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HUMAN HEALTH RISK ASSESSMENT OF THE PROPOSED WABUSH 3 MINE PROJECT

FINAL REPORT

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Prepared For: **Callie Andrews, B.Sc., EP**
Iron Ore Company of Canada
2 Avalon Drive
Labrador City, NL
A2V 2Y6

6605 Hurontario Street, Suite 500 , Mississauga, Ontario ▪ L5T 0A3
Tel: 905-364-7800 ▪ Fax: 905-364-7816 ▪ www.intrinsik.com

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HUMAN HEALTH RISK ASSESSMENT OF THE PROPOSED WABUSH 3 MINE PROJECT

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1.0 INTRODUCTION

As part of the Environmental Impact Assessment (EIA) for the Wabush 3 Mine (hereafter referred to as the Project), Iron Ore Company of Canada (IOC) commissioned a Human Health Risk Assessment (HHRA) of possible releases from the mine to address questions and considerations related to potential effects on human health associated with future mine operations.

The HHRA follows standardized guidance (Health Canada, 2012a), and involved a review and evaluation of possible exposure pathways and risks associated with the proposed mine. The focus of the risk assessment was on the possible effect of emissions released from Wabush 3 mining activities on air, soil, water and country foods in nearby areas used by residents for recreational purposes (e.g., skiing, hiking, camping, berry picking, hunting), as well as in the Town of Labrador City (where impacts extend into that area).

Section 2 of this report provides a brief overview of methods, whereas Section 3 provides outcomes of the Problem Formulation of the HHRA. Under Section 4, the Exposure, Hazard and Risk Characterization approaches and results are provided and uncertainties associated with the assessment are provided in Section 5. Section 6 provides conclusions of the HHRA with references being provided in Section 7. A series of appendices are included to provide detailed technical information regarding the assumptions, data and methods used in the HHRA.

2.0 METHODS

A HHRA is a scientific study which estimates the nature and likelihood of the occurrence of adverse health effects in humans following chemical exposures. The fundamental purpose of a HHRA is to estimate whether people working, living, or visiting at a given location are being exposed, or are likely to be exposed to concentrations of chemicals that have the potential to result in adverse health effects. The basic premise in assessing risk is that for risk to be present, a hazard must be present (such as a chemical of concern), along with a viable exposure pathway (such as inhalation of the chemical in air) by which a human (or receptor) can be exposed. If these three components are present (see Figure 2-1), there is a potential for risk to occur, and an assessment of that chemical, exposure pathway and receptor is merited to confirm whether risk is at an acceptable level.

Figure 2-1 Identification of Elements Required for a Potential Risk to be Present

The prediction of people's exposure to specific chemicals in the environment and the potential risks resulting from exposure may be determined through the completion of a site-specific HHRA. A HHRA is a stepwise assessment approach consisting of the main steps outlined below (Health Canada, 2012a):

- **Problem Formulation:** identification of chemicals, receptors and exposure pathways of potential concern;
- **Exposure Assessment:** estimation of exposure of identified receptors to each of the chemicals of potential concern (COPC);
- **Toxicity Assessment:** determination of a health-based exposure limit for each COPC;
- **Risk Characterization:** calculation and/or description of risks associated with the estimated exposures and toxicity, including any uncertainties.

Each of these steps was followed in the current assessment of potential risks related to the proposed Wabush 3 mine (the Project). There are a number of differing levels of effort that can be taken to characterize risks to human health associated with a project ranging from Preliminary Quantitative to a Detailed Quantitative Human Health Risk Assessment approach (which involves quantitatively modeling), as outlined by Health Canada (2012a). Each of these methods provides an adequate evaluation of potential risks but as one moves to the more detailed quantitative approaches, the risk assessment becomes more complex and uncertainties are reduced.

The approach taken in the current assessment is described in the sections which follow.

3.0 PROBLEM FORMULATION

The key tasks requiring evaluation within the problem formulation step included the following:

- A description of the regulatory context and Project/Site;
- Identification of the COPCs to be assessed within the HHRA based on existing data and predictions;
- Identification of receptors of concern, which included those persons with the greatest probability of exposure to COPCs from the Project and those that have the greatest sensitivity to these chemicals;
- Identification of exposure pathways and scenarios based on consideration of various factors that influence the means by which receptors come into contact with COPCs in environmental media including: chemical-specific parameters; characteristics of the site, such as physical geography, geology, and hydrogeology; as well as the physiology and behaviour patterns of receptors

3.1 Regulatory Context and Project Description

The proposed Project is undergoing an Environmental Impact Assessment (EIA), under the provincial processes, as outlined in the registration document for the Project (IOC, 2013). As described in IOC (2013), the Wabush 3 Project will include an open pit mine (estimated 900 M tonnes of iron ore) located within IOCs existing property boundary and active mine lease. IOC has several active open pits, and they have identified a need to create a new mine pit to meet future demands.

The Wabush 3 project will operate for a period of approximately 40 years. Mining activities will remove overburden and will create waste rock, and therefore, the mine will have an overburden storage area to the south of the open pit and a waste rock disposal site, northwest of the open pit (see Figure 3-1). Haul roads will be built to connect the open pit to existing ore conveyers and concentrator facilities associated with the Luce Pit area. A groundwater management system will be developed, to dewater the mine and manage surface water flow through the 40 years of operations. Four phases of mining are conceptualized (see Figure 3-1), which include:

- Phase 1 (construction; clearing of overburden; mining of northern section; years 2 to 16);
- Phase 2 (development of the central pit section, with overburden and waste rock removal, mining in the northern and central section; years 17 to 28);
- Phase 3 (development of the southern pit section, with overburden and waste rock removal and mining in all sections; years 29 to 40); and
- Phase 4 (site closure and rehabilitation).

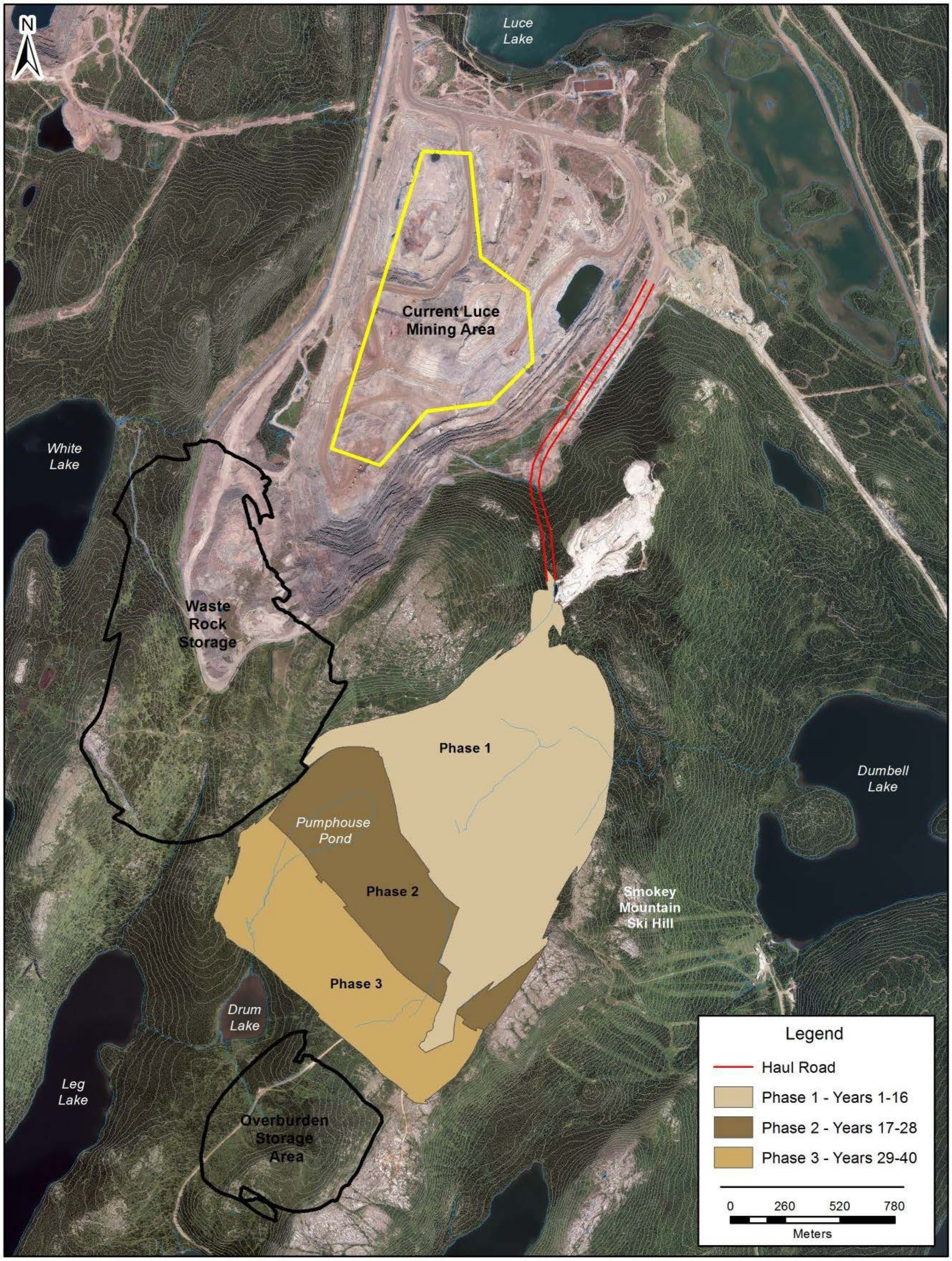

Figure 3-1 Phases of Wabush 3 Project and Main Mining and Storage Areas (IOC, 2013)

The proposed Wabush 3 pit is north of the Town of Labrador City, south of the Luce Pit, and just west of several recreational areas used by the community of Labrador City, including the Smokey Mountain ski hill, and the Nordic ski trails (which are actively used for hiking in summer months). There are also numerous snowmobile trails in the area, as well as hunting and berry picking activities. The vast majority of cottages are remote to the Project, but there is a cottage on Dumbell Lake, which is an area actively used for recreational activities by local residents. Figure 3-2 outlines the location of the proposed Project, relative to the towns of Labrador City, and Wabush as well as recreationally used areas, and cottage locations.

There are a number of lakes or ponds in close proximity to the mine, which are used for recreational activities, including fishing. Figure 3-3 provides an overview of area lakes. The area lakes used for fishing activities including Leg Lake, Pumphouse Pond, Drum Lake, Trout Lake and Dumbell Lake (AMEC, 2014a). Both Pumphouse Pond and Drum Lake will become part of the Project and eventually will no longer be accessible for fishing or other activities.

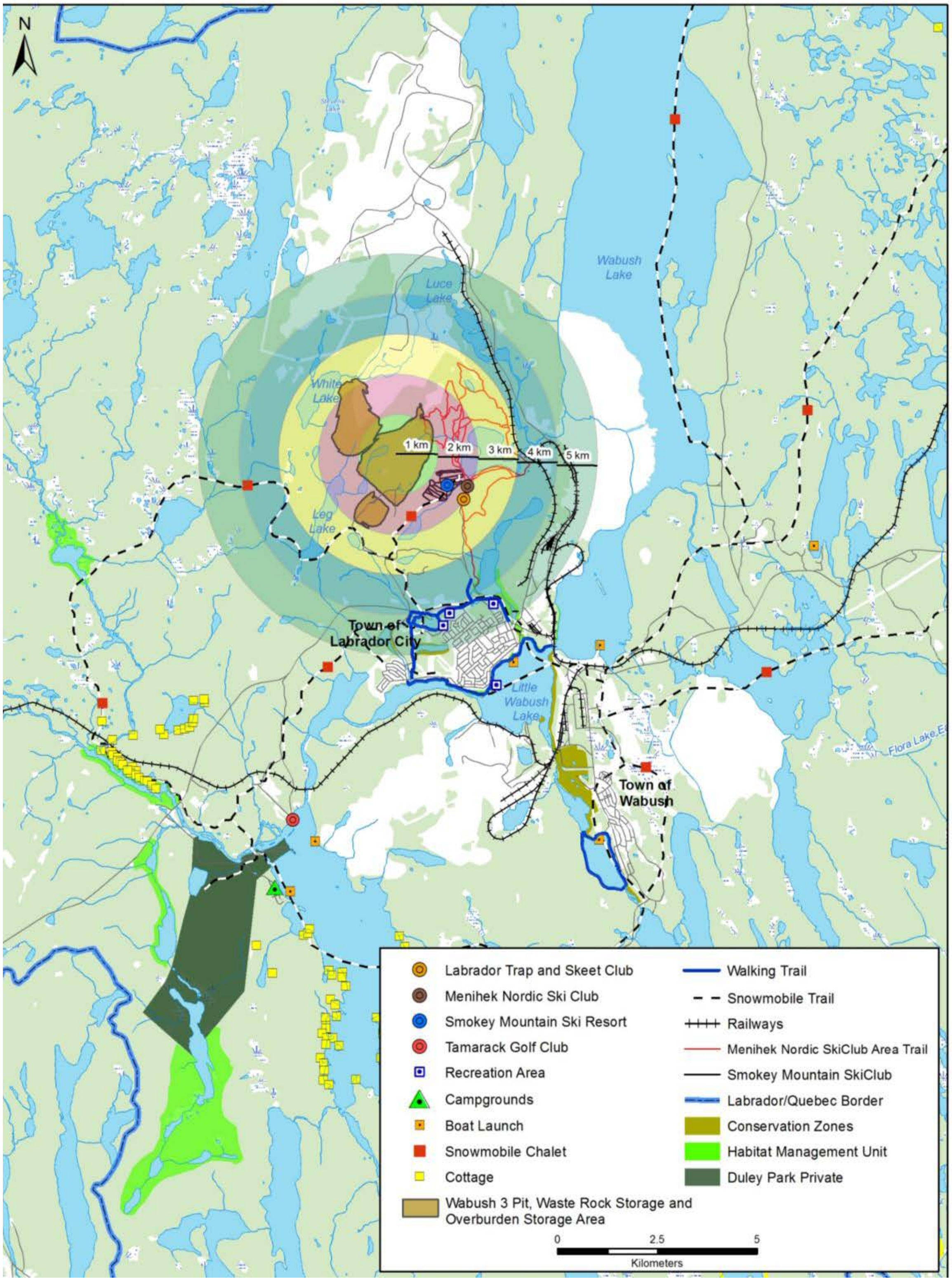

Figure 3-2 Wabush 3 Project - Existing (Regional) Socioeconomic Environment (IOC, 2013)

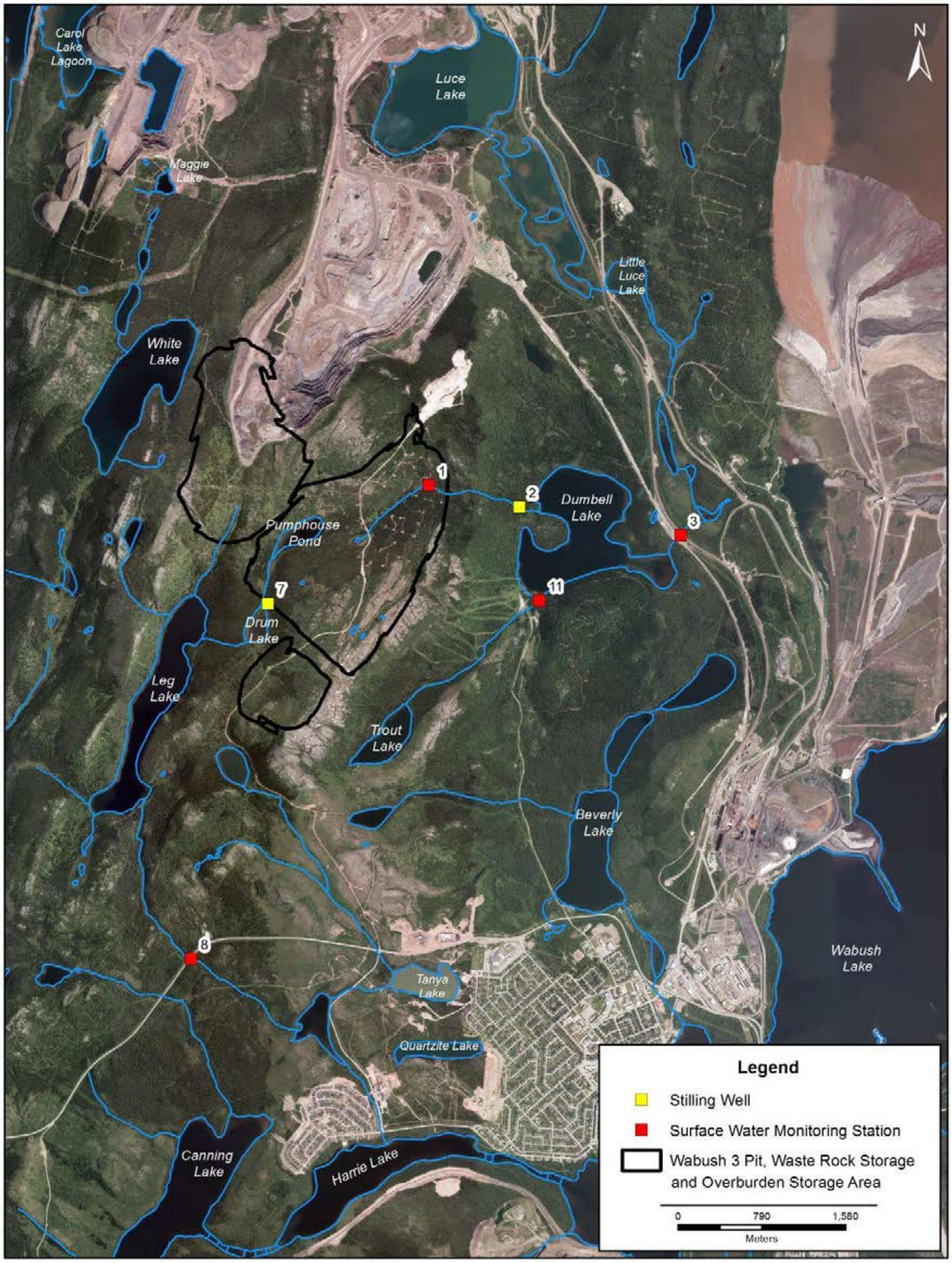

Figure 3-3 Lakes in Project Area (IOC, 2013)

The mine pit will require water removal in order to keep the pit dry (IOC, 2013), groundwater will require pumping out of the main pit area, and will need to be directed into other watershed areas. Golder (2014) conducted a detailed hydrology study investigating water balance for the four stages on mining development, flood flows within the project area, a water management strategy and development of collection ponds, as well as an effects assessment to assess water quantity and quality effects to the watershed area due to the Project. Based on the registration document (IOC, 2013) and the Golder (2014) study, the development of the Wabush 3 pit will reduce total drainage into the Leg Lake and Dumbell Lake watersheds (and to a lesser extent, the White Lake watershed), as well as Leg Lake itself. A water management plan has been developed, to minimize possible impacts related to groundwater and surface water.

While the final dewatering strategy is still being developed, in Phase 1 of mining, dewatering in the active mining area will occur through a settling and treatment system, which will feed into the Dumbell Lake watershed (IOC, 2013). In Phase 2 of mining, dewatering wells will be installed near the pit perimeter to manage groundwater within the pit (Golder, 2014). Drainage from the wells will be managed such that it will have no impact on area surface water quality. Surface water into the mine pit will be managed using settling ponds. Settling ponds will be discharged into Dumbell Lake, following an appropriate settling time, to minimize impacts and mine effluent will be treated through the Luce pit system.

Area lakes will also receive drainage from the waste rock and overburden storage areas, which will be located within both the Leg Lake and White Lake watersheds. Golder (2014) concluded that contributions from these sources represent a small percentage of the total drainage area of each watershed, and hence, water quality impacts are expected to be diluted.

Based on this project description, air emissions from the mine activities (such as dust and gases) could deposit onto area soils. Some of these substances could be taken up by vegetation, and local country foods, to a limited extent, or be transferred to area lakes through runoff and snow melt. The three area lakes that will receive inputs at different stages of mining include:

- Dumbell Lake watershed;
- Leg Lake watershed;.
- White Lake watershed.

These lakes are currently used by local residents for fishing / ice fishing (Leg Lake, Dumbell Lake, White Lake) as well recreational boating activities (Dumbell Lake). In addition, a cottage is located on Dumbell Lake (AMEC, 2014a). Trout Lake is also a nearby water body used for fishing but will not receive inputs from the mine, other than dusting.

3.2 Identification of COPCs

3.2.1 Air

Possible sources of dust and gases which may affect air quality include material handling, crushing of materials, bulldozing, grading of roads, hauling of materials on roads, movement of employee vehicles on the mine road, wind erosion of tailings and combustion of diesel by the various equipment operating at IOC (RWDI, 2014a). Since fuel combustion and earthworks will produce dusts and gases, the air COPCs are largely focused on Criteria Air Contaminants (CACs), such as particulate matter (e.g., fine particulate matter, or $PM_{2.5}$, and the more coarse fraction, known as PM_{10}), as well as sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) and carbon monoxide (CO). Metals will be adhered to these dusts, and therefore metals were also selected for assessment via the air pathway.

To determine the possible metals composition of dusts, the geochemistry of the ore within the vicinity of the proposed Wabush 3 pit was evaluated and reviewed. The following was undertaken:

- IOC provided ore geochemistry and waste assay data for over 5800 samples taken from IOC mining areas, broken down by the major rock types and then weighted to ore, waste rock and total material average qualities. IOC provided the percent composition of each compound in the rock. These data are provided in Appendix A (Tables A-1 and A-2).
- Based on the percent composition data provided by IOC, aluminum, chromium, iron, silica, manganese and titanium were selected for evaluation in the HHRA, due to their predominance within the ore geochemistry and potential toxicity. Silica and iron comprise approximately 70% of the composition of the ore. Calcium, sulphur, phosphorus, sodium, potassium and magnesium, while present in the rock types, were not carried forward for further assessment as these are essential nutrients and would not be considered to be of potential health concern. In total, these elements comprise approximately 5.6% of the total ore geochemistry. The percentages of the COPCs in ore are provided in Table 3-1.
- To provide a check on the metals selected for assessment, the trace metals composition of 25 drill core samples from the Wabush 3 area which were selected to "represent the range of lithologies within the Wabush 3 area" (Lorax, 2014) were examined for percent metal content. Silica was not measured in these samples, and accounts for approximately 40% of the total composition (see Table A-1 and A-2), and hence the percent metal content calculated using the Lorax (2014) data is biased high (i.e., the metals will represent a higher percentage of the total than if silica were included). The 25 samples were weighted based on rock type and percent metal concentrations determined (See Appendix A; Table A-3). Based on these calculations, the only chemicals present at >0.1% were Al, Ba, Ca, Fe, K, Mg, Mn, Na, S and Ti. Of these, Al, Fe, Mn and Ti were selected for evaluation based on core data evaluation and potential toxicity. Ba, Ca, K, Mg, Na and S were not carried forward since they are essential nutrients and would not be expected to impact health.

Table 3-1 COPCs in Air on Dusts and Percent Metal in Ore		
Metal	***Percent %***	***Comment***
Aluminum (Al)	1.03	Calculated from percent composition of Al_2O_3 in ore (1.94%) [a]
Chromium (Cr)	0.021	Calculated from percent composition of Cr_2O_3 in ore (0.03%) [a]
Iron (Fe)	31.82	
Manganese (Mn)	0.73	
Silica (SiO_2)	39.73	
Titanium (Ti)	0.29	Calculated from percent composition of TiO_2 in ore (0.48%) [a]

Notes:
See Appendix A for overall percent composition of ore and how percentages were derived.
[a]. Percent composition of the metal of interest was calculated by first determining the molecular weight of the compound containing the metal of interest. Then the molecular weight of metal of interest in the compound was divided by total molecular weight of compound resulting in percent composition of the metal of interest. For example the molecular weight (mol wt) of Al_2O_3 is 2 x 26.98 (mol wt of Al) + 3 x 16 (mol wt of O) = 101.96. Molecular weight of aluminum (53.96) divided by the total molecular weight (101.96) provided the total percentage of aluminum in the ore of 1.03% (53.96/101.96).

Other potential air quality COPCs could include PAHs and some selected VOCs, which can result from fuel combustion of diesel engines. Benzo(a)pyrene (B(a)P) was selected to represent PAHs, and benzene was selected to represent VOCs. Risks related to other possible VOCs and PAHs will be discussed in the Risk Characterization section, relative to risks estimated for these compounds.

In addition to the more continuous emissions from the Wabush 3 Project, periodic blasting activities will result in short term elevated exposures to a number of substances, including CO, SO_2, NO_2, hydrogen sulphide (H_2S) and total hydrocarbons (THC, as C_4H_8) (RWDI, 2014b). Each of these compounds was assessed in an acute exposure scenario, related to blasting which is discussed in Section 4.4.1.

3.2.2 Soils

Possible COPCs in soils can be present currently in soils, as a result of baseline activities or natural enrichment, and can occur in the future as a result of mining activities. Future soils COPCs will predominantly be linked to dust deposition, and the possible accumulation of metals or other substances as a result of deposition.

Metals in ore dusts present in air (which could deposit on soils, and hence accumulate in soils) were identified in Section 3.2.1 (Table 3-1), and were included as soil COPCs. To identify whether any other metals in soils require assessment in the HHRA as a result of baseline conditions, baseline soil data were screened as follows:

- Data from baseline soil samples collected at 0 to 0.3 m in 2012 (See AMEC, 2012a for raw data) and grab surface samples collected in 2013 by Pinchin LeBlanc Environmental (see Appendix B for 2013 sample results) were combined and evaluated. The maximum detected soil concentration was compared to human-health based soil quality guidelines to determine if baseline metal concentrations were elevated. The results of this comparison are provided in Appendix A (Table A-4). The maximum baseline soil concentration for Al, Co, Fe, Mn, Tl and V were greater than the human health-based guidelines. Al, Fe and Mn were already selected as COPCs via the ore geochemistry screening step (see Table 3-1), and these substances are anticipated to be present in ore dust which will deposit on area soils. Co, Tl and V were not selected as COPCs as they represented a very small percentage of the total metals geochemistry in ore, based on the Lorax (2014) samples (*i.e.*, 0.007%, 0.00003% and 0.008%, respectively), and hence would not be expected to appreciably change in soils as a result of proposed mining activities and dust deposition (See Appendix A; Table A-3). Of the metals that were selected as COPCs from ore (*i.e.*, Al, Cr, Fe, Mn and Ti), Al, Fe and Mn baseline soil concentrations are greater than the human health-based soil quality guidelines. This is likely due to the area being naturally enriched (hence it being an active mining area), but could also include contributions from the IOC pelletizing plant over its many years of operation.

Other potential future soil COPCs as a result of mining activities will include those chemicals released by the mine fleet via fuel combustion that, although only emitted into air, could be expected to deposit nearby and possibly persist or accumulate in the environment in sufficient quantities for people to be exposed via soil, food and water pathways. To identify these substances, the follow was considered:

- Gaseous chemicals (*e.g.*, CO, NO_2, SO_2, volatile organic compounds (VOCs) such as benzene), which are unlikely to contribute to human exposure via secondary pathways as they will remain airborne for extended periods and over extended distances. In addition, the health effects of these gaseous chemicals are strictly related to inhalation (*i.e.*, these act at the point of contact). Accordingly, the gaseous chemicals were removed from further consideration in the multiple pathway assessment and only evaluated in the inhalation assessment.
- Non-gaseous chemicals associated with fuel combustion (*e.g.*, metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbon (PHC) fractions), which may deposit in the vicinity of the mine as a result of fuel combustion and persist or accumulate in the environment in sufficient quantities for residents and recreational users of the area to be exposed via secondary pathways. The potential occurrence of these chemicals in the secondary pathways of exposure required further consideration. Given the nature of the emissions from the mine fleet, only PAHs were assessed for the secondary soil pathway, due to their long half life in soils. Benzo(a)pyrene was used to represent PAH emissions from mine fleet exhaust. Both PHCs and metals related to vehicle exhaust emissions were considered to insignificant compared with the metals on mine dusts (which are already being considered).

3.2.3 Country Foods

Humans can be exposed to chemicals via the consumption of country foods such as berries and other vegetation, small mammals, game birds and fish. Berries and other vegetation could be exposed to mining emissions through both direct deposition of dusts onto vegetation (leaves and above ground plant parts), as well as uptake through soils which have received dust deposition. Small mammals and game birds could be exposed via the consumption of impacted vegetation and incidental soil ingestion. Since uptake is linked to dust deposition, the list of possible COPCs for vegetation and small mammals and game birds is based on that for soils. Gases, such as SO_2, NO_2, benzene, do not accumulate in vegetation, and hence do not require assessment relative to human health via the oral pathway.

Exposure to humans via fish consumption could be altered as a result of the project, if fish tissue concentration were to change as a result of the project. For fish tissues to change, water and/or sediment concentrations would have to be projected to change. Possible mine-related sources to nearby lakes include direct pumping of groundwater from below the mine (for de-watering of the pit) into Leg Lake and Dumbell Lake. Golder (2014) has concluded the potential impact of this additional water on either lake is low, and the Water Resources VEC chapter has concluded insignificant impacts related to water re-direction (AMEC, 2014b). In addition, dusting associated with the Project has the potential to deposit directly on area lakes (and hence affect surface water, and/or sediments) and to deposit on soils or snow present within the watershed areas for the lakes in the near-field of the Project, and possibly run-off into area lakes from soils or snowmelt. The lakes most likely affect by this would include Dumbell Lake and Trout Lake, which are both outside of the areas projected to experience the more predominant dustfall rates (see isopleth figures in Appendix B).

Predicted future soil concentrations at a mixing depth of 20 cm depth suggest low percent changes in soil COPC concentrations (0.3 – 1.5% change; see Table 4-11) following 40 years of operations in areas experiencing higher dustfalls than these lakes. Based on the small predicted change in soil metals levels, any change in sediments or surface water through run off of affected soils into area lakes or direct deposition of dust is likely to be within natural variability of the lakes current chemistry characterization. In addition, the primary COPCs associated with ore dusting (aluminum, chromium, iron, manganese, titanium and silica) are not reported to bioconcentrate to any significant extent in the environment (http://www.oehha.org/air/hot_spots/pdf/apenh.pdf), and hence, concentrations of these COPCs in fish would not be expected to change as a result of surface water or sediment deposition / runoff. Fish in Dumbell Lake and Trout Lake are generally pelagic (Ecometrix, 2012), which would further limit their direct exposures to sediments. Therefore, tissue metal levels of fish were considered to have a limited potential to change as a result of Project emissions. Therefore, potential exposures related to consumption of fish were assessed in Baseline, but no specific Project increment was predicted.

3.2.4 Water

Humans can be exposed to water via direct consumption. The pathways for water to be affected by emissions from the proposed facility are linked to direct release of re-directed groundwater resulting from de-watering activities from within the mine pit to either Dumbell Lake or Leg Lake, dust deposition either directly on area lakes, or as a result of dust runoff from soils contained within the lake watershed. Beverly Lake (the main water supply for the town of Labrador City) will not receive any direct inputs from the mine (through water management or de-watering), and is distant to the mine, with respect to potential impacts related to dust deposition and run-off into the lake. Therefore, Beverly Lake data were not used in the current assessment. Dumbell Lake is currently the backup water supply for the town of Labrador City, and will receive groundwater de-watering inputs in Phase 1 (see Water Resources VEC Chapter; AMEC, 2014b), and the watershed for Dumbell Lake is within the dust deposition area related to the Project, and therefore existing data from this lake was used to characterize baseline conditions.

Since the primary source of impacts could be related to dust deposition on the lake, and run-off from the water shed, the COPCs for water are therefore linked to those identified for soils. With respect to dusting contributions, the COPCs of interest (based on the ore geochemistry COPC list) include aluminum, chromium, iron, manganese, titanium and silica. Concentrations of these elements in Dumbell Lake surface waters are low (see Appendix B, Table B-2). Dusting contributions are anticipated to be within natural variability of the existing surface water chemistry, and hence, no significant change to surface waters is anticipated (see Water Resources VEC chapter (AMEC, 2014b). Of the COPCs listed above, three have Canadian Drinking Water Quality Guidelines (Chromium 0.05 mg/L; Iron 0.3 mg/L; Manganese 0.05 mg/L; CCME, 2014a), and measured concentrations are well below these limits (some of which are aesthetic, rather than health-based). Therefore, water was assessed in Baseline, but no specific Project increment was predicted.

3.2.5 Final COPC List

The final list of COPCs is presented in Table 3-2. Some COPCs are only assessed via the air inhalation route, as they do not appreciably accumulate in soils (COPCs for Inhalation Assessment). Other COPCs are being assessed via both air and oral exposure pathways (COPCs for Multi-pathway Assessment), due to their environmental fate characteristics which enable them to persist in area soils, and potentially accumulate in other media within the environment.

Table 3-2 Final List of COPCs	
COPCs for Multi-pathway Assessment	***COPCs for Inhalation Assessment***
Aluminum (Al)	Nitrogen dioxide (NO_2)
Chromium (Cr)	Sulphur dioxide (SO_2)
Iron (Fe)	Carbon monoxide (CO)
Manganese (Mn)	Respirable particulate matter ($PM_{2.5}$)
Silica (SiO_2)	Inhalable particulate matter (PM_{10})
Titanium (Ti)	Hydrogen sulphide (H_2S)
Benzo(a)pyrene (B(a)P)	Benzene
	C_4H_8

3.3 Identification of Possible Receptors

A human receptor is a hypothetical person (*i.e.*, an infant, toddler, child, teen, or adult) who may reside, spend leisure time and/or work in the area being investigated and is, or could potentially be, exposed to the chemicals identified as being of potential concern. General physical and behavioural characteristics specific to the receptor type (*e.g.*, body weight, exposed surface areas, incidental soil ingestion rate, *etc*.) are used to approximate the amount of chemical exposure received by each receptor. The HHRA must be sufficiently comprehensive to ensure that those receptors with the greatest potential for exposure to COPCs, and those that have the greatest sensitivity, or potential for developing adverse effects from these exposures, are included. With this in mind, the selection of hypothetical receptors, with somewhat exaggerated life style habits (to ensure a conservative assessment), should be developed for consideration in the HHRA. Due to differences in physiological characteristics and activity patterns between children and adults, the exposures received by a child and an adult will be different. Consequently, the potential risks estimated for the same COPC will differ depending on the receptor chosen for evaluation.

With respect to the area potential affected by the Project, only off-site users have been considered in the HHRA. Exposures for mine workers will need to meet all relevant occupational health and safety requirements, and hence, should not be of concern and were not assessed further.

Based on predicted air dispersion patterns related to the Project, the vast majority of dust and air emissions are predicted to occur in areas fairly close to the proposed project area (i.e., 1 to 2 km of the mine pit). This area is largely a recreational area (used for skiing, hiking, hunting, berry picking, *etc*.), and may have a few residents (in cottages) living in the area. Therefore the primary receptors are considered to be a recreational site users (at all life stages), in addition to a cottage dweller (at all life stages). The cottage dweller could be present for limited time frames, or as a permanent resident, based on available information (IOC, personal communications). To ensure a conservative assessment with respect to multi-pathway modelling, receptors were assumed to be in the area on a full-time basis (as residents), which is unlikely for the vast majority of individuals who will only be in the area for a short time when undertaking recreational activities.

For chemicals considered to be carcinogenic, it is common to assess exposure over a lifetime, as development of cancer associated with chemical exposure is a long-term process that may take many years to manifest. Health risks associated with exposure to carcinogenic compounds are usually expressed as an estimate of excess or Incremental Lifetime Cancer Risk (ILCR) for a population resulting from exposure to a particular source. Thus, risks associated with carcinogenic compounds are predicted using the average daily dose over a human receptor's entire life span (*e.g.*, 80 years), or as preferred by Health Canada (2012a), the duration of a specific life stage (*e.g.*, 60-year adult life span).

In order to evaluate potential exposures, it is necessary to characterize the physiological and behavioural characteristics of each receptor group. Several published resources were considered in the selection of these parameters, including but not limited to:

- Federal Contaminated Sites Risk Assessment in Canada. PART I: Guidance on Complex Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRA). (Health Canada, 2012a);
- Compendium of Canadian Human Exposure Factors for Risk Assessment. O'Connor Associates Environmental Inc. (Richardson and O'Connor, 1997);

These sources have been used in numerous HHRAs that have been critically reviewed and accepted by regulatory agencies across Canada and the United States. Both the Compendium of Canadian Human Exposure Factors for Risk Assessment (Richardson and O'Connor, 1997) and Health Canada (2012a) rely on data from published and reliable Canadian sources, such as Health Canada, Statistics Canada, and the Canadian Fitness and Lifestyles Research Institute. While there is an updated version of the Compendium of Canadian Exposure Factors (Richardson and Stantec, 2013), this version has not been used at this time, as no firm statement from Health Canada regarding the acceptance of revised parameter values has been issued to our knowledge.

3.4 Identification of Exposure Scenarios and Operable Pathways

Receptors can come into contact with chemicals in their environment in a variety of ways, depending on their daily activities and land use patterns. The means by which a person comes into contact with a chemical in an environmental medium are referred to as exposure pathways. The means by which a chemical enters the body from the environmental medium are referred to as exposure routes. There are three major exposure routes through which chemicals can enter the body which are inhalation; ingestion; and dermal absorption (*i.e.*, uptake through the skin).

Exposure pathways may require direct contact between receptors and the environmental media of concern (*e.g.*, incidental ingestion of soil), or may be indirect requiring the movement of the chemical from one environmental medium to another (*e.g.*, the deposition of dusts on soils, and uptake through vegetation).

For the residential/recreational site user, all life stages were initially considered, with the results being presented for the most sensitive receptor (i.e., the toddler; age 7 months to 4 years). The modelling assumed that the residential / recreational user could be present in the area 24 hours/day, 7 days/week, 52 weeks/year for their entire life span (Health Canada, 2012a). This assumption overestimates potential exposures to recreational users as they are only in the area for a short period of the day and only on certain days of the year. Similarly, exposures to the residential receptor are overestimated as even full time residents would need to leave the area during some occasions (e.g., to go to town for groceries and other needs, visit friends, vacation).

The recreational/residential site user was assumed to be exposed to COPCs in soils *via* ingestion of soil, inhalation of soil/dust, and direct dermal contact with soil. In addition, exposures through ingestion of vegetation (such as berries), game meats (such as hare and grouse), fish, and water from area lakes, was also assumed to occur. Vegetable garden produce consumption was not considered, as the potentially affected area is remote and the growing season for garden produce is extremely limited. The media–related exposure pathways that were considered for the assessment of human health are described below (Table 3-3), with specific receptor characteristics being presented in Section 4.2.

The focus of this assessment is on the operations phase of the Project. When examining potential emissions from the 3 phases of a mine lifecycle (construction, operations, decommissioning), typically, the operations phase represents the highest predicted emissions scenarios, and hence, all predictions presented in this report are related to this phase.

The following scenarios are being assessed for the Project operations phase:

1) Baseline Scenario:

   For the air assessment, the baseline scenario was characterized by the Future No Build scenario (as provided by RWDI), which included existing baseline of the emissions from the pelletizing plant, as well as emissions related to a potential future expansion of the Luce Pit, and other pits, to the north of the pelletizing plant (which includes potential for increased diesel emissions, and truck traffic).

   For the oral multipathway assessment, measured baseline data were available for soils, berries and water, and hence, baseline was characterized using these data.

2) Project Increment Scenario:

   The potential increment provided by the Wabush 3 Project operations was assessed separately. This increment was obtained by subtracting the Baseline scenario (Future No Build) from the Baseline + Project (Future Build) scenario, for both air and multipathway assessments..

3) Baseline + Project Scenario:

   For the air assessment, the Baseline + Project scenario was represented by the Future Build scenario (as provided by RWDI) which includes the pelletizing plant emissions, as well as Luce Pit and other pits, in their current form, in conjunction with possible emissions related to the Wabush 3 Project.

For the oral multipathway assessment, baseline measured data were combined with the Project increment scenario to provide the Baseline + Project Increment scenario. In addition, baseline measured data were combined with the full Future Build scenario, to enable an assessment of dustfall from other sources (e.g., pelletizing facility and Luce Pit), which will continue to contribute to the environment in the future (Baseline + Future Build scenario).

With respect to temporal and spatial boundaries for the assessment, the proposed project will be mined for an operations period of 40 years. Spatially, the HHRA has considered the air isopleths as defining the potential affected areas related to project emissions.

Table 3-3 Exposure Pathway Identification and Assumptions/Rationale for Selection of Open Exposure Pathways

Media Potentially Influenced by Project	***Open Pathway?***	***Specific Exposure Pathways***	***Comments***
Air	Yes	- Inhalation of outdoor air (dusts; vapours; gases; particulate)	Active recreational areas close to Wabush 3 Mine (cross country ski trails; downhill Ski trails; hiking; hunting and berry picking; cottage locations on Dumbell Lake, etc.)
Soil	Yes	- Ingestion of outdoor soil - Inhalation of outdoor soil - Dermal contact with outdoor soil	Same comment as above; Active use areas in close proximity to Wabush 3 Mine. Snow cover over approximately 7 months of year would limit direct soil contact, but was assumed to be an open pathway 12 months of year
Surface Water	Yes	-Ingestion and dermal contact with surface water (Dumbell Lake is a backup water supply)	Beverly Lake, the main water supply is distant to the influence of the Project; Dumbell Lake is a back up water supply for the town of Labrador City, and hence, could represent drinking water.
Groundwater	Yes	- Ingestion and dermal contact of groundwater	There is limited groundwater consumption in the area, with only wells at a Dumbell Lake cabin, the Smokey Mountain Lodge and Menihek Lodge. Groundwater is not anticipated to change as a result of project activities and as such, Dumbell Lake surface water data were used as a surrogate for drinking water and dermal exposure.
Country Foods	Yes	-Ingestion of game meats, fish and berries within the Project area	Berries and game meats could be influenced by Project activities through the deposition of dusts on area soils, and vegetation. Metals or B(a)P could be taken up via the vegetation, and ingested by upland game birds, or small mammals. These are actively hunted and consumed by residents. Fish in the area are consumed by local residents, but are not anticipated to change in the future, due to limited contributions to area lakes.

4.0 EXPOSURE, HAZARD AND RISK CHARACTERIZATION

4.1 Summary of Approach Taken

The approach taken to characterize and/or predict exposure, hazard and risk for receptors using the area of interest is presented under each of the possibly affected media sections below. Table 4-1 provides a high level summary of the approach, and the various types of information used.

Table 4-1 Summary of Exposure, Hazard and Risk Characterization Approaches for Each Environmental Media Potentially Affected by Project Activities

Media	***Exposure Assessment***		***Hazard Assessment***	***Risk Characterization***
	Baseline	***Baseline + Project***		
Air	Criteria Air Contaminants (CACs) were predicted using air dispersion modelling (including existing pelletizing plant emissions, as well as potential future emissions associated with an already approved expansion of the Luce Pit). For non-CACs, current ground level air concentrations were predicted using a ratio based on NOx emissions (for B(a)P and benzene), or based on the relative contribution of ore dust to PM10 or PM2.5 emissions (for metals).	CACs predicted using air dispersion modelling (including existing pelletizing plant, as well as existing Luce Pit and other pit emissions, and the proposed Wabush 3 Project emissions). For non-CACs, future ground level air concentrations were predicted using a ratio based on NOx emissions (for B(a)P and benzene), or based on the relative contribution of ore dust to PM10 or PM2.5 emissions (for metals). For acute blasting scenario, measured ambient air concentrations from blasting events at Luce Pit were assessed and used to predict potential concentrations associated with Wabush 3 Project blast events.	Human health-based ambient air quality guidelines, standards or reference air concentrations from regulatory agencies; health effects literature, as needed	Comparison of predicted ambient air concentrations to health-based ambient air concentrations, guidelines or standards, for each scenario (Baseline; Project Increment; Baseline + Project) Examination of potential incremental change as a result of the Project.
Soil	Surface soil sampling in Wabush 3 pit area (AMEC, 2012a; 0 to 0.3 m depth); surface soil grab samples taken in fall of 2013 through the hiking trail systems north of Labrador City.	Modelled approach, through the application of annual dustfall rates predicted as a result of project (RWDI, 2014a) onto area soils, with an assumed mixing layer, for 40 years of operations. The potential change in soils as a result of project activities was added to measured baseline. Ore geochemistry provided by IOC was used to characterize potential metals in deposited dusts.	Oral TRVs from appropriate regulatory agencies	Comparisons of exposures as a result of incidental ingestion of predicted Baseline, Project, and Baseline + Project soils, as well as inclusion of other oral pathways (country foods; water - see below) to regulatory oral TRVs. Examination of potential incremental change as a result of the Project.

Table 4-1 Summary of Exposure, Hazard and Risk Characterization Approaches for Each Environmental Media Potentially Affected by Project Activities

Media	***Exposure Assessment***		***Hazard Assessment***	***Risk Characterization***
	Baseline	***Baseline + Project***		
Country Foods	Baseline berry metals concentrations (collected in 2013); for other country foods, a baseline assessment is being undertaken as part of the EIS commitments; baseline tissue concentrations in a representative upland game bird and small mammal were therefore predicted using baseline soil concentrations and models. Similarly, baseline fish concentrations were predicted using standardized approaches.	Modelled approach, through the application of dustfall rates predicted as a result of project (RWDI, 2014a) onto area soils and vegetation directly for the projected 40 year operations phase. Ore geochemistry provided by IOC was used to characterize potential metals in deposited dusts. Uptake factors from literature were used to estimate potential uptake into vegetation / berries by both soil pathway and direct deposition. Small mammal and game bird were estimated using vegetation / berry data. Future fish concentrations were assumed to equal baseline concentrations, as no significant change to water or sediment is predicted to occur (See Water Resources VEC chapter (AMEC, 2014b)	Oral TRVs from appropriate regulatory agencies	Comparisons of exposures as a result of incidental ingestion of Baseline, Project Increment and Baseline + Project predicted future country foods, in conjunction with other oral pathways (incidental soil ingestion; water) to regulatory oral TRVs. Examination of potential incremental change as a result of the Project.
Surface Waters	Baseline metals data from area lakes directly predicted to be affected (Leg Lake; Dumbell Lake), or potentially affected through atmospheric deposition (Dumbell Lake; Trout Lake) and used by area residents were considered	No predicted change to water concentrations as a result of Project activities (see Water Resources VEC chapter (AMEC, 2014b)	Oral TRVs from appropriate regulatory agencies	Comparisons of exposures as a result of incidental ingestion of Baseline, Project Increment and Baseline + Project predicted future water, in conjunction with other oral pathways (incidental soil ingestion; country foods) to regulatory oral TRVs.

Notes:
TRV = toxicity reference values
Baseline soil, berry and water data used in the assessment, in addition to predicted existing and future air data, are provided in Appendix B; Appendix C provides details of data treatment, while a worked example of the exposure modeling / results are provided in Appendix D

4.2 Exposure Assessment

The assessment of the potential for adverse effects from chemicals is based on the dose-response concept that is fundamental to the responses of biological systems to chemicals (Filov *et al*., 1979; Amdur *et al*., 1991). Since it is not usually practical to measure concentrations of chemicals at the actual site where the adverse response occurs within tissues and cells, exposures are estimated based on either the dose of the chemical that actually enters a receptor or more commonly, by the concentrations in various environmental media that act as pathways for exposure.

The primary objective of the exposure assessment is to predict, using a series of conservative assumptions, either the concentration of the COPC (e.g., such as an air concentration of a substance, which is assumed to be an inhaled dose expressed in µg/m^3), or the rate of exposure (expressed in µg/kg body weight/day) of human receptors to COPCs through the exposure scenarios and pathways identified in the problem formulation. The degree of exposure of receptors to chemicals in the environment depends on the interactions of a number of parameters, including:

- The concentrations of COPCs in various environmental media;
- The physical-chemical characteristics of the COC which affect their environmental fate and transport and determine such factors as efficiency of absorption into the body of a given external exposure;
- The influence of site-specific environmental characteristics, such as geology, soil type, topography, hydrology, hydrogeology, local meteorology and climatology *etc*. on a chemical's behaviour within environmental media; and,
- The physiological and behavioural characteristics of the receptors (*e.g*., soil ingestion rate, surface area of exposed skin, time spent outdoors, *etc*.).

For the HHRA, the characterization/estimation of COPC concentrations was conducted differently for COPCs that were assessed via the air inhalation pathway, versus those assessed through the oral ingestion pathways (e.g., soil, game meat, vegetation and water pathways). Therefore, these two approaches are explained separately in Sections 4.2.1.

4.2.1 Characterization/Estimation of Chemical Concentrations

4.2.1.1 Air Concentrations

To characterize air inhalation exposures, air dispersion modeling was undertaken to predict existing and future ground level air concentrations (RWDI, 2014a). Assumptions used in the modeling study are explained in detail in Rowan Williams Davies and Irwin Inc. (RWDI; 2014a), but included an assessment of detailed emission inventories of Project-related COPC emissions, as well as emissions from existing mining activities and the pelletizing facility. The approach taken to estimate COPC concentrations in ambient air for the various scenarios being evaluated included the following:

- Initial Evaluation of Air Dispersion Isopleths and Selection of Receptor Locations: Air dispersion predictions, conducted by RWDI (2014a) using the CALPUFF model version 5.8 were provided for all CACs (See Appendix B). These isopleths were examined to identify specific receptor locations which could experience more heavily influenced air quality, due to their proximity to the Project. The selection of these receptor locations considered land use information provided by AMEC (2014a,b), which involved a series of interviews with residents related to specific activities undertaken in the area in addition to land use maps. Based on the isopleths and the land use information, receptor locations were selected on the Smokey Mountain downhill ski slopes, the Menihek cross country ski trails (which are also used for hiking in the summer months), and the Dumbell Lake area (as a cottage is located on Dumbell Lake which acts as a full time residence). Dumbell Lake is actively used by many area residents for fishing and water activities, and also serves as a back-up water supply for Labrador City. In addition to these three locations, the hospital in Labrador City, which is located on the northern side of town, was also selected, although it is outside the influence of the facility. Figure 4-1 illustrates the receptor locations, relative to dustfall isopleths.

- Calculation of Baseline (Future No Build) Scenario Exposures: Typically, ambient air monitoring data are used to characterize baseline exposures. Several of the COPCs have been monitored within the Town of Labrador City for many years ($PM_{2.5}$, $PM_{10,}$ and more recently, SO_2, and NO_2), but the most affected areas related to the future Project emissions are north of the town, and no ambient air monitoring data are available from these more northern areas, nor are there ambient air monitoring data for metals, B(a)P or benzene. As such, the air dispersion analysis and additional supplemental calculations were used to characterize possible air quality at the receptor locations. Briefly, the baseline scenario was characterized through an air dispersion model that included existing baseline of the emissions from the pelletizing plant, as well as a potential future expansion of the Luce Pit, and other pits, to the north of the pelletizing plant (which includes potential for increased diesel emissions, and truck traffic) (RWDI, 2014a). This scenario is already approved, and could possibly occur in the future, in the instance that Wabush 3 Project does not proceed. This scenario is referred to on the RWDI air dispersion isopleths as the "Future No Build Scenario" and isopleths were generated for all CACs including CO, $PM_{2.5}$, PM_{10}, SO_2, and NO_2 for all relevant averaging periods (see Appendix B and RWDI, 2014a). Ground level air concentrations for all CACs with the exception of CO (which was well below ambient air quality guidelines) were predicted at all four receptor locations for the averaging times of interest.

Figure 4-1 Receptor Locations

Predictions of baseline metals ambient air concentrations were based on the predicted ground level air concentrations (GLACs) for PM_{10} and $PM_{2.5}$, as metals related to mining activities are associated with dusts (See RWDI, 2014a; isopleth figures for Future No Build Scenario). To calculate possible metals ambient air concentrations at specific receptor locations, RWDI (Pers Comm) provided an adjustment factor, based on the relative contribution of ore dust (as fugitive dust) to the predicted PM_{10} and $PM_{2.5}$ GLACs. The emission inventory for the mine indicates that the fugitive dust portion makes up 95% of the total PM_{10} emission in the baseline (i.e., Future No-Build) scenario, and it makes up 80% of the total $PM_{2.5}$ emission in the baseline (i.e., Future No-Build) scenario, on an annual basis (RWDI, Pers Comm). Therefore, to estimate metal GLACs, PM_{10} concentrations at the four receptor locations were multiplied by 0.95 and then ore geochemistry fractions were applied to generate metal-specific GLACs (Section 3.2.1).

A similar approach was used for $PM_{2.5}$ (based on an 80% relative contribution of fugitive dust). The ore geochemistry used to characterize the relative percentage of baseline metals adhered to particulate matter (which was based on the geochemistry of 5800 samples taken from IOC mining areas) was assumed to be similar to that related to the Luce Pit (and other pits currently influencing air quality in the area). This was considered to be a reasonable assumption, as the entire geochemistry of the area is iron enriched and based on discussions with IOC, this assumption was considered to be reasonable.

- Predictions of B(a)P and benzene from the mine fleet emissions in baseline air were provided by RWDI (Pers Comm). The annual average B(a)P concentrations at the four receptor locations were estimated by scaling from predicted annual average NO_2 concentrations, using data on PM, NOx and B(a)P emissions for diesel vehicles from U.S. EPA (2010a, 2012). For Tier 3, non-road compression ignition vehicles, which were considered to represent the IOC mine fleet adequately, a ratio for PM/NOx emissions of 0.060 was derived (based on data in U.S. EPA, 2010a). This was combined with a B(a)P/$OC_{2.5}$ ratio (organic carbon in the $PM_{2.5}$ size range) of 0.0000042 (U.S. EPA, 2012), to estimate a B(a)P/NOx emission ratio of 0.00000025. In this calculation, $OC_{2.5}$ was used as a surrogate for total exhaust PM. This gives a conservatively high ratio of B(a)P/NOx since, in reality, $OC_{2.5}$ makes up only a modest portion of diesel exhaust PM. The resulting ratio of B(a)P/NOx was applied to the predicted annual average NO_2 concentrations to obtain annual average concentration of B(a)P. A similar approach was used for benzene, working with a ratio of benzene/VOC emissions from the U.S. EPA (2012). For post-2007 vehicles, the ratio was 0.013. The ratio of VOC/NOx ranges from 0.033 (Tier 1) to 0.081 (Tier 0) (U.S. EPA, 2010a), and a Tier 3 value of 0.068 was selected to represent the IOC project. Combining these ratios, a ratio for benzene/NOx of 0.00088 was applied to the annual average NO_2 concentrations to predict annual average benzene concentrations (RWDI, Pers Comm).

- <u>Calculation of Baseline + Project (Future Build) Scenario</u>: Baseline + Project ground level air concentrations were provided by RWDI (2014a), wherein they assumed emissions from the pelletizing plant, Luce Pit and other mine pits, as well as Wabush 3 would be influencing local air quality (See Appendix B; isopleth figures for Future Build Scenario). For Baseline + Project, no expansion of Luce Pit was assumed, as the Wabush 3 Project was assumed to be proceeding. GLACs for all CACs were also predicted at the four receptor locations, and metals, B(a)P and benzene concentrations were calculated based on the same assumptions used in the Baseline scenario, with the exception of the fugitive dust portion of PM_{10} was assumed to be 96% of the total PM_{10} emission in the future build scenario, and it makes up 82% of the total $PM_{2.5}$ emission in the future build scenario, on an annual basis.

- <u>Calculation of Project Increment</u>: The incremental contribution related to the Wabush 3 Project alone was calculated by subtracting the predicted ambient air concentration for the Baseline scenario (Future No Build) from the Baseline + Project (Future Build) scenario for all CACs, metals, B(a)P and benzene at each of the four receptor locations.

- Predicted Acute Blasting Exposure Scenario: The acute blasting predictions were estimated by RWDI (2014b). Briefly, IOC conducted ambient air monitoring approximately 500 m downwind from blasting events in all active pits during 2012 and 2014. Monitoring was conducted weekly for PM_{10}, CO, NO_x, H_2S, SO_2 and total hydrocarbons (THC, as C_4H_8), and worst case 1-hour and 24-hour concentrations of gases were calculated by RWDI from the monitoring data. RWDI (2014b) estimated concentrations at a distance of 1200 m from the blast site, as this distance represents a set-back zone wherein non-occupational site users could potentially be present. These concentrations were assessed with respect to potential health implications for recreational site users.

4.2.1.2 Soil and Other Media Concentrations

To characterize or estimate COPC concentrations in soil and other media, the following general approaches were used:

- Calculation of Baseline Scenario Exposures: Ambient measurements in the area of the Project were included where available and necessary to characterize the Baseline concentrations of COPC in environmental media (e.g., soil and water) and biological media (e.g., berries). When measured data were not available or analytical results were equivalent or below analytical method detection limits (MDLs), exposure models were used to predict environmental media concentrations (e.g., browse, fish, soil invertebrates). In circumstances when exposure models were unable to predict concentrations (e.g., drinking water), the HHRA assumed a proxy value equivalent to the detection limit (See Appendices C and D).
- Calculation of Baseline + Project Exposure Scenario and Project Increment Exposures: Exposures models used to predict Baseline Scenario Exposures were also used to predict Baseline + Project Exposure Scenario and Project Increment exposures (See Appendix D).

Additional information on how exposure concentrations were determined for soil and other media are provided in Sections 4.2.1.2.1 to 4.2.1.2.4.

4.2.1.2.1 Soil and Vegetation

Baseline Scenario:

Soil and berry samples collected in the vicinity of the Wabush 3 Project and analyzed for metals were used for estimating Baseline exposures to these media (See Appendix B). Most of the samples contained detectable concentrations of metals. In most instances, sufficient data (n = >10) were available for the calculation of the 95 percent upper confidence limit of the mean (95UCLM)(See Appendix C). The use of the estimated 95UCLM takes into account the observed variability and uncertainty in the data; thereby providing a conservative estimate of the long term exposure point concentrations that are expected from harvesting foods and exposure to the local environment.

Guidance on preliminary quantitative risk assessment at federal contaminated sites (Health Canada 2012a) in Canada, generally recommends using maximum values to represent exposure point concentrations. However, the same reference also suggests using the arithmetic mean or 95UCLM for site specific assessments. The 95UCLM is judged to be a conservative metric for the HHRA based on the following:

- Human (and most wildlife) receptors will not be chronically exposed to a 95UCLM or higher concentration. Instead, exposures are likely well represented in most situations by the average concentration due to spatial averaging that would occur through harvesting or foraging in different areas and at different times of the year or season.
- Given data of sufficient quality, the use of the 95UCLM provides a reasonable and conservative estimate of chronic exposures (U.S. EPA 1996a, 2001).
- The use of the estimated 95UCLM in the HHRA takes into account the observed variability and uncertainty in the data; thereby providing a conservative estimate of the long term exposure concentrations.

Concentrations for other vegetation types required for the predicting of game meat concentrations (i.e., browse) were derived from measured soil concentrations and literature based bio-concentrations factor (BCFs). Methods used to predict media concentrations for predicting game meat concentrations and for the HHRA are presented in Appendix D.

The soil concentrations were used to estimate wildlife soil ingestion and soil invertebrate concentrations, which is a food component of the ruffed grouse diet. In addition, soil concentrations and air deposition were used to estimate browse concentrations, which are a major food component for snowshoe hare. The soil concentrations were used in the HHRA model for soil ingestion, predicting dust concentrations and predicting berry concentrations.

If insufficient data were available to calculate a 95UCLM, maximum values were used and if the data were entirely non-detect or unavailable then the exposure model was used to predict concentrations based on fate and transport algorithms. Further details in regards to the measured soil and plant data and exposure point concentrations used in the HHRA are provided in Appendix C.

Baseline + Project and Incremental Project:

To calculate Baseline + Project and Incremental Project soil concentrations (which were then used to predict concentrations in other media), the estimated percentages of the COPCs (i.e., Al, Cr, Fe, Mn, SiO_2 and Ti) on the ore (See Table 3-1 and Section 3.2.1) were applied to a calculated annual total dust deposition rate predicted by RWDI (2014a). The Project Increment (which were calculated as the Future Build dustfall rates at each receptor location minus the Future No Build dustfall rates at the same receptor locations) was calculated for each of the four receptor locations based on 40 years of operation [i.e., x-country ski trails (12.6 g/m^2/year);

downhill ski trails (10.9 g/m^2/year); Dumbell Lake area (5.52 g/m^2/year) and the hospital (0.60 g/m2/year). As the dustfall rate at the hospital was miniscule at 0.60 g/m^2/year, no oral multipathway assessment was conducted at this receptor location, rather potential risks at this location were discussed based on results for the other receptor locations. Metals specific deposition rates at each of these receptor locations were then calculated by applying the ore geochemistry composition in Table 3-1. To predict the deposition of B(a)P onto soil resulting from the mine (which is contained in the tailpipe portion of the vehicular fleet emissions), RWDI (Pers Comm) reviewed emission factors used in a number of previous studies for on-road diesel trucks, and locomotives were examined (U.S. EPA, 2010b). A ratio of B(a)P/$OC_{2.5}$ of 0.0000042 was indicated for post-2007 vehicles, and based on the assumption that $OC_{2.5}$ is equal to $PM_{2.5}$, a conservatively high estimate of B(a)P was obtained. To estimate the B(a)P fraction in dustfall, this ratio (0.0000042) was applied to the portion of dustfall associated with tailpipe emissions. The annual emission inventory for TSP for the Project was reviewed, and the tailpipe portion was estimated at 1.2% of the overall TSP inventory, which yields a net ratio of B(a)P/dustfall of 0.0000000496 (when the B(a)P/$OC_{2.5}$ ratio is combined with the contribution of 1.2% (RWDI, pers. comm). These deposition rates were used in the multiple pathway exposure assessment are provided in Appendix C. Further details in regards to the baseline environmental and biological media available for the HHRA are described below and presented in Appendices C and D.

Soil concentrations were predicted for both soils and surface soils assuming mixing depths of 20 cm and 2 cm, respectively as per U.S. EPA (2005a). To estimate exposure from dust and soil ingestion, estimated surface soil concentrations were used in the exposure models (top 2 cm). To predict vegetation and invertebrate tissue concentrations, the predicted soil concentrations were used (assuming a mixing depth of 20 cm). It is important to note that the loading into the top 2 and 20 cm of soil do not account for any soil erosion, surface runoff, or leaching or other natural processes which would be expected to occur and as such, would over estimate actual concentrations, and hence exposures.

To predict Baseline + Future and Incremental Project concentrations for other vegetation types required for the predicting of game meat concentrations (i.e., browse), and to estimate wildlife soil ingestion and invertebrate concentrations (which is a food component of the ruffed grouse diet), the same methods used for Baseline exposures were used (with the exception of the use of predicted rather than measured soil data). These methods are presented in Appendix D.

Additional calculations were also conducted to examine the potential dustfall, and incremental soil, berry, game meat and upland bird concentration changes as a result of the entire Future Build scenario, which includes Wabush 3, as well as the pelletizing plant, and Luce Pit and other pits. To conduct these calculations, the annual average dustfall rates were selected off the dustfall isopleths (see Figure 4-1) for the Future Build scenario near the Project area (2.5, 3.5 and 4.6 g/m^2/30 days,) which were converted to total annual dustfall rates of 30, 40, and 55 g/m^2/year. Maximum dustfall rates for the 4 receptor locations equaled 36.8 g/m^2/year (x-country ski trails); 31.7 g/m^2/year (downhill trails), 31.6 g/m^2/year (Dumbell Lake area) and 30.7 g/m^2/year (hospital). These values are within the range of the values assessed (i.e., 30 to 55 g/m^2/year). This broader approach was taken for this part of the assessment, in order to examine exposures across a range of areas, as seen in Figure 4-1 (as opposed to only the 4 specific receptor locations) and to examine the total changes from baseline conditions over time related to the project and other sources.

4.2.1.2.2 Surface Water and Fish

Measured surface water concentrations were used to estimate wildlife water ingestion and fish concentrations for the Baseline, Baseline + Project and Project Increment scenarios (See Appendix B for surface water data). Measured surface water data were used for all scenarios as surface water concentrations are not expected to change appreciably in the future as a result of the Project (AMEC, 2014b; Water Resources VEC chapter). Wildlife receptors were assumed to be exposed to the estimated 95UCLM water concentration from surface water samples collected from Leg Lake, Trout Lake, Dumbell Lake and the Dumbell Lake discharge. Further details in regards to the surface water data and exposure point concentrations used to predict fish concentrations are provided in Appendix C.

Surface water exposure point concentrations were also used to predict fish concentrations for predicting dietary exposures in the HHRA for the Baseline, Baseline + Project and Project Increment (See Appendix B). The fish tissue concentrations were based on literature BCFs and predicted exposure point concentrations are presented in Appendix D.

4.2.1.2.3 Drinking water

A total of seven drinking water samples were collected from the North Pond of Beverley Lake from July 2012 to October 2013 (See Appendix B). Data from these samples were used to characterize baseline drinking water exposures for humans. Given water concentrations were not expected to change appreciably as a result of the Project (AMEC, 2014b; Water Resources VEC chapter), measured drinking water concentrations were used to represent Baseline + Project and Project Increment water concentrations. Further details in regards to the drinking water data and exposure point concentrations used in the HHRA are presented in Appendix C.

4.2.1.2.4 Wild Game Meat

Baseline, Baseline + Project and Project Increment wild game (i.e., ruffed grouse and snowshoe hare) meat concentrations were predicted based on exposures to soil (measured for Baseline, and predicted for Baseline + Project and Project Increment as per Section 4.2.1.2.1), deposition, surface water, browse and soil invertebrate concentrations. The predicted game meat concentrations were used in the HHRA as exposure point concentrations for consumption of game meat. Biotransfer factors (BTFs) are used to translate the predicted daily intake of a COPC by wildlife to a tissue concentration. Appendix D presents the methods that were used to predict game meat concentrations and the concentrations that were used in the HHRA.

4.2.2 Receptor Characterization

As previously indicated in Section 3.3, human receptor parameters used in the exposure modelling were obtained from Health Canada (2012a;1994) and Richardson and O'Connor (1997) and are provided in Tables 4-2 and 4-3 for general physical characteristics and food consumption rates, respectively. No aboriginal consumption rates for foods were used in this assessment, as an aboriginal community is not present in the immediate vicinity of the Project. Fish consumption rates were selected from Health Canada (2007), and were based on eaters only data. No small game or upland bird specific consumption rates were available. As such, consumption rates were assumed to be the same as the mean Canadian consumption rates for roast and stewing beef (for snowshoe hare) and poultry (for spruce grouse) from the Nutrition Canada Study (Health Canada, 1994). The consumption rate for local berries / fruit was assumed to be the same as the mean consumption rates for cherries, strawberries, blueberries and syrup from the same study. The use of these consumption rates likely overestimates potential exposures from country foods as it is unlikely that all beef poultry and fruit would come from local sources.

Table 4–2 General Physical Characteristics Assumed for Receptors in the Multiple Pathway Exposure Assessment

Physical Characteristic	*Life Stage (Health Canada 2012a)*				
	Infant	*Toddler*	*Child*	*Adolescent*	*Adult*
Inhalation rate (m^3/d)	2.2	8.3	14.5	15.6	16.6
Soil ingestion rate (g/d)	0.02	0.08	0.02	0.02	0.02
Water ingestion rate (L/d)	0.3	0.6	0.8	1.0	1.5
Body Weight (kg)	8.2	16.5	32.9	59.7	70.7
Lifetime Adjustment Factor (i.e., for carcinogenic exposures)	0.0063	0.056	0.088	0.1	0.75
Arms and legs body surface area (cm^2)	1,460	2,580	4,550	7,200	8,220
Hand surface area (cm^2)	320	430	590	800	890
Total surface area (cm^2)	3,620	6,130	10,140	15,470	17,640
Soil adherence factor – hands only (g/cm^2/d)	0.0001	0.0001	0.0001	0.0001	0.0001
Soil adherence factor – other than hands (g/cm^2/d)	0.00001	0.00001	0.00001	0.00001	0.00001

Table 4-3	**Food Consumption Rates (g/d) Assumed for the Residential Group**					
Local Foods	***Life Stage***					***Source/Comment***
	Infant([a])	***Toddler***	***Child***	***Adolescent***	***Adult***	
Small mammal (i.e., snowshoe hare)	0.27	6.49	12.0	23.3	27.0	Assumed same as roast and stewing beef; Health Canada (1994)
Upland birds (i.e., ruffed grouse)	0	13	17	20	21	Assumed same as poultry Health Canada (1994)
Total game([b])	0.27	19.49	29.0	43.3	48.0	Calculated
Fish	0	10	14	22	22	Health Canada (2007)
Berries / fruit([c])	3.8	7.47	16.2	13.4	16.3	Health Canada (1994)

Notes:
a. Infants were assumed to consume 664 g of breast milk per day (Richardson and O'Connor 1997)
b. Sum of snowshoe hare and ruffed grouse consumption rates.
c. Fruit consumption rate is based on composite of cherries, strawberries, blueberries & syrup

4.2.3 Exposure Estimation

For air inhalation, exposures were assumed to equal the predicted ambient air concentrations (Section 4.2.1.1). The procedures by which exposures to humans via the oral exposure pathways are estimated are provided in Section 4.2.1.2 and Appendix D. The equations to predict the Baseline Scenario Exposures, Baseline + Project Scenario Exposures and Project Increment Exposures were the same with the exception of the Baseline Scenario where actual ambient data were used where it existed. Predicted or measured air, soil, game meat and berry concentrations for Baseline, Baseline + Project, and Project Increment are presented in Section 4.4.

4.3 Hazard Assessment

Toxicity is the potential for a chemical or agent to produce temporary or permanent damage to the structure or functioning of any part of the body. The toxicity of a chemical depends on the amount of chemical taken into the body (referred to as the "dose") and the duration of exposure (*i.e.*, the length of time the person is exposed to the chemical). For every chemical, there is a specific dose and duration of exposure necessary to produce a toxic effect in humans (this is referred to as the "dose-response relationship" of a chemical). In the toxicity assessment, information related to the dose-response relationships of each chemical is evaluated (usually from laboratory animal studies and studies of human exposure in the workplace) in order to determine the maximum dose of chemicals to which humans can be exposed that would be associated with a very low probability of experiencing adverse health effects. These toxicity estimates are called typically called exposure limits or toxicity reference values (TRVs) and indicate an exposure that will not likely result in harmful effects. For each COPC, chemical-specific assessments have been completed by Health Canada, U.S. EPA, or other reputable agencies.

Two basic and quite different methods are commonly recognized by regulatory agencies for the estimation of toxicological criteria for humans and are applied depending on the mode of toxic action of the compound. These are the threshold approach (or the no-observed-adverse-effect levels [NOAELs] - extrapolation factor approach) and the non-threshold (or the mathematical model unit risk estimation) approach. The selection of the appropriate method to establish an exposure limit depends on several factors including the characteristics of the relationship between exposure level and adverse response (*i.e*., the shape of the dose-response curve) and available scientific data on the mechanism(s) through which the chemical produces its adverse response (*i.e*., does the chemical cause damage to genetic material in cells).

For chemicals with threshold type dose-response relationships (*i.e*., for which NOAELs can be determined), it is assumed for practical purposes, that there is a threshold of exposure below which the risk of adverse effects is essentially zero, and no adverse effects will occur. This threshold is commonly referred to as a reference dose (RfD), or allowable daily intake (ADI). Conservative estimates of this threshold are based on an experimentally-determined NOAEL, with the application of low-dose extrapolation factors. These factors are also called "uncertainty factors" (FDA, 1982; U.S. EPA, 1989), and their magnitude is dependent on the level of confidence in the use of available data as a basis for extrapolation to the exposure scenario of the risk assessment. This confidence is dependent on differences in species and duration of exposure, safety of sensitive species and individuals, and the quality of available data (*i.e*., the weight of evidence of the supporting data). Where available, route-specific exposure limits (*e.g*., inhalation RfCs and oral RfDs) are used to characterize the hazard of chemicals.

For non-threshold substances, the mathematical model unit risk estimation approach assumes that there would be no risk of the occurrence of adverse effects if the rate of exposure or dose was zero. This approach, generally applied to genotoxic carcinogens, yields an estimate of a cancer slope factor or unit risk cancer potency estimate. The cancer slope factor or unit risk value may be used directly in risk characterization to yield predicted risks of cancer incidence in a population. Health Canada (2012a) has indicated that Incremental Lifetime Cancer Risk (ILCR) levels that are less than one-in-one hundred thousand are considered acceptable, that is, risks which are associated with an increased risk of cancer in one person out of one hundred thousand people.

Ambient air quality benchmarks were used as TRVs in the assessment of COPCs associated with the Acute Blast scenario and CACs.

4.3.1 Summary of Toxicological Reference Values

Individuals with compromised health or within sensitive life stages (*e.g*., pregnancy, newborn infants, children and elderly) were considered in the assessment by ensuring that the selected exposure limits were sufficiently stringent to protect such individuals under most exposure conditions. TRVs are presented for those substances which are related to the inhalation pathway only (such as COPCs associated with the Acute Blast scenario and CACs), as well as substances which may be inhaled directly on particulate matter (such as metals) or as a result of diesel exhaust emissions (such as B(a)P and benzene), but could potentially also be ingested as a result of deposition on soils (such as metals and B(a)P). Where the endpoints for a specific COPC differ between the inhalation and oral pathways, two separate TRVs are used in the assessment accordingly.

4.3.1.1 Inhalation TRVs - Acute Blasting Scenario and CACs

The acute blasting scenario involved assessment of predicted 1 hour concentrations of CO, NO_2, SO_2, hydrogen sulphide (H_2S) and total hydrocarbons (as C_4H_8). For this aspect of the assessment, acute TRVs were selected from appropriate jurisdictions and are presented in Table 4-4.

For CACs, which include CO, $PM_{2.5}$, PM_{10}, NO_2 and SO_2, these substances were only assessed via the inhalation pathways, as these substances do not appreciably contribute to exposure via other pathways. Therefore, ambient air quality guidelines or standards established by reputable regulatory agencies, such as those set in the Canada Wide Standard (CWS) process (CAAQ, 2013), the U.S. EPA (2010c,d), and the World Health Organization (WHO, 2006; values reaffirmed in 2013), were the focus of the hazard assessment, as these agencies have conducted recent extensive evaluations of the health effects associated with these substances. Ambient air standards used in the province of Newfoundland and Labrador for compliance purposes, were also considered, and where the basis of these values could be confirmed as being health-based, or where they matched other regulatory agency health-based values, they were used in the assessment. If the basis of values could not be confirmed as being health-based, they were not chosen to assess potential risks, where a more robust and recent value was available from other agencies. Relevant TRVs for CACs for all relevant averaging times are presented in Table 4-4.

TSP (Total Suspended Particulate matter, also known as Total Particulate Matter, or TPM, which includes particulate matter) was not included in the HHRA, as this fraction of particulate matter, which typically ranges from < 44 um, to < 100 um, are well beyond inhalable (<10 um) or respirable (<2.5 um) particle fraction ranges. As such, existing ambient air quality benchmarks for TPM are not human health-based but rather, are aesthetic standards related to soiling, visibility or nuisance dust issues (e.g., NL DOEC, 2013).

Table 4-4 Toxicity Reference Values (µg/m³) Used in Assessment of Ambient Air for Both the Acute Blasting Scenario and for Criteria Air Contaminants

Scenario and COPC	***Toxicity Reference Values (µg/m³)***		
Acute Blasting Scenario			
COPCs	**1 hour Averaging Period**		
CO	30,000 (WHO)		
NO_2	190 (U.S. EPA)		
SO_2	200 (U.S. EPA)		
H_2S	98 (MRL; ATSDR)		
C_4H_8	34,000 (TCEQ)		
Criteria Air Contaminants			
COPCs	***Toxicity Reference Values (µg/m³)***		
	1 hour	**24 hour**	**Annual Average**
CO[a]	30,000 (WHO)	NA	NA
$PM_{2.5}$[b]	NA	25 (NL DOEC); 27 (CCME)	8.8 (NL DOEC; CAAQS)
PM_{10}[c]	NA	50 (NL DOEC)	20 (WHO)
NO_2[d]	190 (U.S. EPA)	NA	100 (NL DOEC; U.S. EPA)
SO_2[e]	200 (U.S. EPA)	NA	NA

NA = not applicable

[a] The 1 hour CO limit from WHO (2000) is 30 mg/m³ or 25 ppm. This value is set to protect human health. Since CO is a short term response, no longer averaging period guidelines are available.

[b]. There is no 1 hour ambient air quality guideline for $PM_{2.5}$. The daily standard from NLDOEC (25 µg/m³), and the most recent CAAQS (2013) standard (27 µg/m³; to be met in 2020) were used in this assessment. These two standards are both 24 hour averaging time standards, but are calculated in different fashions, and hence, both will be used. The basis of the CAAQS was not available, but it is stated as being health-based, and is therefore assumed to reflect the most recent scientific literature related to health effects of $PM_{2.5}$. The basis of the NLDOEC limit is unknown, but since the value is the same as the WHO (2006) value, which is currently still in effect and health-based, comparisons to this standard will be conducted. The CAAQS comparisons will carry more weight in conclusions related to health impacts associated with exposures measured in the community, as the metric used in comparing ambient data is a 3 year time frame (i.e., 3-year average of the annual 98th percentile of the daily 24-hour average concentrations). For annual average, NL DOEC has implemented the 8.8 µg/m³ standard that was developed as a CAAQS (to be met in 2020 under the CCME Air Quality Management System), and therefore, this value will be used.

[c.] There is no 1 hour ambient air quality guideline for PM_{10}. The NL DOEC standard of 50 µg/m³ will be used in this assessment. The basis of this value is not known, but this value is identical to the WHO (2006) value, which is health-based and was re-affirmed in 2013 (WHO, 2013). The annual average value of 20 µg/m³ from WHO (2006) was selected, as no value is available from Canadian jurisdictions related to this averaging period.

[d.] NO_2 - standard selected is from U.S. EPA (2010c), wherein a comprehensive health effects assessment was conducted. This value is to be compared against the 3 year average of the 98th percentile of the yearly distribution of the 1-hour daily maximum (U.S. EPA, 2010c). Annual average standard from the U.S. EPA was reaffirmed in 2010 (U.S. EPA, 2010c). This value is identical to the annual average value used for compliance purposes in Newfoundland and Labrador, although the basis for the value in Newfoundland is not cited. The U.S. EPA did not derive a 24-hour benchmark for NO_2 as the 1-hour benchmark can be considered to be effective at protecting against 24-hour exposures to NO_2 (U.S. EPA, 2010c). Other values available from NL DOEC and CCME were not selected for this assessment, as they are not as current with respect to the health effects literature as those from the U.S. EPA.

[e.] SO_2 - standard was selected is from U.S. EPA (2010d), wherein a comprehensive health effects assessment was conducted. This value is to be compared against the 99th percentile of 1-hour daily maximum concentrations averaged over 3 years (U.S. EPA, 2010d). The U.S. EPA revoked its existing 24-hour and annual standards, citing that these standards would not add any additional protection to public health over the new 1-hour standard of 75 ppb (200 µg/m³). In addition, the U.S. EPA indicated that there was little evidence based on health outcomes to suggest an association of health effects with long-term exposures to SO_2. Therefore, other metrics (3-hour, 24-hour and annual average) are not considered in this health evaluation

4.3.1.2 Inhalation and Oral TRVs – Metals and Benzo(a)Pyrene and Benzene

Metals are anticipated to be present on dusts released from mining activities (associated with PM_{10} and $PM_{2.5}$), and therefore, could be inhaled on airborne particulate matter, as well as ingested through incidental soil, vegetation and game meat. Where toxicological endpoints differ between oral and inhalation pathways, the exposures were assessed using route-specific TRVs. TRVs were identified from various regulatory agencies, such as Health Canada (2012b), U.S. EPA (2006a,b), Texas Commission on Environmental Quality (TCEQ), and others, based on consideration of the form of metal (i.e., chromium 3^+ is the form of chromium present in the ore, and as such, chromium 6^+ limits were not used in the current assessment), how recently the regulatory review was conducted, and interpretation of the literature re: effects. With respect to other COPCs identified for assessment (B(a)P and benzene), releases related to fuel combustion could result in exposures in the study area. In both cases, these compounds have the ability to elicit carcinogenic effects, and as such, TRVs identified were Inhalation Unit Risk factors (IUR) from Health Canada (2012b), which were converted to Risk Specific Concentrations (µg/m^3) (RSC = Target Risk level of 1:100,000/IUR).

Table 4-5 presents the inhalation and oral TRVs and endpoints related to metals and other COPCs.

Table 4-5 Summary of Inhalation and Oral TRVs for Chronic Exposures to Metals and Other COPCs

COPC	*Route*	*Type*	*Value*	*Critical Health Effect*	*Source*
Aluminum	Inhalation	RfC	5 µg/m^3	Neurological effects	U.S. EPA (2006a)
	Oral	RfD	143 µg/kg bw/d	Reproductive and developmental, neurological, liver and kidney effects	WHO 2014, 2010a,b
Chromium $^{3+}$	Inhalation[a,b]	Chronic ESL	0.041 µg/m^3	Increased total lung and trachea weights, relative to body weight (rats)	TCEQ, 2009; 2014c
	Oral	RfD	1500 ug/kg bw/d	Reduced absolute weight of livers and spleen (rats)	U.S. EPA 2013, 1998
Iron	Inhalation[b]	Chronic ESL	5 µg/m^3	Health based; endpoint not provided	TCEQ, 2003; 2014c
	Oral	RfD	700 µg/kg bw/d	Adverse gastrointestinal effects (humans)	U.S. EPA (2006b) provisional TRV
Manganese	Inhalation	RfC	0.05 µg/m^3	Impairment of neurobehavioral function	IRIS, 1993
	Oral	RfD	140 µg/kg/d	CNS effects	U.S. EPA, 1996b
Silica	Inhalation	Chronic health based value	3 µg/m^3	Silicosis in humans; (PM_4 fraction)	MDH, 2013
	Oral	NA[c]	NA	NA	NA
Titanium	Inhalation[b]	Chronic ESL	5 µg/m^3	Health based; endpoint not provided	TCEQ, 2003; 2014c
	Oral	NA[d]	NA	NA	NA
Benzo(a)pyrene	Inhalation	IUR	0.031 (mg/m^3)$^{-1}$; converts to 0.32 µg/m^3 (1:100,000 risk level)	Respiratory tract tumours (mouse)	Health Canada, 2012b
	Oral	OSF	2.3E-03 (µg/kg/day)$^{-1}$	Gastric tumours (hamster)	Health Canada, 2012b
Benzene	Inhalation	IUR	0.0033 (mg/m^3)$^{-1}$; converts to 3 µg/m^3 (1:100,000 risk level)	leukemia	Health Canada, 2012b
	Oral	NA	NA	NA	NA

Notes:

RfC: Reference Air Concentration; RfD; Reference Dose; ESL : Effects Screening Level; IUR: inhalation unit risk; OSF: oral slope factor; NA = not applicable. Silica was not assessed by the oral route, as silicon, the form present in soils, is essentially non-toxic. Benzene will not accumulate in soils, and hence, was not assessed via the oral route; titanium is not considered toxic by the oral route, and no oral RFD has been established.

a. TCEQ (2014c); Long-term ESL (Effects Screening Level) for chromium metal and trivalent compounds. Health Canada limit included Cr+6 which is not being released from the mine and as such, was not selected. No U.S. EPA IRIS (Integrated Risk Information System) RfC for chromium 3+ available. While ATSDR (Agency for Toxic Substances and Disease Registry) has two RfCs for chromium 3+, they are both for intermediate exposure times only and thus were not used.

b. The TCEQ ESL is conservative to use as this value is a value to be applied to permitting (i.e., accounting for one source) rather than ambient air monitoring data (where all sources are accounted for). The TCEQ also derives AMCV (Air Monitoring Comparison Values) to be used for ambient air data, but no AMCV is available for this chemical. The derivation method for ESLs is to apply a factor to the AMCV, such that the ESL represents a Hazard Quotient of 0.3 rather than 1.0 (which is the hazard quotient for an AMCV).

c. Silica via the oral exposure route is relatively non-toxic. Data from rodent ingestion studies (Federation of American Societies for Experimental Biology, 1979) indicates that silica readily passes through the digestive tract unchanged. These studies found that 95% of ingested silica is excreted in the feces in an un-metabolized form, while another 4% is excreted in urine. The European Food Safety Authority (EFSA, 2009) concluded that the use of silicon dioxide up to 1500 mg SiO2/day added to food supplements is of no safety concern. Therefore, silica via the oral pathway was not considered further.

d. No oral RFD for titanium could be found in the literature reviewed. Evaluations of titanium dioxide by JECFA, SCF, and EFSA have each concluded that there are no safety concerns associated with the use of titanium dioxide as a food additive at levels ranging up to 3% (US EPA, 2005b). As such, titanium via the oral route was not considered further.

4.4 Risk Characterization

Risk characterization for chemicals with a threshold-type dose-response consists of a comparison between the toxicological criteria (*i.e.*, the rate of exposure that would not produce adverse effects) against the total estimated exposure. For COPCs in ambient air, risk characterization was undertaken by comparing estimated ambient air concentrations to relevant ambient air guidelines.

For COPCs assessed in the multipathway model, a Hazard Quotient (HQ) was calculated. These ratios are calculated by dividing the predicted exposure (from the exposure model) by the toxicological criterion, as indicated in the following equations:

$$Hazard\ Quotient\ = \frac{Estimated\ Exposure\,(ug/kg/day)}{Exposure\,Limit\,(ug/kg/day)}$$

Risk characterization for chemicals with a non-threshold-type dose response (*i.e.*, carcinogens) consists of a calculation of the ILCR, which is defined as the predicted risk of an individual in a population of a given size developing cancer over a lifetime. The ILCR is expressed as a fraction representing the prediction that 1 person per n people would develop cancer, where the magnitude of n reflects the risks to that population; for example, if the ILCR is 0.1 (representing 1 person per 10), the predicted risks of any individual developing cancer would be higher than if the ILCR is 0.001 (1 per 1,000). The following equation provides the method whereby the ILCR is calculated:

$$ILCR = Estimated\ Exposure\,(ug/kg/day)\,x\,q_1^*\,(ug/kg/day)^{-1}$$

HQs and ILCR levels are effective tools for expressing potential adverse health effects from exposures to COPCs in that:

- they allow comparisons of potential adverse effects on health between chemicals and different exposure scenarios (e.g., background versus site-specific conditions);
- potential adverse effects can be estimated from exposures to mixtures of chemicals that act on similar biological systems (e.g., all chemicals that cause liver toxicity, or kidney toxicity, or respiratory tract cancers); and,
- they help simplify the presentation of the HHRA results so that the reader may have a clear understanding of the significance of these results, and an appreciation of their significance.

If the total exposure to a chemical is equal to or less than the toxicological criterion, then the HQ would be 1.0 or less, and no adverse health effects would be expected. For human exposures to non-carcinogens, the toxicological criteria represent the level of total exposure derived from multi-source and multimedia exposures, which would not result in adverse health effects, regardless of the source or route of exposure. In cases where total exposure has been estimated from both background and site sources, it would be valid to compare the estimated exposure to the entire exposure limit, and an acceptable HQ level would be 1.0. If the RA addresses risks associated with a single source and a limited number of environmental pathways, the selection of an HQ of 1.0 as a benchmark to indicate that exposure does not exceed the toxicological criterion is not valid. In an attempt to address this problem, Health Canada has apportioned 20% of the total exposure to any one environmental medium. HQ values for non-carcinogens that are less than 0.20 are considered to represent a situation in which media-related exposures account for less than 20% of the toxicological criterion, and no adverse effects are expected to be associated with the estimated level of exposure. HQ exceedances above 0.20 are not necessarily indicative of potential risks, as they may reflect overestimation of risk due to the use of overly conservative estimates (*e.g.*, overestimating exposures through the use of maximum soil ingestion rates). This procedure is followed to ensure that the predicted potential impacts on human health were not under-estimated, but also recognizes the potential magnitude of the conservatism built into the risk estimate. With respect to the current project, an HQ of 0.2 for the Project has been established. Many pathways have been included in this assessment (soil, water, country foods, etc.), and the critical issue is the relative contribution of the Project increment to the overall HQ. If this incremental contribution is minimal, the Project exposures will have a negligible contribution to over exposures, and hence, risks.

ILCR levels represent the predicted incremental risk of cancer over a lifetime to an individual member of a population of a given size and are expressed as a risk level. ILCRs are evaluated by comparison to a benchmark risk level that is considered to be acceptable. For example, negligible or de minimis cancer risk levels are generally considered to range from 1x10-4 to 1x10-6. Health Canada considers 1x10-5 (one in one hundred thousand) an acceptable risk level. In cases where the estimated exposures or risks are less than the acceptable level, it can be concluded that no observable adverse health effects would be expected to occur. If predicted exposure ratios are greater than the acceptable level, this may trigger the need to re-evaluate the model parameters (e.g., chemical concentration estimates, exposure parameters, and toxicological criteria) to minimize the uncertainty related to the initial predictions.

For COPCs wherein inhalation and oral TRVs were based on a similar endpoint, HQs were calculated for the air inhalation pathway and summed with oral HQs to account for potential systemic effects of both exposure pathways.

When predicted exposures or risks are greater than the acceptable level, this may indicate the potential for adverse effects in sensitive individuals or in some of the exposure scenarios considered. In these cases, the evaluation of HQs or ILCRs is extremely important since both the exposure estimation procedures and the toxicological criteria are based on a series of conservative assumptions. A sensitivity analysis facilitates the re-evaluation by focusing on the proportional contribution of various parameters to the final HQ or ILCR value. Once the major contributing model parameters have been identified, they can be evaluated to assess whether health risks have been either under-estimated or grossly over-estimated. A certain level of over-estimation of risk is inherently built into the HHRA process.

4.4.1 Air Quality Risk Assessment

4.4.1.1 Acute Blasting Scenario

An assessment of possible exposures that could occur during blasting at the Wabush 3 pit was conducted by RWDI (RWDI, 2014b). The concentrations of selected contaminants were estimated by RWDI at 1200 m from the blast, based on measured data collected over 2012 and 2014, at a distance of 500 m from the existing active pits (during blasts). Since transient receptors (such as hikers, or cross country skiers) are not allowed access to areas less than 1200 m from a blasting event (for safety reasons), this distance is considered to represent a reasonable worst case distance for possible exposures to contaminants emitted during a blast. The contaminants of interest for this assessment include CO, NO_2, SO_2, H_2S, C_4H_8 as these substances have the potential to cause acute responses to short term elevated concentrations.

Estimated concentrations for both the average hourly concentrations, as well as the maximum 1-hour concentration, measured through 32 different blasting events near the active pits, are presented in Table 4-6. These estimated values are compared to health-based air quality guidelines for a one hour time frame, where available. For NO_2 and SO_2, the most stringent 1-hour limits are from the U.S. EPA (2010c,d). These standards are meant to be respectively applied to the annual 98th and 99th percentile of the maximum 1-hour daily concentrations, averaged over three years. Therefore, the application of these standards to a single hour of data is not following the intended calculation approach, but this method has been applied for the current assessment, as a preliminary (conservative) assessment. Where these comparisons indicate exceedances, Acute Exposure Guideline Levels (AEGL) from the National Academy of Sciences (NRC, 2012) were also used to assess the potential health implications of exposures. These AEGLs are developed by expert panels and represent exposure levels below which adverse health effects are not likely to occur. These values are developed for use in responding to emergencies, and identify possible limits that may have either no effects or reversible effects (i.e., AEGL-1), up to levels associated with life-threatening impacts (i.e., AEGL-3 which were not used in this assessment).

Table 4-6	**Summary of Estimated One Hour Concentrations of CO, NO_2, SO_2, H_2S and C_4H_8 at 1200 m from Blasting and Comparisons to Acute Air Quality Guidelines**									
Exposure Limits	***CO***[a]		***NO₂***[b]		***SO₂***[c]		***H₂S***[d]		***C₄H₈***[e]	
	ppm	***μg/m³***	***ppm***	***μg/m³***	***ppm***	***μg/m³***	***ppm***	***μg/m³***	***ppm***	***μg/m³***
Average	0.215	246	0.045	84.6	0.012	31.9	0.006	7.5	0.030	68
Maximum	0.764	875	0.23	432	0.045	120	0.056	70	0.19	431
Acute Air Quality Guideline	25	30,000	0.101; 0.5	190 [f] 940[g]	0.075	200 [f]	0.0784	98[h]	15 (health); 0.36 (odour)	34,000 (health); 820 (odour)

a Conversion of CO from ppm to μg/m³ was done using a factor of 1 ppm = 1145 μg/m³; acute air quality guideline (WHO, 2000)
b. Conversion of NO_2 from ppm to μg/m³ was done using a factor of 1 ppm = 1880 μg/m³ (WHO, 2006)
c. Conversion of SO_2 from ppm to μg/m³ was done using the a factor of 1 ppm = 2660 μg/m³ (WHO, 2006)
d. Conversion of H_2S from ppm to μg/m³ was done using the factor of 10 μg/m³ = 0.008 ppm (http://www.oehha.org/air/chronic_rels/pdf/7783064.pdf)
e. Assumed to be the more toxic and more odorous of 1-butene or 2-butene (TCEQ, 2014a). Conversion factors for 2-Butene are 15 ppm = 34,000 μg/m³ (TCEQ, 2014b). The health based value is for 2-butene, whereas the odour value is for 1-butene.
f. U.S. EPA (2010c,d). These limits are intended to be applied to the 3 year average of the annual 98th percentile (in the case of NO_2) or 99th percentile (in the case of SO_2) of the daily 1 hour maxima, as opposed to a single 1 hour maxima.
g. NRC, 2012. This value is the AEGL-1 value for 1 hour time limit; possible health effects at this level include slight burning of the eyes, slight headache, chest tightness or labored breathing with exercise.
h. ATSDR, 2006; 2013 (1 hour exposures)

Based on the comparisons of estimated concentrations to health-based guidelines, CO, SO_2, H_2S and C_4H_8 concentrations for either the average or the maximum scenario are not anticipated to exceed the relevant health-based standards (Table 4-6). NO_2 is not estimated to exceed health-based standards in the average scenario, but the highest 1-hour level estimated is predicted to exceed the U.S. EPA ambient air quality standard, albeit, the approach for calculating exposure has not followed U.S. EPA guidance, and hence the direct comparison of this value to the standard is conservative. The maximum estimated NO_2 concentration does not exceed the AEGL-1 limit, and is approximately ½ of that limit, suggesting that health effects from this exposure would be minimal and transient, if any.

Based on these comparisons, it is possible that if people were in the immediate set back zone of the blast (1200 m from the blast), that they could incur elevated exposures to NO_2, but the likelihood of this occurring is low, due to the infrequent nature of the blasting (once per week), the topography within the area near the mine, and the remoteness of some of the locations within 1200 m of the Wabush 3 pit. The Smokey Mountain ski hill could be located within 1200 m, depending on the location of a specific blasting activity. If concentrations similar to the maximum estimated concentrations for NO_2 were to occur within the vicinity of the ski hill, some transient health effects are possible, but are considered unlikely, based on the comparisons to the AEGL-1.

4.4.1.2 Criteria Air Contaminants (CACs)

Table 4-7 presents the predicted GLACs at each receptor location for Baseline, Project increment, and Project + Baseline, for each averaging period, and relevant ambient air quality guidelines. Where predicted concentrations exceed guidelines, values are shaded.

Table 4-7 Comparison of Predicted Baseline, Incremental Project and Future (Project + Baseline) Air Concentrations at Various Receptor Locations to Ambient Air Quality Guidelines (μg/m3)

COPC (Guideline)	Cross Country Trials			Downhill Trails			Dumbell Lake Area			Hospital		
	Baseline	Project	Project + Baseline	Baseline	Project	Project + Baseline	Baseline	Project	Project + Baseline	Baseline	Project	Project + Baseline
$PM_{2.5}$												
24 hour (25 μg/m^3)[a]	8.7	2.1	10.8	7.4	7.7	15.1	5.3	0.7	6.0	11.8	-	11.8
24 hour (27 μg/m^3)[b]	3.3	2.1	5.4	4.4	4.6	9.0	3.2	0.5	3.8	5.5	0.2	5.7
Annual (8.8 μg/m^3)[c]	1.2	0.4	1.6	0.9	1.0	1.9	0.7	0.2	0.9	0.9	-	0.9
PM_{10}												
24 hour (50 μg/m^3)[d]	38.1	19.6	57.7	29.2	33.4	62.6	18.7	4.8	23.5	80.4	1.9	82.3
Annual (20 μg/m^3)[e]	5.7	2.2	7.9	3.7	5.5	9.2	2.9	1.2	4.1	4.1	0.2	4.3
NO_2												
1-hour (190 μg/m^3)[f]	177.3	0.9	178.2	221.5	6.9	228.4	165	-	165.0	149.2	-	149.2
Annual (100 μg/m^3)[g]	5.6	1.5	7.1	5.2	2.8	8.0	4.1	0.6	4.7	4.9	0.2	5.1
SO_2												
1- hour (200 μg/m^3)[h]	231.1	1	232.1	329.7	5.1	334.8	235.0	6.9	241.9	234.9	3.6	238.5

Notes:

Project + Baseline (Future Build Scenario) – Baseline (Future No build scenario) = Project Increment

a. NLDOEC, 2014. 24 hour averaging time. The value reported is the highest of the 2nd maxima from each year, identified from each receptor location over four years of meteorological data.

b. CAAQS, 2013. 24 hour averaging time; will come into effect in 2020. This value is calculated as the 3 year average of the annual 98th%ile of daily 24 hour data. The 3 year average was calculated 2 ways i) using the 2007, 2008 and 2009 meteorological data and ii) using the 2008, 2009 and 2010 meteorological data. The higher of these 3-year averages is provided in this table.

c. NLDOEC, 2014; CAAQS, 2013. Annual average. This value is calculated as the 3 year average of the annual average concentrations. The 3 year average was calculated 2 ways i) using the 2007, 2008 and 2009 meteorological data and ii) using the 2008, 2009 and 2010 meteorological data. The higher of these 3-year averages is provided in this table.

d. NLDOEC, 2004. 24 hour averaging time. The value reported is the highest of the 2nd maxima from each year, identified from each receptor location over four years of meteorological data.

e. WHO (2006). Annual average. Calculated as the annual average of each of 4 years of predicted data. The highest annual average of the 4 years is presented for each receptor location.

f. U.S. EPA (2010c); Standard converted from 100 ppb (1-hour) to 188 μg/m^3 (rounded to 190 μg/m^3) by using a conversion factor of 1 ppb =1.88 μg/m^3 (WHO, 2006b). This standard was compared against the 3 year average of the 98th percentile of the yearly distribution of the 1-hour daily maximum (U.S. EPA, 2010c). The 3 year average was calculated 2 ways i) using the 2007, 2008 and 2009 meteorological data and ii) using the 2008, 2009 and 2010 meteorological data. The higher of these 3-year averages is provided in this table.

g. U.S. EPA (2010d); Standard converted from 53 ppb (annual) to 99.64 μg/m^3 (rounded to100 μg/m^3).

The following conclusions can be drawn from Table 4-7:

- Predicted $PM_{2.5}$ exposures are well within 24-hr and annual average ambient air quality guidelines for Baseline, Project alone, and Baseline + Project at all four receptor locations. The increment added by the Project at both the downhill ski trails and the cross country ski trails is higher than at the Dumbell Lake area, or the hospital. As stated earlier, the hospital is distant to the Project, and hence, air quality is more affected by emissions from the pelletizing plant than the Project, as evidenced by the predicted insignificant changes in $PM_{2.5}$.
- Predicted PM_{10} exposures are within annual average ambient air quality guidelines, and 24-hr ambient guidelines, at all receptor locations with the exception Project + Baseline at the cross country ski trails and downhill trails, and Baseline, and Project + Baseline at the hospital. The Project contributes to 24 hr PM_{10} concentrations at both ski trails. Predicted frequency of exceedance for Project + Baseline at each of these locations is low (for cross country ski trails, a total of 4 days over 4 years are predicted to exceed the ambient air quality guidelines [0.3%], whereas for downhill ski trails, a total of 14 days over 4 years are predicted to exceed the guideline [1 %]). Since these two areas are not full time residential locations, and since the frequency of exceedance is low, the likelihood of any health risks is considered to be low. The Dumbell Lake area receptor location, where a full-time resident may be present, is not predicted to exceed the guideline. For the hospital, the Project does not add appreciably to Baseline, and exceedances are related to pelletizing plant emissions. Frequency of exceedance at this receptor location is similarly low (9 days over 4 years; 0.6%).
- Predicted NO_2 concentrations were within 1 hour and annual average guidelines at all locations with the exception of the downhill ski trails for both Baseline and Project + Baseline. The Project alone is not adding significantly to Baseline. Since the guideline being used is a 98^{th} percentile of the daily 1 hour maximum concentrations, averaged over 3 years, it is not appropriate to compare individual hours to the guideline. Nevertheless, the frequency of exceedance over the guideline on an hourly basis was examined and amounts to 0.2%. The predicted 98^{th} percentile concentrations (averaged over 3 years) were approximately 30 µg/m^3 over the U.S. EPA guideline. None of the predicted hourly concentrations were higher than 400 µg/m^3 , which is the existing 1 hour standard in Canada and Newfoundland (which is not considered to be health protective, based on more recent reviews of the literature conducted by U.S. EPA, 2010c). For effects to occur, sensitive individuals, such as exercising asthmatics or individuals with other respiratory sensitivities, would have to be in the area where air concentrations are elevated at the time the short-term elevations in air concentrations occurred. Effects, if any, would be transient and short term, based on the available literature (U.S. EPA. 2010c). Consideration of the low frequency, short-duration and degree of exceedances, suggests that the likelihood of adverse health effects associated with 1-hour NO_2 concentrations is low for those with respiratory sensitivities, such as asthmatics, and negligible for the general public.

- The Project alone contributed very little in terms of predicted SO_2 concentrations at any of the receptor locations. The existing Baseline concentrations at all receptor locations are driven by emissions from the pelletizing plant (RWDI, Pers Comm), and at all four receptor locations, predicted concentrations exceeded the U.S. EPA 1 hour guidelines. Since the guideline being used is a 99th percentile of the daily 1 hour maximum concentrations, averaged over 3 years, it is not appropriate to compare individual hours to the guideline. Nevertheless, the frequency of exceedance over the guideline on an hourly basis was examined and amounts to 0.2% at the cross country ski trails, the Dumbell Lake area and the hospital, and a 0.4% frequency at the downhill slopes.
- The predicted 99th percentile concentrations (averaged over 3 years) of SO_2 were approximately 30 – 40 µg/m^3 over the U.S. EPA guideline at the cross country ski trails, the Dumbell Lake area and the hospital, but are 130 µg/m^3 over the guideline at the downhill ski slopes. Only two of the predicted hourly concentrations at the downhill ski slopes are over 450 µg/m^3 ,which is the existing 1 hour standard in Canada (CCME, 1999; Maximum Desirable Level) (which is not considered to be health protective, based on more recent reviews of the literature conducted by U.S. EPA, 2010d). Based on the key short-term clinical studies reported by the U.S. EPA and considered in deriving the 1-hour SO_2 standard (U.S. EPA, 2008), effects have not been reported to occur in sensitive individuals below concentrations of 500 µg/m^3. Exposures from 500 to 800 µg/m^3 for 5 to 10 minutes have been reported to reduce the amount of air an asthmatic can expel in short term studies, but there is limited evidence of increases in respiratory symptoms. Longer exposures to this concentration range (1 – 6 hours) have enhanced airway responses, but have not been associated with respiratory symptoms. For effects to occur, sensitive individuals, such as exercising asthmatics or individuals with other respiratory sensitivities, would have to be in the area where air concentrations are elevated at the time the short-term elevations in air concentrations occurred. It is plausible that exercising asthmatics could be present on the downhill ski slopes. Based on the literature, and the number of hours in which SO_2 was predicted to be over 450 µg/m^3 (two at the downhill slopes and none at any other receptor locations), effects, if any, would be expected to be transient and short term.
- Therefore, consideration of both the frequency and degree of exceedance of modeled SO_2 data suggests that the likelihood of adverse health effects in sensitive individuals associated with SO_2 emissions is low, while potential risks to healthy individuals is considered negligible. However, there is a potential that sensitive individuals could experience short-term reversible health effects during the brief periods when ambient air concentrations of SO_2 exceed levels at which health effects have been reported at the downhill ski area. Based on the available data, this is anticipated to occur infrequently.

4.4.1.3 Metals, Benzo(a)Pyrene and Benzene

For metals, B(a)P and benzene, GLACs were predicted at the four receptor locations of interest. As the hospital is distant to the proposed Project, the application of these metal fractions to the predicted GLACs of PM_{10} or $PM_{2.5}$ at the hospital adds uncertainty to the assessment, as air quality near the hospital is more influenced by the pellet plant emissions, than emissions of the proposed Project. These comparisons are therefore presented for illustrative purposes, to present calculations which show the relative contribution of the Project to air quality in a northern part of the town of Labrador City. Table 4-8 provides the annual metals concentrations based on PM_{10}, as well as the annual B(a)P and benzene concentrations. Table 4-9 provided the annual metals concentrations predicted from $PM_{2.5}$.

In each table, where predicted concentrations exceed relevant ambient air quality guidelines/TRVs, values are shaded.

Table 4-8 Predicted Annual Average Concentrations of Metals Benzo(a)Pyrene and Benzene (µg/m3) in Baseline, Project, and Baseline + Project Scenarios Calculated from Ground Level Air Concentrations at Each Receptor Location, based on PM10 or NOx Concentrations (µg/m^3), and Relevant Ambient Air Quality Guidelines

Predicted Annual Average Air Concentration (µg/m^3)									
Based on Percent Metal on PM10 from Ore								***Based on Predictions from NOx***	
COPC		***Al***	***Cr***	***Fe***	***Mn***	***SiO_2***	***Ti***	***B(a)P***	***Benzene***
Ambient Air Guideline/TRV (µg/m^3)		**5**	**0.041**	**5**	**0.05**	**3 [a]**	**5**	**0.32**	**3**
X-Country Trials	**Baseline**	0.056	0.00112	1.72	0.040	2.2	0.016	0.00000093	0.0033
	Project	0.022	0.00046	0.69	0.016	0.86	0.0063	0.00000036	0.0013
	Project + Baseline	0.078	0.0016	2.41	0.055	3.0	0.022	0.0000013	0.0045
Downhill Trails	**Baseline**	0.036	0.00074	1.12	0.026	1.4	0.010	0.00000058	0.0020
	Project	0.055	0.0011	1.69	0.039	2.1	0.015	0.00000081	0.0028
	Project + Baseline	0.091	0.0019	2.81	0.064	3.5	0.026	0.0000014	0.0049
Dumbell Lake Area	**Baseline**	0.028	0.00058	0.88	0.020	1.1	0.008	0.00000039	0.0014
	Project	0.012	0.00025	0.38	0.0086	0.47	0.0034	0.00000017	0.00058
	Project + Baseline	0.041	0.00083	1.25	0.029	1.6	0.011	0.00000056	0.0019
Hospital	**Baseline**	0.040	0.00082	1.25	0.028	1.6	0.011	0.00000017	0.00059
	Project	0.002	0.000049	0.07	0.001	0.1	0.001	0.000000044	0.00015
	Project + Baseline	0.043	0.00087	1.31	0.030	1.7	0.012	0.00000021	0.00075

Notes:
Shaded cells exceed the health-based ambient air quality benchmark or Reference Air Concentration
[a.] MDH, 2013. The silica guideline is set for PM_4, as opposed to a PM_{10} fraction.

Based on the information presented in Table 4-8, the following conclusions can be drawn:

- Predicted exposures to aluminum, chromium, iron, titanium, B(a)P, and benzene are below annual average ambient air quality guidelines for Baseline, Project alone, and Baseline + Project at all four receptor locations. The increment added by the Project at both the downhill ski trails and the cross country ski trails is higher than at the Dumbell Lake area, or the hospital. As stated earlier, the hospital is distant to the Project, and hence, air quality is more affected by emissions from the pelletizing plant than the Project, as evidenced by the predicted insignificant changes in $PM_{2.5}$.
- Predicted exposures to manganese and silica are greater than annual average ambient air quality guidelines at the cross country ski hills and downhill slope for manganese (Baseline + Project), and at the downhill slope for Silica (Baseline + Project). Neither of these receptor locations have full time residents at these locations, hence exposures will be lower than those estimated. The Project increment on its own does not exceed guidelines, but when added to Baseline, it represents a substantial increase in manganese (38% increase in manganese at the cross country ski trails, and 146% increase at the downhill slopes), and silica (150% increase at the downhill slopes). The ambient air quality guideline for silica is based on a PM_4 cut, as opposed to a PM_{10} cut, and hence, exposures calculated from PM_{10} will be biased high. These increases are unlikely to pose a health risk due to the transient use of the recreational area, and the conservative nature of the assumptions used.
- U.S. EPAs emissions profile for stationary diesel engines (AP42; U.S. EPA,1995), indicates that a number of carcinogenic PAHs (cPAHs) and VOCs can be emitted during normal operation. The current assessment only evaluates benzo(a)pyrene, and benzene as representative compounds for the cPAHs and VOCs chemicals groups, respectively. Given the magnitude of predicted releases and the relative toxicity of benzo(a)pyrene, and benzene within the cPAHs and VOCs groups, respectively, other potential emissions are not expected to present an increased health risk.

In Table 4-9, estimated annual average metals concentrations are presented, based on calculations from $PM_{2.5.}$ None of the predicted concentrations exceeded ambient air quality guidelines at any of the receptor locations, or within Baseline, Project alone, or Project + Baseline.

Table 4-9	**Predicted Annual Average Concentrations of Metals Calculated from Ground Level Air Concentrations at Each Receptor Location, based on PM2.5 Concentrations (µg/m³)**						
Estimated Annual Average Air Concentration (µg/m³) Based on Percent Metal on $PM_{2.5}$ in Ore							
		Al	***Cr***	***Fe***	***Mn***	***SiO_2***	***Ti***
Ambient Air Guideline (µg/m³)		***5***	***0.041***	***5***	***0.05***	***3 [a]***	***5***
X-Country Trials	**Baseline**	0.011	0.00022	0.33	0.0076	0.41	0.0030
	Project	0.0036	0.000074	0.11	0.0026	0.14	0.0010
	Project + Baseline	0.014	0.00029	0.44	0.010	0.55	0.0040
Downhill Trails	**Baseline**	0.0074	0.00015	0.23	0.0053	0.29	0.0021
	Project	0.0095	0.00019	0.29	0.0067	0.37	0.0027
	Project + Baseline	0.017	0.00034	0.52	0.012	0.65	0.0048
Dumbell Lake Area	**Baseline**	0.0058	0.00012	0.18	0.0041	0.22	0.0016
	Project	0.0027	0.00005	0.083	0.0019	0.10	0.00075
	Project + Baseline	0.0084	0.00017	0.26	0.0060	0.33	0.0024
Hospital	**Baseline**	0.0082	0.00017	0.25	0.0058	0.32	0.0023
	Project	0.0002	0.0000042	0.0064	0.00015	0.0079	0.000058
	Project + Baseline	0.008	0.00017	0.26	0.0060	0.33	0.0024

Notes:
[a.] MDH, 2013. The silica guideline is set for PM_4, as opposed to a $PM_{2.5}$ fraction.

4.4.2 Oral Multipathway Risk Assessment

4.4.2.1 Baseline + Project Increment

The predicted change in the selected COPCs within various environmental media as a result of 40 years of operations of the Project at the predicted annual dust fall rates at the x-country ski trails (12.6 g/m^2/year), downhill ski trails (10.9 g/m^2/year) and Dumbell Lake area (5.52 g/m^2/year) are presented in Tables 4-10 to 4-14. The predicted annual dustfall rate at the hospital was miniscule at 0.60 g/m^2/year. As such, an oral multipathway assessment was not conducted at this receptor location, rather potential risks at this location were discussed based on results for the other receptor locations.

In Tables 4-10 to 4-13, the following is presented:

- Measured baseline soil (Table 4-10; 4-11), and baseline berry tissue concentrations (Table 4-12), as well as predicted surface soil and berry concentrations as a result of 40 years of dustfall at the rates outlined above (Project increment and Baseline + Project). In addition, the calculated percent change in baseline, as a result of 40 years of operations is presented.
- Soil concentrations were predicted for both surface soils and deeper soils assuming mixing depths of 2 cm and 20 cm, respectively as per U.S. EPA (2005a). Loading into the top 2 and 20 cm of soil does not account for any soil erosion, surface runoff, or leaching or other natural processes which would be expected to occur and as such, would over estimate actual concentrations, and hence exposures.
- Predicted soil concentrations were also compared to soil quality guidelines and baseline soil concentrations at the 2 cm mixing depth (Table 4-10).
- Predicted baseline game meat tissue concentrations (small mammal – assumed to be a hare; Table 4-13; and upland game bird – assumed to be a grouse; Table 4-14), as well as predicted future game meat tissue concentrations as a result of 40 years of operation, at each of the dustfall rates (Project increment and Baseline + Project).

Table 4-10 Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project) Surface Soil Concentrations (mg/kg) Assuming a Mixing Depth of 2 cm

Predicted Future Site Dust Deposition ($g/m^2/year$)	*Chemical*	*Soil Quality Guideline / Reference Soil Range [a] (mg/kg)*	*Surface Soil (mg/kg); (Assumes a mixing depth of 2cm)*			*% Change (Baseline to Predicted Future)*
			Baseline	*Incremental Project*	*Baseline + Incremental Project*	
X-Country Trails	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	1.62E+02	1.32E+04	1.2
	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	3.71E-09	3.71E-09	NC
	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	3.29E+00	5.73E+01	6.1
	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	4.99E+03	8.90E+04	5.9
	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	1.15E+02	2.01E+03	6.0
	Silica	NGA / NA	0.00E+00	6.23E+03	6.23E+03	NC
	Titanium	NGA / 2.0E+3 – 1.2E+4 [e]	9.70E+02	4.55E+01	1.02E+03	4.7
Downhill Trails	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	1.40E+02	1.31E+04	1.1
	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	3.21E-09	3.21E-09	NC
	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	2.85E+00	5.68E+01	5.3
	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	4.32E+03	8.83E+04	5.1
	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	9.91E+01	2.00E+03	5.2
	Silica	NGA / NA	0.00E+00	5.39E+03	5.39E+03	NC
	Titanium	NGA / 2.0E+3 – 1.2E+4	9.70E+02	3.94E+01	1.01E+03	4.1
Dumbell Lake Area	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	7.08E+01	1.31E+04	0.54
	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	1.63E-09	1.63E-09	NC
	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	1.44E+00	5.54E+01	2.7
	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	2.19E+03	8.62E+04	2.6
	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	5.02E+01	1.95E+03	2.6
	Silica	NGA / NA	0.00E+00	2.73E+03	2.73E+03	NC
	Titanium	NGA / 2.0E+3 – 1.2E+4	9.70E+02	1.99E+01	9.90E+02	2.1

Note: NC = not calculated as no baseline soil data for this parameter were available; NGA = no guideline available; NA = reference area soil concentration no available.

a. Reference area data were baseline surface soil data (0 to 15 cm) collected for the Kami Mine EIA (AMEC, 2012b).

b. US EPA (2013) Regional Screening Level for residential soil adjusted from HQ = 0.1 to HQ = 0.2 by multiplying by 2.

c. CCME (2010) human-health based soil quality guideline for carcinogenic polycyclic aromatic hydrocarbons (PAHs) for residential / parkland land use assuming a 1 in 100,000 risk level. This guideline is intended to be compared to total PAHs based on B(a)P total potency equivalents. Future soils concentrations for other PAHs were not available, however given how small the Baseline + Incremental project B(A)P concentrations is, it is assumed total carcinogenic soil concentrations would also be below this guideline.

d. CCME (1997) human health-based soil quality guideline for residential / parkland land use; from factsheet provided on CCME (2014b) on-line http://ceqg-rcqe.ccme.ca/

e. No local reference area or Canadian reference data were available. Reference soil concentration range in California is presented in this table from Bradford et al. (1996).

Table 4-11 Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project) Soil Concentrations (mg/kg) Assuming a Mixing Depth of 20 cm

Predicted Future Site Dust Deposition (g/m²/year)	***Chemical***	***Soil (mg/kg) (Assumes soil mixing depth of 20cm)***			***% Change (Baseline to Predicted Future)***
		Baseline	***Incremental Project***	***Baseline + Incremental Project***	
X-Country Trails	Aluminum	1.30E+04	1.62E+01	1.30E+04	0.12
	Benzo(a)pyrene	0.00E+00	3.71E-10	3.71E-10	NC
	Chromium	5.40E+01	3.29E-01	5.43E+01	0.61
	Iron	8.40E+04	4.99E+02	8.45E+04	0.59
	Manganese	1.90E+03	1.15E+01	1.91E+03	0.60
	Silica	0.00E+00	6.23E+02	6.23E+02	NC
	Titanium	9.70E+02	4.55E+00	9.75E+02	0.47
Downhill Trails	Aluminum	1.30E+04	1.40E+01	1.30E+04	0.11
	Benzo(a)pyrene	0.00E+00	3.21E-10	3.21E-10	NC
	Chromium	5.40E+01	2.85E-01	5.43E+01	0.53
	Iron	8.40E+04	4.32E+02	8.44E+04	0.51
	Manganese	1.90E+03	9.91E+00	1.91E+03	0.52
	Silica	0.00E+00	5.39E+02	5.39E+02	NC
	Titanium	9.70E+02	3.94E+00	9.74E+02	0.41
Dumbell Lake Area	Aluminum	1.30E+04	7.08E+00	1.30E+04	0.054
	Benzo(a)pyrene	0.00E+00	1.63E-10	1.63E-10	NC
	Chromium	5.40E+01	1.44E-01	5.41E+01	0.27
	Iron	8.40E+04	2.19E+02	8.42E+04	0.26
	Manganese	1.90E+03	5.02E+00	1.91E+03	0.27
	Silica	0.00E+00	2.73E+02	2.73E+02	NC
	Titanium	9.70E+02	1.99E+00	9.72E+02	0.21

Note: NC = not calculated as no baseline soil data for this parameter were available

Based on the information presented in Table 4-10 (2 cm surface soil depth), the predicted change in surface soils as a result of 40 years of operations is reasonably small in the areas affected by these dustfall rates, and ranges from 1.2 to 6.1%, 1.1 to 5.3%, and 0.54 to 2.7% at the x-country ski trails, downhill ski trails and Dumbell Lake area, respectively. In Table 4-11, where mixing depths were assumed to equal 20 cm, predicted change in soils is much less pronounced, and ranges from 0.12 to 0.61%, 0.11 to 0.53%, and 0.054 to 0.27% at the x-country ski trails, downhill ski trails and Dumbell Lake area, respectively.

Predicted Baseline + Incremental Project soil concentrations were either within guidelines and / or within reference area concentrations (See Table 4-10) with the exception of iron. Baseline concentrations of iron exceeded both the guideline and reference area concentrations, but were not predicted to pose a risk to human health (See Table 4-15).

With respect to berry concentrations (Table 4-12), the predicted change as a result of 40 years of operations is ranges from 0.68 to 23%, 0.58 to 20%, and 0.29 to 10% at the x-country ski trails, downhill ski trails and Dumbell Lake area, respectively. Berry picking activities at the x-country trails (which had the highest dustfall rate) are likely limited due to their distance from roads and ground trails, but would be expected to occur more frequently at around the downhill ski area and Dumbell Lake area due to easier access. Small mammal (Table 4-13) and upland bird (Table 4-14) game meat tissue concentrations had similar predicted changes for the x-country ski trails, downhill ski trails and Dumbell Lake area (2.7 to 12%; 2.4 to 11%; 1.2 to 5.4% change respectively for small mammals; Table 4-13; 2.1 to 9.6%; 1.8 to 8.3%; 0.90 to 4.2% change respectively for upland birds; Table 4-14). These predictions assume game animals are present in areas affected by these dustfall rates their entire lifespan, which, if this were to occur, there would be a limited number of individuals affected by these dusting rates as the receptors are not sedentary.

Table 4-12 Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project) Berry Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition (g/m^2/year)	*Chemical*	*Berries (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Incremental Project*	*Baseline + Incremental Project*	
X-Country Trails	Aluminum	9.44E+00	1.82E-01	9.62E+00	1.9
	Benzo(a)pyrene	0.00E+00	8.69E-11	8.69E-11	NC
	Chromium	4.05E-01	5.95E-03	4.11E-01	1.5
	Iron	2.33E+01	5.41E+00	2.88E+01	23
	Manganese	1.95E+02	1.30E+00	1.96E+02	0.68
	Silica	0.00E+00	2.25E+02	2.25E+02	NC
	Titanium	6.04E-01	5.09E-02	6.55E-01	8.4
Downhill Trials	Aluminum	9.44E+00	1.58E-01	9.60E+00	1.7
	Benzo(a)pyrene	0.00E+00	7.52E-11	7.52E-11	NC
	Chromium	4.05E-01	5.15E-03	4.10E-01	1.3
	Iron	2.33E+01	4.68E+00	2.80E+01	20
	Manganese	1.95E+02	1.12E+00	1.96E+02	0.58
	Silica	0.00E+00	1.94E+02	1.94E+02	NC
	Titanium	6.04E-01	4.40E-02	6.48E-01	7.3
Dumbell Lake Area	Aluminum	9.44E+00	7.99E-02	9.52E+00	0.85
	Benzo(a)pyrene	0.00E+00	3.81E-11	3.81E-11	NC
	Chromium	4.05E-01	2.61E-03	4.08E-01	0.64
	Iron	2.33E+01	2.37E+00	2.57E+01	10
	Manganese	1.95E+02	5.68E-01	1.95E+02	0.29
	Silica	0.00E+00	9.84E+01	9.84E+01	NC
	Titanium	6.04E-01	2.23E-02	6.26E-01	3.7

Note: NC = not calculated as no baseline soil data for this parameter were available

Table 4-13 Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project) Small Mammal Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition ($g/m^2/year$)	*Chemical*	*Small Mammal (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Incremental Project*	*Baseline + Incremental Project*	
X-Country Trails	Aluminum	2.3E-02	6.2E-04	2.3E-02	2.7
	Benzo(a)pyrene	0.0E+00	3.2E-13	3.2E-13	NC
	Chromium	1.4E-03	9.9E-05	1.5E-03	7.2
	Iron	2.0E-01	2.4E-02	2.2E-01	12
	Manganese	1.5E-02	8.3E-04	1.6E-02	5.4
	Silica	0.0E+00	2.5E-01	2.5E-01	NC
	Titanium	1.8E-02	1.8E-03	1.9E-02	10
Downhill Trails	Aluminum	2.3E-02	5.4E-04	2.3E-02	2.4
	Benzo(a)pyrene	0.0E+00	2.8E-13	2.8E-13	NC
	Chromium	1.4E-03	8.6E-05	1.5E-03	6.2
	Iron	2.0E-01	2.1E-02	2.2E-01	11
	Manganese	1.5E-02	7.2E-04	1.6E-02	4.6
	Silica	0.0E+00	2.1E-01	2.2E-01	NC
	Titanium	1.8E-02	1.5E-03	1.9E-02	8.6
Dumbell Lake Area	Aluminum	2.3E-02	2.7E-04	2.3E-02	1.2
	Benzo(a)pyrene	0.0E+00	1.4E-13	1.4E-13	NC
	Chromium	1.4E-03	4.3E-05	1.4E-03	3.2
	Iron	2.0E-01	1.1E-02	2.1E-01	5.4
	Manganese	1.5E-02	3.6E-04	1.6E-02	2.3
	Silica	0.0E+00	1.1E-01	1.1E-01	NC
	Titanium	1.8E-02	7.7E-04	1.8E-02	4.4

Note: NC = not calculated as no baseline soil data for this parameter were available

Table 4-14 Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project) Game Bird Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition (g/m²/year)	*Chemical*	*Game Bird (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Incremental Project*	*Baseline + Incremental Project*	
X-Country Trails	Aluminum	1.5E-02	3.1E-04	1.5E-02	2.1
	Benzo(a)pyrene	0.0E+00	9.3E-14	9.3E-14	NC
	Chromium	1.2E-03	5.1E-05	1.2E-03	4.3
	Iron	1.2E-01	1.2E-02	1.3E-01	9.6
	Manganese	7.4E-03	4.0E-04	7.8E-03	5.4
	Silica	0.0E+00	1.2E-01	1.2E-01	NC
	Titanium	1.1E-02	8.6E-04	1.2E-02	8.0
Downhill Trails	Aluminum	1.5E-02	2.6E-04	1.5E-02	1.8
	Benzo(a)pyrene	0.0E+00	8.0E-14	8.1E-14	NC
	Chromium	1.2E-03	4.4E-05	1.2E-03	3.7
	Iron	1.2E-01	1.0E-02	1.3E-01	8.3
	Manganese	7.4E-03	3.5E-04	7.8E-03	4.7
	Silica	0.0E+00	1.1E-01	1.1E-01	NC
	Titanium	1.1E-02	7.4E-04	1.1E-02	6.9
Dumbell Lake Area	Aluminum	1.5E-02	1.3E-04	1.5E-02	0.90
	Benzo(a)pyrene	0.0E+00	4.1E-14	4.1E-14	NC
	Chromium	1.2E-03	2.2E-05	1.2E-03	1.9
	Iron	1.2E-01	5.2E-03	1.3E-01	4.2
	Manganese	7.4E-03	1.8E-04	7.6E-03	2.4
	Silica	0.0E+00	5.3E-02	5.3E-02	NC
	Titanium	1.1E-02	3.8E-04	1.1E-02	3.5

Note: NC = not calculated as no baseline soil data for this parameter were available

Exposure modelling of baseline and predicted future concentrations for all lifestages was conducted, and Hazard Quotients (HQs) for the toddler (the most sensitive receptor) are presented in Table 4-15. Receptors were assumed to live at the various receptor locations (i.e., x-country ski trails, downhill ski trails and Dumbell Lake area) on a full time basis, and consume drinking water, incidental soils, berries, fish and game meats from those areas.

The HQ values associated with the project increment are all well below 0.2, and have a minimal effect on the overall Baseline + Project HQ, relative to the Baseline HQ on its own (Table 4-15). For carcinogens, the calculated ILCR is below the acceptable ILCR level of 1.0E-05 established by Health Canada (2012a), and hence, is not considered to represent a health concern. Since there is more than a 10-fold margin of safety, the consideration of the full suite of cPAHs is not expected to alter this conclusion.

Table 4-15 Toddler Hazard Quotients (HQs) for Measured Baseline, Predicted Incremental Project and Predicted Future (Baseline + Project)

Predicted Future Site Dust Deposition (g/m^2/year)	***Chemical***	***TRV***	***Toddler HQ***		
			Baseline	***Incremental Project***	***Baseline + Incremental Project***
X-Country Trails	Aluminum	RfD	0.54	0.0067	0.55
	Benzo(a)pyrene	SF	0	3.41E-08	3.41E-08
	Chromium	RfD	0.00022	0.000012	0.00023
	Iron	RfD	0.72	0.043	0.76
	Manganese	RfD	0.19	0.0054	0.20
	Silica	NA	NC	NC	NC
	Titanium	NA	NC	NC	NC
Downhill Trails	Aluminum	RfD	0.54	0.0058	0.55
	Benzo(a)pyrene	SF	0	2.95E-08	2.95E-08
	Chromium	RfD	0.00022	0.000010	0.00023
	Iron	RfD	0.72	0.037	0.76
	Manganese	RfD	0.19	0.0047	0.19
	Silica	NA	NC	NC	NC
	Titanium	NA	NC	NC	NC
Dumbell Lake Area	Aluminum	RfD	0.54	0.0030	0.54
	Benzo(a)pyrene	SF	0	1.49E-08	1.49E-08
	Chromium	RfD	0.00022	0.0000052	0.00022
	Iron	RfD	0.72	0.019	0.74
	Manganese	RfD	0.19	0.0024	0.19
	Silica	NA	NC	NC	NC
	Titanium	NA	NC	NC	NC

Notes:
NA = Not available; NC = Not calculated; TRV = toxicity reference value; HQ = hazard quotient, RfD = reference dose; SF = slope factor
HQs are rounded to 2 significant figures
a. ILCR: Incremental Lifetime Cancer Risk estimate

4.4.2.2 Baseline + Future Build

The predicted change in the selected COPCs within various environmental media as a result of 40 years of operations of the Project and other IOC facilities (such as the pelletizing facility, and Luce and other pits) at the predicted annual dust fall rates of 30, 40 and 55.2 g/m^2/ are presented in Tables 4-16 to 4-20.

Table 4-16 Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build) Surface Soil Concentrations (mg/kg) Assuming a Mixing Depth of 2 cm

Predicted Future Site Dust Deposition (g/m^2/year)	*Chemical*	*Soil Quality Guideline / Reference Soil Concentration Range [a] (mg/kg)*	*Surface Soil (mg/kg) (Assumes a mixing depth of 2cm)*			*% Change (Baseline to Predicted Future)*
			Baseline	*Future Build*	*Baseline + Future Build*	
55.2	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	7.05E+02	1.37E+04	5.4
55.2	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	1.62E-08	1.62E-08	NC
55.2	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	1.44E+01	6.84E+01	26.6
55.2	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	2.18E+04	1.06E+05	25.9
55.2	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	5.00E+02	2.40E+03	26.3
55.2	Silica	NGA / NA	0.00E+00	2.72E+04	2.72E+04	NC
55.2	Titanium	NGA / 2.0E+3 – 1.2E+4 [e]	9.70E+02	1.99E+02	1.17E+03	20.5
40	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	5.39E+02	1.35E+04	4.1
40	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	1.24E-08	1.24E-08	NC
40	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	1.10E+01	6.50E+01	20.3
40	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	1.66E+04	1.01E+05	19.8
40	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	3.82E+02	2.28E+03	20.1
40	Silica	NGA / NA	0.00E+00	2.08E+04	2.08E+04	NC
40	Titanium	NGA / 2.0E+3 – 1.2E+4	9.70E+02	1.52E+02	1.12E+03	15.6
30	Aluminum	1.5E+4 [b] / 4.3E+2 – 1.0E+4	1.30E+04	3.85E+02	1.34E+04	2.96
30	Benzo(a)pyrene	5.3E+0 [c] / NA	0.00E+00	8.83E-09	8.83E-09	NC
30	Chromium	2.0E+2 [d] / 2.0E+0 – 4.9E+1	5.40E+01	7.84E+00	6.18E+01	14.5
30	Iron	1.1E+4 [b] / 4.3E+3 – 4.1E+4	8.40E+04	1.19E+04	9.59E+04	14.1
30	Manganese	3.8E+2 [b] / 3.3E+1 – 8.6E+3	1.90E+03	2.73E+02	2.17E+03	14.4
30	Silica	NGA / NA	0.00E+00	1.48E+04	1.48E+04	NC
30	Titanium	NGA / 2.0E+3 – 1.2E+4	9.70E+02	1.08E+02	1.08E+03	11.2

Note: NC = not calculated as no baseline soil data for this parameter were available; NGA = no guideline available; NA = reference area soil concentration no available.
a. Reference area data were baseline surface soil data (0 to 15 cm) collected for the Kami Mine EIA (AMEC, 2012b).
b. US EPA (2013) Regional Screening Level for residential soil adjusted from HQ = 0.1 to HQ = 0.2 by multiplying by 2.
c. CCME (2010) human-health based soil quality guideline for carcinogenic polycyclic aromatic hydrocarbons (PAHs) for residential / parkland land use assuming a 1 in 100,000 risk level. This guideline is intended to be compared to total PAHs based on B(a)P total potency equivalents. Future soils concentrations for other PAHs were not available, however given how small the Baseline + Incremental project B(A)P concentrations is, it is assumed total carcinogenic soil concentrations would also be below this guideline.
d. CCME (1997) human health-based soil quality guideline for residential / parkland land use; from factsheet provided on CCME (2014b) on-line http://ceqg-rcqe.ccme.ca/
e. No local reference area data were available for this chemical. No Canadian reference data were identified in the literature reviewed. Reference soil concentration range in California is presented in this table from Bradford et al. (1996).

Table 4 – 17 Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build) Soil Concentrations (mg/kg) Assuming a Mixing Depth of 20 cm

Predicted Future Site Dust Deposition (g/m²/year)	*Chemical*	*Soil (mg/kg) (Assumes soil mixing depth of 20cm)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Future Build*	*Baseline + Future Build*	
55.2	Aluminum	1.30E+04	7.05E+01	1.31E+04	0.5
55.2	Benzo(a)pyrene	0.00E+00	1.62E-09	1.62E-09	NC
55.2	Chromium	5.40E+01	1.44E+00	5.54E+01	2.7
55.2	Iron	8.40E+04	2.18E+03	8.62E+04	2.6
55.2	Manganese	1.90E+03	5.00E+01	1.95E+03	2.6
55.2	Silica	0.00E+00	2.72E+03	2.72E+03	NC
55.2	Titanium	9.70E+02	1.99E+01	9.90E+02	2.1
40	Aluminum	1.30E+04	5.39E+01	1.31E+04	0.4
40	Benzo(a)pyrene	0.00E+00	1.24E-09	1.24E-09	NC
40	Chromium	5.40E+01	1.10E+00	5.51E+01	2.0
40	Iron	8.40E+04	1.66E+03	8.57E+04	2.0
40	Manganese	1.90E+03	3.82E+01	1.94E+03	2.0
40	Silica	0.00E+00	2.08E+03	2.08E+03	NC
40	Titanium	9.70E+02	1.52E+01	9.85E+02	1.6
30	Aluminum	1.30E+04	3.85E+01	1.30E+04	0.3
30	Benzo(a)pyrene	0.00E+00	8.83E-10	8.83E-10	NC
30	Chromium	5.40E+01	7.84E-01	5.48E+01	1.5
30	Iron	8.40E+04	1.19E+03	8.52E+04	1.4
30	Manganese	1.90E+03	2.73E+01	1.93E+03	1.4
30	Silica	0.00E+00	1.48E+03	1.48E+03	NC
30	Titanium	9.70E+02	1.08E+01	9.81E+02	1.1

Note: NC = not calculated as no baseline soil data for this parameter were available

Based on the information presented in Table 4-16 (2 cm surface soil depth), the predicted change in surface soils as a result of 40 years of operations is reasonably large in the areas affected by these dustfall rates, and ranges from 5 to 26%, 4 to 20%, and 3 to 15% at the high, medium and low dustfall rates (55.2; 40 and 30 g/m^2/year, respectively). These dustfall rates occur in a relatively limited area, and are represented by the blue (2.5 g/m^2/30 days = 30 g/m^2/year), green (3.5 g/m^2/30 days = 40 g/m^2/year) and yellow (4.6 g/m^2/30 days = 55.2 g/m^2/year) isopleths in Figure 4-1. The areas affected include the Menihek cross country ski trails, as well as the downhill ski slopes area, with the highest deposition rate being limited to the upper area of the Menihek trails, and the middle deposition rate influencing the northern most slope of the downhill area and the upper trails of the cross country area. The lower deposition rate applies to a broader area of the downhill slopes, and the cross country ski trails. Annual maximum dustfall rates were predicted for the four receptor locations discussed in Section 4.4.1 (Baseline + Project), and deposition is predicted to be 36.8 g/m^2/year at the cross country trails, 31.7 g/m^2/year (downhill slopes), which is within the range assessed in Table 4-10, but are similar to maximum predicted rates for the Dumbell Lake area (31.6 g/m^2/year), and the hospital (30.7 g/m^2/year, which is largely related to the pelletizing facility). In Table 4-17, where mixing depths were assumed to equal 20 cm, predicted change in soils is much less pronounced, and ranges from 0.5 – 2.7%, 0.4 – 2%, and 0.3 – 1.5% at the high, medium and low dustfall rates, respectively.

Predicted Baseline + Incremental Future Build soil concentrations were either within guidelines and / or within reference area concentrations (See Table 4-16) with the exception of iron, which is not predicted to pose a risk to human health (See Table 4-21).

With respect to berry concentrations (Table 4-18), the predicted change as a result of 40 years of operations is ranges from 3 to 100%, 2 to 77%, and 2 to 55% at the high, medium and low dustfall rates (55.2; 40 and 30 g/m^2/year, respectively). Berry picking activities at the highest dustfall rate areas are likely limited, but would be expected to occur more frequently at the mid to low dustfall rate areas. Small mammal (Table 4-19) and upland bird (Table 4-20) game meat tissue concentrations had similar predicted changes for areas affected by high, medium and low dustfall rates (12 to 54% ; 9 to 41%; 6 to 29% change for small mammals; Table 4-19; 9 to 42%; 7 to 32%; 5 to 23% change for upland birds; Table 4-20). These predictions assume game animals are present in areas affected by these dustfall rates their entire lifespan, which, if this were to occur, there would be a limited number of individuals affected by these dusting rates.

Table 4-18 Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build) Berry Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition (g/m²/year)	*Chemical*	*Berries (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Future Build*	*Baseline + Future Build*	
55.2	Aluminum	9.44E+00	7.96E-01	1.02E+01	8.4
55.2	Benzo(a)pyrene	0.00E+00	3.79E-10	3.79E-10	NC
55.2	Chromium	4.05E-01	2.60E-02	4.31E-01	6.4
55.2	Iron	2.33E+01	2.36E+01	4.70E+01	101.1
55.2	Manganese	1.95E+02	5.66E+00	2.01E+02	2.9
55.2	Silica	0.00E+00	9.81E+02	9.81E+02	NC
55.2	Titanium	6.04E-01	2.22E-01	8.26E-01	36.8
40	Aluminum	9.44E+00	6.08E-01	1.00E+01	6.4
40	Benzo(a)pyrene	0.00E+00	2.90E-10	2.90E-10	NC
40	Chromium	4.05E-01	1.98E-02	4.25E-01	4.9
40	Iron	2.33E+01	1.80E+01	4.14E+01	77.2
40	Manganese	1.95E+02	4.32E+00	1.99E+02	2.2
40	Silica	0.00E+00	7.49E+02	7.49E+02	NC
40	Titanium	6.04E-01	1.70E-01	7.74E-01	28.1
30	Aluminum	9.44E+00	4.34E-01	9.87E+00	4.6
30	Benzo(a)pyrene	0.00E+00	2.07E-10	2.07E-10	NC
30	Chromium	4.05E-01	1.42E-02	4.19E-01	3.5
30	Iron	2.33E+01	1.29E+01	3.62E+01	55.2
30	Manganese	1.95E+02	3.09E+00	1.98E+02	1.6
30	Silica	0.00E+00	5.35E+02	5.35E+02	NC
30	Titanium	6.04E-01	1.21E-01	7.25E-01	20.0

Note: NC = not calculated as no baseline soil data for this parameter were available

Table 4-19 Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build) Small Mammal Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition (g/m²/year)	*Chemical*	*Small Mammal (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Future Build*	*Baseline + Future Build*	
55.2	Aluminum	2.3E-02	2.7E-03	2.5E-02	11.9
55.2	Benzo(a)pyrene	0.0E+00	1.4E-12	1.4E-12	NC
55.2	Chromium	1.4E-03	4.3E-04	1.8E-03	31.5
55.2	Iron	2.0E-01	1.1E-01	3.0E-01	53.6
55.2	Manganese	1.5E-02	3.6E-03	1.9E-02	23.4
55.2	Silica	0.0E+00	1.1E+00	1.1E+00	NC
55.2	Titanium	1.8E-02	7.7E-03	2.5E-02	43.6
40	Aluminum	2.3E-02	2.1E-03	2.5E-02	9.1
40	Benzo(a)pyrene	0.0E+00	1.1E-12	1.1E-12	NC
40	Chromium	1.4E-03	3.3E-04	1.7E-03	24.1
40	Iron	2.0E-01	8.0E-02	2.8E-01	41.0
40	Manganese	1.5E-02	2.8E-03	1.8E-02	17.9
40	Silica	0.0E+00	8.4E-01	8.4E-01	NC
40	Titanium	1.8E-02	5.8E-03	2.3E-02	33.3
30	Aluminum	2.3E-02	1.5E-03	2.4E-02	6.5
30	Benzo(a)pyrene	0.0E+00	7.6E-13	7.6E-13	NC
30	Chromium	1.4E-03	2.4E-04	1.6E-03	17.2
30	Iron	2.0E-01	5.7E-02	2.5E-01	29.3
30	Manganese	1.5E-02	2.0E-03	1.7E-02	12.8
30	Silica	0.0E+00	6.0E-01	6.0E-01	NC
30	Titanium	1.8E-02	4.2E-03	2.2E-02	23.8

Note: NC = not calculated as no baseline soil data for this parameter were available

Table 4-20 Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build) Game Bird Tissue Concentrations (mg/kg wet weight)

Predicted Future Site Dust Deposition (g/m^2/year)	*Chemical*	*Game Bird (mg/kg wet weight)*			*% Change (Baseline to Predicted Future)*
		Baseline	*Future Build*	*Baseline + Future Build*	
55.2	Aluminum	1.5E-02	1.3E-03	1.6E-02	9.0
55.2	Benzo(a)pyrene	0.0E+00	4.0E-13	4.0E-13	NC
55.2	Chromium	1.2E-03	2.2E-04	1.4E-03	18.7
55.2	Iron	1.2E-01	5.2E-02	1.7E-01	42.1
55.2	Manganese	7.4E-03	1.8E-03	9.2E-03	23.6
55.2	Silica	0.0E+00	5.3E-01	5.3E-01	NC
55.2	Titanium	1.1E-02	3.7E-03	1.4E-02	35.0
40	Aluminum	1.5E-02	1.0E-03	1.6E-02	6.9
40	Benzo(a)pyrene	0.0E+00	3.1E-13	3.1E-13	NC
40	Chromium	1.2E-03	1.7E-04	1.4E-03	14.3
40	Iron	1.2E-01	3.9E-02	1.6E-01	32.1
40	Manganese	7.4E-03	1.3E-03	8.8E-03	18.1
40	Silica	0.0E+00	4.1E-01	4.1E-01	NC
40	Titanium	1.1E-02	2.9E-03	1.4E-02	26.7
30	Aluminum	1.5E-02	7.3E-04	1.6E-02	4.9
30	Benzo(a)pyrene	0.0E+00	2.2E-13	2.2E-13	NC
30	Chromium	1.2E-03	1.2E-04	1.3E-03	10.2
30	Iron	1.2E-01	2.8E-02	1.5E-01	22.9
30	Manganese	7.4E-03	9.6E-04	8.4E-03	12.9
30	Silica	0.0E+00	2.9E-01	2.9E-01	NC
30	Titanium	1.1E-02	2.0E-03	1.3E-02	19.1

Note: NC = not calculated as no baseline soil data for this parameter were available

Exposure modelling of baseline and predicted future concentrations for all lifestages was conducted, and Hazard Quotients (HQs) for the toddler (the most sensitive receptor) are presented in Table 4-21. Receptors were assumed to live in the various dustfall zones on a full time basis, and consume drinking water, incidental soils, berries, fish and game meats. For carcinogens, the calculated ILCR is below the acceptable ILCR level of 1.0E-05 established by Health Canada (2012a), and hence, is not considered to represent a health concern. Since there is more than a 10-fold margin of safety, the consideration of the full suite of cPAHs is not expected to alter this conclusion.

Since aluminum and manganese have oral and inhalation TRVs that affect similar endpoints (see Table 4-5), exposures related to these pathways were summed, and total HQs were calculated at the Dumbell Lake area receptor location (see Table 4-22). The Air HQs presented in Table 4-22 are based on predicted manganese and aluminum concentrations from PM_{10}, as opposed to $PM_{2.5}$, as this represents a worst case calculation, and better represents the fraction that will be deposited on soil and in the oral pathways.

For manganese, the air pathway was the predominant contributor to exposure in both Baseline (HQ = 0.4), and for the Project increment on its own (HQ = 0.17). Oral HQs were lower, with the Project HQ (HQ = 0.013) representing a much lower contribution to overall risks as compared to Baseline on its own (HQ = 0.2). Within the multipathway model, foods were assumed to come from the local environment, and included berries, game meats and fish. Other local foods, such as vegetable garden produce, were not included, due to the short growing season in the area. The Project overall has a predicted total HQ of 0.18 for manganese. While this HQ is approaching 0.2, the inhalation estimates are based on PM_{10} GLACs, and oral bioavailability of manganese in soils and dusts was assumed to be 100%, and no soil loss processes were accounted for in the modeling. Additional consideration of garden produce could increase this estimate; however, based on the low toxicity of manganese via the oral route (relative to inhalation), and the relatively low percentage of the diet that could potentially come from home garden produce (based on the short growing season), it is not considered likely that the overall contributions from the Project will change substantially.

For aluminum, oral pathways dominated exposure, relative to air pathways (Table 4-22). In addition, the Project contribution overall was small (HQ = 0.018 for oral + inhalation pathways), and hence does not represent a concern.

Table 4-21 Toddler Hazard Quotients (HQs) for Measured Baseline, Predicted Future Build and Predicted Future (Baseline + Future Build)

Predicted Future Site Dust Deposition ($g/m^2/year$)	*Chemical*	*TRV*	*Toddler HQ*		
			Baseline	*Future Build*	*Baseline + Future Build*
55.2	Aluminum	RfD	0.54	0.029	0.57
55.2	Benzo(a)pyrene	SF	0	1.5E-07[a]	1.5E-07[a]
55.2	Chromium	RfD	0.00022	0.000052	0.00026
55.2	Iron	RfD	0.72	0.19	0.91
55.2	Manganese	RfD	0.20	0.024	0.22
55.2	Silica	NA	NC	NC	NC
55.2	Titanium	NA	NC	NC	NC
40	Aluminum	RfD	0.54	0.022	0.56
40	Benzo(a)pyrene	SF	0	1.1E-07[a]	1.1E-07[a]
40	Chromium	RfD	0.00022	0.000040	0.00026
40	Iron	RfD	0.72	0.14	0.86
40	Manganese	RfD	0.20	0.018	0.21
40	Silica	NA	NC	NC	NC
40	Titanium	NA	NC	NC	NC
30	Aluminum	RfD	0.54	0.016	0.56
30	Benzo(a)pyrene	SF	0	8.1E-08[a]	8.1E-08[a]
30	Chromium	RfD	0.00022	0.000028	0.00024
30	Iron	RfD	0.72	0.10	0.82
30	Manganese	RfD	0.20	0.013	0.20
30	Silica	NA	NC	NC	NC
30	Titanium	NA	NC	NC	NC

Notes:
NA = not available; NC = not calculated; TRV = toxicity reference value; HQ = hazard quotient, RfD = reference dose; SF = slope factor
HQs rounded to 2 significant figures
a. ILCR: Incremental Lifetime Cancer Risk estimate

Table 4-22 Total HQs for COPCs With Similar Toxicity Endpoints For the Dumbell Lake Area Receptor Location (30 g/m2/year Dust Deposition Zone)[a]				
COPC	***Scenario***	***Air HQ***[b]	***Oral HQ***	***Total HQ***
Manganese	Baseline	0.4	0.2	0.6
	Project	0.17	0.013	0.18
	Baseline + Future Build	0.58	0.20	0.78
Aluminum	Baseline	0.0056	0.54	0.55
	Project	0.0024	0.016	0.018
	Baseline + Future Build	0.0082	0.56	0.57

Notes:
a. HQs were added for the Dumbell Lake area receptor location as this is the only receptor location where receptors could live on a full time basis.
b. Air HQs, also known as Concentration Ratios, were calculated by dividing the predicted ambient air concentration by the TRV or ambient air guideline.

4.4.3 Consideration of Mixtures

Simultaneous exposures of some COPCs could occur, and as such, consideration of potential implications of mixtures requires discussion. Mixtures only require assessment for those substances that act in a similar fashion.

Acute Blasting Scenario

With respect to the Acute blasting scenario, NO_2, SO_2 and H_2S would be considered to have similar endpoints (respiratory irritation), whereas C_4H_8 effects are related to CNS or reproduction (TQEC, 2014), and CO is an asphyxiant (WHO, 2000). The predicted additive acute CR values for inhalation exposures to mixtures of COPC as a result of blasting emissions are provided in Table 4-23.

Table 4-23 Acute Inhalation Concentration Ratios (CRs) Associated with Potential Additive Interactions of COPCs: Blasting Scenario		
Chemical Mixture/Endpoint	***Concentration Ratios***	
	1-hourAverage	***1-hour Maxima***
NO_2	0.44	**2.2**
SO_2	0.16	0.6
H_2S	0.08	0.71
Total CR	0.68	**3.51**

BOLDED and shaded values indicate an exceedance of a CR of 1.0; comparisons are provided for information only.

The 1-hour average CRs for respiratory irritants are less than 1.0, but the 1-hour maximum concentrations exceeded the single-chemical regulatory benchmark of 1.0 (Table 4-23). The 1-hour maxima CR estimate is within an order of magnitude of the single chemical benchmark of 1.0, and is driven by NO_2. The ambient air guideline used for NO_2 is conservative, in that it is not meant to be applied to hourly data; rather, it is meant to be applied to the 98^{th} percentile of the daily 1 hour maxima, averaged over 3 years. Both H_2S and SO_2 were less than their individual guidelines, with NO_2 exceeding the guideline. Although 1-hour CR estimates for chemical mixtures associated with respiratory irritation exceeded the single-chemical regulatory benchmark of 1.0 (under worst-case conditions), no regulatory benchmarks are currently available (beyond those chemical groups that have established toxic equivalent factors) by which one could evaluate whether exposure to a given chemical mixture could pose a health concern. It is possible that simultaneous exposure to these substances could result in some health effects, but based on the CR level, any health effects would be expected to be transient and reversible.

Chronic Exposure Scenarios

For the CACs, NO_2 and SO_2 would be considered to have a similar endpoint (respiratory irritation). It is improbable that these two concentrations would occur at the same location at the same time, and hence, additive CRs were not evaluated. In addition, the Project is an extremely small contributor to the overall predicted concentrations within the area (Table 4-7; see Project increment). With respect to the metals, B(a)P and benzene, only aluminum and manganese act in a similar fashion (neurological effects; see Table 4-5), whereas the carcinogenic effects of B(a)P and benzene have different endpoints (Table 4-5), and thus do not merit further consideration.

With respect to aluminum and manganese, Table 4-22 presents HQs for both substances. If Baseline + Project are added for both substances, the HQ is 1.4, with the Project on its own contributing 0.2 to the total HQ. The highest contributor to the total HQ is manganese from the air pathway (Baseline + Project = 0.58), whereas the second highest contributor is aluminum via the oral pathways (Baseline + Project = 0.56). While the total HQ value of 1.4 is slightly elevated over the benchmark of 1, exposures have been overestimated due to the conservatism in the modeling, as air and environmental media concentrations were based on biased high predictions, and applied to a 40 year operations period.

5.0 UNCERTAINTIES

When assumptions need to be made during the HHRA process, either in filling data gaps or in selecting representative characteristics describing receptor behaviour, chemical environmental fate, *etc*., some degree of uncertainty can be ascribed to the assumption. In order to provide an HHRA which is adequately protective, it is necessary to make assumptions which are conservative, that is, which attempt to overestimate exposure, toxicity and risk, rather than underestimate these parameters. Table 5-1 describes key areas of uncertainty in the HHRA.

One of the main areas of uncertainty is the calculation of the incremental project estimates. The potential increment provided by the Wabush 3 Project operations was obtained by subtracting the Baseline scenario (Future No Build) from the Baseline + Project (Future Build) scenario, as provided by RWDI. The baseline scenario was characterized as including existing baseline of the emissions from the pelletizing plant, as well as emissions related to a potential future expansion of the Luce Pit, and other pits, to the north of the pelletizing plant (which includes potential for increased diesel emissions, and truck traffic).The Baseline + Project (Future Build) scenario includes the pelletizing plant emissions, as well as Luce Pit and other pits, in their current form, in conjunction with possible emissions related to the Wabush 3 Project.

The Future No Build in essence represents a future baseline, in the situation wherein the Wabush 3 Mine is not built. The Project increment on its own, relative to existing baseline would be larger, but since the Future No Build scenario is an approved scenario, this becomes the baseline for comparison purposes. However, the results of the Baseline + Project scenario and the Future Build would not change, and given the low HQ's in the multipathway assessment and small contribution from the facility in the assessment, there would be no impact on the overall conclusions of the assessment.

Table 5-1 Major Assumptions and Associated Uncertainties Applied in the HHRA

Risk Assessment Step	***Assumption***	***Discussion of Uncertainty***
Problem Formulation	Selection of COPCs was based on criteria air contaminants, metals, PAH and VOCs	These COPCs are considered to represent the primary substances that could be emitted from the Project. Other metals present in ore were cross checked to determine whether additional substances should be added to the assessment. These additional metals were present in concentrations that were extremely small, on a relative percentage basis, and were not considered to require further assessment. PAH and VOC uncertainties are discussed further below

Table 5-1	**Major Assumptions and Associated Uncertainties Applied in the HHRA**	
Risk Assessment Step	***Assumption***	***Discussion of Uncertainty***
Exposure Assessment	Air dispersion modelling incorporated 4 years of meteorological data that is considered to represent conditions contributing to maximum predicted ground level air concentrations of the COPC.	Use of the 2nd maximum predicted ground level air concentrations from 4-years of predicted data for COPC on an acute basis represents an upper-bound concentration estimate and likely contributed to the overstatement of the actual exposures that might be received by people residing in or visiting the area under most circumstances. Maximum annual average concentrations (from 4-years of predicted data) were used to represent chronic exposures. The use of the worst year of the four years modelled provides a conservative estimate of chronic health risks. For the air assessment, the calculation of the project increment was done in different fashions depending upon the air quality metric. To obtain the increment, the Future No Build was subtracted from the Future Build. The increment was either calculated by selecting the maximum increment of inter-year calculations, or by selecting the maximum of each scenario, and subtracting them, depending on the air quality metric. Where the maximum increment of inter-year comparisons was not used in the assessment, a sensitivity analysis was conducted to examine whether the selection of this value would alter conclusions. In all cases, there is no change to the conclusions of the assessment, relative to comparison of increments to air quality guidelines.
	Persons might be found in various recreational areas in the vicinity of the Project not just at the four receptor locations.	The selection of the receptor locations were intended to overstate the exposures that might actually be received as it is unlikely that individuals would be present at these areas at the exact time when the meteorological conditions contributing to the maximum concentrations occur. As a result, this assumption is conservative.
	Predicted chronic exposures were based on the assumption that individuals would be exposed 24 hours per day, 365 days per year to the maximum predicted ground level air concentrations of the COPC (based on 4 years of meteorological data) for the entire duration of their lives (i.e., 80 years).	The operational life of the Project is expected to be 40 years. It was conservatively assumed that people permanently reside at cottages, recreational areas, or traditional areas over an 80-year period.
	Predicted chronic multiple pathway exposures associated with the non-carcinogens were estimated for all life stages, but only the results of the most sensitive age groups were reported.	Predicted exposures for the other life stages are lower than those reported.
	Residents were assumed to obtain 100% of their fruit, meat and fish exposures from local sources (e.g., berries, wild game and fish) and drinking water from local surface water sources.	The assumption that people obtain all of their food and water over their lifetime from the area likely contributes to the overstatement of the exposures that might be received by these people under actual circumstances.

Table 5-1 Major Assumptions and Associated Uncertainties Applied in the HHRA		
Risk Assessment Step	***Assumption***	***Discussion of Uncertainty***
	Home grown vegetables were not considered in the assessment.	Due to the extremely short growing season, it was considered unlikely that a significant portion of the diet would be obtained from locally home grown produce. That said, it is likely that small vegetable gardens exist and that small portions of the diet are obtained from locally grown vegetables. This assumptions likely underestimates risks slightly.
	Tissue concentrations from local wild game, such as snowshoe hare, and ruffed grouse, were based on reasonable worst-case predicted ground level air concentrations	It is unlikely that wild game will forage at one fixed location over their entire lifetime. Assuming that wild game will forage at the location where reasonable worst-case isopleths occurred and which were used to predict air, soil, water and vegetation over their lifetime likely overstates the exposures to people who consume wild game.
	COPC in the soil were assumed to be 100% available for uptake into vegetation, game and people. COPC in game meat, fish and vegetation were assumed to be 100% bioavailable to people.	There is plenty of scientific literature available to suggest that the availability of COPC in the vicinity of mine sites for uptake into people, animals and vegetation is less than 100%, This is especially true of metals bound within the ore. The assumption of 100% used within the assessment will overestimate exposures.
	Carcinogenic PAHs were represented by B(a)P only; VOCs by benzene.	Emissions data available from the U.S. EPA indicates that several carcinogenic PAHs (cPAH) and several VOCs are emitted from diesel emission sources. The decision to represent cPAHs with B(a)P only and VOCs with benzene only will underestimate risk; however, given the relative toxicity of these two COPCs as compared to the other compounds within the PAH and VOC groups, this decision is not likely to substantially impact overall risk estimates.
	B(a)P and benzene predicted based on relationship to NOx	This assumption is likely reasonable, but remains as an uncertainty in the assessment, since direct emission rates of these compounds were not used.
	Metals in dust predicted based on total dustfall and relationship to ore	This assumption is likely reasonable, but remains as an uncertainty in the assessment, since direct metals emission rates were not used. Also, metals in vehicular exhaust were not considered. This is likely a small contribution, relative to ore dusting sources, and hence, is unlikely to substantially impact overall risk estimates.
Toxicity Assessment	TRVs were developed to be protective of sensitive and more susceptible individuals in the general population (e.g., infants and young children, the elderly, individuals with compromised health) (Health Canada, 2012b; ATSDR 2013; U.S. EPA 2010c,d, etc.).	A considerable amount of conservatism is incorporated in the TRVs. TRVs are deliberately set to be protective of sensitive individuals. The use of uncertainty factors is already directed, in part, toward the protection of sensitive individuals.

Table 5-1	**Major Assumptions and Associated Uncertainties Applied in the HHRA**	
Risk Assessment Step	***Assumption***	***Discussion of Uncertainty***
	The findings from toxicity studies with laboratory rodents can be used to gauge the types of responses and health effects that the chemicals may cause in humans and the findings from the laboratory rodent studies can be used, in part, to determine exposure limits for the chemicals.	Laboratory rodents have traditionally served as suitable surrogate species for humans. The use of uncertainty factors accounts for the possible differences in responses to chemicals that might be observed between laboratory rodents and other species, such as humans (see Appendix 4A). However, recent evidence suggests that rodents might be more sensitive to nasal effects than humans as a result of higher doses reaching the critical target site or tissue in rodents (Harkema et al. 2006; Reznik 1990; Dorman et al. 1999; Reznik and Stinson 1983; Kimbell 2006). In some instances, these differences contribute uncertainty to the predicted results with respect to COPC with nasal effects as the critical toxicological effect.
	Possible interactions of the COPC released by the Project, which might lead to enhanced toxicity, were adequately addressed in the assessment.	Consistent with Health Canada (2012) guidance, potential health risks associated with the COPC were considered to be additive if the exposure limit for the COPC had the same toxicological endpoint. In some instances, it is possible that components of a mixture may have different mechanisms of effect, contributing some uncertainty in the predicted risk estimates for mixtures.

Overall, individual conservative assumptions made in the exposure and toxicity assessments likely contribute to an overestimation of the actual risks. This potential overestimation is further magnified by the compounding effects of multiple conservative assumptions that were applied throughout the exposure and risk characterization phases.

6.0 CONCLUSIONS

The following conclusions can be made from the HHRA:

- Acute blasting events have the potential to cause increased levels of NO_2, within 1200 m of the blast location, relative to conservative health-based guidelines, but would not exceed AEGL-1 levels. Predicted maxima concentrations are less than 50% of the current AEGL-1 level and if concentrations were to approach these levels, some transient health effects, such as headache, could be experienced. This is considered unlikely, based on the available data.
- With respect to predicted air quality changes, the Project will add to the existing particulate matter present in the surrounding environment. PM_{10} concentrations at the cross country trails and downhill slopes locations are predicted to sporadically exceed guidelines as a result of the mines contributions. Exceedances were also predicted at the hospital; however, these were considered to be more related to the pellet plant, than the proposed mine. NO_2 concentrations at the downhill slopes were predicted to exceed ambient air quality guidelines, but the mine contribution, relative to baseline is minimal. The frequency of exceedance over the guideline on an hourly basis equals to 0.2%. Consideration of the low frequency, short-duration and degree of exceedances, suggests that the likelihood of adverse health effects associated with 1-hour NO_2 concentrations is low for those with respiratory sensitivities, such as asthmatics, and negligible for the general public. Similarly, SO_2 is predicted to exceed health-based guidelines at all 4 receptor locations, but the proposed mine contribution is negligible, and existing baseline (i.e., pellet plant and Luce Pit and other pits) are the main contributors. The frequency of exceedance over the guideline on an hourly basis was 0.2% at the cross country ski trails, the Dumbell Lake area and the hospital, and a 0.4% frequency at the downhill slopes. Therefore, consideration of both the frequency and degree of exceedance of modeled data suggests that the likelihood of adverse health effects in sensitive individuals associated with SO_2 emissions is low, while potential risks to healthy individuals is considered negligible. However, there is a potential that sensitive individuals could experience short-term reversible health effects during the brief periods when ambient air concentrations exceed levels at which health effects have been reported at the downhill ski area. Based on the available data, this is anticipated to occur infrequently. With respect to metals, PAHs, and VOCs, only manganese and silica were predicted to exceed ambient air guidelines at either the cross country trails (manganese) or the downhill slopes (manganese and silica). These exceedances were considered marginal, and were not considered to represent a concern for health due to the conservative approaches taken to estimate GLACs, and the transient nature of landuse in these two areas.
- Other environmental media concentrations (such as soil, game meats and vegetation) were predicted to increase as a result of the proposed Project. The estimated HQs and ILCR values associated with these changes are negligible or within acceptable levels, and hence, the likelihood of any adverse health effects as a result of the Project are considered low.

- Predicted Baseline + Incremental Project soil concentrations were either within guidelines, within reference area concentrations or were not predicted to pose a risk to human health.
- Two metals (aluminum and manganese) were noted to have similar inhalation and oral toxicity endpoints, and as such the combined exposures were considered. Project-related HQs for aluminum were predicted to be negligible, and not considered a concern. For manganese, air inhalation was the driving pathway, and the total Project-related HQ was considered to represent an acceptable degree of exposure and risk, based on the assumptions applied in the assessment. When considered together due to their similar toxic endpoints, HQ were slightly elevated, but project contributions less than an HQ of 0.2, or equal to an HQ of 0.2 (where the entire Future Build was considered), and hence, were not considered to pose a risk due to the conservatism in the exposure estimates.

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APPENDIX A

SCREENING OF CHEMICALS OF POTENTIAL CONCERN

Table A-1 Percent Chemical Composition by Rock Type in the Vicinity of the Proposed Wabush 3 Pit (Provided by IOC, 2014)

Rock Type		Count of Fe	Count of Cr2O3_2	Assays (%)													
				Al_2O_3	CaO	CO_2	TiO_2	S	Fe	H_2O	Cr_2O_3	P	SiO_2	Na_2O	K_2O	MgO	Mn
30	Orthoquartzite	10	6	0.35	0.48	0.46	0.05	0.09	8.29	0.92	0.04	0.05	83.84	0.07	0.07	0.35	0.31
32	Quartzite with accessory carbonate	3		0.27	3.17	8.89	0.05	0.10	11.46	0.59		0.03	66.78	0.06	0.03	2.09	1.34
34	Quartz-muscovite±garnet schist	1		0.62	1.27	8.29	0.09	0.07	21.81	0.83		0.06	40.52	0.04		3.06	3.57
35	Undifferentiated quartzite	2		0.55	0.10	0.24	0.04	0.06	21.01	0.96		0.05	69.68	0.05	0.07	0.05	0.16
Quartzite Total		**16**	**6**	**0.38**	**0.99**	**2.50**	**0.05**	**0.09**	**11.32**	**0.85**	**0.04**	**0.05**	**76.16**	**0.06**	**0.06**	**0.84**	**0.69**
40	Quartz carbonate gneiss	170	119	0.37	3.32	8.80	0.05	0.03	21.26	2.21	0.03	0.04	47.89	0.07	0.05	2.77	1.71
42	Quartz-(carbonate-grunerite) gneiss	6	3	0.16	5.61	10.64	0.02	0.02	15.94	0.35	0.03	0.03	37.67	0.12	0.02	5.63	1.33
43	Quartz-grunerite schist	1	1	0.24	3.73	10.51	0.02	0.06	12.35	0.70	0.02	0.03	39.78	0.05	0.06	6.23	1.15
45	Undifferentiated iron formation	3		2.12	2.39	11.69	0.31		25.05	0.77			41.21			4.19	1.80
50	Quartz-carbinate-magnetite gneiss	93	56	0.22	3.27	8.84	0.05	0.03	27.78	1.40	0.02	0.03	41.87	0.06	0.03	2.96	1.13
51	Quartz-grunerite-magnetite schist	4	4	0.08	3.54	9.01	0.01	0.04	20.28	0.35	0.01	0.04	32.50	0.05	0.01	5.75	0.63
52	Quartz-magnetite-grunerite schist	20	20	0.21	2.73	2.35	0.03	0.03	23.06	0.49	0.03	0.03	44.92	0.05	0.03	2.30	0.66
53	Quartz-magnetite-carbonate schist	274	209	0.30	3.46	6.65	0.06	0.03	31.34	0.64	0.03	0.03	41.70	0.06	0.05	2.30	0.83
Waste Iron Formation Total		**571**	**412**	**0.31**	**3.38**	**7.59**	**0.05**	**0.03**	**27.16**	**1.22**	**0.03**	**0.03**	**43.57**	**0.06**	**0.04**	**2.62**	**1.14**
60	Quartz-magnetite	866	655	0.33	2.79	5.06	0.05	0.03	35.27	0.33	0.03	0.03	39.27	0.08	0.05	2.01	0.67
61	Quartz-magnetite-specularite	2967	2332	0.23	2.32	3.67	0.03	0.03	38.35	0.33	0.03	0.03	36.94	0.07	0.04	1.40	0.60
62	Quartz-specularite schist	1264	1043	0.18	1.72	2.30	0.02	0.02	37.75	0.48	0.03	0.03	39.46	0.06	0.03	0.90	0.95
63	Quartz-specularite-anthophyllite±talc schist	4	3	1.90	3.29	5.75	0.46		30.79	0.43	0.06	0.07	39.47	0.07	0.35	2.28	2.28
Ore Iron Formation Total		**5101**	**4033**	**0.24**	**2.26**	**3.57**	**0.03**	**0.03**	**37.67**	**0.37**	**0.03**	**0.03**	**37.96**	**0.07**	**0.04**	**1.39**	**0.70**
80	Gabbro	3	2	13.59	6.88	0.06	3.71	0.07	11.43	1.59	0.03	0.47	44.57	1.21	1.56	5.05	0.39
81	Metagabbro	67	52	11.36	6.05	1.65	3.13	0.10	13.26	1.66	0.03	0.32	43.76	1.13	1.17	4.23	0.45
82	Amphibolite: Hornblend-biotite±garnet schist	72	36	10.16	5.86	2.76	2.42	0.10	12.09	1.21	0.03	0.29	38.89	0.21	1.13	5.48	0.54
89		4	4	12.03	5.68	5.60	3.36	0.05	11.07	1.08	0.03	0.34	42.39	1.05	1.29	3.91	0.42
Gabbro Total		**146**	**94**	**10.83**	**5.96**	**2.27**	**2.80**	**0.10**	**12.59**	**1.42**	**0.03**	**0.31**	**41.34**	**0.71**	**1.16**	**4.81**	**0.49**

Table A-2 Percent Chemical Composition by Major Rock Types in the Vicinity of the Proposed Wabush 3 Pit - Weighted to Ore, Waste and Total Material Average Qualities

		%	Assays (%)													
			Al_2O_3	**CaO**	**CO_2**	**TiO_2**	**S**	**Fe**	**H_2O**	**Cr_2O_3**	**P**	**SiO_2**	**Na_2O**	**K_2O**	**MgO**	**Mn**
Waste	Quartzite	1	0.38	0.99	2.50	0.05	0.09	11.32	0.85	0.04	0.05	76.16	0.06	0.06	0.84	0.69
	Iron Formation	15	0.31	3.38	7.59	0.05	0.03	27.16	1.22	0.03	0.03	43.57	0.06	0.04	2.62	1.14
	Gabbro	16	10.83	5.96	2.27	2.80	0.10	12.59	1.42	0.03	0.31	41.34	0.71	1.16	4.81	0.49
	Waste Average	**32**	**5.57**	**4.60**	**4.77**	**1.43**	**0.07**	**19.38**	**1.31**	**0.03**	**0.17**	**43.47**	**0.39**	**0.61**	**3.66**	**0.80**
Ore		**68**	**0.24**	**2.26**	**3.57**	**0.03**	**0.03**	**37.67**	**0.37**	**0.03**	**0.03**	**37.96**	**0.07**	**0.04**	**1.39**	**0.70**
Total Material		**100**	**1.94**	**3.01**	**3.95**	**0.48**	**0.04**	**31.82**	**0.67**	**0.03**	**0.08**	**39.73**	**0.17**	**0.22**	**2.12**	**0.73**

Notes:
Assay percentages do not add up to 100%. Based on data provided by IOC, this is due to the species that are targeted by the analysis are not selected to account for 100% of the rock mass. IOC reported that the main reason for the summations being <100% results from oxygen associated with the iron compounds not being considered.

Table A-3 Concentration (ppm or mg/kg) and Weighted Percent Metals in Rock based on Rock Type from 25 Core Samples Obtained in the Wabush 3 Area

Sample ID	Rock Type	Ag	Al	B	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti	V	Zn	Zr	As	Be	Bi	Cd	Ce
W3-ARD-001	QC	0.04	400	60	139	15700	95	22.2	150000	100	1	14000	6790	100	5.3	0.027	100	6.6	100	9	9	2.9	1	0.2	0.02	0.06	4.4
W3-ARD-002	QC	0.02	300	50	104	74300	86	8.8	150000	100	1	41600	10000	100	3.4	0.019	100	30.6	100	1	10	2.6	1	0.1	0.02	0.11	11.9
W3-ARD-003	QC	0.02	200	70	616	15100	141	8.1	150000	100	3	6400	1470	100	4.1	0.018	100	14.4	100	4	3	3.4	2	0.2	0.03	0.03	2.69
W3-ARD-012	QC	0.06	2100	40	97	22600	67	20.2	134000	1800	1	17300	7700	100	7.8	0.061	2900	13.5	400	21	6	3.4	1	0.2	0.02	0.05	14.2
W3-ARD-013	QC	0.1	4700	20	119	19000	63	25.3	75400	4700	3	8500	2820	200	12.1	0.098	4300	22.6	900	68	11	7.3	1	0.4	0.04	0.09	17.1
W3-ARD-014	QC	0.02	1500	60	162	18900	100	8.6	150000	700	1	13500	7250	100	4.7	0.05	200	15.6	200	5	10	3.2	1	0.1	0.02	0.03	8.87
W3-ARD-023 *	QC	0.14	100	5	0.5	6250	118.5	8.25	5850	50	0.5	2650	195.5	50	12.6	0.0025	2150	1.9	50	1.5	0.5	0.25	9	0.05	0.02	0.01	0.5
Avg Concentration for QC		0.06	1329	44	177	24550	96	14	116464	1079	2	14850	5175	107	7.1	0.039	1407	15	264	15.6	7.1	3.3	2.29	0.18	0.02	0.05	8.52
Avg adjusted for 15% rock type		0.01	199	7	27	3683	14	2	17470	162	0.2	2228	776	16	1.1	0.006	211	2	40	2.3	1.1	0.5	0.34	0.03	0.004	0.01	1.28
W3-ARD-004	O	0.08	300	50	119	200	180	6.6	150000	100	1	200	10000	100	4.4	0.01	100	3.1	100	1	6	3.1	1	0.3	0.02	0.04	7.78
W3-ARD-005	O	0.08	500	80	177	100	147	9.5	150000	100	1	100	9130	100	4.1	0.02	100	1.8	100	1	5	3.5	3	0.4	0.02	0.04	9.55
W3-ARD-007	O	0.02	200	60	115	7700	142	5.8	150000	100	1	1100	1470	100	3.8	0.02	100	3.7	100	1	5	3.7	13	0.2	0.02	0.03	2.82
W3-ARD-008	O	0.01	200	60	111	8900	143	5.5	150000	100	1	1700	1740	100	3.4	0.011	100	4.5	100	1	4	3.7	9	0.3	0.02	0.03	2.19
W3-ARD-011	O	0.03	600	80	156	14500	93	7.9	150000	100	1	6600	2950	100	3.4	0.014	100	5.6	100	1	2	3.7	2	0.1	0.02	0.04	2.09
W3-ARD-015	O	0.04	100	90	189	7900	107	8.3	150000	100	6	1500	1480	100	3.5	0.013	100	20.5	100	2	18	3.7	3	0.3	0.04	0.04	2.96
W3-ARD-016	O	0.02	200	70	140	1500	129	6	150000	100	1	100	4850	100	4.5	0.005	100	8.3	100	1	5	3.9	2	0.2	0.02	0.02	13.8
W3-ARD-018	O	0.07	400	50	130	200	154	5.9	150000	300	1	100	10000	100	5.8	0.008	100	3.1	100	1	7	3.4	2	0.4	0.02	0.05	12.6
W3-ARD-019	O	0.03	600	70	155	100	139	7.7	150000	500	1	100	10000	100	5	0.014	100	15	100	1	9	3.6	1	0.5	0.02	0.05	4.4
W3-ARD-020	O	0.02	200	50	98	200	168	4.6	150000	200	1	200	10000	100	3.6	0.006	100	12.3	100	1	4	5.1	1	0.5	0.02	0.02	9.54
W3-ARD-021	O	0.03	400	50	119	200	168	5.5	150000	200	1	300	10000	100	6.1	0.005	100	8.6	100	1	8	3.3	1	0.3	0.02	0.06	7.05
W3-ARD-024	O	0.05	200	50	104	100	150	8.3	150000	100	1	100	1680	100	5.2	0.006	100	2	100	2	3	4.3	2	0.4	0.02	0.02	3.22
W3-ARD-025	O	0.04	300	60	126	100	162	6.1	150000	100	1	100	10000	100	4.8	0.009	100	1.6	100	1	5	5.4	1	0.4	0.02	0.02	9.68
Avg Concentration for O		0.04	323	63	134	3208	145	7	150000	162	1.4	938	6408	100	4.4	0.011	100	6.9	100	1.2	6.2	3.9	3	0.33	0.02	0.04	6.74
Avg adjusted for 68% rock type		0.03	220	43	91	2181	98	5	102000	110	0.9	638	4357	68	3.0	0.007	68	4.7	68	0.8	4.2	2.6	2	0.22	0.01	0.02	4.59
W3-ARD-006	G	0.01	14900	20	619	17200	128	42.1	61900	7400	9	11000	761	1400	27.9	0.398	1200	34.4	2400	57	75	4.1	1	0.6	0.02	0.03	79.9
W3-ARD-009	G	0.03	15400	10	548	16000	88	36.2	30700	8300	13	12200	299	2100	39.5	0.385	1500	38.4	2400	48	54	2.7	7	0.2	0.02	0.06	80.8
W3-ARD-010	G	0.01	15000	10	424	16300	115	61.7	25100	5600	10	13500	208	1300	50.7	0.237	1100	30.5	1300	54	41	1.5	1	0.2	0.02	0.05	43.9
W3-ARD-017	G	0.04	19900	10	300	17400	168	29.6	32100	6300	6	12000	250	2800	60	0.308	1200	67.2	1700	78	45	4.8	8	0.2	0.02	0.08	45.6
W3-ARD-022	G	0.03	13400	40	475	13600	111	31.3	118000	7000	10	10400	848	1100	20.6	0.308	1000	22.9	1600	49	50	3.1	1	0.3	0.02	0.04	15.7
Avg Concentration for G		0.02	15720	18	473	16100	122	40.2	53560	6920	9.6	11820	473	1740	39.7	0.327	1200	38.7	1880	57.2	53	3.24	3.6	0.3	0.02	0.052	53.2
Avg Adjusted for 16% rock type		0.004	2515	3	76	2576	19.52	6.43	8570	1107	1.5	1891	76	278	6.36	0.052	192	6.2	301	9.15	8.5	0.52	0.58	0.048	0.0032	0.01	8.51
W3-ARD-023 *	Q	0.14	100	5	0.5	6250	118.5	8.25	5850	50	0.5	2650	196	50	12.6	0.0025	2150	1.9	50	1.5	0.5	0.25	9	0.05	0.02	0.01	0.5
Concentration for Q		0.14	100	5	0.5	6250	118.5	8.25	5850	50	0.5	2650	196	50	12.6	0.0025	2150	1.9	50	1.5	0.5	0.25	9	0.05	0.02	0.01	0.5
Adjusted for 1% rock type		0.001	1	0.05	0.005	62.5	1.185	0.08	58.5	0.5	0.005	26.5	1.2	0.5	0.13	0.00003	21.5	0.02	0.5	0.02	0.01	0.003	0.09	0.0005	0.0002	0.0001	0.005
Total metal in rock avg (ppm)		0.041	2935	52	193	8502	134	13	128098	1379	3	4783	5211	363	11	0.0657	493	13	409	12	14	3.65	3.2	0.30	0.02	0.04	14.4
Total avg of metals in rock = 152686 ppm																											
% of each metal type within total		0.00003	1.92	0.03	0.13	5.57	0.087	0.0087	83.9	0.90	0.002	3.13	3.41	0.24	0.0069	0.00004	0.32	0.009	0.27	0.008	0.009	0.002	0.002	0.0002	0.00001	0.00003	0.0094

For original data, refer to Lorax, 2014
For samples presented in Lorax as > a certain number, sample was assumed to equal that number
Assumed non-detects equaled detection limit for purposes of calculations
*Assumed sample 23 was 50% Q and 50% QC (divided sample by 2 and added 1/2 to Q and 1/2 to QC)
Shaded percentages are = or > 0.1%

Table A-3 (Continued) Concentration (ppm or mg/kg) and Weighted Percent Metals in Rock based on Rock Type from 25 Core Samples Obtained in the Wabush 3 Area

Sample ID	Rock Type	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
W3-ARD-001	QC	8.8	0.05	0.7	1.9	0.06	0.05	0.02	2.3	0.06	3.92	0.51	1.2	0.2	0.05	0.2	1	0.3	0.27	0.11	0.05	0.1	0.02	0.11	1.4	4.65	0.4
W3-ARD-002	QC	12.2	0.05	0.6	0.1	0.05	0.04	0.02	7.2	0.06	3.39	0.19	0.8	0.2	0.05	0.2	1	0.3	0.07	0.2	0.05	0.1	0.02	0.07	0.2	6.9	0.4
W3-ARD-003	QC	5.2	0.05	0.8	0.7	0.05	0.04	0.02	1.7	0.06	4.57	0.24	1.2	0.2	0.06	0.1	1	0.3	0.05	0.08	0.05	0.1	0.02	0.13	0.5	4.33	0.4
W3-ARD-012	QC	7.1	0.15	1.4	0.2	0.05	0.01	0.02	7.5	0.05	3.1	0.9	1.8	8.6	0.05	0.4	1	0.3	0.05	0.18	0.19	0.5	0.08	0.3	0.4	5.83	0.3
W3-ARD-013	QC	5.9	0.47	3	0.4	0.14	0.01	0.02	8	0.07	3.8	0.83	3	19.7	0.05	0.7	1	0.3	0.05	0.29	0.13	0.6	0.16	0.98	0.9	8.21	0.5
W3-ARD-014	QC	6.9	0.08	1.1	0.9	0.05	0.01	0.02	4.3	0.07	4.4	0.17	0.7	3.5	0.05	0.7	1	0.3	0.05	0.17	0.05	0.2	0.02	0.06	0.1	6.84	0.4
W3-ARD-023 *	QC	10.05	0.025	0.2	0.05	0.025	0.005	0.01	0.2	0.005	5.15	0.025	0.35	0.1	0.025	0.25	0.5	0.15	0.025	0.01	0.035	0.05	0.02	0.095	0.55	0.38	0.05
Avg Concentration for QC		8.02	0.13	1.11	0.61	0.06	0.02	0.02	4.5	0.054	4.0	0.41	1.3	4.6	0.048	0.36	0.93	0.28	0.08	0.15	0.08	0.24	0.05	0.25	0.58	5.31	0.35
Avg adjusted for 15% rock type		1.20	0.02	0.17	0.09	0.009	0.004	0.003	0.67	0.008	0.61	0.061	0.19	0.70	0.007	0.05	0.14	0.04	0.01	0.02	0.01	0.04	0.007	0.04	0.09	0.80	0.05
W3-ARD-004	O	7.7	0.05	0.9	2	0.05	0.01	0.02	5.9	0.08	5.89	0.52	1.1	0.3	0.06	0.1	1	0.3	0.05	0.15	0.05	0.1	0.02	0.05	1	7.05	0.6
W3-ARD-005	O	10.4	0.05	0.8	2.2	0.05	0.02	0.02	4.7	0.06	4.56	0.63	1.3	0.2	0.05	0.1	1	0.3	0.05	0.13	0.05	0.1	0.02	0.07	0.8	5.84	0.4
W3-ARD-007	O	8.1	0.05	0.6	1.2	0.05	0.01	0.02	2	0.05	4.16	0.17	0.8	0.2	0.2	0.1	1	0.3	0.05	0.07	0.05	0.1	0.02	0.05	0.9	4.3	0.3
W3-ARD-008	O	8	0.05	0.6	1.1	0.05	0.01	0.02	1.6	0.05	4.09	0.22	0.5	0.2	0.21	0.1	1	0.3	0.05	0.06	0.05	0.1	0.02	0.05	0.9	3.64	0.3
W3-ARD-011	O	8.3	0.05	0.9	1.7	0.05	0.01	0.02	1.2	0.04	3.26	0.43	0.5	0.2	0.05	0.2	1	0.3	0.05	0.05	0.05	0.1	0.02	0.05	0.8	3.03	0.3
W3-ARD-015	O	5	0.05	0.6	0.7	0.05	0.01	0.02	2.2	0.06	3.49	0.2	0.7	0.2	0.11	0.1	1	0.3	0.05	0.08	0.05	0.1	0.02	0.08	0.3	4.87	0.4
W3-ARD-016	O	14.3	0.05	0.7	2.9	0.05	0.01	0.02	8	0.09	4.85	0.44	0.8	0.3	0.09	0.1	1	0.3	0.05	0.18	0.05	0.1	0.02	0.05	2.7	7.8	0.6
W3-ARD-018	O	10	0.05	0.7	2.9	0.05	0.01	0.02	8.3	0.11	5.57	0.47	0.8	0.7	0.08	0.1	1	0.3	0.05	0.22	0.06	0.1	0.07	0.05	2.8	9.13	0.8
W3-ARD-019	O	9.8	0.05	1	3.3	0.05	0.01	0.02	2.9	0.05	4.87	0.31	0.9	1.2	0.05	0.2	1	0.3	0.05	0.1	0.05	0.1	0.02	0.07	0.8	5.75	0.3
W3-ARD-020	O	5.9	0.05	0.5	2.6	0.05	0.03	0.02	5.8	0.08	5.08	0.9	0.7	1.3	0.07	0.1	1	0.3	0.05	0.15	0.15	0.1	0.02	0.05	1.2	6.58	0.5
W3-ARD-021	O	11.4	0.18	0.7	2.2	0.05	0.01	0.02	7.2	0.13	5.82	0.41	0.7	2	0.06	0.1	1	0.3	0.05	0.23	0.05	0.1	0.02	0.05	1.1	13.8	0.9
W3-ARD-024	O	7.8	0.05	0.7	1	0.05	0.01	0.02	1.8	0.05	4.6	0.47	0.9	0.2	0.08	0.2	1	0.3	0.05	0.08	0.06	0.1	0.02	0.05	1.1	3.84	0.3
W3-ARD-025	O	8.6	0.05	0.7	3	0.05	0.01	0.02	6.5	0.1	5.42	0.75	0.8	0.2	0.05	0.1	1	0.3	0.05	0.17	0.11	0.1	0.02	0.06	1.1	7.54	0.7
Avg Concentration for O		8.87	0.06	0.72	2.06	0.05	0.01	0.02	4.5	0.073	4.7	0.46	0.81	0.55	0.09	0.12	1	0.3	0.05	0.13	0.06	0.1	0.02	0.06	1.19	6.40	0.49
Avg adjusted for 68% rock type		6.03	0.04	0.49	1.40	0.034	0.008	0.01	3.0	0.050	3.2	0.31	0.55	0.38	0.06	0.08	0.68	0.20	0.03	0.09	0.043	0.07	0.02	0.04	0.81	4.35	0.33
W3-ARD-006	G	21.8	0.56	6.9	0.5	0.12	0.02	0.03	35.5	0.16	4.74	0.26	0.9	27.8	0.05	6.4	1	0.5	0.05	0.86	0.05	4.3	0.19	0.44	0.2	15.8	1
W3-ARD-009	G	22.7	1.18	6.9	0.2	0.11	0.01	0.02	38.5	0.15	3.15	0.2	2.6	34.5	0.22	5.6	1	0.4	0.05	0.7	0.05	4	0.24	0.35	3.2	13.9	0.9
W3-ARD-010	G	27	0.69	6	0.1	0.05	0.02	0.02	20.7	0.06	3.14	0.05	1.5	19.9	0.05	3.8	1	0.3	0.05	0.36	0.05	2.2	0.14	0.22	0.1	5.73	0.4
W3-ARD-017	G	25.4	0.34	7.1	0.1	0.14	0.16	0.02	19.6	0.22	3.45	0.19	3	22	0.05	3.3	1	0.6	0.05	0.81	0.05	2.8	0.15	0.24	0.1	19.3	1.4
W3-ARD-022	G	20.8	0.36	6.1	0.5	0.05	0.01	0.02	7.4	0.13	3.77	0.14	2.9	24.4	0.11	4.7	1	0.5	0.05	0.27	0.05	0.8	0.14	0.11	0.3	9.05	0.8
Avg Concentration for G		23.54	0.63	6.60	0.28	0.09	0.044	0.022	24.34	0.144	3.65	0.168	2.18	25.7	0.096	4.76	1	0.46	0.05	0.6	0.05	2.82	0.172	0.272	0.78	12.8	0.9
Avg adjusted for 16% rock type		3.77	0.10	1.06	0.04	0.02	0.007	0.004	3.9	0.02	0.58	0.03	0.35	4.1	0.02	0.76	0.16	0.07	0.008	0.10	0.008	0.45	0.028	0.04	0.12	2.04	0.144
W3-ARD-023 *	Q	10.05	0.025	0.2	0.05	0.025	0.005	0.01	0.2	0.005	5.15	0.025	0.35	0.1	0.025	0.25	0.5	0.15	0.025	0.01	0.035	0.05	0.02	0.095	0.55	0.38	0.05
Concentration for Q		10.05	0.025	0.2	0.05	0.025	0.005	0.01	0.2	0.005	5.15	0.025	0.35	0.1	0.025	0.25	0.5	0.15	0.025	0.01	0.035	0.05	0.02	0.095	0.55	0.38	0.05
Adjusted for 1% rock type		0.1005	0.0002 5	0.002	0.000 5	0.0002 5	0.0000 5	0.0001	0.002	0.0000 5	0.05	0.000 25	0.003 5	0.001	0.0002 5	0.002 5	0.005	0.001 5	0.0002 5	0.000 1	0.0003 5	0.000 5	0.0002	0.0009 5	0.005 5	0.003 8	0.0005
Total metal in rock avg (ppm)		11.10	0.16	1.72	1.54	0.06	0.02	0.02	7.6	0.08	4.5	0.40	1.1	5.2	0.08	0.90	0.98	0.32	0.05	0.21	0.06	0.56	0.05	0.12	1.0	7.2	0.53
Total average ppm of metals in rock = 152686 ppm																											
% of each metal type within total		0.007	0.0001	0.001 1	0.001 0	0.0000 4	0.0000 1	0.0000 1	0.005	0.0000 5	0.00 29	0.000 3	0.000 7	0.003 4	0.0000 5	0.001	0.000 6	0.000 2	0.0000 4	0.000 1	0.0000 4	0.000 4	0.0000 3	0.0000 8	0.000 7	0.004 7	0.0003
For original data, refer to Lorax, 2014																											

For samples presented in Lorax as > a certain number, sample was assumed to equal that number
Assumed non-detects equaled detection limit for purposes of calculations
*Assumed sample 23 was 50% Q and 50% QC (divided sample by 2 and added 1/2 to Q and 1/2 to QC)
Highlighted percentages are = or > 0.1%

Table A-4 Summary Statistics of 2012 and 2013 Surface Soil Data Collected Within, and in the Vicinity of, the Proposed Wabush 3 Pit (mg/kg)

Metal	Min	Mean	Median	95th Percentile	97.5th Percentile	Max	Guideline
Aluminum (Al)	1260	10967	11000	20840	24240	40700	7700 (US EPA, 2013) [c]
Antimony (Sb) [b]	<0.1	1.00	0.12	2	2	0.15[a]	7.5 (OMOE, 2011) [d]
Arsenic (As)	<1.15	2.39	2.3	4.052	4.16	4.45	12 (CCME, 1997)
Barium (Ba)	7.68	58.91	42	170.6	193.4	271	6800 (CCME, 2013)
Beryllium (Be) [g]	<0.4	1.21	1.13	2	2	1.18 [a]	38 (OMOE, 2011) [d]
Boron (B)	<5	NC	NC	NC	NC	<5	4300 (OMOE, 2011) [e]
Cadmium (Cd)	<0.05	0.26	0.3	0.698	1.01	1.24	14 (CCME, 1999)
Chromium (Cr)	5.9	46.13	46.5	99.36	122.8	135	220 (CCME, 1999)
Cobalt (Co)	1.62	8.81	6.7	20.42	25.04	54.2	22 (OMOE, 2011) [d]
Copper (Cu)	<2	12.81	9.01	27.52	55.7	73.8	1100 (CCME, 1999)
Iron (Fe)	15000	60011	48000	142200	175200	198000	5500 (US EPA, 2013) [c]
Lead (Pb)	1.78	8.52	7.6	13.4	15.3	56.1	140 (CCME, 1999)
Manganese (Mn)	120	1418	750	3908	7668	12500	180 (US EPA, 2013) [f]
Mercury (Hg)	<0.05	0.08	0.098	0.1	0.112	0.188	6.6 (CCME, 1999)
Molybdenum (Mo)	<0.56	2.39	2	6.124	11.488	17.8	110 (OMOE, 2011) [d]
Nickel (Ni)	1.89	19.29	17	43.08	59.78	132	330 (OMOE, 2011) [d]
Selenium (Se)	<0.5	1.24	0.69	2	2	2.06	80 (CCME, 2009)
Silver (Ag)	<0.05	0.35	0.5	0.63	0.86	1.41	77 (OMOE, 2011) [d]
Thallium (Tl)	<0.05	0.23	0.17	0.596	1.018	2.04	1 (CCME, 1999)
Tin (Sn)	<0.1	1.11	0.51	2	2	0.68 [a]	50 (CCME,1991) [h]
Titanium (Ti)	134	762.97	645	1531	1952.5	3040	NGA
Uranium (U)	0.188	0.95	0.623	3.212	3.836	8.8	23 (2007)
Vanadium (V)	11.5	37.78	38	64.04	72.98	90.9	39 (OMOE, 2011) [d]
Zinc (Zn)	7.2	39.61	31	110	160.8	211	5600 (OMOE, 2011) [d]

Notes:
Shaded cell means maximum measured soil concentration is greater than human-health based guideline; NC = not calculated, all samples not detected
2012 soil samples were collected by AMEC at a depth of 0 to 0.3 m (AMEC, 2012); 2013 soil samples were grab soil samples collected by Pinchin LeBlanc Environmental; N = 57 for all metals with the exception of titanium where N=30 as titanium was only measured in the 2013 soil sampling; < = less than the detection limit, value provided in cell is the detection limit; CCME = Canadian Council of Ministers of the Environment soil quality guideline for human health SQG_{hh} for residential land use. Guidelines obtained from CCME online (http://www.ccme.ca/publications/ceqg_rcqe.html); derivation date of CCME guideline is provided in table.
The 2012 and / or 2013 data for bismuth, lithium, strontium, rubidium and zirconium are not included in this table. There were no Canadian guidelines for these chemicals and they were identified in waste rock at <0.01% (See Table A-3).
Data for sodium, potassium, phosphorus, magnesium, calcium were not includes as these chemicals are nutrients and would not be considered COPCs.
a. Maximum detected value was less than highest detection limit. Max is reported as maximum detected value.
b. Only 5 of 30 samples had detectable concentrations

c. US EPA Regional Screening Value (RSL) for residential soil
d. OMOE (Ontario Ministry of the Environment) soil screening standards from their generic site condition standards (SCS) document (OMOE, 2012). Standard provided is the S1 (soil contact) guideline.
e. Total boron
f. Residential soil, non-diet
g. Only 8 of 30 samples detected
h. CCME (1991) guideline; basis of guideline not provided. Used this 1991 value, as it is the CCME guideline listed for tin at the time of this assessment.

APPENDIX B

SOIL, BERRY, WATER AND AIR DATA

APPENDIX B-1.0 INTRODUCTION

This appendix provides some of the data used in the human health evaluation for the Wabush 3 Mine are provided in this Appendix.

B-2.0 SOIL AND BERRY DATA

In the fall of 2013, Pinchin LeBlanc Environmental collected paired berry and soil samples along transects in the vicinity of the proposed Wabush 3 Mine. Sampling occurred in three main areas (*i.e*., the upper part of Smokey Mountain, the lower part of Smokey Mountain and in the vicinity of the New Hospital). The location of the soil and berry sampling transects are provided in Figure B-1, while individual sampling locations are provided in Figures B2 to B4.

Once collected, the berries and soil samples were sent to Maxxam Analytics in Burnaby, BC for analysis. Berries were analyzed unwashed to provide a worst-case assessment of potential exposures to berries. Sample results for soil and berry samples are provided in the following lab sheets. Berry samples are identified as BB (blueberries), PB (partridgeberries) and SB (squash berries).

B-3.0 WATER DATA

Water data used in the assessment to estimate potential exposures to small game and to humans were obtained from:

- EcoMetrix (2012) baseline aquatic assessment (data for Dumbell and Trout Lake) collected in September, 2011 (Dumbell used for human and ecological exposures, Trout used for ecological exposures);
- Water sample for Leg Lake collected by Pinchin LeBlanc in August, 2011 (used for ecological exposures); and
- 2012 and 2013 water data collected from the Dumbell Lake Discharge (collected by IOC as part of their regular monitoring program; used for human and ecological exposures).

Data used in the assessment for both human and ecological exposures are provided in Tables B-1 and B-2.

B-4.0 AIR DATA

Air dispersion modelling was undertaken by RWDI (Rowan Williams Davies and Irwin Inc.) to predict existing and future ground level air concentrations. Assumptions used in the modeling study are explained in detail in RWDI (2014). Air dispersion isopleth figures derived by RWDI and used by Intrinsik in the human health risk assessment are provided at the end of this appendix. Additional isopleth diagrams can be found in RWDI (2014).

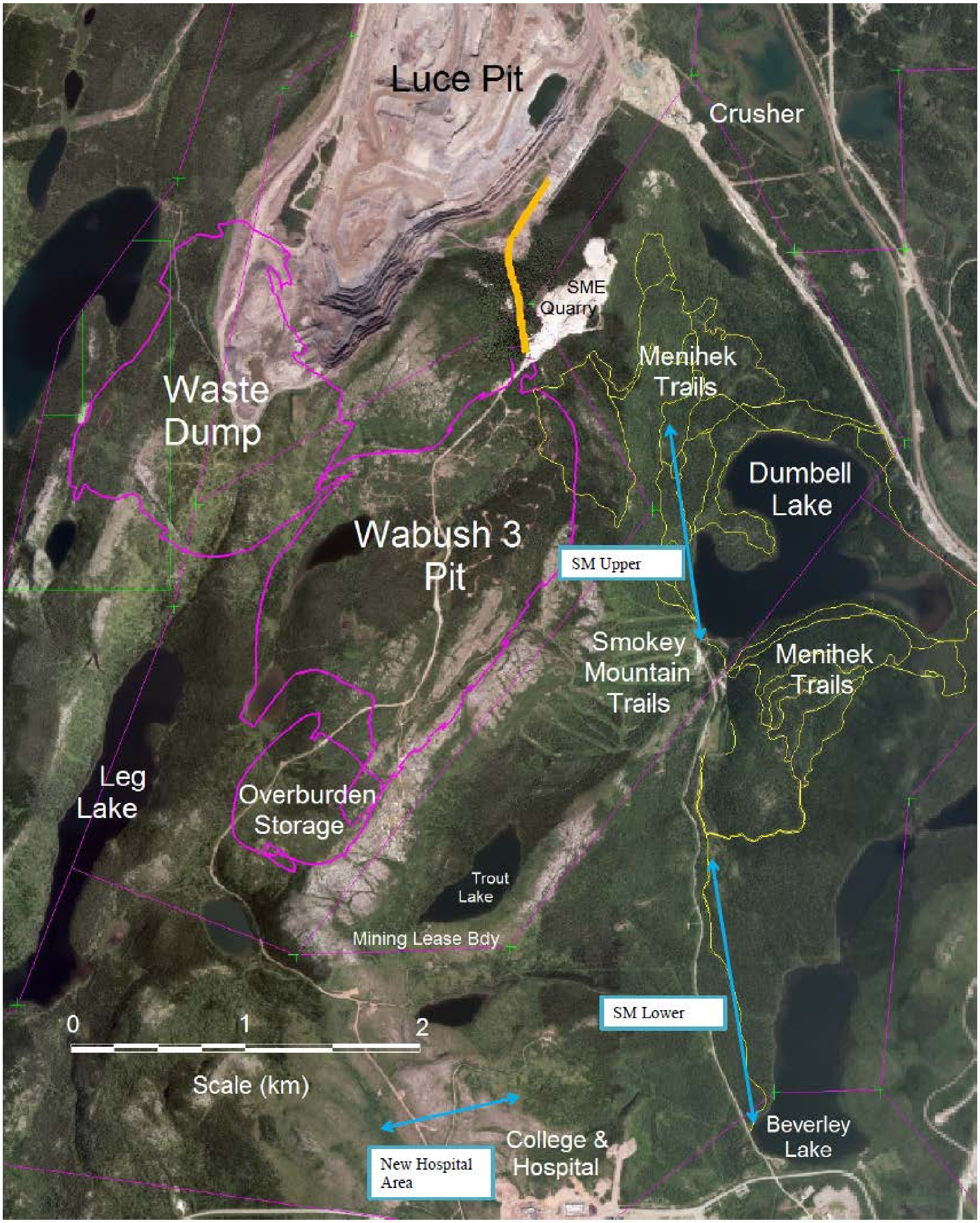

Figure B-1 Transects Showing General Location of 2013 Soil and Berry Samples

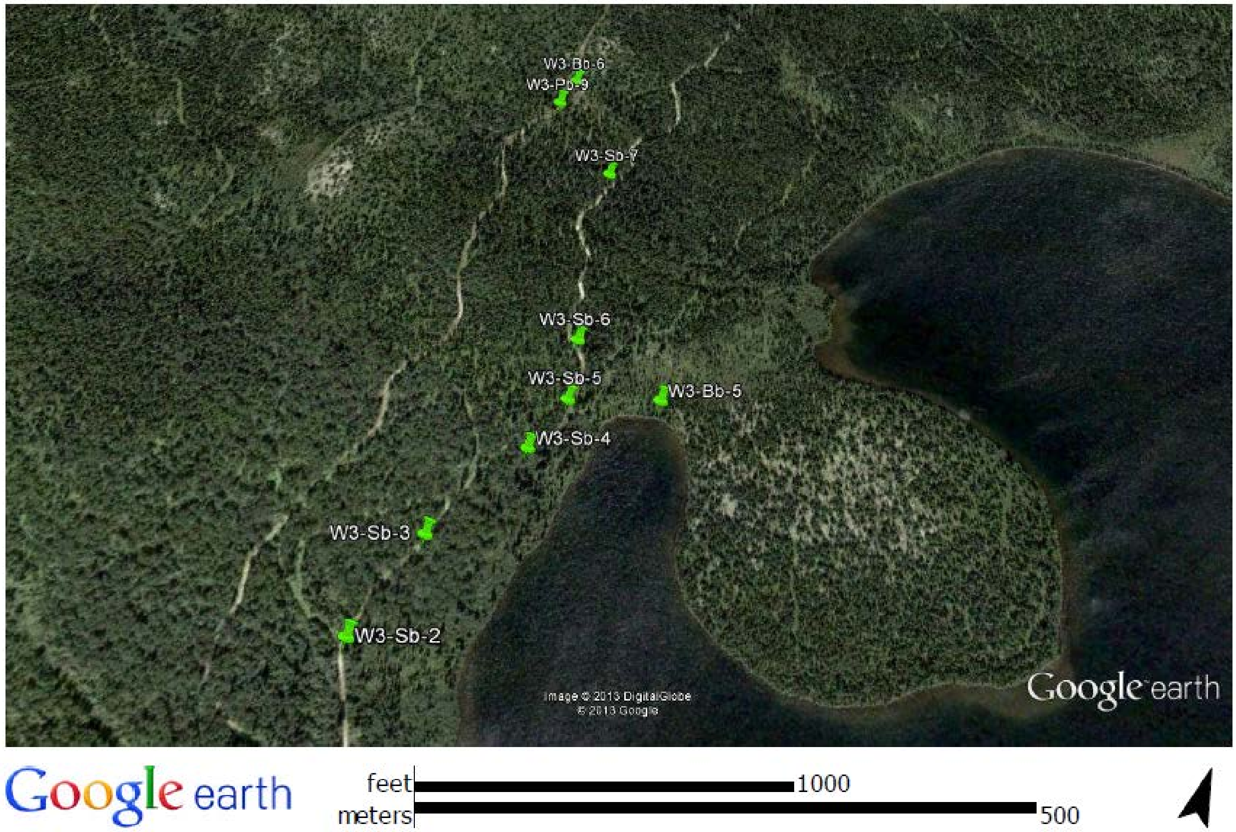

Figure B-2 Soil and Berry Sampling Locations from the Upper Smokey Mountain

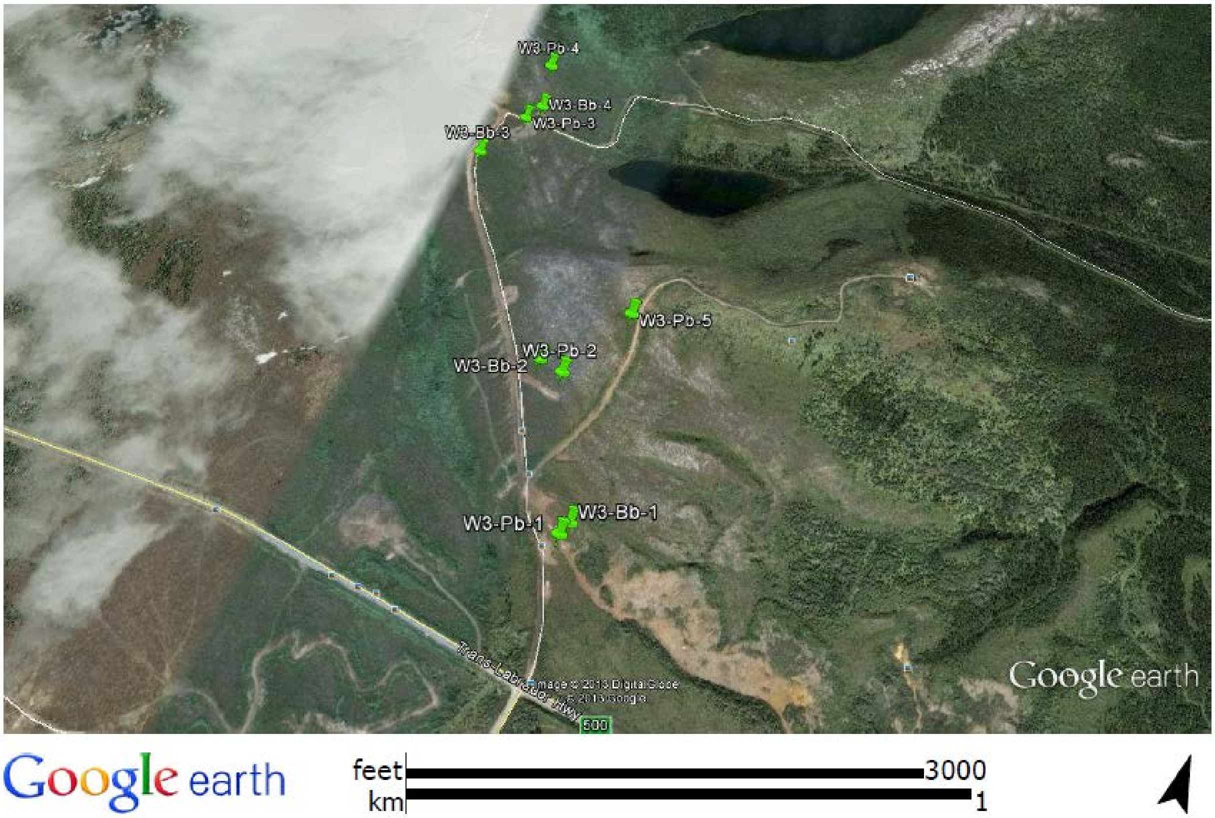

Figure B-3 Soil and Berry Sampling Locations from the New Hospital Area

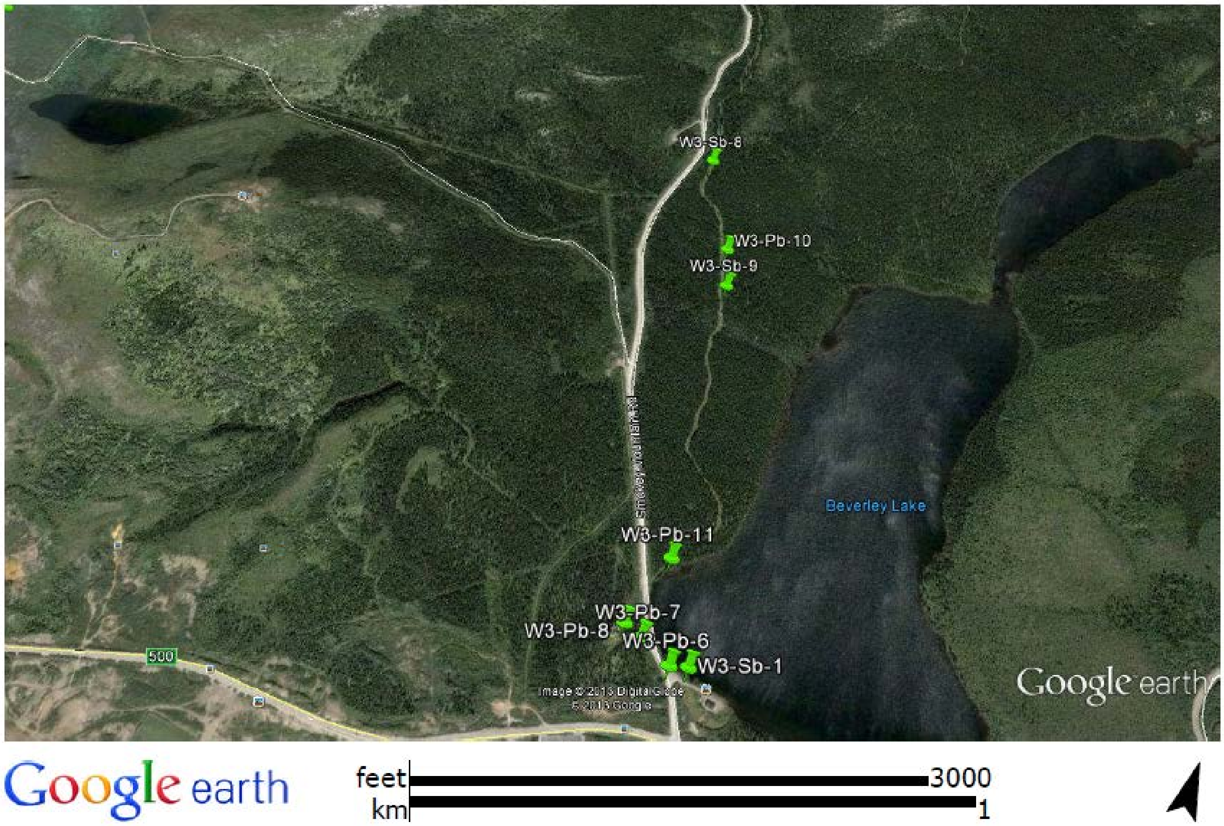

Figure B-3 Soil and Berry Sampling Locations from the Lower Smokey Mountain

Table B-1 Water Data Used to Estimate Ecological Exposures

	IOC Regular Monitoring Program (2012 – 2013)							EcoMetrix (2011)		Pinchin (2011)
	Dumbell Lake Discharge							Dumbell Lake	Trout Lake	Leg Lake
	6/27/13	09/12/13	10/31/13	09/06/12	10/25/12	08/08/13	07/31/12	09/14/11	09/14/11	08/14/11
Aluminum	0.019	0.011	0.014	0.012	0.016	0.019	0.017	0.02	<0.010	0.0418
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	0.051	<0.05	<0.05	<0.05	0.061	0.056	0.059	<0.05	0.083	0.069
Manganese	0.0077	0.0067	0.0058	0.0083	0.0066	0.012	0.012	0.0039	0.0207	0.0043
Titanium	<0.002	<0.002	<0.002	0.0024	0.0023	<0.002	<0.002	<0.002	<0.002	NDA

Table B-2 Water Data Used to Estimate Human Exposures

	IOC Regular Monitoring Program (2012 – 2013)							EcoMetrix (2011)
	Dumbell Lake Discharge							Dumbell Lake
	6/27/13	09/12/13	10/31/13	09/06/12	10/25/12	08/08/13	07/31/12	09/14/11
Aluminum	0.019	0.011	0.014	0.012	0.016	0.019	0.017	0.02
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	0.051	<0.05	<0.05	<0.05	0.061	0.056	0.059	<0.05
Manganese	0.0077	0.0067	0.0058	0.0083	0.0066	0.012	0.012	0.0039
Titanium	<0.002	<0.002	<0.002	0.0024	0.0023	<0.002	<0.002	<0.002

B-5.0 REFERENCES

EcoMetrix Incorporated. 2012. Baseline Aquatic Assessment of Magy, Trout and Dumbell Lakes and two Wabush 6 Area Ponds – 2011. Prepared for Iron Ore Company of Canada.

RWDI. 2014. Wabush 3 – Air Quality Assessment. Draft Report. Prepared for Iron Ore Corporation of Canada (IOC), Labrador City, Newfoundland and Labrador. RWDI # 1400675.

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Your P.O. #: 4700058846
Your Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your C.O.C. #: 08391182, 08391183, 08391184

Attention: Ross O'Keefe
Pinchin LeBlanc Environmental
2 Avalon Drive
Labrador City, NF
Canada A2V 2Y6

Report Date: 2014/04/04
Report #: R1546548
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B424740
Received: 2014/03/28, 09:10

Sample Matrix: Soil
Samples Received: 30

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	20	2014/04/01	2014/04/02	BBY7SOP-00001	EPA 6020a
Elements by ICPMS (total)	1	2014/04/01	2014/04/03	BBY7SOP-00001	EPA 6020a
Elements by ICPMS (total)	9	2014/04/03	2014/04/03	BBY7SOP-00001	EPA 6020a
Moisture	30	N/A	2014/04/01	BBY8SOP-00017	Ont MOE -E 3139
pH (2:1 DI Water Extract)	20	2014/04/01	2014/04/01	BBY6SOP-00028	BC Env Lab Manual
pH (2:1 DI Water Extract)	1	2014/04/01	2014/04/03	BBY6SOP-00028	BC Env Lab Manual
pH (2:1 DI Water Extract)	9	2014/04/03	2014/04/03	BBY6SOP-00028	BC Env Lab Manual

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Amandeep Nagra, Account Specialist
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Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		JE4028		JE4029	JE4030		JE4031		JE4032		
Sampling Date		2013/09/12		2013/09/12	2013/09/12		2013/09/12		2013/09/15		
COC#		08391182		08391182	08391182		08391182		08391182		
	UNITS	**W3-BB-01-SOIL**	**QC Batch**	**W3-BB-02-SOIL**	**W3-BB-03-SOIL**	**QC Batch**	**W3-BB-04-SOIL**	**QC Batch**	**W3-BB-05-SOIL**	**RDL**	**QC Batch**
Physical Properties											
Soluble (2:1) pH	pH	4.73	7439365	5.40	5.22	7436509	4.87	7439365	3.73	N/A	7436509

Maxxam ID		JE4033		JE4034		JE4035	JE4036	JE4037		
Sampling Date		2013/09/15		2013/09/12		2013/09/12	2013/09/12	2013/09/12		
COC#		08391182		08391182		08391182	08391182	08391182		
	UNITS	**W3-BB-06-SOIL**	**QC Batch**	**W3-BB-07-SOIL**	**QC Batch**	**W3-BB-16-SOIL**	**W3-PB-01-SOIL**	**W3-PB-02-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Soluble (2:1) pH	pH	4.21	7439365	4.64	7436509	4.60	4.73	4.81	N/A	7439365

Maxxam ID		JE4038	JE4039		JE4058	JE4059	JE4060	JE4061		
Sampling Date		2013/09/12	2013/09/12		2013/09/13	2013/09/13	2013/09/13	2013/09/13		
COC#		08391182	08391182		08391183	08391183	08391183	08391183		
	UNITS	**W3-PB-03-SOIL**	**W3-PB-04-SOIL**	**QC Batch**	**W3-PB-05-SOIL**	**W3-PB-06-SOIL**	**W3-PB-07-SOIL**	**W3-PB-08-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Soluble (2:1) pH	pH	4.85	4.81	7439365	5.13	5.83	5.00	6.30	N/A	7436509

Maxxam ID		JE4062	JE4063	JE4064		JE4065		JE4066		
Sampling Date		2013/09/15	2013/09/16	2013/09/16		2013/09/13		2013/09/13		
COC#		08391183	08391183	08391183		08391183		08391183		
	UNITS	**W3-PB-09-SOIL**	**W3-PB-10-SOIL**	**W3-PB-11-SOIL**	**QC Batch**	**W3-PB-16-SOIL**	**QC Batch**	**W3-SB-01-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Soluble (2:1) pH	pH	4.52	4.65	4.51	7436509	6.35	7439365	7.27	N/A	7436509

Maxxam ID		JE4067	JE4068		JE4069		JE4071		
Sampling Date		2013/09/15	2013/09/15		2013/09/15		2013/09/15		
COC#		08391183	08391183		08391183		08391184		
	UNITS	**W3-SB-02-SOIL**	**W3-SB-03-SOIL**	**QC Batch**	**W3-SB-04-SOIL**	**QC Batch**	**W3-SB-05-SOIL**	**RDL**	**QC Batch**
Physical Properties									
Soluble (2:1) pH	pH	5.10	5.72	7436509	5.63	7439365	4.21	N/A	7436509

N/A = Not Applicable
RDL = Reportable Detection Limit

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Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		JE4072	JE4073	JE4074	JE4075	JE4076		
Sampling Date		2013/09/15	2013/09/16	2013/09/16	2013/09/25	2013/09/25		
COC#		08391184	08391184	08391184	08391184	08391184		
	UNITS	**W3-SB-06-SOIL**	**W3-SB-07-SOIL**	**W3-SB-08-SOIL**	**W3-SB-09-SOIL**	**W3-SB-10-SOIL**	**RDL**	**QC Batch**
Physical Properties								
Soluble (2:1) pH	pH	6.35	6.14	6.29	5.29	6.73	N/A	7436509

PHYSICAL TESTING (SOIL)

Maxxam ID		JE4028		JE4029	JE4030	JE4031	JE4032	JE4033		
Sampling Date		2013/09/12		2013/09/12	2013/09/12	2013/09/12	2013/09/15	2013/09/15		
COC#		08391182		08391182	08391182	08391182	08391182	08391182		
	UNITS	**W3-BB-01-SOIL**	**QC Batch**	**W3-BB-02-SOIL**	**W3-BB-03-SOIL**	**W3-BB-04-SOIL**	**W3-BB-05-SOIL**	**W3-BB-06-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	16	7435706	12	16	15	17	38	0.30	7435772

Maxxam ID		JE4034	JE4035	JE4036	JE4037	JE4038	JE4039	JE4058		
Sampling Date		2013/09/12	2013/09/12	2013/09/12	2013/09/12	2013/09/12	2013/09/12	2013/09/13		
COC#		08391182	08391182	08391182	08391182	08391182	08391182	08391183		
	UNITS	**W3-BB-07-SOIL**	**W3-BB-16-SOIL**	**W3-PB-01-SOIL**	**W3-PB-02-SOIL**	**W3-PB-03-SOIL**	**W3-PB-04-SOIL**	**W3-PB-05-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	16	15	12	10	8.9	13	11	0.30	7435772

Maxxam ID		JE4059	JE4060	JE4061	JE4062	JE4063		JE4064		
Sampling Date		2013/09/13	2013/09/13	2013/09/13	2013/09/15	2013/09/16		2013/09/16		
COC#		08391183	08391183	08391183	08391183	08391183		08391183		
	UNITS	**W3-PB-06-SOIL**	**W3-PB-07-SOIL**	**W3-PB-08-SOIL**	**W3-PB-09-SOIL**	**W3-PB-10-SOIL**	**QC Batch**	**W3-PB-11-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	17	14	4.9	16	27	7435772	41	0.30	7435706

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

PHYSICAL TESTING (SOIL)

Maxxam ID		JE4065		JE4066	JE4067	JE4068	JE4069	JE4071		
Sampling Date		2013/09/13		2013/09/13	2013/09/15	2013/09/15	2013/09/15	2013/09/15		
COC#		08391183		08391183	08391183	08391183	08391183	08391184		
	UNITS	**W3-PB-16-SOIL**	**QC Batch**	**W3-SB-01-SOIL**	**W3-SB-02-SOIL**	**W3-SB-03-SOIL**	**W3-SB-04-SOIL**	**W3-SB-05-SOIL**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	4.3	7435772	6.1	18	23	53	31	0.30	7435706

Maxxam ID		JE4072	JE4073	JE4074	JE4075	JE4076		
Sampling Date		2013/09/15	2013/09/16	2013/09/16	2013/09/25	2013/09/25		
COC#		08391184	08391184	08391184	08391184	08391184		
	UNITS	**W3-SB-06-SOIL**	**W3-SB-07-SOIL**	**W3-SB-08-SOIL**	**W3-SB-09-SOIL**	**W3-SB-10-SOIL**	**RDL**	**QC Batch**
Physical Properties								
Moisture	%	51	19	58	8.3	69	0.30	7435706

RDL = Reportable Detection Limit

Maxxam

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4028		JE4029	JE4030		JE4031		JE4032		
Sampling Date		2013/09/12		2013/09/12	2013/09/12		2013/09/12		2013/09/15		
COC#		08391182		08391182	08391182		08391182		08391182		
	UNITS	**W3-BB-01-SOIL**	**QC Batch**	**W3-BB-02-SOIL**	**W3-BB-03-SOIL**	**QC Batch**	**W3-BB-04-SOIL**	**QC Batch**	**W3-BB-05-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS											
Total Aluminum (Al)	mg/kg	5750	7439348	1750	20500	7436574	3980	7439348	3290	100	7436574
Total Antimony (Sb)	mg/kg	ND	7439348	ND	ND	7436574	ND	7439348	ND	0.10	7436574
Total Arsenic (As)	mg/kg	2.13	7439348	3.66	2.65	7436574	1.77	7439348	1.15	0.50	7436574
Total Barium (Ba)	mg/kg	18.9	7439348	22.7	59.7	7436574	23.6	7439348	12.2	0.10	7436574
Total Beryllium (Be)	mg/kg	ND	7439348	0.79	1.03	7436574	0.63	7439348	ND	0.40	7436574
Total Bismuth (Bi)	mg/kg	ND	7439348	ND	ND	7436574	ND	7439348	ND	0.10	7436574
Total Cadmium (Cd)	mg/kg	0.087	7439348	ND	0.134	7436574	0.096	7439348	ND	0.050	7436574
Total Calcium (Ca)	mg/kg	361	7439348	227	321	7436574	ND	7439348	535	100	7436574
Total Chromium (Cr)	mg/kg	21.1	7439348	6.3	65.0	7436574	13.9	7439348	8.3	1.0	7436574
Total Cobalt (Co)	mg/kg	5.81	7439348	7.37	13.0	7436574	4.59	7439348	1.62	0.30	7436574
Total Copper (Cu)	mg/kg	4.28	7439348	3.37	20.0	7436574	5.72	7439348	2.31	0.50	7436574
Total Iron (Fe)	mg/kg	129000	7439348	194000	141000	7436574	147000	7439348	26900	100	7436574
Total Lead (Pb)	mg/kg	5.56	7439348	3.34	7.51	7436574	4.41	7439348	2.03	0.10	7436574
Total Lithium (Li)	mg/kg	ND	7439348	ND	11.2	7436574	ND	7439348	ND	5.0	7436574
Total Magnesium (Mg)	mg/kg	1230	7439348	225	6540	7436574	355	7439348	1160	100	7436574
Total Manganese (Mn)	mg/kg	1100	7439348	3130	2170	7436574	1680	7439348	181	0.20	7436574
Total Mercury (Hg)	mg/kg	ND	7439348	ND	ND	7436574	ND	7439348	ND	0.050	7436574
Total Molybdenum (Mo)	mg/kg	0.93	7439348	1.35	2.22	7436574	0.97	7439348	1.76	0.10	7436574
Total Nickel (Ni)	mg/kg	5.35	7439348	2.70	20.8	7436574	3.34	7439348	4.11	0.80	7436574
Total Phosphorus (P)	mg/kg	604	7439348	241	366	7436574	232	7439348	147	10	7436574
Total Potassium (K)	mg/kg	360	7439348	ND	1810	7436574	160	7439348	339	100	7436574
Total Selenium (Se)	mg/kg	ND	7439348	ND	ND	7436574	ND	7439348	ND	0.50	7436574
Total Silver (Ag)	mg/kg	0.082	7439348	ND	0.070	7436574	0.112	7439348	ND	0.050	7436574
Total Sodium (Na)	mg/kg	ND	7439348	ND	ND	7436574	ND	7439348	ND	100	7436574
Total Strontium (Sr)	mg/kg	3.98	7439348	1.75	6.92	7436574	1.97	7439348	9.76	0.10	7436574
Total Thallium (Tl)	mg/kg	0.059	7439348	ND	0.210	7436574	0.054	7439348	ND	0.050	7436574
Total Tin (Sn)	mg/kg	0.30	7439348	0.26	0.27	7436574	0.32	7439348	0.22	0.10	7436574
Total Titanium (Ti)	mg/kg	642	7439348	261	879	7436574	366	7439348	194	1.0	7436574
Total Uranium (U)	mg/kg	0.264	7439348	0.201	1.22	7436574	0.383	7439348	0.246	0.050	7436574
Total Vanadium (V)	mg/kg	40.6	7439348	23.4	38.7	7436574	26.6	7439348	11.5	2.0	7436574
Total Zinc (Zn)	mg/kg	17.6	7439348	13.5	47.3	7436574	19.0	7439348	9.9	1.0	7436574
Total Zirconium (Zr)	mg/kg	0.51	7439348	ND	2.95	7436574	ND	7439348	ND	0.50	7436574

ND = Not detected
RDL = Reportable Detection Limit

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Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4033		JE4034		JE4035	JE4036	JE4037		
Sampling Date		2013/09/15		2013/09/12		2013/09/12	2013/09/12	2013/09/12		
COC#		08391182		08391182		08391182	08391182	08391182		
	UNITS	**W3-BB-06-SOIL**	**QC Batch**	**W3-BB-07-SOIL**	**QC Batch**	**W3-BB-16-SOIL**	**W3-PB-01-SOIL**	**W3-PB-02-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	4010	7439348	5440	7436574	4780	3200	1260	100	7439348
Total Antimony (Sb)	mg/kg	0.11	7439348	0.10	7436574	ND	ND	ND	0.10	7439348
Total Arsenic (As)	mg/kg	1.16	7439348	3.71	7436574	2.85	1.39	1.50	0.50	7439348
Total Barium (Ba)	mg/kg	28.8	7439348	12.7	7436574	10.5	10.9	7.68	0.10	7439348
Total Beryllium (Be)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	0.40	7439348
Total Bismuth (Bi)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	0.10	7439348
Total Cadmium (Cd)	mg/kg	0.075	7439348	0.067	7436574	0.066	0.065	ND	0.050	7439348
Total Calcium (Ca)	mg/kg	543	7439348	316	7436574	262	276	ND	100	7439348
Total Chromium (Cr)	mg/kg	20.1	7439348	23.8	7436574	20.6	11.7	5.9	1.0	7439348
Total Cobalt (Co)	mg/kg	2.69	7439348	4.37	7436574	4.21	4.04	2.84	0.30	7439348
Total Copper (Cu)	mg/kg	3.09	7439348	9.01	7436574	8.35	3.85	2.19	0.50	7439348
Total Iron (Fe)	mg/kg	33700	7439348	76500	7436574	78300	89200	89200	100	7439348
Total Lead (Pb)	mg/kg	8.78	7439348	8.26	7436574	7.57	4.27	2.07	0.10	7439348
Total Lithium (Li)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	5.0	7439348
Total Magnesium (Mg)	mg/kg	1870	7439348	1540	7436574	1200	673	119	100	7439348
Total Manganese (Mn)	mg/kg	163	7439348	492	7436574	429	570	615	0.20	7439348
Total Mercury (Hg)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	0.050	7439348
Total Molybdenum (Mo)	mg/kg	1.01	7439348	1.29	7436574	1.15	1.13	0.56	0.10	7439348
Total Nickel (Ni)	mg/kg	5.99	7439348	6.84	7436574	5.80	3.40	1.89	0.80	7439348
Total Phosphorus (P)	mg/kg	173	7439348	760	7436574	645	266	155	10	7439348
Total Potassium (K)	mg/kg	832	7439348	233	7436574	198	271	ND	100	7439348
Total Selenium (Se)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	0.50	7439348
Total Silver (Ag)	mg/kg	0.322	7439348	0.122	7436574	0.102	ND	ND	0.050	7439348
Total Sodium (Na)	mg/kg	ND	7439348	ND	7436574	ND	ND	ND	100	7439348
Total Strontium (Sr)	mg/kg	6.51	7439348	5.63	7436574	4.22	4.41	1.16	0.10	7439348
Total Thallium (Tl)	mg/kg	0.071	7439348	ND	7436574	ND	ND	ND	0.050	7439348
Total Tin (Sn)	mg/kg	0.49	7439348	0.37	7436574	0.40	0.39	0.18	0.10	7439348
Total Titanium (Ti)	mg/kg	616	7439348	856	7436574	837	819	296	1.0	7439348
Total Uranium (U)	mg/kg	0.202	7439348	0.626	7436574	0.603	0.253	0.188	0.050	7439348
Total Vanadium (V)	mg/kg	24.0	7439348	44.7	7436574	44.9	37.9	18.5	2.0	7439348
Total Zinc (Zn)	mg/kg	12.3	7439348	17.9	7436574	15.5	10.3	7.2	1.0	7439348
Total Zirconium (Zr)	mg/kg	ND	7439348	0.91	7436574	0.87	0.97	ND	0.50	7439348

ND = Not detected
RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4038	JE4039		JE4058	JE4059	JE4060	JE4061		
Sampling Date		2013/09/12	2013/09/12		2013/09/13	2013/09/13	2013/09/13	2013/09/13		
COC#		08391182	08391182		08391183	08391183	08391183	08391183		
	UNITS	**W3-PB-03-SOIL**	**W3-PB-04-SOIL**	**QC Batch**	**W3-PB-05-SOIL**	**W3-PB-06-SOIL**	**W3-PB-07-SOIL**	**W3-PB-08-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	2790	7330	7439348	4330	12200	7350	5640	100	7436574
Total Antimony (Sb)	mg/kg	ND	ND	7439348	ND	ND	0.10	ND	0.10	7436574
Total Arsenic (As)	mg/kg	1.46	2.82	7439348	2.04	3.00	1.59	2.80	0.50	7436574
Total Barium (Ba)	mg/kg	8.37	11.3	7439348	10.2	71.2	19.7	48.7	0.10	7436574
Total Beryllium (Be)	mg/kg	1.18	ND	7439348	0.65	ND	ND	ND	0.40	7436574
Total Bismuth (Bi)	mg/kg	ND	ND	7439348	ND	ND	ND	ND	0.10	7436574
Total Cadmium (Cd)	mg/kg	0.086	0.066	7439348	0.059	0.164	0.053	0.154	0.050	7436574
Total Calcium (Ca)	mg/kg	ND	255	7439348	ND	2200	603	2200	100	7436574
Total Chromium (Cr)	mg/kg	12.4	29.1	7439348	14.6	53.1	27.7	32.4	1.0	7436574
Total Cobalt (Co)	mg/kg	5.17	5.07	7439348	5.49	9.90	4.03	7.05	0.30	7436574
Total Copper (Cu)	mg/kg	4.82	12.0	7439348	6.13	24.9	5.13	14.0	0.50	7436574
Total Iron (Fe)	mg/kg	198000	81500	7439348	129000	50700	31600	56200	100	7436574
Total Lead (Pb)	mg/kg	1.78	7.48	7439348	2.63	6.70	5.00	6.34	0.10	7436574
Total Lithium (Li)	mg/kg	ND	ND	7439348	ND	8.2	ND	ND	5.0	7436574
Total Magnesium (Mg)	mg/kg	ND	2120	7439348	610	7000	2570	3300	100	7436574
Total Manganese (Mn)	mg/kg	1240	478	7439348	728	1490	387	1280	0.20	7436574
Total Mercury (Hg)	mg/kg	ND	ND	7439348	ND	0.053	ND	ND	0.050	7436574
Total Molybdenum (Mo)	mg/kg	0.56	1.20	7439348	1.05	1.14	0.65	0.92	0.10	7436574
Total Nickel (Ni)	mg/kg	3.13	8.57	7439348	4.92	24.5	8.66	16.0	0.80	7436574
Total Phosphorus (P)	mg/kg	250	778	7439348	203	860	495	1000	10	7436574
Total Potassium (K)	mg/kg	ND	274	7439348	201	3170	597	1370	100	7436574
Total Selenium (Se)	mg/kg	ND	ND	7439348	ND	ND	ND	ND	0.50	7436574
Total Silver (Ag)	mg/kg	0.051	0.142	7439348	0.069	ND	ND	ND	0.050	7436574
Total Sodium (Na)	mg/kg	ND	ND	7439348	ND	ND	ND	ND	100	7436574
Total Strontium (Sr)	mg/kg	0.29	4.25	7439348	1.38	14.6	6.70	10.1	0.10	7436574
Total Thallium (Tl)	mg/kg	ND	ND	7439348	ND	0.310	0.087	0.180	0.050	7436574
Total Tin (Sn)	mg/kg	0.10	0.30	7439348	0.24	0.22	0.25	0.12	0.10	7436574
Total Titanium (Ti)	mg/kg	134	845	7439348	284	833	508	374	1.0	7436574
Total Uranium (U)	mg/kg	0.328	0.682	7439348	0.520	0.710	0.288	0.623	0.050	7436574
Total Vanadium (V)	mg/kg	14.1	42.6	7439348	23.7	32.3	24.3	21.9	2.0	7436574
Total Zinc (Zn)	mg/kg	23.6	21.7	7439348	16.6	42.2	17.6	26.6	1.0	7436574
Total Zirconium (Zr)	mg/kg	1.12	1.07	7439348	0.69	2.92	0.55	1.82	0.50	7436574

ND = Not detected
RDL = Reportable Detection Limit

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4062	JE4063	JE4064		JE4065		JE4066		
Sampling Date		2013/09/15	2013/09/16	2013/09/16		2013/09/13		2013/09/13		
COC#		08391183	08391183	08391183		08391183		08391183		
	UNITS	**W3-PB-09-SOIL**	**W3-PB-10-SOIL**	**W3-PB-11-SOIL**	**QC Batch**	**W3-PB-16-SOIL**	**QC Batch**	**W3-SB-01-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	11600	5390	9750	7436574	5370	7439348	5490	100	7436574
Total Antimony (Sb)	mg/kg	ND	ND	ND	7436574	ND	7439348	ND	0.10	7436574
Total Arsenic (As)	mg/kg	1.33	1.60	2.21	7436574	1.92	7439348	1.75	0.50	7436574
Total Barium (Ba)	mg/kg	40.9	38.5	28.3	7436574	52.2	7439348	85.0	0.10	7436574
Total Beryllium (Be)	mg/kg	ND	ND	ND	7436574	ND	7439348	ND	0.40	7436574
Total Bismuth (Bi)	mg/kg	ND	ND	ND	7436574	ND	7439348	ND	0.10	7436574
Total Cadmium (Cd)	mg/kg	0.061	0.059	0.057	7436574	0.187	7439348	0.121	0.050	7436574
Total Calcium (Ca)	mg/kg	310	1120	1300	7436574	1680	7439348	2780	100	7436574
Total Chromium (Cr)	mg/kg	71.8	29.2	47.2	7436574	25.4	7439348	32.9	1.0	7436574
Total Cobalt (Co)	mg/kg	8.63	3.76	4.37	7436574	6.01	7439348	7.56	0.30	7436574
Total Copper (Cu)	mg/kg	10.1	5.16	6.28	7436574	12.8	7439348	20.6	0.50	7436574
Total Iron (Fe)	mg/kg	47200	36700	52700	7436574	44300	7439348	34700	100	7436574
Total Lead (Pb)	mg/kg	6.17	7.91	6.33	7436574	4.40	7439348	5.22	0.10	7436574
Total Lithium (Li)	mg/kg	ND	ND	ND	7436574	ND	7439348	5.7	5.0	7436574
Total Magnesium (Mg)	mg/kg	8050	3010	4270	7436574	3190	7439348	5090	100	7436574
Total Manganese (Mn)	mg/kg	214	357	390	7436574	1400	7439348	703	0.20	7436574
Total Mercury (Hg)	mg/kg	ND	0.056	0.072	7436574	ND	7439348	ND	0.050	7436574
Total Molybdenum (Mo)	mg/kg	17.8	1.84	1.07	7436574	0.81	7439348	0.87	0.10	7436574
Total Nickel (Ni)	mg/kg	24.7	8.85	12.8	7436574	14.7	7439348	19.0	0.80	7436574
Total Phosphorus (P)	mg/kg	425	258	779	7436574	725	7439348	559	10	7436574
Total Potassium (K)	mg/kg	3170	943	1050	7436574	1430	7439348	2420	100	7436574
Total Selenium (Se)	mg/kg	ND	ND	ND	7436574	ND	7439348	ND	0.50	7436574
Total Silver (Ag)	mg/kg	0.081	0.153	0.284	7436574	ND	7439348	ND	0.050	7436574
Total Sodium (Na)	mg/kg	ND	ND	ND	7436574	ND	7439348	ND	100	7436574
Total Strontium (Sr)	mg/kg	6.23	16.4	10.6	7436574	7.98	7439348	10.7	0.10	7436574
Total Thallium (Tl)	mg/kg	0.152	0.115	0.118	7436574	0.176	7439348	0.134	0.050	7436574
Total Tin (Sn)	mg/kg	0.39	0.45	0.27	7436574	0.10	7439348	0.19	0.10	7436574
Total Titanium (Ti)	mg/kg	3040	1040	655	7436574	349	7439348	515	1.0	7436574
Total Uranium (U)	mg/kg	0.324	0.619	0.600	7436574	0.448	7439348	0.534	0.050	7436574
Total Vanadium (V)	mg/kg	90.9	41.1	32.7	7436574	16.7	7439348	21.1	2.0	7436574
Total Zinc (Zn)	mg/kg	29.7	20.9	24.0	7436574	22.7	7439348	26.4	1.0	7436574
Total Zirconium (Zr)	mg/kg	1.69	0.79	0.58	7436574	1.59	7439348	1.67	0.50	7436574

ND = Not detected
RDL = Reportable Detection Limit

Maxxam

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4067	JE4068		JE4069		JE4071		
Sampling Date		2013/09/15	2013/09/15		2013/09/15		2013/09/15		
COC#		08391183	08391183		08391183		08391184		
	UNITS	**W3-SB-02-SOIL**	**W3-SB-03-SOIL**	**QC Batch**	**W3-SB-04-SOIL**	**QC Batch**	**W3-SB-05-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	11700	20800	7436574	40700	7439348	3110	100	7436574
Total Antimony (Sb)	mg/kg	ND	ND	7436574	0.15	7439348	ND	0.10	7436574
Total Arsenic (As)	mg/kg	3.01	2.72	7436574	4.20	7439348	1.43	0.50	7436574
Total Barium (Ba)	mg/kg	97.7	173	7436574	271	7439348	40.3	0.10	7436574
Total Beryllium (Be)	mg/kg	ND	ND	7436574	1.13	7439348	ND	0.40	7436574
Total Bismuth (Bi)	mg/kg	ND	ND	7436574	ND	7439348	ND	0.10	7436574
Total Cadmium (Cd)	mg/kg	0.261	0.278	7436574	1.21	7439348	0.097	0.050	7436574
Total Calcium (Ca)	mg/kg	2980	3910	7436574	3630	7439348	655	100	7436574
Total Chromium (Cr)	mg/kg	59.8	96.2	7436574	135	7439348	18.3	1.0	7436574
Total Cobalt (Co)	mg/kg	14.9	18.0	7436574	54.2	7439348	4.03	0.30	7436574
Total Copper (Cu)	mg/kg	20.8	22.1	7436574	67.5	7439348	3.97	0.50	7436574
Total Iron (Fe)	mg/kg	84800	52900	7436574	90200	7439348	60000	100	7436574
Total Lead (Pb)	mg/kg	9.99	12.6	7436574	56.1	7439348	4.87	0.10	7436574
Total Lithium (Li)	mg/kg	15.7	15.2	7436574	23.3	7439348	ND	5.0	7436574
Total Magnesium (Mg)	mg/kg	7380	12700	7436574	12400	7439348	1920	100	7436574
Total Manganese (Mn)	mg/kg	1410	1830	7436574	12500	7439348	2010	0.20	7436574
Total Mercury (Hg)	mg/kg	ND	0.057	7436574	0.084	7439348	ND	0.050	7436574
Total Molybdenum (Mo)	mg/kg	2.76	3.55	7436574	8.62	7439348	1.80	0.10	7436574
Total Nickel (Ni)	mg/kg	31.4	38.3	7436574	68.3	7439348	6.75	0.80	7436574
Total Phosphorus (P)	mg/kg	565	676	7436574	879	7439348	256	10	7436574
Total Potassium (K)	mg/kg	2520	4580	7436574	6230	7439348	718	100	7436574
Total Selenium (Se)	mg/kg	ND	ND	7436574	ND	7439348	ND	0.50	7436574
Total Silver (Ag)	mg/kg	0.111	0.430	7436574	1.41	7439348	0.150	0.050	7436574
Total Sodium (Na)	mg/kg	ND	ND	7436574	ND	7439348	ND	100	7436574
Total Strontium (Sr)	mg/kg	13.3	20.9	7436574	23.1	7439348	9.74	0.10	7436574
Total Thallium (Tl)	mg/kg	0.248	0.387	7436574	2.04	7439348	0.083	0.050	7436574
Total Tin (Sn)	mg/kg	0.43	0.51	7436574	0.68	7439348	0.37	0.10	7436574
Total Titanium (Ti)	mg/kg	994	1520	7436574	1540	7439348	623	1.0	7436574
Total Uranium (U)	mg/kg	1.61	1.64	7436574	2.11	7439348	0.360	0.050	7436574
Total Vanadium (V)	mg/kg	42.7	63.8	7436574	78.3	7439348	29.7	2.0	7436574
Total Zinc (Zn)	mg/kg	47.1	100	7436574	150	7439348	25.6	1.0	7436574
Total Zirconium (Zr)	mg/kg	0.94	2.12	7436574	2.51	7439348	0.75	0.50	7436574

ND = Not detected
RDL = Reportable Detection Limit

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		JE4072	JE4073	JE4074	JE4075	JE4076		
Sampling Date		2013/09/15	2013/09/16	2013/09/16	2013/09/25	2013/09/25		
COC#		08391184	08391184	08391184	08391184	08391184		
	UNITS	**W3-SB-06-SOIL**	**W3-SB-07-SOIL**	**W3-SB-08-SOIL**	**W3-SB-09-SOIL**	**W3-SB-10-SOIL**	**RDL**	**QC Batch**
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	26400	7520	10600	11000	14100	100	7436574
Total Antimony (Sb)	mg/kg	ND	0.12	ND	ND	ND	0.10	7436574
Total Arsenic (As)	mg/kg	2.02	2.43	4.45	1.53	4.04	0.50	7436574
Total Barium (Ba)	mg/kg	207	75.6	109	72.5	158	0.10	7436574
Total Beryllium (Be)	mg/kg	0.47	ND	ND	ND	0.40	0.40	7436574
Total Bismuth (Bi)	mg/kg	ND	ND	ND	0.12	ND	0.10	7436574
Total Cadmium (Cd)	mg/kg	1.24	0.156	0.266	0.122	0.695	0.050	7436574
Total Calcium (Ca)	mg/kg	9710	2150	9710	1640	18300	100	7436574
Total Chromium (Cr)	mg/kg	112	35.1	48.0	49.2	46.5	1.0	7436574
Total Cobalt (Co)	mg/kg	22.1	8.15	11.2	11.9	10.9	0.30	7436574
Total Copper (Cu)	mg/kg	73.8	13.9	14.4	8.50	38.0	0.50	7436574
Total Iron (Fe)	mg/kg	65000	29400	37100	51600	37200	100	7436574
Total Lead (Pb)	mg/kg	9.25	15.5	6.12	7.27	11.9	0.10	7436574
Total Lithium (Li)	mg/kg	29.5	6.0	12.9	8.3	8.8	5.0	7436574
Total Magnesium (Mg)	mg/kg	11600	5680	6410	7710	6710	100	7436574
Total Manganese (Mn)	mg/kg	5220	1350	882	811	3580	0.20	7436574
Total Mercury (Hg)	mg/kg	0.098	ND	0.075	ND	0.188	0.050	7436574
Total Molybdenum (Mo)	mg/kg	13.4	0.89	1.90	1.76	1.61	0.10	7436574
Total Nickel (Ni)	mg/kg	132	20.5	27.7	16.1	42.1	0.80	7436574
Total Phosphorus (P)	mg/kg	1630	565	422	186	967	10	7436574
Total Potassium (K)	mg/kg	3210	2170	430	2940	1360	100	7436574
Total Selenium (Se)	mg/kg	0.69	ND	ND	ND	2.06	0.50	7436574
Total Silver (Ag)	mg/kg	0.508	0.051	0.119	ND	0.625	0.050	7436574
Total Sodium (Na)	mg/kg	ND	ND	ND	ND	ND	100	7436574
Total Strontium (Sr)	mg/kg	33.5	9.92	18.1	10.7	26.7	0.10	7436574
Total Thallium (Tl)	mg/kg	1.15	0.198	0.179	0.213	0.304	0.050	7436574
Total Tin (Sn)	mg/kg	0.42	0.22	0.26	0.45	0.38	0.10	7436574
Total Titanium (Ti)	mg/kg	643	647	767	1500	312	1.0	7436574
Total Uranium (U)	mg/kg	3.74	0.558	3.08	0.580	8.80	0.050	7436574
Total Vanadium (V)	mg/kg	57.5	23.1	30.8	44.4	24.8	2.0	7436574
Total Zinc (Zn)	mg/kg	168	39.0	54.1	44.2	211	1.0	7436574
Total Zirconium (Zr)	mg/kg	0.63	1.16	0.82	3.44	0.83	0.50	7436574

ND = Not detected
RDL = Reportable Detection Limit

Maxxam

Success Through Science®

Maxxam Job #: B424740
Report Date: 2014/04/04

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7435706	Moisture	2014/04/01					ND, RDL=0.30	%	2.8	20		
7435772	Moisture	2014/04/01					ND, RDL=0.30	%	3.2	20		
7436509	Soluble (2:1) pH	2014/04/01			100	97 - 103			1.0	20		
7436574	Total Antimony (Sb)	2014/04/02	93	75 - 125	99	75 - 125	ND, RDL=0.10	mg/kg	NC	30	100	70 - 130
7436574	Total Arsenic (As)	2014/04/02	94	75 - 125	98	75 - 125	ND, RDL=0.50	mg/kg	2.1	30	100	70 - 130
7436574	Total Barium (Ba)	2014/04/02	NC	75 - 125	102	75 - 125	0.10, RDL=0.10	mg/kg	3.9	35	110	70 - 130
7436574	Total Beryllium (Be)	2014/04/02	90	75 - 125	103	75 - 125	ND, RDL=0.40	mg/kg	NC	30		
7436574	Total Cadmium (Cd)	2014/04/02	98	75 - 125	100	75 - 125	ND, RDL=0.050	mg/kg	NC	30	95	70 - 130
7436574	Total Chromium (Cr)	2014/04/02	NC	75 - 125	102	75 - 125	ND, RDL=1.0	mg/kg	2.9	30	115	70 - 130
7436574	Total Cobalt (Co)	2014/04/02	97	75 - 125	105	75 - 125	ND, RDL=0.30	mg/kg	2.5	30	103	70 - 130
7436574	Total Copper (Cu)	2014/04/02	99	75 - 125	105	75 - 125	ND, RDL=0.50	mg/kg	4.5	30	93	70 - 130
7436574	Total Lead (Pb)	2014/04/02	99	75 - 125	103	75 - 125	ND, RDL=0.10	mg/kg	1.4	35	109	70 - 130
7436574	Total Lithium (Li)	2014/04/02	96	75 - 125	101	75 - 125	ND, RDL=5.0	mg/kg	NC	30		
7436574	Total Manganese (Mn)	2014/04/02	NC	75 - 125	103	75 - 125	0.22, RDL=0.20	mg/kg	1.4	30	112	70 - 130
7436574	Total Mercury (Hg)	2014/04/02	96	75 - 125	96	75 - 125	ND, RDL=0.050	mg/kg	NC	35	93	70 - 130
7436574	Total Molybdenum (Mo)	2014/04/02	104	75 - 125	101	75 - 125	ND, RDL=0.10	mg/kg	5.8	35	116	70 - 130
7436574	Total Nickel (Ni)	2014/04/02	98	75 - 125	99	75 - 125	ND, RDL=0.80	mg/kg	3.7	30	93	70 - 130
7436574	Total Selenium (Se)	2014/04/02	95	75 - 125	103	75 - 125	ND, RDL=0.50	mg/kg	NC	30		
7436574	Total Silver (Ag)	2014/04/02	97	75 - 125	101	75 - 125	ND, RDL=0.050	mg/kg	NC	35		
7436574	Total Strontium (Sr)	2014/04/02	94	75 - 125	104	75 - 125	ND, RDL=0.10	mg/kg	9.3	35	112	70 - 130
7436574	Total Thallium (Tl)	2014/04/02	99	75 - 125	100	75 - 125	ND, RDL=0.050	mg/kg	5.1	30	100	70 - 130
7436574	Total Tin (Sn)	2014/04/02	95	75 - 125	97	75 - 125	ND, RDL=0.10	mg/kg	NC	35		
7436574	Total Titanium (Ti)	2014/04/02	NC	75 - 125	98	75 - 125	ND, RDL=1.0	mg/kg	4.5	35	119	70 - 130
7436574	Total Uranium (U)	2014/04/02	104	75 - 125	99	75 - 125	ND, RDL=0.050	mg/kg	2.0	30	98	70 - 130
7436574	Total Vanadium (V)	2014/04/02	NC	75 - 125	101	75 - 125	ND, RDL=2.0	mg/kg	5.1	30	114	70 - 130
7436574	Total Zinc (Zn)	2014/04/02	NC	75 - 125	103	75 - 125	ND, RDL=1.0	mg/kg	3.8	30	90	70 - 130
7436574	Total Aluminum (Al)	2014/04/02					ND, RDL=100	mg/kg	4.7	35	116	70 - 130
7436574	Total Calcium (Ca)	2014/04/02					ND, RDL=100	mg/kg	5.0	30	111	70 - 130
7436574	Total Iron (Fe)	2014/04/02					ND, RDL=100	mg/kg	7.2	30	112	70 - 130
7436574	Total Magnesium (Mg)	2014/04/02					ND, RDL=100	mg/kg	6.6	30	97	70 - 130
7436574	Total Phosphorus (P)	2014/04/02					ND, RDL=10	mg/kg	5.6	30	92	70 - 130
7436574	Total Bismuth (Bi)	2014/04/02					ND, RDL=0.10	mg/kg	NC	30		
7436574	Total Potassium (K)	2014/04/02					ND, RDL=100	mg/kg	6.6	35		
7436574	Total Sodium (Na)	2014/04/02					ND, RDL=100	mg/kg	NC	35		
7436574	Total Zirconium (Zr)	2014/04/02					ND, RDL=0.50	mg/kg	4.9	30		
7439348	Total Antimony (Sb)	2014/04/03	91	75 - 125	100	75 - 125	ND, RDL=0.10	mg/kg	NC	30	113	70 - 130
7439348	Total Arsenic (As)	2014/04/03	99	75 - 125	97	75 - 125	ND, RDL=0.50	mg/kg	15.8	30	102	70 - 130
7439348	Total Barium (Ba)	2014/04/03	NC	75 - 125	99	75 - 125	ND, RDL=0.10	mg/kg	4.2	35	108	70 - 130
7439348	Total Beryllium (Be)	2014/04/03	81	75 - 125	110	75 - 125	ND, RDL=0.40	mg/kg	NC	30		

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7439348	Total Cadmium (Cd)	2014/04/03	103	75 - 125	100	75 - 125	ND, RDL=0.050	mg/kg	12.5	30	100	70 - 130
7439348	Total Chromium (Cr)	2014/04/03	NC	75 - 125	103	75 - 125	ND, RDL=1.0	mg/kg	4.0	30	112	70 - 130
7439348	Total Cobalt (Co)	2014/04/03	NC	75 - 125	105	75 - 125	ND, RDL=0.30	mg/kg	2.0	30	103	70 - 130
7439348	Total Copper (Cu)	2014/04/03	NC	75 - 125	100	75 - 125	ND, RDL=0.50	mg/kg	6.0	30	94	70 - 130
7439348	Total Lead (Pb)	2014/04/03	108	75 - 125	103	75 - 125	ND, RDL=0.10	mg/kg	4.0	35	112	70 - 130
7439348	Total Lithium (Li)	2014/04/03	NC	75 - 125	101	75 - 125	ND, RDL=5.0	mg/kg				
7439348	Total Manganese (Mn)	2014/04/03	NC	75 - 125	104	75 - 125	ND, RDL=0.20	mg/kg	4.5	30	111	70 - 130
7439348	Total Mercury (Hg)	2014/04/03	102	75 - 125	98	75 - 125	ND, RDL=0.050	mg/kg	NC	35	92	70 - 130
7439348	Total Molybdenum (Mo)	2014/04/03	NC	75 - 125	104	75 - 125	ND, RDL=0.10	mg/kg	34.3	35	121	70 - 130
7439348	Total Nickel (Ni)	2014/04/03	NC	75 - 125	108	75 - 125	ND, RDL=0.80	mg/kg	5.2	30	94	70 - 130
7439348	Total Selenium (Se)	2014/04/03	101	75 - 125	100	75 - 125	ND, RDL=0.50	mg/kg	NC	30		
7439348	Total Silver (Ag)	2014/04/03	102	75 - 125	103	75 - 125	ND, RDL=0.050	mg/kg	14.6	35		
7439348	Total Strontium (Sr)	2014/04/03	106	75 - 125	106	75 - 125	ND, RDL=0.10	mg/kg	4.2	35	116	70 - 130
7439348	Total Thallium (Tl)	2014/04/03	NC	75 - 125	100	75 - 125	ND, RDL=0.050	mg/kg	3.5	30	102	70 - 130
7439348	Total Tin (Sn)	2014/04/03	99	75 - 125	97	75 - 125	ND, RDL=0.10	mg/kg	4.7	35		
7439348	Total Titanium (Ti)	2014/04/03	NC	75 - 125	99	75 - 125	ND, RDL=1.0	mg/kg	4.7	35	116	70 - 130
7439348	Total Uranium (U)	2014/04/03	110	75 - 125	98	75 - 125	ND, RDL=0.050	mg/kg			100	70 - 130
7439348	Total Vanadium (V)	2014/04/03	NC	75 - 125	102	75 - 125	ND, RDL=2.0	mg/kg	3.8	30	114	70 - 130
7439348	Total Zinc (Zn)	2014/04/03	NC	75 - 125	99	75 - 125	ND, RDL=1.0	mg/kg	6.9	30	91	70 - 130
7439348	Total Aluminum (Al)	2014/04/03					ND, RDL=100	mg/kg	3.6	35	117	70 - 130
7439348	Total Calcium (Ca)	2014/04/03					ND, RDL=100	mg/kg	4.0	30	113	70 - 130
7439348	Total Iron (Fe)	2014/04/03					ND, RDL=100	mg/kg	3.8	30	118	70 - 130
7439348	Total Magnesium (Mg)	2014/04/03					ND, RDL=100	mg/kg	5.1	30	102	70 - 130
7439348	Total Phosphorus (P)	2014/04/03					ND, RDL=10	mg/kg	4.1	30	95	70 - 130
7439348	Total Bismuth (Bi)	2014/04/03					ND, RDL=0.10	mg/kg	NC	30		
7439348	Total Potassium (K)	2014/04/03					ND, RDL=100	mg/kg	5.1	35		
7439348	Total Sodium (Na)	2014/04/03					ND, RDL=100	mg/kg	NC	35		
7439348	Total Zirconium (Zr)	2014/04/03					ND, RDL=0.50	mg/kg	16.1	30		
7439365	Soluble (2:1) pH	2014/04/03			101	97 - 103			1.8	20		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B424740

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Rob Reinert, Data Validation Coordinator

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Your P.O. #: 4700058846
Your Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your C.O.C. #: 08391185, 08391186, 08391187

Attention: Ross O'Keefe
Pinchin LeBlanc Environmental
2 Avalon Drive
Labrador City, NF
Canada A2V 2Y6

Report Date: 2014/04/16
Report #: R1553343
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B424729
Received: 2014/03/28, 09:10

Sample Matrix: TISSUE
Samples Received: 31

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	11	2014/04/07	2014/04/09	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS - Tissue Wet Wt	20	2014/04/07	2014/04/12	BBY7SOP-00002	EPA 6020A
Moisture	20	N/A	2014/04/08	BBY8SOP-00017	Ont MOE -E 3139
Moisture	11	N/A	2014/04/09	BBY8SOP-00017	Ont MOE -E 3139

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Amandeep Nagra, Account Specialist
Email: ANagra@maxxam.ca
Phone# (604) 639-2602

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		JE3950	JE3951	JE3952	JE3953	JE3954	JE3955	JE3956	JE3957	JE3958		
Sampling Date		2013/09/12	2013/09/12	2013/09/12	2013/09/12	2013/09/15	2013/09/15	2013/09/12	2013/09/12	2013/09/12		
COC#		08391185	08391185	08391185	08391185	08391185	08391185	08391185	08391185	08391185		
	UNITS	**W3-BB-01**	**W3-BB-02**	**W3-BB-03**	**W3-BB-04**	**W3-BB-05**	**W3-BB-06**	**W3-BB-07**	**W3-BB-16**	**W3-PB-01**	**RDL**	**QC Batch**
Total Metals by ICPMS												
Total Aluminum (Al)	mg/kg	2.08	4.51	4.81	1.64	1.45	2.22	1.41	1.51	3.21	0.20	7444329
Total Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0010	7444329
Total Arsenic (As)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.010	7444329
Total Barium (Ba)	mg/kg	2.55	2.89	4.12	2.80	2.85	2.78	2.39	2.46	1.23	0.020	7444329
Total Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Boron (B)	mg/kg	0.65	0.69	0.87	0.67	0.53	0.47	0.67	0.94	0.87	0.40	7444329
Total Cadmium (Cd)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	0.0021	0.0020	7444329
Total Calcium (Ca)	mg/kg	206	236	281	207	262	227	136	196	129	2.0	7444329
Total Chromium (Cr)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.040	7444329
Total Cobalt (Co)	mg/kg	ND	0.0043	0.0067	ND	ND	ND	ND	ND	ND	0.0040	7444329
Total Copper (Cu)	mg/kg	0.577	0.815	0.699	0.688	0.899	0.619	0.446	0.633	0.371	0.050	7444329
Total Iron (Fe)	mg/kg	11	42	79	11	13	17	ND	ND	ND	10	7444329
Total Lead (Pb)	mg/kg	0.0021	0.0046	0.0028	ND	0.0031	0.0026	ND	ND	ND	0.0020	7444329
Total Magnesium (Mg)	mg/kg	73.6	89.3	102	75.0	113	97.2	53.1	71.1	59.1	2.0	7444329
Total Manganese (Mn)	mg/kg	154	113	120	146	83.4	116	111	109	43.7	0.020	7444329
Total Mercury (Hg)	mg/kg	0.0048	0.0027	ND	0.0026	ND	ND	ND	ND	0.0025	0.0020	7444329
Total Molybdenum (Mo)	mg/kg	0.020	ND	0.014	0.013	0.012	0.022	ND	ND	0.013	0.010	7444329
Total Nickel (Ni)	mg/kg	0.074	0.106	0.118	0.079	0.114	0.114	0.066	0.131	0.045	0.010	7444329
Total Phosphorus (P)	mg/kg	183	220	193	184	190	189	128	183	91.4	2.0	7444329
Total Potassium (K)	mg/kg	801	800	841	733	786	763	594	845	717	2.0	7444329
Total Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.010	7444329
Total Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0040	7444329
Total Sodium (Na)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0	7444329
Total Strontium (Sr)	mg/kg	0.216	0.342	0.430	0.367	1.02	0.189	0.324	0.380	0.170	0.020	7444329
Total Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00040	7444329
Total Tin (Sn)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Titanium (Ti)	mg/kg	ND	0.40	0.31	ND	ND	ND	ND	ND	ND	0.20	7444329
Total Uranium (U)	mg/kg	ND	ND	0.00044	ND	ND	ND	ND	ND	ND	0.00040	7444329
Total Vanadium (V)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.040	7444329
Total Zinc (Zn)	mg/kg	1.11	1.47	1.26	1.47	1.63	1.40	0.836	0.965	0.999	0.040	7444329

ND = Not detected
RDL = Reportable Detection Limit

Maxxam Job #: B424729
Report Date: 2014/04/16

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		JE3959	JE3960	JE3961	JE3965	JE3966	JE3967	JE3968	JE3969	JE3970		
Sampling Date		2013/09/12	2013/09/12	2013/09/12	2013/09/13	2013/09/13	2013/09/13	2013/09/13	2013/09/15	2013/09/16		
COC#		08391185	08391185	08391185	08391186	08391186	08391186	08391186	08391186	08391186		
	UNITS	**W3-PB-02**	**W3-PB-03**	**W3-PB-04**	**W3-PB-05**	**W3-PB-06**	**W3-PB-07**	**W3-PB-08**	**W3-PB-09**	**W3-PB-10**	**RDL**	**QC Batch**
Total Metals by ICPMS												
Total Aluminum (Al)	mg/kg	5.73	4.05	4.62	5.88	8.12	7.08	7.01	6.33	5.68	0.20	7444329
Total Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0010	7444329
Total Arsenic (As)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.010	7444329
Total Barium (Ba)	mg/kg	1.32	1.61	2.37	1.35	1.60	2.09	1.92	1.98	2.17	0.020	7444329
Total Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Boron (B)	mg/kg	0.51	0.94	0.84	0.49	ND	0.53	0.74	ND	0.68	0.40	7444329
Total Cadmium (Cd)	mg/kg	0.0033	ND	ND	ND	ND	ND	ND	ND	0.0024	0.0020	7444329
Total Calcium (Ca)	mg/kg	115	132	163	125	122	141	170	173	217	2.0	7444329
Total Chromium (Cr)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.040	7444329
Total Cobalt (Co)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0040	7444329
Total Copper (Cu)	mg/kg	0.465	0.437	0.505	0.441	0.285	0.512	0.573	0.408	0.413	0.050	7444329
Total Iron (Fe)	mg/kg	11	16	ND	16	15	ND	ND	15	12	10	7444329
Total Lead (Pb)	mg/kg	0.0021	ND	ND	0.0022	0.0026	0.0030	ND	0.0039	0.0081	0.0020	7444329
Total Magnesium (Mg)	mg/kg	53.0	56.0	70.3	54.4	61.5	72.4	82.3	70.4	81.4	2.0	7444329
Total Manganese (Mn)	mg/kg	35.5	40.9	63.4	50.0	43.8	52.4	47.5	53.3	72.5	0.020	7444329
Total Mercury (Hg)	mg/kg	ND	ND	ND	0.0031	ND	ND	ND	ND	ND	0.0020	7444329
Total Molybdenum (Mo)	mg/kg	ND	ND	ND	ND	ND	ND	ND	0.014	ND	0.010	7444329
Total Nickel (Ni)	mg/kg	0.119	0.046	0.030	0.046	0.067	0.088	0.090	0.061	0.041	0.010	7444329
Total Phosphorus (P)	mg/kg	99.2	93.0	141	82.9	102	149	157	153	151	2.0	7444329
Total Potassium (K)	mg/kg	816	658	705	719	744	841	879	752	803	2.0	7444329
Total Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.010	7444329
Total Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0040	7444329
Total Sodium (Na)	mg/kg	ND	ND	ND	ND	6.9	ND	2.1	ND	ND	2.0	7444329
Total Strontium (Sr)	mg/kg	0.234	0.307	0.410	0.238	0.190	0.482	0.898	0.177	0.191	0.020	7444329
Total Thallium (Tl)	mg/kg	ND	ND	0.00155	0.00048	ND	ND	ND	ND	ND	0.00040	7444329
Total Tin (Sn)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	7444329
Total Titanium (Ti)	mg/kg	ND	ND	ND	ND	0.39	ND	ND	0.27	ND	0.20	7444329
Total Uranium (U)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00040	7444329
Total Vanadium (V)	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.040	7444329
Total Zinc (Zn)	mg/kg	0.908	0.914	1.05	0.990	1.10	1.14	1.08	1.20	1.43	0.040	7444329

ND = Not detected
RDL = Reportable Detection Limit

Maxxam Job #: B424729
Report Date: 2014/04/16

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		JE3971	JE3972		JE3973	JE3974	JE3975	JE3976	JE3983		
Sampling Date		2013/09/16	2013/09/13		2013/09/13	2013/09/15	2013/09/15	2013/09/15	2013/09/15		
COC#		08391186	08391186		08391186	08391186	08391186	08391186	08391187		
	UNITS	**W3-PB-11**	**W3-PB-16**	**QC Batch**	**W3-SB-01**	**W3-SB-02**	**W3-SB-03**	**W3-SB-04**	**W3-SB-05**	**RDL**	**QC Batch**
Total Metals by ICPMS											
Total Aluminum (Al)	mg/kg	6.67	4.42	7444329	1.59	0.48	0.45	0.91	0.90	0.20	7444172
Total Antimony (Sb)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.0010	7444172
Total Arsenic (As)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.010	7444172
Total Barium (Ba)	mg/kg	1.75	1.49	7444329	0.878	0.951	1.05	0.923	0.512	0.020	7444172
Total Beryllium (Be)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.020	7444172
Total Bismuth (Bi)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.020	7444172
Total Boron (B)	mg/kg	0.94	0.83	7444329	4.53	0.67	1.10	0.43	0.42	0.40	7444172
Total Cadmium (Cd)	mg/kg	ND	0.0033	7444329	0.0020	0.0052	0.0063	ND	0.0046	0.0020	7444172
Total Calcium (Ca)	mg/kg	164	155	7444329	393	216	269	229	177	2.0	7444172
Total Chromium (Cr)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.040	7444172
Total Cobalt (Co)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.0040	7444172
Total Copper (Cu)	mg/kg	0.470	0.562	7444329	0.498	0.675	0.341	0.464	0.275	0.050	7444172
Total Iron (Fe)	mg/kg	19	ND	7444329	14	ND	ND	ND	ND	10	7444172
Total Lead (Pb)	mg/kg	0.0063	ND	7444329	ND	ND	ND	ND	ND	0.0020	7444172
Total Magnesium (Mg)	mg/kg	76.6	63.1	7444329	200	160	139	152	96.5	2.0	7444172
Total Manganese (Mn)	mg/kg	49.7	35.7	7444329	1.15	0.675	0.581	1.11	0.441	0.020	7444172
Total Mercury (Hg)	mg/kg	ND	0.0020	7444329	ND	ND	ND	ND	ND	0.0020	7444172
Total Molybdenum (Mo)	mg/kg	0.013	ND	7444329	0.021	0.023	0.028	ND	0.013	0.010	7444172
Total Nickel (Ni)	mg/kg	0.047	0.089	7444329	0.144	0.047	0.047	0.065	0.051	0.010	7444172
Total Phosphorus (P)	mg/kg	172	94.3	7444329	312	198	199	216	145	2.0	7444172
Total Potassium (K)	mg/kg	832	844	7444329	2490	1620	1640	1550	1360	2.0	7444172
Total Selenium (Se)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.010	7444172
Total Silver (Ag)	mg/kg	ND	ND	7444329	ND	ND(1)	ND	ND	ND	0.0040	7444172
Total Sodium (Na)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	2.0	7444172
Total Strontium (Sr)	mg/kg	0.184	0.399	7444329	0.870	0.349	0.504	0.556	0.446	0.020	7444172
Total Thallium (Tl)	mg/kg	0.00047	ND	7444329	ND	ND	ND	ND	ND	0.00040	7444172
Total Tin (Sn)	mg/kg	ND	ND	7444329	0.035	ND	ND	ND	ND	0.020	7444172
Total Titanium (Ti)	mg/kg	0.44	ND	7444329	ND	ND	ND	ND	ND	0.20	7444172
Total Uranium (U)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.00040	7444172
Total Vanadium (V)	mg/kg	ND	ND	7444329	ND	ND	ND	ND	ND	0.040	7444172
Total Zinc (Zn)	mg/kg	1.41	0.927	7444329	1.98	1.53	1.07	1.19	0.937	0.040	7444172

ND = Not detected
RDL = Reportable Detection Limit
(1) - Matrix Spike outside acceptance criteria (10% of analytes failure allowed).

Success Through Science®

Maxxam Job #: B424729
Report Date: 2014/04/16

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		JE3984	JE3985	JE3986	JE3987	JE3988	JE3989		
Sampling Date		2013/09/15	2013/09/16	2013/09/16	2013/09/25	2013/09/25	2013/09/15		
COC#		08391187	08391187	08391187	08391187	08391187	08391187		
	UNITS	**W3-SB-06**	**W3-SB-07**	**W3-SB-08**	**W3-SB-09**	**W3-SB-10**	**W3-SB-16**	**RDL**	**QC Batch**
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	0.40	2.66	0.54	1.82	1.36	0.41	0.20	7444172
Total Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	0.0010	7444172
Total Arsenic (As)	mg/kg	ND	ND	ND	ND	ND	ND	0.010	7444172
Total Barium (Ba)	mg/kg	0.986	1.59	0.886	1.14	0.390	0.761	0.020	7444172
Total Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	0.020	7444172
Total Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	ND	0.020	7444172
Total Boron (B)	mg/kg	0.77	1.22	1.65	1.19	1.42	0.59	0.40	7444172
Total Cadmium (Cd)	mg/kg	0.0109	0.0066	0.0034	0.0027	ND	0.0078	0.0020	7444172
Total Calcium (Ca)	mg/kg	418	284	361	334	278	248	2.0	7444172
Total Chromium (Cr)	mg/kg	ND	ND	ND	ND	ND	ND	0.040	7444172
Total Cobalt (Co)	mg/kg	ND	ND	ND	ND	ND	ND	0.0040	7444172
Total Copper (Cu)	mg/kg	0.454	0.446	0.442	0.434	0.342	0.413	0.050	7444172
Total Iron (Fe)	mg/kg	ND	ND	ND	10	11	ND	10	7444172
Total Lead (Pb)	mg/kg	ND	ND	ND	0.0021	0.0021	ND	0.0020	7444172
Total Magnesium (Mg)	mg/kg	125	168	169	198	155	98.9	2.0	7444172
Total Manganese (Mn)	mg/kg	0.766	0.951	0.898	0.985	1.09	0.558	0.020	7444172
Total Mercury (Hg)	mg/kg	ND	ND	ND	ND	ND	ND	0.0020	7444172
Total Molybdenum (Mo)	mg/kg	0.041	0.015	0.061	0.012	0.021	0.041	0.010	7444172
Total Nickel (Ni)	mg/kg	0.086	0.148	0.064	0.089	0.048	0.071	0.010	7444172
Total Phosphorus (P)	mg/kg	187	279	255	277	187	138	2.0	7444172
Total Potassium (K)	mg/kg	1430	1800	1380	1710	1580	1320	2.0	7444172
Total Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	0.010	7444172
Total Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.0040	7444172
Total Sodium (Na)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	7444172
Total Strontium (Sr)	mg/kg	0.672	0.558	0.257	0.840	0.184	0.434	0.020	7444172
Total Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	0.00040	7444172
Total Tin (Sn)	mg/kg	ND	ND	ND	0.050	ND	ND	0.020	7444172
Total Titanium (Ti)	mg/kg	ND	ND	ND	ND	ND	ND	0.20	7444172
Total Uranium (U)	mg/kg	ND	ND	ND	ND	0.00040	ND	0.00040	7444172
Total Vanadium (V)	mg/kg	ND	ND	ND	ND	ND	ND	0.040	7444172
Total Zinc (Zn)	mg/kg	1.76	1.57	1.74	1.63	1.41	1.34	0.040	7444172

ND = Not detected
RDL = Reportable Detection Limit

Maxxam Job #: B424729
Report Date: 2014/04/16

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

PHYSICAL TESTING (TISSUE)

Maxxam ID		JE3950	JE3951	JE3952	JE3953	JE3954	JE3955	JE3956	JE3957	JE3958	JE3959		
Sampling Date		2013/09/12	2013/09/12	2013/09/12	2013/09/12	2013/09/15	2013/09/15	2013/09/12	2013/09/12	2013/09/12	2013/09/12		
COC#		08391185	08391185	08391185	08391185	08391185	08391185	08391185	08391185	08391185	08391185		
	UNITS	**W3-BB-01**	**W3-BB-02**	**W3-BB-03**	**W3-BB-04**	**W3-BB-05**	**W3-BB-06**	**W3-BB-07**	**W3-BB-16**	**W3-PB-01**	**W3-PB-02**	**RDL**	**QC Batch**
Physical Properties													
Moisture	%	85	80	84	87	86	86	84	83	87	88	0.30	7444035

Maxxam ID		JE3960	JE3961	JE3965	JE3966	JE3967	JE3968	JE3969	JE3970	JE3971		
Sampling Date		2013/09/12	2013/09/12	2013/09/13	2013/09/13	2013/09/13	2013/09/13	2013/09/15	2013/09/16	2013/09/16		
COC#		08391185	08391185	08391186	08391186	08391186	08391186	08391186	08391186	08391186		
	UNITS	**W3-PB-03**	**W3-PB-04**	**W3-PB-05**	**W3-PB-06**	**W3-PB-07**	**W3-PB-08**	**W3-PB-09**	**W3-PB-10**	**W3-PB-11**	**RDL**	**QC Batch**
Physical Properties												
Moisture	%	87	87	87	88	87	86	87	87	86	0.30	7444035

Maxxam ID		JE3972		JE3973	JE3974	JE3975	JE3976	JE3983		
Sampling Date		2013/09/13		2013/09/13	2013/09/15	2013/09/15	2013/09/15	2013/09/15		
COC#		08391186		08391186	08391186	08391186	08391186	08391187		
	UNITS	**W3-PB-16**	**QC Batch**	**W3-SB-01**	**W3-SB-02**	**W3-SB-03**	**W3-SB-04**	**W3-SB-05**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	87	7444035	81	88	83	87	88	0.30	7445482

Maxxam ID		JE3984	JE3985	JE3986	JE3987	JE3988	JE3989		
Sampling Date		2013/09/15	2013/09/16	2013/09/16	2013/09/25	2013/09/25	2013/09/15		
COC#		08391187	08391187	08391187	08391187	08391187	08391187		
	UNITS	**W3-SB-06**	**W3-SB-07**	**W3-SB-08**	**W3-SB-09**	**W3-SB-10**	**W3-SB-16**	**RDL**	**QC Batch**
Physical Properties									
Moisture	%	83	87	82	83	85	87	0.30	7445482

RDL = Reportable Detection Limit

Maxxam Job #: B424729
Report Date: 2014/04/16

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7444035	Moisture	2014/04/08					ND, RDL=0.30	%	0.1	20		
7444172	Total Arsenic (As)	2014/04/09	96	75 - 125	101	75 - 125	ND, RDL=0.010	mg/kg	NC	35	118	75 - 125
7444172	Total Barium (Ba)	2014/04/09	NC	75 - 125	101	75 - 125	ND, RDL=0.020	mg/kg	10.0	35	85	75 - 125
7444172	Total Beryllium (Be)	2014/04/09	92	75 - 125	99	75 - 125	ND, RDL=0.020	mg/kg	NC	35		
7444172	Total Cadmium (Cd)	2014/04/09	97	75 - 125	101	75 - 125	ND, RDL=0.0020	mg/kg	NC	35	87	75 - 125
7444172	Total Chromium (Cr)	2014/04/09	95	75 - 125	103	75 - 125	ND, RDL=0.040	mg/kg	NC	35	31	28 - 97
7444172	Total Cobalt (Co)	2014/04/09	95	75 - 125	105	75 - 125	ND, RDL=0.0040	mg/kg	NC	35	85	75 - 125
7444172	Total Copper (Cu)	2014/04/09	NC	75 - 125	104	75 - 125	ND, RDL=0.050	mg/kg	27.8	35	88	75 - 125
7444172	Total Lead (Pb)	2014/04/09	90	75 - 125	98	75 - 125	ND, RDL=0.0020	mg/kg	NC	35		
7444172	Total Manganese (Mn)	2014/04/09	NC	75 - 125	103	75 - 125	ND, RDL=0.020	mg/kg	8.4	35	95	75 - 125
7444172	Total Mercury (Hg)	2014/04/09	86	75 - 125	119	75 - 125	ND, RDL=0.0020	mg/kg	NC	35	129 (1, 2)	75 - 125
7444172	Total Nickel (Ni)	2014/04/09	96	75 - 125	106	75 - 125	ND, RDL=0.010	mg/kg	NC	35	62	58 - 126
7444172	Total Selenium (Se)	2014/04/09	100	75 - 125	101	75 - 125	ND, RDL=0.010	mg/kg	NC	35	129 (1, 2)	75 - 125
7444172	Total Silver (Ag)	2014/04/09	72 (1)	75 - 125	78	75 - 125	ND, RDL=0.0040	mg/kg	NC	35		
7444172	Total Strontium (Sr)	2014/04/09	90	75 - 125	96	75 - 125	ND, RDL=0.020	mg/kg	7.1	35	94	75 - 125
7444172	Total Thallium (Tl)	2014/04/09	97	75 - 125	96	75 - 125	ND, RDL=0.00040	mg/kg	NC	35		
7444172	Total Uranium (U)	2014/04/09	90	75 - 125	94	75 - 125	ND, RDL=0.00040	mg/kg	NC	35		
7444172	Total Vanadium (V)	2014/04/09	95	75 - 125	101	75 - 125	ND, RDL=0.040	mg/kg	NC	35		
7444172	Total Zinc (Zn)	2014/04/09	NC	75 - 125	104	75 - 125	0.047, RDL=0.040	mg/kg	22.5	35	81	75 - 125
7444172	Total Aluminum (Al)	2014/04/09					ND, RDL=0.20	mg/kg	NC	35	30	20 - 93
7444172	Total Antimony (Sb)	2014/04/09					ND, RDL=0.0010	mg/kg	NC	35	101	75 - 125
7444172	Total Boron (B)	2014/04/09					ND, RDL=0.40	mg/kg	NC	35	88	75 - 125
7444172	Total Iron (Fe)	2014/04/09					ND, RDL=10	mg/kg	NC	35	80	75 - 125
7444172	Total Magnesium (Mg)	2014/04/09					ND, RDL=2.0	mg/kg	27.7	35	82	75 - 125
7444172	Total Molybdenum (Mo)	2014/04/09					ND, RDL=0.010	mg/kg	NC	35	88	75 - 125
7444172	Total Sodium (Na)	2014/04/09					ND, RDL=2.0	mg/kg	NC	35	78	75 - 125
7444172	Total Bismuth (Bi)	2014/04/09					ND, RDL=0.020	mg/kg	NC	35		
7444172	Total Calcium (Ca)	2014/04/09					ND, RDL=2.0	mg/kg	0.2	35		
7444172	Total Phosphorus (P)	2014/04/09					ND, RDL=2.0	mg/kg	23.7	35		
7444172	Total Potassium (K)	2014/04/09					ND, RDL=2.0	mg/kg	5.7	35		
7444172	Total Tin (Sn)	2014/04/09					ND, RDL=0.020	mg/kg	NC	35		
7444172	Total Titanium (Ti)	2014/04/09					ND, RDL=0.20	mg/kg	NC	35		
7444329	Total Arsenic (As)	2014/04/12	101	75 - 125	103	75 - 125	ND, RDL=0.010	mg/kg	NC	35	109	75 - 125
7444329	Total Barium (Ba)	2014/04/12	NC	75 - 125	102	75 - 125	ND, RDL=0.020	mg/kg	3.6	35	77	75 - 125
7444329	Total Beryllium (Be)	2014/04/12	102	75 - 125	106	75 - 125	ND, RDL=0.020	mg/kg	NC	35		
7444329	Total Cadmium (Cd)	2014/04/12	104	75 - 125	108	75 - 125	ND, RDL=0.0020	mg/kg	NC	35	79	75 - 125
7444329	Total Chromium (Cr)	2014/04/12	101	75 - 125	105	75 - 125	ND, RDL=0.040	mg/kg	NC	35		
7444329	Total Cobalt (Co)	2014/04/12	104	75 - 125	106	75 - 125	ND, RDL=0.0040	mg/kg	NC	35	77	75 - 125
7444329	Total Copper (Cu)	2014/04/12	NC	75 - 125	103	75 - 125	ND, RDL=0.050	mg/kg	0.2	35	79	75 - 125

Maxxam Job #: B424729
Report Date: 2014/04/16

Success Through Science®

Pinchin LeBlanc Environmental
Client Project #: BASELINE COUNTRY FOODS ASSESSM
Site Location: LABRADOR CITY, NL
Your P.O. #: 4700058846
Sampler Initials: ROK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7444329	Total Lead (Pb)	2014/04/12	100	75 - 125	100	75 - 125	ND, RDL=0.0020	mg/kg	NC	35		
7444329	Total Manganese (Mn)	2014/04/12	NC	75 - 125	107	75 - 125	ND, RDL=0.020	mg/kg	2.3	35	85	75 - 125
7444329	Total Mercury (Hg)	2014/04/12	100	75 - 125	105	75 - 125	ND, RDL=0.0020	mg/kg	NC	35	98	75 - 125
7444329	Total Nickel (Ni)	2014/04/12	102	75 - 125	106	75 - 125	ND, RDL=0.010	mg/kg	5.9	35	61	58 - 126
7444329	Total Selenium (Se)	2014/04/12	103	75 - 125	112	75 - 125	ND, RDL=0.010	mg/kg	NC	35	133(1, 2)	75 - 125
7444329	Total Silver (Ag)	2014/04/12	84	75 - 125	78	75 - 125	ND, RDL=0.0040	mg/kg	NC	35		
7444329	Total Strontium (Sr)	2014/04/12	108	75 - 125	98	75 - 125	ND, RDL=0.020	mg/kg	11.9	35	85	75 - 125
7444329	Total Thallium (Tl)	2014/04/12	110	75 - 125	89	75 - 125	ND, RDL=0.00040	mg/kg	NC	35		
7444329	Total Uranium (U)	2014/04/12	104	75 - 125	104	75 - 125	ND, RDL=0.00040	mg/kg	NC	35		
7444329	Total Vanadium (V)	2014/04/12	102	75 - 125	106	75 - 125	ND, RDL=0.040	mg/kg	NC	35		
7444329	Total Zinc (Zn)	2014/04/12	NC	75 - 125	115	75 - 125	0.042, RDL=0.040	mg/kg	2.0	35	76	75 - 125
7444329	Total Aluminum (Al)	2014/04/12					ND, RDL=0.20	mg/kg	3.5	35	26	20 - 93
7444329	Total Antimony (Sb)	2014/04/12					ND, RDL=0.0010	mg/kg	NC	35	86	75 - 125
7444329	Total Boron (B)	2014/04/12					ND, RDL=0.40	mg/kg	NC	35	82	75 - 125
7444329	Total Iron (Fe)	2014/04/12					ND, RDL=10	mg/kg	NC	35	80	75 - 125
7444329	Total Magnesium (Mg)	2014/04/12					ND, RDL=2.0	mg/kg	0.3	35	83	75 - 125
7444329	Total Molybdenum (Mo)	2014/04/12					ND, RDL=0.010	mg/kg	NC	35	79	75 - 125
7444329	Total Sodium (Na)	2014/04/12					ND, RDL=2.0	mg/kg	NC	35	88	75 - 125
7444329	Total Bismuth (Bi)	2014/04/12					ND, RDL=0.020	mg/kg	NC	35		
7444329	Total Calcium (Ca)	2014/04/12					ND, RDL=2.0	mg/kg	0.2	35		
7444329	Total Phosphorus (P)	2014/04/12					ND, RDL=2.0	mg/kg	1	35		
7444329	Total Potassium (K)	2014/04/12					ND, RDL=2.0	mg/kg	0.3	35		
7444329	Total Tin (Sn)	2014/04/12					ND, RDL=0.020	mg/kg	NC	35		
7444329	Total Titanium (Ti)	2014/04/12					ND, RDL=0.20	mg/kg	NC	35		
7445482	Moisture	2014/04/09					ND, RDL=0.30	%	0.3	20		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) - Reference outside acceptance criteria (10% of analytes failure allowed).

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Validation Signature Page

Maxxam Job #: B424729

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Rob Reinert, Data Validation Coordinator

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Ph: (604) 734-7276 Fax: (604) 731-2386, Toll Free: (800) 665-8566

CHAIN OF CUSTODY RECORD

Maxxam Job #: B424729

COC Click here to get the COC number 08391185

Invoice To: Require Report? Yes ☑ No ☐

Invoice To		Report To	
Company Name:	Iron Ore Company of Canada	Company Name:	IOC / Pinchin LeBlanc Environmental
Contact Name:	IOC Accounts Payable	Contact Name:	Callie Andrews / Ross O'Keefe
Address:	1 Rue Retty	Address:	2 Avalon Drive
	Sept Iles, QC PC: G4R 3C7		Labrador City, NL PC: A2V 2Y6
Phone / Fax#:	Ph: 418-968-7400 Fax:	Phone / Fax#:	Ph: 709-944-8400 Fax:
E-mail		E-mail	callie.andrews@riotinto.com / rokeefe@pinchinleblanc.com

PO #:	4700058846
Quotation #:	
Project # :	
Proj. Name:	Baseline Country Foods Assessment
Location:	Labrador City, NL
Sampled by:	ROK / WT/ MW/ DG

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

- ◉ Regular Turn Around Time (TAT) (5 days for most tests)
- **RUSH** (Please contact the lab) ○ 1 Day ○ 2 Day ○ 3 Day
- Date Required:

SPECIAL INSTRUCTIONS:

Return Cooler ☑ **Ship Sample Bottles (please specify)** ☐

Please use analysis method CRC-ICPMS metals.

ANALYSIS REQUESTED

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) — Field Filtered? Y/N	Field Acidified? Y/N	Total Metals — Field Acidified? Y/N	Please Analyse for total metals wet weight	Number of Containers
1	W3-BB-01	JE3950	Plant	13/09/12				X	
2	W3-BB-02	JE3951	Plant	13/09/12				X	
3	W3-BB-03	JE3952	Plant	13/09/12				X	
4	W3-BB-04	JE3953	Plant	13/09/12				X	
5	W3-BB-05	JE3954	Plant	13/09/15				X	
6	W3-BB-06	JE3955	Plant	13/09/15				X	
7	W3-BB-07	JE3956	Plant	13/09/12				X	
8	W3-BB-16	JE3957	Plant	13/09/12				X	
9	W3-PB-01	JE3958	Plant	13/09/12				X	
10	W3-PB-02	JE3959	Plant	13/09/12				X	
11	W3-PB-03	JE3960	Plant	13/09/12				X	
12	W3-PB-04	JE3961	Plant	13/09/12				X	

B424729

*Relinquished By: (Print name and sign)	Date (yy/mm/dd):	Time (24hr):	Received by : (Print name and sign)	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive
Wanda Taylor	14/03/26	08:00	[signature]	14/03/28	~~09:3~~ 2014/03/28	☐
[signature]						

Laboratory Use Only

Temperature on Receipt (°C)	Custody Seal	Yes	No
A) B) C)	Present?	☐	☑
Just sampled & rec'd on ice: ☐	Intact?	☐	☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORDS. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

BBY FCD-00077R2_C

Maxxam Analytics Success Through Science © 09:10

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CHAIN OF CUSTODY RECORD

Maxxam

Maxxam Job #: B3-B424729 COC # 08391186

Page: 2 of 3

Invoice To: Require Report? Yes ☑ No ☐

Company Name:	Iron Ore Company of Canada
Contact Name:	IOC Accounts Payable
Address:	1 Rue Retty
	Sept Iles, QC PC: G4R 3C7
Phone / Fax#:	Ph: 418-968-7400 Fax:
E-mail	

Report To:

Company Name:	IOC / Pinchin LeBlanc Environmental
Contact Name:	Callie Andrews / Ross O'Keefe
Address:	2 Avalon Drive
	Labrador City, NL PC: A2V 2Y6
Phone / Fax#:	Ph: 709-944-8400 Fax:
E-mail	callie.andrews@riotinto.com / rokeefe@pinchinleblanc.com

PO #:	4700058846
Quotation #:	
Project # :	
Proj. Name:	Baseline Country Foods Assessment
Location:	Labrador City, NL
Sampled by:	ROK / WT/ MW/ DG

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

- ◉ Regular Turn Around Time (TAT) (5 days for most tests)
- **RUSH** (Please contact the lab) ◯ 1 Day ◯ 2 Day ◯ 3 Day
- Date Required:

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Please use analysis method CRC-ICPMS metals.

ANALYSIS REQUESTED

	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Field Filtered? Y/N — Dissolved Metals (DM)	Field Acidified? Y/N	Field Acidified? Y/N — Total Metals	Please Analyse for total metals wet weight	Number of Containers
1	W3-PB-05	JE3965	Plant	13/09/13				X	
2	W3-PB-06	JE3966	Plant	13/09/13				X	
3	W3-PB-07	JE3967	Plant	13/09/13				X	
4	W3-PB-08	JE3968	Plant	13/09/13				X	
5	W3-PB-09	JE3969	Plant	13/09/15				X	
6	W3-PB-10	JE3970	Plant	13/09/16				X	
7	W3-PB-11	JE3971	Plant	13/09/16				X	
8	W3-PB-16	JE3972	Plant	13/09/13				X	
9	W3-SB-01	JE3973	Plant	13/09/13				X	
10	W3-SB-02	JE3974	Plant	13/09/15				X	
11	W3-SB-03	JE3975	Plant	13/09/15				X	
12	W3-SB-04	JE3976	Plant	13/09/15				X	

B424729

*Relinquished By: (Print name and sign)	Date (yy/mm/dd):	Time (24hr):	Received by : (Print name and sign)	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive
Wanda Taylor	14/03/26	08:00	S. CHRISWONG	14/03/28	09:10	☐
Wanda Taylor (signature)						

Laboratory Use Only

Temperature on Receipt (°C)			Custody Seal	Yes	No
A)	B)	C)	Present?	☐	☑
Just sampled & rec'd on ice: ☐			Intact?	☐	☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORDS. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

BBY FCD-00077R2_C

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CHAIN OF CUSTODY RECORD

Maxxam Job #: B424729 **COC #:** 08391187 Page: 3 of 3

Invoice To: Require Report? Yes ☑ No ☐

Company Name:	Iron Ore Company of Canada
Contact Name:	IOC Accounts Payable
Address:	1 Rue Retty
	Sept Iles, QC PC: G4R 3C7
Phone / Fax#:	Ph: 418-968-7400 Fax:
E-mail	

Report To:

Company Name:	IOC / Pinchin LeBlanc Environmental
Contact Name:	Callie Andrews / Ross O'Keefe
Address:	2 Avalon Drive
	Labrador City, NL PC: A2V 2Y6
Phone / Fax#:	Ph: 709-944-8400 Fax:
E-mail	callie.andrews@riotinto.com / rokeefe@pinchinleblanc.com

PO #:	4700058846
Quotation #:	
Project # :	
Proj. Name:	Baseline Country Foods Assessment
Location:	Labrador City, NL
Sampled by:	ROK / WT/ MW/ DG

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☐ Other ____
- ☐ DRINKING WATER

SERVICE REQUESTED:

- ◉ Regular Turn Around Time (TAT) (5 days for most tests)
- **RUSH** (Please contact the lab) ○ 1 Day ○ 2 Day ○ 3 Day
- Date Required:

SPECIAL INSTRUCTIONS:

Return Cooler ☑ **Ship Sample Bottles (please specify)** ☐

Please use analysis method CRC-ICPMS metals.

ANALYSIS REQUESTED

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) (Field Filtered? Y/N; Field Acidified? Y/N)	Total Metals (Field Acidified? Y/N)	Please Analyse for total metals wet weight	Number of Containers
1	W3-SB-05	JE3983	Plant	13/09/15			X	
2	W3-SB-06	JE3984	Plant	13/09/15			X	
3	W3-SB-07	JE3985	Plant	13/09/16			X	
4	W3-SB-08	JE3986	Plant	13/09/16			X	
5	W3-SB-09	JE3987	Plant	13/09/25			X	
6	W3-SB-10	JE3988	Plant	13/09/25			X	
7	W3-SB-16	JE3989	Plant	13/09/15			X	
8								
9								
10								
11								
12								

B424729

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by :	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive
Wanda Taylor	14/03/26	08:00	Chris Wong	14/03/28	09:10	☐

Laboratory Use Only

Temperature on Receipt (°C)	Custody Seal	Yes	No
A) B) C)	Present?	☐	☑
Just sampled & rec'd on ice: ☐	Intact?	☐	☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORDS. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

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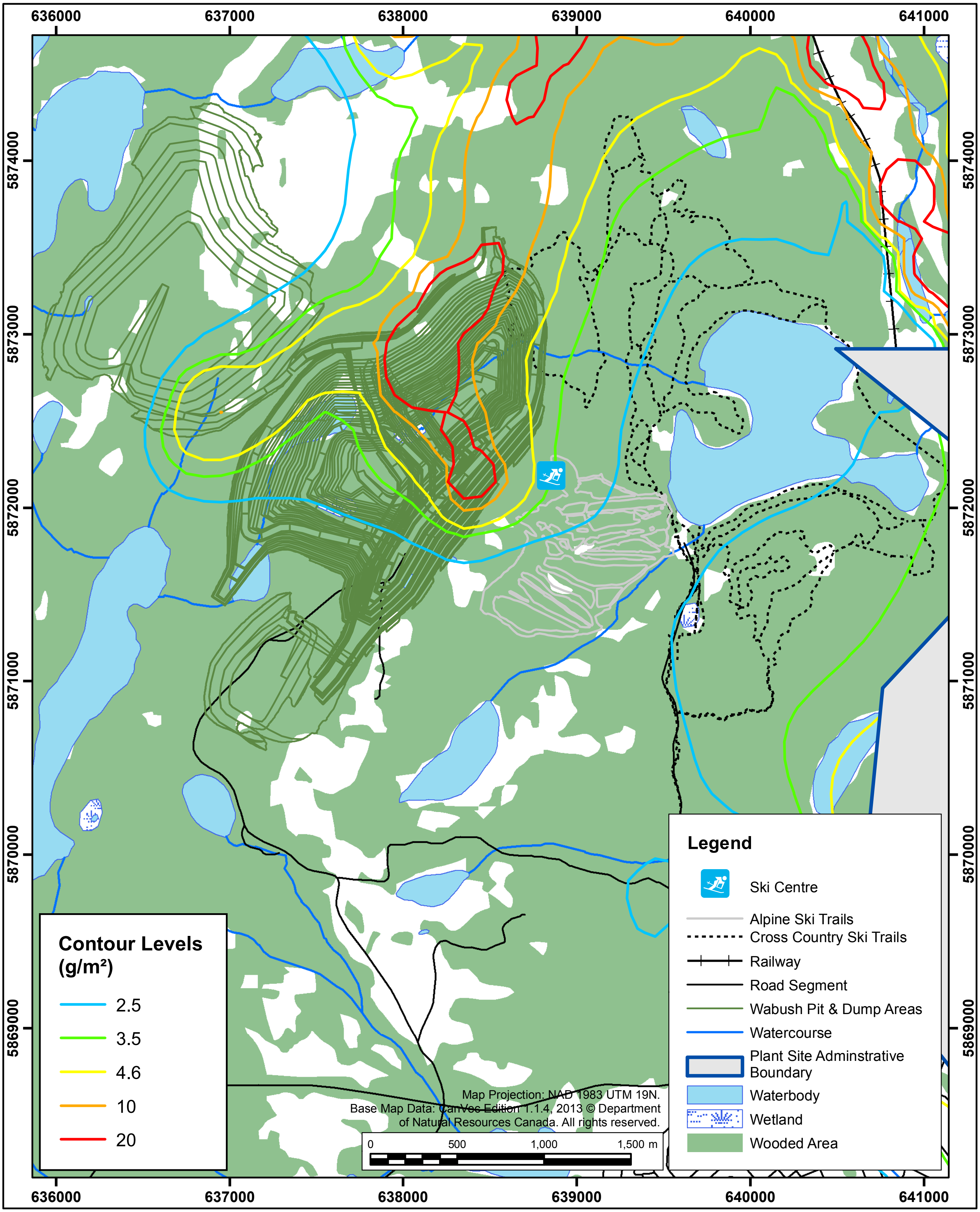


Dustfall - Annual Averaging Period

Future Build Scenario

POI Limit = 4.6 g/m²/30 Days for an Averaging Period of 1 Year

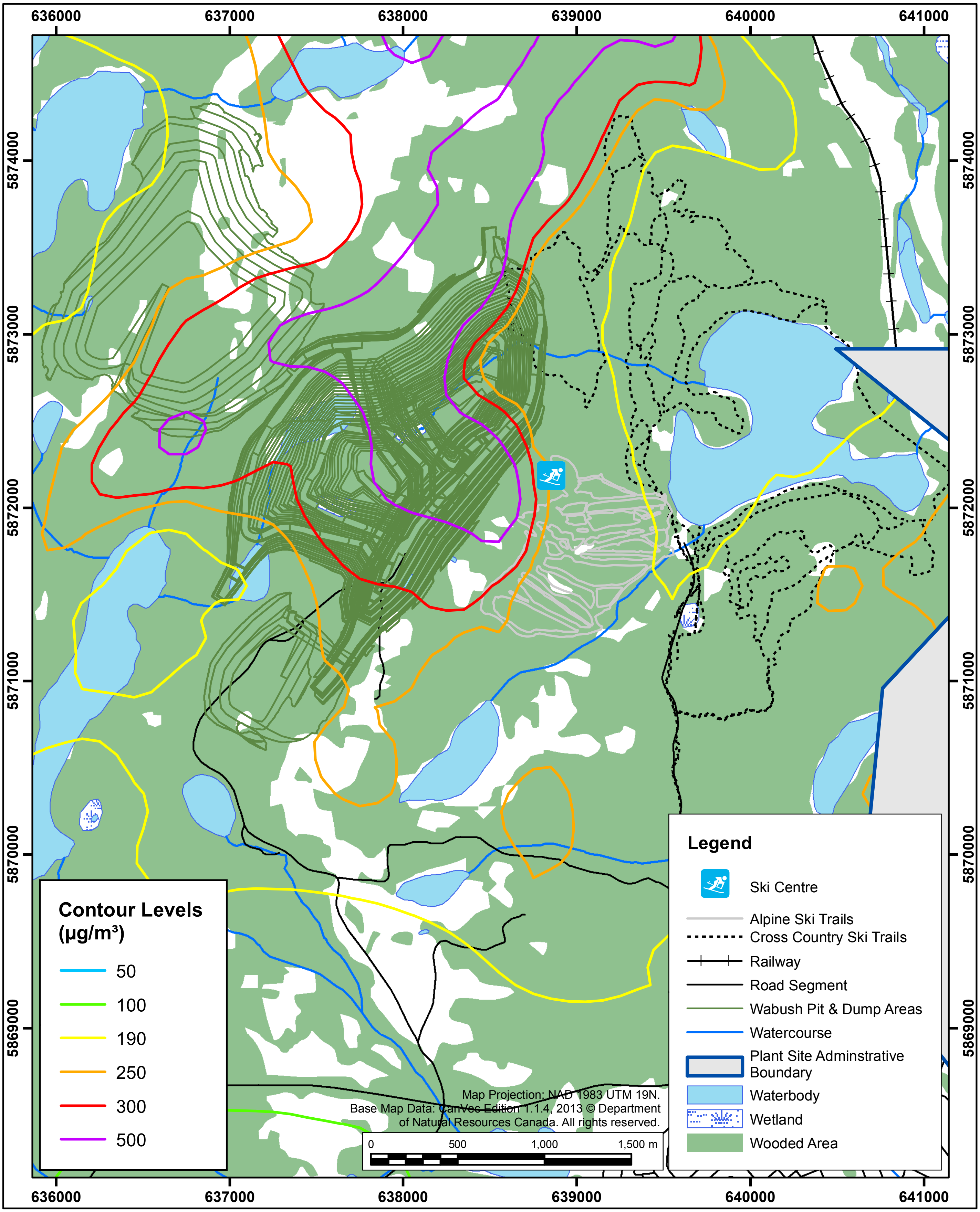
Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

True North

Project #1400675

Drawn by:	NBN	Figure:	
Approx. Scale:	1:30,000		
Date Revised:	Apr. 29, 2014		

RWDI



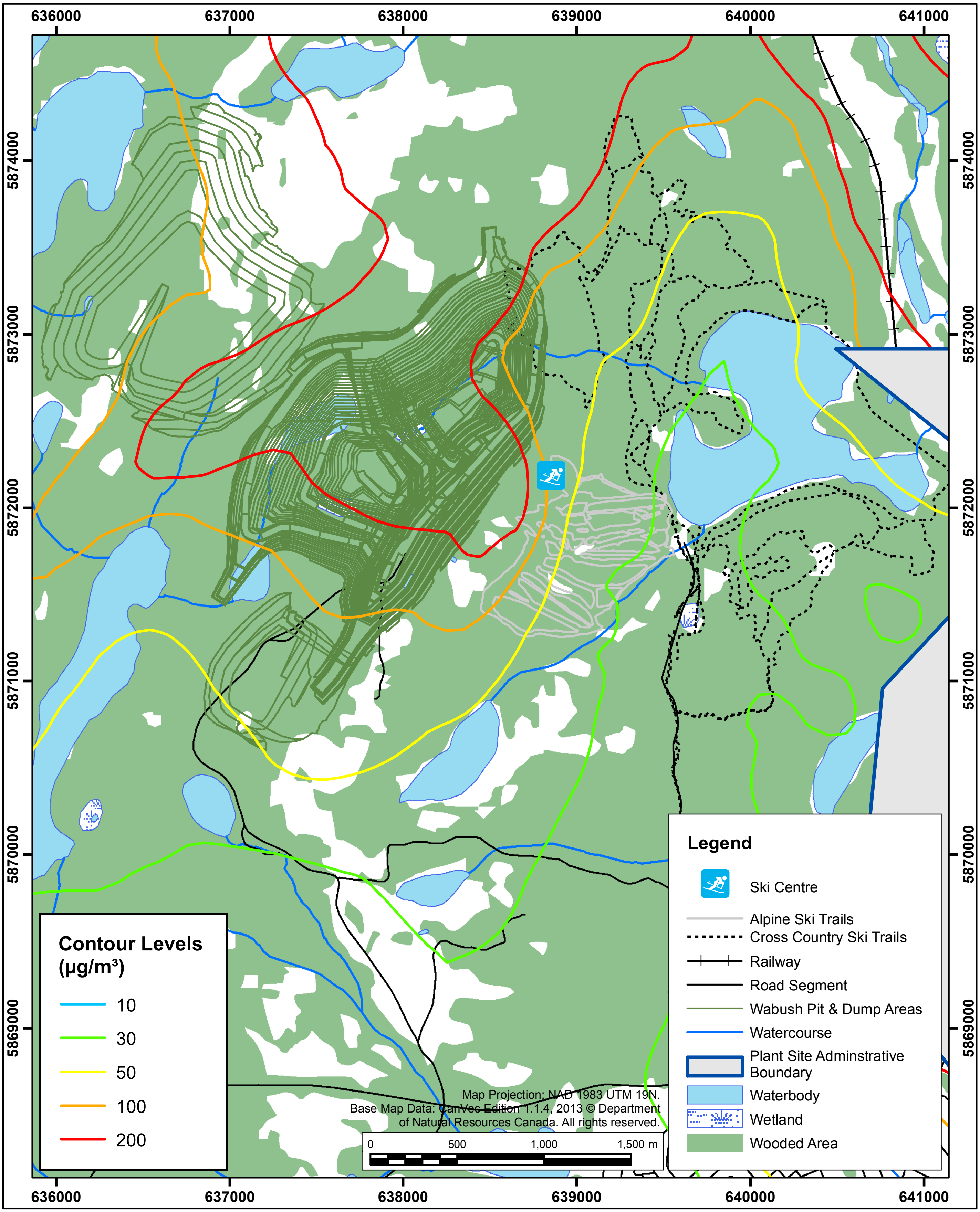
Nitrogen Dioxide - 98th Percentile Daily Maximum
1 Hour Averaging Period
Future Build Scenario

Guideline = 190 µg/m³, Averaged Over 3 Years (US EPA)
Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

Project #1400675

Drawn by: NBN	Figure:
Approx. Scale:	1:30,000
Date Revised:	Apr. 30, 2014

RWDI



PM10 - 24 Hour Averaging Period

Future Build Scenario

POI Limit = 50 µg/m³

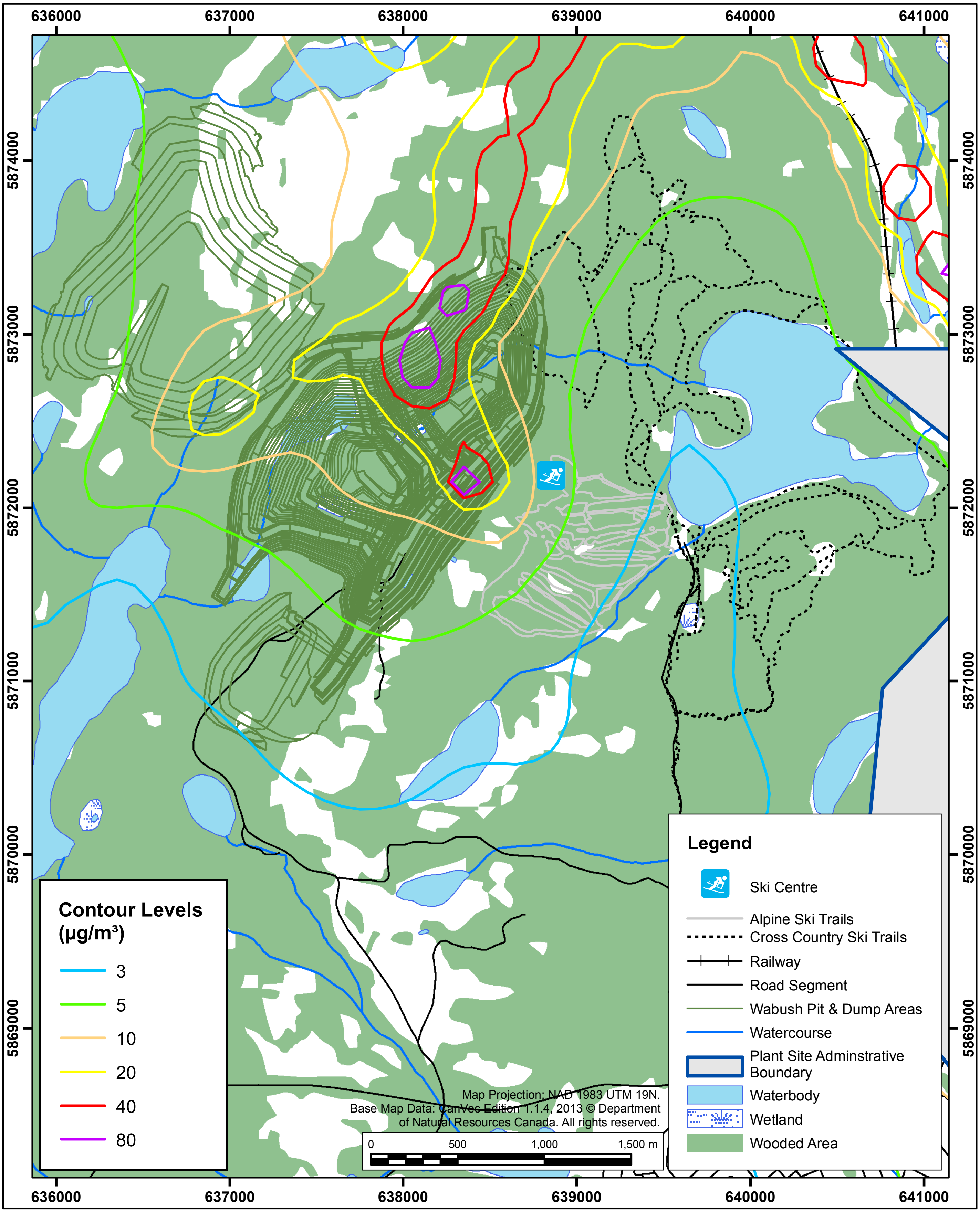
Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

True North

Project #1400675

Drawn by: NBN	Figure:
Approx. Scale:	1:30,000
Date Revised:	Apr. 29, 2014

RWDI



PM_{10} - Arithmetic Annual Average

Future Build Scenario

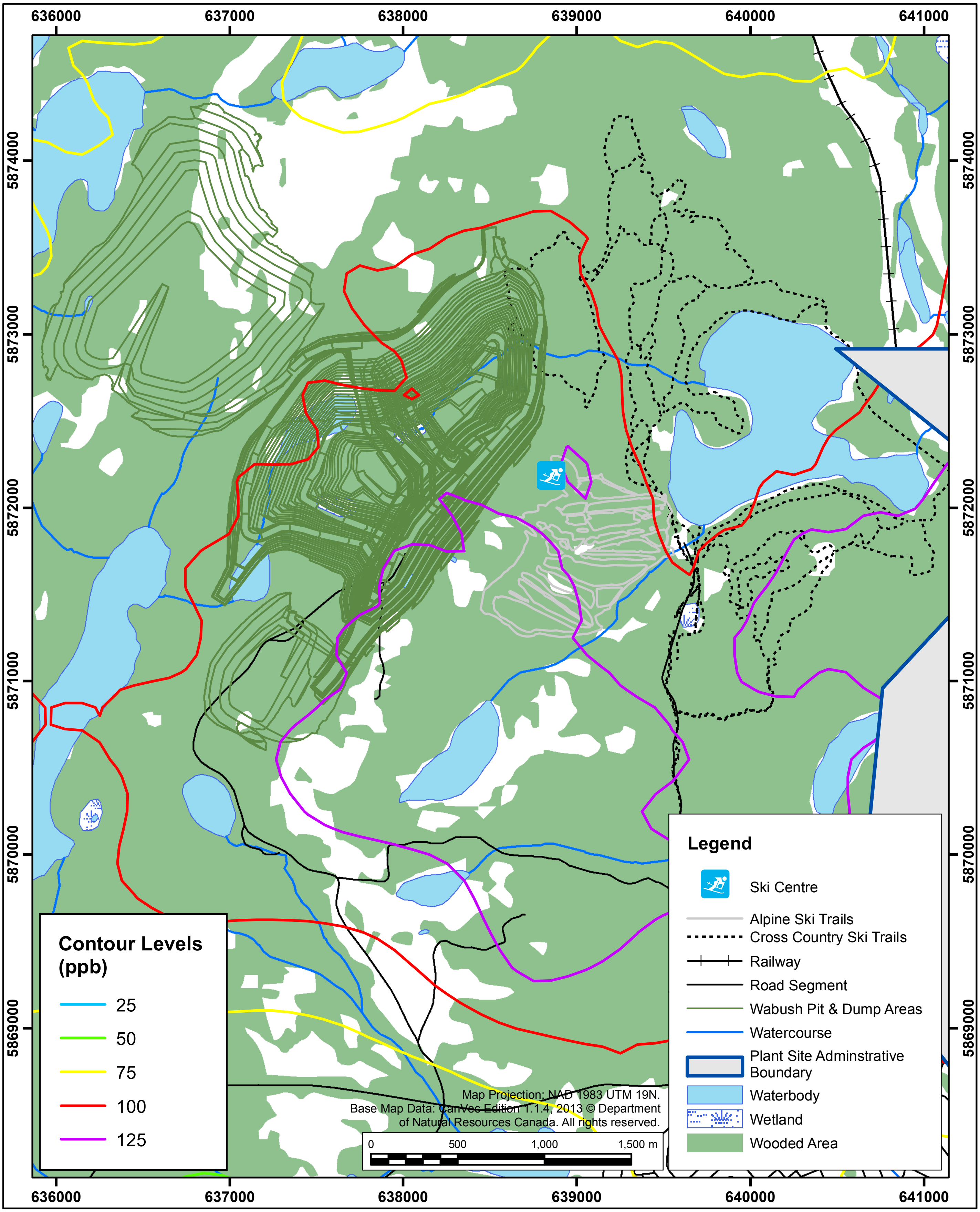
Guideline = 20 µg/m³ (WHO)

Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

True North

Project #1400675

Drawn by: NBN	Figure:	RWDI
Approx. Scale:	1:30,000	
Date Revised:	Apr. 30, 2014	



Sulphur Dioxide - 99th Percentile Daily Maximum
1 Hour Averaging Period
Future Build Scenario

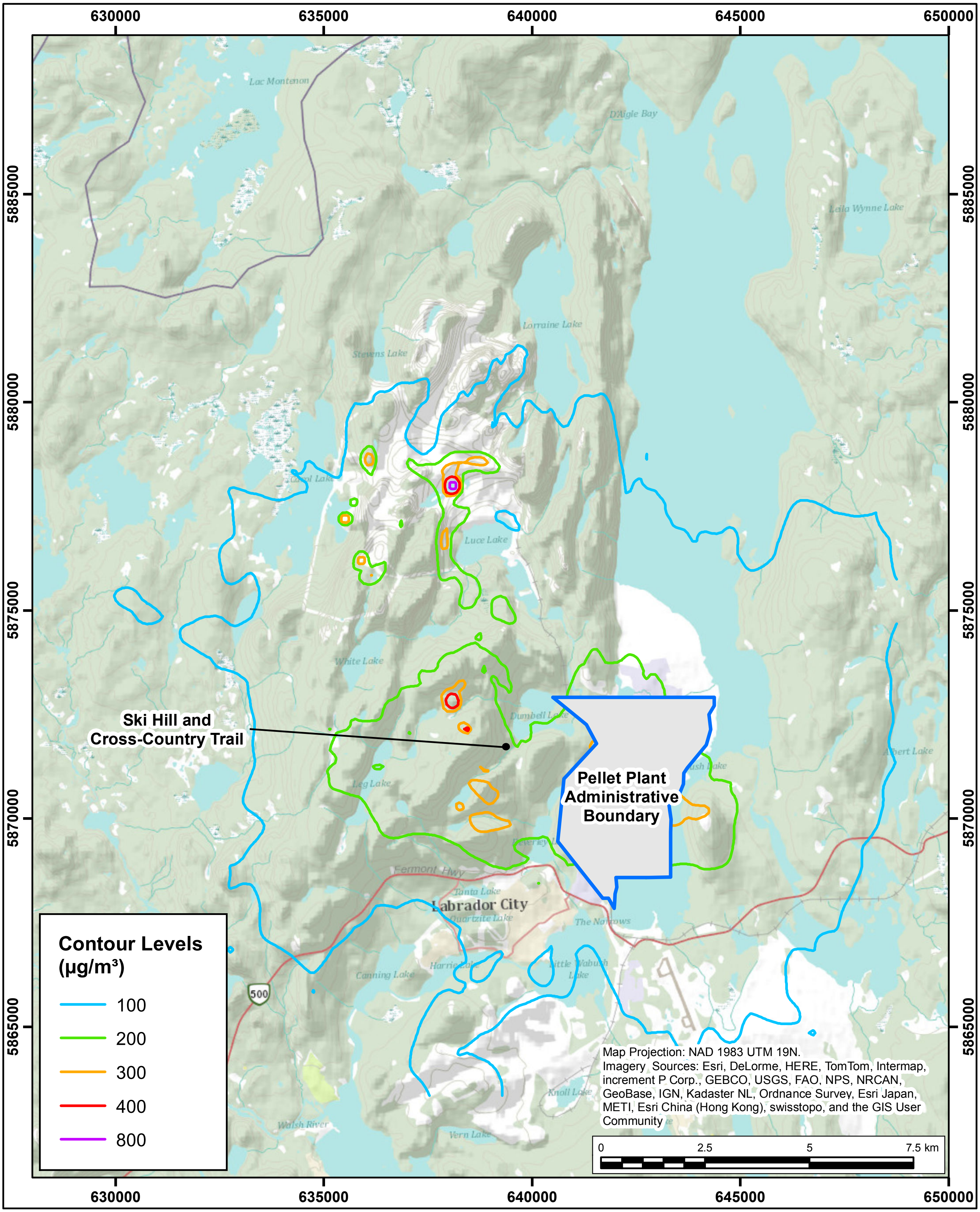
Guideline = 75 ppb, Averaged Over 3 Years (US EPA)
Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

True North

Project #1400675

Drawn by:	NBN	Figure:	
Approx. Scale:	1:30,000		
Date Revised:	Apr. 30, 2014		

RWDI



Carbon Monoxide - 1 Hour Averaging Period

Future Build Scenario

POI Limit = 35,000 µg/m³

Iron Ore Company of Canada - Labrador City, Newfoundland and Labrador

True North

Project #1400675

Drawn by: NBN	Figure:	RWDI
Approx. Scale:	1:125,000	
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APPENDIX C

SAMPLE DATA AND DATA TREATMENT USED IN MODELLING

C-1.0 INTRODUCTION

This appendix describes the environmental sample data used to estimate baseline exposures to chemicals of potential concern (COPC) in the human health risk assessment (HHRA) for the proposed Wabush 3 Project. This appendix presents summary statistics for the following media:

- COPC in soil and berries collected as part of the baseline sampling program for the Project.
- COPC in surface water samples collected as part of the baseline sampling program from lakes in the vicinity of the Project.
- COPC in drinking water source water samples collected as part of the regular monitoring program for the existing IOC mine.

Summary statistics include the average, standard deviation (St Dev), minimum value (Min), maximum value (Max), 95^{th} percentile, and upper 95 percent confidence limit on the mean (95UCLM). These statistical parameters were used to describe the distribution of measured baseline environmental data. In cases where the chemical concentrations were non-detect, a proxy value equal to the method detection limit (MDL) was used to calculate the summary statistics.
The summary statistics provided in the following sections were used in the HHRA model to estimate baseline concentrations of metals in environmental media for the HHRA. This appendix will provide an overview of the methodologies used to analyze the collected sample data and the results following the analyses.

A worked example of the equations used in the exposure modelling is provided in Appendix D.

C-2.0 SUMMARY STATISTIC SELECTION

The 95th upper confidence limit on the mean (95UCLM) was selected when there were sufficient data (i.e., sample size greater than 10 with less than 80% of the samples below analytical detection limits). The 95UCLM value was based on ProUCL Software (US EPA 2011), a statistical software program that computes summary statistics and upper limits for parametric and non-parametric methods. The 95UCLM selected from the ProUCL software is the recommended statistic to use identified by the software based on the data distribution and the statistical method. If insufficient data were available for the calculation of the 95UCLM, but the data set included at least one detected value greater than the MDL, the maximum measured concentration was assumed.

When the proportion of non-detectable results exceeded 60 to 80% of the data, Alberta Environment and Sustainable Resource Development (ESRD 2006) and Helsel (2005) both state that any statistical analysis is likely to result in unacceptably high error rates. As a result, the 95UCLM was not calculated in the following circumstances:

- When sample sizes were less than 10; or
- When greater than 80% of the chemical concentrations were non-detect (i.e., less than 20% were detected above the MDL).

Table C-1 provides the method used in the HHRA for selecting concentration summary statistics.

Table C-1 Method for Selecting Summary Statistics

% Non-detects	**Amount of Available Data**	
	< 10 Samples available	**≥ 10 Samples available**
≤ 80%	Maximum concentration used	95UCLM used
>80% but <100%	Maximum concentration used	Maximum concentration used
100%	Predicted concentration used(1)	Predicted concentration used(1)

Notes:
1) Predicted concentration must be lower than detection limit or the concentration assumed to be equal to MDL will be selected.

C-3.0 SAMPLING DATA

The sampling data used for the Project included soil, berries, surface water and drinking water. The following sections provide brief descriptions of the sampling data for the various environmental media in relation to the Project.

C-3.1 Chemical Concentrations Analyzed in Soil in All Sampling Locations

A total of 54 soil samples were collected from the Project area in June 2012 and September 2013. These samples were analyzed for metal concentrations, pH and percent moisture. Six field duplicates were also collected. Duplicate samples were adjusted such that the higher measured concentration between the duplicate and the original samples was used to calculate the summary statistics for each of the chemicals. Summary statistics for the analyses of metals in soil are presented in Table C-2. Raw soil data for 2012 are presented in AMEC (2012) while the 2013 raw soil data are presented in Appendix B.

Table C-2 Summary Statistics of Metal Concentrations in Soil Samples (mg/kg)

Chemical	Average	Standard Deviation	Min	Max	Count	95th Percentile	# of Non-Detect	% Non-Detect	95UCLM
Aluminum	1.1E+04	7.0E+03	1.3E+03	4.1E+04	54	2.1E+04	0	0%	1.3E+04
Chromium	4.7E+01	2.9E+01	5.9E+00	1.4E+02	54	1.0E+02	0	0%	5.4E+01
Iron	6.0E+04	3.9E+04	1.5E+04	2.0E+05	54	1.4E+05	0	0%	8.4E+04
Manganese	1.5E+03	2.1E+03	1.2E+02	1.3E+04	54	4.2E+03	0	0%	1.9E+03
Titanium	7.8E+02	5.8E+02	1.3E+02	3.0E+03	28	1.5E+03	0	0%	9.7E+02

Note: Values rounded to 2 significant figures.

C-3.2 Chemical Concentrations in Berries

A total of 28 berry samples (and 3 duplicate samples) were collected from the Project area in September 2013, including seven blueberry, 11 partridgeberry and 10 squash berry samples. A duplicate samples was also collected for each of the berry types. These samples were analyzed for metals (in wet weight) and percent moisture. Duplicate samples were adjusted such that the higher measured concentrations between the duplicate and the original sample was used to calculate the summary statistic for each of the chemicals. The summary statistics for the analyses of metals in berries are presented in Table C-3.

Table C-3 Summary Statistics of Metal Concentrations in Berry Samples (mg/kg wet weight)

Chemical	Average	Standard Deviation	Min	Max	Count	95th Percentile	# of Non-Detect	% Non-Detect	95UCLM
Aluminum	3.3	2.4	0.41	8.12	28	7.1	0	0%	4.4
Chromium	--	--	<0.04	<0.04	28	--	28	100%	--
Iron	15	14	10	79	28	34	12	43%	20
Manganese	50	48	0.441	154	28	140	0	0%	110
Titanium	--	--	0.2	0.44	28	0.40	23	82%	--
% Moisture	85.75	2.20	80	88	28	--	--	--	--

Note:
Wet weight (ww) sample results were converted to dry weight (dw) values (for use in the HHRA modelling) but using the following equation: dw = ww / (1 - % moisture).
Average, standard deviation and UCLM were not calculated for chromium and titanium, due to the number of non-detects

Soil-to-plant bioconcentration factors (BCFs) were also calculated for the berry samples by dividing the metal concentrations measured in the berry samples by the metal concentrations measured in the soil samples collected from the corresponding sampling locations.

$$BCF = \frac{Concentration\ in\ berries}{Concentration\ in\ soil}$$

The average of the BCFs for each of the metals was then calculated and used for the BCF values in the exposure model. Table C-4 presents the BCF values.

Table C-4 Average BCF Values for Metal Concentrations in Berry Samples

Chemical	BCF
Aluminum	7.3E-04
Chromium	--
Iron	2.8E-04
Manganese	1.0E-01
Titanium	6.2E-04

C-3.3 Chemical Concentrations Analyzed in Surface Water

A total of 10 surface water samples were collected from Leg Lake, Trout Lake, Dumbell Lake and the Dumbell Lake Discharge from August 2011 to October 2013. These samples were analyzed for total metal concentrations. Data from these samples were used to characterize baseline surface water quality for the Project's study area. Summary statistics for metal concentrations in lakes from the Project area are presented in Table C-5.

Table C-5 Summary Statistics of Total Metal Concentrations in Surface Water [mg/L]

Chemical	Average	Standard Deviation	Min	Max	Count	95^{th} Percentile	# Non-Detect	% Non-Detect	95UCLM
Aluminum	1.8E-02	9.1E-03	0.01	0.0418	10	3.2E-02	1	10%	2.3E-02
Chromium	--	--	<0.001	<0.001	10	--	10	100%	--
Iron	5.8E-02	1.1E-02	0.05	0.083	10	7.7E-02	4	40%	6.6E-02
Manganese	8.8E-03	5.0E-03	0.0039	0.0207	10	1.7E-02	0	0%	1.2E-02
Titanium	2.1E-03	1.6E-04	0.002	0.0024	9	2.4E-03	7	78%	--

Average, standard deviation and UCLM were not calculated for chromium, due to the number of non-detects; for titanium, a UCLM could not be calculated due to the number of non-detects

C-3.4 Chemical Concentrations Analyzed in Drinking Water

A total of seven water samples from drinking water source water were collected from the North Pond of Beverley Lake from July 2012 to October 2013. These samples were analyzed for metal concentrations. Data from these samples were used to characterize baseline drinking water quality for the Project. Summary statistics for metal concentrations in drinking water are presented in Table C-6.

Table C-6 Summary Statistics of Metal Concentrations in Drinking Water [mg/L]

Chemical	Average	Standard Deviation	Min	Max	Count	95th Percentile	# Non-Detect	% Non-Detect	95 UCLM
Aluminum	1.1E-02	3.3E-03	0.0056	0.015	7	1.5E-02	0	0%	--
Chromium	--	--	<0.001	<0.001	7	--	7	100%	--
Iron	8.6E-02	6.2E-02	0.05	0.22	7	1.8E-01	3	43%	--
Manganese	3.3E-02	2.2E-02	0.014	0.08	7	6.6E-02	0	0%	--
Titanium	2.0E-03	7.6E-05	0.002	0.0022	7	2.1E-03	6	86%	--

Notes: Average, standard deviation and UCLM were not calculated for some chemicals, due to the number of non-detects;

C-3.5 Summary of Sample Data

Exposure point concentrations for metals were used to represent baseline concentrations of COPCs in environmental media for the exposure model.

Table C-7 summarizes the baseline exposure point concentrations of COPCs in soil, berries, surface water and drinking water that were used in the HHRA.

Table C-7 Baseline Metal Concentrations in Soil, Berries, Surface Water and Drinking Water Used in the Multiple Pathway Exposure Assessment

Chemicals	Concentration Values Based on 95UCLM Unless Otherwise Noted			
	Soil [mg/kg dw]	Berries [mg/kg dw]	Surface Water [mg/L]	Drinking Water[1] [mg/L]
Aluminum	1.3E+04	4.4E+00	2.3E-02	1.5E-02
Chromium	5.4E+01	ND (<0.04)	ND (<0.001)	ND (<0.001)
Iron	8.4E+04	2.0E+01	6.6E-02	2.2E-01
Manganese	1.9E+03	1.1E+02	1.2E-02	8.0E-02
Titanium	9.7E+02	4.4E-01	2.4E-03[1]	2.2E-03

Notes:
[1] Based on maximum measured concentration
ND = Non-detect value (value in bracket is the detection limit)

C-4.0 REFERENCES

AMEC. 2012. Baseline surface soil survey for proposed Wabush 3 mine site Labrador City, Labrador. AMEC Environment and Infrastructure a Division of AMEC Americas Limited.

ESRD (Environment and Sustainable Resource Development). 2006. Guidelines for Quality Assurance and Quality Control in Surface Water Quality Programs in Alberta. July 2006.

Helsel, D.R. 2005. Nondetects and Data Analysis – Statistics for Censored Environmental Data. Wiley-Interscience, Denver, CO. 2005. pp.77-78.

US EPA. 2011. ProUCL Software version 4.00.05 for Environmental Applications for Data Sets with and without Nondetect Observations. Available at: http://www.epa.gov/osp/hstl/tsc/software.htm.

APPENDIX D

WORKED EXAMPLE

D-1.0 WORKED EXAMPLE

This worked example presents the methods that were used to predict environmental concentrations of aluminum in the Baseline + Future Build scenario. Similar methods were applied in other scenarios evaluated. This worked example assumed a project life of 40 years. Model work sheets are provided at the end of this worked example.

D-1.1 Predicted Chemical Concentrations in Soil

Soil concentrations were estimated based on the calculated chemical-specific deposition rates. Deposition to soil on a mass basis was calculated using the following equation:

$$D_s = \frac{D_{tot}}{Z_s \times BD}$$

Where:

D_s = chemical-specific deposition (mg/kg/yr)

D_{tot} = chemical-specific deposition rate (mg/m^2/yr)

Z_s = soil mixing zone depth (m)

BD = soil bulk density (kg/m^3)

For the current assessment, the bulk density was assumed to be 1,500 kg/m^3, and soil concentrations were predicted for two mixing depths (i.e., 2 cm and 20 cm) to calculate surface soil and soil concentrations, respectively.

Example 1 *Deposition of aluminum to surface soil for prediction of wildlife and human exposure*

$$D_s = \frac{5.67E+02}{0.02 \times 1{,}500}$$

$$D_s = 1.89E+01\ mg/kg/yr$$

Example 2 *Deposition of aluminum to soil for prediction of wildlife and human exposure*

$$D_s = \frac{5.67E+02}{0.2 \times 1{,}500}$$

$$D_s = 1.89E+00\ mg/kg/yr$$

Calculating Chemical Loss Constants

Organic chemicals may be lost from soil by leaching, runoff, erosion, biotic and abiotic degradation, and volatilization. Only abiotic and biotic degradation and volatilization processes were considered for this assessment. The total rate at which a chemical is lost from soil was designated as *kt*. A very long half-life was assumed (i.e., 73,000 days) for inorganic compounds to maximize accumulation of metals in the environment for a period of 40 years.

Chemical Loss via Biotic and Abiotic Degradation

The soil half-life values for abiotic and biotic degradation (i.e., ks) were obtained from the Canadian Council of Ministries of the Environment (CCME 2008), the US EPA OSW (2005) or literature, depending on the chemical. A soil loss constant (ks) of 0.00347 yrs^{-1}(i.e., 73,000 day half-life) was assumed for aluminum.

Total Soil Loss Constant

$$kt = ks + kv$$

Where:

kt = chemical-specific soil loss constant as a result of all processes (yrs^{-1})
ks = chemical-specific soil loss constant as a result of abiotic and biotic degradation (yrs^{-1})
kv = chemical-specific soil loss constant as a result of volatilization (yrs^{-1})

Example 3 Total soil loss constant as a result of all processes for aluminum

$$kt = 3.47E - 03 + 0$$

$$kt = 3.47E - 03\ yrs^{-1}$$

D-1.1 Chemical Concentrations in Dust

The chemical concentrations in dust were calculated using the measured and/or predicted soil concentration, as follows (Health Canada 2012):

$$C_{dust} = DL \times C_s \times CF$$

Where:

C_{dust} = chemical concentration in dust (µg/m³)
DL = dust level (kg/m³)
C_s = surface soil concentration from deposition over time (mg/kg)
CF = conversion factor from mg to µg (1,000 µg/mg)

A dust level (DL) of 0.76 µg/m³ (7.6E-10 kg/m³) was recommended by Health Canada (2012) based on the average airborne concentration of respirable particulate matter (<10 µm aerodynamic diameter).

Example 4 Concentration of formaldehyde in dust for the prediction of wildlife exposure

$$C_{dust} = 7.6E-10 \times 5.1E-08 \times 1{,}000$$

$$C_{dust} = 3.9E-14\ \mu g/m^3$$

D-1.1.1 Calculation of Soil Concentrations

Soil concentrations were calculated on a mass per mass basis (mg/kg) based on the following equation:

$$C_s = \frac{D_s \times [1 - \exp(-kt \times tD)]}{kt}$$

Where:

C_s	=	average soil concentration over exposure duration (mg/kg soil)
D_s	=	deposition to surface soil or soil (mg of chemical/kg of soil/yr)
kt	=	chemical soil loss constant due to all processes (degradation or loss due to volatilization) (yrs^{-1})
tD	=	time period over which deposition occurs (yrs)

The life of the Project is anticipated to be 40 years.

Example 5 Concentration of aluminum in surface soil for the prediction wildlife and human exposure

$$C_s = \frac{1.89E+01 \times [1 - \exp(-3.47E-03 \times 40)]}{3.47E-03}$$

$$C_s = 7.05E+02\ mg/kg$$

Example 6 Concentration of aluminum in soil the prediction of wildlife and human exposure

$$C_s = \frac{1.89E+00 \times [1 - \exp(-3.47E-03 \times 40)]}{3.47E-03}$$

$$C_s = 7.05E+01\ mg/kg$$

D-1.2 Chemical Concentrations in Fish

Fish concentrations were predicted only for the calculation of human exposure. The BCF value for aluminum was provided by US EPA OSW (2005).

The following equation was used to predict the chemical concentration in fish:

$$C_{fish} = C_{sw} \times BCF$$

Where:

C_{fish}	=	chemical concentration in fish (mg/kg WW)
C_{sw}	=	chemical concentration in surface water (mg/L)
BCF	=	surface water-to-fish bioconcentration factor (L water/kg fish WW)

Example 7 Concentration of aluminum in fish for the prediction of human exposure

$$C_{fish} = 0 \times 2.7$$

$$C_{fish} = 0\ mg/kg\ WW$$

D-1.3 Plant Concentrations

Concentrations in Plants as a Result of Root Uptake

Chemicals in soil can be taken up into edible portions of plants. The US EPA OSW (2005) provides an equation to predict above-ground plant concentrations as a result of root uptake using soil concentrations and plant-to-soil bioconcentration factors (BCFs).

The following equation was used to predict the chemical concentration in above-ground plants as a result of root uptake (US EPA OSW 2005).

$$\Pr = C_s \times BCF$$

Where:

Pr	=	chemical concentration in above-ground plant as a result of root uptake (mg/kg DW)
C_s	=	chemical concentration in soil (mg/kg)
BCF	=	plant-soil bioconcentration factor for above-ground produce (kg soil/kg plant DW)

Example 8 *Concentration of aluminum in plant as a result of root uptake for the prediction of wildlife exposure*

$$\Pr = 7.05E + 01 \times 7.26E - 04$$

$$\Pr = 5.12E - 02\ mg/kg\ DW$$

Concentrations in Plants as a Result of Deposition

The following equation was used to predict concentrations of plants for consumption by wildlife as a result of deposition processes on a dry weight (DW) basis (US EPA OSW 2005):

$$Pd = \frac{Dtot \times Rp \times [1.0 - \exp(-kp \times Tp)]}{Yp \times kp}$$

Where:

Pd = forage concentration as a result of direct deposition (mg/kg DW)
D_{tot} = chemical-specific deposition rate (mg/m²/yr)
Fv = fraction that is volatile (%)
Rp = intercept fraction of edible portions of plant (unitless)
kp = plant surface loss coefficient (yr^{-1})
Tp = length of plant exposure to deposition per harvest of the edible portion of the ith plant group (yr)
Yp = yield or productivity (kg DW/m²)

The US EPA OSW (2005) recommends the use of the default intercept fraction of edible portions of plant (*Rp*) value (unitless), because it represents the most current information available with respect to productivity and relative ingestion rates.

The *kp* value is a measure of the amount of chemical lost as a result of removal by wind and water and growth dilution. The US EPA OSW (2005) recommends a default *kp* value of 18 yr^{-1} for forage, which corresponds to a 14-day half-life.

The US EPA OSW (2005) recommends using a *Yp* value of 0.24 kg DW/m² for forage.

Example 9 *Concentration of aluminum in forage as a result of direct deposition for prediction of wildlife exposure*

$$Pd = \frac{566.5 \times 0.39 \times [1.0 - \exp(-18 \times 0.16)]}{2.24 \times 18}$$

$$Pd = 5.17E + 00\ mg/kg\ DW$$

The P_d value was converted from dry weight to wet weight using the water content (WC) found in berries.

$$Pd = 5.17E + 00\ mg / kg \times (1 - WC)$$

$$Pd = 5.17E + 00\ mg / kg \times (1 - 0.86)$$

$$Pd = 7.45E - 01\ mg / kg\ WW$$

Concentrations in Plants as a Result of Vapour Uptake

There is no vapour form for aluminum. Therefore, the concentration of aluminum in plant from direct vapour uptake (*Pv*) was not calculated.

D-1.3.1 Total Chemical Concentration in Plants

The following equation was used to estimate the chemical concentration in above ground plants as a result of direct deposition, vapour uptake, and root uptake.

$$C_{plant} = (Pd + Pv + \mathrm{Pr})$$

Where:

C_{plant}	=	total chemical concentration in plant (mg/kg).
Pd	=	plant concentration as a result of direct deposition (mg/kg)
Pv	=	COPC concentration in plant as a result of vapour uptake (mg/kg)
Pr	=	chemical concentration in above-ground plants as a result of root uptake (mg/kg)

Example 10 *Concentration of aluminum in plants as a result of direct deposition, vapour uptake and root uptake for the prediction of human exposure*

$$C_{plant} = (7.45E - 01 + 0 + 5.12E - 02)$$

$$C_{plant} = 7.96E - 01\ mg / kg$$

D-1.4 Wildlife Exposure Calculations

Tissue concentrations were calculated following the US EPA OSW (2005) methodology. To estimate tissue concentrations, wildlife species were assumed to be exposed to chemicals through consumption or exposure to soil, water and food. The following sections provide the equations used to calculate the total daily dose of a chemical via the individual exposure pathways for wildlife (grouse and snowshoe hare) and the corresponding tissue concentrations. The following example calculation is for grouse.

D-1.4.1 Food Ingestion Rates

The food ingestion rate is influenced by a number of factors, such as the metabolic rate and composition of the diet. The rate of food consumption that an animal must achieve to meet its metabolic needs can be calculated by dividing its free-living (or field) metabolic rate (FMR) by the metabolizable energy in its food (US EPA 1993; Nagy 1987).

Metabolizable Energy

Metabolizable energy (ME) is the gross energy (GE) in a unit of food consumed minus the energy lost in feces and urine (US EPA 1993). Assimilation efficiency (AE) equals the ratio of metabolizable energy to gross energy, or the fraction of gross energy that is metabolizable (US EPA 1993). Thus, the metabolizable energy for dietary items can be calculated as follows:

$$ME = GE \times AE$$

Where:

ME	=	metabolizable energy of dietary item (kcal/kg)
GE	=	gross energy of dietary item (kcal/kg DW)
AE	=	assimilation efficiency of dietary item (%)

The assimilation efficiency and gross energy values for the different dietary items were provided by the US EPA (1993).

Example 11 Metabolizable energy of forage for grouse

$$ME = 4{,}200 \times 0.41$$

$$ME = 1.72E + 03\ kcal / kg$$

Free-Living Metabolic Rate (Normalized)

Nagy (1987) provides allometric equations to estimate FMRs based on doubly-labelled water measurements of CO_2 production in free-living animals (US EPA 1993). The equations provided by Nagy (1987) are based on the following formula:

$$FMR = \frac{a \times BW^{b}}{4.184\ kJ / kcal}$$

Where:

FMR	=	free-living metabolic rate (kcal/d)
a	=	slope of the allometric equation for the FMR (unitless)
BW	=	body weight (g)
b	=	y-intercept of the allometric equation for the FMR (unitless)

Nagy et al. (1999) provide a number of slope and y-intercept values for FMRs specific to orders and trophic levels (e.g., rodentia, galliformes, and herbivores). These values were used to estimate the FMR values for each species. Note: The equation used to calculate the FMR for moose does not require the conversion to kcal units; thus the conversion factor of 4.184 kJ/kcal is not needed. However, the conversion factor of 4.184 kJ/kcal is needed in the calculation of the FMR for grouse and snowshoe hare.

Example 12 Free-living metabolic rate for grouse

$$FMR = (8.51E-01 \times 7.02E+02^{0.959}) / 4.184$$

$$FMR = 1.09E+02\ kcal/d$$

To normalize the FMR to body weight, the FMR was divided by the body weight of the species:

$$NFMR = \frac{FMR}{BW}$$

Where:

NFMR	=	normalized free-living metabolic rate (kcal/kg bw/d)
FMR	=	free-living metabolic rate (kcal/d)
BW	=	body weight (kg)

Example 13 Normalized free-living metabolic rate for grouse

$$NFMR = \frac{1.09E+02}{7.02E-01}$$

$$NFMR = 1.55E+02\ kcal/kg\ bw/d$$

D-1.4.2 Wildlife Soil Ingestion Rates

The wildlife soil ingestion rates were calculated as a percentage of the total estimated food ingestion rate for all dietary items. The percentage of soil in the diet for each of the wildlife species was obtained from the US EPA OSW (2005) and/or Suter et al. (2000).

The soil ingestion rates were calculated as follows:

$$SIR = P_{soil} \times FIR_{total}$$

Where:

SIR	=	soil ingestion rate (mg/d)
P_{soil}	=	percent of soil in diet (%)
FIR_{total}	=	total food ingestion rate of chemical for all dietary items (mg /d)

Example 14 Soil ingestion rate for grouse

$$SIR = 0.093 \times 5.63E-02$$

$$SIR = 5.24E-03\ mg/d$$

D-1.4.3 Estimated Daily Intake of Chemicals in Wildlife via All Media

Soil Ingestion

The estimated daily intake of a chemical through incidental ingestion of soil by wildlife was calculated by applying the soil ingestion rate to the chemical concentration in the soil.

$$EDI_{soil} = C_s \times SIR$$

Where:

EDI_{soil}	=	estimated daily intake of chemical in soil (mg/d)
C_s	=	chemical concentration in surface soil (mg/kg)
SIR	=	soil ingestion rate (mg/d)

Example 15 Estimated daily intake of aluminum from ingestion of soil by grouse

$$EDI_{soil} = 7.05E+02 \times 5.24E-03$$

$$EDI_{soil} = 3.69E+00\ mg/d$$

D-1.4.4 Food Ingestion

The estimated daily intake of a chemical through ingestion of food (i.e. invertebrates, forage and aquatic plants) by wildlife for each dietary item was calculated as follows:

$$EDI_i = \frac{FMR \times P_i \times C_i}{ME_i}$$

Where:

EDI_i	=	estimated daily intake of a chemical in the 'i' dietary item (mg/d)
FMR	=	free-living metabolic rate (kcal/d)
P_i	=	portion of diet consisting of 'i' dietary item (%)
C_i	=	concentration of 'i' chemical in 'i' dietary item (mg/kg)
ME_i	=	metabolizable energy of 'i' dietary item (kcal/kg)

Grouse were assumed to consume a diet consisting of 80% forage and 20% invertebrates.

Example 16 Estimated forage ingestion for grouse

$$EDI_{browse} = \frac{1.09E+02 \times 0.80 \times 5.8E+01}{1{,}722}$$

$$EDI_{browse} = 2.95E+00 mg/d$$

The total estimated daily intake of a chemical from all dietary items was estimated by summing the individual EDIs for each dietary item:

$$EDI_{diet} = EDI_{invert} + EDI_{browse}$$

Where:

EDI_{diet}	=	estimated daily intake of chemical for all dietary items (mg /d)
EDI_{invert}	=	estimated daily intake of chemical from ingestion of terrestrial invertebrates (mg/d)
EDI_{browse}	=	estimated daily intake of a chemical from ingestion of browse (i.e. forage) (mg/d)

Example 17 Total estimated daily intake of chemical from diet for grouse

$$EDI_{diet} = 2.10E-02 + 2.95E+00$$

$$EDI_{diet} = 2.97E+00\ mg/d$$

D.1.4.5 Ingestion of Water

The estimated daily intake of a chemical through ingestion of surface water by wildlife was calculated by applying the water ingestion rate to the surface water concentrations.

$$EDI_{water} = C_{sw} \times WIR$$

Where:

EDI_{water}	=	estimated daily intake of chemical in surface water (mg/d)
C_{sw}	=	chemical concentration in surface water (mg/L)
WIR	=	water ingestion rate (L/d)

Example 18 *Estimated daily intake of aluminum from consumption of surface water by grouse*

$$EDI_{water} = 0 \times 4.65E-02$$
$$EDI_{water} = 0\ mg/d$$

D.1.4.6 Ingestion of Dust

The air inhalation rate for wildlife was predicted using allometric equations for birds provided by the US EPA (1993).

Inhalation rate for birds:

$$AIR = 0.4089 \times BW^{0.77}$$

Where:

AIR	=	predicted air inhalation rate (m^3/d)
BW	=	body weight (kg)

Example 19 *Predicted inhalation rate for grouse*

$$AIR = 0.4089 \times 0.702^{0.77}$$
$$AIR = 3.1E-01\ m^3/d$$

The estimated daily intake of a chemical through inhalation/ingestion of dust is as follows.

$$EDI_{inh} = C_{dust} \times AIR \times CF$$

Where:

EDI_{inh}	=	estimated daily intake of chemical via inhalation (mg/d)
C_{air}	=	chemical concentration in air (µg/m^3)
C_{dust}	=	chemical concentration in dust (µg/m^3)
AIR	=	air inhalation rate (m^3/d)
CF	=	conversion factor from µg to mg (0.001 mg/µg)

Example 20 Estimated daily intake of aluminum by grouse via inhalation

$$EDI_{inh} = 5.36E - 04 \times 3.1E - 01 \times 0.001$$

$$EDI_{inh} = 1.67E - 07 mg / d$$

D.1.4.7 Estimated Total Daily Intake

The estimated daily intake for wildlife and game from all potential pathways of exposure was calculated as follows:

$$EDI_{total} = EDI_{soil} + EDI_{browse} + EDI_{invert} + EDI_{water} + EDI_{inh}$$

Where:

EDI_{total}	=	total estimated daily intake of chemical via all routes of exposure (mg/d)
EDI_{soil}	=	estimated daily intake of chemical from ingestion of soil (mg/d)
EDI_{browse}	=	estimated daily intake of chemical from consumption of browse (mg/d)
EDI_{invert}	=	estimated daily intake of chemical from consumption of invertebrates (mg/d)
EDI_{water}	=	estimated daily intake of chemical from ingestion of water (mg/d)
EDI_{inh}	=	estimated daily intake of chemical from inhalation of dust (mg/d)

Example 21 Total estimated daily intake of aluminum from all routes of exposure for grouse

$$EDI_{total} = 3.69E + 00 + 2.95E + 00 + 2.1E - 02 + 0 + 1.67E - 07$$

$$EDI_{total} 6.67E + 00 mg / d$$

D-1.5 Wildlife Tissue Concentrations

D-1.5.1 Biotransfer Factors

Biotransfer factors (BTFs) are used to translate an estimated dose of a chemical to a tissue concentration. The BTF for aluminum in grouse is 2.00E-04 as referenced from Baes et al. (1984).

D-1.5.2 Tissue Concentrations

Chemical concentrations in animal meat were predicted based on the following equation (US EPA OSW 2005):

$$C_{animal} = BTF \times EDI_{total}$$

Where:

C_{animal} = chemical concentration in game meat (mg/kg WW)
BTF_{adj} = adjusted biotransfer factor for metabolism ([mg/kg tissue] / [mg/d])
EDI_{total} = total estimated daily intake of chemical via all routes of exposure (mg/d)

Example 22 Predicted concentration of aluminum in grouse meat

$$C_{grouse} = 2.0E-04 \times 6.67E+00$$

$$C_{grouse} = 1.33E-03 mg/kg\ WW$$

Similar methods were applied to the calculation of snowshoe hare concentrations.

D-1.6 Human Exposure Estimates

D-1.6.1 Ingestion of Soil (Incidental)

The following equation was used to estimate human exposure via incidental ingestion of soil. Soil ingestion rates and equations used to predict exposures were based on recommendations from Health Canada (2012).

$$EDI_{soil} = C_s \times SIR \times CF1 \times CF2$$

Where:

EDI_{soil} = estimated daily intake of chemical via ingestion of soil (µg/d)

C_s = chemical concentration in surface soil (mg/kg)

SIR = incidental soil ingestion rate (g/d)

CF1 = conversion factor from µg to mg (1,000 µg/mg)

CF2 = conversion factor from g to kg (0.001 kg/g)

Example 23 Estimated daily intake of aluminum by a toddler resident from incidental ingestion of soil

$$EDI_{soil} = 7.05E+02 \times 0.08 \times 1000 \times 0.001$$

$$EDI_{soil} = 5.64E+01 \mu g/d$$

D-1.6.2 Ingestion of Drinking Water

It was assumed that residents consumed municipal-supplied drinking water. Water ingestion rates and equations used to predict exposures were based on recommendations from Health Canada (2012) and exposures were based on the following equation:

$$EDI_{water} = C_{dw} \times WIR \times CF$$

Where:

EDI_{water} = estimated daily intake of chemical via ingestion of water (µg/d)
C_{dw} = chemical concentration in drinking water (mg/L)
WIR = water ingestion rate (L/d)
CF = conversion factor from mg to µg (1,000 µg/mg)

Example 24 Estimated daily intake of aluminum by a toddler resident from ingestion of surface water

$$EDI_{water} = 0 \times 0.6 \times 1{,}000$$

$$EDI_{water} = 0 \mu g / d$$

D-1.6.3 Inhalation of Dust

The following equation was used to estimate human exposure via inhalation of dust. Air inhalation rates and equations used to predict exposures were based on recommendations from Health Canada (2012).

$$EDI_{dust} = C_{dust} \times AIR$$

Where:

EDI_{dust} = estimated daily intake of chemical via inhalation of dust (µg/d)

C_{dust} = chemical concentration in dust (µg/m³)

AIR = air inhalation rate (m³/d)

Example 25 Estimated daily intake of aluminum by a toddler resident from inhalation of dust

$$EDI_{dust} = 5.36E-04 \times 8.3$$

$$EDI_{dust} = 4.45E-03 \ \mu g / d$$

D-1.6.4 Ingestion of Plants

D-1.6.4.1 Wild Berries

Consumption rates and equations used to predict wild berry exposures were obtained from Health Canada (1994, 2012). The following equation was used to estimate human exposure via consumption of wild berries (Health Canada 2012).

$$EDI_{berry} = Pb \times (1 - FWC) \times IR_{berry}$$

Where:

EDI_{berry} = estimated daily intake of chemical via consumption of fruit and berries (µg/d)

Pb = chemical concentration in fruit and berries from root uptake (mg/kg WW)

FWC = water content in food (%)

IR_{berry} = fruit and berry ingestion rate (g/d)

Example 26 Estimated daily intake of aluminum by a toddler resident from consumption of berries

$$EDI_{berry} = 7.96E-01 \times (1 - 0.856) \times 7.47$$

$$EDI_{berry} = 8.56E-01\ \mu g/d$$

D-1.6.5 Ingestion of Wild Game and Fish

Consumption rates and equations used to predict exposures were obtained from Health Canada (2012) and Health Canada (2007). The following equation was used to estimate human exposure via consumption of fish or wild game meat (Health Canada 2012).

$$EDI_{animal} = C_{animal} \times IR_{animal}$$

Where:

EDI_{animal} = estimated daily intake of chemical via consumption of fish or wild game (µg/d)

C_{animal} = chemical concentration in animal tissue (mg/kg WW)

IR_{animal} = fish or wild game ingestion rate (g/d)

Example 27 Estimated daily intake of aluminum by a toddler resident from consumption of ruffed grouse

$$EDI_{grouse} = 1.33E-03 \times 13$$

$$EDI_{grouse} = 1.73E-02\ \mu g/d$$

Example 28 Estimated daily intake of aluminum by a toddler resident from consumption of snowshoe hare

$$EDI_{hare} = 2.71E-03 \times 6.49$$

$$EDI_{hare} = 1.76E-02 \mu g/d$$

Example 29 Estimated daily intake of aluminum by a toddler resident from consumption of fish

$$EDI_{fish} = 0 \times 10$$

$$EDI_{fish} = 0 \mu g/d$$

D-1.6.6 Dermal Exposures

D-1.6.6.1 Dermal Exposures from Soil

Potential dermal exposure was estimated by applying soil loading rates to exposed skin, skin surface areas, and dermal absorption factors to measured or predicted soil concentrations. Dermal exposures were estimated separately for hands only and for surfaces other than hands (e.g., arms and legs).

Dermal Exposure to Hands

The following equation was used to estimate dermal exposure for hands only. Dermal exposures were based on recommendations from Health Canada (2010) or RAIS (2009) and Health Canada (2012).

$$EDI_{dermal\_h} = C_s \times SAH \times SLH \times RAF_{dermal}$$

Where:

EDI_{dermal_h} = estimated daily intake of chemical from dermal contact of hands with soil (µg/d)

C_s = chemical concentration in surface soil (mg/kg)

SAH = skin surface area of hands (cm^2)

SLH = soil loading rate to exposed skin on hands (g/cm^2/event)

RAF_{dermal} = relative dermal absorption factor (%)

Example 30 Estimated daily intake of aluminum by a toddler resident from dermal exposure to soil with hands only

$$EDI_{dermal\_h} = 7.05E+02 \times 430 \times 0.0001 \times 0.25$$

$$EDI_{dermal\_h} = 7.58E+00\ \mu g / d$$

Dermal Exposure to Surfaces Other than Hands

The following equation was used to estimate dermal exposure for surfaces other than hands. Dermal exposures were based on recommendations from Health Canada (2010) or RAIS (2009).

$$EDI_{dermal\_o} = C_s \times SAO \times SLO \times RAF_{dermal}$$

Where:

EDI_{dermal_o} = estimated daily intake of chemical from dermal contact of surfaces other than hands with soil (µg/d)

C_s = chemical concentration in surface soil (mg/kg)

SAO = skin surface area of upper and lower arms and legs (cm^2)

SLO = soil loading rate to exposed skin on surfaces other than hands ($g/cm^2/event$)

RAF_{dermal} = relative dermal absorption factor (%)

Example 31 Estimated daily intake of aluminum by a toddler resident from dermal exposure to soil with surfaces other than hands

$$EDI_{dermal\_o} = 7.05E+02 \times 2{,}580 \times 1.0E-05 \times 0.25$$

$$EDI_{dermal\_o} = 4.55E+00 \mu g / d$$

D-1.6.7 Total Human Exposure

Total exposure was calculated by summing the individual exposures from each medium (i.e., soil, water, dust, and food intake) for all relevant exposure pathways on a per chemical and per life stage basis (Health Canada 2012):

$$EDI_{total} = EDI_{soil} + EDI_{water} + EDI_{dust} + EDI_{food} + EDI_{dermal}$$

Where:

EDI_{total}= total estimated daily intake of chemical via all routes (µg/d)

EDI_{soil} = estimated daily intake of chemical from soil ingestion (µg/d)

EDI_{water} = estimated daily intake of chemical from ingestion of water (µg/d)

EDI_{dust} = estimated daily intake of chemical from dust and air inhalation (µg/d)

EDI_{food} = estimated daily intake of chemical from consumption of all food types (µg/d [sum of berries, fish, grouse, snowshoe hare])

EDI_{dermal} = estimated daily intake of chemical from total dermal contact soil (µg/d)

Example 32 Total estimated daily intake of aluminum for a toddler resident from all routes of exposure

$$EDI_{total} = 5.64E + 01 + 0 + 4.45E - 03 + 8.91E - 01 + 1.21E + 01$$

$$EDI_{total} = 6.94E + 01 \mu g / d$$

The total estimated daily intake was normalized to body weight as follows:

$$EDI_{total\_BW} = \frac{EDI_{total}}{BW}$$

Where:

EDI_{total_BW} = total estimated daily intake of chemical via all routes adjusted to body weight (µg/kg bw/d)

EDI_{total}= total estimated daily intake of chemical via all routes (µg/d)

BW = body weight (kg)

Example 33 Total estimated daily intake of aluminum for a toddler resident from all routes of exposure adjusted to body weight

$$EDI_{total\_BW} = \frac{6.94E+01}{16.5}$$

$$EDI_{total\_BW} = 4.21E+00 \mu g/kg\ bw/d$$

D-1.7 Human Risk Calculations

Risk quotient (RQ) values for non–carcinogens and incremental lifetime cancer risks (ILCRs) for carcinogens were estimated using the following equations and the calculated exposure estimates.

D-1.7.1 Non-Carcinogens

The following equation was used to calculate the hazard quotients for non–carcinogens (Health Canada 2012):

$$RQ_i = \frac{EDI_{total\_BW}}{RfD}$$

Where:

RQ_i = risk quotient of chemical for the 'i' lifestage of the residents (unitless)

EDI_{total_BW} = total estimated daily intake of chemical via all routes adjusted to body weight for the 'i' lifestage (µg/kg bw/d)

RfD = chemical-specific reference dose (µg/kg bw/d)

The maximum RQ value of all the life stages (i.e., infant, toddler, child, adolescent, and adult) was presented in the HHRA report for non-carcinogens. The toddler lifestage had the highest RQ of all the lifestages.

Example 34 Risk quotient for aluminum for the toddler life-stage of the resident in the application case

$$RQ_i = \frac{4.21E+00}{143}$$

$$RQ_i = 2.94E-02$$

D-2.0 REFERENCES

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Appendix D
Exposure Model

Predicted Hazard Quotient Values [Unitless]

Scenario	Type	Site	Chemical	TRV	Infant	Toddler	Child	Adolescent	Adult	Max HQ	ILCR / LCR
Baseline	RESI	MAX	Aluminum	RfD	3.55E-01	5.40E-01	1.32E-01	9.07E-02	8.32E-02	5.40E-01	0.00E+00
Baseline	RESI	MAX	Benzo(a)pyrene	RsD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Chromium	RfD	1.26E-04	2.16E-04	5.86E-05	3.52E-05	3.24E-05	2.16E-04	0.00E+00
Baseline	RESI	MAX	Iron	RfD	4.65E-01	7.21E-01	1.79E-01	1.25E-01	1.14E-01	7.21E-01	0.00E+00
Baseline	RESI	MAX	Manganese	RfD	1.45E-01	1.92E-01	1.32E-01	7.08E-02	6.91E-02	1.92E-01	0.00E+00
Baseline	RESI	MAX	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline	RESI	MAX	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline	RESI	MED	Aluminum	RfD	3.55E-01	5.40E-01	1.32E-01	9.07E-02	8.32E-02	5.40E-01	0.00E+00
Baseline	RESI	MED	Benzo(a)pyrene	RsD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Chromium	RfD	1.26E-04	2.16E-04	5.86E-05	3.52E-05	3.24E-05	2.16E-04	0.00E+00
Baseline	RESI	MED	Iron	RfD	4.65E-01	7.21E-01	1.79E-01	1.25E-01	1.14E-01	7.21E-01	0.00E+00
Baseline	RESI	MED	Manganese	RfD	1.45E-01	1.92E-01	1.32E-01	7.08E-02	6.91E-02	1.92E-01	0.00E+00
Baseline	RESI	MED	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline	RESI	MED	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline	RESI	LOW	Aluminum	RfD	3.55E-01	5.40E-01	1.32E-01	9.07E-02	8.32E-02	5.40E-01	0.00E+00
Baseline	RESI	LOW	Benzo(a)pyrene	RsD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Chromium	RfD	1.26E-04	2.16E-04	5.86E-05	3.52E-05	3.24E-05	2.16E-04	0.00E+00
Baseline	RESI	LOW	Iron	RfD	4.65E-01	7.21E-01	1.79E-01	1.25E-01	1.14E-01	7.21E-01	0.00E+00
Baseline	RESI	LOW	Manganese	RfD	1.45E-01	1.92E-01	1.32E-01	7.08E-02	6.91E-02	1.92E-01	0.00E+00
Baseline	RESI	LOW	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline	RESI	LOW	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Project	RESI	MAX	Aluminum	RfD	1.94E-02	2.94E-02	7.32E-03	4.98E-03	4.58E-03	2.94E-02	0.00E+00
Project	RESI	MAX	Benzo(a)pyrene	RsD	3.51E-10	8.16E-08	3.22E-08	1.75E-08	1.70E-08	0.00E+00	1.49E-07
Project	RESI	MAX	Chromium	RfD	3.00E-05	5.18E-05	1.03E-05	6.37E-06	5.76E-06	5.18E-05	0.00E+00
Project	RESI	MAX	Iron	RfD	1.22E-01	1.86E-01	4.61E-02	3.14E-02	2.89E-02	1.86E-01	0.00E+00
Project	RESI	MAX	Manganese	RfD	1.65E-02	2.37E-02	7.88E-03	4.79E-03	4.53E-03	2.37E-02	0.00E+00
Project	RESI	MAX	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Project	RESI	MAX	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Project	RESI	MED	Aluminum	RfD	1.48E-02	2.25E-02	5.59E-03	3.80E-03	3.50E-03	2.25E-02	0.00E+00
Project	RESI	MED	Benzo(a)pyrene	RsD	2.68E-10	6.23E-08	2.46E-08	1.34E-08	1.29E-08	0.00E+00	1.14E-07
Project	RESI	MED	Chromium	RfD	2.29E-05	3.96E-05	7.85E-06	4.87E-06	4.40E-06	3.96E-05	0.00E+00
Project	RESI	MED	Iron	RfD	9.35E-02	1.42E-01	3.52E-02	2.40E-02	2.20E-02	1.42E-01	0.00E+00
Project	RESI	MED	Manganese	RfD	1.26E-02	1.81E-02	6.02E-03	3.66E-03	3.46E-03	1.81E-02	0.00E+00
Project	RESI	MED	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Project	RESI	MED	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Project	RESI	LOW	Aluminum	RfD	1.06E-02	1.61E-02	3.99E-03	2.72E-03	2.50E-03	1.61E-02	0.00E+00
Project	RESI	LOW	Benzo(a)pyrene	RsD	1.92E-10	4.45E-08	1.76E-08	9.56E-09	9.25E-09	0.00E+00	8.11E-08
Project	RESI	LOW	Chromium	RfD	1.64E-05	2.83E-05	5.61E-06	3.48E-06	3.14E-06	2.83E-05	0.00E+00
Project	RESI	LOW	Iron	RfD	6.68E-02	1.01E-01	2.52E-02	1.71E-02	1.57E-02	1.01E-01	0.00E+00
Project	RESI	LOW	Manganese	RfD	8.99E-03	1.29E-02	4.30E-03	2.61E-03	2.47E-03	1.29E-02	0.00E+00
Project	RESI	LOW	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Predicted Hazard Quotient Values [Unitless]

Scenario	Type	Site	Chemical	TRV	Infant	Toddler	Child	Adolescent	Adult	Max HQ	ILCR / LCR
Project	RESI	LOW	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	MAX	Aluminum	RfD	3.75E-01	5.70E-01	1.40E-01	9.57E-02	8.78E-02	5.70E-01	0.00E+00
Baseline + Project	RESI	MAX	Benzo(a)pyrene	RsD	3.51E-10	8.16E-08	3.22E-08	1.75E-08	1.70E-08	8.16E-08	1.49E-07
Baseline + Project	RESI	MAX	Chromium	RfD	1.56E-04	2.68E-04	6.89E-05	4.16E-05	3.82E-05	2.68E-04	0.00E+00
Baseline + Project	RESI	MAX	Iron	RfD	5.88E-01	9.07E-01	2.25E-01	1.56E-01	1.43E-01	9.07E-01	0.00E+00
Baseline + Project	RESI	MAX	Manganese	RfD	1.62E-01	2.15E-01	1.40E-01	7.56E-02	7.36E-02	2.15E-01	0.00E+00
Baseline + Project	RESI	MAX	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	MAX	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	MED	Aluminum	RfD	3.70E-01	5.63E-01	1.38E-01	9.45E-02	8.67E-02	5.63E-01	0.00E+00
Baseline + Project	RESI	MED	Benzo(a)pyrene	RsD	2.68E-10	6.23E-08	2.46E-08	1.34E-08	1.29E-08	6.23E-08	1.14E-07
Baseline + Project	RESI	MED	Chromium	RfD	1.49E-04	2.55E-04	6.64E-05	4.01E-05	3.68E-05	2.55E-04	0.00E+00
Baseline + Project	RESI	MED	Iron	RfD	5.59E-01	8.63E-01	2.14E-01	1.49E-01	1.36E-01	8.63E-01	0.00E+00
Baseline + Project	RESI	MED	Manganese	RfD	1.58E-01	2.10E-01	1.38E-01	7.45E-02	7.25E-02	2.10E-01	0.00E+00
Baseline + Project	RESI	MED	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	MED	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	LOW	Aluminum	RfD	3.66E-01	5.56E-01	1.36E-01	9.34E-02	8.57E-02	5.56E-01	0.00E+00
Baseline + Project	RESI	LOW	Benzo(a)pyrene	RsD	1.92E-10	4.45E-08	1.76E-08	9.56E-09	9.25E-09	4.45E-08	8.11E-08
Baseline + Project	RESI	LOW	Chromium	RfD	1.43E-04	2.44E-04	6.42E-05	3.87E-05	3.56E-05	2.44E-04	0.00E+00
Baseline + Project	RESI	LOW	Iron	RfD	5.32E-01	8.22E-01	2.04E-01	1.42E-01	1.29E-01	8.22E-01	0.00E+00
Baseline + Project	RESI	LOW	Manganese	RfD	1.54E-01	2.05E-01	1.36E-01	7.34E-02	7.15E-02	2.05E-01	0.00E+00
Baseline + Project	RESI	LOW	Silica	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Baseline + Project	RESI	LOW	Titanium	RfD	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

NA indicates exposure limit not available

Predicted Estimated Daily Intake [ug/kg/day]

Scenario	Type	Site	Chemical	Infant	Toddler	Child	Adolescent	Adult
Baseline	RESI	MAX	Aluminum	5.08E+01	7.73E+01	1.89E+01	1.30E+01	1.19E+01
Baseline	RESI	MAX	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Chromium	1.90E-01	3.24E-01	8.79E-02	5.29E-02	4.86E-02
Baseline	RESI	MAX	Iron	3.26E+02	5.05E+02	1.25E+02	8.74E+01	7.96E+01
Baseline	RESI	MAX	Manganese	2.03E+01	2.68E+01	1.85E+01	9.91E+00	9.67E+00
Baseline	RESI	MAX	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Titanium	3.79E+00	5.77E+00	1.42E+00	9.73E-01	8.92E-01
Baseline	RESI	MED	Aluminum	5.08E+01	7.73E+01	1.89E+01	1.30E+01	1.19E+01
Baseline	RESI	MED	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Chromium	1.90E-01	3.24E-01	8.79E-02	5.29E-02	4.86E-02
Baseline	RESI	MED	Iron	3.26E+02	5.05E+02	1.25E+02	8.74E+01	7.96E+01
Baseline	RESI	MED	Manganese	2.03E+01	2.68E+01	1.85E+01	9.91E+00	9.67E+00
Baseline	RESI	MED	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Titanium	3.79E+00	5.77E+00	1.42E+00	9.73E-01	8.92E-01
Baseline	RESI	LOW	Aluminum	5.08E+01	7.73E+01	1.89E+01	1.30E+01	1.19E+01
Baseline	RESI	LOW	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Chromium	1.90E-01	3.24E-01	8.79E-02	5.29E-02	4.86E-02
Baseline	RESI	LOW	Iron	3.26E+02	5.05E+02	1.25E+02	8.74E+01	7.96E+01
Baseline	RESI	LOW	Manganese	2.03E+01	2.68E+01	1.85E+01	9.91E+00	9.67E+00
Baseline	RESI	LOW	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Titanium	3.79E+00	5.77E+00	1.42E+00	9.73E-01	8.92E-01
Project	RESI	MAX	Aluminum	2.78E+00	4.21E+00	1.05E+00	7.13E-01	6.54E-01
Project	RESI	MAX	Benzo(a)pyrene	7.87E-11	1.14E-10	4.51E-11	2.45E-11	2.37E-11
Project	RESI	MAX	Chromium	4.50E-02	7.78E-02	1.54E-02	9.56E-03	8.65E-03
Project	RESI	MAX	Iron	8.57E+01	1.30E+02	3.23E+01	2.20E+01	2.02E+01
Project	RESI	MAX	Manganese	2.31E+00	3.32E+00	1.10E+00	6.70E-01	6.34E-01
Project	RESI	MAX	Silica	1.71E+02	2.25E+02	1.08E+02	5.87E+01	5.74E+01
Project	RESI	MAX	Titanium	7.82E-01	1.19E+00	2.99E-01	2.04E-01	1.88E-01
Project	RESI	MED	Aluminum	2.12E+00	3.21E+00	8.00E-01	5.44E-01	5.00E-01
Project	RESI	MED	Benzo(a)pyrene	6.01E-11	8.73E-11	3.45E-11	1.87E-11	1.81E-11
Project	RESI	MED	Chromium	3.44E-02	5.94E-02	1.18E-02	7.30E-03	6.60E-03
Project	RESI	MED	Iron	6.54E+01	9.93E+01	2.47E+01	1.68E+01	1.54E+01
Project	RESI	MED	Manganese	1.76E+00	2.53E+00	8.43E-01	5.12E-01	4.84E-01
Project	RESI	MED	Silica	1.30E+02	1.72E+02	8.26E+01	4.48E+01	4.38E+01
Project	RESI	MED	Titanium	5.97E-01	9.09E-01	2.28E-01	1.56E-01	1.43E-01
Project	RESI	LOW	Aluminum	1.51E+00	2.30E+00	5.71E-01	3.89E-01	3.57E-01
Project	RESI	LOW	Benzo(a)pyrene	4.29E-11	6.23E-11	2.46E-11	1.34E-11	1.29E-11

Predicted Estimated Daily Intake [ug/kg/day]

Scenario	Type	Site	Chemical	Infant	Toddler	Child	Adolescent	Adult
Project	RESI	LOW	Chromium	2.45E-02	4.24E-02	8.41E-03	5.22E-03	4.72E-03
Project	RESI	LOW	Iron	4.67E+01	7.09E+01	1.76E+01	1.20E+01	1.10E+01
Project	RESI	LOW	Manganese	1.26E+00	1.81E+00	6.02E-01	3.66E-01	3.46E-01
Project	RESI	LOW	Silica	9.30E+01	1.23E+02	5.90E+01	3.20E+01	3.13E+01
Project	RESI	LOW	Titanium	4.26E-01	6.49E-01	1.63E-01	1.11E-01	1.02E-01
Baseline + Project	RESI	MAX	Aluminum	5.36E+01	8.15E+01	2.00E+01	1.37E+01	1.26E+01
Baseline + Project	RESI	MAX	Benzo(a)pyrene	7.87E-11	1.14E-10	4.51E-11	2.45E-11	2.37E-11
Baseline + Project	RESI	MAX	Chromium	2.35E-01	4.02E-01	1.03E-01	6.24E-02	5.73E-02
Baseline + Project	RESI	MAX	Iron	4.11E+02	6.35E+02	1.57E+02	1.09E+02	9.98E+01
Baseline + Project	RESI	MAX	Manganese	2.27E+01	3.01E+01	1.96E+01	1.06E+01	1.03E+01
Baseline + Project	RESI	MAX	Silica	1.71E+02	2.25E+02	1.08E+02	5.87E+01	5.74E+01
Baseline + Project	RESI	MAX	Titanium	4.57E+00	6.96E+00	1.71E+00	1.18E+00	1.08E+00
Baseline + Project	RESI	MED	Aluminum	5.29E+01	8.05E+01	1.97E+01	1.35E+01	1.24E+01
Baseline + Project	RESI	MED	Benzo(a)pyrene	6.01E-11	8.73E-11	3.45E-11	1.87E-11	1.81E-11
Baseline + Project	RESI	MED	Chromium	2.24E-01	3.83E-01	9.97E-02	6.02E-02	5.52E-02
Baseline + Project	RESI	MED	Iron	3.91E+02	6.04E+02	1.50E+02	1.04E+02	9.51E+01
Baseline + Project	RESI	MED	Manganese	2.21E+01	2.94E+01	1.93E+01	1.04E+01	1.02E+01
Baseline + Project	RESI	MED	Silica	1.30E+02	1.72E+02	8.26E+01	4.48E+01	4.38E+01
Baseline + Project	RESI	MED	Titanium	4.38E+00	6.68E+00	1.64E+00	1.13E+00	1.04E+00
Baseline + Project	RESI	LOW	Aluminum	5.23E+01	7.96E+01	1.95E+01	1.34E+01	1.23E+01
Baseline + Project	RESI	LOW	Benzo(a)pyrene	4.29E-11	6.23E-11	2.46E-11	1.34E-11	1.29E-11
Baseline + Project	RESI	LOW	Chromium	2.14E-01	3.66E-01	9.63E-02	5.81E-02	5.34E-02
Baseline + Project	RESI	LOW	Iron	3.73E+02	5.75E+02	1.43E+02	9.94E+01	9.06E+01
Baseline + Project	RESI	LOW	Manganese	2.16E+01	2.86E+01	1.91E+01	1.03E+01	1.00E+01
Baseline + Project	RESI	LOW	Silica	9.30E+01	1.23E+02	5.90E+01	3.20E+01	3.13E+01
Baseline + Project	RESI	LOW	Titanium	4.21E+00	6.42E+00	1.58E+00	1.08E+00	9.94E-01

Measured and Predicted Soil and Surface Soil Concentrations [mg/kg]

		Soil			Surface Soil		
Site	Chemical	Baseline	Project	Base + Proj	Baseline	Project	Base + Proj
MAX	Aluminum	1.30E+04	7.05E+01	1.31E+04	1.30E+04	7.05E+02	1.37E+04
MAX	Benzo(a)pyrene	0.00E+00	1.62E-09	1.62E-09	0.00E+00	1.62E-08	1.62E-08
MAX	Chromium	5.40E+01	1.44E+00	5.54E+01	5.40E+01	1.44E+01	6.84E+01
MAX	Iron	8.40E+04	2.18E+03	8.62E+04	8.40E+04	2.18E+04	1.06E+05
MAX	Manganese	1.90E+03	5.00E+01	1.95E+03	1.90E+03	5.00E+02	2.40E+03
MAX	Silica	0.00E+00	2.72E+03	2.72E+03	0.00E+00	2.72E+04	2.72E+04
MAX	Titanium	9.70E+02	1.99E+01	9.90E+02	9.70E+02	1.99E+02	1.17E+03
MED	Aluminum	1.30E+04	5.39E+01	1.31E+04	1.30E+04	5.39E+02	1.35E+04
MED	Benzo(a)pyrene	0.00E+00	1.24E-09	1.24E-09	0.00E+00	1.24E-08	1.24E-08
MED	Chromium	5.40E+01	1.10E+00	5.51E+01	5.40E+01	1.10E+01	6.50E+01
MED	Iron	8.40E+04	1.66E+03	8.57E+04	8.40E+04	1.66E+04	1.01E+05
MED	Manganese	1.90E+03	3.82E+01	1.94E+03	1.90E+03	3.82E+02	2.28E+03
MED	Silica	0.00E+00	2.08E+03	2.08E+03	0.00E+00	2.08E+04	2.08E+04
MED	Titanium	9.70E+02	1.52E+01	9.85E+02	9.70E+02	1.52E+02	1.12E+03
LOW	Aluminum	1.30E+04	3.85E+01	1.30E+04	1.30E+04	3.85E+02	1.34E+04
LOW	Benzo(a)pyrene	0.00E+00	8.83E-10	8.83E-10	0.00E+00	8.83E-09	8.83E-09
LOW	Chromium	5.40E+01	7.84E-01	5.48E+01	5.40E+01	7.84E+00	6.18E+01
LOW	Iron	8.40E+04	1.19E+03	8.52E+04	8.40E+04	1.19E+04	9.59E+04
LOW	Manganese	1.90E+03	2.73E+01	1.93E+03	1.90E+03	2.73E+02	2.17E+03
LOW	Silica	0.00E+00	1.48E+03	1.48E+03	0.00E+00	1.48E+04	1.48E+04
LOW	Titanium	9.70E+02	1.08E+01	9.81E+02	9.70E+02	1.08E+02	1.08E+03

Measured and Predicted Berry Concentrations [mg/kg-WW]

Site	Chemical	Baseline	Project	Base + Proj
MAX	Aluminum	9.44E+00	7.96E-01	1.02E+01
MAX	Benzo(a)pyrene	0.00E+00	3.79E-10	3.79E-10
MAX	Chromium	4.05E-01	2.60E-02	4.31E-01
MAX	Iron	2.33E+01	2.36E+01	4.70E+01
MAX	Manganese	1.95E+02	5.66E+00	2.01E+02
MAX	Silica	0.00E+00	9.81E+02	9.81E+02
MAX	Titanium	6.04E-01	2.22E-01	8.26E-01
MED	Aluminum	9.44E+00	6.08E-01	1.00E+01
MED	Benzo(a)pyrene	0.00E+00	2.90E-10	2.90E-10
MED	Chromium	4.05E-01	1.98E-02	4.25E-01
MED	Iron	2.33E+01	1.80E+01	4.14E+01
MED	Manganese	1.95E+02	4.32E+00	1.99E+02
MED	Silica	0.00E+00	7.49E+02	7.49E+02
MED	Titanium	6.04E-01	1.70E-01	7.74E-01
LOW	Aluminum	9.44E+00	4.34E-01	9.87E+00
LOW	Benzo(a)pyrene	0.00E+00	2.07E-10	2.07E-10
LOW	Chromium	4.05E-01	1.42E-02	4.19E-01
LOW	Iron	2.33E+01	1.29E+01	3.62E+01
LOW	Manganese	1.95E+02	3.09E+00	1.98E+02
LOW	Silica	0.00E+00	5.35E+02	5.35E+02
LOW	Titanium	6.04E-01	1.21E-01	7.25E-01

Predicted Game Concentration (mg/kg-WW)

Chemical	Game	MAX Baseline	MAX Project	MAX Base + Proj	MED Baseline	MED Project	MED Base + Proj	LOW Baseline	LOW Project	LOW Base + Proj
Aluminum	Ruffed_Grouse	1.5E-02	1.3E-03	1.6E-02	1.5E-02	1.0E-03	1.6E-02	1.5E-02	7.3E-04	1.6E-02
Benzo(a)pyrene	Ruffed_Grouse	0.0E+00	4.0E-13	4.0E-13	0.0E+00	3.1E-13	3.1E-13	0.0E+00	2.2E-13	2.2E-13
Chromium	Ruffed_Grouse	1.2E-03	2.2E-04	1.4E-03	1.2E-03	1.7E-04	1.4E-03	1.2E-03	1.2E-04	1.3E-03
Iron	Ruffed_Grouse	1.2E-01	5.2E-02	1.7E-01	1.2E-01	3.9E-02	1.6E-01	1.2E-01	2.8E-02	1.5E-01
Manganese	Ruffed_Grouse	7.4E-03	1.8E-03	9.2E-03	7.4E-03	1.3E-03	8.8E-03	7.4E-03	9.6E-04	8.4E-03
Silica	Ruffed_Grouse	0.0E+00	5.3E-01	5.3E-01	0.0E+00	4.1E-01	4.1E-01	0.0E+00	2.9E-01	2.9E-01
Titanium	Ruffed_Grouse	1.1E-02	3.7E-03	1.4E-02	1.1E-02	2.9E-03	1.4E-02	1.1E-02	2.0E-03	1.3E-02
Aluminum	Snowshoe_Hare	2.3E-02	2.7E-03	2.5E-02	2.3E-02	2.1E-03	2.5E-02	2.3E-02	1.5E-03	2.4E-02
Benzo(a)pyrene	Snowshoe_Hare	0.0E+00	1.4E-12	1.4E-12	0.0E+00	1.1E-12	1.1E-12	0.0E+00	7.6E-13	7.6E-13
Chromium	Snowshoe_Hare	1.4E-03	4.3E-04	1.8E-03	1.4E-03	3.3E-04	1.7E-03	1.4E-03	2.4E-04	1.6E-03
Iron	Snowshoe_Hare	2.0E-01	1.1E-01	3.0E-01	2.0E-01	8.0E-02	2.8E-01	2.0E-01	5.7E-02	2.5E-01
Manganese	Snowshoe_Hare	1.5E-02	3.6E-03	1.9E-02	1.5E-02	2.8E-03	1.8E-02	1.5E-02	2.0E-03	1.7E-02
Silica	Snowshoe_Hare	0.0E+00	1.1E+00	1.1E+00	0.0E+00	8.4E-01	8.4E-01	0.0E+00	6.0E-01	6.0E-01
Titanium	Snowshoe_Hare	1.8E-02	7.7E-03	2.5E-02	1.8E-02	5.8E-03	2.3E-02	1.8E-02	4.2E-03	2.2E-02

Summary of Predicted Human Exposures for Each Lifestyle Category, Scenario and Chemical

						Estimated Daily Intake											
Scenario	Type	Site	Receptor	Chemical	Abbreviation	Soil SIR ug/day	Drinking Water WIR ug/day	Dust AIR ug/day	Berries Berries ug/day	Fish Fish ug/day	Ruffed_Grouse Ruffed_Grouse ug/day	Snowshoe_Hare Snowshoe_Hare ug/day	Dermal Hands ug/day	Dermal Other ug/day	Total EDI ug/day	Total EDI ug/kg/day	HQ Total Unitless
Baseline	RESI	MAX	Adolescent	Aluminum	Baseline_RESI_MAX_Adolescent_Aluminum	2.60E+02	1.50E-02	1.54E-01	1.82E+01	1.37E+00	2.96E-01	5.29E-01	2.60E+02	2.34E+02	7.75E+02	1.30E+01	9.07E-02
Baseline	RESI	MAX	Adolescent	Benzo(a)pyrene	Baseline_RESI_MAX_Adolescent_Benzo(a)pyr	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Adolescent	Chromium	Baseline_RESI_MAX_Adolescent_Chromium	1.08E+00	1.00E-03	6.40E-04	7.80E-01	4.18E-01	2.39E-02	3.20E-02	4.32E-01	3.89E-01	3.16E+00	5.29E-02	3.52E-05
Baseline	RESI	MAX	Adolescent	Iron	Baseline_RESI_MAX_Adolescent_Iron	1.68E+03	2.20E-01	9.96E-01	4.49E+01	2.90E+02	2.45E+00	4.56E+00	1.68E+03	1.51E+03	5.22E+03	8.74E+01	1.25E-01
Baseline	RESI	MAX	Adolescent	Manganese	Baseline_RESI_MAX_Adolescent_Manganese	3.80E+01	8.00E-02	2.25E-02	3.75E+02	1.06E+02	1.49E-01	3.60E-01	3.80E+01	3.42E+01	5.92E+02	9.91E+00	7.08E-02
Baseline	RESI	MAX	Adolescent	Silica	Baseline_RESI_MAX_Adolescent_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	MAX	Adolescent	Titanium	Baseline_RESI_MAX_Adolescent_Titanium	1.94E+01	2.20E-03	1.15E-02	1.16E+00	0.00E+00	2.14E-01	4.09E-01	1.94E+01	1.75E+01	5.81E+01	9.73E-01	**NA**
Baseline	RESI	MED	Adolescent	Aluminum	Baseline_RESI_MED_Adolescent_Aluminum	2.60E+02	1.50E-02	1.54E-01	1.82E+01	1.37E+00	2.96E-01	5.29E-01	2.60E+02	2.34E+02	7.75E+02	1.30E+01	9.07E-02
Baseline	RESI	MED	Adolescent	Benzo(a)pyrene	Baseline_RESI_MED_Adolescent_Benzo(a)pyr	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Adolescent	Chromium	Baseline_RESI_MED_Adolescent_Chromium	1.08E+00	1.00E-03	6.40E-04	7.80E-01	4.18E-01	2.39E-02	3.20E-02	4.32E-01	3.89E-01	3.16E+00	5.29E-02	3.52E-05
Baseline	RESI	MED	Adolescent	Iron	Baseline_RESI_MED_Adolescent_Iron	1.68E+03	2.20E-01	9.96E-01	4.49E+01	2.90E+02	2.45E+00	4.56E+00	1.68E+03	1.51E+03	5.22E+03	8.74E+01	1.25E-01
Baseline	RESI	MED	Adolescent	Manganese	Baseline_RESI_MED_Adolescent_Manganese	3.80E+01	8.00E-02	2.25E-02	3.75E+02	1.06E+02	1.49E-01	3.60E-01	3.80E+01	3.42E+01	5.92E+02	9.91E+00	7.08E-02
Baseline	RESI	MED	Adolescent	Silica	Baseline_RESI_MED_Adolescent_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	MED	Adolescent	Titanium	Baseline_RESI_MED_Adolescent_Titanium	1.94E+01	2.20E-03	1.15E-02	1.16E+00	0.00E+00	2.14E-01	4.09E-01	1.94E+01	1.75E+01	5.81E+01	9.73E-01	**NA**
Baseline	RESI	LOW	Adolescent	Aluminum	Baseline_RESI_LOW_Adolescent_Aluminum	2.60E+02	1.50E-02	1.54E-01	1.82E+01	1.37E+00	2.96E-01	5.29E-01	2.60E+02	2.34E+02	7.75E+02	1.30E+01	9.07E-02
Baseline	RESI	LOW	Adolescent	Benzo(a)pyrene	Baseline_RESI_LOW_Adolescent_Benzo(a)pyr	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Adolescent	Chromium	Baseline_RESI_LOW_Adolescent_Chromium	1.08E+00	1.00E-03	6.40E-04	7.80E-01	4.18E-01	2.39E-02	3.20E-02	4.32E-01	3.89E-01	3.16E+00	5.29E-02	3.52E-05
Baseline	RESI	LOW	Adolescent	Iron	Baseline_RESI_LOW_Adolescent_Iron	1.68E+03	2.20E-01	9.96E-01	4.49E+01	2.90E+02	2.45E+00	4.56E+00	1.68E+03	1.51E+03	5.22E+03	8.74E+01	1.25E-01
Baseline	RESI	LOW	Adolescent	Manganese	Baseline_RESI_LOW_Adolescent_Manganese	3.80E+01	8.00E-02	2.25E-02	3.75E+02	1.06E+02	1.49E-01	3.60E-01	3.80E+01	3.42E+01	5.92E+02	9.91E+00	7.08E-02
Baseline	RESI	LOW	Adolescent	Silica	Baseline_RESI_LOW_Adolescent_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	LOW	Adolescent	Titanium	Baseline_RESI_LOW_Adolescent_Titanium	1.94E+01	2.20E-03	1.15E-02	1.16E+00	0.00E+00	2.14E-01	4.09E-01	1.94E+01	1.75E+01	5.81E+01	9.73E-01	**NA**
Baseline	RESI	MAX	Adult	Aluminum	Baseline_RESI_MAX_Adult_Aluminum	2.60E+02	2.25E-02	1.64E-01	2.22E+01	1.37E+00	3.11E-01	6.14E-01	2.89E+02	2.67E+02	8.41E+02	1.19E+01	8.32E-02
Baseline	RESI	MAX	Adult	Benzo(a)pyrene	Baseline_RESI_MAX_Adult_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Adult	Chromium	Baseline_RESI_MAX_Adult_Chromium	1.08E+00	1.50E-03	6.81E-04	9.52E-01	4.18E-01	2.50E-02	3.71E-02	4.81E-01	4.44E-01	3.44E+00	4.86E-02	3.24E-05
Baseline	RESI	MAX	Adult	Iron	Baseline_RESI_MAX_Adult_Iron	1.68E+03	3.30E-01	1.06E+00	5.49E+01	2.90E+02	2.57E+00	5.29E+00	1.87E+03	1.73E+03	5.63E+03	7.96E+01	1.14E-01
Baseline	RESI	MAX	Adult	Manganese	Baseline_RESI_MAX_Adult_Manganese	3.80E+01	1.20E-01	2.40E-02	4.58E+02	1.06E+02	1.56E-01	4.18E-01	4.23E+01	3.90E+01	6.84E+02	9.67E+00	6.91E-02
Baseline	RESI	MAX	Adult	Silica	Baseline_RESI_MAX_Adult_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	MAX	Adult	Titanium	Baseline_RESI_MAX_Adult_Titanium	1.94E+01	3.30E-03	1.22E-02	1.42E+00	0.00E+00	2.25E-01	4.74E-01	2.16E+01	1.99E+01	6.31E+01	8.92E-01	**NA**
Baseline	RESI	MED	Adult	Aluminum	Baseline_RESI_MED_Adult_Aluminum	2.60E+02	2.25E-02	1.64E-01	2.22E+01	1.37E+00	3.11E-01	6.14E-01	2.89E+02	2.67E+02	8.41E+02	1.19E+01	8.32E-02
Baseline	RESI	MED	Adult	Benzo(a)pyrene	Baseline_RESI_MED_Adult_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Adult	Chromium	Baseline_RESI_MED_Adult_Chromium	1.08E+00	1.50E-03	6.81E-04	9.52E-01	4.18E-01	2.50E-02	3.71E-02	4.81E-01	4.44E-01	3.44E+00	4.86E-02	3.24E-05
Baseline	RESI	MED	Adult	Iron	Baseline_RESI_MED_Adult_Iron	1.68E+03	3.30E-01	1.06E+00	5.49E+01	2.90E+02	2.57E+00	5.29E+00	1.87E+03	1.73E+03	5.63E+03	7.96E+01	1.14E-01
Baseline	RESI	MED	Adult	Manganese	Baseline_RESI_MED_Adult_Manganese	3.80E+01	1.20E-01	2.40E-02	4.58E+02	1.06E+02	1.56E-01	4.18E-01	4.23E+01	3.90E+01	6.84E+02	9.67E+00	6.91E-02
Baseline	RESI	MED	Adult	Silica	Baseline_RESI_MED_Adult_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	MED	Adult	Titanium	Baseline_RESI_MED_Adult_Titanium	1.94E+01	3.30E-03	1.22E-02	1.42E+00	0.00E+00	2.25E-01	4.74E-01	2.16E+01	1.99E+01	6.31E+01	8.92E-01	**NA**
Baseline	RESI	LOW	Adult	Aluminum	Baseline_RESI_LOW_Adult_Aluminum	2.60E+02	2.25E-02	1.64E-01	2.22E+01	1.37E+00	3.11E-01	6.14E-01	2.89E+02	2.67E+02	8.41E+02	1.19E+01	8.32E-02
Baseline	RESI	LOW	Adult	Benzo(a)pyrene	Baseline_RESI_LOW_Adult_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Adult	Chromium	Baseline_RESI_LOW_Adult_Chromium	1.08E+00	1.50E-03	6.81E-04	9.52E-01	4.18E-01	2.50E-02	3.71E-02	4.81E-01	4.44E-01	3.44E+00	4.86E-02	3.24E-05
Baseline	RESI	LOW	Adult	Iron	Baseline_RESI_LOW_Adult_Iron	1.68E+03	3.30E-01	1.06E+00	5.49E+01	2.90E+02	2.57E+00	5.29E+00	1.87E+03	1.73E+03	5.63E+03	7.96E+01	1.14E-01
Baseline	RESI	LOW	Adult	Manganese	Baseline_RESI_LOW_Adult_Manganese	3.80E+01	1.20E-01	2.40E-02	4.58E+02	1.06E+02	1.56E-01	4.18E-01	4.23E+01	3.90E+01	6.84E+02	9.67E+00	6.91E-02
Baseline	RESI	LOW	Adult	Silica	Baseline_RESI_LOW_Adult_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	LOW	Adult	Titanium	Baseline_RESI_LOW_Adult_Titanium	1.94E+01	3.30E-03	1.22E-02	1.42E+00	0.00E+00	2.25E-01	4.74E-01	2.16E+01	1.99E+01	6.31E+01	8.92E-01	**NA**
Baseline	RESI	MAX	Child	Aluminum	Baseline_RESI_MAX_Child_Aluminum	2.60E+02	1.20E-02	1.43E-01	2.20E+01	8.69E-01	2.52E-01	2.78E-01	1.92E+02	1.48E+02	6.23E+02	1.89E+01	1.32E-01
Baseline	RESI	MAX	Child	Benzo(a)pyrene	Baseline_RESI_MAX_Child_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Child	Chromium	Baseline_RESI_MAX_Child_Chromium	1.08E+00	8.00E-04	5.95E-04	9.42E-01	2.66E-01	2.03E-02	1.68E-02	3.19E-01	2.46E-01	2.89E+00	8.79E-02	5.86E-05
Baseline	RESI	MAX	Child	Iron	Baseline_RESI_MAX_Child_Iron	1.68E+03	1.76E-01	9.26E-01	5.43E+01	1.85E+02	2.08E+00	2.39E+00	1.24E+03	9.56E+02	4.12E+03	1.25E+02	1.79E-01
Baseline	RESI	MAX	Child	Manganese	Baseline_RESI_MAX_Child_Manganese	3.80E+01	6.40E-02	2.09E-02	4.54E+02	6.72E+01	1.27E-01	1.89E-01	2.80E+01	2.16E+01	6.09E+02	1.85E+01	1.32E-01
Baseline	RESI	MAX	Child	Silica	Baseline_RESI_MAX_Child_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**NA**
Baseline	RESI	MAX	Child	Titanium	Baseline_RESI_MAX_Child_Titanium	1.94E+01	1.76E-03	1.07E-02	1.41E+00	0.00E+00	1.82E-01	2.14E-01	1.43E+01	1.10E+01	4.66E+01	1.42E+00	**NA**
Baseline	RESI	MED	Child	Aluminum	Baseline_RESI_MED_Child_Aluminum	2.60E+02	1.20E-02	1.43E-01	2.20E+01	8.69E-01	2.52E-01	2.78E-01	1.92E+02	1.48E+02	6.23E+02	1.89E+01	1.32E-01
Baseline	RESI	MED	Child	Benzo(a)pyrene	Baseline_RESI_MED_Child_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Summary of Predicted Human Exposures for Each Lifestyle Category, Scenario and Chemical

						Estimated Daily Intake											
Scenario	Type	Site	Receptor	Chemical	Abbreviation	Soil SIR ug/day	Drinking Water WIR ug/day	Dust AIR ug/day	Berries Berries ug/day	Fish Fish ug/day	Ruffed_Grouse Ruffed_Grouse ug/day	Snowshoe_Hare Snowshoe_Hare ug/day	Dermal Hands ug/day	Dermal Other ug/day	Total EDI ug/day	Total EDI ug/kg/day	HQ Total Unitless
Baseline	RESI	MED	Child	Chromium	Baseline_RESI_MED_Child_Chromium	1.08E+00	8.00E-04	5.95E-04	9.42E-01	2.66E-01	2.03E-02	1.68E-02	3.19E-01	2.46E-01	2.89E+00	8.79E-02	5.86E-05
Baseline	RESI	MED	Child	Iron	Baseline_RESI_MED_Child_Iron	1.68E+03	1.76E-01	9.26E-01	5.43E+01	1.85E+02	2.08E+00	2.39E+00	1.24E+03	9.56E+02	4.12E+03	1.25E+02	1.79E-01
Baseline	RESI	MED	Child	Manganese	Baseline_RESI_MED_Child_Manganese	3.80E+01	6.40E-02	2.09E-02	4.54E+02	6.72E+01	1.27E-01	1.89E-01	2.80E+01	2.16E+01	6.09E+02	1.85E+01	1.32E-01
Baseline	RESI	MED	Child	Silica	Baseline_RESI_MED_Child_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	MED	Child	Titanium	Baseline_RESI_MED_Child_Titanium	1.94E+01	1.76E-03	1.07E-02	1.41E+00	0.00E+00	1.82E-01	2.14E-01	1.43E+01	1.10E+01	4.66E+01	1.42E+00	NA
Baseline	RESI	LOW	Child	Aluminum	Baseline_RESI_LOW_Child_Aluminum	2.60E+02	1.20E-02	1.43E-01	2.20E+01	8.69E-01	2.52E-01	2.78E-01	1.92E+02	1.48E+02	6.23E+02	1.89E+01	1.32E-01
Baseline	RESI	LOW	Child	Benzo(a)pyrene	Baseline_RESI_LOW_Child_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Child	Chromium	Baseline_RESI_LOW_Child_Chromium	1.08E+00	8.00E-04	5.95E-04	9.42E-01	2.66E-01	2.03E-02	1.68E-02	3.19E-01	2.46E-01	2.89E+00	8.79E-02	5.86E-05
Baseline	RESI	LOW	Child	Iron	Baseline_RESI_LOW_Child_Iron	1.68E+03	1.76E-01	9.26E-01	5.43E+01	1.85E+02	2.08E+00	2.39E+00	1.24E+03	9.56E+02	4.12E+03	1.25E+02	1.79E-01
Baseline	RESI	LOW	Child	Manganese	Baseline_RESI_LOW_Child_Manganese	3.80E+01	6.40E-02	2.09E-02	4.54E+02	6.72E+01	1.27E-01	1.89E-01	2.80E+01	2.16E+01	6.09E+02	1.85E+01	1.32E-01
Baseline	RESI	LOW	Child	Silica	Baseline_RESI_LOW_Child_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	LOW	Child	Titanium	Baseline_RESI_LOW_Child_Titanium	1.94E+01	1.76E-03	1.07E-02	1.41E+00	0.00E+00	1.82E-01	2.14E-01	1.43E+01	1.10E+01	4.66E+01	1.42E+00	NA
Baseline	RESI	MAX	Toddler	Aluminum	Baseline_RESI_MAX_Toddler_Aluminum	1.04E+03	9.00E-03	8.20E-02	1.02E+01	6.21E-01	1.93E-01	1.48E-01	1.40E+02	8.39E+01	1.27E+03	7.73E+01	5.40E-01
Baseline	RESI	MAX	Toddler	Benzo(a)pyrene	Baseline_RESI_MAX_Toddler_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Toddler	Chromium	Baseline_RESI_MAX_Toddler_Chromium	4.32E+00	6.00E-04	3.41E-04	4.36E-01	1.90E-01	1.55E-02	8.92E-03	2.32E-01	1.39E-01	5.34E+00	3.24E-01	2.16E-04
Baseline	RESI	MAX	Toddler	Iron	Baseline_RESI_MAX_Toddler_Iron	6.72E+03	1.32E-01	5.30E-01	2.51E+01	1.32E+02	1.59E+00	1.27E+00	9.03E+02	5.42E+02	8.33E+03	5.05E+02	7.21E-01
Baseline	RESI	MAX	Toddler	Manganese	Baseline_RESI_MAX_Toddler_Manganese	1.52E+02	4.80E-02	1.20E-02	2.10E+02	4.80E+01	9.68E-02	1.00E-01	2.04E+01	1.23E+01	4.43E+02	2.68E+01	1.92E-01
Baseline	RESI	MAX	Toddler	Silica	Baseline_RESI_MAX_Toddler_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	MAX	Toddler	Titanium	Baseline_RESI_MAX_Toddler_Titanium	7.76E+01	1.32E-03	6.12E-03	6.50E-01	0.00E+00	1.39E-01	1.14E-01	1.04E+01	6.26E+00	9.52E+01	5.77E+00	NA
Baseline	RESI	MED	Toddler	Aluminum	Baseline_RESI_MED_Toddler_Aluminum	1.04E+03	9.00E-03	8.20E-02	1.02E+01	6.21E-01	1.93E-01	1.48E-01	1.40E+02	8.39E+01	1.27E+03	7.73E+01	5.40E-01
Baseline	RESI	MED	Toddler	Benzo(a)pyrene	Baseline_RESI_MED_Toddler_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Toddler	Chromium	Baseline_RESI_MED_Toddler_Chromium	4.32E+00	6.00E-04	3.41E-04	4.36E-01	1.90E-01	1.55E-02	8.92E-03	2.32E-01	1.39E-01	5.34E+00	3.24E-01	2.16E-04
Baseline	RESI	MED	Toddler	Iron	Baseline_RESI_MED_Toddler_Iron	6.72E+03	1.32E-01	5.30E-01	2.51E+01	1.32E+02	1.59E+00	1.27E+00	9.03E+02	5.42E+02	8.33E+03	5.05E+02	7.21E-01
Baseline	RESI	MED	Toddler	Manganese	Baseline_RESI_MED_Toddler_Manganese	1.52E+02	4.80E-02	1.20E-02	2.10E+02	4.80E+01	9.68E-02	1.00E-01	2.04E+01	1.23E+01	4.43E+02	2.68E+01	1.92E-01
Baseline	RESI	MED	Toddler	Silica	Baseline_RESI_MED_Toddler_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	MED	Toddler	Titanium	Baseline_RESI_MED_Toddler_Titanium	7.76E+01	1.32E-03	6.12E-03	6.50E-01	0.00E+00	1.39E-01	1.14E-01	1.04E+01	6.26E+00	9.52E+01	5.77E+00	NA
Baseline	RESI	LOW	Toddler	Aluminum	Baseline_RESI_LOW_Toddler_Aluminum	1.04E+03	9.00E-03	8.20E-02	1.02E+01	6.21E-01	1.93E-01	1.48E-01	1.40E+02	8.39E+01	1.27E+03	7.73E+01	5.40E-01
Baseline	RESI	LOW	Toddler	Benzo(a)pyrene	Baseline_RESI_LOW_Toddler_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Toddler	Chromium	Baseline_RESI_LOW_Toddler_Chromium	4.32E+00	6.00E-04	3.41E-04	4.36E-01	1.90E-01	1.55E-02	8.92E-03	2.32E-01	1.39E-01	5.34E+00	3.24E-01	2.16E-04
Baseline	RESI	LOW	Toddler	Iron	Baseline_RESI_LOW_Toddler_Iron	6.72E+03	1.32E-01	5.30E-01	2.51E+01	1.32E+02	1.59E+00	1.27E+00	9.03E+02	5.42E+02	8.33E+03	5.05E+02	7.21E-01
Baseline	RESI	LOW	Toddler	Manganese	Baseline_RESI_LOW_Toddler_Manganese	1.52E+02	4.80E-02	1.20E-02	2.10E+02	4.80E+01	9.68E-02	1.00E-01	2.04E+01	1.23E+01	4.43E+02	2.68E+01	1.92E-01
Baseline	RESI	LOW	Toddler	Silica	Baseline_RESI_LOW_Toddler_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	LOW	Toddler	Titanium	Baseline_RESI_LOW_Toddler_Titanium	7.76E+01	1.32E-03	6.12E-03	6.50E-01	0.00E+00	1.39E-01	1.14E-01	1.04E+01	6.26E+00	9.52E+01	5.77E+00	NA
Baseline	RESI	MAX	Infant	Aluminum	Baseline_RESI_MAX_Infant_Aluminum	2.60E+02	4.50E-03	2.17E-02	5.17E+00	0.00E+00	0.00E+00	6.14E-03	1.04E+02	4.75E+01	4.17E+02	5.08E+01	3.55E-01
Baseline	RESI	MAX	Infant	Benzo(a)pyrene	Baseline_RESI_MAX_Infant_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MAX	Infant	Chromium	Baseline_RESI_MAX_Infant_Chromium	1.08E+00	3.00E-04	9.03E-05	2.22E-01	0.00E+00	0.00E+00	3.71E-04	1.73E-01	7.88E-02	1.55E+00	1.90E-01	1.26E-04
Baseline	RESI	MAX	Infant	Iron	Baseline_RESI_MAX_Infant_Iron	1.68E+03	6.60E-02	1.40E-01	1.28E+01	0.00E+00	0.00E+00	5.29E-02	6.72E+02	3.07E+02	2.67E+03	3.26E+02	4.65E-01
Baseline	RESI	MAX	Infant	Manganese	Baseline_RESI_MAX_Infant_Manganese	3.80E+01	2.40E-02	3.18E-03	1.07E+02	0.00E+00	0.00E+00	4.18E-03	1.52E+01	6.94E+00	1.67E+02	2.03E+01	1.45E-01
Baseline	RESI	MAX	Infant	Silica	Baseline_RESI_MAX_Infant_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	MAX	Infant	Titanium	Baseline_RESI_MAX_Infant_Titanium	1.94E+01	6.60E-04	1.62E-03	3.31E-01	0.00E+00	0.00E+00	4.74E-03	7.76E+00	3.54E+00	3.10E+01	3.79E+00	NA
Baseline	RESI	MED	Infant	Aluminum	Baseline_RESI_MED_Infant_Aluminum	2.60E+02	4.50E-03	2.17E-02	5.17E+00	0.00E+00	0.00E+00	6.14E-03	1.04E+02	4.75E+01	4.17E+02	5.08E+01	3.55E-01
Baseline	RESI	MED	Infant	Benzo(a)pyrene	Baseline_RESI_MED_Infant_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	MED	Infant	Chromium	Baseline_RESI_MED_Infant_Chromium	1.08E+00	3.00E-04	9.03E-05	2.22E-01	0.00E+00	0.00E+00	3.71E-04	1.73E-01	7.88E-02	1.55E+00	1.90E-01	1.26E-04
Baseline	RESI	MED	Infant	Iron	Baseline_RESI_MED_Infant_Iron	1.68E+03	6.60E-02	1.40E-01	1.28E+01	0.00E+00	0.00E+00	5.29E-02	6.72E+02	3.07E+02	2.67E+03	3.26E+02	4.65E-01
Baseline	RESI	MED	Infant	Manganese	Baseline_RESI_MED_Infant_Manganese	3.80E+01	2.40E-02	3.18E-03	1.07E+02	0.00E+00	0.00E+00	4.18E-03	1.52E+01	6.94E+00	1.67E+02	2.03E+01	1.45E-01
Baseline	RESI	MED	Infant	Silica	Baseline_RESI_MED_Infant_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	MED	Infant	Titanium	Baseline_RESI_MED_Infant_Titanium	1.94E+01	6.60E-04	1.62E-03	3.31E-01	0.00E+00	0.00E+00	4.74E-03	7.76E+00	3.54E+00	3.10E+01	3.79E+00	NA
Baseline	RESI	LOW	Infant	Aluminum	Baseline_RESI_LOW_Infant_Aluminum	2.60E+02	4.50E-03	2.17E-02	5.17E+00	0.00E+00	0.00E+00	6.14E-03	1.04E+02	4.75E+01	4.17E+02	5.08E+01	3.55E-01
Baseline	RESI	LOW	Infant	Benzo(a)pyrene	Baseline_RESI_LOW_Infant_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	RESI	LOW	Infant	Chromium	Baseline_RESI_LOW_Infant_Chromium	1.08E+00	3.00E-04	9.03E-05	2.22E-01	0.00E+00	0.00E+00	3.71E-04	1.73E-01	7.88E-02	1.55E+00	1.90E-01	1.26E-04
Baseline	RESI	LOW	Infant	Iron	Baseline_RESI_LOW_Infant_Iron	1.68E+03	6.60E-02	1.40E-01	1.28E+01	0.00E+00	0.00E+00	5.29E-02	6.72E+02	3.07E+02	2.67E+03	3.26E+02	4.65E-01

Summary of Predicted Human Exposures for Each Lifestyle Category, Scenario and Chemical

Scenario	Type	Site	Receptor	Chemical	Abbreviation	Estimated Daily Intake											
						Soil SIR ug/day	Drinking Water WIR ug/day	Dust AIR ug/day	Berries Berries ug/day	Fish Fish ug/day	Ruffed_Grouse Ruffed_Grouse ug/day	Snowshoe_Hare Snowshoe_Hare ug/day	Dermal Hands ug/day	Dermal Other ug/day	Total EDI ug/day	Total EDI ug/kg/day	HQ Total Unitless
Baseline	RESI	LOW	Infant	Manganese	Baseline_RESI_LOW_Infant_Manganese	3.80E+01	2.40E-02	3.18E-03	1.07E+02	0.00E+00	0.00E+00	4.18E-03	1.52E+01	6.94E+00	1.67E+02	2.03E+01	1.45E-01
Baseline	RESI	LOW	Infant	Silica	Baseline_RESI_LOW_Infant_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Baseline	RESI	LOW	Infant	Titanium	Baseline_RESI_LOW_Infant_Titanium	1.94E+01	6.60E-04	1.62E-03	3.31E-01	0.00E+00	0.00E+00	4.74E-03	7.76E+00	3.54E+00	3.10E+01	3.79E+00	NA
Project	RESI	MAX	Adolescent	Aluminum	Project_RESI_MAX_Adolescent_Aluminum	1.41E+01	0.00E+00	8.36E-03	1.53E+00	0.00E+00	2.67E-02	6.32E-02	1.41E+01	1.27E+01	4.25E+01	7.13E-01	4.98E-03
Project	RESI	MAX	Adolescent	Benzo(a)pyrene	Project_RESI_MAX_Adolescent_Benzo(a)pyrer	3.24E-10	0.00E+00	1.92E-13	7.31E-10	0.00E+00	8.08E-12	3.24E-11	1.94E-10	1.75E-10	1.46E-09	2.45E-11	1.75E-08
Project	RESI	MAX	Adolescent	Chromium	Project_RESI_MAX_Adolescent_Chromium	2.88E-01	0.00E+00	1.70E-04	5.00E-02	0.00E+00	4.47E-03	1.01E-02	1.15E-01	1.04E-01	5.71E-01	9.56E-03	6.37E-06
Project	RESI	MAX	Adolescent	Iron	Project_RESI_MAX_Adolescent_Iron	4.36E+02	0.00E+00	2.58E-01	4.55E+01	0.00E+00	1.03E+00	2.45E+00	4.36E+02	3.92E+02	1.31E+03	2.20E+01	3.14E-02
Project	RESI	MAX	Adolescent	Manganese	Project_RESI_MAX_Adolescent_Manganese	1.00E+01	0.00E+00	5.93E-03	1.09E+01	0.00E+00	3.52E-02	8.42E-02	1.00E+01	9.00E+00	4.00E+01	6.70E-01	4.79E-03
Project	RESI	MAX	Adolescent	Silica	Project_RESI_MAX_Adolescent_Silica	5.44E+02	0.00E+00	3.23E-01	1.89E+03	0.00E+00	1.06E+01	2.55E+01	5.44E+02	4.90E+02	3.50E+03	5.87E+01	NA
Project	RESI	MAX	Adolescent	Titanium	Project_RESI_MAX_Adolescent_Titanium	3.97E+00	0.00E+00	2.35E-03	4.28E-01	0.00E+00	7.49E-02	1.78E-01	3.97E+00	3.57E+00	1.22E+01	2.04E-01	NA
Project	RESI	MED	Adolescent	Aluminum	Project_RESI_MED_Adolescent_Aluminum	1.08E+01	0.00E+00	6.39E-03	1.17E+00	0.00E+00	2.04E-02	4.82E-02	1.08E+01	9.69E+00	3.25E+01	5.44E-01	3.80E-03
Project	RESI	MED	Adolescent	Benzo(a)pyrene	Project_RESI_MED_Adolescent_Benzo(a)pyrer	2.47E-10	0.00E+00	1.47E-13	5.58E-10	0.00E+00	6.17E-12	2.48E-11	1.48E-10	1.34E-10	1.12E-09	1.87E-11	1.34E-08
Project	RESI	MED	Adolescent	Chromium	Project_RESI_MED_Adolescent_Chromium	2.20E-01	0.00E+00	1.30E-04	3.82E-02	0.00E+00	3.41E-03	7.69E-03	8.78E-02	7.91E-02	4.36E-01	7.30E-03	4.87E-06
Project	RESI	MED	Adolescent	Iron	Project_RESI_MED_Adolescent_Iron	3.33E+02	0.00E+00	1.97E-01	3.47E+01	0.00E+00	7.88E-01	1.87E+00	3.33E+02	2.99E+02	1.00E+03	1.68E+01	2.40E-02
Project	RESI	MED	Adolescent	Manganese	Project_RESI_MED_Adolescent_Manganese	7.63E+00	0.00E+00	4.53E-03	8.32E+00	0.00E+00	2.69E-02	6.43E-02	7.63E+00	6.87E+00	3.06E+01	5.12E-01	3.66E-03
Project	RESI	MED	Adolescent	Silica	Project_RESI_MED_Adolescent_Silica	4.15E+02	0.00E+00	2.46E-01	1.44E+03	0.00E+00	8.11E+00	1.95E+01	4.15E+02	3.74E+02	2.67E+03	4.48E+01	NA
Project	RESI	MED	Adolescent	Titanium	Project_RESI_MED_Adolescent_Titanium	3.03E+00	0.00E+00	1.80E-03	3.26E-01	0.00E+00	5.72E-02	1.36E-01	3.03E+00	2.73E+00	9.32E+00	1.56E-01	NA
Project	RESI	LOW	Adolescent	Aluminum	Project_RESI_LOW_Adolescent_Aluminum	7.69E+00	0.00E+00	4.56E-03	8.36E-01	0.00E+00	1.45E-02	3.45E-02	7.69E+00	6.92E+00	2.32E+01	3.89E-01	2.72E-03
Project	RESI	LOW	Adolescent	Benzo(a)pyrene	Project_RESI_LOW_Adolescent_Benzo(a)pyre	1.77E-10	0.00E+00	1.05E-13	3.99E-10	0.00E+00	4.41E-12	1.77E-11	1.06E-10	9.54E-11	7.99E-10	1.34E-11	9.56E-09
Project	RESI	LOW	Adolescent	Chromium	Project_RESI_LOW_Adolescent_Chromium	1.57E-01	0.00E+00	9.30E-05	2.73E-02	0.00E+00	2.44E-03	5.49E-03	6.27E-02	5.65E-02	3.11E-01	5.22E-03	3.48E-06
Project	RESI	LOW	Adolescent	Iron	Project_RESI_LOW_Adolescent_Iron	2.38E+02	0.00E+00	1.41E-01	2.48E+01	0.00E+00	5.63E-01	1.33E+00	2.38E+02	2.14E+02	7.16E+02	1.20E+01	1.71E-02
Project	RESI	LOW	Adolescent	Manganese	Project_RESI_LOW_Adolescent_Manganese	5.45E+00	0.00E+00	3.23E-03	5.94E+00	0.00E+00	1.92E-02	4.60E-02	5.45E+00	4.91E+00	2.18E+01	3.66E-01	2.61E-03
Project	RESI	LOW	Adolescent	Silica	Project_RESI_LOW_Adolescent_Silica	2.97E+02	0.00E+00	1.76E-01	1.03E+03	0.00E+00	5.79E+00	1.39E+01	2.97E+02	2.67E+02	1.91E+03	3.20E+01	NA
Project	RESI	LOW	Adolescent	Titanium	Project_RESI_LOW_Adolescent_Titanium	2.17E+00	0.00E+00	1.28E-03	2.33E-01	0.00E+00	4.09E-02	9.72E-02	2.17E+00	1.95E+00	6.65E+00	1.11E-01	NA
Project	RESI	MAX	Adult	Aluminum	Project_RESI_MAX_Adult_Aluminum	1.41E+01	0.00E+00	8.90E-03	1.87E+00	0.00E+00	2.80E-02	7.33E-02	1.57E+01	1.45E+01	4.63E+01	6.54E-01	4.58E-03
Project	RESI	MAX	Adult	Benzo(a)pyrene	Project_RESI_MAX_Adult_Benzo(a)pyrene	3.24E-10	0.00E+00	2.04E-13	8.92E-10	0.00E+00	8.48E-12	3.76E-11	2.16E-10	2.00E-10	1.68E-09	2.37E-11	1.70E-08
Project	RESI	MAX	Adult	Chromium	Project_RESI_MAX_Adult_Chromium	2.88E-01	0.00E+00	1.81E-04	6.10E-02	0.00E+00	4.69E-03	1.17E-02	1.28E-01	1.18E-01	6.11E-01	8.65E-03	5.76E-06
Project	RESI	MAX	Adult	Iron	Project_RESI_MAX_Adult_Iron	4.36E+02	0.00E+00	2.75E-01	5.55E+01	0.00E+00	1.08E+00	2.84E+00	4.85E+02	4.48E+02	1.43E+03	2.02E+01	2.89E-02
Project	RESI	MAX	Adult	Manganese	Project_RESI_MAX_Adult_Manganese	1.00E+01	0.00E+00	6.31E-03	1.33E+01	0.00E+00	3.69E-02	9.78E-02	1.11E+01	1.03E+01	4.48E+01	6.34E-01	4.53E-03
Project	RESI	MAX	Adult	Silica	Project_RESI_MAX_Adult_Silica	5.44E+02	0.00E+00	3.43E-01	2.31E+03	0.00E+00	1.12E+01	2.96E+01	6.05E+02	5.59E+02	4.05E+03	5.74E+01	NA
Project	RESI	MAX	Adult	Titanium	Project_RESI_MAX_Adult_Titanium	3.97E+00	0.00E+00	2.51E-03	5.22E-01	0.00E+00	7.87E-02	2.07E-01	4.42E+00	4.08E+00	1.33E+01	1.88E-01	NA
Project	RESI	MED	Adult	Aluminum	Project_RESI_MED_Adult_Aluminum	1.08E+01	0.00E+00	6.79E-03	1.43E+00	0.00E+00	2.14E-02	5.60E-02	1.20E+01	1.11E+01	3.53E+01	5.00E-01	3.50E-03
Project	RESI	MED	Adult	Benzo(a)pyrene	Project_RESI_MED_Adult_Benzo(a)pyrene	2.47E-10	0.00E+00	1.56E-13	6.81E-10	0.00E+00	6.48E-12	2.87E-11	1.65E-10	1.52E-10	1.28E-09	1.81E-11	1.29E-08
Project	RESI	MED	Adult	Chromium	Project_RESI_MED_Adult_Chromium	2.20E-01	0.00E+00	1.39E-04	4.66E-02	0.00E+00	3.58E-03	8.92E-03	9.77E-02	9.03E-02	4.67E-01	6.60E-03	4.40E-06
Project	RESI	MED	Adult	Iron	Project_RESI_MED_Adult_Iron	3.33E+02	0.00E+00	2.10E-01	4.24E+01	0.00E+00	8.27E-01	2.17E+00	3.70E+02	3.42E+02	1.09E+03	1.54E+01	2.20E-02
Project	RESI	MED	Adult	Manganese	Project_RESI_MED_Adult_Manganese	7.63E+00	0.00E+00	4.82E-03	1.02E+01	0.00E+00	2.82E-02	7.46E-02	8.49E+00	7.84E+00	3.42E+01	4.84E-01	3.46E-03
Project	RESI	MED	Adult	Silica	Project_RESI_MED_Adult_Silica	4.15E+02	0.00E+00	2.62E-01	1.76E+03	0.00E+00	8.52E+00	2.26E+01	4.62E+02	4.27E+02	3.10E+03	4.38E+01	NA
Project	RESI	MED	Adult	Titanium	Project_RESI_MED_Adult_Titanium	3.03E+00	0.00E+00	1.91E-03	3.99E-01	0.00E+00	6.01E-02	1.58E-01	3.37E+00	3.12E+00	1.01E+01	1.43E-01	NA
Project	RESI	LOW	Adult	Aluminum	Project_RESI_LOW_Adult_Aluminum	7.69E+00	0.00E+00	4.85E-03	1.02E+00	0.00E+00	1.53E-02	4.00E-02	8.56E+00	7.91E+00	2.52E+01	3.57E-01	2.50E-03
Project	RESI	LOW	Adult	Benzo(a)pyrene	Project_RESI_LOW_Adult_Benzo(a)pyrene	1.77E-10	0.00E+00	1.11E-13	4.86E-10	0.00E+00	4.63E-12	2.05E-11	1.18E-10	1.09E-10	9.15E-10	1.29E-11	9.25E-09
Project	RESI	LOW	Adult	Chromium	Project_RESI_LOW_Adult_Chromium	1.57E-01	0.00E+00	9.90E-05	3.33E-02	0.00E+00	2.56E-03	6.37E-03	6.98E-02	6.45E-02	3.33E-01	4.72E-03	3.14E-06
Project	RESI	LOW	Adult	Iron	Project_RESI_LOW_Adult_Iron	2.38E+02	0.00E+00	1.50E-01	3.03E+01	0.00E+00	5.91E-01	1.55E+00	2.64E+02	2.44E+02	7.79E+02	1.10E+01	1.57E-02
Project	RESI	LOW	Adult	Manganese	Project_RESI_LOW_Adult_Manganese	5.45E+00	0.00E+00	3.44E-03	7.25E+00	0.00E+00	2.02E-02	5.33E-02	6.07E+00	5.60E+00	2.44E+01	3.46E-01	2.47E-03
Project	RESI	LOW	Adult	Silica	Project_RESI_LOW_Adult_Silica	2.97E+02	0.00E+00	1.87E-01	1.26E+03	0.00E+00	6.08E+00	1.61E+01	3.30E+02	3.05E+02	2.21E+03	3.13E+01	NA
Project	RESI	LOW	Adult	Titanium	Project_RESI_LOW_Adult_Titanium	2.17E+00	0.00E+00	1.37E-03	2.85E-01	0.00E+00	4.29E-02	1.13E-01	2.41E+00	2.23E+00	7.24E+00	1.02E-01	NA
Project	RESI	MAX	Child	Aluminum	Project_RESI_MAX_Child_Aluminum	1.41E+01	0.00E+00	7.77E-03	1.85E+00	0.00E+00	2.27E-02	3.31E-02	1.04E+01	8.02E+00	3.44E+01	1.05E+00	7.32E-03
Project	RESI	MAX	Child	Benzo(a)pyrene	Project_RESI_MAX_Child_Benzo(a)pyrene	3.24E-10	0.00E+00	1.78E-13	8.83E-10	0.00E+00	6.86E-12	1.70E-11	1.43E-10	1.11E-10	1.48E-09	4.51E-11	3.22E-08
Project	RESI	MAX	Child	Chromium	Project_RESI_MAX_Child_Chromium	2.88E-01	0.00E+00	1.58E-04	6.04E-02	0.00E+00	3.80E-03	5.28E-03	8.48E-02	6.54E-02	5.08E-01	1.54E-02	1.03E-05
Project	RESI	MAX	Child	Iron	Project_RESI_MAX_Child_Iron	4.36E+02	0.00E+00	2.40E-01	5.49E+01	0.00E+00	8.77E-01	1.28E+00	3.21E+02	2.48E+02	1.06E+03	3.23E+01	4.61E-02
Project	RESI	MAX	Child	Manganese	Project_RESI_MAX_Child_Manganese	1.00E+01	0.00E+00	5.51E-03	1.32E+01	0.00E+00	2.99E-02	4.42E-02	7.37E+00	5.69E+00	3.63E+01	1.10E+00	7.88E-03
Project	RESI	MAX	Child	Silica	Project_RESI_MAX_Child_Silica	5.44E+02	0.00E+00	3.00E-01	2.28E+03	0.00E+00	9.03E+00	1.34E+01	4.01E+02	3.09E+02	3.56E+03	1.08E+02	NA

Summary of Predicted Human Exposures for Each Lifestyle Category, Scenario and Chemical

						Estimated Daily Intake											
Scenario	Type	Site	Receptor	Chemical	Abbreviation	Soil SIR ug/day	Drinking Water WIR ug/day	Dust AIR ug/day	Berries Berries ug/day	Fish Fish ug/day	Ruffed_Grouse Ruffed_Grouse ug/day	Snowshoe_Hare Snowshoe_Hare ug/day	Dermal Hands ug/day	Dermal Other ug/day	Total EDI ug/day	Total EDI ug/kg/day	HQ Total Unitless
Project	RESI	MAX	Child	Titanium	Project_RESI_MAX_Child_Titanium	3.97E+00	0.00E+00	2.19E-03	5.17E-01	0.00E+00	6.37E-02	9.35E-02	2.93E+00	2.26E+00	9.84E+00	2.99E-01	NA
Project	RESI	MED	Child	Aluminum	Project_RESI_MED_Child_Aluminum	1.08E+01	0.00E+00	5.94E-03	1.41E+00	0.00E+00	1.73E-02	2.53E-02	7.94E+00	6.13E+00	2.63E+01	8.00E-01	5.59E-03
Project	RESI	MED	Child	Benzo(a)pyrene	Project_RESI_MED_Child_Benzo(a)pyrene	2.47E-10	0.00E+00	1.36E-13	6.74E-10	0.00E+00	5.24E-12	1.30E-11	1.09E-10	8.44E-11	1.13E-09	3.45E-11	2.46E-08
Project	RESI	MED	Child	Chromium	Project_RESI_MED_Child_Chromium	2.20E-01	0.00E+00	1.21E-04	4.61E-02	0.00E+00	2.90E-03	4.03E-03	6.48E-02	5.00E-02	3.88E-01	1.18E-02	7.85E-06
Project	RESI	MED	Child	Iron	Project_RESI_MED_Child_Iron	3.33E+02	0.00E+00	1.83E-01	4.20E+01	0.00E+00	6.69E-01	9.80E-01	2.45E+02	1.89E+02	8.11E+02	2.47E+01	3.52E-02
Project	RESI	MED	Child	Manganese	Project_RESI_MED_Child_Manganese	7.63E+00	0.00E+00	4.21E-03	1.01E+01	0.00E+00	2.28E-02	3.38E-02	5.63E+00	4.34E+00	2.77E+01	8.43E-01	6.02E-03
Project	RESI	MED	Child	Silica	Project_RESI_MED_Child_Silica	4.15E+02	0.00E+00	2.29E-01	1.74E+03	0.00E+00	6.90E+00	1.02E+01	3.06E+02	2.36E+02	2.72E+03	8.26E+01	NA
Project	RESI	MED	Child	Titanium	Project_RESI_MED_Child_Titanium	3.03E+00	0.00E+00	1.67E-03	3.95E-01	0.00E+00	4.86E-02	7.14E-02	2.24E+00	1.72E+00	7.51E+00	2.28E-01	NA
Project	RESI	LOW	Child	Aluminum	Project_RESI_LOW_Child_Aluminum	7.69E+00	0.00E+00	4.24E-03	1.01E+00	0.00E+00	1.24E-02	1.81E-02	5.67E+00	4.38E+00	1.88E+01	5.71E-01	3.99E-03
Project	RESI	LOW	Child	Benzo(a)pyrene	Project_RESI_LOW_Child_Benzo(a)pyrene	1.77E-10	0.00E+00	9.73E-14	4.82E-10	0.00E+00	3.74E-12	9.28E-12	7.82E-11	6.03E-11	8.10E-10	2.46E-11	1.76E-08
Project	RESI	LOW	Child	Chromium	Project_RESI_LOW_Child_Chromium	1.57E-01	0.00E+00	8.64E-05	3.30E-02	0.00E+00	2.07E-03	2.88E-03	4.63E-02	3.57E-02	2.77E-01	8.41E-03	5.61E-06
Project	RESI	LOW	Child	Iron	Project_RESI_LOW_Child_Iron	2.38E+02	0.00E+00	1.31E-01	3.00E+01	0.00E+00	4.78E-01	7.00E-01	1.75E+02	1.35E+02	5.79E+02	1.76E+01	2.52E-02
Project	RESI	LOW	Child	Manganese	Project_RESI_LOW_Child_Manganese	5.45E+00	0.00E+00	3.00E-03	7.18E+00	0.00E+00	1.63E-02	2.41E-02	4.02E+00	3.10E+00	1.98E+01	6.02E-01	4.30E-03
Project	RESI	LOW	Child	Silica	Project_RESI_LOW_Child_Silica	2.97E+02	0.00E+00	1.64E-01	1.25E+03	0.00E+00	4.93E+00	7.29E+00	2.19E+02	1.69E+02	1.94E+03	5.90E+01	NA
Project	RESI	LOW	Child	Titanium	Project_RESI_LOW_Child_Titanium	2.17E+00	0.00E+00	1.19E-03	2.82E-01	0.00E+00	3.47E-02	5.10E-02	1.60E+00	1.23E+00	5.36E+00	1.63E-01	NA
Project	RESI	MAX	Toddler	Aluminum	Project_RESI_MAX_Toddler_Aluminum	5.64E+01	0.00E+00	4.45E-03	8.56E-01	0.00E+00	1.73E-02	1.76E-02	7.58E+00	4.55E+00	6.94E+01	4.21E+00	2.94E-02
Project	RESI	MAX	Toddler	Benzo(a)pyrene	Project_RESI_MAX_Toddler_Benzo(a)pyrene	1.30E-09	0.00E+00	1.02E-13	4.08E-10	0.00E+00	5.25E-12	9.05E-12	1.04E-10	6.27E-11	1.89E-09	1.14E-10	8.16E-08
Project	RESI	MAX	Toddler	Chromium	Project_RESI_MAX_Toddler_Chromium	1.15E+00	0.00E+00	9.07E-05	2.79E-02	0.00E+00	2.90E-03	2.81E-03	6.18E-02	3.71E-02	1.28E+00	7.78E-02	5.18E-05
Project	RESI	MAX	Toddler	Iron	Project_RESI_MAX_Toddler_Iron	1.74E+03	0.00E+00	1.37E-01	2.54E+01	0.00E+00	6.70E-01	6.82E-01	2.34E+02	1.41E+02	2.14E+03	1.30E+02	1.86E-01
Project	RESI	MAX	Toddler	Manganese	Project_RESI_MAX_Toddler_Manganese	4.00E+01	0.00E+00	3.15E-03	6.08E+00	0.00E+00	2.29E-02	2.35E-02	5.37E+00	3.22E+00	5.47E+01	3.32E+00	2.37E-02
Project	RESI	MAX	Toddler	Silica	Project_RESI_MAX_Toddler_Silica	2.18E+03	0.00E+00	1.72E-01	1.06E+03	0.00E+00	6.91E+00	7.11E+00	2.92E+02	1.75E+02	3.71E+03	2.25E+02	NA
Project	RESI	MAX	Toddler	Titanium	Project_RESI_MAX_Toddler_Titanium	1.59E+01	0.00E+00	1.25E-03	2.39E-01	0.00E+00	4.87E-02	4.97E-02	2.13E+00	1.28E+00	1.96E+01	1.19E+00	NA
Project	RESI	MED	Toddler	Aluminum	Project_RESI_MED_Toddler_Aluminum	4.31E+01	0.00E+00	3.40E-03	6.54E-01	0.00E+00	1.32E-02	1.35E-02	5.79E+00	3.47E+00	5.30E+01	3.21E+00	2.25E-02
Project	RESI	MED	Toddler	Benzo(a)pyrene	Project_RESI_MED_Toddler_Benzo(a)pyrene	9.89E-10	0.00E+00	7.80E-14	3.12E-10	0.00E+00	4.01E-12	6.91E-12	7.98E-11	4.79E-11	1.44E-09	8.73E-11	6.23E-08
Project	RESI	MED	Toddler	Chromium	Project_RESI_MED_Toddler_Chromium	8.78E-01	0.00E+00	6.93E-05	2.13E-02	0.00E+00	2.22E-03	2.14E-03	4.72E-02	2.83E-02	9.80E-01	5.94E-02	3.96E-05
Project	RESI	MED	Toddler	Iron	Project_RESI_MED_Toddler_Iron	1.33E+03	0.00E+00	1.05E-01	1.94E+01	0.00E+00	5.12E-01	5.21E-01	1.79E+02	1.07E+02	1.64E+03	9.93E+01	1.42E-01
Project	RESI	MED	Toddler	Manganese	Project_RESI_MED_Toddler_Manganese	3.05E+01	0.00E+00	2.41E-03	4.65E+00	0.00E+00	1.75E-02	1.79E-02	4.10E+00	2.46E+00	4.18E+01	2.53E+00	1.81E-02
Project	RESI	MED	Toddler	Silica	Project_RESI_MED_Toddler_Silica	1.66E+03	0.00E+00	1.31E-01	8.06E+02	0.00E+00	5.27E+00	5.43E+00	2.23E+02	1.34E+02	2.84E+03	1.72E+02	NA
Project	RESI	MED	Toddler	Titanium	Project_RESI_MED_Toddler_Titanium	1.21E+01	0.00E+00	9.57E-04	1.82E-01	0.00E+00	3.72E-02	3.79E-02	1.63E+00	9.78E-01	1.50E+01	9.09E-01	NA
Project	RESI	LOW	Toddler	Aluminum	Project_RESI_LOW_Toddler_Aluminum	3.08E+01	0.00E+00	2.43E-03	4.67E-01	0.00E+00	9.46E-03	9.61E-03	4.14E+00	2.48E+00	3.79E+01	2.30E+00	1.61E-02
Project	RESI	LOW	Toddler	Benzo(a)pyrene	Project_RESI_LOW_Toddler_Benzo(a)pyrene	7.07E-10	0.00E+00	5.57E-14	2.23E-10	0.00E+00	2.86E-12	4.93E-12	5.70E-11	3.42E-11	1.03E-09	6.23E-11	4.45E-08
Project	RESI	LOW	Toddler	Chromium	Project_RESI_LOW_Toddler_Chromium	6.27E-01	0.00E+00	4.95E-05	1.52E-02	0.00E+00	1.58E-03	1.53E-03	3.37E-02	2.02E-02	7.00E-01	4.24E-02	2.83E-05
Project	RESI	LOW	Toddler	Iron	Project_RESI_LOW_Toddler_Iron	9.51E+02	0.00E+00	7.50E-02	1.39E+01	0.00E+00	3.66E-01	3.72E-01	1.28E+02	7.67E+01	1.17E+03	7.09E+01	1.01E-01
Project	RESI	LOW	Toddler	Manganese	Project_RESI_LOW_Toddler_Manganese	2.18E+01	0.00E+00	1.72E-03	3.32E+00	0.00E+00	1.25E-02	1.28E-02	2.93E+00	1.76E+00	2.98E+01	1.81E+00	1.29E-02
Project	RESI	LOW	Toddler	Silica	Project_RESI_LOW_Toddler_Silica	1.19E+03	0.00E+00	9.36E-02	5.76E+02	0.00E+00	3.77E+00	3.88E+00	1.60E+02	9.57E+01	2.03E+03	1.23E+02	NA
Project	RESI	LOW	Toddler	Titanium	Project_RESI_LOW_Toddler_Titanium	8.67E+00	0.00E+00	6.83E-04	1.30E-01	0.00E+00	2.66E-02	2.71E-02	1.16E+00	6.99E-01	1.07E+01	6.49E-01	NA
Project	RESI	MAX	Infant	Aluminum	Project_RESI_MAX_Infant_Aluminum	1.41E+01	0.00E+00	1.18E-03	4.36E-01	0.00E+00	0.00E+00	7.33E-04	5.64E+00	2.57E+00	2.28E+01	2.78E+00	1.94E-02
Project	RESI	MAX	Infant	Benzo(a)pyrene	Project_RESI_MAX_Infant_Benzo(a)pyrene	3.24E-10	0.00E+00	2.71E-14	2.08E-10	0.00E+00	0.00E+00	3.76E-13	7.77E-11	3.55E-11	6.45E-10	7.87E-11	5.62E-08
Project	RESI	MAX	Infant	Chromium	Project_RESI_MAX_Infant_Chromium	2.88E-01	0.00E+00	2.40E-05	1.42E-02	0.00E+00	0.00E+00	1.17E-04	4.60E-02	2.10E-02	3.69E-01	4.50E-02	3.00E-05
Project	RESI	MAX	Infant	Iron	Project_RESI_MAX_Infant_Iron	4.36E+02	0.00E+00	3.64E-02	1.29E+01	0.00E+00	0.00E+00	2.84E-02	1.74E+02	7.95E+01	7.03E+02	8.57E+01	1.22E-01
Project	RESI	MAX	Infant	Manganese	Project_RESI_MAX_Infant_Manganese	1.00E+01	0.00E+00	8.36E-04	3.10E+00	0.00E+00	0.00E+00	9.78E-04	4.00E+00	1.82E+00	1.89E+01	2.31E+00	1.65E-02
Project	RESI	MAX	Infant	Silica	Project_RESI_MAX_Infant_Silica	5.44E+02	0.00E+00	4.55E-02	5.37E+02	0.00E+00	0.00E+00	2.96E-01	2.18E+02	9.93E+01	1.40E+03	1.71E+02	NA
Project	RESI	MAX	Infant	Titanium	Project_RESI_MAX_Infant_Titanium	3.97E+00	0.00E+00	3.32E-04	1.22E-01	0.00E+00	0.00E+00	2.07E-03	1.59E+00	7.25E-01	6.41E+00	7.82E-01	NA
Project	RESI	MED	Infant	Aluminum	Project_RESI_MED_Infant_Aluminum	1.08E+01	0.00E+00	9.01E-04	3.33E-01	0.00E+00	0.00E+00	5.60E-04	4.31E+00	1.97E+00	1.74E+01	2.12E+00	1.48E-02
Project	RESI	MED	Infant	Benzo(a)pyrene	Project_RESI_MED_Infant_Benzo(a)pyrene	2.47E-10	0.00E+00	2.07E-14	1.59E-10	0.00E+00	0.00E+00	2.87E-13	5.94E-11	2.71E-11	4.93E-10	6.01E-11	4.29E-08
Project	RESI	MED	Infant	Chromium	Project_RESI_MED_Infant_Chromium	2.20E-01	0.00E+00	1.84E-05	1.09E-02	0.00E+00	0.00E+00	8.92E-05	3.51E-02	1.60E-02	2.82E-01	3.44E-02	2.29E-05
Project	RESI	MED	Infant	Iron	Project_RESI_MED_Infant_Iron	3.33E+02	0.00E+00	2.78E-02	9.87E+00	0.00E+00	0.00E+00	2.17E-02	1.33E+02	6.07E+01	5.37E+02	6.54E+01	9.35E-02
Project	RESI	MED	Infant	Manganese	Project_RESI_MED_Infant_Manganese	7.63E+00	0.00E+00	6.38E-04	2.36E+00	0.00E+00	0.00E+00	7.46E-04	3.05E+00	1.39E+00	1.44E+01	1.76E+00	1.26E-02
Project	RESI	MED	Infant	Silica	Project_RESI_MED_Infant_Silica	4.15E+02	0.00E+00	3.47E-02	4.10E+02	0.00E+00	0.00E+00	2.26E-01	1.66E+02	7.58E+01	1.07E+03	1.30E+02	NA
Project	RESI	MED	Infant	Titanium	Project_RESI_MED_Infant_Titanium	3.03E+00	0.00E+00	2.54E-04	9.28E-02	0.00E+00	0.00E+00	1.58E-03	1.21E+00	5.53E-01	4.89E+00	5.97E-01	NA
Project	RESI	LOW	Infant	Aluminum	Project_RESI_LOW_Infant_Aluminum	7.69E+00	0.00E+00	6.43E-04	2.38E-01	0.00E+00	0.00E+00	4.00E-04	3.08E+00	1.40E+00	1.24E+01	1.51E+00	1.06E-02

Summary of Predicted Human Exposures for Each Lifestyle Category, Scenario and Chemical

Scenario	Type	Site	Receptor	Chemical	Abbreviation	Estimated Daily Intake											
						Soil SIR ug/day	Drinking Water WIR ug/day	Dust AIR ug/day	Berries Berries ug/day	Fish Fish ug/day	Ruffed_Grouse Ruffed_Grouse ug/day	Snowshoe_Hare Snowshoe_Hare ug/day	Dermal Hands ug/day	Dermal Other ug/day	Total EDI ug/day	Total EDI ug/kg/day	HQ Total Unitless
Project	RESI	LOW	Infant	Benzo(a)pyrene	Project_RESI_LOW_Infant_Benzo(a)pyrene	1.77E-10	0.00E+00	1.48E-14	1.13E-10	0.00E+00	0.00E+00	2.05E-13	4.24E-11	1.93E-11	3.52E-10	4.29E-11	3.07E-08
Project	RESI	LOW	Infant	Chromium	Project_RESI_LOW_Infant_Chromium	1.57E-01	0.00E+00	1.31E-05	7.75E-03	0.00E+00	0.00E+00	6.37E-05	2.51E-02	1.15E-02	2.01E-01	2.45E-02	1.64E-05
Project	RESI	LOW	Infant	Iron	Project_RESI_LOW_Infant_Iron	2.38E+02	0.00E+00	1.99E-02	7.05E+00	0.00E+00	0.00E+00	1.55E-02	9.51E+01	4.34E+01	3.83E+02	4.67E+01	6.68E-02
Project	RESI	LOW	Infant	Manganese	Project_RESI_LOW_Infant_Manganese	5.45E+00	0.00E+00	4.56E-04	1.69E+00	0.00E+00	0.00E+00	5.33E-04	2.18E+00	9.95E-01	1.03E+01	1.26E+00	8.99E-03
Project	RESI	LOW	Infant	Silica	Project_RESI_LOW_Infant_Silica	2.97E+02	0.00E+00	2.48E-02	2.93E+02	0.00E+00	0.00E+00	1.61E-01	1.19E+02	5.42E+01	7.63E+02	9.30E+01	**NA**
Project	RESI	LOW	Infant	Titanium	Project_RESI_LOW_Infant_Titanium	2.17E+00	0.00E+00	1.81E-04	6.63E-02	0.00E+00	0.00E+00	1.13E-03	8.67E-01	3.95E-01	3.50E+00	4.26E-01	**NA**

Note:
A value of zero indicates that exposure pathway or risk quotient not applicable.
NA Indicates exposure limit not available.

Summary of Predicted Exposures and Game Meat Concentrations

Scenario	Site	Receptor	Chemical	EDI							Game Meat Concentration
				Soil EDI mg/day	Browse EDI mg/day	Invert EDI mg/day	Water EDI mg/day	Air EDI mg/day	Total EDI mg/day	Total EDI mg/kg-BW/day	mg/kg ww
Baseline	MAX	Ruffed_Grouse	Aluminum	6.81E+01	2.11E+00	3.87E+00	1.07E-03	3.08E-06	7.41E+01	1.06E+02	1.48E-02
Baseline	MAX	Ruffed_Grouse	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Ruffed_Grouse	Chromium	2.83E-01	1.79E-01	3.33E-01	4.65E-05	1.28E-08	7.95E-01	1.13E+00	1.19E-03
Baseline	MAX	Ruffed_Grouse	Iron	4.40E+02	3.25E+01	1.79E+01	3.07E-03	1.99E-05	4.90E+02	6.98E+02	1.23E-01
Baseline	MAX	Ruffed_Grouse	Manganese	9.95E+00	1.09E+01	4.31E-01	5.59E-04	4.50E-07	2.13E+01	3.03E+01	7.44E-03
Baseline	MAX	Ruffed_Grouse	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Ruffed_Grouse	Titanium	5.08E+00	2.70E-01	0.00E+00	1.12E-04	2.30E-07	5.35E+00	7.62E+00	1.07E-02
Baseline	MED	Ruffed_Grouse	Aluminum	6.81E+01	2.11E+00	3.87E+00	1.07E-03	3.08E-06	7.41E+01	1.06E+02	1.48E-02
Baseline	MED	Ruffed_Grouse	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Ruffed_Grouse	Chromium	2.83E-01	1.79E-01	3.33E-01	4.65E-05	1.28E-08	7.95E-01	1.13E+00	1.19E-03
Baseline	MED	Ruffed_Grouse	Iron	4.40E+02	3.25E+01	1.79E+01	3.07E-03	1.99E-05	4.90E+02	6.98E+02	1.23E-01
Baseline	MED	Ruffed_Grouse	Manganese	9.95E+00	1.09E+01	4.31E-01	5.59E-04	4.50E-07	2.13E+01	3.03E+01	7.44E-03
Baseline	MED	Ruffed_Grouse	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Ruffed_Grouse	Titanium	5.08E+00	2.70E-01	0.00E+00	1.12E-04	2.30E-07	5.35E+00	7.62E+00	1.07E-02
Baseline	LOW	Ruffed_Grouse	Aluminum	6.81E+01	2.11E+00	3.87E+00	1.07E-03	3.08E-06	7.41E+01	1.06E+02	1.48E-02
Baseline	LOW	Ruffed_Grouse	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Ruffed_Grouse	Chromium	2.83E-01	1.79E-01	3.33E-01	4.65E-05	1.28E-08	7.95E-01	1.13E+00	1.19E-03
Baseline	LOW	Ruffed_Grouse	Iron	4.40E+02	3.25E+01	1.79E+01	3.07E-03	1.99E-05	4.90E+02	6.98E+02	1.23E-01
Baseline	LOW	Ruffed_Grouse	Manganese	9.95E+00	1.09E+01	4.31E-01	5.59E-04	4.50E-07	2.13E+01	3.03E+01	7.44E-03
Baseline	LOW	Ruffed_Grouse	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Ruffed_Grouse	Titanium	5.08E+00	2.70E-01	0.00E+00	1.12E-04	2.30E-07	5.35E+00	7.62E+00	1.07E-02
Baseline	MAX	Snowshoe_Hare	Aluminum	1.08E+02	5.50E+00	0.00E+00	3.08E-03	7.06E-06	1.14E+02	8.13E+01	2.28E-02
Baseline	MAX	Snowshoe_Hare	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Snowshoe_Hare	Chromium	4.50E-01	4.66E-01	0.00E+00	1.34E-04	2.93E-08	9.16E-01	6.54E-01	1.37E-03
Baseline	MAX	Snowshoe_Hare	Iron	7.00E+02	8.46E+01	0.00E+00	8.84E-03	4.56E-05	7.84E+02	5.60E+02	1.96E-01
Baseline	MAX	Snowshoe_Hare	Manganese	1.58E+01	2.84E+01	0.00E+00	1.61E-03	1.03E-06	4.42E+01	3.16E+01	1.55E-02
Baseline	MAX	Snowshoe_Hare	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Snowshoe_Hare	Titanium	8.08E+00	7.05E-01	0.00E+00	3.22E-04	5.27E-07	8.78E+00	6.27E+00	1.76E-02
Baseline	MED	Snowshoe_Hare	Aluminum	1.08E+02	5.50E+00	0.00E+00	3.08E-03	7.06E-06	1.14E+02	8.13E+01	2.28E-02
Baseline	MED	Snowshoe_Hare	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Snowshoe_Hare	Chromium	4.50E-01	4.66E-01	0.00E+00	1.34E-04	2.93E-08	9.16E-01	6.54E-01	1.37E-03
Baseline	MED	Snowshoe_Hare	Iron	7.00E+02	8.46E+01	0.00E+00	8.84E-03	4.56E-05	7.84E+02	5.60E+02	1.96E-01
Baseline	MED	Snowshoe_Hare	Manganese	1.58E+01	2.84E+01	0.00E+00	1.61E-03	1.03E-06	4.42E+01	3.16E+01	1.55E-02
Baseline	MED	Snowshoe_Hare	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Snowshoe_Hare	Titanium	8.08E+00	7.05E-01	0.00E+00	3.22E-04	5.27E-07	8.78E+00	6.27E+00	1.76E-02
Baseline	LOW	Snowshoe_Hare	Aluminum	1.08E+02	5.50E+00	0.00E+00	3.08E-03	7.06E-06	1.14E+02	8.13E+01	2.28E-02
Baseline	LOW	Snowshoe_Hare	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Snowshoe_Hare	Chromium	4.50E-01	4.66E-01	0.00E+00	1.34E-04	2.93E-08	9.16E-01	6.54E-01	1.37E-03
Baseline	LOW	Snowshoe_Hare	Iron	7.00E+02	8.46E+01	0.00E+00	8.84E-03	4.56E-05	7.84E+02	5.60E+02	1.96E-01
Baseline	LOW	Snowshoe_Hare	Manganese	1.58E+01	2.84E+01	0.00E+00	1.61E-03	1.03E-06	4.42E+01	3.16E+01	1.55E-02
Baseline	LOW	Snowshoe_Hare	Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Snowshoe_Hare	Titanium	8.08E+00	7.05E-01	0.00E+00	3.22E-04	5.27E-07	8.78E+00	6.27E+00	1.76E-02
Project	MAX	Ruffed_Grouse	Aluminum	3.69E+00	2.95E+00	2.10E-02	0.00E+00	1.67E-07	6.67E+00	9.50E+00	1.33E-03
Project	MAX	Ruffed_Grouse	Benzo(a)pyrene	8.48E-11	1.43E-09	3.81E-12	0.00E+00	3.83E-18	1.52E-09	2.16E-09	4.04E-13
Project	MAX	Ruffed_Grouse	Chromium	7.53E-02	6.47E-02	8.88E-03	0.00E+00	3.40E-09	1.49E-01	2.12E-01	2.23E-04
Project	MAX	Ruffed_Grouse	Iron	1.14E+02	9.17E+01	4.65E-01	0.00E+00	5.16E-06	2.06E+02	2.94E+02	5.16E-02

Summary of Predicted Exposures and Game Meat Concentrations

Scenario	Site	Receptor	Chemical	EDI Soil EDI mg/day	EDI Browse EDI mg/day	EDI Invert EDI mg/day	EDI Water EDI mg/day	EDI Air EDI mg/day	EDI Total EDI mg/day	EDI Total EDI mg/kg-BW/day	Game Meat Concentration mg/kg ww
Project	MAX	Ruffed_Grouse	Manganese	2.62E+00	2.37E+00	3.60E-02	0.00E+00	1.18E-07	5.02E+00	7.16E+00	1.76E-03
Project	MAX	Ruffed_Grouse	Silica	1.42E+02	1.23E+02	0.00E+00	0.00E+00	6.44E-06	2.66E+02	3.78E+02	5.31E-01
Project	MAX	Ruffed_Grouse	Titanium	1.04E+00	8.34E-01	0.00E+00	0.00E+00	4.70E-08	1.87E+00	2.67E+00	3.75E-03
Project	MED	Ruffed_Grouse	Aluminum	2.82E+00	2.25E+00	1.60E-02	0.00E+00	1.27E-07	5.09E+00	7.25E+00	1.02E-03
Project	MED	Ruffed_Grouse	Benzo(a)pyrene	6.48E-11	1.09E-09	2.91E-12	0.00E+00	2.93E-18	1.16E-09	1.65E-09	3.08E-13
Project	MED	Ruffed_Grouse	Chromium	5.75E-02	4.94E-02	6.78E-03	0.00E+00	2.60E-09	1.14E-01	1.62E-01	1.71E-04
Project	MED	Ruffed_Grouse	Iron	8.71E+01	7.00E+01	3.55E-01	0.00E+00	3.94E-06	1.58E+02	2.24E+02	3.94E-02
Project	MED	Ruffed_Grouse	Manganese	2.00E+00	1.81E+00	3.00E-02	0.00E+00	9.03E-08	3.84E+00	5.47E+00	1.34E-03
Project	MED	Ruffed_Grouse	Silica	1.09E+02	9.40E+01	0.00E+00	0.00E+00	4.92E-06	2.03E+02	2.89E+02	4.06E-01
Project	MED	Ruffed_Grouse	Titanium	7.94E-01	6.37E-01	0.00E+00	0.00E+00	3.59E-08	1.43E+00	2.04E+00	2.86E-03
Project	LOW	Ruffed_Grouse	Aluminum	2.01E+00	1.61E+00	1.14E-02	0.00E+00	9.10E-08	3.64E+00	5.18E+00	7.27E-04
Project	LOW	Ruffed_Grouse	Benzo(a)pyrene	4.63E-11	7.79E-10	2.08E-12	0.00E+00	2.09E-18	8.28E-10	1.18E-09	2.20E-13
Project	LOW	Ruffed_Grouse	Chromium	4.11E-02	3.53E-02	4.84E-03	0.00E+00	1.86E-09	8.12E-02	1.16E-01	1.22E-04
Project	LOW	Ruffed_Grouse	Iron	6.22E+01	5.00E+01	2.54E-01	0.00E+00	2.81E-06	1.13E+02	1.60E+02	2.81E-02
Project	LOW	Ruffed_Grouse	Manganese	1.43E+00	1.29E+00	2.38E-02	0.00E+00	6.45E-08	2.75E+00	3.91E+00	9.61E-04
Project	LOW	Ruffed_Grouse	Silica	7.77E+01	6.71E+01	0.00E+00	0.00E+00	3.51E-06	1.45E+02	2.06E+02	2.90E-01
Project	LOW	Ruffed_Grouse	Titanium	5.67E-01	4.55E-01	0.00E+00	0.00E+00	2.56E-08	1.02E+00	1.46E+00	2.04E-03
Project	MAX	Snowshoe_Hare	Aluminum	5.87E+00	7.70E+00	0.00E+00	0.00E+00	3.83E-07	1.36E+01	9.69E+00	2.71E-03
Project	MAX	Snowshoe_Hare	Benzo(a)pyrene	1.35E-10	3.72E-09	0.00E+00	0.00E+00	8.79E-18	3.86E-09	2.76E-09	1.39E-12
Project	MAX	Snowshoe_Hare	Chromium	1.20E-01	1.69E-01	0.00E+00	0.00E+00	7.81E-09	2.88E-01	2.06E-01	4.33E-04
Project	MAX	Snowshoe_Hare	Iron	1.81E+02	2.39E+02	0.00E+00	0.00E+00	1.18E-05	4.21E+02	3.00E+02	1.05E-01
Project	MAX	Snowshoe_Hare	Manganese	4.16E+00	6.18E+00	0.00E+00	0.00E+00	2.71E-07	1.03E+01	7.39E+00	3.62E-03
Project	MAX	Snowshoe_Hare	Silica	2.27E+02	3.21E+02	0.00E+00	0.00E+00	1.48E-05	5.48E+02	3.91E+02	1.10E+00
Project	MAX	Snowshoe_Hare	Titanium	1.65E+00	2.17E+00	0.00E+00	0.00E+00	1.08E-07	3.83E+00	2.73E+00	7.65E-03
Project	MED	Snowshoe_Hare	Aluminum	4.49E+00	5.88E+00	0.00E+00	0.00E+00	2.92E-07	1.04E+01	7.40E+00	2.07E-03
Project	MED	Snowshoe_Hare	Benzo(a)pyrene	1.03E-10	2.84E-09	0.00E+00	0.00E+00	6.71E-18	2.95E-09	2.11E-09	1.06E-12
Project	MED	Snowshoe_Hare	Chromium	9.14E-02	1.29E-01	0.00E+00	0.00E+00	5.96E-09	2.20E-01	1.57E-01	3.30E-04
Project	MED	Snowshoe_Hare	Iron	1.39E+02	1.83E+02	0.00E+00	0.00E+00	9.03E-06	3.21E+02	2.29E+02	8.03E-02
Project	MED	Snowshoe_Hare	Manganese	3.18E+00	4.72E+00	0.00E+00	0.00E+00	2.07E-07	7.90E+00	5.64E+00	2.76E-03
Project	MED	Snowshoe_Hare	Silica	1.73E+02	2.45E+02	0.00E+00	0.00E+00	1.13E-05	4.18E+02	2.99E+02	8.36E-01
Project	MED	Snowshoe_Hare	Titanium	1.26E+00	1.66E+00	0.00E+00	0.00E+00	8.23E-08	2.92E+00	2.09E+00	5.84E-03
Project	LOW	Snowshoe_Hare	Aluminum	3.20E+00	4.20E+00	0.00E+00	0.00E+00	2.09E-07	7.40E+00	5.29E+00	1.48E-03
Project	LOW	Snowshoe_Hare	Benzo(a)pyrene	7.36E-11	2.03E-09	0.00E+00	0.00E+00	4.80E-18	2.11E-09	1.50E-09	7.60E-13
Project	LOW	Snowshoe_Hare	Chromium	6.53E-02	9.20E-02	0.00E+00	0.00E+00	4.26E-09	1.57E-01	1.12E-01	2.36E-04
Project	LOW	Snowshoe_Hare	Iron	9.90E+01	1.30E+02	0.00E+00	0.00E+00	6.45E-06	2.29E+02	1.64E+02	5.73E-02
Project	LOW	Snowshoe_Hare	Manganese	2.27E+00	3.37E+00	0.00E+00	0.00E+00	1.48E-07	5.64E+00	4.03E+00	1.97E-03
Project	LOW	Snowshoe_Hare	Silica	1.24E+02	1.75E+02	0.00E+00	0.00E+00	8.06E-06	2.99E+02	2.13E+02	5.97E-01
Project	LOW	Snowshoe_Hare	Titanium	9.02E-01	1.19E+00	0.00E+00	0.00E+00	5.88E-08	2.09E+00	1.49E+00	4.17E-03

Summary of Media Concentrations

Scenario	Site	Chemical	Abbreviation	Soil mg/kg	Deposition Soil mg/kg	Total Soil mg/kg	Surface Soil mg/kg	Deposition Surface Soil mg/kg	Total Surface Soil mg/kg	Drinking Water mg/L	Surface Water mg/L	Air ug/m3	Dust ug/m3	Deposition mg/m2/yr	Environmental Concentrations Browse Deposition mg/kg dw	Browse Air mg/kg dw	Browse Soil mg/kg dw	Browse Total mg/kg dw	Berries Deposition mg/kg ww	Berries Air mg/kg ww	Berries Soil mg/kg ww	Berries Total mg/kg ww	Fish Aquatic mg/kg ww	Invertebrates Soil mg/kg dw
Baseline	MAX	Aluminum	Baseline_MAX_Aluminum	1.30E+04	0.00E+00	1.30E+04	1.30E+04	0.00E+00	1.30E+04	1.50E-02	2.30E-02	0.00E+00	9.88E-03	0.00E+00	0.00E+00	0.00E+00	4.16E+01	4.16E+01	0.00E+00	0.00E+00	9.44E+00	9.44E+00	6.21E-02	6.89E+02
Baseline	MAX	Benzo(a)pyrene	Baseline_MAX_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Chromium	Baseline_MAX_Chromium	5.40E+01	0.00E+00	5.40E+01	5.40E+01	0.00E+00	5.40E+01	1.00E-03	1.00E-03	0.00E+00	4.10E-05	0.00E+00	0.00E+00	0.00E+00	3.53E+00	3.53E+00	0.00E+00	0.00E+00	4.05E-01	4.05E-01	1.90E-02	5.94E+01
Baseline	MAX	Iron	Baseline_MAX_Iron	8.40E+04	0.00E+00	8.40E+04	8.40E+04	0.00E+00	8.40E+04	2.20E-01	6.60E-02	0.00E+00	6.38E-02	0.00E+00	0.00E+00	0.00E+00	6.40E+02	6.40E+02	0.00E+00	0.00E+00	2.33E+01	2.33E+01	1.32E+01	3.19E+03
Baseline	MAX	Manganese	Baseline_MAX_Manganese	1.90E+03	0.00E+00	1.90E+03	1.90E+03	0.00E+00	1.90E+03	8.00E-02	1.20E-02	0.00E+00	1.44E-03	0.00E+00	0.00E+00	0.00E+00	2.15E+02	2.15E+02	0.00E+00	0.00E+00	1.95E+02	1.95E+02	4.80E+00	7.67E+01
Baseline	MAX	Silica	Baseline_MAX_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MAX	Titanium	Baseline_MAX_Titanium	9.70E+02	0.00E+00	9.70E+02	9.70E+02	0.00E+00	9.70E+02	2.20E-03	2.40E-03	0.00E+00	7.37E-04	0.00E+00	0.00E+00	0.00E+00	5.34E+00	5.34E+00	0.00E+00	0.00E+00	6.04E-01	6.04E-01	0.00E+00	0.00E+00
Baseline	MED	Aluminum	Baseline_MED_Aluminum	1.30E+04	0.00E+00	1.30E+04	1.30E+04	0.00E+00	1.30E+04	1.50E-02	2.30E-02	0.00E+00	9.88E-03	0.00E+00	0.00E+00	0.00E+00	4.16E+01	4.16E+01	0.00E+00	0.00E+00	9.44E+00	9.44E+00	6.21E-02	6.89E+02
Baseline	MED	Benzo(a)pyrene	Baseline_MED_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Chromium	Baseline_MED_Chromium	5.40E+01	0.00E+00	5.40E+01	5.40E+01	0.00E+00	5.40E+01	1.00E-03	1.00E-03	0.00E+00	4.10E-05	0.00E+00	0.00E+00	0.00E+00	3.53E+00	3.53E+00	0.00E+00	0.00E+00	4.05E-01	4.05E-01	1.90E-02	5.94E+01
Baseline	MED	Iron	Baseline_MED_Iron	8.40E+04	0.00E+00	8.40E+04	8.40E+04	0.00E+00	8.40E+04	2.20E-01	6.60E-02	0.00E+00	6.38E-02	0.00E+00	0.00E+00	0.00E+00	6.40E+02	6.40E+02	0.00E+00	0.00E+00	2.33E+01	2.33E+01	1.32E+01	3.19E+03
Baseline	MED	Manganese	Baseline_MED_Manganese	1.90E+03	0.00E+00	1.90E+03	1.90E+03	0.00E+00	1.90E+03	8.00E-02	1.20E-02	0.00E+00	1.44E-03	0.00E+00	0.00E+00	0.00E+00	2.15E+02	2.15E+02	0.00E+00	0.00E+00	1.95E+02	1.95E+02	4.80E+00	7.67E+01
Baseline	MED	Silica	Baseline_MED_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	MED	Titanium	Baseline_MED_Titanium	9.70E+02	0.00E+00	9.70E+02	9.70E+02	0.00E+00	9.70E+02	2.20E-03	2.40E-03	0.00E+00	7.37E-04	0.00E+00	0.00E+00	0.00E+00	5.34E+00	5.34E+00	0.00E+00	0.00E+00	6.04E-01	6.04E-01	0.00E+00	0.00E+00
Baseline	LOW	Aluminum	Baseline_LOW_Aluminum	1.30E+04	0.00E+00	1.30E+04	1.30E+04	0.00E+00	1.30E+04	1.50E-02	2.30E-02	0.00E+00	9.88E-03	0.00E+00	0.00E+00	0.00E+00	4.16E+01	4.16E+01	0.00E+00	0.00E+00	9.44E+00	9.44E+00	6.21E-02	6.89E+02
Baseline	LOW	Benzo(a)pyrene	Baseline_LOW_Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Chromium	Baseline_LOW_Chromium	5.40E+01	0.00E+00	5.40E+01	5.40E+01	0.00E+00	5.40E+01	1.00E-03	1.00E-03	0.00E+00	4.10E-05	0.00E+00	0.00E+00	0.00E+00	3.53E+00	3.53E+00	0.00E+00	0.00E+00	4.05E-01	4.05E-01	1.90E-02	5.94E+01
Baseline	LOW	Iron	Baseline_LOW_Iron	8.40E+04	0.00E+00	8.40E+04	8.40E+04	0.00E+00	8.40E+04	2.20E-01	6.60E-02	0.00E+00	6.38E-02	0.00E+00	0.00E+00	0.00E+00	6.40E+02	6.40E+02	0.00E+00	0.00E+00	2.33E+01	2.33E+01	1.32E+01	3.19E+03
Baseline	LOW	Manganese	Baseline_LOW_Manganese	1.90E+03	0.00E+00	1.90E+03	1.90E+03	0.00E+00	1.90E+03	8.00E-02	1.20E-02	0.00E+00	1.44E-03	0.00E+00	0.00E+00	0.00E+00	2.15E+02	2.15E+02	0.00E+00	0.00E+00	1.95E+02	1.95E+02	4.80E+00	7.67E+01
Baseline	LOW	Silica	Baseline_LOW_Silica	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Baseline	LOW	Titanium	Baseline_LOW_Titanium	9.70E+02	0.00E+00	9.70E+02	9.70E+02	0.00E+00	9.70E+02	2.20E-03	2.40E-03	0.00E+00	7.37E-04	0.00E+00	0.00E+00	0.00E+00	5.34E+00	5.34E+00	0.00E+00	0.00E+00	6.04E-01	6.04E-01	0.00E+00	0.00E+00
Project	MAX	Aluminum	Project_MAX_Aluminum	0.00E+00	7.05E+01	7.05E+01	0.00E+00	7.05E+02	7.05E+02	0.00E+00	0.00E+00	0.00E+00	5.36E-04	5.67E+02	5.80E+01	0.00E+00	2.26E-01	5.82E+01	7.45E-01	0.00E+00	5.12E-02	7.96E-01	0.00E+00	3.74E+00
Project	MAX	Benzo(a)pyrene	Project_MAX_Benzo(a)pyrene	0.00E+00	1.62E-09	1.62E-09	0.00E+00	1.62E-08	1.62E-08	0.00E+00	0.00E+00	0.00E+00	1.23E-14	2.75E-07	2.82E-08	0.00E+00	1.80E-11	2.82E-08	3.62E-10	0.00E+00	1.80E-11	3.79E-10	0.00E+00	6.79E-10
Project	MAX	Chromium	Project_MAX_Chromium	0.00E+00	1.44E+00	1.44E+00	0.00E+00	1.44E+01	1.44E+01	0.00E+00	0.00E+00	0.00E+00	1.09E-05	1.16E+01	1.18E+00	0.00E+00	9.39E-02	1.28E+00	1.52E-02	0.00E+00	1.08E-02	2.60E-02	0.00E+00	1.58E+00
Project	MAX	Iron	Project_MAX_Iron	0.00E+00	2.18E+03	2.18E+03	0.00E+00	2.18E+04	2.18E+04	0.00E+00	0.00E+00	0.00E+00	1.66E-02	1.75E+04	1.79E+03	0.00E+00	1.66E+01	1.81E+03	2.30E+01	0.00E+00	6.06E-01	2.36E+01	0.00E+00	8.28E+01
Project	MAX	Manganese	Project_MAX_Manganese	0.00E+00	5.00E+01	5.00E+01	0.00E+00	5.00E+02	5.00E+02	0.00E+00	0.00E+00	0.00E+00	3.80E-04	4.02E+02	4.11E+01	0.00E+00	5.65E+00	4.68E+01	5.28E-01	0.00E+00	5.13E+00	5.66E+00	0.00E+00	6.42E+00
Project	MAX	Silica	Project_MAX_Silica	0.00E+00	2.72E+03	2.72E+03	0.00E+00	2.72E+04	2.72E+04	0.00E+00	0.00E+00	0.00E+00	2.07E-02	2.19E+04	2.24E+03	0.00E+00	1.90E+02	2.43E+03	2.87E+01	0.00E+00	9.52E+02	9.81E+02	0.00E+00	0.00E+00
Project	MAX	Titanium	Project_MAX_Titanium	0.00E+00	1.99E+01	1.99E+01	0.00E+00	1.99E+02	1.99E+02	0.00E+00	0.00E+00	0.00E+00	1.51E-04	1.60E+02	1.63E+01	0.00E+00	1.09E-01	1.64E+01	2.10E-01	0.00E+00	1.24E-02	2.22E-01	0.00E+00	0.00E+00
Project	MED	Aluminum	Project_MED_Aluminum	0.00E+00	5.39E+01	5.39E+01	0.00E+00	5.39E+02	5.39E+02	0.00E+00	0.00E+00	0.00E+00	4.09E-04	4.33E+02	4.43E+01	0.00E+00	1.72E-01	4.45E+01	5.69E-01	0.00E+00	3.91E-02	6.08E-01	0.00E+00	2.85E+00
Project	MED	Benzo(a)pyrene	Project_MED_Benzo(a)pyrene	0.00E+00	1.24E-09	1.24E-09	0.00E+00	1.24E-08	1.24E-08	0.00E+00	0.00E+00	0.00E+00	9.40E-15	2.10E-07	2.15E-08	0.00E+00	1.37E-11	2.15E-08	2.76E-10	0.00E+00	1.37E-11	2.90E-10	0.00E+00	5.18E-10
Project	MED	Chromium	Project_MED_Chromium	0.00E+00	1.10E+00	1.10E+00	0.00E+00	1.10E+01	1.10E+01	0.00E+00	0.00E+00	0.00E+00	8.35E-06	8.82E+00	9.03E-01	0.00E+00	7.17E-02	9.75E-01	1.16E-02	0.00E+00	8.24E-03	1.98E-02	0.00E+00	1.21E+00
Project	MED	Iron	Project_MED_Iron	0.00E+00	1.66E+03	1.66E+03	0.00E+00	1.66E+04	1.66E+04	0.00E+00	0.00E+00	0.00E+00	1.26E-02	1.34E+04	1.37E+03	0.00E+00	1.27E+01	1.38E+03	1.76E+01	0.00E+00	4.62E-01	1.80E+01	0.00E+00	6.32E+01
Project	MED	Manganese	Project_MED_Manganese	0.00E+00	3.82E+01	3.82E+01	0.00E+00	3.82E+02	3.82E+02	0.00E+00	0.00E+00	0.00E+00	2.90E-04	3.07E+02	3.14E+01	0.00E+00	4.31E+00	3.57E+01	4.03E-01	0.00E+00	3.92E+00	4.32E+00	0.00E+00	5.34E+00
Project	MED	Silica	Project_MED_Silica	0.00E+00	2.08E+03	2.08E+03	0.00E+00	2.08E+04	2.08E+04	0.00E+00	0.00E+00	0.00E+00	1.58E-02	1.67E+04	1.71E+03	0.00E+00	1.45E+02	1.85E+03	2.19E+01	0.00E+00	7.27E+02	7.49E+02	0.00E+00	0.00E+00
Project	MED	Titanium	Project_MED_Titanium	0.00E+00	1.52E+01	1.52E+01	0.00E+00	1.52E+02	1.52E+02	0.00E+00	0.00E+00	0.00E+00	1.15E-04	1.22E+02	1.25E+01	0.00E+00	8.34E-02	1.26E+01	1.60E-01	0.00E+00	9.44E-03	1.70E-01	0.00E+00	0.00E+00
Project	LOW	Aluminum	Project_LOW_Aluminum	0.00E+00	3.85E+01	3.85E+01	0.00E+00	3.85E+02	3.85E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-04	3.09E+02	3.16E+01	0.00E+00	1.23E-01	3.18E+01	4.06E-01	0.00E+00	2.79E-02	4.34E-01	0.00E+00	2.04E+00
Project	LOW	Benzo(a)pyrene	Project_LOW_Benzo(a)pyrene	0.00E+00	8.83E-10	8.83E-10	0.00E+00	8.83E-09	8.83E-09	0.00E+00	0.00E+00	0.00E+00	6.71E-15	1.50E-07	1.54E-08	0.00E+00	9.80E-12	1.54E-08	1.97E-10	0.00E+00	9.80E-12	2.07E-10	0.00E+00	3.70E-10
Project	LOW	Chromium	Project_LOW_Chromium	0.00E+00	7.84E-01	7.84E-01	0.00E+00	7.84E+00	7.84E+00	0.00E+00	0.00E+00	0.00E+00	5.96E-06	6.30E+00	6.45E-01	0.00E+00	5.12E-02	6.96E-01	8.28E-03	0.00E+00	5.88E-03	1.42E-02	0.00E+00	8.63E-01
Project	LOW	Iron	Project_LOW_Iron	0.00E+00	1.19E+03	1.19E+03	0.00E+00	1.19E+04	1.19E+04	0.00E+00	0.00E+00	0.00E+00	9.03E-03	9.55E+03	9.77E+02	0.00E+00	9.06E+00	9.86E+02	1.25E+01	0.00E+00	3.30E-01	1.29E+01	0.00E+00	4.52E+01
Project	LOW	Manganese	Project_LOW_Manganese	0.00E+00	2.73E+01	2.73E+01	0.00E+00	2.73E+02	2.73E+02	0.00E+00	0.00E+00	0.00E+00	2.07E-04	2.19E+02	2.24E+01	0.00E+00	3.08E+00	2.55E+01	2.88E-01	0.00E+00	2.80E+00	3.09E+00	0.00E+00	4.24E+00
Project	LOW	Silica	Project_LOW_Silica	0.00E+00	1.48E+03	1.48E+03	0.00E+00	1.48E+04	1.48E+04	0.00E+00	0.00E+00	0.00E+00	1.13E-02	1.19E+04	1.22E+03	0.00E+00	1.04E+02	1.32E+03	1.57E+01	0.00E+00	5.19E+02	5.35E+02	0.00E+00	0.00E+00
Project	LOW	Titanium	Project_LOW_Titanium	0.00E+00	1.08E+01	1.08E+01	0.00E+00	1.08E+02	1.08E+02	0.00E+00	0.00E+00	0.00E+00	8.23E-05	8.70E+01	8.91E+00	0.00E+00	5.96E-02	8.97E+00	1.14E-01	0.00E+00	6.75E-03	1.21E-01	0.00E+00	0.00E+00

Human Oral Exposure Limits

Chemical	Exposure Limit Type	Oral Exposure Limit [ug/kg/day]	Reference
Aluminum	RfD	143	WHO 2014, 2010a,b
Benzo(a)pyrene	RsD	0.0014	US EPA 2014, 1994
Chromium	RfD	1500	US EPA 2013, 1998
Iron	RfD	700	US EPA (2006) provisional TRV
Manganese	RfD	140	US EPA 2013a, 1996
Silica	RfD	NA	
Titanium	RfD	NA	
Notes: NA = Not available			

Human Receptor Exposure Variables

Type	Receptor	Variable	Abbreviation	Value	Units	Reference/Comment
RESI	Adolescent	AIR	RESI_AIR_Adolescent	1.56E+01	m^3/d	Health Canada (2012); air inhalation rate
RESI	Adult	AIR	RESI_AIR_Adult	1.66E+01	m^3/d	Health Canada (2012); air inhalation rate
RESI	Child	AIR	RESI_AIR_Child	1.45E+01	m^3/d	Health Canada (2012); air inhalation rate
RESI	Infant	AIR	RESI_AIR_Infant	2.20E+00	m^3/d	Health Canada (2012); air inhalation rate
RESI	Toddler	AIR	RESI_AIR_Toddler	8.30E+00	m^3/d	Health Canada (2012); air inhalation rate
RESI	Adolescent	Berries	RESI_Berries_Adolescent	1.34E+01	g/d	Health Canada (1994); sum of cherries, strawberries, blueberries & syrup
RESI	Adult	Berries	RESI_Berries_Adult	1.63E+01	g/d	Health Canada (1994); sum of cherries, strawberries, blueberries & syrup
RESI	Child	Berries	RESI_Berries_Child	1.62E+01	g/d	Health Canada (1994); sum of cherries, strawberries, blueberries & syrup
RESI	Infant	Berries	RESI_Berries_Infant	3.80E+00	g/d	Health Canada (1994); sum of cherries, strawberries, blueberries & syrup
RESI	Toddler	Berries	RESI_Berries_Toddler	7.47E+00	g/d	Health Canada (1994); sum of cherries, strawberries, blueberries & syrup
RESI	Adolescent	BW	RESI_BW_Adolescent	5.97E+01	kg	Health Canada (2012); body weight
RESI	Adult	BW	RESI_BW_Adult	7.07E+01	kg	Health Canada (2012); body weight
RESI	Child	BW	RESI_BW_Child	3.29E+01	kg	Health Canada (2012); body weight
RESI	Infant	BW	RESI_BW_Infant	8.20E+00	kg	Health Canada (2012); body weight
RESI	Toddler	BW	RESI_BW_Toddler	1.65E+01	kg	Health Canada (2012); body weight
RESI	Adolescent	Fish	RESI_Fish_Adolescent	2.20E+01	g/d	Health Canada (2007)
RESI	Adult	Fish	RESI_Fish_Adult	2.20E+01	g/d	Health Canada (2007)
RESI	Child	Fish	RESI_Fish_Child	1.40E+01	g/d	Health Canada (2007)
RESI	Infant	Fish	RESI_Fish_Infant	0.00E+00	g/d	Health Canada (2007)
RESI	Toddler	Fish	RESI_Fish_Toddler	1.00E+01	g/d	Health Canada (2007)
RESI	Adolescent	LAF	RESI_LAF_Adolescent	1.00E-01	yr-lifestage/yr-total	Health Canada (2012); lifetime adjustment factor for gen. pop.
RESI	Adult	LAF	RESI_LAF_Adult	7.50E-01	yr-lifestage/yr-total	Health Canada (2012); lifetime adjustment factor for gen. pop.
RESI	Child	LAF	RESI_LAF_Child	8.75E-02	yr-lifestage/yr-total	Health Canada (2012); lifetime adjustment factor for gen. pop.
RESI	Infant	LAF	RESI_LAF_Infant	6.25E-03	yr-lifestage/yr-total	Health Canada (2012); lifetime adjustment factor for gen. pop.
RESI	Toddler	LAF	RESI_LAF_Toddler	5.63E-02	yr-lifestage/yr-total	Health Canada (2012); lifetime adjustment factor for gen. pop.
RESI	Adolescent	Ruffed_Grouse	RESI_Ruffed_Grouse_Adolescent	2.00E+01	g/d	Health Canada (1994); Assumed same as poultry
RESI	Adult	Ruffed_Grouse	RESI_Ruffed_Grouse_Adult	2.10E+01	g/d	Health Canada (1994); Assumed same as poultry
RESI	Child	Ruffed_Grouse	RESI_Ruffed_Grouse_Child	1.70E+01	g/d	Health Canada (1994); Assumed same as poultry
RESI	Infant	Ruffed_Grouse	RESI_Ruffed_Grouse_Infant	0.00E+00	g/d	assumed, diet entirely breast milk
RESI	Toddler	Ruffed_Grouse	RESI_Ruffed_Grouse_Toddler	1.30E+01	g/d	Health Canada (1994); Assumed same as poultry
RESI	Adolescent	SAH	RESI_SAH_Adolescent	8.00E+02	cm^2	Health Canada (2012); surface area hands
RESI	Adult	SAH	RESI_SAH_Adult	8.90E+02	cm^2	Health Canada (2012); surface area hands
RESI	Child	SAH	RESI_SAH_Child	5.90E+02	cm^2	Health Canada (2012); surface area hands
RESI	Infant	SAH	RESI_SAH_Infant	3.20E+02	cm^2	Health Canada (2012); surface area hands
RESI	Toddler	SAH	RESI_SAH_Toddler	4.30E+02	cm^2	Health Canada (2012); surface area hands
RESI	Adolescent	SAO	RESI_SAO_Adolescent	7.20E+03	cm^2	Health Canada (2012); surface area other (arms and legs)
RESI	Adult	SAO	RESI_SAO_Adult	8.22E+03	cm^2	Health Canada (2012); surface area other (arms and legs)
RESI	Child	SAO	RESI_SAO_Child	4.55E+03	cm^2	Health Canada (2012); surface area other (arms and legs)
RESI	Infant	SAO	RESI_SAO_Infant	1.46E+03	cm^2	Health Canada (2012); surface area other (arms and legs)

Human Receptor Exposure Variables

Type	Receptor	Variable	Abbreviation	Value	Units	Reference/Comment
RESI	Toddler	SAO	RESI_SAO_Toddler	2.58E+03	cm^2	Health Canada (2012); surface area other (arms and legs)
RESI	Adolescent	SAT	RESI_SAT_Adolescent	1.55E+04	cm^2	Health Canada (2012); surface area total
RESI	Adult	SAT	RESI_SAT_Adult	1.76E+04	cm^2	Health Canada (2012); surface area total
RESI	Child	SAT	RESI_SAT_Child	1.01E+04	cm^2	Health Canada (2012); surface area total
RESI	Infant	SAT	RESI_SAT_Infant	3.62E+03	cm^2	Health Canada (2012); surface area total
RESI	Toddler	SAT	RESI_SAT_Toddler	6.13E+03	cm^2	Health Canada (2012); surface area total
RESI	Adolescent	SEF	RESI_SEF_Adolescent	2.55E-01	hr/d	Assumed: 1hr/day and 93 days/365 days; swim exposure factor
RESI	Adult	SEF	RESI_SEF_Adult	2.55E-01	hr/d	Assumed: 1hr/day and 93 days/365 days; swim exposure factor
RESI	Child	SEF	RESI_SEF_Child	2.55E-01	hr/d	Assumed: 1hr/day and 93 days/365 days; swim exposure factor
RESI	Infant	SEF	RESI_SEF_Infant	2.55E-01	hr/d	Assumed: 1hr/day and 93 days/365 days; swim exposure factor
RESI	Toddler	SEF	RESI_SEF_Toddler	2.55E-01	hr/d	Assumed: 1hr/day and 93 days/365 days; swim exposure factor
RESI	Adolescent	SIR	RESI_SIR_Adolescent	2.00E-02	g/d	Health Canada (2012); soil ingestion rate
RESI	Adult	SIR	RESI_SIR_Adult	2.00E-02	g/d	Health Canada (2012); soil ingestion rate
RESI	Child	SIR	RESI_SIR_Child	2.00E-02	g/d	Health Canada (2012); soil ingestion rate
RESI	Infant	SIR	RESI_SIR_Infant	2.00E-02	g/d	Health Canada (2012); soil ingestion rate
RESI	Toddler	SIR	RESI_SIR_Toddler	8.00E-02	g/d	Health Canada (2012); soil ingestion rate
RESI	Adolescent	SLH	RESI_SLH_Adolescent	1.00E-04	g/cm^2/event	Health Canada (2012); skin loading hands
RESI	Adult	SLH	RESI_SLH_Adult	1.00E-04	g/cm^2/event	Health Canada (2012); skin loading hands
RESI	Child	SLH	RESI_SLH_Child	1.00E-04	g/cm^2/event	Health Canada (2012); skin loading hands
RESI	Infant	SLH	RESI_SLH_Infant	1.00E-04	g/cm^2/event	Health Canada (2012); skin loading hands
RESI	Toddler	SLH	RESI_SLH_Toddler	1.00E-04	g/cm^2/event	Health Canada (2012); skin loading hands
RESI	Adolescent	SLO	RESI_SLO_Adolescent	1.00E-05	g/cm^2/event	Health Canada (2012); skin loading other
RESI	Adult	SLO	RESI_SLO_Adult	1.00E-05	g/cm^2/event	Health Canada (2012); skin loading other
RESI	Child	SLO	RESI_SLO_Child	1.00E-05	g/cm^2/event	Health Canada (2012); skin loading other
RESI	Infant	SLO	RESI_SLO_Infant	1.00E-05	g/cm^2/event	Health Canada (2012); skin loading other
RESI	Toddler	SLO	RESI_SLO_Toddler	1.00E-05	g/cm^2/event	Health Canada (2012); skin loading other
RESI	Adolescent	Snowshoe_Hare	RESI_Snowshoe_Hare_Adolescent	2.33E+01	g/d	Health Canada 1994; Assumed same as roast and stewing beef
RESI	Adult	Snowshoe_Hare	RESI_Snowshoe_Hare_Adult	2.70E+01	g/d	Health Canada 1994; Assumed same as roast and stewing beef
RESI	Child	Snowshoe_Hare	RESI_Snowshoe_Hare_Child	1.22E+01	g/d	Health Canada 1994; Assumed same as roast and stewing beef
RESI	Infant	Snowshoe_Hare	RESI_Snowshoe_Hare_Infant	2.70E-01	g/d	Health Canada 1994; Assumed same as roast and stewing beef
RESI	Toddler	Snowshoe_Hare	RESI_Snowshoe_Hare_Toddler	6.49E+00	g/d	Health Canada 1994; Assumed same as roast and stewing beef
RESI	Adolescent	WIR	RESI_WIR_Adolescent	1.00E+00	L/d	Health Canada (2012); water or drinking water ingestion rate
RESI	Adult	WIR	RESI_WIR_Adult	1.50E+00	L/d	Health Canada (2012); water or drinking water ingestion rate
RESI	Child	WIR	RESI_WIR_Child	8.00E-01	L/d	Health Canada (2012); water or drinking water ingestion rate
RESI	Infant	WIR	RESI_WIR_Infant	3.00E-01	L/d	Health Canada (2012); water or drinking water ingestion rate
RESI	Toddler	WIR	RESI_WIR_Toddler	6.00E-01	L/d	Health Canada (2012); water or drinking water ingestion rate

Wildlife Receptor Exposure Variables

Receptor	Variable	Abbreviation	Value	Units	Reference
Ruffed_Grouse	AIR	AIR_Ruffed_Grouse	3.1E-01	m^3/day	Allometric equation for birds 3-19; US EPA 1993
Ruffed_Grouse	BW	BW_Ruffed_Grouse	7.02E-01	kg-WW	US EPA 1993
Ruffed_Grouse	Per_SIR	Per_SIR_Ruffed_Grouse	9.3%	% of Diet	Assumed similar to wild turkey; Suter et al. 2000
Ruffed_Grouse	SIR	SIR_Ruffed_Grouse	5.24E-03	kg-soil/day	Calculated; See estimation of Soil Ingestion Rate
Ruffed_Grouse	WIR	WIR_Ruffed_Grouse	4.65E-02	L/day	Allometric equation 3-15; US EPA 1993
Snowshoe_hare	AIR	AIR_Snowshoe_hare	7.1E-01	m^3/day	Allometric equation for mammals 3-20; US EPA 1993
Snowshoe_hare	BW	BW_Snowshoe_hare	1.40E+00	kg-WW	US EPA 1993
Snowshoe_hare	Per_SIR	Per_SIR_Snowshoe_hare	6.3%	% of Diet	Assumed similar to jackrabbit; Suter et al. 2000
Snowshoe_hare	SIR	SIR_Snowshoe_hare	8.33E-03	kg-soil/day	Calculated; See estimation of Soil Ingestion Rate
Snowshoe_hare	WIR	WIR_Snowshoe_hare	1.34E-01	L/day	Allometric equation 3-17; US EPA 1993

NOTES:
AIR = Air inhalation rate
BW = Body Weight
SIR = Soil ingestion rate
WIR = Water ingestion rate

Soil & Sediment Ingestion Rates

	Ingestion Rate [kg/day]	
Receptor	Soil	Sediment
Ruffed_Grouse	5.24E-03	0.00E+00
Snowshoe_Hare	8.33E-03	0.00E+00

Receptor	Soil in Diet %	Sediment In Diet %	BW kg	NFMR kcal/kg/day	kcal/day	Diet	Portion %	GE [kcal/kg-DW]	AE [%]	FIR kg-food/day	Soil Ingestion Rate kg-soil/day	Sediment Ingestion Rate kg-sediment/day
Ruffed_Grouse	9.3%	0.0%	7.02E-01	1.55E+02	1.09E+02	Invert	20%	5.40E+03	72%	5.61E-03	5.22E-04	0.00E+00
Ruffed_Grouse	9.3%	0.0%	7.02E-01	1.55E+02	1.09E+02	Browse	80%	4.20E+03	41%	5.07E-02	4.72E-03	0.00E+00
Ruffed_Grouse	9.3%	0.0%	7.02E-01	1.55E+02	1.09E+02	Aquatic Plant	0%	4.30E+03	73%	0.00E+00	0.00E+00	0.00E+00
Ruffed_Grouse										5.63E-02	5.24E-03	0.00E+00
Snowshoe_Hare	6.3%	0.0%	1.40E+00	1.63E+02	2.28E+02	Invert	0%	5.40E+03	72%	0.00E+00	0.00E+00	0.00E+00
Snowshoe_Hare	6.3%	0.0%	1.40E+00	1.63E+02	2.28E+02	Browse	100%	4.20E+03	41%	1.32E-01	8.33E-03	0.00E+00
Snowshoe_Hare	6.3%	0.0%	1.40E+00	1.63E+02	2.28E+02	Aquatic Plant	0%	4.30E+03	73%	0.00E+00	0.00E+00	0.00E+00
Snowshoe_Hare										1.32E-01	8.33E-03	0.00E+00

Normalized to Body Weight Free-living (Field) Metabolic Rate (NFMR)

Receptor	NFMR [kcal/kg bw/day] [A]	FMR [kcal/day] [B]	Body Weight [grams]	a	b	Reference/Comments
Ruffed_Grouse	1.55E+02	1.09E+02	7.02E+02	8.51E-01	9.59E-01	Used "Galliformes" (Nagy et al. 1999)
Snowshoe_hare	1.63E+02	2.28E+02	1.40E+03	5.48E+00	7.12E-01	Used "Rodentia" (Nagy et al. 1999)

NOTES:
A) NFMR = Normalized Free Metabolic Rate = FMR / BW; Where BW is in kg.
B) FMR = Free Metabolic Rate [kcal/day] = (a x BW^b) / 4.184 Kj/calorie; Where BW is in grams; moose equation already in kcal units.

Receptor Dietary Composition [media % of diet]

Receptor	Media	Abbreviation	Value
Ruffed_grouse	Browse	Ruffed_grouse_Browse	80.0%
Ruffed_grouse	Invert	Ruffed_grouse_Invert	20.0%
Ruffed_grouse	Aquatic Plant	Ruffed_grouse_Aquatic Plant	0.0%
Snowshoe_hare	Browse	Snowshoe_hare_Browse	100.0%
Snowshoe_hare	Invert	Snowshoe_hare_Invert	0.0%
Snowshoe_hare	Aquatic Plant	Snowshoe_hare_Aquatic Plant	0.0%

Metabolizable Energy (ME) of Dietary Items [kcal/kg] A

Receptor	Dietary Item	Abbreviation	Value
Ruffed_grouse	Browse	Ruffed_grouse_Browse	1722
Ruffed_grouse	Invert	Ruffed_grouse_Invert	3888
Ruffed_grouse	Aquatic Plant	Ruffed_grouse_Aquatic Plant	3139
Snowshoe_hare	Browse	Snowshoe_hare_Browse	1722
Snowshoe_hare	Invert	Snowshoe_hare_Invert	3888
Snowshoe_hare	Aquatic Plant	Snowshoe_hare_Aquatic Plant	3139

NOTES:
A) US EPA 1993; Equation 4-17.

Gross Energy (GE) of Dietary Items [kcal/kg dw] A

Receptor	Dietary Item	Abbreviation	Value	Reference/Comments
Ruffed_grouse	Browse	Ruffed_grouse_Browse	4200	monocot young grasses; US EPA 1993
Ruffed_grouse	Invert	Ruffed_grouse_Invert	5400	grasshopper, crickets; US EPA 1993
Ruffed_grouse	Aquatic Plant	Ruffed_grouse_Aquatic Plant	4300	aquatic emergent vegetation; US EPA 1993
Snowshoe_hare	Browse	Snowshoe_hare_Browse	4200	monocot young grasses; US EPA 1993
Snowshoe_hare	Invert	Snowshoe_hare_Invert	5400	grasshopper, crickets; US EPA 1993
Snowshoe_hare	Aquatic Plant	Snowshoe_hare_Aquatic Plant	4300	aquatic emergent vegetation; US EPA 1993

NOTES:
A) US EPA 1993; Tables 4-1 & 4-2.

Assimilation Efficiency (AE) of Dietary Items [Percent Efficiency] A

Receptor	Dietary Item	Abbreviation	Value	Reference/Comments
Ruffed_grouse	Aquatic Plant	Ruffed_grouse_Aquatic Plant	73%	green forbs; US EPA 1993
Ruffed_grouse	Browse	Ruffed_grouse_Browse	41%	mature grasses; US EPA 1993
Ruffed_grouse	Invert	Ruffed_grouse_Invert	72%	terrestrial insects; US EPA 1993
Snowshoe_hare	Aquatic Plant	Snowshoe_hare_Aquatic Plant	73%	green forbs; US EPA 1993
Snowshoe_hare	Browse	Snowshoe_hare_Browse	41%	mature grasses; US EPA 1993
Snowshoe_hare	Invert	Snowshoe_hare_Invert	72%	terrestrial insects; US EPA 1993

NOTES:
A) US EPA 1993; Table 4-3.

Kow

Chemical	Value	Log(Kow)	Reference
Aluminum	0.00E+00	0.00E+00	Not required
Chromium	0.00E+00	0.00E+00	Not required
Iron	0.00E+00	0.00E+00	Not required
Manganese	0.00E+00	0.00E+00	Not required
Silica	0.00E+00	0.00E+00	Not required
Titanium	0.00E+00	0.00E+00	Not required
Benzo(a)pyrene	1.35E+06	6.13E+00	Syracuse Research Corporation 2013

Molecular Weight [grams/mole]

Chemical	Value	Comment / Reference
Aluminum	NR	Not required
Chromium	NR	Not required
Iron	NR	Not required
Manganese	NR	Not required
Silica	NR	Not required
Titanium	NR	Not required
Benzo(a)pyrene	2.52E+02	Syracuse Research Corporation 2013

Soil to Pore Water Partition Coefficient (Kd) [L/kg]

Chemical	Value	Reference
Aluminum	25.0%	Assumed RAF for metals
Chromium	10.0%	Health Canada 2010
Iron	25.0%	Assumed RAF for metals
Manganese	25.0%	Assumed RAF for metals
Silica	25.0%	Assumed RAF for metals
Titanium	25.0%	Assumed RAF for metals
Benzo(a)pyrene	15.0%	Health Canada 2010

Percent of Exposure Derived from Impacted Area

Receptor	Value	Comment
Ruffed_Grouse	100%	Assumed
Snowshoe_hare	100%	Assumed

Water Content in Wildlife Food [%]

Receptor	Value	Reference
Berries	86%	Site specific
Browse	85%	US EPA 2005
Invert	69%	Suter et al. 2000 (Table 3.5)
Ruffed_Grouse	70%	WBEA 2009
Snowshoe_hare	74%	WBEA 2009

Equation Variables Plant Concentration Due to Direct Deposition

Variable	Value	Units	Reference
Empirical Constant - (y)	2.88	Unitless	US EPA OSW 2005
Yield or Standing Biomass for Forage/Browse (Yp)	0.24	kg DW/m^2	US EPA OSW 2005
Plant Surface Loss Coefficient - (kp)	18	yr^{-1}	US EPA OSW 2005
Period of Browse Exposure - (Tp)	0.12	yr	US EPA OSW 2005
Fraction of COPC in Vapour Phase	n/a	Chemical Specific	
Deposition Velocity	n/a	Chemical Specific	

Time Period of Deposition [years]

Variable	Value	Comment
Time	40	Life of facility

Soil Properties

Variable	Value	Units	Reference
Surface Soil Mixing Depth = Depth1	0.02	m	US EPA OSW 2005
Soil Mixing Depth for Plants = Depth2	0.2	m	US EPA OSW 2005
Soil Bulk Density	1500	kg/m^3	US EPA OSW 2005

Gas Constants

Variable	Value	Units
Universal Gas Constant (R)	8.21E-05	atm m^3/ mol
Temperature (T)	288	Kelvin
R x T	2.36E-02	Kelvin atm m^3 / mol

Uptake Factors for the ERA [DW basis]

Media	Chemical	Abbreviation	Regression Model		UF	Model	Reference/Comment
			Constant	Slope	Value		
Browse	Aluminum	Browse_Aluminum			3.20E-03	BCF	BJC 1998
Browse	Benzo(a)pyrene	Browse_Benzo(a)pyrene			1.11E-02	BCF	US EPA 2005
Browse	Chromium	Browse_Chromium			6.53E-02	BCF	BJC 1998
Browse	Iron	Browse_Iron			7.62E-03	BCF	BJC 1998
Browse	Manganese	Browse_Manganese			1.13E-01	BCF	BJC 1998
Browse	Silica	Browse_Silica			7.00E-02	BCF	Baes et al 1984; Based on silicone
Browse	Titanium	Browse_Titanium			5.50E-03	BCF	Baes et al 1984
Berries	Aluminum	Berries_Aluminum			7.3E-04	BCF	Site-specific; Based on Average
Berries	Benzo(a)pyrene	Berries_Benzo(a)pyrene			1.11E-02	BCF	US EPA 2005
Berries	Chromium	Berries_Chromium			7.50E-03	BCF	Baes et al 1984
Berries	Iron	Berries_Iron			2.8E-04	BCF	Site-specific; Based on Average
Berries	Manganese	Berries_Manganese			1.0E-01	BCF	Site-specific; Based on Average
Berries	Silica	Berries_Silica			3.50E-01	BCF	Baes et al 1984
Berries	Titanium	Berries_Titanium			6.2E-04	BCF	Site-specific; Based on Average
Fish	Aluminum	Fish_Aluminum			2.70E+00	BCF	US EPA 1999
Fish	Benzo(a)pyrene	Fish_Benzo(a)pyrene			5.00E+01	BCF	ATSDR
Fish	Chromium	Fish_Chromium			1.90E+01	BCF	US EPA 2005
Fish	Iron	Fish_Iron			2.00E+02	BCF	Yu et al 2001
Fish	Manganese	Fish_Manganese			4.00E+02	BCF	Yu et al 2001
Fish	Silica	Fish_Silica					Not available
Fish	Titanium	Fish_Titanium					Not available
Invertebrates	Aluminum	Invertebrates_Aluminum			5.30E-02	BCF	Sample et al 1998
Invertebrates	Benzo(a)pyrene	Invertebrates_Benzo(a)pyrene			4.19E-01	BCF	US EPA OSW 1999 App C, Table C-1 Soil to Invert
Invertebrates	Chromium	Invertebrates_Chromium			1.10E+00	BCF	Sample et al 1998
Invertebrates	Iron	Invertebrates_Iron			3.80E-02	BCF	Sample et al 1998
Invertebrates	Manganese	Invertebrates_Manganese	-8.09E-01	6.82E-01		Ln_Normal	Sample et al 1998
Invertebrates	Silica	Invertebrates_Silica					
Invertebrates	Titanium	Invertebrates_Titanium					

Bio Transfer Factors [day/kg FW]

Media	Chemical	Value	Comment
Ruffed_Grouse	Aluminum	2.00E-04	Baes et al 1984
Ruffed_Grouse	Benzo(a)pyrene	2.66E-04	US EPA OSW 2005
Ruffed_Grouse	Chromium	1.50E-03	Baes et al 1984
Ruffed_Grouse	Iron	2.50E-04	Baes et al 1984
Ruffed_Grouse	Manganese	3.50E-04	Baes et al 1984
Ruffed_Grouse	Silica	2.00E-03	Baes et al 1984; based on silcone
Ruffed_Grouse	Titanium	2.00E-03	Baes et al 1984
Snowshoe_Hare	Aluminum	2.00E-04	Baes et al 1984
Snowshoe_Hare	Benzo(a)pyrene	3.61E-04	US EPA OSW 2005
Snowshoe_Hare	Chromium	1.50E-03	Baes et al 1984
Snowshoe_Hare	Iron	2.50E-04	Baes et al 1984
Snowshoe_Hare	Manganese	3.50E-04	Baes et al 1984
Snowshoe_Hare	Silica	2.00E-03	Baes et al 1984; based on silcone
Snowshoe_Hare	Titanium	2.00E-03	Baes et al 1984

NOTES:
U EPA 2005 Equation: 10^(-0.099*LOG(Kow)^2+1.07*LOG(Kow)-3.56*FC*MF)

Fat Content

Receptor	%	Reference/Comment
Ruffed_Grouse	0.14	US EPA OSW 2005; assumed equal to chicken
Snowshoe_Hare	0.19	US EPA OSW 2005; assumed equal to beef

Metabolism Factor

Chemical	Value	Reference
Aluminum	1.00	Assumed most conservative value
Chromium	1.00	Assumed most conservative value
Manganese	1.00	Assumed most conservative value
Titanium	1.00	Assumed most conservative value
Benzo(a)pyrene	0.01	Hofelt et al 2001

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Concentrations Used in the Model

Scenario	Site	Chemical	Media	Abbreviation	Value	Units	Comment/Reference
Baseline	MAX	Aluminum	Air	Baseline_MAX_Aluminum_Air	0.00E+00	ug/m3	
Baseline	MAX	Benzo(a)pyrene	Air	Baseline_MAX_Benzo(a)pyrene_Air	0.00E+00	ug/m3	
Baseline	MAX	Chromium	Air	Baseline_MAX_Chromium_Air	0.00E+00	ug/m3	
Baseline	MAX	Iron	Air	Baseline_MAX_Iron_Air	0.00E+00	ug/m3	
Baseline	MAX	Manganese	Air	Baseline_MAX_Manganese_Air	0.00E+00	ug/m3	
Baseline	MAX	Silica	Air	Baseline_MAX_Silica_Air	0.00E+00	ug/m3	
Baseline	MAX	Titanium	Air	Baseline_MAX_Titanium_Air	0.00E+00	ug/m3	
Project	MAX	Aluminum	Air	Project_MAX_Aluminum_Air	0.00E+00	ug/m3	
Project	MAX	Benzo(a)pyrene	Air	Project_MAX_Benzo(a)pyrene_Air	0.00E+00	ug/m3	
Project	MAX	Chromium	Air	Project_MAX_Chromium_Air	0.00E+00	ug/m3	
Project	MAX	Iron	Air	Project_MAX_Iron_Air	0.00E+00	ug/m3	
Project	MAX	Manganese	Air	Project_MAX_Manganese_Air	0.00E+00	ug/m3	
Project	MAX	Silica	Air	Project_MAX_Silica_Air	0.00E+00	ug/m3	
Project	MAX	Titanium	Air	Project_MAX_Titanium_Air	0.00E+00	ug/m3	
Baseline	MAX	Aluminum	Deposition	Baseline_MAX_Aluminum_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Benzo(a)pyrene	Deposition	Baseline_MAX_Benzo(a)pyrene_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Chromium	Deposition	Baseline_MAX_Chromium_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Iron	Deposition	Baseline_MAX_Iron_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Manganese	Deposition	Baseline_MAX_Manganese_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Silica	Deposition	Baseline_MAX_Silica_Deposition	0.00E+00	mg/m2/year	
Baseline	MAX	Titanium	Deposition	Baseline_MAX_Titanium_Deposition	0.00E+00	mg/m2/year	
Project	MAX	Aluminum	Deposition	Project_MAX_Aluminum_Deposition	5.67E+02	mg/m2/year	
Project	MAX	Benzo(a)pyrene	Deposition	Project_MAX_Benzo(a)pyrene_Deposition	2.75E-07	mg/m2/year	
Project	MAX	Chromium	Deposition	Project_MAX_Chromium_Deposition	1.16E+01	mg/m2/year	
Project	MAX	Iron	Deposition	Project_MAX_Iron_Deposition	1.75E+04	mg/m2/year	
Project	MAX	Manganese	Deposition	Project_MAX_Manganese_Deposition	4.02E+02	mg/m2/year	
Project	MAX	Silica	Deposition	Project_MAX_Silica_Deposition	2.19E+04	mg/m2/year	
Project	MAX	Titanium	Deposition	Project_MAX_Titanium_Deposition	1.60E+02	mg/m2/year	
Baseline	MAX	Aluminum	Drinking Water	Baseline_MAX_Aluminum_Drinking Water	1.50E-02	mg/L	Based on Maximum
Baseline	MAX	Benzo(a)pyrene	Drinking Water	Baseline_MAX_Benzo(a)pyrene_Drinking Water	0.00E+00	mg/L	Not measured
Baseline	MAX	Chromium	Drinking Water	Baseline_MAX_Chromium_Drinking Water	1.00E-03	mg/L	Used detection limit
Baseline	MAX	Iron	Drinking Water	Baseline_MAX_Iron_Drinking Water	2.20E-01	mg/L	Based on Maximum
Baseline	MAX	Manganese	Drinking Water	Baseline_MAX_Manganese_Drinking Water	8.00E-02	mg/L	Based on Maximum
Baseline	MAX	Silica	Drinking Water	Baseline_MAX_Silica_Drinking Water	0.00E+00	mg/L	Not measured
Baseline	MAX	Titanium	Drinking Water	Baseline_MAX_Titanium_Drinking Water	2.20E-03	mg/L	Based on Maximum
Project	MAX	Aluminum	Drinking Water	Project_MAX_Aluminum_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Benzo(a)pyrene	Drinking Water	Project_MAX_Benzo(a)pyrene_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Chromium	Drinking Water	Project_MAX_Chromium_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Iron	Drinking Water	Project_MAX_Iron_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Manganese	Drinking Water	Project_MAX_Manganese_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Silica	Drinking Water	Project_MAX_Silica_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Titanium	Drinking Water	Project_MAX_Titanium_Drinking Water	0.00E+00	mg/L	Assumed no changes due to the project
Baseline	MAX	Aluminum	Soil	Baseline_MAX_Aluminum_Soil	1.30E+04	mg/kg	
Baseline	MAX	Benzo(a)pyrene	Soil	Baseline_MAX_Benzo(a)pyrene_Soil	0.00E+00	mg/kg	
Baseline	MAX	Chromium	Soil	Baseline_MAX_Chromium_Soil	5.40E+01	mg/kg	
Baseline	MAX	Iron	Soil	Baseline_MAX_Iron_Soil	8.40E+04	mg/kg	
Baseline	MAX	Manganese	Soil	Baseline_MAX_Manganese_Soil	1.90E+03	mg/kg	
Baseline	MAX	Silica	Soil	Baseline_MAX_Silica_Soil	0.00E+00	mg/kg	
Baseline	MAX	Titanium	Soil	Baseline_MAX_Titanium_Soil	9.70E+02	mg/kg	
Project	MAX	Aluminum	Soil	Project_MAX_Aluminum_Soil	0.00E+00	mg/kg	
Project	MAX	Benzo(a)pyrene	Soil	Project_MAX_Benzo(a)pyrene_Soil	0.00E+00	mg/kg	
Project	MAX	Chromium	Soil	Project_MAX_Chromium_Soil	0.00E+00	mg/kg	
Project	MAX	Iron	Soil	Project_MAX_Iron_Soil	0.00E+00	mg/kg	
Project	MAX	Manganese	Soil	Project_MAX_Manganese_Soil	0.00E+00	mg/kg	
Project	MAX	Silica	Soil	Project_MAX_Silica_Soil	0.00E+00	mg/kg	
Project	MAX	Titanium	Soil	Project_MAX_Titanium_Soil	0.00E+00	mg/kg	
Baseline	MAX	Aluminum	Surface Soil	Baseline_MAX_Aluminum_Surface Soil	1.30E+04	mg/kg	
Baseline	MAX	Benzo(a)pyrene	Surface Soil	Baseline_MAX_Benzo(a)pyrene_Surface Soil	0.00E+00	mg/kg	
Baseline	MAX	Chromium	Surface Soil	Baseline_MAX_Chromium_Surface Soil	5.40E+01	mg/kg	
Baseline	MAX	Iron	Surface Soil	Baseline_MAX_Iron_Surface Soil	8.40E+04	mg/kg	
Baseline	MAX	Manganese	Surface Soil	Baseline_MAX_Manganese_Surface Soil	1.90E+03	mg/kg	
Baseline	MAX	Silica	Surface Soil	Baseline_MAX_Silica_Surface Soil	0.00E+00	mg/kg	
Baseline	MAX	Titanium	Surface Soil	Baseline_MAX_Titanium_Surface Soil	9.70E+02	mg/kg	
Project	MAX	Aluminum	Surface Soil	Project_MAX_Aluminum_Surface Soil	0.00E+00	mg/kg	
Project	MAX	Benzo(a)pyrene	Surface Soil	Project_MAX_Benzo(a)pyrene_Surface Soil	0.00E+00	mg/kg	

Scenario	Site	Chemical	Media	Abbreviation	Value	Units	Comment/Reference
Project	MAX	Chromium	Surface Soil	Project_MAX_Chromium_Surface Soil	0.00E+00	mg/kg	
Project	MAX	Iron	Surface Soil	Project_MAX_Iron_Surface Soil	0.00E+00	mg/kg	
Project	MAX	Manganese	Surface Soil	Project_MAX_Manganese_Surface Soil	0.00E+00	mg/kg	
Project	MAX	Silica	Surface Soil	Project_MAX_Silica_Surface Soil	0.00E+00	mg/kg	
Project	MAX	Titanium	Surface Soil	Project_MAX_Titanium_Surface Soil	0.00E+00	mg/kg	
Baseline	MAX	Aluminum	Surface Water	Baseline_MAX_Aluminum_Surface Water	2.30E-02	mg/L	Based on 95UCLM
Baseline	MAX	Benzo(a)pyrene	Surface Water	Baseline_MAX_Benzo(a)pyrene_Surface Water	0.00E+00	mg/L	Not measured
Baseline	MAX	Chromium	Surface Water	Baseline_MAX_Chromium_Surface Water	1.00E-03	mg/L	Used detection limit
Baseline	MAX	Iron	Surface Water	Baseline_MAX_Iron_Surface Water	6.60E-02	mg/L	Based on 95UCLM
Baseline	MAX	Manganese	Surface Water	Baseline_MAX_Manganese_Surface Water	1.20E-02	mg/L	Based on 95UCLM
Baseline	MAX	Silica	Surface Water	Baseline_MAX_Silica_Surface Water	0.00E+00	mg/L	Not measured
Baseline	MAX	Titanium	Surface Water	Baseline_MAX_Titanium_Surface Water	2.40E-03	mg/L	Based on Maximum
Project	MAX	Aluminum	Surface Water	Project_MAX_Aluminum_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Benzo(a)pyrene	Surface Water	Project_MAX_Benzo(a)pyrene_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Chromium	Surface Water	Project_MAX_Chromium_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Iron	Surface Water	Project_MAX_Iron_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Manganese	Surface Water	Project_MAX_Manganese_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Silica	Surface Water	Project_MAX_Silica_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project
Project	MAX	Titanium	Surface Water	Project_MAX_Titanium_Surface Water	0.00E+00	mg/L	Assumed no changes due to the project

Henry's Constant [atm m³ / mol]

Chemical	Value	H [Pa m^3/mol]	H' [Unitless]	Reference
Aluminum	0.00E+00	0.00E+00	0.00E+00	Not required
Chromium	0.00E+00	0.00E+00	0.00E+00	Not required
Iron	0.00E+00	0.00E+00	0.00E+00	Not required
Manganese	0.00E+00	0.00E+00	0.00E+00	Not required
Silica	0.00E+00	0.00E+00	0.00E+00	Not required
Titanium	0.00E+00	0.00E+00	0.00E+00	Not required
Benzo(a)pyrene	4.57E-07	4.63E-02	1.87E-05	Syracuse Research Corporation 2013

Deposition Velocities [m/s]

Chemical	Wet	Dry	Reference Wet	Reference Dry
Aluminum	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Chromium	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Iron	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Manganese	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Silica	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Titanium	3.79E-03	3.00E-02	Mackay 1991	US EPA OSW 2005
Benzo(a)pyrene	3.79E-03	7.60E-03	Mackay 1991	Chang et al. 2003 & Sheu et al 1996

NOTES:
Wet deposition velocity based on annual average precipitation of 598mm (Hydrology Assessment)

Vapour Pressure [mmHg]

Chemical	Value	VP[atm]	VP[Pa]	VP[kPa]	Reference
Aluminum	NR	NR	NR	NR	Not required
Chromium	NR	NR	NR	NR	Not required
Iron	NR	NR	NR	NR	Not required
Manganese	NR	NR	NR	NR	Not required
Silica	NR	NR	NR	NR	Not required
Titanium	NR	NR	NR	NR	Not required
Benzo(a)pyrene	5.49E-09	7.22E-12	7.32E-07	7.32E-10	Syracuse Research Corporation 2013

Solubility [mg/L] or [ppm]

Chemical	Value	$S[kg/m^3]$	Reference
Aluminum	NR	NR	Not required
Chromium	NR	NR	Not required
Iron	NR	NR	Not required
Manganese	NR	NR	Not required
Silica	NR	NR	Not required
Titanium	NR	NR	Not required
Benzo(a)pyrene	1.62E-03	1.62E-06	Syracuse Research Corporation 2013

Koc [(mg/g) / (mg/mL)] or [L/kg] or [mL/g]

Chemical	Value	Log(Koc)	Reference
Aluminum	NR	NR	Not required
Chromium	NR	NR	Not required
Iron	NR	NR	Not required
Manganese	NR	NR	Not required
Silica	NR	NR	Not required
Titanium	NR	NR	Not required
Benzo(a)pyrene	6.31E+05	5.80E+00	US EPA 2011 (EPI Suite Database)

Fraction of Chemical in the Vapour Phase

Chemical	Value	Reference
Aluminum	0.0%	Assumed all particulate
Chromium	0.0%	Assumed all particulate
Iron	0.0%	Assumed all particulate
Manganese	0.0%	Assumed all particulate
Silica	0.0%	Assumed all particulate
Titanium	0.0%	Assumed all particulate
Benzo(a)pyrene	30.0%	US EPA OSW 2005

Degradation and Volatilization Soil Loss Constant (kt) [yr-1]

Chemical	Kt	Ks(yr-1)	Half-life [Days]	Reference	Kv(yr-1)	Half-life [Days]	Comment/ Reference
Aluminum	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Chromium	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Iron	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Manganese	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Silica	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Titanium	3.47E-03	3.47E-03	7.30E+04	Assumed	NR	NR	Not required
Benzo(a)pyrene	5.66E-01	4.80E-01	5.27E+02	US EPA OSW 2005	8.60E-02	2.94E+03	Lyman et al. 1990

NOTES:
n/a: Indicates not available.
Volatilization half-life [Days] = (0.0000000158 x Koc x S) / VP

Surface Water Loss Constant (ksw) [yr-1]

Chemical	Value	Half-life [Days]	Reference
Aluminum	1.73E-02	1.46E+04	Assumed = 40 years
Chromium	1.73E-02	1.46E+04	Assumed = 40 years
Iron	1.73E-02	1.46E+04	Assumed = 40 years
Manganese	1.73E-02	1.46E+04	Assumed = 40 years
Silica	1.73E-02	1.46E+04	Assumed = 40 years
Titanium	1.73E-02	1.46E+04	Assumed = 40 years
Benzo(a)pyrene	3.57E+00	7.10E+01	Mackay & Hickie 2000

Soil to Pore Water Partition Coefficient (Kd) [L/kg]

Chemical	Value	Reference
Aluminum	1.50E+03	Baes 1984
Chromium	6.31E+03	Allison and Allison 2005
Iron	2.50E+01	Baes 1984
Lead	5.01E+03	Allison and Allison 2005
Manganese	6.50E+01	Baes 1984
Silica	3.00E+01	Baes 1984; Assumed value for Silicon
Titanium	1.00E+03	Baes 1984
Benzo(a)pyrene	3.15E+03	Calculated; CCME 2008
NOTES:		
Calculated Kd = Koc x foc		
foc(g/g) =	*0.5%*	*Site-specific*

Soil Erosion Load (Le) [mg/yr]

Description	Variable	Units	Value	Reference / Comment
Unit soil loss	Xe	kg / m²-yr	8.92E-01	Calculated; US EPA OSW 2005
	Xe - converted	ton/acre-yr	3.98E+00	Calculated
Pervious watershed area	Ap	m²	7.20E+06	Drainage area for H1; Surface water assessment
Sediment delivery ratio	SD	Unitless	2.64E-01	Calculated below; US EPA OSW 2005
Soil enrichment ratio	ER	Unitless	Variable	Default value for organics = 3 & metals = 1; US EPA OSW 2005. Macro will select the value based on the chemical group of a chemical.
Xe Parameters				
Rainfall factor	RF	yr-1	6.80E+01	Assumed; US EPA OSW 2005
Erodibility factor	K	ton/acre	3.90E-01	Default; US EPA OSW 2005
Length-slope factor	LS	Unitless	1.50E+00	Default; US EPA OSW 2005
Cover management factor	C	Unitless	1.00E-01	Default value for vegetation cover; US EPA OSW 2005
Supporting practice factor	PF	Unitless	1.00E+00	Default value for the absense of erosion management; US EPA OSW 2005
Unit conversion factor1	CF1	kg/ton	9.07E+02	US EPA OSW 2005
Unit conversino factor2	CF2	m²/acre	4.05E+03	US EPA OSW 2005

Sediment Delivery Ratio (US EPA OSW 2005)

Watershed area [square miles]	m²	Coefficient
0.1	2.59E+05	2.1
1	2.59E+06	1.9
10	2.59E+07	1.4
100	2.59E+08	1.2
1000	2.59E+09	0.6

Guidelines for Assessing Potential Soil Erosion Classes (Wall et al. 2002)

Soil Erosion Class	Potential Soil Loss	
	tonnes/ha/yr	tons/acre/yr
1 Very Low	<6	<3
2 Low	6 to 11	3 to 5
3 Moderate	11 to 22	5 to 10
4 High	22 to 33	10 to 15
5 Severe	>33	>15