0.059	30.8	0.00068	0.00025	0.011	0.0010	0.0776	0.0308	0.000062	0.00027	0.000078	0.000608	0.2	0.000116	0.0252	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	14-Sep-2017	7.55	8.33	2.2	174	174	0.68	0.072	32.9	0.00025	0.00025	0.0025	0.0010	0.111	0.0146	0.000043	0.000325	0.000083	0.000395	0.294	0.000051	0.0497	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	05-Oct-2017	7.89	8.23	1.4	182	174	1.1	0.071	31.2	0.00025	0.00025	0.028	0.0010	0.119	0.00847	0.000039	0.000317	0.000077	0.000406	0.322	0.000033	0.061	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	03-Nov-2017	7.87	8.06	0	181	184	0.73	0.076	34.5	0.00053	0.00025	0.011	0.0010	0.172	0.00636	0.000036	0.000317	0.000079	0.000265	0.318	0.000024	0.0635	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	05-Dec-2017	7.22	8.24	0	220	220	0.62	0.081	32.6	0.00051	0.00025	0.0025	0.0010	0.173	0.0076	0.00004	0.000365	0.0000724	0.00026	0.317	0.0000192	0.0758	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	09-Jan-2018	7.82	7.97	0.3	205	203	0.25	0.094	33	0.00025	0.00025	0.017	0.0010	0.197	0.00706	0.000034	0.000415	0.0000659	0.000208	0.604	0.0000218	0.0834	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	14-Feb-2018	6.89	8.28	0	223	237	0.25	0.11	30.1	0.00058	0.00058	0.027	0.0010	0.201	0.0086	0.000028	0.000342	0.0000774	0.000205	0.493	0.0000176	0.165	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	21-Feb-2018	6.77	7.92	-0.1	217	209	0.56	0.1	31.1	0.00025	0.00025	0.052	0.0010	0.213	0.0317	0.00003	0.000567	0.0000891	0.000679	0.578	0.0000813	0.143	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	01-Mar-2018	6.97	8.26	-0.1	221	226	0.25	0.11	29.4	0.00061	0.00062	0.024	0.0010	0.2	0.00542	0.000033	0.00036	0.0000651	0.000228	0.384	0.0000173	0.139	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	07-Mar-2018	7.04	7.81	-0.3	203	231	0.84	0.11	29.5	0.00078	0.00087	0.031	0.0010	0.196	0.00659	0.000027	0.000394	0.0000842	0.000178	0.446	0.0000192	0.146	0.0000010
KZ-37	Lower Geona Creek d/s east-side trib	15-Mar-2018	7.01	8.23	-0.4	235	236	0.25	0.11	28.9	0.00065	0.00025	0.022	0.0010	0.198	0.00715	0.000022	0.00043	0.0000574	0.000156	0.384	0.0000136	0.132	0.0000010
Average			7.49	8.06	1.8	171.4	173.7	0.578	0.078	27.082	0.000596	0.000527	0.02825	0.00161	0.1384	0.06143	0.000043	0.000453	0.0000894	0.000815	0.475	0.0002388	0.0812	0.00000135
Count			20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Minimum			6.77	7.44	-0.4	59	50.5	0.25	0.034	0.25	0.00025	0.00025	0.0025	0.0010	0.010	0.00542	0.000022	0.00027	0.000056	0.000145	0.2	0.0000136	0.0147	0.0000010
Maximum			8.71	8.33	7.3	235	237	1.4	0.11	34.5	0.00182	0.00163	0.097	0.010	0.232	0.503	0.000072	0.00105	0.000323	0.00346	1.74	0.00161	0.165	0.0000064
Geometric Mean			7.48	8.05	1.9	160.3	161.4	0.499	0.074	22.052	0.000517	0.000424	0.02043	0.00123	0.1076	0.02070	0.000040	0.000428	0.0000812	0.000475	0.416	0.0000670	0.0652	0.00000115
Count <DL			0	0	0	0	0	7	0	1	6	11	2	18	1	0	0	0	0	0	0	0	0	18
Standard Deviation			0.50	0.24	2.7	55.7	58.0	0.317	0.026	8.157	0.000354	0.000392	0.02242	0.00204	0.0751	0.11804	0.000015	0.000181	0.0000574	0.000940	0.333	0.0004201	0.0478	0.00000124
1st Quartile			7.03	7.92	-0.02	123.2	130.8	0.25	0.054	25.625	0.00025	0.00025	0.01425	0.0010	0.0729	0.00713	0.000032	0.000338	0.0000648	0.000207	0.318	0.0000188	0.0364	0.0000010
Median			7.42	8.12	0.2	189.0	193.0	0.595	0.078	30.200	0.000600	0.00025	0.02300	0.0010	0.1725	0.00935	0.000040	0.000404	0.0000777	0.000351	0.386	0.0000290	0.0796	0.0000010
3rd Quartile			7.87	8.25	3.9	218.5	220.5	0.73	0.099	31.325	0.000708	0.000677	0.03250	0.0010	0.1985	0.06040	0.000052	0.000506	0.0000854	0.001088	0.461	0.0002967	0.1178	0.0000010
95th Percentile			8.1875	8.311	7.02	224	236	1.115	0.11	33.08	0.00088	0.00125	0.06185	0.00307	0.229	0.2475	0.0000682	0.0007356	0.0001406	0.00258	0.923	0.0011255	0.14695	2.695E-06
Mean + 2 Standard Deviation			8.49	8.54	7.2	283	290	1.212	0.13	43.4	0.001304	0.001311	0.07309	0.00569	0.289	0.2975	0.000073	0.000815	0.0002042	0.0027	1.141	0.001079	0.1768	3.83E-06

Station Name	Sample Date	Molybdenum (Mo), total	Nickel (Ni), total	Selenium (Se), total	Silver (Ag), total	Thallium (Tl), total	Uranium (U), total	Zinc (Zn), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Cadmium (Cd), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Selenium (Se), dissolved	Silver (Ag), dissolved	Thallium (Tl), dissolved	Uranium (U), dissolved	Zinc (Zn), dissolved
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME Guidelines - Protection of Aquatic Life		0.073	*	0.001	0.00025	0.0008	0.015	0.03																
CCME Guidelines - Protection of Aquatic Life vs. Dissolved Metals									*		0.005	*	*	0.3	*		0.000026	0.073	*	0.001	0.00025	0.0008	0.015	0.03
BC-MOE - Maximum Guidelines for Aquatic Life				0.002				*	*			*		0.35										
KZ-26	05-Apr-1995	0.0002	0.0005	0.00092	0.000005			0.0005	0.007		0.00022	0.000005	0.0004	0.0025	0.0011	0.002	0.000005	0.0002	0.0005	0.00086	0.000005			0.003
KZ-26	08-May-1995	0.0002	0.003	0.0002	0.000005			0.053	0.003		0.0002	0.000005	0.001	0.0025	0.00005	0.0001		0.0009	0.001	0.0002	0.000005			0.0005
KZ-26	11-Jun-1995	0.0002	0.002	0.000025	0.00063			0.009	0.015		0.0005	0.000005	0.002	0.05	0.0002	0.0024	0.000005	0.0002	0.001	0.000025	0.00004			0.002
KZ-26	23-Jul-1995	0.0002	0.0005	0.00037	0.000005			0.0005	0.006		0.000025	0.000005	0.0005	0.011	0.0001	0.0028	0.000005	0.0002	0.0005	0.00032	0.00001			0.002
KZ-26	15-Aug-1995	0.0002	0.003	0.0001	0.00001			0.002	0.003		0.000025	0.000005	0.0007	0.007	0.00005	0.0018	0.000005	0.0002	0.0005	0.0001	0.000005			0.003
KZ-26	22-Aug-1995	0.0002	0.001	0.00066	0.000005			0.003	0.008		0.00033	0.000005	0.0011	0.01	0.00005	0.0023	0.000005	0.0002	0.0005	0.00015	0.000005			0.0005
KZ-26	30-Aug-1995	0.0002	0.003	0.00007	0.000005			0.009	0.006		0.00017	0.000005	0.0006	0.024	0.00005	0.0037	0.000005	0.0002	0.001	0.00007	0.000005			0.002
KZ-26	06-Sep-1995	0.0002	0.002	0.00006	0.00002			0.004	0.017		0.00017	0.000005	0.0008	0.036	0.00005	0.0046		0.0002	0.001	0.00006	0.00001			0.002
KZ-26	13-Sep-1995	0.0002	0.0005	0.00014	0.000005			0.002	0.023		0.00031	0.00003	0.0012	0.036	0.0001	0.0034	0.000005	0.0002	0.0005	0.00014	0.000005			0.001
KZ-26	23-Aug-2002							0.0025	0.02					0.041		0.006								0.0025
KZ-26	19-Aug-2004			0.0005			0.00229	0.0025	0.0005		0.0005	0.000005	0.0005	0.0025	0.00025	0.002				0.0005			0.00065	0.0025
KZ-26	24-Aug-2006			0.0005			0.0018	0.0025	0.002		0.0005	0.00002	0.0006	0.06	0.00025	0.005	0.000005			0.0005			0.0019	0.0025
KZ-26	14-Aug-2008	0.001	0.0005	0.0005			0.0024	0.0025	0.004		0.0009	0.00003	0.0005	0.035	0.0001	0.004	0.00001	0.001	0.0005	0.0005			0.0024	0.0025
KZ-26	18-Aug-2010	0.001	0.0005	0.0004			0.0022	0.0025	0.0015		0.0006	0.00001	0.0005	0.009	0.0001	0.003	0.00001	0.001	0.0005	0.0005			0.0028	0.0025
KZ-26	16-Aug-2012	0.00104	0.00138	0.000665	0.0000025	0.0000010	0.00195	0.0011	0.00603	0.000097	0.000845	0.000011	0.000662	0.0634	0.000007	0.00704		0.0011	0.00123	0.000354	0.0000025	0.0000010	0.00191	0.00051
KZ-26	22-Aug-2014	0.00114	0.0007	0.000465	0.0000025	0.0000010	0.00231	0.00063	0.00104	0.000067	0.000613	0.000008	0.000454	0.0224	0.0000025	0.00211	0.0000039	0.00112	0.000711	0.000439	0.0000025	0.0000010	0.00234	0.00025
KZ-26	29-Apr-2015	0.00115	0.00082	0.000866	0.0000025	0.0000010	0.00376	0.00041	0.00061	0.000055	0.000533	0.0000119	0.000334	0.0109	0.0000025	0.00176	0.0000010	0.00114	0.000807	0.000862	0.0000025	0.0000010	0.00391	0.00029
KZ-26	11-May-2015	0.000651	0.00239	0.000206	0.0000112	0.0000022	0.000937	0.0044	0.00908	0.00005	0.000775	0.0000228	0.000987	0.161	0.0000087	0.00733	0.0000029	0.000568	0.00178	0.000226	0.0000025	0.0000010	0.000907	0.00127
KZ-26	14-May-2015																							
KZ-26	23-Jun-2015	0.00115	0.00183	0.000426	0.0000133	0.0000043	0.00188	0.0024	0.00352	0.000101	0.000799	0.0000118	0.000845	0.0405	0.0000112	0.00212	0.0000010	0.0011	0.00123	0.000449	0.0000025	0.0000010	0.00182	0.00031
KZ-26	29-Jul-2015	0.00121	0.00146	0.000484	0.0000025	0.0000010	0.00237	0.00086	0.00196	0.000094	0.000836	0.0000085	0.000565	0.0357	0.0000025	0.00285	0.0000010	0.0012	0.00135	0.000511	0.0000025	0.0000010	0.00233	0.00035
KZ-26	22-Aug-2015	0.000947	0.00249	0.000455	0.0000025	0.000003	0.00163	0.0038	0.00764	0.000138	0.000952	0.000012	0.00109	0.0657	0.000008	0.00811	0.0000010	0.000958	0.00184	0.00047	0.0000025	0.0000010	0.00171	0.00074
KZ-26	08-Sep-2015	0.000912	0.00165	0.000593	0.0000025	0.0000010	0.00204	0.00177	0.00583	0.000102	0.00084	0.000011	0.000771	0.0538	0.000006	0.00985	0.0000010	0.000913	0.00141	0.000547	0.0000025	0.0000010	0.00202	0.00081
KZ-26	11-Sep-2015																							
KZ-26	15-Oct-2015	0.00109	0.00094	0.000689	0.0000025	0.0000010	0.00267	0.0011	0.00109	0.00007	0.000725	0.000011	0.000423	0.0241	0.000006	0.00552	0.0000010	0.00105	0.000909	0.000806	0.0000025	0.0000010	0.00267	0.00035
KZ-26	18-Nov-2015	0.000944	0.000744	0.000912	0.0000025	0.0000010	0.00289	0.00077	0.00677	0.000073	0.000413	0.000008	0.000442	0.0068	0.000014	0.00152	0.0000010	0.000968	0.000792	0.000919	0.0000025	0.0000010	0.00303	0.0006
KZ-26	01-Dec-2015	0.00109	0.000672	0.00116	0.0000025	0.0000010	0.00325	0.00028	0.00076	0.00006	0.000514	0.000005	0.000353	0.0128	0.0000025	0.000557	0.0000010	0.00103	0.000663	0.00107	0.0000025	0.0000010	0.00307	0.00023
KZ-26	19-Jan-2016																							
KZ-26	08-Feb-2016	0.000963	0.00157	0.000874	0.0000025	0.0000010	0.00355	0.00421	0.00072	0.000048	0.000426	0.000009	0.000331	0.0034	0.0000025	0.0019	0.0000010	0.00105	0.000688	0.000891	0.0000025	0.0000010	0.00363	0.00062
KZ-26	19-Mar-2016	0.00104	0.000698	0.00133	0.0000025	0.0000010	0.00376	0.00053	0.0026	0.000066	0.000411	0.000008	0.000332	0.0027	0.0000025	0.0013	0.0000010	0.00115	0.000621	0.000957	0.0000025	0.0000010	0.00404	0.00033
KZ-26	19-Apr-2016	0.00114	0.00114	0.000649	0.0000025	0.0000010	0.00309	0.0005	0.00186	0.000064	0.00086	0.000014	0.000525	0.0866	0.0000025	0.00822	0.0000010	0.00118	0.00124	0.000664	0.0000025	0.0000010	0.00354	0.00059
KZ-26	03-May-2016	0.00126	0.00128	0.000535	0.0000025	0.0000010	0.00263	0.0012	0.0015	0.000084	0.000883	0.000006	0.000519	0.0607	0.0000025	0.00113	0.0000010	0.00121	0.00113	0.000589	0.0000025	0.0000010	0.0025	0.00025
KZ-26	14-May-2016	0.00105	0.00089	0.000543	0.0000025	0.000003	0.00245	0.0005	0.00104	0.000086	0.000662	0.000006	0.000538	0.0217	0.0000025	0.00164	0.0000010	0.00124	0.000876	0.000549	0.0000025	0.0000010	0.00281	0.00027
KZ-26	13-Jun-2016	0.00104	0.0008	0.000496	0.000005	0.0000010	0.00205	0.0005	0.00085	0.000074	0.000582	0.0000061	0.00053	0.0124	0.0000025	0.00141	0.0000010	0.00106	0.000716	0.000539	0.0000025	0.0000010	0.00224	0.0003
KZ-26	25-Jul-2016	0.00107	0.00211	0.000489	0.000005	0.000002	0.0019	0.0017	0.00576	0.000139	0.000931	0.00001	0.000977	0.0509	0.000012	0.00862	0.0000010	0.00102	0.00168	0.000442	0.0000025	0.0000010	0.00182	0.00053
KZ-26	26-Aug-2016	0.000982	0.0025	0.000401	0.000005	0.000003	0.00179	0.0045	0.00304	0.000091	0.000863	0.000008	0.000711	0.0335	0.000006	0.000673	0.0000010	0.00102	0.00119	0.000388	0.0000025	0.0000010	0.00194	0.00034
KZ-26	06-Sep-2016	0.000912	0.00179	0.000569	0.0000025	0.000002	0.00182	0.00252	0.00341	0.000092	0.000789	0.000009	0.000721	0.0331	0.000009	0.00372	0.0000010	0.000887	0.00125	0.000543	0.0000025	0.0000010	0.00186	0.00057
KZ-26	30-Sep-2016	0.000982	0.00121	0.000846	0.000005	0.0000010	0.00229	0.0019	0.00193	0.000071	0.000907	0.000008	0.000438	0.0363	0.0000025	0.0119	0.0000010	0.00105	0.000974	0.000968	0.0000025	0.0000010	0.00233	0.0006
KZ-26	15-Nov-2016	0.00107	0.000834	0.000962	0.0000025	0.0000010	0.00312	0.00069	0.00253	0.00007	0.00039	0.00001	0.000412	0.0051	0.000007	0.00236	0.0000010	0.0011	0.000791	0.00101	0.0000025	0.0000010	0.00301	0.00057
KZ-26	19-Dec-2016	0.000867	0.00307	0.00108	0.000026	0.000007	0.0033	0.0447	0.00089	0.000063	0.000356	0.000018	0.000416	0.007	0.000053	0.00432	0.0000010	0.000883	0.000742	0.00102	0.0000025	0.0000010	0.00322	0.00336
KZ-26	15-Jan-2017	0.000953	0.000898	0.00104	0.000006	0.0000010	0.00355	0.00612	0.00144	0.000063	0.000323	0.000013	0.000401	0.0085	0.000101	0.0058	0.0000010	0.000955	0.000699	0.00105	0.0000025	0.0000010	0.00347	0.00126
KZ-26	22-Feb-2017	0.00129	0.000896	0.00102	0.0000025	0.0000010	0.00355	0.0027	0.00472	0.000077	0.000402	0.000018	0.000535	0.0058	0.000049	0.00657	0.0000010	0.000963	0.000812	0.0011	0.0000025	0.0000010	0.00361	0.00291
KZ-26	20-Mar-2017	0.000876	0.000824	0.00109	0.0000025	0.0000010	0.00347	0.00072	0.00064	0.000062	0.000341	0.000011	0.000298	0.0057	0.000005	0.00432	0.0000010	0.000905	0.000726	0.000989	0.0000025	0.0000010	0.00372	0.00068
KZ-26	28-Apr-2017	0.000963	0.00087	0.000848	0.0000025	0.0000010	0.00363	0.00096	0.00064	0.000052	0.000419	0.000014	0.00029	0.0162	0.0000025	0.00673	0.0000010	0.000981	0.000824	0.000942	0.0000025	0.0000010	0.00365	0.00063
KZ-26	16-May-2017	0.000933	0.00275	0.000401	0.000005	0.000003	0.0012	0.0042	0.0199	0.000059	0.00109	0.000028	0.0011	0.217	0.0000181	0.0464	0.0000028	0.000794	0.0022	0.000377	0.0000025	0.0000010	0.00111	0.00175
KZ-26	26-May-2017	0.000976	0.00187	0.000462	0.000005	0.0000010	0.00141	0.0023	0.0101	0.000069	0.000872	0.000013	0.00112	0.134	0.000015	0.00464	0.0000010	0.000954	0.0016	0.000477	0.0000025	0.0000010	0.00138	0.00103
KZ-26	31-May-2017	0.000848	0.00137	0.000385	0.000005	0.000002	0.00117	0.0018	0.0101	0.000064	0.000714	0.000011	0.000995	0.101	0.000016	0.00401	0.0000010	0.000866	0.00126	0.000396	0.0000025	0.0000010	0.00124	0.00101
KZ-26	05-Jun-2017	0.00095	0.00206	0.000436	0.000005	0.000003	0.00146	0.0036	0.00664	0.000088	0.000749	0.000011	0.00086	0.0761	0.000023	0.00508	0.0000010	0.00101	0.00138	0.000403	0.0000025	0.0000010	0.00151	0.00064
KZ-26	14-Jun-2017	0.00071	0.00512	0.000427	0.000025	0.00001	0.00107	0.0094	0.0116	0.000107	0.000829	0.000013	0.00147	0.1	0.000035	0.00909	0.0000010	0.000802	0.00204	0.000356	0.0000025	0.0000010	0.00101	0.00075
KZ-26	18-Jul-2017	0.000707	0.00406	0.000527	0.000013	0.0000049	0.00163	0.0073	0.00796	0.000119	0.000944	0.000011	0.000859	0.0522	0.000036	0.0126	0.0000010	0.000926	0.00138	0.000596	0.0000025	0.0000010	0.00162	0.0005
KZ-26	09-Aug-2017	0.000967	0.002	0.000818	0.000005	0.0000028	0.00189	0.0032	0.00492	0.000111	0.000946	0.0000118	0.000677	0.0577	0.0000178	0.0155	0.0000010	0.00102	0.00129	0.000869	0.0000025	0.0000010	0.00189	0.00068
KZ-26	13-Sep-2017	0.00117	0.0013	0.000783	0.000005	0.0000010	0.00263	0.0014	0.00224	0.000076	0.000961	0.000012	0.000461	0.0697	0.0000025	0.021	0.0000010	0.00121	0.00111	0.000845	0.0000025	0.0000010	0.00292	0.00069
KZ-26	04-Oct-2017	0.00115	0.00131	0.000909	0.0000025	0.0000010	0.00286	0.00154	0.00168	0.000072	0.000875	0.000013	0.00347	0.0549	0.000005	0.0228	0.0000010	0.00116	0.00105	0.000835	0.0000025	0.0000010	0.00295	0.00058
KZ-26	01-Nov-2017	0.00104	0.000858	0.000891	0.0000025	0.0000010	0.00301	0.00069	0.0011	0.000083	0.000517	0.000013	0.000414	0.0152	0.0000025	0.0111	0.0000010	0.00111	0.000861	0.00092	0.0000025	0.0000010	0.00303	0.00049
KZ-26	04-Dec-2017	0.000971	0.00112	0.000921	0.0000025	0.0000010	0.00327	0.00182	0.0011	0.000067	0.000411	0.0000178	0.000459	0.0079	0.0000093	0.00972	0.0000010	0.000977	0.000855	0.000909	0.0000025	0.0000010	0.00332	0.00125
KZ-26	07-Jan-2018	0.000817	0.000727	0.000898	0.0000025	0.0000010	0.00357	0.00176	0.00332	0.000072	0.000336	0.0000199	0.000457	0.0069	0.0000418	0.0078	0.0000010	0.000854	0.000735	0.000984	0.0000025	0.0000010	0.00356	0.00708
KZ-26	13-Feb-2018	0.000817	0.000772	0.000938	0.0000025	0.0000010	0.00365	0.00177	0.00112	0.000065	0.000312	0.0000176	0.00041	0.0053	0.0000201	0.0039	0.0000010	0.000816	0.000728	0.000905	0.0000025	0.0000010	0.00354	0.00178
KZ-26	21-Feb-2018																							
KZ-26	01-Mar-2018	0.000915	0.000579	0.0011	0.0000051	0.0000010	0.00402	0.00371	0.00115	0.000071	0.000775	0.000051	0.000215	0.0029	0.0000174	0.00711	0.0000010	0.000854	0.000609	0.00111	0.0000025	0.0000028	0.00438	0.0042
KZ-26	07-Mar-2018	0.000862	0.000608	0.0012	0.0000152	0.0000010	0.00435	0.00623	0.00086	0.000073	0.000588	0.000081	0.000526	0.0017	0.0000232	0.00459	0.0000010	0.00095	0.00053	0.00115	0.0000025	0.0000010	0.00388	0.00455
KZ-26	15-Mar-2018	0.000867	0.000691	0.0011	0.0000025	0.0000010	0.00355	0.00138	0.00157	0.00007	0.000427	0.0000171	0.000559	0.003	0.0000176	0.00584	0.0000010	0.000991	0.000805	0.00101	0.0000025	0.0000010	0.00377	0.0026
Average		0.000857	0.001484	0.000649	0.00001764	0.00000189	0.002576	0.00419	0.00490	0.000078	0.000593	0.0000137	0.000703	0.0372	0.00005506	0.006205	0.00000209	0.000881	0.000993	0.000631	0.00000380	0.00000104	0.002595	0.00136
Count		54	54	56	52	43	47	57	57	43	56	56	56	57	56	57	52	54	54	56	52	43	47	57
Minimum		0.0002	0.0005	0.000025	0.0000025	0.0000010	0.000937	0.00028	0.0005	0.000048	0.000025	0.000005	0.000215	0.0017	0.0000025	0.0001	0.0000010	0.0002	0.0005	0.000025	0.0000025	0.0000010	0.00065	0.00023
Maximum		0.00129	0.00512	0.00133	0.00063	0.00001	0.00435	0.053	0.023	0.000139	0.00109	0.000081	0.00347	0.217	0.0011	0.0464	0.00001	0.00124	0.0022	0.00115	0.00004	0.0000028	0.00438	0.00708
Geometric Mean		0.000751	0.001234	0.000529	0.00000471	0.00000147	0.002411	0.00203	0.00293	0.000076	0.000497	0.0000111	0.000606	0.0194	0.00001522	0.004039	0.00000150	0.000782	0.000918	0.000509	0.00000301	0.00000102	0.002390	0.00092
Count <DL		9	5	3	41	29	0	10	4	0	4	9	0	3	23	1	49	8	7	3	49	42	0	7
Standard Deviation		0.000323	0.000979	0.000323	0.00008675	0.00000181	0.000886	0.00890	0.00530	0.000021	0.000269	0.0000122	0.000499	0.0421	0.00015266	0.007096	0.00000219	0.000312	0.000412	0.000320	0.00000537	0.00000027	0.000955	0.00132
1st Quartile		0.000825	0.000779	0.000434	0.0000025	0.0000010	0.001885	0.00096	0.00112	0.000064	0.000399	0.000008	0.000434	0.007	0.00000438	0.00212	0.0000010	0.000857	0.000712	0.000401	0.0000025	0.0000010	0.001875	0.0005
Median		0.000958	0.001175	0.000581	0.000005	0.0000010	0.00245	0.002	0.003	0.000072	0.000585	0.000011	0.000532	0.024	0.00001450	0.00432	0.0000010	0.000973	0.000868	0.000548	0.0000025	0.0000010	0.00267	0.00069
3rd Quartile		0.001047	0.002	0.000910	0.000005	0.00000210	0.003385	0.00371	0.00664	0.000090	0.000841	0.000014	0.000849	0.0538	0.00005	0.00733	0.00000145	0.001057	0.001237	0.000919	0.0000025	0.0000010	0.003505	0.002
95th Percentile		0.00118	0.00302	0.001115	0.00002225	4.84E-06	0.00376	0.00908	0.01758	0.000118	0.0009475	0.00003	0.0012675	0.1076	0.0002125	0.0166	0.000005	0.0012	0.0018	0.0010775	7.25E-06	0.000001	0.0039	0.003528
Mean + 2 Standard Deviation		0.0015	0.00344	0.001295	0.00019114	5.51E-06	0.00435	0.02199	0.0155	0.00012	0.001131	0.0000381	0.001701	0.1214	0.00036038	0.0204	6.47E-06	0.00151	0.00182	0.001271	0.00001454	1.58E-06	0.00451	0.004
KZ-37	23-Feb-2017	0.00104	0.000466	0.00134	0.0000025	0.0000010	0.00218	0.0108	0.0016	0.000024	0.000384	0.000041	0.000109	0.133	0.0000025	0.0897	0.0000010	0.00106	0.000445	0.00125	0.0000025	0.0000010	0.00215	0.0106
KZ-37	21-Mar-2017	0.00111	0.000501	0.0013	0.0000025	0.0000010	0.0021	0.0113	0.00177	0.000034	0.000382	0.000057	0.000156	0.189	0.000006	0.0992	0.0000010	0.00104	0.000479	0.0012	0.0000025	0.0000010	0.00218	0.00988
KZ-37	29-Apr-2017	0.000917	0.000538	0.00105	0.0000025	0.0000010	0.00201	0.0113	0.00273	0.000026	0.000395	0.000063	0.000257	0.225	0.0000025	0.0994	0.0000010	0.000935	0.000545	0.00112	0.0000025	0.0000010	0.002	0.0121
KZ-37	17-May-2017	0.000314	0.00272	0.000395	0.000011	0.0000093	0.000377	0.0525	0.152	0.000032	0.000301	0.000104	0.0019	0.24	0.0000877	0.0336	0.0000072	0.000259	0.0015	0.000328	0.000008	0.0000026	0.000278	0.0222
KZ-37	27-May-2017	0.00047	0.00103	0.000666	0.000005	0.000004	0.000676	0.0192	0.0228	0.000053	0.000328	0.000061	0.00136	0.194	0.000109	0.0255	0.0000010	0.000495	0.00083	0.000621	0.0000025	0.000003	0.000671	0.0134
KZ-37	01-Jun-2017	0.000432	0.00131	0.000568	0.000011	0.000007	0.00052	0.0268	0.0104	0.00007	0.00028	0.000046	0.00133	0.16	0.000104	0.0164	0.0000010	0.000423	0.000581	0.000493	0.000006	0.000002	0.000502	0.012
KZ-37	07-Jun-2017	0.00053	0.000672	0.000761	0.0000025	0.000003	0.000872	0.014	0.00816	0.000067	0.000258	0.000042	0.000869	0.127	0.000039	0.0203	0.0000010	0.000535	0.000464	0.000717	0.0000025	0.000002	0.000874	0.0103
KZ-37	13-Jun-2017	0.000447	0.00105	0.000558	0.000007	0.000004	0.000447	0.0187	0.0188	0.000047	0.00026	0.000042	0.00163	0.0875	0.000042	0.0116	0.0000010	0.000437	0.000703	0.000583	0.0000025	0.0000010	0.000426	0.0108
KZ-37	19-Jul-2017	0.000515	0.00062	0.00063	0.000005	0.0000010	0.000796	0.0153	0.00979	0.000048	0.000223	0.00006	0.000791	0.0719	0.000074	0.0102	0.0000010	0.000506	0.000456	0.000813	0.0000025	0.000002	0.000845	0.0111
KZ-37	10-Aug-2017	0.000631	0.000402	0.00105	0.0000025	0.0000010	0.00114	0.0129	0.00663	0.000063	0.000211	0.0000617	0.00045	0.103	0.0000111	0.0223	0.0000010	0.000624	0.000384	0.00104	0.0000025	0.0000010	0.00116	0.0112
KZ-37	14-Sep-2017	0.000786	0.000417	0.00106	0.0000025	0.0000010	0.00154	0.0112	0.00329	0.00004	0.000262	0.00007	0.000328	0.17	0.000006	0.0487	0.0000010	0.000796	0.000376	0.00105	0.0000025	0.0000010	0.00157	0.0102
KZ-37	05-Oct-2017	0.000743	0.000457	0.00105	0.0000025	0.0000010	0.00143	0.0118	0.00259	0.000038	0.00025	0.000069	0.000284	0.196	0.000006	0.0556	0.0000010	0.000745	0.000384	0.00105	0.0000025	0.0000010	0.00151	0.0107
KZ-37	03-Nov-2017	0.000793	0.000397	0.00121	0.0000025	0.0000010	0.00161	0.015	0.00188	0.000037	0.000265	0.000065	0.000241	0.168	0.0000025	0.0626	0.0000010	0.000824	0.000392	0.00118	0.0000025	0.0000010	0.00167	0.0152
KZ-37	05-Dec-2017	0.000894	0.000475	0.00117	0.0000025	0.0000010	0.00184	0.0154	0.00228	0.000035	0.000328	0.0000731	0.000251	0.157	0.0000124	0.075	0.0000010	0.000924	0.000454	0.00124	0.0000025	0.0000010	0.00186	0.0163
KZ-37	09-Jan-2018	0.000889	0.000484	0.00122	0.0000025	0.0000010	0.00206	0.0123	0.00209	0.000041	0.000306	0.0000652	0.000337	0.145	0.0000399	0.0723	0.0000010	0.000921	0.000402	0.00127	0.0000025	0.0000010	0.002	0.0112
KZ-37	14-Feb-2018	0.000774	0.000647	0.00108	0.0000025	0.0000010	0.00188	0.0136	0.0021	0.00003	0.000299	0.0000789	0.000171	0.245	0.0000025	0.16	0.0000010	0.00092	0.000656	0.00124	0.0000025	0.0000010	0.00211	0.0128
KZ-37	21-Feb-2018	0.000943	0.000724	0.00119	0.0000025	0.0000010	0.00202	0.013	0.00251	0.000032	0.000411	0.0000876	0.000807	0.209	0.0000516	0.142	0.0000010	0.001	0.000715	0.00106	0.0000025	0.0000010	0.00213	0.0129
KZ-37	01-Mar-2018	0.000932	0.000547	0.00114	0.0000025	0.0000010	0.00185	0.0119	0.00196	0.000027	0.000319	0.0000636	0.000025	0.23	0.0000172	0.143	0.0000010	0.000843	0.000601	0.00115	0.0000025	0.0000010	0.00208	0.0125
KZ-37	07-Mar-2018	0.00082	0.000635	0.00113	0.0000025	0.0000010	0.00207	0.0126	0.00228	0.000027	0.000291	0.0000877	0.000173	0.278	0.0000081	0.149	0.0000010	0.000866	0.000596	0.00127	0.0000025	0.0000010	0.00179	0.0132
KZ-37	15-Mar-2018	0.000749	0.000566	0.00143	0.0000025	0.0000010	0.00162	0.0109	0.00317	0.000048	0.000362	0.0000808	0.00094	0.223	0.0000209	0.14	0.0000010	0.000979	0.000612	0.00115	0.0000025	0.0000010	0.00192	0.0128
Average		0.000736	0.000733	0.001000	0.00000383	0.00000211	0.001452	0.0160	0.01294	0.000041	0.000306	0.0000659	0.0006204	0.1776	0.00003224	0.0738	0.00000131	0.000757	0.000579	0.000991	0.00000295	0.00000133	0.001486	0.01257
Count		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Minimum		0.000314	0.000397	0.000395	0.0000025	0.0000010	0.000377	0.0108	0.0016	0.000024	0.000211	0.000041	0.000025	0.0719	0.0000025	0.0102	0.0000010	0.000259	0.000376	0.000328	0.0000025	0.0000010	0.000278	0.00988
Maximum		0.00111	0.00272	0.00143	0.000011	0.0000093	0.00218	0.0525	0.152	0.00007	0.000411	0.000104	0.0019	0.278	0.000109	0.16	0.0000072	0.00106	0.0015	0.00127	0.000008	0.000003	0.00218	0.0222
Geometric Mean		0.000700	0.000639	0.000949	0.00000327	0.00000150	0.001279	0.0147	0.00457	0.000039	0.000301	0.0000639	0.0003939	0.1680	0.00001571	0.0538	0.00000110	0.000712	0.000544	0.000937	0.00000277	0.00000123	0.001285	0.01233
Count <DL		0	0	0	17	15	0	0	0	0	0	0	1	0	4	0	19	0	0	0	18	15	0	0
Standard Deviation		0.000222	0.000526	0.000295	0.00000274	0.00000232	0.000624	0.0094	0.03326	0.000014	0.000058	0.0000165	0.0005567	0.0556	0.00003541	0.0514	0.00000139	0.000238	0.000252	0.000291	0.00000142	0.00000062	0.000656	0.00281
1st Quartile		0.000526	0.000473	0.000737	0.0000025	0.0000010	0.000853	0.0117	0.00210	0.000032	0.000262	0.0000592	0.0002240	0.1420	0.000006	0.0247	0.0000010	0.000528	0.000434	0.000789	0.0000025	0.0000010	0.000867	0.01078
Median		0.000780	0.000556	0.001070	0.0000025	0.0000010	0.001615	0.0130	0.00266	0.000038	0.000300	0.0000643	0.0003325	0.1795	0.00001480	0.0675	0.0000010	0.000834	0.000512	0.001090	0.0000025	0.0000010	0.001730	0.01205
3rd Quartile		0.000900	0.000685	0.001195	0.00000312	0.00000150	0.002012	0.0153	0.00857	0.000048	0.000336	0.0000746	0.0008868	0.2235	0.00004440	0.1096	0.0000010	0.000927	0.000623	0.001210	0.0000025	0.00000125	0.002020	0.01298
95th Percentile		0.00104	0.00138	0.0013445	0.000011	7.115E-06	0.0021	0.02809	0.02926	6.72E-05	0.0003958	8.852E-05	0.0016435	0.24665	0.00010425	0.14955	1.31E-06	0.00104	0.00086	0.00127	0.0000061	2.62E-06	0.00215	0.016595
Mean + 2 Standard Deviation		0.00118	0.00179	0.00159	0.00000931	6.75E-06	0.0027	0.0348	0.07946	0.000069	0.000422	0.0000989	0.0017338	0.2888	0.00010306	0.1766	4.09E-06	0.00123	0.00108	0.001573	0.00000579	2.57E-06	0.0028	0.01819