Bellekeno Mine
Environmental Effects Monitoring
Cycle 1 Interpretive Report

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March 2013

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March 2013

EXECUTIVE SUMMARY

The Bellekeno Mine, located in the Keno Hill Silver District of central Yukon, is a silver-lead-zinc mine operated by Alexco Resources Corp. (Alexco). The mine began commercial production in 2010, with ore from underground operations processed off-site at Alexco's Flame and Moth Mill. Bellekeno Mine waste water consists of drainage collected from a waste containment facility, adit discharge, and mine dewatering. The Bellekeno Mine waste water treatment process includes lime and ferric chloride addition followed by settling and filtration, with effluent released to the ground within the Lightning Creek catchment. From the discharge location, effluent infiltrates to ground, flows underground and is assumed to enter Lightning Creek downstream of Thunder Gulch. Placer mining is conducted by a separate operator in lower Thunder Gulch upstream of the area believed to receive the Bellekeno treated effluent discharge. In addition, historical placer mining in Lightning Creek near the mine has resulted in substantial habitat alteration at mine effluent-exposed areas of the creek. From the mine, Lightning Creek drains southwest approximately 5.7 km to Duncan Creek, which then flows south into the Stewart River, a key tributary of the Yukon River.

Under the Metal Mining Effluent Regulations (MMER) of the *Fisheries Act*, Environmental Effects Monitoring (EEM) must be conducted at the Bellekeno Mine to determine whether mine effluent is causing effects on benthic invertebrate communities, fish populations and/or fish tissues (e.g., mercury accumulation; Environment Canada 2012a). The EEM program consists of routine effluent and water quality monitoring studies as well as biological monitoring studies. The Bellekeno Mine became subject to MMER on September 7th 2010 as a result of exceeding the treated effluent flow rate of 50 $m^3 \cdot day^{-1}$ stipulated in the regulation. In accordance with the EEM schedule, a Study Design report was provided to Environment Canada more than six months prior to the field study (September 2011), which was conducted during two field visits in June (11th to 13th) and August (24th to 26th) 2012. During field sampling, it became evident that habitat conditions and an absence of sentinel fish precluded implementation of the benthic invertebrate and fish population surveys, respectively, as described in the study design. As a result, adjustments were made to the Bellekeno Mine biological monitoring studies following consultation with Environment Canada.

Bellekeno Mine effluent quality has generally met MMER limits since the mine became subject to the regulations in September 2010. The only exceptions occurred for total suspended solids (TSS), with monthly average TSS concentrations exceeding the MMER limit of 15 mg/L in three separate months between September 2010 and December 2012.

Sublethal toxicity testing indicated that effluent from the mine was non-toxic to rainbow trout embryos and had minimal influence on green algae (*Pseudokirchneriella subcapitata*) growth, but elicited effects on invertebrate (*Ceriodaphnia dubia*) reproduction and duckweed (*Lemna minor*) growth. However, because laboratory geometric mean effect concentrations of 44% and 40% (observed for *C. dubia* and duckweed, respectively) were well above estimated effluent concentrations in the mine receiver, effluent-related toxicity was not predicted for Lightning Creek.

Water quality monitoring at Lightning Creek showed slightly higher pH and specific conductance downstream of the mine discharge, with specific conductance data used to indicate that average effluent concentration in Lightning Creek ranged between 2.3% to 3.2% just below the mine. Water quality at the effluent-exposed area showed elevated concentrations of total suspended solids and several metals compared to reference, with annual average aluminum, cadmium, copper, iron, lead and phosphorus concentrations elevated above jurisdictional water quality guidelines at the effluent-exposed area. However, several metals appeared to have been elevated at the effluent-exposed area due to upstream historical mine influences and/or active placer mining at Thunder Gulch. In consideration of the spatial patterns in water quality, the Bellekeno Mine effluent appeared to be a key source of cobalt, iron, manganese, nickel, phosphorus and silver to Lightning Creek. This suggested that any potential biological effects to Lightning Creek biota were more likely to be associated with metals originating from sources other than the Bellekeno Mine effluent.

Benthic invertebrate community analysis indicated significantly lower organism density at the effluent-exposed area (EXP) compared to a placer mining-influenced reference area located just upstream of the Thunder Gulch confluence (REF2), as well as significant differences in Bray Curtis Index (i.e., community composition) between these areas. The magnitude of difference for each of these differences was greater than the Environment Canada critical effect size of 2 standard deviations (SD). Similar differences were indicated between EXP and the upstream-most (pristine) reference area (REF1), but at lower magnitudes of difference, suggesting greater similarity between in benthic invertebrate community of EXP and REF1. Because the proportion of metal-sensitive invertebrates was greater at the effluent-exposed area than at either reference area, the differences in community composition between these areas was not consistent with an effluent related effect. Rather, comparison of the relative abundance of other functional feeding groups between effluent-exposed and REF2 areas, as well as greater similarity in community composition between the effluent-exposed and REF1, suggested that placer mining-related influences on habitat (e.g., total suspended solids load, silt accumulation, substrate size alteration, reduced riparian coverage) could have accounted for the significant differences observed between the effluent-exposed and reference areas of Lightning Creek.

A fish population survey could not be implemented as part of the Bellekeno Mine EEM as a result of naturally low abundance of a suitable sentinel fish species at the effluent-exposed area and the complete absence of a suitable sentinel fish species at reference areas. The fish tissue survey indicated that Arctic grayling collected at the effluent-exposed area had significantly lower muscle tissue mercury concentrations than those collected from the reference area (REF1) of Lightning Creek. Muscle tissue mercury concentrations at both areas were well below the human health consumption limit of 0.50 µg/g wet weight. In addition, concentrations of most other metals in grayling muscle tissue from effluent-exposed fish were similar to or lower than in reference fish. Accordingly, no effects on usability of Arctic grayling tissue were apparent at the Bellekeno Mine.

Overall, the Bellekeno Mine EEM study suggested some minor effluent-related influences on water quality of Lightning Creek. However, no clear effluent-related influences on the benthic invertebrate community of Lightning Creek were indicated, with differences in organism density and composition between effluent-exposed and reference areas more consistent with a placer mining-related habitat influence than an effluent toxicity-related response. In addition, no effluent-related influences on the usability of fish tissues were indicated at the effluent-exposed area, with mercury and other metal concentrations often much lower in Arctic grayling collected downstream of the mine discharge than in reference grayling.

Based on the EEM schedule prescribed in the MMER, the next Bellekeno Mine EEM biological study Interpretive Report must be submitted to Environment Canada no later than March 7th 2016. Accordingly, a Study Design for the next EEM biological studies must be submitted to Environment Canada at least six months prior to implementation of the field portion of the study in the spring/summer of 2015.

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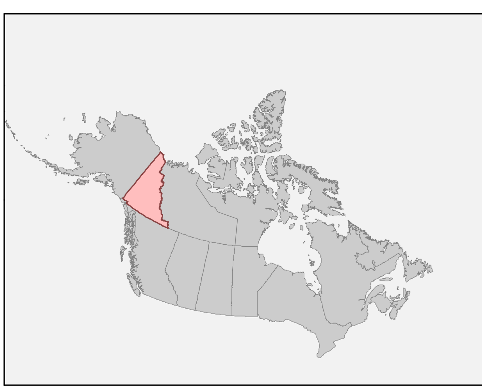
1.0 INTRODUCTION

1.1 Background

The Bellekeno Mine is a silver-lead-zinc mine located in the Keno Hill Silver District of central Yukon, approximately 45 km northeast of the Town of Mayo (Figure 1.1). The mine, which is operated by Alexco Resources Corp. (Alexco), began commercial production in 2010. An average of approximately 260 tonnes of ore (2012 figure) is extracted per day from underground operations at the Bellekeno Mine using mechanized cut-and-fill methods augmented by conventional stoping. Ore is processed off-site (Flame and Moth Mill), with mill-generated solid wastes deposited to a dry-stack tailings facility and liquid wastes directed to a sedimentation pond at the mill site that, to date, has yet to discharge (Figure 1.2). Waste water generated at the Bellekeno Mine consists of drainage collected from a waste containment facility (which includes waste rock classified as acidic- and/or metal leaching), adit discharge, and mine dewatering. The Bellekeno Mine waste water treatment process includes lime and ferric chloride addition followed by settling and multi-media filtration prior to discharge to a decant box that releases treated effluent to the ground within the Lightning Creek catchment. From the discharge location (KV-43), effluent infiltrates to ground, flows underground, and is assumed to enter Lightning Creek downstream of Thunder Gulch (Figure 1.3). Placer mining is conducted by a separate operator in lower Thunder Gulch upstream of the area believed to receive the Bellekeno treated effluent discharge. In addition, historical placer mining in Lightning Creek near the mine has resulted in substantial habitat alteration at mine effluent-exposed areas of the creek (ACG and Minnow 2011). From the mine, Lightning Creek drains southwest approximately 5.7 km to Duncan Creek, which then flows south into the Mayo River, a key tributary of the Stewart River.

Under the Metal Mining Effluent Regulations (MMER) of the *Fisheries Act*, Environmental Effects Monitoring (EEM) must be conducted at the Bellekeno Mine to determine whether mine effluent is causing effects on benthic invertebrate communities, fish populations and/or fish tissues (e.g., mercury accumulation; Environment Canada 2012a). The EEM program consists of routine effluent and water quality monitoring studies as well as biological monitoring studies (Government of Canada 2012). The Bellekeno Mine became subject to MMER on September 7th 2010 as a result of exceeding the treated effluent flow rate of 50 $m^3 \cdot day^{-1}$ stipulated in the regulation (ACG and Minnow 2011).

In accordance with the MMER, a Study Design was provided to Environment Canada in September 2011 which outlined the biological monitoring studies to be conducted at Bellekeno Mine to satisfy EEM requirements. The study design was developed, in part,



ALEXCO KENO HILL MINING CORP.

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BELLEKENO MINE PROJECT - ENVIRONMENTAL EFFECTS MONITORING PROGRAM - CYCLE I INTERPRETIVE REPORT

FIGURE 1.1
PROJECT LOCATION

DRAWN BY MD	VERIFIED BY DP

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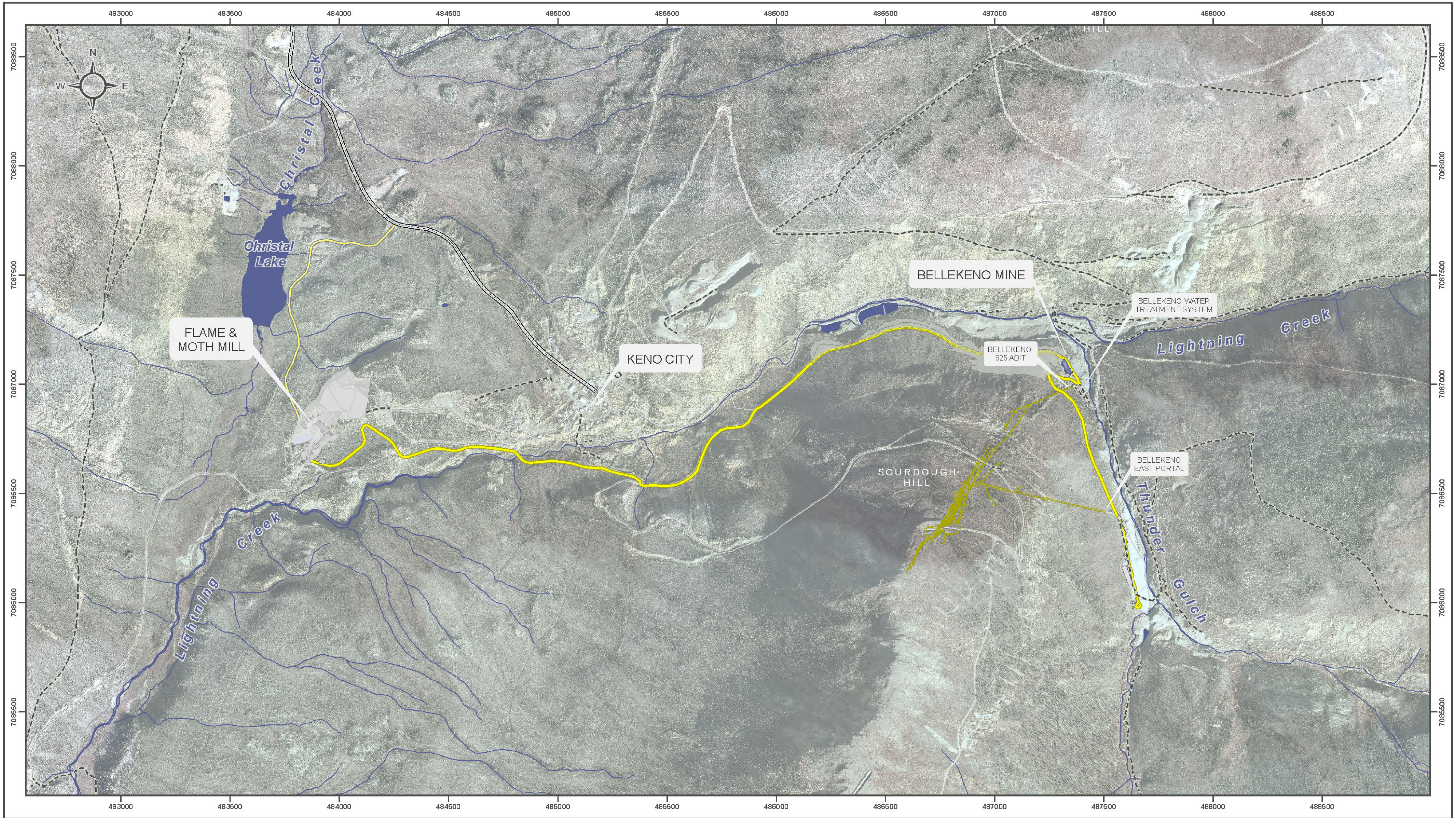

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13 and 14 2006. Site hydrography and contours provided by Aero Geometrics LTD, derived from aerial photograph.

Datum: NAD 83; Map Projection: UTM Zone 8N

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FIGURE 1.2

LOCATION AND SITE OVERVIEW OF THE BELLEKENO MINE

DRAWN BY MD	FEBRUARY 2013	VERIFIED BY VB

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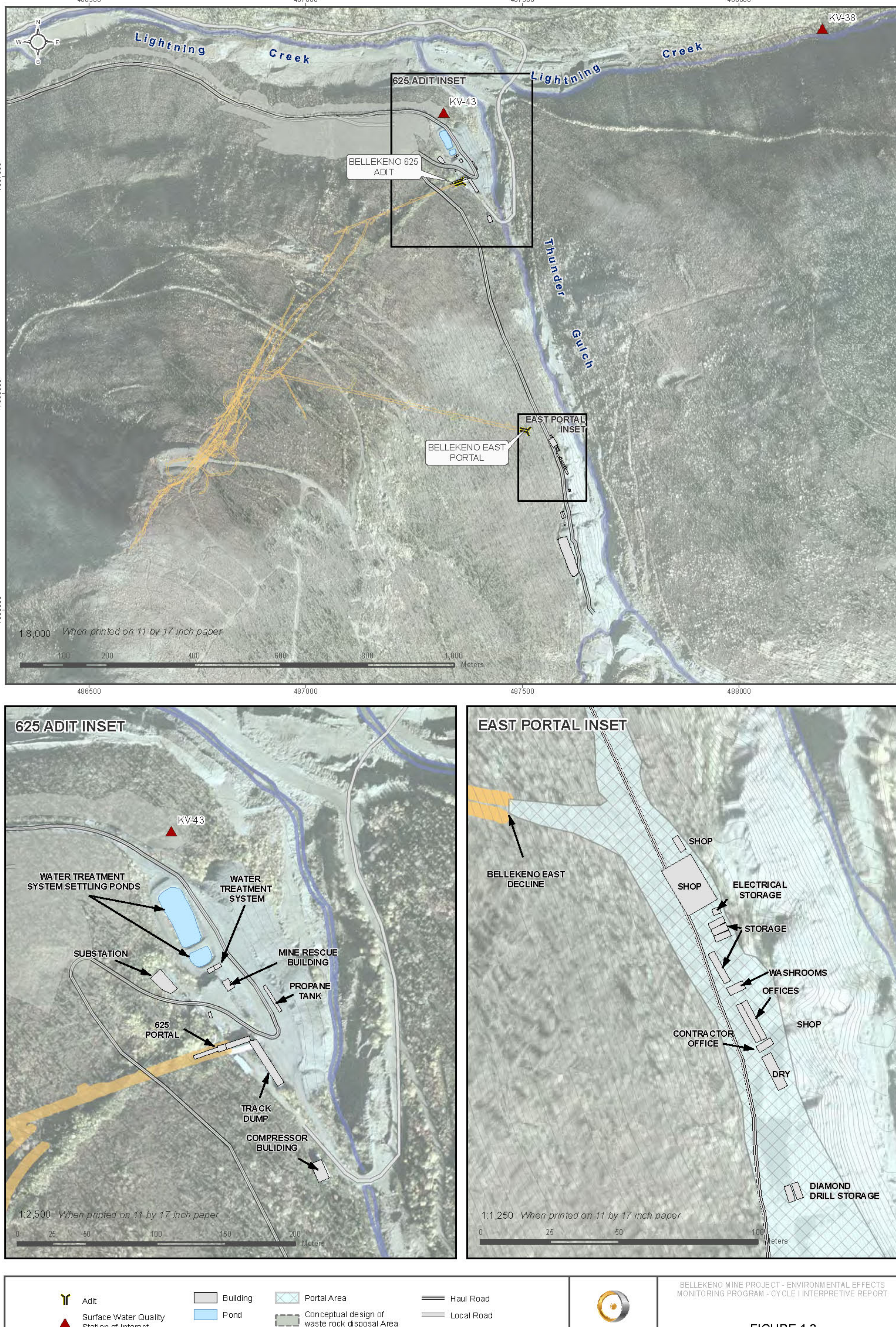

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006. Site hydrography and contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

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FIGURE 1.3
BELLEKENO MINE SITE LAYOUT

DRAWN BY MD	SEPTEMBER 2011	VERIFIED BY VB

using information from previous Lightning Creek biological studies that showed moderate density and diversity of benthic invertebrates sampled using artificial substrates, but a very limited fish community that appeared to be confined to lower Lightning Creek (ACG and Minnow 2011). During biological sampling in 2012, it became evident that habitat conditions and an absence of sentinel fish precluded implementation of the benthic invertebrate and fish population surveys, respectively, as described in the study design. As a result, adjustments were made to the Bellekeno Mine biological monitoring studies following consultation with Environment Canada. Pursuant to MMER requirements, this Interpretive Report provides a summary of Bellekeno Mine effluent and water quality monitoring data and the methods, results and conclusions of the initial Bellekeno Mine biological monitoring describing, where applicable, any deviations from the design approved for the study.

1.2 Interpretive Report Organization

The methods utilized for sample collection, sample analysis and data analysis for the effluent and water quality monitoring and the biological monitoring are presented in Section 2.0. A description of any deviations from the study design and any impacts that these deviations may have had on the biological monitoring is also provided in Section 2.0. Section 3.0 presents a summary of the effluent quality monitoring data, including effluent volume, characterization and sublethal toxicity. Receiving environment water quality monitoring data collected routinely by the mine are summarized in Section 4.0 along with supporting water quality data collected during the implementation of biological monitoring. Benthic invertebrate community survey results are presented in Section 5.0, with the results of the fish population and fish tissue surveys presented in Section 6.0. The conclusions of the Bellekeno Mine EEM study and recommendations for the next EEM program are provided in Section 7.0. Finally, all references cited in this report are listed in Section 8.0.

2.0 METHODS

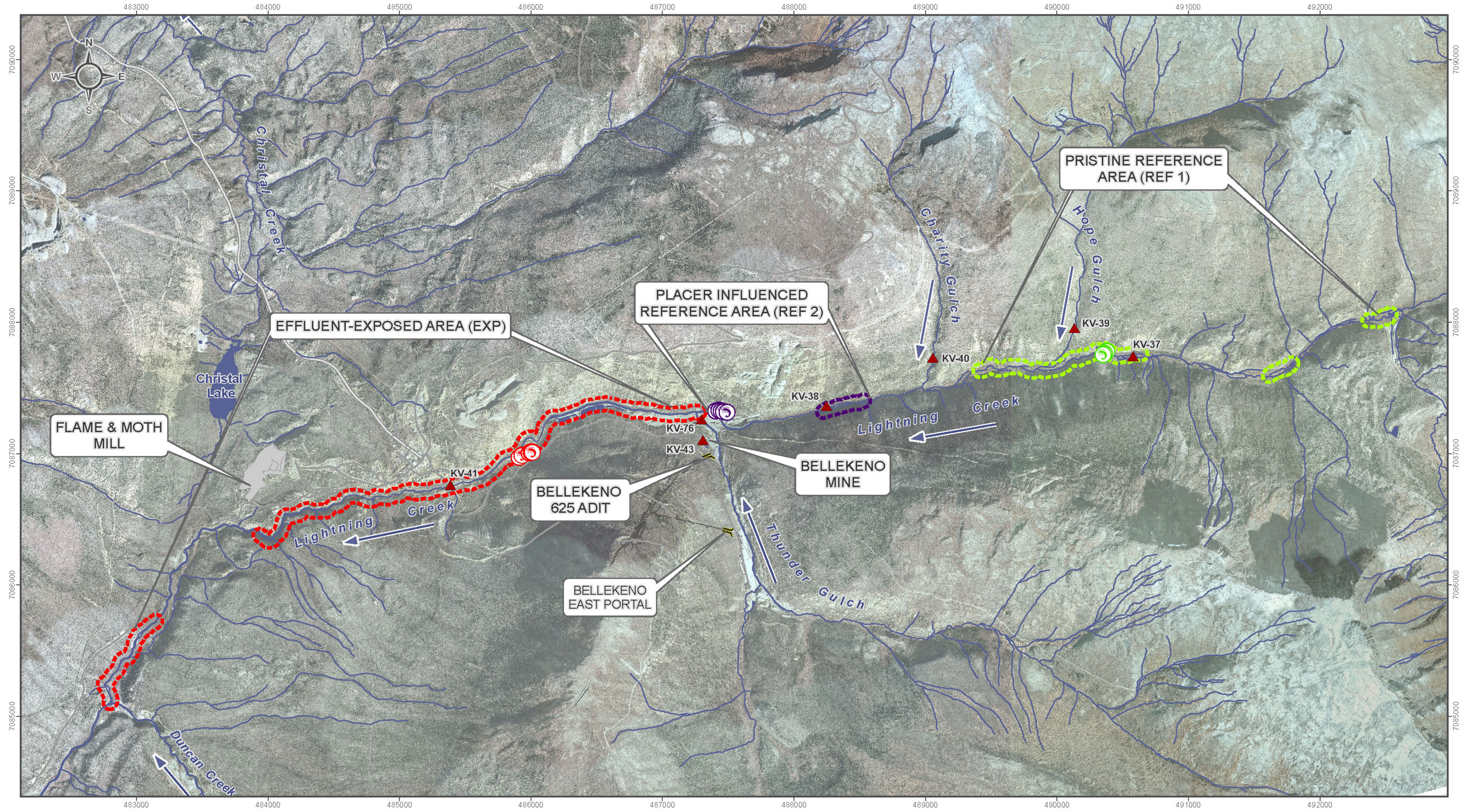
The EEM program consists of effluent and water quality monitoring studies as well as biological monitoring studies (Government of Canada 2012). Effluent and water quality monitoring data were collected by Bellekeno Mine personnel at a minimum of four times per calendar year, at intervals not less than one month apart, as stipulated in the MMER. Additional receiving environment water quality data were also collected during the biological monitoring study. Biological monitoring was conducted by Minnow Environmental Inc. (Minnow) personnel with assistance provided by Access Consulting Group (ACG) in June and August 2012, consistent with the EEM schedule stipulated by the MMER.

2.1 Effluent and Water Quality Monitoring

The Bellekeno Mine EEM study included effluent monitoring (effluent volume, quality and sublethal toxicity) and receiving environment water quality monitoring. As part of its EEM requirements, the Bellekeno Mine must provide an annual effluent and water quality monitoring report to Environment Canada by March 31st of the following year that includes sampling locations, dates, methods and results together with information on quality assurance and quality control (QA/QC) for this sampling (Government of Canada 2012). Only a summary of the results of routine effluent and water quality monitoring data need be included in the biological monitoring report, and therefore the following paragraphs provide a very brief overview of the effluent and water quality monitoring methods. Additional receiving environment water quality sampling was completed at the time of biological monitoring to support the benthic invertebrate community survey data, and therefore methods pertaining to the analyses of these samples are provided accordingly.

2.1.1 Effluent Quality

Effluent quality monitoring included routine MMER monitoring and effluent characterization and sublethal toxicity sampling. Although effluent characterization samples for EEM are required to be collected four times per calendar year, weekly sampling is required to meet territorial Water Use Licence (WUL No. QZ09-092) requirements for Bellekeno Mine, and therefore these additional data were included as part of the effluent quality results summary. Effluent volume and characterization samples were collected at the outlet of the Bellekeno 625 Water Treatment System decant point of compliance, referred to as Station KV-43 (Figure 2.1). In addition to deleterious substances (arsenic, copper, lead, nickel, zinc, total suspended solids and radium-226) and pH, effluent characterization included analysis of temperature, conductivity, hardness, alkalinity, ammonia, nitrate and additional metals



Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13 and 14 2006. Site hydrography and contours provided by Aero Geometrics LTD, derived from aerial photograph.

Datum: NAD 83; Map Projection: UTM Zone 8N

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Kilometers
0 0.5 1 2

BENTHIC SAMPLING STATIONS

- Pristine Reference
- Placer-Influenced Reference
- Effluent-Exposed

FISH SAMPLING AREAS

- Pristine Reference
- Placer-Influenced Reference
- Effluent-Exposed
- Water Quality Stations

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FIGURE 2.1

LOCATION OF EEM BENTHIC INVERTEBRATE COMMUNITY AND FISH SURVEY SAMPLING LOCATIONS

MARCH 2013

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(aluminum, cadmium, iron, mercury, molybdenum and selenium). Effluent volume was calculated as the sum of the total monthly volume deposited from Station KV-43 in cubic meters (m^3). For each deleterious substance and effluent characterization parameter, monthly means were calculated. For the deleterious substances, monthly mean concentrations were compared to MMER limits and for mercury, monthly mean concentrations were compared to the EEM fish tissue survey trigger limit (i.e., 0.0001 mg/L).

Sublethal toxicity testing was initiated shortly after the start of commercial production in 2010 and twice per calendar year thereafter using effluent collected at the Station KV-43 control point. Final effluent samples were collected into pre-labeled plastic containers provided by the toxicity laboratory, put on ice inside coolers and shipped to the toxicity laboratory where they arrived within 48 hours of collection. Sublethal toxicity tests were conducted using rainbow trout (*Oncorhynchus mykiss;* 9-day early life stage survival test), a cladoceran invertebrate (*Ceriodaphnia dubia;* 7-day survival and reproduction test), duckweed (*Lemna minor*; 7-day growth inhibition test), and a green algae (*Psuedokirchneriella subcapitata*; 3-day growth inhibition test) using standard test methods (i.e., Environment Canada 1998; 2007a,b,c). For *C. dubia* chronic toxicity tests, an LC_{50} (i.e., lethal concentration to 50% of test organisms) was calculated from the mortality data. Chronic toxicity test EC_{25} or IC_{25} (effective or inhibitory concentration, respectively, that reduced rainbow trout embryo survival by 25%, reduced the number of *C. dubia* neonates produced by 25%, inhibited *P. subcapitata* and *L. minor* growth and/or frond production by 25%) values were calculated from the growth or reproductive data. Reference toxicant testing was employed to ensure that all test systems met protocol criteria during effluent testing. All EC_{25} and IC_{25} data were derived by the toxicity laboratory using non-linear regression models or linear interpolation models, as appropriate, aided by Comprehensive Environmental Toxicity Information System (CETIS) software (Tidepool Scientific Software, McKinleyville, CA). Sublethal toxicity test results were subsequently reported to Environment Canada as part of the Bellekeno Mine annual reporting and were summarized in this report.

2.1.2 Receiving Environment Water Quality

Receiving environment water quality monitoring data were collected monthly at EEM effluent-exposed (Station KV-41) and reference (Station KV-37) stations in Lightning Creek (Figure 2.1). Similar to the minimum sampling frequency required for EEM effluent characterization, this water quality monitoring frequency exceeded the EEM requirement of four times per calendar year since monthly sampling is required under the mine WUL. Additional water quality data collected from Hope Gulch, Charity Gulch, lower Thunder Gulch and Lightning Creek (Stations KV-39, KV-40, KV-76 and KV-38, respectively; Figure 2.1) collected to meet territorial WUL regulatory commitments were used to augment the EEM data and provide additional perspective. Water quality sampling was also conducted during biological monitoring in August, 2012 at Lightning Creek EEM study areas (i.e., the effluent-exposed area and placer-influenced and pristine reference areas; Figure 2.1).

Water quality samples were collected from approximately mid-water column directly into labeled sample bottles pre-dosed with required chemical preservatives or into collection bottles triple-rinsed with ambient water for those not requiring preservation. The water quality samples were placed in coolers and maintained at cool temperatures during shipment to the analytical laboratory. Water monitoring samples were analyzed for the same parameters indicated previously for routine effluent monitoring and effluent characterization (i.e., temperature, pH, conductivity, hardness, alkalinity, TSS, ammonia, nitrate, radium-226 and total metals). Notably, cyanide was not included as an analyte because it is not used at the Bellekeno Mine. Annual means were calculated by station for each water quality monitoring parameter. These water quality data were compared among EEM study areas and/or among routine water quality monitoring stations, and were also evaluated relative to the Canadian Water Quality Guidelines (CWQG; CCME 1999) and provincial criteria for British Columbia (BCMOE 2006) and Ontario (OMOEE 1994).

During biological monitoring, *in-situ* water temperature, dissolved oxygen, pH and specific conductance measurements were taken at replicate benthic invertebrate stations at the effluent-exposed area (EXP), the pristine reference area (REF1), and the placer-influenced reference area (REF2; Figure 2.1). A calibrated YSI 650 MDS (Multiparameter Display System) equipped with a YSI 6820 Sonde (YSI Inc., Yellow Springs, OH) was used to collect each *in-situ* measure during biological monitoring. These *in-situ* water quality measures were compared statistically among effluent-exposed and reference areas using Analysis-of-Variance (ANOVA) and *post-hoc* testing using Tukey's Honestly Significant Difference (HSD) comparisons. Prior to ANOVA, all data were transformed as necessary to satisfy assumptions of normality and homogeneity of variance. In instances where normality could not be achieved through data transformation, non-parametric Kruskal-Wallis and/or Mann-Whitney U-test statistics were used. Similarly, in instances in which variances of normal data could not be homogenized by transformation, Tamhane's *post-hoc* comparisons were employed. All statistical comparisons were conducted using SPSS Version 12.0 (SPSS Inc., Chicago, IL). In addition to these comparisons, dissolved oxygen and pH data from each station were compared to applicable CWQG (CCME 1999).

2.2 Biological Monitoring

The Bellekeno Mine biological monitoring study included a benthic invertebrate community survey, a fish population survey and a fish tissue survey. Biological monitoring was completed during two separate field visits, with fish population and fish tissue sampling attempted in June 2012, and benthic invertebrate, as well as a second attempt at fish population and fish tissue sampling (see Sections 2.2.2 and 2.2.3), conducted in August 2012. Each biological monitoring component was supported by habitat observations, water quality field measurements, and water quality sampling (Section 2.1.2). In addition, each biological monitoring study component incorporated a data quality program to provide checks for sample collection and analysis, and to allow for the assessment of the overall quality of the data (Appendix A).

Lightning Creek is the immediate receiver of the Bellekeno Mine effluent, and therefore served as the focus for biological monitoring. An effluent-exposed study area (EXP) was established downstream of the mine discharge (Figure 2.1). Placer mining was historically conducted in Lightning Creek at and upstream of where the Bellekeno Mine discharge is assumed to discharge into the creek. Placer mining is currently conducted in Thunder Gulch, which is a key tributary that discharges into Lightning Creek just upstream of the mine (Figure 2.1). Therefore, to help distinguish any potential mine effluent-related influences to biological communities from those potentially associated with placer mining, reference areas were established well upstream of and also within areas disturbed by historical placer mining (REF1 and REF2, respectively; Figure 2.1). Because the location of mine effluent discharge to Lightning Creek is unknown and there is very limited distance between Thunder Gulch and the area of Lightning Creek that is believed to recieve mine effluent, no reference area could be established that took into account the influence of current placer mine on Lightning Creek. Benthic invertebrate community sampling was conducted at each of the three study areas, but because no physical barriers were present between study areas and fish densities were expected to be low, fish population and fish tissue sampling were conducted only at the effluent-exposed and upstream-most reference area (REF1; Figure 2.1).

2.2.1 Benthic Invertebrate Community Survey

2.2.1.1 Approach

The benthic invertebrate community survey employed a multiple Control-Impact design with sampling conducted at erosional habitat of the effluent-exposed area and both upstream reference areas of Lightning Creek (Figure 2.1) on August 24th and 25th, 2012. The benthic invertebrate community survey described in the study design indicated that a 0.1 m^2 Hess

Sampler outfitted with 250 µm mesh would be used for sample collection, with each sample consisting of a replicate of three grabs (ACG and Minnow 2011). However, during the field survey, visual identification of suitable sites for individual Hess sampler replicates was highly impaired by the combination of poor water clarity, large-sized substrate and fast water at the mine effluent-exposed area as a result of current placer mining activity and historical placer mining-related habitat alteration.

Rather than proceeding with 'blind' sampling that may have confounded data interpretation, and following consultation with Environment Canada (D. Lacroix) by telephone on June 13th and again on August 24th, it was agreed that benthic invertebrate samples would be collected by kick net instead of Hess sampler. Kick sampling is the method of choice for samples being collected as part of the Canadian Aquatic Biomonitoring Network (CABIN), which is an aquatic monitoring program maintained by Environment Canada (2012b). Under the kick sampling approach, sampling is conducted across/along a riffle stream section to provide a timed- rather than area-delimited estimate of relative organism abundance. As a result of greater variability in substrate size and water velocity sampled by kick methods, a broader assemblage of the overall benthic invertebrate community is generally sampled using kick sampling compared to Hess sampling, perhaps offsetting the influences associated with tighter habitat site-selectivity reflected in a well designed Hess sampling study. Therefore, a kick sampling versus a Hess sampling approach may potentially result in different benthic invertebrate community endpoints showing differences among study areas, but would not be expected to hamper the ability of the study to detect effluent-related influences among study areas.

2.2.1.2 Sample Collection and Laboratory Processing

As proposed for Hess sampling and consistent with EEM guidance regarding adequate statistical power to detect differences of ± two standard deviations at an α and β of 0.10, kick sampling was conducted at five stations from each study area (Environment Canada 2012a). Benthic invertebrate community samples were collected using a triangular kick net (36 cm base; 510 cm^2 aperture) outfitted with 400 µm mesh. Briefly, as per CABIN protocols (Environment Canada 2012), riffle habitat at each station was sampled using a 3-minute travelling kick sampling method. Beginning at the downstream end of the sampling station and with the kick net positioned on the stream bottom downstream of the sampler, the sampler disturbed the substrate in front of the kick net using his/her feet to dislodge attached benthic invertebrates. While disturbing the substrate and keeping the kick net immediately downstream, the sampler proceeded to move backwards in a zig-zag pattern from bank to bank and in an upstream direction for a period of three minutes. Following the three minute collection period, all material and organisms retained in the collection net were carefully transferred into wide-mouth plastic jars containing both internal and external station identification labels. The benthic samples were later preserved to a level of 10% buffered formalin in ambient water.

Supporting information collected at each study area included sampling depth and water velocity across the sampled riffle, channel and bankfull width, substrate size measurements, general habitat notes (e.g., stream morphology, in-stream vegetation, riparian features, surrounding land use, etc.) and *in-situ* water quality (see Section 2.1.2). Global positioning system (GPS) latitude and longitude coordinates based on the North America Datum of 1983 (NAD 83) were also taken at each station. Finally, photographs of the benthic invertebrate community sampling area were taken to support the habitat descriptions.

Benthic invertebrate community samples were submitted to Zeas Inc. (Nobleton, ON) for analysis following standard sorting methods which incorporated recommended Environment Canada (2012a) QA/QC measures for sub-sampling error and sorting recovery checks. Upon arrival at the laboratory, a biological stain was added to each benthic invertebrate community sample to facilitate greater sorting accuracy. The samples were washed free of formalin in a 400 μm sieve and the remaining sample material was then examined under a stereomicroscope at a magnification of at least ten times by a technician. All benthic invertebrates were removed from the sample debris and placed into vials containing a 70% ethanol solution according to major taxonomic groups (e.g., phyla, orders). A senior taxonomist later enumerated and identified the benthic organisms to the lowest practical level (typically to genus or species) using up-to-date taxonomic keys. Following identification, representative specimens of each taxon were placed in separately labeled vials containing a 75% ethanol-3% glycerol preservative to create a benthic invertebrate voucher collection.

2.2.1.3 Data Analysis

Benthic invertebrate communities were evaluated using summary metrics including mean taxon richness (as identified to the family level [FL] and lowest practical level [LPL]), mean relative invertebrate abundance (or "density"; average number of organisms per three-minute kick sample), and Simpson's Evenness Index (E) and the Bray-Curtis Index of Dissimilarity (each calculated based on FL and LPL taxonomy) to meet MMER requirements (Environment Canada 2012a). Simpson's E and the Bray-Curtis indices were calculated according to the formulae presented by Environment Canada (2012a). Additional comparisons were conducted using the percent composition of dominant/indicator taxa and functional feeding groups (calculated as the abundance of each respective taxon group relative to the total number of organisms in the sample). Dominant/indicator taxon groups were defined as those groups representing, on average, greater than 10% of total organism abundance for a study area or any groups considered to be important indicators of environmental stress. Functional feeding groups (FFG) were assigned based on Mandaville (2002) and Merritt and Cummins (2008) designations for each taxon. All required and selected benthic invertebrate community endpoints were summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each study area.

Differences among effluent-exposed and reference areas were tested using ANOVA and *post-hoc* comparisons. Prior to ANOVA, all data were transformed as necessary to meet assumptions of normality and homogeneity of variance. Bonferroni *post-hoc* tests were employed in instances in which parametric, homogeneous data were encountered. In instances where variances could not be homogenized by transformation, Tamhane's *post-hoc* comparisons were employed. All statistical comparisons were conducted using SPSS Version 12.0 software. An effect on benthic invertebrate communities was defined as a statistically significant difference in density, taxon richness, Simpson's E or Bray-Curtis Index calculated at family-level taxonomy between the effluent-exposed area and the reference area at an alpha level of 0.10 (Environment Canada 2012a). Notably, the effluent-exposed and REF2 study areas were located at reaches of Lightning Creek that had historically been physically altered by placer mining activity. Therefore, REF2 served as the primary reference area for assessing current Bellekeno Mine effluent-related effects. The purpose for the inclusion of REF1 in the study was to provide information on potential influences of historical placer mining on the benthic invertebrate community of Lightning Creek.

Following the statistical comparisons, the magnitude of difference between effluent-exposed and reference area means was calculated for each benthic invertebrate community metric where a significant difference was detected. The benthic invertebrate community survey should minimally have sufficient power to detect a difference (effect size) of ± two standard deviations (SDs; Environment Canada 2012a). Therefore, the magnitude of the difference was calculated to reflect the number of reference mean SDs using the formula provided by Environment Canada (2012a). If a significant difference between areas was not detected for a benthic invertebrate community metric, then the minimum effect size that could be detected was calculated using the mean square error generated from the ANOVA as an estimate of variability, with alpha and beta equal to 0.10. The minimum detectable effect size was based on the minimum number of reference area standard deviations, which was calculated using equations provided by Environment Canada (2012a).

2.2.2 Fish Population Survey

The fish population survey proposed for the Bellekeno Mine EEM included a lethal sampling design targeting slimy sculpin (*Cottus cognatus*) at the effluent-exposed (EXP) and upstream-most reference area (REF1; Figure 2.1) prior to spawning (i.e., early June). Low densities of fish were expected at Lightning Creek study areas based on previous fish community assessments conducted at the lower reaches of the creek (see ACG and Minnow 2011). Using electrofishing collection methods described in the study design (ACG and Minnow 2011), catches of slimy sculpin in June (11th and 12th) were limited to only two male slimy sculpin in reproductive condition at the effluent-exposed area, with no slimy sculpin captured at the reference area, despite considerable effort applied at both study areas. During consultation with Mr. D. Lacroix of Environment Canada by telephone on June 13th, it was agreed that sufficient sampling effort had been applied to show that target numbers of sentinel fish would not be attained at either study area in the spring, and as a consequence, the “lethal” fish population survey could be discontinued.

Because a second field visit was scheduled to conduct benthic invertebrate community sampling at the Bellekeno Mine in August 2012, additional fish population sampling was applied at this time to determine whether slimy sculpin would be present in sufficient numbers to implement a non-lethal design. However, fish community sampling conducted in August (25th and 26th) verified very low densities of slimy sculpin at the effluent-exposed area and complete absence from the upstream-most reference area. As a result, no EEM fish population survey was possible at Bellekeno Mine. Despite the fact that the fish population survey could not be completed as outlined in the study design, associated methods and the limited amount of fish community data collected as part of the 2012 field visits are provided in this Interpretive Report.

2.2.2.1 Sample Collection and Processing

Fish communities of each study area were sampled semi-quantitatively using an LR-24 battery-powered backpack electrofishing unit (Smith-Root Inc., Vancouver, WA). For the lethal survey (i.e., June sampling), a minimum of 20 male and 20 female slimy sculpin were targeted from each study area, whereas for the non-lethal survey (i.e., August sampling), a total of 100 slimy sculpin older than young-of-the-year (YOY) were targeted from each study area. An electrofishing team, consisting of the electrofisher operator and a single netter, fished suitable habitat at each study area. All captured fish were placed in buckets of water, and at the conclusion of each electrofishing session total shocking effort (i.e., electrofishing seconds) was recorded to allow calculation of time-standardized catches. Baited minnow

('Gee') traps were also deployed at the effluent-exposed and upstream-most study areas during June and August sampling. All captured fish were then identified and enumerated, with all non-target fish species subsequently released to the waters from which they were captured and all sentinel species retained in aerated buckets of water for further processing. Supporting measures collected at each fish sampling study area included *in-situ* water quality measures and measurement of the physical dimensions associated with representative creek sections sampled (length and width). In addition, general habitat features such as stream morphology, substrate composition, in-stream vegetation and riparian zone characteristics were recorded. Finally, latitude and longitude coordinates from a GPS unit were recorded at the upstream and downstream boundary of each fish sampling reach.

Slimy sculpin were subjected to total length measurement to the nearest 0.01 millimeter using digital callipers, fresh body weight measurement to the nearest 0.001 gram with ± 1% precision using a Ohaus Scout Pro Balance (Model SPE-123; Ohaus Corp., Pine Brook, NJ), and documentation of any visible lesions, tumours, parasites, or other abnormalities. From any sexually mature individuals, ageing structures (otoliths and fin rays) were removed, sex was identified, and gonads and livers were excised and weighed to the nearest 0.0001 g using a Scout Pro balance.

2.2.2.2 Data Analysis

Due to low numbers or the absence of slimy sculpin at the Lightning Creek study areas, data analysis as described in the study design (ACG and Minnow 2011) was not possible. Thus, the data analysis included a comparison of fish community data from effluent-exposed and reference study areas based on total fish species richness, total catch and total catch-per-unit-effort (CPUE) for each fish sampling method. Electrofishing CPUE was calculated as the number of fish captured per electrofishing minute, and minnow trap CPUE was calculated as the number of fish captured in each trap per day for each fish species and collectively. Fish health endpoints of fork/total length, fresh body weight and Fulton's condition factor (body weight / fork length^3 x 10^5) were summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each study area.

2.2.3 Fish Tissue Survey

The fish tissue survey employed a Control-Impact design with sampling conducted at the effluent-exposed area and the upstream-most reference area (REF1) of Lightning Creek (Figure 2.1). The objective of the fish tissue survey was to document and compare fish tissue metal (including mercury) concentrations between the effluent-exposed and reference areas and to evaluate whether human consumption of fish is (or should be) limited as a result of mercury concentrations (Environment Canada 2012a). Arctic grayling (*Thymallus arcticus*) were targeted for the fish tissue survey, mainly due to its regional importance as a sport fish, but also because this species represents a top predator (i.e., likely to incorporate highest mercury body burdens within an aquatic ecosystem). However, it is noteworthy that Arctic grayling undergo substantial migration between spring spawning, summer feeding and overwintering sites (McPhail 2007), and therefore, fish captured at Lightning Creek may not truly represent a strictly 'effluent-exposed' or 'reference' condition (i.e., effluent-exposure history will be unknown).

The fish tissue survey targeted eight Arctic grayling from each study area using a non-lethal collection and tissue sampling design to limit any mortalities since Lightning Creek Arctic grayling densities were known to be low (ACG and Minnow 2011). The fish tissue survey was originally scheduled for June 2012 (ACG and Minnow 2011). However, similar to catches for the fish population survey, low numbers of grayling were captured at the effluent-exposed area and no grayling were captured at the reference area during sampling on June 11th and 12th, despite considerable effort applied at both study areas. Following consultation with Mr. D. Lacroix of Environment Canada by telephone on June 13th, it was agreed that sufficient sampling effort had been applied to show that target numbers of grayling would not be captured at the reference study area at that time, and as a result, that the spring fish tissue survey could be discontinued. Additional fish community sampling was conducted on August 25th and 26th to determine whether sufficient numbers of Arctic grayling were present at each study area to implement a fish tissue survey. Because suitable numbers of Arctic grayling were captured, a fish tissue survey was completed at this time based on the collection, processing and data analysis methods described in the approved study design (ACG and Minnow 2011).

The change in the seasonal timing of collection for the fish tissue sampling likely provided some improvement in the interpretation of any effluent-related influences on tissue mercury concentrations in Lightning Creek Arctic grayling. The later sampling period means that Arctic grayling, which display strong territoriality, would have likely been well established at summer feeding sites for the longest time possible. Therefore, the period of exposure to mine effluent would have been maximized for grayling residing in lower Lightning Creek, and conversely, grayling captured at the reference area would likely have been upstream of any effluent-influenced areas of Lightning Creek for a relatively long period.

2.2.3.1 Sample Collection and Processing

Fishing was conducted at each study area as described for the fish population survey (Section 2.2.2). As indicated above, a non-lethal sampling design was used for the fish tissue assessment which was based on methods recommended by Environment Canada (2012a). Fish tissue samples were taken from large (i.e., >90 mm total length) Arctic grayling, with attempts made to sample a similar size range of Arctic grayling from each area. Each individual Arctic grayling was retained alive and subject to the same measurements, tissue collections and observations outlined previously as part of the fish population survey (Section 2.2.2). Muscle tissue samples were collected non-lethally from Arctic grayling using methods described by Baker et al. (2004) and Environment Canada (2012a). Briefly, sampled Arctic grayling were lightly anaesthetized in the field and, using a biopsy punch, a dorsal muscle tissue plug sample was removed from each fish, skin was removed from the plug, and the plug was placed into a pre-labelled vial, put on ice in a cooler and, upon return from the field, frozen. Following tissue sampling, fish wounds were sealed using VetBond, the fish placed into a recovery tub filled with fresh aerated water and, once recovered, the fish was released at the location of capture.

Arctic grayling muscle tissue samples were shipped frozen to ALS Canada Ltd. (ALS; Burnaby, BC) for analysis using high-resolution inductively coupled plasma mass spectrometry (HR-ICPMS) and a low-level mercury analysis suitable for small samples based on a variant of "EPA Method 1631- Mercury in Water by Oxidation, Purge and Trap, and Cold Vapour Atomic Fluorescence Spectrometry (CVAFS)". Arctic grayling scale samples were dried and shipped to North Shore Environmental Services (NSES; Thunder Bay, ON) for age determination using methods that were fully consistent with EEM technical guidance (Environment Canada 2012a). Scale samples were cleaned, embedded in a epoxy resin, pressed, and the epoxy impressions were then mounted on a glass slide and examined under a microfiche to determine fish age. For each structure, the age and edge condition was recorded along with a confidence rating for the age determination.

2.2.3.2 Data Analysis

Fish tissue metal and mercury concentrations were compared statistically between the effluent-exposed and reference areas and mercury concentrations were also compared to applicable human health consumption guidelines (Environment Canada 2012a). Using ANOVA, comparisons were made to determine any significant differences in tissue metal and mercury levels among study areas, with each data set assessed for normality and equality of variance prior to statistical analysis. Non-homogenous data were assessed using t-tests assuming unequal variance. The Arctic grayling data sets included only fish collected during August sampling to eliminate differing collection times as a confounding factor in the data interpretation. Significantly higher mercury concentrations at the effluent-exposed area or tissue mercury levels exceeding the human health consumption guidelines would be indicative of an effect on the usability of the fisheries resource (Environment Canada 2012a). As stipulated by Environment Canada (2012a), the muscle mercury data were compared to a tissue consumption restriction limit of 0.50 µg Hg/g wet weight (ww).

3.0 EFFLUENT QUALITY AND SUBLETHAL TOXICITY

3.1 Effluent Quality

Effluent has been continuously discharged from the Bellekeno Mine effluent treatment system since the mine became subject to the MMER in September 2010 (Figure 3.1). Total monthly effluent discharge ranged from approximately 6,130 to 19,343 cubic meters (m^3) between September 2010 and December 2012, with highest annual effluent discharge occurring in 2012 (Figure 3.1). The annual fluctuation in total discharge volume reflected changes in precipitation and commensurate treatment of site runoff among years.

Final effluent at the treatment system compliance point (KV-43) generally met MMER authorized monthly mean and grab concentration limits for deleterious substances since September 2010, with the only exceptions being for total suspended solids (TSS; Table 3.1; Appendix Tables B.1 to B.3). Concentrations of TSS in Bellekeno Mine treated effluent exceeded the monthly mean limit of 15 mg/L in September and October 2010, and May 2011 (Table 3.1), and were greater than the grab concentration limit of 30 mg/L on four separate occasions in the same months (Appendix Tables B.1 to B.3). Monthly acute toxicity tests conducted using Bellekeno Mine final effluent between September 2010 and December 2012 achieved ‘pass’ results for rainbow trout (*Oncorhynchus mykiss*) and *Daphnia magna* survival in all but one test for each species (n = 29 and 26, respectively; Table 3.1). Effluent quality during unsuccessful tests was well within MMER limits and did not show any unusually elevated concentrations of any analytes (Appendix Table B.2), and therefore no clear cause for higher organism mortality was evident during these tests. Concentrations of deleterious substances in effluent showed no clear annual change from 2011 to 2012 (Table 3.1). In addition, no clear seasonal patterns in effluent concentrations of deleterious substances were indicated with the exceptions of arsenic and nickel, which appeared to be greater in late fall (October, November and December) than at other times of the year (Table 3.1).

Laboratory Method Detection Limits (MDL) for the determination of mercury concentrations in mine effluent were greater than the 0.0001 mg/L trigger concentration for an EEM fish tissue survey in nearly 85% of samples analyzed since September 2010 (Appendix Tables B.1 to B.3; Table 3.1). As a result, it was unclear whether effluent mercury concentrations were consistently below the trigger limit. However, results from samples with appropriate MDL showed that effluent mercury concentrations were less than the trigger limit and very low in general (i.e., less than 0.00005 mg/L; Appendix Tables B.2 and B.3). Mercury is not used in the ore extraction process at the Bellekeno Mine, and therefore mercury concentrations are

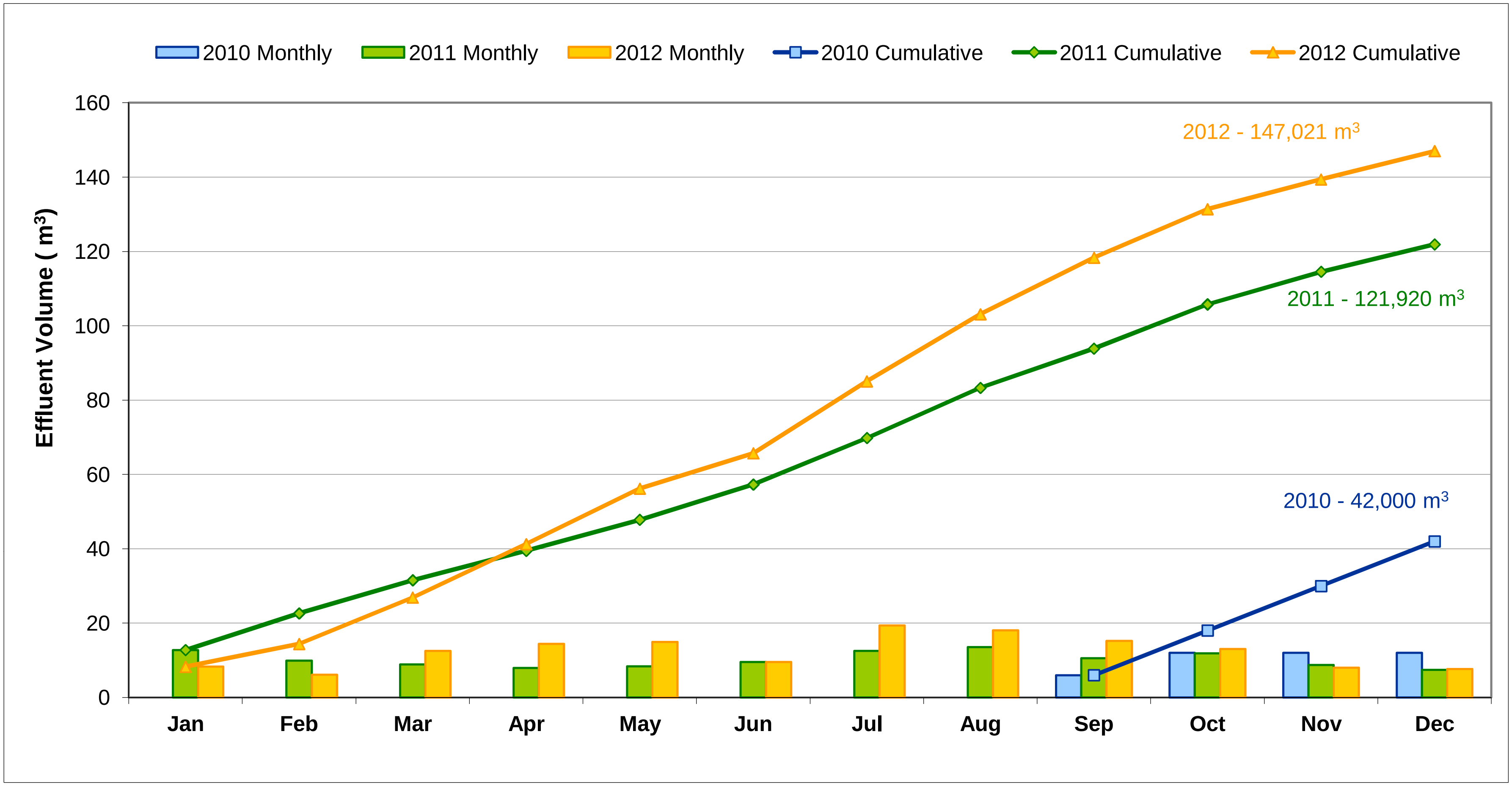


Figure 3.1: Bellekeno Mine effluent treatment system average monthly and cumulative effluent discharge rates since the mine became subject to the MMER in September 2010.

Table 3.1: Bellekeno Mine mean monthly final effluent quality[a] from September 2010 to December 2012.

Parameter		Applicable Limit[d]	2010 Month				2011 Month												2012 Month												Grab Sample Compliance Rate[f]	n
			Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Deleterious Substances and pH[b]	Arsenic	0.5	0.005	0.008	0.006	0.004	0.003	0.003	0.002	0.001	0.012	0.002	0.001	0.003	0.004	0.010	0.010	0.009	0.001	0.003	0.003	0.004	0.001	0.001	0.001	0.002	0.002	0.010	0.011	0.014	100%	136
	Copper	0.3	0.003	0.004	0.006	0.001	0.001	0.001	0.001	0.001	0.006	0.002	0.001	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.004	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	100%	136
	Lead	0.2	0.043	0.119	0.037	0.097	0.035	0.050	0.014	0.002	0.138	0.013	0.025	0.050	0.002	0.007	0.097	0.026	0.007	0.031	0.013	0.044	0.007	0.008	0.012	0.019	0.018	0.064	0.021	0.018	100%	135
	Nickel	0.5	0.015	0.010	0.005	0.006	0.006	0.005	0.002	0.002	0.006	0.005	0.003	0.005	0.005	0.010	0.007	0.010	0.005	0.004	0.004	0.005	0.002	0.002	0.002	0.003	0.002	0.008	0.009	0.010	100%	131
	Zinc	0.5	0.123	0.117	0.061	0.041	0.020	0.020	0.017	0.010	0.091	0.019	0.032	0.142	0.011	0.076	0.079	0.015	0.009	0.019	0.016	0.035	0.011	0.022	0.012	0.035	0.011	0.031	0.013	0.018	100%	136
	Radium	0.37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	0.01	-	0.01	0.01	-	0.01	-	-	< 0.01	-	< 0.01	-	-	0.02	0.02	-	100%	52
	TSS	15	22.7	25.6	3.4	7.3	1.0	2.2	1.4	1.0	42.8	3.2	2.3	8.6	1.2	1.0	6.3	2.9	1.3	4.2	6.3	13.4	2.6	1.6	1.1	8.6	1.6	4.1	1.2	1.3	98%	135
	pH	6.0 - 9.5	8.17	8.38	8.86	8.75	8.42	8.42	8.68	8.36	8.51	8.15	8.28	8.70	8.64	8.83	8.93	8.69	8.60	8.57	8.97	8.18	8.14	7.83	8.48	8.12	8.40	7.94	8.20	7.89	100%	133
Required Effluent Characterization & Site-Specific Parameters[c]	Aluminum	na	0.066	0.082	0.058	0.026	0.013	0.019	0.012	0.012	0.174	0.026	0.015	0.044	0.016	0.010	0.052	0.018	0.009	0.018	0.029	0.031	0.010	0.019	0.018	0.044	0.021	0.027	0.016	0.018	na	135
	Cadmium	na	0.720	0.620	0.460	0.483	0.225	0.220	0.160	0.100	0.800	0.392	0.175	1.520	0.113	1.100	1.088	0.207	0.089	0.252	0.171	0.325	0.153	0.191	0.167	0.224	0.138	0.390	0.158	0.208	na	135
	Iron	na	2.36	4.63	0.65	0.69	0.08	0.43	0.09	0.04	5.04	0.48	0.50	2.59	0.08	0.06	0.23	0.08	0.11	0.30	1.50	3.55	0.63	0.94	0.17	2.35	0.14	0.14	0.06	0.05	na	131
	Mercury	0.0001	0.00016	0.00020	0.00020	0.00014	0.00020	0.00016	0.00020	0.00020	0.00020	0.00017	0.00020	0.00020	0.00017	0.00020	0.00017	0.00018	0.00017	0.00017	0.00014	0.00016	0.00016	0.00015	0.00014	0.00017	0.00015	0.00017	0.00012	0.00015	16%	135
	Molybdenum	na	0.006	0.007	0.007	0.005	0.005	0.005	0.003	0.002	0.006	0.004	0.004	0.006	0.005	0.005	0.006	0.006	0.006	0.007	0.009	0.008	0.004	0.006	0.006	0.004	0.005	0.007	0.006	0.006	na	135
	Selenium	na	0.0017	0.0012	0.0011	0.0008	0.0008	0.0008	0.0008	0.0008	0.0010	0.0028	0.0052	0.0041	0.0035	0.0029	0.0021	0.0014	0.0011	0.0009	0.0010	0.0008	0.0010	0.0037	0.0022	0.0024	0.0022	0.0019	0.0011	0.0010	na	136
	Silver	na	0.0005	0.0010	0.0002	0.0007	0.0002	0.0002	0.0001	0.0001	0.0014	0.0001	0.0001	0.0003	0.0001	0.0001	0.0006	0.0001	0.0001	0.0002	0.0002	0.0005	0.0001	0.0001	0.0001	0.0003	0.0001	0.0003	0.0001	0.0001	na	136
	Ammonia	na	3.23	1.64	1.46	0.70	2.34	2.80	0.95	0.30	1.48	0.61	1.59	1.34	1.33	1.78	2.08	3.80	2.85	3.20	2.53	0.96	0.73	1.71	4.53	1.25	2.25	2.38	1.62	1.38	na	136
	Nitrate	na	4.20	2.79	2.03	1.27	3.53	4.88	1.85	0.45	2.89	1.90	2.73	3.02	3.42	4.48	5.18	4.59	4.51	5.01	3.59	1.46	1.74	4.61	3.68	2.71	5.79	4.69	2.92	2.06	na	135
	Alkalinity	na	77	72	34	52	52	56	29	30	84	58	41	63	27	65	35	29	34	35	42	70	47	45	31	48	28	46	48	57	na	135
	Hardness	na	793	794	733	793	743	736	724	615	648	608	590	660	642	641	665	635	672	681	716	549	579	571	503	606	489	569	620	627	na	136
	Specific Conductance	na	-	-	-	-	1,371	1,329	1,213	1,140	1,119	1,132	1,048	1,243	1,251	1,242	1,249	1,155	1,229	1,279	1,318	1,149	1,095	1,223	1,125	1,279	1,212	1,161	1,210	1,264	na	113
Acute Toxicity	Rainbow Trout	100% pass[e]	-	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F / P	P / P	P	P	P	P	P	P	P	P	P	P	P	97%	29
	Daphnia magna	100% pass[e]	-	-	-	-	P	P	P	P	P	P	P	P	P	F	P	P	P / P	P	P	P	P	P	P	P	P	P	P	P	96%	25

(grey box) Indicates monthly mean value that exceeds applicable limit for deleterious substances and/or pH _or_ sample concentration that exceeded fish usability assessment trigger value (mercury only) _or_ acute toxicity test failure based on individual test result.

[a] Parameter concentrations are total values expressed in mg/L except cadmium (ug/L), Radium (in Bq/L), pH (in pH units), specific conductance (uS/cm) and acute toxicity results (% of tests that passed in accordance with Environment Canada test protocols). In cases where parameter concentrations were less than Method Detection Limits (MDL), the MDL was used for calculation of mean values - see Appendix C for raw data.

[b] Deleterious substances and pH as defined under Schedule 4 of the MMER (Government of Canada 2012).

[c] Required effluent characterization and site-specific parameters as defined under Schedule 5 of the MMER (Government of Canada 2012) with the exception of silver, with is a site-specific metal of concern.

[d] Limits indicated refer to maximum authorized monthly mean concentrations as per Schedule 4 of the MMER (Government of Canada 2012) _except_ the limit for mercury, which has been included as a fish usability assessment trigger limit based on grab sample concentration of 0.0001 mg/L in this study.

[e] Indicates that all acute toxicity tests must 'pass' test criteria (i.e., an effluent at 100% concentration that kills less than 50% of test organisms over a 96-hour [rainbow trout] or 48-hour *D. magna*] period when tested in accordance with Environment Canada protocols). "P" refers to a pass, "F" refers to a failure to meet test criteria.

[f] Refers to proportion of total number of grab samples from Sept 2010 to Dec 2012 for which the respective parameter met applicable _grab_ sample limits (as per Schedule 4 of the MMER and the fish usability assessment trigger limit for mercury [see note d above]); grab sample limits are as follows: As - 1.00 mg/L; Cu - 0.60 mg/L; Pb - 0.40 mg/L; Ni - 1.00 mg/L; Zn - 1.00 mg/L; Radium - 1.11 Bq/L; TSS - 30 mg/L (Government of Canada 2012).

not expected to be high in mine water. No clear seasonal patterns in monthly average concentrations of effluent characterization parameters were apparent (Table 3.1).

3.2 Effluent Sub-lethal Toxicity

Sublethal effluent toxicity tests conducted using Bellekeno Mine final effluent (KV-43) showed no adverse effects on the viability of rainbow trout embryos (Table 3.2). Although *Ceriodaphnia dubia* survival was reduced in a single test (July 8th, 2012), reproduction of this invertebrate was affected more regularly, with inhibition shown at a geometric mean effect concentration (GMEC) of 44% (Table 3.2). Duckweed (*Lemna minor*) growth inhibition was also observed on occasion, with influences most apparent on frond production at an effluent GMEC of 40% (Table 3.2). Mine effluent did not result in any substantial reduction in growth of the alga *Pseudokirchneriella subcapitata*, with the effluent GMEC at 91% (Table 3.2).

Based on final effluent and receiving environment specific conductance measurements taken in 2011 and 2012 by the mine and during the August 2012 EEM benthic invertebrate community survey, mean effluent concentrations in lower Lightning Creek were between 2.3% and 3.2% (at Station KV-41; see Section 4.1). As a result, no effluent-related adverse influences to fish embryos, planktonic invertebrates, aquatic plants or algae were predicted in Lightning Creek based on comparison to sublethal toxicity GMEC data and predicted receiving environment effluent concentrations.

Table 3.2: Summary of sublethal toxicity test results[a] using final effluent since the Bellekeno Mine became subject to the MMER.

Study Period	Sample Date	Rainbow Trout (early life stage)	*Ceriodaphnia dubia*		*Lemna minor*		*Pseudokerchneriella subcapitata*
		Growth EC25	Survival LC50	Reproduction IC25	Dry Weight IC25	Frond Increase IC25	Growth IC25
EEM Cycle 1	13-Dec-10	> 100	> 100	71 (56-98)	> 97	> 97	89 (54-100)
	17-Sep-11	> 100	> 100	> 100	91 (80-99.9)	> 97	91
	18-Dec-11	> 100	> 100	11 (<1.6-54)	> 97	46 (28-65)	91
	8-Jul-12	> 100	77 (59-67)	37 (2.7-54)	> 97	> 97	91
	21-Oct-12	> 100	> 100	60	> 97	35 (16-44)	91
	Geometric mean	**100**	**95**	**44**	**96**	**40**	**91**

[a] LC_{50} represents effluent concentration causing 50% mortality among tested organisms; EC25 or IC_{25} represents effluent concentration at which a 25% inhibition/reduction in endpoint was observed among tested organisms relative to the control group

4.0 WATER QUALITY

4.1 *In-situ* Water Quality

Mean water temperature during the benthic invertebrate community survey showed only minor variability among Lightning Creek study areas, with slightly warmer water temperature at the effluent-exposed area likely reflecting slight differences in ambient air temperature between sampling times/dates (Figure 4.1; Appendix Tables B.4 and B.5). On average, the dissolved oxygen concentration at the effluent-exposed area was similar to or slightly greater than at the reference areas, with dissolved oxygen concentrations at all study areas well above the CWQG minimum limit of 9.5 mg/L for the protection of cold-water biota early life stages at the time of the benthic invertebrate community survey (Figure 4.1; Appendix Tables B.4 and B.5). The differences in mean water temperature and dissolved oxygen among Lightning Creek study areas were very small during the benthic invertebrate community survey (i.e., ≤ 0.3˚C and 0.4 mg/L, respectively; Figure 4.1), and were therefore not likely to be ecologically meaningful.

Aqueous pH was slightly greater (i.e., water was more alkaline) at the effluent-exposed area compared to both reference areas based on measurements collected during the fall benthic invertebrate community survey and during routine sampling from 2010 through 2012 (Figure 4.1; Appendix Tables B.4 and B.5), suggesting a slight effluent-related influence on Lightning Creek pH conditions. However, pH at the effluent-exposed area and reference areas were well within CWQG acceptable limits (Figure 4.1), and therefore the slightly higher pH at the effluent-exposed area was not likely to be ecologically meaningful. Specific conductance was significantly different among all three study areas, with highest values consistently indicated at the effluent-exposed area compared to both reference areas based on fall benthic invertebrate community survey and on 2010 to 2012 routine sampling data (Figure 4.1; Appendix Tables B.4 and B.5). Using average specific conductance of mine effluent, the effluent-exposed area and reference area 2 (immediately upstream of the mine), effluent concentrations in Lightning Creek were estimated to be approximately 2.3% and 3.2% based on fall benthic invertebrate community survey and 2010 to 2012 routine sampling data, respectively (Appendix Table B.6). It is noteworthy that pH and specific conductance were both higher at Reference 2 compared to Reference 1 (Figure 4.1), indicating that tributaries and/or placer mining activity influenced the water quality of Lightning Creek between these areas.

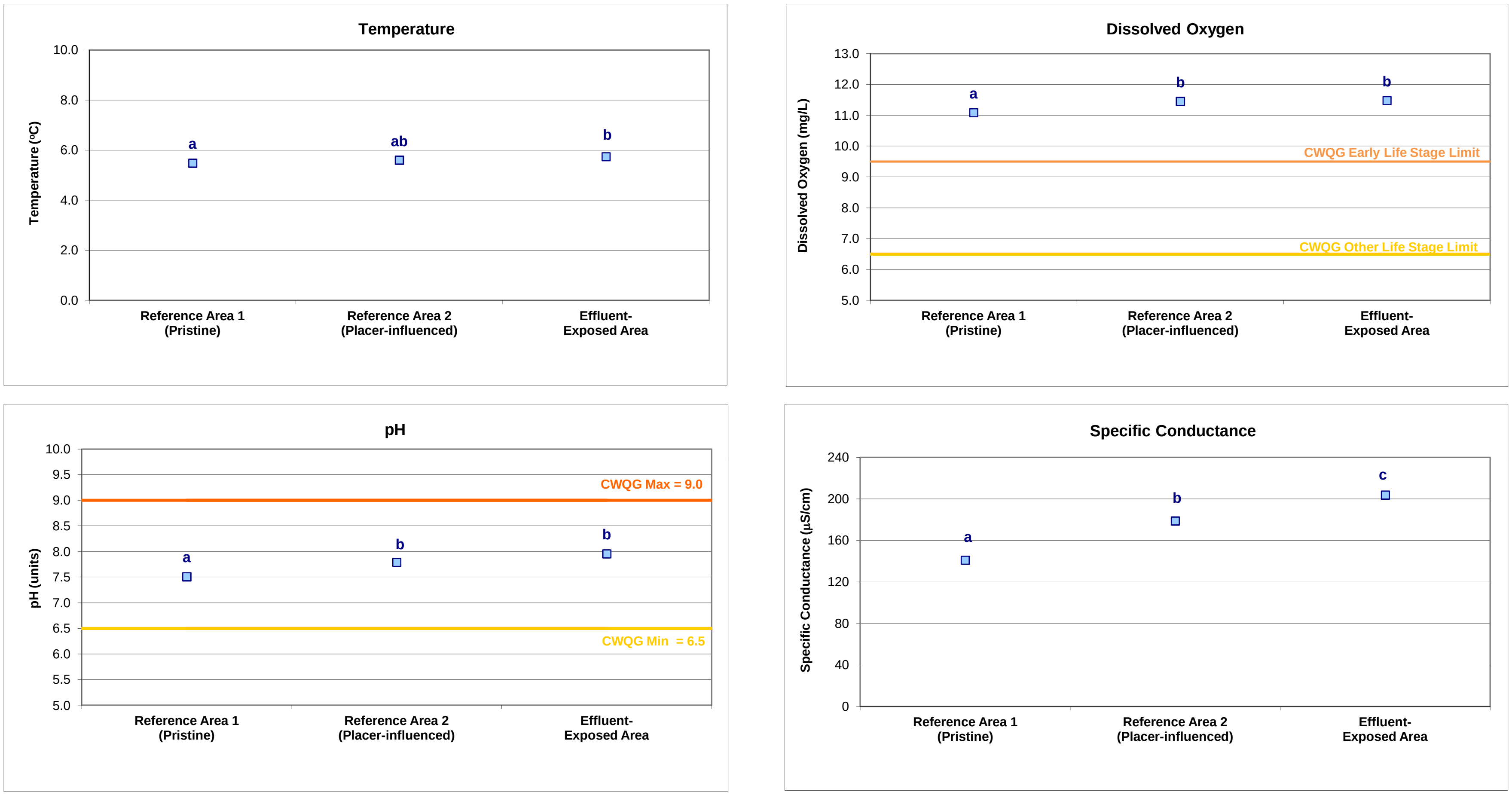


Figure 4.1: Comparison of water quality measurements (mean ± SE, n = 5) at Lightning Creek study areas, Bellekeno Mine EEM, August 2012. Similar letters above error bars indicate no significant differences among areas.

4.2 Water Chemistry

Concentrations of TSS and several metals were elevated at the effluent-exposed area compared to REF2, of which average concentrations of TSS, aluminum, cobalt and iron were elevated by highest magnitudes (i.e., ≥ 10-fold; Table 4.1; Appendix Table B.11). Average copper, chromium, manganese, nickel, phosphorus, silver, thallium, uranium and vanadium concentrations were also moderately elevated (i.e., between 3- and 10-fold higher) at the effluent-exposed area compared to REF2 (Table 4.1). Of these, average concentrations of TSS, aluminum and copper were much higher at the effluent-exposed area compared to mine effluent, suggesting that the mine effluent was not the only source of these analytes. Active placer mining in lower Thunder Gulch likely accounted for the elevated TSS, copper and aluminum concentrations at lower Lightning Creek, and was also a dominant contributor to higher concentrations of several other metals at EXP compared to REF2 (e.g., cobalt, nickel, phosphorus, iron, silver, vanadium; Appendix Tables B.8 to B.11). The influence of active placer mining in lower Thunder Gulch to water quality of Lightning Creek was particularly evident in (spring-summer) 2012, including during the EEM benthic invertebrate survey in August 2012. At this time, TSS at the effluent-exposed area was shown to be elevated by a factor of approximately an order of magnitude or greater compared to REF2 (Appendix Tables B.9, B.11, B.12), and higher than concentrations in Bellekeno Mine effluent. In general, metal concentrations were often disproportionately high at the Lightning Creek effluent-exposed area compared to reference based on the Bellekeno Mine effluent metal concentrations and the predicted effluent concentrations in Lightning Creek (i.e., 2.3 – 3.2%). This suggested that placer mining in Thunder Gulch was likely a predominant source of several metals to lower Lightning Creek other than just aluminum and copper.

Notably, average concentrations of antimony, cadmium, lead and zinc were also moderately elevated at REF2 compared to REF1, with historical mining in upper Hope and/or Charity gulches likely acting as sources of these metals to Lightning Creek (Table 4.1). Although active placer mining and historical mine activity appeared to be contributing to higher TSS and metal concentrations in Lightning Creek, mine effluent appeared to be a key source of some metals including cobalt, iron, manganese, nickel, phosphorus and silver. Water chemistry at EEM study areas during biological sampling was consistent with ranges observed throughout the year (Appendix Tables B.7 to B.10).

Of the metals shown to be elevated, only mean annual aluminum, cadmium, copper, lead, iron and phosphorus concentrations were greater than water quality guidelines at the effluent-exposed study area (Table 4.1). Average annual cadmium and lead concentrations were also higher than CWQG at REF2, with Hope and/or Charity gulches appearing to be

Table 4.1: Mean annual receiving environment water quality monitoring results for the Bellekeno Mine since the mine became subject to the MMER (September 2010).

	Variable	Units	Guideline[a]	Lightning Creek Pristine Reference Area 1[d] (Station KV-37)			Lightning Creek Placer-Influenced Reference Area 2[d] (Station KV-38)			Lightning Creek Effluent-Exposed Area[d] (Station KV-41)			Hope Gulch[d] (Station KV-39)			Charity Gulch[d] (Station KV-40)			Thunder Gulch[d] (Station KV-76)		
				2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
Deleterious Substances[b] and pH	Arsenic	mg/L	0.005	0.0024	0.0026	0.0026	0.0028	0.0031	0.0031	0.0014	0.0024	0.0025	0.0087	0.0092	0.0072	0.0034	0.0007	0.0007	0.0008	0.0006	0.0136
	Copper	mg/L	0.002 - 0.004*	0.0005	0.0005	0.0004	0.0005	0.0007	0.0006	0.0011	0.0036	0.0045	0.0011	0.0011	0.0008	0.0026	0.0006	0.0032	0.0008	0.0012	0.0278
	Lead	mg/L	0.001 - 0.007*	0.0003	0.0005	0.0002	0.0007	0.0024	0.0020	0.0012	0.0035	0.0064	0.0027	0.0096	0.0010	0.0005	0.0002	0.0006	0.0034	0.0044	0.1678
	Nickel	mg/L	0.025 - 0.150*	0.0004	0.0004	0.0003	0.0004	0.0005	0.0004	0.0006	0.0020	0.0024	0.0010	0.0010	0.0009	0.0019	0.0012	0.0027	0.0005	0.0006	0.0141
	Zinc	mg/L	0.030	0.0018	0.0020	0.0024	0.0125	0.0229	0.0149	0.0121	0.0133	0.0207	0.1607	0.2400	0.1356	0.0542	0.0033	0.0054	0.0092	0.0056	0.2108
	Radium-226	Bq/L	-	-	<0.01	0.0100	-	-	-	-	0.0100	<0.01	-	-	-	-	-	-	-	-	-
	TSS	mg/L	-	2.0	2.4	1.4	2.8	4.5	2.1	9.1	24	96	3.7	8.7	1.4	1.0	1.0	3.0	12.3	14.5	434
	pH (field)	pH units	6.5-9.0	7.81	7.79	7.57	7.97	7.80	7.61	7.88	7.93	7.58	7.98	7.87	7.84	7.74	7.53	5.49	8.20	8.02	7.81
Required Receiving Environment & Site-Specific Parameters[c]	Aluminum	mg/L	0.100	0.022	0.018	0.011	0.020	0.026	0.019	0.082	0.449	0.392	0.034	0.025	0.048	0.039	0.022	0.077	0.058	0.109	3.466
	Cadmium	mg/L	0.000008 - 0.0003*	0.00001	0.00002	0.00003	0.00015	0.00026	0.00017	0.00010	0.00013	0.00026	0.00212	0.00309	0.00185	0.00070	0.00005	0.00008	0.00016	0.00008	0.00323
	Iron	mg/L	0.300	0.060	0.066	0.057	0.056	0.069	0.080	0.126	0.757	1.150	0.060	0.043	0.042	0.023	0.012	0.045	0.102	0.122	8.039
	Mercury	mg/L	0.00010	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	Molybdenum	mg/L	0.073 [ON]	0.0001	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0004	0.0003	0.0004	0.0002	0.0001	0.0001	0.0002	0.0002	0.0006
	Selenium	mg/L	0.001	0.0004	0.0005	0.0005	0.0005	0.0006	0.0007	0.0008	0.0008	0.0009	0.0008	0.0009	0.0012	0.0010	0.0011	0.0012	0.0007	0.0006	0.0009
	Silver	mg/L	0.0001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00009	0.00006	0.00002	0.00015	0.00001	0.00001	0.00001	0.00001	0.00010	0.00002	0.00106
	Ammonia	mg/L	-	-	0.009	0.009	-	-	-	0.043	0.021	0.024	-	-	0.015	0.019	0.019	0.019	0.030	0.018	0.048
	Nitrate	mg/L	-	-	0.14	0.30	-	0.20	0.19	0.18	0.19	0.44	-	-	-	-	-	-			
	Alkalinity	mg/L	-	34	30	33	38	31	37	51	48	48	58	40	53	36	27	25	66	51	73
	Hardness (as $CaCO_3$)	mg/L	-	48	56	61	65	69	81	99	103	102	111	111	153	122	133	137	114	82	150
	Sp. Conductivity	uS/cm		-	142	138	-	165	181	-	196	215	-	282	325	285	200	291	175	125	244
Others	Total Phosphorus	mg/L	0.030 [ON]	-	0.008	0.007	0.009	0.010	0.009	-	0.032	0.111	0.014	0.008	0.007	0.008	0.006	0.008	0.021	0.019	0.709
	Sulphate	mg/L	-	-	27	30	41	35	44	-	55	52	78	68	100	87	106	113	56	33	74
	Total Kjeldahl Nitrogen	mg/L	-	-	0.24	0.15	-	0.20	0.21	-	0.18	0.27	-	-	-	-	-	-			
	DOC	mg/L	-	-	1.6	0.9	1.0	2.2	1.1	-	1.2	1.2	0.7	1.6	2.6	4.1	1.8	5.1	0.9	3.7	1.8
	Antimony	mg/L	0.0200 [BC]	-	0.0001	0.0001	0.0003	0.0003	0.0003	-	0.0003	0.0003	0.0015	0.0017	0.0015	0.0006	0.0001	0.0001	0.0002	0.0001	0.0011
	Boron	mg/L	0.2 [ON]	-	0.050	0.050	0.050	0.050	0.050	-	0.050	0.050	0.050	0.050	0.050	0.050	0.033	0.025	0.050	0.050	0.100
	Calcium	mg/L	-	-	17	18	20	21	25	-	32	31	33	34	47	35	36	38	36	26	46
	Chromium	mg/L	0.0089	-	0.0003	0.0002	0.0004	0.0003	0.0001	-	0.0012	0.0009	0.0003	0.0002	0.0001	0.0001	0.0001	0.0002	0.0004	0.0004	0.0064
	Cobalt	mg/L	0.0009 [ON]	-	0.00010	0.00003	0.00005	0.00005	0.00005	-	0.00070	0.00086	0.00007	0.00005	0.00008	0.00007	0.00004	0.00013	0.00010	0.00014	0.00599
	Lithium	mg/L	-	-	0.0012	0.0007	0.0009	0.0009	0.0009	-	0.0022	0.0018	0.0021	0.0016	0.0020	0.0018	0.0018	0.0015	0.0024	0.0019	0.0070
	Magnesium	mg/L	-	-	3.3	3.5	3.9	3.8	4.7	-	5.8	5.8	7.0	6.4	8.9	8.4	10.3	10.8	5.6	4.0	8.9
	Manganese	mg/L	-	-	0.009	0.008	0.008	0.010	0.011	-	0.033	0.070	0.008	0.010	0.007	0.007	0.003	0.012	0.011	0.009	0.521
	Potassium	mg/L	-	-	0.19	0.17	0.14	0.19	0.17	-	0.22	0.26	0.18	0.20	0.26	0.55	0.21	0.64	0.14	0.16	0.60
	Silicon	mg/L	-	-	3.1	3.1	2.7	2.8	3.0	-	3.6	3.4	2.3	2.6	3.0	2.6	2.5	2.2	3.0	2.5	7.0
	Sodium	mg/L	-	-	0.7	1.0	0.8	0.8	0.9	-	0.9	1.1	0.9	0.9	1.3	0.7	0.7	0.7	0.7	0.5	1.1
	Strontium	mg/L	-	-	0.059	0.063	0.067	0.070	0.081	-	0.085	0.087	0.112	0.102	0.139	0.110	0.124	0.127	0.089	0.068	0.120
	Sulphur	mg/L	-	-	10	12	14	13	16	-	19	19	26	26	37	34	40	43	17	14	16
	Thallium	mg/L	0.0003 [BC]	0.000002	0.000008	0.000002	0.000002	0.000002	0.000002	0.000002	0.000012	0.000010	0.000002	0.000004	0.000002	0.000002	0.000001	0.000001	0.000003	0.000004	0.000101
	Uranium	mg/L	0.005 [BC]	-	0.0001	0.0001	0.0001	0.0002	0.0002	-	0.0005	0.0005	0.0005	0.0005	0.0009	0.0003	0.0000	0.0000	0.0008	0.0006	0.0014
	Vanadium	mg/L	0.006 [BC]	-	0.0008	0.0002	0.0002	0.0002	0.0002	-	0.0016	0.0016	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0003	0.0004	0.0107

(Shaded box) Indicates annual mean value that exceeded applicable CWQG limit. For those parameters with concentrations less than Method Detection Limits (MDL), the MDL was used to calculate the average annual value.

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); interim values used for screening purposes where applicable; values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

[b] Deleterious substances and pH as defined under Schedule 4 of the MMER (Government of Canada 2012).

[c] Required receiving environment parameters as defined under Schedule 5 of the MMER (Government of Canada 2012) as well as silver, a site-specific parameter.

[d] Pristine reference area 1 and effluent-exposed areas are required EEM water monitoring locations. All others, including the placer-influenced reference, Hope Gulch, Charity Gulch and Thunder Gulch are monitored to satisfy water use licence requirements.

key sources of these metals (Table 4.1). Annual average concentrations of arsenic, copper, selenium, silver and zinc were also routinely greater than CWQG at tributaries that drain into Lightning Creek upstream of the Bellekeno Mine discharge (Table 4.1), reflecting historical mining influences and/or natural mineralogy in these sub-watersheds and, in Thunder Gulch, active placer mining influences as well.

Overall, Bellekeno Mine effluent appeared to be a source of some metals (e.g., cobalt, iron, manganese, nickel, phosphorus and silver) to Lightning Creek, of which only iron and phosphorus were elevated above water quality guidelines at the effluent-exposed area. Although TSS and other metals (e.g., aluminum, copper, cadmium and lead) were elevated at the effluent-exposed area compared to reference and/or water quality guidelines, historical mining influences to tributaries that drain into Lightning Creek upstream of the Bellekeno Mine discharge as well as active placer mining in Thunder Gulch appeared to be key sources of these variables rather than mine effluent.

5.0 BENTHIC INVERTEBRATE COMMUNITY SURVEY

5.1 Effluent-Exposed Area versus Reference 2 Comparisons

The number of benthic invertebrates per kick sample was significantly lower at the effluent-exposed area (EXP) compared to Reference 2 (REF2) at a magnitude of difference of 3.6 SD (Figure 5.1; Table 5.1). Using family-level (FL) taxonomy, no significant differences in the number of $taxa_{FAM}$ were indicated between EXP and REF2 study areas, although it is noteworthy that the highest number of $taxa_{FAM}$ among all study areas was observed at the effluent-exposed area (Figure 5.1; Table 5.1). Simpson's $Evenness_{FAM}$ also did not differ significantly between EXP and REF2 study areas (Figure 5.1; Table 5.1). However, comparisons of Bray-Curtis $Index_{FAM}$ based on Reference 2 median values ($BCI_{FAM\text{-}REF2}$) indicated significant differences between these study areas at a magnitude of difference of 8.9 SD (Figure 5.1; Table 5.1).

The differences in $BCI_{FAM\text{-}REF2}$ between EXP and REF2 likely reflected differences in number of benthic invertebrates per kick sample combined with community composition differences that included a significantly higher proportion of mayflies and mites but a significantly lower proportion of oligochaetes at the effluent-exposed area (Figure 5.2; Table 5.1). Because mayflies and oligochaetes are generally considered to be metal-sensitive and metal-tolerant, respectively (Taylor and Bailey 1997; Chapman et al. 1982a,b), differences in benthic invertebrate composition between EXP and REF2 were not consistent with a metal-related influence. Similarly, analyses based on comparison of benthic invertebrate functional feeding groups (FFG) indicated that the proportion of scrapers was significantly higher at EXP compared to REF2 (Figure 5.2; Table 5.1). Scrapers tend to be sensitive to high metal conditions, and therefore the higher proportion of scrapers at EXP compared to REF2 was, again, not consistent with a metal-related influence.

Rather than metal-related influences associated with mine effluent, the differences in the number of benthic invertebrates per kick sample and $BCI_{FAM\text{-}REF2}$ between EXP and REF2 may have reflected habitat differences. Substrate at EXP was generally larger than at REF2 (reflecting historical placer mine alterations to the natural channel; Appendix Table C.2), with creek reaches containing suitable substrate for benthic invertebrate kick sampling very limited spatially. Sampled substrate at EXP was significantly smaller and, typical of placer mining influences (see Weber 1986), contained a much higher proportion of fine interstitial materials compared to REF2 (Appendix Table C.2), which may have accounted for the lower number of benthic invertebrates per kick sample but higher number of $taxa_{FAM}$ at EXP.

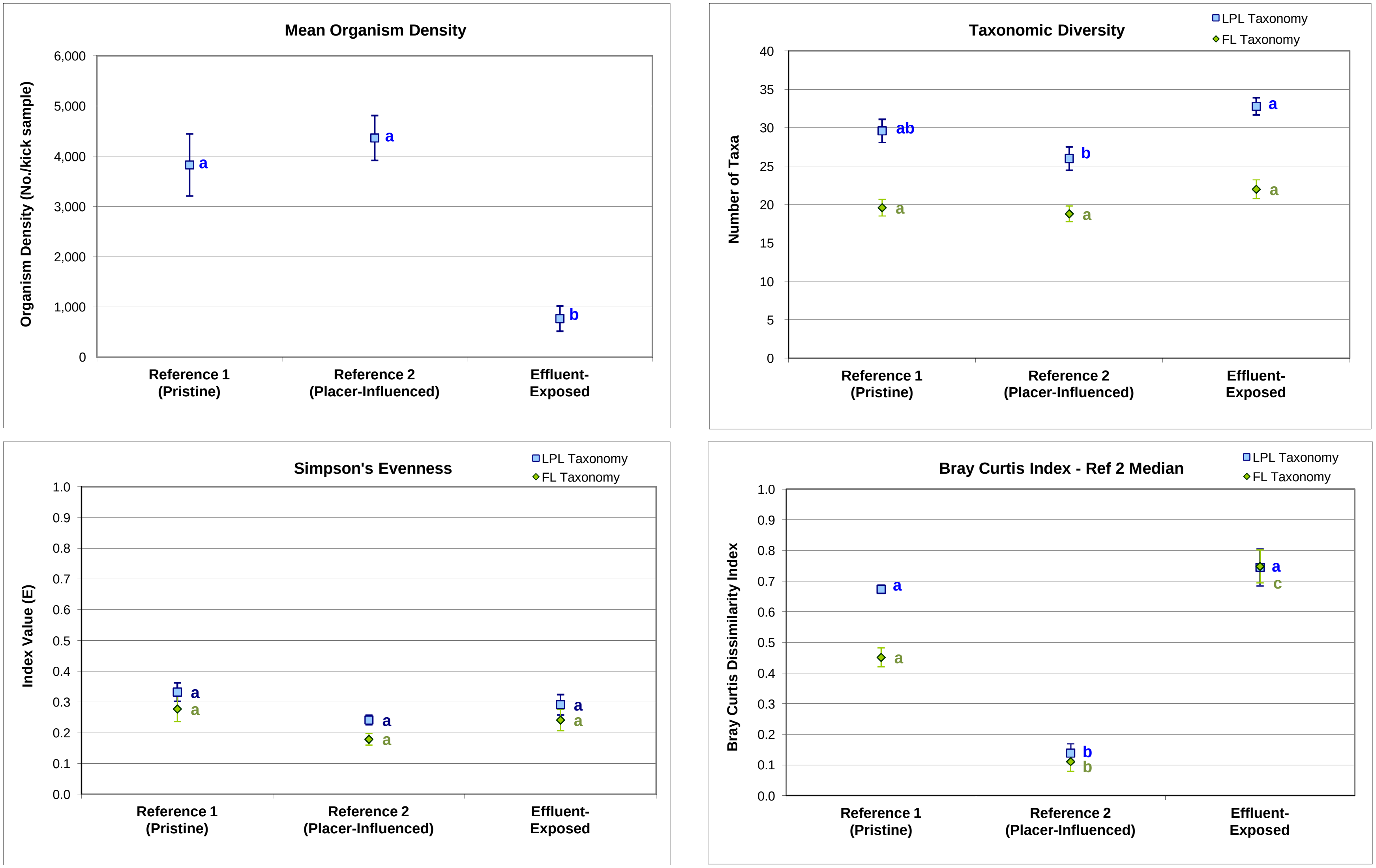


Figure 5.1: Comparison of benthic invertebrate community primary EEM endpoints (mean ± SE, n = 5), Bellekeno Mine EEM, August 2012. The same, like-coloured letters next to data points indicate no significant differences among study areas.

Table 5.1: Benthic invertebrate community statistical comparison results among Lightning Creek study areas calculated at family level taxonomy, Bellekeno Mine EEM, August 2012.

Metric	Area	Mean	Overall 3-group ANOVA			Post-hoc Pair-Wise Comparisons					Estimation of Effect Size	
			Significant Difference Among Areas?	*p*-value	Power	Test Type	(I) Area	(J) Area	Significant Difference Between Areas?	*p*-value	Magnitude of Difference [a] (No. of SD)	Minimum Detectable Effect Size [b] (No. of SD)
Density (Individuals/kick sample)	REF1	3,828	Yes	0.000	1.000	Bonferroni	REF1	EXP	Yes	0.002	2.215	-
	REF2	4,366					REF2	EXP	Yes	0.000	3.603	-
	EXP	768					REF1	REF2	No	1.000	-	2.022
Number of Taxa (Family Level)	REF1	19.6	No	0.148	0.515	Bonferroni	REF1	EXP	No	0.457	-	2.482
	REF2	18.8					REF2	EXP	No	0.193	-	2.562
	EXP	22.0					REF1	REF2	No	1.000	-	2.257
Simpson's Evenness (Family Level)	REF1	0.277	No	0.143	0.522	Bonferroni	REF1	EXP	No	1.000	-	2.137
	REF2	0.179					REF2	EXP	No	0.617	-	3.384
	EXP	0.241					REF1	REF2	No	0.167	-	1.806
Bray-Curtis Distance (REF 2 median) (Family Level)	REF1	0.452	Yes	0.000	1.000	Bonferroni	REF1	EXP	Yes	0.001	4.303	-
	REF2	0.111					REF2	EXP	Yes	0.000	8.912	-
	EXP	0.748					REF1	REF2	Yes	0.000	4.932	-
Oligochaeta (%)	REF1	2%	Yes	0.000	1.000	Tamhane	REF1	EXP	Yes	0.037	4.311	-
	REF2	27%					REF2	EXP	Yes	0.002	3.682	-
	EXP	5%					REF1	REF2	Yes	0.002	32.260	-
Mites (%)	REF1	7%	Yes	0.000	1.000	Tamhane	REF1	EXP	No	0.219	-	2.318
	REF2	1%					REF2	EXP	Yes	0.005	39.333	-
	EXP	11%					REF1	REF2	Yes	0.033	1.989	-
Mayflies (%)	REF1	17%	Yes	0.002	0.989	Bonferroni	REF1	EXP	No	1.000	-	2.051
	REF2	6%					REF2	EXP	Yes	0.008	12.345	-
	EXP	16%					REF1	REF2	Yes	0.003	2.008	-
Stoneflies (%)	REF1	35%	Yes	0.012	0.904	Bonferroni	REF1	EXP	No	0.126	-	1.864
	REF2	16%					REF2	EXP	No	0.674	-	3.457
	EXP	23%					REF1	REF2	Yes	0.012	1.524	-
Chironomidae (%)	REF1	35%	No	0.133	0.537	Bonferroni	REF1	EXP	No	1.000	-	2.227
	REF2	47%					REF2	EXP	No	0.267	-	2.761
	EXP	35%					REF1	REF2	No	0.230	-	1.981
Shredders (%)	REF1	32%	Yes	0.030	0.806	Bonferroni	REF1	EXP	No	0.222	-	1.901
	REF2	16%					REF2	EXP	No	0.891	-	3.536
	EXP	22%					REF1	REF2	Yes	0.030	1.336	-
Scrapers (%)	REF1	13%	Yes	0.004	0.973	Tamhane	REF1	EXP	No	0.759	-	2.153
	REF2	5%					REF2	EXP	Yes	0.004	12.498	-
	EXP	17%					REF1	REF2	Yes	0.034	1.447	-
Collector - Gatherers (%)	REF1	42%	Yes	0.000	1.000	Bonferroni	REF1	EXP	No	1.000	-	2.259
	REF2	76%					REF2	EXP	Yes	0.000	8.432	-
	EXP	45%					REF1	REF2	Yes	0.000	3.167	-

[a] Magnitude calculated by comparing the difference between the reference area and effluent-exposed area means divided by the reference area standard deviation (Environment Canada 2011)

[b] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10 (Environment Canada 2011)

Highlighted values indicates significant difference among/between study areas based on a p-value less than 0.10.

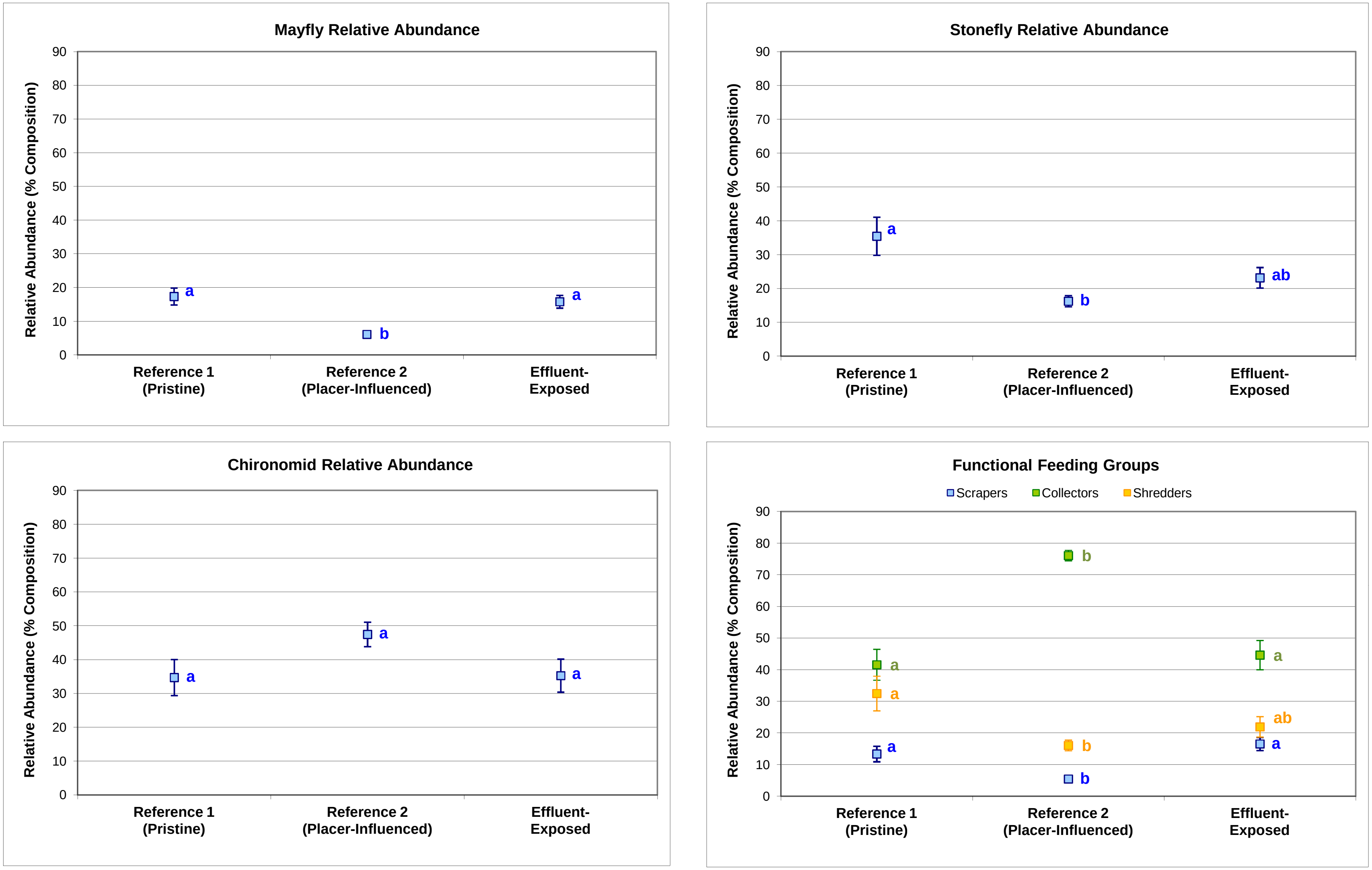


Figure 5.2: Comparison of benthic invertebrate community composition among Lightning Creek study areas (mean ± SE, n = 5), Bellekeno Mine EEM, August 2012. Similar, like-coloured letters next to data points indicate no significant differences among areas.

Substrate embeddedness was also notably lower at EXP compared to REF2 (mean of 25% versus 70%, respectively), with the latter area containing a greater amount of compact coarse sand and fine gravel interstitially (Appendix Table C.2). This difference likely accounted for a much higher proportion of the benthic community being represented by invertebrates within the collector-gatherer FFG at REF2 compared to the other study areas, as this FFG is often represented by deposit feeders that prefer finer substrate (e.g., oligochaetes). Differences in the proportion of benthic invertebrates represented by the shredder FFG among study areas also appeared to be related to historical placer mining-associated habitat alteration of riparian cover. Higher relative abundance of shredders was observed at areas with greater amount of intact riparian canopy coverage, potentially because the food source for shredders mainly includes allochthonous vegetation originating from the riparian zone. Higher allochthonous inputs would be expected at EXP compared to REF2 due to the occurrence of greater canopy coverage. The changes in community composition that included greater proportion of scrapers and shredders but lower proportion of collector-gatherers at EXP compared to REF2 likely accounted for differences in $BCI_{FAM-REF2}$ between areas. Collectively, the weight-of-evidence suggested that the differences in number of organisms per kick sample and $BCI_{FAM-REF2}$ between Lightning Creek EXP and REF2 areas were more consistent with historical and/or active placer mining-related habitat alteration rather than a metal-toxicity response associated with mine-effluent exposure.

5.2 Effluent-Exposed Area versus Reference 1 Comparisons

Comparison of primary EEM benthic invertebrate community endpoints between EXP and Reference 1 (REF1) areas at FL-taxonomy generally reflected the same differences indicated between EXP and REF2 (Figure 5.1; Table 5.1). Specifically, EXP had significantly lower number of benthic invertebrates per kick sample and significantly higher $BCI_{FAM-REF2}$ compared to REF1, but no differences in number of $taxa_{FAM}$ or Simpson's $Evenness_{FAM}$ were indicated between these areas (Figure 5.1; Table 5.1). Notably, the magnitude of difference was smaller between EXP and REF1 than between EXP and REF2 (Table 5.1). In addition, unlike comparisons to REF2, no differences in the proportion of mayflies, mites, scrapers and collector-gatherers were indicated between EXP and REF1 study areas (Figure 5.1; Table 5.1). Moreover, Bray-Curtis Index calculated using lowest-practical-level (LPL) taxonomy and based on REF2 median values ($BCI_{LPL-REF2}$) was not significantly different between EXP and REF1 areas (Appendix Table C.6).

The differences in benthic invertebrate community endpoints between EXP and REF1 generally corroborated the findings of the comparison of EXP to REF2. For example, significantly lower number of benthic invertebrates per kick sample at EXP compared to REF1 may have reflected accumulation of fine gray silt on in-stream substrate that was observed only at the effluent-exposed area (Appendix Table C.2). In turn, despite similar substrate embeddedness, the accumulation of fine silt may have resulted in slightly, but significantly, greater relative abundance of oligochaetes at EXP compared to REF1 (Table 5.1). A lower proportion of shredders at EXP also seemed to be related to lower riparian canopy coverage compared to REF1 (Figure 5.1; Appendix Tables C.2 and C.4). Therefore, similar to comparisons to REF2, slight changes in benthic invertebrate community composition between EXP and REF1 that included lower number of organisms per kick sample and $BCI_{FAM\text{-}REF2}$ appeared to be more consistent with placer mining-related habitat alteration rather than a metal-toxicity response associated with mine-effluent exposure. Overall, consideration of benthic community condition at EXP relative to both references suggested that the benthic invertebrate community of EXP was more similar to that of REF1 than REF2, further indicating that benthic invertebrate community differences between the effluent-exposed and upstream reference areas likely reflected historical and/or active placer mining influences on Lightning Creek habitat to a greater degree than effluent-related influences (if any).

6.0 FISH POPULATION AND FISH TISSUE SURVEYS

6.1 Fish Community and Population Characterization

The study design for the Bellekeno Mine EEM fish population survey indicated that a traditional (lethal) sampling design would be implemented targeting slimy sculpin (*Cottus cognatus*) at an effluent-exposed area and a reference area of Lightning Creek in the spring of 2012 (ACG and Minnow 2011). However, as indicated previously (Section 2.0), very low numbers of slimy sculpin were encountered at the effluent-exposed area and none were captured at the reference area despite application of considerable fishing effort, precluding completion of a fish population survey for the Bellekeno Mine EEM. The paragraphs below summarize the catch data collected during the EEM fish population survey.

Two fish species were captured during each of the June and August 2012 fish population surveys at Lightning Creek, with higher numbers of fish and greater fish species diversity encountered at the effluent-exposed area compared to reference in both months (Table 6.1; Appendix Tables D.1 and D.2). In June, low numbers of slimy sculpin and Arctic grayling were captured at the effluent-exposed area, with no fish captured at the reference area (Table 6.1). In August, catches at the effluent-exposed area included very low numbers of slimy sculpin and moderate numbers of Arctic grayling, with catches at the reference area including only Arctic grayling (Table 6.1). August densities of Arctic grayling were similar at the effluent-exposed and reference areas based on similar catch-per-unit-effort (CPUE; Table 6.1). Higher catches of Arctic grayling at both Lightning Creek study areas in August compared to June was consistent with expected migration patterns to summer feeding sites by this species (McPhail 2007). Low fish species diversity and abundance in Lightning Creek during both sampling events confirmed the findings of previous studies that showed similarly low catches (see ACG and Minnow 2011), and suggested that fish productivity in Lightning Creek is naturally low.

Slimy sculpin catches at the effluent-exposed area during June included a total of eight fish, of which only two (males) had developed gonads (Table 6.2). Although a third fish appeared to be at a sexually mature size, limited gonad development had occurred by mid-June suggesting non-annual spawning in the geographic region by this species. Water temperatures were below 4˚C at the time of the survey, and because slimy sculpin generally spawn after water temperatures rise above this temperature (McPhail 2007), it was unlikely that this fish had spawned earlier in the year, prior to the EEM fish population survey. Based on the limited amount of information collected, slimy sculpin size at maturity appeared to be a minimum of approximately 90 mm total length (Table 6.2). Juvenile individuals ranged from

Table 6.1: Summary of EEM electrofishing and minnow trapping catch data for Lightning Creek effluent-exposed and reference areas during June and August, 2012.

Sampling Month (Dates)	Study Area	Fishing Method	Effort (seconds or trap days)	Summary Statistic	Fish Species		Total Catch
					Slimy Sculpin	Arctic Grayling	
June (11^{th} and 12^{th})	Reference	Electrofishing	2,725	Number of Fish Captured	0	0	**0**
				CPUE *	0	0	**0**
		Minnow Trap	4.3	Number of Fish Captured	0	0	**0**
				CPUE **	0	0	**0**
	Effluent-Exposed	Electrofishing	2,407	Number of Fish Captured	8	4	**12**
				CPUE *	0.199	0.100	**0.299**
		Minnow Trap	2.6	Number of Fish Captured	0	0	**0**
				CPUE **	0	0	**0**
August (25^{th} and 26^{th})	Reference	Electrofishing	1,073	Number of Fish Captured	0	10	**10**
				CPUE *	0.000	0.559	**0.559**
		Minnow Trap	13.9	Number of Fish Captured	0	0	**0**
				CPUE **	0	0	**0**
	Effluent-Exposed	Electrofishing	2,910	Number of Fish Captured	2	32	**34**
				CPUE *	0.041	0.660	**0.701**
		Minnow Trap	9.6	Number of Fish Captured	0	0	**0**
				CPUE **	0	0	**0**

* Electrofishing CPUE represents number of fish captured per minute of electrofisher operation

** Minnow trap CPUE represents number of fish captured per trap per day

Table 6.2: Information collected from slimy sculpin captured at the Lightning Creek effluent-exposed area during June and August 2012 fish population surveys, Bellekeno Mine EEM.

Date of Capture	Life-Stage and Sex	Total Length (mm)	Body Weight (g)	Fulton's Condition Factor	Gonad Weight (g)	Liver Weight (g)	Abnormalities
June 11th	Adult - Undeveloped	100.15	9.206	0.916	undeveloped	0.184	None
	Adult - Male	94.99	8.583	1.001	0.071	0.243	None
	Adult - Male	91.73	7.520	0.974	0.059	0.128	None
	Juvenile	42.60	0.627	0.811	na	nm	None
	Juvenile	42.10	0.676	0.906	na	nm	None
	Juvenile	49.57	1.104	0.906	na	nm	None
	Juvenile	48.41	0.905	0.798	na	nm	None
	Juvenile	44.35	0.697	0.799	na	nm	None
August 25th	Adult	111	16.25	1.188	nm	nm	None
	Juvenile	66	2.52	0.877	na	nm	None

na - not applicable

nm - not measured

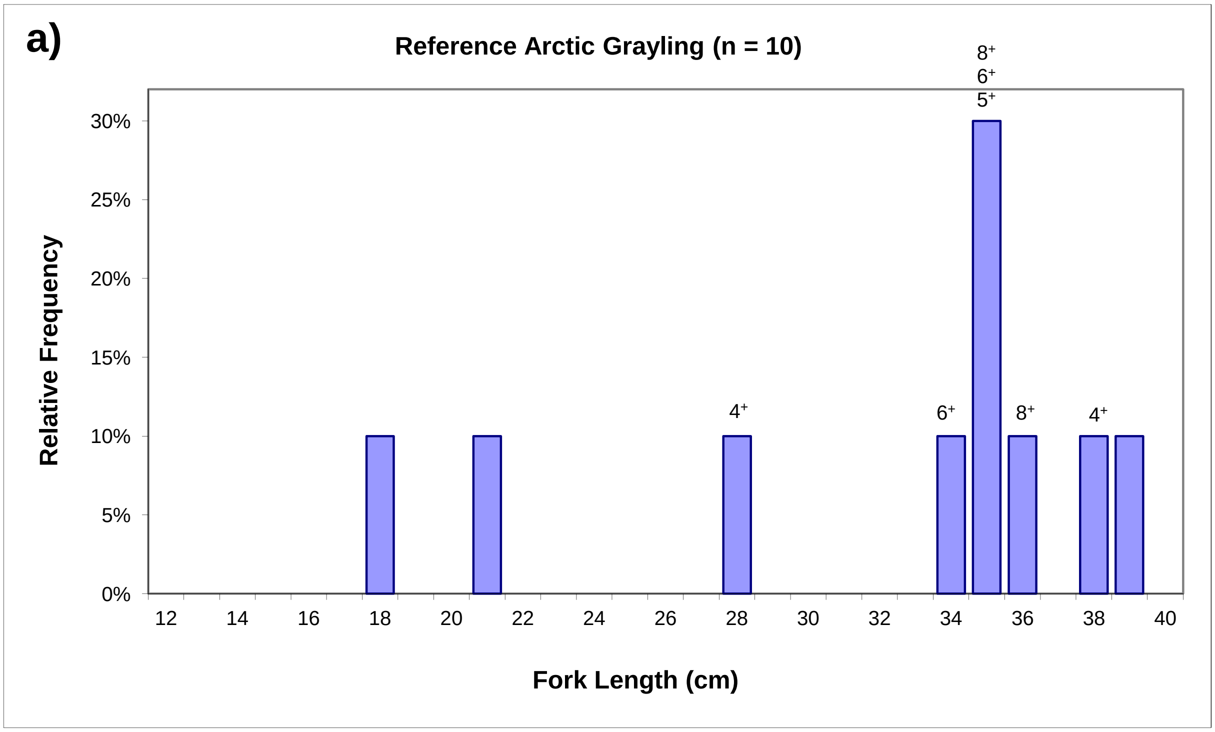
approximately 42 – 50 mm long in June, with a 66 mm long individual captured in August likely representing a similar cohort (Table 6.2). All captured slimy sculpin appeared to be healthy, with no visible external abnormalities recorded (Table 6.2).

Arctic grayling captured at the effluent-exposed area were generally larger in June than in August (Figure 6.1). In addition, the mean size of Arctic grayling captured in August at the effluent-exposed area was smaller than at the reference area, with fish ageing confirming that the smaller fish captured at the effluent-exposed area were younger than those at the reference area (Figure 6.1). The absence of Arctic grayling at the reference area in June followed by the presence of larger, older fish at the reference area by August was consistent with typical upstream migration from overwintering areas in spring (at or shortly after ice-out) shown by this species, with largest grayling generally migrating the farthest upstream (see McPhail 2007). It is unknown how long individual grayling may have resided in the effluent-exposed or reference areas prior to capture. All captured Arctic grayling generally appeared to be healthy, with a cyst on the caudal fin of the largest captured fish the only visible externally abnormality noted (Appendix Tables D.4 to D.6).

6.2 Fish Tissue Survey

The study design for the Bellekeno Mine EEM fish tissue survey was based on a non-lethal, control-impact assessment targeting Arctic grayling at an effluent-exposed and reference area of Lightning Creek in spring 2012 (ACG and Minnow 2011). As indicated previously (Section 2.0) and discussed above, few grayling were captured at the effluent-exposed area and none were captured at the reference area in June despite application of considerable fishing effort. Therefore, fish tissue survey sampling was re-attempted in August, with sufficient numbers of grayling captured at this time to complete the survey.

Average grayling muscle mercury concentrations were significantly lower in fish collected at the effluent-exposed area (mean = 0.010 µg/g ww) than at the reference area (mean = 0.023 µg/g ww) based on fish sampled in August (Table 6.3). Although these differences may have partly reflected the presence of younger, smaller fish at the effluent-exposure area, muscle tissue mercury concentrations were more than an order of magnitude below the consumption restriction of 0.50 µg/g ww for sensitive human populations for all sampled effluent-exposed and reference grayling (Figure 6.2). Effluent-exposed grayling muscle tissue had similar or lower concentrations of all other metals compared to reference grayling tissues, of which tissue arsenic, cesium and rubidium concentrations were significantly lower at the effluent-exposed area compared to reference (Table 6.3). Accordingly, no effects on usability of Arctic grayling tissue were indicated at the Bellekeno Mine effluent-exposed area.



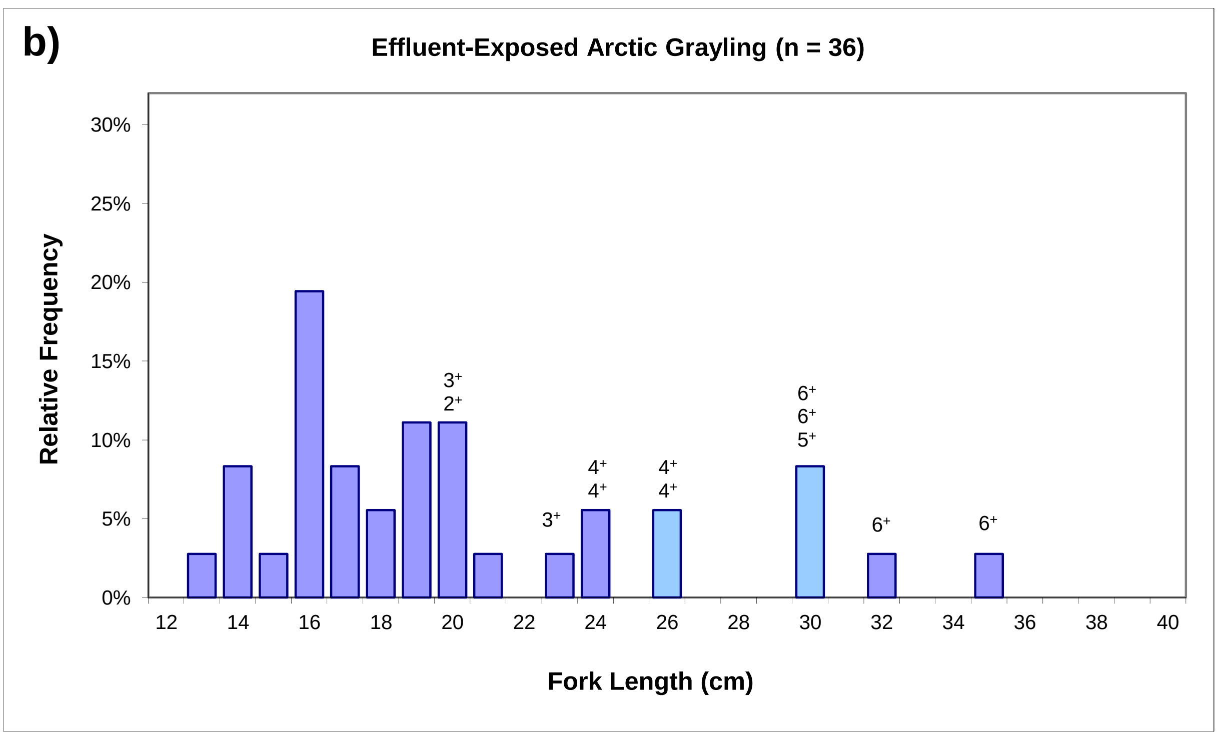


Figure 6.1: Length-frequency distributions for Arctic grayling collected at Lightning Creek reference (a) and effluent-exposed (b) study areas in June (light blue bars) and August (dark blue bars) 2012. Values above bars indicate fish ages for specified sizes.

Table 6.3: Dorsal muscle metal concentration (µg/g ww) comparisons between Arctic grayling captured at Lightning Creek effluent-exposed and reference study areas in August 2012.

Metric	Study Area	Sample Size	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Two-Sample Comparison [a]		
								Significant Difference Among Areas?	p-value	Statistical Test
Arsenic	Reference	8	0.091	0.025	0.009	0.062	0.145	YES	0.0104	ANOVA
	Effluent-Exposed	7	0.051	0.027	0.010	0.024	0.108			
Barium	Reference	8	0.297	0.263	0.093	0.047	0.879	NO	0.1391	ANOVA
	Effluent-Exposed	7	0.136	0.058	0.022	0.037	0.194			
Cadmium	Reference	8	0.007	0.002	0.001	0.004	0.011	NO	0.0971	ANOVA
	Effluent-Exposed	7	0.005	0.002	0.001	0.002	0.008			
Calcium	Reference	8	236	285	101	70	908	NO	0.2739	t-test
	Effluent-Exposed	7	115	46	17	89	218			
Cesium	Reference	8	0.076	0.030	0.010	0.030	0.121	YES	0.0021	ANOVA
	Effluent-Exposed	7	0.029	0.016	0.006	0.009	0.055			
Chromium	Reference	8	0.135	0.086	0.030	0.046	0.328	NO	0.6844	ANOVA
	Effluent-Exposed	7	0.120	0.045	0.017	0.081	0.191			
Cobalt	Reference	8	0.052	0.019	0.007	0.021	0.083	NO	0.5739	ANOVA
	Effluent-Exposed	7	0.047	0.015	0.006	0.025	0.074			
Copper	Reference	8	0.331	0.028	0.010	0.273	0.358	NO	0.2899	ANOVA
	Effluent-Exposed	7	0.303	0.064	0.024	0.243	0.428			
Iron	Reference	8	15	7	2	8	26	NO	0.2581	ANOVA
	Effluent-Exposed	7	11	4	2	5	16			
Lead	Reference	8	0.100	0.044	0.016	0.024	0.167	NO	0.0738	ANOVA
	Effluent-Exposed	7	0.064	0.021	0.008	0.024	0.094			
Magnesium	Reference	8	311	36	13	252	354	NO	0.0658	t-test
	Effluent-Exposed	7	339	12	5	327	360			
Manganese	Reference	8	0.875	0.538	0.190	0.290	1.710	NO	0.3046	ANOVA
	Effluent-Exposed	7	0.639	0.233	0.088	0.260	0.899			
Mercury	Reference	8	0.023	0.011	0.004	0.008	0.034	YES	0.0111	t-test
	Effluent-Exposed	8	0.010	0.004	0.001	0.005	0.018			
Molybdenum	Reference	8	0.026	0.014	0.005	0.011	0.052	NO	0.5183	ANOVA
	Effluent-Exposed	7	0.021	0.014	0.005	0.008	0.040			
Nickel	Reference	8	1.761	1.473	0.521	0.239	4.860	NO	0.5625	ANOVA
	Effluent-Exposed	7	1.401	0.659	0.249	0.500	2.250			
Phosphorus	Reference	8	2,735	162	57	2,520	2,940	NO	0.9912	t-test
	Effluent-Exposed	7	2,734	72	27	2,610	2,820			
Potassium	Reference	8	5,189	347	123	4,700	5,810	NO	0.1491	ANOVA
	Effluent-Exposed	7	5,414	186	70	5,100	5,600			
Rubidium	Reference	8	4.451	0.691	0.244	3.710	5.520	YES	0.0062	t-test
	Effluent-Exposed	7	3.510	0.333	0.126	3.180	4.030			
Selenium	Reference	8	0.992	0.262	0.093	0.610	1.310	NO	0.9382	ANOVA
	Effluent-Exposed	7	0.982	0.236	0.089	0.834	1.500			
Strontium	Reference	8	0.225	0.239	0.085	0.061	0.646	NO	0.1595	t-test
	Effluent-Exposed	7	0.091	0.046	0.017	0.048	0.181			
Thallium	Reference	8	0.004	0.001	0.000	0.002	0.005	NO	0.3122	ANOVA
	Effluent-Exposed	7	0.003	0.001	0.000	0.002	0.004			
Vanadium	Reference	8	0.049	0.040	0.014	0.011	0.125	NO	0.1228	t-test
	Effluent-Exposed	7	0.024	0.011	0.004	0.014	0.040			
Zinc	Reference	8	5.021	0.881	0.312	3.880	6.110	NO	0.2127	ANOVA
	Effluent-Exposed	7	4.477	0.698	0.264	3.660	5.800			

[a] ANOVA conduted using homogenous data; t-tests completed assuming unequal variance for non-homongenous data.

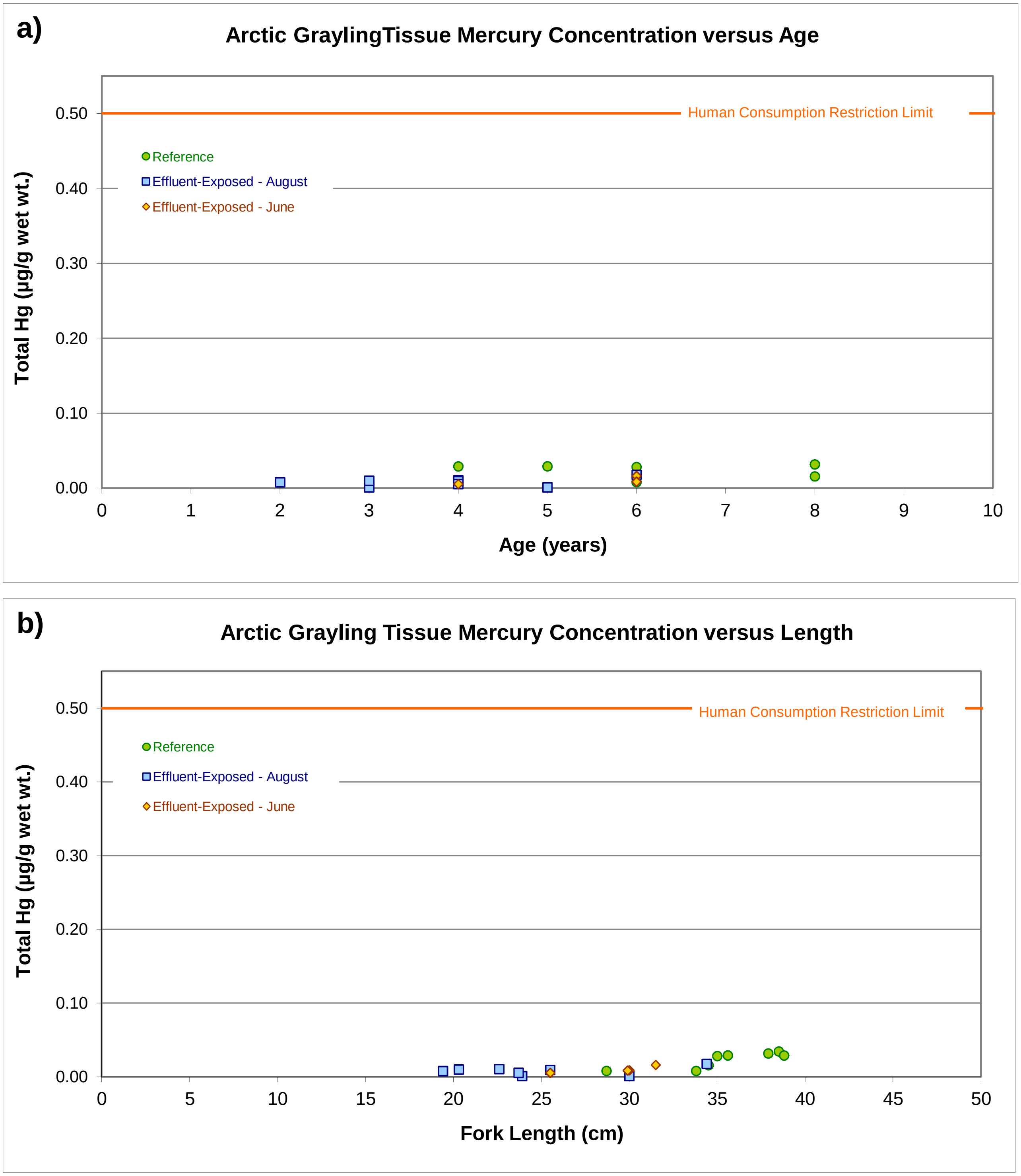


Figure 6.2: Arctic grayling muscle mercury concentrations relative to age (a) and fork length (b) for Lightning Creek study areas, Bellekeno Mine EEM

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The objective of the first Bellekeno Mine EEM study was to determine the influence of treated mine effluent on biological communities of Lightning Creek. To meet this objective, effluent quality and receiving environment water quality monitoring data collected by the mine were used to support the interpretation of benthic invertebrate community, fish population and fish tissue survey data collected at one effluent-exposed area and up to two reference areas of Lightning Creek. Notably, historical hard rock and placer influence water quality and/or habitat of the Lightning Creek watershed in the area receiving mine effluent, and therefore the EEM study was designed to help distinguish any biological effects associated with these historical mine influences from that of the Bellekeno Mine effluent. Active placer mining also influences water quality of the Lightning Creek effluent-exposed area, but delineating the relative contribution of each was not possible as a result of limited distance between the perceived location of Bellekeno Mine effluent discharge and active placer mine inputs. The principal conclusions of the Bellekeno Mine EEM study are:

1) Treated effluent from the Bellekeno Mine (Station KV-43) has generally met MMER limits since the mine became subject to these regulations in September 2010. The only exceptions occurred for TSS, with monthly average concentrations of TSS exceeding the MMER limit of 15 mg/L in three separate months between September 2010 and December 2012. Effluent from the mine was non-toxic to rainbow trout embryos and had minimal influence on green algae (*Pseudokirchneriella subcapitata*) growth, but elicited effects on invertebrate (*Ceriodaphnia dubia*) reproduction and duckweed (*Lemna minor*) growth. However, because laboratory geometric mean effect concentrations of 44% and 40% (observed for *C. dubia* and duckweed, respectively) were well above estimated effluent concentrations in the mine receiver, no effluent-related toxicity was likely in Lightning Creek.

2) Water quality in Lightning Creek downstream of the mine discharge showed slightly higher pH and specific conductance than upstream, with the latter suggesting that average effluent concentration ranged between 2.3% and 3.2% just downstream of the mine. Water quality at the effluent-exposed area showed elevated concentrations of total suspended solids and several metals compared to reference, with annual average aluminum, cadmium, copper, iron, lead and phosphorus concentrations elevated above water quality guidelines at the effluent-exposed area. However, several metals appeared to have been elevated at the effluent-exposed area due to

upstream historical mine influences and/or active placer mining at Thunder Gulch. In consideration of the spatial patterns in water quality, the Bellekeno Mine effluent appeared to be a key source of cobalt, iron, manganese, nickel, phosphorus and silver to Lightning Creek. This suggested that any potential biological effects to Lightning Creek biota were more likely to be associated with metals originating from sources other than the Bellekeno Mine effluent.

3) The benthic invertebrate community survey indicated significantly lower organism density at EXP compared to the nearest upstream reference (REF2), as well as significant differences in Bray Curtis Index (i.e., community composition) between these areas, each at magnitudes of difference greater than 2 SD. Similar differences were indicated between EXP and the upstream-most (pristine) reference area (REF1), but at lower magnitudes of difference, suggesting greater similarity between in benthic invertebrate community of EXP and REF1. In addition, because the proportion of metal-sensitive mayflies and scrapers was greater at the effluent-exposed area than at the reference, the differences in community composition between these areas was not consistent with an effluent related effect. Rather, comparison of the relative abundance of other functional feeding groups between effluent-exposed and REF2 areas, as well as greater similarity in community composition between EXP and REF1, suggested that placer mining-related influences on habitat (e.g., total suspended load, silt accumulation, substrate size alteration, reduced riparian coverage) could have accounted for the significant differences observed between the effluent-exposed and reference areas of Lightning Creek during the EEM.

4) A fish population survey could not be implemented as part of the Bellekeno Mine EEM due to naturally low abundance of a suitable sentinel fish species at the effluent-exposed and complete absence of a suitable sentinel fish species at reference areas.

5) The fish tissue survey indicated that Arctic grayling muscle tissue had significantly lower mercury concentrations in fish collected at the effluent-exposed area compared to the reference area, with tissue mercury concentrations at both areas well below the human health consumption limit of 0.50 µg/g wet weight. In addition, concentrations of most other metals in grayling muscle tissue from effluent-exposed fish were similar to or lower than in reference fish. Accordingly, no effects on usability of Arctic grayling tissue were apparent at the Bellekeno Mine.

Overall, the Bellekeno Mine EEM study suggested some minor effluent-related influences on water quality of Lightning Creek. However, no clear effluent-related influences on the benthic invertebrate community of Lightning Creek were indicated, with differences in organism density and composition between effluent-exposed and reference areas more consistent with a placer mining-related habitat influence than with an effluent toxicity-related response. In addition, no effluent-related influences on the usability of fish tissues were indicated at the effluent-exposed area, with mercury and other metal concentrations often much lower in Arctic grayling collected downstream of the mine discharge than in reference grayling.

Under the MMER, biological monitoring studies to assess effects must be conducted at a frequency of every 36- or 72- months, the latter only if no effects have been observed for two consecutive EEM studies (Environment Canada 2012a). Because only one biological monitoring study has been implemented at the Bellekeno Mine, Alexco will be required to submit the next biological monitoring Interpretive Report for the mine within 36-months. Therefore, in accordance with the prescribed frequency under the MMER, the Study Design for the next EEM biological studies must be submitted to Environment Canada at least six months prior to implementing the field collections in spring/summer 2015 (assuming a spring fish survey is repeated), and a corresponding Interpretive Report must be submitted to Environment Canada by March 7th 2016.

7.2 Recommendations

The initial Bellekeno Mine EEM study suggested that historical mining activity (hard rock and placer) and current placer mining activity in the Lightning Creek watershed are confounding factors to the determination of effluent-related effects to the benthic invertebrate community of Lightning Creek. In addition, the fish community of Lightning Creek appears to be naturally depauperate, with the only suitable resident species for EEM (i.e., slimy sculpin) not likely to be found in sufficient numbers to implement a lethal or non-lethal fish population survey, and the only other species observed in any appreciable numbers (i.e., Arctic grayling) exhibiting a migratory life history that likely results in minimal or transient exposure to effluent. Based on information acquired from the first EEM biological study, recommendations for future monitoring include:

- Achieve lower analytical Method Detection Limits (MDL) for mercury analysis in mine effluent. Mercury is not used at the Bellekeno Mine. Although mine effluent mercury concentrations appear to be lower than the 0.0001 mg/L trigger concentration for the implementation of an EEM fish tissue survey, high laboratory MDL for mercury has precluded definitive evaluation and as a result, fish tissue sampling is required as part of the EEM biological studies. Should mine effluent mercury concentrations be below

0.0001 mg/L for 12 consecutive samples (collected not less than one month apart), a fish tissue survey will not be required.

- Determine the location of effluent infiltration into Lightning Creek. Knowledge concerning the location of effluent reception in Lightning Creek is important for possibly delineating the relative influence of mine effluent on water quality of Lightning Creek from that of active placer mining. Based on this information, and if possible, a water quality monitoring station should be established between the effluent-reception location and any area of active placer mining. It is suspected that high concentrations of TSS, aluminum, copper and other metals likely originate from active placer mining, and therefore routine sampling would be useful in quantifying metals originating from this source.
- Repeat the benthic invertebrate community survey implemented in this study as part of the second EEM for the Bellekeno Mine. Confirmation of effects is an EEM requirement under the MMER, and therefore the same sampling locations, seasonal timing and sampling methods should be used evaluate whether the same benthic invertebrate community effects occur in 36-months time.
- Consideration should be given to an alternative fish population study. The current EEM fish population survey and historical fish community surveys have shown that resident fish populations in Lightning Creek are extremely low. Therefore, an alternative to a traditional fish population survey should be sought.

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APPENDIX A

DATA QUALITY ASSESSMENT

APPENDIX A: DATA QUALITY ASSESSMENT

A1.0 INTRODUCTION

Data Quality Assessment (DQA) was conducted on data collected as part of the Bellekeno Mine Cycle 1 EEM study. The objective of DQA is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. DQA involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of method detection limits, blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials).

DQOs were established at the outset of the field program that reflects reasonable and achievable performance expectations (Table A.1). Programs involving a large amount of samples and analytes usually have some results that exceed the DQOs. This is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the analytes fail to meet the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure any questionable data received

Table A.1: Data quality objectives for environmental samples.

Quality Control Measure	Quality Control Sample Type	Study Component	
		Water Quality	**Fish Tissue Quality**
Method Detection Limits (MDL)	Comparison actual MDL versus target MDL	MDL for each parameter should be at least as low as applicable guidelines, ideally half the guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally half the guideline value[a]
Blank Analysis	Field or Laboratory Blank	≤ two-times the laboratory MDL	≤ two-times the laboratory MDL
Field Precision	Field Duplicates	≤ 25% RPD[b]	≤ 25% RPD[b]
Laboratory Precision	Laboratory Duplicates	≤ 25% RPD[b]	n/a
Accuracy	Recovery of Blank Spikes	80-120%	n/a
	Recovery of Matrix Spikes	75-125%	n/a
	Recovery of Certified Reference Material, Quality Control Standards	85-115%	70-130%

[a] or below predictions, if applicable and no guideline exists for the substance.

[b] RPD - Relative Percent Difference

n/a - not applicable

more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples, and a description of each, include the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination of samples occurring in the field (in the case of field or trip blanks) or the laboratory (in the case of laboratory or method blanks). Concentrations of analytes should not be detectable, although a DQO of twice the method detection limit allows for slight "noise" around the detection limit.

- **Field Duplicates** are replicate samples collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The data from field replicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.

- **Laboratory Duplicates** are replicate sub-samples created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.

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

- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

A2.0 WATER SAMPLES

A2.1 Method Detection Limits

Target laboratory method detection limits (MDL) were established at levels below applicable water quality guidelines (Table A.2). Achieved MDLs were at or below the target concentrations and below guideline concentrations. Consequently, data for the sample analytes could be reliably interpreted relative to the guidelines.

A2.2 Laboratory Blank Sample Analysis

The blank samples analyzed contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table A.3).

A2.3 Field Duplicate Samples

One set of duplicate water samples was collected in the field which showed relatively good agreement in analyte concentrations (Table A.4). All analytes except ammonia, aluminium and chromium achieved the DQO of ≤25%.

A2.4 Laboratory Duplicate Samples

Laboratory duplicate sample analysis was limited to two analytes (Table A.5). Therefore, a full assessment of analytical precision was not possible.

A2.5 Data Accuracy

A2.5.1 Blank Spike Recovery Samples

The analytes measured for recovery of spiked blanks (laboratory control) all met the data quality objective of 80% - 120% (Table A.3).

A2.5.2 Matrix Spike Recovery Samples

Analyte recoveries for matrix spikes all met the data quality objective of 75 - 125% (Table A.3). One sample of colourimetric measured phosphorous could not be accurately calculated due to high background levels of analyte in spike. The DQA indicates good analytical accuracy associated with the analysis of water samples.

A2.5.3 Certified Reference Materials

The reported reference material recoveries of all but two analytes (boron and lithium) were within DQO of 85 - 115% (Table A.3), indicating good analytical accuracy.

Table A.2: Laboratory method detection limits (MDLs) for water quality samples collected during EEM biological sampling.

Analyte		Units	CWQG[a]	Method Detection Limit	
				Target	Achieved
Misc.	Hardness (as $CaCO_3$)	mg/L	-	-	0.5
	Total Suspended Solids	mg/L	-	-	3.0
Anions and nutrients	Alkalinity (as $CaCO_3$)	mg/L	-	5	2.0
	Ammonia (as N)	mg/L	-	0.005	0.005
	Nitrate (as N)	mg/L	-	0.3	0.005
	Orthophosphate-Dissolved (as P)	mg/L	-	0.001	0.001
	Phosphorus (P)-Total	mg/L	0.030	0.003	0.002
Total metals	Aluminum (Al)-Total	mg/L	0.100	0.05	0.003
	Antimony (Sb)-Total	mg/L	0.02	0.01	0.0001
	Arsenic (As)-Total	mg/L	0.005	0.0025	0.0001
	Barium (Ba)-Total	mg/L	-	0.1	0.00005
	Beryllium (Be)-Total	mg/L	-	0.001	0.0001
	Bismuth (Bi)-Total	mg/L	-	-	0.0005
	Boron (B)-Total	mg/L	0.2	0.1	0.01
	Cadmium (Cd)-Total	mg/L	0.00008	0.00004	0.00001
	Calcium (Ca)-Total	mg/L	-	-	0.05
	Chromium (Cr)-Total	mg/L	0.0089	0.0005	0.0001
	Cobalt (Co)-Total	mg/L	0.0009	0.0004	0.0001
	Copper (Cu)-Total	mg/L	0.002	0.001	0.0005
	Iron (Fe)-Total	mg/L	0.30	0.15	0.01
	Lead (Pb)-Total	mg/L	0.001	0.0005	0.00005
	Lithium (Li)-Total	mg/L	-	-	0.0005
	Magnesium (Mg)-Total	mg/L	-	-	0.1
	Manganese (Mn)-Total	mg/L	-	0.0907	0.00005
	Mercury (Hg) - Total	mg/L	0.000026	0.000013	0.00001
	Molybdenum (Mo)-Total	mg/L	0.073	0.035	0.00005
	Nickel (Ni)-Total	mg/L	0.025	0.013	0.0005
	Phosphorus (P)-Total	mg/L	0.03	0.015	0.05
	Potassium (K)-Total	mg/L	-	-	0.1
	Selenium (Se)-Total	mg/L	0.001	0.0005	0.0001
	Silicon (Si)-Total	mg/L	-	-	0.05
	Silver (Ag)-Total	mg/L	0.0001	0.00005	0.00001
	Sodium (Na)-Total	mg/L	-	-	0.05
	Strontium (Sr)-Total	mg/L	-	-	0.0002
	Thallium (Tl)-Total	mg/L	0.0003	0.00015	0.00001
	Tin (Sn)-Total	mg/L	-	-	0.0001
	Titanium (Ti)-Total	mg/L	-	-	0.01
	Uranium (U)-Total	mg/L	0.005	0.003	0.00001
	Vanadium (V)-Total	mg/L	0.006	0.003	0.001
	Zinc (Zn)-Total	mg/L	0.030	0.015	0.003

[a] Canadian Water Quality Guidelines (CCME 1999)

(grey box) Inidcates achieved MDL greater than half the target MDL

Table A.3: Laboratory QAQC for water quality samples collected during the Bellekeno Mine EEM biolgical study.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
	Total Suspended Solids	mg/L	< 3.0	< 3.0	75	64	85%	-	-	-	-	-	-	-
Anions and nutrients	Alkalinity (as $CaCO_3$)	mg/L	< 2.0	< 2.0	-	-	-	-	-	-	15.0	14.7	98%	VA-ALKL-CONTROL
		mg/L	< 2.0	< 2.0	-	-	-	-	-	-	75.0	76.9	103%	VA-ALKM-CONTROL
		mg/L	< 2.0	< 2.0	-	-	-	-	-	-	250	259	104%	VA-ALKH-CONTROL
	Ammonia (as N)	mg/L	< 0.005	< 0.005	-	-	-	0.200	0.191	96%	0.120	0.123	103%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	0.233	0.232	100%	0.120	0.114	95%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.120	0.119	99%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.120	0.120	100%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.120	0.120	100%	VA-NH3-F
	Nitrate (as N)	mg/L	< 0.005	< 0.005	2.50	2.56	102%	1.28	1.31	102%	-	-	-	-
	Orthophosphate-Dissolved	mg/L	< 0.001	< 0.001	-	-	-	0.0500	0.0484	97%	0.0300	0.0306	102%	VA-OPO4-CONTROL
		mg/L	< 0.001	< 0.001	-	-	-	0.0500	0.0477	95%	0.0300	0.0320	107%	VA-OPO4-CONTROL
		mg/L	-	-	-	-	-	0.0500	0.0472	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.0500	0.0465	93%	-	-	-	-
	Phosphorus (P)-Total	mg/L	< 0.002	< 0.002	-	-	-	0.0917	0.0992	108%	3.99	3.99	100%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.0500	0.0491	98%	3.99	3.92	98%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	1.24	1.21	MS-B	3.99	3.94	99%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.0527	0.0531	101%	3.99	4.12	103%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.13	104%	VA-ERA-PO4
Total metals	Aluminum (Al)-Total	mg/L	< 0.003	< 0.003	-	-	-	0.254	0.241	95%	2.00	1.91	96%	VA-HIGH-WATRM
		mg/L	< 0.003	< 0.003	-	-	-	-	-	-	2.00	2.03	102%	VA-HIGH-WATRM
	Antimony (Sb)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.0200	0.0197	99%	1.00	1.07	107%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.04	104%	VA-HIGH-WATRM
	Arsenic (As)-Total	mg/L	< 0.001	< 0.0001	-	-	-	0.0203	0.0215	106%	1.00	0.98	98%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.02	102%	VA-HIGH-WATRM
	Barium (Ba)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	0.0310	0.0308	99%	0.250	0.245	98%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.250	0.263	105%	VA-HIGH-WATRM
	Beryllium (Be)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.0400	0.0383	96%	0.100	0.097	97%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.100	0.092	92%	VA-HIGH-WATRM
	Bismuth (Bi)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	0.0100	0.00973	97%	1.00	1.01	101%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	1.00	1.06	106%	VA-HIGH-WATRM
	Boron (B)-Total	mg/L	< 0.01	< 0.01	-	-	-	0.1000	0.0927	93%	1.00	0.91	91%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	0.83	83%	VA-HIGH-WATRM
	Cadmium (Cd)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	0.00400	0.00408	102%	0.100	0.102	102%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.100	0.101	101%	VA-HIGH-WATRM
	Calcium (Ca)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	48.4	97%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	50.7	101%	VA-HIGH-WATRM
	Chromium (Cr)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.0400	0.0397	99%	0.250	0.246	98%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.250	0.259	104%	VA-HIGH-WATRM
	Cobalt (Co)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.0202	0.0202	100%	0.250	0.239	96%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.250	0.253	101%	VA-HIGH-WATRM
	Copper (Cu)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	0.0236	0.0235	100%	0.250	0.238	95%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.250	0.252	101%	VA-HIGH-WATRM
	Iron (Fe)-Total	mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	0.961	96%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
	Lead (Pb)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	0.0200	0.0196	98%	0.500	0.485	97%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.500	0.531	106%	VA-HIGH-WATRM
	Lithium (Li)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	0.102	0.10	99%	0.250	0.245	98%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.250	0.206	82%	VA-HIGH-WATRM
	Magnesium (Mg)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	49.2	98%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.1	102%	VA-HIGH-WATRM
	Manganese (Mn)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	0.0288	0.0276	96%	0.250	0.238	95%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.250	0.245	98%	VA-HIGH-WATRM
	Mercury (Hg) - Total	mg/L	< 0.00001	< 0.00001	0.0001	0.0000974	97%	0.0001	0.0000935	94%	-	-	-	-
		mg/L	< 0.00001	< 0.00001	0.0001	0.0001	100%	0.0001	0.0000943	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000871	87%	-	-	-	-
		mg/L	-	-	-	-	-	0.000131	0.000119	91%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000939	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000959	96%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000944	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000963	96%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000968	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000929	93%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000945	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0000911	91%	-	-	-	-
	Molybdenum (Mo)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	0.0201	0.0204	101%	0.250	0.252	101%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.250	0.241	96%	VA-HIGH-WATRM
	Nickel (Ni)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	0.0419	0.0416	99%	0.500	0.481	96%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.500	0.515	103%	VA-HIGH-WATRM
	Phosphorus (P)-Total	mg/L	< 0.05	< 0.05	-	-	-	0.04	0.04	100%	2.50	2.44	98%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	2.50	2.52	101%	VA-HIGH-WATRM
	Potassium (K)-Total	mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	49.3	99%	VA-HIGH-WATRM
		mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	51.7	103%	VA-HIGH-WATRM
	Selenium (Se)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	100%	1.00	0.968	97%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	0.999	100%	VA-HIGH-WATRM
	Silicon (Si)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	0.953	95%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	1.02	102%	VA-HIGH-WATRM
	Silver (Ag)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	0.00400	0.00393	98%	0.100	0.0989	99%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.100	0.0979	98%	VA-HIGH-WATRM
	Sodium (Na)-Total	mg/L	< 0.05	< 0.05	-	-	-	3.16	3.09	98%	50.0	51.8	104%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.9	104%	VA-HIGH-WATRM
	Strontium (Sr)-Total	mg/L	< 0.0002	< 0.0002	-	-	-	0.0381	0.0380	100%	0.250	0.245	98%	VA-HIGH-WATRM
		mg/L	< 0.0002	< 0.0002	-	-	-	-	-	-	0.250	0.238	95%	VA-HIGH-WATRM
	Thallium (Tl)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	0.00400	0.00397	99%	1.00	1.04	104%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	1.00	1.08	108%	VA-HIGH-WATRM
	Tin (Sn)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	0.0200	0.0192	96%	0.500	0.496	99%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.500	0.502	100%	VA-HIGH-WATRM
	Titanium (Ti)-Total	mg/L	< 0.01	< 0.01	-	-	-	0.040	0.044	109%	0.25	0.23	92%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	0.25	0.26	104%	VA-HIGH-WATRM
	Uranium (U)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	0.00418	0.00409	98%	0.005	0.00498	100%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.005	0.00531	106%	VA-HIGH-WATRM
	Vanadium (V)-Total	mg/L	< 0.001	< 0.001	-	-	-	0.100	0.099	99%	0.500	0.483	97%	VA-HIGH-WATRM
		mg/L	< 0.001	< 0.001	-	-	-	-	-	-	0.500	0.517	103%	VA-HIGH-WATRM
	Zinc (Zn)-Total	mg/L	< 0.003	< 0.003	-	-	-	0.411	0.380	92%	0.500	0.493	99%	VA-HIGH-WATRM
		mg/L	< 0.003	< 0.003	-	-	-	-	-	-	0.500	0.487	97%	VA-HIGH-WATRM

(grey box) Indicates value greater than DQO

Table A.4: Water quality field duplicates results for samples collected during the Bellekeno Mine EEM benthic invertbrate community survey (August 24th, 2012).

Analyte		Units	Duplicate 1		
			REF2	LIC-X	RPD[1] (%)
Misc.	Hardness (as $CaCO_3$)	mg/L	90.4	92.6	2%
	Total Suspended Solids	mg/L	< 3.0	< 3.0	0%
Anions and nutrients	Alkalinity (as $CaCO_3$)	mg/L	38.3	38.6	1%
	Ammonia (as N)	mg/L	0.0187	< 0.005	116%
	Nitrate (as N)	mg/L	0.0365	0.0359	2%
	Orthophosphate-Dissolved (as P)	mg/L	0.0022	0.0019	15%
	Phosphorus (P)-Total	mg/L	0.0035	0.0030	15%
Total metals	Aluminum (Al)-Total	mg/L	0.0135	0.0194	36%
	Antimony (Sb)-Total	mg/L	0.00027	0.00026	4%
	Arsenic (As)-Total	mg/L	0.00202	0.00238	16%
	Barium (Ba)-Total	mg/L	0.0570	0.0567	1%
	Beryllium (Be)-Total	mg/L	< 0.0001	< 0.0001	0%
	Bismuth (Bi)-Total	mg/L	< 0.0005	< 0.0005	0%
	Boron (B)-Total	mg/L	< 0.01	< 0.01	0%
	Cadmium (Cd)-Total	mg/L	0.000105	0.000097	8%
	Calcium (Ca)-Total	mg/L	27.5	28.2	3%
	Chromium (Cr)-Total	mg/L	0.00016	0.00012	29%
	Cobalt (Co)-Total	mg/L	< 0.0001	< 0.0001	0%
	Copper (Cu)-Total	mg/L	< 0.0005	< 0.0005	0%
	Iron (Fe)-Total	mg/L	0.032	0.040	22%
	Lead (Pb)-Total	mg/L	0.000086	0.000109	24%
	Lithium (Li)-Total	mg/L	0.00086	0.00094	9%
	Magnesium (Mg)-Total	mg/L	5.29	5.39	2%
	Manganese (Mn)-Total	mg/L	0.00547	0.00522	5%
	Mercury (Hg)-Total	mg/L	< 0.00001	< 0.00001	0%
	Molybdenum (Mo)-Total	mg/L	0.00019	0.00018	7%
	Nickel (Ni)-Total	mg/L	< 0.0005	< 0.0005	0%
	Phosphorus (P)-Total	mg/L	< 0.05	< 0.05	0%
	Potassium (K)-Total	mg/L	0.13	0.14	7%
	Selenium (Se)-Total	mg/L	0.00061	0.00062	2%
	Silicon (Si)-Total	mg/L	3.12	3.18	2%
	Silver (Ag)-Total	mg/L	< 0.00001	< 0.00001	0%
	Sodium (Na)-Total	mg/L	0.824	0.825	0%
	Strontium (Sr)-Total	mg/L	0.0867	0.0875	1%
	Thallium (Tl)-Total	mg/L	< 0.00001	< 0.00001	0%
	Tin (Sn)-Total	mg/L	< 0.0001	< 0.0001	0%
	Titanium (Ti)-Total	mg/L	< 0.01	< 0.01	0%
	Uranium (U)-Total	mg/L	0.000124	0.000123	1%
	Vanadium (V)-Total	mg/L	< 0.001	< 0.001	0%
	Zinc (Zn)-Total	mg/L	0.0100	0.0101	1%

[1] RPD - Relative Percent Difference

(grey shading) Indicates RPD greater than 25%

Table A.5: Water quality laboratory duplicates results for water samples collected during the Bellekeno Mine EEM biological study.

Analyte		Units	Replicate 1	Replicate 2	RPD[1] (%)
Anions and nutrients	Nitrate (as N)	mg/L	0.102	0.102	0%
Total Metals	Mercury (Hg)- Total	mg/L	< 0.00001	< 0.00001	0%

[1] RPD - Relative Percent Difference

(grey box) Indicates PRD was greater than 25%

A3.0 BENTHIC INVERTEBRATE SAMPLES

A3.1 Benthic Invertebrate Community Sample DQA Results

Precision and accuracy of the sub-sampled benthic invertebrate community samples met the DQO of 20% (Table A.6). The objective for percent organism recovery was also met for each of the two re-sorted samples, with an average percent recovery of approximately 99% (Table A.7). Therefore, the benthic invertebrate community sample data were of acceptable quality, meeting all established precision, accuracy and percent recovery QC criteria.

Table A.6: Subsampling error for benthic invertebrate samples collected for the Bellekeno Mine Cycle 1 EEM, 2012.

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision % range		Accuracy	
									min	max
Ref 2-2	0	837	948	958	1,045	3,788	1.0	19.9	0.1	11.6
Ref 2-2	0	1,795	1,993			3,788	9.9	-	5.2	-

* whole large organisms excluded in calculations.
min = minimum absolute % error
max = maximum absolute % error

Table A.7: Percent recovery of benthic invertebrates from samples processed for the Bellekeno Mine Cycle 1 EEM, 2012.

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
Exp-1	551	556	99.1%
Ref 1-3	1,035	1,042	99.3%
		Average % Recovery	99.2%

Table A.8: Sample fractions sorted from Bellekeno Mine Cycle 1 EEM, 2012.

Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)
Ref 1-1	1/2	Ref 2-4	1/2
Ref 1-2	1/8	Ref 2-5	1/4
Ref 1-3	1/4	Exp-1	Whole
Ref 1-4	1/4	Exp-2	Whole
Ref 1-5	1/4	Exp-3	Whole
Ref 2-1	1/4b	Exp-4	Whole
Ref 2-2a	Whole	Exp-5	Whole
Ref 2-3	1/4		

QA/QC Notes

Pupae were not counted toward total number of taxa unless they were the sole representative of their taxa group
Immatures were not counted toward total number of taxa unless they were the sole representative of their taxa group

A4.0 FISH TISSUE SAMPLES

A4.1 Method Detection Limits

Target method detection limits were based off of advertised concentrations supplied from the laboratory. Achieved MDLs were above the target concentrations for a number of analytes, including aluminum, arsenic, barium, calcium, copper, magnesium, manganese, mercury, molybdenum, strontium and zinc (Table A.9). In part, small tissue sample volumes required greater sample dilutions that in turn, resulted in higher detection limits. However, because tissue metal concentrations were above MDL for some of these metals, higher MDL were not considered problematic for key metals of concern.

A4.2 Laboratory Blank Sample Analysis

Most laboratory blanks prepared for tissue metal analyses resulted in non-detectable concentrations (Table A.10). Only aluminum and titanium did not meet DQO in some of the tests.

A4.3 Data Accuracy

Analyte recovery for certified reference materials were within the target range of 70 - 130% (Table A.10). These results indicated good analytical accuracy.

Table A.9: Laboratory method detection limits (MDLs) for fish tissue samples collected during the Bellekeno Mine EEM, August 2012.

Analyte		Units	Method Detection Limit	
			Target[a]	Achieved
Total metals (wet wt)	Aluminum (Al)-Total	mg/kg	2	0.8 - 35
	Antimony (Sb)-Total	mg/kg	0.01	0.002 - 0.006
	Arsenic (As)-Total	mg/kg	0.01	0.004 - 0.012
	Barium (Ba)-Total	mg/kg	0.01	0.01 - 0.03
	Beryllium (Be)-Total	mg/kg	0.1	0.002 - 0.006
	Bismuth (Bi)-Total	mg/kg	0.03	0.002 - 0.006
	Boron (B)-Total	mg/kg	-	0.2 - 0.6
	Cadmium (Cd)-Total	mg/kg	0.005	0.002 - 0.006
	Calcium (Ca)-Total	mg/kg	2	5 - 40
	Cesium (Cs)-Total	mg/kg	-	0.001 - 0.003
	Chromium (Cr)-Total	mg/kg	0.1	0.01 - 0.03
	Cobalt (Co)-Total	mg/kg	0.02	0.004 - 0.012
	Copper (Cu)-Total	mg/kg	0.01	0.01 - 0.03
	Gallium (Ga)-Total	mg/kg	-	0.004 - 0.012
	Iron (Fe)-Total	mg/kg	-	0.2 - 13
	Lead (Pb)-Total	mg/kg	0.02	0.004 - 0.012
	Lithium (Li)-Total	mg/kg	0.1	0.02 - 0.06
	Magnesium (Mg)-Total	mg/kg	1.0	10 - 80
	Manganese (Mn)-Total	mg/kg	0.01	0.02 - 1.4
	Mercury (Hg) - Total	mg/kg	0.001	0.001 - 0.009
	Molybdenum (Mo)-Total	mg/kg	0.010	0.004 - 0.012
	Nickel (Ni)-Total	mg/kg	0.1	0.01 - 0.03
	Phosphorus (P)-Total	mg/kg	-	50 - 400
	Potassium (K)-Total	mg/kg	-	200 - 1600
	Rhenium (Re)-Total	mg/kg	-	0.002 - 0.006
	Rubidium(Rb)-Total	mg/kg	-	0.01 - 0.03
	Selenium (Se)-Total	mg/kg	0.2	0.02 - 0.06
	Sodium (Na)-Total	mg/kg	-	200 - 1600
	Strontium (Sr)-Total	mg/kg	0.01	0.01 - 0.03
	Tellurium (Te)-Total	mg/kg	-	0.004 - 0.012
	Thallium (Tl)-Total	mg/kg	0.01	0.0004 - 0.0012
	Thorium (Th)-Total	mg/kg	-	0.002 - 0.006
	Tin (Sn)-Total	mg/kg	0.05	0.004 -0.012
	Titanium (Ti)-Total	mg/kg	-	0.01 - 0.82
	Uranium (U)-Total	mg/kg	0.002	0.004 - 0.0012
	Vanadium (V)-Total	mg/kg	0.1	0.004 - 0.012
	Yttrium (Y)-Total	mg/kg	-	0.002 - 0.006
	Zinc (Zn)-Total	mg/kg	0.1	0.1 - 0.3
	Zirconium (Zr)-Total	mg/kg	-	0.04 - 0.12

[a] Target levels based off of advertised detection limits from the laboratory

(grey shading) Indicates achieved MDL did not meet DQO

Table A.10: Laboratory QAQC for fish tissue samples collected for the Bellekeno Mine EEM.

	Analyte	Units	Method Blank		Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Material
Total metals (wet weight)	Aluminum (Al)	mg/kg	< 0.4	< 0.4	-	-	-	-
		mg/kg	< 0.4	< 0.4	-	-	-	-
		mg/kg	< 0.4	1.14	-	-	-	-
	Antimony (Sb)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Arsenic (As)	mg/kg	< 0.004	< 0.004	21.6	21.6	100%	VA-NRC-TORT2
		mg/kg	< 0.004	< 0.004	9.66	8.60	89%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Barium (Ba)	mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Beryllium (Be)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Bismuth (Bi)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Boron (B)	mg/kg	< 0.2	< 0.2	-	-	-	-
		mg/kg	< 0.2	< 0.2	-	-	-	-
		mg/kg	< 0.2	< 0.2	-	-	-	-
	Cadmium (Cd)	mg/kg	< 0.002	< 0.002	26.7	31.6	118%	VA-NRC-TORT2
		mg/kg	< 0.002	< 0.002	24.3	26.4	109%	VA-NRC-DOLT4
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Calcium (Ca)	mg/kg	< 5.0	< 5.0	680	690	101%	VA-NRC-DOLT4
		mg/kg	< 5.0	< 5.0	-	-	-	-
		mg/kg	< 5.0	< 5.0	-	-	-	-
	Cesium (Cs)	mg/kg	< 0.001	< 0.001	-	-	-	-
		mg/kg	< 0.001	< 0.001	-	-	-	-
		mg/kg	< 0.001	< 0.001	-	-	-	-
	Chromium (Cr)	mg/kg	< 0.01	< 0.01	0.770	0.825	107%	VA-NRC-TORT2
		mg/kg	< 0.01	< 0.01	1.40	1.31	94%	VA-NRC-DOLT4
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Cobalt (Co)	mg/kg	< 0.004	< 0.004	0.510	0.541	106%	VA-NRC-TORT2
		mg/kg	< 0.004	< 0.004	0.250	0.216	86%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Copper (Cu)	mg/kg	< 0.01	< 0.01	106	113	107%	VA-NRC-TORT2
		mg/kg	< 0.01	< 0.01	31.2	31.1	100%	VA-NRC-DOLT4
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Gallium (Ga)	mg/kg	< 0.004	< 0.004	-	-	-	-
		mg/kg	< 0.004	< 0.004	-	-	-	-
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Iron (Fe)	mg/kg	< 0.2	0.28	105	113	108%	VA-NRC-TORT2
		mg/kg	< 0.2	0.25	1830	1770	97%	VA-NRC-DOLT4
		mg/kg	< 0.2	< 0.2	-	-	-	-
	Lead (Pb)	mg/kg	< 0.004	< 0.004	0.350	0.343	98%	VA-NRC-TORT2
		mg/kg	< 0.004	< 0.004	0.160	0.135	84%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Lithium (Li)	mg/kg	< 0.02	0.028	-	-	-	-
		mg/kg	< 0.02	0.032	-	-	-	-
		mg/kg	< 0.02	0.024	-	-	-	-
	Magnesium (Mg)	mg/kg	< 10	< 10	1500	1440	96%	VA-NRC-DOLT4
		mg/kg	< 10	< 10	-	-	-	-
		mg/kg	< 10	< 10	-	-	-	-
	Manganese (Mn)	mg/kg	< 0.004	< 0.004	13.6	14.1	104%	VA-NRC-TORT2
		mg/kg	< 0.004	0.0071	-	-	-	-
		mg/kg	< 0.004	0.0040	-	-	-	-
	Mercury (Hg)	mg/kg	< 0.001	< 0.001	0.270	0.254	94%	VA-NRC-TORT2
		mg/kg	< 0.001	< 0.001	2.58	2.25	87%	VA-NRC-DOLT4
		mg/kg	< 0.001	< 0.001	-	-	-	-
	Molybdenum (Mo)	mg/kg	< 0.004	< 0.004	0.95	1.06	112%	VA-NRC-TORT2
		mg/kg	< 0.004	< 0.004	1.00	1.12	112%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-

Table A.10: Laboratory QAQC for fish tissue samples collected for the Bellekeno Mine EEM.

	Analyte	Units	Method Blank		Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Material
Total metals (wet weight)	Nickel (Ni)	mg/kg	< 0.01	< 0.01	2.50	2.78	111%	VA-NRC-TORT2
		mg/kg	< 0.01	< 0.01	0.970	0.913	94%	VA-NRC-DOLT4
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Phosphorus (P) - Total	mg/kg	< 50	< 50	-	-	-	-
		mg/kg	< 50	< 50	-	-	-	-
		mg/kg	< 50	< 50	-	-	-	-
	Potassium (K)	mg/kg	< 200	< 200	9800	10400	106%	VA-NRC-DOLT4
		mg/kg	< 200	< 200	-	-	-	-
		mg/kg	< 200	< 200	-	-	-	-
	Rhenium (Re)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Rubidium (Rb)	mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Selenium (Se)	mg/kg	< 0.02	< 0.02	5.63	6.18	110%	VA-NRC-TORT2
		mg/kg	< 0.02	< 0.02	8.30	8.81	106%	VA-NRC-DOLT4
		mg/kg	< 0.02	< 0.02	-	-	-	-
	Sodium (Na)	mg/kg	< 200	< 200	6800	7230	106%	VA-NRC-DOLT4
		mg/kg	< 200	< 200	-	-	-	-
		mg/kg	< 200	< 200	-	-	-	-
	Strontium (Sr)	mg/kg	< 0.01	< 0.01	45.2	38.8	86%	VA-NRC-TORT2
		mg/kg	< 0.01	< 0.01	5.50	4.96	90%	VA-NRC-DOLT4
		mg/kg	< 0.01	< 0.01	-	-	-	-
	Telluriu (Te)	mg/kg	< 0.004	< 0.004	-	-	-	-
		mg/kg	< 0.004	< 0.004	-	-	-	-
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Thallium (Tl)	mg/kg	< 0.0004	< 0.0004	-	-	-	-
		mg/kg	< 0.0004	< 0.0004	-	-	-	-
		mg/kg	< 0.0004	< 0.0004	-	-	-	-
	Thorium (Th)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Tin (Sn)	mg/kg	< 0.004	< 0.004	0.170	0.196	115%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Titanium (Ti)	mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	< 0.01	-	-	-	-
		mg/kg	< 0.01	0.033	-	-	-	-
	Uranium (U)	mg/kg	< 0.0004	< 0.0004	-	-	-	-
		mg/kg	< 0.0004	< 0.0004	-	-	-	-
		mg/kg	< 0.0004	< 0.0004	-	-	-	-
	Vanadium (V)	mg/kg	< 0.004	< 0.004	1.64	1.92	117%	VA-NRC-TORT2
		mg/kg	< 0.004	< 0.004	0.600	0.633	106%	VA-NRC-DOLT4
		mg/kg	< 0.004	< 0.004	-	-	-	-
	Yttrium (Y)	mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
		mg/kg	< 0.002	< 0.002	-	-	-	-
	Zinc (Zn)	mg/kg	< 0.10	< 0.10	180	221	123%	VA-NRC-TORT2
		mg/kg	< 0.10	< 0.10	116	127	109%	VA-NRC-DOLT4
		mg/kg	< 0.10	< 0.10	-	-	-	-
	Zirconium (Zr)	mg/kg	< 0.04	< 0.04	-	-	-	-
		mg/kg	< 0.04	< 0.04	-	-	-	-
		mg/kg	< 0.04	< 0.04	-	-	-	-

(shaded) value greater than DQO

A5.0 DATA QUALITY STATEMENT

The quality of data for this project was adequate to serve the project objectives.

APPENDIX B

EFFLUENT AND WATER QUALITY MONITORING DATA

Table B.1: Final effluent (Station KV-43) quality in 2010 since the Bellekeno Mine became subject to the MMER on September 7th, 2010.

Analyte	Units	Limit [a]	Sample Date												
			9/17/2010	9/22/2010	9/29/2010	10/7/2010	10/13/2010	10/20/2010	10/27/2010	11/2/2010	11/10/2010	11/17/2010	11/24/2010	12/1/2010	12/8/2010
pH (field)	pH units	6.5-9.5		7.91	8.42	9.18	8.59	7.99	7.75	8.44	8.73	8.62	9.64	8.97	8.69
Conductivity (field)	µS/cm														
Temperature (field)	C														
Discharge (Flow)	L/s														
Total Suspended Solids	mg/L	30		2	47	19	26	< 1	25	58	18	11	2	< 1	< 1
Turbidity (field)	NTU														
Hardness (from total)	mg/L		784	562	943	882	769	758	801	859	785	743	695	718	773
Alkalinity, total	mg/L			53	110	68	86	28	60	120	64	51	35	17	28
Sulphate, dissolved	mg/L														
Ammonia (N)	mg/L		4.8	3.7	2.3	2.1	2.4	1.9	1.5	1.4	1	1.3	1.3	1.6	1.5
Nitrite (N)	mg/L			1.12		0.89	1.07	0.81	0.81	0.58	0.56	0.6	0.52	0.8	0.477
Nitrate (N)	mg/L			5.2		3.2	3.8	3.2	2.4	2.27	2.28	1.91	1.79	2.48	1.95
Phosphate, total	mg/L														
Dissolved Organic Carbon	mg/L														
Aluminum (Al), total	mg/L		0.025	0.013	0.198	0.027	0.05	0.011	0.076	0.233	0.039	0.069	0.189	< 0.01	< 0.01
Antimony (Sb), total	mg/L														
Arsenic (As), total	mg/L	1	0.0005	0.0013	0.0128	0.0073	0.0078	0.0009	0.0072	0.0176	0.0045	0.0079	0.0068	0.0062	0.0041
Barium (Ba), total	mg/L														
Beryllium (Be), total	mg/L														
Bismuth (Bi), total	mg/L														
Boron (B), total	mg/L														
Cadmium (Cd), total	mg/L	0.01	0.00038	< 0.0001	0.0021	0.0003	0.0005	< 0.0001	0.0008	0.0015	0.0002	0.0006	0.001	0.0005	< 0.0001
Calcium (Ca), total	mg/L														
Chromium (Cr), total	mg/L		0.001	< 0.002	0.006	0.003	0.003	< 0.002	0.005	0.006	< 0.002	< 0.002	0.009	0.003	0.006
Cobalt (Co), total	mg/L														
Copper (Cu), total	mg/L	0.6	0.0013	< 0.001	0.007	0.004	0.004	< 0.001	0.005	0.009	0.003	0.003	0.024	< 0.001	< 0.001
Iron (Fe), total	mg/L		0.062	0.053	6.11	3.21	4.5	0.064	4.67	11.2	2.7	1.76	0.366	0.035	0.061
Lead (Pb), total	mg/L	0.4	0.0055	0.0022	0.116	0.0472	0.0643	0.0015	0.236	0.242	0.0535	0.0748	0.0705	0.0065	0.0062
Lithium (Li), total	mg/L														
Magnesium (Mg), total	mg/L														
Manganese (Mn), total	mg/L														
Mercury (Hg), total	mg/L		0.00003	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Molybdenum (Mo), total	mg/L		0.005	0.004	0.008	0.008	0.007	0.008	0.007	0.006	0.006	0.006	0.009	0.006	0.006
Nickel (Ni), total	mg/L	1	0.01	0.01	0.022	0.016	0.01	0.003	0.01	0.016	0.011	0.005	0.004	0.003	0.006
Phosphorous (P), total	mg/L														
Potassium (K), total	mg/L														
Radium-226	Bq/L	1.11			0.02	< 0.005	0.01	0.01	0.006	< 0.005	< 0.005	< 0.005	< 0.005	0.008	0.01
Selenium (Se), total	mg/L		0.0019	0.0016	0.0017	0.0016	0.001	0.001	0.0011	0.0013	0.0015	0.0012	0.0013	0.0011	0.0009
Silicon (Si), total	mg/L														
Silver (Ag), total	mg/L		0.00034	0.0001	0.0013	0.0001	0.0002	< 0.0001	0.001	0.0035	0.0003	0.0006	< 0.0001	0.0002	< 0.0001
Sodium (Na), total	mg/L														
Strontium (Sr), total	mg/L														
Sulphur (S), total	mg/L														
Thallium (Tl), total	mg/L		0.00022	0.00014	0.00024	0.00016	0.0001	0.00009	0.00032	0.00031	0.00011	< 0.00005	0.00011	0.00006	0.00007
Tin (Sn), total	mg/L														
Titanium (Ti), total	mg/L														
Uranium (U), total	mg/L														
Vanadium (V), total	mg/L														
Zinc (Zn), total	mg/L	1	0.065	0.012	0.302	0.114	0.139	< 0.01	0.12	0.265	0.051	0.08	0.185	< 0.01	< 0.01
Zirconium (Zr), total	mg/L														
LC50 % RT Mortality at 96 Hrs	%	50		0		0			0			0			0
LC50 % DM Mortality at 48 Hrs	%	50		0					0						0

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.1: Final effluent (Station KV-43) quality in 2010 since the Bellekeno Mine became subject to the MMER on September 7th, 2010.

Analyte	Units	Limit [a]	Sample Date 12/9/2010	12/15/2010	12/22/2010	12/29/2010	Mean [b]	Minimum	Maximum
pH (field)	pH units	6.5-9.5	9.41	8.91	8.18	8.33	8.61	7.75	9.64
Conductivity (field)	µS/cm								
Temperature (field)	C								
Discharge (Flow)	L/s								
Total Suspended Solids	mg/L	30	2	12	9	< 1	15	1	58
Turbidity (field)	NTU								
Hardness (from total)	mg/L		736	795	820	764	776	562	943
Alkalinity, total	mg/L		37	63	47	45	57	17	120
Sulphate, dissolved	mg/L								
Ammonia (N)	mg/L		1.6	1	0.63	0.47	1.79	0.47	4.8
Nitrite (N)	mg/L			0.66	0.53	0.465	0.71	0.47	1.12
Nitrate (N)	mg/L			1.8	1.09	0.91	2.45	0.91	5.2
Phosphate, total	mg/L								
Dissolved Organic Carbon	mg/L								
Aluminum (Al), total	mg/L		0.012	0.042	0.025	0.012	0.061	0.010	0.233
Antimony (Sb), total	mg/L								
Arsenic (As), total	mg/L	1	0.0055	0.0058	0.0036	0.0019	0.0060	0.0005	0.0176
Barium (Ba), total	mg/L								
Beryllium (Be), total	mg/L								
Bismuth (Bi), total	mg/L								
Boron (B), total	mg/L								
Cadmium (Cd), total	mg/L	0.01	0.0001	0.00075	0.0006	0.0001	0.0006	0.0001	0.0021
Calcium (Ca), total	mg/L								
Chromium (Cr), total	mg/L		0.008	0.007	< 0.002	< 0.002	0.004	0.001	0.009
Cobalt (Co), total	mg/L								
Copper (Cu), total	mg/L	0.6	0.001	0.0016	0.001	< 0.001	0.0041	0.0010	0.024
Iron (Fe), total	mg/L		1.02	1.46	0.532	0.07	2.23	0.04	11.20
Lead (Pb), total	mg/L	0.4	0.0268	0.152	0.118	0.0223	0.073	0.002	0.242
Lithium (Li), total	mg/L								
Magnesium (Mg), total	mg/L								
Manganese (Mn), total	mg/L								
Mercury (Hg), total	mg/L		< 0.0002	< 0.00002	< 0.0002	< 0.0002	0.0002	0.0000	0.0002
Molybdenum (Mo), total	mg/L		0.007	0.007	0.005	0.004	0.006	0.004	0.009
Nickel (Ni), total	mg/L	1	0.005	0.009	0.006	0.004	0.009	0.003	0.022
Phosphorous (P), total	mg/L								
Potassium (K), total	mg/L								
Radium-226	Bq/L	1.11	0.01	< 0.005	< 0.005	< 0.005	0.008	0.005	0.020
Selenium (Se), total	mg/L		0.0011	0.0009	< 0.0008	< 0.0008	0.0012	0.0008	0.0019
Silicon (Si), total	mg/L								
Silver (Ag), total	mg/L		< 0.0001	0.001	0.001	0.0002	0.0006	0.0001	0.0035
Sodium (Na), total	mg/L								
Strontium (Sr), total	mg/L								
Sulphur (S), total	mg/L								
Thallium (Tl), total	mg/L		0.00008	0.00016	0.00007	0.00006	0.00014	0.00005	0.00032
Tin (Sn), total	mg/L								
Titanium (Ti), total	mg/L								
Uranium (U), total	mg/L								
Vanadium (V), total	mg/L								
Zinc (Zn), total	mg/L	1	0.02	0.062	0.049	0.013	0.089	0.010	0.302
Zirconium (Zr), total	mg/L								
LC50 % RT Mortality at 96 Hrs	%	50	0			0	0.0	0.0	0
LC50 % DM Mortality at 48 Hrs	%	50				0	0.0	0.0	0

[a] Metal Mining Effluent Regulations (MMER) maximum authorized conc entration in a grab sample

[b] Mean annual value. In cases where concentration was less than the r reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.2: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2011.

Analyte	Units	Limit [a]	Sample Date																
			1/5/2011	1/12/2011	1/19/2011	1/26/2011	2/2/2011	2/9/2011	2/10/2011	2/16/2011	2/23/2011	3/2/2011	3/9/2011	3/16/2011	3/23/2011	3/30/2011	4/6/2011	4/13/2011	4/20/2011
pH (field)	pH units	6.5-9.5	8.24	8.82	8.36	8.24	8.36	8.08	8.7	8.64	8.3	8.97	8.47	9.07	8.45	8.44	8.44	8.47	8.35
Conductivity (field)	µS/cm		1,361	1,233	1,523	1,368	1,291	1,229	1,482	1,229	1,412	1,363	1,336	1,242	785	1,337	1,123	1,142	1,262
Temperature (field)	C		1.2	1	0.3	0	1.3	2.3	3.1	0.2	0	0.3	1.4	1.4	2.1	2	1.9	2.1	3.3
Discharge (Flow)	L/s		5.08	4.20	4.92	4.87	3.87	4.27	3.91	4.19	4.15	5.05	1.20	2.97	3.90	3.50	3.16	2.81	3.08
Total Suspended Solids	mg/L	30	< 1	1	1	< 1	< 1	1	< 1	7	< 1	3	< 1	< 1	1	< 1	< 1	< 1	< 1
Turbidity (field)	NTU		0.4	-	2.9	0.8	1.1	0.6	-	7.9	0.5	1.6	1	1.3	-	0.7	0.1	0	-
Hardness (from total)	mg/L		746	739	738	749	715	768	703	699	797	800	725	633	640	821	595	655	591
Alkalinity, total	mg/L		36	45	80	48	37	69	64	63	49	14	29	15	51	36	31	21	31
Sulphate, dissolved	mg/L		590	630	610	590	570	670	550	540	570	620	610	540	520	510	510	530	530
Ammonia (N)	mg/L		0.35	1.8	3.2	4	3.3	3	3.5	2.3	1.9	0.97	0.38	1.9	1	0.51	0.29	0.2	0.31
Nitrite (N)	mg/L		0.397	0.67	0.94	1.21	1.43	1.31	0.99	0.67	0.52	0.47	0.347	0.494	0.399	0.141	0.082	0.052	0.085
Nitrate (N)	mg/L		0.79	2.43	4.7	6.2	6.1	5.3	6	3.9	3.09	2.13	1.07	3.3	1.93	0.84	0.43	0.27	0.55
Phosphate, total	mg/L		< 0.005	0.005	0.002	0.003	0.004	0.003	0.009	0.002	0.002	0.003	< 0.002	< 0.002	0.002	< 0.002	0.002	0.003	0.003
Dissolved Organic Carbon	mg/L		1.5	1	3.6	2.1	1.5	1.3	1.2	2.1	0.8	1	1.1	0.8	< 0.5	0.9	0.7	0.7	0.9
Aluminum (Al), total	mg/L		0.018	< 0.01	0.013	0.01	< 0.01	0.033	< 0.01	0.032	0.01	0.013	< 0.01	0.011	0.013	0.012	0.018	< 0.01	< 0.01
Antimony (Sb), total	mg/L		0.0165	0.0223	0.0214	0.0289	0.0247	0.0215	0.0165	0.0167	0.0135	0.0099	0.0104	0.0077	0.0062	0.0059	0.0048	0.0048	0.0071
Arsenic (As), total	mg/L	1	0.0016	0.0024	0.0028	0.0037	0.0026	0.0022	0.0016	0.0067	0.0015	0.0013	0.0006	0.0057	0.0009	0.0005	0.0006	0.0009	0.001
Barium (Ba), total	mg/L		0.01	0.012	0.019	0.014	0.014	0.013	0.01	0.009	0.008	0.006	0.007	0.005	0.004	0.005	0.006	0.006	0.007
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Cadmium (Cd), total	mg/L		0.0001	0.0002	0.0005	< 0.0001	0.0001	0.0002	< 0.0001	0.0006	< 0.0001	0.0001	< 0.0001	< 0.0001	0.0004	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Calcium (Ca), total	mg/L		212	207	207	206	195	220	194	196	221	223	200	171	179	230	166	186	163
Chromium (Cr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Cobalt (Co), total	mg/L		< 0.0005	< 0.0005	0.0006	0.0005	< 0.0005	0.0006	0.0006	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper (Cu), total	mg/L	0.6	0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Iron (Fe), total	mg/L		0.055	0.089	0.146	0.04	0.049	0.079	0.102	1.84	0.065	0.157	0.028	0.037	0.129	0.074	0.072	0.027	0.029
Lead (Pb), total	mg/L	0.4	0.0253	0.0252	0.0774	0.0102	0.0204	0.0197	0.0105	0.195	0.0054	0.019	0.0006	0.0054	0.0433	0.0021	0.0018	0.0019	0.0018
Lithium (Li), total	mg/L		0.029	0.026	0.03	0.032	0.03	0.032	0.027	0.029	0.031	0.031	0.027	0.024	0.023	0.027	0.021	0.022	0.022
Magnesium (Mg), total	mg/L		52	54	54	57	55	53	53	51	59	59	55	50	47	60	44	46	44
Manganese (Mn), total	mg/L		0.064	0.094	0.146	0.086	0.07	0.116	0.096	0.111	0.089	0.027	0.056	0.01	0.111	0.05	0.034	0.017	0.032
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Molybdenum (Mo), total	mg/L		0.003	0.005	0.004	0.008	0.006	0.006	0.005	0.005	0.004	0.003	0.005	0.003	0.002	0.002	0.002	0.002	0.002
Nickel (Ni), total	mg/L	1	0.003	0.005	0.009	0.008	0.005	0.006	0.005	0.004	0.004	0.001	0.002	<0.001	0.002	0.002	0.001	<0.001	0.002
Phosphorous (P), total	mg/L		-	0.033	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium (K), total	mg/L		2	2	2	3	3	3	2	2	2	2	2	1	1	1	<1	1	1
Radium-226	Bq/L	1.11	0.007	< 0.005	0.01	0.02	< 0.005	< 0.005	0.005	< 0.005	0.009	< 0.005	0.006	0.02	0.009	< 0.01	< 0.01	< 0.01	0.005
Selenium (Se), total	mg/L		< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008
Silicon (Si), total	mg/L		2.84	3.05	3.63	4.49	2.99	3.59	2.84	3.02	2.59	< 2	< 2	2.71	< 2	< 2	< 2	2.34	2.85
Silver (Ag), total	mg/L		< 0.0001	0.0002	0.0004	< 0.0001	0.0001	0.0002	< 0.0001	0.0007	0.0001	< 0.0001	< 0.0001	0.0002	0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium (Na), total	mg/L		6	9	7	14	11	10	8	7	7	6	8	5	4	5	4	7	6
Strontium (Sr), total	mg/L		0.583	0.619	0.557	0.666	0.627	0.629	0.565	0.6	0.619	0.632	0.581	0.52	0.504	0.618	0.521	0.563	0.549
Sulphur (S), total	mg/L		236	227	233	236	227	211	190	205	224	231	218	209	172	239	160	193	185
Thallium (Tl), total	mg/L		0.00005	0.00008	0.00008	0.00014	0.00011	0.00012	0.00011	0.00022	0.00007	0.00006	0.00005	< 0.00005	0.00007	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Tin (Sn), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Uranium (U), total	mg/L		0.0157	0.0156	0.0238	0.022	0.0181	0.0199	0.021	0.0248	0.0269	0.0077	0.0188	0.0049	0.0208	0.0245	0.021	0.0119	0.0168
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc (Zn), total	mg/L	1	0.01	0.015	0.044	< 0.01	< 0.01	0.012	< 0.01	0.06	< 0.01	0.01	< 0.01	< 0.01	0.043	< 0.01	< 0.01	< 0.01	< 0.01
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
LC50 % RT Mortality at 96 Hrs	%	50		0					0						0				0
LC50 % DM Mortality at 48 Hrs	%	50		0					0						0				0

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.2: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2011.

Analyte	Units	Limit [a]	Sample Date																
			4/27/2011	5/4/2011	5/11/2011	5/18/2011	5/25/2011	5/28/2011	6/1/2011	6/8/2011	6/15/2011	6/21/2011	6/29/2011	7/6/2011	7/13/2011	7/19/2011	7/27/2011	8/3/2011	8/10/2011
pH (field)	pH units	6.5-9.5	8.17	7.97	8.48	8.48	8.56	9.07	8.14	8.48	7.77	8.54	7.8	7.76	7.91	8.66	8.78	8.67	8.9
Conductivity (field)	µS/cm		1,031	1,177	1,203	1,183	1,143	891	1,162	1,071	1,118	1,092	1,216	1,076	1,020	-	1,048	1,087	1,233
Temperature (field)	C		5.4	6.1	4.7	9.9	10.6	11.7	10.3	10.8	11.9	13.3	11.5	11.2	14.8	13	12.1	11	9.8
Discharge (Flow)	L/s		3.15	2.99	3.99	4.00	2.57	2.05	4.59	4.14	3.00	2.50	4.11	3.70	3.19	3.97	7.80	4.10	4.82
Total Suspended Solids	mg/L	30	< 1	< 1	17	22	74	100	11	2	< 1	< 1	< 1	< 1	< 1	< 1	6	13	12
Turbidity (field)	NTU		0.3	1.9	12.6	29.3	32.8	-	13.7	5.5	0.5	0.2	0.4	0.9	4.9	-	8.1	9.1	11.3
Hardness (from total)	mg/L		620	622	680	608	618	710	620	557	625	557	681	635	588	591	546	619	653
Alkalinity, total	mg/L		35	43	89	87	93	110	100	52	66	12	59	53	44	26	40	67	49
Sulphate, dissolved	mg/L		330	530	550	490	480	460	480	450	490	400	410	440	410	380	440	490	510
Ammonia (N)	mg/L		0.396	0.39	3.4	0.013	1.77	1.83	1.1	0.55	0.34	0.21	0.84	0.99	0.41	0.46	4.5	1.5	1.5
Nitrite (N)	mg/L		0.059	0.102	0.242	<0.005	0.194	0.228	0.224	0.185	0.159	0.109	0.301	0.38	0.15	0.123	0.308	0.295	0.362
Nitrate (N)	mg/L		0.54	0.67	4.9	<0.02	2.83	3.16	2.8	1.47	1.36	1.15	2.71	3	2.32	1.61	4	3.7	3.2
Phosphate, total	mg/L		< 0.002	0.002	0.005	0.013	0.044	0.041	0.009	< 0.002	0.002	0.004	0.003	0.005	0.002	0.005	0.014	0.014	0.014
Dissolved Organic Carbon	mg/L		< 0.5	< 0.5	4.1	5.7	8.6	18.3	5.9	0.8	1	< 0.5	1.1	0.7	4.2	1.4	5.1	6.8	< 0.5
Aluminum (Al), total	mg/L		< 0.01	<0.01	0.066	0.095	0.131	0.403	0.074	0.013	0.021	< 0.01	0.014	< 0.01	< 0.01	< 0.01	0.031	0.03	0.05
Antimony (Sb), total	mg/L		0.0063	0.0093	0.016	0.0163	0.0148	0.0209	0.0153	0.0097	0.0094	0.0056	0.0123	0.0083	0.0065	0.007	0.016	0.0139	0.0186
Arsenic (As), total	mg/L	1	0.0009	0.001	0.0063	0.0132	0.0163	0.0224	0.0046	0.0018	0.0004	0.0007	< 0.0004	< 0.0004	< 0.0004	< 0.0004	0.0025	0.0035	0.0045
Barium (Ba), total	mg/L		0.007	0.009	0.014	0.013	0.014	0.019	0.015	0.009	0.007	0.007	0.011	0.009	0.009	0.008	0.014	0.011	0.012
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Cadmium (Cd), total	mg/L		< 0.0001	< 0.0001	0.0004	0.0006	0.0011	0.0018	0.0003	< 0.0001	0.00006	0.0014	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0004	0.0004	0.0006
Calcium (Ca), total	mg/L		173	169	193	173	179	205	183	154	180	180	201	184	173	180	158	184	188
Chromium (Cr), total	mg/L		< 0.002	< 0.002	< 0.002	0.003	0.004	0.006	< 0.002	< 0.002	0.006	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Cobalt (Co), total	mg/L		< 0.0005	< 0.0005	< 0.0005	0.0007	0.001	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper (Cu), total	mg/L	0.6	< 0.001	< 0.001	0.003	0.006	0.008	0.012	0.003	0.002	0.0007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.003	0.002
Iron (Fe), total	mg/L		< 0.02	< 0.02	2.46	4.74	9.16	8.84	1.79	0.454	0.086	< 0.02	0.035	0.021	0.027	0.04	1.92	3.4	3.4
Lead (Pb), total	mg/L	0.4	0.0006	0.0009	0.105	0.111	0.132	0.341	0.0564	0.0081	0.0013	0.0005	0.0005	<0.0002	0.0004	0.0003	0.074	0.062	0.0773
Lithium (Li), total	mg/L		0.02	0.022	0.024	0.021	0.022	0.025	0.021	0.021	0.022	0.027	0.024	0.024	0.023	0.025	0.021	0.03	0.04
Magnesium (Mg), total	mg/L		46	49	48	43	41	48	39	42	42.5	26	43	43	38	34	37	39	44
Manganese (Mn), total	mg/L		0.042	0.052	0.117	0.159	0.245	0.434	0.112	0.039	0.065	0.013	0.065	0.046	0.032	0.021	0.063	0.087	0.086
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Molybdenum (Mo), total	mg/L		0.002	0.003	0.004	0.007	0.007	0.008	0.005	0.003	0.003	0.003	0.004	0.004	0.004	0.003	0.003	0.005	0.006
Nickel (Ni), total	mg/L	1	0.002	0.003	0.005	0.007	0.008	0.009	0.005	0.002	0.007	<0.001	0.004	0.003	0.002	0.001	0.004	0.004	0.004
Phosphorous (P), total	mg/L		-	-	-	-	-	-	-	-	< 0.01	-	-	-	-	-	-	-	< 0.04
Potassium (K), total	mg/L		1	1	2	3	2	3	2	1	1.17	2	2	2	2	2	2	2	3
Radium-226	Bq/L	1.11	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-	< 0.01	-	< 0.01	-	-	-
Selenium (Se), total	mg/L		< 0.0008	< 0.0008	< 0.0008	< 0.0008	0.0009	0.0016	0.0032	0.0036	0.0022	0.0029	0.0022	0.0032	0.005	0.0062	0.0062	0.0051	0.0034
Silicon (Si), total	mg/L		3.03	3.12	3.58	4.08	3.9	4.88	3.32	2.19	1.88	<2	2.33	2.79	2.12	<2	2.23	2	3
Silver (Ag), total	mg/L		< 0.0001	< 0.0001	0.0007	0.0009	0.0021	0.0031	0.0004	< 0.0001	< 0.00002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	0.0006	0.0004
Sodium (Na), total	mg/L		5	6	11	16	16	20	12	8	6.34	7	10	11	10	9	9	11	13
Strontium (Sr), total	mg/L		0.531	0.557	0.584	0.523	0.565	0.648	0.515	0.506	0.502	0.604	0.612	0.591	0.507	0.545	0.546	0.531	0.589
Sulphur (S), total	mg/L		185	197	199	176	170	197	168	163	171	146	187	171	172	156	155	169	187
Thallium (Tl), total	mg/L		< 0.00005	< 0.00005	0.00017	0.00015	0.00011	0.00047	0.00006	< 0.00005	< 0.00005	< 0.00005	0.00005	0.00006	< 0.00005	0.00005	0.00009	0.00015	0.00007
Tin (Sn), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	0.007	0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Uranium (U), total	mg/L		0.0202	0.0239	0.0259	0.0253	0.0263	0.0307	0.0226	0.0151	0.0171	0.003	0.0149	0.0168	0.0104	0.0066	0.0086	0.0153	0.0167
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc (Zn), total	mg/L	1	< 0.01	< 0.01	0.049	0.073	0.119	0.204	0.035	< 0.01	< 0.005	0.037	< 0.01	< 0.01	< 0.01	< 0.01	0.099	0.1	0.12
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
LC50 % RT Mortality at 96 Hrs	%	50						0				0				10			
LC50 % DM Mortality at 48 Hrs	%	50						0				0				0			

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.2: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2011.

Analyte	Units	Limit [a]	Sample Date																
			8/18/2011	8/24/2011	8/31/2011	9/7/2011	9/14/2011	9/17/2011	9/21/2011	9/25/2011	9/28/2011	10/5/2011	10/12/2011	10/19/2011	10/25/2011	10/26/2011	11/2/2011	11/9/2011	11/16/2011
pH (field)	pH units	6.5-9.5	9.15	8.63	8.16	8.41	8.93	8.42	8.67	8.27	9.12	8.63	9.05	8.86	8.82	8.79	8.48	8.89	8.56
Conductivity (field)	µS/cm		-	1,324	1,327	1,345	1,236	1,176	1,267	1,189	1,290	1,238		1,183	1,311	1,234	1,281	1,286	1,257
Temperature (field)	C		9.1	8.5	7.2	7.3	7	6.5	6.8	5.9	3.9	1.4	2.1	2	2.6	0.5	0.6	1.3	-0.5
Discharge (Flow)	L/s		6.16	4.67	5.48	5.47	3.08	3.82	4.05	4.06	3.98	3.95	4.75	3.64	4.86	4.99	3.30	3.50	3.35
Total Suspended Solids	mg/L	30	3	14	1	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	< 1	1.1
Turbidity (field)	NTU		-	11.6	0.8	1.1	1.4	-	0.5	-	0	0.4	0.6	0.5	-	0.1	1.4	1.3	1.6
Hardness (from total)	mg/L		638	709	680	623	631	636	616	676	671	624	640	652	680	608	700	626	647
Alkalinity, total	mg/L		30	100	69	36	16	29	31	28	24	45	65	66	76	73	62	47.8	36.6
Sulphate, dissolved	mg/L		510	500	540	620	570	562	589	566	583	480	590	561	623	611	677	624	626
Ammonia (N)	mg/L		1.6	1.1	0.98	1.4	0.78	1.8	1.2	1.3	1.5	1.8	2.3	2	0.28	2.5	0.33	0.46	2.8
Nitrite (N)	mg/L		0.5	0.449	0.54	0.72	0.72	0.66	0.55	0.6	0.59	0.83	1.15	0.8	1.02	1.07	1.45	1.1	1.11
Nitrate (N)	mg/L		3	2.4	2.82	3.6	4.5	4.4	2.6	2.76	2.67	3.8	4.6	4.2	4.7	5.1	5.8	4.13	4.51
Phosphate, total	mg/L		0.01	0.032	0.009	0.007	0.004	0.008	0.006	0.004	0.006	0.003	0.084	0.037	0.018	0.019	0.007	0.013	0.016
Dissolved Organic Carbon	mg/L		1.6	4.4	1.1	2.5	1.3	1.7	1.2	1.6	2.1	1.8	< 0.5	1	1.1	1.4	1.9	1.14	1.6
Aluminum (Al), total	mg/L		0.04	0.07	0.03	< 0.01	< 0.01	0.006	< 0.01	0.05	< 0.01	< 0.01	< 0.01	< 0.01	< 0.008	< 0.01	0.03	0.01	0.01
Antimony (Sb), total	mg/L		0.0134	0.0119	0.0142	0.0126	0.0139	0.02	0.0175	0.0183	0.0184	0.0219	0.026	0.0235	0.023	0.021	0.0349	0.027	0.0271
Arsenic (As), total	mg/L	1	0.0021	0.0049	0.0012	0.0007	0.0015	0.00606	0.0032	0.0042	0.0064	0.0094	0.0105	0.01	0.0108	0.0099	0.0106	0.0095	0.0084
Barium (Ba), total	mg/L		0.013	0.023	0.014	0.011	0.01	0.0106	0.012	0.017	0.017	0.022	0.024	0.017	0.016	0.014	0.017	0.013	0.013
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0003	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.003	< 0.001	< 0.001	< 0.001	< 0.001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Cadmium (Cd), total	mg/L		0.0008	0.0053	0.0005	0.0002	< 0.0001	0.000064	< 0.0001	0.0001	<0.0001	0.0004	0.0023	0.0016	0.0007	0.0005	0.0006	0.0004	0.0003
Calcium (Ca), total	mg/L		187	213	201	180	180	176	170	187	193	172	176	180	186	167	193	169	178
Chromium (Cr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.0001	< 0.002	< 0.002	0.005	< 0.002	< 0.002	< 0.002	< 0.003	< 0.002	< 0.002	< 0.002	< 0.002
Cobalt (Co), total	mg/L		< 0.0005	0.001	0.0006	< 0.0005	< 0.0005	0.000378	< 0.0005	< 0.0005	< 0.0005	0.0008	0.0013	0.0013	0.001	0.0012	0.0014	0.0009	0.0008
Copper (Cu), total	mg/L	0.6	0.002	0.003	< 0.001	< 0.001	< 0.001	0.00031	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0011	0.001	0.001	< 0.001	< 0.001
Iron (Fe), total	mg/L		1.29	4.66	0.18	0.19	0.03	0.019	0.09	0.13	0.03	0.03	0.11	<0.02	0.03	<0.02	0.05	0.02	0.05
Lead (Pb), total	mg/L	0.4	0.0207	0.0803	0.0084	0.0066	0.0008	0.00136	0.0009	0.003	0.0006	0.0132	0.0005	0.01	0.0032	0.0103	0.0132	0.004	0.0148
Lithium (Li), total	mg/L		0.03	0.03	0.03	0.03	0.03	0.028	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.03
Magnesium (Mg), total	mg/L		41	43	43	42	44	47.6	47	51	46	47	49	49	52.3	46	53	49	49
Manganese (Mn), total	mg/L		0.056	0.287	0.163	0.094	0.061	0.0915	0.079	0.108	0.05	0.249	0.493	0.443	0.334	0.277	0.257	0.209	0.145
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Molybdenum (Mo), total	mg/L		0.007	0.006	0.005	0.005	0.004	0.00412	0.005	0.005	0.007	0.006	0.006	0.004	0.004	0.004	0.006	0.005	0.006
Nickel (Ni), total	mg/L	1	0.002	0.007	0.006	0.004	0.002	0.00517	0.005	0.006	0.005	0.007	0.01	0.01	0.011	0.011	0.013	0.009	0.008
Phosphorous (P), total	mg/L		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.018	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.03	< 0.04	< 0.04	< 0.04	< 0.04
Potassium (K), total	mg/L		3	3	3	3	3	2.79	3	4	4	4	3	3	2.5	2	4	3	3
Radium-226	Bq/L	1.11	-	-	-	-	-	< 0.01	-	-	-	-	-	-	-	-	-	-	-
Selenium (Se), total	mg/L		0.0032	0.0039	0.0047	0.0038	0.0036	0.00385	0.0034	0.0034	0.0032	0.0031	0.0034	0.0031	0.0024	0.0026	0.0023	0.002	0.0018
Silicon (Si), total	mg/L		<2	3	3	2	2	3.3	4	4	5	5	4	4	4.6	4	5	4	4
Silver (Ag), total	mg/L		0.0001	0.0003	< 0.0001	< 0.0001	< 0.0001	0.000019	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00005	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium (Na), total	mg/L		12	14	13	12	12	12.2	15	17	21	16	15	13	13.5	12	18	16	16
Strontium (Sr), total	mg/L		0.641	0.648	0.646	0.622	0.616	0.608	0.597	0.604	0.628	0.621	0.662	0.556	0.578	0.515	0.637	0.612	0.579
Sulphur (S), total	mg/L		187	186	187	190	199	217	198	232	223	212	206	197	208	188	211	203	218
Thallium (Tl), total	mg/L		0.00009	0.00016	0.00008	0.00008	0.00009	0.000106	0.0001	0.00011	0.0001	0.00013	0.00016	0.00015	0.0002	0.00015	0.00017	0.00015	0.00013
Tin (Sn), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.00006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<0.01	< 0.005	< 0.005	< 0.005	< 0.005
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Uranium (U), total	mg/L		0.0103	0.0199	0.018	0.0108	0.0069	0.015	0.0114	0.0115	0.0089	0.0162	0.0204	0.0199	0.0218	0.0186	0.0208	0.0175	0.0149
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.0022	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Zinc (Zn), total	mg/L	1	0.06	0.4	0.03	0.02	< 0.01	0.0062	< 0.01	0.01	< 0.01	0.03	0.1	0.11	0.08	0.06	0.04	0.03	0.02
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.000	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002
LC50 % RT Mortality at 96 Hrs	%	50	0							0					40				
LC50 % DM Mortality at 48 Hrs	%	50	20							0					100				

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.2: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2011.

Analyte	Units	Limit [a]	Sample Date									Mean	Minimum	Maximum
			11/20/2011	11/23/2011	11/30/2011	12/7/2011	12/13/2011	12/14/2011	12/18/2011	12/21/2011	12/28/2011			
pH (field)	pH units	6.5-9.5	9.65	9.46	8.56	8.83	8.38	8.35	8.96	8.42	9.21	8.57	7.76	9.65
Conductivity (field)	µS/cm		1,231	1,243	1,198	1,167	-	1,134	1,234	1,113	1,129	1,212	785	1,523
Temperature (field)	C		1.9	-	0.9	0.6	2.3	0.6	2.7	0	0.6	4.81	-0.50	14.8
Discharge (Flow)	L/s		4.65	2.40	3.09	2.79	2.80	2.78	2.81	1.89	3.48	3.83	1.20	7.80
Total Suspended Solids	mg/L	30	13.8	13.4	6.6	2.4	1.5	6.2	1.7	4.2	1.6	6.3	1.0	100.0
Turbidity (field)	NTU		-	15.4	4.81	3.7	-	3.9	-	0.3	5.7	4.4	0.0	32.8
Hardness (from total)	mg/L		732	657	626	584	654	651	648	650	624	659	546	821
Alkalinity, total	mg/L		16.6	23.4	23.2	25.7	33.7	37.4	31.1	26.4	17	46.9	12.0	110
Sulphate, dissolved	mg/L		629	674	650	585	582	580	569	579	607	545	330	677
Ammonia (N)	mg/L			3.5	3.3	4.8	5.9	2.7	3.5	3	2.9	1.7	0.0	5.9
Nitrite (N)	mg/L		1.27	1.2	0.87	1.36	0.81	0.85	0.84	0.7	0.98	0.62	0.05	1.45
Nitrate (N)	mg/L		6.23	5.57	4.84	6.98	4	3.87	3.98	4.27	4.42	3.36	0.27	6.98
Phosphate, total	mg/L		0.027	0.026	0.032	0.014	0.021	0.028	0.044	0.039	0.031	0.013	0.002	0.084
Dissolved Organic Carbon	mg/L		1.24	0.98	0.95	< 0.5	0.99	0.6	2.03	1.28	1.64	2.09	0.50	18.3
Aluminum (Al), total	mg/L		0.0518	0.16	0.05	0.03	0.02	0.02	0.018	< 0.01	0.01	0.03	0.01	0.40
Antimony (Sb), total	mg/L		0.0355	0.037	0.0288	0.0274	0.0277	0.0281	0.0298	0.0295	0.0284	0.0177	0.0048	0.0370
Arsenic (As), total	mg/L	1	0.00796	0.0109	0.0104	0.0096	0.0095	0.0085	0.0092	0.0089	0.0081	0.0051	0.0004	0.0224
Barium (Ba), total	mg/L		0.0163	0.019	0.012	0.009	0.009	0.01	0.009	0.011	0.01	0.012	0.004	0.024
Beryllium (Be), total	mg/L		< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0002	0.0000	0.0003
Bismuth (Bi), total	mg/L		0.000011	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.000	0.003
Boron (B), total	mg/L		< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	0.10	0.05	0.10
Cadmium (Cd), total	mg/L		0.00123	0.0029	0.0011	0.0003	0.0002	< 0.0001	0.00014	0.0002	0.0003	0.0005	0.0001	0.0053
Calcium (Ca), total	mg/L		214	193	171	159	178	177	176	177	169	186	154	230
Chromium (Cr), total	mg/L		0.0007	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.001	< 0.002	< 0.002	0.002	0.000	0.006
Cobalt (Co), total	mg/L		0.000298	< 0.0005	0.0006	< 0.0005	0.0008	0.0009	0.0006	0.0005	< 0.0005	0.0006	0.0003	0.0014
Copper (Cu), total	mg/L	0.6	0.00154	0.004	0.001	< 0.001	< 0.001	0.005	0.0007	< 0.001	< 0.001	0.0017	0.0003	0.0120
Iron (Fe), total	mg/L		0.264	0.73	0.24	0.11	0.07	<0.02	0.059	0.04	0.1	0.84	0.02	9.16
Lead (Pb), total	mg/L	0.4	0.138	0.311	0.0991	0.0169	0.0139	0.0064	0.0105	0.0646	0.0434	0.0395	0.0003	0.3410
Lithium (Li), total	mg/L		0.0312	0.03	0.03	0.03	0.03	0.03	0.027	0.03	0.03	0.03	0.02	0.04
Magnesium (Mg), total	mg/L		47.9	43	48	45	51	51	50.7	51	49	47	26	60
Manganese (Mn), total	mg/L		0.0873	0.114	0.129	0.059	0.093	0.109	0.071	0.057	0.055	0.118	0.010	0.493
Mercury (Hg), total	mg/L		< 0.00002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00005	< 0.0002	< 0.0002	0.0002	0.00001	0.0002
Molybdenum (Mo), total	mg/L		0.00569	0.006	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.005	0.002	0.008
Nickel (Ni), total	mg/L	1	0.00451	0.002	0.007	0.008	0.011	0.012	0.012	0.01	0.008	0.006	0.001	0.013
Phosphorous (P), total	mg/L		0.033	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.032	< 0.04	< 0.04	0.04	0.01	0.04
Potassium (K), total	mg/L		4.32	4	4	3	3	3	3.98	4	4	2.54	1.00	4.32
Radium-226	Bq/L	1.11	< 0.01	-	-	-	-	-	< 0.01	-	-	0.01	0.01	0.02
Selenium (Se), total	mg/L		0.00246	0.0021	0.0018	0.0014	0.0014	0.0013	0.0015	0.0014	0.0015	0.0022	0.0008	0.0062
Silicon (Si), total	mg/L		4.8	4	4	4	4	4	4.33	5	5	3.36	1.88	5.0
Silver (Ag), total	mg/L		0.000073	0.0025	0.0007	0.0001	< 0.0001	< 0.0001	0.00005	0.0001	0.0003	0.00030	0.00002	0.00310
Sodium (Na), total	mg/L		18.7	17	16	16	16	16	20.7	21	19	11.9	4.0	21
Strontium (Sr), total	mg/L		0.649	0.65	0.612	0.552	0.595	0.599	0.615	0.684	0.616	0.589	0.502	0.684
Sulphur (S), total	mg/L		259	225	215	193	221	220	207	228	211	200	146	259
Thallium (Tl), total	mg/L		0.000128	0.00016	0.00012	0.00013	0.00013	0.00012	0.00013	0.00013	0.00011	0.00011	0.00005	0.00047
Tin (Sn), total	mg/L		0.00014	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	0.000	0.007
Titanium (Ti), total	mg/L		0.0027	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.01	< 0.01	0.01	0.00	0.01
Uranium (U), total	mg/L		0.00623	0.002	0.014	0.016	0.0222	0.023	0.022	0.0189	0.0146	0.0169	0.0020	0.0307
Vanadium (V), total	mg/L		0.0021	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	0.002	0.010
Zinc (Zn), total	mg/L	1	0.086	0.22	0.08	0.02	0.02	< 0.01	0.01	0.01	0.02	0.05	0.01	0.40
Zirconium (Zr), total	mg/L		< 0.0005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0005	< 0.002	< 0.002	0.0019	0.0001	0.0020
LC50 % RT Mortality at 96 Hrs	%	50	20				80			40		14.6	0.0	80
LC50 % DM Mortality at 48 Hrs	%	50	10				0					10.8	0.0	100

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.3: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2012.

Analyte	Units	Limit [a]	Sample Date																	
			1/5/2012	1/11/2012	1/17/2012	1/18/2012	1/25/2012	1/31/2012	2/8/2012	2/14/2012	2/15/2012	2/22/2012	2/29/2012	3/13/2012	3/21/2012	3/28/2012	4/4/2012	4/10/2012	4/11/2012	4/18/2012
pH (field)	pH units	6.5-9.5	8.36	8.34	8.58	8.41	8.71	9.18	8.21	9.49	8.93	8.02	8.21	8.74	9.45	8.73	8.62		7.32	7.92
Conductivity (field)	µS/cm		1201	1283	1262	1215	1220	1190	1152	1454	1193	1337	1258	1408	1371	1176	1091		1137	1027
Temperature (field)	C		0.7	0	0.7	0	0.5	0.2	0.6	3.1	0.4	0.3	0.1	1.8	1.1	2.8	2.1	3.9	2.6	18.8
Discharge (Flow)	L/s		4.81	3.81	2.33	2.33	2.5	2.73	2.2	2.68	2.67	2.56	2.56	5.35	3.64	5	5.1	5.54	6.84	6.36
Total Suspended Solids	mg/L	30	1.4	2.3	< 1	< 1	< 1	< 1	17.1	< 1	< 1	< 1	< 1	3.1	1.6	14.3	26	1.8	6.3	13.2
Turbidity (field)	NTU		2.4	2		0.3	1.2	0.7	2.3		0.7	0.4	1.6		1.6	11.5	15.2		4.9	8.4
Hardness (from total)	mg/L		629	700	707	685	636	675	628	726	653	685	712	727	756	666	584	396	653	529
Alkalinity, total	mg/L		42.5	50.5	31.4	31.1	26	21.3	28.3	20.4	22.4	54.7	47.9	38.7	20.1	67.7	74.9	48.7	75.7	73.3
Chloride	mg/L			43	41	41	41	39	40	44	50	46	38	58	60	61	58	82	89	71
Sulphate, dissolved	mg/L		628	659	592	595	658	668	651	650	631	617	614	636	656	509	455	471	509	495
Ammonia (N)	mg/L		1.9	2.2	3.4	3.2	2.8	3.6	2.6	3.5	4.7	2.3	2.9	2.7	2.9	2	1.5	0.096	1.5	1.6
Nitrite (N)	mg/L		0.85	1.09	1.14	1.15	1.57	1.52	1.19	1.55	1.85	1.01	1	0.83	1.28	1.01	0.71	0.67	0.7	0.575
Nitrate (N)	mg/L		2.88	3.27	5.11	4.69	5.19	5.93	4.32	5.67	7.58	3.39	4.07	3.08	4.49	3.21	2.02	1.74	1.14	1.3
Phosphate, total	mg/L		0.018	0.035	0.04	0.034	0.048	0.028	0.027	0.041	0.039	0.019	0.011	0.03	0.029	0.025	0.015	0.012	< 0.0020	0.0309
Dissolved Organic Carbon	mg/L		1.13	0.68	1.19	1.13	1.72	2.26	1.73	1.72	2.18	1.95	2.21	2.04	2.6	3.99	3	1.51	3.14	4.16
Aluminum (Al), total	mg/L		< 0.01	0.01	0.0038	< 0.01	< 0.01	< 0.01	0.05	0.01	< 0.01	< 0.01	< 0.01	0.0062	< 0.01	0.07	0.07	0.0066	< 0.01	0.024
Antimony (Sb), total	mg/L		0.0191	0.0206	0.024	0.0222	0.0204	0.0256	0.0223	0.0344	0.0303	0.0207	0.0282	0.0217	0.0215	0.0182	0.0177	0.0139	0.0125	0.0147
Arsenic (As), total	mg/L	1	0.0011	0.0014	0.00097	0.001	0.0015	0.0026	0.004	0.0047	0.0019	0.001	0.0012	0.00106	0.0014	0.0057	0.0063	0.00129	0.0016	0.00539
Barium (Ba), total	mg/L		0.01	0.012	0.00929	0.009	0.012	0.014	0.012	0.0148	0.015	0.011	0.012	0.0138	0.012	0.018	0.014	0.0053	0.016	0.0154
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0000	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0000	< 0.0002	< 0.0002	< 0.0002	< 0.0000	< 0.0002	< 0.0002
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.0000	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0000	< 0.001	< 0.001	< 0.001	< 0.0000	< 0.001	< 0.001	< 0.001	< 0.0000	< 0.001	< 0.001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	< 0.1	< 0.1	< 0.3	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1
Cadmium (Cd), total	mg/L		< 0.0001	0.0001	0.000033	< 0.0001	< 0.0001	< 0.0001	0.0009	0.00006	< 0.0001	< 0.0001	< 0.0001	0.000112	< 0.0001	0.0003	0.0006	0.000186	0.0003	0.00023
Calcium (Ca), total	mg/L		172	201	203	195	184	200	180	218	195	197	205	210	225	193	163	88.8	183	151
Chromium (Cr), total	mg/L		< 0.002	< 0.002	< 0.0001	< 0.002	0.003	0.004	< 0.002	0.001	< 0.002	< 0.002	< 0.002	0.0005	< 0.002	< 0.002	< 0.002	0.0002	< 0.002	< 0.002
Cobalt (Co), total	mg/L		< 0.0005	< 0.0005	0.000228	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0001	< 0.0005	< 0.0005	< 0.0005	0.000281	< 0.0005	0.0006	0.0006	0.000289	0.0008	0.00056
Copper (Cu), total	mg/L	0.6	< 0.001	< 0.001	0.00182	< 0.001	< 0.001	0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	0.00038	< 0.001	0.004	0.005	0.00147	0.002	0.0039
Iron (Fe), total	mg/L		0.11	0.21	0.038	0.05	0.11	0.14	1.05	0.171	0.14	0.06	0.06	0.307	0.32	3.87	5.19	0.696	1.7	3.85
Lead (Pb), total	mg/L	0.4	0.0082	0.0158	0.00123	0.0046	0.0092	0.0024	0.126	0.015	0.0076	0.003	0.0018	0.0144	0.0036	0.0222	0.0854	0.0216	0.0241	0.0415
Lithium (Li), total	mg/L		0.03	0.03	0.0358	0.04	0.03	0.03	0.03	0.039	0.03	0.03	0.04	0.0383	0.04	0.04	0.03	0.0512	0.04	0.044
Magnesium (Mg), total	mg/L		48	48	48.5	48	43	43	43	44.3	40	47	49	49.3	47	45	43	42.4	48	36.6
Manganese (Mn), total	mg/L		0.072	0.123	0.0495	0.077	0.071	0.027	0.12	0.0158	0.025	0.128	0.09	0.0989	0.014	0.081	0.107	0.0158	0.188	0.0843
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00005	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002
Molybdenum (Mo), total	mg/L		0.006	0.006	0.00547	0.005	0.008	0.008	0.006	0.0076	0.007	0.007	0.008	0.00775	0.009	0.01	0.008	0.00793	0.006	0.0103
Nickel (Ni), total	mg/L	1	0.004	0.007	0.00412	0.005	0.004	0.003	0.004	0.0014	0.002	0.006	0.006	0.0042	0.002	0.005	0.006	0.00246	0.006	0.0054
Phosphorous (P), total	mg/L		< 0.04	< 0.04	0.037	< 0.04	< 0.04	< 0.04	< 0.04	0.04	< 0.04	< 0.04	< 0.04	0.04	< 0.04	< 0.04	< 0.04	0.018	< 0.04	< 0.04
Potassium (K), total	mg/L		4	4	4.01	4	5	5	4	5.3	5	4	4	5.92	6	5	4	3.35	4	5.4
Radium-226	Bq/L	1.11								0.01										
Selenium (Se), total	mg/L		0.0012	0.001	0.00118	0.001	0.0012	0.0011	0.0009	0.0011	0.001	0.0009	< 0.0008	0.00105	0.001	0.0009	< 0.0008	0.00069	< 0.0008	< 0.0008
Silicon (Si), total	mg/L		3	3	2.7	2	3	5	3	2.8	3	3	3	3	3	3	3	2.3	2	4.03
Silver (Ag), total	mg/L		< 0.0001	0.0001	0.000007	< 0.0001	< 0.0001	< 0.0001	0.0008	0.00005	< 0.0001	< 0.0001	< 0.0001	0.000065	< 0.0001	0.0005	0.001	0.000025	0.0001	0.00033
Sodium (Na), total	mg/L		18	18	18.5	18	23	27	19	26.6	25	23	25	27.5	31	36	22	133	22	53.9
Strontium (Sr), total	mg/L		0.582	0.703	0.642	0.624	0.671	0.681	0.639	0.721	0.672	0.651	0.68	0.702	0.729	0.663	0.559	0.164	0.647	0.568
Sulphur (S), total	mg/L		223	219	255	207	197	199	190	220	211	214	221	260	246	198	159	181	172	165
Thallium (Tl), total	mg/L		0.0001	0.00011	0.000115	0.00011	0.00009	0.0001	0.00012	0.00008	0.00007	0.00009	0.00011	0.000108	0.00008	0.00005	0.00007	0.00001	0.00007	0.000066
Tin (Sn), total	mg/L		< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.005	< 0.005	< 0.005	0.0003	< 0.005	< 0.005	< 0.005	0.0008	< 0.005	< 0.005
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.003	< 0.01	< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01
Uranium (U), total	mg/L		0.0185	0.0146	0.0186	0.0181	0.0116	0.0101	0.0151	0.00254	0.0052	0.0171	0.0226	0.0129	0.0016	0.0129	0.0159	0.0139	0.0118	0.015
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	0.0009	< 0.005	< 0.005
Zinc (Zn), total	mg/L	1	< 0.01	0.01	0.0016	< 0.01	< 0.01	< 0.01	0.06	0.0072	< 0.01	< 0.01	< 0.01	0.009	< 0.01	0.03	0.06	0.0205	0.03	0.027
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0005	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002
LT50 % RT Mortality at 96 Hrs	%			0	0					10				0				0		
LC50 % RT Mortality at 96 Hrs	%	50		0	0					0				0				0		
LC50 [%] 50% RT Mortality	%			>100	>100					>100				>100				>100		
LC50 % DM Mortality at 48 Hrs	%	50			0					0				10				0		
LC50 [%] 50% DM Mortality	%				>100					>100				>100				>100		

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.3: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2012.

Analyte	Units	Limit [a]	Sample Date																	
			4/27/2012	5/2/2012	5/8/2012	5/16/2012	5/23/2012	5/30/2012	6/5/2012	6/13/2012	6/20/2012	6/27/2012	7/4/2012	7/8/2012	7/10/2012	7/11/2012	7/18/2012	7/25/2012	8/1/2012	8/7/2012
pH (field)	pH units	6.5-9.5	8.84	8.18	9.14	7.23	7.79	8.35	7.83	8.11	8.2	7.19	7.68	8.75	8.48	8.38	8.44	9.15	8.52	8.65
Conductivity (field)	µS/cm		1339	1350	794	1085	1123	1125	1465	1162	1148	1116	1067	1141	1231	1118	1146	1046	1142	1349
Temperature (field)	C		7.9	7.3	7.4	7.2	10	9.4	12.8	10.6	12.3	12.5	11	12.7	11.8	10	12.3	12.5	13.4	11.5
Discharge (Flow)	L/s		3.9	2.46	4.51	7.09	7.06	6.76	0.343		5.31	5.36	7.62		6.5	6.48	7.66	7.85	2.85	7
Total Suspended Solids	mg/L	30	19.6	8	< 1	1.5	< 1	1.5	1	< 1	2.1	2.2	< 1	1	< 1	< 1	< 1	1.6	8.8	11.8
Turbidity (field)	NTU		31.9	6.9		1.1		0.5				5.4	1.2			0.2		4	16.2	
Hardness (from total)	mg/L		583	602	657	563	483	590	666	530	533	556	510	483	562	491	506	466	492	659
Alkalinity, total	mg/L		79.3	75	22.8	70.9	36.5	29	36.2	25.5	48.2	68.2	39.4	31	36.5	34.2	28.5	17.2	69.2	69.3
Chloride	mg/L		110	140	150	93	92	85	86	63	65	66	77		75	73	78	100	89	120
Sulphate, dissolved	mg/L		488	431	425	391	428	477	513	417	408	385	403	353	424	393	416	356	434	396
Ammonia (N)	mg/L		0.091	0.16	0.91	0.8	0.86	0.9	0.55	2.1	1.6	2.6	19	1.3	1.6	1.4	3.1	0.79	1.1	1
Nitrite (N)	mg/L		0.292	0.326	0.311	0.353	0.354	0.423	0.603	0.918	1.02	0.713	0.728	0.639	0.741	0.662	0.812	0.767	0.698	0.411
Nitrate (N)	mg/L		1.08	3.27	1.46	1.43	1.37	1.15	5.18	5.14	3.78	4.34	4.08	2.47	2.8	2.71	5.62	4.37	3.49	1.68
Phosphate, total	mg/L		0.0161	0.0071	0.0058	0.0127	0.0078	0.0074	0.0092	0.0089	0.0176	0.0122	0.0118	0.0064	0.009	0.0053	0.013	0.0068	0.0093	0.0072
Dissolved Organic Carbon	mg/L		6.03	11.7	< 0.5	2.59	1.69	4.5	1.2	1.28	2.04	5.94	3.88	1.8	2.31	2.31	2.95	5.47	15.9	3.07
Aluminum (Al), total	mg/L		0.042	0.015	0.00503	< 0.01	< 0.01	< 0.01	0.00606	< 0.01	0.013	0.047	< 0.01	0.00519	0.00684	< 0.01	< 0.01	0.066	0.111	0.0371
Antimony (Sb), total	mg/L		0.00899	0.00765	0.00476	0.00871	0.00993	0.0106	0.00988	0.014	0.0149	0.00942	0.00839	0.0091	0.0103	0.00853	0.0114	0.00695	0.0107	0.00683
Arsenic (As), total	mg/L	1	0.00505	0.00214	0.000282	0.00051	< 0.0004	0.00044	0.000491	< 0.0004	0.00105	0.00128	< 0.0004	0.000357	0.000388	0.00056	0.00058	0.00076	0.00369	0.002
Barium (Ba), total	mg/L		0.003	0.0049	0.00876	0.0114	0.0115	0.009	0.00588	0.0025	0.0327	0.0283	0.0044	0.02	0.0177	0.016	0.0167	0.0023	0.0039	0.014
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0000	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.0000	< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05
Cadmium (Cd), total	mg/L		0.00031	0.00022	0.000075	0.00027	< 0.0001	< 0.0001	0.000155	< 0.0001	0.00022	0.00029	< 0.0001	0.000251	0.000202	0.00015	0.00018	0.00012	0.00036	0.000315
Calcium (Ca), total	mg/L		170	172	193	157	152	165	198	150	154	164	148	142	169	144	148	145	144	201
Chromium (Cr), total	mg/L		< 0.002	< 0.002	0.00025	< 0.002	< 0.002	< 0.002	0.00047	< 0.002	< 0.002	< 0.002	< 0.002	0.00019	0.00049	< 0.002	< 0.002	< 0.002	< 0.002	0.00104
Cobalt (Co), total	mg/L		0.00054	< 0.0005	0.000138	< 0.0005	< 0.0005	< 0.0005	0.000168	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.000209	0.00026	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.00043
Copper (Cu), total	mg/L	0.6	0.0063	0.003	0.000712	< 0.001	< 0.001	< 0.001	0.000467	< 0.001	0.0012	0.0015	0.001	0.00192	0.00123	0.0014	0.0014	0.0012	0.004	0.00232
Iron (Fe), total	mg/L		6.3	2.44	0.12	0.269	0.053	0.274	0.353	<0.020	0.816	1.64	0.022	0.0951	0.128	0.152	0.095	0.529	4.9	3.87
Lead (Pb), total	mg/L	0.4	0.0453	0.0216	0.00416	0.00651	0.00143	0.00342	0.0062	0.0012	0.0106	0.0122	0.0018	0.022	0.016	0.0105	0.0132	0.0103	0.037	0.0303
Lithium (Li), total	mg/L		0.034	0.04	0.0404	0.031	0.033	0.032	0.041	0.03	0.031	0.029	0.027	0.0279	0.0283	0.024	0.027	0.027	0.024	0.0313
Magnesium (Mg), total	mg/L		38.4	41.9	42.5	41.5	25.2	43	41.6	38	35.8	35.7	34.3	31	34.3	31.7	32.9	25.5	32.1	38.3
Manganese (Mn), total	mg/L		0.119	0.0542	0.0273	0.135	0.0322	0.0479	0.0815	0.0215	0.0626	0.17	0.0589	0.031	0.089	0.0405	0.0256	0.0108	0.0774	0.15
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001
Molybdenum (Mo), total	mg/L		0.0083	0.0059	0.00452	0.003	0.003	0.005	0.0059	0.0051	0.0063	0.0056	0.0044	0.00555	0.00674	0.0057	0.0073	0.0057	0.0053	0.00428
Nickel (Ni), total	mg/L	1	0.0044	0.0029	0.00127	0.0024	0.0013	0.0016	0.00279	0.0011	0.0019	0.004	0.0018	0.00132	0.00187	0.0022	0.0014	<0.0010	0.0036	0.00318
Phosphorous (P), total	mg/L		< 0.04	< 0.04	0.0076	< 0.04	< 0.04	< 0.04	0.0215	< 0.04	0.041	< 0.04	< 0.04	0.0148	0.0174	< 0.04	< 0.04	< 0.04	< 0.04	0.0055
Potassium (K), total	mg/L		3.4	6.5	3.41	2.5	2.3	3	12.1	4.6	3.3	3.1	4.5	3.51	3.79	3.1	3.8	2.9	4.4	2.7
Radium-226	Bq/L	1.11			<0.01										<0.01					
Selenium (Se), total	mg/L		< 0.0008	< 0.0008	0.000615	< 0.0008	< 0.0008	0.00178	0.0071	0.00382	0.00205	0.00173	0.0016	0.00203	0.00202	0.00176	0.00274	0.00292	0.00237	0.0024
Silicon (Si), total	mg/L		2.6	2.7	0.72	2.1	< 2.0000	< 2.0	2.56	< 2.0	< 2.0	2.9	2.3	1.48	1.97	< 2.0	< 2.0	< 2.0	2.7	1.92
Silver (Ag), total	mg/L		0.00087	0.00014	0.000009	< 0.0001	< 0.0001	< 0.0001	0.0000665	< 0.0001	< 0.0001	0.00013	< 0.0001	0.0000087	0.0000136	< 0.0001	< 0.0001	0.00011	0.00074	0.000196
Sodium (Na), total	mg/L		29.5	57.7	18	13.2	14.7	17.9	30.5	17.1	16.3	17.4	16.9	16.9	17.4	16.2	20	32.2	26.3	18.8
Strontium (Sr), total	mg/L		0.46	0.288	0.696	0.557	0.608	0.615	0.388	0.513	0.54	0.541	0.41	0.541	0.582	0.521	0.563	0.32	0.323	0.607
Sulphur (S), total	mg/L		147	163	168	134	123	164	204	150	161	144	138	144	158	133	148	140	128	152
Thallium (Tl), total	mg/L		< 0.0001	< 0.0001	0.000037	< 0.0001	< 0.0001	< 0.0001	0.0000225	< 0.00005	< 0.00005	0.000063	< 0.00005	0.0000426	0.0000564	< 0.00005	0.000059	< 0.00005	< 0.00005	0.000048
Tin (Sn), total	mg/L		0.0065	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	0.00041	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0002	0.00021	< 0.005	< 0.005	< 0.005	0.0065	0.00557
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.0005	< 0.0005	< 0.01	< 0.01	< 0.01	< 0.01	0.0007
Uranium (U), total	mg/L		0.0155	0.0129	0.00302	0.00467	0.00285	0.0068	0.00706	0.00525	0.00903	0.00839	0.00696	0.00553	0.00601	0.00538	0.00373	0.00121	0.00922	0.00939
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.005	0.0002
Zinc (Zn), total	mg/L	1	0.035	0.018	0.0045	0.013	< 0.01	< 0.01	0.0119	< 0.01	0.022	0.045	< 0.01	0.0201	0.0124	< 0.01	< 0.01	< 0.01	0.075	0.0493
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.0001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0001
LT50 % RT Mortality at 96 Hrs	%				0				0						0					0
LC50 % RT Mortality at 96 Hrs	%	50			0				0						0					0
LC50 [%] 50% RT Mortality	%				>100				>100						>100					>100
LC50 % DM Mortality at 48 Hrs	%	50			0				0						0					0
LC50 [%] 50% DM Mortality	%				>100				>100						>100					>100

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.3: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2012.

Analyte	Units	Limit [a]	Sample Date																	
			8/8/2012	8/15/2012	8/22/2012	8/29/2012	9/5/2012	9/12/2012	9/19/2012	9/25/2012	10/3/2012	10/10/2012	10/17/2012	10/21/2012	10/24/2012	10/31/2012	11/7/2012	11/14/2012	11/18/2012	11/20/2012
pH (field)	pH units	6.5-9.5	8.24	7.93	7.71	7.67	8.34	8.28	8.64	8.32	7.57	7.78	8.35	8.15		7.87	8.79	8.01	8.26	8.04
Conductivity (field)	µS/cm		1254	1395	1294	1238	1359	1240	1089	1160	1185	1228	1214	952		1227	1071	1471	1068	1091
Temperature (field)	C		12.9	11.7	10.1	7.8	8.7	4.7	5.5	7.4	3.3	1.6	4.2	1		2.8	2.8	1.6	1.3	2
Discharge (Flow)	L/s		7.59	8.42	7.92	6.67	6.53	6.49	6.79	3.68	6.15	6.07	4.34	3		4.8	3.61	1.77		3.75
Total Suspended Solids	mg/L	30	27.6	< 1	1.1	< 1	1.5	< 1	1.6	2.3	5.8	2.8	2	7.8	5.4	< 1	1.3	1.2	< 1	< 1
Turbidity (field)	NTU		14.7		1.2	1.8	1.1	2.49	2		2.7	1.8	1.7		0.8	0.5		2.1		
Hardness (from total)	mg/L		583	653	627	619	643	393	479	440	538	596	550	615	542	574	527	649	616	637
Alkalinity, total	mg/L		64.6	28.9	24.6	33	20.4	30.3	21.6	38.2	51.3	48.6	49.8	60.1	20.3	45.4	21.4	64.1	38.7	58.1
Chloride	mg/L		130	140	110	96	110	96	63	17	6.5	5.9	2.9	20	6.2	9.7	3	59	13	8
Sulphate, dissolved	mg/L		419	445	461	508	522	348	319	443	513	514	556	618	542	606	530	559	608	615
Ammonia (N)	mg/L		0.88	1.5	1.3	1.7	2.1	2.7	2.1	2.1	2.1	2	2.5	2.9	2.6	2.2	2.2	1.7	1.4	1.4
Nitrite (N)	mg/L		0.407	0.637	0.55	0.527	0.883	0.873	0.928	1.1	1.11	0.903	0.777	0.869	0.923	1.03	0.762	0.577	0.503	0.785
Nitrate (N)	mg/L		1.66	2.69	2.7	4.03	5.17	7	5.32	5.66	4.08	4.48	4.35	4.91	4.68	5.64	4.15	2.89	2.66	2.62
Phosphate, total	mg/L		0.011	0.0031	0.0043	0.0046	0.0197	0.0178	0.0087	0.0138	0.0185	0.0276	0.0228	0.0226	0.0182	0.0216	0.0192	0.007	0.0086	0.0112
Dissolved Organic Carbon	mg/L		3.5	1.57	3.41	3.78	0.92	1.59	2.82	2.23	1.28	0.75	1.5	0.84	1.84	0.65	0.5	1.49	0.99	0.83
Aluminum (Al), total	mg/L		0.064	0.011	0.023	0.016	0.029	0.017	0.014	0.0224	0.039	0.022	0.025	0.0421	0.02	0.012	0.019	0.015	0.00859	0.0234
Antimony (Sb), total	mg/L		0.00597	0.00448	0.00485	0.0085	0.0122	0.00965	0.011	0.0276	0.0304	0.0265	0.0345	0.0315	0.028	0.0282	0.0254	0.0256	0.02	0.0234
Arsenic (As), total	mg/L	1	0.0023	< 0.0004	< 0.0004	< 0.0004	0.00074	< 0.0004	0.00044	0.00534	0.0106	0.00985	0.0103	0.0121	0.00797	0.00849	0.0129	0.00926	0.00991	0.0116
Barium (Ba), total	mg/L		0.0127	0.0098	0.0068	0.0087	0.0106	0.0053	0.0082	0.00727	0.0078	0.0072	0.0099	0.0115	0.0096	0.0071	0.0064	0.0093	0.00825	0.0088
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.00001
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	0.000025	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00001	0.000011
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.05
Cadmium (Cd), total	mg/L		0.00037	< 0.0001	< 0.0001	< 0.0001	0.00023	< 0.0001	< 0.0001	0.000122	0.00064	0.0003	0.00032	0.000832	0.00015	< 0.0001	0.00014	0.00011	0.00007	0.000319
Calcium (Ca), total	mg/L		175	195	193	177	187	114	136	113	144	160	143	168	143	148	133	166	162	170
Chromium (Cr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.00034	< 0.002	< 0.002	< 0.002	0.00011	< 0.002	< 0.002	< 0.002	< 0.002	0.00077	0.00047
Cobalt (Co), total	mg/L		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.000302	0.00053	0.00069	0.0007	0.000787	< 0.0005	0.00079	< 0.0005	0.00075	0.00059	0.000753
Copper (Cu), total	mg/L	0.6	0.0041	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.00102	< 0.001	0.0015	< 0.001	0.00102	0.0012	< 0.001	< 0.001	< 0.001	0.000305	0.000561
Iron (Fe), total	mg/L		4.7	0.23	0.202	0.209	0.15	0.118	0.253	0.0443	0.178	0.087	0.106	0.235	0.106	<0.020	0.061	0.051	0.02	0.121
Lead (Pb), total	mg/L	0.4	0.0366	0.00311	0.00208	0.00652	0.0371	0.00838	0.00731	0.0207	0.121	0.0372	0.0457	0.14	0.0333	0.00469	0.0111	0.0167	0.007	0.0555
Lithium (Li), total	mg/L		0.028	0.035	0.034	0.03	0.036	0.018	0.023	0.0233	0.026	0.027	0.028	0.0297	0.028	0.027	0.029	0.025	0.027	0.028
Magnesium (Mg), total	mg/L		35.4	40.3	35.1	43.2	42.6	26.4	33.7	38.3	43.2	48	46.9	47.2	45.1	49.6	47.4	56.8	51.3	51.5
Manganese (Mn), total	mg/L		0.133	0.0809	0.048	0.16	0.0671	0.0395	0.0289	0.052	0.106	0.111	0.112	0.181	0.0375	0.146	0.0433	0.153	0.0832	0.141
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	0.00003	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00001	0.00001
Molybdenum (Mo), total	mg/L		0.004	0.0033	0.0042	0.0033	0.0054	0.0043	0.0051	0.007	0.0099	0.0071	0.0065	0.00604	0.0053	0.0059	0.0055	0.0053	0.00506	0.00576
Nickel (Ni), total	mg/L	1	0.0035	0.0014	<0.0010	0.0026	0.0012	0.0011	0.0012	0.00484	0.0075	0.0093	0.0088	0.00877	0.0035	0.0104	0.0043	0.0111	0.00794	0.0092
Phosphorous (P), total	mg/L		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.0119	< 0.04	< 0.04	< 0.04	0.0194	< 0.04	< 0.04	< 0.04	< 0.04	0.0087	0.0127
Potassium (K), total	mg/L		2.7	2.8	3.8	3.5	4.1	2.3	2.8	2.89	3.5	3.1	3.5	4.11	3.8	2.6	3	3.8	3.54	3.35
Radium-226	Bq/L	1.11												0.02					0.02	
Selenium (Se), total	mg/L		0.00243	0.00265	0.00224	0.00201	0.00229	0.00212	0.00227	0.00212	0.00221	0.00229	0.00172	0.00227	0.00182	0.00128	0.00116	< 0.0008	0.00118	0.0012
Silicon (Si), total	mg/L		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	3.57	4.3	4.2	4.2	4.61	4.1	4.1	5.1	5.2	5.44	4.55
Silver (Ag), total	mg/L		0.00083	< 0.0001	< 0.0001	< 0.0001	0.00024	< 0.0001	< 0.0001	0.000059	0.00018	0.00021	0.00046	0.000506	0.00021	< 0.0001	0.00013	< 0.0001	0.000011	0.000076
Sodium (Na), total	mg/L		18.8	15.7	17.3	16.9	19	30.4	18.7	30.7	23.7	23	18.8	28.2	20.4	28.6	19	68.2	26.6	24.2
Strontium (Sr), total	mg/L		0.56	0.652	0.601	0.587	0.624	0.378	0.469	0.451	0.558	0.609	0.593	0.592	0.562	0.506	0.493	0.504	0.551	0.6
Sulphur (S), total	mg/L		140	155	169	169	181	104	135	163	180	194	187	210	185	192	182	225	217	230
Thallium (Tl), total	mg/L		0.000054	0.000056	< 0.00005	0.000067	0.000071	< 0.00005	0.000065	0.000051	0.000068	0.000092	0.000098	0.000117	0.000083	0.000056	< 0.00005	0.000075	0.000068	0.000069
Tin (Sn), total	mg/L		0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.0002
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	< 0.01	0.00087	< 0.01	< 0.01	< 0.01	< 0.01	< 0.0005	0.00051
Uranium (U), total	mg/L		0.00791	0.0032	0.00207	0.00513	0.00268	0.00414	0.0045	0.0166	0.0169	0.0146	0.0171	0.0181	0.00825	0.0174	0.00949	0.0202	0.0189	0.0195
Vanadium (V), total	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	< 0.005	0.00055	< 0.005	< 0.005	< 0.005	< 0.005	0.00046	0.0004
Zinc (Zn), total	mg/L	1	0.058	< 0.01	< 0.01	< 0.01	0.016	< 0.01	< 0.01	0.00914	0.05	0.027	0.024	0.0606	0.014	< 0.01	0.01	0.014	0.00599	0.0235
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	< 0.002	0.0001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0001	< 0.0001
LT50 % RT Mortality at 96 Hrs	%									0				20						0
LC50 % RT Mortality at 96 Hrs	%	50								0				30						0
LC50 [%] 50% RT Mortality	%									>100				>100						>100
LC50 % DM Mortality at 48 Hrs	%	50								10				0						0
LC50 [%] 50% DM Mortality	%									>100				>100						>100

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.3: Final effluent monitoring data (Station KV-43) for the Bellekeno Mine, 2012.

Analyte	Units	Limit [a]	Sample Date					Mean	Minimum	Maximum
			11/28/2012	12/5/2012	12/11/2012	12/19/2012	12/26/2012			
pH (field)	pH units	6.5-9.5	7.92	8.04	7.69	8.29	7.55	8.27	7.19	9.49
Conductivity (field)	µS/cm		1349	1279	1291	1223	1262	1208.11	794.00	1471
Temperature (field)	C		1.2	2	1.98	1.5	1.9	5.69	0.00	18.8
Discharge (Flow)	L/s		3.23	3.1	2.54	2.43	3.32	4.73	0.34	8.42
Total Suspended Solids	mg/L	30	1.6	< 1	< 1	1.4	1.7	3.97	1.00	27.6
Turbidity (field)	NTU		3.4					4.36	0.20	31.9
Hardness (from total)	mg/L		669	634	550	661	662	596	393	756
Alkalinity, total	mg/L		58.6	40.8	43.3	69.1	75.8	44.1	17.2	79.3
Chloride	mg/L		2.9	2.4	3		2.9	60.2	2.4	150.0
Sulphate, dissolved	mg/L		619	594	607	602	585	515	319	668
Ammonia (N)	mg/L		1.4	1.4	1.4	1.4	1.3	2.16	0.09	19
Nitrite (N)	mg/L		0.535	0.521	0.516	0.57	0.534	0.80	0.29	1.85
Nitrate (N)	mg/L		2.28	1.77	2.4	2.22	1.83	3.55	1.08	7.58
Phosphate, total	mg/L		0.0054	0.0097	0.0102	0.0131	0.0165	0.02	0.00	0.048
Dissolved Organic Carbon	mg/L		1.73	0.93	0.89	<0.50	0.73	2.56	0.50	15.9
Aluminum (Al), total	mg/L		0.013	0.014	0.0137	0.029	0.016	0.02	0.00	0.111
Antimony (Sb), total	mg/L		0.0289	0.0274	0.0313	0.0291	0.0258	0.02	0.00	0.0345
Arsenic (As), total	mg/L	1	0.0117	0.0107	0.0176	0.0148	0.012	0.00	0.00	0.0176
Barium (Ba), total	mg/L		0.0069	0.0069	0.00571	0.0093	0.0101	0.01	0.00	0.0327
Beryllium (Be), total	mg/L		< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	0.00	0.00	0.0002
Bismuth (Bi), total	mg/L		< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	0.00	0.00	0.001
Boron (B), total	mg/L		< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	0.11	0.05	0.5
Cadmium (Cd), total	mg/L		0.00015	0.00011	0.000191	0.00031	0.00022	0.00	0.00	0.0009
Calcium (Ca), total	mg/L		176	166	145	178	178	168.64	88.80	225
Chromium (Cr), total	mg/L		< 0.002	< 0.002	0.00053	< 0.002	< 0.002	0.00	0.00	0.004
Cobalt (Co), total	mg/L		0.00081	0.00062	0.000499	0.00079	0.0007	0.00	0.00	0.00081
Copper (Cu), total	mg/L	0.6	< 0.001	< 0.001	0.000327	< 0.001	< 0.001	0.00	0.00	0.0063
Iron (Fe), total	mg/L		0.034	0.035	0.0447	0.079	0.057	0.83	0.02	6.3
Lead (Pb), total	mg/L	0.4	0.0164	0.00987	0.0165	0.0222	0.0229	0.02	0.00	0.14
Lithium (Li), total	mg/L		0.028	0.029	0.0267	0.03	0.03	0.03	0.02	0.0512
Magnesium (Mg), total	mg/L		55.7	53.2	46	52.4	52.7	42.35	25.20	56.8
Manganese (Mn), total	mg/L		0.129	0.0906	0.0839	0.147	0.107	0.08	0.01	0.188
Mercury (Hg), total	mg/L		< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	0.00	0.00	0.0002
Molybdenum (Mo), total	mg/L		0.0059	0.0067	0.00507	0.0059	0.0061	0.01	0.00	0.0103
Nickel (Ni), total	mg/L	1	0.0108	0.0111	0.00759	0.0115	0.0104	0.00	0.00	0.0115
Phosphorous (P), total	mg/L		< 0.04	< 0.04	0.0067	< 0.04	< 0.04	0.03	0.01	0.041
Potassium (K), total	mg/L		3.4	3.8	3.52	4	4	3.95	2.30	12.1
Radium-226	Bq/L	1.11						0.02	0.01	0.02
Selenium (Se), total	mg/L		0.00112	0.00112	0.00104	0.00081	0.00085	0.00	0.00	0.0071
Silicon (Si), total	mg/L		5.1	5.6	4.28	5.5	5.5	3.07	0.72	5.6
Silver (Ag), total	mg/L		< 0.0001	< 0.0001	0.000074	0.00011	0.00014	0.00	0.00	0.001
Sodium (Na), total	mg/L		21	22.2	18	21.2	20.8	25.68	13.20	133
Strontium (Sr), total	mg/L		0.645	0.632	0.592	0.675	0.682	0.57	0.16	0.729
Sulphur (S), total	mg/L		218	212	215	216	225	182.03	104.00	260
Thallium (Tl), total	mg/L		< 0.00005	< 0.00005	0.000036	0.000072	0.000056	0.00	0.00	0.00012
Tin (Sn), total	mg/L		< 0.005	< 0.005	< 0.0002	< 0.005	< 0.005	0.00	0.00	0.007
Titanium (Ti), total	mg/L		< 0.01	< 0.01	< 0.0005	< 0.01	< 0.01	0.01	0.00	0.01
Uranium (U), total	mg/L		0.0238	0.0196	0.0216	0.0225	0.0241	0.01	0.00	0.0241
Vanadium (V), total	mg/L		< 0.005	< 0.005	0.00064	< 0.005	< 0.005	0.00	0.00	0.005
Zinc (Zn), total	mg/L	1	0.014	0.012	0.0145	0.027	0.02	0.02	0.00	0.075
Zirconium (Zr), total	mg/L		< 0.002	< 0.002	< 0.0001	< 0.002	< 0.002	0.00	0.00	0.002
LT50 % RT Mortality at 96 Hrs	%				0			2.31	0.00	20
LC50 % RT Mortality at 96 Hrs	%	50			0			2.31	0.00	30
LC50 [%] 50% RT Mortality	%				>100			>100	0.00	0
LC50 % DM Mortality at 48 Hrs	%	50			0			1.67	0.00	10
LC50 [%] 50% DM Mortality	%				>100			>100	0.00	0

[a] Metal Mining Effluent Regulations (MMER) maximum authorized concentration in a grab sample

[b] Mean annual value. In cases where concentration was less than the reportable detection limit (RDL), the RDL was used to calculate the mean.

Table B.4: *In-situ* water quality measurements collected at benthic invertebrate community stations, Bellekeno Mine Cycle 1 EEM, August 25th and 26th, 2012

Lightning Creek Study Area	Station	Temperature (^oC)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (uS/cm)
Pristine Reference (REF1)	Ref 1-1	5.3	10.93	86.2	7.50	140.7
	Ref 1-2	5.4	11.16	88.3	7.52	140.9
	Ref 1-3	5.5	11.04	87.7	7.52	140.9
	Ref 1-4	5.6	11.15	88.6	7.47	140.7
	Ref 1-5	5.6	11.15	88.7	7.53	141.6
	Mean	5.5	11.09	87.9	7.51	141.0
	St. Deviation	0.1	0.10	1.0	0.02	0.4
Placer-Influenced Reference (REF2)	Ref 2-1	5.7	11.57	92.3	7.89	178.9
	Ref 2-2	5.7	11.55	92.4	7.85	178.9
	Ref 2-3	5.6	11.46	91.1	7.78	179.0
	Ref 2-4	5.5	11.43	90.6	7.72	179.1
	Ref 2-5	5.5	11.26	89.3	7.70	177.8
	Mean	5.6	11.45	91.1	7.79	178.7
	St. Deviation	0.1	0.12	1.3	0.08	0.5
Effluent-Exposed (EXP)	Exp-1	5.7	11.50	91.4	8.24	199.9
	Exp-2	5.7	11.58	92.6	7.90	200.4
	Exp-3	5.7	11.35	90.7	7.92	200.5
	Exp-4	5.8	11.47	91.6	7.85	200.6
	Exp-5	5.8	11.48	91.8	7.87	217.0
	Mean	5.7	11.48	91.6	7.96	203.7
	St. Deviation	0.1	0.08	0.7	0.16	7.5

Table B.5: Summary of in-situ water quality statistical comparisons among areas for data collected during the benthic invertebrate community survey on 25th and 26th August 2012, BelleKeno Mine Cycle 1 EEM.

Metric	Area	Mean	Overall 3-group test			Pair-wise comparisons				
			Significant Difference Among Areas?	***p*-value**	**Test**	**(I) Area**	**(J) Area**	**Significant Difference Between**	***p*-value**	**Test Type**
Temperature (˚C)	REF1	5.48	Yes	0.011	Kruskal-Wallis	REF1	REF2	No	0.222	Mann-Whitney
	REF2	5.60				REF1	EXP	Yes	0.008	
	EXP	5.74				REF2	EXP	No	0.056	
Dissolved Oxygen (mg/L)	REF1	11.09	Yes	0.000	ANOVA	REF1	REF2	Yes	0.000	Tukey's
	REF2	11.45				REF1	EXP	Yes	0.000	
	EXP	11.48				REF2	EXP	No	0.940	
Dissolved Oxygen (% Sat.)	REF1	87.90	Yes	0.000	ANOVA	REF1	REF2	Yes	0.001	Tukey's
	REF2	91.14				REF1	EXP	Yes	0.000	
	EXP	91.62				REF2	EXP	No	0.747	
pH	REF1	7.51	Yes	0.003	Kruskal-Wallis	REF1	REF2	Yes	0.008	Mann-Whitney
	REF2	7.79				REF1	EXP	Yes	0.008	
	EXP	7.96				REF2	EXP	No	0.032	
Specific Conductance (uS/cm)	REF1	140.96	Yes	0.002	Kruskal-Wallis	REF1	REF2	Yes	0.008	Mann-Whitney
	REF2	178.74				REF1	EXP	Yes	0.008	
	EXP	203.68				REF2	EXP	Yes	0.008	

Highlighted values indicate significant difference at p-value less than 0.10

Table B.6: Effluent concentration predictions for the Lightning Creek effluent-exposed area based on specific conductance measurements collected from September 2010 to December 2012 and during the benthic invertebrate community survey in August 2012.

Sample Period	Average Specific Conductance ($\mu S \cdot cm^{-1}$)			Predicted Effluent Concentration (%)
	Final Effluent	Reference Area 2	Effluent-Exposed Area	
September 2010 to December 2012	1,209.7	173.1	205.6	3.14%
August 2012 [a]	1,266.0	178.7	203.7	2.30%

[a] Effluent specific conductance bracketed field sampling program, including measurements from August 22 [nd] and 29[th].

Appendix Table B.7: Receiving environment water quality monitoring data for 2010 at Bellekeno Mine.

Analyte	Units	Guideline [a]	Pristine Reference (REF1) KV-37				Placer-Influenced Reference (REF2) KV-38				Effluent-Exposed Area (EXP) KV-41							
			Sample Date				Sample Date				Sample Date							
			2/10/2010	5/27/2010	7/8/2010	10/6/2010	2/10/2010	5/27/2010	7/8/2010	10/6/2010	1/12/2010	2/10/2010	3/11/2010	4/8/2010	5/3/2010	6/8/2010	7/6/2010	8/4/2010
Arsenic (As), total	mg/L	0.005	0.00249	0.00251	0.00251	0.00223	0.00242	0.00364	0.00272	0.0025	0.00126	0.00097	0.00091	0.00112	0.00206	0.002	0.00222	0.00174
Copper (Cu), total	mg/L	0.002 - 0.004*	0.00028	0.0009	0.0006	0.00036	0.00028	0.00119	0.00044	0.00026	0.00066	0.00036	0.00031	0.00073	0.00225	0.00127	0.00195	0.00311
Lead (Pb), total	mg/L	0.001 - 0.007*	0.000129	0.000364	0.000364	0.000266	0.000159	0.00202	0.00033	0.00019	0.00134	0.00072	0.00050	0.00083	0.00375	0.00121	0.00256	0.00085
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.00022	0.00049	0.00049	0.00028	0.00021	0.00056	0.00042	0.00032	0.00061	0.00032	0.00037	0.00056	0.00119	0.00075	0.00114	0.00064
Zinc (Zn), total	mg/L	0.03	0.0024	0.0014	0.0014	0.0019	0.0037	0.0203	0.0126	0.0132	0.0141	0.0127	0.0136	0.0149	0.0145	0.0109	0.0204	0.0112
Total Suspended Solids	mg/L	-	< 1.0	3	3	1	< 1.0	7	2	< 1.0	10	4	2	2	31	12	18	15
pH (field)	pH units	6.5-9.0	7.96	7.43	8	7.83	8.04	-	7.9	7.97	8.1	7.75	8.2	8.17	7.94	7.91	8.26	8.07
Aluminum (Al), total	mg/L	0.100	0.009	0.036	0.036	0.007	0.005	0.055	0.013	0.006	0.063	0.023	0.017	0.027	0.197	0.133	0.230	0.122
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000007	0.000017	0.000017	0.000015	0.000033	0.000242	0.000172	0.000142	0.000057	0.000054	0.000041	0.000049	0.000161	0.000113	0.000267	0.000122
Iron (Fe), total	mg/L	0.3	0.034	0.084	0.084	0.038	0.020	0.126	0.046	0.032	0.116	0.040	0.030	0.048	0.360	0.175	0.345	0.140
Mercury (Hg), total	mg/L	0.00010	< 0.00001	< 0.00001	< 0.00001	0.000005	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00001	0.000005	0.00001	0.000005	-	0.000005	0.000005	0.00002
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.00016	0.00008	0.00008	0.00013	0.00024	0.00013	0.00014	0.00022	0.0002	0.0002	0.00023	0.00023	0.00025	0.00017	0.0002	0.00022
Selenium (Se), total	mg/L	0.001	0.0005	0.0003	0.0003	0.0005	0.0006	0.0003	0.0005	0.0006	0.0010	0.0009	0.0010	0.0011	0.0007	0.0004	0.0005	0.0007
Ammonia (N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.025
Nitrate (N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, total	mg/L	-	-	-	-	34	-	-	-	38	-	-	-	-	-	-	-	-
Hardness (from total)	mg/L	-	61	34.1	34.1	61.9	77.7	40	68	76.1	115	121	116	117	81.1	57	74.3	91.8
Specific Conductivity (field)	µS/cm		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous (P), total	mg/L	0.030 [ON]	-	-	-	-	0.009	0.015	0.004	-	-	-	-	-	-	-	-	-
Sulphate, dissolved	mg/L	-	-	-	-	-	32	-	-	50	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon	mg/L	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Antimony (Sb), total	mg/L	0.0200 [BC]	-	-	-	-	0.00022	0.00027	0.00027	0.00025	-	-	-	-	-	-	-	-
Boron (B), total	mg/L	0.2 [ON]	-	-	-	-	< 0.05	< 0.05	< 0.05	< 0.05	-	-	-	-	-	-	-	-
Calcium (Ca), total	mg/L	-	-	-	-	-	23.9	12.1	20.4	22.9	-	-	-	-	-	-	-	-
Chromium (Cr), total	mg/L	0.0089	0.0005	0.0002	0.0002	0.0006	0.0003	0.0003	0.0004	0.0004	0.0004	0.0003	0.0003	0.0004	0.0005	0.0005	0.0008	0.0006
Cobalt (Co), total	mg/L	0.0009 [ON]	-	-	-	-	0.00002	0.000104	0.000037	0.000026	-	-	-	-	-	-	-	-
Lithium (Li), total	mg/L	-	-	-	-	-	0.001	<0.0005	0.0007	0.0011	-	-	-	-	-	-	-	-
Magnesium (Mg), total	mg/L	-	-	-	-	-	4.36	2.4	4.16	4.58	-	-	-	-	-	-	-	-
Manganese (Mn), total	mg/L	-	-	-	-	-	0.0037	0.0143	0.00779	0.00785	-	-	-	-	-	-	-	-
Potassium (K), total	mg/L	-	-	-	-	-	0.19	0.15	0.08	0.15	-	-	-	-	-	-	-	-
Silicon (Si), total	mg/L	-	-	-	-	-	4.13	1.59	2.03	3.05	-	-	-	-	-	-	-	-
Silver (Ag), total	mg/L	0.0001	< 0.000005	0.000012	0.000012	0.000003	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000015	0.000003	0.000008	0.000003	0.00002	0.000006	0.000045	0.000023
Sodium (Na), total	mg/L	-	-	-	-	-	1.13	0.38	0.58	0.91	-	-	-	-	-	-	-	-
Strontium (Sr), total	mg/L	-	-	-	-	-	0.0735	0.0426	0.0693	0.0821	-	-	-	-	-	-	-	-
Sulphur (S), total	mg/L	-	-	-	-	-	13	<10	14	15	-	-	-	-	-	-	-	-
Thallium (Tl), total	mg/L	0.0003 [BC]	< 0.000002	< 0.000002	< 0.000002	0.000001	< 0.000002	< 0.000002	< 0.000002	< 0.000002	0.000001	0.000001	0.000001	0.000001	0.000003	0.000003	0.000005	0.000002
Uranium (U), total	mg/L	0.005 [BC]	-	-	-	-	0.000226	0.000079	0.000104	0.000159	-	-	-	-	-	-	-	-
Vanadium (V), total	mg/L	0.006 [BC]	-	-	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-	-	-	-	-	-	-	-

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

Appendix Table B.7: Receiving environment water quality monitoring data for 2010 at Bellekeno Mine.

Analyte	Units	Guideline [a]	Effluent-Exposed Area (EXP) KV-41 (con't)				Hope Gulch KV-39			Charity Gulch KV-40			Thunder Gulch KV-76		
			Sample Date				Sample Date			Sample Date			Sample Date		
			9/14/2010	10/5/2010	11/16/2010	12/7/2010	5/27/2010	7/8/2010	10/6/2010	10/10/2012	5/27/2010	7/8/2010	2/10/2010	7/6/2010	10/6/2010
Arsenic (As), total	mg/L	0.005	0.00149	0.00123	0.00074	0.00102	0.00938	0.00851	0.00806	0.00895	0.000426	0.000944	0.00051	0.00156	0.00045
Copper (Cu), total	mg/L	0.002 - 0.004*	0.00079	0.0005	0.00028	0.00052	0.00235	0.00053	0.00041	0.000319	0.00669	0.000921	0.00049	0.00151	0.00041
Lead (Pb), total	mg/L	0.001 - 0.007*	0.00069	0.00062	0.00031	0.00106	0.00531	0.00097	0.00173	0.00048	0.00057	0.00049	0.00072	0.00897	0.00056
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.00058	0.00049	0.00038	0.00049	0.00104	0.0009	0.00098	0.000751	0.00384	0.001	0.00032	0.00073	0.0003
Zinc (Zn), total	mg/L	0.03	0.0099	0.0085	0.0074	0.0076	0.133	0.158	0.191	0.152	0.00719	0.00352	0.006	0.0167	0.005
Total Suspended Solids	mg/L	-	5	4	0.5	6	9	1	< 1.0	< 1.0	< 1.0	< 1.0	8	23	6
pH (field)	pH units	6.5-9.0	6.82	8.03	7.05	8.25	7.87	8.13	7.95	7.5	7.9	7.81	8.19	8.33	8.08
Aluminum (Al), total	mg/L	0.100	0.079	0.043	0.012	0.034	0.077	0.011	0.013	0.006	0.100	0.010	0.027	0.121	0.027
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000111	0.000082	0.00006	0.000047	0.00153	0.00229	0.00254	0.00198	0.000078	0.0000412	0.000074	0.000342	0.000065
Iron (Fe), total	mg/L	0.3	0.103	0.064	0.027	0.067	0.140	0.017	0.024	0.009	0.051	0.008	0.042	0.233	0.031
Mercury (Hg), total	mg/L	0.00010	0.00001	0.000005	0.000005	0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.00024	0.00023	0.0003	0.00025	0.00024	0.00038	0.00043	0.00037	0.000057	0.000085	0.00028	0.0002	0.00024
Selenium (Se), total	mg/L	0.001	0.0007	0.0008	0.0009	0.0008	0.0004	0.0008	0.0012	0.0012	0.0001	0.0016	0.0008	0.0005	0.0008
Ammonia (N)	mg/L	-	0.0025	0.009	0.056	0.12	-	-	-	-	0.019	-	0.01	0.05	-
Nitrate (N)	mg/L	-	0.1	0.17	0.22	0.23	-	-	-	-	-	-	-	-	-
Alkalinity, total	mg/L	-	48	49	55	53	-	-	58	54.1	16.1	36.7	-	-	66
Hardness (from total)	mg/L	-	97.4	99.4	114	109	57.5	113	163	146	32.1	187	168	71.9	102
Specific Conductivity (field)	µS/cm		-	-	-	-	-	-	-	365.9	67.6	421	312	93.1	119
Phosphorous (P), total	mg/L	0.030 [ON]	-	-	-	-	0.023	0.005	-	0.0055	0.0121	0.0065	0.021	0.021	-
Sulphate, dissolved	mg/L	-	-	-	-	-	33	82	120	107	13.8	139	68	-	44
Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon	mg/L	-	-	-	-	-	-	-	0.7	1.85	9.83	0.56	-	-	0.9
Antimony (Sb), total	mg/L	0.0200 [BC]	-	-	-	-	0.00125	0.00168	0.00154	0.00143	0.000121	0.000099	0.00012	0.00036	0.00011
Boron (B), total	mg/L	0.2 [ON]	-	-	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	-	-	-	-	17.5	32.9	48.5	45	8.21	51.4	54.8	22.5	32
Chromium (Cr), total	mg/L	0.0089	0.0006	0.0003	0.0004	0.0002	0.0003	0.0003	0.0004	<0.00010	0.00012	0.00013	0.0003	0.0006	0.0004
Cobalt (Co), total	mg/L	0.0009 [ON]	-	-	-	-	0.000154	0.000023	0.000026	0.000013	0.000149	0.0000337	0.00004	0.000224	0.000044
Lithium (Li), total	mg/L	-	-	-	-	-	0.0014	0.0023	0.0027	0.00203	0.0013	0.00205	0.0028	0.002	0.0025
Magnesium (Mg), total	mg/L	-	-	-	-	-	3.33	7.42	10.2	8.24	2.81	14.2	7.58	3.84	5.37
Manganese (Mn), total	mg/L	-	-	-	-	-	0.019	0.00189	0.00283	0.00166	0.0173	0.00236	0.00407	0.0249	0.00392
Potassium (K), total	mg/L	-	-	-	-	-	0.17	0.18	0.19	0.216	1.3	0.141	0.16	0.13	0.12
Silicon (Si), total	mg/L	-	-	-	-	-	1.73	2.2	2.88	3.16	1.46	3.2	3.5	2.67	2.79
Silver (Ag), total	mg/L	0.0001	0.000015	0.000015	0.000003	0.000003	0.000032	< 0.000005	0.000014	0.000008	0.000026	< 0.000005	< 0.000005	0.000291	0.000006
Sodium (Na), total	mg/L	-	-	-	-	-	0.47	0.95	1.29	1.09	0.217	0.934	0.81	0.56	0.69
Strontium (Sr), total	mg/L	-	-	-	-	-	0.0574	0.125	0.155	0.134	0.0323	0.164	0.115	0.0641	0.0869
Sulphur (S), total	mg/L	-	-	-	-	-	12	28	39	39	< 10.0	52	27	< 10.0	< 15.0
Thallium (Tl), total	mg/L	0.0003 [BC]	0.000002	0.000001	0.000001	0.000001	0.000002	0.000002	0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	0.000005	0.000002
Uranium (U), total	mg/L	0.005 [BC]	-	-	-	-	0.000173	0.000482	0.000968	0.000704	0.000058	0.0000349	0.00145	0.000356	0.000671
Vanadium (V), total	mg/L	0.006 [BC]	-	-	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0004	0.0002

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent

Appendix Table B.8: Receiving environment water quality monitoring data for 2011 at the Bellekeno Mine.

Analyte	Units	Guideline [a]	Lightning Creek - Pristine Reference (REF1) KV-37								Lightning Creek - Placer-Influenced Reference (REF2) KV-38					Lightning Creek - Effluent-Exposed (EXP) KV-41					
			Sample Date								Sample Date					Sample Date					
			2/8/2011	5/25/2011	7/14/2011	9/17/2011	10/30/2011	11/22/2011	12/18/2011	12/18/2011	2/8/2011	5/25/2011	7/14/2011	10/30/2011	12/18/2011	1/12/2011	2/8/2011	3/22/2011	4/19/2011	5/13/2011	6/21/2011
Arsenic (As), total	mg/L	0.005	0.0027	0.0034	0.0022	0.0025	0.0024	0.0025	0.0027	0.0029	0.0025	0.0050	0.0031	0.0023	0.0026	0.0010	0.0009	0.0010	0.0009	0.0010	0.0036
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0004	0.0013	0.0009	0.0004	0.0003	0.0001	0.0003	0.0003	0.0001	0.0016	0.0013	0.0002	0.0003	0.0007	0.0003	0.0005	0.0004	0.0008	0.0060
Lead (Pb), total	mg/L	0.001 - 0.007*	0.00028	0.00228	0.00011	0.00079	0.00004	0.00010	< 0.0002	0.00005	0.00019	0.01030	0.00130	0.00023	0.00010	0.00196	0.00053	0.00083	0.00053	0.00083	0.00509
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0007	0.0007	0.0005	0.0002	0.0002	0.0001	< 0.001	0.0002	0.0003	0.0009	0.0006	0.0002	0.0003	0.0005	0.0004	0.0004	0.0004	0.0005	0.0036
Zinc (Zn), total	mg/L	0.03	0.001	0.005	0.001	0.002	0.001	0.001	< 0.005	0.001	0.007	0.067	0.026	0.008	0.008	0.011	0.008	0.008	0.007	0.009	0.017
Total Suspended Solids	mg/L	-	2	11	1	< 1.0	< 1.0	< 1.0	1	< 1.0	1	13	3	< 1.0	<1.0	4	3	4	1	2	70
pH (field)	pH units	6.5-9.0	7.98	7.75	7.71	7.88	7.72	8.06	-	7.4	8.12	7.73	7.75	7.86	7.56	7.98	7.97	8.11	-	7.92	8.52
Aluminum (Al), total	mg/L	0.100	0.008	0.071	0.029	0.011	0.009	0.005	0.010	0.005	0.004	0.077	0.039	0.006	0.004	0.032	0.021	0.030	0.018	0.039	0.890
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000008	0.000067	0.000012	0.000025	0.000008	0.000007	0.00002	0.000009	0.00007	0.000784	0.000291	0.000089	0.000077	0.000081	0.000044	0.000051	0.00005	0.000069	0.000193
Iron (Fe), total	mg/L	0.3	0.047	0.165	0.059	0.055	0.043	0.042	0.065	0.053	0.030	0.202	0.072	0.021	0.018	0.075	0.037	0.067	0.034	0.058	1.480
Mercury (Hg), total	mg/L	0.00010	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00005	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.00015	0.00008	0.00009	0.00011	0.00013	0.00011	< 0.001	0.00015	0.00025	0.00011	0.00013	0.00017	0.00021	0.0003	0.00024	0.00025	0.00025	0.00026	0.00024
Selenium (Se), total	mg/L	0.001	0.0005	0.0003	0.0004	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0003	0.0004	0.0008	0.0008	0.0009	0.0009	0.0010	0.0011	0.0008	0.0005
Ammonia (N)	mg/L	-	-	-	-	0.01	-	-	0.0076	-	-	-	-	-	-	< 0.005	0.014	0.013	0.007	0.008	0.032
Nitrate (N)	mg/L	-	-	-	-	0.07	< 0.2	0.143	0.155	-	-	-	-	< 0.2	-	0.26	0.33	0.27	0.21	0.23	< 0.0
Alkalinity, total	mg/L	-	38	11	26	34	33	-	35.7	-	44	12	26	41	-	52	54	60	60	55	33
Hardness (from total)	mg/L	-	58	27.8	53.8	63.8	62.7	60.2	63.5	58.4	77.7	34.3	61	87	82.6	123	118	127	127	116	69.4
Specific Conductivity (field)	µS/cm		-	-	112	171	141.6	-	-	-	-	-	128	185.3	182.5	-	-	-	-	-	-
Phosphorous (P), total	mg/L	0.030 [ON]	0.007	0.019	0.005	0.007	0.004	0.005	< 0.01	0.006	0.007	0.029	0.008	0.003	0.004	0.019	0.007	0.007	0.006	0.005	0.064
Sulphate, dissolved	mg/L	-	29	18	30	32.1	27.6	27.9	23.8	29.7	40	22	31	40.8	43.4	69	64	70	67	59	35
Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	0.3	0.185	-	-	-	-	-	0.2	-	-	-	-	-	-	-
Dissolved Organic Carbon	mg/L	-	1	4.6	2.7	< 0.5	1.1	0.62	0.67	-	< 0.5	4.6	2.8	0.9	-	0.6	0.6	0.5	1.1	2.1	1.3
Antimony (Sb), total	mg/L	0.0200 [BC]	0.00007	0.0001	0.00012	0.00009	0.00009	0.00008	< 0.0005	0.00007	0.00024	0.00043	0.00039	0.00025	0.00022	0.00036	0.0003	0.00024	0.00023	0.0003	0.00032
Boron (B), total	mg/L	0.2 [ON]	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	18.1	8.31	16.2	19.7	19	18.4	19.3	17.5	24.1	10.4	18.6	27.4	25.2	38.3	37	39.5	39.7	36.2	20.9
Chromium (Cr), total	mg/L	0.0089	0.0003	0.0004	0.0003	0.0001	0.0001	< 0.0001	0.001	0.0002	0.0004	0.0003	0.0004	< 0.0001	0.0002	0.0008	0.0004	0.0005	0.0004	0.0004	0.0024
Cobalt (Co), total	mg/L	0.0009 [ON]	0.00002	0.00012	0.00004	0.00003	0.00002	0.00002	< 0.0005	0.00002	0.00002	0.00015	0.00005	0.00001	0.00001	0.00010	0.00007	0.00012	0.00006	0.00005	0.00129
Lithium (Li), total	mg/L	-	0.0008	< 0.0005	< 0.0005	0.0006	0.0008	0.0008	< 0.005	0.0008	0.0011	< 0.0005	0.0007	0.0011	0.0011	0.0018	0.0018	0.0017	0.0015	0.0016	0.0017
Magnesium (Mg), total	mg/L	-	3.13	1.72	3.23	3.57	3.67	3.5	3.72	3.57	4.28	2.03	3.55	4.55	4.79	6.59	6.15	6.86	6.77	6.35	4.2
Manganese (Mn), total	mg/L	-	0.00554	0.0193	0.00695	0.00925	0.00731	0.00698	0.008	0.00675	0.00483	0.032	0.00896	0.00389	0.00277	0.0113	0.00566	0.0122	0.0064	0.0059	0.0684
Potassium (K), total	mg/L	-	0.18	0.33	<0.05	0.12	0.16	0.17	0.165	0.17	0.17	0.32	0.12	0.16	0.16	0.22	0.2	0.2	0.2	0.23	<0.3
Silicon (Si), total	mg/L	-	3.84	1.34	2.04	2.8	3.5	3.6	3.91	3.5	3.57	1.46	2.21	3.6	3.4	3.63	3.16	3.47	3.45	3.38	3.03
Silver (Ag), total	mg/L	0.0001	< 0.000005	0.000023	< 0.000005	0.00001	< 0.000005	< 0.000005	< 0.00002	< 0.000005	< 0.000005	0.000056	0.000009	< 0.000005	< 0.000005	0.00004	< 0.000005	0.00001	< 0.000005	0.000011	0.000105
Sodium (Na), total	mg/L	-	0.86	0.25	0.43	0.62	0.89	0.95	1.02	0.96	0.99	0.3	0.56	0.91	1.01	1.11	1.02	1.1	1.09	1.1	0.5
Strontium (Sr), total	mg/L	-	0.0637	0.0273	0.049	0.0607	0.0655	0.0654	0.071	0.0666	0.0857	0.0329	0.0582	0.0838	0.0877	0.0957	0.0942	0.0969	0.102	0.0879	0.0607
Sulphur (S), total	mg/L	-	< 10.0	< 10.0	10	13	12	< 10.0	8	< 10.0	11	< 10.0	11	16	15	21	19	23	20	22	<50
Thallium (Tl), total	mg/L	0.0003 [BC]	0.000003	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.00005	< 0.000002	< 0.000002	0.000003	< 0.000002	< 0.000002	< 0.000002	0.000003	< 0.000002	< 0.000002	< 0.000002	0.000002	0.000021
Uranium (U), total	mg/L	0.005 [BC]	0.000091	0.000039	0.000032	0.000057	0.000066	0.000079	< 0.0001	0.000078	0.000242	0.000071	0.000078	0.000161	0.000199	0.000651	0.000618	0.00074	0.000748	0.000701	0.00025
Vanadium (V), total	mg/L	0.006 [BC]	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0003	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0025

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

Appendix Table B.8: Receiving environment water quality monitoring data for 2011 at the Bellekeno Mine.

Analyte	Units	Guideline [a]	Lightning Creek - Effluent-Exposed (EXP) KV-41								Hope Gulch KV-39			Charity Gulch KV-40			Thunder Gulch KV-76			
			Sample Date								Sample Date			Sample Date			Sample Date			
			7/13/2011	8/17/2011	9/17/2011	9/23/2011	10/30/2011	11/20/2011	12/18/2011	12/18/2011	5/25/2011	7/14/2011	10/30/2011	2/8/2011	5/25/2011	10/30/2011	2/10/2011	5/25/2011	7/14/2011	10/25/2011
Arsenic (As), total	mg/L	0.005	0.0114	0.0025	0.0025	0.0042	0.0014	0.0010	0.0009	0.0010	0.0104	0.0100	0.0071	0.0009	0.0007	0.0004	0.0004	0.0008	0.0007	0.0006
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0253	0.0025	0.0025	0.0090	0.0005	0.0004	0.0006	0.0004	0.0023	0.0006	0.0003	0.0002	0.0014	0.0002	0.0002	0.0024	0.0016	0.0006
Lead (Pb), total	mg/L	0.001 - 0.007*	0.01950	0.00655	0.00328	0.00778	0.00097	0.00005	0.00030	0.00032	0.02640	0.00186	0.00044	0.00006	0.00044	0.00006	0.00036	0.00353	0.01270	0.00088
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0121	0.0014	0.0013	0.0042	0.0004	0.0002	0.0020	0.0003	0.0014	0.0008	0.0008	0.0007	0.0021	0.0007	0.0002	0.0014	0.0007	0.0003
Zinc (Zn), total	mg/L	0.03	0.047	0.019	0.017	0.023	0.006	0.003	0.007	0.005	0.401	0.150	0.169	0.003	0.005	0.003	0.002	0.007	0.007	0.007
Total Suspended Solids	mg/L	-	29	41	34	140	3	< 1.0	2.5	2.5	24	1	< 1.0	< 1.0	1.6	0.5	2	37	17	2
pH (field)	pH units	6.5-9.0	7.92	8.29	7.03	8.04	7.89	7.87	-	7.66	7.92	7.92	7.77	7.38	7.84	7.38	7.8	7.77	7.85	8.66
Aluminum (Al), total	mg/L	0.100	3.520	0.294	0.245	1.060	0.050	0.018	0.047	0.021	0.052	0.015	0.008	0.007	0.052	0.007	0.012	0.290	0.113	0.023
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000515	0.000216	0.000185	0.000279	0.000067	0.000007	0.00006	0.00006	0.00486	0.00198	0.00242	0.000036	0.0000651	0.000036	0.00002	0.000115	0.0001	0.000087
Iron (Fe), total	mg/L	0.3	6.310	0.563	0.296	1.500	0.055	0.016	0.068	0.033	0.092	0.028	0.009	0.003	0.030	0.003	0.014	0.315	0.133	0.027
Mercury (Hg), total	mg/L	0.00010	0.00003	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00005	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.000005	0.000005	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.00045	0.00016	0.00017	0.00015	0.00022	0.00029	< 0.001	0.00024	0.00013	0.00032	0.00046	0.000069	0.000079	0.000057	0.00026	0.0001	0.00017	0.00023
Selenium (Se), total	mg/L	0.001	0.0005	0.0006	0.0007	0.0006	0.0008	0.0011	0.0009	0.0010	0.0005	0.0006	0.0016	0.0020	0.0012	0.0001	0.0007	0.0003	0.0004	0.0009
Ammonia (N)	mg/L	-	0.037	0.022	0.012	0.023	0.043	-	< 0.005	0.048	-	-	-	-	0.019	0.019	-	-	-	0.018
Nitrate (N)	mg/L	-	0.03	<2	0.11	0.1	< 0.2	0.245	0.249	0.261	-	-	-	-	-	-	-	-	-	-
Alkalinity, total	mg/L	-	37	35	45	44	48	54	49.6	50.2	25	38	58	37.1	29.3	15	85	13	36	70
Hardness (from total)	mg/L	-	78	82.2	87.5	89.6	97.3	110	110	103	58.8	93.4	182	209	158.3	32.1	126	25.5	53.9	121
Specific Conductivity (field)	µS/cm		167	-	158	189	217.6	217	-	225.9	-	191	372.5	-	332.1	67.6	103	32.5	107	259
Phosphorous (P), total	mg/L	0.030 [ON]	0.165	0.041	0.029	0.077	0.007	0.004	< 0.01	0.005	0.012	0.006	0.005	0.0055	0.0083	0.003	0.003	0.038	0.024	0.009
Sulphate, dissolved	mg/L	-	37	47	44.1	45	49.7	60.5	55.9	60.1	41	56	107	180	123.1	13.8	59	8.8	15	48.8
Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	0.3	0.208	-	0.039	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon	mg/L	-	1.7	2.4	1.7	1	1.1	1.1	0.54	< 0.5	3.4	1	< 0.5	1.74	3.19	0.56	0.8	9.2	4.1	0.7
Antimony (Sb), total	mg/L	0.0200 [BC]	0.00074	0.00032	0.00025	0.00032	0.00029	0.00028	< 0.0005	0.00022	0.0019	0.00144	0.00174	0.000084	0.000099	0.000084	0.00009	0.0001	0.0002	0.00015
Boron (B), total	mg/L	0.2 [ON]	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.025	0.025	< 0.05	< 0.05	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	23	25.1	26.8	27.3	29.9	33.8	33.7	32	18.1	28.7	55.7	58.2	42.9	8.21	40.7	7.92	16.9	38.7
Chromium (Cr), total	mg/L	0.0089	0.007	0.0007	0.0004	0.0022	0.0002	0.0001	0.001	0.0001	0.0001	0.0003	< 0.0001	0.00013	0.00021	0.0001	0.0004	0.0007	0.0005	< 0.0001
Cobalt (Co), total	mg/L	0.0009 [ON]	0.00463	0.00043	0.00059	0.00185	0.00008	0.00002	0.00050	0.00004	0.00012	0.00003	0.00001	0.00001	0.00010	0.00001	0.00001	0.00031	0.00019	0.00003
Lithium (Li), total	mg/L	-	0.0055	0.0014	0.0017	0.0028	0.0016	0.0018	< 0.005	0.0015	0.0008	0.0016	0.0025	0.00217	0.00204	0.0013	0.0025	0.001	0.0015	0.0024
Magnesium (Mg), total	mg/L	-	5	4.77	4.99	5.21	5.53	6.29	6.21	5.71	3.3	5.26	10.5	15.5	12.46	2.81	5.89	1.39	2.85	5.98
Manganese (Mn), total	mg/L	-	0.205	0.0271	0.0363	0.0721	0.0055	0.00203	0.004	0.00334	0.0262	0.00363	0.00151	0.00053	0.00913	0.00053	0.00079	0.0186	0.0144	0.00176
Potassium (K), total	mg/L	-	0.5	0.14	0.18	0.28	0.2	0.2	0.174	0.17	0.25	0.15	0.21	0.185	0.32	0.13	0.12	0.28	0.1	0.13
Silicon (Si), total	mg/L	-	6.86	2.8	3	4.2	3.1	3.7	3.31	3	1.79	2.49	3.4	3.37	2.7	1.46	2.48	1.61	2.8	3.2
Silver (Ag), total	mg/L	0.0001	0.00052	0.00006	0.000093	0.000261	0.000012	< 0.000005	<0.00002	0.000008	0.000422	0.000012	0.000006	< 0.000005	0.0000094	0.0000025	0.000005	< 0.000040	0.000039	< 0.000007
Sodium (Na), total	mg/L	-	0.6	0.62	0.74	0.76	0.95	1.12	1.04	0.97	0.45	0.74	1.41	0.959	0.787	0.217	0.66	0.24	0.51	0.77
Strontium (Sr), total	mg/L	-	0.0721	0.0714	0.0795	0.0819	0.0894	0.0854	0.091	0.0887	0.0543	0.0861	0.167	0.193	0.1461	0.0323	0.102	0.0256	0.0498	0.0934
Sulphur (S), total	mg/L	-	<50	18	17	16	19	21	17	18	16	19	42	69	46	5	16	10	< 10.0	18
Thallium (Tl), total	mg/L	0.0003 [BC]	0.000048	0.000005	0.000006	0.000016	< 0.000002	< 0.000002	< 0.00005	< 0.000002	0.000007	< 0.000002	< 0.000002	< 0.000002	0.000001	0.000001	< 0.000002	< 0.000004	0.000006	< 0.000002
Uranium (U), total	mg/L	0.005 [BC]	0.000723	0.000194	0.000361	0.00042	0.000395	0.000041	0.0005	0.000431	0.000111	0.00029	0.00111	0.000033	0.0000447	0.000033	0.00115	0.000145	0.000188	0.000858
Vanadium (V), total	mg/L	0.006 [BC]	0.0089	0.0009	0.0008	0.0032	< 0.0002	< 0.0002	< 0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0001	0.0001	< 0.0002	< 0.0007	< 0.0003	< 0.0002

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

Appendix Table B.9: Receiving environment water quality monitoring data for 2012 at the Bellekeno Mine.

Analyte	Units	CWGQ [a]	Lightning Creek - Pristine Reference (REF1) KV-37															Lightning Creek - Placer-Influenced Reference (REF1)			
			Sample Date															Sample Date			
			1/18/2012	2/9/2012	3/9/2012	4/7/2012	5/6/2012	6/1/2012	6/13/2012	7/1/2012	7/8/2012	8/1/2012	9/20/2012	10/10/2012	11/16/2012	11/18/2012	12/6/2012	3/9/2012	4/7/2012	5/6/2012	6/1/2012
Arsenic (As), total	mg/L	0.005	0.0028	0.0035	0.0031	0.0029	0.0031	0.0024	0.0019	0.0024	0.0022	0.0025	0.0025	0.0024	0.0026	0.0025	0.0029	0.0028	0.0026	0.0030	0.0030
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0004	0.0003	0.0006	0.0002	0.0006	0.0010	0.0006	0.0005	0.0004	0.0004	0.0003	0.0003	0.0004	0.0004	0.0002	0.0003	0.0002	0.0005	0.0013
Lead (Pb), total	mg/L	0.001 - 0.007*	0.0004	0.0005	0.0006	0.0001	0.0002	0.0004	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0005	0.0037	0.0001	0.0003	0.0013
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0002	0.0002	0.0002	0.0002	0.0003	0.0006	0.0004	0.0003	0.0003	0.0003	0.0002	0.0002	0.0003	0.0002	0.0004	0.0002	0.0002	0.0003	0.0009
Zinc (Zn), total	mg/L	0.03	0.003	0.002	0.005	0.004	0.001	0.010	0.003	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.010	0.007	0.011	0.039
Total Suspended Solids	mg/L	-	< 1.0	4.9	< 1.0	< 1.0	< 1.0	2.5	1.7	1	< 1.0	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.8	< 1.0	< 1.0	1.9
pH (field)	pH units	6.5-9.0	7.51	7.64	7.37	7.87	8.21	7.65	-	7.77	7.64	7	8.03	7.6	7.83	6.75	7.06	7.44	8.2	7.74	7.68
Aluminum (Al), total	mg/L	0.100	0.007	0.018	0.007	0.005	0.009	0.036	0.021	0.013	0.009	0.009	0.008	0.006	0.006	0.007	0.007	0.011	0.002	0.007	0.036
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000012	0.000014	0.000014	0.000014	0.000011	0.0000982	0.0000268	0.0000156	0.0000124	0.000102	0.000013	0.000014	0.000007	0.000011	0.000011	0.000103	0.000076	0.000112	0.000423
Iron (Fe), total	mg/L	0.3	0.049	0.095	0.043	0.03	0.0775	0.0773	0.0592	0.0442	0.0391	0.0576	0.0478	0.0446	0.081	0.0531	0.0569	0.042	0.009	0.0308	0.0657
Mercury (Hg), total	mg/L	0.00010	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0001
Selenium (Se), total	mg/L	0.001	0.0006	0.0006	0.0006	0.0006	0.0006	0.0003	0.0004	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0008	0.0008	0.0009	0.0005
Ammonia (N)	mg/L	-	-	-	-	-	-	-	0.015	-	< 0.005	-	-	-	-	0.0082	-	-	-	-	-
Nitrate (N)	mg/L	-	0.168	0.228	1.93	0.141	0.103	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.176	0.26	0.162	0.102	< 0.2
Alkalinity, total	mg/L	-	-	37.4	-	-	37.7	-	20.8	-	28.5	-	-	35.5	-	37.6	-	-	-	44.4	-
Hardness (from total)	mg/L	-	58.2	61.4	64.1	58.8	58.9	35.9	47.5	63.5	59.8	68.7	74.6	65.8	67.4	65.9	59.5	87.8	85.8	86.1	50.8
Specific Conductivity (field)	µS/cm		114.7	132.3	-	154.4	116	70.63	-	146.8	154	160	-	175.2	149.3	128.4	150	188.1	217.3	173	94.69
Phosphorous (P), total	mg/L	0.030 [ON]	0.01	0.012	0.01	0.006	0.0081	0.0099	0.0049	< 0.002	0.0044	<0.0020	0.004	0.0054	0.0067	0.0076	0.0078	0.02	0.004	0.0061	0.0099
Sulphate, dissolved	mg/L	-	25.7	24.3	27.3	26.1	21.5	20	28.7	34.1	37.7	35.4	43	37.3	29.7	29.5	25.6	41.9	42.3	43	29.7
Total Kjeldahl Nitrogen	mg/L	-	0.054	0.043	< 0.2	0.05	0.169	< 0.2	-	< 0.2	-	< 0.2	< 0.2	0.21	0.22	-	0.088	< 0.2	0.042	0.508	0.23
Dissolved Organic Carbon	mg/L	-	0.83	< 0.5	0.74	< 0.5	1.56	< 0.5	1.36	1.22	0.72	1.12	0.69	1.85	< 0.5	< 0.5	0.7	< 0.5	< 0.5	1.29	2.7
Antimony (Sb), total	mg/L	0.0200 [BC]	0.00007	0.00008	0.00011	0.00008	0.00008	0.00008	0.00012	0.00012	0.00013	0.00011	0.00009	0.00009	0.00012	0.00009	0.00009	0.00025	0.00025	0.00027	0.00029
Boron (B), total	mg/L	0.2 [ON]	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	17.9	18.8	19.9	18.1	17.4	10.4	14.6	19.7	18.4	21.1	22.8	20.2	20.3	20	17.8	27.2	26.4	26.1	14.9
Chromium (Cr), total	mg/L	0.0089	0.0003	0.0002	0.0006	0.0002	< 0.0001	0.00015	< 0.0001	0.00014	< 0.0001	< 0.0001	< 0.0001	0.00011	< 0.0001	0.0004	< 0.0001	0.0001	< 0.0001	< 0.0001	0.00011
Cobalt (Co), total	mg/L	0.0009 [ON]	0.00002	0.00004	0.00004	0.00002	0.00003	0.00005	0.00004	0.00003	0.00003	0.00005	0.00003	0.00003	0.00003	0.00003	0.00003	0.00004	0.00001	0.00001	0.00005
Lithium (Li), total	mg/L	-	0.0008	0.0008	0.0009	0.0008	0.00083	< 0.0005	< 0.0005	< 0.0005	0.00051	0.00058	0.00051	0.00058	0.00078	0.00079	0.00072	0.0012	0.0011	0.00112	0.00057
Magnesium (Mg), total	mg/L	-	3.27	3.49	3.49	3.33	3.76	2.41	2.68	3.47	3.39	3.91	4.29	3.76	4.05	3.86	3.62	4.85	4.83	5.1	3.32
Manganese (Mn), total	mg/L	-	0.00658	0.00904	0.00528	0.00398	0.00721	0.00827	0.00535	0.00561	0.00665	0.0107	0.00866	0.00863	0.00973	0.00904	0.00959	0.00633	0.002	0.00367	0.00824
Potassium (K), total	mg/L	-	0.2	0.19	0.24	0.17	0.32	0.209	0.09	0.062	0.068	0.069	0.127	0.149	0.187	0.17	0.232	0.19	0.17	0.262	0.23
Silicon (Si), total	mg/L	-	4	4	4.1	3.6	3.35	1.44	1.59	2.15	1.88	2.78	2.69	3.41	3.48	3.85	3.46	3.7	3.5	3.36	1.74
Silver (Ag), total	mg/L	0.0001	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.0000055	0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000006	0.000006	< 0.000005	< 0.000005	0.0000806
Sodium (Na), total	mg/L	-	1.93	1.03	2.96	1	0.966	0.4	0.338	0.46	0.429	0.648	0.646	0.744	0.981	0.929	1	1.1	1.13	1.08	0.611
Strontium (Sr), total	mg/L	-	0.0663	0.0672	0.0675	0.0661	0.0704	0.0421	0.0419	0.0556	0.0564	0.066	0.0707	0.0654	0.067	0.0696	0.0688	0.0851	0.0861	0.0865	0.0554
Sulphur (S), total	mg/L	-	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	13	13	13	17	14	11.9	10.5	10.1	15	15	16	10
Thallium (Tl), total	mg/L	0.0003 [BC]	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	0.000005	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Uranium (U), total	mg/L	0.005 [BC]	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0003	0.0003	0.0001
Vanadium (V), total	mg/L	0.006 [BC]	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.00024	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

Appendix Table B.9: Receiving environment water quality monitoring data for 2012 at the Bellekeno Mine.

Analyte	Units	CWGQ [a]	Lightning Creek - Placer-Influenced Reference (REF1) KV-38						Lightning Creek - Effluent-Exposed (EXP) KV-41												
			Sample Date						Sample Date												
			7/2/2012	8/1/2012	9/20/2012	10/16/2012	11/21/2012	12/6/2012	1/17/2012	2/13/2012	3/9/2012	4/7/2012	5/1/2012	5/31/2012	7/2/2012	7/8/2012	8/1/2012	9/21/2012	10/16/2012	11/18/2012	11/18/2012
Arsenic (As), total	mg/L	0.005	0.0033	0.0026	0.0027	0.0062	0.0025	0.0026	0.0010	0.0009	0.0009	0.0008	0.0027	0.0043	0.0091	0.0045	0.0036	0.0018	0.0015	0.0013	0.0012
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0008	0.0004	0.0004	0.0013	0.0009	0.0004	0.0004	0.0009	0.0008	0.0003	0.0036	0.0094	0.0247	0.0088	0.0076	0.0009	0.0007	0.0010	0.0010
Lead (Pb), total	mg/L	0.001 - 0.007*	0.0018	0.0002	0.0001	0.0048	0.0071	0.0009	0.0005	0.0004	0.0005	0.0005	0.0099	0.0114	0.0296	0.0114	0.0095	0.0013	0.0008	0.0028	0.0016
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0006	0.0004	0.0003	0.0006	0.0003	0.0005	0.0002	0.0004	0.0004	0.0003	0.0016	0.0059	0.0137	0.0044	0.0042	0.0005	0.0004	0.0006	0.0005
Zinc (Zn), total	mg/L	0.03	0.015	0.016	0.011	0.022	0.011	0.008	0.006	0.005	0.007	0.006	0.018	0.042	0.080	0.036	0.029	0.011	0.008	0.012	0.014
Total Suspended Solids	mg/L	-	7.3	< 1.0	< 1.0	< 1.0	4	< 1.0	3.9	2.7	1.5	<1.0	53.1	246	540	197	166	12.9	4.6	5.4	7.1
pH (field)	pH units	6.5-9.0	7.64	7.13	7.95	6.96	8.43	6.89	8.48	7.53	7.46	7.69	8.2	7.78	7.79	7.9	7.51	7.73	7.67	6.84	6.84
Aluminum (Al), total	mg/L	0.100	0.040	0.006	0.007	0.065	0.012	0.007	0.018	0.024	0.023	0.011	0.344	1.000	2.330	0.723	0.715	0.100	0.033	0.053	0.042
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000174	0.000168	0.000135	0.000309	0.000101	0.000065	0.000056	0.000044	0.000047	0.000053	0.000229	0.000607	0.00113	0.000512	0.000399	0.000124	0.000081	0.000091	0.000074
Iron (Fe), total	mg/L	0.3	0.123	0.0299	0.0302	0.384	0.0562	0.0246	0.025	0.028	0.035	0.02	0.746	2.91	7.54	2.34	1.94	0.108	0.0571	0.106	0.0898
Mercury (Hg), total	mg/L	0.00010	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0002	0.0003	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002
Selenium (Se), total	mg/L	0.001	0.0004	0.0007	0.0007	0.0007	0.0006	0.0009	0.0012	0.0010	0.0012	0.0011	0.0011	0.0005	0.0006	0.0006	0.0007	0.0008	0.0009	0.0009	0.0011
Ammonia (N)	mg/L	-	-	-	-	-	-	-	0.022	0.017	0.014	0.012	0.01	0.053	0.034	0.016	0.034	0.014	0.015	0.013	0.017
Nitrate (N)	mg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	0.22	0.195	0.304	0.253	0.33	0.309	2.63	< 0.2	0.39	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.42
Alkalinity, total	mg/L	-	28.3	-	-	38	-	-	53.7	53.9	57	57.2	54	28.8	32.7	37.3	42.5	40.6	46.2	51.2	53.1
Hardness (from total)	mg/L	-	67	84.4	85.3	89.1	89.9	86.3	108	109	115	118	122	60.4	96.3	85.1	101	85.4	94.9	108	110
Specific Conductivity (field)	µS/cm		152.4	198.1	-	210.3	-	214	219.8	239.7	244.3	-	249.4	97.86	164.2	181.5	213.2	219.5	226.9	239	239
Phosphorous (P), total	mg/L	0.030 [ON]	0.0061	< 0.0020	0.0033	0.0258	0.0091	0.0049	0.007	0.006	0.008	<0.002	0.0406	0.243	0.681	0.226	0.172	0.0107	0.0101	0.0101	0.0153
Sulphate, dissolved	mg/L	-	34.9	47.8	53.4	50.4	46.1	48.3	55.4	60.1	60.3	60.5	60	25.6	35	39.5	49.8	51.8	50.1	56	57.9
Total Kjeldahl Nitrogen	mg/L	-	< 0.2	0.24	< 0.2	0.22	< 0.2	0.059	0.029	0.102	< 0.2	0.044	0.17	0.44	< 0.2	-	0.34	< 0.2	0.22	0.66	-
Dissolved Organic Carbon	mg/L	-	1.8	0.94	1.02	0.72	0.81	0.89	0.72	0.5	< 0.5	< 0.5	2.12	3.63	2.21	0.57	0.94	0.97	0.58	0.62	< 0.5
Antimony (Sb), total	mg/L	0.0200 [BC]	0.00027	0.00027	0.00026	0.00028	0.00028	0.00022	0.00023	0.00023	0.00022	0.00027	0.00053	0.00036	0.00047	0.00037	0.00038	0.00026	0.00025	0.00026	0.00025
Boron (B), total	mg/L	0.2 [ON]	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	20.6	25.6	25.9	27.9	27.3	26.2	33.7	34.1	35.8	36.3	37.6	17.4	27.8	26.1	30.4	26.2	30	33.6	34.2
Chromium (Cr), total	mg/L	0.0089	0.00026	< 0.0001	< 0.0001	0.00019	0.00018	< 0.0001	< 0.0001	0.0001	0.0001	< 0.0001	0.00073	0.00198	0.00463	0.0014	0.00132	0.00015	0.00014	0.00041	0.00044
Cobalt (Co), total	mg/L	0.0009 [ON]	0.00007	0.00003	0.00002	0.00021	0.00006	0.00002	0.00005	0.00004	0.00006	0.00002	0.00060	0.00212	0.00523	0.00180	0.00161	0.00014	0.00006	0.00010	0.00009
Lithium (Li), total	mg/L	-	0.00059	0.00094	0.0008	0.00096	0.00101	0.00113	0.0015	0.0016	0.0017	0.0016	0.002	0.00215	0.00324	0.0019	0.00225	0.00134	0.00145	0.00148	0.00153
Magnesium (Mg), total	mg/L	-	3.8	4.97	4.99	4.71	5.25	5.04	5.76	5.93	6.32	6.57	6.87	4.14	6.53	4.85	5.98	4.83	4.88	5.95	6.07
Manganese (Mn), total	mg/L	-	0.0125	0.00698	0.00574	0.0439	0.011	0.00508	0.00481	0.00374	0.00566	0.00343	0.0473	0.158	0.414	0.18	0.108	0.00911	0.00663	0.0102	0.0081
Potassium (K), total	mg/L	-	0.077	0.095	0.145	0.154	0.198	0.201	0.19	0.19	0.22	0.21	0.364	0.347	0.392	0.26	0.24	0.154	0.167	0.196	0.193
Silicon (Si), total	mg/L	-	2.17	2.9	2.72	3.44	3.46	3.35	3.5	3	3.4	3.1	3.55	3	5.38	3.42	3.91	2.54	3.23	3.18	3.51
Silver (Ag), total	mg/L	0.0001	0.0000169	< 0.000005	< 0.000005	0.000014	< 0.000005	< 0.000005	0.000006	< 0.000005	0.000006	< 0.000005	0.000035	0.0000218	0.000312	0.0002	0.000162	0.000006	0.000007	0.000005	0.000005
Sodium (Na), total	mg/L	-	0.506	0.777	0.753	0.781	1.1	1.05	1.02	1.07	1.82	1.37	1.5	0.621	0.708	0.635	0.942	0.783	0.802	1.09	1.09
Strontium (Sr), total	mg/L	-	0.0589	0.0806	0.0844	0.0863	0.0911	0.0907	0.0898	0.0918	0.0894	0.0946	0.0965	0.0606	0.0811	0.0761	0.0892	0.0832	0.086	0.0929	0.0877
Sulphur (S), total	mg/L	-	14	17	19	20	16.6	16.6	22	18	21	21	22	< 10.0	14	14	18	18	20	20.4	19.8
Thallium (Tl), total	mg/L	0.0003 [BC]	< 0.000002	< 0.000002	< 0.000002	0.000002	0.000003	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	0.00001	0.0000274	0.0000503	0.0000206	0.000018	< 0.000002	< 0.000002	0.000004	0.000002
Uranium (U), total	mg/L	0.005 [BC]	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0005	0.0006	0.0005	0.0006	0.0009	0.0004	0.0008	0.0004	0.0004	0.0002	0.0003	0.0004	0.0004
Vanadium (V), total	mg/L	0.006 [BC]	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.00151	0.00376	0.0096	0.00289	0.00261	< 0.0002	< 0.0002	< 0.0002	< 0.0002

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dependent guidelines apply.

Appendix Table B.9: Receiving environment water quality monitoring data for 2012 at the Bellekeno Mine.

Analyte	Units	CWGQ [a]	KV-41	Hope Gulch KV-39				Charity Gulch KV-40			Thunder Gulch KV-76			
			Date	Sample Date				Sample Date			Sample Date			
			12/6/2012	2/9/2012	5/6/2012	7/2/2012	10/10/2012	2/9/2012	5/6/2012	10/10/2012	2/13/2012	5/8/2012	7/10/2012	10/21/2012
Arsenic (As), total	mg/L	0.005	0.0014	0.0057	0.0047	0.0094	0.0090	0.0011	0.0007	0.0003	0.0006	0.0216	0.0317	0.0005
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0025	0.0003	0.0021	0.0006	0.0003	0.0067	0.0007	0.0022	0.0003	0.0448	0.0655	0.0005
Lead (Pb), total	mg/L	0.001 - 0.007*	0.0091	0.0008	0.0010	0.0017	0.0005	0.0012	0.0003	0.0004	0.0003	0.0820	0.5870	0.0020
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0007	0.0008	0.0011	0.0008	0.0008	0.0048	0.0017	0.0015	0.0003	0.0300	0.0260	0.0003
Zinc (Zn), total	mg/L	0.03	0.018	0.152	0.095	0.143	0.152	0.009	0.004	0.002	0.012	0.165	0.658	0.008
Total Suspended Solids	mg/L	-	9.1	< 1.0	1.2	2.2	< 1.0	6	1	1.9	1.6	< 337.0	1390	6.2
pH (field)	pH units	6.5-9.0	6.76	7.71	8.11	8.03	7.5	8.35	7.84	0.28*	7.85	8.17	7.97	7.26
Aluminum (Al), total	mg/L	0.100	0.071	0.007	0.163	0.015	0.006	0.149	0.034	0.049	0.010	9.960	3.870	0.023
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000156	0.00225	0.00135	0.0018	0.00198	0.000144	0.0000577	0.0000372	0.00018	0.00173	0.0109	0.000126
Iron (Fe), total	mg/L	0.3	0.152	0.008	0.117	0.0346	0.0087	0.089	0.0166	0.0305	0.014	21.8	10.3	0.0437
Mercury (Hg), total	mg/L	0.00010	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.000005	0.000005		< 0.00001	< 0.00001	< 0.00001	< 0.00001
Molybdenum (Mo), total	mg/L	0.073 [ON]	0.0002	0.0006	0.0004	0.0004	0.0004	0.0001	0.0001	0.0000	0.0002	0.0019	0.0002	0.0002
Selenium (Se), total	mg/L	0.001	0.0010	0.0017	0.0010	0.0009	0.0012	0.0020	0.0008	0.0007	0.0010	0.0012	0.0007	0.0009
Ammonia (N)	mg/L	-	0.071	-	0.015	-	-	0.019	0.019		0.018	0.082	0.076	0.016
Nitrate (N)	mg/L	-	0.273	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, total	mg/L	-	57.1	68.8	47.8	43	54.1	38	27.3	10.8	89.3	66.9	-	64.2
Hardness (from total)	mg/L	-	110	211	143	113	146	209	139.1	63.1	178	201	123	99.9
Specific Conductivity (field)	µS/cm		267	405.2	272.1	255.4	365.9	431	266.1	176.6	372	283.4	163.1	157.6
Phosphorous (P), total	mg/L	0.030 [ON]	0.0188	0.008	0.0082	0.0068	0.0055	0.014	0.0074	0.0039	0.009	0.788	2.03	0.009
Sulphate, dissolved	mg/L	-	64.4	138	92.8	63.5	107	180	94.7	64.6	101	76.6	-	45.3
Total Kjeldahl Nitrogen	mg/L	-	0.65	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon	mg/L	-	3.06	0.99	6.68	0.76	1.85	9.83	1.85	3.68	0.73	2.8	2.91	0.87
Antimony (Sb), total	mg/L	0.0200 [BC]	0.00030	0.00168	0.00136	0.00147	0.00143	0.00012	0.00010	0.00001	0.00017	0.00220	0.00208	0.00014
Boron (B), total	mg/L	0.2 [ON]	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.025	0.025		< 0.05	< 0.25	< 0.05	< 0.05
Calcium (Ca), total	mg/L	-	33.7	63.9	42.6	35	45	58.2	37.36	17.59	58.1	56.8	35.6	32.3
Chromium (Cr), total	mg/L	0.0089	0.0003	< 0.0001	0.00015	0.00014	< 0.0001	0.0004	0.00019	0.00011	0.0001	0.0179	0.00744	< 0.0001
Cobalt (Co), total	mg/L	0.0009 [ON]	0.00016	0.00001	0.00027	0.00003	0.00001	0.00025	0.00006	0.00009	0.00002	0.01010	0.01380	0.00004
Lithium (Li), total	mg/L	-	0.00161	0.0023	0.00183	0.00203	0.00203	0.0023	0.00201	0.00031	0.0027	0.0163	0.00694	0.00212
Magnesium (Mg), total	mg/L	-	6.26	12.4	8.81	6.31	8.24	16.5	11.11	4.71	8.05	14.4	8.36	4.69
Manganese (Mn), total	mg/L	-	0.0142	0.00253	0.0187	0.00441	0.00166	0.0236	0.00459	0.00885	0.00148	0.516	1.56	0.00453
Potassium (K), total	mg/L	-	0.541	0.33	0.32	0.169	0.216	1.3	0.222	0.4	0.16	1.7	0.413	0.131
Silicon (Si), total	mg/L	-	3.07	3.4	2.64	2.89	3.16	3.37	2.61	0.67	2.9	15.9	6.19	3.13
Silver (Ag), total	mg/L	0.0001	0.000027	0.000006	0.000012	0.0000275	0.000008	0.000027	0.0000054	0.0000108	< 0.000005	0.001070	0.003160	0.000014
Sodium (Na), total	mg/L	-	1.35	2.2	1.17	0.865	1.09	1.06	0.715	0.289	0.8	2.2	0.807	0.651
Strontium (Sr), total	mg/L	-	0.0962	0.186	0.132	0.103	0.134	0.193	0.1297	0.0568	0.13	0.152	0.117	0.0808
Sulphur (S), total	mg/L	-	22.8	52	34	24	39	69	38	21	31	10	10	13
Thallium (Tl), total	mg/L	0.0003 [BC]	< 0.000002	< 0.000002	0.000002	< 0.000002	< 0.000002	0.000001	0.000001	-	< 0.000002	< 0.000200	< 0.000199	< 0.000002
Uranium (U), total	mg/L	0.005 [BC]	0.0005	0.0015	0.0011	0.0004	0.0007	0.0001	0.0000	0.0000	0.0020	0.0016	0.0015	0.0006
Vanadium (V), total	mg/L	0.006 [BC]	0.00024	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0001	0.0001	-	< 0.0002	< 0.0266	< 0.0158	< 0.0002

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; (CME 1999) with the exception of British Columbia guidelines (BC; BCMOE 2006) and Ontario objectives (ON; OMOEE 1994); values with asterisks (*) indicate parameters for which hardness dep

Appendix Table B.10: Annual average receiving environment water quality at Bellekeno Mine, 2010 to 2012.

Analyte	Units	CWGQ [a]	Lightning Creek Pristine Reference (REF1)			Lightning Creek Placer-Influenced Reference (REF2) KV-38			Lightning Creek Effluent-Exposed (EXP)		
			2010	2011	2012	2010	2011	2012	2010	2011	2012
Arsenic (As), total	mg/L	0.005	0.00244	0.00265	0.00265	0.00282	0.00307	0.00315	0.00140	0.00238	0.00249
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0005	0.0005	0.0004	0.0005	0.0007	0.0006	0.0011	0.0036	0.0045
Lead (Pb), total	mg/L	0.001 - 0.007*	0.0003	0.0005	0.0002	0.0007	0.0024	0.0020	0.0012	0.0035	0.0064
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0004	0.0004	0.0003	0.0004	0.0005	0.0004	0.0006	0.0020	0.0024
Zinc (Zn), total	mg/L	0.03	0.002	0.002	0.002	0.012	0.023	0.015	0.012	0.013	0.021
Total Suspended Solids	mg/L	-	2.0	2.4	1.4	2.8	4.5	2.1	9.1	24.1	96.1
pH (field)	pH units	6.5-9.0	7.81	7.79	7.57	7.97	7.80	7.61	7.88	7.93	7.58
Aluminum (Al), total	mg/L	0.100	0.022	0.018	0.011	0.020	0.026	0.019	0.082	0.449	0.392
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.000014	0.000020	0.000025	0.000147	0.000262	0.000167	0.000097	0.000134	0.000257
Iron (Fe), total	mg/L	0.3	0.060	0.066	0.057	0.056	0.069	0.080	0.126	0.757	1.150
Mercury (Hg), total	mg/L	0.000026	0.000009	0.000015	0.000010	0.000010	0.000010	0.000010	0.000009	0.000014	0.000010
Molybdenum (Mo), total	mg/L	0.073	0.000113	0.000228	0.000126	0.000183	0.000174	0.000174	0.000227	0.000301	0.000219
Selenium (Se), total	mg/L	0.001	0.0004	0.0005	0.0005	0.0005	0.0006	0.0007	0.0008	0.0008	0.0009
Ammonia (N)	mg/L	-	-	0.0088	0.0094	-	-	-	0.0425	0.0207	0.0244
Nitrate (N)	mg/L	-	-	0.142	0.303	-	0.200	0.194	0.180	0.193	0.436
Alkalinity, total	mg/L	-	34	30	33	38	31	37	51	48	48
Hardness (from total)	mg/L	-	48	56	61	65	69	81	99	103	102
Specific Conductivity (field)	µS/cm		-	142	138	-	165	181	-	196	215
Phosphorous (P), total	mg/L	0.03	-	0.008	0.007	0.009	0.010	0.009	-	0.032	0.111
Sulphate, dissolved	mg/L	-	-	27.3	29.7	41.0	35.4	43.8	-	54.5	51.9
Total Kjeldahl Nitrogen	mg/L	-	-	0.24	0.15	#DIV/0!	0.20	0.21	-	0.18	0.27
Dissolved Organic Carbon	mg/L	-	-	1.60	0.89	1.00	2.20	1.12	-	1.16	1.24
Antimony (Sb), total	mg/L	0.02	-	0.0001	0.0001	0.0003	0.0003	0.0003	-	0.0003	0.0003
Boron (B), total	mg/L	0.2	-	0.05	0.05	0.05	0.05	0.05	-	0.05	0.05
Calcium (Ca), total	mg/L	-	-	17.1	18.5	19.8	21.1	24.8	-	31.7	31.2
Chromium (Cr), total	mg/L	0.0089	0.0004	0.0003	0.0002	0.0004	0.0003	0.0001	0.0004	0.0012	0.0009
Cobalt (Co), total	mg/L	0.0009	-	0.00010	0.00003	0.00005	0.00005	0.00005	-	0.00070	0.00086
Lithium (Li), total	mg/L	-	-	0.00123	0.00067	0.00093	0.00090	0.00094	-	0.00224	0.00181
Magnesium (Mg), total	mg/L	-	-	3.26	3.52	3.88	3.84	4.69	-	5.76	5.78
Manganese (Mn), total	mg/L	-	-	0.0088	0.0076	0.0084	0.0105	0.0105	-	0.0332	0.0695
Potassium (K), total	mg/L	-	-	0.185	0.166	0.143	0.186	0.172	-	0.223	0.262
Silicon (Si), total	mg/L	-	-	3.07	3.05	2.70	2.85	3.03	-	3.58	3.41
Silver (Ag), total	mg/L	0.0001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00009	0.00006
Sodium (Na), total	mg/L	-	-	0.748	0.964	0.750	0.754	0.889	-	0.909	1.057
Strontium (Sr), total	mg/L	-	-	0.059	0.063	0.067	0.070	0.081	-	0.085	0.087
Sulphur (S), total	mg/L	-	-	10.4	11.5	14.0	12.6	15.9	-	19.3	18.6
Thallium (Tl), total	mg/L	0.0003	0.000002	0.000008	0.000002	0.000002	0.000002	0.000002	0.000002	0.000012	0.000010
Uranium (U), total	mg/L	0.005	-	0.0001	0.0001	0.0001	0.0002	0.0002	-	0.0005	0.0005
Vanadium (V), total	mg/L	0.006	-	0.0008	0.0002	0.0002	0.0002	0.0002	-	0.0016	0.0016

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CCME 1999)

Appendix Table B.10: Annual average receiving environment water quality at Bellekeno Mine, 2010 to 2012.

Analyte	Units	CWGQ [a]	Hope Gulch KV-39			Charity Gulch KV-40			Thunder Gulch KV-76		
			2010	2011	2012	2010	2011	2012	2010	2011	2012
Arsenic (As), total	mg/L	0.005	0.00865	0.00917	0.00719	0.00344	0.00069	0.00070	0.00084	0.00062	0.01360
Copper (Cu), total	mg/L	0.002 - 0.004*	0.0011	0.0011	0.0008	0.0026	0.0006	0.0032	0.0008	0.0012	0.0278
Lead (Pb), total	mg/L	0.001 - 0.007*	0.0027	0.0096	0.0010	0.0005	0.0002	0.0006	0.0034	0.0044	0.1678
Nickel (Ni), total	mg/L	0.025 - 0.150*	0.0010	0.0010	0.0009	0.0019	0.0012	0.0027	0.0005	0.0006	0.0141
Zinc (Zn), total	mg/L	0.03	0.161	0.240	0.136	0.054	0.003	0.005	0.009	0.006	0.211
Total Suspended Solids	mg/L	-	3.7	8.7	1.4	1.0	1.0	3.0	12.3	14.5	433.7
pH (field)	pH units	6.5-9.0	7.98	7.87	7.84	7.74	7.53	8.10	8.20	8.02	7.81
Aluminum (Al), total	mg/L	0.100	0.034	0.025	0.048	0.039	0.022	0.077	0.058	0.109	3.466
Cadmium (Cd), total	mg/L	0.000008 - 0.0003*	0.002120	0.003087	0.001845	0.000700	0.000046	0.000080	0.000160	0.000081	0.003234
Iron (Fe), total	mg/L	0.3	0.060	0.043	0.042	0.023	0.012	0.045	0.102	0.122	8.039
Mercury (Hg), total	mg/L	0.000026	0.000010	0.000010	0.000010	0.000010	0.000007	0.000005	0.000010	0.000010	0.000010
Molybdenum (Mo), total	mg/L	0.073	0.000350	0.000303	0.000442	0.000171	0.000068	0.000064	0.000240	0.000190	0.000622
Selenium (Se), total	mg/L	0.001	0.0008	0.0009	0.0012	0.0010	0.0011	0.0012	0.0007	0.0006	0.0009
Ammonia (N)	mg/L	-	-	-	0.0150	0.0190	0.0190	0.0190	0.0300	0.0180	0.0480
Nitrate (N)	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, total	mg/L	-	58	40	53	36	27	25	66	51	73
Hardness (from total)	mg/L	-	111	111	153	122	133	137	114	82	150
Specific Conductivity (field)	µS/cm		-	282	325	285	200	291	175	125	244
Phosphorous (P), total	mg/L	0.03	0.014	0.008	0.007	0.008	0.006	0.008	0.021	0.019	0.709
Sulphate, dissolved	mg/L	-	78.3	68.0	100.3	86.6	105.6	113.1	56.0	32.9	74.3
Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-			
Dissolved Organic Carbon	mg/L	-	0.70	1.63	2.57	4.08	1.83	5.12	0.90	3.70	1.83
Antimony (Sb), total	mg/L	0.02	0.0015	0.0017	0.0015	0.0006	0.0001	0.0001	0.0002	0.0001	0.0011
Boron (B), total	mg/L	0.2	0.05	0.05	0.05	0.05	0.03	0.03	0.05	0.05	0.10
Calcium (Ca), total	mg/L	-	33.0	34.2	46.6	34.9	36.4	37.7	36.4	26.1	45.7
Chromium (Cr), total	mg/L	0.0089	0.0003	0.0002	0.0001	0.0001	0.0001	0.0002	0.0004	0.0004	0.0064
Cobalt (Co), total	mg/L	0.0009	0.00007	0.00005	0.00008	0.00007	0.00004	0.00013	0.00010	0.00014	0.00599
Lithium (Li), total	mg/L	-	0.00213	0.00163	0.00205	0.00179	0.00184	0.00154	0.00243	0.00185	0.00702
Magnesium (Mg), total	mg/L	-	6.98	6.35	8.94	8.42	10.26	10.77	5.60	4.03	8.88
Manganese (Mn), total	mg/L	-	0.0079	0.0104	0.0068	0.0071	0.0034	0.0123	0.0110	0.0089	0.5205
Potassium (K), total	mg/L	-	0.180	0.203	0.259	0.552	0.212	0.641	0.137	0.158	0.601
Silicon (Si), total	mg/L	-	2.27	2.56	3.02	2.61	2.51	2.22	2.99	2.52	7.03
Silver (Ag), total	mg/L	0.0001	0.00002	0.00015	0.00001	0.00001	0.00001	0.00001	0.00010	0.00002	0.00106
Sodium (Na), total	mg/L	-	0.903	0.867	1.331	0.747	0.654	0.688	0.687	0.545	1.115
Strontium (Sr), total	mg/L	-	0.112	0.102	0.139	0.110	0.124	0.127	0.089	0.068	0.120
Sulphur (S), total	mg/L	-	26.3	25.7	37.3	33.7	40.0	42.7	17.3	13.5	16.0
Thallium (Tl), total	mg/L	0.0003	0.000002	0.000004	0.000002	0.000002	0.000001	0.000001	0.000003	0.000004	0.000101
Uranium (U), total	mg/L	0.005	0.0005	0.0005	0.0009	0.0003	0.0000	0.0000	0.0008	0.0006	0.0014
Vanadium (V), total	mg/L	0.006	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0003	0.0004	0.0107

[a] Canadian Water Quality Guidelines for the protection of aquatic life (CCME 1·99)

Table B.11: Magnitude of difference between study areas compared to reference area 2 (REF2) based on mean annual receiving environment water quality monitoring results for the Bellekeno Mine from 2010 to 2012.

Variable		Units	Reference Area 2 versus…			
			Lightning Creek Effluent-Exposed	Hope Gulch	Charity Gulch	Thunder Gulch
Deleterious Substances and pH	Arsenic	mg/L	0.7	2.8	0.5	1.7
	Copper	mg/L	4.9	1.6	3.4	16.0
	Lead	mg/L	2.2	2.6	0.3	34.4
	Nickel	mg/L	4.0	2.3	4.6	12.2
	Zinc	mg/L	0.9	10.7	1.3	4.5
	TSS	mg/L	13.8	1.5	0.5	49.3
	pH (field)[a]	pH units	1.0	1.0	0.9	1.0
Required Receiving Environment & Site-Specific Parameters	Aluminum	mg/L	14.2	1.6	2.1	55.9
	Cadmium	mg/L	0.8	12.2	1.4	6.0
	Iron	mg/L	10.0	0.7	0.4	40.5
	Mercury	mg/L	1.1	1.0	0.7	1.0
	Molybdenum	mg/L	1.4	2.1	0.6	2.0
	Selenium	mg/L	1.4	1.6	1.8	1.2
	Silver	mg/L	4.4	5.0	0.9	33.2
	Ammonia	mg/L	-	-	-	-
	Nitrate	mg/L	1.4	-	-	-
	Alkalinity	mg/L	1.4	1.4	0.8	1.8
	Hardness (as $CaCO_3$)	mg/L	1.4	1.7	1.8	1.6
	Specific Conductivity	uS/cm	1.2	1.8	1.5	1.0
Others	Total Phosphorus	mg/L	7.5	1.0	0.8	26.1
	Sulphate	mg/L	1.3	2.1	2.5	1.4
	Total Kjeldahl Nitrogen	mg/L	1.1	-	-	-
	DOC	mg/L	0.8	1.1	2.6	1.5
	Antimony	mg/L	1.2	5.7	0.9	1.8
	Boron	mg/L	1.0	1.0	0.7	1.3
	Calcium	uS/cm	1.4	1.7	1.7	1.6
	Chromium	mg/L	4.0	0.8	0.7	9.5
	Cobalt	NTU	15.8	1.3	1.6	42.1
	Lithium	mg/L	2.2	2.1	1.9	4.1
	Magnesium	mg/L	1.4	1.8	2.4	1.5
	Manganese	mg/L	5.2	0.9	0.8	18.4
	Potassium	mg/L	1.5	1.3	2.8	1.8
	Silicon	mg/L	1.2	0.9	0.9	1.5
	Sodium	mg/L	1.2	1.3	0.9	1.0
	Strontium	mg/L	1.2	1.6	1.7	1.3
	Sulphur	mg/L	1.3	2.1	2.7	1.1
	Thallium	mg/L	3.8	1.2	0.7	17.0
	Uranium	mg/L	3.1	4.1	0.7	5.9
	Vanadium	mg/L	8.1	1.0	0.7	18.9

(blue) Denotes average concentration for 2010 to 2012 between three-fold and ten-fold higher than mean reference concentration

(green) Denotes average concentration for 2010 to 2012 greater than ten-fold higher than mean reference concentration

Table B.12: Lightning Creek water quality at EEM study areas on August 25th/26th and magnitude of difference between study areas relative to REF2.

Variable		Units	CWQG[a]	Parameter Concentrations			Magnitude of Difference versus REF2	
				REF1	REF2	EXP	REF1	Effluent-Exposed
Deleterious Substances	Arsenic	mg/L	0.005*	0.0028	0.0022	0.0029	1.3	1.3
	Copper	mg/L	0.005*	0.0005	0.0005	0.0031	1.0	6.2
	Lead	mg/L	0.005*	0.0001	0.0001	0.0025	0.5	25.7
	Nickel	mg/L	0.025	0.0005	0.0005	0.0018	1.0	3.5
	Zinc	mg/L	0.020	0.0030	0.0101	0.0124	0.3	1.2
	TSS	mg/L	-	3	3	29	1.0	9.6
Required Receiving Environment & Site-Specific Parameters	Aluminum	mg/L	0.075*	0.013	0.016	0.772	0.8	46.9
	Cadmium	mg/L	0.0005*	0.000011	0.000101	0.000125	0.1	1.2
	Iron	mg/L	0.300	0.056	0.036	1.100	1.6	30.6
	Mercury	mg/L	0.0002	<0.000010	<0.0000010	<0.000010	1.0	1.0
	Molybdenum	mg/L	0.040	0.0001	0.0002	0.0003	0.5	1.4
	Selenium	mg/L		0.0005	0.0006	0.0008	0.8	1.2
	Ammonia	mg/L	-	0.005	0.012	0.023	0.4	2.0
	Nitrate	mg/L	-	0.031	0.036	0.102	0.9	2.8
	Alkalinity	mg/L	-	33	38	46	0.8	1.2
	Hardness (as $CaCO_3$)	mg/L	-	69	92	102	0.7	1.1
	Specific Conductivity	uS/cm		-	-	-	-	-
Others	Total Phosphorus	mg/L	0.020	0.004	0.003	0.018	1.1	5.6
	Sulphate	mg/L	-	-	-	-	-	-
	Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-
	DOC	mg/L	-	-	-	-	-	-
	Antimony	mg/L	-	0.0001	0.0003	0.0004	0.4	1.4
	Boron	mg/L	-	<0.010	<0.010	0.01	1.0	1.0
	Calcium	uS/cm	-	21	28	31	0.8	1.1
	Chromium	mg/L	-	0.00018	0.00014	0.00170	1.3	12.1
	Cobalt	NTU	-	0.0001	0.0001	0.0006	1.0	5.5
	Lithium	mg/L	-	0.0005	0.0009	0.0025	0.6	2.8
	Magnesium	mg/L	-	4.0	5.3	5.9	0.7	1.1
	Manganese	mg/L	-	0.012	0.005	0.028	2.2	5.3
	Potassium	mg/L	-	0.100	0.135	0.340	0.7	2.5
	Silicon	mg/L	-	2.9	3.2	4.5	0.9	1.4
	Sodium	mg/L	-	0.744	0.825	0.943	0.9	1.1
	Strontium	mg/L	-	0.065	0.087	0.093	0.7	1.1
	Sulphur	mg/L	0.0001	-	-	-	-	-
	Thallium	mg/L	-	0.000010	0.000010	0.000011	1.0	1.1
	Uranium	mg/L	-	0.00005	0.00012	0.00026	0.4	2.1
	Vanadium	mg/L	-	0.0010	0.0010	0.0020	1.0	2.0

[Blue] Denotes average concentration for 2010 to 2012 between three-fold and ten-fold higher than mean reference concentration

[Green] Denotes average concentration for 2010 to 2012 greater than ten-fold higher than mean reference concentration

APPENDIX C

BENTHIC INVERTEBRATE COMMUNITY SURVEY DATA

Table C.1: Latitudes and longitudes of benthic invertebrate sampling stations, Bellekeno Mine Cycle 1 EEM, August 2012.

Study Area	Station	Date Sampled	Latitude (dd mm.mmm)[a]	Longitude (ddd mm.mmm)[a]
REF1 Pristine Reference	REF1-1	24-Aug-12	63 55.014	135 11.776
	REF1-2	24-Aug-12	63 55.020	135 11.765
	REF1-3	24-Aug-12	63 55.020	135 11.767
	REF1-4	24-Aug-12	63 55.011	135 11.787
	REF1-5	24-Aug-12	63 55.006	135 11.800
REF2 Placer-Influenced Reference	REF2-1	23-Aug-12	63 54.770	135 15.401
	REF2-2	23-Aug-12	63 54.772	135 15.371
	REF2-3	23-Aug-12	63 54 770	135 15.349
	REF2-4	23-Aug-12	63 54 767	135 15.329
	REF2-5	23-Aug-12	63 54.764	135 15.297
EXP Effluent-Exposed	EXP-1	23-Aug-12	63 54.576	135 17.226
	EXP-2	23-Aug-12	63 54.584	135 17.203
	EXP-3	23-Aug-12	63 54.594	135 17.136
	EXP-4	23-Aug-12	63 54.597	135 17.119
	EXP-5	23-Aug-12	63 54.597	135 17.107

[a] d-degrees, m-minutes
Map Datum (NAD) 83

Table C.2: Summary of habitat features at Lightning Creek study areas during the benthic invertebrate community survey, August 2012.

Habitat Characteristic		Reference Area 1	Reference Area 2	Effluent-Exposed
		Pristine	Placer-Influenced	Downstream of Mine
Width (m)	Wetted	3	3.8	4.8
	Bankfull	3.5	5.6	5.4
Depth (m)	Mean	0.35	0.19	0.34
Water Velocity (m/s)	Mean	0.59	0.52	0.78
Water Colour		Clear, colourless	Clear, colourless	Gray, turbid (visibility less than 0.1 m)
Stream Morphology	% Pool	-	-	-
	% Rapid	-	80	100
	% Riffle	100	20	-
	% Run	-	-	-
Bank Stability & Condition		moderate	stable	moderate
Substrate Properties	General Composition	40% boulder 40% cobble 10% pebble 11% gravel 9% sand	48% boulder 31% cobble 1% pebble 11% gravel 9% sand	68% boulder 18% cobble 7% gravel 7% sand
	Average Size (cm)	15.2	9.6	5.1
	Embeddedness (%)	30%	70%	25%
	Interstitial Material	Coarse, loose sand	Compact fine gravel and coarse sand	Loose gray silt, sand and gravel
Aquatic Vegetation (% areal coverage)	Macrophytes	none observed	none observed	none observed
	Attached Algae	none observed	none observed	none observed
Riparian Features	Types	ferns/grasses shrubs conifereous trees	ferns/grass shrubs deciduous trees coniferous trees	ferns/grass shrubs deciduous trees
	Canopy Coverage (% area covered)	26 - 50%	1 - 25%	51 - 75%

Table C.3: Benthic macroinvertebrates collected at Lightening Creek for the Bellekeno Mine Cycle 1 EEM. Values represent the number of invertebrates collected during a three minute kick sample.

Study Area	Reference 1 (Pristine)					Reference 2 (Placer Mining)					Effluent-Exposed Area				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ROUNDWORMS															
P. Nemata	10	24	16	28	20	25	6	16	4	4	4	-	1	3	10
ANNELIDS															
P. Annelida															
WORMS															
Cl. Oligochaeta															
F. Enchytraeidae	-	-	-	4	4	116	125	80	108	-	-	-	1	-	6
F. Naididae															
indeterminate	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. Tubificidae															
Arctodrilus wulikensis	-	-	-	-	-	234	42	80	-	-	-	2	-	2	26
immatures with hair chaetae	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
F. Lumbriculidae															
Stylodrilus	54	128	68	24	104	1,020	626	1,440	966	1,032	15	22	21	28	95
ARTHROPODS															
P. Arthropoda															
MITES															
Cl. Arachnida															
Subcl. Acari	74	392	160	320	452	50	42	20	24	20	48	42	49	125	129
HARPACTICOIDS															
O. Harpacticoida	-	16	-	4	4	4	6	-	6	12	6	1	-	4	5
SEED SHRIMPS															
Cl. Ostracoda	14	40	24	32	28	-	-	-	-	-	-	-	-	-	-
SPRINGTAILS															
Cl. Entognatha															
O. Collembola	-	-	-	-	4	4	5	4	2	-	4	2	3	-	28
INSECTS															
Cl. Insecta															
MAYFLIES															
O. Ephemeroptera															
F. Ameletidae															
Ameletus	42	56	55	24	80	3	9	12	6	4	-	-	4	9	6
F. Baetidae															
Baetis immature	46	192	191	156	89	**53**	**41**	**12**	**30**	**32**	-	**4**	**4**	**13**	**12**
Baetis foemina	-	-	-	-	-	6	17	28	10	17	9	3	3	5	6
F. Ephemerellidae															
Drunella	6	8	3	-	-	3	-	-	-	1	-	-	-	1	1
immature	**48**	**64**	**72**	16	16	**4**	7	4	4	**12**	-	4	-	**3**	**3**
F. Heptageniidae															
Cinygmula	70	80	140	64	48	52	55	28	32	20	5	15	9	17	42
Epeorus grandis	-	-	4	4	-	12	4	4	2	12	6	1	-	7	9
Epeorus sp.	2	32	**2**	**4**	1	**61**	**50**	**116**	**28**	**43**	**33**	**20**	27	**44**	**36**
Rhithrogena	8	8	-	-	-	3	-	-	-	-	-	-	-	2	-
immature	**278**	**520**	**236**	**176**	**284**	**101**	**44**	**108**	**106**	**116**	**9**	**17**	**23**	**65**	**86**
STONEFLIES															
O. Plecoptera															
F. Capniidae															
immature	154	256	329	96	108	78	40	12	48	52	16	13	14	33	30
F. Chloroperlidae															
?Alloperla	46	24	39	8	28	-	-	-	-	-	1	1	1	1	1
Sweltsa	6	8	17	8	4	-	-	-	-	-	-	-	-	-	1
immature	**48**	**48**	**56**	**20**	**64**	-	-	-	-	-	**4**	**5**	**5**	**9**	**5**
F. Leuctridae															
Despaxia	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
immature	-	8	-	4	4	-	-	-	-	-	-	-	-	-	-
F. Nemouridae															
Zapada	64	208	97	136	128	93	40	4	30	24	58	26	11	77	120
immature	**172**	**704**	**920**	**320**	**488**	**220**	**204**	**168**	**156**	**204**	**16**	**21**	**5**	**77**	**219**
F. Perlodidae															
Megarcys	14	16	25	8	6	3	2	16	1	2	2	1	2	5	4
indeterminate	-	-	-	-	**4**	**13**	-	-	-	-	-	-	-	-	-
immature	**2**	-	**4**	**4**	-	-	**7**	-	**2**	-	-	-	-	-	-
F. Taeniopterygidae															
Doddsia	-	-	-	-	-	267	174	416	316	344	-	-	-	-	-
immature	164	824	792	256	108	**110**	**49**	**52**	**100**	**220**	17	12	17	37	128
CADDISFLIES															
O. Trichoptera															
F. Glossosomatidae															
Glossosoma	14	88	28	36	40	31	37	40	12	24	11	16	10	10	16
F. Hydropsychidae															
Parapsyche	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
F. Limnephilidae															
Ecclisomyia	-	-	-	4	-	-	-	-	-	-	2	-	-	3	2
indeterminate	-	-	-	-	-	-	-	-	-	-	**2**	-	-	**2**	**1**
F. Rhyacophilidae															
Rhyacophila	2	-	1	-	-	-	-	-	-	-	5	2	5	20	32
F. Uenoidae															
Neophylax	4	-	-	-	-	-	2	-	-	-	2	3	3	4	3
?Apatania immature	-	-	-	-	-	-	-	-	-	-	-	1	2	2	2
TRUE FLIES															
O. Diptera															
indeterminate	-	-	-	**4**	**4**	**3**	-	-	-	-	**1**	**2**	**1**	-	**2**

Table C.3: Benthic macroinvertebrates collected at Lightening Creek for the Bellekeno Mine Cycle 1 EEM. Values represent the number of invertebrates collected during a three minute kick sample.

Study Area	Reference 1 (Pristine)					Reference 2 (Placer Mining)					Effluent-Exposed Area				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
MIDGES															
F. Chironomidae															
chironomid pupae	**10**	**24**	**8**	-	**24**	**64**	**41**	**56**	**28**	**32**	**3**	**2**	**3**	**3**	**16**
S.F. Chironominae															
Micropsectra	10	192	116	96	156	12	29	-	8	8	6	6	1	1	-
Sergentia	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
S.F. Diamesinae															
Diamesa	4	16	8	8	-	173	144	292	158	196	36	13	14	10	85
Pagastia	100	496	220	176	344	8	-	-	-	8	-	-	-	-	-
Pseudodiamesa	4	-	16	8	8	-	-	-	-	-	-	1	1	-	15
S.F. Orthocladiinae															
Chaetocladius	-	-	-	-	-	17	-	-	-	-	-	1	-	-	15
Corynoneura	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Diplocladius	-	-	-	-	-	-	19	-	-	-	6	4	1	-	-
Eukiefferiella	96	336	128	700	1,220	190	87	180	56	120	18	3	25	16	90
Hydrobaenus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Orthocladius	92	384	264	84	328	160	336	32	42	60	11	19	9	3	-
Orthocladius (Euorthocladius)	58	-	-	16	36	814	288	360	396	508	172	44	101	125	354
Orthocladius (Symposiocladius) lignicol	-	-	16	-	-	-	-	-	-	-	-	-	3	-	-
Parorthocladius	162	176	128	68	284	1,937	1,142	808	926	708	11	8	15	2	55
Rheocricotopus	6	-	-	-	24	-	-	-	-	-	-	-	-	-	-
Tvetenia	-	8	-	49	16	17	10	-	-	-	-	-	-	-	-
indeterminate	**4**	-	**16**	-	-	**40**	-	-	-	-	**1**	**2**	-	-	-
F. Deuterophlebiidae															
Deuterophlebia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
F. Empididae															
Clinocera	-	-	-	-	-	-	-	-	-	-	1	1	2	2	1
Oreogeton	4	-	-	4	-	17	45	72	18	36	6	5	11	11	7
F. Psychodidae															
Pericoma	-	-	-	4	8	3	3	-	-	-	1	2	2	2	8
F. Simuliidae	-	-	-	20	88	37	10	12	8	-	3	-	-	7	2
F. Tipulidae															
Dicranota	2	-	16	-	-	-	-	4	2	-	2	1	-	5	7
Limnophila	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
indeterminate	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Total Number of Organisms (No./3-min. sweep	1,902	5,376	4,215	2,993	4,656	6,058	3,788	4,476	3,635	3,871	556	348	410	802	1,724
Lowest Practical Level															
Total Number of Taxa[a]	33	26	26	32	31	30	29	24	25	22	32	31	31	33	37
Simpson's Evenness (E)	0.377	0.425	0.316	0.277	0.268	0.199	0.234	0.247	0.235	0.294	0.220	0.411	0.306	0.274	0.246
Bray-Curtis Index (Ref 1 Median)	0.324	0.237	0.227	0.207	0.239	0.662	0.600	0.714	0.699	0.674	0.849	0.855	0.866	0.744	0.590
Bray-Curtis Index (Ref 2 Median)	0.627	0.667	0.679	0.684	0.712	0.219	0.188	0.144	0.047	0.097	0.780	0.858	0.837	0.732	0.519
Family Level															
Total Number of Taxa	21	17	17	22	21	20	21	19	19	15	22	20	19	23	26
Simpson's Evenness (E)	0.308	0.348	0.366	0.210	0.153	0.139	0.138	0.195	0.183	0.240	0.168	0.322	0.233	0.318	0.165
Bray-Curtis Index (Ref 1 Median)	0.297	0.222	0.223	0.086	0.230	0.508	0.418	0.467	0.427	0.421	0.740	0.828	0.803	0.654	0.442
Bray-Curtis Index (Ref 2 Median)	0.541	0.405	0.511	0.395	0.406	0.221	0.140	0.094	0.044	0.057	0.776	0.855	0.833	0.728	0.551
Percent Composition															
% Oligochaeta	2.9%	2.4%	1.6%	0.9%	2.3%	22.6%	20.9%	35.7%	29.5%	26.7%	2.7%	6.9%	5.4%	4.6%	7.4%
% Mites	3.9%	7.3%	3.8%	10.7%	9.7%	0.8%	1.1%	0.4%	0.7%	0.5%	8.6%	12.1%	12.0%	15.6%	7.5%
% Mayflies	26.3%	17.9%	16.7%	14.8%	11.1%	4.9%	6.0%	7.0%	6.0%	6.6%	11.2%	18.4%	17.1%	20.7%	11.7%
% Stoneflies	35.3%	39.0%	54.1%	28.7%	20.2%	12.9%	13.6%	14.9%	18.0%	21.9%	20.5%	22.7%	13.4%	29.8%	29.5%
% Caddisflies	1.1%	1.6%	0.7%	1.3%	0.9%	0.5%	1.0%	0.9%	0.3%	0.6%	4.1%	6.3%	4.9%	5.1%	3.3%
% EPT	62.7%	58.5%	71.4%	44.9%	32.2%	18.4%	20.6%	22.8%	24.3%	29.1%	35.8%	47.4%	35.4%	55.6%	44.4%
% Chironomids	28.7%	30.4%	21.8%	40.3%	52.4%	56.7%	55.3%	38.6%	44.4%	42.4%	47.8%	29.6%	42.4%	20.0%	36.5%
Functional Feeding Groups															
% Shredders	29.2%	37.2%	50.7%	27.3%	18.0%	12.7%	13.4%	14.6%	17.9%	21.8%	20.0%	20.7%	11.5%	28.6%	29.0%
% Scrapers	22.2%	14.7%	11.5%	10.0%	8.4%	4.4%	5.3%	6.7%	5.1%	5.9%	11.9%	22.1%	18.0%	19.1%	11.5%
% Collector - Gatherers	39.9%	35.9%	28.4%	46.7%	57.1%	80.8%	77.8%	76.0%	75.3%	70.6%	54.1%	39.1%	52.2%	29.3%	48.4%
% Filterers	0.5%	3.6%	2.8%	3.9%	5.2%	0.8%	1.0%	0.3%	0.4%	0.2%	1.8%	1.7%	0.2%	1.0%	0.2%

[a] Bold entries excluded from taxa count

Table C.4: Descriptive statistics of benthic invertebrate community metrics at family-level (FL) taxonomy, Bellekeno Mine Cycle 1 EEM, August 2012.

Variable	Area	n	Median	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Min	Max
							Lower Bound	Upper Bound		
Density (No. individuals / 3-min kick sample)	REF1	5	4,215	3,828	1,382	618	2,113	5,544	1,902	5,376
	REF2	5	3,871	4,366	999	447	3,126	5,605	3,635	6,058
	EXP	5	556	768	562	251	70	1,466	348	1,724
Number of Taxa (FL)	REF1	5	21.0	19.6	2.4	1.1	16.6	22.6	17.0	22.0
	REF2	5	19.0	18.8	2.3	1.0	16.0	21.6	15.0	21.0
	EXP	5	22.0	22.0	2.7	1.2	18.6	25.4	19.0	26.0
Simpson's Evenness (FL)	REF1	5	0.308	0.277	0.092	0.041	0.163	0.391	0.153	0.366
	REF2	5	0.183	0.179	0.043	0.019	0.126	0.232	0.138	0.240
	EXP	5	0.233	0.241	0.077	0.034	0.146	0.337	0.165	0.322
Bray-Curtis Distance (REF 1 median) (FL)	REF1	5	0.223	0.212	0.077	0.034	0.116	0.307	0.086	0.297
	REF2	5	0.427	0.448	0.039	0.017	0.400	0.496	0.418	0.508
	EXP	5	0.740	0.693	0.156	0.070	0.500	0.887	0.442	0.828
Bray-Curtis Distance (REF 2 median) (FL)	REF1	5	0.406	0.452	0.069	0.031	0.366	0.537	0.395	0.541
	REF2	5	0.094	0.111	0.071	0.032	0.022	0.200	0.044	0.221
	EXP	5	0.776	0.748	0.121	0.054	0.598	0.899	0.551	0.855
% Oligochaeta	REF1	5	2%	2%	1%	0%	1%	3%	1%	3%
	REF2	5	27%	27%	6%	3%	20%	34%	21%	36%
	EXP	5	5%	5%	2%	1%	3%	8%	3%	7%
% Mites	REF1	5	7%	7%	3%	1%	3%	11%	4%	11%
	REF2	5	1%	1%	0%	0%	0%	1%	0%	1%
	EXP	5	12%	11%	3%	1%	7%	15%	7%	16%
% Mayflies	REF1	5	17%	17%	6%	3%	10%	24%	11%	26%
	REF2	5	6%	6%	1%	0%	5%	7%	5%	7%
	EXP	5	17%	16%	4%	2%	11%	21%	11%	21%
% Stoneflies	REF1	5	35%	35%	13%	6%	20%	51%	20%	54%
	REF2	5	15%	16%	4%	2%	12%	21%	13%	22%
	EXP	5	23%	23%	7%	3%	15%	32%	13%	30%
% Caddisflies	REF1	5	1%	1%	0%	0%	1%	2%	1%	2%
	REF2	5	1%	1%	0%	0%	0%	1%	0%	1%
	EXP	5	5%	5%	1%	1%	3%	6%	3%	6%
% EPT	REF1	5	58%	54%	15%	7%	35%	73%	32%	71%
	REF2	5	23%	23%	4%	2%	18%	28%	18%	29%
	EXP	5	44%	44%	8%	4%	33%	54%	35%	56%
% Chironomids	REF1	5	30%	35%	12%	5%	20%	49%	22%	52%
	REF2	5	44%	47%	8%	4%	37%	57%	39%	57%
	EXP	5	37%	35%	11%	5%	22%	49%	20%	48%
% Shredders	REF1	5	29%	32%	12%	5%	17%	48%	18%	51%
	REF2	5	15%	16%	4%	2%	11%	21%	13%	22%
	EXP	5	21%	22%	7%	3%	13%	31%	11%	29%
% Scrapers	REF1	5	12%	13%	5%	2%	7%	20%	8%	22%
	REF2	5	5%	5%	1%	0%	4%	7%	4%	7%
	EXP	5	18%	17%	5%	2%	11%	22%	12%	22%
% Collector - Gatherers	REF1	5	40%	42%	11%	5%	28%	55%	28%	57%
	REF2	5	76%	76%	4%	2%	71%	81%	71%	81%
	EXP	5	48%	45%	10%	5%	32%	57%	29%	54%
% Filterers	REF1	5	4%	3%	2%	1%	1%	5%	1%	5%
	REF2	5	0%	1%	0%	0%	0%	1%	0%	1%
	EXP	5	1%	1%	1%	0%	0%	2%	0%	2%

Table C.5: Descriptive statistics of benthic invertebrate community metrics at lowest-practical-level (LPL) taxonomy, Bellekeno Mine Cycle 1 EEM, August 2012.

Variable	Area	n	Median	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Min	Max
							Lower Bound	Upper Bound		
Number of Taxa (LPL)	REF1	5	31.0	29.6	3.4	1.5	25.4	33.8	26.0	33.0
	REF2	5	25.0	26.0	3.4	1.5	21.8	30.2	22.0	30.0
	EXP	5	32.0	32.8	2.5	1.1	29.7	35.9	31.0	37.0
Simpson's Evenness (LPL)	REF1	5	0.316	0.333	0.067	0.030	0.249	0.416	0.268	0.425
	REF2	5	0.235	0.242	0.034	0.015	0.199	0.284	0.199	0.294
	EXP	5	0.274	0.291	0.074	0.033	0.200	0.383	0.220	0.411
Bray-Curtis Distance (REF 1 median) (LPL)	REF1	5	0.237	0.247	0.045	0.020	0.191	0.303	0.207	0.324
	REF2	5	0.674	0.670	0.044	0.020	0.615	0.724	0.600	0.714
	EXP	5	0.849	0.781	0.117	0.052	0.635	0.926	0.590	0.866
Bray-Curtis Distance (REF 2 median) (LPL)	REF1	5	0.679	0.674	0.031	0.014	0.635	0.712	0.627	0.712
	REF2	5	0.144	0.139	0.069	0.031	0.054	0.225	0.047	0.219
	EXP	5	0.780	0.745	0.136	0.061	0.577	0.914	0.519	0.858

Table C.6: Benthic invertebrate community statistical comparison results among Lightning Creek study areas calculated at lowest practical level (LPL) taxonomy, Bellekeno Mine EEM, August 2012.

Metric	Area	Mean	Overall 3-group ANOVA			Post-hoc Pair-Wise Comparisons					Estimation of Effect Size	
			Significant Difference Among Areas?	*p*-value	Power	Test Type	(I) Area	(J) Area	Significant Difference Between Areas?	*p*-value	Magnitude of Difference [a] (No. of SD)	Minimum Detectable Effect Size [b] (No of SD)
Number of Taxa (Lowest Practical Level)	REF1	29.6	Yes	0.016	0.881	Bonferroni	REF1	EXP	No	0.389	-	2.040
	REF2	26.0					REF2	EXP	Yes	0.014	2.005	-
	EXP	32.8					REF1	REF2	No	0.276	-	2.328
Simpson's Evenness (Lowest Practical Level)	REF1	0.33	No	0.101	0.596	Bonferroni	REF1	EXP	No	0.914	-	2.441
	REF2	0.24					REF2	EXP	No	0.665	-	3.910
	EXP	0.29					REF1	REF2	No	0.108	-	1.840
Bray-Curtis Distance (REF 1 median) (Lowest Practical Level)	REF1	0.25	Yes	0.000	1.000	Bonferroni	REF1	EXP	Yes	0.000	11.883	-
	REF2	0.67					REF2	EXP	No	0.124	-	4.688
	EXP	0.78					REF1	REF2	Yes	0.000	9.413	-
Bray-Curtis Distance (REF 2 median) (Lowest Practical Level)	REF1	0.67	Yes	0.000	1.000	Bonferroni	REF1	EXP	No	0.696	-	7.375
	REF2	0.14					REF2	EXP	Yes	0.000	8.798	-
	EXP	0.75					REF1	REF2	Yes	0.000	17.280	-

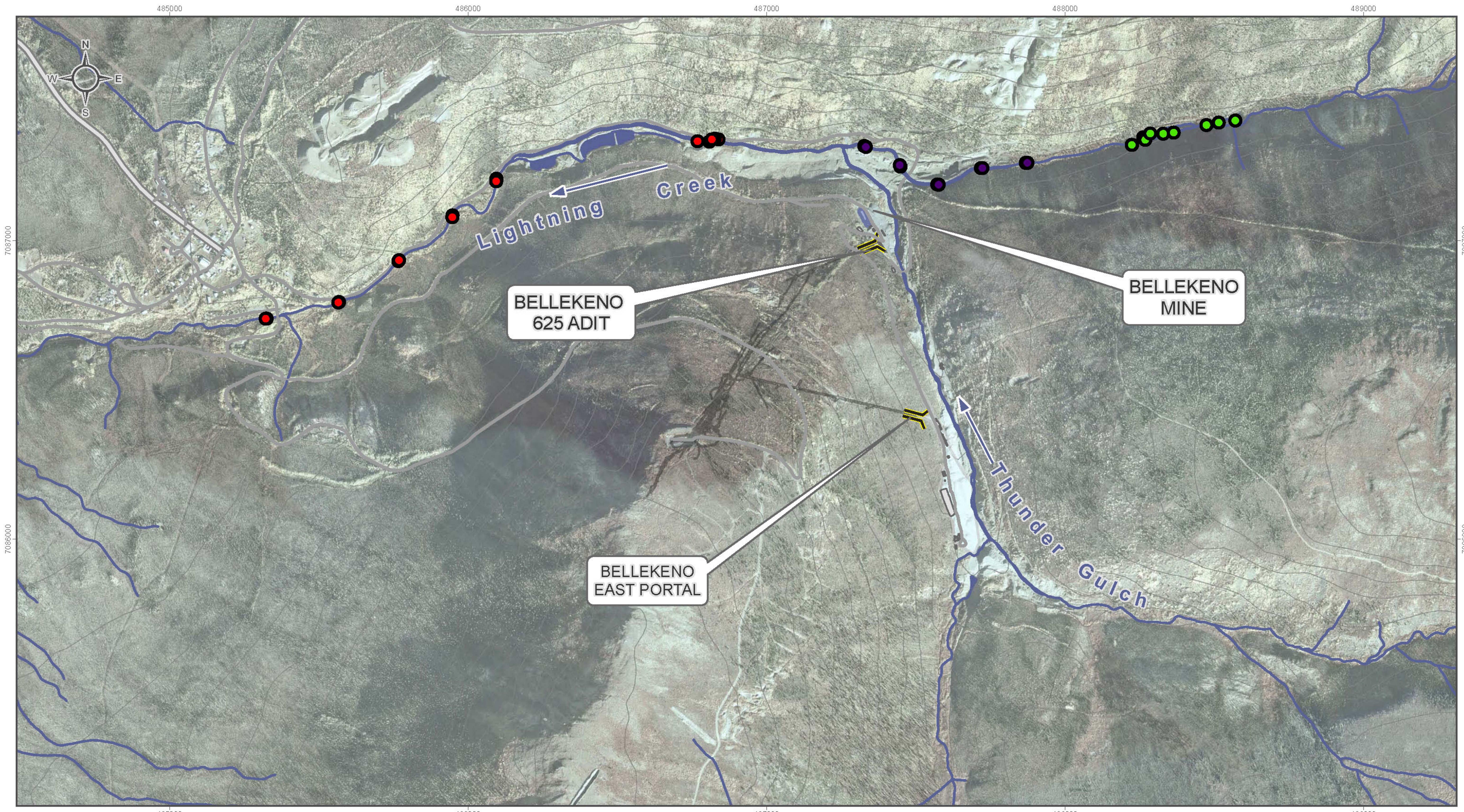
[a] Magnitude calculated by comparing the difference between the reference area and effluent-exposed area means divided by the reference area standard deviation (Environment Canada 2011)

[b] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10 (Environment Canada 2011)

Highlighted values indicates significant difference among/between study areas based on a p-value less than 0.10.

APPENDIX D

FISH POPULATION AND FISH TISSUE SURVEY DATA



Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13 and 14 2006. Site hydrography and contours provided by Aero Geometrics LTD, derived from aerial photograph.

Datum: NAD 83; Map Projection: UTM Zone 8N

1:12,000 (when printed on 11 x17 inch paper)

0 250 500 1,000 Meters

MINNOW TRAPPING LOCATIONS

- Reference Pristine (REF 1)
- Reference Placer Impacted (REF 2)
- Effluent-Exposed (EXP)

AKHM

ACCESS

BELLEKNO MINE PROJECT - ENVIRONMENTAL EFFECTS MONITORING PROGRAM - CYCLE I INTERPRETIVE REPORT

FIGURE D1

MINNOW TRAPPING LOCATIONS FOR EEM FISH SURVEY

MARCH 2013

I:\ALEX-05-01\Bellekeno\GIS\mxd\Studies\EEM_Cycle_1\02-Report\Fig_D1_Minnow_Trapping_20130228.mxd
(Last edited by: jpan;3/1/2013/13:04 PM)

Table D.1: Electrofishing details and catches for Lightning Creek on June 11th and 12th, Bellekeno Mine Cycle 1 EEM. Catch-per-unit-effort (CPUE) represents number of fish captured per electrofishing minute.

			Pristine Reference (REF1)					Effluent-Exposed (EXP)					
Electrofishing Details	**Study Area**												
	Area Pass ID		REF1-1	REF1-2	REF1-3	REF1-4	REF1-5	EXP-1	EXP-2	EXP-3	EXP-4	EXP-5	EXP-6
	Date		12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	11-Jun-12	11-Jun-12	11-Jun-12	11-Jun-12	11-Jun-12	11-Jun-12
	Start Location	Latitude	63 55.011	63 54.926	63 55.011	63 55.152	63 54.972	63 54.783	63 54.283	63 53.622	63 53.622	63 54.459	63 54.415
		Longitude	135 11.923	135 12.943	135 11.923	135 09.329	135 10.042	132 16.230	135 20.034	135 21.047	135 21.047	135 17.862	135 18.548
	End Location	Latitude	63 55.017	63 54.950	63 54.948	63 55.178	63 54.925	63 54.773	63 54.253	63 53.898	63 53.562	62 54.441	63 54.409
		Longitude	135 11.449	135 12.391	135 12.410	135 09.136	135 10.261	135 15.997	135 19.644	135 20.602	135 21.024	135 18.053	135 18.571
	Length of Run (m)		410	453	370	160	200	200	175	630	112	160	25
	Fishing Effort (Minutes)		15.9	13.3	5.5	6.4	4.4	6.9	5.8	19.6	2.1	4.3	1.4
Captures	Slimy Sculpin	Catch	0	0	0	0	0	0	0	6	2	0	0
		CPUE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.94	0.00	0.00
	Arctic Grayling	Catch	0	0	0	0	0	0	2	1	0	1	0
		CPUE	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.05	0.00	0.23	0.00
	Totals	Catch	0	0	0	0	0	0	2	7	2	1	0
		CPUE	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.36	0.94	0.23	0.00

Table D.2: Electrofishing details and catches for Lightning Creek on August 25th and 26th, Bellekeno Mine Cycle 1 EEM. Catch-per-unit-effort (CPUE) represents number of fish captured per electrofishing minute.

	Study Area		Pristine Reference (REF1)		Effluent-Exposed (EXP)			
Electrofishing Details	Area Pass ID		REF1-1	REF1-2	EXP-1	EXP-2	EXP-3	EXP-4
	Date		25-Aug-12	26-Aug-12	25-Aug-12	25-Aug-12	25-Aug-12	26-Aug-12
	Start Location	Latitude	63 55.063	63 55.310	63 54.863	63 54.755	63 55.062	63 53.900
		Longitude	135 14.043	135 11.893	135 17.387	135 17.878	135 15.960	135 21.048
	End Location	Latitude	63 55.118	63 55.310	63 54.863	63 54.765	63 55.052	63 54.130
		Longitude	135 14.043	135 11.880	135 17.045	135 17.772	135 15.558	135 20.750
	Length of Run (m)		275	25	310	89	310	477
	Fishing Effort (Minutes)		17.7	0.2	16.7	17.2	17.2	6.2
Captures	Slimy Sculpin	Catch	0	0	0	0	0	2
		CPUE	0.00	0.00	0.00	0.00	0.00	0.32
	Arctic Grayling	Catch	9	1	2	1	8	21
		CPUE	0.51	5.00	0.12	0.06	0.47	3.38
	Totals	Catch	9	1	2	1	8	23
		CPUE	0.51	5.00	0.12	0.06	0.47	3.70

Table D.3: Catch records for minnow traps set in Lightning Creek during June and August sampling, Bellekeno Mine Cycle 1 EEM.

Month	Area	Set ID	No. of traps	Location (NAD83)		Set Date	Lift Date	Set Time	Lift Time	Time (days)	Trap hours	Total Catches	
				Latitude	Longitude							Catch	CPUE
June	Reference	RMT1	1	63 55.065	135 14.403	June 10, 2012	June 11, 2012	19:00	16:30	0.90	21.50	0	0.00
		RMT2	1	63 54.783	135 14.355			19:00	16:30	0.90	21.50	0	0.00
		RMT3	1	63 54.781	135 14.347			19:00	16:30	0.90	21.50	0	0.00
		RMT4	1	63 54.794	135 14.276			19:15	16:30	0.89	21.25	0	0.00
		RMT5	1	63 54.790	135 14.326			19:15	16:30	0.89	21.25	0	0.00
	TOTAL		**5**							**4.46**	**107.00**	**0**	**0.00**
	Effluent-Exposed	EMT1	1	63 54.772	135 16.058	June 10, 2012	June 11, 2012	20:00	07:30	0.48	11.50	0	0.00
		EMT2	1	63 54.776	135 16.095			20:00	07:30	0.48	11.50	0	0.00
		EMT3	1	63 54.777	135 16.097			20:05	07:30	0.48	11.42	0	0.00
		EMT4	1	63 54.776	135 16.122			20:10	07:30	0.47	11.33	0	0.00
		EMT5	1	63 54.772	135 16.180			20:10	07:30	0.47	11.33	0	0.00
	TOTAL		**5**							**2.38**	**57.08**	**0**	**0.00**
August	Reference	Ref-1	10	63 55.065	135 14.403	Aug 24, 2012	Aug 25, 2012	17:00	08:00	0.63	15.00	0	0.00
		Ref-2	10	63 55.065	135 15.500			17:40	12:00	0.76	18.33	0	0.00
	TOTAL		**20**							**1.39**	**33.33**	**0**	**0.00**
	Effluent-Exposed	Exp-1	10	63 55.002	135 17.015	Aug 23, 2012	Aug 24, 2012	17:20	16:30	0.97	23.17	0	0.00
	TOTAL		**10**							**0.97**	**23.17**	**0**	**0.00**

Minnow Trap CPUE = # fish/day/trap

Table D.4: Arctic grayling meristic data for the Lightning Creek Reference (REF1) area in August, 2012

Specimen ID	Collection Method	Fork Length (cm)	Total Length (cm)	Whole Body Weight (g)	Age (years)	Fulton's Condition Factor (K)	Abnormalities
REF - AG - 01	Electrofishing	37.9	40.4	400	8	0.735	None observed
REF - AG - 02	Electrofishing	33.8	36.6	530	6	1.373	None observed
REF - AG - 03	Electrofishing	38.5	41.9	660		1.157	Cyst on caudal fin
REF - AG - 04	Electrofishing	34.5	37.7	560	8	1.364	None observed
REF - AG - 05	Electrofishing	34.8	37.2	420	4	0.997	None observed
REF - AG - 06	Electrofishing	35.6	38.2	520	5	1.153	None observed
REF - AG - 07	Electrofishing	35.0	38.2	450	6	1.050	None observed
REF - AG - 08	Electrofishing	20.2	21.9	92		1.116	None observed
REF - AG - 09	Electrofishing	17.6	19.1	63		1.156	None observed
REF - AG - 10	Electrofishing	27.7	31.5	286	4	1.346	None observed
Summary Statistics - All data	total number	10	10	10	7	10	na
	average	31.6	34.3	398	5.9	1.144	na
	median	34.7	37.5	435	6.0	1.154	na
	standard deviation	7.3	7.8	197	1.7	0.194	na
	standard error	2.3	2.5	62	0.6	0.062	na
	minimum	17.6	19.1	63	4	0.735	na
	maximum	38.5	41.9	660	8	1.373	na

Table D.5: Arctic grayling meristic data for the Lightning Creek Effluent-Exposed (EXP) area in June, 2012

Specimen ID	Collection Method	Fork Length (cm)	Total Length (cm)	Whole Body Weight (g)	Age (years)	Fulton's Condition Factor (K)	Abnormalities
EXP - AG - 01	Electrofishing	31.5	33.4	290	6	0.928	None observed
EXP - AG - 02	Electrofishing	30.0	32.8	340	6	1.259	None observed
EXP - AG - 03	Electrofishing	29.9	31.2	280	6	1.047	None observed
EXP - AG - 04	Electrofishing	25.5	28.0	152	4	0.917	None observed
Summary Statistics - All data	total number	4	4	4	4	4	na
	average	29.2	31.4	265.5	5.5	1.038	na
	median	30.0	32.0	285.0	6.0	0.988	na
	standard deviation	2.6	2.4	80.1	1.0	0.159	na
	standard error	1.3	1.2	40.0	0.5	0.080	na
	minimum	25.5	28.0	152	4.0	0.917	na
	maximum	31.5	33.4	340	6.0	1.259	na

Table D.6: Arctic grayling meristic data for the Lightning Creek Effluent-Exposed (EXP) area in August, 2012

Specimen ID	Collection Method	Fork Length (cm)	Total Length (cm)	Whole Body Weight (g)	Age (years)	Fulton's Condition Factor (K)	Abnormalities
EXP - AG - 01	Electrofishing	22.6	24.6	120	4	1.040	None observed
EXP - AG - 02	Electrofishing	18.1	19.4	67		1.130	None observed
EXP - AG - 03	Electrofishing	15.9	17.2	45		1.119	None observed
EXP - AG - 04	Electrofishing	25.5	27.7	188	4	1.134	None observed
EXP - AG - 05	Electrofishing	34.4	37.4	390	6	0.958	None observed
EXP - AG - 06	Electrofishing	30.0	32.4	264	5	0.978	None observed
EXP - AG - 07	Electrofishing	23.9	25.4	142	3	1.040	None observed
EXP - AG - 08	Electrofishing	18.0	19.6	66		1.132	None observed
EXP - AG - 09	Electrofishing	18.9	20.5	72		1.066	None observed
EXP - AG - 10	Electrofishing	17.1	18.8	50		1.000	None observed
EXP - AG - 11	Electrofishing	19.6	21.2	81		1.076	None observed
EXP - AG - 12	Electrofishing	23.7	26.2	148	4	1.112	None observed
EXP - AG - 13	Electrofishing	20.3	22.4	108	3	1.291	None observed
EXP - AG - 14	Electrofishing	19.4	20.9	88	2	1.205	None observed
EXP - AG - 15	Electrofishing	13.9	15.2	32		1.192	None observed
EXP - AG - 16	Electrofishing	15.7	17.1	40		1.034	None observed
EXP - AG - 17	Electrofishing	16.8	18.5	56		1.181	None observed
EXP - AG - 18	Electrofishing	13.6	14.7	24		0.944	None observed
EXP - AG - 19	Electrofishing	15.3	16.8	37		1.033	None observed
EXP - AG - 20	Electrofishing	15.3	16.6	38		1.061	None observed
EXP - AG - 21	Electrofishing	14.3	15.3	26		0.898	None observed
EXP - AG - 22	Electrofishing	18.7	20.6	80		1.223	None observed
EXP - AG - 23	Electrofishing	19.4	20.9	73		1.000	None observed
EXP - AG - 24	Electrofishing	15.3	16.5	36		1.005	None observed
EXP - AG - 25	Electrofishing	18.6	20.2	77		1.197	None observed
EXP - AG - 26	Electrofishing	16.4	17.9	51		1.156	None observed
EXP - AG - 27	Electrofishing	15.1	16.7	51		1.481	None observed
EXP - AG - 28	Electrofishing	16.0	17.5	42		1.025	None observed
EXP - AG - 29	Electrofishing	19.9	21.5	85		1.079	None observed
EXP - AG - 30	Electrofishing	16.6	18.1	46		1.006	None observed
EXP - AG - 31	Electrofishing	13.4	14.4	23		0.935	None observed
EXP - AG - 32	Electrofishing	12.9	14.1	21		0.990	None observed
Summary Statistics - All data	total number	32	32	32	8	32	na
	average	18.6	20.2	83.3	3.9	1.085	na
	median	17.6	19.1	61.0	4.0	1.064	na
	standard deviation	4.8	5.2	76.6	1.2	0.118	na
	standard error	0.8	0.9	13.5	0.4	0.021	na
	minimum	12.9	14.1	21.25	2.0	0.898	na
	maximum	34.4	37.4	390	6.0	1.481	na

Table D.7: Arctic grayling dorsal muscle moisture (%) and metal concentrations (ug/g wet weight) in fish collected at Lightning Creek study areas during June and August, 2012

	Reference Area (REF1) - August Data								Effluent-Exposed Area (EXP) - June Data				Effluent-Exposed Area (EXP) - August Data							
Sample ID	REF-AG01	REF-AG02	REF-AG03	REF-AG04	REF-AG05	REF-AG06	REF-AG07	REF-AG10	EXP-AG01	EXP-AG02	EXP-AG03	EXP-AG04	EXP-AG01	EXP-AG04	EXP-AG05	EXP-AG06	EXP-AG07	EXP-AG12	EXP-AG13	EXP-AG14
Date Sampled	25-Aug	25-Aug	25-Aug	25-Aug	25-Aug	25-Aug	25-Aug	26-Aug	11-Jun	11-Jun	11-Jun	11-Jun	25-Aug	25-Aug	25-Aug	25-Aug	25-Aug	26-Aug	26-Aug	26-Aug
% Moisture	83	76.9	78.9	77.7	76.8	75.7	77.6	79	81.1	80.8	80.4	80.4	81.6	79.8	82.5	80.9	80	85.6	80.6	81
Arsenic	0.062	0.09	0.074	0.0904	0.073	0.094	0.0996	0.145	0.0318	0.06	0.0531	0.0847	0.0321	0.0526	0.108	0.046	0.049	0.024	0.0415	0.0243
Barium	0.246	0.129	0.12	0.378	0.2	0.376	0.047	0.879	0.099	0.108	0.048	0.151	0.119	0.194	0.18	0.14	0.19	0.058	0.092	0.037
Boron	< 0.6	< 0.6	< 0.4	< 0.4	< 0.6	< 0.6	< 0.4	< 0.4	5.58	< 0.4	1.44	7.42	< 0.4	< 0.4	31.2	< 0.2	16.6	< 0.4	< 0.4	< 0.4
Cadmium	0.0079	< 0.006	0.0052	0.007	0.011	0.0079	< 0.004	< 0.004	0.0055	0.009	0.0043	0.0078	0.0081	0.005	0.0064	< 0.002	< 0.002	< 0.004	< 0.004	< 0.004
Calcium	908	105	70	341	102	113	80	166	454	129	92	114	104	94	218	101	103	65	94	89
Cesium	0.0772	0.0832	0.106	0.121	0.0612	0.0838	0.0497	0.0296	0.0396	0.0583	0.0307	0.0533	0.0324	0.0153	0.0551	0.023	0.024	0.0107	0.042	0.009
Chromium	0.328	0.085	0.083	0.137	0.112	0.127	0.046	0.164	0.254	0.669	0.037	0.103	0.099	0.18	0.191	< 0.10	0.1	0.039	0.081	0.09
Cobalt	0.049	0.051	0.034	0.0212	0.057	0.083	0.054	0.0651	0.0423	0.0622	0.0361	0.0199	0.025	0.0461	0.0536	0.074	< 0.040	0.0294	0.0462	0.042
Copper	0.336	0.339	0.353	0.358	0.309	0.333	0.273	0.343	0.408	0.446	0.455	0.405	0.284	0.308	0.428	0.26	0.34	0.173	0.243	0.258
Iron	26.4	12.8	< 8.5	21	< 11.0	< 13.0	< 7.5	18.6	< 6.5	13.4	< 5.0	8.38	15.8	11.3	< 11.0	16.3	13.8	< 4.0	< 6.5	< 5.0
Lead	0.126	0.167	0.0528	0.106	0.104	0.098	0.0239	0.12	0.0613	0.0778	0.061	0.0932	0.0625	0.0697	0.0723	0.094	0.069	0.203	0.0569	0.0239
Magnesium	252	346	270	300	336	354	311	316	298	303	300	278	327	338	329	360	350	196	341	328
Mangances	1.71	1.7	0.462	0.827	0.633	0.672	0.29	0.702	0.604	0.594	0.394	0.372	0.603	0.663	0.826	0.807	0.899	0.298	0.418	< 0.3
Mercury	0.0317	< 0.0080	0.0344	0.0157	0.029	0.0291	0.0282	< 0.008	0.0162	0.0089	0.0086	0.0053	0.0105	0.0094	0.0177	< 0.0010	< 0.0010	0.0054	0.0099	0.0078
Molybdenum	0.024	0.03	0.0108	0.04	0.017	< 0.01	0.0237	0.0516	< 0.008	0.022	0.0114	0.0118	0.0094	< 0.008	0.0211	< 0.004	< 0.004	< 0.008	0.0203	0.0107
Nickel	2.71	2.06	0.762	1.25	1.38	0.829	0.239	4.86	0.22	1.71	0.16	0.447	1.66	2.25	1.17	0.5	0.62	0.576	1.71	1.9
Phophorus	2860	2940	2520	2650	2730	2940	2670	2570	2570	2540	2360	2220	2820	2730	2800	2760	2740	1480	2680	2610
Potassium	4900	5500	5100	4700	5300	5810	5100	5100	4800	5100	4730	4320	5600	5500	5500	5600	5300	3030	5100	5300
Rubidium	3.76	5.52	5.05	4.34	3.96	5.13	4.14	3.71	2.57	3.17	3.31	2.87	3.46	3.93	3.18	3.29	3.35	1.75	4.03	3.33
Selenium	0.667	1.13	1.22	0.61	1	1.31	1.17	0.831	0.702	0.733	0.721	1.04	0.955	0.871	0.834	1	1.5	0.666	0.869	0.845
Strontium	0.646	0.073	0.063	0.239	0.07	0.098	0.061	0.552	0.339	0.099	0.055	0.086	0.078	0.057	0.181	< 0.10	0.11	0.068	0.048	0.06
Thallium	0.0041	0.0038	0.00316	0.00457	0.0041	0.0047	0.00257	0.00248	0.00288	0.00407	0.00326	0.00336	0.00316	0.00237	0.00309	< 0.0040	< 0.0040	0.00174	0.00394	0.00208
Tin	0.036	0.013	< 0.008	0.0127	0.014	0.018	< 0.008	0.0204	0.0082	0.0176	< 0.004	< 0.008	< 0.008	0.0122	0.0212	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008
Uranium	< 0.0012	< 0.0012	< 0.0008	0.00304	< 0.0012	0.0016	< 0.0008	0.0014	< 0.0008	0.00227	0.00135	0.00097	< 0.0008	< 0.0008	< 0.0008	< 0.0004	< 0.0004	< 0.0008	< 0.0008	< 0.0008
Vanadium	0.019	0.023	0.0422	0.0507	0.031	0.125	0.011	0.0935	0.0096	0.0266	0.0061	0.0592	0.0175	0.0143	0.0246	< 0.004	< 0.004	< 0.008	0.016	0.0162
Zinc	5.62	5.84	3.88	4.42	5.72	6.11	4.25	4.33	7.07	12.2	5.42	19.3	4.66	4.22	4.8	4	5.8	2.44	4.2	3.66