Appendix 11-C

Murray River Coal Project: 2010 to 2012 Soil and Vegetation Tissue Metals Baseline Report

HD Mining International Ltd.

MURRAY RIVER COAL PROJECT
2010 to 2012 Soil and Vegetation Tissue Metals Baseline Report

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MURRAY RIVER COAL PROJECT

2010 TO 2012 SOIL AND VEGETATION TISSUE METALS BASELINE REPORT

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Prepared for:

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Executive Summary

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Executive Summary

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum (6 Mtpa) underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia. The Project is located within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly from open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) through underground mining techniques.

To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were initiated by Rescan Environmental Services Ltd. (Rescan). Project-specific studies began in 2010 and have continued through 2012. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into analysis.

Tracking metal concentrations in soils and plant tissues is useful to guide reclamation planning and establishing end land use objectives (BC Ministry of Energy and Mines 1998). This report presents a cumulative summary of metals characterization in soil, lichen, and plant tissue within the Local Study Area (LSA) and at reference sites within the Regional Study Area (RSA). The main objectives of the Metal Baseline Program were:

- to sample soils, lichens, and plant tissue in the LSA and at reference sites outside of the LSA;
- to determine metal concentrations in collected material;
- to analyze and summarize laboratory results; and
- to provide assessment of metal levels and distribution in the LSA before Project development.

Baseline information will be used to evaluate the potential effects of the Project on vegetation and terrestrial ecosystems, including at-risk or endangered plant species and ecosystems, or those species/ecosystems identified by regulators, relevant First Nations or the public as socially, economically or ecologically important. Consequently, the goal of this program was also to document baseline metal levels in soil and vegetation to provide a means for assessing future changes to terrestrial and wetland ecosystems related to the proposed development.

Soil and vegetation samples have been collected and analyzed as part of several baseline studies conducted for the Murray River Coal Project. A complete description of each of the terrain and soil baseline programs (including methodologies, samples collected, and results) can be found in the Terrain and Soils Baseline Report (Rescan 2013a). This report focuses only on the efforts associated with terrestrial metal sampling and analysis conducted between 2010 and 2012. This data can be used for Country Foods assessment and baseline report and for future monitoring during mine operations, closure and reclamation phases. Special attention was given to soil sampling conducted in the top mineral soil layer (0 to 10 cm depth) as this is the zone where potential changes in metal concentration are expected to be the easiest to discern.

A total of 118 soil samples were collected from 72 sites between 2010 and 2012. Forty-four of the soil sampling sites are potential future monitoring sites and thirty-three of them were sampled in conjunction with the plant tissue sampling. It was determined that soils in the LSA are predominantly acidic.

Approximately 80% of the soils sampled at the 0 to 10 cm depth had a pH less than 7.0 and 55% of the samples exceeded the CCME minimum guideline (i.e., are below pH 6) for residential, parkland and industrial use. Metals of potential concern, whose concentration exceeds CCME soil quality guidelines and/or BC Contaminated Sites Regulation Soil Criteria at least once at the sites sampled, include: arsenic (As), barium (Ba), cadmium (Cd), molybdenum (Mo), selenium (Se), tin (Sn), and zinc (Zn). Of these metals, exceedances of barium, cadmium and selenium were most frequent. Metal concentrations found in soil samples collected at 30 to 50 cm below surface were in general higher compared to surficial horizons, however, at sites where CCME and BC CSR guidelines were exceeded, the highest concentrations were typically found in surficial horizons.

Vegetation tissues sampled included lichens, shrub leaves, berries and wetland sedges. A total of 157 vegetation tissue samples were collected from 55 sites between 2010 and 2012. Of these, 56 lichen samples were collected from 38 sites. The lichens sampled included *Cladina rangiferina* (Reindeer Lichen), *Stereocaulon paschal* (Cottontail Foam Lichen) and *Peltigera scabrosa*. Twenty *Ribes* spp. and 15 *Viburnum edule* (Highbush Cranberry) berry samples were collected from 20 sites. Highbush Cranberry leaf samples were also collected (39 leaf samples from 30 sites). Twenty-seven *Carex aquatilis* sedge samples were collected from 8 wetlands.

Concentrations of certain metals in vegetation tissues were very low (e.g., antimony, beryllium, bismuth, lithium, selenium, silver, thallium, tin, and uranium); hence the analytical results were often below detection limits. Metal concentrations also varied depending on the plant species. In the terrestrial plant tissues, four of the essential macronutrients (potassium, phosphorous, calcium, and magnesium) exhibited the highest concentrations. In the lichens and leaf tissues aluminum and iron contents were also high. In wetland vegetation the elements calcium and magnesium exhibited the highest concentrations. A relatively high correlation between the metal concentrations found in soil and vegetation (including lichens) suggests that increased metal loadings may be distributed in some areas either by air (e.g., in form of dust) or by runoff / seepage.

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MURRAY RIVER COAL PROJECT
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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CCME	Canadian Council of Ministers of the Environment is comprised of the environment ministers from the federal, provincial and territorial governments.
COPC	Contaminant of Potential Concern
Ecosystem (terrestrial)	A volume of earth-space that is composed of non-living parts (climate, mineral materials, and groundwater) and living or biotic parts, which are all constantly in a state of motion, transformation, and development. No size or scale is inferred.
Hectare	10,000 m^2 or 0.01 km^2 or 2.47 acres.
LSA	Local Study Area
Rescan	Rescan Environmental Services Ltd.
RSA	Regional Study Area

1. Introduction

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1. Introduction

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum (6 Mtpa) underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia (Figure 1-1), and consists of 57 coal licences covering an area of 16,024 hectares. The Project is located within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly from open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) through underground mining techniques.

In October 2011, HD Mining submitted an application to the BC Ministry of Energy and Mines and Ministry of Environment seeking permission to complete a bulk sampling program as part of exploration of the property. In March 2012, HD Mining received approval to conduct a 100,000 tonne bulk sample for the purpose of conducting testing to assist in developing markets for the coal.

Beyond the bulk sample program, in order to develop a full mine at the proposed 6 Mtpa, the Project is subject to both the BC and Canadian environmental assessment processes. Development of any infrastructure for the full mine is not permitted before the requirements of these processes are met.

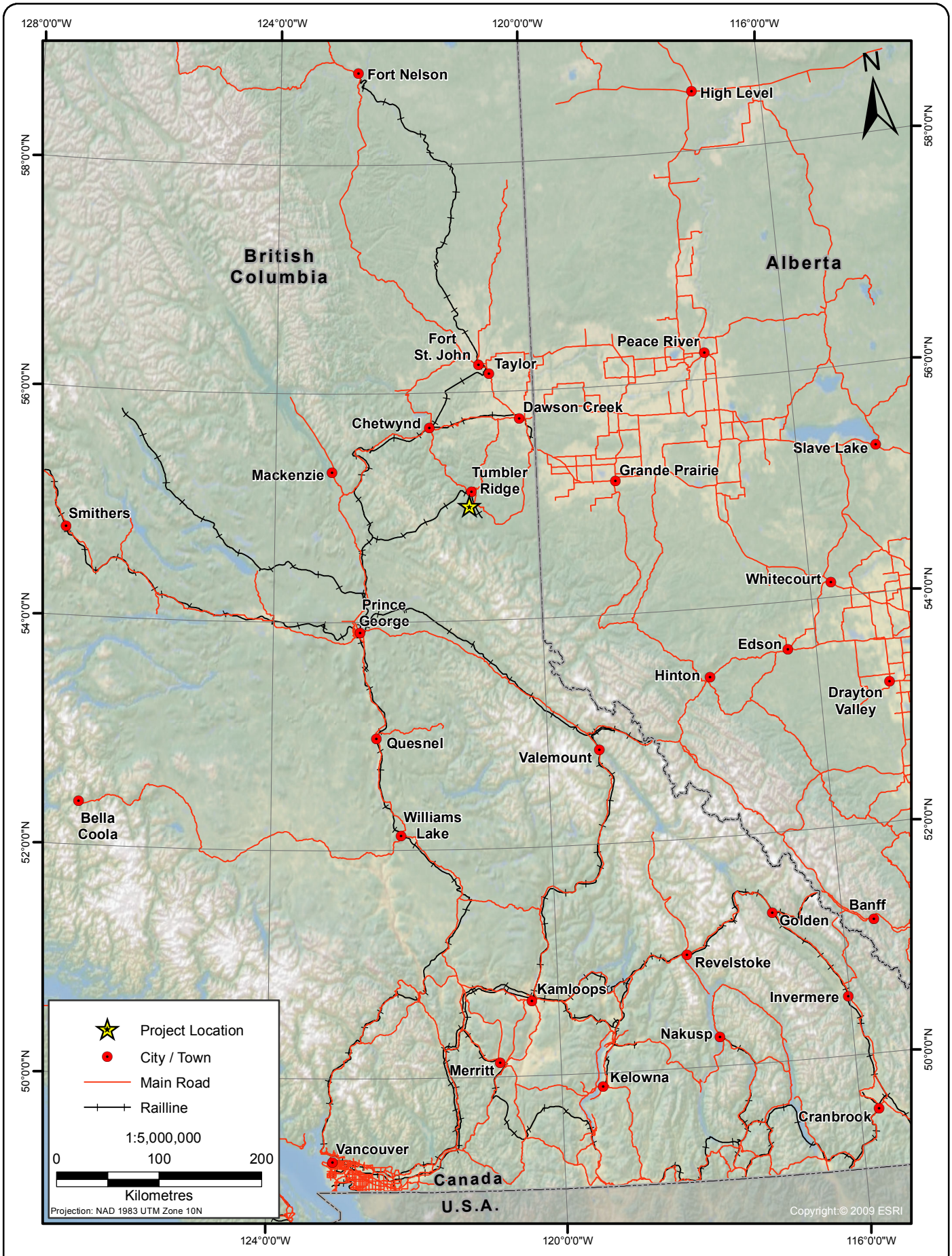
To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were initiated by Rescan Environmental Services Ltd. (Rescan). Project-specific studies began in 2010 and have continued through 2012. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into analysis.

In order to help guide the scope of baseline studies, regional and local study areas (RSA and LSA, respectively) have been developed (Figures 1-2 and 1-3). The RSA is intended to encompass an area beyond which effects of the Project would not be expected. It is also intended to be ecologically relevant based on the home range of key wildlife species known to inhabit the region. The LSA encompasses an area surrounding the proposed Project infrastructure within which direct effects from the Project may be anticipated. The LSA outline follows natural terrain and drainage boundaries in order to be ecologically relevant. For consistency, the same RSA and LSA are used for all environmental studies.

This report presents a cumulative summary of all terrestrial metal sampling data compiled for the Project to date. Soil and plant tissue samples have been collected and analyzed as part of several baseline studies conducted for the Murray River Coal Project. This data can be used for Country Foods assessment and baseline reporting and for future monitoring during mine operation, closure, and reclamation phases. Future metal levels in soils and plant tissues will be compared to baseline and reference site values in order to determine if changes in metal levels are occurring.

Most of the results of the 2010, 2011 and 2012 vegetation tissue and soil chemistry sampling have been presented in previous internal reports. Baseline studies and respective reports containing soil chemistry and plant tissue metal data include:

1. Murray River Coal Project 2010 to 2012 Terrain and Soils Baseline Report: presents the soil sampling methodologies and metal analysis results from 2012 field program (Rescan 2013a).
2. Murray River Project Wetland Baseline Report: presents the wetland sampling methodology and metal analysis results from 2010 and 2011 (Rescan 2011).
3. Murray River Coal Project 2012 Country Foods Baseline Report (Rescan 2013b).



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Project Location

Figure 1-1

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PROJECT # 0194106 GIS # MUR-15-058 VERSION # T0.10 April 10 2013

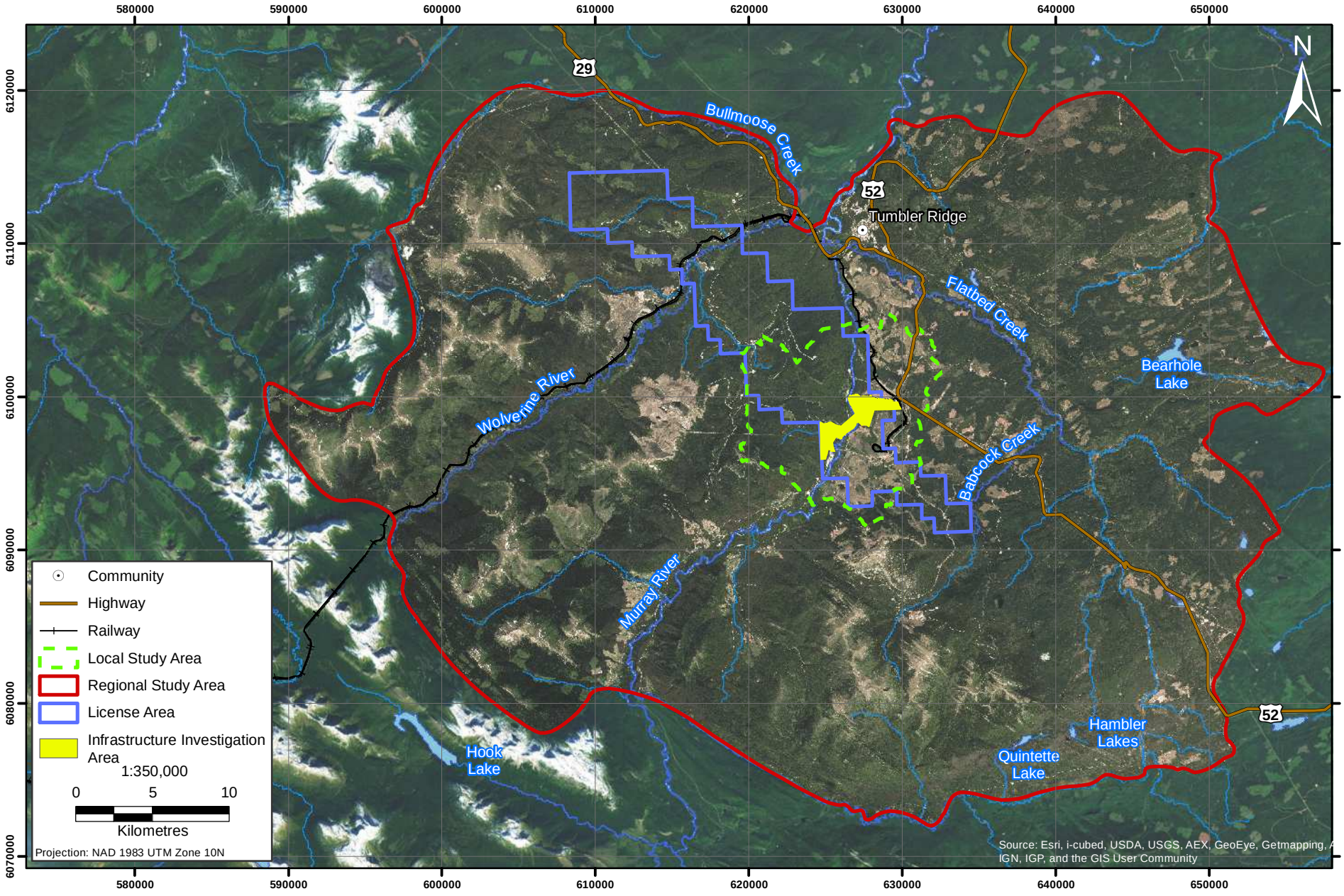

Figure 1-2

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MURRAY RIVER COAL PROJECT

Project Study Boundaries

Figure 1-2

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The following chapters outline the available background information that supports the study (Chapter 2); a description of the methods and rationale used to identify sites and collect Project-specific data (Chapter 3); the results of data collection (Chapter 4); and a summary that synthesizes the key findings of the baseline program (Chapter 5).

PROJECT # 0194106-003-0009 *GIS #* MUR-15-053 *VERSION #* T0.10 April 08 2013

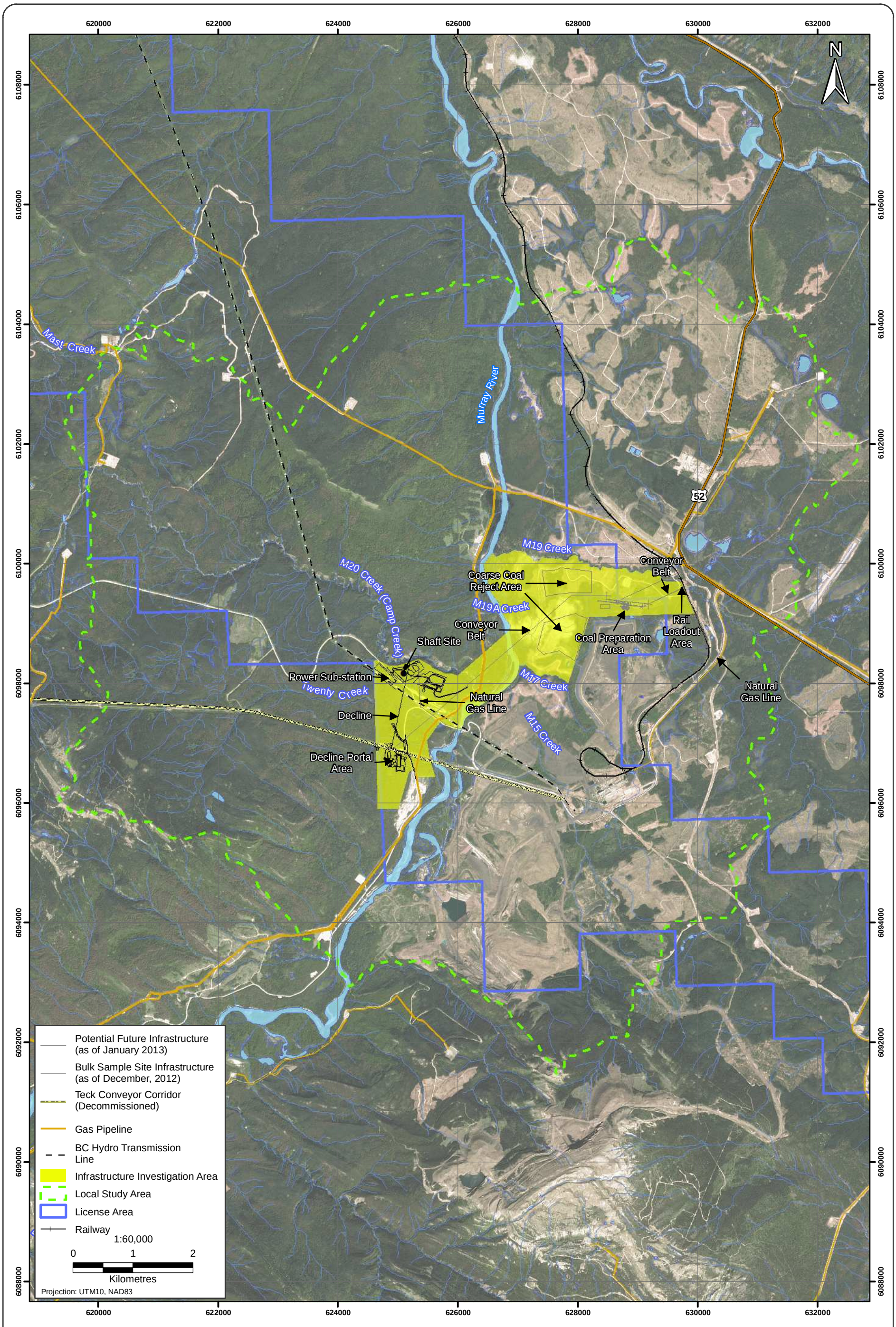

Figure 1-3

MURRAY RIVER COAL PROJECT

Preliminary Site Layout

Figure 1-3

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2. Background Information

2. Background Information

2.1 APPLICABLE STANDARDS

Provincial and federal acts, along with best practice guidelines and standards, help ensure developments are designed and carried out in a manner that will not cause harm to the natural environment. Certain plants and ecosystems are given special attention because of their conservation status and/or sensitivity to development. This section summarizes the legislation, regulations, and guidelines that may have a direct effect on the requirements for the activities associated with the management of terrestrial ecosystems and vegetation.

The Canadian *Environmental Protection Act* (1999) regulates the release of toxic substances into the environment, which includes potential contamination of soil by mining activities (Section 9).

Matters related to the assessment of potential contamination of the terrestrial habitat are described in the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (2007). These guidelines provide Canada-wide standards for the maximum concentrations of various toxic substances (e.g., metals, hydrocarbons, pesticides, etc.) in the soil for various potential uses.

The BC *Environmental Management Act* (2004) prohibits the unauthorized introduction of deleterious substances into the environment in any manner or quantity that may cause pollution to the environment as defined in the *Act*. The *Act* also provides procedural requirements for planning release of potentially polluting substances to the environment, reporting spills, or conducting remediation of contaminated sites.

The *Contaminated Sites Regulation* (BC Reg. 131/92) included in British Columbia's *Environmental Management Act* (2004) lists Soil Criteria for Toxicity to Soil Invertebrates and Plants. These provide numerical standards to define whether a site is contaminated, to determine liability for site remediation, and to assess reclamation success.

The *BC Ministry of Energy and Mines* (BC MEM 1998) requires characterization of baseline metal concentrations in plant tissues. This information is used to assess changes over time and to guide reclamation planning.

2.2 REGIONAL SETTING

The Murray River Project LSA is located in the eastern foothills (Inner Foothills Belt) of the Rocky Mountains in the Interior Platform Geological Province, near the eastern limits of the Cordilleran Orogen Geological Province.

Terrestrial ecosystems and vegetation were assessed at the regional scale within the RSA and at the local scale within the LSA (Figure 1-2). The RSA extends over 227,578 ha and was delineated according to the distribution of habitat of wildlife species that may come into contact with proposed Project infrastructure, and for the most part it is influenced by watershed boundaries (height of land). The LSA covers 7,747 ha, and was defined by a combination of topographical features and buffers around proposed Project infrastructure.

The Project's license area is located within the Peace River Coalfield, known for producing metallurgical grade (hard coking) coal. In the 1950s and 60s, 15 significant coal deposits were discovered in this region. As coal prices rose after the 1973 Organization of Arab Petroleum Exporting Countries oil crisis, the Government of Canada examined the viability of accessing and transporting

coal to the shore. In 1981 the governments of British Columbia and Canada, two Canadian mining companies, and a consortium of Japanese steel mills signed an agreement to develop the mining industry in the area. A new town (Tumbler Ridge), two coal mines (Quintette and Bullmoose), two highways (52 and 29) connecting the town with Highway 97, a power line from the W.A.C. Bennett Dam, and a rail line through the Rocky Mountains were built as a result of this agreement. Quintette mine and the Bullmoose mine started production in 1982. The Quintette mine was closed in August 2000. Oil and natural gas exploration and development are also active in the region, with gas wells and gas pipelines located throughout the Project area (Norwest Corporation 2010).

The bedrock is mostly composed of Mesozoic (65 to 225 million years old) sedimentary rock, such as shale and mudstone (Natural Resources Canada 2009a). While both types of rock weather rapidly, bedrock layers differ in resistance to erosion, which creates “plateau and escarpment” topography (Valentine et al. 1978). Valleys erode along belts of softer rock and are generally wide.

Periodic changes in the global climate of the Quaternary period (about 2 million to 8.5 thousand years ago) induced four major glaciations. Glacial erosion and subsequent deposition of eroded material formed undulating and rolling terrain in lower elevations (Valentine et al. 1978) most of which is covered by overburden of morainal origin (Natural Resources Canada 2009b). Morainal material (often referred to as glacial till), deposited directly from the melting glacier, is a compact, unsorted, and non-stratified mineral material that contains a variable proportion of mineral particle sizes. While overburden and underlying bedrock are likely of the similar mineral origin, since last glaciation metals in overburden were subjected to higher intensity of leaching compared to the bedrock.

A review of recent field work suggests that mineral soils in the LSA are slightly to very strongly acidic and have low levels of carbonates (Rescan 2013b). Current metal concentration in the top 50 cm of soil is generally low, with the exception of areas where metal accumulation was likely associated with human activity (Rescan 2013b). The overburden is expected to produce neutral rock drainage, however, some of the deeper material that will be excavated during mine development may produce acidic drainage containing dissolved aluminum, antimony, arsenic, molybdenum, phosphorus, and selenium (Rescan 2012c).

While a number of potential pathways of metal distribution within the adjacent ecosystems are possible (Zhi-Qing 1996), two main pathways involving aerial deposition with dust and aqueous transportation by groundwater are very likely. Fugitive dust and drainage associated with mining activity may alter metal concentrations in surrounding soils and vegetation and this way alter soil fertility, plant vigour, and vegetation community composition. Furthermore, once metals enter the food chain, they can affect food quality for wildlife and humans (Witte et al. 2004, NADP 2008, Kerin and Lin 2010).

3. Methodology

3. Methodology

The goal of the Project baseline metal sampling program was to document current conditions and to provide a means of assessing future changes to ecosystems related to the proposed development. Thus, the sampling program was designed to determine baseline metal levels in the area of proposed infrastructure as well as in reference (control) sites outside of the expected zone of influence of Project environmental effects.

This report will focus only on the efforts associated with metal sampling and analysis conducted between 2010 and 2012. Special attention is given to soil sampling conducted in the top mineral soil layer (0 to 10 cm depth) as this is the zone where potential changes in metal concentration are expected to be the easiest to discern.

3.1 SOIL SAMPLE COLLECTION AND ANALYSIS

In 2010, soil samples were collected from 23 sites distributed throughout the LSA (Table 3.1-1). Where possible, the soil samples were collected at three depths: 0 to 10 cm, 20-30 cm, and 50 to 60 cm. At several of the inspected sites, the mineral soils were shallow and only the upper soil layer(s) were sampled. Samples collected at 0 to 10 cm depth represent the organically enriched mineral layer where atmospherically deposited contaminants (e.g., dust) can potentially accumulate. The 50 to 60 cm depth samples target subsoil conditions, which reflect parent material chemistry.

In 2011 and 2012, twenty-eight soil samples were collected near the proposed Project infrastructure to assess soil suitability for salvage and reclamation. These samples consisted of one composite sample per site from the entire recommended soil salvage depth. Due to this difference in sampling technique soil salvage suitability samples were not compared directly with the 2010 and 2012 data, however, the results of their analyses are included in this report.

In addition, in 2012, a total of 21 soil samples were collected from the 0 to 10 cm depth zone. Three soil samples were collected (at least 100 m apart) in each of five different locations within the LSA (west, north-west, north-east, east, and south) and in two reference sites located at a distance of at least 15 km from the Project footprint, outside of the LSA.

Approximately 0.5 kg of soil was placed in clean, plastic, labelled bags and submitted for chemical analysis to ALS Environmental laboratories in Vancouver, BC. Among other information, sample labels contained the collection dates and the sampling site ID numbers. While ALS Environmental Labs follow their own quality control procedures, each sampling program included a few sample duplicates (up to 5% of samples) to check if the results are similar. Samples were analyzed for soil reaction (pH), total organic carbon content and concentration of 31 metals. Baseline soil parameters measured and the realized detection limits are listed in Table 3.1-2. Soil reaction (pH) analysis helped assess soil nutrient availability and potential metal mobility. Determination of organic carbon content helped assessing soil fertility.

The metal analysis was carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment. Thus, the analytical method approximates metal environmental availability. Details of the analytical procedures and results are included in Appendix 1.

Table 3.1-1. 2010 to 2012 Soil Sampling Sites

2010 Soil Sampling Sites					2011 Soil Salvage Sampling Sites					2012 Soil Sampling Sites				
Sampling Site	Easting	Northing	Location	Plant Tissue Collected	Sampling Site	Easting	Northing	Location	Plant Tissue Collected	Sampling Site	Easting	Northing	Location	Plant Tissue Collected
007	627183	6093094	LSA		301	628368	6100850	LSA		E-1	629454	6099917	LSA	Lichen, leaves, berries
012	626442	6097640	LSA		302	628335	6100571	LSA		E-2	629516	6099944	LSA	Lichen, leaves, berries
016	626088	6099653	LSA	Leaves	303	628192	6100985	LSA		E-3	629606	6099645	LSA	Lichen, leaves, berries
020	626616	6098557	LSA		305	627985	6100552	LSA		NE-1	627364	6104184	LSA	Lichen, leaves, berries
023	626281	6098221	LSA		306	628157	6101130	LSA		NE-2	627439	6104088	LSA	Lichen, leaves, berries
026	625042	6098877	LSA	Leaves	308	628365	6101401	LSA		NE-3	627570	6103907	LSA	Lichen, leaves, berries
029	625014	6099181	LSA		310	628570	6101352	LSA	*Lichen*	NW-1	620275	6103290	LSA	Lichen, leaves, berries
031	625114	6098091	LSA	Leaves	311	628927	6101163	LSA		NW-2	620369	6103071	LSA	Lichen, leaves, berries
034	625338	6097016	LSA		312	629191	6101303	LSA	*Lichen*	NW-3	619922	6102460	LSA	Lichen, leaves, berries
039	625748	6097231	LSA	Leaves	314	628934	6101693	LSA	*Lichen*	S-1	623777	6093345	LSA	Lichen, leaves, berries
040	625947	6097186	LSA	Leaves	316	628467	6101810	LSA		S-2	623918	6093301	LSA	Lichen, leaves, berries
042	626130	6096411	LSA	Leaves	317	628355	6101978	LSA		S-3	623915	6093550	LSA	Lichen, leaves, berries
045	625730	6095613	LSA	Leaves	318	628095	6101620	LSA		W-1	621124	6099376	LSA	Lichen, leaves, berries
048	624750	6095646	LSA	Leaves	320	624897	6098284	LSA		W-2	621614	6099167	LSA	Lichen, leaves, berries
054	624695	6097981	LSA	Leaves	321	625185	6098334	LSA		W-3	621653	6099487	LSA	Lichen, leaves, berries
070	622293	6100192	LSA		323	625490	6098211	LSA		RN-1	632070	6113487	Reference site	Lichen, leaves, berries
075	621257	6100600	LSA		324	625741	6098048	LSA		RN-2	631824	6113526	Reference site	Lichen, leaves, berries
085	620195	6101403	LSA		326	625468	6097988	LSA		RN-3	633556	6114138	Reference site	Lichen, leaves, berries
088	620223	6102771	LSA		327	625345	6098156	LSA		RS-1	612764	6080513	Reference site	Lichen, leaves, berries
089	619938	6102236	LSA		328	624805	6098138	LSA		RS-2	612831	6080448	Reference site	Lichen, leaves, berries
093	620169	6101942	LSA		331	624958	6096778	LSA		RS-3	612788	6080065	Reference site	Lichen, leaves, berries
100	620119	6100904	LSA		332	624786	6096872	LSA						
107	627445	6098677	LSA		336	624764	6096263	LSA						
					408	627938	6098831	LSA						
					410	627804	6099238	LSA						
					411	627590	6099181	LSA						
					412	627566	6098920	LSA						
					413	627430	6098375	LSA						
Total Number of Sampled Sites:			**23**		**28**					**21**				

Notes:

Sampling site locations are listed using UTM coordinates. All sampling sites were from UTM Zone 10

In 2010 soil samples were collected from 3 depths (0 - 10 cm, 10 - 20 cm and 30 - 50 cm)

In 2012 soil samples were collected from the 0 to 10 cm depth.

Soil samples collected at soil salvage sites were collected by scraping the soil profile from 0 to 35 cm depth.

** See Table 2.2-2 for a complete list of vegetation tissues collected at each site*

V. edule = Viburnum edule; C. rangiferina = Cladina rangiferina

MSDA = mine surface development area.

LSA = Local study area

RSA = Regional study area.

CCR area = Coarse coal reject area.

Table 3.1-2. 2010 to 2012 Soil Parameters Measured and Realized Detection Limits

Collection Year	Realized Detection Limits			Collection Year	Realized Detection Limits		
	2010a	2010b	2012		2010a	2010b	2012
pH (pH units)	0.1	0.1	0.1	Magnesium (Mg)	-	-	20.0
Total Organic Carbon (%)	0.1	0.1	-	Manganese (Mn)	-	-	1.0
Metals				Mercury (Hg)	0.01	0.01	0.01
Aluminum (Al)	-	-	50.0	Molybdenum (Mo)	4.0	0.5	0.5
Antimony (Sb)	10.0	0.1	0.1	Nickel (Ni)	5.0	0.5	0.5
Arsenic (As)	5.0	0.1	0.1	Phosphorus (P)	-	-	50.0
Barium (Ba)	1.0	0.5	0.5	Potassium (K)	-	-	100.0
Beryllium (Be)	0.5	0.2	0.2	Selenium (Se)	0.5	0.2	0.2
Bismuth (Bi)	-	-	0.2	Silver (Ag)	2.0	0.1	0.1 - 0.8
Cadmium (Cd)	0.5	0.1	0.1	Sodium (Na)	-	-	100.0
Calcium (Ca)	-	-	50.0	Strontium (Sr)	-	-	0.5
Chromium (Cr)	2.0	0.5	0.5	Thallium (Tl)	1.0	0.1	0.1
Cobalt (Co)	2.0	0.1	0.1	Tin (Sn)	5.0	2.0	2.0
Copper (Cu)	1.0	0.5	0.5	Titanium (Ti)	-	-	1.0
Iron (Fe)	-	-	50.0	Uranium (U)	0.1	0.1	0.1
Lead (Pb)	30.0	0.5	0.5	Vanadium (V)	2.0	0.2	0.2
Lithium (Li)	-	-	5.0	Zinc (Zn)	1.0	1.0	1.0

Summary statistics (e.g., maximum, minimum and mean values) were calculated for soil parameters measured in the 0 to 10 cm depth zone. Values below the detection limit were replaced with one-half detection limit. Although this methodology for addressing what are essentially missing values does not capture the true frequency distribution of the concentrations (Nosal, Legge, and Krupa 2000), assigning values to undetected concentrations in this manner is common practice where it can be assumed the values are not zero, but where the level of risk is low enough not to warrant additional statistical analyses (i.e., with regards to human health) (US EPA 2000).

The interpretation of baseline data included comparing analytical results to the industrial guidelines provided for 19 of the metals in the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (CCME 2012) and to the BC Contaminated Sites Regulation guidelines (BC CSR 2011; Table 3.1-3).

3.2 VEGETATION TISSUE SAMPLING AND ANALYSIS

Vegetation species sampled are known to be effective bio-monitors of metal deposition and/or are potential food sources for wildlife or people. The vegetation sampled included lichens, berries, shrub leaves and sedges. Sampled species were chosen according to the following criteria:

- frequency of occurrence/ease of collection;
- known bio-accumulator; and
- likelihood of providing food source for animals.

Table 3.1-3. Summary of Regulatory Guidelines (BC-CSR, CCME)

	BC CSR Limits		CCME Limits	
	Livestock	Industrial	Agricultural	Industrial
Metals	mg / kg (ppm)	mg / kg (ppm)	mg / kg (ppm)	mg / kg (ppm)
Aluminum (Al)	-	-	-	-
Antimony (Sb)	20	40	20	40
Arsenic (As)	25	100	12	12
Barium (Ba)	400	1500	750	2000
Beryllium (Be)	4	8	4	8
Bismuth (Bi)	-	-	-	-
Cadmium (Cd)	70	500	1.4	22
Calcium (Ca)	-	-	-	-
Chromium (Cr)	50	700	64	87
Cobalt (Co)	40	300	40	300
Copper (Cu)	150	250	63	91
Iron (Fe)	-	-	-	-
Lead (Pb)	350	2000	70	600
Lithium (Li)	-	-	-	-
Magnesium (Mg)	-	-	-	-
Manganese (Mn)	-	-	-	-
Mercury (Hg)	0.6	150	6.6	50
Molybdenum (Mo)	5	40	5	40
Nickel (Ni)	150	500	50	50
Phosphorus (P)	-	-	-	-
Potassium (K)	-	-	-	-
Selenium (Se)	2	10	1	2.9
Silver (Ag)	20	40	20	40
Sodium (Na)	-	-	-	-
Strontium (Sr)	-	-	-	-
Thallium (Tl)	2	-	1	1
Tin (Sn)	5	300	5	300
Titanium (Ti)	-	-	-	-
Uranium (U)	-	-	23	300
Vanadium (V)	200	-	130	130
Zinc (Zn)	200	600	200	360

Vegetation tissue samples were collected from sites distributed throughout the LSA as well as from several reference sites outside of it (Figure 3.2-1). During the 2010, 2011, and 2012 field programs 157 samples were collected from 55 sites. Thirty-three of the soil sampling sites were sampled in conjunction with the plant tissue sampling (Table 3.2-1).

Vibrunum edule (highbush cranberry) occurred throughout the RSA and their leaves were sampled in 2010 and 2012. In 2010, 18 samples were collected from 9 sites near the Infrastructure Investigation Area. In 2012, 21 samples were collected from the perimeter of the LSA and from reference sites located more than 15 km from the proposed Project footprint. In total 39 leaf samples were collected from 30 sites.

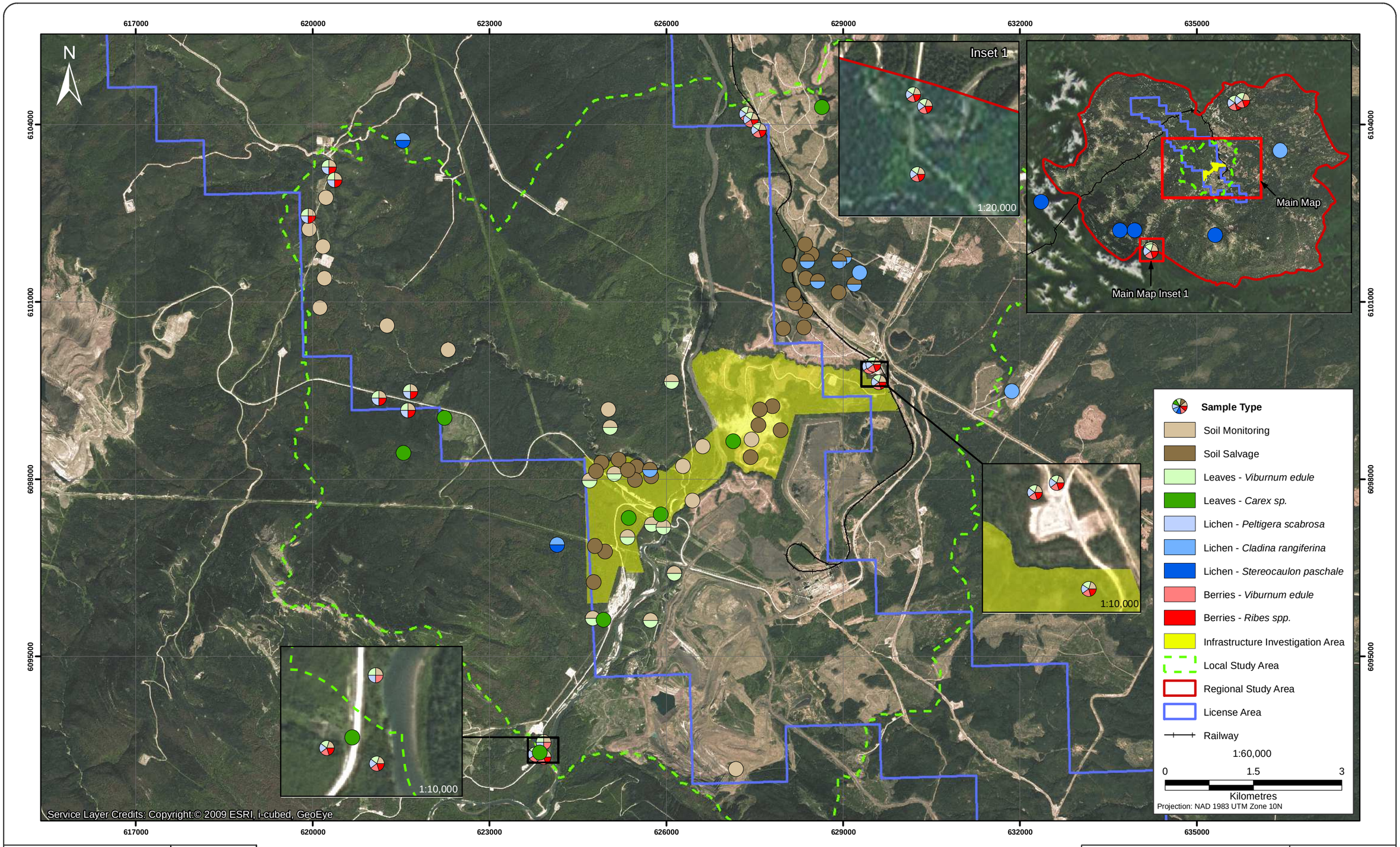

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Figure 3.2-1

Vegetation and Soil Sampling Sites for Metal Analysis: 2010, 2011, and 2012

Table 3.2-1. Summary of Plant Tissue Samples Collected for Metals Analysis in 2010, 2011 and 2012

Type	Plant Tissues Sampled		2010 Plant Tissue		Sites with Corresponding Soil[a] Samples	2011 Plant Tissue		Sites with Corresponding Soil[a] Samples	2012 Plant Tissue		Sites with Corresponding Soil[a] Samples	Total		Sites with Corresponding Soil[a] Samples
	Genus species	Common Name	Number of Sites	Number of Samples		Number of Sites	Number of Samples		Number of Sites[c]	Number of Samples[c]		Number of Sites	Number of Samples	
Lichens	*Cladina rangiferina*	Reindeer Lichen				11	23	3				11	23	3
	Stereocaulon paschale	Cottontail Foam Lichen				6	12					6	12	0
	Peltigera scabrosa								21	21	21	21	21	21
Berries	*Viburnum edule*	Highbush Cranberry							15	15	15	15	15	15
	Ribes spp.	Gooseberries and Currants							20	20	20	20	20	20
Leaves	*Viburnum edule*	Highbush Cranberry	9	18	9				21	21	21	30	39	30
Wetland Sedge Leaves	*Carex* aquatilis	Sedge	4	12		5[b]	15					8[b]	27	
Total Number of Samples:				30			50			77			157	
Total Number of Sites:			13		9	22[b]		3	21		21	55		33

Notes:

[a] *Sediment samples were collected at wetland sites*

[b] *One wetland site was sampled in both 2010 and 2011*

[c] *In 2012, there were a total of 21 sampling sites from seven different locations. All available plants and soil samples were collected at each site.*

Berries were sampled for metal content because they are often consumed by people and by animals. In 2012, 20 *Ribes spp*. (current and gooseberry) and 15 *Viburnum edule* (highbush cranberry) berry samples were collected from 20 sites. Berry samples consisted of 100 to 150 ripe berries. To collect a sufficient number, berries were collected from multiple plants at each site.

In 2010 and 2011 a total of 27 *Carex aquatilis* (water sedge) tissue samples were collected from 8 randomly selected wetland sites within the LSA. Three replicate samples were collected at each site and one site (MW01) was sampled in both 2010 and 2011. Samples consisted of several leaves of the above-ground portion of the sedge plants.

During the 2011 and 2012 field programs 56 lichen samples collected from 38 sites. The lichens sampled included *Cladina rangiferina* (reindeer lichen), *Stereocaulon paschale* (cottontail foam lichen) and *Peltigera scabrosa* (scabby pelt).

Nitrile gloves were worn during vegetation tissue collection. Only the above-ground portions vegetation tissue were sampled. All foreign debris was removed prior to the sample being placed into a plastic sampling bag. Bags were labeled (with species name, date, and sampling site ID) and kept frozen until delivery to the ALS Environmental Laboratories in Vancouver, BC, for analysis.

Metal concentrations in vegetation tissue were analyzed using both dry and wet weights. Dry weight represents a relatively objective measure of metal concentration as it is independent of tissue moisture content, which can vary greatly over time. Thus, dry-weight concentrations are the metal levels present in plant tissue irrespective of moisture status. All dry-weight and wet-weight vegetation tissue metal concentrations can be found in the Appendices 3 to 9. Detection limits for each species and each of the metals tested are presented in Table 3.2-2.

In order to assess plant tissue metal concentration data, summary statistics (maximum, minimum, median, mean and standard deviation values) were calculated for dry-weight metal concentrations. Uptake, allocation, and thus concentration of various metals differ according to factors such as species and tissue type (Bagatto and Shorthouse 1990; Mbila and Thompson 2004; Poykio et al. 2005). For this reason, metal concentrations were summarized separately for each species/tissue type. Metal concentrations with values below the detection limit were replaced with half the value of the detection limit for summary calculations. There are no regulatory guidelines for plant tissue metal concentrations.

3.3 QUALITY ASSURANCE

The quality assurance (QA) and quality control (QC) measures completed for this report included a review of precision and accuracy, representativeness, and sample holding times. Precision and accuracy were controlled through an assessment of laboratory sample duplicate analysis. The laboratory's QA/QC procedures include replicate testing and instrument calibration verification. Sample results are not released unless all internal QA/QC data are acceptable. The average Relative Percent Difference (RPD) was below 5% for metals, below 1% for pH, and below 15% for organic carbon. Rescan's replicate QA/QC results confirmed the ALS conclusion: the average RPD for metal analyses was 9.2% and 0.5% for pH. ALS Environmental laboratory's QA/QC results are included with the laboratory reports included in the *Murray River Coal Project 2010 to 2012 Terrain and Soils Baseline Report* (Rescan 2013a).

Acceptable representativeness was achieved through use of the standard Rescan sampling procedures. All laboratory data were electronically transferred to tables (no manual entry) to prevent transcription error. All internal tables and figures were peer reviewed. Sample holding times for the analyses ensured that samples were analyzed before degradation of the sample occurred. No recommended holding times were surpassed.

Table 3.2-2. Parameters Measured in Lichen, Leaf and Berry Tissues Sampled Between 2010 and 2012 and Realized Detection Limits (RDL)

		Lichen			Leaves		Berries		Wetland Sedge Leaves
Plant Tissue Sampled:		*Cladina rangiferina*	*Stereocaulon paschale*	*Peltigera scabrosa*	*Viburnum edule*	*Viburnum edule*	*Ribes* sp.	*Viburnum edule*	*Carex* sp.
Collection Year:		2011	2011	2012	2010	2012	2012	2012	2010 and 2011
Parameter	**Units**	**RDL**	**RDL**	**RDL**	**RDL**	**RDL**	**RDL**	**RDL**	**Detection Limits ***
% Moisture	%	0.10	0.10	0.10	0.10	0.10	0.1	0.10	
Total Metals									
Aluminum (Al)	mg/kg	10.0	10.0	2.0	10.0	2.00	2	2.00	10
Aluminum (Al)	mg/kg wwt	2 - 4	2 - 4	0.40	2 - 4	0.40	0.4	0.40	2.7
Antimony (Sb)	mg/kg	0.05	0.05	0.010	0.05	0.010	0.010	0.010	0.05
Antimony (Sb)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.002	0.01 - 0.02	0.002	0.002	0.002	0.0135
Arsenic (As)	mg/kg	0.05	0.05	0.02	0.05	0.02	0.02	0.02	0.05
Arsenic (As)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.004	0.01 - 0.02	0.004	0.004	0.004	0.0135
Barium (Ba)	mg/kg	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Barium (Ba)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.010	0.01 - 0.02	0.01	0.01	0.01	0.0135
Beryllium (Be)	mg/kg	0.30	0.30	0.010	0.30	0.01	0.01	0.01	0.3
Beryllium (Be)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.002	0.1 - 0.2	0.002	0.002	0.002	0.135
Bismuth (Bi)	mg/kg	0.30	0.30	0.01	0.30	0.01	0.01	0.01	0.3
Bismuth (Bi)	mg/kg wwt	0.03 - 0.06	0.03 - 0.06	0.002	0.03 - 0.06	0.00	0.002	0.002	0.0405
Boron (B)	mg/kg	-	-	1.0	-	1.0	1	1.0	
Boron (B)	mg/kg wwt	-	-	0.20	-	0.20	0.2	0.20	
Cadmium (Cd)	mg/kg	0.03	0.03	0.01	0.03	0.01	0.01	0.01	0.03
Cadmium (Cd)	mg/kg wwt	0.005 - 0.01	0.005 - 0.01	0.002	0.005 - 0.01	0.002	0.002	0.002	0.00675
Calcium (Ca)	mg/kg	10.0	10.0	15 - 3	10.0	30.0	12 - 3	30 - 6	10
Calcium (Ca)	mg/kg wwt	2 - 4	2 - 4	2.5 - 0.5	2 - 4	30 - 5	3 - 0.5	10 - 1	2.7
Cesium (Cs)	mg/kg	-	-	0.005	-	0.005	0.005	0.005	
Cesium (Cs)	mg/kg wwt	-	-	0.001	-	0.001	0.001	0.001	
Chromium (Cr)	mg/kg	0.50	0.50	0.05	0.50	0.05	0.05	0.05	0.5
Chromium (Cr)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.01	0.1 - 0.2	0.01	0.01	0.01	0.135
Cobalt (Co)	mg/kg	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.1
Cobalt (Co)	mg/kg wwt	0.02 - 0.04	0.02 - 0.04	0.004	0.02 - 0.04	0.004	0.004	0.004	0.027
Copper (Cu)	mg/kg	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Copper (Cu)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.01	0.01 - 0.02	0.01	0.01	0.01	0.0135
Gallium (Ga)	mg/kg	-	-	0.02	-	0.02	0.02	0.02	
Gallium (Ga)	mg/kg wwt	-	-	0.004	-	0.004	0.004	0.004	
Iron (Fe)	mg/kg	1 - 3	1 - 3	1.0	1.00	1.0	1.0	1.0	
Iron (Fe)	mg/kg wwt	0.2 - 2	0.2 - 2	0.20	0.2 - 0.4	0.20	0.2	0.20	
Lead (Pb)	mg/kg	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.1
Lead (Pb)	mg/kg wwt	0.02 - 0.04	0.02 - 0.04	0.004	0.02 - 0.04	0.004	0.004	0.004	0.027
Lithium (Li)	mg/kg	0.50	0.50	0.10	0.50	0.10	0.1	0.10	0.5
Lithium (Li)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.02	0.1 - 0.2	0.02	0.02	0.02	0.135
Magnesium (Mg)	mg/kg	3.00	3.00	25 - 5	3.00	50.00	20 - 5	50 - 10	3
Magnesium (Mg)	mg/kg wwt	1 - 2	1 - 2	5 - 1	1 - 2	60 - 10	6 - 1	20 - 2	1.35
Manganese (Mn)	mg/kg	0.05	0.05	0.02	0.05	0.02	0.02	0.02	0.05
Manganese (Mn)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.004	0.01 - 0.02	0.004	0.004	0.0	0.0135
Mercury (Hg)	mg/kg	0.005	0.005	0.005	0.005	0.005	0.01 - 0.005	0.005	0.005

(continued)

Table 3.2-2. Parameters Measured in Lichen, Leaf and Berry Tissues Sampled Between 2010 and 2012 and Realized Detection Limits (RDL) (completed)

		Lichen			Leaves		Berries		Wetland Sedge Leaves
Plant Tissue Sampled:		*Cladina rangiferina*	*Stereocaulon paschale*	*Peltigera scabrosa*	*Viburnum edule*	*Viburnum edule*	*Ribes* sp.	*Viburnum edule*	*Carex* sp.
Collection Year:		2011	2011	2012	2010	2012	2012	2012	2010 and 2011
Parameter	**Units**	RDL	RDL	RDL	RDL	RDL	RDL	RDL	Detection Limits *
Mercury (Hg)	mg/kg wwt	0.001	0.001	0.001	0.001	0.006 - 0.001	0.003 - 0.001	0.002 - 0.001	0.001
Molybdenum (Mo)	mg/kg	0.05	0.05	0.02	0.05	0.02	0.02	0.02	0.05
Molybdenum (Mo)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.004	0.01 - 0.02	0.004	0.004	0.004	0.0135
Nickel (Ni)	mg/kg	0.50	0.50	0.05	0.50	0.05	0.05	0.05	0.5
Nickel (Ni)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.01	0.1 - 0.2	0.01	0.01	0.01	0.135
Phosphorus (P)	mg/kg	20 - 60	20 - 60	100 - 20	20.00	200.00	80 - 20	200 - 40	
Phosphorus (P)	mg/kg wwt	5 - 50	5 - 50	25 - 5	5 - 10	300 - 50	30 - 5	100 - 10	
Potassium (K)	mg/kg	100 - 300	100 - 300	500 - 100	100.00	1000.00	400 - 100	1000 - 200	
Potassium (K)	mg/kg wwt	20 - 200	20 - 200	100 - 20	20 - 40	1200 - 200	120 - 20	400 - 40	
Rhenium (Re)	mg/kg	-	-	0.01	-	0.01	0.01	0.01	
Rhenium (Re)	mg/kg wwt	-	-	0.002	-	0.002	0.002	0.002	
Rubidium (Rb)	mg/kg	-	-	0.05	-	0.05	0.05	0.05	
Rubidium (Rb)	mg/kg wwt	-	-	0.01	-	0.01	0.01	0.01	
Selenium (Se)	mg/kg	1.00	1.00	0.10	1.00	0.10	0.1	0.10	1
Selenium (Se)	mg/kg wwt	0.2 - 0.4	0.2 - 0.4	0.02	0.2 - 0.4	0.02	0.02	0.02	0.27
Silver (Ag)	mg/kg	-	-	-	0.03		-	-	
Silver (Ag)	mg/kg wwt	-	-	-	0.01 - 0.02		-	-	
Sodium (Na)	mg/kg	100 - 300	100 - 300	500 - 100	100.00	1000.00	400 - 100	1000 - 200	
Sodium (Na)	mg/kg wwt	20 - 200	20 - 200	100 - 20	20 - 40	1200 - 200	120 - 20	400 - 40	
Strontium (Sr)	mg/kg	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Strontium (Sr)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.01	0.01 - 0.02	0.01	0.01	0.01	0.0135
Tellurium (Te)	mg/kg	-	-	0.02	-	0.02	0.02	0.02	
Tellurium (Te)	mg/kg wwt	-	-	0.004	-	0.004	0.004	0.004	
Thallium (Tl)	mg/kg	0.03	0.03	0.002	0.03	0.002	0.002	0.002	0.03
Thallium (Tl)	mg/kg wwt	0.01 - 0.02	0.01 - 0.02	0.0004	0.01 - 0.02	0.0004	0.0004	0.0004	0.0135
Thorium (Th)	mg/kg	-	-	0.01	-	0.01	0.01	0.01	
Thorium (Th)	mg/kg wwt	-	-	0.002	-	0.002	0.002	0.002	
Tin (Sn)	mg/kg	0.20	0.20	0.02	0.20	0.02	0.02	0.02	0.2
Tin (Sn)	mg/kg wwt	0.05 - 0.1	0.05 - 0.1	0.004	0.05 - 0.1	0.004	0.004	0.004	0.0675
Titanium (Ti)	mg/kg	0.5 - 1.5	0.5 - 1.5	0.05	0.50	0.05	0.05	0.05	
Titanium (Ti)	mg/kg wwt	0.1 - 1	0.1 - 1	0.01	0.1 - 0.2	0.01	0.01	0.01	
Uranium (U)	mg/kg	0.01	0.01	0.002	0.01	0.002	0.002	0.002	0.01
Uranium (U)	mg/kg wwt	0.002 - 0.004	0.002 - 0.004	0.0004	0.002 - 0.004	0.0004	0.0004	0.0004	0.0027
Vanadium (V)	mg/kg	0.50	0.50	0.02	0.50	0.02	0.02	0.02	0.5
Vanadium (V)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.004	0.1 - 0.2	0.004	0.004	0.004	0.135
Yttrium (Y)	mg/kg	-	-	0.01	-	0.01	0.01	0.01	
Yttrium (Y)	mg/kg wwt	-	-	0.002	-	0.002	0.002	0.002	
Zinc (Zn)	mg/kg	0.50	0.50	0.50	0.50	0.50	0.5	0.50	0.5
Zinc (Zn)	mg/kg wwt	0.1 - 0.2	0.1 - 0.2	0.10	0.1 - 0.2	0.10	0.1	0.10	0.135
Zirconium (Zr)	mg/kg	-	-	0.20	-	0.20	0.2	0.20	
Zirconium (Zr)	mg/kg wwt	-	-	0.04	-	0.04	0.04	0.04	

Notes:

RDL = Realized detection limit

** = Wetland sedge detection limits are presented as the dry weight detection limit and average wet weight detection limits.*

While considerable effort was made to conduct soil inspections in areas most representative of each polygon, there is an inherent assumption that the soil inspection data reflect the conditions found in the entire polygon (the median area of a polygon is 10.7 ha, while the soil pit is representative of approximately 0.3 m^2).

4. Results

4. Results

This report provides summary statistics (maximum, minimum, median, mean, and standard deviation) for soil metal concentrations in the 0 - 10 cm depth zone of mineral soil and for all lichen and plant tissue dry weight metal concentrations. Chapter 4 contains a discussion of soil chemistry, as well as the results of lichen and plant tissue metals analyses. Original data for all samples are presented in the following appendices:

- Soil sample analysis results for samples collected in 2010 are included in Appendix 1 (Appendix 1a and 1b).
- Soil sample analysis results for samples collected in 2011 and 2012 as part of soil salvage suitability assessment are included in Appendix 1c.
- Soil sample analysis results for samples collected in 2012 are included in Appendix 2.
- Lichen tissue analysis results for *Cladina rangiferina* and *Stereocaulon paschale* samples collected in 2011 are included in Appendix 3.
- Lichen tissue results for *Peltigera scabrosa* samples collected in 2012 can be found in Appendix 4.
- *Viburnum edule* leaf sample results for samples collected in 2010 can be found in Appendix 5.
- *Viburnum edule* leaf sample results for samples collected in 2012 can be found in Appendix 6.
- *Ribes* sp. berry sample results for samples collected in 2012 can be found in Appendix 7.
- *Viburnum edule* berry sample results for samples collected in 2012 can be found in Appendix 8.
- Carex sp. samples collected from wetlands in 2010 and 2011 can be found in Appendix 9 and in the 2011 Wetland Baseline Report (Rescan 2011c).

4.1 SOIL ANALYTICAL RESULTS

Figure 4.1-1 shows the distribution of soil sampling sites, with site labels, within the LSA and the RSA respectively.

4.1.1 Soil pH

Soil reaction (pH) can change over time and space, but it is generally affected by mineralogical composition of the parent material, soil moisture index, organic acids produced by vegetation and decaying organic matter, and weathering factors such as precipitation and temperature. Soil pH was predominantly acidic (Tables 4.1-1 and 4.1-2). Soil reaction is predominantly below the interim CCME guideline optimal range of between pH 6 and 8) for residential, parkland, and industrial use (CCME 2012) i.e. 24 (55%) of the 44 samples collected from the 0 to 10 cm layer (Appendices 1a, 1b, and 2). In the 0 to 10 cm layer, only approximately 25% of the soil samples were neutral to mildly alkaline (pH > 6.5).

Soil reaction results from the area sampled in 2010 reflect a potential for higher metal mobility compared to 2012 samples. While metal mobility is generally higher in acidic than in neutral soils, the retention of metals by soil has been also correlated with such soil properties as redox potential, cation exchange capacity, organic matter and clay content, iron and manganese oxide content, and carbonate content (McLean and Bledsoe 1992).

Table 4.1-1. Summary Statistics for Soil Samples Collected from the 0 to 10 cm Depth Zone in 2010

	Guidelines				2010 Samples with Higher Detection Limits (n= 15)						2010 Samples with Lower Detection Limits (n = 8)					
Parameters	CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	RDL	Maximum	Minimum	Median	Mean	SD	RDL	Maximum	Minimum	Median	Mean	SD
pH (pH units)	6 to 8[e]	6 to 8[e]			0.1	7.9	4.3	5.1	5.7	1.2	0.1	7.8	4.3	5.0	5.5	1.3
Total Organic Carbon (%)					0.1	39.0	0.5	1.7	5.5	9.9	0.1	1.5	0.3	1.0	1.0	0.4
Metals																
Antimony (Sb)	20	40	20	40	10	<10	<10	<10	<10	0	0.1	0.7	<0.1	0.2	0.3	0.2
Arsenic (As)	12	12	25	100	5	9	<5	<5	4	2	0.05	6.09	1.99	3.45	3.82	1.39
Barium (Ba)	750	2000	400	1500	1	510	32	190	206	171	0.5	239	41	65	103	74
Beryllium (Be)					0.5	0.7	<0.5	<0.5	0.3	0.1	0.2	0.4	<0.2	<0.2	0.2	0.1
Cadmium (Cd)	1.4	22	9	500	0.5	1.9	<0.5	<0.5	0.7	0.6	0.1	0.7	<0.1	0.1	0.2	0.2
Chromium (Cr)	64	87	50	700	2	15	<2	12	10	4	0.5	11.3	5.8	7.8	8.1	2.0
Cobalt (Co)	40	300	40	300	2	10	<2	6	5	3	0.1	6.3	0.6	2.2	2.5	2.0
Copper (Cu)					1	23	1	11	11	7	0.5	12.0	1.4	3.2	4.7	3.8
Lead (Pb)	70	600	350	2000	30	<30	<30	<30	<30	0	0.5	9.3	3.8	5.4	5.9	1.8
Mercury (Hg)	6.6	50	0.6	150	0.01	0.11	0.01	0.02	0.04	0.04	0.005	0.054	0.007	0.012	0.019	0.016
Molybdenum (Mo)	5	40	5	40	4	<4	<4	<4	<4	0	0.5	1.4	<0.5	0.7	0.8	0.4
Nickel (Ni)	50	50	150	500	5	27	3	14	14	9	0.5	18.1	1.9	7.4	8.1	5.8
Selenium (Se)	1	2.9	2	10	0.5	1.3	0.3	0.3	0.4	0.3	0.2	0.4	<0.2	<0.2	0.2	0.1
Silver (Ag)	20	40	20	40	2	<2	<2	<2	<2	0	0.1	0.2	<0.1	0.1	0.1	0.1
Thallium (Tl)	1	1	2		1	<1	<1	<1	<1	0	0.05	0.11	0.06	0.09	0.09	0.02
Tin (Sn)	5	300	5	300	5	<5	<5	<5	<5	0	2	6	<2	<2	2	2
Uranium (U)	23	300			0.05	1.1	0.0	0.4	0.5	0.3	0.05	0.57	0.15	0.25	0.31	0.16
Vanadium (V)	130	130	200		2	38	<2	24	24	9	0.2	29.7	16.7	23.6	23.6	5.0
Zinc (Zn)	200	360	200	600	1	120	7	67	59	35	1	79	13	27	34	23

Notes

All sampling sites were located within the local study area.

All units are mg/kg unless otherwise indicated.

Shaded cells indicate concentrations greater than CCME or BC CSR guideline levels.

RDL = Realized detection limit

a) CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.

b) CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.

c) CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria

d) CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria

e) CCME interim remediation criteria for soil.

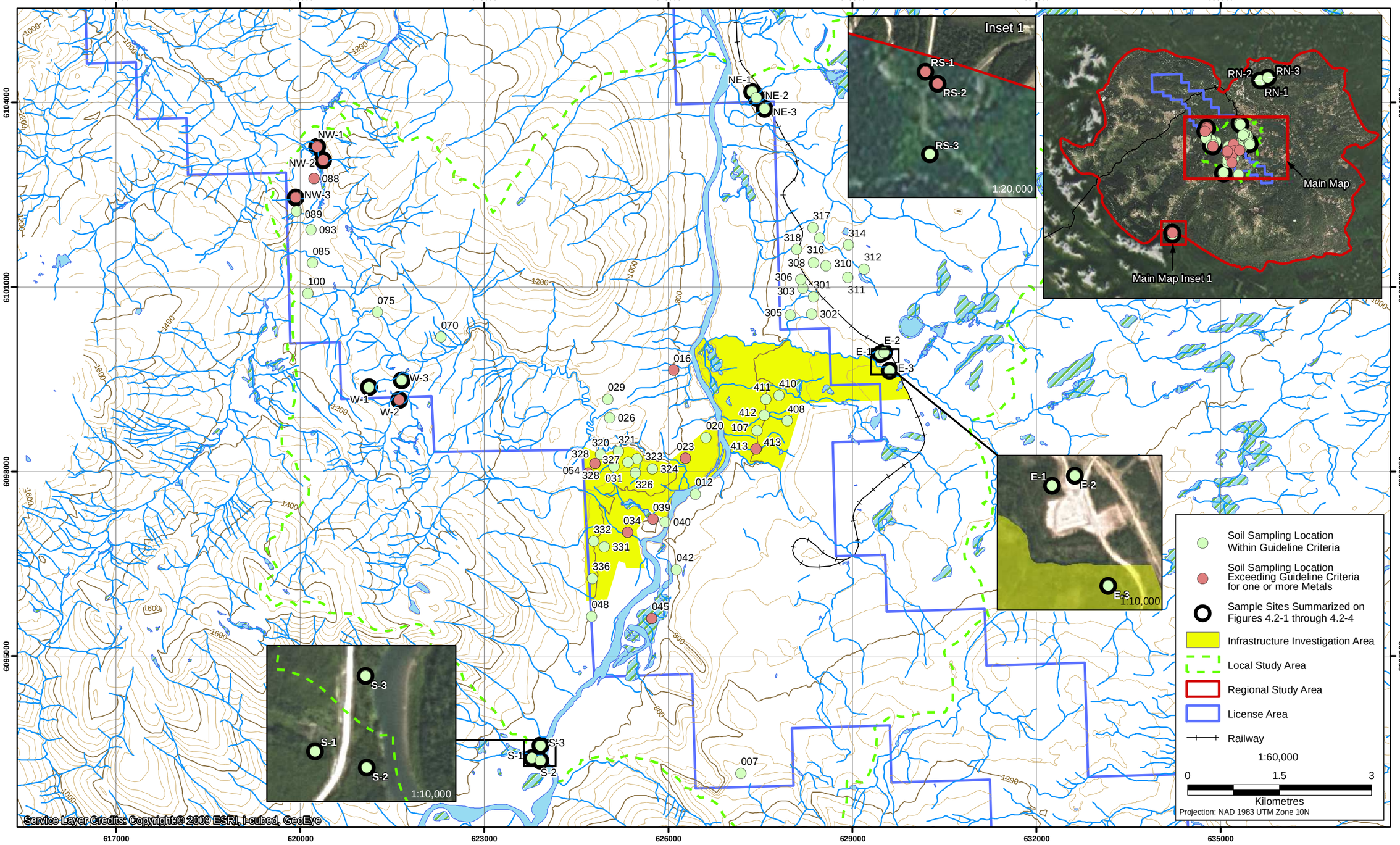

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Figure 4.1-1

Soil Sample Site Locations and Soil Metal Concentration Guideline Rating

Table 4.1-2. Summary Statistics for Soil Samples Collected in 2012

Parameter	Realized Detection Limit	Guidelines				Soil Summary Statistics from LSA Sites (n = 15)					Soil Summary Statistics from Reference Sites (n= 6)				
		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Maximum	Minimum	Median	Mean	SD	Maximum	Minimum	Median	Mean	SD
pH (1:2 soil:water)	0.1	6 to 8[e]	6 to 8[e]			7.9	4.2	6.5	6.1	1.1	8.1	4.3	6.9	6.5	1.6
Metals															
Aluminum (Al)	50					11600	2200	7200	7339.33	2613.98	7620	4090	6750	6170	1526
Antimony (Sb)	0.1	20	40	20	40	0.82	0.17	0.33	0.37	0.19	0.74	<0.1	0.39	0.42	0.28
Arsenic (As)	0.05	12	12	25	100	17.60	1.55	4.12	5.39	3.91	7.52	2.65	4.90	5.13	1.89
Barium (Ba)	0.5	750	2000	400	1500	1010	36	124	284	306	302	54	133	161	92
Beryllium (Be)	0.2	4	8	4	8	0.7	<0.2	0.3	0.4	0.2	0.6	<0.2	0.3	0.3	0.2
Bismuth (Bi)	0.2					<0.2	<0.2	<0.2	<0.2	0.0	<0.2	<0.2	<0.2	<0.2	0.0
Cadmium (Cd)	0.05	1.4	22	9	500	2.16	0.07	0.46	0.72	0.66	1.41	0.12	0.43	0.61	0.52
Calcium (Ca)	50					54700	308	2700	8456	13803	63400	607	23255	26823	28669
Chromium (Cr)	0.5	64	87	50	700	20.8	4.4	13.4	12.7	4.6	19.1	8.7	11.1	12.7	4.4
Cobalt (Co)	0.1	40	300	40	300	10.2	1.2	5.5	5.1	2.7	7.3	1.3	4.2	4.3	2.4
Copper (Cu)	0.5	63	91	150	250	30.5	3.9	6.9	11.7	8.1	20.3	1.8	9.1	10.3	7.7
Iron (Fe)	50					36800	5780	17100	16113	7711	18400	7620	12750	13370	4262
Lead (Pb)	0.5	70	600	350	2000	13.4	3.4	7.9	8.3	3.1	10.7	4.4	7.0	7.7	2.5
Lithium (Li)	5					14	<5	9	8	4	10	<5	8	7	3
Magnesium (Mg)	20					13400	591	2250	2923	3123	17800	850	7000	8306	8027
Manganese (Mn)	1					779	32	256	296	230	346	38	173	163	113
Mercury (Hg)	0.005	6.6	50	0.6	150	0.101	0.015	0.032	0.042	0.026	0.111	0.022	0.035	0.051	0.037
Molybdenum (Mo)	0.5	5	40	5	40	2.9	<0.5	0.9	1.1	0.6	2.9	<0.5	1.5	1.6	1.2
Nickel (Ni)	0.5	50	50	150	500	32.7	4.9	15.1	16.9	9.1	32.3	3.0	15.2	17.0	12.1
Phosphorus (P)	50					1190	209	546	554	239	1380	160	873	831	510
Potassium (K)	100					1650	350	800	904	390	2090	570	1065	1222	625
Selenium (Se)	0.2	1	2.9	2	10	1.7	0.1	0.2	0.4	0.4	1.2	<0.2	0.3	0.5	0.5
Silver (Ag)	0.8 - 0.1	20	40	20	40	1.1	0.1	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.0
Sodium (Na)	100					<100	<100	<100	<100	0	110	<100	<100	60	24
Strontium (Sr)	0.5					51.2	2.6	10.2	19.1	16.1	79.3	5.2	38.5	39.8	34.7
Thallium (Tl)	0.05	1	1	2		0.23	<0.05	0.13	0.12	0.05	0.33	<0.05	0.11	0.15	0.13
Tin (Sn)	2	5	300	5	300	<2	<2	<2	<2	0	<2	<2	<2	<2	0
Titanium (Ti)	1					114	13	37	43	26	105	15	28	42	34
Uranium (U)	0.05	23	300			1.35	0.20	0.51	0.64	0.37	1.30	0.27	0.78	0.77	0.49
Vanadium (V)	0.2	130	130	200		46.8	12.3	30.3	30.9	9.0	42.9	24.0	26.3	30.5	8.1
Zinc (Zn)	1	200	360	200	600	87	18	55	54	24	138	22	50	67	44

Notes:

All units are mg/kg unless otherwise indicated

Shaded cells indicate paramater concentration exceeds CCME or BC CSR guidelines.

a) CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.

b) CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits

c) CSR-L = Contaminated site Regulation (BC Reg. 375/96), Livestock Criteria

d) CSR-I = Contaminated site Regulation (BC Reg. 375/96), Industrial Criteria

4.1.2 Soil Metals

Metal concentration of soil samples varied substantially between sampling locations. Coefficient of variation (average 64%) ranged between 17 and 180% for different metals. This is typical for natural soil datasets, especially when soils develop on a number of different surficial materials subjected to different land uses (Rescan 2011a).

Soil metal concentrations were compared to CCME *Guidelines for the Protection of Environmental and Human Health* for Agricultural and Industrial use (CCME 2012) and to the BC Contaminated Sites Regulation Soil Criteria (BC Reg. 375/96) for Livestock and Industrial use. Exceedence of guideline criteria is noted, by site, in Figure 4.1-1. This figure includes sample results from all 72 sites inspected/sampled from 2010 through 2012.

Summary statistics of metal concentration in the 0 to 10 cm depth zone are presented in Tables 4.1-1 and 4.1-2. Table 4.1-3 lists the sites where metal concentrations found in the top 10 cm of mineral soil exceeded guideline limits. Metal concentrations found in soil samples collected at 30 to 50 cm below surface were, in general, higher compared to surficial horizons, however, at sites where CCME and BC CSR guidelines were exceeded, the highest concentrations were typically found in surficial horizons.

Table 4.1-3. Sampling Sites where Soil Metal Concentrations Exceeded Regulatory Guidelines in the 0 - 10 cm Depth Zone

Metals	Percent of Samples (%)	Number of Sites	Sampling Sites	Guidelines Exceeded
Arsenic (As)	2.3	1	NW-1	CCME-A, CCME-I
Barium (Ba)	13.6	6	NW-1, NW-3, W-2, 34, 39, 23	CCME-A, CSR-L
Cadmium (Cd)	11.4	5	NW-2, W-2, RS-2, 16, 45	CCME-A
Selenium (Se)	9.1	4	NW-1, RS-1, RS-2, 45	CCME-A
Tin (Sn)	2.3	1	88	CCME-A, CSR-L

Notes:
CCME-A = CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.
CCME-I = CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.
CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria
CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria

In the subdued terrain, east of the Murray River, the mineral soil sites, comprising till and sand capped till soils, consistently display metal concentrations that do not exceed soil guideline criteria (Figure 4.1-1). Two low lying sites located in the floodplain of the Murray River (sites 045) and in a ravine leading to the floodplain (site 413), show exceedence of guideline criteria. These fluvial soil sites are both down gradient of past anthropogenic (coal mining) activities, which may be a contributor to these results. Peat (organic) soils, located in the uplands, east of the Murray River, were not sampled.

In the generally mountainous terrain, west of the Murray River, the mineral soil sites, primarily comprising colluvium, fluvial and locally derived till soils, displayed inconsistent metal concentrations, with some sites exceeding soil guideline criteria (Figure 4.1-1).

Metals of potential concern, whose concentration exceeds guideline limits at least once at the sites sampled, include: arsenic (As), barium (Ba), cadmium (Cd), molybdenum (Mo), selenium (Se), tin (Sn), and zinc (Zn). Of these metals, exceedences of barium, cadmium and selenium were most frequent. Least common exceedences, ie. singular occurrences, were noted for molybdenum, tin and zinc. Within the IIA, the area of potentially extensive soil salvage, 5 of 22 sites sampled displayed exeedences of one or more of the following six metals: As (1 site), Ba (4 sites), Cd (3 sites), Mo (1 site), Se (2 sites) and Zn (1 site), (Figure 4.1-1).

4.2 PLANT TISSUE METALS

4.2.1 Lichen Tissue Metals

Lichens are known bio-accumulators and as such, can be used to detect the patterns of dispersal and deposition of atmospheric particles and to monitor resulting levels of metal accumulation in vegetation (Addison and Puckett 1980; Furbish, Geiser, and Rector 2000; Garty 2000). Lichens are also consumed by animals and thus provide a link between the contaminant dispersal and the food chain.

4.2.1.1 Cladina rangiferina

Concentrations of 30 metals were measured in the 23 *Cladina rangiferina* (reindeer lichen) tissue samples collected in 2011. Summary statistics for dry weight metal concentrations from LSA and RSA samples are presented in Table 4.2-1. The *C. rangiferina* samples do not appear to vary greatly between samples collected; however, *C. rangiferina* distribution was discontinuous, making systematic and spatially representative sample collection difficult.

4.2.1.2 Stereocaulon paschale

Concentrations of 30 metals were also measured in the 12 *Stereocaulon paschale* (cottontail foam lichen) samples collected in 2011. Summary statistics for dry weight metal concentrations from samples collected in the LSA, RSA and outside the RSA are presented in Table 4.2-2. Metal concentrations in the *S. paschale* samples varied greatly between the collection sites. Metal concentrations were typically higher in the samples collected outside of the LSA. The sample collected from outside the RSA (Lichen 5) had the highest metal concentrations of all.

4.2.1.3 Peltigera scabrosa

Concentrations of 39 metals were measured in the 21 tissue samples of *Peltigera scabrosa* (scabby pelt) collected in 2012. Summary statistics for dry weight metal concentrations for metals detected in more than 50% of the samples are presented in Table 4.2-3. The highest metal concentrations were consistently detected in samples collected in the north-western section of the LSA (Figures 3.2-1 and 4.2-1 to 4.2-4).

4.2.2 Leaf Tissue Metals

Vascular plants can also be used to monitor metal deposition due to fugitive dust. Plants not only intercept pollutants from atmospheric deposition, but also take-up metals from the soil and translocate them to the above ground tissues of the plant. Leaves and roots typically retain higher nutrient and metal concentrations than stems and fruits. Because plants are consumed by animals, uptake and allocation of metals into the leaf tissue can link contaminants with the food chain.

In 2010, 31 metals were measured in the *Vibrunum edule* leaf tissue samples. Of these, 10 metals fell below detection limit in all samples (antimony, beryllium, bismuth, lithium, selenium, silver, sodium, thallium, tin, and uranium) and another five metals fell below the detection limit in more than 50% of the samples (arsenic, cobalt, lead, mercury and vanadium). In 2012, 39 metals were measured in the leaf tissue samples. Of these, concentrations of bismuth, rhenium, sodium and tellurium fell below the detection limit. Concentration of the metals: antimony, beryllium, tin and zirconium were below detection limit in more than 50 % of the samples. Overall, metal concentration in the *Vibrunum edule* leaf samples showed high spatial variability and highest concentrations were recorded predominantly in the samples collected within the north-western section of the LSA (Tables 4.2-4 and 4.2-5, (Figures 3.1-1 and 4.2-1 to 4.2-4).

Table 4.2-1. Summary of Dry Weight Metal Concentrations in *Cladina rangiferina* Tissue Samples Collected in 2011

Total Metals	RDL	*Cladina rangiferina* LSA Summary Statistics (n = 19)					*Cladina rangiferina* RSA Summary Statistics (n = 4)				
		Maximum	Minimum	Median	Mean	SD	Maximum	Minimum	Median	Mean	SD
Aluminum (Al)	10	632	189	363	398	141	647	410	446	487	108
Antimony (Sb)	0.05	0.15	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0
Arsenic (As)	0.05	0.50	0.11	0.19	0.22	0.10	0.34	0.25	0.32	0.31	0.04
Barium (Ba)	0.05	40.10	9.39	18.90	20.28	7.80	95.30	13.10	15.40	34.80	40.38
Beryllium (Be)	0.3	0.15	0.15	0.15	0.15	0	0.15	0.15	0.15	0.15	0
Bismuth (Bi)	0.3	0.15	0.15	0.15	0.15	0	0.15	0.15	0.15	0.15	0
Cadmium (Cd)	0.03	0.20	0.03	0.12	0.12	0.05	0.15	0.04	0.06	0.08	0.05
Calcium (Ca)	10	2740	552	1280	1390	498	2110	733	1061	1241	631
Chromium (Cr)	0.5	6.8	0.8	2.1	2.7	1.9	3.2	1.3	2.1	2.2	1.0
Cobalt (Co)	0.1	0.4	0.1	0.2	0.2	0.1	0.5	0.2	0.2	0.2	0.2
Copper (Cu)	0.05	2.26	1.15	1.56	1.61	0.30	2.42	1.27	1.39	1.62	0.54
Iron (Fe)	1 - 3	759	169	316	374	173	517	366	389	415	70
Lead (Pb)	0.1	1.02	0.10	0.45	0.48	0.21	0.78	0.36	0.38	0.48	0.20
Lithium (Li)	0.5	0.25	0.25	0.25	0.25	0	0.25	0.25	0.25	0.25	0
Magnesium (Mg)	3	812	266	330	410	152	574	311	345	394	122
Manganese (Mn)	0.05	192.0	62.7	107.0	115.6	40.7	211.0	74.8	99.2	121.0	63.0
Mercury (Hg)	0.01	0.05	0.003	0.03	0.03	0.01	0.02	0.01	0.02	0.02	0
Molybdenum (Mo)	0.05	0.72	0.10	0.17	0.21	0.13	0.21	0.12	0.13	0.14	0.04
Nickel (Ni)	0.5	3.7	0.5	1.3	1.7	1.0	2.5	0.8	1.2	1.4	0.8
Phosphorus (P)	20 - 60	954	536	694	696	93	877	562	571	645	155
Potassium (K)	100 - 300	2570	1140	1460	1564	357	1810	1320	1345	1455	238
Selenium (Se)	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0
Sodium (Na)	100 - 300	150	50	50	55	23	50	50	50	50	0
Strontium (Sr)	0.05	6.68	1.64	3.13	3.35	1.40	9.02	1.41	1.70	3.46	3.72
Thallium (Tl)	0.03	0.06	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0
Tin (Sn)	0.20	0.10	0.10	0.10	0.10	0	0.10	0.10	0.10	0.10	0
Titanium (Ti)	0.5 - 1.5	8.4	0.8	5.3	5.4	1.7	5.1	3.9	4.8	4.7	0.6
Uranium (U)	0.01	0.09	0.01	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.01
Vanadium (V)	0.5	13.3	0.7	1.4	2.1	2.8	2.3	1.5	1.6	1.7	0.4
Zinc (Zn)	0.5	31.9	14.5	20.8	21.7	4.8	25.8	14.8	17.6	19.0	4.9

Note:

RDL = realized detection limit

Metals below detection limit were replaced with one-half the detection limit

Table 4.2-2. Summary of Dry Weight Metal Concentrations in *Stereocaulon paschale* Tissue Samples Collected in 2011

		***Stereocaulon paschale* LSA Summary Statistics (n = 2)**				***Stereocaulon paschale* RSA Summary Statistics (n = 8)**					***Stereocaulon paschale* Outside RSA Summary Statistics (n = 2)**			
Total Metals	**RDL**	**Maximum**	**Minimum**	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**	**Maximum**	**Minimum**	**Mean**	**SD**
Aluminum (Al)	10	251	211	231	28	1390	143	409	577	426	3190	1780	2485	997
Antimony (Sb)	0.05	0.03	0.03	0.03	0	0.05	0.03	0.03	0.03	0.01	0.76	0.43	0.59	0.23
Arsenic (As)	0.05	0.18	0.15	0.16	0.02	0.86	0.11	0.24	0.36	0.28	7.87	3.59	5.73	3.03
Barium (Ba)	0.05	14.50	12.40	13.45	1.48	80.80	7.74	33.95	40.62	25.55	27.60	13.90	20.75	9.69
Beryllium (Be)	0.3	0.15	0.15	0.15	0	0.15	0.15	0.15	0.15	0	0.15	0.15	0.15	0
Bismuth (Bi)	0.3	0.15	0.15	0.15	0	0.15	0.15	0.15	0.15	0	0.15	0.15	0.15	0
Cadmium (Cd)	0.03	0.12	0.11	0.12	0.01	0.78	0.12	0.34	0.40	0.27	4.12	1.84	2.98	1.61
Calcium (Ca)	10	872	720	796	107	5770	1120	3335	3448	1620	22100	8150	15125	9864
Chromium (Cr)	0.5	2.15	2.12	2.14	0.02	9.97	2.14	3.92	4.98	2.77	43.40	16.50	29.95	19.02
Cobalt (Co)	0.10	0.12	0.11	0.12	0.01	0.93	0.05	0.28	0.37	0.30	2.26	1.05	1.66	0.86
Copper (Cu)	0.05	1.85	1.82	1.84	0.02	3.22	0.67	1.63	1.82	0.94	12.00	6.24	9.12	4.07
Iron (Fe)	1 - 3	188	179	184	6	1850	148	389	636	572	5870	2890	4380	2107
Lead (Pb)	0.10	0.49	0.33	0.41	0.11	1.25	0.16	0.66	0.70	0.41	3.66	1.90	2.78	1.24
Lithium (Li)	0.5	0.25	0.25	0.25	0	1.22	0.25	0.25	0.45	0.38	2.55	1.16	1.86	0.98
Magnesium (Mg)	3	220	178	199	30	529	243	469	439	101	1170	564	867	429
Manganese (Mn)	0.05	92.40	52.20	72.30	28.43	40.50	13.20	23.80	25.29	10.99	75.90	42.10	59.00	23.90
Mercury (Hg)	0.01	0.028	0.022	0.025	0.004	0.051	0.017	0.030	0.030	0.010	0.039	0.021	0.030	0.012
Molybdenum (Mo)	0.1	0.3	0.2	0.3	0.07	0.7	0.2	0.2	0.3	0.2	24.9	10.8	17.9	10.0
Nickel (Ni)	0.5	1.4	1.4	1.4	0	6.7	1.5	3.3	3.6	2.0	49.4	20.9	35.2	20.2
Phosphorus (P)	20 - 60	575	558	567	12	1580	577	773	896	322	1120	552	836	402
Potassium (K)	100 - 300	1580	1370	1475	148	3070	1580	2205	2250	440	3080	1540	2310	1089
Selenium (Se)	1	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.0	1.6	0.5	1.1	0.8
Sodium (Na)	100 - 300	50	50	50	0	50	50	50	50	0	50	50	50	0
Strontium (Sr)	0.05	2.59	2.03	2.31	0.40	9.54	2.73	7.78	7.21	2.40	21.80	9.24	15.52	8.88
Thallium (Tl)	0.03	0.015	0.015	0.015	0	0.015	0.015	0.015	0.015	0	2.09	1.12	1.61	0.69
Tin (Sn)	0.2	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0.1	0.1	0
Titanium (Ti)	0.5 - 1.5	5.4	4.8	5.1	0.5	7.8	3.7	6.4	6.2	1.3	30.2	20.0	25.1	7.2
Uranium (U)	0.01	0.02	0.02	0.02	0	0.08	0.01	0.03	0.04	0.03	1.62	0.86	1.24	0.54
Vanadium (V)	0.5	3.3	0.9	2.1	1.7	5.3	0.6	1.9	2.4	1.5	548.0	273.0	410.5	194.5
Zinc (Zn)	0.5	27.7	25.6	26.7	1.5	36.3	13.5	27.6	27.0	7.5	191.0	83.3	137.2	76.2

Note:

RDL = realized detection limit

Metals below detection limit were replaced with one-half the detection limit

Table 4.2-3. Summary of Dry Weight Metal Concentrations in *Peltigera scabrosa* Tissue Samples Collected in 2012

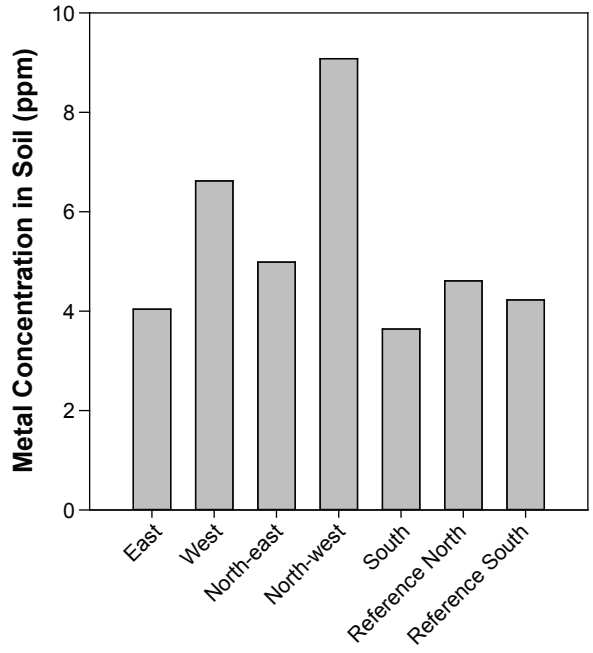
	P. scabrosa Samples from LSA (n = 15)					*P. scabrosa* Samples from Reference Sites (n = 6)				
Total Metals	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**
Aluminum (Al)	1210	128	373	503	322	417	182	290	285	87
Antimony (Sb)	0.08	0.01	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.00
Arsenic (As)	0.80	0.10	0.19	0.27	0.19	0.29	0.16	0.16	0.19	0.05
Barium (Ba)	173.0	14.5	31.3	45.8	41.2	74.0	18.2	36.9	38.8	20.0
Beryllium (Be)	0.10	0.01	0.03	0.03	0.03	0.03	0.01	0.02	0.02	0.01
Boron (B)	13.3	3.8	5.7	6.7	2.9	8.4	3.3	6.6	6.2	2.1
Cadmium (Cd)	1.36	0.05	0.21	0.29	0.31	0.41	0.05	0.21	0.23	0.15
Calcium (Ca)	9520	1300	3000	3775	2420	8710	1560	3780	4163	2906
Cesium (Cs)	0.23	0.06	0.11	0.12	0.05	0.17	0.05	0.06	0.09	0.05
Chromium (Cr)	2.95	0.34	0.78	1.10	0.74	0.96	0.45	0.63	0.64	0.19
Cobalt (Co)	1.03	0.10	0.23	0.34	0.28	0.24	0.18	0.20	0.20	0.02
Copper (Cu)	6.1	2.5	3.5	3.6	1.0	5.9	2.1	3.5	3.7	1.4
Gallium (Ga)	0.36	0.03	0.10	0.14	0.10	0.12	0.06	0.08	0.08	0.03
Iron (Fe)	1540	128	374	539	420	418	194	315	302	88
Lead (Pb)	1.55	0.19	0.41	0.55	0.38	0.54	0.36	0.42	0.44	0.07
Lithium (Li)	1.31	0.05	0.41	0.54	0.40	0.46	0.18	0.30	0.30	0.11
Magnesium (Mg)	2230	624	978	1068	452	1470	648	980	1030	384
Manganese (Mn)	242.0	29.2	63.8	87.9	58.9	98.3	20.2	43.4	52.2	32.0
Mercury (Hg)	0.15	0.03	0.05	0.06	0.04	0.07	0.04	0.05	0.05	0.01
Molybdenum (Mo)	0.49	0.15	0.33	0.31	0.09	0.66	0.16	0.36	0.39	0.24
Nickel (Ni)	4.6	0.6	1.1	1.5	1.1	2.5	0.6	1.0	1.2	0.7
Phosphorus (P)	2740	1090	1880	1913	521	1890	1290	1590	1607	237
Potassium (K)	9030	4830	8010	7512	1268	9010	5770	7335	7307	1194
Rubidium (Rb)	11.6	2.6	6.5	6.6	2.7	11.1	2.7	6.0	5.9	3.0
Strontium (Sr)	19.4	2.2	5.2	7.1	5.1	11.6	2.6	7.2	7.0	3.8
Thallium (Tl)	0.04	0.01	0.02	0.02	0.01	0.03	0.01	0.01	0.02	0.01
Thorium (Th)	0.28	0.03	0.09	0.13	0.09	0.11	0.05	0.09	0.08	0.03
Tin (Sn)	0.81	0.02	0.03	0.13	0.25	0.43	0.02	0.03	0.09	0.17
Titanium (Ti)	11.9	2.1	5.5	5.7	2.9	7.7	2.7	4.8	4.8	1.9
Uranium (U)	0.11	0.01	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.01
Vanadium (V)	5.9	0.5	1.7	2.4	1.6	2.4	0.9	1.6	1.6	0.6
Yttrium (Y)	1.54	0.06	0.25	0.39	0.38	0.32	0.14	0.23	0.23	0.08
Zinc (Zn)	66.2	23.7	32.2	36.3	11.7	57.4	29.3	36.5	39.7	11.0

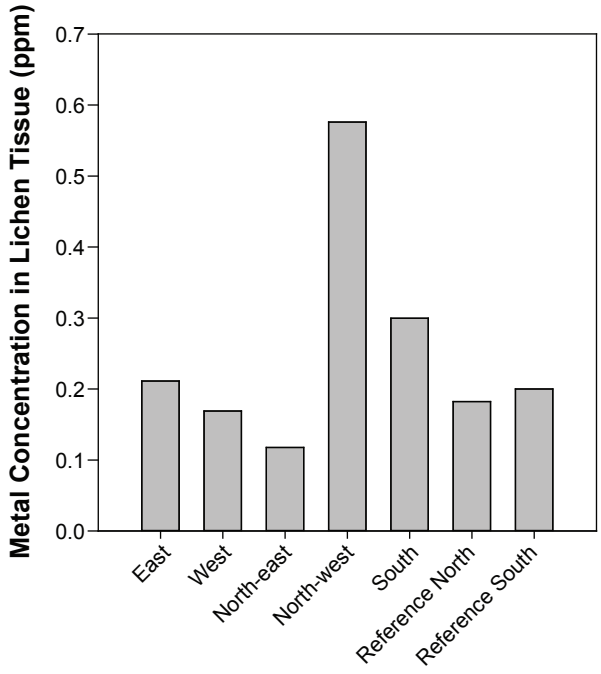
Notes:

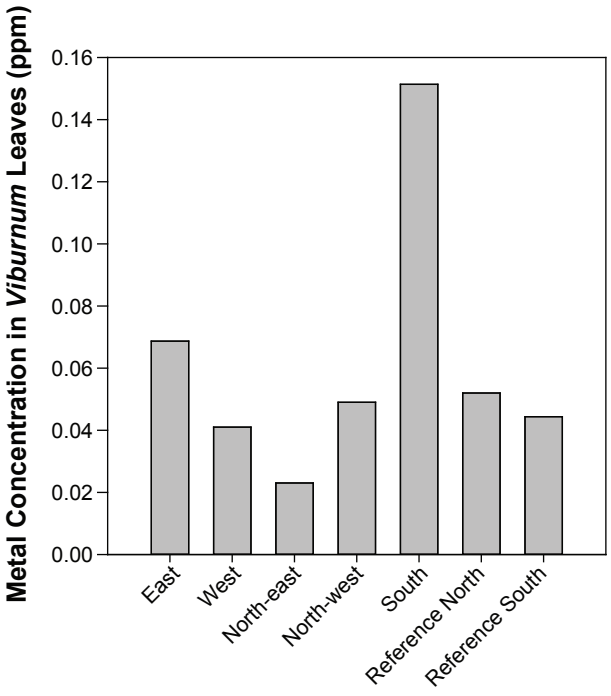
Table includes total metal concentrations for parameters detected in more than 50% of the samples.

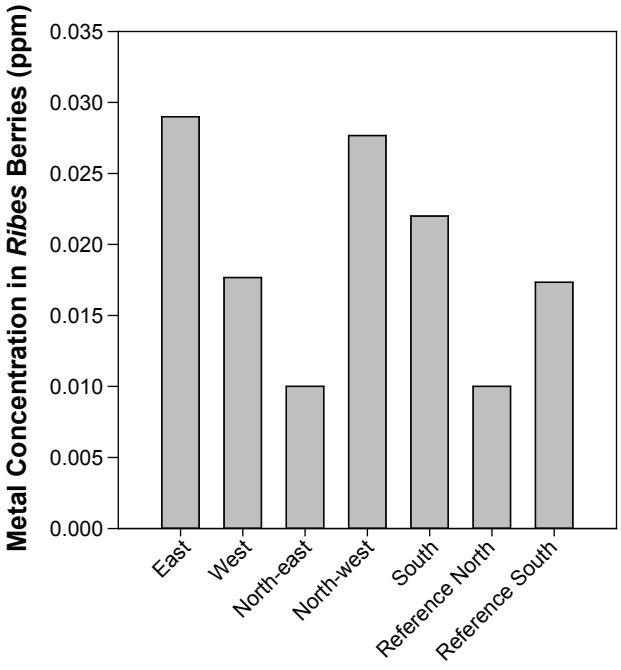
Metals below realized detection limit in all samples: bismuth, rhenium, selenium, sodium and tellurium.

Metals below realized detection limit in more than 50% of the samples: zirconium.









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Distribution of Mean Arsenic Concentrations in the Study Area

Figure 4.2-1

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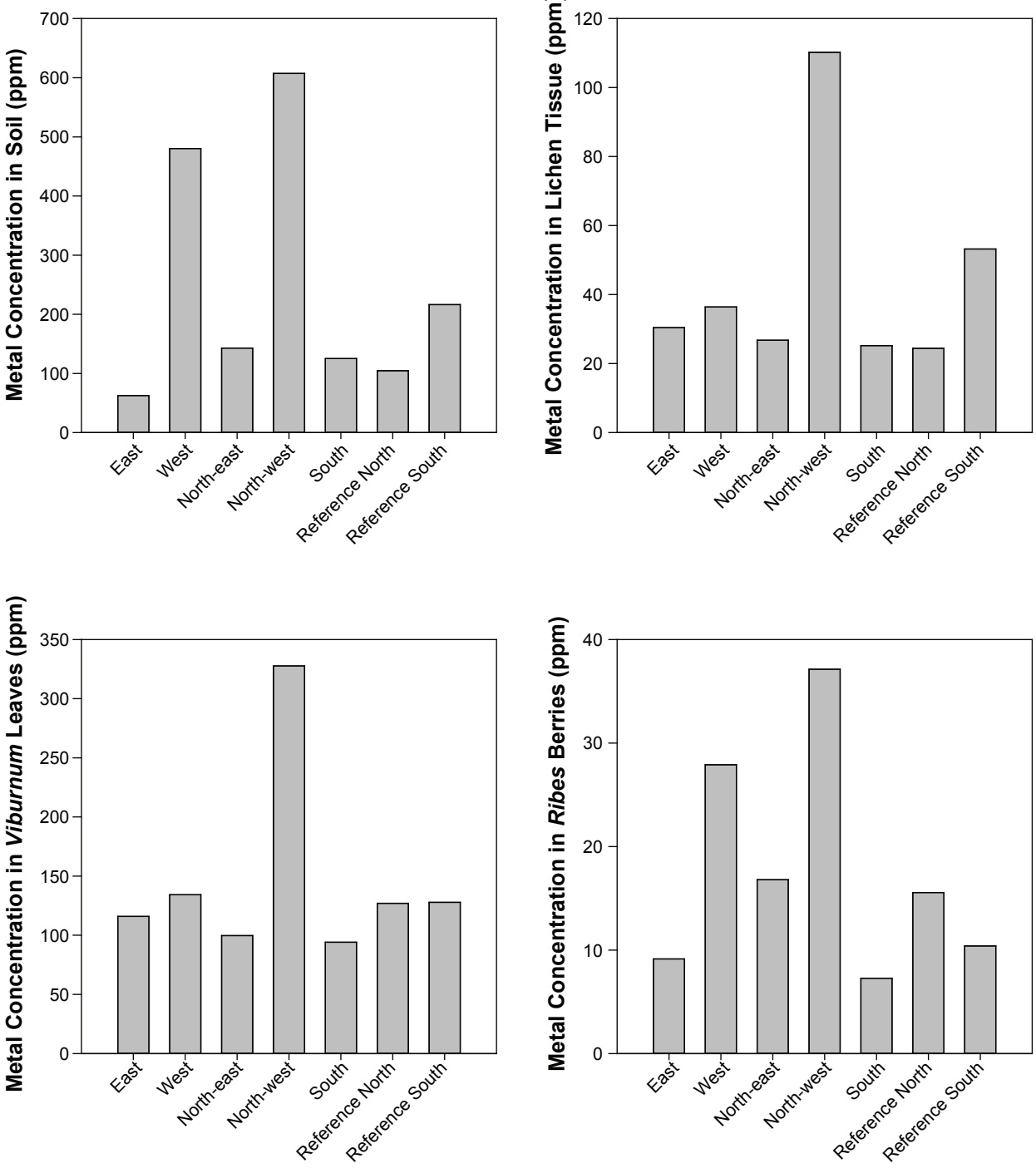

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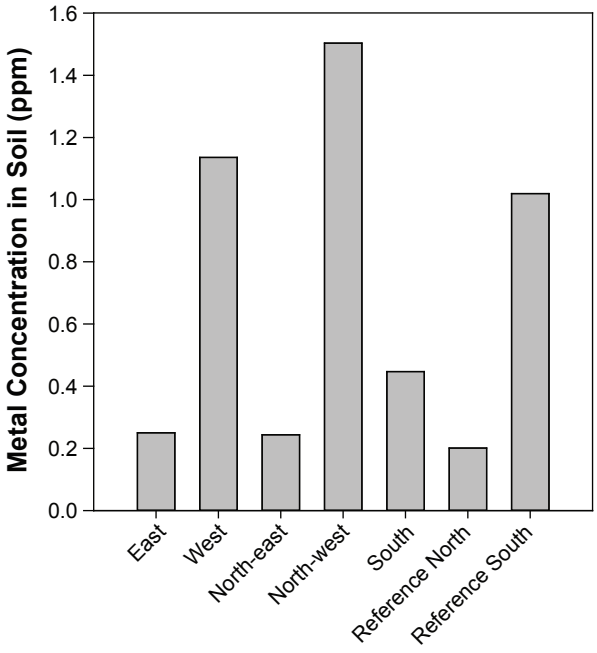
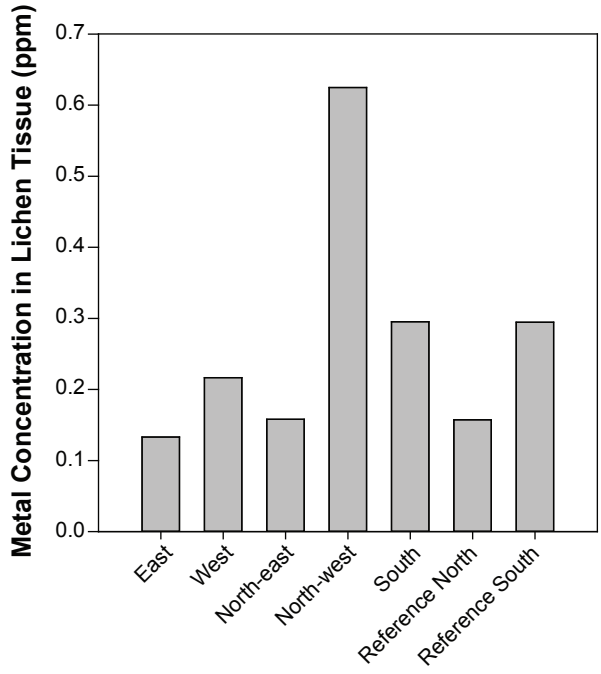
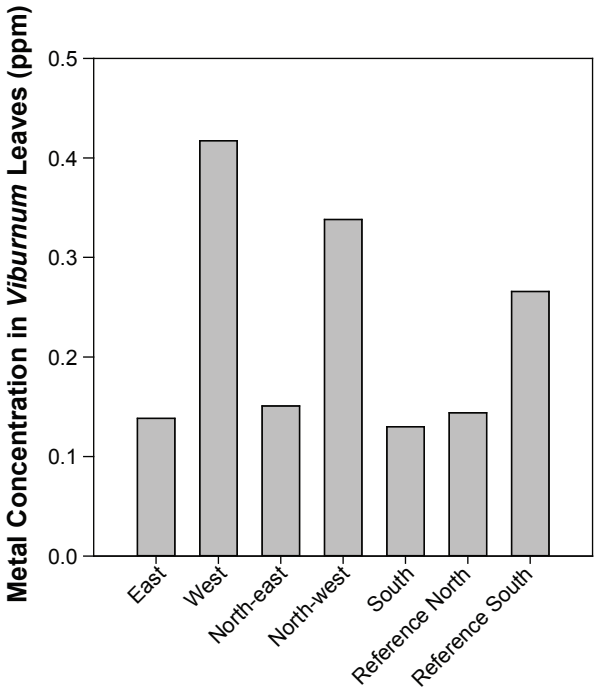
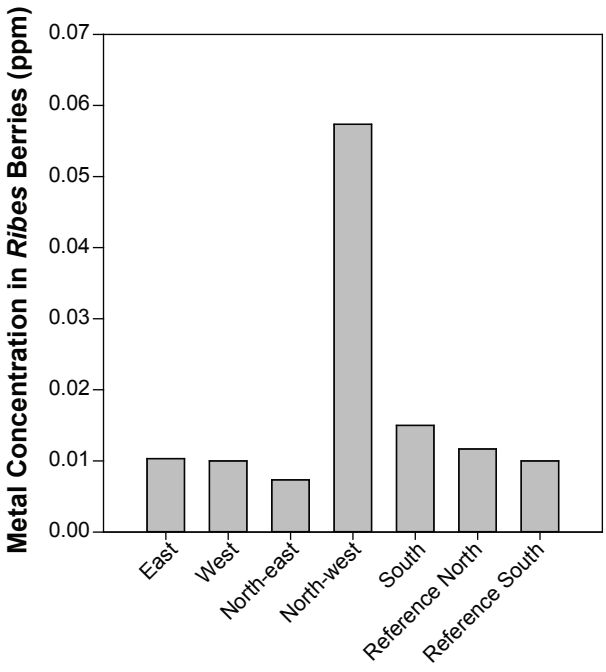
Distribution of Mean Barium Concentrations in the Study Area

Figure 4.2-2









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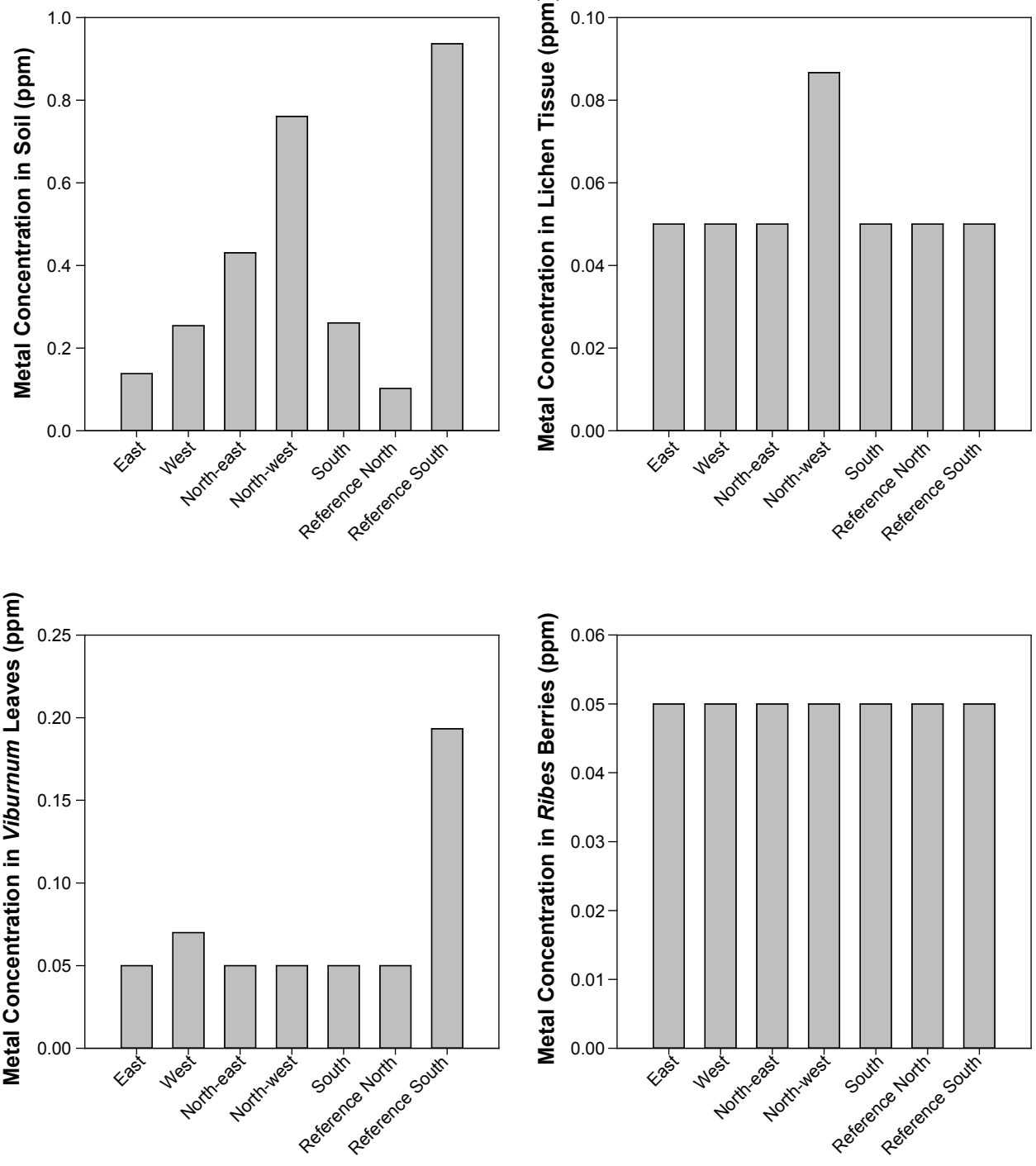
Distribution of Mean Cadmium Concentrations in the Study Area

Figure 4.2-3



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Distribution of Mean Selenium Concentrations in the Study Area

Figure 4.2-4

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Table 4.2-4. Summary of Dry Weight Metal Concentrations in *Viburnum edule* Leaf Tissue Samples Collected in 2010

Total Metals	*Virburnum edule* leaf samples from LSA (n = 18)					
	RDL	Maximum	Minimum	Median	Mean	SD
Aluminum (Al)	10	182	16	50	69.3	51.50
Antimony (Sb)	0.05	0.025	0.025	0.025	0.03	0
Arsenic (As)	0.05	0.074	0.025	0.025	0.03	0.01
Barium (Ba)	0.05	220	34.2	53.8	91.3	65.7
Beryllium (Be)	0.3	0.15	0.15	0.15	0.15	0
Bismuth (Bi)	0.3	0.15	0.15	0.15	0.15	0
Cadmium (Cd)	0.03	1.71	0.053	0.199	0.32	0.38
Calcium (Ca)	10	15,200	7,320	11,100	11,097	1,982
Chromium (Cr)	0.5	5.33	0.25	0.845	1.57	1.38
Cobalt (Co)	0.1	0.15	0.05	0.05	0.06	0.03
Copper (Cu)	0.05	6.63	2.18	4.14	4.09	1.18
Iron (Fe)	1	220	42.1	82.9	97.8	53.1
Lead (Pb)	0.1	0.14	0.05	0.05	0.06	0.03
Lithium (Li)	0.5	0.25	0.25	0.25	0.25	0
Magnesium (Mg)	3	4,140	1,650	2,765	2,772	741
Manganese (Mn)	0.05	55.9	9.63	17.95	22.52	11.62
Mercury (Hg)	0.005	0.0065	0.0025	0.0025	0.00	0.002
Molybdenum (Mo)	0.05	0.398	0.025	0.078	0.10	0.10
Nickel (Ni)	0.5	3.37	0.25	1.25	1.33	0.95
Phosphorus (P)	20	4,800	834	3,070	2,744	1,205
Potassium (K)	100	39,400	10,300	23,200	2,4006	7,421
Selenium (Se)	1	0.5	0.5	0.5	0.5	0
Silver (Ag)	0.03	0.015	0.015	0.015	0.015	0
Sodium (Na)	100	50	50	50	50.00	0
Strontium (Sr)	0.05	40.3	11	16.3	19.1	8.3
Thallium (Tl)	0.03	0.015	0.015	0.015	0.015	0
Tin (Sn)	0.2	0.1	0.1	0.1	0.10	0
Titanium (Ti)	0.5	2.18	0.25	1.325	1.27	0.47
Uranium (U)	0.01	0.005	0.005	0.005	0.005	0
Vanadium (V)	0.5	0.73	0.25	0.25	0.29	0.13
Zinc (Zn)	0.5	40.6	8.22	17.5	18.98	9.02

Note
RDL = realized detection limit
Metals below detection limit were replaced with one-half the detection limit

Table 4.2-5. Summary of Dry Weight Metal Concentrations in *Viburnum edule* Leaf Tissue Samples Collected in 2012

		V. edule Leaf Samples from LSA (n = 15)					*V. edule* Leaf Samples from Reference Sites (n = 6)				
Total Metals	**RDL**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**
Aluminum (Al)	10	531	40	177	193	141	177	56	79	100	50
Arsenic (As)	0.05	0.23	0.01	0.06	0.07	0.06	0.06	0.04	0.05	0.05	0.01
Barium (Ba)	0.05	559	70	115	154	121	154	92	129	127	21
Boron (B)	0.05	51.2	16.3	31.2	31.38	9.40	45.6	18	22.05	28.00	12.30
Cadmium (Cd)	0.3	0.69	0.07	0.16	0.23	0.19	0.33	0.10	0.19	0.20	0.08
Calcium (Ca)	10.0	26300	17200	19800	20393	2477	24800	15700	18500	18983	3192
Cesium (Cs)	0.03	0.0497	0.0073	0.0167	0.02	0.01	0.015	0.007	0.010	0.011	0.00
Chromium (Cr)	0.05	0.94	0.14	0.31	0.38	0.23	0.37	0.17	0.20	0.24	0.09
Cobalt (Co)	0.1	0.255	0.029	0.118	0.11	0.06	0.115	0.040	0.050	0.063	0.03
Copper (Cu)	0.1	4.77	2.29	3.27	3.29	0.76	4.45	2.29	2.92	3.05	0.78
Gallium (Ga)	0.05	0.155	0.01	0.03	0.05	0.04	0.044	0.021	0.0245	0.03	0.01
Iron (Fe)	1	601	76	128	187	150	161	87	112	120	34
Lead (Pb)	0.1	0.394	0.045	0.086	0.12	0.10	0.10	0.05	0.08	0.07	0.02
Lithium (Li)	0.5	0.77	0.05	0.15	0.20	0.20	0.11	0.05	0.08	0.08	0.03
Magnesium (Mg)	3	5550	2190	3550	3822	910	4170	2810	2970	3212	529
Manganese (Mn)	0.05	57.9	22.9	34.4	35.5	9.9	35.7	14.0	21.7	23.4	8.9
Mercury (Hg)	0.005	0.0172	0.0025	0.0097	0.0101	0.0032	0.0116	0.0071	0.0107	0.01	0.002
Molybdenum (Mo)	0.05	0.411	0.036	0.123	0.158	0.095	0.223	0.104	0.165	0.17	0.04
Nickel (Ni)	0.5	2.61	0.223	1.05	1.1	0.6	2.5	0.2	0.5	0.9	0.9
Phosphorus (P)	20	7080	1240	2860	3245	1913	10600	1260	1740	3603	3685
Potassium (K)	100	37000	19600	25700	26760	4349	30600	22500	29150	27733	3399
Rubidium (Rb)	1	13	2	5	6.5	3.7	10.5	2.6	3.9	5.4	3.4
Selenium (Se)	0.03	0.11	0.05	0.05	0.05	0.02	0.29	0.05	0.08	0.12	0.10
Strontium (Sr)	1	90	26	31	37	18	54	23	28	33	12
Thallium (Tl)	0.03	0.016	0.001	0.003	0.005	0.004	0.007	0.002	0.004	0.004	0.002
Thorium (Th)	0.03	0.199	0.005	0.027	0.044	0.053	0.036	0.013	0.026	0.026	0.008
Titanium (Ti)	0.2	7.08	0.922	1.48	2.07	1.84	2.21	1.01	1.73	1.71	0.48
Uranium (U)	0.01	0.030	0.001	0.007	0.010	0.008	0.008	0.003	0.006	0.006	0.002
Vanadium (V)	0.01	2.69	0.156	0.475	0.76	0.77	0.82	0.24	0.51	0.51	0.19
Yttrium (Y)	0.5	0.348	0.019	0.077	0.111	0.092	0.076	0.027	0.05	0.05	0.02
Zinc (Zn)	0.5	48.8	7.04	14.6	17.16	10.09	26.7	9.35	17.85	17.82	7.52

Notes:

Table includes total metal concentrations for parameters detected in more than 50% of the samples.

Metals below realized detection limit in all samples: bismuth, rhenium, sodium and tellurium.

Metals below realized detection limit in more than 50% of the samples: antimony, beryllium, tin and zirconium.

4.2.3 Berry Tissue Metals

Ribes spp. (gooseberries and currants) *Vibrunum edule* (highbush cranberries) samples were collected in 2012 from the LSA and reference sites. Tables 4.2-6 and 4.2-7 list summary statistics for dry weight metal concentrations detected in at least 50% of the samples. Parameters which were below the detection limits in more than 50% of the samples were excluded. Berry samples had the lowest concentrations of the elements measured among all terrestrial vegetation tissues sampled.

Typically, *Ribes spp*. berry samples collected within the north-western section of the LSA exhibited higher metal concentrations compared to other sites. Metal concentrations in *Viburnum* edule berry samples did not display any consistent pattern (Figures 3.1-1 and 4.2-1 to 4.2-4).

4.2.4 Sedge Tissue Metals from Wetland Sites

Twenty-seven *Carex aquatilis* (water sedge) tissue samples collected at eight wetland sites were analyzed for 25 metals. The metals antimony, beryllium, bismuth, cadmium, thallium, tin, and uranium were not detected in any sedge tissue samples. Table 4.2-8 lists summary statistics for metals which had concentrations above the detection limits in at least 50% of the samples (barium, calcium, chromium, copper, magnesium, manganese, mercury, molybdenum, nickel, strontium and zinc). Table 4.2-9 lists sedge sample sites with tissues displaying relatively low (below 5th percentile) and relatively high (ablove 95th percentile) metal concentrations.

Sites MW01 and MW07 (located near existing roads, in the Infrastructure Investigation Area and in the western section of the LSA respectively) displayed the highest metal concentrations compared to other sites. The cause for this is not known, but it may be related to some historical industrial activity of proximity to a road. Both sites are not far from the Murray River and Mast Forest Service roads.

4.3 SYNTHESIS OF SOIL AND VEGETATION TISSUE METAL DATA

Metal absorption by vegetation can vary with soil characteristics such as metals concentration and availability, pH, and organic matter content, but it is also influenced by species and the time of year the samples are collected. In an effort to decrease data variability, the 2012 sampling program was carried out within three consecutive days. Vegetation sampling was conducted within 100 m radius from the soil sampling sites. The analysis of the resulting data was focused on the assessment of range and spatial distribution of metal concentrations in soil and vegetation. Concentrations of metals in vegetation tissue samples were also compared to soil metal concentrations to determine if there were any similar patterns.

Soil samples collected during the 2012 field program exceeded soil quality guidelines for the metals arsenic, barium, cadmium, and selenium, for this reason these metals are highlighted in the summary presented in Table 4.3-1. Metal concentration was consistently higher in the samples collected in the north-western section of the LSA and the lowest in the samples collected in the northern reference and eastern sections (Table 4.3-1, Figures 3.2-1 and 4.2-1 to 4.2-4).

This pattern was reflected in soil and in vegetation data. Despite differences in mechanisms of metal retention in soil matrix and vegetation tissues, the correlations between the metal levels found in both media were surprisingly high, especially for barium and cadmium (Table 4.3-2).

Table 4.2-6. Summary of Dry Weight Metal Concentrations in *Ribes sp*. Berry Tissue Samples Collected in 2012

Total Metals	RDL	*Ribes* sp. Berry Samples from the LSA (n = 14)					*Ribes* sp. Berry Samples from Reference Sites (n = 6)				
		Maximum	Minimum	Median	Mean	SD	Maximum	Minimum	Median	Mean	SD
Aluminum (Al)	2	30.7	3.4	15.7	15.8	9.0	9.7	3.5	7.9	7.3	2.3
Arsenic (As)	0.02	0.035	0.010	0.023	0.021	0.008	0.022	0.010	0.010	0.014	0.006
Barium (Ba)	0.05	46.0	4.2	17.6	20.5	14.2	22.6	6.7	11.4	13.0	6.0
Boron (B)	1	19.5	8.0	11.6	11.8	3.0	14.6	8.6	11.4	11.6	2.1
Cadmium (Cd)	0.01	0.142	0.005	0.012	0.020	0.036	0.025	0.005	0.008	0.011	0.008
Calcium (Ca)	3 - 12	6530	1940	4705	4568	1525	4680	2260	4085	3883	854
Chromium (Cr)	0.05	0.300	0.025	0.090	0.102	0.068	0.078	0.025	0.025	0.034	0.022
Copper (Cu)	0.05	8.3	1.1	4.0	4.0	1.8	5.3	2.3	2.7	3.3	1.2
Iron (Fe)	1	58.2	17.4	29.1	33.2	12.8	33.0	16.1	24.9	24.5	7.2
Magnesium (Mg)	5 - 20	1850	800	1185	1232	319	1160	795	1035	1013	146
Manganese (Mn)	0.02	32.0	7.2	13.3	15.8	7.4	24.5	6.2	7.9	10.4	7.0
Molybdenum (Mo)	0.02	0.994	0.070	0.185	0.259	0.239	0.609	0.065	0.325	0.324	0.202
Nickel (Ni)	0.05	0.648	0.119	0.326	0.350	0.183	0.714	0.146	0.237	0.306	0.209
Phosphorus (P)	20 - 80	3290	1700	2370	2489	473	2550	1580	2110	2100	353
Potassium (K)	100 - 400	22400	14400	16850	17536	2297	17100	13700	15150	15217	1246
Rubidium (Rb)	0.05	12.2	2.4	6.5	6.7	2.8	7.5	3.0	3.7	4.2	1.7
Strontium (Sr)	0.05	20.7	2.0	7.3	7.3	4.5	11.4	3.4	6.3	6.5	2.8
Tin (Sn)	0.02	2.010	0.078	0.412	0.560	0.517	2.840	0.090	0.202	0.652	1.080
Titanium (Ti)	0.05	0.435	0.069	0.163	0.169	0.093	0.163	0.051	0.109	0.113	0.039
Vanadium (V)	0.02	0.152	0.010	0.062	0.064	0.041	0.061	0.010	0.041	0.038	0.020
Zinc (Zn)	0.05	15.9	7.5	9.7	10.9	2.8	13.8	5.2	10.2	9.8	3.5

Notes:

Table includes total metal concentrations for parameters detected in more than 50% of the samples.

Metals below realized detection limit in all samples: antimony, beryllium, bismuth, gallium, lithium, mercury, rhenium, selenium, sodium, tellurium, thallium, thorium, and zirconium.

Metals below realized detection limit in more than 50% of the samples: cesium, cobalt, lead, uranium and yttrium.

Table 4.2-7. Summary of Dry Weight Metal Concentrations in *Viburnum edule* Berry Tissue Samples Collected in 2012

		V. edule Berry Samples from LSA (n = 9)					*V. edule* Berry Samples from Reference Sites (n = 6)				
Total Metals	**RDL**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**
Aluminum (Al)	2	27.0	1.0	8.9	12.5	10.0	11.3	2.0	4.1	4.9	3.3
Barium (Ba)	0.05	13.8	3.9	7.1	7.7	2.8	14.9	4.5	10.6	10.4	4.2
Boron (B)	1	23.3	12.7	18.7	18.9	3.5	19.3	13.3	17.7	17.2	2.1
Cadmium (Cd)	0.01	0.115	0.027	0.082	0.07	0.03	0.193	0.088	0.129	0.14	0.04
Calcium (Ca)	6 - 30	3040	848	2090	1972	613	2170	1580	1935	1897	196
Chromium (Cr)	0.05	0.155	0.025	0.082	0.09	0.04	0.096	0.057	0.072	0.07	0.01
Copper (Cu)	0.05	6.3	1.8	3.3	3.5	1.4	3.4	1.8	2.8	2.7	0.6
Iron (Fe)	1	38.7	5.3	16.1	20.1	11.4	27.9	11.1	14.8	17.1	6.3
Magnesium (Mg)	10 - 50	1670	879	1080	1114	235	1280	914	1044	1059	149
Manganese (Mn)	0.02	4.5	1.0	2.6	2.7	1.2	4.5	1.6	2.3	2.8	1.3
Molybdenum (Mo)	0.02	0.107	0.022	0.031	0.045	0.030	0.086	0.036	0.064	0.063	0.021
Nickel (Ni)	0.05	1.58	0.10	0.65	0.70	0.47	1.61	0.24	0.40	0.60	0.52
Phosphorus (P)	40 - 200	2500	1330	1700	1688	350	2070	1140	1615	1652	339
Potassium (K)	200 - 1000	14200	9760	10800	11062	1322	13400	10200	11600	11683	1420
Rubidium (Rb)	0.05	8.1	1.5	4.9	4.5	2.2	12.7	3.0	3.7	5.1	3.8
Strontium (Sr)	0.05	3.6	1.4	2.6	2.6	0.6	5.4	1.9	2.4	2.8	1.3
Tin (Sn)	0.02	2.5	0.1	0.3	0.8	1.0	3.4	0.7	2.2	2.0	1.1
Titanium (Ti)	0.05	0.534	0.025	0.074	0.152	0.168	0.199	0.025	0.042	0.070	0.068
Vanadium (V)	0.02	0.140	0.010	0.036	0.057	0.052	0.057	0.010	0.017	0.025	0.020
Zinc (Zn)	0.5	12.5	4.5	6.9	8.5	3.0	10.1	8.6	9.5	9.4	0.7

Notes:

Table includes total metal concentrations for parameters detected in more than 50% of the samples.

Metals below realized detection limit in all samples: antimony, arsenic, beryllium, bismuth, cesium, gallium, lead, lithium, mercury, rhenium, sodium, tellurium, thallium, thorium, and zirconium.

Metals below realized detection limit in more than 50% of the samples: cobalt, selenium, uranium, yttrium.

Table 4.2-8. Summary of Dry Weight Metal Concentrations in *Carex aquatilis* Tissue Samples Collected in 2010 and 2011

	RSA Wetlands (n = 24)					Reference Wetland (n = 3)				
Total Metals	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**Mean**	**SD**
Barium (Ba)	166.00	5.16	33.90	42.08	38.95	40.40	24.70	34.50	33.20	7.93
Calcium (Ca)	9300	1280	3840	4310	2310	5170	3270	3680	4040	1000
Chromium (Cr)	3.69	0.25	0.79	1.06	0.99	2.94	1.29	1.54	1.92	0.89
Copper (Cu)	12.20	0.71	2.34	4.31	3.54	14.60	1.33	1.49	5.81	7.62
Magnesium (Mg)	5290	799	1440	1864	1236	1880	1460	1560	1633	219
Manganese (Mn)	472	60	188	205	98	107	88	104	100	10
Mercury (Hg)	0.021	0.003	0.005	0.006	0.004	0.01	0.003	0.003	0.004	0.002
Molybdenum (Mo)	14.90	0.11	0.44	1.58	3.21	2.18	1.24	1.93	1.78	0.49
Nickel (Ni)	3.09	0.25	0.71	0.99	0.88	2.09	1.22	1.74	1.68	0.44
Strontium (Sr)	38.50	1.90	9.83	12.38	10.51	18.80	13.20	14.10	15.37	3.01
Zinc (Zn)	42.40	11.50	24.20	26.58	9.24	15.60	10.70	12.80	13.03	2.46

Notes:

Only parameters with concentrations above detection limits in more than 50% of the samples listed.

Parameters with all concentrations below the detection limit: antimony, beryllium, bismuth, cadmium, thallium, tin, uranium.

Parameters with more than 50% of samples below detection limit: arsenic, cobalt, lead, lithium, selenium, vanadium.

Table 4.2-9. Wetland Sedge Samples Sites with Results Metal Concentrations beyond the 90% Confidence Interval

Parameter	Sites Below 5th Percentile	Sites Above 95th Percentile
Barium (Ba)	MW07 and LW11	MW01
Calcium (Ca)	MW07	RW3 and MW01
Chromium (Cr)	-	MW01
Copper (Cu)	MW12	Reference and MW14
Magnesium (Mg)	MW12	RW3 and MW01
Manganese (Mn)	LW11	MW01 and MW07
Mercury (Hg)	-	MW07
Molybdenum (Mo)	RW3	MW07
Nickel (Ni)	-	MW07
Strontium (Sr)	MW07	LW11 and RW3
Zinc (Zn)	Reference	MW07

Table 4.3-1. Average Concentrations of Arsenic, Barium, Cadmium, and Selenium in Soil and Vegetation Tissue Samples Collected Within (5 areas) and Outside (2 reference areas) the LSA

	Ribes Berries	Viburnum Berries	Viburnum Leaves	Peltigera Thalus	Mineral Soil
Arsenic					
East	0.03	0.01	0.07	0.21	4.04
West	0.02	-	0.04	0.17	6.62
North-east	0.01	0.01	0.02	0.12	4.99
North-west	0.03	-	0.05	0.58	9.08
South	0.02	0.01	0.15	0.3	3.64
Reference North	0.01	0.01	0.05	0.18	4.61
Reference South	0.02	0.01	0.04	0.2	4.23
Barium					
East	9.2	9.4	115.9	30.4	62.6
West	27.9	-	134.3	36.4	480.3
North-east	16.8	5.6	99.7	26.8	143.0
North-west	37.1	-	327.7	110.2	607.3
South	7.3	8.3	94.1	25.2	125.1
Reference North	15.6	13.9	127.0	24.4	104.7
Reference South	10.4	6.9	127.8	53.2	216.3
Cadmium					
East	0.01	0.09	0.14	0.13	0.25
West	0.01	-	0.42	0.22	1.14
North-east	0.01	0.05	0.15	0.16	0.24
North-west	0.06	-	0.34	0.62	1.5
South	0.02	0.07	0.13	0.3	0.45
Reference North	0.01	0.12	0.14	0.16	0.2
Reference South	0.01	0.15	0.27	0.29	1.02

(continued)

Table 4.3-1. Average Concentrations of Arsenic, Barium, Cadmium, and Selenium in Soil and Vegetation Tissue Samples Collected Within (5 areas) and Outside (2 reference areas) the LSA (completed)

	Ribes Berries	Viburnum Berries	Viburnum Leaves	Peltigera Thalus	Mineral Soil
Selenium					
East	0.05	0.05	0.05	0.05	0.14
West	0.05	-	0.07	0.05	0.25
North-east	0.05	0.05	0.05	0.05	0.43
North-west	0.05	-	0.05	0.09	0.76
South	0.05	0.05	0.05	0.05	0.26
Reference North	0.05	0.05	0.05	0.05	0.1
Reference South	0.05	0.07	0.19	0.05	0.94

Table 4.3-2. Spearman Rank Correlation Coefficient Matrix for Metal Concentrations in Soil and Vegetation Tissues

	Ribes Berries	Viburnum Berries	Viburnum Leaves	Peltigera Thalus	Mineral Soil
Arsenic					
Ribes berries	-	NA	0.54	0.76	-0.16
Viburnum berries	NA	-	NA	NA	NA
Viburnum leaves	0.54	NA	-	0.71	-0.68
Peltigera thalus	0.76	NA	0.71	-	-0.21
Mineral Soil	-0.16	NA	-0.68	-0.21	-
Barium					
Ribes berries	-	-0.30	0.75	0.50	0.75
Viburnum berries	-0.30	-	0.20	-0.50	-0.80
Viburnum leaves	0.75	0.20	-	0.75	0.71
Peltigera thalus	0.50	-0.50	0.75	-	0.75
Mineral Soil	0.75	-0.80	0.71	0.75	-
Cadmium					
Ribes berries	-	0.21	-0.11	0.54	0.37
Viburnum berries	0.21	-	0.40	0.05	0.30
Viburnum leaves	-0.11	0.40	-	0.40	0.64
Peltigera thalus	0.54	0.05	0.40	-	0.77
Mineral Soil	0.37	0.30	0.64	0.77	-
Selenium					
Ribes berries	-	NA	NA	NA	NA
Viburnum berries	NA	-	1.00	NA	0.71
Viburnum leaves	NA	1.00	-	-0.25	0.40
Peltigera thalus	NA	NA	-0.25	-	0.41
Mineral Soil	NA	0.71	0.40	0.41	-

Note: positive values indicate a positive correlation (similarity) between the metal concentrations found in tissues or soil listed in corresponding row and column. Negative values indicate a negative correlation (dissimilarity). Higher values indicate stronger correlation.

5. Summary

5. Summary

This report summarizes all baseline terrestrial metal sampling efforts undertaken between 2010 and 2012. Soil and vegetation tissue have been sampled extensively within and beyond the LSA during the 2010, 2011, and 2012 field programs. Most sampling effort was focused on the LSA, however, two reference sampling locations located more than 15 km from the proposed Project footprint were established in 2012.

5.1 SOIL SUMMARY

A total of 118 soil samples have been collected at 72 sites between 2010 and 2012. These samples were collected as part of the terrain and soils program, to assess soil suitability for salvage, and to document baseline conditions for future monitoring. Forty-four of the soil sampling sites are potential future monitoring sites and thirty-three of the soil sampling sites were sampled in conjunction with the vegetation tissue sampling.

From the collected soil data it was determined that soils in the LSA were predominantly acidic with 80% of the samples from the 0 to 10 cm depth zone characterized by pH less than 7.0 and 55% of the samples below the CCME interim guideline for pH for residential, parkland and industrial use (pH 6).

Metal concentrations in the soil samples varied widely between sampling locations. In some samples metal concentrations exceeded Agricultural and Industrial Limits of the CCME Guidelines for the Protection of Environmental and Human Health (CCME 2012) and/or the BC Contaminated Sites Regulation Soil Criteria (BC Reg. 375/96) for Livestock and Industrial use. Metals of potential concern, whose concentration exceeds guideline limits at least once at the sites sampled, include: arsenic (As), barium (Ba), cadmium (Cd), molybdenum (Mo), selenium (Se), tin (Sn), and zinc (Zn). Of these metals, exceedences of barium, cadmium and selenium were most frequent.

5.2 VEGETATION TISSUE SUMMARY

Vegetation tissues sampled included lichens, shrub leaves, berries and wetland sedges. A total of 157 vegetation tissue samples were collected from 55 sites between 2010, 2011 and 2012. Of these, 56 lichen samples were collected from 38 sites. The lichens sampled included *Cladina rangiferina* (Reindeer Lichen), *Stereocaulon paschal* (Cottontail Foam Lichen) and *Peltigera scabrosa*. Twenty *Ribes* spp. and 15 *Viburnum edule* (Highbush Cranberry) berry samples were collected from 20 sites. Highbush Cranberry leaf samples were also collected (39 leaf samples from 30 sites). Twenty-seven *Carex aquatilis* sedge samples were collected from 8 wetlands.

Concentrations of certain metals in vegetation tissues were very low (e.g., antimony, beryllium, bismuth, lithium, selenium, silver, thallium, tin, and uranium); hence the analytical results were often below detection limits. Metal concentrations also varied depending on the plant species. In the terrestrial plant tissues, four of the six essential macronutrients (potassium, phosphorous, calcium, and magnesium) attained the highest concentrations, while the other two macronutrients, (nitrogen and sulphur) were not measured. In the lichens and leaf tissues aluminum and iron contents were also high. In wetland vegetation the elements calcium and magnesium attained the highest concentrations. A general trend of higher metal levels was observed in vegetation sampled in the north-western section of the LSA. A relatively high correlation between the metal concentrations found in soil and vegetation (including lichens) suggests that metals may be distributed in some areas either by air (e.g., in form of dust) or by runoff.

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Appendix 1a

Metal Levels in Soil Samples Collected in 2010

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Appendix 1a. Metal Levels in Soil Samples Collected in 2010

RESULTS OF ANALYSIS																	
Sample ID							MURRAY 007-1	MURRAY 007-2	MURRAY 007-3	MURRAY 012-1	MURRAY 012-2	MURRAY 012-3	MURRAY 016 -1	MURRAY 016 -2	MURRAY 016 -3	MURRAY 026-1	MURRAY 026-2	MURRAY 026-3	MURRAY 029-1	MURRAY 029-2	MURRAY 029-3
Depth Sampled			Guidelines				0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30
ALS Sample ID		Realized Detection Limits					L915119-1	L915119-2	L915119-3	L915119-4	L915119-5	L915119-6	L915119-7	L915119-8	L915119-9	L915119-10	L915119-11	L915119-12	L915119-13	L915119-14	L915119-15
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																					
pH	pH	0.10	6 to 8[e]	6 to 8[e]			4.70	5.13	5.13	4.33	4.67	5.18	4.78	5.38	6.13	6.27	6.04	5.71	4.47	5.10	5.10
Organic / Inorganic Carbon																					
Total Organic Carbon	%	0.10					1.27	0.46	0.50	0.71	0.62	0.50	1.65	0.97	1.23	1.67	1.54	1.13	0.64	0.57	0.66
Metals																					
Antimony (Sb)	mg/kg	10.00	20	40	20	40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	5.00	12	12	25	100	5.4	<5.0	5.0	<5.0	<5.0	<5.0	<5.0	7.3	5.9	<5.0	<5.0	6.4	5.1	9.0	7.9
Barium (Ba)	mg/kg	1.00	750	2000	400	1500	89.6	68.0	95.0	37.1	111	112	247	216	155	394	395	339	84.3	128	143
Beryllium (Be)	mg/kg	0.50					<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.57	<0.50	<0.50	<0.50	<0.50	<0.50	0.61	0.63
Cadmium (Cd)	mg/kg	0.50	1.4	22	9	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.87	0.66	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chromium (Cr)	mg/kg	2.00	64	87	50	700	13.3	7.6	13.8	3.5	13.0	12.2	15.1	18.4	15.8	13.0	11.2	15.2	6.7	14.8	15.4
Cobalt (Co)	mg/kg	2.00	40	300	40	300	3.1	<2.0	4.0	<2.0	3.4	3.3	7.2	9.4	7.6	2.8	3.2	9.1	<2.0	4.2	4.8
Copper (Cu)	mg/kg	1.00					5.9	2.3	9.8	1.3	4.6	3.7	12.5	11.0	11.6	11.6	9.3	13.8	5.7	12.3	14.5
Lead (Pb)	mg/kg	30.00	70	600	350	2000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0220	0.0069	0.0145	0.0068	0.0099	0.0079	0.0157	0.0200	0.0373	0.0072	0.0076	0.0090	0.0111	0.0208	0.0238
Molybdenum (Mo)	mg/kg	4.00	5	40	5	40	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Nickel (Ni)	mg/kg	5.00	50	50	150	500	9.0	<5.0	16.2	<5.0	9.6	8.6	13.6	20.1	19.1	9.8	10.1	16.4	6.7	18.4	22.2
Selenium (Se)	mg/kg	0.50	1	2.9	2	10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	2.00	20	40	20	40	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium (Tl)	mg/kg	1.00	1	1	2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tin (Sn)	mg/kg	5.00	5	300	5	300	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Uranium (U)	mg/kg	0.05	23	300			0.399	0.281	0.433	0.136	0.386	0.331	0.460	0.683	0.883	0.448	0.389	0.550	0.233	0.432	0.431
Vanadium (V)	mg/kg	2.00	130	130	200		32.5	18.4	29.3	11.4	35.7	33.3	38.4	35.1	31.7	26.4	21.5	30.3	23.9	32.1	29.8
Zinc (Zn)	mg/kg	1.00	200	360	200	600	45.8	23.1	57.6	7.1	40.8	38.4	82.5	67.6	55.0	66.5	52.3	80.4	38.4	95.8	101

Notes

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 1a. Metal Levels in Soil Samples Collected in 2010

RESULTS OF ANALYSIS																		
Sample ID							MURRAY 034-1	MURRAY 034-2	MURRAY 034-3	MURRAY 039-1	MURRAY 039-2	MURRAY 039-3	MURRAY 040-1	MURRAY 040-2	MURRAY 040-3	MURRAY 042-1	MURRAY 042-2	MURRAY 042-3	MURRAY 045-1	MURRAY 045-2	MURRAY 045-3
Depth Sampled			Guidelines				0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30
ALS Sample ID		Realized Detection Limits					L915119-16	L915119-17	L915119-18	L915119-19	L915119-20	L915119-21	L915119-22	L915119-23	L915119-24	L915119-25	L915119-26	L915119-27	L915119-28	L915119-29	L915119-30
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																					
pH	pH	0.10	6 to 8[e]	6 to 8[e]			5.89	6.18	6.17	5.87	6.36	6.75	7.73	7.96	8.27	5.03	5.58	5.97	7.87	7.92	7.88
Organic / Inorganic Carbon																					
Total Organic Carbon	%	0.10					5.81	1.75	3.41	1.78	1.70	1.88	8.18	6.15	3.24	0.70	0.40	0.43	13.0	5.66	4.97
Metals																					
Antimony (Sb)	mg/kg	10.00	20	40	20	40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	5.00	12	12	25	100	7.1	7.9	6.6	8.5	8.1	8.1	<5.0	5.2	5.6	<5.0	<5.0	5.0	5.2	7.7	7.6
Barium (Ba)	mg/kg	1.00	750	2000	400	1500	453	245	462	419	466	476	191	329	156	55.0	53.9	59.3	190	189	228
Beryllium (Be)	mg/kg	0.50					0.63	0.61	0.72	0.66	0.66	0.54	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.69	0.65
Cadmium (Cd)	mg/kg	0.50	1.4	22	9	500	1.21	0.55	0.99	<0.50	<0.50	0.52	1.12	1.19	1.03	<0.50	<0.50	<0.50	1.72	1.88	1.51
Chromium (Cr)	mg/kg	2.00	64	87	50	700	14.6	12.2	16.8	12.2	13.3	13.0	10.8	12.3	10.6	7.5	9.0	11.6	11.8	16.6	16.3
Cobalt (Co)	mg/kg	2.00	40	300	40	300	8.5	6.8	8.8	9.7	9.0	7.5	5.6	6.4	5.9	2.5	3.8	4.7	6.8	8.7	9.3
Copper (Cu)	mg/kg	1.00					22.8	15.2	22.0	17.9	18.6	16.8	17.3	19.0	16.4	2.4	3.6	6.6	17.7	17.4	23.2
Lead (Pb)	mg/kg	30.00	70	600	350	2000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0737	0.0502	0.0878	0.0561	0.0653	0.0397	0.0999	0.118	0.0582	0.0083	0.0054	0.0107	0.114	0.0831	0.0897
Molybdenum (Mo)	mg/kg	4.00	5	40	5	40	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Nickel (Ni)	mg/kg	5.00	50	50	150	500	27.4	22.3	27.7	21.5	23.8	20.5	21.9	25.8	22.5	7.0	11.0	17.0	24.2	30.3	36.7
Selenium (Se)	mg/kg	0.50	1	2.9	2	10	0.82	0.65	0.82	<0.50	<0.50	<0.50	0.67	1.11	0.76	<0.50	<0.50	<0.50	1.31	1.43	1.11
Silver (Ag)	mg/kg	2.00	20	40	20	40	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium (Tl)	mg/kg	1.00	1	1	2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tin (Sn)	mg/kg	5.00	5	300	5	300	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Uranium (U)	mg/kg	0.05	23	300			0.870	0.735	1.06	0.884	0.823	0.609	0.776	0.779	0.791	0.210	0.203	0.298	1.07	0.859	0.840
Vanadium (V)	mg/kg	2.00	130	130	200		30.0	25.6	32.2	23.1	25.0	26.3	23.5	25.9	25.6	23.3	24.4	25.9	25.8	38.4	37.9
Zinc (Zn)	mg/kg	1.00	200	360	200	600	120	113	105	68.7	64.9	69.4	89.3	88.3	71.8	22.4	30.5	42.6	94.9	104	100

Notes

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 1a. Metal Levels in Soil Samples Collected in 2010

RESULTS OF ANALYSIS																		
Sample ID							MURRAY 048-1	MURRAY 048-2	MURRAY 048-3	MURRAY 054-1	MURRAY 054-2	MURRAY 054-3	MURRAY 020-1	MURRAY 020-2	MURRAY 020-3	MURRAY 023-1	MURRAY 023-2	MURRAY 023-3	MURRAY 031-1	MURRAY 031-2	MURRAY 031-3
Depth Sampled			Guidelines				0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30
ALS Sample ID		Realized Detection Limits					L915119-31	L915119-32	L915119-33	L915119-34	L915119-35	L915119-36	L915119-37	L915119-38	L915119-39	L915119-40	L915119-41	L915119-42	L915119-43	L915119-44	L915119-45
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																					
pH	pH	0.10	6 to 8[e]	6 to 8[e]			5.10	5.48	8.38	5.32	7.28	7.34	5.05	5.46	5.70	7.38	7.42	7.45	5.04	5.58	5.79
Organic / Inorganic Carbon																					
Total Organic Carbon	%	0.10					0.68	0.43	0.79	39.0	36.3	32.2	2.42	1.42	1.30	4.40	3.62	1.56	0.47	0.84	0.69
Metals																					
Antimony (Sb)	mg/kg	10.00	20	40	20	40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	5.00	12	12	25	100	<5.0	6.2	<5.0	<5.0	<5.0	<5.0	7.1	<5.0	7.2	6.3	6.7	7.4	<5.0	6.5	6.5
Barium (Ba)	mg/kg	1.00	750	2000	400	1500	38.4	42.8	28.9	42.8	975	2710	309	320	218	510	761	335	32.2	41.5	45.4
Beryllium (Be)	mg/kg	0.50					<0.50	0.59	<0.50	<0.50	<0.50	<0.50	0.52	0.55	<0.50	<0.50	0.56	0.53	<0.50	0.50	<0.50
Cadmium (Cd)	mg/kg	0.50	1.4	22	9	500	<0.50	<0.50	<0.50	0.86	0.83	2.53	1.25	1.20	0.76	0.54	5.70	<0.50	<0.50	<0.50	<0.50
Chromium (Cr)	mg/kg	2.00	64	87	50	700	14.8	17.4	6.5	<2.0	<2.0	3.7	12.6	13.1	9.4	10.3	13.6	11.9	5.6	16.8	18.1
Cobalt (Co)	mg/kg	2.00	40	300	40	300	7.0	11.4	3.8	<2.0	<2.0	8.0	7.7	8.8	6.9	7.8	8.5	6.6	<2.0	5.6	9.1
Copper (Cu)	mg/kg	1.00					8.1	17.2	11.8	2.0	6.0	11.9	10.8	12.0	12.4	19.6	20.6	11.8	1.9	7.4	11.0
Lead (Pb)	mg/kg	30.00	70	600	350	2000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0142	0.0323	0.0284	0.0983	0.0750	0.0836	0.0175	0.0167	0.0276	0.0822	0.0362	0.0562	0.0090	0.0121	0.0177
Molybdenum (Mo)	mg/kg	4.00	5	40	5	40	<4.0	<4.0	<4.0	<4.0	<4.0	8.7	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Nickel (Ni)	mg/kg	5.00	50	50	150	500	16.9	25.7	12.6	<5.0	6.7	19.9	14.7	18.3	16.6	25.3	21.4	21.4	<5.0	18.1	28.0
Selenium (Se)	mg/kg	0.50	1	2.9	2	10	<0.50	<0.50	<0.50	<0.50	0.66	1.94	<0.50	<0.50	<0.50	0.52	0.68	0.54	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	2.00	20	40	20	40	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium (Tl)	mg/kg	1.00	1	1	2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tin (Sn)	mg/kg	5.00	5	300	5	300	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Uranium (U)	mg/kg	0.05	23	300			0.256	0.476	0.492	<0.050	0.997	1.54	0.618	0.587	0.721	0.855	0.600	0.722	0.165	0.393	0.571
Vanadium (V)	mg/kg	2.00	130	130	200		24.3	27.4	14.3	<2.0	3.8	9.2	33.8	25.2	16.8	19.1	29.2	24.1	21.7	40.5	28.7
Zinc (Zn)	mg/kg	1.00	200	360	200	600	35.8	51.2	32.0	7.6	13.1	40.4	91.5	108	97.1	91.3	329	60.6	25.9	88.7	63.0

Notes

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 1b

Metal Levels in Soil Samples Collected in 2010

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Appendix 1b. Metal Levels in Soil Samples Collected in 2010

RESULTS OF ANALYSIS																		
Sample ID			Guidelines				MURRAY 70 (10-20)	MURRAY 70 (30-50)	MURRAY 75 (0-10)	MURRAY 75 (10-20)	MURRAY 75 (30-50)	MURRAY 85 (0-10)	MURRAY 85 (10-20)	MURRAY 85 (30-50)	MURRAY 88 (0-10)	MURRAY 88 (10-20)	MURRAY 88 (30-50)	MURRAY 89 (0-10)	MURRAY 89 (10-20)	MURRAY 89 (30-50)	MURRAY 93 (0-10)
ALS Sample ID		Realized Detection Limits					L980265-2	L980265-3	L980265-4	L980265-5	L980265-6	L980265-7	L980265-8	L980265-9	L980265-10	L980265-11	L980265-12	L980265-13	L980265-14	L980265-15	L980265-16
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																					
pH	pH	0.1	6 to 8[e]	6 to 8[e]			5.53	6.79	7.79	8.10	8.28	4.39	4.46	5.27	4.75	5.25	6.38	6.01	6.23	6.23	4.29
Organic / Inorganic Carbon																					
Total Organic Carbon	%	0.1					0.87	0.87	1.46	0.98	0.96	1.19	1.03	0.73	0.76	0.91	0.65	1.42	1.39	1.54	0.85
Metals																					
Antimony (Sb)	mg/kg	0.1	20	40	20	40	0.23	0.51	0.44	0.68	0.46	0.27	0.53	0.68	<0.10	0.15	0.38	0.65	0.63	0.68	0.16
Arsenic (As)	mg/kg	0.05	12	12	25	100	5.19	8.19	5.50	6.99	4.61	3.33	5.97	8.38	1.99	4.37	5.96	6.09	6.57	7.38	3.34
Barium (Ba)	mg/kg	0.5	750	2000	400	1500	176	327	186	232	213	68.8	70.5	174	53.1	143	134	239	280	323	40.7
Beryllium (Be)	mg/kg	0.2					0.31	0.77	0.29	0.40	0.31	<0.20	<0.20	0.63	<0.20	<0.20	0.27	0.43	0.53	0.57	<0.20
Cadmium (Cd)	mg/kg	0.1	1.4	22	9	500	0.18	0.15	0.37	0.54	0.34	0.12	0.17	0.67	0.12	0.23	0.30	0.73	0.77	0.60	<0.10
Chromium (Cr)	mg/kg	0.5	64	87	50	700	15.1	24.1	7.33	9.54	8.61	5.88	7.74	13.6	5.75	9.49	11.5	10.3	12.0	13.1	7.07
Cobalt (Co)	mg/kg	0.1	40	300	40	300	8.19	10.4	4.19	4.83	3.92	0.86	2.19	5.53	0.55	1.70	2.84	6.30	6.84	6.43	0.71
Copper (Cu)	mg/kg	0.5					5.10	19.5	9.05	13.7	10.2	3.36	7.05	13.5	1.36	2.60	5.82	12.0	13.6	15.1	1.92
Lead (Pb)	mg/kg	0.5	70	600	350	2000	11.1	12.7	6.95	8.91	6.44	3.80	6.70	9.70	4.29	9.01	8.30	9.29	10.3	10.4	5.60
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0120	0.0544	0.0539	0.0534	0.0493	0.0135	0.0175	0.0287	0.0082	0.0131	0.0182	0.0314	0.0372	0.0656	0.0098
Molybdenum (Mo)	mg/kg	0.5	5	40	5	40	1.03	1.24	1.08	1.80	0.96	1.19	1.52	1.56	<0.50	0.78	1.05	1.41	1.35	1.30	0.61
Nickel (Ni)	mg/kg	0.5	50	50	150	500	13.3	32.3	15.0	21.5	14.9	4.08	9.86	21.0	1.88	4.26	10.6	18.1	19.7	22.4	2.69
Selenium (Se)	mg/kg	0.2	1	2.9	2	10	<0.20	0.44	0.38	0.38	0.28	<0.20	0.25	0.42	<0.20	<0.20	<0.20	0.29	0.36	0.38	<0.20
Silver (Ag)	mg/kg	0.1	20	40	20	40	<0.10	<0.10	0.16	0.18	0.13	0.17	<0.10	<0.10	<0.10	0.12	0.10	0.16	0.19	0.42	<0.10
Thallium (Tl)	mg/kg	0.05	1	1	2		0.106	0.212	0.110	0.144	0.105	0.103	0.099	0.101	0.093	0.079	0.104	0.095	0.111	0.124	0.108
Tin (Sn)	mg/kg	2	5	300	5	300	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	6.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	mg/kg	0.05	23	300			0.367	0.953	0.570	0.640	0.624	0.149	0.210	0.572	0.192	0.263	0.304	0.536	0.701	0.781	0.189
Vanadium (V)	mg/kg	0.2	130	130	200		33.5	43.2	16.7	21.5	19.0	27.7	31.4	30.3	19.1	40.0	38.1	23.2	26.0	29.0	29.7
Zinc (Zn)	mg/kg	1	200	360	200	600	43.9	70.0	59.6	80.3	52.6	22.8	52.0	102	13.2	37.1	65.5	78.5	88.2	81.0	15.6

Notes

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 1b. Metal Levels in Soil Samples Collected in 2010

RESULTS OF ANALYSIS Sample ID ALS Sample ID Matrix	Units	Realized Detection Limits	Guidelines CCME-A[a]	 CCME-I[b]	 CSR-L[c]	 CSR-I[d]	MURRAY 93 (10-20) L980265-17 Soil	MURRAY 93 (30-50) L980265-18 Soil	MURRAY 100 (0-10) L980265-19 Soil	MURRAY 100 (10-20) L980265-20 Soil	MURRAY 100 (30-50) L980265-21 Soil	MURRAY 107 (0-10) L980265-22 Soil	MURRAY 107 (10-20) L980265-23 Soil	MURRAY 107 (30-50) L980265-24 Soil
Physical Tests														
pH	pH	0.1	6 to 8[e]	6 to 8[e]			4.97	5.19	4.67	5.12	5.41	6.75	6.99	7.72
Organic / Inorganic Carbon														
Total Organic Carbon	%	0.1					0.99	0.66	1.35	0.83	0.61	0.34	0.38	0.69
Metals														
Antimony (Sb)	mg/kg	0.1	20	40	20	40	0.48	0.69	0.26	0.36	0.12	0.12	0.17	0.70
Arsenic (As)	mg/kg	0.05	12	12	25	100	7.79	8.96	4.13	5.38	2.65	2.59	4.26	9.81
Barium (Ba)	mg/kg	0.5	750	2000	400	1500	92.7	100	61.4	82.0	104	49.9	79.6	171
Beryllium (Be)	mg/kg	0.2					0.40	0.64	<0.20	<0.20	<0.20	<0.20	0.32	0.71
Cadmium (Cd)	mg/kg	0.1	1.4	22	9	500	0.26	0.40	0.10	0.12	<0.10	<0.10	0.12	0.30
Chromium (Cr)	mg/kg	0.5	64	87	50	700	19.7	13.5	8.29	6.80	5.31	8.77	13.2	23.4
Cobalt (Co)	mg/kg	0.1	40	300	40	300	3.58	4.74	1.59	1.82	0.72	3.21	4.77	9.91
Copper (Cu)	mg/kg	0.5					8.95	13.1	3.62	4.35	2.80	2.97	4.26	26.1
Lead (Pb)	mg/kg	0.5	70	600	350	2000	10.8	8.83	5.16	5.97	4.19	5.06	7.26	12.3
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0293	0.0384	0.0200	0.0162	0.0122	0.0090	0.0115	0.0764
Molybdenum (Mo)	mg/kg	0.5	5	40	5	40	1.51	1.74	0.77	1.15	<0.50	0.54	0.83	1.78
Nickel (Ni)	mg/kg	0.5	50	50	150	500	13.4	27.5	6.93	7.15	3.32	7.92	11.5	40.6
Selenium (Se)	mg/kg	0.2	1	2.9	2	10	0.28	0.41	<0.20	<0.20	<0.20	<0.20	0.22	0.45
Silver (Ag)	mg/kg	0.1	20	40	20	40	0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Thallium (Tl)	mg/kg	0.05	1	1	2		0.130	0.129	0.085	0.074	0.084	0.060	0.077	0.326
Tin (Sn)	mg/kg	2	5	300	5	300	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	mg/kg	0.05	23	300			0.405	0.461	0.236	0.217	0.219	0.357	0.565	0.626
Vanadium (V)	mg/kg	0.2	130	130	200		50.1	29.4	23.9	25.0	15.6	19.2	30.3	42.0
Zinc (Zn)	mg/kg	1	200	360	200	600	76.1	108	31.3	32.5	13.9	20.0	38.5	68.3

Notes

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits.*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 2

Soil Metal Content for 2012 Sites with Corresponding Plant Tissue Samples

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Appendix 2. Soil Metal Content for 2012 Sites with Corresponding Plant Tissue Samples

RESULTS OF ANALYSIS																				
Sample ID							E-1	E-2	E-3	E-3X	NE-1	NE-2	NE-3	NW-1	NW-2	NW-3	S-1	S-2	S-2X	S-3	W-1	W-2	W-3
Date Sampled							18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			Guidelines				00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit					L1214351-1	L1214351-2	L1214351-3	L1214351-4	L1214351-12	L1214351-13	L1214351-14	L1214351-15	L1214351-16	L1214351-17	L1214351-5	L1214351-6	L1214351-7	L1214351-8	L1214351-9	L1214351-10	L1214351-11
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																							
pH (1:2 soil:water)	pH	0.10	6 to 8[e]	6 to 8[e]			4.45	6.94	4.20	4.19	6.51	7.87	6.50	6.82	5.88	6.30	5.44	7.59	7.64	5.91	6.50	6.71	4.51
Metals																							
Aluminum (Al)	mg/kg	50.0					3590	6910	3820	4530	10400	2200	8610	7200	7510	11600	7030	8560	8610	6410	9930	6950	9370
Antimony (Sb)	mg/kg	0.1	20	40	20	40	0.27	0.40	0.17	0.20	0.63	0.26	0.24	0.55	0.35	0.39	0.33	0.82	0.86	0.52	0.24	0.18	0.18
Arsenic (As)	mg/kg	0.05	12	12	25	100	3.64	5.50	2.98	3.27	9.07	1.85	4.04	17.6	4.12	5.53	3.56	7.17	7.28	3.11	5.09	1.55	6.04
Barium (Ba)	mg/kg	0.5	750	2000	400	1500	36.4	83.1	68.4	80.3	107	275	46.9	570	381	871	124	186	190	65.3	323	1010	108
Beryllium (Be)	mg/kg	0.2	4	8	4	8	<0.20	0.43	<0.20	0.21	0.61	<0.20	0.34	0.48	0.41	0.65	0.22	0.60	0.60	0.27	0.44	0.33	0.24
Bismuth (Bi)	mg/kg	0.2					<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.1	1.4	22	9	500	0.080	0.372	0.299	0.402	0.164	0.497	0.071	1.30	1.88	1.33	0.456	0.472	0.456	0.413	0.958	2.16	0.289
Calcium (Ca)	mg/kg	50.0					308	3420	514	668	2010	54700	1360	16200	2600	6060	2700	12000	12000	2230	6880	14800	1060
Chromium (Cr)	mg/kg	0.5	64	87	50	700	5.30	12.6	6.91	8.15	20.8	4.41	15.4	13.0	13.5	19.0	10.8	15.4	15.0	10.5	15.7	13.4	14.5
Cobalt (Co)	mg/kg	0.1	40	300	40	300	1.54	5.53	1.38	1.52	6.96	2.51	7.15	7.23	10.2	6.32	6.54	7.78	7.74	3.75	5.13	1.18	4.03
Copper (Cu)	mg/kg	0.5	63	91	150	250	3.86	11.9	3.99	5.37	18.5	4.83	5.93	16.8	16.6	17.3	6.20	21.6	21.1	5.49	6.91	30.5	4.38
Iron (Fe)	mg/kg	50.0					8330	15800	9130	10300	22200	6050	17100	36800	18000	19000	14300	21000	21400	13500	17200	5780	17500
Lead (Pb)	mg/kg	0.5	70	600	350	2000	4.29	7.62	4.94	5.79	9.61	3.38	6.60	7.90	13.4	12.4	6.81	11.6	12.0	8.01	9.29	6.56	12.0
Lithium (Li)	mg/kg	5.0					<5.0	8.3	<5.0	<5.0	12.1	<5.0	10.8	10.1	7.9	13.4	8.8	11.1	12.3	8.7	12.4	<5.0	13.5
Magnesium (Mg)	mg/kg	20.0					591	2220	594	676	2600	13400	2250	2310	1320	2370	1890	5610	6040	2420	2850	1490	1930
Manganese (Mn)	mg/kg	1.0					38.2	206	37.3	40.8	234	271	256	779	525	358	735	371	325	181	259	31.6	162
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0264	0.0316	0.0148	0.0146	0.0716	0.0302	0.0147	0.101	0.0179	0.0563	0.0247	0.0681	0.0763	0.0178	0.0570	0.0712	0.0336
Molybdenum (Mo)	mg/kg	0.5	5	40	5	40	1.09	1.01	0.59	0.70	1.23	<0.50	0.83	2.91	1.08	0.77	0.91	1.42	1.50	1.67	0.80	0.52	0.84
Nickel (Ni)	mg/kg	0.5	50	50	150	500	5.72	18.2	4.94	5.64	30.2	7.28	15.1	23.7	19.4	32.7	10.8	29.4	29.8	12.1	13.6	21.6	9.49
Phosphorus (P)	mg/kg	50.0					209	510	351	362	576	641	757	1190	483	724	379	707	711	384	546	299	558
Potassium (K)	mg/kg	100.0					360	780	670	810	1260	350	700	1160	1650	1490	850	1340	1260	630	800	810	710
Selenium (Se)	mg/kg	0.2	1	2.9	2	10	<0.20	0.21	<0.20	<0.20	0.35	0.84	<0.20	1.66	<0.20	0.52	<0.20	0.58	0.53	<0.20	0.28	0.38	<0.20
Silver (Ag)	mg/kg	0.1 - 0.8	20	40	20	40	<0.10	0.12	<0.10	<0.10	0.20	<0.10	<0.10	<0.45	<0.60	<0.80	<0.10	0.21	0.25	<0.10	0.48	1.14	0.17
Sodium (Na)	mg/kg	100.0					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)	mg/kg	0.5					2.61	9.31	4.34	5.13	9.11	51.2	6.42	51.2	23.8	24.1	10.2	28.1	26.0	6.59	17.5	33.7	8.08
Thallium (Tl)	mg/kg	0.05	1	1	2		0.076	0.131	0.073	0.082	0.225	<0.050	0.073	0.146	0.133	0.172	0.105	0.152	0.163	0.144	0.115	0.134	0.134
Tin (Sn)	mg/kg	2.0	5	300	5	300	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	1.0					26.9	54.6	36.5	30.9	55.7	34.0	114	12.5	18.5	21.3	48.7	58.8	32.6	59.3	28.6	17.0	62.8
Uranium (U)	mg/kg	0.1	23	300			0.228	0.508	0.202	0.251	0.703	0.612	0.427	1.35	0.409	1.01	0.379	0.624	0.696	0.338	1.27	1.05	0.429
Vanadium (V)	mg/kg	0.2	130	130	200		20.9	29.3	23.1	27.2	42.3	12.3	29.1	30.7	37.3	42.1	27.0	30.3	30.0	32.7	34.8	24.9	46.8
Zinc (Zn)	mg/kg	1.0	200	360	200	600	21.3	48.1	30.4	37.6	67.5	17.8	34.5	81.8	81.6	86.6	41.4	81.4	80.1	65.9	55.3	28.1	61.0

Notes:

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 2. Soil Metal Content for 2012 Sites with Corresponding Plant Tissue Samples

RESULTS OF ANALYSIS												
Sample ID							RN-1	RN-2	RN-3	RS-1	RS-2	RS-3
Date Sampled							18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			Guidelines				00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit					L1214351-18	L1214351-19	L1214351-20	L1214351-21	L1214351-22	L1214351-23
Matrix	Units		CCME-A[a]	CCME-I[b]	CSR-L[c]	CSR-I[d]	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests												
pH (1:2 soil:water)	pH	0.10	6 to 8[e]	6 to 8[e]			6.13	4.30	4.86	7.88	7.64	8.08
Metals												
Aluminum (Al)	mg/kg	50.0					7040	6460	4450	7620	7360	4090
Antimony (Sb)	mg/kg	0.1	20	40	20	40	0.20	<0.10	0.31	0.74	0.73	0.47
Arsenic (As)	mg/kg	0.05	12	12	25	100	3.78	2.65	4.50	7.52	7.05	5.29
Barium (Ba)	mg/kg	0.5	750	2000	400	1500	155	54.1	105	236	302	111
Beryllium (Be)	mg/kg	0.2	4	8	4	8	0.28	<0.20	<0.20	0.56	0.56	0.34
Bismuth (Bi)	mg/kg	0.2					<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.1	1.4	22	9	500	0.253	0.115	0.236	1.04	1.41	0.609
Calcium (Ca)	mg/kg	50.0					2010	607	1220	49200	44500	63400
Chromium (Cr)	mg/kg	0.5	64	87	50	700	12.3	9.29	8.65	19.1	17.3	9.85
Cobalt (Co)	mg/kg	0.1	40	300	40	300	4.10	1.25	2.11	6.53	7.29	4.33
Copper (Cu)	mg/kg	0.5	63	91	150	250	3.77	1.84	5.64	17.8	20.3	12.6
Iron (Fe)	mg/kg	50.0					14000	7620	10700	18000	18400	11500
Lead (Pb)	mg/kg	0.5	70	600	350	2000	6.96	6.34	4.39	10.7	10.7	6.94
Lithium (Li)	mg/kg	5.0					10.0	5.9	<5.0	9.7	9.6	5.5
Magnesium (Mg)	mg/kg	20.0					1800	850	888	17800	12200	16300
Manganese (Mn)	mg/kg	1.0					195	52.6	37.8	150	346	195
Mercury (Hg)	mg/kg	0.005	6.6	50	0.6	150	0.0235	0.0222	0.0246	0.0784	0.111	0.0451
Molybdenum (Mo)	mg/kg	0.5	5	40	5	40	0.52	<0.50	0.85	2.63	2.92	2.23
Nickel (Ni)	mg/kg	0.5	50	50	150	500	10.5	2.98	7.15	29.4	32.3	19.8
Phosphorus (P)	mg/kg	50.0					525	462	160	1380	1220	1240
Potassium (K)	mg/kg	100.0					1080	570	670	1870	2090	1050
Selenium (Se)	mg/kg	0.2	1	2.9	2	10	<0.20	<0.20	<0.20	1.19	1.15	0.47
Silver (Ag)	mg/kg	0.1 - 0.8	20	40	20	40	<0.10	<0.15	<0.10	<0.25	<0.25	<0.15
Sodium (Na)	mg/kg	100.0					<100	<100	<100	110	<100	<100
Strontium (Sr)	mg/kg	0.5					8.45	5.18	11.8	65.2	68.8	79.3
Thallium (Tl)	mg/kg	0.05	1	1	2		0.062	0.062	<0.050	0.275	0.330	0.166
Tin (Sn)	mg/kg	2.0	5	300	5	300	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	1.0					56.0	105	33.1	23.2	17.5	15.1
Uranium (U)	mg/kg	0.1	23	300			0.413	0.303	0.268	1.30	1.14	1.20
Vanadium (V)	mg/kg	0.2	130	130	200		25.7	24.0	24.7	42.9	38.6	26.8
Zinc (Zn)	mg/kg	1.0	200	360	200	600	42.0	22.4	38.1	101	138	58.5

Notes:

[a] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Agricultural Limits.*

[b] *CCME Canadian Soil Quality Guidelines for Protection for Environmental and Human Health, Industrial Limits*

[c] *CSR-L = Contaminated Site Regulation (BC Reg. 375/96), Livestock Criteria*

[d] *CSR-I = Contaminated Site Regulation (BC Reg. 375/96), Industrial Criteria*

[e] *CCME interim remediation criteria for soil.*

Appendix 3

Lichen Tissue Metal Analysis Results for
Cladina rangiferina and *Stereocaulon paschale* Samples
Collected in 2011

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Appendix 3. Lichen Tissue Metal Analysis Results for *Cladina rangiferina* and *Stereocaulon paschale* Samples Collected in 2011

RESULTS OF ANALYSIS															
Sample ID			LICHENA CLADRAN	LICHENB CLADRAN	LICHENC STERPAS	LICHEND STERPAS	LICHENF STERPAS	LICHENG STERPAS	LICHENH STERPAS	LICHENI STERPAS	LICHENJ STERPAS	LICHENK STERPAS	LICHENL STERPAS	LICHENM STERPAS	LICHENN CLADRAN	LICHENO CLADRAN
Sampling Site			Lichen1A	Lichen1B	Lichen1C	Lichen1D	Lichen2A	Lichen2B	Lichen3A	Lichen3B	Lichen4A	Lichen4B	Lichen5A	Lichen5B	310	310
Replicate			1	2	1	2	1	2	1	2	1	2	1	2	1	2
Genus species			*Cladina rangiferina*	*Cladina rangiferina*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Stereocaulon paschale*	*Cladina rangiferina*	*Cladina rangiferina*
Date Sampled			16-AUG-11	16-AUG-11	16-AUG-11	16-AUG-11	17-AUG-11	17-AUG-11	18-AUG-11	18-AUG-11	18-AUG-11	18-AUG-11	18-AUG-11	18-AUG-11	10-SEP-11	10-SEP-11
ALS Sample ID			L1072208-1	L1072208-2	L1072208-3	L1072208-4	L1072208-5	L1072208-6	L1072208-7	L1072208-8	L1072208-9	L1072208-10	L1072208-11	L1072208-12	L1072208-13	L1072208-14
Matrix	Units	Realized Detection Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																
% Moisture	%	0.10	14.3	24.1	24.2	17.2	50.8	53.5	63.6	62.8	56.0	56.3	39.4	47.2	11.6	11.0
Metals																
Aluminum (Al)-Total	mg/kg	10.00	263	516	211	251	459	603	359	276	143	346	3190	1780	382	524
Aluminum (Al)-Total	mg/kg wwt	2 - 4	226	392	160	208	226	280	131	103	62.9	151	1930	939	337	466
Antimony (Sb)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	0.052	<0.050	<0.050	<0.050	<0.050	0.755	0.429	<0.050	<0.050
Antimony (Sb)-Total	mg/kg wwt	0.01 - 0.02	0.013	0.020	0.028	0.013	0.015	0.024	<0.010	<0.010	<0.010	<0.010	0.458	0.226	0.022	0.028
Arsenic (As)-Total	mg/kg	0.05	0.128	0.219	0.180	0.149	0.259	0.334	0.205	0.167	0.107	0.211	7.87	3.59	0.178	0.246
Arsenic (As)-Total	mg/kg wwt	0.01 - 0.02	0.110	0.166	0.137	0.123	0.128	0.155	0.075	0.062	0.047	0.092	4.76	1.89	0.158	0.218
Barium (Ba)-Total	mg/kg	0.05	18.9	20.4	12.4	14.5	38.7	50.4	26.4	29.2	7.74	19.5	27.6	13.9	17.5	18.2
Barium (Ba)-Total	mg/kg wwt	0.01 - 0.02	16.2	15.5	9.38	12.0	19.1	23.4	9.60	10.9	3.40	8.52	16.7	7.35	15.5	16.2
Beryllium (Be)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	mg/kg wwt	0.03 - 0.06	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.060	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	mg/kg	0.03	0.125	0.160	0.124	0.107	0.427	0.659	0.776	0.666	0.115	0.256	4.12	1.84	0.193	0.198
Cadmium (Cd)-Total	mg/kg wwt	0.005 - 0.01	0.107	0.122	0.0943	0.0888	0.210	0.306	0.283	0.248	0.0506	0.112	2.49	0.971	0.171	0.176
Calcium (Ca)-Total	mg/kg	10.00	1280	1490	720	872	3950	5770	4600	4990	1120	2070	22100	8150	1090	1180
Calcium (Ca)-Total	mg/kg wwt	2 - 4	1100	1130	546	722	1940	2680	1670	1860	492	904	13400	4300	961	1050
Chromium (Cr)-Total	mg/kg	0.50	1.28	1.82	2.12	2.15	6.35	4.07	2.14	3.77	2.81	2.97	43.4	16.5	2.78	3.17
Chromium (Cr)-Total	mg/kg wwt	0.1 - 0.2	1.10	1.38	1.60	1.78	3.12	1.89	0.78	1.40	1.24	1.30	26.3	8.70	2.46	2.82
Cobalt (Co)-Total	mg/kg	0.10	0.14	0.19	0.11	0.12	0.38	0.44	0.16	0.17	<0.10	0.17	2.26	1.05	0.17	0.20
Cobalt (Co)-Total	mg/kg wwt	0.02 - 0.04	0.117	0.140	0.087	0.102	0.187	0.204	0.058	0.062	0.041	0.072	1.37	0.555	0.150	0.181
Copper (Cu)-Total	mg/kg	0.05	1.72	2.26	1.85	1.82	2.02	3.22	1.20	1.05	0.666	1.23	12.0	6.24	1.56	1.83
Copper (Cu)-Total	mg/kg wwt	0.01 - 0.02	1.47	1.72	1.41	1.50	0.996	1.50	0.435	0.391	0.293	0.537	7.29	3.30	1.38	1.63
Iron (Fe)-Total	mg/kg	1 - 3	220	381	179	188	439	595	335	270	148	339	5870	2890	316	398
Iron (Fe)-Total	mg/kg wwt	0.2 - 2	189	289	135	156	216	277	122	101	65.1	148	3560	1530	279	354
Lead (Pb)-Total	mg/kg	0.10	0.45	1.02	0.33	0.49	0.85	1.25	0.46	0.34	0.16	0.45	3.66	1.90	0.55	0.79
Lead (Pb)-Total	mg/kg wwt	0.02 - 0.04	0.382	0.776	0.253	0.405	0.419	0.581	0.166	0.125	0.072	0.194	2.22	1.00	0.488	0.702
Lithium (Li)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.55	1.16	<0.50	<0.50
Lithium (Li)-Total	mg/kg wwt	0.1 - 0.2	0.15	0.20	<0.10	0.13	0.11	0.15	<0.10	<0.10	<0.10	<0.10	1.55	0.61	0.13	0.22
Magnesium (Mg)-Total	mg/kg	3.00	266	356	178	220	324	464	517	498	243	460	1170	564	301	299
Magnesium (Mg)-Total	mg/kg wwt	1 - 2	228	270	135	182	159	216	188	185	107	201	710	298	266	266
Manganese (Mn)-Total	mg/kg	0.05	140	150	52.2	92.4	35.3	40.5	14.6	13.2	14.4	23.5	75.9	42.1	67.1	78.9
Manganese (Mn)-Total	mg/kg wwt	0.01 - 0.02	120	113	39.6	76.5	17.4	18.8	5.31	4.90	6.34	10.2	46.0	22.2	59.3	70.2
Mercury (Hg)-Total	mg/kg	0.01	0.0260	0.0538	0.0280	0.0219	0.0167	0.0296	0.0313	0.0232	0.0268	0.0513	0.0386	0.0212	0.0267	0.0341
Mercury (Hg)-Total	mg/kg wwt	0.00	0.0223	0.0408	0.0212	0.0181	0.0082	0.0138	0.0114	0.0086	0.0118	0.0224	0.0234	0.0112	0.0236	0.0303
Molybdenum (Mo)-Total	mg/kg	0.05	0.183	0.280	0.344	0.242	0.489	0.692	0.241	0.213	0.151	0.254	24.9	10.8	0.243	0.241
Molybdenum (Mo)-Total	mg/kg wwt	0.01 - 0.02	0.157	0.213	0.261	0.200	0.240	0.322	0.088	0.079	0.067	0.111	15.1	5.70	0.215	0.214
Nickel (Ni)-Total	mg/kg	0.50	0.94	1.33	1.38	1.38	5.10	4.37	1.49	1.95	1.63	2.14	49.4	20.9	1.92	2.05
Nickel (Ni)-Total	mg/kg wwt	0.1 - 0.2	0.80	1.01	1.05	1.14	2.51	2.03	0.54	0.72	0.72	0.93	29.9	11.0	1.70	1.82
Phosphorus (P)-Total	mg/kg	20 - 60	629	753	575	558	1040	1580	796	750	748	1030	1120	552	536	585
Phosphorus (P)-Total	mg/kg wwt	5 - 50	539	571	436	462	510	735	290	279	329	450	679	292	473	521
Potassium (K)-Total	mg/kg	100 - 300	1350	1550	1370	1580	2360	3070	2280	2080	1580	2550	3080	1540	1140	1140
Potassium (K)-Total	mg/kg wwt	20 - 200	1160	1180	1040	1310	1160	1430	832	773	694	1110	1860	815	1010	1010
Selenium (Se)-Total	mg/kg	1.00	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<1.0	<1.0	<1.0
Selenium (Se)-Total	mg/kg wwt	0.2 - 0.4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.95	0.39	<0.20	<0.20
Sodium (Na)-Total	mg/kg	100 - 300	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	20 - 200	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<40	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	2.77	3.34	2.03	2.59	6.72	9.54	7.42	8.14	2.73	4.82	21.8	9.24	2.01	2.30
Strontium (Sr)-Total	mg/kg wwt	0.01 - 0.02	2.37	2.54	1.54	2.14	3.30	4.44	2.70	3.03	1.20	2.10	13.2	4.88	1.77	2.05
Thallium (Tl)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	2.09	1.12	<0.030	<0.030
Thallium (Tl)-Total	mg/kg wwt	0.01 - 0.02	<0.010	0.014	0.014	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	1.26	0.590	0.011	0.014
Tin (Sn)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total	mg/kg wwt	0.05 - 0.1	<0.050	0.059	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050	<0.050
Titanium (Ti)-Total	mg/kg	0.5 - 1.5	5.33	8.43	4.75	5.44	7.14	7.75	6.53	5.22	3.65	5.93	30.2	20.0	5.53	7.22
Titanium (Ti)-Total	mg/kg wwt	0.1 - 1	4.57	6.40	3.60	4.50	3.51	3.60	2.38	1.94	1.61	2.59	18.3	10.6	4.89	6.42
Uranium (U)-Total	mg/kg	0.01	0.011	0.025	0.017	0.016	0.043	0.074	0.026	0.021	0.012	0.022	1.62	0.862	0.023	0.029
Uranium (U)-Total	mg/kg wwt	0.002 - 0.004	0.0098	0.0188	0.0131	0.0132	0.0210	0.0343	0.0094	0.0077	0.0051	0.0095	0.980	0.456	0.0207	0.0257
Vanadium (V)-Total	mg/kg	0.50	0.81	1.84	3.32	0.88	2.05	2.77	1.74	1.30	0.59	1.31	548	273	1.48	1.87
Vanadium (V)-Total	mg/kg wwt	0.1 - 0.2	0.69	1.39	2.52	0.73	1.01	1.29	0.63	0.48	0.26	0.57	332	144	1.31	1.66
Zinc (Zn)-Total	mg/kg	0.50	26.2	31.9	27.7	25.6	29.6	36.3	35.3	30.2	13.5	25.5	191	83.3	16.3	20.8
Zinc (Zn)-Total	mg/kg wwt	0.1 - 0.2	22.5	24.2	21.0	21.2	14.5	16.9	12.9	11.2	5.94	11.2	116	44.0	14.4	18.5

Appendix 3. Lichen Tissue Metal Analysis Results for *Cladina rangiferina* and *Stereocaulon paschale* Samples Collected in 2011

RESULTS OF ANALYSIS															
Sample ID			LICHENP CLADRAN	LICHENQ CLADRAN	LICHENR CLADRAN	LICHENS CLADRAN	LICHENT CLADRAN	LICHENU CLADRAN	LICHENV CLADRAN	LICHENX CLADRAN	LICHENY CLADRAN	LICHENAA CLADRAN	LICHENBB CLADRAN	LICHENCC CLADRAN	LICHENDD CLADRAN	LICHENGG
Sampling Site			312	312	313	313	313	314	314	319	319	325	325	337	337	339
Replicate			1	2	1	2	3	1	2	1	2	1	2	1	2	1
Genus species			*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*
Date Sampled		Realized	10-SEP-11	10-SEP-11	11-SEP-11	11-SEP-11	11-SEP-11	11-SEP-11	11-SEP-11	11-SEP-11	11-SEP-11	12-SEP-11	12-SEP-11	13-SEP-11	13-SEP-11	13-SEP-11
ALS Sample ID		Detection	L1072208-15	L1072208-16	L1072208-17	L1072208-18	L1072208-19	L1072208-20	L1072208-21	L1072208-22	L1072208-23	L1072208-24	L1072208-25	L1072208-26	L1072208-27	L1072208-28
Matrix	Units	Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																
% Moisture	%	0.10	9.61	8.50	16.6	17.0	17.6	15.5	16.0	13.6	13.3	17.9	19.1	12.8	12.0	13.9
Metals																
Aluminum (Al)-Total	mg/kg	10.00	577	465	305	276	363	263	342	200	189	356	615	632	584	647
Aluminum (Al)-Total	mg/kg wwt	2 - 4	522	425	254	229	299	222	287	172	164	293	497	551	514	557
Antimony (Sb)-Total	mg/kg	0.05	0.153	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total	mg/kg wwt	0.01 - 0.02	0.138	0.034	0.014	0.014	0.019	0.015	0.018	0.012	0.012	0.013	0.027	0.036	0.032	0.033
Arsenic (As)-Total	mg/kg	0.05	0.497	0.293	0.158	0.150	0.189	0.152	0.183	0.139	0.106	0.260	0.293	0.355	0.351	0.342
Arsenic (As)-Total	mg/kg wwt	0.01 - 0.02	0.449	0.268	0.132	0.124	0.156	0.128	0.154	0.120	0.092	0.213	0.237	0.309	0.309	0.295
Barium (Ba)-Total	mg/kg	0.05	32.3	40.1	16.1	15.9	19.7	9.39	11.5	21.2	9.70	13.3	25.4	25.7	16.8	95.3
Barium (Ba)-Total	mg/kg wwt	0.01 - 0.02	29.2	36.6	13.4	13.2	16.3	7.93	9.66	18.3	8.41	10.9	20.5	22.4	14.8	82.1
Beryllium (Be)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	mg/kg wwt	0.03 - 0.06	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	mg/kg	0.03	0.161	0.115	0.060	0.059	0.079	0.137	0.155	0.079	0.057	0.177	0.180	0.083	0.034	0.152
Cadmium (Cd)-Total	mg/kg wwt	0.005 - 0.01	0.145	0.105	0.0496	0.0487	0.0649	0.116	0.130	0.0684	0.0490	0.145	0.146	0.0725	0.0300	0.131
Calcium (Ca)-Total	mg/kg	10.00	1570	1790	1580	1500	1830	975	1070	1410	863	927	2110	2740	552	2110
Calcium (Ca)-Total	mg/kg wwt	2 - 4	1420	1640	1320	1250	1500	823	902	1220	748	761	1700	2390	486	1820
Chromium (Cr)-Total	mg/kg	0.50	2.97	0.98	1.37	0.92	1.13	1.60	3.07	0.75	1.45	6.42	6.51	6.78	2.55	3.23
Chromium (Cr)-Total	mg/kg wwt	0.1 - 0.2	2.68	0.90	1.14	0.76	0.93	1.35	2.58	0.64	1.25	5.27	5.27	5.91	2.24	2.79
Cobalt (Co)-Total	mg/kg	0.10	0.28	0.24	0.11	0.10	0.13	0.11	0.15	<0.10	<0.10	0.41	0.40	0.35	0.26	0.49
Cobalt (Co)-Total	mg/kg wwt	0.02 - 0.04	0.255	0.218	0.095	0.085	0.111	0.093	0.124	0.083	0.074	0.336	0.326	0.307	0.231	0.423
Copper (Cu)-Total	mg/kg	0.05	2.07	1.89	1.44	1.27	1.57	1.40	1.65	1.51	1.15	1.25	1.86	1.84	1.31	2.42
Copper (Cu)-Total	mg/kg wwt	0.01 - 0.02	1.87	1.73	1.20	1.05	1.30	1.18	1.39	1.31	0.996	1.03	1.51	1.61	1.16	2.09
Iron (Fe)-Total	mg/kg	1 - 3	632	493	258	232	310	221	269	177	169	448	520	759	682	517
Iron (Fe)-Total	mg/kg wwt	0.2 - 2	571	451	215	192	256	187	226	153	147	368	420	662	601	445
Lead (Pb)-Total	mg/kg	0.10	0.31	0.71	0.43	0.35	0.49	0.32	0.40	0.46	0.30	0.27	0.62	0.66	0.10	0.78
Lead (Pb)-Total	mg/kg wwt	0.02 - 0.04	0.279	0.652	0.357	0.292	0.402	0.269	0.335	0.396	0.260	0.225	0.501	0.572	0.092	0.671
Lithium (Li)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total	mg/kg wwt	0.1 - 0.2	0.40	0.29	0.13	0.11	0.15	0.12	0.10	<0.10	0.14	0.16	0.27	0.40	0.35	0.30
Magnesium (Mg)-Total	mg/kg	3.00	487	488	321	296	325	312	324	330	286	597	612	812	632	574
Magnesium (Mg)-Total	mg/kg wwt	1 - 2	440	447	267	246	268	264	272	285	248	490	494	708	556	495
Manganese (Mn)-Total	mg/kg	0.05	135	105	154	140	166	65.8	62.7	79.7	78.0	192	172	128	72.0	211
Manganese (Mn)-Total	mg/kg wwt	0.01 - 0.02	122	96.3	128	116	136	55.6	52.7	68.8	67.6	157	139	112	63.4	182
Mercury (Hg)-Total	mg/kg	0.01	<0.0050	0.0444	0.0247	0.0240	0.0261	0.0328	0.0370	0.0319	0.0254	-	0.0319	0.0219	-	0.0121
Mercury (Hg)-Total	mg/kg wwt	0.00	0.0028	0.0406	0.0206	0.0199	0.0215	0.0277	0.0311	0.0275	0.0220	-	0.0258	0.0191	-	0.0104
Molybdenum (Mo)-Total	mg/kg	0.05	0.720	0.228	0.141	0.128	0.166	0.143	0.187	0.112	0.101	0.139	0.242	0.195	0.171	0.210
Molybdenum (Mo)-Total	mg/kg wwt	0.01 - 0.02	0.651	0.208	0.118	0.106	0.136	0.121	0.157	0.097	0.088	0.114	0.196	0.170	0.150	0.181
Nickel (Ni)-Total	mg/kg	0.50	2.18	0.97	0.91	0.74	0.99	1.10	1.95	0.54	1.17	3.61	3.69	3.35	1.34	2.53
Nickel (Ni)-Total	mg/kg wwt	0.1 - 0.2	1.97	0.88	0.76	0.62	0.82	0.93	1.64	0.46	1.01	2.97	2.98	2.92	1.18	2.18
Phosphorus (P)-Total	mg/kg	20 - 60	844	954	666	626	694	744	700	725	625	711	725	694	612	877
Phosphorus (P)-Total	mg/kg wwt	5 - 50	763	873	555	519	572	629	589	626	541	584	586	605	539	756
Potassium (K)-Total	mg/kg	100 - 300	2240	2570	1320	1300	1400	1770	1720	1780	1680	1280	1400	1630	1440	1810
Potassium (K)-Total	mg/kg wwt	20 - 200	2030	2350	1100	1080	1160	1500	1440	1540	1460	1050	1130	1420	1270	1560
Selenium (Se)-Total	mg/kg	1.00	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total	mg/kg wwt	0.2 - 0.4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Sodium (Na)-Total	mg/kg	100 - 300	<100	<100	<100	<100	<100	<100	<100	<100	<100	<300	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	20 - 200	<40	<40	<20	<20	<20	<20	<20	<20	<20	<200	<20	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	6.12	6.68	2.75	2.48	3.13	1.70	2.00	2.60	1.64	3.49	4.02	5.09	3.63	9.02
Strontium (Sr)-Total	mg/kg wwt	0.01 - 0.02	5.53	6.12	2.29	2.06	2.58	1.44	1.68	2.25	1.42	2.87	3.25	4.44	3.19	7.77
Thallium (Tl)-Total	mg/kg	0.03	0.064	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total	mg/kg wwt	0.01 - 0.02	0.058	0.016	0.011	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	0.018	0.020	0.017	0.012
Tin (Sn)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total	mg/kg wwt	0.05 - 0.1	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Titanium (Ti)-Total	mg/kg	0.5 - 1.5	6.05	4.83	4.81	4.97	6.34	4.07	4.67	3.61	4.35	<1.5	6.94	6.41	7.15	5.09
Titanium (Ti)-Total	mg/kg wwt	0.1 - 1	5.47	4.42	4.01	4.13	5.23	3.44	3.93	3.12	3.77	<1.0	5.61	5.59	6.29	4.38
Uranium (U)-Total	mg/kg	0.01	0.089	0.061	0.017	0.016	0.021	0.016	0.024	0.013	0.011	<0.010	0.032	0.036	0.025	0.034
Uranium (U)-Total	mg/kg wwt	0.002 - 0.004	0.0808	0.0559	0.0141	0.0130	0.0172	0.0133	0.0204	0.0109	0.0098	0.0036	0.0255	0.0310	0.0217	0.0289
Vanadium (V)-Total	mg/kg	0.50	13.3	1.69	1.05	0.95	1.44	1.01	1.18	0.71	0.74	0.81	2.35	2.75	2.39	2.29
Vanadium (V)-Total	mg/kg wwt	0.1 - 0.2	12.0	1.55	0.88	0.79	1.18	0.85	0.99	0.61	0.64	0.67	1.90	2.39	2.10	1.97
Zinc (Zn)-Total	mg/kg	0.50	26.3	21.5	20.2	18.0	21.0	19.5	23.4	23.3	17.5	30.9	26.3	20.1	14.5	25.8
Zinc (Zn)-Total	mg/kg wwt	0.1 - 0.2	23.7	19.7	16.8	15.0	17.3	16.4	19.7	20.1	15.2	25.4	21.2	17.5	12.8	22.2

Appendix 3. Lichen Tissue Metal Analysis Results for *Cladina rangiferina* and *Stereocaulon paschale* Samples Collected in 2011

RESULTS OF ANALYSIS								
Sample ID			LICHENMM STERPAS	LICHENNN STERPAS	LICHENII CLADRAN	LICHENJJ CLADRAN	LICHENKK CLADRAN	LICHENLL CLADRAN	LICHENOO
Sampling Site			339	339	340	340	Lichen 6A	Lichen 6B	Lichen 6C
Replicate			2	1	1	2	1	2	3
Genus species			*Stereocaulon paschale*	*Stereocaulon paschale*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*	*Cladina rangiferina*
Date Sampled		Realized	13-SEP-11	13-SEP-11	13-SEP-11	13-SEP-11	19-AUG-11	19-AUG-11	19-AUG-11
ALS Sample ID		Detection	L1072208-29	L1072208-30	L1072208-31	L1072208-32	L1072208-33	L1072208-34	L1072208-35
Matrix	Units	Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests									
% Moisture	%	0.10	13.1	12.3	14.0	14.5	11.9	12.1	11.5
Metals									
Aluminum (Al)-Total	mg/kg	10.00	1390	1040	327	377	453	438	410
Aluminum (Al)-Total	mg/kg wwt	2 - 4	1210	911	282	322	399	385	363
Antimony (Sb)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total	mg/kg wwt	0.01 - 0.02	0.042	0.035	0.021	0.024	0.015	0.019	0.016
Arsenic (As)-Total	mg/kg	0.05	0.858	0.723	0.169	0.196	0.247	0.315	0.323
Arsenic (As)-Total	mg/kg wwt	0.01 - 0.02	0.745	0.634	0.145	0.168	0.217	0.277	0.286
Barium (Ba)-Total	mg/kg	0.05	80.8	72.2	26.6	26.7	17.5	13.1	13.3
Barium (Ba)-Total	mg/kg wwt	0.01 - 0.02	70.2	63.3	22.9	22.8	15.4	11.5	11.7
Beryllium (Be)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	mg/kg wwt	0.03 - 0.06	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	mg/kg	0.03	0.151	0.130	0.094	0.071	0.074	0.044	0.053
Cadmium (Cd)-Total	mg/kg wwt	0.005 - 0.01	0.131	0.114	0.0806	0.0608	0.0649	0.0389	0.0472
Calcium (Ca)-Total	mg/kg	10.00	2360	2720	1250	1200	1300	733	821
Calcium (Ca)-Total	mg/kg wwt	2 - 4	2050	2380	1070	1030	1150	644	726
Chromium (Cr)-Total	mg/kg	0.50	9.97	7.79	2.05	3.37	2.78	1.30	1.34
Chromium (Cr)-Total	mg/kg wwt	0.1 - 0.2	8.66	6.83	1.77	2.88	2.45	1.14	1.18
Cobalt (Co)-Total	mg/kg	0.10	0.93	0.66	0.15	0.18	0.19	0.15	0.15
Cobalt (Co)-Total	mg/kg wwt	0.02 - 0.04	0.812	0.580	0.130	0.153	0.171	0.131	0.137
Copper (Cu)-Total	mg/kg	0.05	2.97	2.23	1.41	1.52	1.46	1.27	1.32
Copper (Cu)-Total	mg/kg wwt	0.01 - 0.02	2.58	1.96	1.21	1.30	1.28	1.12	1.16
Iron (Fe)-Total	mg/kg	1 - 3	1850	1110	289	339	366	401	376
Iron (Fe)-Total	mg/kg wwt	0.2 - 2	1610	976	248	289	323	353	333
Lead (Pb)-Total	mg/kg	0.10	1.20	0.91	0.41	0.48	0.39	0.36	0.37
Lead (Pb)-Total	mg/kg wwt	0.02 - 0.04	1.04	0.802	0.353	0.407	0.345	0.317	0.324
Lithium (Li)-Total	mg/kg	0.50	1.22	0.90	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total	mg/kg wwt	0.1 - 0.2	1.06	0.78	0.19	0.18	0.26	0.21	0.24
Magnesium (Mg)-Total	mg/kg	3.00	529	474	352	385	356	311	333
Magnesium (Mg)-Total	mg/kg wwt	1 - 2	459	415	303	329	313	274	294
Manganese (Mn)-Total	mg/kg	0.05	36.7	24.1	107	103	118	74.8	80.3
Manganese (Mn)-Total	mg/kg wwt	0.01 - 0.02	31.9	21.1	92.5	87.8	104	65.7	71.0
Mercury (Hg)-Total	mg/kg	0.01	0.0296	0.0330	0.0247	0.0228	0.0191	0.0149	0.0198
Mercury (Hg)-Total	mg/kg wwt	0.00	0.0257	0.0289	0.0212	0.0195	0.0168	0.0131	0.0175
Molybdenum (Mo)-Total	mg/kg	0.05	0.240	0.246	0.145	0.164	0.132	0.116	0.120
Molybdenum (Mo)-Total	mg/kg wwt	0.01 - 0.02	0.209	0.216	0.125	0.141	0.117	0.102	0.106
Nickel (Ni)-Total	mg/kg	0.50	6.70	5.07	1.24	1.85	1.55	0.80	0.84
Nickel (Ni)-Total	mg/kg wwt	0.1 - 0.2	5.82	4.44	1.07	1.58	1.37	0.70	0.75
Phosphorus (P)-Total	mg/kg	20 - 60	577	644	675	719	562	580	562
Phosphorus (P)-Total	mg/kg wwt	5 - 50	501	565	581	615	495	510	497
Potassium (K)-Total	mg/kg	100 - 300	1950	2130	1460	1550	1320	1320	1370
Potassium (K)-Total	mg/kg wwt	20 - 200	1700	1870	1260	1320	1160	1160	1220
Selenium (Se)-Total	mg/kg	1.00	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total	mg/kg wwt	0.2 - 0.4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Sodium (Na)-Total	mg/kg	100 - 300	<100	<100	<100	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	20 - 200	<20	<20	<20	<20	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	8.86	9.48	3.80	4.08	1.94	1.41	1.45
Strontium (Sr)-Total	mg/kg wwt	0.01 - 0.02	7.70	8.31	3.27	3.49	1.71	1.24	1.29
Thallium (Tl)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total	mg/kg wwt	0.01 - 0.02	0.021	0.016	<0.010	0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total	mg/kg wwt	0.05 - 0.1	<0.050	<0.050	<0.050	0.083	<0.050	<0.050	<0.050
Titanium (Ti)-Total	mg/kg	0.5 - 1.5	7.37	6.35	5.20	5.70	5.14	4.56	3.92
Titanium (Ti)-Total	mg/kg wwt	0.1 - 1	6.40	5.56	4.47	4.87	4.52	4.00	3.47
Uranium (U)-Total	mg/kg	0.01	0.083	0.059	0.039	0.044	0.021	0.020	0.019
Uranium (U)-Total	mg/kg wwt	0.002 - 0.004	0.0717	0.0514	0.0336	0.0376	0.0182	0.0176	0.0167
Vanadium (V)-Total	mg/kg	0.50	5.26	3.84	1.22	1.43	1.53	1.61	1.46
Vanadium (V)-Total	mg/kg wwt	0.1 - 0.2	4.57	3.36	1.05	1.22	1.34	1.41	1.30
Zinc (Zn)-Total	mg/kg	0.50	23.8	21.7	16.2	18.3	18.8	14.8	16.4
Zinc (Zn)-Total	mg/kg wwt	0.1 - 0.2	20.7	19.0	13.9	15.7	16.5	13.0	14.5

Appendix 4

Lichen Tissue Metal Analysis Results for *Peltigera scabrosa* Samples Collected in 2012

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Appendix 4. Lichen Tissue Metal Analysis Results for *Peltigera scabrosa* Samples Collected in 2012

RESULTS OF ANALYSIS																	
Sample ID			E-1 P.SCABR.	E-2 P.SCABR.	E-3 P.SCABR.	S-1 P.SCABR.	S-2 P.SCABR.	S-3 P.SCABR.	W-1 P.SCABR.	W-2 P.SCABR.	W-3 P.SCABR.	NE-1 P.SCABR.	NE-2 P.SCABR.	NE-3 P.SCABR.	NW-1 P.SCABR.	NW-2 P.SCABR.	NW-3 P.SCABR.	RN-1 P.SCABR.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized	L1227201-1	L1227201-2	L1227201-3	L1227201-4	L1227201-5	L1227201-6	L1227201-7	L1227201-8	L1227201-9	L1227201-10	L1227201-11	L1227201-12	L1227201-13	L1227201-14	L1227201-15	L1227201-16
Matrix	Units	Detection Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																		
% Moisture	%	0.10	7.33	7.87	7.53	8.52	7.85	7.95	7.92	9.36	9.44	12.2	14.8	12.6	8.75	8.70	8.17	8.29
Metals																		
Aluminum (Al)-Total	mg/kg	2.00	265	684	382	347	833	691	373	256	321	128	163	223	755	914	1210	182
Aluminum (Al)-Total	mg/kg wwt	0.40	245	630	354	317	768	636	343	232	291	112	139	195	689	835	1110	167
Antimony (Sb)-Total	mg/kg	0.01	0.021	0.025	0.028	0.019	0.042	0.035	0.022	0.013	0.018	0.017	0.025	0.020	0.040	0.059	0.076	0.021
Antimony (Sb)-Total	mg/kg wwt	0.002	0.0195	0.0229	0.0254	0.0171	0.0389	0.0326	0.0204	0.0120	0.0163	0.0149	0.0212	0.0171	0.0369	0.0536	0.0698	0.0192
Arsenic (As)-Total	mg/kg	0.02	0.143	0.305	0.186	0.162	0.408	0.329	0.191	0.136	0.180	0.112	0.137	0.104	0.392	0.535	0.801	0.156
Arsenic (As)-Total	mg/kg wwt	0.004	0.132	0.281	0.172	0.148	0.376	0.303	0.176	0.123	0.163	0.0988	0.117	0.0912	0.358	0.489	0.735	0.143
Barium (Ba)-Total	mg/kg	0.05	31.3	19.0	40.9	20.6	31.4	23.6	50.5	30.2	28.6	14.5	50.9	14.9	61.3	96.3	173	31.9
Barium (Ba)-Total	mg/kg wwt	0.01	29.0	17.5	37.8	18.8	28.9	21.7	46.5	27.4	25.9	12.8	43.3	13.0	56.0	87.9	159	29.2
Beryllium (Be)-Total	mg/kg	0.01	0.031	0.039	0.028	0.017	0.051	0.041	0.022	0.011	0.021	<0.010	0.011	<0.010	0.052	0.078	0.099	0.012
Beryllium (Be)-Total	mg/kg wwt	0.002	0.0291	0.0361	0.0263	0.0157	0.0468	0.0379	0.0204	0.0097	0.0191	0.0063	0.0094	0.0085	0.0475	0.0708	0.0907	0.0114
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	0.015	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.002	0.0032	0.0052	0.0047	0.0039	0.0070	0.0070	0.0048	0.0034	0.0035	0.0021	0.0041	0.0028	0.0079	0.0097	0.0135	0.0035
Boron (B)-Total	mg/kg	1.00	7.4	4.7	5.0	4.9	5.7	6.3	13.3	3.8	4.9	4.5	6.4	4.4	10.3	7.8	11.6	6.8
Boron (B)-Total	mg/kg wwt	0.20	6.88	4.30	4.61	4.45	5.28	5.81	12.2	3.46	4.46	3.94	5.46	3.81	9.42	7.12	10.6	6.24
Cadmium (Cd)-Total	mg/kg	0.01	0.049	0.179	0.171	0.356	0.269	0.261	0.218	0.200	0.232	0.157	0.154	0.163	0.206	1.36	0.308	0.049
Cadmium (Cd)-Total	mg/kg wwt	0.002	0.0453	0.165	0.158	0.326	0.248	0.240	0.201	0.181	0.210	0.138	0.132	0.142	0.188	1.24	0.283	0.0445
Calcium (Ca)-Total	mg/kg	15 - 3	1300	1310	2740	5900	9520	6820	3790	1810	2980	1410	3150	1720	3000	5640	5540	2050
Calcium (Ca)-Total	mg/kg wwt	2.5 - 0.5	1210	1200	2530	5400	8770	6280	3490	1640	2700	1230	2680	1500	2740	5150	5090	1880
Cesium (Cs)-Total	mg/kg	0.01	0.164	0.193	0.151	0.0661	0.119	0.0939	0.111	0.109	0.0754	0.0763	0.0614	0.0576	0.160	0.163	0.230	0.0512
Cesium (Cs)-Total	mg/kg wwt	0.001	0.152	0.178	0.140	0.0605	0.110	0.0865	0.102	0.0984	0.0683	0.0670	0.0524	0.0503	0.146	0.149	0.211	0.0470
Chromium (Cr)-Total	mg/kg	0.05	0.582	1.45	0.783	0.710	1.67	1.35	0.789	0.465	0.638	0.342	0.513	0.514	1.59	2.12	2.95	0.446
Chromium (Cr)-Total	mg/kg wwt	0.01	0.539	1.34	0.724	0.650	1.54	1.24	0.726	0.422	0.578	0.300	0.437	0.449	1.45	1.94	2.71	0.409
Cobalt (Co)-Total	mg/kg	0.02	0.151	0.310	0.208	0.233	0.461	0.404	0.254	0.113	0.205	0.096	0.116	0.141	0.827	0.610	1.03	0.204
Cobalt (Co)-Total	mg/kg wwt	0.004	0.140	0.286	0.192	0.213	0.425	0.371	0.234	0.102	0.185	0.0842	0.0991	0.123	0.754	0.557	0.943	0.187
Copper (Cu)-Total	mg/kg	0.05	3.00	2.56	3.17	2.48	3.51	2.53	4.95	3.91	2.77	2.98	3.86	4.26	6.09	3.90	4.59	2.09
Copper (Cu)-Total	mg/kg wwt	0.01	2.78	2.36	2.93	2.27	3.24	2.33	4.56	3.55	2.51	2.62	3.29	3.72	5.55	3.56	4.21	1.92
Gallium (Ga)-Total	mg/kg	0.02	0.082	0.191	0.102	0.095	0.238	0.200	0.100	0.089	0.079	0.027	0.054	0.062	0.216	0.276	0.359	0.055
Gallium (Ga)-Total	mg/kg wwt	0.004	0.0757	0.176	0.0940	0.0873	0.219	0.184	0.0922	0.0809	0.0716	0.0238	0.0460	0.0545	0.197	0.252	0.330	0.0508
Iron (Fe)-Total	mg/kg	1.00	210	506	377	374	937	816	362	205	327	128	189	207	704	1210	1540	194
Iron (Fe)-Total	mg/kg wwt	0.20	194	466	349	342	864	751	333	186	296	112	161	181	643	1110	1410	178
Lead (Pb)-Total	mg/kg	0.02	0.274	0.400	0.405	0.331	0.677	0.562	0.478	0.298	0.481	0.187	0.332	0.235	0.847	1.14	1.55	0.540
Lead (Pb)-Total	mg/kg wwt	0.004	0.254	0.368	0.375	0.302	0.624	0.517	0.440	0.270	0.436	0.164	0.283	0.205	0.773	1.04	1.42	0.495
Lithium (Li)-Total	mg/kg	0.10	0.41	0.66	0.32	0.44	1.17	1.06	0.33	0.16	0.27	<0.10	0.17	0.21	0.59	0.97	1.31	0.18
Lithium (Li)-Total	mg/kg wwt	0.02	0.379	0.605	0.300	0.403	1.08	0.973	0.305	0.146	0.247	0.080	0.145	0.184	0.542	0.886	1.20	0.165
Magnesium (Mg)-Total	mg/kg	25 - 5	752	656	918	1130	2230	1850	978	759	998	772	738	624	1100	1140	1380	648
Magnesium (Mg)-Total	mg/kg wwt	5 - 1	697	604	849	1030	2050	1700	900	688	904	678	629	545	1000	1040	1270	594
Manganese (Mn)-Total	mg/kg	0.02	52.7	42.9	78.3	56.8	62.7	51.4	172	104	242	63.8	29.2	97.1	68.1	41.8	156	46.6
Manganese (Mn)-Total	mg/kg wwt	0.004	48.8	39.5	72.4	51.9	57.8	47.3	158	94.5	219	56.0	24.9	84.9	62.2	38.1	143	42.7
Mercury (Hg)-Total	mg/kg	0.01	0.0331	0.0354	0.0340	0.0274	0.0421	0.0513	0.139	0.0624	0.0528	0.0371	0.0642	0.0469	0.147	0.0400	0.0809	0.0485
Mercury (Hg)-Total	mg/kg wwt	0.001	0.0306	0.0326	0.0315	0.0251	0.0388	0.0472	0.128	0.0565	0.0478	0.0326	0.0547	0.0410	0.134	0.0366	0.0743	0.0445
Molybdenum (Mo)-Total	mg/kg	0.02	0.218	0.307	0.233	0.334	0.390	0.347	0.369	0.262	0.241	0.153	0.358	0.251	0.362	0.365	0.489	0.189
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.202	0.282	0.216	0.306	0.360	0.320	0.340	0.238	0.218	0.134	0.305	0.219	0.330	0.333	0.449	0.173
Nickel (Ni)-Total	mg/kg	0.05	1.11	1.25	1.10	1.25	2.11	1.41	1.11	0.739	1.04	0.566	0.754	0.578	2.38	3.12	4.60	0.623
Nickel (Ni)-Total	mg/kg wwt	0.01	1.03	1.15	1.02	1.14	1.94	1.30	1.02	0.670	0.946	0.497	0.643	0.506	2.17	2.85	4.22	0.571
Phosphorus (P)-Total	mg/kg	100 - 20	1420	1280	1520	2310	1870	1650	2740	2210	2370	2340	1230	2410	1880	1090	2380	1860
Phosphorus (P)-Total	mg/kg wwt	25 - 5	1320	1180	1400	2110	1730	1520	2520	2000	2140	2060	1050	2110	1710	997	2180	1700
Potassium (K)-Total	mg/kg	500 - 100	6090	5980	7900	7320	8550	8010	8380	8420	9030	8250	6190	8660	8520	4830	6550	6240
Potassium (K)-Total	mg/kg wwt	100 - 20	5640	5510	7310	6700	7880	7380	7710	7630	8180	7250	5280	7570	7770	4410	6010	5720
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	11.6	5.51	8.12	2.61	5.73	3.69	9.67	7.25	10.5	6.51	3.58	5.26	7.92	3.03	7.74	2.68
Rubidium (Rb)-Total	mg/kg wwt	0.01	10.8	5.08	7.50	2.39	5.28	3.40	8.90	6.57	9.55	5.71	3.05	4.60	7.23	2.77	7.11	2.46
Selenium (Se)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.11	<0.10
Selenium (Se)-Total	mg/kg wwt	0.02	0.050	0.061	0.058	0.064	0.039	0.036	0.042	0.045	0.029	0.021	0.057	0.041	0.095	0.069	0.105	0.036
Sodium (Na)-Total	mg/kg	500 - 100	<100	<100	<100	<500	<100	<100	<500	<500	<500	<100	<200	<400	<200	<200	<200	<200
Sodium (Na)-Total	mg/kg wwt	100 - 20	<20	30	<20	<100	31	28	<100	<100	<100	<20	<40	<80	<40	<40	<40	<40
Strontium (Sr)-Total	mg/kg	0.05	2.65	3.49	5.13	7.05	12.3	9.35	5.15	3.00	4.20	2.20	6.31	2.16	8.28	19.4	15.1	4.73
Strontium (Sr)-Total	mg/kg wwt	0.01	2.45	3.21	4.74	6.45	11.4	8.61	4.74	2.72	3.80	1.93	5.38	1.88	7.56	17.7	13.8	4.34
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040

Appendix 4. Lichen Tissue Metal Analysis Results for *Peltigera scabrosa* Samples Collected in 2012

RESULTS OF ANALYSIS																	
Sample ID			E-1 P.SCABR.	E-2 P.SCABR.	E-3 P.SCABR.	S-1 P.SCABR.	S-2 P.SCABR.	S-3 P.SCABR.	W-1 P.SCABR.	W-2 P.SCABR.	W-3 P.SCABR.	NE-1 P.SCABR.	NE-2 P.SCABR.	NE-3 P.SCABR.	NW-1 P.SCABR.	NW-2 P.SCABR.	NW-3 P.SCABR.	RN-1 P.SCABR.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized	L1227201-1	L1227201-2	L1227201-3	L1227201-4	L1227201-5	L1227201-6	L1227201-7	L1227201-8	L1227201-9	L1227201-10	L1227201-11	L1227201-12	L1227201-13	L1227201-14	L1227201-15	L1227201-16
Matrix	Units	Detection Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)																		
Thallium (Tl)-Total	mg/kg	0.002	0.0108	0.0226	0.0177	0.0090	0.0234	0.0200	0.0344	0.0218	0.0228	0.0095	0.0073	0.0109	0.0197	0.0216	0.0377	0.0073
Thallium (Tl)-Total	mg/kg wwt	0.000	0.0101	0.0209	0.0164	0.00824	0.0216	0.0184	0.0317	0.0197	0.0206	0.00834	0.00619	0.00953	0.0180	0.0197	0.0346	0.00665
Thorium (Th)-Total	mg/kg	0.01	0.067	0.131	0.090	0.119	0.248	0.264	0.084	0.060	0.088	0.025	0.043	0.083	0.182	0.221	0.283	0.050
Thorium (Th)-Total	mg/kg wwt	0.002	0.0621	0.121	0.0832	0.109	0.229	0.243	0.0773	0.0540	0.0801	0.0222	0.0365	0.0730	0.166	0.202	0.260	0.0461
Tin (Sn)-Total	mg/kg	0.02	0.021	0.031	0.102	0.021	0.025	0.666	0.040	0.027	0.024	0.138	0.024	0.023	0.814	0.039	0.027	0.021
Tin (Sn)-Total	mg/kg wwt	0.004	0.0193	0.0283	0.0946	0.0190	0.0227	0.613	0.0369	0.0249	0.0220	0.121	0.0209	0.0197	0.743	0.0355	0.0252	0.0189
Titanium (Ti)-Total	mg/kg	0.05	2.78	4.60	3.48	5.53	11.9	11.0	5.70	3.86	3.44	2.13	3.49	5.68	7.14	7.92	6.96	2.70
Titanium (Ti)-Total	mg/kg wwt	0.01	2.57	4.24	3.22	5.06	11.0	10.1	5.25	3.50	3.12	1.87	2.98	4.97	6.52	7.23	6.39	2.47
Uranium (U)-Total	mg/kg	0.002	0.0215	0.0448	0.0316	0.0216	0.0576	0.0537	0.0256	0.0207	0.0258	0.0084	0.0169	0.0147	0.0528	0.0852	0.110	0.0152
Uranium (U)-Total	mg/kg wwt	0.000	0.0200	0.0413	0.0293	0.0198	0.0531	0.0494	0.0236	0.0187	0.0233	0.00736	0.0144	0.0129	0.0482	0.0778	0.101	0.0139
Vanadium (V)-Total	mg/kg	0.02	1.11	3.01	1.70	1.55	4.61	3.60	1.74	1.06	1.51	0.478	0.881	0.878	2.96	4.45	5.92	0.884
Vanadium (V)-Total	mg/kg wwt	0.00	1.03	2.77	1.57	1.42	4.25	3.31	1.60	0.960	1.36	0.419	0.750	0.767	2.70	4.07	5.44	0.810
Yttrium (Y)-Total	mg/kg	0.01	0.261	0.289	0.246	0.199	0.655	0.501	0.249	0.154	0.231	0.064	0.117	0.103	0.483	0.725	1.54	0.144
Yttrium (Y)-Total	mg/kg wwt	0.002	0.242	0.267	0.228	0.182	0.604	0.461	0.229	0.140	0.209	0.0565	0.100	0.0902	0.441	0.662	1.41	0.132
Zinc (Zn)-Total	mg/kg	0.50	24.9	28.0	35.7	23.7	29.4	32.2	49.1	39.6	28.3	26.6	41.1	31.1	66.2	50.6	38.0	29.3
Zinc (Zn)-Total	mg/kg wwt	0.10	23.0	25.8	33.0	21.7	27.1	29.6	45.2	35.9	25.6	23.4	35.1	27.2	60.4	46.2	34.9	26.8
Zirconium (Zr)-Total	mg/kg	0.20	0.28	0.33	0.28	<0.20	<0.20	0.25	<0.20	<0.20	<0.20	<0.20	0.21	<0.20	0.49	0.59	0.24	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	0.260	0.304	0.263	0.151	0.181	0.233	0.177	0.140	0.153	0.088	0.179	0.110	0.446	0.543	0.218	0.156

Appendix 4. Lichen Tissue Metal Analysis Results for *Peltigera scabrosa* Samples Collected in 2012

RESULTS OF ANALYSIS Sample ID Date Sampled Time Sampled ALS Sample ID Matrix	Units	Realized Detection Limit	RN-2 P.SCABR. 18-SEP-12 00:00 L1227201-17 Tissue	RN-3 P.SCABR. 18-SEP-12 00:00 L1227201-18 Tissue	RS-1 P.SCABR. 18-SEP-12 00:00 L1227201-19 Tissue	RS-2 P.SCABR. 18-SEP-12 00:00 L1227201-20 Tissue	RS-3 P.SCABR. 18-SEP-12 00:00 L1227201-21 Tissue
Physical Tests							
% Moisture	%	0.10	7.07	9.40	8.43	9.54	9.55
Metals							
Aluminum (Al)-Total	mg/kg	2.00	323	206	321	417	258
Aluminum (Al)-Total	mg/kg wwt	0.40	300	186	294	377	234
Antimony (Sb)-Total	mg/kg	0.01	0.021	0.017	0.025	0.027	0.026
Antimony (Sb)-Total	mg/kg wwt	0.002	0.0194	0.0158	0.0227	0.0245	0.0233
Arsenic (As)-Total	mg/kg	0.02	0.223	0.168	0.159	0.286	0.155
Arsenic (As)-Total	mg/kg wwt	0.004	0.207	0.152	0.146	0.259	0.140
Barium (Ba)-Total	mg/kg	0.05	23.1	18.2	41.9	43.8	74.0
Barium (Ba)-Total	mg/kg wwt	0.01	21.5	16.5	38.4	39.6	67.0
Beryllium (Be)-Total	mg/kg	0.01	0.022	0.014	0.019	0.026	0.015
Beryllium (Be)-Total	mg/kg wwt	0.002	0.0201	0.0129	0.0172	0.0234	0.0133
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.002	0.0038	0.0032	0.0044	0.0042	0.0059
Boron (B)-Total	mg/kg	1.00	4.0	3.3	8.3	6.3	8.4
Boron (B)-Total	mg/kg wwt	0.20	3.73	2.99	7.57	5.73	7.56
Cadmium (Cd)-Total	mg/kg	0.01	0.136	0.287	0.107	0.413	0.364
Cadmium (Cd)-Total	mg/kg wwt	0.002	0.126	0.260	0.0979	0.374	0.329
Calcium (Ca)-Total	mg/kg	15 - 3	1600	1560	5550	5510	8710
Calcium (Ca)-Total	mg/kg wwt	2.5 - 0.5	1480	1410	5080	4990	7880
Cesium (Cs)-Total	mg/kg	0.01	0.114	0.0583	0.0702	0.167	0.0559
Cesium (Cs)-Total	mg/kg wwt	0.001	0.106	0.0528	0.0643	0.151	0.0505
Chromium (Cr)-Total	mg/kg	0.05	0.686	0.457	0.715	0.960	0.578
Chromium (Cr)-Total	mg/kg wwt	0.01	0.637	0.414	0.655	0.868	0.523
Cobalt (Co)-Total	mg/kg	0.02	0.239	0.186	0.181	0.216	0.179
Cobalt (Co)-Total	mg/kg wwt	0.004	0.222	0.169	0.166	0.195	0.162
Copper (Cu)-Total	mg/kg	0.05	2.58	4.58	3.81	5.94	3.16
Copper (Cu)-Total	mg/kg wwt	0.01	2.40	4.15	3.49	5.37	2.85
Gallium (Ga)-Total	mg/kg	0.02	0.090	0.059	0.091	0.124	0.078
Gallium (Ga)-Total	mg/kg wwt	0.004	0.0833	0.0534	0.0834	0.112	0.0705
Iron (Fe)-Total	mg/kg	1.00	360	211	343	418	286
Iron (Fe)-Total	mg/kg wwt	0.20	335	191	314	378	259
Lead (Pb)-Total	mg/kg	0.02	0.405	0.383	0.358	0.443	0.511
Lead (Pb)-Total	mg/kg wwt	0.004	0.376	0.347	0.328	0.400	0.463
Lithium (Li)-Total	mg/kg	0.10	0.32	0.19	0.36	0.46	0.27
Lithium (Li)-Total	mg/kg wwt	0.02	0.293	0.168	0.333	0.420	0.242
Magnesium (Mg)-Total	mg/kg	25 - 5	659	770	1440	1470	1190
Magnesium (Mg)-Total	mg/kg wwt	5 - 1	613	698	1320	1330	1080
Manganese (Mn)-Total	mg/kg	0.02	98.3	40.1	24.2	20.2	84.0
Manganese (Mn)-Total	mg/kg wwt	0.004	91.4	36.3	22.2	18.2	76.0
Mercury (Hg)-Total	mg/kg	0.01	0.0369	0.0598	0.0661	0.0468	0.0555
Mercury (Hg)-Total	mg/kg wwt	0.001	0.0343	0.0542	0.0605	0.0423	0.0502
Molybdenum (Mo)-Total	mg/kg	0.02	0.155	0.182	0.647	0.659	0.536
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.144	0.165	0.592	0.596	0.485
Nickel (Ni)-Total	mg/kg	0.05	0.965	0.803	1.29	2.52	1.05
Nickel (Ni)-Total	mg/kg wwt	0.01	0.897	0.727	1.18	2.28	0.952
Phosphorus (P)-Total	mg/kg	100 - 20	1420	1890	1620	1290	1560
Phosphorus (P)-Total	mg/kg wwt	25 - 5	1320	1710	1480	1170	1410
Potassium (K)-Total	mg/kg	500 - 100	7250	7420	9010	8150	5770
Potassium (K)-Total	mg/kg wwt	100 - 20	6740	6720	8250	7370	5220
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	11.1	5.85	6.11	6.71	3.21
Rubidium (Rb)-Total	mg/kg wwt	0.01	10.3	5.30	5.60	6.07	2.90
Selenium (Se)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	mg/kg wwt	0.02	0.041	0.045	0.051	0.057	0.045
Sodium (Na)-Total	mg/kg	500 - 100	<200	<200	<200	<200	<200
Sodium (Na)-Total	mg/kg wwt	100 - 20	<40	<40	<40	<40	<40
Strontium (Sr)-Total	mg/kg	0.05	2.63	3.46	10.0	9.66	11.6
Strontium (Sr)-Total	mg/kg wwt	0.01	2.45	3.13	9.20	8.74	10.5
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040

Appendix 4. Lichen Tissue Metal Analysis Results for *Peltigera scabrosa* Samples Collected in 2012

RESULTS OF ANALYSIS							
Sample ID			RN-2 P.SCABR.	RN-3 P.SCABR.	RS-1 P.SCABR.	RS-2 P.SCABR.	RS-3 P.SCABR.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled		Realized	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Detection	L1227201-17	L1227201-18	L1227201-19	L1227201-20	L1227201-21
Matrix	Units	Limit	Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)							
Thallium (Tl)-Total	mg/kg	0.002	0.0132	0.0112	0.0139	0.0197	0.0286
Thallium (Tl)-Total	mg/kg wwt	0.000	0.0123	0.0102	0.0127	0.0178	0.0259
Thorium (Th)-Total	mg/kg	0.01	0.106	0.053	0.092	0.112	0.083
Thorium (Th)-Total	mg/kg wwt	0.002	0.0989	0.0479	0.0839	0.101	0.0751
Tin (Sn)-Total	mg/kg	0.02	0.032	0.023	0.433	0.025	0.035
Tin (Sn)-Total	mg/kg wwt	0.004	0.0300	0.0205	0.397	0.0225	0.0318
Titanium (Ti)-Total	mg/kg	0.05	5.87	2.96	4.77	7.74	4.89
Titanium (Ti)-Total	mg/kg wwt	0.01	5.46	2.68	4.37	7.00	4.42
Uranium (U)-Total	mg/kg	0.002	0.0249	0.0157	0.0292	0.0339	0.0214
Uranium (U)-Total	mg/kg wwt	0.000	0.0232	0.0142	0.0267	0.0306	0.0193
Vanadium (V)-Total	mg/kg	0.02	1.47	0.959	2.07	2.42	1.79
Vanadium (V)-Total	mg/kg wwt	0.00	1.37	0.869	1.90	2.19	1.62
Yttrium (Y)-Total	mg/kg	0.01	0.270	0.149	0.285	0.323	0.192
Yttrium (Y)-Total	mg/kg wwt	0.002	0.251	0.135	0.261	0.292	0.173
Zinc (Zn)-Total	mg/kg	0.50	30.4	34.9	38.1	48.0	57.4
Zinc (Zn)-Total	mg/kg wwt	0.10	28.3	31.6	34.9	43.4	51.9
Zirconium (Zr)-Total	mg/kg	0.20	0.28	<0.20	<0.20	0.44	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	0.257	0.142	0.180	0.394	0.141

Appendix 5

Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2010

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Appendix 5. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2010

RESULTS OF ANALYSIS														
Sample ID			SITE 016A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 016B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 031A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 031B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 039A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 039B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 040A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 040B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 042A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 042B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 045A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 045B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 048A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)
Date Sampled			02-JUL-10	02-JUL-10	07-JUL-10	07-JUL-10	08-JUL-10	08-JUL-10	08-JUL-10	08-JUL-10	09-JUL-10	09-JUL-10	09-JUL-10	09-JUL-10	10-JUL-10
ALS Sample ID		Realized	L981893-1	L981893-2	L981893-3	L981893-4	L981893-5	L981893-6	L981893-7	L981893-8	L981893-9	L981893-10	L981893-11	L981893-12	L981893-13
Matrix	Units	Detection Limit	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests															
% Moisture	%	0.10	72.0	68.7	80.4	79.8	69.8	76.4	74.0	76.1	76.5	75.3	71.7	72.0	75.3
Metals															
Aluminum (Al)-Total	mg/kg	10.00	37	39	182	155	86	129	68	60	39	40	18	115	78
Aluminum (Al)-Total	mg/kg wwt	2 - 4	10.4	12.2	35.6	31.3	25.8	30.5	17.6	14.2	9.2	10.0	5.2	32.3	19.2
Antimony (Sb)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total	mg/kg wwt	0.01 - 0.02	<0.020	<0.020	<0.010	<0.010	<0.020	<0.020	<0.020	<0.010	<0.020	<0.020	<0.020	<0.020	<0.020
Arsenic (As)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	0.065	<0.050	<0.050	<0.050	<0.050	<0.050	0.074	<0.050
Arsenic (As)-Total	mg/kg wwt	0.01 - 0.02	<0.020	<0.020	<0.010	<0.010	<0.020	<0.020	<0.020	<0.010	<0.020	<0.020	<0.020	0.021	<0.020
Barium (Ba)-Total	mg/kg	0.05	76.7	137	66.1	53.5	213	220	52.8	34.2	49.3	50.3	54.0	58.3	50.0
Barium (Ba)-Total	mg/kg wwt	0.01 - 0.02	21.4	42.7	12.9	10.8	64.3	51.8	13.7	8.17	11.6	12.4	15.3	16.3	12.3
Beryllium (Be)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total	mg/kg wwt	0.1 - 0.2	<0.20	<0.20	<0.10	<0.10	<0.20	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	mg/kg wwt	0.03 - 0.06	<0.060	<0.060	<0.030	<0.030	<0.060	<0.060	<0.060	<0.030	<0.060	<0.060	<0.060	<0.060	<0.060
Cadmium (Cd)-Total	mg/kg	0.03	0.674	1.71	0.146	0.151	0.233	0.303	0.237	0.131	0.137	0.162	0.073	0.165	0.053
Cadmium (Cd)-Total	mg/kg wwt	0.005 - 0.01	0.188	0.535	0.0285	0.0304	0.070	0.072	0.061	0.0314	0.032	0.040	0.021	0.046	0.013
Calcium (Ca)-Total	mg/kg	10.00	8130	11100	12600	10200	13200	15200	11100	7320	12600	11400	8250	10400	11100
Calcium (Ca)-Total	mg/kg wwt	2 - 4	2270	3480	2450	2050	3990	3600	2890	1750	2960	2820	2330	2930	2740
Chromium (Cr)-Total	mg/kg	0.50	<0.50	0.68	2.79	3.39	2.28	5.33	2.04	2.21	0.99	1.61	0.51	2.96	0.55
Chromium (Cr)-Total	mg/kg wwt	0.1 - 0.2	<0.20	0.21	0.55	0.68	0.69	1.26	0.53	0.53	0.23	0.40	<0.20	0.83	<0.20
Cobalt (Co)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.15	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	mg/kg wwt	0.02 - 0.04	<0.040	<0.040	<0.020	0.020	<0.040	<0.040	<0.040	<0.020	<0.040	<0.040	<0.040	<0.040	<0.040
Copper (Cu)-Total	mg/kg	0.05	4.30	6.04	4.62	4.03	3.08	4.50	6.63	3.14	5.36	4.75	2.40	3.19	3.79
Copper (Cu)-Total	mg/kg wwt	0.01 - 0.02	1.20	1.89	0.904	0.812	0.929	1.06	1.72	0.751	1.26	1.17	0.679	0.895	0.935
Iron (Fe)-Total	mg/kg	1.00	46.5	60.0	161	147	138	220	134	117	84.4	87.6	42.1	174	59.8
Iron (Fe)-Total	mg/kg wwt	0.2 - 0.4	13.0	18.8	31.4	29.7	41.7	51.9	34.7	27.9	19.8	21.7	11.9	48.8	14.7
Lead (Pb)-Total	mg/kg	0.10	<0.10	<0.10	0.12	0.11	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)-Total	mg/kg wwt	0.02 - 0.04	<0.040	<0.040	0.024	0.023	<0.040	<0.040	<0.040	<0.020	<0.040	<0.040	<0.040	<0.040	<0.040
Lithium (Li)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total	mg/kg wwt	0.1 - 0.2	<0.20	<0.20	<0.10	<0.10	<0.20	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	<0.20
Magnesium (Mg)-Total	mg/kg	3.00	1920	2290	3120	3180	2930	4030	2780	1650	2850	2810	1990	2750	2180
Magnesium (Mg)-Total	mg/kg wwt	1 - 2	538	717	610	641	884	952	722	393	669	695	562	772	537
Manganese (Mn)-Total	mg/kg	0.05	38.3	55.9	37.9	31.8	14.2	19.2	14.4	9.63	16.5	15.9	16.6	18.9	23.5
Manganese (Mn)-Total	mg/kg wwt	0.01 - 0.02	10.7	17.5	7.40	6.41	4.28	4.52	3.74	2.30	3.87	3.94	4.70	5.30	5.81
Mercury (Hg)-Total	mg/kg	0.01	<0.0050	<0.0050	0.0055	0.0055	<0.0050	<0.0050	0.0058	<0.0050	0.0065	0.0061	<0.0050	0.0059	<0.0050
Mercury (Hg)-Total	mg/kg wwt	0.00	<0.0010	0.0010	0.0011	0.0011	<0.0010	<0.0010	0.0015	<0.0010	0.0015	0.0015	<0.0010	0.0016	0.0012
Molybdenum (Mo)-Total	mg/kg	0.05	<0.050	<0.050	0.076	0.082	<0.050	0.074	0.174	0.092	<0.050	0.063	0.340	0.398	<0.050
Molybdenum (Mo)-Total	mg/kg wwt	0.01 - 0.02	<0.020	<0.020	0.015	0.017	<0.020	<0.020	0.045	0.022	<0.020	<0.020	0.096	0.112	<0.020
Nickel (Ni)-Total	mg/kg	0.50	1.63	1.75	2.78	2.89	1.65	3.37	1.05	1.01	1.04	1.18	<0.50	1.52	1.32
Nickel (Ni)-Total	mg/kg wwt	0.1 - 0.2	0.46	0.55	0.54	0.58	0.50	0.80	0.27	0.24	0.24	0.29	<0.20	0.43	0.32
Phosphorus (P)-Total	mg/kg	20.00	3300	3410	4390	3780	2170	2770	1580	834	3630	2840	1120	1340	3310
Phosphorus (P)-Total	mg/kg wwt	5 - 10	923	1070	859	762	655	654	410	199	852	703	316	377	817
Potassium (K)-Total	mg/kg	100.00	20800	22700	39400	36900	20500	26400	26600	16700	29700	25900	10300	12000	21000
Potassium (K)-Total	mg/kg wwt	20 - 40	5810	7110	7700	7430	6170	6230	6900	3990	6960	6420	2910	3360	5170
Selenium (Se)-Total	mg/kg	1.00	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total	mg/kg wwt	0.2 - 0.4	<0.40	<0.40	<0.20	<0.20	<0.40	<0.40	<0.40	<0.20	<0.40	<0.40	<0.40	<0.40	<0.40
Silver (Ag)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Silver (Ag)-Total	mg/kg wwt	0.01 - 0.02	<0.020	<0.020	<0.010	<0.010	<0.020	<0.020	<0.020	<0.010	<0.020	<0.020	<0.020	<0.020	<0.020
Sodium (Na)-Total	mg/kg	100.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	20 - 40	<20	<40	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	13.7	19.9	17.0	14.7	24.0	26.9	16.9	11.0	13.7	13.4	16.4	20.4	14.3
Strontium (Sr)-Total	mg/kg wwt	0.01 - 0.02	3.83	6.24	3.33	2.97	7.24	6.35	4.37	2.64	3.22	3.31	4.64	5.71	3.54
Thallium (Tl)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total	mg/kg wwt	0.01 - 0.02	<0.020	<0.020	<0.010	<0.010	<0.020	<0.020	<0.020	<0.010	<0.020	<0.020	<0.020	<0.020	<0.020
Tin (Sn)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total	mg/kg wwt	0.05 - 0.1	<0.10	<0.10	<0.050	<0.050	<0.10	<0.10	<0.10	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium (Ti)-Total	mg/kg	0.50	<0.50	<0.50	1.22	1.17	1.30	1.83	1.42	1.18	1.58	1.66	1.16	2.18	1.35
Titanium (Ti)-Total	mg/kg wwt	0.1 - 0.2	0.13	<0.20	0.24	0.24	0.39	0.43	0.37	0.28	0.37	0.41	0.33	0.61	0.33
Uranium (U)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/kg wwt	0.002 - 0.004	<0.0040	<0.0040	<0.0020	<0.0020	<0.0040	<0.0040	<0.0040	<0.0020	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Vanadium (V)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.73	<0.50	<0.50	<0.50	<0.50	<0.50	0.57	<0.50
Vanadium (V)-Total	mg/kg wwt	0.1 - 0.2	<0.20	<0.20	<0.10	<0.10	<0.20	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	<0.20
Zinc (Zn)-Total	mg/kg	0.50	23.7	40.6	23.9	19.4	15.6	12.8	23.8	15.6	9.85	9.34	9.54	12.1	8.22
Zinc (Zn)-Total	mg/kg wwt	0.1 - 0.2	6.62	12.7	4.68	3.90	4.71	3.03	6.16	3.73	2.31	2.31	2.70	3.40	2.03

Appendix 5. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2010

RESULTS OF ANALYSIS							
Sample ID			SITE 048B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 054A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 054B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 026A VIRBURNUM EDULE (HIGHBUSH CRANBERRY)	SITE 026B VIRBURNUM EDULE (HIGHBUSH CRANBERRY)
Date Sampled		Realized	10-JUL-10	11-JUL-10	11-JUL-10		
ALS Sample ID		Detection	L981893-14	L981893-15	L981893-16	L981893-17	L981893-18
Matrix	Units	Limit	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests							
% Moisture	%	0.10	76.4	74.1	72.9	76.6	77.2
Metals							
Aluminum (Al)-Total	mg/kg	10.00	122	27	20	16	17
Aluminum (Al)-Total	mg/kg wwt	2 - 4	28.9	6.9	5.4	3.6	4.0
Antimony (Sb)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total	mg/kg wwt	0.01 - 0.02	<0.010	<0.020	<0.020	<0.010	<0.010
Arsenic (As)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic (As)-Total	mg/kg wwt	0.01 - 0.02	<0.010	<0.020	<0.020	<0.010	<0.010
Barium (Ba)-Total	mg/kg	0.05	51.3	51.4	45.0	181	200
Barium (Ba)-Total	mg/kg wwt	0.01 - 0.02	12.1	13.3	12.2	42.5	45.6
Beryllium (Be)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.20	<0.20	<0.10	<0.10
Bismuth (Bi)-Total	mg/kg	0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	mg/kg wwt	0.03 - 0.06	<0.030	<0.060	<0.060	<0.030	<0.030
Cadmium (Cd)-Total	mg/kg	0.03	0.063	0.306	0.318	0.500	0.443
Cadmium (Cd)-Total	mg/kg wwt	0.005 - 0.01	0.0149	0.079	0.086	0.117	0.101
Calcium (Ca)-Total	mg/kg	10.00	12900	12600	11700	9840	10100
Calcium (Ca)-Total	mg/kg wwt	2 - 4	3060	3250	3180	2310	2310
Chromium (Cr)-Total	mg/kg	0.50	0.65	0.53	0.59	<0.50	0.70
Chromium (Cr)-Total	mg/kg wwt	0.1 - 0.2	0.15	<0.20	<0.20	0.10	0.16
Cobalt (Co)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	mg/kg wwt	0.02 - 0.04	0.021	<0.040	<0.040	<0.020	<0.020
Copper (Cu)-Total	mg/kg	0.05	4.66	3.71	4.25	2.18	3.06
Copper (Cu)-Total	mg/kg wwt	0.01 - 0.02	1.10	0.959	1.15	0.512	0.698
Iron (Fe)-Total	mg/kg	1.00	81.3	51.1	52.7	52.4	52.1
Iron (Fe)-Total	mg/kg wwt	0.2 - 0.4	19.2	13.2	14.3	12.3	11.9
Lead (Pb)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)-Total	mg/kg wwt	0.02 - 0.04	<0.020	<0.040	<0.040	0.021	<0.020
Lithium (Li)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.20	<0.20	<0.10	<0.10
Magnesium (Mg)-Total	mg/kg	3.00	2520	4140	4140	2370	2240
Magnesium (Mg)-Total	mg/kg wwt	1 - 2	596	1070	1120	556	510
Manganese (Mn)-Total	mg/kg	0.05	26.3	17.9	18.0	16.9	13.5
Manganese (Mn)-Total	mg/kg wwt	0.01 - 0.02	6.21	4.64	4.88	3.97	3.08
Mercury (Hg)-Total	mg/kg	0.01	0.0058	0.0055	<0.0050	<0.0050	<0.0050
Mercury (Hg)-Total	mg/kg wwt	0.00	0.0014	0.0014	0.0013	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg	0.05	0.095	0.064	0.095	0.079	0.099
Molybdenum (Mo)-Total	mg/kg wwt	0.01 - 0.02	0.022	<0.020	0.026	0.019	0.022
Nickel (Ni)-Total	mg/kg	0.50	1.51	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)-Total	mg/kg wwt	0.1 - 0.2	0.36	<0.20	<0.20	<0.10	<0.10
Phosphorus (P)-Total	mg/kg	20.00	4800	1300	1600	3660	3550
Phosphorus (P)-Total	mg/kg wwt	5 - 10	1130	336	434	857	808
Potassium (K)-Total	mg/kg	100.00	30900	20400	22500	25700	23700
Potassium (K)-Total	mg/kg wwt	20 - 40	7280	5290	6080	6020	5400
Selenium (Se)-Total	mg/kg	1.00	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total	mg/kg wwt	0.2 - 0.4	<0.20	<0.40	<0.40	<0.20	<0.20
Silver (Ag)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030
Silver (Ag)-Total	mg/kg wwt	0.01 - 0.02	<0.010	<0.020	<0.020	<0.010	<0.010
Sodium (Na)-Total	mg/kg	100.00	<100	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	20 - 40	<20	<20	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	16.2	13.9	13.2	37.7	40.3
Strontium (Sr)-Total	mg/kg wwt	0.01 - 0.02	3.83	3.61	3.58	8.84	9.20
Thallium (Tl)-Total	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total	mg/kg wwt	0.01 - 0.02	<0.010	<0.020	<0.020	<0.010	<0.010
Tin (Sn)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total	mg/kg wwt	0.05 - 0.1	<0.050	<0.10	<0.10	<0.050	<0.050
Titanium (Ti)-Total	mg/kg	0.50	1.36	1.45	1.39	1.07	0.97
Titanium (Ti)-Total	mg/kg wwt	0.1 - 0.2	0.32	0.38	0.38	0.25	0.22
Uranium (U)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/kg wwt	0.002 - 0.004	<0.0020	<0.0040	<0.0040	<0.0020	<0.0020
Vanadium (V)-Total	mg/kg	0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vanadium (V)-Total	mg/kg wwt	0.1 - 0.2	<0.10	<0.20	<0.20	<0.10	<0.10
Zinc (Zn)-Total	mg/kg	0.50	9.96	22.6	28.1	26.4	30.1
Zinc (Zn)-Total	mg/kg wwt	0.1 - 0.2	2.35	5.85	7.61	6.18	6.87

Appendix 6

Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2012

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Appendix 6. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2012

RESULTS OF ANALYSIS																	
Sample ID			E-1 V.EDULE	E-2 V.EDULE	E-3 V.EDULE	S-1 V.EDULE	S-2 V.EDULE	S-3 V.EDULE	W-1 V.EDULE	W-2 V.EDULE	W-3 V.EDULE	NE-1 V.EDULE	NE-2 V.EDULE	NE-3 V.EDULE	NW-1 V.EDULE	NW-2 V.EDULE	NW-3 V.EDULE	RN-1 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227200-1	L1227200-2	L1227200-3	L1227200-4	L1227200-5	L1227200-6	L1227200-7	L1227200-8	L1227200-9	L1227200-10	L1227200-11	L1227200-12	L1227200-13	L1227200-14	L1227200-15	L1227200-16
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																		
% Moisture	%	0.10	8.68	7.17	10.2	7.31	9.70	19.6	30.5	7.27	7.05	6.59	11.5	6.32	6.55	6.52	5.96	5.30
Metals																		
Aluminum (Al)-Total	mg/kg	2.00	325	237	177	130	403	531	99.4	52.3	57.1	67.7	39.8	221	241	117	195	177
Aluminum (Al)-Total	mg/kg wwt	0.40	297	220	159	121	364	427	69.1	46.4	53.1	63.2	35.2	207	225	109	183	168
Antimony (Sb)-Total	mg/kg	0.01	0.014	0.015	0.013	<0.010	0.028	0.031	<0.010	<0.010	<0.010	0.024	0.022	0.029	<0.010	<0.010	<0.010	0.012
Antimony (Sb)-Total	mg/kg wwt	0.00	0.0126	0.0142	0.0114	0.0071	0.0250	0.0247	0.0047	0.0040	0.0053	0.0226	0.0192	0.0274	0.0078	0.0053	0.0086	0.0110
Arsenic (As)-Total	mg/kg	0.02	0.070	0.068	0.068	0.044	0.181	0.229	0.084	<0.020	0.029	0.021	0.022	0.026	0.059	0.033	0.055	0.062
Arsenic (As)-Total	mg/kg wwt	0.00	0.0643	0.0632	0.0608	0.0405	0.163	0.184	0.0585	0.0201	0.0270	0.0195	0.0193	0.0241	0.0551	0.0305	0.0521	0.0590
Barium (Ba)-Total	mg/kg	0.05	137	115	95.8	117	70.4	95.0	187	127	88.8	102	83.1	114	229	195	559	132
Barium (Ba)-Total	mg/kg wwt	0.01	125	107	86.1	109	63.6	76.4	130	116	82.5	95.4	73.6	107	214	183	526	125
Beryllium (Be)-Total	mg/kg	0.01	0.019	0.014	<0.010	<0.010	0.020	0.027	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	0.018	<0.010	0.015	<0.010
Beryllium (Be)-Total	mg/kg wwt	0.00	0.0175	0.0127	0.0089	0.0076	0.0183	0.0216	0.0028	<0.0020	0.0024	0.0053	<0.0020	0.0118	0.0167	0.0080	0.0144	0.0072
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.00	<0.0020	0.0024	<0.0020	<0.0020	0.0035	0.0042	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg	1.00	16.3	31.6	34.1	17.3	28.9	26.3	28.4	34.3	51.2	40.5	46.0	24.0	28.2	31.2	32.4	22.1
Boron (B)-Total	mg/kg wwt	0.20	14.9	29.4	30.6	16.0	26.1	21.1	19.7	25.3	47.6	37.9	40.7	22.5	26.3	29.1	30.5	20.9
Cadmium (Cd)-Total	mg/kg	0.01	0.083	0.174	0.158	0.133	0.157	0.100	0.263	0.303	0.686	0.201	0.179	0.072	0.164	0.687	0.163	0.104
Cadmium (Cd)-Total	mg/kg wwt	0.00	0.0755	0.161	0.142	0.123	0.142	0.0805	0.183	0.240	0.637	0.188	0.158	0.0677	0.154	0.642	0.154	0.0980
Calcium (Ca)-Total	mg/kg	30.00	19200	17600	20800	19800	19100	23000	26300	19200	23100	22100	19400	17400	17200	20300	21400	16800
Calcium (Ca)-Total	mg/kg wwt	30 - 5	17600	16300	18700	18400	17200	18500	18300	17800	21500	20700	17100	16300	16100	18900	20100	15900
Cesium (Cs)-Total	mg/kg	0.01	0.0398	0.0396	0.0320	0.0086	0.0331	0.0497	0.0167	0.0094	0.0105	0.0093	0.0091	0.0073	0.0196	0.0110	0.0200	0.0147
Cesium (Cs)-Total	mg/kg wwt	0.00	0.0363	0.0367	0.0288	0.0079	0.0299	0.0400	0.0116	0.0082	0.0098	0.0087	0.0080	0.0069	0.0183	0.0103	0.0188	0.0139
Chromium (Cr)-Total	mg/kg	0.05	0.534	0.518	0.403	0.347	0.775	0.937	0.284	0.139	0.160	0.281	0.184	0.312	0.381	0.219	0.291	0.347
Chromium (Cr)-Total	mg/kg wwt	0.01	0.487	0.481	0.362	0.321	0.700	0.753	0.197	0.120	0.149	0.263	0.163	0.293	0.356	0.205	0.273	0.328
Cobalt (Co)-Total	mg/kg	0.02	0.135	0.132	0.145	0.063	0.186	0.255	0.043	0.035	0.178	0.095	0.029	0.069	0.118	0.052	0.126	0.115
Cobalt (Co)-Total	mg/kg wwt	0.00	0.123	0.122	0.130	0.0582	0.168	0.205	0.0296	0.0291	0.165	0.0891	0.0256	0.0645	0.110	0.0490	0.119	0.109
Copper (Cu)-Total	mg/kg	0.05	2.29	2.39	3.64	2.37	4.08	2.64	4.09	4.77	3.61	3.03	2.98	2.64	3.27	3.40	4.09	2.44
Copper (Cu)-Total	mg/kg wwt	0.01	2.10	2.22	3.27	2.20	3.68	2.12	2.84	3.69	3.35	2.83	2.64	2.48	3.06	3.18	3.84	2.31
Gallium (Ga)-Total	mg/kg	0.02	0.070	0.075	0.050	0.030	0.128	0.155	0.028	<0.020	<0.020	<0.020	<0.020	<0.020	0.044	0.029	0.037	0.044
Gallium (Ga)-Total	mg/kg wwt	0.00	0.0636	0.0693	0.0451	0.0273	0.115	0.125	0.0195	0.0112	0.0170	0.0137	0.0121	0.0185	0.0411	0.0275	0.0348	0.0414
Iron (Fe)-Total	mg/kg	1.00	195	204	178	121	471	601	128	86.5	94.7	97.1	75.9	102	183	108	161	160
Iron (Fe)-Total	mg/kg wwt	0.20	178	190	160	112	425	483	89.0	68.5	88.0	90.7	67.2	95.4	171	101	151	152
Lead (Pb)-Total	mg/kg	0.02	0.152	0.158	0.135	0.081	0.305	0.394	0.079	0.089	0.055	0.045	0.046	0.053	0.118	0.063	0.086	0.095
Lead (Pb)-Total	mg/kg wwt	0.00	0.139	0.147	0.121	0.0753	0.276	0.317	0.0549	0.0675	0.0507	0.0416	0.0411	0.0494	0.110	0.0588	0.0812	0.0900
Lithium (Li)-Total	mg/kg	0.10	0.19	0.40	0.18	0.15	0.46	0.77	0.13	<0.10	<0.10	0.11	<0.10	<0.10	0.17	<0.10	0.15	0.11
Lithium (Li)-Total	mg/kg wwt	0.02	0.176	0.373	0.162	0.137	0.420	0.617	0.093	0.034	0.054	0.105	0.049	0.041	0.162	0.082	0.137	0.103
Magnesium (Mg)-Total	mg/kg	50.00	3490	4230	4630	2190	3480	3550	5420	3160	4200	3840	2700	3380	3420	5550	4090	2860
Magnesium (Mg)-Total	mg/kg wwt	60 - 10	3190	3930	4160	2030	3140	2850	3770	2930	3910	3580	2390	3170	3200	5190	3840	2700
Manganese (Mn)-Total	mg/kg	0.02	31.7	35.6	22.9	34.6	31.1	35.5	57.9	30.0	25.6	34.4	37.4	57.9	30.5	35.1	31.8	35.7
Manganese (Mn)-Total	mg/kg wwt	0.00	29.0	33.1	20.5	32.1	28.1	28.6	40.2	25.1	23.8	32.2	33.1	54.2	28.5	32.8	29.9	33.8
Mercury (Hg)-Total	mg/kg	0.01	0.0113	0.0092	0.0133	0.0101	0.0122	0.0113	<0.0050	0.0172	0.0086	0.0111	0.0084	0.0086	0.0097	0.0077	0.0097	0.0103
Mercury (Hg)-Total	mg/kg wwt	0.006 - 0.001	0.0103	0.0085	0.0119	0.0094	0.0110	0.0091	<0.0010	0.0160	0.0080	0.0104	0.0074	0.0081	0.0091	0.0072	0.0091	0.0098
Molybdenum (Mo)-Total	mg/kg	0.02	0.179	0.190	0.089	0.129	0.118	0.220	0.411	0.190	0.294	0.088	0.090	0.097	0.114	0.123	0.036	0.104
Molybdenum (Mo)-Total	mg/kg wwt	0.00	0.163	0.176	0.0796	0.119	0.106	0.177	0.285	0.141	0.273	0.0825	0.0800	0.0906	0.107	0.115	0.0342	0.0989
Nickel (Ni)-Total	mg/kg	0.05	1.60	1.17	1.18	0.742	0.945	1.05	0.383	0.528	0.823	1.11	0.223	1.84	1.98	0.925	2.61	2.51
Nickel (Ni)-Total	mg/kg wwt	0.01	1.46	1.08	1.06	0.688	0.853	0.845	0.266	0.415	0.765	1.03	0.197	1.72	1.85	0.865	2.45	2.38
Phosphorus (P)-Total	mg/kg	200.00	5720	4150	1330	2860	3850	6460	1610	1240	2140	1400	1660	7080	3340	3620	2210	10600
Phosphorus (P)-Total	mg/kg wwt	300 - 50	5220	3860	1190	2650	3480	5200	1120	1150	1990	1310	1470	6630	3120	3380	2080	10100
Potassium (K)-Total	mg/kg	1000.00	23100	23100	22900	27300	37000	31100	24800	27300	27600	25300	24800	31800	30000	25700	19600	30500
Potassium (K)-Total	mg/kg wwt	1200 - 200	21100	21400	20500	25300	33400	25000	17200	25300	25700	23600	21900	29800	28000	24000	18400	28800
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	3.24	2.05	6.36	1.68	4.28	4.37	13.4	12.8	11.6	7.36	6.30	4.85	5.41	4.17	9.41	2.64

Appendix 6. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2012

RESULTS OF ANALYSIS																	
Sample ID			E-1 V.EDULE	E-2 V.EDULE	E-3 V.EDULE	S-1 V.EDULE	S-2 V.EDULE	S-3 V.EDULE	W-1 V.EDULE	W-2 V.EDULE	W-3 V.EDULE	NE-1 V.EDULE	NE-2 V.EDULE	NE-3 V.EDULE	NW-1 V.EDULE	NW-2 V.EDULE	NW-3 V.EDULE	RN-1 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227200-1	L1227200-2	L1227200-3	L1227200-4	L1227200-5	L1227200-6	L1227200-7	L1227200-8	L1227200-9	L1227200-10	L1227200-11	L1227200-12	L1227200-13	L1227200-14	L1227200-15	L1227200-16
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)																		
Rubidium (Rb)-Total	mg/kg wwt	0.01	2.96	1.90	5.71	1.55	3.86	3.51	9.32	11.1	10.8	6.87	5.58	4.54	5.05	3.90	8.85	2.50
Selenium (Se)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	mg/kg wwt	0.02	0.074	0.057	0.073	0.046	0.071	0.021	<0.020	<0.020	0.100	<0.020	<0.020	0.024	0.035	<0.020	0.080	<0.020
Sodium (Na)-Total	mg/kg	1000.00	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Sodium (Na)-Total	mg/kg wwt	1200 - 200	<200	<200	<200	<200	<200	<200	<200	<1200	<200	<200	<200	<200	<200	<200	<200	<200
Strontium (Sr)-Total	mg/kg	0.05	26.2	40.5	26.6	29.0	29.1	30.8	33.9	28.3	29.3	36.2	26.0	30.9	37.5	90.3	67.3	26.5
Strontium (Sr)-Total	mg/kg wwt	0.01	23.9	37.6	23.9	26.9	26.3	24.8	23.5	22.7	27.2	33.8	23.0	28.9	35.0	84.4	63.3	25.1
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.00	0.0063	0.0065	0.0046	0.0032	0.0106	0.0160	0.0026	<0.0020	<0.0020	0.0049	<0.0020	0.0029	0.0037	0.0021	0.0034	0.0024
Thallium (Tl)-Total	mg/kg wwt	0.00	0.00572	0.00605	0.00417	0.00296	0.00961	0.0128	0.00180	0.00152	0.00156	0.00455	0.00109	0.00268	0.00344	0.00195	0.00324	0.00223
Thorium (Th)-Total	mg/kg	0.01	0.049	0.061	0.040	0.033	0.126	0.199	0.026	0.013	0.016	<0.010	<0.010	<0.010	0.031	0.018	0.027	0.027
Thorium (Th)-Total	mg/kg wwt	0.00	0.0450	0.0562	0.0359	0.0304	0.113	0.160	0.0183	0.0099	0.0148	0.0079	0.0068	0.0092	0.0288	0.0171	0.0258	0.0260
Tin (Sn)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	<0.020	0.031	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Tin (Sn)-Total	mg/kg wwt	0.00	0.0151	0.0159	0.0137	0.0101	0.0097	0.0085	0.0153	0.0148	0.0286	0.0154	0.0129	0.0120	0.0109	0.0170	0.0145	0.0163
Titanium (Ti)-Total	mg/kg	0.05	1.72	2.02	1.48	1.56	5.94	7.08	1.81	1.21	1.56	0.922	1.02	1.00	1.46	1.10	1.23	2.21
Titanium (Ti)-Total	mg/kg wwt	0.01	1.57	1.87	1.33	1.45	5.36	5.69	1.26	0.951	1.45	0.861	0.907	0.938	1.37	1.03	1.16	2.09
Uranium (U)-Total	mg/kg	0.00	0.0153	0.0150	0.0103	0.0064	0.0226	0.0298	0.0116	0.0036	0.0038	0.0031	<0.0020	0.0054	0.0093	0.0042	0.0067	0.0064
Uranium (U)-Total	mg/kg wwt	0.00	0.0139	0.0139	0.00929	0.00592	0.0204	0.0240	0.00809	0.00224	0.00349	0.00286	0.00173	0.00502	0.00872	0.00396	0.00633	0.00602
Vanadium (V)-Total	mg/kg	0.02	1.04	1.10	0.746	0.475	2.32	2.69	0.467	0.189	0.269	0.168	0.156	0.231	0.652	0.356	0.522	0.546
Vanadium (V)-Total	mg/kg wwt	0.00	0.949	1.02	0.671	0.440	2.09	2.16	0.325	0.161	0.250	0.157	0.138	0.216	0.609	0.333	0.491	0.517
Yttrium (Y)-Total	mg/kg	0.01	0.142	0.129	0.097	0.068	0.258	0.348	0.063	0.029	0.036	0.030	0.019	0.077	0.136	0.063	0.175	0.072
Yttrium (Y)-Total	mg/kg wwt	0.00	0.130	0.120	0.0875	0.0631	0.233	0.280	0.0440	0.0223	0.0333	0.0281	0.0167	0.0722	0.127	0.0585	0.165	0.0680
Zinc (Zn)-Total	mg/kg	0.50	7.04	10.5	16.2	11.0	18.9	11.6	25.9	14.6	48.8	10.5	13.6	11.3	16.6	18.4	22.4	9.35
Zinc (Zn)-Total	mg/kg wwt	0.10	6.42	9.77	14.5	10.2	17.1	9.32	18.0	12.2	45.4	9.82	12.1	10.6	15.5	17.2	21.0	8.85
Zirconium (Zr)-Total	mg/kg	0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.20	<0.20	0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	0.106	0.146	0.183	0.065	0.105	0.094	0.132	0.313	0.054	0.111	0.162	0.095	0.080	0.070	0.061	0.092

Appendix 6. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2012

RESULTS OF ANALYSIS							
Sample ID			RN-2 V.EDULE	RN-3 V.EDULE	RS-1 V.EDULE	RS-2 V.EDULE	RS-3 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227200-17	L1227200-18	L1227200-19	L1227200-20	L1227200-21
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests							
% Moisture	%	0.10	6.63	6.20	6.68	8.50	6.00
Metals							
Aluminum (Al)-Total	mg/kg	2.00	146	55.6	69.4	62.5	89.1
Aluminum (Al)-Total	mg/kg wwt	0.40	137	52.2	64.7	57.2	83.7
Antimony (Sb)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	0.014
Antimony (Sb)-Total	mg/kg wwt	0.00	0.0089	0.0080	0.0081	0.0085	0.0129
Arsenic (As)-Total	mg/kg	0.02	0.058	0.036	0.040	0.036	0.057
Arsenic (As)-Total	mg/kg wwt	0.00	0.0538	0.0337	0.0375	0.0328	0.0535
Barium (Ba)-Total	mg/kg	0.05	124	125	91.5	154	138
Barium (Ba)-Total	mg/kg wwt	0.01	116	117	85.3	141	130
Beryllium (Be)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total	mg/kg wwt	0.00	0.0081	0.0024	0.0035	0.0027	0.0047
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	0.0028	<0.0020	<0.0020
Boron (B)-Total	mg/kg	1.00	18.6	18.0	22.0	45.6	41.7
Boron (B)-Total	mg/kg wwt	0.20	17.3	16.9	20.5	41.7	39.2
Cadmium (Cd)-Total	mg/kg	0.01	0.147	0.181	0.200	0.268	0.329
Cadmium (Cd)-Total	mg/kg wwt	0.00	0.137	0.170	0.187	0.245	0.309
Calcium (Ca)-Total	mg/kg	30.00	15700	19100	19600	24800	17900
Calcium (Ca)-Total	mg/kg wwt	30 - 5	14700	17900	18300	22700	16900
Cesium (Cs)-Total	mg/kg	0.01	0.0146	0.0070	0.0083	0.0100	0.0094
Cesium (Cs)-Total	mg/kg wwt	0.00	0.0137	0.0066	0.0078	0.0091	0.0088
Chromium (Cr)-Total	mg/kg	0.05	0.366	0.177	0.166	0.175	0.228
Chromium (Cr)-Total	mg/kg wwt	0.01	0.342	0.166	0.155	0.160	0.214
Cobalt (Co)-Total	mg/kg	0.02	0.082	0.050	0.040	0.044	0.049
Cobalt (Co)-Total	mg/kg wwt	0.00	0.0768	0.0470	0.0372	0.0403	0.0458
Copper (Cu)-Total	mg/kg	0.05	2.29	3.12	3.27	4.45	2.72
Copper (Cu)-Total	mg/kg wwt	0.01	2.14	2.93	3.05	4.08	2.55
Gallium (Ga)-Total	mg/kg	0.02	0.039	0.021	0.021	0.021	0.028
Gallium (Ga)-Total	mg/kg wwt	0.00	0.0366	0.0201	0.0198	0.0195	0.0261
Iron (Fe)-Total	mg/kg	1.00	161	87.1	99.1	90.9	124
Iron (Fe)-Total	mg/kg wwt	0.20	150	81.7	92.5	83.2	116
Lead (Pb)-Total	mg/kg	0.02	0.091	0.051	0.072	0.051	0.084
Lead (Pb)-Total	mg/kg wwt	0.00	0.0852	0.0482	0.0668	0.0464	0.0794
Lithium (Li)-Total	mg/kg	0.10	0.10	0.11	<0.10	<0.10	<0.10
Lithium (Li)-Total	mg/kg wwt	0.02	0.095	0.107	0.061	0.062	0.088
Magnesium (Mg)-Total	mg/kg	50.00	3490	2810	2990	4170	2950
Magnesium (Mg)-Total	mg/kg wwt	60 - 10	3260	2630	2790	3820	2770
Manganese (Mn)-Total	mg/kg	0.02	32.1	19.5	15.3	23.9	14.0
Manganese (Mn)-Total	mg/kg wwt	0.00	30.0	18.3	14.3	21.9	13.2
Mercury (Hg)-Total	mg/kg	0.01	0.0071	0.0111	0.0116	0.0101	0.0114
Mercury (Hg)-Total	mg/kg wwt	0.006 - 0.001	0.0067	0.0104	0.0108	0.0093	0.0107
Molybdenum (Mo)-Total	mg/kg	0.02	0.161	0.152	0.223	0.194	0.169
Molybdenum (Mo)-Total	mg/kg wwt	0.00	0.150	0.143	0.208	0.177	0.159
Nickel (Ni)-Total	mg/kg	0.05	1.37	0.223	0.316	0.555	0.357
Nickel (Ni)-Total	mg/kg wwt	0.01	1.28	0.209	0.295	0.508	0.335
Phosphorus (P)-Total	mg/kg	200.00	4880	1260	1400	1850	1630
Phosphorus (P)-Total	mg/kg wwt	300 - 50	4560	1190	1310	1690	1530
Potassium (K)-Total	mg/kg	1000.00	24500	22500	29000	29300	30600
Potassium (K)-Total	mg/kg wwt	1200 - 200	22900	21100	27100	26900	28800
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	0.0039	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	10.5	2.72	4.26	8.95	3.58

Appendix 6. Plant Tissue Metal Analysis Results for *Viburnum edule* Leaf Samples Collected in 2012

RESULTS OF ANALYSIS							
Sample ID			RN-2 V.EDULE	RN-3 V.EDULE	RS-1 V.EDULE	RS-2 V.EDULE	RS-3 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227200-17	L1227200-18	L1227200-19	L1227200-20	L1227200-21
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)							
Rubidium (Rb)-Total	mg/kg wwt	0.01	9.78	2.55	3.98	8.19	3.36
Selenium (Se)-Total	mg/kg	0.10	<0.10	<0.10	0.29	0.11	0.18
Selenium (Se)-Total	mg/kg wwt	0.02	<0.020	<0.020	0.268	0.102	0.172
Sodium (Na)-Total	mg/kg	1000.00	<1000	<1000	<1000	<1000	<1000
Sodium (Na)-Total	mg/kg wwt	1200 - 200	<200	<200	<200	<200	<200
Strontium (Sr)-Total	mg/kg	0.05	22.5	53.7	29.0	40.6	24.0
Strontium (Sr)-Total	mg/kg wwt	0.01	21.1	50.3	27.1	37.2	22.6
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.00	0.0049	0.0022	0.0035	0.0049	0.0066
Thallium (Tl)-Total	mg/kg wwt	0.00	0.00461	0.00205	0.00322	0.00444	0.00622
Thorium (Th)-Total	mg/kg	0.01	0.036	0.013	0.025	0.020	0.032
Thorium (Th)-Total	mg/kg wwt	0.00	0.0340	0.0121	0.0232	0.0182	0.0302
Tin (Sn)-Total	mg/kg	0.02	<0.020	0.025	<0.020	<0.020	<0.020
Tin (Sn)-Total	mg/kg wwt	0.00	0.0177	0.0238	0.0165	0.0111	0.0146
Titanium (Ti)-Total	mg/kg	0.05	1.83	1.01	2.21	1.36	1.63
Titanium (Ti)-Total	mg/kg wwt	0.01	1.71	0.946	2.06	1.25	1.53
Uranium (U)-Total	mg/kg	0.00	0.0062	0.0030	0.0064	0.0055	0.0079
Uranium (U)-Total	mg/kg wwt	0.00	0.00582	0.00280	0.00601	0.00503	0.00744
Vanadium (V)-Total	mg/kg	0.02	0.456	0.238	0.524	0.497	0.815
Vanadium (V)-Total	mg/kg wwt	0.00	0.426	0.224	0.489	0.455	0.766
Yttrium (Y)-Total	mg/kg	0.01	0.076	0.027	0.044	0.037	0.056
Yttrium (Y)-Total	mg/kg wwt	0.00	0.0709	0.0254	0.0415	0.0341	0.0530
Zinc (Zn)-Total	mg/kg	0.50	9.57	16.5	19.2	25.6	26.7
Zinc (Zn)-Total	mg/kg wwt	0.10	8.93	15.5	18.0	23.4	25.1
Zirconium (Zr)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	0.052	0.099	0.164	0.062	0.081

Appendix 7

Plant Tissue Metal Analysis Results for *Ribes* sp. Berry Samples Collected in 2012

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Appendix 7. Plant Tissue Metal Analysis Results for *Ribes* sp. Berry Samples Collected in 2012

RESULTS OF ANALYSIS																
Sample ID			E-1 RIBES SP.	E-2 RIBES SP.	E-3 RIBES SP.	S-1 RIBES SP.	S-2 RIBES SP.	W-1 RIBES SP.	W-2 RIBES SP.	W-3 RIBES SP.	NE-1 RIBES SP.	NE-2 RIBES SP.	NE-3 RIBES SP.	NW-1 RIBES SP.	NW-2 RIBES SP.	NW-3 RIBES SP.	RN-1 RIBES SP.	RN-2 RIBES SP.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227199-1	L1227199-2	L1227199-3	L1227199-4	L1227199-5	L1227199-6	L1227199-7	L1227199-8	L1227199-9	L1227199-10	L1227199-11	L1227199-12	L1227199-13	L1227199-14	L1227199-15	L1227199-16
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																		
% Moisture	%	0.1	76.1	74.7	72.9	79.3	77.7	80.5	72.0	80.7	48.7	76.7	61.4	81.0	78.7	80.6	73.8	71.0
Metals		0																
Aluminum (Al)-Total	mg/kg	2	20.4	18.9	26.7	13.5	30.4	3.4	7.4	30.7	4.6	8.9	8.4	16.6	16.6	14.8	3.5	5.9
Aluminum (Al)-Total	mg/kg wwt	0.4	4.88	4.78	7.22	2.79	6.79	0.67	2.07	5.92	2.35	2.07	3.25	3.15	3.52	2.87	0.91	1.70
Antimony (Sb)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/kg	0.02	0.035	0.029	0.023	0.023	0.021	0.021	<0.020	0.022	<0.020	<0.020	<0.020	0.023	0.028	0.032	<0.020	<0.020
Arsenic (As)-Total	mg/kg wwt	0.004	0.0083	0.0072	0.0063	0.0047	0.0047	0.0041	<0.0040	0.0042	0.0052	<0.0040	0.0042	0.0044	0.0059	0.0063	<0.0040	0.0049
Barium (Ba)-Total	mg/kg	0.05	5.15	4.19	18.1	4.76	9.80	17.0	36.8	29.9	11.2	23.0	16.2	20.1	45.3	46.0	6.68	17.4
Barium (Ba)-Total	mg/kg wwt	0.01	1.23	1.06	4.89	0.986	2.19	3.32	10.3	5.78	5.73	5.37	6.24	3.83	9.63	8.94	1.75	5.03
Beryllium (Be)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg	1	8.9	9.2	14.1	8.0	10.9	8.6	10.1	19.5	10.7	12.4	13.6	12.5	13.9	12.2	8.6	13.3
Boron (B)-Total	mg/kg wwt	0.2	2.12	2.33	3.83	1.67	2.44	1.67	2.84	3.76	5.50	2.89	5.27	2.38	2.97	2.37	2.24	3.87
Cadmium (Cd)-Total	mg/kg	0.01	<0.010	<0.010	0.021	0.025	<0.010	<0.010	0.011	0.014	<0.010	<0.010	0.012	0.012	0.142	0.018	<0.010	0.025
Cadmium (Cd)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	0.0057	0.0051	<0.0020	<0.0020	0.0032	0.0027	0.0037	0.0023	0.0045	0.0022	0.0301	0.0034	<0.0020	0.0072
Calcium (Ca)-Total	mg/kg	12 - 3	2040	1940	6300	2930	4140	4160	5190	6330	3770	4990	5060	4420	6530	6150	2260	3800
Calcium (Ca)-Total	mg/kg wwt	3 - 0.5	488	489	1710	607	924	812	1460	1220	1930	1160	1950	839	1390	1200	592	1100
Cesium (Cs)-Total	mg/kg	0.005	0.0101	0.0052	0.0065	<0.0050	<0.0050	<0.0050	<0.0050	0.0070	0.0092	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cesium (Cs)-Total	mg/kg wwt	0.001	0.0024	0.0013	0.0018	<0.0010	<0.0010	<0.0010	0.0013	0.0013	0.0047	0.0012	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium (Cr)-Total	mg/kg	0.05	<0.050	<0.050	0.111	0.071	0.077	0.100	0.300	0.167	0.074	0.103	0.067	0.082	0.129	0.098	<0.050	<0.050
Chromium (Cr)-Total	mg/kg wwt	0.01	0.011	0.011	0.030	0.015	0.017	0.019	0.084	0.032	0.038	0.024	0.026	0.016	0.027	0.019	<0.010	0.012
Cobalt (Co)-Total	mg/kg	0.02	0.043	0.032	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.023	<0.020	0.036	<0.020
Cobalt (Co)-Total	mg/kg wwt	0.004	0.0103	0.0082	0.0062	<0.0040	0.0044	<0.0040	0.0042	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0048	<0.0040	0.0095	<0.0040
Copper (Cu)-Total	mg/kg	0.05	1.10	2.25	3.92	2.00	4.42	4.54	5.69	8.32	3.04	5.42	4.03	3.09	4.61	3.66	2.58	2.67
Copper (Cu)-Total	mg/kg wwt	0.01	0.262	0.568	1.06	0.413	0.986	0.886	1.59	1.61	1.56	1.26	1.56	0.588	0.980	0.711	0.675	0.773
Gallium (Ga)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Gallium (Ga)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	mg/kg	1	36.3	36.7	50.0	27.0	51.0	17.4	25.4	58.2	17.5	24.7	21.9	29.0	40.7	29.2	16.1	25.9
Iron (Fe)-Total	mg/kg wwt	0.2	8.68	9.26	13.5	5.60	11.4	3.39	7.12	11.2	8.99	5.75	8.44	5.51	8.66	5.67	4.21	7.51
Lead (Pb)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.046	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lead (Pb)-Total	mg/kg wwt	0.004	0.0042	<0.0040	0.0050	<0.0040	0.0040	<0.0040	0.0042	0.0089	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Lithium (Li)-Total	mg/kg	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lithium (Li)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	mg/kg	20 - 5	881	800	1850	915	1030	1090	1280	1570	928	1370	1340	1080	1550	1560	795	890
Magnesium (Mg)-Total	mg/kg wwt	6 - 1	210	202	500	189	231	213	358	302	476	321	517	206	329	304	208	258
Manganese (Mn)-Total	mg/kg	0.02	13.1	9.68	27.9	18.3	9.94	7.20	10.9	13.4	24.8	32.0	15.4	10.2	14.8	12.9	6.15	24.5
Manganese (Mn)-Total	mg/kg wwt	0.004	3.13	2.45	7.55	3.78	2.22	1.40	3.06	2.59	12.7	7.46	5.95	1.94	3.15	2.51	1.61	7.09
Mercury (Hg)-Total	mg/kg	0.01 - 0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050
Mercury (Hg)-Total	mg/kg wwt	0.003 - 0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0030	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg	0.02	0.994	0.070	0.290	0.140	0.079	0.139	0.113	0.418	0.086	0.145	0.224	0.372	0.253	0.296	0.065	0.169
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.237	0.0178	0.0785	0.0291	0.0176	0.0271	0.0315	0.0806	0.0440	0.0337	0.0864	0.0707	0.0537	0.0575	0.0171	0.0490
Nickel (Ni)-Total	mg/kg	0.05	0.145	0.185	0.293	0.158	0.330	0.321	0.648	0.512	0.186	0.398	0.119	0.423	0.626	0.562	0.146	0.237
Nickel (Ni)-Total	mg/kg wwt	0.01	0.035	0.047	0.079	0.033	0.074	0.063	0.181	0.099	0.095	0.093	0.046	0.080	0.133	0.109	0.038	0.069
Phosphorus (P)-Total	mg/kg	80 - 20	2880	2780	3290	2010	2090	2120	2360	2380	1700	2360	2480	2200	3170	3030	2550	2210
Phosphorus (P)-Total	mg/kg wwt	30 - 5	687	703	893	416	467	413	662	459	872	550	957	418	673	590	668	640
Potassium (K)-Total	mg/kg	400 - 100	14800	14400	22400	16800	16000	16900	18100	19600	15200	20100	19600	16200	18600	16800	14600	15900
Potassium (K)-Total	mg/kg wwt	120 - 20	3540	3640	6070	3490	3570	3290	5060	3780	7830	4690	7550	3070	3960	3260	3830	4610
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	12.2	5.71	7.44	3.70	2.47	9.60	7.05	9.53	7.74	8.54	6.04	5.85	2.36	5.43	4.21	3.28
Rubidium (Rb)-Total	mg/kg wwt	0.01	2.92	1.44	2.02	0.766	0.552	1.87	1.98	1.84	3.97	1.99	2.33	1.11	0.501	1.06	1.10	0.950
Selenium (Se)-Total	mg/kg	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Appendix 7. Plant Tissue Metal Analysis Results for *Ribes* sp. Berry Samples Collected in 2012

RESULTS OF ANALYSIS																
Sample ID			E-1 RIBES SP.	E-2 RIBES SP.	E-3 RIBES SP.	S-1 RIBES SP.	S-2 RIBES SP.	W-1 RIBES SP.	W-2 RIBES SP.	W-3 RIBES SP.	NE-1 RIBES SP.	NE-2 RIBES SP.	NE-3 RIBES SP.	NW-1 RIBES SP.	NW-2 RIBES SP.	NW-3 RIBES SP.	RN-1 RIBES SP.	RN-2 RIBES SP.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227199-1	L1227199-2	L1227199-3	L1227199-4	L1227199-5	L1227199-6	L1227199-7	L1227199-8	L1227199-9	L1227199-10	L1227199-11	L1227199-12	L1227199-13	L1227199-14	L1227199-15	L1227199-16
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)																		
Selenium (Se)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.029	<0.020	<0.020	<0.020	<0.020	<0.020
Sodium (Na)-Total	mg/kg	400 - 100	<100	<100	<200	<100	<100	<200	<400	<200	<200	<100	<200	<100	<400	<200	<100	<100
Sodium (Na)-Total	mg/kg wwt	120 - 20	<20	<20	<40	<20	<20	<40	<120	<40	<80	<20	<40	<20	<80	<40	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	1.97	3.14	7.26	3.31	8.20	4.92	7.74	8.43	6.00	7.39	5.77	8.09	20.7	9.74	3.38	6.83
Strontium (Sr)-Total	mg/kg wwt	0.01	0.469	0.792	1.97	0.686	1.83	0.960	2.17	1.63	3.08	1.72	2.23	1.54	4.39	1.89	0.884	1.98
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total	mg/kg wwt	0.0004	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Thorium (Th)-Total	mg/kg	0.01	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/kg wwt	0.002	<0.0020	0.0034	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	mg/kg	0.02	0.152	0.143	0.321	0.078	0.342	0.482	0.908	0.839	0.195	0.168	0.598	2.01	1.00	0.599	0.148	0.459
Tin (Sn)-Total	mg/kg wwt	0.004	0.0364	0.0361	0.0870	0.0161	0.0764	0.0940	0.254	0.162	0.0999	0.0391	0.231	0.381	0.213	0.116	0.0386	0.133
Titanium (Ti)-Total	mg/kg	0.05	0.159	0.210	0.202	0.195	0.435	0.073	0.096	0.243	0.069	0.171	0.130	0.126	0.166	0.094	0.051	0.102
Titanium (Ti)-Total	mg/kg wwt	0.01	0.038	0.053	0.055	0.040	0.097	0.014	0.027	0.047	0.036	0.040	0.050	0.024	0.035	0.018	0.013	0.030
Uranium (U)-Total	mg/kg	0.002	<0.0020	0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total	mg/kg wwt	0.0004	<0.00040	0.00101	0.00048	<0.00040	<0.00040	<0.00040	<0.00040	0.00043	<0.00040	<0.00040	0.00044	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total	mg/kg	0.02	0.075	0.071	0.112	0.050	0.152	0.021	0.031	0.126	<0.020	0.034	0.031	0.064	0.063	0.060	<0.020	0.021
Vanadium (V)-Total	mg/kg wwt	0.004	0.0178	0.0180	0.0303	0.0104	0.0339	0.0041	0.0088	0.0244	0.0086	0.0078	0.0119	0.0121	0.0133	0.0116	<0.0040	0.0062
Yttrium (Y)-Total	mg/kg	0.01	0.011	0.014	0.014	<0.010	0.015	<0.010	<0.010	0.021	<0.010	<0.010	<0.010	<0.010	0.011	0.010	<0.010	<0.010
Yttrium (Y)-Total	mg/kg wwt	0.002	0.0026	0.0035	0.0038	<0.0020	0.0034	<0.0020	<0.0020	0.0040	<0.0020	<0.0020	<0.0020	<0.0020	0.0023	0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	mg/kg	0.5	10.2	7.56	14.9	7.50	12.4	9.82	8.95	13.6	9.24	14.3	9.64	9.27	15.9	9.14	5.21	11.0
Zinc (Zn)-Total	mg/kg wwt	0.1	2.44	1.91	4.05	1.55	2.76	1.92	2.51	2.63	4.74	3.34	3.72	1.76	3.37	1.78	1.36	3.19
Zirconium (Zr)-Total	mg/kg	0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040

Appendix 7. Plant Tissue Metal Analysis Results for *Ribes* sp. Berry Samples Collected in 2012

RESULTS OF ANALYSIS						
Sample ID			RN-3 RIBES SP.	RS-1 RIBES SP.	RS-2 RIBES SP.	RS-3 RIBES SP.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection	L1227199-17	L1227199-18	L1227199-19	L1227199-20
Matrix	Units	Limit	Tissue	Tissue	Tissue	Tissue
Physical Tests						
% Moisture	%	0.1	70.3	81.6	76.6	82.0
Metals		0				
Aluminum (Al)-Total	mg/kg	2	9.1	8.1	7.7	9.7
Aluminum (Al)-Total	mg/kg wwt	0.4	2.69	1.50	1.80	1.74
Antimony (Sb)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/kg	0.02	<0.020	0.020	<0.020	0.022
Arsenic (As)-Total	mg/kg wwt	0.004	0.0059	<0.0040	0.0042	0.0041
Barium (Ba)-Total	mg/kg	0.05	22.6	8.46	10.5	12.2
Barium (Ba)-Total	mg/kg wwt	0.01	6.73	1.56	2.45	2.20
Beryllium (Be)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg	1	10.6	10.8	14.6	11.9
Boron (B)-Total	mg/kg wwt	0.2	3.14	1.98	3.41	2.15
Cadmium (Cd)-Total	mg/kg	0.01	<0.010	<0.010	0.011	0.014
Cadmium (Cd)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	0.0026	0.0026
Calcium (Ca)-Total	mg/kg	12 - 3	4390	4210	4680	3960
Calcium (Ca)-Total	mg/kg wwt	3 - 0.5	1300	774	1090	714
Cesium (Cs)-Total	mg/kg	0.005	<0.0050	<0.0050	0.0065	<0.0050
Cesium (Cs)-Total	mg/kg wwt	0.001	<0.0010	<0.0010	0.0015	<0.0010
Chromium (Cr)-Total	mg/kg	0.05	<0.050	<0.050	<0.050	0.078
Chromium (Cr)-Total	mg/kg wwt	0.01	0.012	<0.010	0.010	0.014
Cobalt (Co)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020
Cobalt (Co)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040
Copper (Cu)-Total	mg/kg	0.05	2.69	4.28	5.32	2.28
Copper (Cu)-Total	mg/kg wwt	0.01	0.801	0.786	1.24	0.411
Gallium (Ga)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020
Gallium (Ga)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	mg/kg	1	16.4	33.0	31.5	23.8
Iron (Fe)-Total	mg/kg wwt	0.2	4.86	6.08	7.37	4.30
Lead (Pb)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020
Lead (Pb)-Total	mg/kg wwt	0.004	0.0040	<0.0040	<0.0040	<0.0040
Lithium (Li)-Total	mg/kg	0.1	<0.10	<0.10	<0.10	<0.10
Lithium (Li)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	mg/kg	20 - 5	1020	1050	1160	1160
Magnesium (Mg)-Total	mg/kg wwt	6 - 1	302	194	270	210
Manganese (Mn)-Total	mg/kg	0.02	7.25	9.21	6.65	8.48
Manganese (Mn)-Total	mg/kg wwt	0.004	2.15	1.69	1.55	1.53
Mercury (Hg)-Total	mg/kg	0.01 - 0.005	<0.0050	<0.0050	<0.0050	<0.0050
Mercury (Hg)-Total	mg/kg wwt	0.003 - 0.001	<0.0010	<0.0010	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg	0.02	0.414	0.453	0.236	0.609
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.123	0.0834	0.0551	0.110
Nickel (Ni)-Total	mg/kg	0.05	0.179	0.323	0.714	0.236
Nickel (Ni)-Total	mg/kg wwt	0.01	0.053	0.059	0.167	0.043
Phosphorus (P)-Total	mg/kg	80 - 20	1580	1870	2010	2380
Phosphorus (P)-Total	mg/kg wwt	30 - 5	470	345	470	429
Potassium (K)-Total	mg/kg	400 - 100	14300	17100	15700	13700
Potassium (K)-Total	mg/kg wwt	120 - 20	4250	3150	3660	2480
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	3.10	4.32	7.49	2.97
Rubidium (Rb)-Total	mg/kg wwt	0.01	0.921	0.794	1.75	0.536
Selenium (Se)-Total	mg/kg	0.1	<0.10	<0.10	<0.10	<0.10

Appendix 7. Plant Tissue Metal Analysis Results for *Ribes* sp. Berry Samples Collected in 2012

RESULTS OF ANALYSIS						
Sample ID			RN-3 RIBES SP.	RS-1 RIBES SP.	RS-2 RIBES SP.	RS-3 RIBES SP.
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227199-17	L1227199-18	L1227199-19	L1227199-20
Matrix	Units		Tissue	Tissue	Tissue	Tissue
Metals (cont'd)						
Selenium (Se)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020
Sodium (Na)-Total	mg/kg	400 - 100	<100	<100	<100	<100
Sodium (Na)-Total	mg/kg wwt	120 - 20	<20	<20	<20	<20
Strontium (Sr)-Total	mg/kg	0.05	11.4	5.78	7.10	4.54
Strontium (Sr)-Total	mg/kg wwt	0.01	3.40	1.06	1.66	0.818
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total	mg/kg wwt	0.0004	<0.00040	<0.00040	<0.00040	<0.00040
Thorium (Th)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	mg/kg	0.02	0.118	0.090	0.256	2.84
Tin (Sn)-Total	mg/kg wwt	0.004	0.0352	0.0166	0.0599	0.513
Titanium (Ti)-Total	mg/kg	0.05	0.102	0.144	0.115	0.163
Titanium (Ti)-Total	mg/kg wwt	0.01	0.030	0.026	0.027	0.029
Uranium (U)-Total	mg/kg	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total	mg/kg wwt	0.0004	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total	mg/kg	0.02	0.030	0.051	0.054	0.061
Vanadium (V)-Total	mg/kg wwt	0.004	0.0090	0.0093	0.0127	0.0109
Yttrium (Y)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010
Yttrium (Y)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	mg/kg	0.5	6.29	13.0	13.8	9.42
Zinc (Zn)-Total	mg/kg wwt	0.1	1.87	2.40	3.22	1.70
Zirconium (Zr)-Total	mg/kg	0.2	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.040	<0.040	<0.040	<0.040

Appendix 8

Plant Tissue Metal Analysis Results for *Viburnum edule* Berry Samples Collected in 2012

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Appendix 8. Plant Tissue Metal Analysis Results for *Viburnum edule* Berry Samples Collected in 2012

RESULTS OF ANALYSIS																
Sample ID			E-1 V.EDULE	E-2 V.EDULE	E-3 V.EDULE	S-1 V.EDULE	S-2 V.EDULE	S-3 V.EDULE	NE-1 V.EDULE	NE-2 V.EDULE	NE-3 V.EDULE	RN-1 V.EDULE	RN-2 V.EDULE	RN-3 V.EDULE	RS-1 V.EDULE	RS-2 V.EDULE	RS-3 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227197-1	L1227197-2	L1227197-3	L1227197-4	L1227197-5	L1227197-6	L1227197-7	L1227197-8	L1227197-9	L1227197-10	L1227197-11	L1227197-12	L1227197-13	L1227197-14	L1227197-15
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																	
% Moisture	%	0.10	85.3	74.1	85.5	80.4	84.7	81.1	84.2	82.2	84.3	83.4	87.1	81.7	86.0	84.4	85.5
Metals																	
Aluminum (Al)-Total	mg/kg	2.00	21.7	21.1	8.9	3.7	20.6	27.0	2.5	<2.0	5.6	4.8	11.3	3.3	3.0	2.0	4.9
Aluminum (Al)-Total	mg/kg wwt	0.40	3.19	5.48	1.29	0.72	3.14	5.11	<0.40	<0.40	0.87	0.79	1.45	0.61	0.41	<0.40	0.71
Antimony (Sb)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Arsenic (As)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Barium (Ba)-Total	mg/kg	0.05	13.8	7.46	6.82	9.84	7.97	7.09	6.01	3.85	6.84	14.5	12.4	14.9	4.47	8.76	7.55
Barium (Ba)-Total	mg/kg wwt	0.01	2.03	1.93	0.989	1.93	1.22	1.34	0.946	0.683	1.07	2.41	1.60	2.73	0.627	1.37	1.09
Beryllium (Be)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg	1.00	20.9	20.1	23.3	14.3	18.6	12.7	22.6	18.7	18.6	16.7	19.3	18.3	13.3	17.2	18.2
Boron (B)-Total	mg/kg wwt	0.20	3.08	5.21	3.38	2.82	2.83	2.41	3.56	3.32	2.92	2.77	2.49	3.35	1.86	2.69	2.64
Cadmium (Cd)-Total	mg/kg	0.01	0.063	0.095	0.115	0.101	0.084	0.027	0.082	0.038	0.032	0.119	0.088	0.164	0.114	0.193	0.139
Cadmium (Cd)-Total	mg/kg wwt	0.00	0.0093	0.0248	0.0167	0.0198	0.0128	0.0052	0.0129	0.0067	0.0049	0.0197	0.0114	0.0300	0.0159	0.0301	0.0202
Calcium (Ca)-Total	mg/kg	30 - 6	3040	1640	1820	2090	2250	2270	2270	848	1520	1930	1940	2170	1800	1960	1580
Calcium (Ca)-Total	mg/kg wwt	10 - 1	448	426	264	411	344	430	357	151	238	320	250	397	252	305	229
Cesium (Cs)-Total	mg/kg	0.01	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cesium (Cs)-Total	mg/kg wwt	0.00	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium (Cr)-Total	mg/kg	0.05	0.155	0.116	0.069	0.056	0.120	0.098	0.077	<0.050	0.082	0.096	0.082	0.069	0.071	0.073	0.057
Chromium (Cr)-Total	mg/kg wwt	0.01	0.023	0.030	0.010	0.011	0.018	0.019	0.012	<0.010	0.013	0.016	0.011	0.013	<0.010	0.011	<0.010
Cobalt (Co)-Total	mg/kg	0.02	0.031	0.023	0.027	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Cobalt (Co)-Total	mg/kg wwt	0.00	0.0046	0.0059	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Copper (Cu)-Total	mg/kg	0.05	6.31	2.07	3.56	3.42	4.74	3.05	3.33	1.80	2.97	3.35	2.96	3.30	1.84	2.24	2.64
Copper (Cu)-Total	mg/kg wwt	0.01	0.929	0.538	0.516	0.672	0.723	0.577	0.524	0.320	0.466	0.555	0.381	0.603	0.258	0.350	0.383
Gallium (Ga)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Gallium (Ga)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	mg/kg	1.00	32.8	16.1	21.2	12.5	30.2	38.7	10.6	5.3	13.6	21.0	27.9	11.1	13.5	13.1	16.1
Iron (Fe)-Total	mg/kg wwt	0.20	4.83	4.18	3.07	2.45	4.61	7.32	1.68	0.94	2.13	3.49	3.59	2.03	1.89	2.04	2.33
Lead (Pb)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lead (Pb)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Lithium (Li)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lithium (Li)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	mg/kg	50 - 10	1670	879	1200	1010	1140	1080	1020	898	1130	1280	1150	1130	924	958	914
Magnesium (Mg)-Total	mg/kg wwt	20 - 2	246	228	174	199	175	204	161	159	177	211	148	207	129	150	132
Manganese (Mn)-Total	mg/kg	0.02	4.35	1.87	2.60	3.28	4.51	2.61	2.28	0.975	1.84	4.12	4.52	2.74	1.67	1.95	1.61
Manganese (Mn)-Total	mg/kg wwt	0.00	0.641	0.486	0.377	0.644	0.689	0.493	0.360	0.173	0.288	0.683	0.582	0.502	0.234	0.304	0.234
Mercury (Hg)-Total	mg/kg	0.01	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Mercury (Hg)-Total	mg/kg wwt	0.002 - 0.001	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg	0.02	0.045	0.022	0.031	0.084	0.027	0.107	0.023	0.028	0.034	0.041	0.036	0.085	0.070	0.086	0.058
Molybdenum (Mo)-Total	mg/kg wwt	0.00	0.0066	0.0057	0.0045	0.0166	0.0041	0.0203	<0.0040	0.0050	0.0053	0.0068	0.0046	0.0155	0.0098	0.0134	0.0083
Nickel (Ni)-Total	mg/kg	0.05	1.58	0.148	0.716	0.649	0.543	0.618	1.22	0.099	0.758	1.61	0.702	0.239	0.256	0.465	0.332
Nickel (Ni)-Total	mg/kg wwt	0.01	0.233	0.038	0.104	0.127	0.083	0.117	0.192	0.018	0.119	0.266	0.090	0.044	0.036	0.073	0.048
Phosphorus (P)-Total	mg/kg	200 - 40	2500	1330	1740	1560	1790	1700	1470	1350	1750	2070	1980	1610	1140	1620	1490

Appendix 8. Plant Tissue Metal Analysis Results for *Viburnum edule* Berry Samples Collected in 2012

RESULTS OF ANALYSIS																
Sample ID			E-1 V.EDULE	E-2 V.EDULE	E-3 V.EDULE	S-1 V.EDULE	S-2 V.EDULE	S-3 V.EDULE	NE-1 V.EDULE	NE-2 V.EDULE	NE-3 V.EDULE	RN-1 V.EDULE	RN-2 V.EDULE	RN-3 V.EDULE	RS-1 V.EDULE	RS-2 V.EDULE	RS-3 V.EDULE
Date Sampled			18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12	18-SEP-12
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		Realized Detection Limit	L1227197-1	L1227197-2	L1227197-3	L1227197-4	L1227197-5	L1227197-6	L1227197-7	L1227197-8	L1227197-9	L1227197-10	L1227197-11	L1227197-12	L1227197-13	L1227197-14	L1227197-15
Matrix	Units		Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Metals (cont'd)																	
Phosphorus (P)-Total	mg/kg wwt	100 - 10	368	340	251	307	273	322	231	240	274	343	255	295	160	253	215
Potassium (K)-Total	mg/kg	1000 - 200	14200	9900	10800	10800	10900	10300	11300	9760	11600	12400	13000	10200	10800	10300	13400
Potassium (K)-Total	mg/kg wwt	400 - 40	2090	2560	1560	2120	1660	1960	1770	1730	1820	2060	1680	1870	1510	1610	1940
Rhenium (Re)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	0.05	4.87	2.16	8.12	1.54	3.19	2.55	6.37	5.56	5.94	4.61	12.7	3.82	2.96	3.50	3.15
Rubidium (Rb)-Total	mg/kg wwt	0.01	0.717	0.560	1.18	0.302	0.487	0.482	1.00	0.987	0.931	0.764	1.64	0.698	0.415	0.546	0.456
Selenium (Se)-Total	mg/kg	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10
Selenium (Se)-Total	mg/kg wwt	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sodium (Na)-Total	mg/kg	1000 - 200	<1000	<1000	<200	<200	<200	<200	<200	<500	<200	<200	<200	<200	<200	<200	<200
Sodium (Na)-Total	mg/kg wwt	400 - 40	<200	<400	<40	<40	<40	<40	<40	<100	<40	<40	<40	<40	<40	<40	<40
Strontium (Sr)-Total	mg/kg	0.05	3.17	3.55	2.19	2.41	3.10	2.56	2.68	1.38	2.43	2.69	2.42	5.42	2.05	2.47	1.93
Strontium (Sr)-Total	mg/kg wwt	0.01	0.466	0.922	0.318	0.473	0.473	0.485	0.422	0.245	0.381	0.446	0.311	0.991	0.287	0.385	0.279
Tellurium (Te)-Total	mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	0.00	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total	mg/kg wwt	0.00	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Thorium (Th)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/kg wwt	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	mg/kg	0.02	0.932	0.142	2.37	0.342	0.279	0.167	0.366	0.084	2.47	1.98	3.42	0.787	2.57	2.35	0.700
Tin (Sn)-Total	mg/kg wwt	0.00	0.137	0.0368	0.343	0.0671	0.0426	0.0316	0.0577	0.0148	0.387	0.329	0.440	0.144	0.360	0.366	0.101
Titanium (Ti)-Total	mg/kg	0.05	0.144	0.203	0.074	0.063	0.274	0.534	<0.050	<0.050	<0.050	<0.050	0.199	<0.050	0.058	<0.050	0.087
Titanium (Ti)-Total	mg/kg wwt	0.01	0.021	0.053	0.011	0.012	0.042	0.101	<0.010	<0.010	<0.010	<0.010	0.026	<0.010	<0.010	<0.010	0.013
Uranium (U)-Total	mg/kg	0.00	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0027	<0.0020	<0.0020
Uranium (U)-Total	mg/kg wwt	0.00	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total	mg/kg	0.02	0.083	0.100	0.036	<0.020	0.113	0.140	<0.020	<0.020	<0.020	<0.020	0.042	<0.020	0.023	<0.020	0.057
Vanadium (V)-Total	mg/kg wwt	0.00	0.0122	0.0260	0.0052	<0.0040	0.0173	0.0265	<0.0040	<0.0040	<0.0040	<0.0040	0.0054	<0.0040	<0.0040	<0.0040	0.0083
Yttrium (Y)-Total	mg/kg	0.01	<0.010	<0.010	<0.010	<0.010	0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Yttrium (Y)-Total	mg/kg wwt	0.00	<0.0020	0.0025	<0.0020	<0.0020	<0.0020	0.0026	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	mg/kg	0.50	12.5	4.48	12.0	9.94	11.4	6.70	6.28	6.93	6.16	8.60	10.1	9.90	9.25	9.80	8.59
Zinc (Zn)-Total	mg/kg wwt	0.10	1.83	1.16	1.74	1.95	1.73	1.27	0.99	1.23	0.97	1.43	1.30	1.81	1.30	1.53	1.24
Zirconium (Zr)-Total	mg/kg	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040

Appendix 9

Plant Tissue Metal Analysis Results for *Carex* sp. Samples Collected from Wetlands in 2010 and 2011

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Appendix 9. Plant Tissue Metal Analysis Results for *Carex* sp. Samples Collected from Wetlands in 2010 and 2011

RESULTS OF ANALYSIS																			
Sample ID	Reference	Reference	Reference	LW11	LW11	LW11	RW3	RW3	RW3	MW01	MW01	MW01	MW01	MW01	MW01	MW07	MW07	MW07	MW12
Date Sampled	17-AUG-10	17-AUG-10	17-AUG-10	18-AUG-10	18-AUG-10	18-AUG-10	19-AUG-10	19-AUG-10	19-AUG-10	19-AUG-10	19-AUG-10	19-AUG-10	21-JUN-11	21-JUN-11	21-JUN-11	21-JUN-11	21-JUN-11	21-JUN-11	21-JUN-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L922661-28	L922661-29	L922661-30	L922661-31	L922661-32	L922661-33	L922661-34	L922661-35	L922661-36	L922661-37	L922661-38	L922661-39	L1023099-1	L1023099-2	L1023099-3	L1023099-4	L1023099-5	L1023099-6	L1023099-7
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Metals																			
Aluminum (Al)-Total dw dw	85	74	171	18	15	<10	57	12	<10	51	50	53	<10	14	<10	<10	<10	<10	<10
Aluminum (Al)-Total ww	26.2	21.3	52.0	8.2	5.6	3.7	20.0	4.1	2.9	18.8	18.0	19.6	2.3	4.5	2.2	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total dw dw	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total ww	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total dw dw	0.363	0.314	0.358	<0.050	0.066	0.056	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.052	0.050	0.078	<0.050	<0.050	<0.050
Arsenic (As)-Total ww	0.112	0.091	0.108	0.021	0.025	0.023	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	0.020	0.018	0.023	<0.010	<0.010	<0.010
Barium (Ba)-Total dw	40.4	24.7	34.5	36.4	8.18	5.16	44.0	41.7	56.2	132	93.3	166	40.6	51.0	31.4	10.6	7.41	9.17	19.0
Barium (Ba)-Total ww	12.4	7.15	10.5	16.7	3.14	2.14	15.6	14.2	19.3	49.2	33.6	60.5	16.4	19.7	11.4	3.45	2.34	2.78	6.79
Beryllium (Be)-Total dw	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total ww	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total dw	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total ww	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total dw	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.077	0.188	0.268	<0.030
Cadmium (Cd)-Total ww	0.0068	<0.0050	0.0082	0.0085	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0090	0.0062	0.0268	0.0580	0.0759	<0.0050
Calcium (Ca)-Total dw	5170	3680	3270	4560	2260	2280	7890	9300	7460	7700	6290	7990	4000	3950	3730	1510	1300	1280	2660
Calcium (Ca)-Total ww	1590	1060	991	2090	868	946	2790	3180	2560	2860	2260	2920	1510	1430	1200	520	429	405	872
Chromium (Cr)-Total dw	1.29	1.54	2.94	1.00	0.68	0.64	0.79	1.13	0.81	2.99	2.99	3.69	0.78	1.46	1.23	<0.50	<0.50	<0.50	<0.50
Chromium (Cr)-Total ww	0.40	0.45	0.89	0.46	0.26	0.26	0.28	0.39	0.28	1.11	1.07	1.35	0.33	0.53	0.40	0.14	0.12	0.10	0.13
Cobalt (Co)-Total dw	0.10	0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total ww	0.031	0.030	0.048	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	0.021	0.022	<0.020	0.031	0.047	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total dw	1.33	1.49	14.6	9.58	1.94	1.62	3.42	1.31	1.19	2.16	1.94	3.79	1.65	5.97	5.25	7.07	7.54	6.96	1.11
Copper (Cu)-Total ww	0.408	0.430	4.41	4.37	0.744	0.672	1.21	0.447	0.409	0.802	0.698	1.38	0.613	2.10	1.66	2.28	2.35	2.12	0.346
Lead (Pb)-Total dw	0.19	0.14	0.53	0.32	0.38	0.20	0.42	0.30	0.17	0.45	0.42	0.48	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)-Total ww	0.060	0.042	0.159	0.146	0.145	0.084	0.149	0.102	0.060	0.165	0.152	0.175	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total dw	<0.50	<0.50	<0.50	1.18	1.40	1.84	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total ww	<0.10	<0.10	<0.10	0.54	0.54	0.77	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total dw	1880	1560	1460	2420	1500	1390	4710	4740	5290	1960	1950	2040	1430	1050	1220	1470	1460	1520	949
Magnesium (Mg)-Total ww	579	453	442	1100	576	578	1670	1620	1810	729	702	745	528	368	384	488	461	469	295
Manganese (Mn)-Total dw	107	87.6	104	131	66.2	59.5	249	239	285	165	182	154	160	472	231	263	389	267	164
Manganese (Mn)-Total ww	33.0	25.4	31.6	59.9	25.4	24.7	88.3	81.7	97.8	61.4	65.6	56.5	63.5	174	77.1	91.9	130	85.6	54.1
Mercury (Hg)-Total dw	<0.0050	0.0057	<0.0050	0.0054	<0.0050	<0.0050	0.0057	0.0065	<0.0050	0.0060	0.0056	<0.0050	0.0067	0.0107	0.0058	0.0210	0.0104	0.0112	<0.0050
Mercury (Hg)-Total ww	0.0012	0.0017	0.0015	0.0025	0.0018	0.0020	0.0020	0.0022	0.0015	0.0022	0.0020	0.0017	0.0025	0.0038	0.0018	0.0066	0.0032	0.0036	0.0011
Molybdenum (Mo)-Total dw	2.18	1.93	1.24	1.09	0.116	0.105	0.275	0.231	0.446	0.399	0.383	0.746	1.21	1.96	1.44	14.9	6.89	4.10	0.271
Molybdenum (Mo)-Total ww	0.670	0.558	0.375	0.497	0.045	0.044	0.097	0.079	0.153	0.148	0.138	0.273	0.479	0.728	0.485	5.20	2.29	1.32	0.090
Nickel (Ni)-Total dw	1.22	2.09	1.74	0.87	<0.50	<0.50	<0.50	0.58	<0.50	1.41	1.41	1.64	0.53	0.86	0.83	2.38	2.96	3.09	<0.50
Nickel (Ni)-Total ww	0.38	0.60	0.53	0.40	0.16	0.16	0.16	0.20	0.14	0.52	0.51	0.60	0.20	0.31	0.27	0.78	0.91	0.91	<0.10
Selenium (Se)-Total dw	<1.0	<1.0	<1.0	2.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total ww	<0.20	<0.20	<0.20	0.95	0.38	0.38	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Strontium (Sr)-Total dw	18.8	13.2	14.1	38.5	20.9	16.8	27.3	30.3	27.4	14.4	11.4	15.4	6.26	8.25	5.11	2.09	1.90	1.90	2.82
Strontium (Sr)-Total ww	5.77	3.81	4.26	17.6	8.03	6.96	9.66	10.4	9.42	5.36	4.12	5.63	2.36	2.86	1.66	0.695	0.566	0.585	0.899
Thallium (Tl)-Total dw	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total ww	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total dw	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total ww	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total dw	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total ww	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total dw	<0.50	<0.50	0.66	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vanadium (V)-Total ww	0.12	<0.10	0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	0.13	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total dw	12.8	15.6	10.7	34.2	13.9	11.5	24.1	19.2	28.4	15.2	12.4	19.9	21.6	33.1	35.8	42.4	40.1	39.9	21.3
Zinc (Zn)-Total ww	3.94	4.51	3.24	15.6	5.34	4.77	8.52	6.56	9.75	5.65	4.46	7.30	7.54	10.8	10.5	12.9	11.7	11.3	6.16

Appendix 9. Plant Tissue Metal Analysis Results for *Carex sp*. Samples Collected from Wetlands in 2010 and 2011

RESULTS OF ANALYSIS								
Sample ID	**MW12**	**MW12**	**MW14**	**MW14**	**MW14**	**MW22**	**MW22**	**MW22**
Date Sampled	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**	**21-JUN-11**
Time Sampled	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
ALS Sample ID	**L1023099-8**	**L1023099-9**	**L1023099-10**	**L1023099-11**	**L1023099-12**	**L1023099-13**	**L1023099-14**	**L1023099-15**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Metals								
Aluminum (Al)-Total dw dw	<10	<10	<10	<10	28	<10	<10	<10
Aluminum (Al)-Total ww	<2.0	<2.0	2.0	2.2	6.8	<2.0	<2.0	<2.0
Antimony (Sb)-Total dw dw	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony (Sb)-Total ww	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total dw dw	<0.050	<0.050	<0.050	<0.050	0.052	<0.050	0.077	<0.050
Arsenic (As)-Total ww	0.013	<0.010	<0.010	0.012	0.012	<0.010	0.021	<0.010
Barium (Ba)-Total dw	15.7	18.1	48.2	47.2	47.7	24.7	25.1	31.1
Barium (Ba)-Total ww	5.40	5.40	16.1	16.5	13.4	8.70	9.20	9.99
Beryllium (Be)-Total dw	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Beryllium (Be)-Total ww	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total dw	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total ww	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total dw	<0.030	<0.030	0.129	0.167	0.115	<0.030	<0.030	<0.030
Cadmium (Cd)-Total ww	<0.0050	<0.0050	0.0409	0.0560	0.0301	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total dw	2400	2570	4610	4190	4660	3520	3660	3660
Calcium (Ca)-Total ww	867	813	1410	1370	1230	1140	1210	1060
Chromium (Cr)-Total dw	<0.50	<0.50	1.03	1.26	2.44	0.58	<0.50	<0.50
Chromium (Cr)-Total ww	0.13	0.12	0.32	0.42	0.66	0.21	0.12	<0.10
Cobalt (Co)-Total dw	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total ww	<0.020	<0.020	0.021	<0.020	0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total dw	0.833	0.707	12.2	9.95	10.5	2.51	1.95	2.17
Copper (Cu)-Total ww	0.285	0.204	3.60	3.13	2.60	0.772	0.607	0.602
Lead (Pb)-Total dw	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)-Total ww	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total dw	<0.50	<0.50	0.77	1.54	0.73	<0.50	<0.50	<0.50
Lithium (Li)-Total ww	<0.10	<0.10	0.26	0.43	0.11	<0.10	<0.10	<0.10
Magnesium (Mg)-Total dw	799	1010	1370	1220	1450	1180	1300	1310
Magnesium (Mg)-Total ww	294	310	407	380	359	363	411	363
Manganese (Mn)-Total dw	340	200	193	143	142	91.6	193	140
Manganese (Mn)-Total ww	123	64.5	61.0	48.3	39.4	30.2	65.0	41.3
Mercury (Hg)-Total dw	0.0052	<0.0050	0.0053	<0.0050	0.0054	<0.0050	<0.0050	<0.0050
Mercury (Hg)-Total ww	0.0019	0.0015	0.0016	0.0011	0.0014	0.0011	0.0014	0.0011
Molybdenum (Mo)-Total dw	0.315	0.342	0.579	0.572	0.526	0.340	0.433	0.298
Molybdenum (Mo)-Total ww	0.116	0.114	0.188	0.198	0.147	0.120	0.150	0.087
Nickel (Ni)-Total dw	<0.50	<0.50	1.46	1.45	1.67	<0.50	<0.50	<0.50
Nickel (Ni)-Total ww	<0.10	1.13	0.42	0.49	0.45	0.12	<0.10	<0.10
Selenium (Se)-Total dw	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium (Se)-Total ww	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Strontium (Sr)-Total dw	2.45	2.67	17.6	16.5	15.3	3.55	4.12	4.17
Strontium (Sr)-Total ww	0.849	0.812	5.12	5.13	3.90	1.11	1.30	1.15
Thallium (Tl)-Total dw	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Thallium (Tl)-Total ww	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total dw	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Tin (Sn)-Total ww	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total dw	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total ww	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total dw	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vanadium (V)-Total ww	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total dw	24.3	26.0	33.4	35.1	37.5	22.3	22.8	23.5
Zinc (Zn)-Total ww	7.84	7.40	9.11	10.3	8.93	6.40	6.59	6.06