Bridge River Project Water Use Plan

Bridge-Seton Metals and Contaminant Monitoring Program

Implementation Year 1

Reference: BRGMON-12

Temporal and Spatial Patterns of Metals in Fish

Study Period: 2013

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BRGMON-12: Bridge River Contaminants Monitoring Program, 2013

Temporal and Spatial Patterns of Metals in Fish

Prepared for

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Randy Baker wrote this report with assistance from Maggie McConnell of Azimuth.

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ACRONYMS

ALS	ALS Laboratories Vancouver BC
BT	bull trout
COC	Chain-of-Custody
CRM	Certified Reference Material
DQO	Data quality objective
Hg	mercury
ISQG	Interim Sediment Quality Guideline
LBR	Lower Bridge River
m	meters
MDL	method detection limit
MW	mountain whitefish
ppm	parts per million
QA/QC	Quality Control/Quality Assurance
RB	rainbow trout
RPD	Relative percent difference
SRM	Standard Reference Material
SD	standard deviation
UTM	Universal Transverse Mercator
ww	wet weight

EXECUTIVE SUMMARY

This report has been prepared on behalf of St'at'imx Eco-Resources, Lillooet BC as part of interdisciplinary monitoring of the operation of the Bridge River hydroelectric facility following approval of the Water Use Planning (WUP) for this system. The objective of this BRGMON-12 program is to monitor temporal changes in mercury and other metals concentrations within environmental media in the Bridge River System from 2011 – 2013. The current 2013 investigation is the first year of a long-term study that focuses on fish mercury concentrations of key species, namely bull trout (*Salvelinus malma*), rainbow trout (*Oncorhynchus mykiss*) and mountain whitefish (*Prosopium williamsoni*), in the Bridge River system.

The BRGMON-12 contaminants monitoring program has been designed to determine whether regulation of the Bridge River system under the N2-2P regime has mobilized and caused an increase in metals (in particular, mercury) into the food web of Carpenter Reservoir, Seton Lake and Lower Bridge River. Key 'management questions' were posed in the form of null hypotheses. The main hypothesis addressed by BRGMON-12 was "Implementation of the N2-2P alternative will not increase metal concentration into the abiotic or biotic components of the Carpenter Reservoir, Seton Lake or Lower Bridge River ecosystems." Results of the Azimuth (2012) investigation in 2011 addressed hypotheses H1a and b; H2a and b; and H3a and b; Water and sediment chemistry concentration data in Carpenter Reservoir and Seton Lake were stable and had not changed over at least a 12 year period. This 2013 report addresses H1c, H2c and H3c; to determine if there has been a temporal change in fish metals (mercury) concentrations in these three waterbodies.

During the 2013 open water season, Mr. G. Tisdale captured and sampled 110 fish while fulfilling different monitoring programs. Tissue samples were harvested from bull trout and rainbow trout using non-destructive techniques; mountain whitefish were sacrificed. Fish were sampled from Downton Reservoir (11, all rainbow trout) Carpenter Reservoir (37 fish), Seton Lake (41 fish) and lower Bridge River (21 fish). Forty five were rainbow trout, 33 bull trout, 20 mountain whitefish and 12 kokanee. Ten fish per species from each waterbody were targeted. All fish were sampled for mercury concentration in muscle tissue, while mountain whitefish were also analysed for a full suite of metals concentration from Seton Lake and Carpenter Reservoir. These data were compared to results of 2000 and 2008 fish mercury / metals investigations, to determine if there has been a change over time, in Carpenter Reservoir, Seton Lake and Lower Bridge River.

In 2013, Seton Lake fish were larger and had a higher condition factor than their counterparts from Carpenter Reservoir and Bridge River. Rainbow trout were similar in size among all waterbodies (~350 mm), except from Downton Reservoir (315 mm). This

trend was also observed in 2008 and is likely related to generally lower productivity in high-drawdown reservoirs, such as Carpenter and Downton reservoirs.

Arithmetic mean and maximum mercury concentrations of fish from Carpenter Reservoir from all species were about 3 times higher than fish from Seton Lake and over 5 times higher than fish from the Lower Bridge River. By extension, mercury concentrations of Seton Lake fish were double that of Lower Bridge River fish. These trends were also observed in the 2000 and 2008 fish mercury surveys. In 2013, arithmetic mean mercury concentrations in bull trout from Carpenter Reservoir (0.71 ppm) were higher than from Seton Lake (0.22 ppm) and Lower Bridge River (0.08 ppm), although mean fish size differed between years. Mean mercury concentration of Carpenter Reservoir rainbow trout (0.21 ppm) was higher than in Seton Lake (0.11 ppm) and Lower Bridge River (0.08 ppm). Mean mercury concentration of Carpenter Reservoir mountain whitefish (0.32 ppm) was higher than in Seton Lake (0.11 ppm); no whitefish were captured from Lower Bridge River in 2013 or in 2008.

Arithmetic mean mercury concentrations or species-specific size-standardized concentrations (where derived) from 2013 were compared to similar data from 2000 and 2008 surveys. In Carpenter Reservoir, there has been no change over time in bull trout or mountain whitefish mercury concentrations; however, rainbow trout appear elevated in 2013 relative to earlier data. In Seton Lake, mercury concentrations of bull trout and rainbow trout have remained stable, while mercury concentrations of mountain whitefish appeared higher in 2013 (0.08 ppm) than in 2008 (0.04 ppm). However, these are very concentrations and the difference is negligible. In Lower Bridge River fish, mercury concentrations are very low for all species and have not changed over time, or have been reduced.

Regardless of relative changes over time, mercury concentrations in fish in Carpenter Reservoir are higher than in many other lakes and reservoirs in BC. For example, the size-standardized (450 mm) mercury concentration of bull trout (0.79 ppm) is among the highest for this species in British Columbia lakes and reservoirs, but similar to what is found in other piscivorous species from hundreds of lakes elsewhere in Canada (DePew et al. 2013). These results confirm that Carpenter Reservoir generates more methylmercury that is sequestered and accumulated within the aquatic food web than the rest of the Bridge River system, a pattern that has not changed substantially since monitoring data were first collected 20 years ago. Whether elevated concentrations in Carpenter Reservoir fish is related to annual re-flooding of exposed and re-vegetated areas due to the large drawdown amplitude of the reservoir, or related to chronic inputs of inorganic mercury from natural or mining-related historic lode and mercury mining operations, (e.g., Silverquick Mine), or a combination of both, is unknown.

1. INTRODUCTION

1.1. Background

This report has been prepared on behalf of St'at'imx Eco-Resources, Lillooet BC as part of interdisciplinary monitoring of the operation of the Bridge River hydroelectric facility following approval of the Water Use Planning (WUP) for this system. One of the issues identified in the WUP was that the new N2-2P operating regime may alter hydrodynamics of the system. Concern was expressed that the current operation had the potential to mobilize metals (and mercury) from sediments from Carpenter Reservoir to be re-introduced into the system, especially Seton Lake and Lower Bridge River, potentially leading to changes in metals concentrations that could adversely affect the aquatic food web and/or human health. Monitoring of metals concentrations in water, sediment and biota prior to and following operational changes will serve as the benchmark from which to determine whether or not changes have occurred. While monitoring of hydrodynamic changes and the physical potential for re-mobilization of metals or other contaminants was contemplated, ultimately, changes in metals concentrations within environmental media was considered the best endpoint. Mercury (Hg) has been used as a key indicator metal because of its presence in mineralized soils of the area (e.g., Cinnabar Creek, a tributary to Carpenter Reservoir), its possible historic use in gold mining operations, its tendency to become concentrated in the aquatic food web (especially in fish), and because of its potential toxic effects at elevated concentrations.

The program developed to monitor mercury and metals concentrations within environmental media in the Bridge River System has been termed BRGMON-12. Prior to the 2013 investigation, field studies were conducted in 2000 with a focus on metals and mercury in sediment and fish (Baker and Mann 2001), in 2008 with a focus on metals in water, sediment and fish (Azimuth 2009) and in 2011 – 2012 with a focus on metals in sediment and in water discharged to Seton Lake from Carpenter Reservoir (Azimuth 2012). The purpose of the historic work was to gather data on mercury / metals concentrations in water, sediment and fish tissue and monitor trends in these parameters over time, prior to and subsequent to implementation of the WUP. Ultimately this information may be used to determine ecological health of the system and evaluate if there is a potential for risk to ecological and human health. The 2013 investigation is the first year of a long-term study that was initiated on behalf of BC Hydro and focused on fish mercury concentrations of key species in the Bridge River system.

1.2. Environmental Setting

The La Joie, Terzaghi and Seton dams, which form the Bridge-River system (**Figure 1**), are the third largest of BC Hydro's generation facilities. Water from upper Bridge River flows into Downton Reservoir where water level is controlled by the La Joie Generating Station (GS). This is the first of three generating facilities on the Bridge River system that are operated in concert as a peaking facility by BC Hydro. Water discharged from Downton Reservoir into Carpenter Reservoir is contained by Terzaghi Dam, 30 km downstream. At the downstream end of the reservoir water passes through two tunnels into the Bridge River GS located on the north shore of Seton Lake near the community of Shalalth. A low-head dam is located at the eastern end of Seton Lake that regulates lake levels within a very small range of only 0.4 m. Water from Seton Lake is discharged through Seton Dam, 750 m downstream of the outlet of Seton Lake, into the Power Canal and Seton River. In addition, an annualized flow of 6 m^3/sec is discharged from Terzaghi Dam into the lower Bridge River, to provide base flow in this reach until it joins the Yalakom River, 13 km downstream.

The Bridge River watershed is highly mineralized and has elevated background concentrations of some metals (Baker and Mann 2001). In particular the Tyaughton Creek watershed is elevated in some metals (arsenic) and mercury. This region was subjected to lode and placer mining for more than a century, some of which may have used mercury-amalgamation as an extraction technique. Mercury mineralization is also known to naturally occur in the Carpenter Reservoir watershed, as reflected in the names of two streams; North and South Cinnabar creeks.

The Bridge River camp encompasses five former mines including two large gold producers, Bralorne and Pioneer; three small producers, Wayside, Minto and Congress and more than 60 surrounding mineral prospects. Historically, operation of the Bralorne and Pioneer mines released heavy metals into the Bridge River system via Cadwallader Creek (http://www.gunlake.bc.ca/mining01.htm).

Creation of Carpenter Reservoir from impoundment by the Terzaghi Dam has created lake-like conditions, which has allowed fine sediments, potentially enriched with metals and mercury from upstream sources (e.g., from Tyaughton Creek watershed) to accumulate in the reservoir.

1.3. History of Environmental Investigations

Seacor (1996)

The first dedicated investigation of potential contaminants in the Bridge River system was undertaken by Seacor Environmental Engineering (1996) in Seton Lake on behalf of the Seton Lake First Nation. The purpose of this project was to "investigate levels of contaminants of concern (i.e., PCBs, arsenic and mercury) in various media to which members of the Seton Lake Band may be exposed, including surface water, sediment, fish, drinking water, and representative traditional terrestrial foodstuffs" (Seacor 1996). Environmental sampling of water, sediment and fish within Anderson Lake, Carpenter Reservoir and Seton Lake was undertaken to determine potential contaminant concentrations within these waterbodies. Seacor (1996) concluded that surface water quality within the reservoirs and Seton Lake was high, with no exceedences of water quality guidelines for any regulated metal or PCBs within the system. The sediment data were not very useful because it was collected very nearshore at shallow depths from erosional beach locations. Sediment should be collected from depositional areas, which was the focus of subsequent studies by Azimuth. Nevertheless, minor exceedences of guidelines for the protection of aquatic life were observed for arsenic (one sample in Seton Lake), chromium, copper and manganese (most stations in all lakes) (Seacor 1996). A few rainbow trout (*Oncorhynchus mykiss*) and mountain whitefish (*Prosopium williamsoni)* were analysed for tissue mercury concentrations. These data are not discussed here, and it is noteworthy that the units reported by Seacor (1996) are in parts per million (mg/kg) wet weight when in fact the data are actually in dry weight units (see the original laboratory report). Thus, to convert the data to wet weight, the reported data should be divided by 4, reducing the mercury concentrations reported in Seacor (1996) by approximately 80%.

Aqualibrium 2000

The next comprehensive monitoring program of the Bridge River system was conducted in November 2000 by Aqualibrium Environmental Consulting Inc. (now part of Azimuth Consulting Group, 'Azimuth'; Baker and Mann 2001). Sediment and fish tissue samples were collected from multiple locations from Carpenter Reservoir, Seton Lake, the lower Bridge River and an upstream location, Downton Reservoir, on the upper Bridge River to determine baseline metals and mercury concentrations prior to implementation of the WUP. This program established the network of monitoring stations that have served as sentinel locations for subsequent monitoring of sediment metals and contaminants concentrations in the Bridge River system.

Sediments were collected from deposition areas in each water body and analysed for grain size, organic carbon and a suite of metals. Results showed that arsenic (As),

chromium (Cr), nickel (Ni) and mercury (Hg) exceeded sediment quality guidelines for aquatic life protection. Arsenic and nickel consistently exceeded guideline concentrations at all stations in Carpenter Reservoir and Seton Lake and were associated with fine (silt / clay) sediment particles. The uniform distribution and concentration of arsenic, nickel and chromium in all waterbodies suggested that these metals are widespread and likely due to natural mineralization of this region of BC. Mercury also exceeded sediment quality guidelines but only at the mouth of Tyaughton Creek, suggesting an upstream source in this watershed.

Bull trout (25 fish), rainbow trout (27 fish) and mountain whitefish (17 fish) were sampled from Carpenter Reservoir (30 fish), Bridge River (18 fish) and Seton Lake (21 fish) for mercury concentration in tissues. Based on a common fish size for bull trout (400 mm), the 'size-adjusted' mean mercury concentration in Carpenter Reservoir fish was 0.54 ppm. Although very few trout were captured in Seton and Bridge, their concentrations were lower at 0.16 and 0.20 ppm respectively. Mountain whitefish (0.13 ppm) and rainbow trout (0.06 ppm) had low average mercury concentrations. No other metals were elevated in fish tissue relative to fish from uncontaminated lakes elsewhere in BC (Rieberger 1992).

Azimuth 2008

Azimuth updated the 2000 sediment and fish mercury and metals data in a 2008 investigation (Azimuth 2009), as well as water sampling for conventional parameters (e.g., pH, hardness, alkalinity and nutrients) and metals from multiple locations in each water body. Statistical analysis indicated that sediment metals concentrations had not changed substantially from 2000, with concentrations related to differences in sampling location and sediment grain size. As in 2000, a few metals (arsenic, cadmium, chromium, copper, mercury and zinc) exceeded aquatic life protection guidelines throughout the watershed. Given their widespread distribution and uniform concentration, these metals appear to be naturally elevated in this mineralized region, confirming the 2000 result.

Water samples were collected in May 2008, when water elevations in Downton and Carpenter Reservoirs were near annual low elevations. In downstream, lacustrine stations of Carpenter Reservoir and Seton Lake, water quality was good. Of the 28 metals tested, of which there are BC guidelines for the protection of aquatic life for about 20 of them, nearly all were below their respective guideline concentrations. Only cadmium, chromium and iron in lower Carpenter Reservoir exceeded guideline concentrations for aquatic life protection, likely due to elevated total suspended solids concentrations. There were no exceedences for any metal in Seton Lake.

With respect to fish, mercury concentrations in bull trout, rainbow trout and mountain whitefish were significantly higher in Carpenter Reservoir (by 2 – 7 times) than in Seton Lake or Bridge River in 2008, a pattern that was also observed in 2000, but to a lesser

degree. Mercury concentrations of bull trout, rainbow trout, and mountain whitefish in Seton Lake and Bridge River were low and similar to levels found in fish from pristine lakes. Mercury concentrations of Carpenter Reservoir bull trout have not changed between 1988 and 2008 and suggests that the concentrations measured are stable.

Azimuth 2011

In 2011, sediment was acquired from the same sampling locations as in 2000 and 2008 from Downton Reservoir, Carpenter Reservoir, Seton Lake and lower Bridge River. Of the seven heavy metals for which Canadian Council of Ministers of the Environment (CCME) guidelines exist, five (As, Cr, Cu, Hg and Zn) exceeded the aquatic life screening values at nearly all locations. However, when compared to 'regional' concentrations (Rieberger 1992), Carpenter Reservoir and Seton Lake metals concentrations were lower for all of these metals except arsenic. This result and the uniform spatial distribution and magnitude of sediment metals concentrations does not indicate any point-source location and confirms that concentrations are naturally elevated throughout this region due to regional mineralization. The range in concentrations of most metals in 2011 was similar to what was observed in 2000 and 2008, suggesting that there has been no change in bulk metals concentrations over the intervening 11 year period. Overall, metals concentrations in Bridge River system sediments appear to be stable with no discernible or consistent differences spatially or over time that are associated with anthropogenic (e.g., mining) influences or related to reservoir operation.

The chemistry of water discharged from Carpenter Reservoir to Seton Lake was measured on 14 different occasions between July 2011 and June 2012 for conventional parameters (pH, total suspended solids (TSS), anions, hardness, and alkalinity), nutrients and a suite of 33 metals, in both the particulate and dissolved phases. Water quality of Carpenter Reservoir / Seton Lake was excellent and typical of an uncontaminated oligotrophic lake, with 'soft' water with low nutrient and suspended sediment concentrations. Of the 21 metals for which there are provincial guideline concentrations to protect aquatic life, with rare exceptions, none exceeded even the most conservative 30-day average guideline during all months between August 2011 and May 2012. These results are consistent with what was observed in the 2008 system-wide water quality monitoring program (Azimuth 2009). Mercury concentrations were low and typical of remote, pristine systems. These data confirm that the concentrations and loadings of metals from Carpenter Reservoir to Seton Lake are low.

1.4. Objectives and Management Questions

The primary objective of the BRGMON-12 contaminants monitoring program is to determine whether regulation of the Bridge River system under the N2-2P regime has mobilized and caused an increase in metals (in particular, mercury) into the food web of the Bridge River system, in particular Seton Lake and Bridge River below Terzaghi Dam.

This has been addressed via collections of water, sediment and fish tissue at roughly five year intervals from each water body. A brief summary of results of these collections is provided here, in relation to the key Management Questions (in the form of hypotheses), which are as follows:

H1: Implementation of the N2-2P alternative will not increase metal concentration into the abiotic or biotic components of the Carpenter Reservoir ecosystem.

H1a: There is no significant increase in the concentration of metals and contaminants in water.

H1b: There is no significant increase in the concentration of metals and contaminants in sediment.

H1c: There is no significant increase in the concentration of metals and contaminants in fish tissue.

H2: Implementation of the N2-2P alternative will not increase metal concentration into the abiotic or biotic components of the Lower Bridge River ecosystem.

H2a: There is no significant increase in the concentration of metals and contaminants in water.

H2b: There is no significant increase in the concentration of metals and contaminants in sediment.

H2c: There is no significant increase in the concentration of metals and contaminants in fish tissue.

H3: Implementation of the N2-2P alternative will not increase metal concentration into the abiotic or biotic components of the Seton Lake Reservoir ecosystem.

H3a: There is no significant increase in the concentration of metals and contaminants in water.

H3b: There is no significant increase in the concentration of metals and contaminants in sediment.

H3c: There is no significant increase in the concentration of metals and contaminants in fish tissue.

These management questions have been formulated to address whether there have been changes to metals concentrations in water, sediment and fish in Carpenter Reservoir, Bridge River and Seton Lake subsequent to implementation of N2-2P.

Results of the Azimuth (2012) investigation in 2011 definitively addressed hypotheses H1a and b; H2a and b; and H3a and b. Sediment chemistry data confirmed that metals concentrations in Carpenter Reservoir and Seton Lake are stable and have not changed

over at least a 12 year period. Monitoring of water quality (pH, conventional parameters, metals including mercury and methylmercury) discharged from Carpenter Reservoir to Seton Lake over a one calendar year period confirmed that concentrations of all metals and mercury were low and typical of remote, pristine systems. No metal exceeded guidelines for the protection of aquatic life throughout this annual monitoring program.

Results of the Azimuth (2012) study confirm that management questions posed in H1a H2a and H3a have been addressed and the null hypothesis is accepted: there has been no change in contaminant concentrations in water.

Results of the Azimuth (2012) study also confirm that management questions posed in H1b, H2b and H3b have been addressed and the null hypothesis is accepted: there has been no change in contaminant concentrations in sediment.

The objective of the 2013 investigation is to determine the status of mercury concentrations in bull trout (*Salvelinus confluentus*), rainbow trout (*Oncorhynchus mykiss*) and mountain whitefish (*Prosopium williamsoni*) in Carpenter Reservoir, Seton Lake and Lower Bridge River and determine if mean muscle tissue concentrations have changed since monitoring began in 2000 (Baker and Mann 2001; Azimuth 2009). This will address management questions H1c, H2c and H3c.

2. METHODS

Field sampling methods followed previously established procedures employed in this system in 2000 (Baker and Mann 2001) and 2008 (Azimuth 2009). Mercury concentrations were measured from small (~100 mg) biopsy samples harvested using non-destructive techniques from bull trout and rainbow trout following the methods of Baker et al. (2004). Mountain whitefish were destructively sampled and whole tissue samples were analysed for total metals as well as mercury. All concentrations are reported in units of mg/kg wet weight, which is equivalent to parts per million (ppm).

Gene Tisdale (Tisdale Environmental) has participated in each of the three fish collection programs and he is well experienced at harvesting tissue samples using biopsy tools. R. Baker participated in the preliminary May 2013 field program to initiate the study. Fish collection details are provided below.

2.1. Quality Assurance/Quality Control

Rigorous quality assurance and quality control (QA/QC) measures were followed throughout the field program to ensure the highest standard of data collection and analysis. The objective of QA/QC is to assure that the chemical and biological data collected are representative of the material or populations being sampled, are of known quality, are properly documented, and are scientifically defensible. Data quality was assured throughout the collection and analysis of samples using standardized procedures, by the employment of a laboratory (ALS) that has been certified for all applicable methods, and by staffing the program with experienced people, especially G. Tisdale as noted above.

Field QA/QC – Field QA/QC during fish tissue sampling involved rinsing or sterilizing (with alcohol) the biopsy sampling equipment between fish to ensure that instruments were sterile and free of tissue from the previous fish. Biopsy plug tools were discarded after processing approximately three fish. Biopsy samples were placed in pre-labeled pre-cleaned veterinary sampling vials; whole tissue samples were placed in labeled Ziploc bags. Samples were placed on ice to keep cool in the field, and then moved to a freezer at the end of the day.

Laboratory QA/QC – All relevant laboratory procedures were followed, including the use of method blanks and certified reference materials.

Data Quality Objectives (DQOs) are numerically definable measures of analytical precision and completeness. For this study, these are defined as follows:

- Analytical precision is a measurement of the variability associated with duplicate analyses of the same sample in the laboratory and is assessed using Relative Percent Difference (RPD) calculations.
- Completeness for this study is defined as the percentage of valid analytical results.

The laboratory DQOs for this project were:

- Analytical Precision = 25% RPD for sediment, water and tissue samples. The RPD for concentrations that are less than 10x the method detection limit [MDL] was 50%.
- Completeness = 95% valid data obtained.

Laboratory duplicate results were assessed by the laboratory using the relative percent difference (RPD) between measurements. The equation used to calculate a RPD is:

$$RPD = \frac{(A-B)}{((A+B)/2)} \times 100$$

where: A = analytical result; B = duplicate result.

RPD values may be either positive or negative, and ideally should provide a mix of the two, clustered around zero. Consistently positive or negative values may indicate a bias. Large variations in RPD values are often observed between duplicate samples when the concentrations of analytes are very low and approaching the detection limit. The reason for this is apparent if one considers duplicate samples with concentrations of an analyte of 0.005 and 0.007 mg/L. In absolute terms, the concentration difference between the two is only 0.002 mg/L, a very small amount; however, the RPD value is 33.3%. This may sometimes lead to a belief that the level of precision is less than it actually is.

A laboratory duplicate tissue sample is a second portion of sample taken from the same container as the sub-sample used for the primary analysis that is analyzed independently through all steps of the laboratory's sampling and analytical procedures. Duplicate samples are used to assess variance of the total method including sampling and analysis.

In addition to laboratory duplicates which are typically analysed as part of the same 'run' of tissues on the same day, we instructed ALS to randomly select three whole muscle tissue pieces from archived mountain whitefish and to analyze them separately, in different runs on different days. Split sample duplicates only differ from typical laboratory duplicates in that the original and duplicate samples are run in separate batches, on different days. The objective of this was to assess possible temporal variance in laboratory instrument calibration and performance.

2.2. Fish

Bull trout (*S. confluentus*), rainbow trout (*O. mykiss*) and mountain whitefish (*P. williamsoni*) were collected from several locations within Carpenter Reservoir, Seton Lake and the lower Bridge River between May and October 2013. As noted above, non-destructive tissue biopsy techniques (Baker et al. 2004) were used to harvest tissue from bull trout and rainbow trout for mercury analysis to avoid mortality. Tissue biopsy samples are quite small and there is only sufficient tissue for analysis of mercury. To determine metals as well as mercury in fish from these three areas, mountain whitefish were sacrificed for analysis of both mercury and metals. This is the same protocol that was followed in the 2008 study (Azimuth 2009).

A few individual kokanee (*O. nerka*) were captured opportunistically from Carpenter Reservoir and Seton Lake during a post-spawn mortality event and retained for analysis of total mercury concentration. The kokanee in Carpenter Lake are landlocked fish, residing within this reservoir for the duration of their life. Kokanee within Seton Lake are also non-anadromous and likely to reside within this lake.

2.2.1. Study Design

Mercury is unique among metals in animal tissue in that it tends to increase in concentration at progressively higher levels of the food chain, with highest concentrations being found in large, carnivorous fish. There is a well-known positive correlation between fish size (length and weight) or age and mercury concentration in muscle tissue for many species (Bodaly et al. 1984; Somers and Jackson 1993). That is, larger older fish tend to have higher mercury concentrations than small and young fish. To eliminate the bias associated with differences in fish size, mercury concentrations are usually measured over a wide size (usually length) range of fish. Then, a mean or 'size-adjusted' length is chosen, usually based on the mean size of fish preferred for eating, and the mercury concentration determined for that specific length. In this way, size-adjusted or "standardized" mean mercury concentrations can be compared for the same species between lakes or over time, without bias related to differences in fish size. The standardized size of fish differs by species and for this study we used a standardized size of 450 mm for bull trout, 300 mm for mountain whitefish and 350 mm for rainbow trout.

Given the budgetary constraints and scope of this study, there were insufficient funds available to capture and analyze 25 – 35 fish per species from each area. Instead, we targeted 10 fish per species from Downton Reservoir (rainbow trout is the only species here), Carpenter Reservoir, Seton Lake (including Seton River) and Lower Bridge River, below Terzaghi Dam. These 10 fish were centered near the standardized mean so that the arithmetic mean of the sample of fish captured would be close to this value and allow for a reasonably unbiased comparison to historic data. These standardized sizes are similar to

what have been used elsewhere in BC by Azimuth, and elsewhere in Canada by other consultants, which facilitates comparisons between different lakes or years for the same species.

2.2.2. Fish Capture

All fish captured to satisfy the goals of BRGMON-12 were sampled as part of other sampling programs, specifically BRGMON-4, -7 and -8, targeting Middle Bridge River, Downton Reservoir and Seton Lake respectively, to avoid duplication of effort. Sampling was conducted between May and October 2013, with opportunistic collections of tissue as fish species of the appropriate size were encountered at each of the different fishing areas during execution of the above programs.

All fish were captured either by angling (BC Fish Collection Permit # KA13-87736), boat electrofishing or collection from trash racks. When angling, equipment included a lightweight 9 foot graphite rod with 6 lb. test line, #12-2457 hooks, split-shot lead and quill floats. Bait included worms, single salmon eggs and salmon roe. A running total was kept while collecting samples to ensure that when 10 fish/species were captured, other fish captured were released to reduce handling stress.

During electrofishing along lake shores, particularly in Carpenter Reservoir, four different habitats were targeted including: active stream mouths ± 25m; alluvial fans caused by streams; habitat with slopes less than 15% and habitat with slopes greater than 15%. Boat electrofishing requires a crew of three personnel, with one person navigating the boat, one person capturing fish that have been shocked, and one person recording the catch. Individuals captured were retained in a 250 liter aluminum tank onboard the boat to determine if they met the appropriate size for tissue sampling.

Nearly all mountain whitefish from Seton Lake were collected during the trash rack cleaning on October 16, 2013. These fish reside in Seton Lake but were impinged on the screens that prevent fish becoming entrained through the Seton Generating Station forebay area. As mentioned above, kokanee were gathered from the lake surface when encountered, shortly after a spawning event.

The locations of fish captures, whether by angling or electrofishing are illustrated in **Figure 2**. In Downton Reservoir, rainbow trout were collected from the mouths of Ault and Gwyneth creeks; in Carpenter Reservoir under the bridge between Downton and Carpenter and from the mouths of Steep, Gun, Truax, Marshall, Nosebag and Keary creeks; in Seton Lake from near the Seton G.S. and across the lake, Machute Creek, Seton Dock and in Seton River from the trash racks at the generating station. The specific location of each fish capture is also provided in **Appendix A**.

2.2.3. Tissue Sampling

Bull trout and rainbow trout were sampled non-destructively, using biopsy tools to extract small tissue quantities (~100 mg) for mercury analysis. When captured, fish were quickly measured for length (mm) to determine the size category into which they. Those fish that met the required size category were anaesthetized using clove oil mixed with rubbing alcohol at a rate of 1:10 and then further mixed with water at a rate of 4.4 ml per 10 liters. Fish were left for 1 – 2 minutes in the clove oil mixture, one at a time, until anaesthetized. Exact fork length (mm) was measured and total weight (gm) determined using a digital scale (± 5 gm). Each fish was placed on its right side and several scales were removed from the left side just beneath the distal part of the dorsal fin. Two 50 mg tissue plugs were extracted using a 4 mm diameter Miltex biopsy punch and placed on a small plastic board. Then, 'Nexcare Liquid Bandage' was placed in each tissue sampling hole and permitted to dry for approximately one minute. This antiseptic seal stops any bleeding and facilitates healing. While fish were recovering, a clean stainless steel scalpel was used to cut away the outer skin from the muscle. Forceps were used to transfer the tissue plugs into 5 mL plastic vials, which were then sealed and labeled. Each fish was gently held in fresh water until fully recovered and then released. All tissue samples were placed in a cooler with ice and frozen as soon as possible.

Mountain whitefish are an abundant and key food chain species for bull trout. These fish were destructively sampled for analysis of mercury and total metals, as in the 2000 study. Whitefish taken by angling or captured on trash racks were quickly measured to determine if they fell into the appropriate size category. If not, they were released unharmed. Fish that were required for sampling were sacrificed and measured for fork length and weight. Using a stainless steel knife, approximately 15 – 20 gm of muscle tissue was excised from the left dorsal musculature, placed in a whirl-pac bag, labeled and placed on ice. Samples were frozen at the end of the day.

All tissue samples were delivered to ALS Laboratories, Vancouver BC in three batches. Biopsy and whole tissue samples were stored in a freezer for a period of weeks and were analysed once a sufficient number of samples was gathered. To eliminate bias due to moisture loss or sublimation, samples were dried at 60°C to a constant weight prior to analysis by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7; USEPA 2005). Conversion to wet weight mercury concentration (ppm) was based on mean moisture content of 78% that was derived from a subset of biopsy samples from this area in 2008 (Azimuth 2009). This value is fairly typical for moisture content of fish tissue.

2.2.4. Data Analysis

Arithmetic means and standard deviations for were calculated for length, weight, condition factor (K) and mercury concentration data for each species from Carpenter

Reservoir, Seton Lake and the Bridge River. Condition factor (K) was also determined for each fish as a general measure of health. Condition is calculated as the ratio of length^3/weight x 10^5 (Ricker 1975).

As discussed above, given the positive correlation between fish size (length) and mercury concentration, simple arithmetic means are usually inappropriate means of representing the 'average' fish mercury concentration of a local population because of the size bias. Consequently, linear regression is used to determine the mercury concentration at a standardized or uniform size, based on species. The protocol for describing the relationship between mercury (mg/kg or ppm) and length (mm) is well known (Johnson 1987; Bodaly et al. 1988; McMurtry et al. 1989) and is of the form:

$$\text{Log}_{10}\,[\text{Mercury}] = a + b\,(\text{Log}_{10}\,[\text{Length}])$$

where 'a' is the intercept and 'b' is the slope of the regression model. Size data are normally $\log_{10}$ transformed because growth of fish (irrespective of age, weight, or length data) is curvilinear due to fast growth when fish are young, and slow growth when they are old. Therefore linear regression techniques are applied against log-transformed data (Ricker 1975; Sokal and Rohlf 1981).

These steps were taken during the 2000 and 2008 fish collections to determine the standardized mercury for a 400 mm bull trout, 350 mm rainbow trout and a 300 mm mountain whitefish, as indicated above. During 2013, efforts were made to capture fish near these standardized sizes so that the mercury concentration from the arithmetic mean size was somewhat comparable to the mercury concentration from a standard size fish in the previous investigations. Notwithstanding the relatively narrow size range of fish targeted in 2013 we still tested the relationship between fish size and mercury to determine if there was a relationship.

The following steps were taken to process and analyze the raw data and investigate if a significant length – mercury relationship existed for bull trout, rainbow trout and mountain whitefish where sufficient sample sizes permitted:

- Data were compiled from original laboratory records, and checked for accuracy;
- Length and mercury data were $\log_{10}$ transformed;
- Log (length) and log [mercury] relationships were plotted and examined for linearity and presence of outliers;
- Linear regression equations were calculated to determine slope, intercept, significance of the regression: yes ($p<0.05$) or no ($p>0.05$); and the goodness of fit (r^2);
- Analysis of covariance (ANCOVA) was conducted to test for differences among lakes where significant relationships existed;

- Graphical comparisons of the mercury data were made if appropriate.
- Tukey's test was used to make pair-wise comparisons of mean values (Sokal and Rohlf 1981; Systat 2002) to determine if intercepts or standardized mercury concentrations for each species differed among lakes or over time (i.e., comparing 2000, 2008 and 2013 data).

Where significant relationships between size and mercury existed, ANCOVA was used to make comparisons among lakes, or over time for a given species that are unbiased by differences in fish size. The first test of covariance is for equality of slopes among groups. That is, ANCOVA compares the linear regression relationships for $\log_{10}$ (mercury) and $\log_{10}$ (length) for each species among lakes. If the slopes (i.e., rate of mercury accumulation over the entire size range of the group) are ***not*** significantly different from each another ($p>0.05$), then one is justified in testing whether the intercepts differ significantly from one another. The pair-wise Tukey's test was used to determine which groups are different from one another when more than two groups were present.

If the slopes are significantly different ($p<0.05$) from one another however, then the relationship between the rate of mercury accumulation and fish size is ***not*** consistent between the two populations and one is ***not*** justified in comparing differences in intercepts (or mercury concentrations for fish of a standardized size). However, depending on the degree and nature of the slope differences, some qualitative comparisons can be made.

3. RESULTS

3.1. QA/QC

QA/QC procedures consisted of a combination of careful field collection and sample handling, and the analysis of laboratory replicates and standard reference materials. Results of the tissue chemistry QA/QC analyses are presented in **Table 1**. Two types of QA/QC samples were used to assess data quality:

- *Laboratory Duplicates* – Routine, internal analysis of replicate tissues is a normal QA procedure conducted by the laboratory on a random subset of tissues. Details are provided within the original laboratory reports in **Appendix B**. Note that duplicate analyses can only be conducted on whitefish tissue where sufficient quantity was collected to run additional samples. There is insufficient tissue from biopsy samples to run duplicates. In the laboratory duplicate samples, replicate results were generally consistent with the original samples, with a few exceptions. The DQO for RPD > 25 % was exceeded for calcium and strontium from both the May 2013 and Jun.-Sept. 2013 samples; copper from the Oct/Nov 2013 samples (**Table 1**). Calcium and strontium are common constituents of bone and concentrations are naturally variable depending on whether a small amount of bone is analysed as part of the muscle sample. Copper is not a contaminant to concern in this study and the exceedence above the DQO was minor.
- *Field Split Samples* – Internal QA/QC was performed for metals in three mountain whitefish tissue samples that were subsequently split after field collection from one sampling event (June 2013). The purpose of this was to run 'blind' samples that are analysed in different batches of tissue on different days to test the reproducibility of laboratory precision on the same sample on different days. As with the laboratory duplicates, field split tissues were generally consistent with the original samples, but exceeded the DQO (RPD > 25 %) for calcium (1 sample), copper (2 samples) and strontium (2 samples) (**Table 1**), consistent with laboratory split samples.

Consequently, laboratory QA/QC procedures performed on the tissue samples met the laboratory's internal data quality objectives for precision and completeness defined for this project. RPDs were all met with the exception of calcium, copper and strontium. As noted above, exceedences of RPDs for calcium, magnesium and strontium are not uncommon, depending on whether a small amount of bone occurs in one sample and not another. Other metals including copper are essential elements and concentrations are regulated within the body.

3.2. Fish Meristics

3.2.1. Number and Size Distribution

One hundred and ten (110) fish were captured from Downton Reservoir (11 rainbow trout) Carpenter Reservoir (37 fish), Seton Lake (41 fish) and lower Bridge River (21 fish). Forty five were rainbow trout, 33 bull trout, 20 mountain whitefish and 12 kokanee (**Table 2**). Downton Reservoir had not been previously sampled and this reservoir only contains rainbow trout. No mountain whitefish were collected from the lower Bridge River, despite several attempts by G. Tisdale to capture fish here (note, only 1 was captured here in 2008). It was more difficult to capture fish in Seton Lake than in other areas because of the great depth of the lake and few tributary streams where fish tend to congregate. Thus, fishing was focused more in upper Seton River because of better habitat at this location. Fishing was also focused in the channel below the lake, upstream of the Seton Generating Station. This is the location where nearly all mountain whitefish were captured, during a cleaning of the trash racks.

All individuals were analysed for mercury while only destructively sampled mountain whitefish and kokanee were analysed for total metals (e.g., arsenic, copper, cadmium, lead, zinc, etc.), including mercury (**Appendix A**). Whitefish are an abundant and key food chain species, especially as a dietary item for bull trout. Because the diet of mountain whitefish consists primarily of benthic invertebrates, they are a good indicator species to determine if there is a potential for accumulation of metals (and mercury) in fish tissue, given that they consume organisms that live in the sediments.

As indicated in the methods, there was no effort made to capture fish across the size range present within each waterbody, unlike previous years sampling (2000 and 2008). Instead, due to budgetary constraints, sample size was limited to 10 fish per species, as per the modified study design, near the ‘standardized’ fish size (mm) that is specific to each species.

Fish were captured during the course of the 2013 open water season. By fall, at least 10 fish of most species were captured from all target locations, with a few exceptions. For example, no mountain whitefish were captured from Lower Bridge River, a trend observed in 2008; also, kokanee, a non-target species, were collected opportunistically and analysed for mercury, because we recognize this as a species that is consumed by wildlife and by First Nations.

Mean length of bull trout from each waterbody ranged from 423 – 497 mm, near the target size of 450 mm; mean length of rainbow trout ranged from 315 – 346 mm, near the target of 350 mm; and mean size of mountain whitefish ranged from 298 – 341 mm, near the target size of 300 mm (**Table 2**).

3.2.2. Basic Meristic Data

All fish captured were measured for fork length (mm) and body weight (g). Condition factor (K) was calculated for those fish for which both length and weight were measured. **Table 2** presents arithmetic mean, maximum, minimum, and standard deviation of length, weight, K and mercury concentration (ppm wet weight) for bull trout, rainbow trout and mountain whitefish from Carpenter Reservoir, Seton Lake and lower Bridge River. Although arithmetic mean mercury concentrations are presented, size-adjusted concentrations are more relevant and are discussed in the following section. However, because sampling was conducted across a relatively narrow size range in 2013, size-mercury relationships, if present, were weak (as expected). Nevertheless, where a significant size – mercury relationship existed, this value was used to compare against size-adjusted mercury concentrations from earlier years (2000, 2008) to elucidate temporal trends in mercury concentrations.

Key findings of population meristic data are:

- Seton Lake fish tended to be larger than their counterparts from Carpenter Reservoir and Bridge River (**Table 2**). Bull trout and mountain whitefish from Seton (497 mm, 341 mm respectively) were larger than from Carpenter Reservoir (423 mm, 298 mm respectively) and lower Bridge River (462 mm). A similar magnitude of difference was also observed for body weight.
- Rainbow trout were similar in size among all waterbodies (335 – 346 mm), except from Downton Reservoir which were smaller (315 mm).
- Condition factor of bull trout (1.23), rainbow trout (1.16) and mountain whitefish (1.37) from Seton Lake were significantly higher than for Carpenter Reservoir fish (0.93 bull trout, 0.95 rainbow trout, 1.01 mountain whitefish) and rainbow trout in Downton Reservoir (0.91). High drawdown reservoirs tend to be less productive, which may explain the lower condition factor of fish from Carpenter and Downton reservoirs, relative to Seton Lake.
- Downton Reservoir rainbow trout were small (315 mm, 288 g) with lower condition factor (0.91) than in all other waterbodies. Mercury concentration (0.16 ppm) was similar to Carpenter Reservoir (0.21 ppm) trout, and double concentrations of trout in Seton Lake. As mentioned above, lower size and condition may be due to the large annual drawdown of Downton Reservoir (> 40 m) that limits its benthic productivity. Elevated mercury concentrations may be due to a lack of growth that may constrain dilution of dietary acquired mercury, also as discussed above.
- Three kokanee were captured and sampled from Carpenter Reservoir and nine from Seton Lake; all landlocked sockeye salmon. Kokanee from Carpenter

Reservoir (341 mm, 525 g) were larger than from Seton Lake (173 mm, 49 g), with higher condition factor (1.28 and 0.96). Mean mercury concentration in Carpenter kokanee (0.18 ppm) was also higher than in Seton (0.10 ppm), which is consistent with the pattern seen for other species (**Table 2**).

3.3. 2013 Mercury Data Summary

The 2013 fish survey was not designed to capture fish over a wide size range that would allow for derivation of a precise size (length) – mercury relationship as was done in previous years. Instead, the sample size of 10 fish was targeted near the 'standardized' size so that the arithmetic mean mercury concentration might approximate the size-standardized concentration. Thus the 2013 mean arithmetic mercury concentration are compared to the 2000 and 2008 size-standardized mean, despite some statistical challenges.

This section discusses trends in mercury concentrations from four perspectives:

1) Mercury – fish size relationships
2) Spatial patterns in mercury concentration of fish between waterbodies
3) Differences in mercury concentrations between species
4) Temporal trends in mercury concentration, specifically to address the null hypothesis that there 'is no significant increase in the concentration of metals and contaminants in fish tissue.'

While this section summarizes arithmetic mean concentrations, the length distribution was sufficiently large for bull trout and rainbow trout in Carpenter Reservoir and bull trout and mountain whitefish in Seton Lake to derive a size-standardized mercury concentration. Where these values could be derived, these are compared to 2000 and 2008 concentrations to determine if fish mercury concentrations have changed over time, as described in **Section 3.3.4**.

3.3.1. Mercury – Length Relationship

Depending on the species, there is typically a positive correlation between mercury concentration and increasing fish size. Fish length is typically used as the correlating metric because it is inherently less variable than weight (e.g., independent of a recent meal or spawning) and age (often, destructive sampling is required and the measurement is too coarse relative to length). It is well know that carnivorous, fish-eating species such as bull trout, lake trout and northern pikeminnow have strong positive correlations. Other carnivorous non-fish eating species such as whitefish may also have positive but weaker correlations. Fish that feed very low on the trophic food web (e.g., suckers, grayling), or

small young fish (minnow species) often do not have a positive correlation between size and mercury because they consume food that is naturally low in mercury.

In general, there was a positive correlation between increasing fish size (length) and mercury concentration for bull trout (BT), rainbow trout (RB) and mountain whitefish (MW) (**Figure 3**) in 2013 (although this figure does not depict statistical relationships). Data collected in 2013 indicate that bull trout from Carpenter Reservoir and Seton Lake have weak, but positive correlations between fish length (mm) and mercury concentration (**Figure 4**), as indicated by the solid lines. Mercury concentrations in bull trout from Lower Bridge River were not correlated with fish size (no line). These relationships were weak or not existent because of a limited sample size and size range, as per the study design.

Mercury concentration of Carpenter Reservoir rainbow trout was also weakly positively correlated with mercury (**Figure 5**). However, mercury and fish size were not correlated for rainbow trout from Seton Lake, Lower Bridge River or Downton Reservoir. This is a typical result for rainbow trout, given their generally low-mercury diet that often includes terrestrial organisms.

The pattern for mountain whitefish was slightly different. The size range of mountain whitefish collected from Carpenter Reservoir was quite narrow and although the plot of data in **Figure 6** suggests a relationship, it was not significant, despite the much higher concentrations for this reservoir, relative to Seton Lake. There was a positive but weak correlation between mercury and increasing fish size for Seton Lake mountain whitefish.

3.3.2. Spatial Patterns between Waterbodies

Arithmetic mean, minimum and maximum mercury concentration data are also presented in **Table 2**. Arithmetic mean and maximum mercury concentrations of fish from Carpenter Reservoir from all species were about 3 times higher than fish from Seton Lake and over 5 times higher than fish captured from the Lower Bridge River. By extension then, mercury concentrations of Seton Lake fish were about double the concentration of Lower Bridge River fish. These trends are well illustrated in **Figure 3**, which depict mercury concentration relationships with fish length for each waterbody for bull trout (BT), rainbow trout (RB) and mountain whitefish (MW). This trend was particularly true for bull trout and to a somewhat lesser extent for mountain whitefish. Relative differences among waterbodies for rainbow trout were smaller than for the other species, because of differences in diet. That is, rainbow trout tend to consume invertebrates that may be more terrestrial in origin, so differences in mercury between waterbodies will naturally be smaller for this species. Nevertheless, mercury in Carpenter Reservoir was higher than in Seton Lake and Lower Bridge River, with Downton Reservoir trout intermediate between Carpenter and Seton. Given that Downton Reservoir is also a high drawdown reservoir; this may explain this relatively higher concentration.

This pattern in spatial differences between Carpenter Reservoir, Seton Lake and Lower Bridge River was also observed in the 2000 and 2008 fisheries investigations (see **Section 3.3.4**). This is consistent with dynamics of methylmercury generation in high drawdown reservoirs, such as Carpenter Reservoir. The reason why fish from high drawdown reservoirs tend to have higher mercury concentrations than nearby lakes or reservoirs with lower drawdown is not known. It has been speculated that re-vegetation between alternating wetting and drying periods may be responsible. Vegetation captures atmospheric mercury; when inundated, the organic material breaks down under anoxic conditions creating redox conditions in the flooded sediments that may favor and exacerbate mercury methylation. Carpenter Reservoir is a relatively old reservoir (>40 y) and well past the time period where methylmercury generation was due to flooding of organic soils during reservoir creation; a phenomenon that tends to last less than 20 years (Bodaly et al. 2007; Shetagne et al. 1999).

Carpenter Reservoir also has an ongoing natural inorganic mercury source to the reservoir that might continue to exacerbate natural differences in methylmercury concentrations between waterbodies. Although Carpenter Reservoir and Seton Lake are hydraulically connected, the 2011 study (Azimuth 2012) confirmed that mercury concentrations in water and adhered to sediment particles transported to Seton Lake are very low.

3.3.3. Species Differences

As expected, mercury concentration of bull trout was higher than for mountain whitefish, which were higher than for rainbow trout. This is a characteristic result, a product of the highly carnivorous/piscivorous diet of bull trout relative to mountain whitefish, which consume aquatic invertebrates and to rainbow trout which consume a combination of aquatic and terrestrial organisms. This trend was also observed in previous years (Azimuth 2009). As noted above, **Figure 3** depicts all length – mercury data (note that all data are reported in $\log_{10}$ transformation) for bull trout (BT), rainbow trout (RB), mountain whitefish (MW) and kokanee (KO) from Downton and Carpenter reservoirs, Seton Lake and Lower Bridge River in 2013. This figure illustrates the clear disparity in mercury concentrations at common sizes for each species among reservoirs. As noted above, mercury concentrations in fish from Carpenter Reservoir are higher than in Seton Lake fish, which are higher than in Lower Bridge River fish. This is true for fish of the same size. This trend is very obvious for bull trout and somewhat less clear for rainbow trout and mountain whitefish. The narrow size range of fish collected is evident in this figure as there are few fish at the large or small spectrum of the size range, with most fish collected within 75 mm +/- of the standardized size for each species.

A more detailed breakdown of these data, by species combined over waterbodies is depicted in the following figures. The distribution by waterbody of mercury

concentrations relative to fish size (length, mm) is presented for bull trout (**Figure 4**), rainbow trout (**Figure 5**) and mountain whitefish (**Figure 6**). As noted above, mercury data are presented on a $\log_{10}$ scale as this transformation is used to linearize curvilinear data. Data with a solid line indicate a significant relationship between size and mercury concentration. Key results are as follows:

- Bull trout in Carpenter Reservoir (**Figure 4**) that were greater than 400 mm had mercury concentrations ranging between 0.5 ppm and 1.35 ppm (averaging 0.71 ppm). These concentrations are higher than those measured in the largest fish captured from Seton Lake (0.45 ppm). There was a positive correlation between bull trout fish size and mercury; however, this relationship was driven by one small fish (250 mm) that was captured and analysed. Otherwise, this relationship was not positive because of the narrow size range of fish measured, most between 400 and 450 mm.
- There was a weak but positive relationship between increasing size and mercury concentration for Seton Lake bull trout (**Figure 4**), despite the narrow size range of fish measured, in conformance with the study design. Seton Lake bull trout had uniformly higher mercury concentrations (mean: 0.22 ppm) than lower Bridge River bull trout (mean: 0.08 ppm) where mercury concentration was not related to fish size. There was little overlap between all three bull trout populations.
- Mercury concentrations of Carpenter Reservoir rainbow trout (**Figure 5**) were higher (mean: 0.21 ppm) than from the other waterbodies and had a weak but significant positive relationship with increasing fish length over the 320 – 390 mm size range from which they were collected. Otherwise, there was no relationship between mercury and size for rainbow trout. This is fairly typical for this species, given their insectivorous diet, much of which is terrestrial in origin. Most rainbow trout had mercury concentrations less than 0.2 ppm with no discernable pattern across the size range examined. Downton Reservoir rainbow trout (0.16 ppm) had a higher arithmetic mean mercury concentration than Seton Lake (0.08 ppm) and lower Bridge River (0.06 ppm) rainbow trout.
- There was a similar magnitude of difference in mean mercury concentrations in mountain whitefish as there was for bull trout, between Carpenter Reservoir (0.32 ppm) and Seton Lake (0.11 ppm), i.e., about 3 times difference (**Table 2**, **Figure 6**). No whitefish were captured from Lower Bridge River. The lowest mercury concentration in whitefish from Carpenter reservoir was higher than the highest concentration in Seton Lake whitefish, despite the larger fish size measured in Seton. There was a weak but positive relationship between length and mercury concentration for Seton Lake mountain whitefish because of the wider size range over which they were captured during trash rack cleaning. There was no relationship between size and mercury for Carpenter Reservoir mountain

whitefish, because of the narrow size range over which they were captured. Note that higher mercury concentrations are often found in lakes where condition factor is lower than in other lakes. This is because faster growth rate of fish in more productive systems can 'dilute' the dietary acquired mercury relative to slower growing fish. This may partly explain the difference in mercury between Carpenter Reservoir and the other waterbodies.

3.3.4. Temporal Trends in Fish Mercury Concentration

To determine whether tissue mercury concentrations have changed over time, or between lakes (within species) without the bias of size, we used an established procedure in 2000 and 2008 to derive a statistical relationship between mercury and fish size (Strange and Bodaly 1999) by sampling across a wide size range of fish. As noted above, a common or 'standardized' size was designated for each species and was used to determine a 'standardized mercury concentration'. In 2013, we sampled a smaller number of fish near this standardized size; because of the small sample size and limited size distribution, a comparison of arithmetic means was necessary where we could not use ANCOVA to make statistical comparisons. We also plotted the data from 2000, 2008 and 2013 to visually depict trends, which is a very simple and transparent means of depicting the data and trends, if present.

This final comparison is the 'acid test' that will address the null hypothesis that 'there is no significant increase in the concentration of metals and contaminants in fish tissue' in any of the waterbodies examined. We now have three monitoring periods spread over 13 years to elucidate temporal trends if any, within and between waterbodies and in particular, within species.

A summary of all historic meristic and mercury data, including data collected in 1988 by Ruebens (1989), the BC Ministry of Environment Lands and Parks (B. Grace, personal communication) and BC Hydro in 1999 are compiled in **Table 3** for Carpenter Reservoir, in **Table 4** for Seton Lake and in **Table 5** for the Lower Bridge River. In general, sample sizes in studies conducted prior to 2000 were too small to make any meaningful comparisons, so this discussion focuses only on data collected in 2000, 2008 and in the present study.

Ideally, species-specific size-standardized mercury concentrations should be used to make comparisons over time that are not biased by differences in fish size. Mercury accumulation in fish, especially piscivorous species like bull trout, is strongly dependent on fish size, with larger fish generally tending to have higher mercury concentrations. Consequently, comparisons of tissue mercury concentrations need to be made carefully, recognizing the size-concentration relationship. In some waterbodies such as Lower Bridge River and Seton Lake, the mercury – size relationship was weak or not existent; or fish were intentionally collected over a narrow size range, as in 2013. Consequently

changes in mercury concentrations over time are made using size-standardized mercury concentrations where possible (**Table 6**; e.g., bull trout in Carpenter Reservoir and Seton Lake) or using a combination of size-standardized mercury concentrations and arithmetic mean concentrations, where there was no size-mercury relationship (e.g., mountain whitefish). Thus, **Table7** shows both standardized mercury concentrations that were derived for each species from statistically significant regression equations and shows arithmetic mean concentrations in cases where no significant mercury-size relationship existed. The following sections summarize temporal trends in Carpenter Reservoir, Seton Lake and Lower Bridge River, by species.

Carpenter Reservoir

- Bull trout – Size-standardized mercury (at 450 mm) concentration in 2013 was 0.79 ppm which is similar to 2000 (0.75 ppm) but higher than in 2008 (0.56 ppm). Although these are size-adjusted values, some of this difference may be related to larger fish size acquired in 2013 (423 mm) compared to 2008 (362 mm) and 2000 (387 mm). **Figure 7** depicts the mercury – length relationship for each of these years. ANCOVA results confirm that the 2000 and 2013 size-adjusted mercury concentrations are not statistically different; 2008 was lower, but this was likely because of a smaller fish size captured in that year.
- Mountain whitefish – The size-adjusted (300 mm) mercury concentration of mountain whitefish in 2008 was 0.25 ppm and the arithmetic mean concentration was 0.32 ppm (298 mm) in 2013. These are higher concentrations than in 2000 (0.13 ppm), however the average fish in 2000 was much smaller (228 mm). Because there was no statistical relationship with size in 2013 because of a limited size range, ANCOVA was not possible. Although the arithmetic mean concentration was higher in 2013 than 2008, the difference is relatively small and within the range of natural variability, especially given the small sample size.
- Rainbow trout – Arithmetic mean mercury concentration of Carpenter Reservoir trout in 2013 (0.21 ppm) was significantly higher than in 2008 (0.12 ppm). Notwithstanding the larger size fish in 2013 (346 mm) than 2008 (314 mm), this result suggests that there has been an increase in mercury in Carpenter Reservoir rainbow trout.

Seton Lake

- Bull trout – Temporal patterns in mercury concentrations in Seton Lake bull trout were similar to Carpenter Reservoir, with arithmetic mean concentrations in 2008 (0.10 ppm) being slightly lower than in 2000 (0.16 ppm) and in 2013 (standardized [Hg]: 0.18 ppm), despite a very similar average fish size in each of these, near 450 mm. **Figure 8** depicts the mercury – length relationship for each of these years. Overlap of size-mercury data and similar concentrations between

2000 and 2013 suggest that Seton Lake bull trout concentrations have not changed over time.

- Mountain whitefish – No mountain whitefish were captured in 2000. Although the arithmetic mean mercury concentration in 2008 (0.04 ppm) and standardized mercury concentrations in 2013 was higher (0.08 ppm), these are relatively very low concentrations. While these data suggest that there has been an increase in mercury in Seton Lake mountain whitefish between 2008 and 2013, the small difference between the years (0.04 ppm) is quite low and of negligible consequence.
- Rainbow trout – Mercury concentration in rainbow trout between 2000 and 2013 was low and ranged from 0.03 – 0.08 ppm. There has been no apparent increase in mercury concentration over time in this species.

Lower Bridge River

- Bull trout – There was no statistical relationship between fish size and mercury in lower Bridge River bull trout. Arithmetic mean mercury concentration in 2000 (0.20 ppm) was higher than in 2008 (0.05 ppm) and 2013 (0.08 ppm), over a mean size range between 425 – 462 mm. The 2008 and 2013 concentrations are very low for this species. These data suggest there has been a reduction in mercury concentration since 2000. However, given that these are relatively low concentrations this result has negligible meaning.
- Mountain whitefish – No mountain whitefish were captured in 2013. Mercury concentration of whitefish captured in 2008 was very low (0.04 ppm).
- Rainbow trout – The arithmetic mean mercury concentration in 2013 (0.06 ppm) at 344 mm was slightly higher than what was observed in 2008 (0.03 ppm) for a much smaller mean size fish (255 mm) and similar to 2000 (0.07 ppm at 277 mm) Lower Bridge River rainbow trout. Mercury has not changed over time for this species.

3.3.5. Summary

Figure 9 depicts all data for each species from each waterbody, color coded by year. Reasonably strong size – mercury relationships exist for all species in Carpenter Reservoir and to a lesser extent in Seton Lake. A change in mercury concentration over time would be visually detected where fish of the same size would be higher or lower on the mercury scale in one year than another. In the case of Carpenter Reservoir, only rainbow trout appear elevated in 2013 relative to 2008, confirming the statistical results above. Bull trout and mountain whitefish mercury concentrations do not appear to have changed over time.

In Seton Lake, there appeared to be a good overlap in mercury at size over all three monitoring periods for bull trout and rainbow trout, suggesting no change, despite, as noted above, the higher mean mercury concentration in mountain whitefish from Seton Lake in 2013 than in 2008. Only in mountain whitefish did mercury concentrations appear to have increased over time.

In Lower Bridge River, there is no significant relationship between fish size and mercury concentration and no evidence of temporal changes.

In terms of absolute mercury concentrations, arithmetic mean mercury concentrations for most species in Seton Lake and Bridge River were low, typically less than 0.10 ppm. Only bull trout is slightly higher at 0.22 ppm. From an ecological and human health perspective, there is no health risk from regular consumption of these species.

In Carpenter Reservoir, the mean mercury concentration of bull trout remains elevated (mean = 0.79 ppm; max 1.35 ppm). Carpenter Reservoir bull trout have among the highest concentrations found in British Columbia lakes and reservoirs for this species (Baker 1999) and regional lakes elsewhere in BC (Rieberger 1992). However, these concentrations are very similar to what are found in other piscivorous species from many hundreds of lakes elsewhere in Canada (DePew et al. 2013). Mercury concentrations in rainbow trout and mountain whitefish, which are likely prey items of bull trout in this reservoir are also elevated relative to Seton Lake and explain this phenomenon. These results confirm that Carpenter Reservoir generates more methylmercury that is sequestered and accumulated within the aquatic food web than the rest of the Bridge River system.

Results of this historical examination of temporal trends in mercury concentrations of Carpenter Reservoir fish confirms that mercury concentrations in this reservoir are elevated relative to Seton Lake and Bridge River fish and concentrations have not changed substantially since monitoring data were first collected 20 years ago. As concluded in the 2008 report, the absence of a decline in mercury concentrations in fish in this reservoir suggests that the phenomenon of elevated mercury in fish, as a result of reservoir creation, is not present and that the current values measured are considered 'background'. Whether elevated concentrations in Carpenter Reservoir fish are related to annual re-flooding of exposed and re-vegetated areas due to the large drawdown amplitude of the reservoir, or related to chronic inputs of inorganic mercury from natural or mining-related historic lode and mercury mining operations, (e.g., Silverquick Mine), or a combination of both, is unknown.

3.4. Metals other than Mercury

In 2013, concentrations of 37 metals (only 15 metals are presented herein; see **Appendices A and B** for other metals), including mercury, were measured in muscle tissues from 20 mountain whitefish from Carpenter Reservoir (10 fish) and Seton Lake (10 fish) (summarized in **Table 8**). The concentrations of antimony, beryllium, bismuth, cadmium, lithium, molybdenum, thallium, uranium and vanadium were present at concentrations below detection limits in all species and waterbodies (**Appendices A and B**). Calcium, magnesium and strontium are important constituents of bone and concentrations can vary greatly depending upon whether bone fragments are inadvertently analysed with part of the muscle. Other metals including copper, cobalt, selenium and zinc are essential elements and concentrations are regulated within the body. Mercury, cadmium and lead have no known biological function and can be potentially harmful to aquatic organisms if present at elevated concentrations.

Besides consumption guidelines for mercury from fish consumption, there are no other commonly known guidelines for any other metal with the possible exceptions for arsenic (3.5 ppm; BC Ministry of Environment and Health and Welfare Canada) and cadmium (3.6 ppm; World Health Organization). Concentrations of these two metals in fish from the study area are at least 100 times less than the guideline value.

Perusing data in **Table 8**, there were no metals concentrations in 2013 that were higher in 2000 or 2008 in mountain whitefish from either Seton Lake or Carpenter Reservoir. Aluminum, copper, lead, manganese and nickel appeared to be lower in 2013 than in earlier years, while all other metals (e.g., arsenic, chromium, strontium, zinc) were very similar over time within waterbodies. The concentrations of all metals are similar to ‘uncontaminated’ or reference lakes as measured by Rieberger (1992) in a large number of BC lakes.

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Tables

Table 1. Laboratory QA/QC results for fish tissue chemistry.

Type of QA/QC data		Lab Replicate			Lab Replicate - Split Sample			Lab Replicate - Split Sample		
Sample ID		May 2013			MW-130621.006 (21-Jun-13)			MW-130621.008 (21-Jun-13)		
	MDLs	Original	Duplicate	RPD (%)	Original	Duplicate	RPD (%)	Original	Duplicate	RPD (%)
Physical Tests										
Moisture (%)	*0.10*	-	-	-	-	-	-	-	-	-
Total Metals (mg/kg wet wt.)										
Aluminum	*0.40*	*<0.40*	0.43	NA	0.51	0.57	-11	1.02	1.02	0
Arsenic	*0.0040*	0.12	0.13	-13	0.10	0.10	-4.4	0.10	0.08	16
Barium	*0.010*	0.09	0.11	-19	0.017	0.018	-5.7	0.021	0.022	-4.7
Calcium	*5.0*	112	292	-89	173	132	27	167	211	-23
Chromium	*0.010*	*<0.010*	*<0.010*	NA	*<0.010*	*<0.010*	NA	*<0.010*	*<0.010*	NA
Cobalt	*0.0040*	0.0152	0.0143	6.1	0.007	0.009	-22	*<0.0040*	*<0.0040*	NA
Copper	*0.010*	0.242	0.243	-0.4	0.244	0.325	-28	0.240	0.217	10
Lead	*0.0040*	0.0064	*<0.0040*	NA	0.0097	0.0109	-12	0.0056	0.0061	-8.5
Magnesium	*10*	326	310	5.0	356	299	17	310	278	11
Manganese	*0.0040*	0.1	0.12	-18	0.14	0.13	8.8	0.124	0.134	-7.8
Mercury	*0.0050*	0.24	0.269	-11	0.41	0.39	5.0	0.402	0.374	7.2
Nickel	*0.010*	0.011	*<0.010*	NA	0.011	0.014	-24	*<0.010*	0.016	NA
Selenium	*0.020*	0.239	0.244	-2.1	0.25	0.24	5.0	0.266	0.212	23
Strontium	*0.010*	0.13	0.32	-85	0.13	0.10	27	0.14	0.20	-37
Zinc	*0.10*	3.4	3.1	9.9	4.7	4.6	1.7	2.8	2.7	1.8

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

NA = RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection.

Bolded RPDs exceed 25% but < 10 x MDL.

Shaded RPDs exceed 25% and > 10 x MDL.

Table 1 con't. Laboratory QA/QC results for fish tissue chemistry.

Type of QA/QC data		Lab Replicate - Split Sample			Lab Replicate			Lab Replicate		
Sample ID		MW-130621.009 (21-Jun-13)			Jun.-Sept. 2013			Oct./Nov. 2013		
	MDLs	Original	Duplicate	RPD (%)	Original	Duplicate	RPD (%)	Original	Duplicate	RPD (%)
Physical Tests										
Moisture (%)	*0.10*	-	-	-	-	-	-	68.9	70.6	-2.4
Total Metals (mg/kg wet wt.)										
Aluminum	*0.40*	0.77	0.67	14	0.74	1.48	**-67**	1.85	1.15	**47**
Arsenic	*0.0040*	0.12	0.11	8.8	0.06	0.05	12	0.07	0.06	13
Barium	*0.010*	*<0.010*	*<0.010*	NA	0.072	0.061	17	0.024	0.022	8.7
Calcium	*5.0*	83	90	-8.1	722	494	38	91	98	-7.4
Chromium	*0.010*	*<0.010*	0.044	NA	*<0.010*	*<0.010*	NA	0.031	0.028	10
Cobalt	*0.0040*	0.009	0.009	2.2	0.017	0.016	10	0.009	0.008	16
Copper	*0.010*	0.211	0.720	-109	0.38	0.325	16	0.643	0.417	43
Lead	*0.0040*	0.0066	0.0066	0	0.0044	0.005	-13	0.0208	0.0156	**29**
Magnesium	*10*	330	306	7.5	363	363	0	360	381	-5.7
Manganese	*0.0040*	0.119	0.136	-13	0.281	0.313	-11	0.16	0.151	5.8
Mercury	*0.0050*	0.463	0.418	10	0.0581	0.0515	12	0.0618	0.0631	-2.1
Nickel	*0.010*	*<0.010*	0.182	NA	0.012	0.015	-22	0.062	0.042	**38**
Selenium	*0.020*	0.211	0.208	1.4	0.937	0.855	9.2	0.453	0.476	-5.0
Strontium	*0.010*	0.05	0.08	**-51**	0.55	0.34	47	0.05	0.05	-8.3
Zinc	*0.10*	4.2	4.3	-1.4	7.4	6.3	15.6	4.4	4.3	1.9

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

NA = RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection.

Bolded RPDs exceed 25% but < 10 x MDL.

Shaded RPDs exceed 25% and > 10 x MDL.

Table 2. Length (mm), weight (g), K factor, and mercury concentration (ppm) statistics for bull trout, rainbow trout, mountain whitefish and kokanee from Downton and Carpenter Reservoirs, Seton Lake, and Lower Bridge River, 2013.

		Fork Length (mm)					Body Weight (g)				
Species	**Area**	**n**	**mean**	**SD**	**min**	**max**	**n**	**mean**	**SD**	**min**	**max**
Bull trout	Carpenter Reservoir	10	423	60	279	517	10	744	309	200	1430
	Seton Lake	12	497	70	375	570	13	1691	734	547	2795
	Lower Bridge River	11	462	66	385	630	11	1372	678	677	3232
Rainbow trout	Downton Reservoir	11	315	25	260	348	11	288	60	175	383
	Carpenter Reservoir	14	346	24	312	393	14	395	78	283	541
	Seton Lake	10	335	35	300	412	10	452	171	285	819
	Lower Bridge River	10	344	45	303	440	10	495	183	324	808
Mountain whitefish	Carpenter Reservoir	10	298	11	281	318	10	266	22	240	305
	Seton Lake	10	341	54	268	442	10	602	323	186	1192
Kokanee	Carpenter Reservoir	3	341	28	315	370	3	525	182	356	718
	Seton Lake	9	173	3	170	179	9	49	7	41	63

		Condition (K)					Mercury (ppm wet wt)				
Species	**Area**	**n**	**mean**	**SD**	**min**	**max**	**n**	**mean**	**SD**	**min**	**max**
Bull trout	Carpenter Reservoir	10	0.93	0.07	0.85	1.06	10	0.71	0.32	0.11	1.35
	Seton Lake	12	1.23	0.22	0.86	1.62	13	0.22	0.09	0.09	0.45
	Lower Bridge River	11	1.33	0.19	0.97	1.52	11	0.08	0.05	0.02	0.19
Rainbow trout	Downton Reservoir	11	0.91	0.08	0.79	1.00	10	0.16	0.07	0.08	0.31
	Carpenter Reservoir	14	0.95	0.10	0.65	1.06	14	0.21	0.11	0.10	0.45
	Seton Lake	10	1.16	0.13	0.95	1.35	10	0.08	0.07	0.02	0.25
	Lower Bridge River	10	1.20	0.26	0.75	1.65	9	0.06	0.02	0.03	0.09
Mountain whitefish	Carpenter Reservoir	10	1.01	0.07	0.91	1.12	10	0.32	0.08	0.24	0.46
	Seton Lake	10	1.37	0.25	0.97	1.78	10	0.11	0.04	0.06	0.18
Kokanee	Carpenter Reservoir	3	1.28	0.14	1.14	1.42	3	0.18	0.10	0.09	0.29
	Seton Lake	9	0.96	0.16	0.79	1.28	9	0.10	0.02	0.06	0.11

Notes: n= count; SD=Standard Deviation; ppm=parts per million; Formula for Condition (K) factor=Weight*100,000/Length^3; Individual K factors were calculated for individual fish were both weight and length data were available.

Table 3. Comparison of historic arithmetic mean length, weight, and muscle mercury data for Carpenter Reservoir fish.

Year	Species	Length (mm)			Weight (g)			Muscle Mercury (ppm)			Source
		N	Mean	Range	N	Mean	Range	N	Mean	Range	
1988	Bull trout	3	377	290-440	3	610	270-840	3	0.40	0.28-0.52	Ruebens 1989
1998	Rainbow trout	9	311	255-355	9	333	200-460	9	0.14	0.06-0.23	Ruebens 1989
1998	Mountain whitefish	19	268	160-355	19	243	60-440	19	0.07	0.02-0.22	Ruebens 1989
1993*	Bull trout	2	459	445-472	2	545	420-670	2	0.15	0.14-0.16	B. Grace MELP
1993*	Rainbow trout	2	367	350-375	2	400	340-460	2	0.08	0.05-0.10	B. Grace MELP
1993*	Kokanee	2	301	267-335	2	285	210-360	2	0.12	0.08-0.16	B. Grace MELP
1999	Bull trout	5	354	315-416	5	408	299-659	5	0.41	0.25-0.49	BC Hydro 1999
1999	Rainbow trout	6	381	295-350	6	422	268-443	6	0.23	0.13-0.31	BC Hydro 1999
1999	Mountain whitefish	6	320	230-306	6	259	142-279	6	0.29	0.19-0.29	BC Hydro 1999
2000*	Bull Trout	19	387	261-472	19	645	225-1200	19	0.52	0.22-0.92	Baker and Mann 2001
2000*	Mountain whitefish	11	228	182-275	11	145	75-275	11	0.13	0.09-0.15	Baker and Mann 2001
2008*	Bull trout	23	362	198-661	17	569	65 - 2715	23	0.36	0.02 - 0.80	Azimuth, 2009
2008*	Kokanee	3	248	196 - 278	3	178	75 - 250	3	0.10	0.09 - 0.10	Azimuth, 2009
2008*	Rainbow trout	14	314	278 - 372	11	300	220 - 490	14	0.09	0.04 - 0.22	Azimuth, 2009
2008*	Mountain whitefish	23	273	196 - 322	11	178	75 - 300	23	0.22	0.09 - 0.38	Azimuth, 2009
2013	Bull trout	10	423	279 - 517	10	744	200 - 1430	10	0.71	0.11 - 1.35	Present Study
2013	Kokanee	3	341	315 - 370	3	525	356 - 718	3	0.18	0.09 - 0.29	Present Study
2013	Rainbow trout	14	346	312 - 393	14	395	283 - 541	14	0.21	0.10 - 0.45	Present Study
2013	Mountain whitefish	10	298	281 - 318	10	266	240 - 305	10	0.32	0.24 - 0.46	Present Study

Note* **1993** muscle mercury concentrations were initially reported as dry weight. Conversion to wet weight was performed assuming 78% moisture content
2000 muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed using the mean moisture content (76.9 %)
2008 muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed assuming the mean moisture content (78%)

Table 4. Comparison of historic arithmetic mean length, weight, and muscle mercury data for Seton Lake fish.

Year	Species	Length (mm)			Weight (g)			Muscle Mercury (ppm)			Source
		N	Mean	Range	N	Mean	Range	N	Mean	Range	
1988	Rainbow trout	15	356	235-425	15	535	200-860	15	0.06	0.02-0.23	Ruebens 1989
1988	Mountain whitefish	2	280	263-297	2	310	220-400	2	0.04	0.04	Ruebens 1989
1988	Kokanee	12	253	235-266	12	230	180-270	12	0.06	0.01-0.08	Ruebens 1989
1988	Northern pikeminnow	5	409	357-482	5	816	560-1200	5	0.75	0.55-0.93	Ruebens 1989
1995	Rainbow trout	3	-	-	3	-	-	3	0.05	0.05-0.06	BCMELP 1995
1995	Mountain whitefish	3	-	-	3	-	-	3	0.09	0.07-0.11	BCMELP 1995
1998*	Rainbow trout	3	390	365-420	3	670	600-810	3	0.09	0.07-0.11	BCMELP 1998
1998*	Mountain whitefish	3	377	375-380	3	660	620-700	3	0.09	0.07-0.14	BCMELP 1998
2000*	Bull trout	3	443	412-473	3	-	-	3	0.16	0.11-0.19	Baker and Mann 2001
2000*	Rainbow trout	18	343	219-513	10	494	112-1500	18	0.06	0.04-0.09	Baker and Mann 2001
2008*	Bull trout	16	451	261 - 701	13	1205	95 - 3780	16	0.10	0.03 - 0.36	Azimuth, 2009
2008*	Rainbow trout	18	256	165 - 386	18	217	45 - 615	18	0.03	0.01 - 0.05	Azimuth, 2009
2008*	Mountain whitefish	8	308	249 - 369	7	303	185 -415	8	0.04	0.02 - 0.07	Azimuth, 2009
2013	Bull trout	12	497	375 - 570	13	1691	547 - 2795	13	0.22	0.09 - 0.45	Present Study
2013	Kokanee	9	173	170 - 179	9	49	41 - 63	9	0.10	0.06 - 0.11	Present Study
2013	Rainbow trout	10	335	300 - 412	10	452	285 - 819	10	0.08	0.02 - 0.25	Present Study
2013	Mountain whitefish	10	341	268 - 442	10	602	186 - 1192	10	0.11	0.06 - 0.18	Present Study

Note* **1998** muscle mercury concentrations were believed to be reported as dry weight although there is some uncertainty. Conversion to wet weight was performed assuming 75% moisture content.
2000 muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed using the mean moisture content (76.9 %)
2008 muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed assuming the mean moisture content (78%) from whole tissue

Table 5. Comparison of historic arithmetic mean length, weight, and muscle mercury data for Lower Bridge River fish.

Year	Species	Length (mm)			Weight (g)			Muscle Mercury (ppm)			Source
		N	Mean	Range	N	Mean	Range	N	Mean	Range	
2000*	Bull trout	3	433	362 - 472	-	-	-	3	0.20	0.16 - 0.23	Baker and Mann 2001
2000*	Rainbow trout	9	277	213 - 348	2	137.5	125 - 150	9	0.07	0.05 - 0.10	Baker and Mann 2001
2000*	Mountain whitefish	6	354	337 - 380	1	900	-	6	0.11	0.07 - 0.15	Baker and Mann 2001
2008*	Bull trout	12	425	318 - 592	12	919	315 - 2265	12	0.05	0.02 - 0.14	Azimuth, 2009
2008*	Rainbow trout	23	255	149 - 461	15	273	35 - 1195	23	0.03	0.01 - 0.06	Azimuth, 2009
2008*	Mountain whitefish	1	340	-	1	475	-	1	0.04	-	Azimuth, 2009
2013	Bull trout	11	462	385 - 630	11	1372	677 - 3232	11	0.08	0.02 - 0.19	Present Study
2013	Rainbow trout	10	344	303 - 440	10	495	324 - 808	9	0.06	0.03 - 0.09	Present Study

Note* **2000** muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed using the mean moisture content (76.9 %)
2008 muscle mercury concentrations were from biopsy and whole tissue data. Biopsy concentratons were reported as dry weight. Conversion to wet weight was performed assuming the mean moisture content (78%) from whole tissue

Table 6. Log_{10}[mercury] on log_{10}[length] regression statistics for standardized size mountain whitefish, rainbow trout, bull trout, and kokanee, and from Carpenter and Downton Reservoirs, Seton Lake, and Lower Bridge River, 2013.

Species	Sample Size	R^2	p-Value	Significant Relationship	Mercury (Hg) on Length (L) Relationship $Log_{10}Hg = a + b\ (Log_{10}L)$	Standardized Measures[1]	
						Length (mm)	[Mercury] (mg/kg ww)
Carpenter Reservoir							
Mountain whitefish	10	0.13	0.299	no	-	NA	*0.32
Rainbow trout	14	0.37	0.021	yes	$Log_{10}Hg = -11.8 + 4.37\ (Log_{10}L)$	350	0.21
Bull trout	10	0.69	0.003	yes	$Log_{10}Hg = -9.47 + 3.53\ (Log_{10}L)$	450	0.79
Kokanee	3	0.15	0.743	no	-	NA	*0.18
Seton Lake							
Mountain whitefish	10	0.57	0.012	yes	$Log_{10}Hg = -5.55 + 1.80(Log_{10}L)$	300	0.08
Rainbow trout	10	0.01	0.748	no	-	NA	*0.08
Bull trout	12	0.39	0.029	yes	$Log_{10}Hg = -5.28 + 1.71(Log_{10}L)$	450	0.18
Kokanee	9	0.05	0.551	no	-	NA	*0.01
Lower Bridge River							
Rainbow trout	9	0.20	0.223	no	-	NA	*0.06
Bull trout	11	0.11	0.323	no	-	NA	*0.08
Downton Reservoir							
Rainbow trout	10	0.11	0.351	no	-	NA	*0.16

Notes:

R^2 = coefficient of determination.

p-Value = probability value; not significant at $p \geq 0.05$.

[1][Hg] for standardized lengths were calculated using the above regression equations and the standard length for each species; arithmetic mean concentrations were used for cases where no significant mercury-length relationship was found, these are marked with a *.

Table 7. Standardized tissue mercury concentration in fish from 2001 – 2013.

Reservoir Species	Standardized Length (mm)	[Mercury] (mg/kg ww)[1]					
		2000		2008		2013	
		Mean Length	*Mean / **Standardized [Hg]**	Mean Length	*Mean / **Standardized [Hg]**	Mean Length	*Mean / **Standardized [Hg]**
Carpenter Reservoir							
Mountain whitefish	**300**	228	*0.13		**0.25**	298	*0.32
Rainbow trout	**350**	n/a	n/a		**0.12**		**0.21**
Bull trout	**450**		**0.75**		**0.52**		**0.79**
Seton Lake							
Mountain whitefish	**300**	n/a	n/a	308	*0.04		**0.08**
Rainbow trout	**350**	343	*0.06	256	*0.03	335	*0.08
Bull trout	**450**	443	*0.16	451	*0.10		**0.18**
Lower Bridge River							
Rainbow trout	**350**	277	*0.07	255	*0.03	344	*0.06
Bull trout	**450**	433	*0.20	425	*0.05	462	*0.08

Notes:

[1][Hg] for standardized lengths were calculated using the regression equations (see **Table 6**) and the standard length for each species; arithmetic mean concentrations were used for cases where no significant mercury-length relationship was found (see "Mean Length" above), these are marked with a *.

n/a: not available, no data.

Table 8. Total metals concentration (mg/kg ww) in mountain whitefish relative to regional fish tissue concentrations (Rieberger 1992) for Carpenter Reservoir and Seton Lake, from 2000, 2008 and 2013.

		Mountain Whitefish								
		Carpenter Reservoir					Seton Lake			
	Year	*2000*	*2008*	*2013*			*2008*	*2013*		
Total Metals (mg/kg wet wt)	**Reference Lakes***	**mean**	**mean**	**mean**	**min**	**max**	**mean**	**mean**	**min**	**max**
Aluminum	0.76	13	6.1	1.4	<0.4	3.7	3.0	1.4	0.7	3.3
Arsenic	0.03	0.16	0.06	0.09	0.04	0.15	0.06	0.10	0.03	0.17
Barium	0.23	0.07	0.08	0.09	<0.01	0.32	0.03	0.04	0.02	0.07
Calcium	227	241	270	726	83	4770	235	319	90	722
Chromium	-	<0.10	0.16	0.01	<0.01	0.02	<0.10	0.02	<0.01	0.03
Cobalt	-	-	0.02	0.01	<0.004	0.02	0.02	0.01	<0.004	0.02
Copper	0.38	0.86	0.29	0.25	0.17	0.51	0.37	0.51	0.33	0.80
Lead	0.27	<0.10	0.08	0.01	<0.004	0.07	0.07	0.01	0.00	0.03
Magnesium		-	308	333	284	404	312	331	271	365
Manganese	0.33	0.32	0.23	0.18	0.10	0.45	0.21	0.22	0.14	0.31
Mercury	0.15	0.13	0.22	0.32	0.24	0.46	0.04	0.11	0.06	0.18
Nickel	1.14	0.18	<0.10	0.01	<0.01	0.04	<0.10	0.02	<0.01	0.06
Selenium	-	-	0.33	0.26	0.20	0.34	0.67	0.47	0.25	0.94
Strontium	-	-	0.27	0.62	0.05	3.92	0.21	0.26	0.05	0.55
Zinc	3.8	3.7	3.7	3.7	2.7	4.9	4.0	4.9	3.9	7.4

* Rieberger (1992b)

Figures

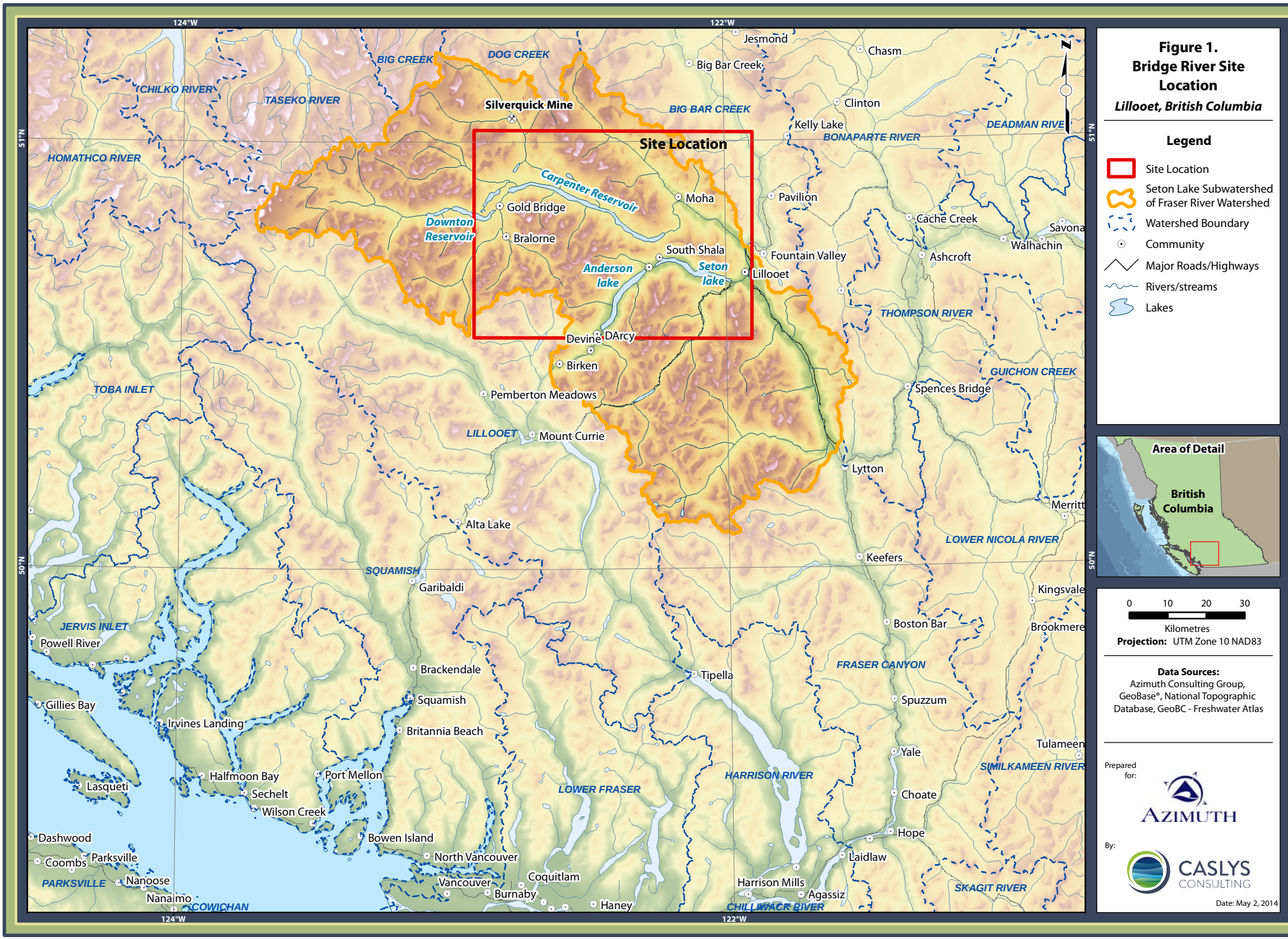


Figure 1.
Bridge River Site Location
Lillooet, British Columbia

Legend

- Site Location
- Seton Lake Subwatershed of Fraser River Watershed
- Watershed Boundary
- Community
- Major Roads/Highways
- Rivers/streams
- Lakes

Figure 2.
Bridge River Fish Sampling Locations, 2013

Legend

- Road
- Highway
- River/Stream
- Lake
- Watershed Boundary

Fish Sampling

- Bull Trout
- Kokanee
- Mountain Whitefish
- Rainbow Trout

Area of Detail

0 2 4 6
Kilometres

Projection: UTM Zone 10 NAD83

Data Sources:
Azimuth Consulting Group, GeoBase®, National Topographic Database, GeoBC - Freshwater Atlas

Prepared By:

AZIMUTH

CASLYS CONSULTING

April 8, 2014

Terzaghi Dam

Seton Generating Station

Carpenter Reservoir

Gun Lake

Downton Reservoir

Anderson Lake

Seton Lake

Seton River

Fraser River

Figure 3. Log(Mercury) – Log(Length) relationship for fish caught in 2013, by reservoir.

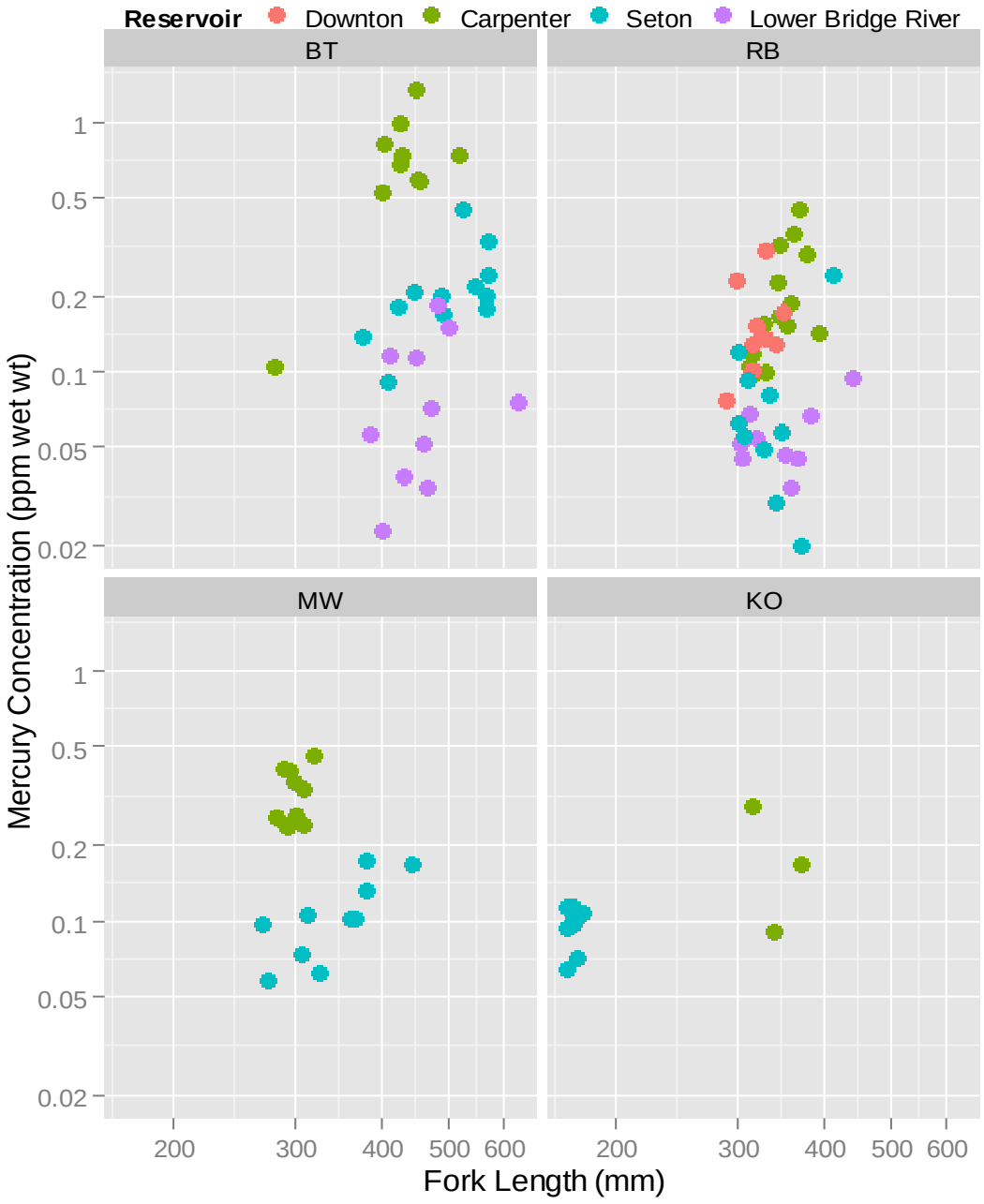


Figure 4. Log(Mercury) – Log(Length) relationship for bull trout caught in 2013, by reservoir.

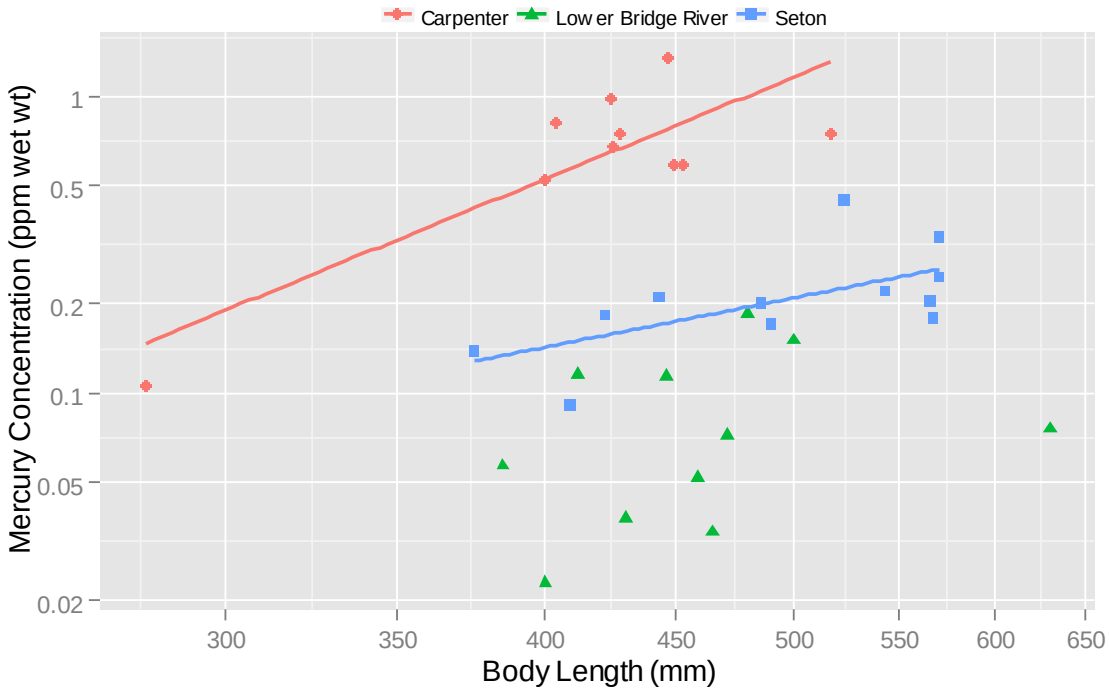


Figure 5. Log(Mercury) – Log(Length) relationship for rainbow trout caught in 2013, by reservoir.

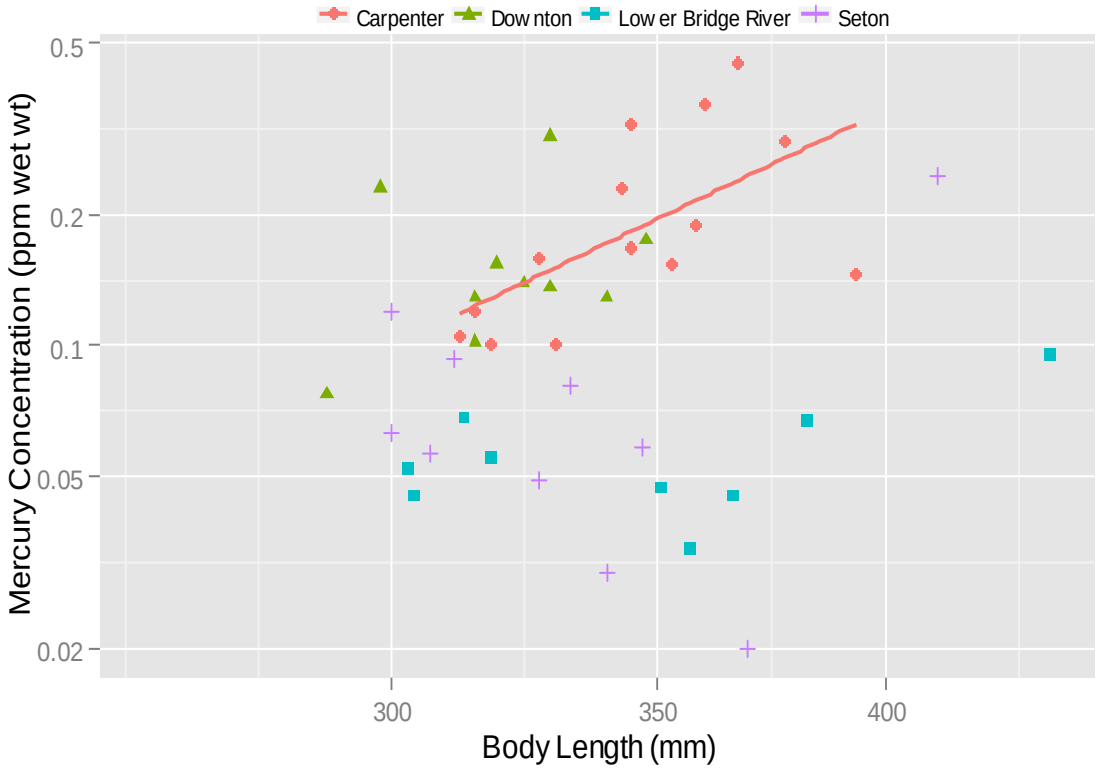


Figure 6. Log(Mercury) – Log(Length) relationship for mountain whitefish caught in 2013, by reservoir.

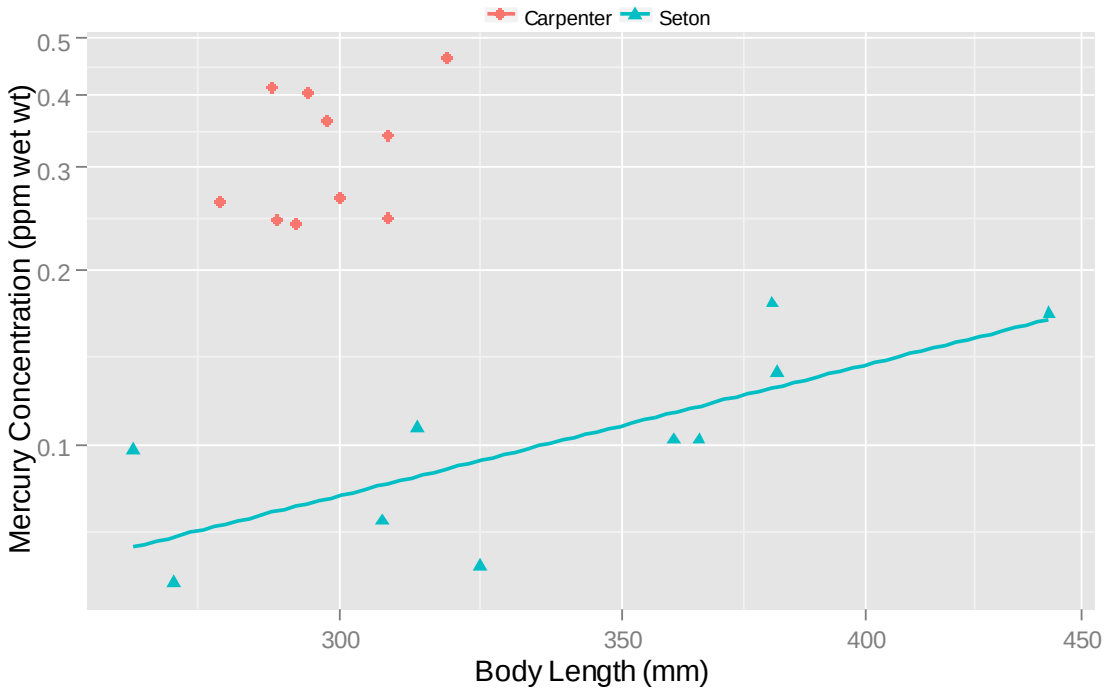


Figure 7. Log(Mercury) – Log(Length) relationship for bull trout caught at Carpenter, by year.

Figure 8. Log(Mercury) – Log(Length) relationship for bull trout caught at Seton, by year.

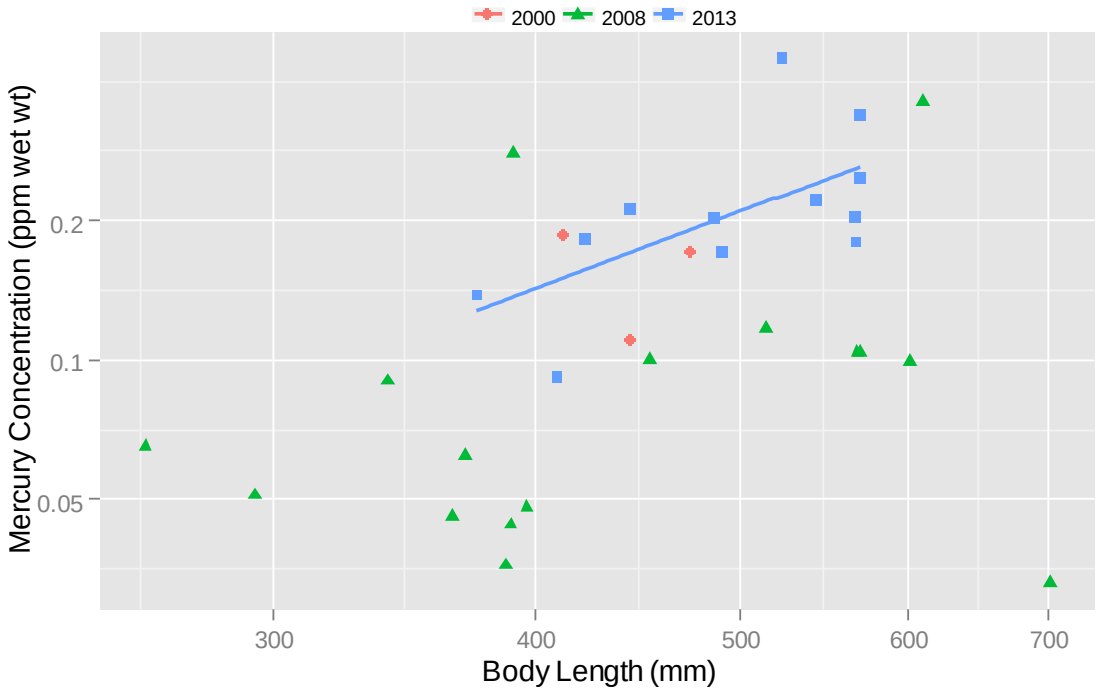
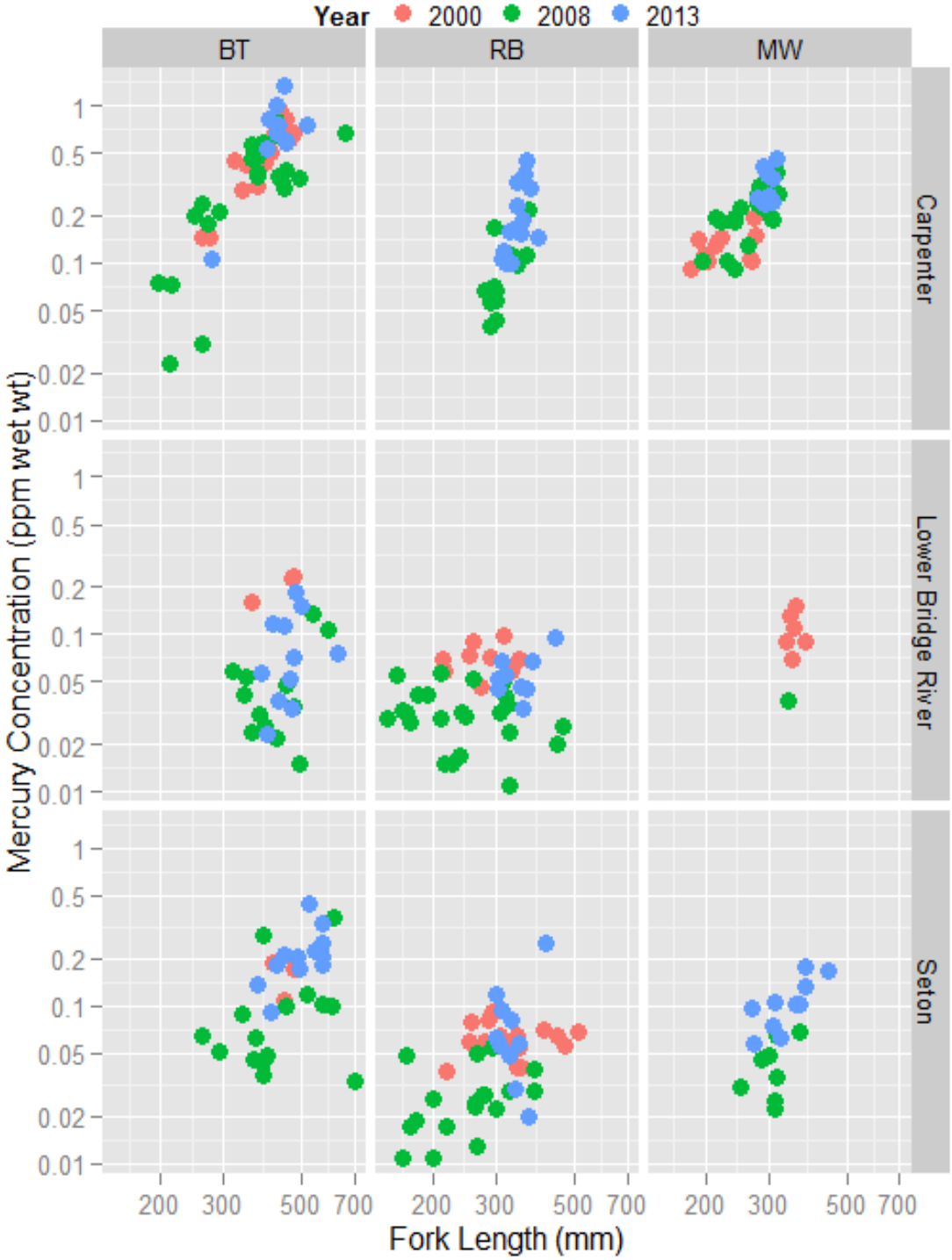


Figure 9. Log(Mercury) – Log(Length) relationship for fish from Carpenter Reservoir, Seton Lake, and Lower Bridge River in 2000, 2008, and 2013.



Appendix A – Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Length.mm	Weight.g	Condition.k	Hg.ppm.wtwt	Age.yr	Collection Date
2013	CARP	NOSEBAG (CARP)	BT	BT130623.003	400	580	0.91	0.527		23 June, 2013
2013	CARP	NOSEBAG (CARP)	BT	BT130623.004	449	865	0.96	0.591		23 June, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-001	517	1430	1.03	0.748		23 May, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-004	428	728	0.93	0.744		23 May, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-005	453	820	0.88	0.585		23 May, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-006	404	560	0.85	0.817		23 May, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-007	424	676	0.89	0.989		23 May, 2013
2013	CARP	NOSEBAG	BT	CARP-BT-009	279	200	0.92	0.106		23 May, 2013
2013	CARP	KEARY	BT	CARP-BT-013	425	812	1.06	0.677		23 May, 2013
2013	CARP	Gun Cr confl	KO	KO130906.001	315	356	1.14	0.288		6 Sept, 2013
2013	CARP	Gun Cr confl	KO	KO130815.001	370	718	1.42	0.170		15 Aug, 2013
2013	CARP	McDonald Cr confl	KO	KO130925.001	338	500	1.29	0.091		25 Sept, 2013
2013	CARP	GBB	MW	CARP-MN-002	281	248	1.12	0.261		22 May, 2013
2013	CARP	GBB	MW	CARP-MN-004	293	279	1.11	0.240		22 May, 2013
2013	CARP	GBB	MW	CARP-MN-008	290	246	1.01	0.244		22 May, 2013
2013	CARP	GBB	MW	CARP-MN-010	308	266	0.91	0.341		22 May, 2013
2013	CARP	MARSHALL	MW	CARP-MN-012	300	263	0.97	0.266		23 May, 2013
2013	CARP	FALLS Cr (CARP)	MW	MW130621.006	289	250	1.04	0.411		21 June, 2013
2013	CARP	FALLS Cr (CARP)	MW	MW130621.007	308	305	1.04	0.245		21 June, 2013
2013	CARP	FALLS Cr (CARP)	MW	MW130621.008	295	240	0.93	0.402		21 June, 2013
2013	CARP	FALLS Cr (CARP)	MW	MW130621.009	318	300	0.93	0.463		21 June, 2013
2013	CARP	Across from Tyaughton Cr	MW	MW130622.001	298	265	1.00	0.361		22 June, 2013
2013	CARP	GBB	RB	CARP-RB-001	343	373	0.92	0.230		22 May, 2013
2013	CARP	GBB	RB	CARP-RB-002	360	303	0.65	0.361		22 May, 2013
2013	CARP	GBB	RB	CARP-RB-003	330	381	1.06	0.100		22 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-004	367	444	0.90	0.449		23 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-005	318	313	0.97	0.100		23 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-006	315	320	1.02	0.119		23 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-007	312	283	0.93	0.105		23 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-008	327	341	0.98	0.158		23 May, 2013
2013	CARP	NOSEBAG	RB	CARP-RB-011	393	541	0.89	0.145		23 May, 2013
2013	CARP	KEARY	RB	CARP-RB-012	353	459	1.04	0.154		23 May, 2013
2013	CARP	KEARY	RB	CARP-RB-015	358	461	1.00	0.190		23 May, 2013
2013	CARP	KEARY	RB	CARP-RB-016	345	395	0.96	0.168		23 May, 2013
2013	CARP	MARSHALL	RB	CARP-RB-019	377	484	0.90	0.297		23 May, 2013
2013	CARP	MARSHALL	RB	CARP-RB-020	345	434	1.06	0.325		23 May, 2013
2013	DWNT	Gwyneth	RB	DWNT-RB-001	298	234	0.88	0.232		22 May, 2013
2013	DWNT	Gwyneth	RB	DWNT-RB-002	289	236	0.98	0.077		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-003	315	282	0.90	0.102		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-004	348	350	0.83	0.175		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-005	319	301	0.93	0.154		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-006	329	350	0.98	0.136		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-007	260	175	1.00			22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-008	315	302	0.97	0.129		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-009	324	273	0.80	0.139		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-010	329	283	0.79	0.305		22 May, 2013
2013	DWNT	Ault	RB	DWNT-RB-011	340	383	0.97	0.129		22 May, 2013
2013	LBR	Top 2 km d/s of dam	BT	BT130814.001	412	677	0.97	0.116		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130813.001	440	635	0.75	0.095		13 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.001	357	517	1.14	0.034		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.002	304	324	1.15	0.045		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.003	351	480	1.11	0.047		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.004	318	326	1.01	0.055		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.005	303	325	1.17	0.052		14 Aug, 2013
2013	LBR	Top 2 km d/s of dam	RB	RB130814.006	313	345	1.13	0.068		14 Aug, 2013
2013	SON	Site 72 (SON)	BT	BT130602.001	490	1600	1.36	0.171		2 June, 2013
2013	SON	Site 72 (SON)	BT	BT130602.002	570	2560	1.38	0.247		2 June, 2013
2013	SON	Site 72 (SON)	BT	BT130602.003	486	1483	1.29	0.202		2 June, 2013

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Length.mm	Weight.g	Condition.k	Hg.ppm.wtwt	Age.yr	Collection Date
2013	SON	Site 72 (SON)	BT	BT130602.004	543	2120	1.32	0.221		2 June, 2013
2013	SON	Site 72 (SON)	BT	BT130617.001	523	1235	0.86	0.449		17 June, 2013
2013	SON	Site 72 (SON)	BT	BT130619.001		2795		0.203		19 June, 2013
2013	SON	Site 72 (SON)	BT	BT130619.002	443	1405	1.62	0.211		19 June, 2013
2013	SON	Site 72 (SON)	BT	BT130619.003	566	2390	1.32	0.204		19 June, 2013
2013	SON	Seton Dock	BT	BT130717.001	409	862	1.26	0.092		17 July, 2013
2013	SON	BRG2 Outlet	BT	SON-BT-001	570	2510	1.36	0.338		21 May, 2013
2013	SON	SON River-LSC Area	BT	SON-BT-002	422	787	1.05	0.183		21 May, 2013
2013	SON	SON River-LSC Area	BT	SON-BT-003	375	547	1.04	0.138		21 May, 2013
2013	SON	SON River-Hwy Br	BT	SON-BT-005	567	1683	0.92	0.180		21 May, 2013
2013	SON	Seton Dock Area	MW	MW130926.001	307	384	1.33	0.074		26 Sept, 2013
2013	SON	Seton Dock Area	MW	MW130927.001	268	186	0.97	0.098		27 Sept, 2013
2013	SON	Seton Dock Area	MW	MW130930.001	274	203	0.99	0.058		30 Sept, 2013
2013	SON	Site 72 (SON)	RB	RB130605.001	327	381	1.09	0.049		5 June, 2013
2013	SON	Site 72 (SON)	RB	RB130605.002	307	352	1.22	0.056		5 June, 2013
2013	SON	Seton Dock	RB	RB130717.001	412	819	1.17	0.247		17 July, 2013
2013	SON	Seton Dock Area	RB	RB130927.001	300	359	1.33	0.120		27 Sept, 2013
2013	SON	Retasket Creek	RB	SON-RB-001	333	390	1.06	0.081		21 May, 2013
2013	SON	Bear Creek	RB	SON-RB-002	347	431	1.03	0.058		21 May, 2013
2013	SON	SON River-LSC Area	RB	SON-RB-004	311	285	0.95	0.093		21 May, 2013
2013	SON	SON River-Hwy Br	RB	SON-RB-006	300	313	1.16	0.063		21 May, 2013
2013	CARP	Gun Cr confl area	MW	MW130924.001	318	360.0	1.12			24 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130924.002	316	351.0	1.11			24 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130924.003	332	425.0	1.16			24 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130924.004	313	382.0	1.25			24 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.007	310	412.0	1.38			25 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.008	308	383.0	1.31			25 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.009	318	386.0	1.20			25 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.010	300	331.0	1.23			25 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.011	306	278.0	0.97			25 Sept, 2013
2013	CARP	Gun Cr confl area	MW	MW130925.012	303	302.0	1.09			25 Sept, 2013
2013	SON	Seton Forebay	MW	MW131016.001	360	662.0	1.42	0.102		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.002	324	484.0	1.42	0.062		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.003	313	492.0	1.60	0.107		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.004	380	780.0	1.42	0.175		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.005	442	1192.0	1.38	0.168		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.006	381	983.0	1.78	0.133		16 Oct, 2013
2013	SON	Seton Forebay	MW	MW131016.007	365	658.0	1.35	0.102		16 Oct, 2013
2013	SON	Seton Forebay	RB	RB131016.001	369	677.0	1.35	0.020		16 Oct, 2013
2013	SON	Seton Forebay	RB	RB131016.002	340	509.0	1.30	0.030		16 Oct, 2013
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-08	382	756.0	1.36	0.067		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-09	303	430.0	1.55			30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-10	366	808.0	1.65	0.045		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-02	446	1253.0	1.41	0.114		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-03	385	800.0	1.40	0.057		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-04	465	1524.0	1.52	0.034		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-05	471	1492.0	1.43	0.072		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-06	430	1103.0	1.39	0.038		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-07	500	1239.0	0.99	0.151		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-08	480	1366.0	1.24	0.185		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-09	459	1463.0	1.51	0.052		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-10	400	944.0	1.48	0.023		30 Oct, 2013
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-11	630	3232.0	1.29	0.076		30 Oct, 2013
2013	SON	~2km W of outlet	KO	SON-GW-01	179	49.0	0.85	0.108		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-02	116	52.0	3.33	0.074		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-03	175	47.0	0.88	0.105		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-04	173	59.0	1.14	0.098		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-05	173	41.0	0.79	0.113		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-06	170	47.0	0.96	0.113		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-07	170	63.0	1.28	0.064		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-08	175	52.0	0.97	0.072		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-09	170	44.0	0.90	0.094		13 Nov, 2013
2013	SON	~2km W of outlet	KO	SON-GW-10	173	43.0	0.83	0.104		13 Nov, 2013

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	**T-Metals (mg/kg ww)**	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Cesium (Cs)	Chromium (Cr)	Cobalt (Co)
2013	CARP	NOSEBAG (CARP)	BT	BT130623.003													
2013	CARP	NOSEBAG (CARP)	BT	BT130623.004													
2013	CARP	NOSEBAG	BT	CARP-BT-001													
2013	CARP	NOSEBAG	BT	CARP-BT-004													
2013	CARP	NOSEBAG	BT	CARP-BT-005													
2013	CARP	NOSEBAG	BT	CARP-BT-006													
2013	CARP	NOSEBAG	BT	CARP-BT-007													
2013	CARP	NOSEBAG	BT	CARP-BT-009													
2013	CARP	KEARY	BT	CARP-BT-013													
2013	CARP	Gun Cr confl	KO	KO130906.001													
2013	CARP	Gun Cr confl	KO	KO130815.001													
2013	CARP	McDonald Cr confl	KO	KO130925.001													
2013	CARP	GBB	MW	CARP-MN-002		0.79	<0.0020	0.0492	0.319	<0.0020	0.0022	0.70	<0.0020	4770	0.0263	0.019	0.0183
2013	CARP	GBB	MW	CARP-MN-004		<0.40	<0.0020	0.115	0.093	<0.0020	<0.0020	<0.20	<0.0020	112	0.0169	<0.010	0.0152
2013	CARP	GBB	MW	CARP-MN-008		3.69	<0.0020	0.0590	0.118	<0.0020	<0.0020	<0.20	<0.0020	471	0.0273	0.019	0.0200
2013	CARP	GBB	MW	CARP-MN-010		0.60	<0.0020	0.0369	0.104	<0.0020	<0.0020	<0.20	<0.0020	743	0.0158	0.024	0.0081
2013	CARP	MARSHALL	MW	CARP-MN-012		1.11	<0.0020	0.0594	0.106	<0.0020	0.0050	<0.20	<0.0020	286	0.0185	0.014	0.0086
2013	CARP	FALLS Cr (CARP)	MW	MW130621.006		0.51	<0.0020	0.0995	0.017	<0.0020	<0.0020	<0.20	0.0040	173	0.0192	<0.010	0.0070
2013	CARP	FALLS Cr (CARP)	MW	MW130621.007		3.18	<0.0020	0.153	0.049	<0.0020	<0.0020	<0.20	<0.0020	207	0.0169	0.018	0.0112
2013	CARP	FALLS Cr (CARP)	MW	MW130621.008		1.02	<0.0020	0.0973	0.021	<0.0020	<0.0020	<0.20	<0.0020	167	0.0194	<0.010	<0.0040
2013	CARP	FALLS Cr (CARP)	MW	MW130621.009		0.77	<0.0020	0.119	<0.010	<0.0020	<0.0020	<0.20	<0.0020	83	0.0209	<0.010	0.0092
2013	CARP	Across from Tyaughton Cr	MW	MW130622.001		2.40	<0.0020	0.0705	0.059	<0.0020	<0.0020	<0.20	0.0023	245	0.0216	0.019	0.0173
2013	CARP	GBB	RB	CARP-RB-001													
2013	CARP	GBB	RB	CARP-RB-002													
2013	CARP	GBB	RB	CARP-RB-003													
2013	CARP	NOSEBAG	RB	CARP-RB-004													
2013	CARP	NOSEBAG	RB	CARP-RB-005													
2013	CARP	NOSEBAG	RB	CARP-RB-006													
2013	CARP	NOSEBAG	RB	CARP-RB-007													
2013	CARP	NOSEBAG	RB	CARP-RB-008													
2013	CARP	NOSEBAG	RB	CARP-RB-011													
2013	CARP	KEARY	RB	CARP-RB-012													
2013	CARP	KEARY	RB	CARP-RB-015													
2013	CARP	KEARY	RB	CARP-RB-016													
2013	CARP	MARSHALL	RB	CARP-RB-019													
2013	CARP	MARSHALL	RB	CARP-RB-020													
2013	DWNT	Gwyneth	RB	DWNT-RB-001													
2013	DWNT	Gwyneth	RB	DWNT-RB-002													
2013	DWNT	Ault	RB	DWNT-RB-003													
2013	DWNT	Ault	RB	DWNT-RB-004													
2013	DWNT	Ault	RB	DWNT-RB-005													
2013	DWNT	Ault	RB	DWNT-RB-006													
2013	DWNT	Ault	RB	DWNT-RB-007													
2013	DWNT	Ault	RB	DWNT-RB-008													
2013	DWNT	Ault	RB	DWNT-RB-009													
2013	DWNT	Ault	RB	DWNT-RB-010													
2013	DWNT	Ault	RB	DWNT-RB-011													
2013	LBR	Top 2 km d/s of dam	BT	BT130814.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130813.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.002													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.003													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.004													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.005													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.006													
2013	SON	Site 72 (SON)	BT	BT130602.001													
2013	SON	Site 72 (SON)	BT	BT130602.002													
2013	SON	Site 72 (SON)	BT	BT130602.003													

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	**T-Metals (mg/kg ww)**	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Cesium (Cs)	Chromium (Cr)	Cobalt (Co)
2013	SON	Site 72 (SON)	BT	BT130602.004													
2013	SON	Site 72 (SON)	BT	BT130617.001													
2013	SON	Site 72 (SON)	BT	BT130619.001													
2013	SON	Site 72 (SON)	BT	BT130619.002													
2013	SON	Site 72 (SON)	BT	BT130619.003													
2013	SON	Seton Dock	BT	BT130717.001													
2013	SON	BRG2 Outlet	BT	SON-BT-001													
2013	SON	SON River-LSC Area	BT	SON-BT-002													
2013	SON	SON River-LSC Area	BT	SON-BT-003													
2013	SON	SON River-Hwy Br	BT	SON-BT-005													
2013	SON	Seton Dock Area	MW	MW130926.001		0.87	<0.0020	0.117	0.057	<0.0020	<0.0020	<0.20	<0.0020	552	0.0076	0.031	0.0080
2013	SON	Seton Dock Area	MW	MW130927.001		0.77	<0.0020	0.0293	0.044	<0.0020	<0.0020	<0.20	0.0025	612	0.0164	0.014	0.0117
2013	SON	Seton Dock Area	MW	MW130930.001		0.74	<0.0020	0.0580	0.072	<0.0020	<0.0020	<0.20	<0.0020	722	0.0202	<0.010	0.0174
2013	SON	Site 72 (SON)	RB	RB130605.001													
2013	SON	Site 72 (SON)	RB	RB130605.002													
2013	SON	Seton Dock	RB	RB130717.001													
2013	SON	Seton Dock Area	RB	RB130927.001													
2013	SON	Retasket Creek	RB	SON-RB-001													
2013	SON	Bear Creek	RB	SON-RB-002													
2013	SON	SON River-LSC Area	RB	SON-RB-004													
2013	SON	SON River-Hwy Br	RB	SON-RB-006													
2013	CARP	Gun Cr confl area	MW	MW130924.001													
2013	CARP	Gun Cr confl area	MW	MW130924.002													
2013	CARP	Gun Cr confl area	MW	MW130924.003													
2013	CARP	Gun Cr confl area	MW	MW130924.004													
2013	CARP	Gun Cr confl area	MW	MW130925.007													
2013	CARP	Gun Cr confl area	MW	MW130925.008													
2013	CARP	Gun Cr confl area	MW	MW130925.009													
2013	CARP	Gun Cr confl area	MW	MW130925.010													
2013	CARP	Gun Cr confl area	MW	MW130925.011													
2013	CARP	Gun Cr confl area	MW	MW130925.012													
2013	SON	Seton Forebay	MW	MW131016.001		1.88	<0.0020	0.116	0.040	<0.0020	<0.0020	<0.20	<0.0020	92	0.0112	0.032	0.0080
2013	SON	Seton Forebay	MW	MW131016.002		1.85	<0.0020	0.0669	0.024	<0.0020	<0.0020	<0.20	<0.0020	91	0.0078	0.031	0.0092
2013	SON	Seton Forebay	MW	MW131016.003		1.61	<0.0020	0.0702	0.021	<0.0020	<0.0020	<0.20	<0.0020	90	0.0098	<0.010	0.0077
2013	SON	Seton Forebay	MW	MW131016.004		3.32	<0.0020	0.169	0.054	<0.0020	<0.0020	<0.20	<0.0020	342	0.0123	0.021	0.0044
2013	SON	Seton Forebay	MW	MW131016.005		1.07	<0.0020	0.150	0.041	<0.0020	<0.0020	<0.20	<0.0020	320	0.0116	0.029	0.0049
2013	SON	Seton Forebay	MW	MW131016.006		0.97	<0.0020	0.0880	0.018	<0.0020	<0.0020	<0.20	<0.0020	129	0.0095	0.015	0.0056
2013	SON	Seton Forebay	MW	MW131016.007		1.23	<0.0020	0.0984	0.032	<0.0020	<0.0020	<0.20	<0.0020	244	0.0088	0.018	0.0078
2013	SON	Seton Forebay	RB	RB131016.001													
2013	SON	Seton Forebay	RB	RB131016.002													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-08													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-09													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-10													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-02													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-03													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-04													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-05													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-06													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-07													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-08													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-09													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-10													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-11													
2013	SON	~2km W of outlet	KO	SON-GW-01		1.73	<0.0020	0.106	0.081	<0.0020	<0.0020	<0.20	<0.0020	468	0.0197	0.044	<0.0040
2013	SON	~2km W of outlet	KO	SON-GW-02		1.86	<0.0020	0.126	0.242	<0.0020	<0.0020	<0.20	<0.0020	2790	0.0198	0.083	<0.0040
2013	SON	~2km W of outlet	KO	SON-GW-03		0.81	<0.0020	0.0380	0.058	<0.0020	<0.0020	<0.20	<0.0020	364	0.0282	0.020	0.0042
2013	SON	~2km W of outlet	KO	SON-GW-04		17.1	0.0021	0.119	0.372	<0.0020	<0.0020	<0.20	<0.0020	314	0.0169	0.113	0.0116
2013	SON	~2km W of outlet	KO	SON-GW-05		2.33	<0.0020	0.109	0.090	<0.0020	<0.0020	<0.20	<0.0020	476	0.0249	0.032	0.0044
2013	SON	~2km W of outlet	KO	SON-GW-06		2.86	<0.0020	0.161	0.096	<0.0020	<0.0020	<0.20	<0.0020	399	0.0215	0.026	0.0046
2013	SON	~2km W of outlet	KO	SON-GW-07		1.37	<0.0020	0.119	0.053	<0.0020	<0.0020	<0.20	<0.0020	293	0.0130	0.018	<0.0040
2013	SON	~2km W of outlet	KO	SON-GW-08		2.82	<0.0020	0.0867	0.072	<0.0020	<0.0020	<0.20	<0.0020	537	0.0197	0.035	<0.0040
2013	SON	~2km W of outlet	KO	SON-GW-09		1.69	0.0151	0.0868	0.069	<0.0020	<0.0020	<0.20	<0.0020	498	0.0168	0.037	0.0108
2013	SON	~2km W of outlet	KO	SON-GW-10		0.73	<0.0020	0.0892	0.063	<0.0020	<0.0020	<0.20	<0.0020	448	0.0284	0.012	<0.0040

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Copper (Cu)	Gallium (Ga)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Rhenium (Re)
2013	CARP	NOSEBAG (CARP)	BT	BT130623.003												
2013	CARP	NOSEBAG (CARP)	BT	BT130623.004												
2013	CARP	NOSEBAG	BT	CARP-BT-001												
2013	CARP	NOSEBAG	BT	CARP-BT-004												
2013	CARP	NOSEBAG	BT	CARP-BT-005												
2013	CARP	NOSEBAG	BT	CARP-BT-006												
2013	CARP	NOSEBAG	BT	CARP-BT-007												
2013	CARP	NOSEBAG	BT	CARP-BT-009												
2013	CARP	KEARY	BT	CARP-BT-013												
2013	CARP	Gun Cr confl	KO	KO130906.001												
2013	CARP	Gun Cr confl	KO	KO130815.001												
2013	CARP	McDonald Cr confl	KO	KO130925.001												
2013	CARP	GBB	MW	CARP-MN-002	0.172	<0.0040	2.26	0.0099	<0.020	404	0.445	<0.0040	<0.010	4590	4880	<0.0020
2013	CARP	GBB	MW	CARP-MN-004	0.242	<0.0040	2.77	0.0064	<0.020	326	0.100	<0.0040	0.011	2600	4990	<0.0020
2013	CARP	GBB	MW	CARP-MN-008	0.235	<0.0040	12.3	0.0049	<0.020	313	0.182	<0.0040	0.013	2630	4860	<0.0020
2013	CARP	GBB	MW	CARP-MN-010	0.257	<0.0040	9.48	<0.0040	<0.020	284	0.141	<0.0040	<0.010	2620	4500	<0.0020
2013	CARP	MARSHALL	MW	CARP-MN-012	0.232	<0.0040	3.51	0.0124	<0.020	355	0.148	<0.0040	0.014	2740	5380	<0.0020
2013	CARP	FALLS Cr (CARP)	MW	MW130621.006	0.244	<0.0040	3.59	0.0097	<0.020	356	0.143	<0.0040	0.011	2800	5430	<0.0020
2013	CARP	FALLS Cr (CARP)	MW	MW130621.007	0.189	<0.0040	6.91	0.0246	<0.020	329	0.193	<0.0040	0.026	2540	4740	<0.0020
2013	CARP	FALLS Cr (CARP)	MW	MW130621.008	0.240	<0.0040	7.10	0.0056	<0.020	310	0.124	<0.0040	<0.010	2540	4830	<0.0020
2013	CARP	FALLS Cr (CARP)	MW	MW130621.009	0.211	<0.0040	2.71	0.0066	<0.020	330	0.119	<0.0040	<0.010	2540	4680	<0.0020
2013	CARP	Across from Tyaughton Cr	MW	MW130622.001	0.507	<0.0040	9.44	0.0675	<0.020	321	0.167	<0.0040	0.036	2670	4800	<0.0020
2013	CARP	GBB	RB	CARP-RB-001												
2013	CARP	GBB	RB	CARP-RB-002												
2013	CARP	GBB	RB	CARP-RB-003												
2013	CARP	NOSEBAG	RB	CARP-RB-004												
2013	CARP	NOSEBAG	RB	CARP-RB-005												
2013	CARP	NOSEBAG	RB	CARP-RB-006												
2013	CARP	NOSEBAG	RB	CARP-RB-007												
2013	CARP	NOSEBAG	RB	CARP-RB-008												
2013	CARP	NOSEBAG	RB	CARP-RB-011												
2013	CARP	KEARY	RB	CARP-RB-012												
2013	CARP	KEARY	RB	CARP-RB-015												
2013	CARP	KEARY	RB	CARP-RB-016												
2013	CARP	MARSHALL	RB	CARP-RB-019												
2013	CARP	MARSHALL	RB	CARP-RB-020												
2013	DWNT	Gwyneth	RB	DWNT-RB-001												
2013	DWNT	Gwyneth	RB	DWNT-RB-002												
2013	DWNT	Ault	RB	DWNT-RB-003												
2013	DWNT	Ault	RB	DWNT-RB-004												
2013	DWNT	Ault	RB	DWNT-RB-005												
2013	DWNT	Ault	RB	DWNT-RB-006												
2013	DWNT	Ault	RB	DWNT-RB-007												
2013	DWNT	Ault	RB	DWNT-RB-008												
2013	DWNT	Ault	RB	DWNT-RB-009												
2013	DWNT	Ault	RB	DWNT-RB-010												
2013	DWNT	Ault	RB	DWNT-RB-011												
2013	LBR	Top 2 km d/s of dam	BT	BT130814.001												
2013	LBR	Top 2 km d/s of dam	RB	RB130813.001												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.001												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.002												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.003												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.004												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.005												
2013	LBR	Top 2 km d/s of dam	RB	RB130814.006												
2013	SON	Site 72 (SON)	BT	BT130602.001												
2013	SON	Site 72 (SON)	BT	BT130602.002												
2013	SON	Site 72 (SON)	BT	BT130602.003												

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Copper (Cu)	Gallium (Ga)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Rhenium (Re)
2013	SON	Site 72 (SON)	BT	BT130602.004												
2013	SON	Site 72 (SON)	BT	BT130617.001												
2013	SON	Site 72 (SON)	BT	BT130619.001												
2013	SON	Site 72 (SON)	BT	BT130619.002												
2013	SON	Site 72 (SON)	BT	BT130619.003												
2013	SON	Seton Dock	BT	BT130717.001												
2013	SON	BRG2 Outlet	BT	SON-BT-001												
2013	SON	SON River-LSC Area	BT	SON-BT-002												
2013	SON	SON River-LSC Area	BT	SON-BT-003												
2013	SON	SON River-Hwy Br	BT	SON-BT-005												
2013	SON	Seton Dock Area	MW	MW130926.001	0.802	<0.0040	10.7	0.0122	<0.020	365	0.307	<0.0040	0.021	3020	4880	<0.0020
2013	SON	Seton Dock Area	MW	MW130927.001	0.510	<0.0040	9.31	0.0088	<0.020	346	0.314	<0.0040	0.019	2920	5050	<0.0020
2013	SON	Seton Dock Area	MW	MW130930.001	0.380	<0.0040	8.35	0.0044	<0.020	363	0.281	<0.0040	0.012	3250	4690	<0.0020
2013	SON	Site 72 (SON)	RB	RB130605.001												
2013	SON	Site 72 (SON)	RB	RB130605.002												
2013	SON	Seton Dock	RB	RB130717.001												
2013	SON	Seton Dock Area	RB	RB130927.001												
2013	SON	Retasket Creek	RB	SON-RB-001												
2013	SON	Bear Creek	RB	SON-RB-002												
2013	SON	SON River-LSC Area	RB	SON-RB-004												
2013	SON	SON River-Hwy Br	RB	SON-RB-006												
2013	CARP	Gun Cr confl area	MW	MW130924.001												
2013	CARP	Gun Cr confl area	MW	MW130924.002												
2013	CARP	Gun Cr confl area	MW	MW130924.003												
2013	CARP	Gun Cr confl area	MW	MW130924.004												
2013	CARP	Gun Cr confl area	MW	MW130925.007												
2013	CARP	Gun Cr confl area	MW	MW130925.008												
2013	CARP	Gun Cr confl area	MW	MW130925.009												
2013	CARP	Gun Cr confl area	MW	MW130925.010												
2013	CARP	Gun Cr confl area	MW	MW130925.011												
2013	CARP	Gun Cr confl area	MW	MW130925.012												
2013	SON	Seton Forebay	MW	MW131016.001	0.608	0.0245	7.32	0.0287	<0.020	315	0.235	<0.0040	0.024	2570	4300	<0.0020
2013	SON	Seton Forebay	MW	MW131016.002	0.643	<0.0040	7.21	0.0208	<0.020	360	0.160	<0.0040	0.062	2890	4660	<0.0020
2013	SON	Seton Forebay	MW	MW131016.003	0.364	<0.0040	4.30	0.0095	<0.020	345	0.174	<0.0040	0.011	2730	4650	<0.0020
2013	SON	Seton Forebay	MW	MW131016.004	0.380	<0.0040	9.34	0.0087	<0.020	274	0.190	<0.0040	0.015	2590	4270	<0.0020
2013	SON	Seton Forebay	MW	MW131016.005	0.571	<0.0040	8.86	0.0101	<0.020	271	0.148	<0.0040	0.024	2420	3900	<0.0020
2013	SON	Seton Forebay	MW	MW131016.006	0.333	<0.0040	4.27	0.0058	<0.020	327	0.139	<0.0040	<0.010	2610	4250	<0.0020
2013	SON	Seton Forebay	MW	MW131016.007	0.484	<0.0040	5.97	0.0062	<0.020	344	0.206	<0.0040	0.010	2830	4700	<0.0020
2013	SON	Seton Forebay	RB	RB131016.001												
2013	SON	Seton Forebay	RB	RB131016.002												
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-08												
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-09												
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-10												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-02												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-03												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-04												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-05												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-06												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-07												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-08												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-09												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-10												
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-11												
2013	SON	~2km W of outlet	KO	SON-GW-01	0.384	<0.0040	11.5	0.0110	<0.020	220	0.285	<0.0040	0.027	2220	4000	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-02	0.591	<0.0040	8.63	0.0095	<0.020	252	0.498	<0.0040	0.048	3290	3990	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-03	0.539	<0.0040	8.91	0.0064	<0.020	233	0.219	<0.0040	0.019	2410	4580	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-04	0.659	0.0050	26.3	0.0229	<0.020	188	0.516	0.0041	0.070	1720	3290	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-05	0.332	<0.0040	7.52	0.0061	<0.020	221	0.296	<0.0040	0.016	2230	3920	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-06	0.445	<0.0040	8.24	0.0080	<0.020	202	0.268	<0.0040	0.016	2140	3880	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-07	0.612	<0.0040	5.61	0.0069	<0.020	195	0.162	<0.0040	0.010	2030	3440	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-08	0.399	<0.0040	6.89	0.0099	<0.020	192	0.297	<0.0040	0.019	2040	3550	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-09	0.452	<0.0040	7.46	0.0067	<0.020	240	0.275	<0.0040	0.027	2100	3740	<0.0020
2013	SON	~2km W of outlet	KO	SON-GW-10	0.433	<0.0040	7.24	<0.0040	<0.020	223	0.285	<0.0040	<0.010	2340	4350	<0.0020

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Rubidium (Rb)	Selenium (Se)	Sodium (Na)	Strontium (Sr)	Tellurium (Te)	Thallium (Tl)	Thorium (Th)	Tin (Sn)	Uranium (U)	Vanadium (V)	Yttrium (Y)	Zinc (Zn)	Zirconium (Zr)
2013	CARP	NOSEBAG (CARP)	BT	BT130623.003													
2013	CARP	NOSEBAG (CARP)	BT	BT130623.004													
2013	CARP	NOSEBAG	BT	CARP-BT-001													
2013	CARP	NOSEBAG	BT	CARP-BT-004													
2013	CARP	NOSEBAG	BT	CARP-BT-005													
2013	CARP	NOSEBAG	BT	CARP-BT-006													
2013	CARP	NOSEBAG	BT	CARP-BT-007													
2013	CARP	NOSEBAG	BT	CARP-BT-009													
2013	CARP	KEARY	BT	CARP-BT-013													
2013	CARP	Gun Cr confl	KO	KO130906.001													
2013	CARP	Gun Cr confl	KO	KO130815.001													
2013	CARP	McDonald Cr confl	KO	KO130925.001													
2013	CARP	GBB	MW	CARP-MN-002	2.46	0.329	270	3.92	<0.0040	0.00888	<0.0020	<0.020	0.00322	0.039	<0.0020	4.89	<0.040
2013	CARP	GBB	MW	CARP-MN-004	2.44	0.239	230	0.127	<0.0040	0.00944	<0.0020	<0.020	<0.00040	<0.020	<0.0020	3.40	<0.040
2013	CARP	GBB	MW	CARP-MN-008	3.22	0.248	250	0.489	<0.0040	0.00712	<0.0020	<0.020	0.00040	<0.020	<0.0020	2.85	<0.040
2013	CARP	GBB	MW	CARP-MN-010	2.16	0.202	220	0.646	<0.0040	0.00669	<0.0020	<0.020	<0.00040	<0.020	<0.0020	3.00	<0.040
2013	CARP	MARSHALL	MW	CARP-MN-012	2.52	0.216	240	0.270	<0.0040	0.0114	<0.0020	<0.020	<0.00040	<0.020	<0.0020	2.71	<0.040
2013	CARP	FALLS Cr (CARP)	MW	MW130621.006	2.93	0.248	<400	0.133	<0.0040	0.0101	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.65	<0.040
2013	CARP	FALLS Cr (CARP)	MW	MW130621.007	2.83	0.279	<400	0.198	<0.0040	0.00652	<0.0020	<0.020	<0.00040	<0.020	<0.0020	3.76	<0.040
2013	CARP	FALLS Cr (CARP)	MW	MW130621.008	2.38	0.266	<400	0.135	<0.0040	0.00832	<0.0020	<0.020	<0.00040	<0.020	<0.0020	2.78	<0.040
2013	CARP	FALLS Cr (CARP)	MW	MW130621.009	2.64	0.211	<400	0.050	<0.0040	0.00850	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.19	<0.040
2013	CARP	Across from Tyaughton Cr	MW	MW130622.001	2.77	0.335	<400	0.202	<0.0040	0.0172	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.32	<0.040
2013	CARP	GBB	RB	CARP-RB-001													
2013	CARP	GBB	RB	CARP-RB-002													
2013	CARP	GBB	RB	CARP-RB-003													
2013	CARP	NOSEBAG	RB	CARP-RB-004													
2013	CARP	NOSEBAG	RB	CARP-RB-005													
2013	CARP	NOSEBAG	RB	CARP-RB-006													
2013	CARP	NOSEBAG	RB	CARP-RB-007													
2013	CARP	NOSEBAG	RB	CARP-RB-008													
2013	CARP	NOSEBAG	RB	CARP-RB-011													
2013	CARP	KEARY	RB	CARP-RB-012													
2013	CARP	KEARY	RB	CARP-RB-015													
2013	CARP	KEARY	RB	CARP-RB-016													
2013	CARP	MARSHALL	RB	CARP-RB-019													
2013	CARP	MARSHALL	RB	CARP-RB-020													
2013	DWNT	Gwyneth	RB	DWNT-RB-001													
2013	DWNT	Gwyneth	RB	DWNT-RB-002													
2013	DWNT	Ault	RB	DWNT-RB-003													
2013	DWNT	Ault	RB	DWNT-RB-004													
2013	DWNT	Ault	RB	DWNT-RB-005													
2013	DWNT	Ault	RB	DWNT-RB-006													
2013	DWNT	Ault	RB	DWNT-RB-007													
2013	DWNT	Ault	RB	DWNT-RB-008													
2013	DWNT	Ault	RB	DWNT-RB-009													
2013	DWNT	Ault	RB	DWNT-RB-010													
2013	DWNT	Ault	RB	DWNT-RB-011													
2013	LBR	Top 2 km d/s of dam	BT	BT130814.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130813.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.001													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.002													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.003													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.004													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.005													
2013	LBR	Top 2 km d/s of dam	RB	RB130814.006													
2013	SON	Site 72 (SON)	BT	BT130602.001													
2013	SON	Site 72 (SON)	BT	BT130602.002													
2013	SON	Site 72 (SON)	BT	BT130602.003													

Appendix A. Length, weight, condition, tissue mercury and metals concentrations for individual fish caught in 2013

Year	Reservoir	Specific Location	Species	Sample.ID	Rubidium (Rb)	Selenium (Se)	Sodium (Na)	Strontium (Sr)	Tellurium (Te)	Thallium (Tl)	Thorium (Th)	Tin (Sn)	Uranium (U)	Vanadium (V)	Yttrium (Y)	Zinc (Zn)	Zirconium (Zr)
2013	SON	Site 72 (SON)	BT	BT130602.004													
2013	SON	Site 72 (SON)	BT	BT130617.001													
2013	SON	Site 72 (SON)	BT	BT130619.001													
2013	SON	Site 72 (SON)	BT	BT130619.002													
2013	SON	Site 72 (SON)	BT	BT130619.003													
2013	SON	Seton Dock	BT	BT130717.001													
2013	SON	BRG2 Outlet	BT	SON-BT-001													
2013	SON	SON River-LSC Area	BT	SON-BT-002													
2013	SON	SON River-LSC Area	BT	SON-BT-003													
2013	SON	SON River-Hwy Br	BT	SON-BT-005													
2013	SON	Seton Dock Area	MW	MW130926.001	1.78	0.607	<400	0.480	<0.0040	0.00353	<0.0020	<0.020	<0.00040	<0.020	<0.0020	6.17	<0.040
2013	SON	Seton Dock Area	MW	MW130927.001	2.28	0.590	<400	0.505	<0.0040	0.00564	<0.0020	<0.020	<0.00040	<0.020	<0.0020	5.33	<0.040
2013	SON	Seton Dock Area	MW	MW130930.001	1.40	0.937	<400	0.553	<0.0040	0.00258	<0.0020	0.028	0.00051	<0.020	<0.0020	7.40	<0.040
2013	SON	Site 72 (SON)	RB	RB130605.001													
2013	SON	Site 72 (SON)	RB	RB130605.002													
2013	SON	Seton Dock	RB	RB130717.001													
2013	SON	Seton Dock Area	RB	RB130927.001													
2013	SON	Retasket Creek	RB	SON-RB-001													
2013	SON	Bear Creek	RB	SON-RB-002													
2013	SON	SON River-LSC Area	RB	SON-RB-004													
2013	SON	SON River-Hwy Br	RB	SON-RB-006													
2013	CARP	Gun Cr confl area	MW	MW130924.001													
2013	CARP	Gun Cr confl area	MW	MW130924.002													
2013	CARP	Gun Cr confl area	MW	MW130924.003													
2013	CARP	Gun Cr confl area	MW	MW130924.004													
2013	CARP	Gun Cr confl area	MW	MW130925.007													
2013	CARP	Gun Cr confl area	MW	MW130925.008													
2013	CARP	Gun Cr confl area	MW	MW130925.009													
2013	CARP	Gun Cr confl area	MW	MW130925.010													
2013	CARP	Gun Cr confl area	MW	MW130925.011													
2013	CARP	Gun Cr confl area	MW	MW130925.012													
2013	SON	Seton Forebay	MW	MW131016.001	1.53	0.331	<400	0.066	<0.0040	0.00233	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.33	<0.040
2013	SON	Seton Forebay	MW	MW131016.002	1.63	0.453	<400	0.046	<0.0040	0.00373	<0.0020	<0.020	0.00051	<0.020	<0.0020	4.35	<0.040
2013	SON	Seton Forebay	MW	MW131016.003	2.19	0.420	<400	0.050	<0.0040	0.00289	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.02	<0.040
2013	SON	Seton Forebay	MW	MW131016.004	2.02	0.280	<400	0.301	<0.0040	0.00402	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.98	<0.040
2013	SON	Seton Forebay	MW	MW131016.005	1.81	0.251	<400	0.292	<0.0040	0.00305	<0.0020	<0.020	<0.00040	<0.020	<0.0020	3.93	<0.040
2013	SON	Seton Forebay	MW	MW131016.006	2.06	0.322	<400	0.093	<0.0040	0.00270	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.09	<0.040
2013	SON	Seton Forebay	MW	MW131016.007	1.76	0.484	<400	0.213	<0.0040	0.00274	<0.0020	<0.020	<0.00040	<0.020	<0.0020	4.88	<0.040
2013	SON	Seton Forebay	RB	RB131016.001													
2013	SON	Seton Forebay	RB	RB131016.002													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-08													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-09													
2013	LBR	Top 2 km d/s of dam	RB	LBR-RB-10													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-02													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-03													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-04													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-05													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-06													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-07													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-08													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-09													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-10													
2013	LBR	Top 2 km d/s of dam	BT	LBR-BT-11													
2013	SON	~2km W of outlet	KO	SON-GW-01	2.16	0.227	<600	0.503	<0.0040	0.00427	<0.0020	<0.020	<0.00040	<0.020	<0.0020	9.05	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-02	2.45	0.234	<400	2.77	<0.0040	0.00469	<0.0020	<0.020	<0.00040	<0.020	<0.0020	15.6	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-03	2.86	0.301	430	0.431	<0.0040	0.00651	<0.0020	<0.020	<0.00040	<0.020	<0.0020	10.9	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-04	1.66	0.229	<400	0.350	<0.0040	0.00382	0.0023	<0.020	0.00052	0.091	0.0101	8.50	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-05	2.46	0.228	<600	0.451	<0.0040	0.00516	<0.0020	<0.020	<0.00040	<0.020	<0.0020	11.1	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-06	2.01	0.207	<400	0.387	<0.0040	0.00639	<0.0020	<0.020	<0.00040	<0.020	<0.0020	10.3	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-07	1.74	0.271	<400	0.302	<0.0040	0.00250	<0.0020	<0.020	<0.00040	<0.020	<0.0020	8.17	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-08	2.06	0.215	520	0.528	<0.0040	0.00335	<0.0020	<0.020	<0.00040	<0.020	<0.0020	17.0	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-09	1.89	0.201	<400	0.514	<0.0040	0.00551	<0.0020	<0.020	<0.00040	<0.020	<0.0020	25.5	<0.040
2013	SON	~2km W of outlet	KO	SON-GW-10	3.10	0.252	<400	0.442	<0.0040	0.00578	<0.0020	<0.020	0.00172	<0.020	<0.0020	11.8	<0.040

Appendix B – ALS Laboratory Analytical Results

AZIMUTH CONSULTING GROUP INC.
ATTN: Randy Baker
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 30-MAY-13
Report Date: 22-JUL-13 13:15 (MT)
Version: FINAL REV. 2

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1309169

Project P.O. #: NOT SUBMITTED
Job Reference: BRGMON12
C of C Numbers: 1, 2, 3
Legal Site Desc:

Comments: This report replaces the previous version and contains additional analyses, as requested.

Brent Mack
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-1	L1309169-2	L1309169-3	L1309169-4	L1309169-5
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13
	Sampled Time					
	Client ID	DWNT-RB-001	DWNT-RB-002	DWNT-RB-003	DWNT-RB-004	DWNT-RB-005
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	1.08	0.357	0.476	0.814	0.716
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-6	L1309169-8	L1309169-9	L1309169-10	L1309169-11
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13
	Sampled Time					
	Client ID	DWNT-RB-006	DWNT-RB-008	DWNT-RB-010	DWNT-RB-011	SON-RB-001
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.632	0.601	1.42	0.600	0.376
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-12 tissue 22-MAY-13 SON-RB-002	L1309169-13 tissue 22-MAY-13 SON-RB-004	L1309169-14 tissue 22-MAY-13 SON-RB-006	L1309169-15 tissue 23-MAY-13 SON-BT-001	L1309169-16 tissue 23-MAY-13 SON-BT-002
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.272	0.432	0.294	1.57	0.853
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-17 tissue 23-MAY-13 SON-BT-003	L1309169-18 tissue 23-MAY-13 SON-BT-005	L1309169-19 tissue 23-MAY-13 CARP-RB-001	L1309169-20 tissue 23-MAY-13 CARP-RB-002	L1309169-21 tissue 23-MAY-13 CARP-RB-003
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.641	0.835	1.07	1.68	0.463
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L1309169-22 tissue 23-MAY-13 CARP-RB-004	L1309169-23 tissue 23-MAY-13 CARP-RB-005	L1309169-24 tissue 23-MAY-13 CARP-RB-006	L1309169-25 tissue 23-MAY-13 CARP-RB-007	L1309169-26 tissue 23-MAY-13 CARP-RB-008
TISSUE							
Physical Tests	% Moisture (%)						
Metals	Aluminum (Al)-Total (mg/kg wwt)						
	Antimony (Sb)-Total (mg/kg wwt)						
	Arsenic (As)-Total (mg/kg wwt)						
	Barium (Ba)-Total (mg/kg wwt)						
	Beryllium (Be)-Total (mg/kg wwt)						
	Bismuth (Bi)-Total (mg/kg wwt)						
	Boron (B)-Total (mg/kg wwt)						
	Cadmium (Cd)-Total (mg/kg wwt)						
	Calcium (Ca)-Total (mg/kg wwt)						
	Cesium (Cs)-Total (mg/kg wwt)						
	Chromium (Cr)-Total (mg/kg wwt)						
	Cobalt (Co)-Total (mg/kg wwt)						
	Copper (Cu)-Total (mg/kg wwt)						
	Gallium (Ga)-Total (mg/kg wwt)						
	Iron (Fe)-Total (mg/kg wwt)						
	Lead (Pb)-Total (mg/kg wwt)						
	Lithium (Li)-Total (mg/kg wwt)						
	Magnesium (Mg)-Total (mg/kg wwt)						
	Manganese (Mn)-Total (mg/kg wwt)						
	Mercury (Hg)-Total (mg/kg)		2.09	0.464	0.555	0.487	0.737
	Mercury (Hg)-Total (mg/kg wwt)						
	Molybdenum (Mo)-Total (mg/kg wwt)						
	Nickel (Ni)-Total (mg/kg wwt)						
	Phosphorus (P)-Total (mg/kg wwt)						
	Potassium (K)-Total (mg/kg wwt)						
	Rhenium (Re)-Total (mg/kg wwt)						
	Rubidium (Rb)-Total (mg/kg wwt)						
	Selenium (Se)-Total (mg/kg wwt)						
	Sodium (Na)-Total (mg/kg wwt)						
	Strontium (Sr)-Total (mg/kg wwt)						
	Tellurium (Te)-Total (mg/kg wwt)						
	Thallium (Tl)-Total (mg/kg wwt)						
	Thorium (Th)-Total (mg/kg wwt)						
	Tin (Sn)-Total (mg/kg wwt)						
	Uranium (U)-Total (mg/kg wwt)						
	Vanadium (V)-Total (mg/kg wwt)						

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L1309169-27 tissue 23-MAY-13 CARP-RB-011	L1309169-28 tissue 23-MAY-13 CARP-RB-012	L1309169-29 tissue 23-MAY-13 CARP-RB-015	L1309169-30 tissue 23-MAY-13 CARP-RB-016	L1309169-31 tissue 23-MAY-13 CARP-RB-019
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.676	0.715	0.883	0.780	1.38
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-32 tissue 23-MAY-13 CARP-RB-020	L1309169-33 tissue 23-MAY-13 CARP-BT-001	L1309169-34 tissue 23-MAY-13 CARP-BT-004	L1309169-35 tissue 23-MAY-13 CARP-BT-005	L1309169-36 tissue 23-MAY-13 CARP-BT-006
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	1.51	3.48	3.46	2.72	3.80
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-37 tissue 23-MAY-13 CARP-BT-007	L1309169-38 tissue 23-MAY-13 CARP-BT-009	L1309169-39 tissue 23-MAY-13 CARP-BT-012	L1309169-40 tissue 23-MAY-13 CARP-BT-013	L1309169-41 tissue 23-MAY-13 CARP-MN-002
TISSUE						
Physical Tests	% Moisture (%)					78.0
Metals	Aluminum (Al)-Total (mg/kg wwt)					0.79
	Antimony (Sb)-Total (mg/kg wwt)					<0.0020
	Arsenic (As)-Total (mg/kg wwt)					0.0492
	Barium (Ba)-Total (mg/kg wwt)					0.319
	Beryllium (Be)-Total (mg/kg wwt)					<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)					0.0022
	Boron (B)-Total (mg/kg wwt)					0.70
	Cadmium (Cd)-Total (mg/kg wwt)					<0.0020
	Calcium (Ca)-Total (mg/kg wwt)					4770
	Cesium (Cs)-Total (mg/kg wwt)					0.0263
	Chromium (Cr)-Total (mg/kg wwt)					0.019
	Cobalt (Co)-Total (mg/kg wwt)					0.0183
	Copper (Cu)-Total (mg/kg wwt)					0.172
	Gallium (Ga)-Total (mg/kg wwt)					<0.0040
	Iron (Fe)-Total (mg/kg wwt)					2.26
	Lead (Pb)-Total (mg/kg wwt)					0.0099
	Lithium (Li)-Total (mg/kg wwt)					<0.020
	Magnesium (Mg)-Total (mg/kg wwt)					404
	Manganese (Mn)-Total (mg/kg wwt)					0.445
	Mercury (Hg)-Total (mg/kg)	4.60	0.494	6.27	3.15	
	Mercury (Hg)-Total (mg/kg wwt)					0.261
	Molybdenum (Mo)-Total (mg/kg wwt)					<0.0040
	Nickel (Ni)-Total (mg/kg wwt)					<0.010
	Phosphorus (P)-Total (mg/kg wwt)					4590
	Potassium (K)-Total (mg/kg wwt)					4880
	Rhenium (Re)-Total (mg/kg wwt)					<0.0020
	Rubidium (Rb)-Total (mg/kg wwt)					2.46
	Selenium (Se)-Total (mg/kg wwt)					0.329
	Sodium (Na)-Total (mg/kg wwt)					270
	Strontium (Sr)-Total (mg/kg wwt)					3.92
	Tellurium (Te)-Total (mg/kg wwt)					<0.0040
	Thallium (Tl)-Total (mg/kg wwt)					0.00888
	Thorium (Th)-Total (mg/kg wwt)					<0.0020
	Tin (Sn)-Total (mg/kg wwt)					<0.020
	Uranium (U)-Total (mg/kg wwt)					0.00322
	Vanadium (V)-Total (mg/kg wwt)					0.039

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-42 tissue 23-MAY-13 CARP-MN-004	L1309169-43 tissue 23-MAY-13 CARP-MN-008	L1309169-44 tissue 23-MAY-13 CARP-MN-010	L1309169-45 tissue 23-MAY-13 CARP-MN-012	L1309169-46 tissue 23-MAY-13 DWNT-RB-009
TISSUE						
Physical Tests	% Moisture (%)	77.2	77.5	78.5	77.6	
Metals	Aluminum (Al)-Total (mg/kg wwt)	<0.40	3.69	0.60	1.11	
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Arsenic (As)-Total (mg/kg wwt)	0.115	0.0590	0.0369	0.0594	
	Barium (Ba)-Total (mg/kg wwt)	0.093	0.118	0.104	0.106	
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0050	
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Calcium (Ca)-Total (mg/kg wwt)	112	471	743	286	
	Cesium (Cs)-Total (mg/kg wwt)	0.0169	0.0273	0.0158	0.0185	
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.019	0.024	0.014	
	Cobalt (Co)-Total (mg/kg wwt)	0.0152	0.0200	0.0081	0.0086	
	Copper (Cu)-Total (mg/kg wwt)	0.242	0.235	0.257	0.232	
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Iron (Fe)-Total (mg/kg wwt)	2.77	12.3	9.48	3.51	
	Lead (Pb)-Total (mg/kg wwt)	0.0064	0.0049	<0.0040	0.0124	
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Magnesium (Mg)-Total (mg/kg wwt)	326	313	284	355	
	Manganese (Mn)-Total (mg/kg wwt)	0.100	0.182	0.141	0.148	
	Mercury (Hg)-Total (mg/kg)					0.646
	Mercury (Hg)-Total (mg/kg wwt)	0.240	0.244	0.341	0.266	
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Nickel (Ni)-Total (mg/kg wwt)	0.011	0.013	<0.010	0.014	
	Phosphorus (P)-Total (mg/kg wwt)	2600	2630	2620	2740	
	Potassium (K)-Total (mg/kg wwt)	4990	4860	4500	5380	
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Rubidium (Rb)-Total (mg/kg wwt)	2.44	3.22	2.16	2.52	
	Selenium (Se)-Total (mg/kg wwt)	0.239	0.248	0.202	0.216	
	Sodium (Na)-Total (mg/kg wwt)	230	250	220	240	
	Strontium (Sr)-Total (mg/kg wwt)	0.127	0.489	0.646	0.270	
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Thallium (Tl)-Total (mg/kg wwt)	0.00944	0.00712	0.00669	0.0114	
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00040	<0.00040	<0.00040	
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-1	L1309169-2	L1309169-3	L1309169-4	L1309169-5
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13
	Sampled Time					
	Client ID	DWNT-RB-001	DWNT-RB-002	DWNT-RB-003	DWNT-RB-004	DWNT-RB-005
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-6	L1309169-8	L1309169-9	L1309169-10	L1309169-11
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13	22-MAY-13
	Sampled Time					
	Client ID	DWNT-RB-006	DWNT-RB-008	DWNT-RB-010	DWNT-RB-011	SON-RB-001
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-12	L1309169-13	L1309169-14	L1309169-15	L1309169-16
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	22-MAY-13	22-MAY-13	22-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	SON-RB-002	SON-RB-004	SON-RB-006	SON-BT-001	SON-BT-002
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-17	L1309169-18	L1309169-19	L1309169-20	L1309169-21
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	SON-BT-003	SON-BT-005	CARP-RB-001	CARP-RB-002	CARP-RB-003
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-22	L1309169-23	L1309169-24	L1309169-25	L1309169-26
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	CARP-RB-004	CARP-RB-005	CARP-RB-006	CARP-RB-007	CARP-RB-008
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-27	L1309169-28	L1309169-29	L1309169-30	L1309169-31
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	CARP-RB-011	CARP-RB-012	CARP-RB-015	CARP-RB-016	CARP-RB-019
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-32	L1309169-33	L1309169-34	L1309169-35	L1309169-36
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	CARP-RB-020	CARP-BT-001	CARP-BT-004	CARP-BT-005	CARP-BT-006
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1309169-37 tissue 23-MAY-13 CARP-BT-007	L1309169-38 tissue 23-MAY-13 CARP-BT-009	L1309169-39 tissue 23-MAY-13 CARP-BT-012	L1309169-40 tissue 23-MAY-13 CARP-BT-013	L1309169-41 tissue 23-MAY-13 CARP-MN-002
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					<0.0020
	Zinc (Zn)-Total (mg/kg wwt)					4.89
	Zirconium (Zr)-Total (mg/kg wwt)					<0.040

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1309169-42	L1309169-43	L1309169-44	L1309169-45	L1309169-46
	Description	tissue	tissue	tissue	tissue	tissue
	Sampled Date	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13	23-MAY-13
	Sampled Time					
	Client ID	CARP-MN-004	CARP-MN-008	CARP-MN-010	CARP-MN-012	DWNT-RB-009
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Zinc (Zn)-Total (mg/kg wwt)	3.40	2.85	3.00	2.71	
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Calcium (Ca)-Total	DUP-H	L1309169-41, -42, -43, -44, -45
Duplicate	Copper (Cu)-Total	DUP-H	L1309169-41, -42, -43, -44, -45
Duplicate	Iron (Fe)-Total	DUP-H	L1309169-41, -42, -43, -44, -45
Duplicate	Strontium (Sr)-Total	DUP-H	L1309169-41, -42, -43, -44, -45

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-WET-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS (WET)	EPA 200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

MET-WET-ICP-VA	Tissue	Metals in Tissue by ICPOES (WET)	EPA 200.3, EPA 6010B

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Optical Emission Spectrophotometry, adapted from US EPA Method 6010B. This digestion procedure was implemented on October 5, 2009.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 2 3

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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1988 Triumph Street, Vancouver, BC Canada V5L 1K5
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Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

www.alsenviro.com

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group				
ADDRESS:	218-2902 W. Broadway				
CITY:	Vancouver	PROV:	BC	POSTAL CODE:	V6K 2G8
CONTACT:	Randy Baker			TELEPHONE:	604 730-1220
PROJECT NAME/#:	BRGMON12			SAMPLER:	R. Baker
ALSE QUOTE #:	Q 35275			ALSE CONTACT:	Brent Mack

REPORT FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail Specify file type: E-mail Address: rbaker@azimuthgroup.ca

INVOICE FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail (pdf format) E-mail Address:

◉ Routine Turn Around
○ Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? ☐ Yes ☐ No

COMPANY:				CONTACT:	
ADDRESS:				P.O. #:	
CITY:		PROV:		POSTAL CODE:	TEL:

ANALYSIS REQUESTED:

FOR LAB USE ONLY WO #	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Hg-Dry-CVAFS (SSY)	PREP-200.8-DIGEST-VA	NOTES (sample specific comments, due dates, etc.)
	DWNT-RB-001	13-5-22		tissue	x	x	small volume biopsy
	DWNT-RB-002	13-5-22			x	x	
	DWNT-RB-003	13-5-22			x	x	
	DWNT-RB-004	13-5-22			x	x	
	DWNT-RB-005	13-5-22			x	x	
	DWNT-RB-006	13-5-22			x	x	
	DWNT-RB-007	13-5-22			x	x	
	DWNT-RB-008	13-5-22			x	x	
	DWNT-RB-010	13-5-22			x	x	
	DWNT-RB-011	13-5-22			x	x	
	SON-RB-001	13-5-22			x	x	
	SON-RB-002	13-5-22			x	x	
	SON-RB-004	13-5-22			x	x	
	SON-RB-006	13-5-22			x	x	

Short Holding Time
Rush Processing

L1309169-COFC

RELINQUISHED BY:

NAME:		DATE:	
OF:		TIME:	
NAME:		DATE:	
OF:		TIME:	

RECEIVED BY:

NAME:	TW	DATE:	May 30
OF:		TIME:	15:15
NAME:		DATE:	
OF:	ALS Environmental	TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No___ N/A___ Sample Temperature: 4 °C Frozen? Yes___ No___ Cooling Method? Icepacks___ Ice___ None___

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Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

www.alsenviro.com

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group				
ADDRESS:	218-2902 W. Broadway				
CITY:	Vancouver	PROV:	BC	POSTAL CODE:	V6K 2G8
CONTACT:	Randy Baker			TELEPHONE:	604 730-1220
PROJECT NAME/#:	BRGMON12			SAMPLER:	R. Baker
ALSE QUOTE #:	Q 35275			ALSE CONTACT:	Brent Mack

REPORT FORMAT:
- ○ Hardcopy ○ Fax #:
- ◉ E-mail Specify file type:
- E-mail Address: rbaker@azimuthgroup.ca

INVOICE FORMAT:
- ○ Hardcopy ○ Fax #:
- ◉ E-mail (pdf format)
- E-mail Address:

- ◉ Routine Turn Around
- ○ Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? ☐ Yes ☐ No

COMPANY:				CONTACT:			
ADDRESS:						P.O. #:	
CITY:		PROV:		POSTAL CODE:		TEL:	

ANALYSIS REQUESTED:

Short Holding Time
Rush Processing

WO #	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Hg-Dry-CVAFS	PREP-HG-DIGEST-VA	NOTES (sample specific comments, due dates, etc.)
FOR LAB USE ONLY	SON-BT-001	13-05-23		tissue	x	x	small volume biopsy
	SON-BT-002	13-05-23			x	x	
	SON-BT-003	13-05-23			x	x	
	SON-BT-005	13-05-23			x	x	
	CARP-RB-001	13-05-23			x	x	
	CARP-RB-002	13-05-23			x	x	
	CARP-RB-003	13-05-23			x	x	
	CARP-RB-004	13-05-23			x	x	
	CARP-RB-005	13-05-23			x	x	
	CARP-RB-006	13-05-23			x	x	
	CARP-RB-007	13-05-23			x	x	
	CARP-RB-008	13-05-23			x	x	
	CARP-RB-011	13-05-23			x	x	
	CARP-RB-012	13-05-23			x	x	
	CARP-RB-015	13-05-23			x	x	
	CARP-RB-016	13-05-23			x	x	

L1309169-COFC

RELINQUISHED BY:				RECEIVED BY:			
NAME:		DATE:		NAME:	TN	DATE:	Mar 30 13:15
OF:		TIME:		OF:		TIME:	
NAME:		DATE:		NAME:		DATE:	
OF:		TIME:		OF:	ALS Environmental	TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No___ N/A___ Sample Temperature: 4 °C Frozen? Yes___ No___ Cooling Method? Icepacks___ Ice___ None___

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Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

www.alsenviro.com

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group				
ADDRESS:	218-2902 W. Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	Randy Baker		TELEPHONE:	604 730-1220	
PROJECT NAME/#:	BRGMON12		SAMPLER:	R. Baker	
ALSE QUOTE #:	Q 35275		ALSE CONTACT:	Brent Mack	

REPORT FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail Specify file type: E-mail Address: rbaker@azimuthgroup.ca

INVOICE FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail (pdf format) E-mail Address:

◉ Routine Turn Around
○ Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? ☐ Yes ☐ No

COMPANY:		CONTACT:			
ADDRESS:				P.O. #:	
CITY:		PROV:	POSTAL CODE:		TEL:

ANALYSIS REQUESTED:

L1309169-COFC

WO #	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Hg-Dry-CVAFS	Hg-WET-CVAFS-VA	MET-WET-ICP+HRMS-VA	PREP-TISS-DIGEST-VA	PREP-BSY-DIGEST-VA	NOTES (sample specific comments, due dates, etc.)
	CARP-RB-019	13-05-23		tissue	x			x	x	small volume biopsy
	CARP-RB-020	13-05-23			x			x	x	
	CARP-BT-001	13-05-23			x			x	x	
	CARP-BT-004	13-05-23			x			x	x	
	CARP-BT-005	13-05-23			x			x	x	
	CARP-BT-006	13-05-23			x			x	x	
	CARP-BT-007	13-05-23			x			x	x	
	CARP-BT-009	13-05-23			x			x	x	
	CARP-BT-012	13-05-23			x			x	x	
	CARP-BT-013	13-05-23			x			x	x	
	CARP-MN-002	13-05-23				x	x	x		
	CARP-MN-004	13-05-23				x	x	x		
	CARP-MN-008	13-05-23				x	x	x		
	CARP-MN-010	13-05-23				x	x	x		
	CARP-MN-012	13-05-23				x	x	x		

FOR LAB USE ONLY

Short Holding Time

Rush Processing

RELINQUISHED BY:				RECEIVED BY:			
NAME:		DATE:		NAME:	IN	DATE:	May 30 13:15
OF:		TIME:		OF:		TIME:	
NAME:		DATE:		NAME:		DATE:	
OF:		TIME:		OF:	ALS Environmental	TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No___ N/A___ Sample Temperature: 4 °C Frozen? Yes___ No___ Cooling Method? Icepacks___ Ice___ None___

AZIMUTH CONSULTING GROUP INC.
ATTN: Randy Baker
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 22-OCT-13
Report Date: 17-DEC-13 18:09 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1381305

Project P.O. #:	NOT SUBMITTED
Job Reference:	BRGMON12
C of C Numbers:	2, OL-1002
Legal Site Desc:	

Comments: Biopsy results for Mercury presented in this report are calculated in dry weight after drying at 60C, digestion, and instrumental analysis.

Brent Mack
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-1	L1381305-2	L1381305-3	L1381305-4	L1381305-5
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	23-JUN-13	23-JUN-13	17-JUL-13	14-AUG-13	15-AUG-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130623.003	BT-130623.004	BT-130717.001	BT-130814.001	KO-130815.001
Grouping	**Analyte**					
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	2.45	2.75	0.427	0.540	0.792
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					
	Yttrium (Y)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-6	L1381305-7	L1381305-8	L1381305-9	L1381305-10
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	06-SEP-13	25-SEP-13	13-AUG-13	14-AUG-13	21-JUN-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	KO-130906.001	KO-130925.001	RB-130813.001	RB-130814.001	MW-130621.006
Grouping	**Analyte**					
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)					0.51
	Antimony (Sb)-Total (mg/kg wwt)					<0.0020
	Arsenic (As)-Total (mg/kg wwt)					0.0995
	Barium (Ba)-Total (mg/kg wwt)					0.017
	Beryllium (Be)-Total (mg/kg wwt)					<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)					<0.0020
	Boron (B)-Total (mg/kg wwt)					<0.20
	Cadmium (Cd)-Total (mg/kg wwt)					0.0040
	Calcium (Ca)-Total (mg/kg wwt)					173
	Cesium (Cs)-Total (mg/kg wwt)					0.0192
	Chromium (Cr)-Total (mg/kg wwt)					<0.010
	Cobalt (Co)-Total (mg/kg wwt)					0.0070
	Copper (Cu)-Total (mg/kg wwt)					0.244
	Gallium (Ga)-Total (mg/kg wwt)					<0.0040
	Iron (Fe)-Total (mg/kg wwt)					3.59
	Lead (Pb)-Total (mg/kg wwt)					0.0097
	Lithium (Li)-Total (mg/kg wwt)					<0.020
	Magnesium (Mg)-Total (mg/kg wwt)					356
	Manganese (Mn)-Total (mg/kg wwt)					0.143
	Mercury (Hg)-Total (mg/kg)	1.34	0.425	0.440	0.158	
	Mercury (Hg)-Total (mg/kg wwt)					0.411
	Molybdenum (Mo)-Total (mg/kg wwt)					<0.0040
	Nickel (Ni)-Total (mg/kg wwt)					0.011
	Phosphorus (P)-Total (mg/kg wwt)					2800
	Potassium (K)-Total (mg/kg wwt)					5430
	Rhenium (Re)-Total (mg/kg wwt)					<0.0020
	Rubidium (Rb)-Total (mg/kg wwt)					2.93
	Selenium (Se)-Total (mg/kg wwt)					0.248
	Sodium (Na)-Total (mg/kg wwt)					<400 DLIV
	Strontium (Sr)-Total (mg/kg wwt)					0.133
	Tellurium (Te)-Total (mg/kg wwt)					<0.0040
	Thallium (Tl)-Total (mg/kg wwt)					0.0101
	Thorium (Th)-Total (mg/kg wwt)					<0.0020
	Tin (Sn)-Total (mg/kg wwt)					<0.020
	Uranium (U)-Total (mg/kg wwt)					<0.00040
	Vanadium (V)-Total (mg/kg wwt)					<0.020
	Yttrium (Y)-Total (mg/kg wwt)					<0.0020

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1381305-11 TISSUE 21-JUN-13 12:00 MW-130621.007	L1381305-12 TISSUE 21-JUN-13 12:00 MW-130621.008	L1381305-13 TISSUE 21-JUN-13 12:00 MW-130621.009	L1381305-14 TISSUE 22-JUN-13 12:00 MW-130622.001	L1381305-15 TISSUE 27-SEP-13 12:00 RB130927.001
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)	3.18	1.02	0.77	2.40	
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Arsenic (As)-Total (mg/kg wwt)	0.153	0.0973	0.119	0.0705	
	Barium (Ba)-Total (mg/kg wwt)	0.049	0.021	<0.010	0.059	
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0023	
	Calcium (Ca)-Total (mg/kg wwt)	207	167	83	245	
	Cesium (Cs)-Total (mg/kg wwt)	0.0169	0.0194	0.0209	0.0216	
	Chromium (Cr)-Total (mg/kg wwt)	0.018	<0.010	<0.010	0.019	
	Cobalt (Co)-Total (mg/kg wwt)	0.0112	<0.0040	0.0092	0.0173	
	Copper (Cu)-Total (mg/kg wwt)	0.189	0.240	0.211	0.507	
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Iron (Fe)-Total (mg/kg wwt)	6.91	7.10	2.71	9.44	
	Lead (Pb)-Total (mg/kg wwt)	0.0246	0.0056	0.0066	0.0675	
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Magnesium (Mg)-Total (mg/kg wwt)	329	310	330	321	
	Manganese (Mn)-Total (mg/kg wwt)	0.193	0.124	0.119	0.167	
	Mercury (Hg)-Total (mg/kg)					0.558
	Mercury (Hg)-Total (mg/kg wwt)	0.245	0.402	0.463	0.361	
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Nickel (Ni)-Total (mg/kg wwt)	0.026	<0.010	<0.010	0.036	
	Phosphorus (P)-Total (mg/kg wwt)	2540	2540	2540	2670	
	Potassium (K)-Total (mg/kg wwt)	4740	4830	4680	4800	
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Rubidium (Rb)-Total (mg/kg wwt)	2.83	2.38	2.64	2.77	
	Selenium (Se)-Total (mg/kg wwt)	0.279	0.266	0.211	0.335	
	Sodium (Na)-Total (mg/kg wwt)	<400 DLIV	<400 DLIV	<400 DLIV	<400 DLIV	
	Strontium (Sr)-Total (mg/kg wwt)	0.198	0.135	0.050	0.202	
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Thallium (Tl)-Total (mg/kg wwt)	0.00652	0.00832	0.00850	0.0172	
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1381305-16 TISSUE 05-JUN-13 12:00 RB-130605.001	L1381305-17 TISSUE 05-JUN-13 12:00 RB-130605.002	L1381305-18 TISSUE 17-JUL-13 12:00 RB-130717.001	L1381305-19 TISSUE 19-JUN-13 12:00 BT-130619.001	L1381305-20 TISSUE 19-JUN-13 12:00 BT-130619.002
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.230	0.259	1.15	0.944	0.981
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					
	Yttrium (Y)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-21	L1381305-22	L1381305-23	L1381305-24	L1381305-25
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	19-JUN-13	17-JUN-13	02-JUN-13	02-JUN-13	02-JUN-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130619.003	BT-130617.001	BT-130602.001	BT-130602.002	BT-130602.003
Grouping	**Analyte**					
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.947	2.09	0.795	1.15	0.940
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					
	Yttrium (Y)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-26	L1381305-27	L1381305-28	L1381305-29	L1381305-30
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	02-JUN-13	14-AUG-13	14-AUG-13	14-AUG-13	14-AUG-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130602.004	RB-130814.002	RB-130814.003	RB-130814.004	RB-130814.005
Grouping	**Analyte**					
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	1.03	0.208	0.218	0.258	0.243
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					
	Yttrium (Y)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1381305-31 TISSUE 14-AUG-13 12:00 RB-130814.006	L1381305-32 TISSUE 26-SEP-13 12:00 MW-130926.001	L1381305-33 TISSUE 27-SEP-13 12:00 MW-130927.001	L1381305-34 TISSUE 30-SEP-13 12:00 MW-130930.001	
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)		0.87	0.77	0.74	
	Antimony (Sb)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	
	Arsenic (As)-Total (mg/kg wwt)		0.117	0.0293	0.0580	
	Barium (Ba)-Total (mg/kg wwt)		0.057	0.044	0.072	
	Beryllium (Be)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	
	Bismuth (Bi)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	
	Boron (B)-Total (mg/kg wwt)		<0.20	<0.20	<0.20	
	Cadmium (Cd)-Total (mg/kg wwt)		<0.0020	0.0025	<0.0020	
	Calcium (Ca)-Total (mg/kg wwt)		552	612	722	
	Cesium (Cs)-Total (mg/kg wwt)		0.0076	0.0164	0.0202	
	Chromium (Cr)-Total (mg/kg wwt)		0.031	0.014	<0.010	
	Cobalt (Co)-Total (mg/kg wwt)		0.0080	0.0117	0.0174	
	Copper (Cu)-Total (mg/kg wwt)		0.802	0.510	0.380	
	Gallium (Ga)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	
	Iron (Fe)-Total (mg/kg wwt)		10.7	9.31	8.35	
	Lead (Pb)-Total (mg/kg wwt)		0.0122	0.0088	0.0044	
	Lithium (Li)-Total (mg/kg wwt)		<0.020	<0.020	<0.020	
	Magnesium (Mg)-Total (mg/kg wwt)		365	346	363	
	Manganese (Mn)-Total (mg/kg wwt)		0.307	0.314	0.281	
	Mercury (Hg)-Total (mg/kg)	0.314				
	Mercury (Hg)-Total (mg/kg wwt)		0.0735	0.0979	0.0581	
	Molybdenum (Mo)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	
	Nickel (Ni)-Total (mg/kg wwt)		0.021	0.019	0.012	
	Phosphorus (P)-Total (mg/kg wwt)		3020	2920	3250	
	Potassium (K)-Total (mg/kg wwt)		4880	5050	4690	
	Rhenium (Re)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	
	Rubidium (Rb)-Total (mg/kg wwt)		1.78	2.28	1.40	
	Selenium (Se)-Total (mg/kg wwt)		0.607	0.590	0.937	
	Sodium (Na)-Total (mg/kg wwt)		<400 DLIV	<400 DLIV	<400 DLIV	
	Strontium (Sr)-Total (mg/kg wwt)		0.480	0.505	0.553	
	Tellurium (Te)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	
	Thallium (Tl)-Total (mg/kg wwt)		0.00353	0.00564	0.00258	
	Thorium (Th)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	
	Tin (Sn)-Total (mg/kg wwt)		<0.020	<0.020	0.028	
	Uranium (U)-Total (mg/kg wwt)		<0.00040	<0.00040	0.00051	
	Vanadium (V)-Total (mg/kg wwt)		<0.020	<0.020	<0.020	
	Yttrium (Y)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-1	L1381305-2	L1381305-3	L1381305-4	L1381305-5
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	23-JUN-13	23-JUN-13	17-JUL-13	14-AUG-13	15-AUG-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130623.003	BT-130623.004	BT-130717.001	BT-130814.001	KO-130815.001
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-6	L1381305-7	L1381305-8	L1381305-9	L1381305-10
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	06-SEP-13	25-SEP-13	13-AUG-13	14-AUG-13	21-JUN-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	KO-130906.001	KO-130925.001	RB-130813.001	RB-130814.001	MW-130621.006
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)					4.65
	Zirconium (Zr)-Total (mg/kg wwt)					<0.040

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-11	L1381305-12	L1381305-13	L1381305-14	L1381305-15
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	21-JUN-13	21-JUN-13	21-JUN-13	22-JUN-13	27-SEP-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-130621.007	MW-130621.008	MW-130621.009	MW-130622.001	RB130927.001
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)	3.76	2.78	4.19	4.32	
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-16	L1381305-17	L1381305-18	L1381305-19	L1381305-20
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	05-JUN-13	05-JUN-13	17-JUL-13	19-JUN-13	19-JUN-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	RB-130605.001	RB-130605.002	RB-130717.001	BT-130619.001	BT-130619.002
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-21	L1381305-22	L1381305-23	L1381305-24	L1381305-25
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	19-JUN-13	17-JUN-13	02-JUN-13	02-JUN-13	02-JUN-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130619.003	BT-130617.001	BT-130602.001	BT-130602.002	BT-130602.003
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-26	L1381305-27	L1381305-28	L1381305-29	L1381305-30
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	02-JUN-13	14-AUG-13	14-AUG-13	14-AUG-13	14-AUG-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	BT-130602.004	RB-130814.002	RB-130814.003	RB-130814.004	RB-130814.005
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1381305-31	L1381305-32	L1381305-33	L1381305-34	
	Description	TISSUE	TISSUE	TISSUE	TISSUE	
	Sampled Date	14-AUG-13	26-SEP-13	27-SEP-13	30-SEP-13	
	Sampled Time	12:00	12:00	12:00	12:00	
	Client ID	RB-130814.006	MW-130926.001	MW-130927.001	MW-130930.001	
Grouping	**Analyte**					
TISSUE						
Metals	Zinc (Zn)-Total (mg/kg wwt)		6.17	5.33	7.40	
	Zirconium (Zr)-Total (mg/kg wwt)		<0.040	<0.040	<0.040	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Sodium (Na)-Total	DLIV	L1381305-10, -11, -12, -13, -14, -32, -33, -34
Method Blank	Zinc (Zn)-Total	MB-LOR	L1381305-10, -11, -12, -13, -14, -32, -33, -34
Method Blank	Zinc (Zn)-Total	MB-LOR	L1381305-10, -11, -12, -13, -14, -32, -33, -34
Method Blank	Zinc (Zn)-Total	MB-LOR	L1381305-10, -11, -12, -13, -14, -32, -33, -34

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLIV	Detection Limit Adjusted: Lower Initial Volume
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-WET-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

MET-WET-ICP-VA	Tissue	Metals in Tissue by ICPOES (WET)	EPA 200.3, EPA 6010B

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Optical Emission Spectrophotometry, adapted from US EPA Method 6010B. This digestion procedure was implemented on October 5, 2009.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2 OL-1002

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1381305-COFC

ALS Enul

hain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1002

Report To			Reporting		Service Requested
Company:	AZIMUTH CONSULTING GROUP INC.		Distribution:	☐Fax ☐Mail ☑Email	◉Regular (Standard Turnaround Times - Business Days) - R
Contact:	Randy Baker		☐Criteria on Report (select from Guidelines below)		○Priority (3 Days) - surcharge will apply - P
Address:	# 218 - 2902 West Broadway Vancouver, BC CANADA, V6K 2G8		Report Type:	☑Excel ☐Digital	○Priority (2 Days) - surcharge will apply - P2
			Report Format:	CROSSTAB_ALS	○Emergency (1-2 day) – surcharge will apply - E
			Report Email(s):	rbaker@azimuthgroup.ca mmcconnell@azimuthgroup.ca	○Same Day or Weekend Emergency - surcharge will apply - E2
					○Specify date required - X
Phone:	604-730-1220	Fax: 604-739-9070			
Invoice To	☑Email ☐Mail		EDD Format:		
Company:	AZIMUTH CONSULTING GROUP INC.		EDD Email(s):		
Contact:	Accounts Payable				
Address:	# 218 - 2902 West Broadway Vancouver, BC CANADA, V6K 2G8	L1381305	Project Info		
			Job #:	BRGMON12	
			PO/AFE:		
Email:	rbaker@azimuthgroup.ca		LSD:		
Phone:	604-730-1220		Quote #:	Q35275	
Lab Work Order # (lab use only)			ALS Contact:	Brent Mack	Sampler:

Short Holding Time

Rush Processing

Analysis Requests

Sample #	Sample Identifi (This will appear on	Coordinates Longitude	Coordinates Latitude	Date	Time	Sample Type	Number of Containers	Mercury in Tissue by CVAFS (DRY)	Tissue/Vegetation Sample Preparation	Mercury in Tissue by CVAFS (WET)	ICPOES + HR-ICPMS in tissue (wet weight)	Please indicate below Filtered, Preserved or both(F, P, F/P)
	BT-130623.003			Jun-23-2013	12:00 PM	tissue	1	R	R			
	BT-130623.004			Jun-23-2013	12:00 PM	tissue	1	R	R			
	BT-130717.001			Jul-17-2013	12:00 PM	tissue	1	R	R			
	BT-130814.001			Aug-14-2013	12:00 PM	tissue	1	R	R			
	KO-130815.001			Aug-15-2013	12:00 PM	tissue	1	R	R			
	KO-130906.001			Sep-06-2013	12:00 PM	tissue	1	R	R			
	KO-130925.001			Sep-25-2013	12:00 PM	tissue	1	R	R			
	RB-130813.001			Aug-13-2013	12:00 PM	tissue	1	R	R			

(See page 2 for further samples)

Special Instructions/Comments

Randy is out of town Oct 26-Nov 24. If issues, pls contact Maggie or Laura at Azimuth (604 7301220)

The questions below must be answered for water samples (check Yes or No)

Are any sample taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF
			Joyce	Oct 22/13	12:10	3.3 °C				

L1381305-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1002

Sample #	Sample Identification (This will appear on the report)	Coordinates		Date	Time	Sample Type	Analysis Requests																
		Longitude	Latitude				Number of Containers	Mercury in Tissue by CVAFS (DRY)	Tissue/Vegetation Sample Preparation	Mercury in Tissue by CVAFS (WET)	ICPOES + HR-ICPMS in tissue (wet weight)												
							Please Indicate below Filtered, Preserved or both(F, P, F/P)																
	RB-130814.001			Aug-14-2013	12:00 PM	tissue	1	R	R														
	MW-130621.006			Jun-21-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130621.007			Jun-21-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130621.008			Jun-21-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130621.009			Jun-21-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130622.001			Jun-22-2013	12:00 PM	tissue	[illegible]		R	R	R												
	RB130927.001			Sep-27-2013	12:00 PM	tissue	1	R	R														
	RB-130605.001			Jun-05-2013	12:00 PM	tissue	1	R	R														
	RB-130605.002			Jun-05-2013	12:00 PM	tissue	1	R	R														
	RB-130717.001			Jul-17-2013	12:00 PM	tissue	1	R	R														
	BT-130619.001			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130619.002			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130619.003			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130617.001			Jun-17-2013	12:00 PM	tissue	1	R	R														
	BT-130602.001			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.002			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.003			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.004			Jun-02-2013	12:00 PM	tissue	1	R	R														
	RB-130814.002			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.003			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.004			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.005			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.006			Aug-14-2013	12:00 PM	tissue	1	R	R														
	MW-130926.001			Sep-26-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130927.001			Sep-27-2013	12:00 PM	tissue	[illegible]		R	R	R												
	MW-130930.001			Sep-30-2013	12:00 PM	tissue	[illegible]		R	R	R												

AZIMUTH CONSULTING GROUP INC.
ATTN: Randy Baker
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 24-OCT-13
Report Date: 17-DEC-13 18:06 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1382952

Project P.O. #: NOT SUBMITTED
Job Reference: BRGMON12
C of C Numbers:
Legal Site Desc:

Comments: The sample results presented in this report are 'Split' samples taken from original samples submitted in the report L1381305. Samples were homogenized and split into 2 sections, and each set of samples was therefore analyzed as part of a separate batch, as requested.

Brent Mack
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1382952-1	L1382952-2	L1382952-3		
	Description	Tissue	Tissue	Tissue		
	Sampled Date	21-JUN-13	21-JUN-13	21-JUN-13		
	Sampled Time	12:00	12:00	12:00		
	Client ID	MW-130621.006 (SPLIT SAMPLE)	MW-130621.008 (SPLIT SAMPLE)	MW-130621.009 (SPLIT SAMPLE)		
Grouping	**Analyte**					
TISSUE						
Metals	Aluminum (Al)-Total (mg/kg wwt)	0.57	1.02	0.67		
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Arsenic (As)-Total (mg/kg wwt)	0.104	0.0828	0.109		
	Barium (Ba)-Total (mg/kg wwt)	0.018	0.022	<0.010		
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20		
	Cadmium (Cd)-Total (mg/kg wwt)	0.0027	<0.0020	<0.0020		
	Calcium (Ca)-Total (mg/kg wwt)	132	211	90		
	Cesium (Cs)-Total (mg/kg wwt)	0.0166	0.0177	0.0190		
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	<0.010	0.044		
	Cobalt (Co)-Total (mg/kg wwt)	0.0087	<0.0040	0.0090		
	Copper (Cu)-Total (mg/kg wwt)	0.325	0.217	0.720		
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Iron (Fe)-Total (mg/kg wwt)	6.00	4.35	7.00		
	Lead (Pb)-Total (mg/kg wwt)	0.0109	0.0061	0.0066		
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020	<0.020		
	Magnesium (Mg)-Total (mg/kg wwt)	299	278	306		
	Manganese (Mn)-Total (mg/kg wwt)	0.131	0.134	0.136		
	Mercury (Hg)-Total (mg/kg wwt)	0.391	0.374	0.418		
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Nickel (Ni)-Total (mg/kg wwt)	0.014	0.016	0.182		
	Phosphorus (P)-Total (mg/kg wwt)	2480	2470	2340		
	Potassium (K)-Total (mg/kg wwt)	4640	4720	4290		
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Rubidium (Rb)-Total (mg/kg wwt)	2.62	2.16	2.53		
	Selenium (Se)-Total (mg/kg wwt)	0.236	0.212	0.208		
	Sodium (Na)-Total (mg/kg wwt)	<400 DLIV	<400 DLIV	<400 DLIV		
	Strontium (Sr)-Total (mg/kg wwt)	0.101	0.197	0.084		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg wwt)	0.00895	0.00726	0.00832		
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020		
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040		
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020		
	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Zinc (Zn)-Total (mg/kg wwt)	4.57	2.73	4.25		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1382952-1	L1382952-2	L1382952-3		
	Description	Tissue	Tissue	Tissue		
	Sampled Date	21-JUN-13	21-JUN-13	21-JUN-13		
	Sampled Time	12:00	12:00	12:00		
	Client ID	MW-130621.006 (SPLIT SAMPLE)	MW-130621.008 (SPLIT SAMPLE)	MW-130621.009 (SPLIT SAMPLE)		
Grouping	**Analyte**					
TISSUE						
Metals	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Sodium (Na)-Total	DLIV	L1382952-1, -2, -3
Method Blank	Zinc (Zn)-Total	MB-LOR	L1382952-1, -2, -3
Method Blank	Zinc (Zn)-Total	MB-LOR	L1382952-1, -2, -3
Method Blank	Zinc (Zn)-Total	MB-LOR	L1382952-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLIV	Detection Limit Adjusted: Lower Initial Volume
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-WET-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

MET-WET-ICP-VA	Tissue	Metals in Tissue by ICPOES (WET)	EPA 200.3, EPA 6010B

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Optical Emission Spectrophotometry, adapted from US EPA Method 6010B. This digestion procedure was implemented on October 5, 2009.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1382952-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1002

Report To		Reporting		Service Requested
Company:	AZIMUTH CONSULTING GROUP INC.	Distribution:	☐Fax ☐Mail ☑Email	⊛Regular (Standard Turnaround Times - Business Days) - R
Contact:	Randy Baker	☐Criteria on Report (select from Guidelines below)		○Priority (3 Days) - surcharge will apply - P
Address:	# 218 - 2902 West Broadway Vancouver, BC CANADA, V6K 2G8	Report Type:	☑Excel ☐Digital	○Priority (2 Days) - surcharge will apply - P2
		Report Format:	CROSSTAB_ALS	○Emergency (1-2 day) – surcharge will apply - E
		Report Email(s):	rbaker@azimuthgroup.ca mmcconnell@azimuthgroup.ca	○Same Day or Weekend Emergency - surcharge will apply - E2
				○Specify date required - X
Phone:	604-730-1220 Fax: 604-739-9070			

Invoice To	☑Email ☐Mail	EDD Format:	
Company:	AZIMUTH CONSULTING GROUP INC.	EDD Email(s):	
Contact:	Accounts Payable		
Address:	# 218 - 2902 West Broadway Vancouver, BC CANADA, V6K 2G8	Project Info	
		Job #:	BRGMON12
		PO/AFE:	
Email:	rbaker@azimuthgroup.ca	LSD:	
Phone:	604-730-1220	Quote #:	Q35275

L1381305

Short Holding Time

Rush Processing

Lab Work Order # (lab use only):

ALS Contact: Brent Mack Sampler:

Analysis Requests

Sample #	Sample Identif (This will appear on	Coordinates Longitude	Coordinates Latitude	Date	Time	Sample Type	Number of Containers	Mercury in Tissue by CVAFS (DRY)	Tissue/Vegetation Sample Preparation	Mercury in Tissue by CVAFS (WET)	ICPOES + HR-ICPMS in tissue (wet weight)	Please indicate below Filtered, Preserved or both(F, P, F/P)
	BT-130623.003			Jun-23-2013	12:00 PM	tissue	1	R	R			
	BT-130623.004			Jun-23-2013	12:00 PM	tissue	1	R	R			
	BT-130717.001			Jul-17-2013	12:00 PM	tissue	1	R	R			
	BT-130814.001			Aug-14-2013	12:00 PM	tissue	1	R	R			
	KO-130815.001			Aug-15-2013	12:00 PM	tissue	1	R	R			
	KO-130906.001			Sep-06-2013	12:00 PM	tissue	1	R	R			
	KO-130925.001			Sep-25-2013	12:00 PM	tissue	1	R	R			
	RB-130813.001			Aug-13-2013	12:00 PM	tissue	1	R	R			

(See page 2 for further samples)

Special Instructions/Comments

Randy is out of town Oct 26 - Nov 24. If issues, pls contact Maggie or Laura at Azimuth (604 7301220)

The questions below must be answered for water samples (check Yes or No)

Are any sample taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF
			Joyce	Oct 22/13	12:10	3.3 °C				

L1382952-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1002

Sample #	Sample Identification (This will appear on the report)	Coordinates		Date	Time	Sample Type	Analysis Requests																
		Longitude	Latitude				Number of Containers	Mercury in Tissue by CVAFS (DRY)	Tissue/Vegetation Sample Preparation	Mercury in Tissue by CVAFS (WET)	ICPOES + HR-ICPMS in tissue (wet weight)												
							Please indicate below Filtered, Preserved or both(F, P, F/P)																
9	RB-130814.001			Aug-14-2013	12:00 PM	tissue	1	R	R														
10	MW-130621.006			Jun-21-2013	12:00 PM	tissue	1		R	R	R												
	MW-130621.007			Jun-21-2013	12:00 PM	tissue	1		R	R	R												
	MW-130621.008			Jun-21-2013	12:00 PM	tissue	1		R	R	R												
	MW-130621.009			Jun-21-2013	12:00 PM	tissue	1		R	R	R												
14	MW-130622.001			Jun-22-2013	12:00 PM	tissue	1		R	R	R												
15	RB130927.001			Sep-27-2013	12:00 PM	tissue	1	R	R														
	RB-130605.001			Jun-05-2013	12:00 PM	tissue	1	R	R														
	RB-130605.002			Jun-05-2013	12:00 PM	tissue	1	R	R														
	RB-130717.001			Jul-17-2013	12:00 PM	tissue	1	R	R														
	BT-130619.001			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130619.002			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130619.003			Jun-19-2013	12:00 PM	tissue	1	R	R														
	BT-130617.001			Jun-17-2013	12:00 PM	tissue	1	R	R														
	BT-130602.001			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.002			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.003			Jun-02-2013	12:00 PM	tissue	1	R	R														
	BT-130602.004			Jun-02-2013	12:00 PM	tissue	1	R	R														
	RB-130814.002			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.003			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.004			Aug-14-2013	12:00 PM	tissue	1	R	R														
	RB-130814.005			Aug-14-2013	12:00 PM	tissue	1	R	R														
31	RB-130814.006			Aug-14-2013	12:00 PM	tissue	1	R	R														
32	MW-130926.001			Sep-26-2013	12:00 PM	tissue	1		R	R	R												
	MW-130927.001			Sep-27-2013	12:00 PM	tissue	1		R	R	R												
	MW-130930.001			Sep-30-2013	12:00 PM	tissue	1		R	R	R												

AZIMUTH CONSULTING GROUP INC.
ATTN: Randy Baker
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 10-DEC-13
Report Date: 08-JAN-14 12:33 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1401674

Project P.O. #: NOT SUBMITTED
Job Reference: BRGMON12
C of C Numbers: 1 of 2, 2 of 2
Legal Site Desc:

Brent Mack
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-1	L1401674-2	L1401674-3	L1401674-4	L1401674-5
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13
	Sampled Time					
	Client ID	MW131016-001	MW131016-002	MW131016-003	MW131016-004	MW131016-005
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	67.1	68.9	70.1	66.4	66.1
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.88	1.85	1.61	3.32	1.07
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.116	0.0669	0.0702	0.169	0.150
	Barium (Ba)-Total (mg/kg wwt)	0.040	0.024	0.021	0.054	0.041
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Calcium (Ca)-Total (mg/kg wwt)	92	91	90	342	320
	Cesium (Cs)-Total (mg/kg wwt)	0.0112	0.0078	0.0098	0.0123	0.0116
	Chromium (Cr)-Total (mg/kg wwt)	0.032	0.031	<0.010	0.021	0.029
	Cobalt (Co)-Total (mg/kg wwt)	0.0080	0.0092	0.0077	0.0044	0.0049
	Copper (Cu)-Total (mg/kg wwt)	0.608	0.643	0.364	0.380	0.571
	Gallium (Ga)-Total (mg/kg wwt)	0.0245	<0.0040	<0.0040	<0.0040	<0.0040
	Iron (Fe)-Total (mg/kg wwt)	7.32	7.21	4.30	9.34	8.86
	Lead (Pb)-Total (mg/kg wwt)	0.0287	0.0208	0.0095	0.0087	0.0101
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Magnesium (Mg)-Total (mg/kg wwt)	315	360	345	274	271
	Manganese (Mn)-Total (mg/kg wwt)	0.235	0.160	0.174	0.190	0.148
	Mercury (Hg)-Total (mg/kg)					
	Mercury (Hg)-Total (mg/kg wwt)	0.102	0.0618	0.107	0.175	0.168
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.024	0.062	0.011	0.015	0.024
	Phosphorus (P)-Total (mg/kg wwt)	2570	2890	2730	2590	2420
	Potassium (K)-Total (mg/kg wwt)	4300	4660	4650	4270	3900
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Rubidium (Rb)-Total (mg/kg wwt)	1.53	1.63	2.19	2.02	1.81
	Selenium (Se)-Total (mg/kg wwt)	0.331	0.453	0.420	0.280	0.251
	Sodium (Na)-Total (mg/kg wwt)	<400 DLIV	<400 DLIV	<400 DLIV	<400 DLIV	<400 DLIV
	Strontium (Sr)-Total (mg/kg wwt)	0.066	0.046	0.050	0.301	0.292
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00233	0.00373	0.00289	0.00402	0.00305
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00051	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-6	L1401674-7	L1401674-8	L1401674-9	L1401674-10
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	MW131016-006	MW131016-007	RB131016-001	RB131016-002	LBR-RB-08
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	68.5	66.9			
Metals	Aluminum (Al)-Total (mg/kg wwt)	0.97	1.23			
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Arsenic (As)-Total (mg/kg wwt)	0.0880	0.0984			
	Barium (Ba)-Total (mg/kg wwt)	0.018	0.032			
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20			
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Calcium (Ca)-Total (mg/kg wwt)	129	244			
	Cesium (Cs)-Total (mg/kg wwt)	0.0095	0.0088			
	Chromium (Cr)-Total (mg/kg wwt)	0.015	0.018			
	Cobalt (Co)-Total (mg/kg wwt)	0.0056	0.0078			
	Copper (Cu)-Total (mg/kg wwt)	0.333	0.484			
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040	<0.0040			
	Iron (Fe)-Total (mg/kg wwt)	4.27	5.97			
	Lead (Pb)-Total (mg/kg wwt)	0.0058	0.0062			
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020			
	Magnesium (Mg)-Total (mg/kg wwt)	327	344			
	Manganese (Mn)-Total (mg/kg wwt)	0.139	0.206			
	Mercury (Hg)-Total (mg/kg)			0.0921	0.139	0.313
	Mercury (Hg)-Total (mg/kg wwt)	0.133	0.102			
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040			
	Nickel (Ni)-Total (mg/kg wwt)	<0.010	0.010			
	Phosphorus (P)-Total (mg/kg wwt)	2610	2830			
	Potassium (K)-Total (mg/kg wwt)	4250	4700			
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Rubidium (Rb)-Total (mg/kg wwt)	2.06	1.76			
	Selenium (Se)-Total (mg/kg wwt)	0.322	0.484			
	Sodium (Na)-Total (mg/kg wwt)	<400 DLIV	<400 DLIV			
	Strontium (Sr)-Total (mg/kg wwt)	0.093	0.213			
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040			
	Thallium (Tl)-Total (mg/kg wwt)	0.00270	0.00274			
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020			
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040			
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-12	L1401674-13	L1401674-14	L1401674-15	L1401674-16
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	LBR-RB-10	LBR-BT-002	LBR-BT-003	LBR-BT-004	LBR-BT-005
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.209	0.531	0.264	0.158	0.333
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-17	L1401674-18	L1401674-19	L1401674-20	L1401674-21
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	LBR-BT-006	LBR-BT-007	LBR-BT-008	LBR-BT-009	LBR-BT-010
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg wwt)					
	Gallium (Ga)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg wwt)					
	Mercury (Hg)-Total (mg/kg)	0.179	0.701	0.862	0.244	0.108
	Mercury (Hg)-Total (mg/kg wwt)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg wwt)					
	Rhenium (Re)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Thorium (Th)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1401674-22 TISSUE 30-OCT-13 LBR-BT-011	L1401674-23 TISSUE 13-NOV-13 SON-GW-01	L1401674-24 TISSUE 13-NOV-13 SON-GW-02	L1401674-25 TISSUE 13-NOV-13 SON-GW-03	L1401674-26 TISSUE 13-NOV-13 SON-GW-04
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)		85.0	83.4	82.8	85.2
Metals	Aluminum (Al)-Total (mg/kg wwt)		1.73	1.86	0.81	17.1
	Antimony (Sb)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	0.0021
	Arsenic (As)-Total (mg/kg wwt)		0.106	0.126	0.0380	0.119
	Barium (Ba)-Total (mg/kg wwt)		0.081	0.242	0.058	0.372
	Beryllium (Be)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)		<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	<0.0020
	Calcium (Ca)-Total (mg/kg wwt)		468	2790	364	314
	Cesium (Cs)-Total (mg/kg wwt)		0.0197	0.0198	0.0282	0.0169
	Chromium (Cr)-Total (mg/kg wwt)		0.044	0.083	0.020	0.113
	Cobalt (Co)-Total (mg/kg wwt)		<0.0040	<0.0040	0.0042	0.0116
	Copper (Cu)-Total (mg/kg wwt)		0.384	0.591	0.539	0.659
	Gallium (Ga)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	0.0050
	Iron (Fe)-Total (mg/kg wwt)		11.5	8.63	8.91	26.3
	Lead (Pb)-Total (mg/kg wwt)		0.0110	0.0095	0.0064	0.0229
	Lithium (Li)-Total (mg/kg wwt)		<0.020	<0.020	<0.020	<0.020
	Magnesium (Mg)-Total (mg/kg wwt)		220	252	233	188
	Manganese (Mn)-Total (mg/kg wwt)		0.285	0.498	0.219	0.516
	Mercury (Hg)-Total (mg/kg)	0.355				
	Mercury (Hg)-Total (mg/kg wwt)		0.108	0.0736	0.105	0.0981
	Molybdenum (Mo)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	0.0041
	Nickel (Ni)-Total (mg/kg wwt)		0.027	0.048	0.019	0.070
	Phosphorus (P)-Total (mg/kg wwt)		2220	3290	2410	1720
	Potassium (K)-Total (mg/kg wwt)		4000	3990	4580	3290
	Rhenium (Re)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	<0.0020
	Rubidium (Rb)-Total (mg/kg wwt)		2.16	2.45	2.86	1.66
	Selenium (Se)-Total (mg/kg wwt)		0.227	0.234	0.301	0.229
	Sodium (Na)-Total (mg/kg wwt)		<600 DLIV	<400 DLIV	430	<400 DLIV
	Strontium (Sr)-Total (mg/kg wwt)		0.503	2.77	0.431	0.350
	Tellurium (Te)-Total (mg/kg wwt)		<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)		0.00427	0.00469	0.00651	0.00382
	Thorium (Th)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	0.0023
	Tin (Sn)-Total (mg/kg wwt)		<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)		<0.00040	<0.00040	<0.00040	0.00052
	Vanadium (V)-Total (mg/kg wwt)		<0.020	<0.020	<0.020	0.091

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1401674-27 TISSUE 13-NOV-13 SON-GW-05	L1401674-28 TISSUE 13-NOV-13 SON-GW-06	L1401674-29 TISSUE 13-NOV-13 SON-GW-07	L1401674-30 TISSUE 13-NOV-13 SON-GW-08	L1401674-31 TISSUE 13-NOV-13 SON-GW-09
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)	84.1	85.2	81.7	85.3	85.2
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.33	2.86	1.37	2.82	1.69
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0151
	Arsenic (As)-Total (mg/kg wwt)	0.109	0.161	0.119	0.0867	0.0868
	Barium (Ba)-Total (mg/kg wwt)	0.090	0.096	0.053	0.072	0.069
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Calcium (Ca)-Total (mg/kg wwt)	476	399	293	537	498
	Cesium (Cs)-Total (mg/kg wwt)	0.0249	0.0215	0.0130	0.0197	0.0168
	Chromium (Cr)-Total (mg/kg wwt)	0.032	0.026	0.018	0.035	0.037
	Cobalt (Co)-Total (mg/kg wwt)	0.0044	0.0046	<0.0040	<0.0040	0.0108
	Copper (Cu)-Total (mg/kg wwt)	0.332	0.445	0.612	0.399	0.452
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Iron (Fe)-Total (mg/kg wwt)	7.52	8.24	5.61	6.89	7.46
	Lead (Pb)-Total (mg/kg wwt)	0.0061	0.0080	0.0069	0.0099	0.0067
	Lithium (Li)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Magnesium (Mg)-Total (mg/kg wwt)	221	202	195	192	240
	Manganese (Mn)-Total (mg/kg wwt)	0.296	0.268	0.162	0.297	0.275
	Mercury (Hg)-Total (mg/kg)					
	Mercury (Hg)-Total (mg/kg wwt)	0.113	0.113	0.0637	0.0715	0.0938
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.016	0.016	0.010	0.019	0.027
	Phosphorus (P)-Total (mg/kg wwt)	2230	2140	2030	2040	2100
	Potassium (K)-Total (mg/kg wwt)	3920	3880	3440	3550	3740
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Rubidium (Rb)-Total (mg/kg wwt)	2.46	2.01	1.74	2.06	1.89
	Selenium (Se)-Total (mg/kg wwt)	0.228	0.207	0.271	0.215	0.201
	Sodium (Na)-Total (mg/kg wwt)	<600 DLIV	<400 DLIV	<400 DLIV	520	<400 DLIV
	Strontium (Sr)-Total (mg/kg wwt)	0.451	0.387	0.302	0.528	0.514
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00516	0.00639	0.00250	0.00335	0.00551
	Thorium (Th)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-32				
	Description	TISSUE				
	Sampled Date	13-NOV-13				
	Sampled Time					
	Client ID	SON-GW-10				
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	84.3				
Metals	Aluminum (Al)-Total (mg/kg wwt)	0.73				
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020				
	Arsenic (As)-Total (mg/kg wwt)	0.0892				
	Barium (Ba)-Total (mg/kg wwt)	0.063				
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020				
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020				
	Boron (B)-Total (mg/kg wwt)	<0.20				
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020				
	Calcium (Ca)-Total (mg/kg wwt)	448				
	Cesium (Cs)-Total (mg/kg wwt)	0.0284				
	Chromium (Cr)-Total (mg/kg wwt)	0.012				
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040				
	Copper (Cu)-Total (mg/kg wwt)	0.433				
	Gallium (Ga)-Total (mg/kg wwt)	<0.0040				
	Iron (Fe)-Total (mg/kg wwt)	7.24				
	Lead (Pb)-Total (mg/kg wwt)	<0.0040				
	Lithium (Li)-Total (mg/kg wwt)	<0.020				
	Magnesium (Mg)-Total (mg/kg wwt)	223				
	Manganese (Mn)-Total (mg/kg wwt)	0.285				
	Mercury (Hg)-Total (mg/kg)					
	Mercury (Hg)-Total (mg/kg wwt)	0.104				
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040				
	Nickel (Ni)-Total (mg/kg wwt)	<0.010				
	Phosphorus (P)-Total (mg/kg wwt)	2340				
	Potassium (K)-Total (mg/kg wwt)	4350				
	Rhenium (Re)-Total (mg/kg wwt)	<0.0020				
	Rubidium (Rb)-Total (mg/kg wwt)	3.10				
	Selenium (Se)-Total (mg/kg wwt)	0.252				
	Sodium (Na)-Total (mg/kg wwt)	<400 DLIV				
	Strontium (Sr)-Total (mg/kg wwt)	0.442				
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040				
	Thallium (Tl)-Total (mg/kg wwt)	0.00578				
	Thorium (Th)-Total (mg/kg wwt)	<0.0020				
	Tin (Sn)-Total (mg/kg wwt)	<0.020				
	Uranium (U)-Total (mg/kg wwt)	0.00172				
	Vanadium (V)-Total (mg/kg wwt)	<0.020				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-1	L1401674-2	L1401674-3	L1401674-4	L1401674-5
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13
	Sampled Time					
	Client ID	MW131016-001	MW131016-002	MW131016-003	MW131016-004	MW131016-005
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Zinc (Zn)-Total (mg/kg wwt)	4.33	4.35	4.02	4.98	3.93
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-6	L1401674-7	L1401674-8	L1401674-9	L1401674-10
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	16-OCT-13	16-OCT-13	16-OCT-13	16-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	MW131016-006	MW131016-007	RB131016-001	RB131016-002	LBR-RB-08
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Zinc (Zn)-Total (mg/kg wwt)	4.09	4.88			
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-12	L1401674-13	L1401674-14	L1401674-15	L1401674-16
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	LBR-RB-10	LBR-BT-002	LBR-BT-003	LBR-BT-004	LBR-BT-005
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-17	L1401674-18	L1401674-19	L1401674-20	L1401674-21
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13	30-OCT-13
	Sampled Time					
	Client ID	LBR-BT-006	LBR-BT-007	LBR-BT-008	LBR-BT-009	LBR-BT-010
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg wwt)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-22	L1401674-23	L1401674-24	L1401674-25	L1401674-26
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	30-OCT-13	13-NOV-13	13-NOV-13	13-NOV-13	13-NOV-13
	Sampled Time					
	Client ID	LBR-BT-011	SON-GW-01	SON-GW-02	SON-GW-03	SON-GW-04
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)		<0.0020	<0.0020	<0.0020	0.0101
	Zinc (Zn)-Total (mg/kg wwt)		9.05	15.6	10.9	8.50
	Zirconium (Zr)-Total (mg/kg wwt)		<0.040	<0.040	<0.040	<0.040

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-27	L1401674-28	L1401674-29	L1401674-30	L1401674-31
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	13-NOV-13	13-NOV-13	13-NOV-13	13-NOV-13	13-NOV-13
	Sampled Time					
	Client ID	SON-GW-05	SON-GW-06	SON-GW-07	SON-GW-08	SON-GW-09
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Zinc (Zn)-Total (mg/kg wwt)	11.1	10.3	8.17	17.0	25.5
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1401674-32				
	Description	TISSUE				
	Sampled Date	13-NOV-13				
	Sampled Time					
	Client ID	SON-GW-10				
Grouping	**Analyte**					
TISSUE						
Metals	Yttrium (Y)-Total (mg/kg wwt)	<0.0020				
	Zinc (Zn)-Total (mg/kg wwt)	11.8				
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040				

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Copper (Cu)-Total	DUP-H	L1401674-1, -2, -23, -24, -25, -26, -27, -28, -29, -3, -30, -31, -32, -4, -5, -6, -7
Duplicate	Iron (Fe)-Total	DUP-H	L1401674-1, -2, -23, -24, -25, -26, -27, -28, -29, -3, -30, -31, -32, -4, -5, -6, -7
Duplicate	Nickel (Ni)-Total	DUP-H	L1401674-1, -2, -23, -24, -25, -26, -27, -28, -29, -3, -30, -31, -32, -4, -5, -6, -7
Duplicate	Thallium (Tl)-Total	DUP-H	L1401674-1, -2, -23, -24, -25, -26, -27, -28, -29, -3, -30, -31, -32, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLIV	Detection Limit Adjusted: Lower Initial Volume
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-WET-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

MET-WET-ICP-VA	Tissue	Metals in Tissue by ICPOES (WET)	EPA 200.3, EPA 6010B

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Optical Emission Spectrophotometry, adapted from US EPA Method 6010B. This digestion procedure was implemented on October 5, 2009.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 2 2 of 2

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

PAGE 1 OF 2

SEND REPORT TO:					
COMPANY:	Azimuth Consulting Group				
ADDRESS:	218-2902 W. Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	Randy Baker		TELEPHONE:	604 730-1220	
PROJECT NAME/#:	BRGMON12		SAMPLER:	R. Baker	
ALSE QUOTE #:	Q 35275		ALSE CONTACT:	Brent Mack	

REPORT FORMAT:	INVOICE FORMAT:
○ Hardcopy ○ Fax #:	○ Hardcopy ○ Fax #:
◉ E-mail Specify file type:	◉ E-mail (pdf format)
E-mail Address: rbaker@azimuthgroup.ca	E-mail Address:
◉ Routine Turn Around	
○ Rush (Surcharges May Apply) Specify Due Date: Time:	

SEND INVOICE TO: (complete if different from Report To at left)				Require copy of Report? ☐ Yes ☐ No
COMPANY:		CONTACT:		
ADDRESS:		P.O. #:		
CITY:	PROV:	POSTAL CODE:	TEL:	

ANALYSIS REQUESTED:

FOR LAB USE ONLY	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Hg-Dry-CVAFS	Tissue PREP-ISS-DIGEST-VA	Moisture	Hg-WET-CVAFS-VA	MET-WET-ICP+HRMS-VA	NOTES (sample specific comments, due dates, etc.)
1	MW131016-001	13-10-16		tissue		x	x	x	x	fillet
2	MW131016-002	13-10-16		tissue		x	x	x	x	fillet
3	MW131016-003	13-10-16		tissue		x	x	x	x	fillet
4	MW131016-004	13-10-16		tissue		x	x	x	x	fillet
5	MW131016-005	13-10-16		tissue		x	x	x	x	fillet
6	MW131016-006	13-10-16		tissue		x	x	x	x	fillet
7	MW131016-007	13-10-16		tissue		x	x	x	x	fillet
8	RB131016-001	13-10-16		tissue	x	x				small volume biopsy
9	RB131016-002	13-10-16		tissue	x	x				small volume biopsy
10	LBR-RB-08	13-10-30		tissue	x	x				small volume biopsy
11	LBR-RB-09	13-10-30		tissue						small volume biopsy
12	LBR-RB-10	13-10-30		tissue	x	x				small volume biopsy
13	LBR-BT-002	13-10-30		tissue	x	x				small volume biopsy
14	LBR-BT-003	13-10-30		tissue	x	x				small volume biopsy
15	LBR-BT-004	13-10-30		tissue	x	x				small volume biopsy
16	LBR-BT-005	13-10-30		tissue	x	x				small volume biopsy

If there is not enough tissue for both metals and moisture analyses (fillet samples only) please call Randy Baker at Azimuth to discuss metals analysis on DRY tissue.

RELINQUISHED BY:				RECEIVED BY:			
NAME:	Maywin Tennell	DATE:	10 12 13	NAME:		DATE:	
OF:	Azimuth	TIME:	10 am	OF:		TIME:	
NAME:		DATE:		NAME:	Elsa	DATE:	Dec 10 12:10
OF:		TIME:		OF:	ALS Environmental	TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No___ (N/A)X Sample Temperature: 3.1°C Frozen? Yes___ (No)X Cooling Method? Icepacks___ (Ice)X None___

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CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

PAGE 2 OF 2

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group				
ADDRESS:	218-2902 W. Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	Randy Baker		TELEPHONE:	604 730-1220	
PROJECT NAME/#:	BRGMON12		SAMPLER:	R. Baker	
ALSE QUOTE #:	Q 35275		ALSE CONTACT:	Brent Mack	

REPORT FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail Specify file type: E-mail Address: rbaker@azimuthgroup.ca

◉ Routine Turn Around
○ Rush (Surcharges May Apply) Specify Due Date: Time:

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COMPANY:		CONTACT:	
ADDRESS:		P.O. #:	
CITY:	PROV:	POSTAL CODE:	TEL:

INVOICE FORMAT: ○ Hardcopy ○ Fax #: ◉ E-mail (pdf format) E-mail Address:

ANALYSIS REQUESTED:

	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Hg-Dry-CVAFS	Hg-WET-CVAFS-VA	MET-WET-ICP+HRMS-VA	PREP-TISS-DIGEST-VA	Moisture	Sample specific comments, due
FOR LAB USE ONLY 17	LBR-BT-006	13-10-30		tissue	x			x		small volume biopsy
18	LBR-BT-007	13-10-30		tissue	x			x		small volume biopsy
19	LBR-BT-008	13-10-30		tissue	x			x		small volume biopsy
20	LBR-BT-009	13-10-30		tissue	x			x		small volume biopsy
21	LBR-BT-010	13-10-30		tissue	x			x		small volume biopsy
22	LBR-BT-011	13-10-30		tissue	x			x		small volume biopsy
23	SON-GW-01	13-11-13		tissue		x	x	x	x	fillet
24	SON-GW-02	13-11-13		tissue		x	x	x	x	fillet
25	SON-GW-03	13-11-13		tissue		x	x	x	x	fillet
26	SON-GW-04	13-11-13		tissue		x	x	x	x	fillet
27	SON-GW-05	13-11-13		tissue		x	x	x	x	fillet
28	SON-GW-06	13-11-13		tissue		x	x	x	x	fillet
29	SON-GW-07	13-11-13		tissue		x	x	x	x	fillet
30	SON-GW-08	13-11-13		tissue		x	x	x	x	fillet
31	SON-GW-09	13-11-13		tissue		x	x	x	x	fillet
32	SON-GW-10	13-11-13		tissue		x	x	x	x	fillet

If there is not enough tissue for both metals and moisture analyses (fillet samples only) please call Randy Baker at Azimuth to discuss metals analysis on DRY tissue.

RELINQUISHED BY:				RECEIVED BY:			
NAME:	Jayne Manne	DATE:	10/12/13	NAME:		DATE:	
OF:	Azimuth	TIME:	10hrs.	OF:		TIME:	
NAME:		DATE:		NAME:	Elsie	DATE:	Dec 10
OF:		TIME:		OF:	ALS Environmental	TIME:	12:10

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No___ (N/A) X Sample Temperature: 3.1 °C Frozen? Yes___ (No) X Cooling Method? Icepacks___ (Ice) X None___