Community Specific Dustfall Calculations Technical Memo

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File:	123510762	Date:	May 17, 2016

Reference: **Community-Specific Dustfall Calculations Technical Memo**

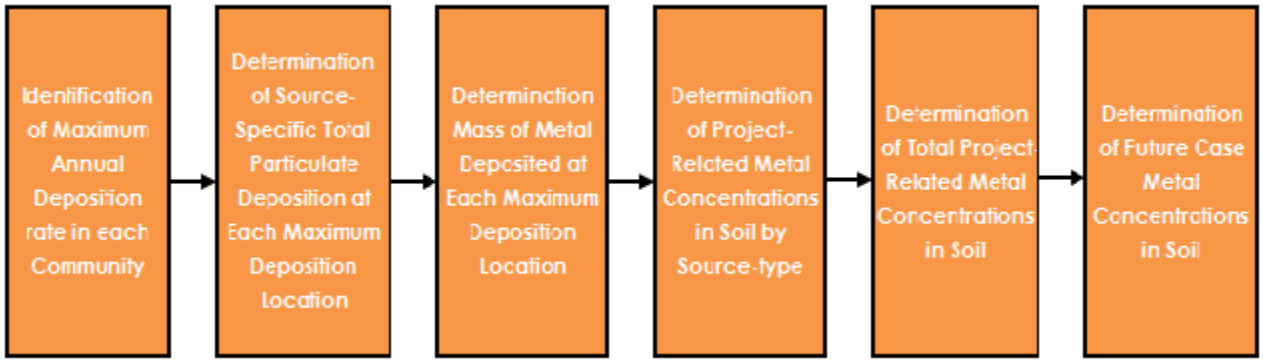
INTRODUCTION

This technical memo has been prepared in response to information requests from the Canadian Environmental Assessment Agency (CEAA) and Health Canada (IR#'s CEAA-025 and HC-022). The information request states:

> "*Health Canada requests that the following information be provided to enable Health Canada to complete a full evaluation of the HHRA. Alternatively, please indicate where this information can be located in the EIS:*
>
> - *Dustfall data (specific to each area and each source: ore, waste rock, tailings, diesel*
>
> *This data is critical to the review of the HHRA as together the characterization data and dustfall data is used to estimate future concentrations of soil and water*"

This memo's purpose is to address questions surrounding calculation of the increase of metal concentrations in soil as a result of dust deposition from the Ajax Project. Included is the step by step process used to calculate the future metal concentrations in soil (Future Case concentrations) at the end of the Operational period as a result of predicted deposition from the Project and existing baseline concentrations (Baseline Case concentrations). This step by step process includes descriptions of the approaches, example calculations and data inputs and outputs for the six Human Health areas (Aberdeen, Brocklehurst, Sahali, Knutsford, North Shore and West End/Downtown) and the Mine Site (i.e., the Plant Boundary). Collectively the Human Health areas and the Mine Site are referred to as "areas".

STEP BY STEP PROCESS



The calculation of community-specific Project-related metal accumulation in soil is a five-step (or maybe 6 step) process that includes:

1. Identification of the maximum annual deposition rate location in each community area
2. Determination of Source-Specific Total Particulate Deposition at Each Maximum Deposition Location
3. Determination Mass of Metal Deposited at Each Maximum Deposition Location
4. Determination of Project-Related Metal Concentrations in Soil by Source-type
5. Determination of Total Project-Related Metal Concentrations in Soil
6. Determination of Future Case Metal Concentrations in Soil

   This last step (if we add it would simply be the summation of baseline soil [ ] and the [metal] we calculated in steps 1 - 5

The calculations used in each step of the process are discussed below and sample calculations for each step are provided

<u>Step 1-</u> Identification of Maximum Annual Deposition Rate Location in Each Health Area

Use the results of the Air Quality Assessment to identify the location within each area with the maximum annual deposition rate for total particulate matter (TPM). These deposition rates, which are predicted to occur during the Operational phase of the Project, include contributions from the four major sources of particulate matter: diesel, ore, tailings and waste rock. The location within each area with the maximum predicted annual deposition rate of TPM are proved in Table 1. The particulate matter deposition rates from each source are also provided; predicted deposition rates are expressed in units of mg/m^2/year. Data for waste rock has been identified as "Other" in the Air

Quality Assessment, but has been labeled as waste rock in the HHERA. The maximum deposition rate for the Mine Site area corresponds to the maximum deposition rate along the Plant Boundary.

Table 1 Annual deposition rates of total particulate matter (TPM) from locations with maximum deposition rates within each area.

Area	Particulate Matter Deposition Rate (mg/m²/yr)				
	Diesel	Ore	Tailings	Waste rock	Total Particulate Matter
Aberdeen	9.16E+00	3.80E+02	1.79E+01	1.99E+03	2.40E+03
Brocklehurst	5.50E-01	1.22E+01	1.86E+00	6.99E+01	8.45E+01
Sahali	1.94E+00	5.78E+01	6.90E+00	3.19E+02	3.86E+02
Knutsford	7.21E+00	2.92E+02	2.21E+01	1.57E+03	1.89E+03
North Shore	9.90E-01	2.39E+01	3.37E+00	1.32E+02	1.60E+02
West End/Downtown	1.50E+00	3.69E+01	4.65E+00	2.18E+02	2.61E+02
Mine Site	1.30E+01	3.94E+02	1.73E+01	2.15E+03	2.57E+03

<u>Step 2-</u> Determination of Source-Specific Total Particulate Deposition at Each Maximum Deposition Location

Determine the total particulate deposited per square metre (kg/m²) in each area at the end of the Operational period, due to each of the four sources. The general equation is provided below followed by a worked example for diesel particulate in Aberdeen. The total particulate matter deposited in each area due to each of the four sources is provided in Table 2 to Table 5.

Worked example for total particulate mass deposited in Aberdeen:

$$TDD\ \left({}^{kg_{dust}}/_{m^2}\right) = ADD\ \left({}^{mg_{dust}}/_{m^2\ year}\right) \times OD(years) \times CF\left({}^{1\ kg}/_{1 \times 10^6 mg}\right)$$

Where:

Parameter	Description	Units
TDD	= Total Dust Deposition	kg/m²
ADD	= Annual Dust Deposition	mg/m²-year
OD	= Operational Duration	years
CF	= mg to kg conversion factor	kg/10⁶ mg

A worked example for calculating TDD is provided below.

$$TDD\ \left({}^{kg_{dust}}/_{m^2}\right) = ADD\ \left({}^{mg_{dust}}/_{m^2\ year}\right) \times OD(years) \times CF\ \left({}^{kg}/_{mg}\right)$$

$$TDD\ \left({}^{kg_{dust}}/_{m^2}\right) = 9.16\ \left({}^{mg_{dust}}/_{m^2\ year}\right) \times 25\ (years)\ \times 0.000001\left({}^{kg}/_{mg}\right)$$

$$TDD\ \left({}^{kg_{dust}}/_{m^2}\right) = 2.29E-04\ \left({}^{kg_{dust}}/_{m^2}\right)$$

The results for each source are provided below in Table 2 to Table 5.

Table 2 Total dust deposited due to diesel sources (based on 25 years of operation)

HHERA Area	mg/m²/yr Annual Dust Deposition	yr Operational Duration	mg/kg Conversion Factor	kg/m² Total Dust Deposited at End of Operation
	A	**B**	**C**	**D = A × B × C**
Aberdeen	9.16E+00	25	1.00E-06	2.29E-04
Brocklehurst	5.50E-01	25	1.00E-06	1.38E-05
Sahali	1.94E+00	25	1.00E-06	4.84E-05
Knutsford	7.21E+00	25	1.00E-06	1.80E-04
North Shore	9.87E-01	25	1.00E-06	2.47E-05
West End/Downtown	1.50E+00	25	1.00E-06	3.75E-05
Mine Site	1.30E+01	25	1.00E-06	3.26E-04

Table 3 Total dust deposited due to ore sources (based on 25 years of operation)

HHERA Area	**mg/m²/yr** Annual Dust Deposition (ADD)	**yr** Operational Duration (OD)	**mg/kg** Conversion Factor	**kg/m²** Total Dust Deposited at End of Operation
	A	**B**	**C**	**D = A × B × C**
Aberdeen	3.80E+02	25	1.00E-06	9.51E-03
Brocklehurst	1.22E+01	25	1.00E-06	3.05E-04
Sahali	5.77E+01	25	1.00E-06	1.44E-03
Knutsford	2.92E+02	25	1.00E-06	7.30E-03
North Shore	2.39E+01	25	1.00E-06	5.97E-04
West End/Downtown	3.69E+01	25	1.00E-06	9.22E-04
Mine Site	3.94E+02	25	1.00E-06	9.86E-03

Table 4 Total dust deposited due to tailings sources (based on 25 years of operation)

HHERA Area	mg/m2/yr	yr	mg/kg	kg/m2
	Annual Dust Deposition (ADD)	Operational Duration (OD)	Conversion Factor	Total Dust Deposited at End of Operation
	A	B	C	D = A × B × C
Aberdeen	1.79E+01	25	1.00E-06	4.48E-04
Brocklehurst	1.86E+00	25	1.00E-06	4.64E-05
Sahali	6.90E+00	25	1.00E-06	1.72E-04
Knutsford	2.21E+01	25	1.00E-06	5.53E-04
North Shore	3.37E+00	25	1.00E-06	8.41E-05
West End/Downtown	4.65E+00	25	1.00E-06	1.16E-04
Mine Site	1.73E+01	25	1.00E-06	4.34E-04

Table 5 Total dust deposited due to waste rock sources (based on 25 years of operation)

HHERA Area	mg/m2/yr	yr	mg/kg	kg/m2
	Annual Dust Deposition (ADD)	Operational Duration (OD)	Conversion Factor	Total Dust Deposited at End of Operation
	A	B	C	D = A × B × C
Aberdeen	1.99E+03	25	1.00E-06	4.97E-02
Brocklehurst	6.99E+01	25	1.00E-06	1.75E-03
Sahali	3.19E+02	25	1.00E-06	7.96E-03
Knutsford	1.57E+03	25	1.00E-06	3.91E-02
North Shore	1.32E+02	25	1.00E-06	3.30E-03
West End/Downtown	2.18E+02	25	1.00E-06	5.45E-03
Mine Site	2.15E+03	25	1.00E-06	5.37E-02

Step 3- Determine Mass of Metal Deposited at Each Maximum Deposition Location

Determine the mass of metal deposited per square metre(mg/m^2) due to deposition from each source (diesel, ore, tailings and waste rock). Each source has a unique metal concentration profile (Table 6). The concentrations for ore is based on the 95% UCLM of approximately 50000 ore samples provided by KGHM and waste rock are based on the 95% UCLM of approximately 1700 samples provided by KGHM and Lorax. Data on metal concentrations in tailings is available for 5 composite tailings samples collected between 2009 and 2014. In March 2015, Lorax noted inconsistencies in the 2014 tailings data and provided metals characterization data for a single composite sample based on the 2013 tailings samples and recommended that this sample be used in the human health and ecological risk assessment. A duplicate analysis of the 2013 composite tailings sample was also provided. The higher of the two values between the composite sample and the duplicate was selected to represent the concentration of each metal in tailings dust. The concentrations in Table 6

are the maximum of the concentration of the sample or the duplicate. The profile for diesel is available online at the following website:
https://www.valleyair.org/busind/pto/emission_factors/emission_factors_idx.htm

Table 6 Metal Concentration Profiles for Diesel, Ore, Tailings and Waste Rock

Metal	Concentration (mg/kg)			
	Waste Rock (95% UCLM)	Ore (95% UCLM)	Tailings (n = 1)	Diesel
Aluminum - Al	1.98E+00	1.71E+04	1.97E+04	0.00E+00
Antimony - Sb	8.07E+00	1.23E+01	2.60E-01	0.00E+00
Arsenic - As	1.27E+01	2.93E+01	6.00E+00	1.86E+02
Chromium - Cr	2.08E+02	1.60E+02	1.80E+02	6.99E+01
Cobalt - Co	3.54E+01	3.94E+01	2.34E+01	0.00E+00
Copper - Cu	3.19E+02	1.57E+03	4.47E+02	4.77E+02
Lead - Pb	1.93E+01	2.42E+01	1.20E+00	9.67E+02
Manganese - Mn	3.62E+02	2.84E+02	3.12E+02	3.61E+02
Mercury - Hg	1.18E+00	2.59E+00	1.80E-01	2.33E+02
Molybdenum - Mo	8.03E+00	1.47E+01	3.13E+01	0.00E+00
Nickel - Ni	2.12E+02	1.40E+02	9.90E+01	4.54E+02
Selenium - Se	2.66E+00	5.01E+00	<1	2.56E+02
Thallium - Tl	1.06E+00	2.50E+00	3.00E-02	0.00E+00
Uranium - U	3.58E+00	4.55E+00	4.40E-01	0.00E+00

A worked example of the mass of metal deposited (for copper) per square meter (mg/m^2) is provided below.

This equation is the same for all types of metals. The mass of each metal deposited in each area due to diesel, ore, waste rock or tailings is provided in Table 7 to Table 10.

$$TMD\ \left({}^{mg_{Metal}}/_{m^2}\right) = TDD\ \left({}^{kg}/_{m^2}\right) \times\ Cs_{raw}\ \left({}^{mg_{Metal}}/_{kg}\right)$$

Where:

Parameter	Description	Units
TMD	=Total Metal deposited	mg/m^2
TDD $_{ore}$	= Total dust deposition	kg/m^2
Cs $_{raw}$	= Metal concentration in source dust	mg/kg

A worked example for mass of metal deposited (for copper) per meter squared (mg/m^2) in Aberdeen due to contributions from ore.

$$TMD\ \left({}^{mg_{copper}}/_{m^2}\right) = TDD\ \left({}^{kg}/_{m^2}\right) \times\ Cs_{raw}\ \left({}^{mg_{copper}}/_{kg}\right)$$

$$TMD\ \left({}^{mg_{copper}}/_{m^2}\right) = 9.51E-03\ \left({}^{kg}/_{m^2}\right) \times\ 1.57E+03\ \left({}^{mg_{copper}}/_{kg}\right)$$

$$TMD\ \left({}^{mg_{copper}}/_{m^2}\right) = 1.49\text{E}+01\ \text{mg}/m^2$$

Table 7 Mass of metal deposited due to diesel sources

COPC	Concentration in Source (mg/kg)	Aberdeen		Brocklehurst		Sahali		Knutsford		North Shore		West End/Downtown		Mine Site	
		Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)
	(A)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)
Aluminum - Al	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00
Antimony - Sb	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00
Arsenic - As	1.86E+02	2.29E-04	4.27E-02	1.38E-05	2.56E-03	4.84E-05	9.03E-03	1.80E-04	3.36E-02	2.47E-05	4.60E-03	3.75E-05	6.98E-03	3.26E-04	6.07E-02
Chromium - Cr	6.99E+01	2.29E-04	1.60E-02	1.38E-05	9.61E-04	4.84E-05	3.38E-03	1.80E-04	1.26E-02	2.47E-05	1.72E-03	3.75E-05	2.62E-03	3.26E-04	2.28E-02
Cobalt - Co	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00
Copper - Cu	4.77E+02	2.29E-04	1.09E-01	1.38E-05	6.57E-03	4.84E-05	2.31E-02	1.80E-04	8.61E-02	2.47E-05	1.18E-02	3.75E-05	1.79E-02	3.26E-04	1.56E-01
Lead - Pb	9.67E+02	2.29E-04	2.21E-01	1.38E-05	1.33E-02	4.84E-05	4.68E-02	1.80E-04	1.74E-01	2.47E-05	2.38E-02	3.75E-05	3.62E-02	3.26E-04	3.15E-01
Manganese - Mn	3.61E+02	2.29E-04	8.26E-02	1.38E-05	4.96E-03	4.84E-05	1.75E-02	1.80E-04	6.51E-02	2.47E-05	8.90E-03	3.75E-05	1.35E-02	3.26E-04	1.18E-01
Mercury - Hg	2.33E+02	2.29E-04	5.33E-02	1.38E-05	3.20E-03	4.84E-05	1.13E-02	1.80E-04	4.20E-02	2.47E-05	5.75E-03	3.75E-05	8.73E-03	3.26E-04	7.59E-02
Molybdenum - Mo	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00
Nickel - Ni	4.54E+02	2.29E-04	1.04E-01	1.38E-05	6.25E-03	4.84E-05	2.20E-02	1.80E-04	8.19E-02	2.47E-05	1.12E-02	3.75E-05	1.70E-02	3.26E-04	1.48E-01
Selenium - Se	2.56E+02	2.29E-04	5.87E-02	1.38E-05	3.52E-03	4.84E-05	1.24E-02	1.80E-04	4.62E-02	2.47E-05	6.32E-03	3.75E-05	9.60E-03	3.26E-04	8.35E-02
Thallium - Tl	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00
Uranium - U	0.00E+00	2.29E-04	0.00E+00	1.38E-05	0.00E+00	4.84E-05	0.00E+00	1.80E-04	0.00E+00	2.47E-05	0.00E+00	3.75E-05	0.00E+00	3.26E-04	0.00E+00

Table 8 Mass of metal deposited due to ore sources

COPC	Concentration in Source (mg/kg)	Aberdeen		Brocklehurst		Sahali		Knutsford		North Shore		West End/Downtown		Mine Site	
		Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)
	(A)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)
Aluminum - Al	1.71E+04	9.51E-03	1.62E+02	3.05E-04	5.20E+00	1.44E-03	2.46E+01	7.30E-03	1.25E+02	5.97E-04	1.02E+01	9.22E-04	1.57E+01	9.86E-03	1.68E+02
Antimony - Sb	1.23E+01	9.51E-03	1.17E-01	3.05E-04	3.74E-03	1.44E-03	1.77E-02	7.30E-03	8.95E-02	5.97E-04	7.32E-03	9.22E-04	1.13E-02	9.86E-03	1.21E-01
Arsenic - As	2.93E+01	9.51E-03	2.79E-01	3.05E-04	8.93E-03	1.44E-03	4.23E-02	7.30E-03	2.14E-01	5.97E-04	1.75E-02	9.22E-04	2.70E-02	9.86E-03	2.89E-01
Chromium - Cr	1.60E+02	9.51E-03	1.52E+00	3.05E-04	4.87E-02	1.44E-03	2.31E-01	7.30E-03	1.17E+00	5.97E-04	9.54E-02	9.22E-04	1.47E-01	9.86E-03	1.57E+00
Cobalt - Co	3.94E+01	9.51E-03	3.74E-01	3.05E-04	1.20E-02	1.44E-03	5.68E-02	7.30E-03	2.87E-01	5.97E-04	2.35E-02	9.22E-04	3.63E-02	9.86E-03	3.88E-01
Copper - Cu	1.57E+03	9.51E-03	1.49E+01	3.05E-04	4.79E-01	1.44E-03	2.27E+00	7.30E-03	1.15E+01	5.97E-04	9.38E-01	9.22E-04	1.45E+00	9.86E-03	1.55E+01
Lead - Pb	2.42E+01	9.51E-03	2.30E-01	3.05E-04	7.36E-03	1.44E-03	3.49E-02	7.30E-03	1.76E-01	5.97E-04	1.44E-02	9.22E-04	2.23E-02	9.86E-03	2.38E-01
Manganese - Mn	2.84E+02	9.51E-03	2.70E+00	3.05E-04	8.65E-02	1.44E-03	4.10E-01	7.30E-03	2.07E+00	5.97E-04	1.70E-01	9.22E-04	2.62E-01	9.86E-03	2.80E+00
Mercury - Hg	2.59E+00	9.51E-03	2.46E-02	3.05E-04	7.89E-04	1.44E-03	3.74E-03	7.30E-03	1.89E-02	5.97E-04	1.55E-03	9.22E-04	2.39E-03	9.86E-03	2.55E-02
Molybdenum - Mo	1.47E+01	9.51E-03	1.40E-01	3.05E-04	4.48E-03	1.44E-03	2.12E-02	7.30E-03	1.07E-01	5.97E-04	8.77E-03	9.22E-04	1.35E-02	9.86E-03	1.45E-01
Nickel - Ni	1.40E+02	9.51E-03	1.33E+00	3.05E-04	4.25E-02	1.44E-03	2.02E-01	7.30E-03	1.02E+00	5.97E-04	8.34E-02	9.22E-04	1.29E-01	9.86E-03	1.38E+00
Selenium - Se	5.01E+00	9.51E-03	4.76E-02	3.05E-04	1.53E-03	1.44E-03	7.23E-03	7.30E-03	3.66E-02	5.97E-04	2.99E-03	9.22E-04	4.62E-03	9.86E-03	4.94E-02
Thallium - Tl	2.50E+00	9.51E-03	2.38E-02	3.05E-04	7.62E-04	1.44E-03	3.61E-03	7.30E-03	1.83E-02	5.97E-04	1.49E-03	9.22E-04	2.31E-03	9.86E-03	2.46E-02
Uranium - U	4.55E+00	9.51E-03	4.33E-02	3.05E-04	1.39E-03	1.44E-03	6.57E-03	7.30E-03	3.32E-02	5.97E-04	2.72E-03	9.22E-04	4.20E-03	9.86E-03	4.49E-02

Table 9 Mass of metal deposited due to tailings sources

COPC	Concentration in Source (mg/kg)	Aberdeen		Brocklehurst		Sahali		Knutsford		North Shore		West End/Downtown		Mine Site	
		Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)
	(A)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)
Aluminum - Al	1.97E+04	4.48E-04	8.83E+00	4.64E-05	9.15E-01	1.72E-04	3.40E+00	5.53E-04	1.09E+01	8.41E-05	1.66E+00	1.16E-04	2.29E+00	4.34E-04	8.54E+00
Antimony - Sb	2.60E-01	4.48E-04	1.17E-04	4.64E-05	1.21E-05	1.72E-04	4.48E-05	5.53E-04	1.44E-04	8.41E-05	2.19E-05	1.16E-04	3.02E-05	4.34E-04	1.13E-04
Arsenic - As	6.00E+00	4.48E-04	2.69E-03	4.64E-05	2.79E-04	1.72E-04	1.03E-03	5.53E-04	3.32E-03	8.41E-05	5.05E-04	1.16E-04	6.97E-04	4.34E-04	2.60E-03
Chromium - Cr	1.80E+02	4.48E-04	8.07E-02	4.64E-05	8.36E-03	1.72E-04	3.10E-02	5.53E-04	9.95E-02	8.41E-05	1.51E-02	1.16E-04	2.09E-02	4.34E-04	7.81E-02
Cobalt - Co	2.34E+01	4.48E-04	1.05E-02	4.64E-05	1.09E-03	1.72E-04	4.04E-03	5.53E-04	1.29E-02	8.41E-05	1.97E-03	1.16E-04	2.72E-03	4.34E-04	1.01E-02
Copper - Cu	4.47E+02	4.48E-04	2.00E-01	4.64E-05	2.08E-02	1.72E-04	7.71E-02	5.53E-04	2.47E-01	8.41E-05	3.76E-02	1.16E-04	5.20E-02	4.34E-04	1.94E-01
Lead - Pb	1.20E+00	4.48E-04	5.38E-04	4.64E-05	5.57E-05	1.72E-04	2.07E-04	5.53E-04	6.63E-04	8.41E-05	1.01E-04	1.16E-04	1.39E-04	4.34E-04	5.20E-04
Manganese - Mn	3.12E+02	4.48E-04	1.40E-01	4.64E-05	1.45E-02	1.72E-04	5.38E-02	5.53E-04	1.72E-01	8.41E-05	2.62E-02	1.16E-04	3.63E-02	4.34E-04	1.35E-01
Mercury - Hg	1.80E-01	4.48E-04	8.07E-05	4.64E-05	8.36E-06	1.72E-04	3.10E-05	5.53E-04	9.95E-05	8.41E-05	1.51E-05	1.16E-04	2.09E-05	4.34E-04	7.81E-05
Molybdenum - Mo	3.13E+01	4.48E-04	1.40E-02	4.64E-05	1.45E-03	1.72E-04	5.40E-03	5.53E-04	1.73E-02	8.41E-05	2.63E-03	1.16E-04	3.64E-03	4.34E-04	1.36E-02
Nickel - Ni	9.90E+01	4.48E-04	4.44E-02	4.64E-05	4.60E-03	1.72E-04	1.71E-02	5.53E-04	5.47E-02	8.41E-05	8.33E-03	1.16E-04	1.15E-02	4.34E-04	4.29E-02
Selenium - Se	1.00E+00	4.48E-04	4.48E-04	4.64E-05	4.64E-05	1.72E-04	1.72E-04	5.53E-04	5.53E-04	8.41E-05	8.41E-05	1.16E-04	1.16E-04	4.34E-04	4.34E-04
Thallium - Tl	3.00E-02	4.48E-04	1.34E-05	4.64E-05	1.39E-06	1.72E-04	5.17E-06	5.53E-04	1.66E-05	8.41E-05	2.52E-06	1.16E-04	3.49E-06	4.34E-04	1.30E-05
Uranium - U	4.40E-01	4.48E-04	1.97E-04	4.64E-05	2.04E-05	1.72E-04	7.59E-05	5.53E-04	2.43E-04	8.41E-05	3.70E-05	1.16E-04	5.11E-05	4.34E-04	1.91E-04

Table 10 Mass of metal deposited due to waste rock sources

COPC	Concentration in Source (mg/kg)	Aberdeen		Brocklehurst		Sahali		Knutsford		North Shore		West End/Downtown		Mine Site	
		Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)	Mass of Dust (kg/m^2)	Mass of Metal (mg/m^2)
	(A)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)	(B)	(C=A × B)
Aluminum - Al	1.98E+00	4.97E-02	9.84E-02	1.75E-03	3.45E-03	7.96E-03	1.58E-02	3.91E-02	7.74E-02	3.30E-03	6.54E-03	5.45E-03	1.08E-02	5.37E-02	1.06E-01
Antimony - Sb	8.07E+00	4.97E-02	4.01E-01	1.75E-03	1.41E-02	7.96E-03	6.43E-02	3.91E-02	3.16E-01	3.30E-03	2.67E-02	5.45E-03	4.40E-02	5.37E-02	4.33E-01
Arsenic - As	1.27E+01	4.97E-02	6.32E-01	1.75E-03	2.22E-02	7.96E-03	1.01E-01	3.91E-02	4.98E-01	3.30E-03	4.20E-02	5.45E-03	6.93E-02	5.37E-02	6.83E-01
Chromium - Cr	2.08E+02	4.97E-02	1.04E+01	1.75E-03	3.64E-01	7.96E-03	1.66E+00	3.91E-02	8.15E+00	3.30E-03	6.89E-01	5.45E-03	1.14E+00	5.37E-02	1.12E+01
Cobalt - Co	3.54E+01	4.97E-02	1.76E+00	1.75E-03	6.18E-02	7.96E-03	2.82E-01	3.91E-02	1.38E+00	3.30E-03	1.17E-01	5.45E-03	1.93E-01	5.37E-02	1.90E+00
Copper - Cu	3.19E+02	4.97E-02	1.58E+01	1.75E-03	5.57E-01	7.96E-03	2.54E+00	3.91E-02	1.25E+01	3.30E-03	1.05E+00	5.45E-03	1.74E+00	5.37E-02	1.71E+01
Lead - Pb	1.93E+01	4.97E-02	9.58E-01	1.75E-03	3.37E-02	7.96E-03	1.53E-01	3.91E-02	7.54E-01	3.30E-03	6.37E-02	5.45E-03	1.05E-01	5.37E-02	1.04E+00
Manganese - Mn	3.62E+02	4.97E-02	1.80E+01	1.75E-03	6.33E-01	7.96E-03	2.88E+00	3.91E-02	1.42E+01	3.30E-03	1.20E+00	5.45E-03	1.97E+00	5.37E-02	1.95E+01
Mercury - Hg	1.18E+00	4.97E-02	5.87E-02	1.75E-03	2.06E-03	7.96E-03	9.41E-03	3.91E-02	4.62E-02	3.30E-03	3.90E-03	5.45E-03	6.44E-03	5.37E-02	6.34E-02
Molybdenum - Mo	8.03E+00	4.97E-02	3.99E-01	1.75E-03	1.40E-02	7.96E-03	6.39E-02	3.91E-02	3.14E-01	3.30E-03	2.65E-02	5.45E-03	4.38E-02	5.37E-02	4.31E-01
Nickel - Ni	2.12E+02	4.97E-02	1.05E+01	1.75E-03	3.70E-01	7.96E-03	1.69E+00	3.91E-02	8.29E+00	3.30E-03	7.00E-01	5.45E-03	1.15E+00	5.37E-02	1.14E+01
Selenium - Se	2.66E+00	4.97E-02	1.32E-01	1.75E-03	4.64E-03	7.96E-03	2.12E-02	3.91E-02	1.04E-01	3.30E-03	8.78E-03	5.45E-03	1.45E-02	5.37E-02	1.43E-01
Thallium - Tl	1.06E+00	4.97E-02	5.29E-02	1.75E-03	1.86E-03	7.96E-03	8.47E-03	3.91E-02	4.16E-02	3.30E-03	3.51E-03	5.45E-03	5.79E-03	5.37E-02	5.71E-02
Uranium - U	3.58E+00	4.97E-02	1.78E-01	1.75E-03	6.25E-03	7.96E-03	2.85E-02	3.91E-02	1.40E-01	3.30E-03	1.18E-02	5.45E-03	1.95E-02	5.37E-02	1.92E-01

Step 4: Determination of Project-Related Metal Concentrations in Soil by Source-type

Determine the concentration of metal in each area due to each of the four deposition sources. The step only considered the concentration increase that occurs as a result of the Project. The predicted increase in concentration is calculated by multiplying the predicted increase in metal mass per metre squared (mg/m^2) by the area of the modelled soil plot (1 m^2), and then dividing that product by the mass of the surface horizon (100 kg), which has a length and width of 1 m and a depth of 10 cm. The increases in concentration due to contributions from diesel, ore, tailings and waste rock for each area are provided in Table 11 to Table 38.

Calculating Mass of soil horizon:

$$SH_{mass\ (kg)} = SA_{m^2} \times HD_m \times SM_{kg/m^3}$$

Where:

Parameter	Description	Units
SH $_{mass}$	=Weight of surface horizon	kg
SA $_{m^2}$	= Surface area of soil horizon	m^2
HD$_m$	= Horizon depth	m
SM$_{kg/m^3}$	=soil mass per cubic meter	Kg/m^3

A worked example of the mass of the soil horizon is provided below.

$$SH_{mass\ (kg)} = SA_{m^2} \times HD_m \times SM_{kg/m^3}$$

$$SH_{mass\ (kg)} = 1\ m^2 \times 0.1\ m \times 1000\ {}^{kg}/_{m^3}$$

$$SH_{mass\ (kg)} = 100\ kg$$

A worked example for concentration of metal in Aberdeen soil due to Project related contributions from ore is provided below.

$$Cs_{\ Project}\left({}^{mg}/_{kg}\right) = \frac{Cw_{mass}(mg)}{SH_{mass}\ (kg)}$$

Where:

Parameter	Description	Units
Cs $_{Project}$	= Concentration of metal due to contributions from Project only (ore sources)	mg/kg
Cw $_{mass}$	= Weight of metal due to contributions from Project only (ore sources)	mg
SH $_{mass}$	=Weight of surface horizon- 100 kg	kg

A worked example for copper $Cs_{Project}$ is provided below.

$$Cs_{Project}\left({}^{mg}/_{kg}\right) = \frac{Cw_{mass}(mg)}{SH_{mass}\,(kg)}$$

$$Cs_{Project}\left({}^{mg}/_{kg}\right) = \frac{1.49E+01(mg)}{1.0E+02\,(kg)}$$

$$Cs_{Project}\left({}^{mg}/_{kg}\right) = 1.49E-01$$

Table 11 Concentration of metal deposited due to diesel sources- Aberdeen

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	4.27E-02	1.00E+02	4.27E-04
Chromium - Cr	1.60E-02	1.00E+02	1.60E-04
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	1.09E-01	1.00E+02	1.09E-03
Lead - Pb	2.21E-01	1.00E+02	2.21E-03
Manganese - Mn	8.26E-02	1.00E+02	8.26E-04
Mercury - Hg	5.33E-02	1.00E+02	5.33E-04
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	1.04E-01	1.00E+02	1.04E-03
Selenium - Se	5.87E-02	1.00E+02	5.87E-04
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 12 Concentration of metal deposited due to diesel sources- Brocklehurst

COPC	Mass of Metal Deposited (mg/m2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	2.56E-03	1.00E+02	2.56E-05
Chromium - Cr	9.61E-04	1.00E+02	9.61E-06
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	6.57E-03	1.00E+02	6.57E-05
Lead - Pb	1.33E-02	1.00E+02	1.33E-04
Manganese - Mn	4.96E-03	1.00E+02	4.96E-05
Mercury - Hg	3.20E-03	1.00E+02	3.20E-05
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	6.25E-03	1.00E+02	6.25E-05
Selenium - Se	3.52E-03	1.00E+02	3.52E-05
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 13 Concentration of metal deposited due to diesel sources- Sahali

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	9.03E-03	1.00E+02	9.03E-05
Chromium - Cr	3.38E-03	1.00E+02	3.38E-05
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	2.31E-02	1.00E+02	2.31E-04
Lead - Pb	4.68E-02	1.00E+02	4.68E-04
Manganese - Mn	1.75E-02	1.00E+02	1.75E-04
Mercury - Hg	1.13E-02	1.00E+02	1.13E-04
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	2.20E-02	1.00E+02	2.20E-04
Selenium - Se	1.24E-02	1.00E+02	1.24E-04
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 14 Concentration of metal deposited due to diesel sources- Knutsford

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	3.36E-02	1.00E+02	3.36E-04
Chromium - Cr	1.26E-02	1.00E+02	1.26E-04
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	8.61E-02	1.00E+02	8.61E-04
Lead - Pb	1.74E-01	1.00E+02	1.74E-03
Manganese - Mn	6.51E-02	1.00E+02	6.51E-04
Mercury - Hg	4.20E-02	1.00E+02	4.20E-04
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	8.19E-02	1.00E+02	8.19E-04
Selenium - Se	4.62E-02	1.00E+02	4.62E-04
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 15 Concentration of metal deposited due to diesel sources- North Shore

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	4.60E-03	1.00E+02	4.60E-05
Chromium - Cr	1.72E-03	1.00E+02	1.72E-05
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	1.18E-02	1.00E+02	1.18E-04
Lead - Pb	2.38E-02	1.00E+02	2.38E-04
Manganese - Mn	8.90E-03	1.00E+02	8.90E-05
Mercury - Hg	5.75E-03	1.00E+02	5.75E-05
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	1.12E-02	1.00E+02	1.12E-04
Selenium - Se	6.32E-03	1.00E+02	6.32E-05
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 16 Concentration of metal deposited due to diesel sources- West End/Downtown

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	6.98E-03	1.00E+02	6.98E-05
Chromium - Cr	2.62E-03	1.00E+02	2.62E-05
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	1.79E-02	1.00E+02	1.79E-04
Lead - Pb	3.62E-02	1.00E+02	3.62E-04
Manganese - Mn	1.35E-02	1.00E+02	1.35E-04
Mercury - Hg	8.73E-03	1.00E+02	8.73E-05
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	1.70E-02	1.00E+02	1.70E-04
Selenium - Se	9.60E-03	1.00E+02	9.60E-05
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 17 Concentration of metal deposited due to diesel sources- Mine Site

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	0.00E+00	1.00E+02	0.00E+00
Antimony - Sb	0.00E+00	1.00E+02	0.00E+00
Arsenic - As	6.07E-02	1.00E+02	6.07E-04
Chromium - Cr	2.28E-02	1.00E+02	2.28E-04
Cobalt - Co	0.00E+00	1.00E+02	0.00E+00
Copper - Cu	1.56E-01	1.00E+02	1.56E-03
Lead - Pb	3.15E-01	1.00E+02	3.15E-03
Manganese - Mn	1.18E-01	1.00E+02	1.18E-03
Mercury - Hg	7.59E-02	1.00E+02	7.59E-04
Molybdenum - Mo	0.00E+00	1.00E+02	0.00E+00
Nickel - Ni	1.48E-01	1.00E+02	1.48E-03
Selenium - Se	8.35E-02	1.00E+02	8.35E-04
Thallium - Tl	0.00E+00	1.00E+02	0.00E+00
Uranium - U	0.00E+00	1.00E+02	0.00E+00

Table 18 Concentration of metal deposited due to ore sources- Aberdeen

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.62E+02	1.00E+02	1.62E+00
Antimony - Sb	1.17E-01	1.00E+02	1.17E-03
Arsenic - As	2.79E-01	1.00E+02	2.79E-03
Chromium - Cr	1.52E+00	1.00E+02	1.52E-02
Cobalt - Co	3.74E-01	1.00E+02	3.74E-03
Copper - Cu	1.49E+01	1.00E+02	1.49E-01
Lead - Pb	2.30E-01	1.00E+02	2.30E-03
Manganese - Mn	2.70E+00	1.00E+02	2.70E-02
Mercury - Hg	2.46E-02	1.00E+02	2.46E-04
Molybdenum - Mo	1.40E-01	1.00E+02	1.40E-03
Nickel - Ni	1.33E+00	1.00E+02	1.33E-02
Selenium - Se	4.76E-02	1.00E+02	4.76E-04
Thallium - Tl	2.38E-02	1.00E+02	2.38E-04
Uranium - U	4.33E-02	1.00E+02	4.33E-04

Table 19 Concentration of metal deposited due to ore sources- Brocklehurst

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	5.20E+00	1.00E+02	5.20E-02
Antimony - Sb	3.74E-03	1.00E+02	3.74E-05
Arsenic - As	8.93E-03	1.00E+02	8.93E-05
Chromium - Cr	4.87E-02	1.00E+02	4.87E-04
Cobalt - Co	1.20E-02	1.00E+02	1.20E-04
Copper - Cu	4.79E-01	1.00E+02	4.79E-03
Lead - Pb	7.36E-03	1.00E+02	7.36E-05
Manganese - Mn	8.65E-02	1.00E+02	8.65E-04
Mercury - Hg	7.89E-04	1.00E+02	7.89E-06
Molybdenum - Mo	4.48E-03	1.00E+02	4.48E-05
Nickel - Ni	4.25E-02	1.00E+02	4.25E-04
Selenium - Se	1.53E-03	1.00E+02	1.53E-05
Thallium - Tl	7.62E-04	1.00E+02	7.62E-06
Uranium - U	1.39E-03	1.00E+02	1.39E-05

Table 20 Concentration of metal deposited due to ore sources- Sahali

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	2.46E+01	1.00E+02	2.46E-01
Antimony - Sb	1.77E-02	1.00E+02	1.77E-04
Arsenic - As	4.23E-02	1.00E+02	4.23E-04
Chromium - Cr	2.31E-01	1.00E+02	2.31E-03
Cobalt - Co	5.68E-02	1.00E+02	5.68E-04
Copper - Cu	2.27E+00	1.00E+02	2.27E-02
Lead - Pb	3.49E-02	1.00E+02	3.49E-04
Manganese - Mn	4.10E-01	1.00E+02	4.10E-03
Mercury - Hg	3.74E-03	1.00E+02	3.74E-05
Molybdenum - Mo	2.12E-02	1.00E+02	2.12E-04
Nickel - Ni	2.02E-01	1.00E+02	2.02E-03
Selenium - Se	7.23E-03	1.00E+02	7.23E-05
Thallium - Tl	3.61E-03	1.00E+02	3.61E-05
Uranium - U	6.57E-03	1.00E+02	6.57E-05

Table 21 Concentration of metal deposited due to ore sources- Knutsford

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.25E+02	1.00E+02	1.25E+00
Antimony - Sb	8.95E-02	1.00E+02	8.95E-04
Arsenic - As	2.14E-01	1.00E+02	2.14E-03
Chromium - Cr	1.17E+00	1.00E+02	1.17E-02
Cobalt - Co	2.87E-01	1.00E+02	2.87E-03
Copper - Cu	1.15E+01	1.00E+02	1.15E-01
Lead - Pb	1.76E-01	1.00E+02	1.76E-03
Manganese - Mn	2.07E+00	1.00E+02	2.07E-02
Mercury - Hg	1.89E-02	1.00E+02	1.89E-04
Molybdenum - Mo	1.07E-01	1.00E+02	1.07E-03
Nickel - Ni	1.02E+00	1.00E+02	1.02E-02
Selenium - Se	3.66E-02	1.00E+02	3.66E-04
Thallium - Tl	1.83E-02	1.00E+02	1.83E-04
Uranium - U	3.32E-02	1.00E+02	3.32E-04

Table 22 Concentration of metal deposited due to ore sources- North Shore

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.02E+01	1.00E+02	1.02E-01
Antimony - Sb	7.32E-03	1.00E+02	7.32E-05
Arsenic - As	1.75E-02	1.00E+02	1.75E-04
Chromium - Cr	9.54E-02	1.00E+02	9.54E-04
Cobalt - Co	2.35E-02	1.00E+02	2.35E-04
Copper - Cu	9.38E-01	1.00E+02	9.38E-03
Lead - Pb	1.44E-02	1.00E+02	1.44E-04
Manganese - Mn	1.70E-01	1.00E+02	1.70E-03
Mercury - Hg	1.55E-03	1.00E+02	1.55E-05
Molybdenum - Mo	8.77E-03	1.00E+02	8.77E-05
Nickel - Ni	8.34E-02	1.00E+02	8.34E-04
Selenium - Se	2.99E-03	1.00E+02	2.99E-05
Thallium - Tl	1.49E-03	1.00E+02	1.49E-05
Uranium - U	2.72E-03	1.00E+02	2.72E-05

Table 23 Concentration of metal deposited due to ore sources- West End/Downtown

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.57E+01	1.00E+02	1.57E-01
Antimony - Sb	1.13E-02	1.00E+02	1.13E-04
Arsenic - As	2.70E-02	1.00E+02	2.70E-04
Chromium - Cr	1.47E-01	1.00E+02	1.47E-03
Cobalt - Co	3.63E-02	1.00E+02	3.63E-04
Copper - Cu	1.45E+00	1.00E+02	1.45E-02
Lead - Pb	2.23E-02	1.00E+02	2.23E-04
Manganese - Mn	2.62E-01	1.00E+02	2.62E-03
Mercury - Hg	2.39E-03	1.00E+02	2.39E-05
Molybdenum - Mo	1.35E-02	1.00E+02	1.35E-04
Nickel - Ni	1.29E-01	1.00E+02	1.29E-03
Selenium - Se	4.62E-03	1.00E+02	4.62E-05
Thallium - Tl	2.31E-03	1.00E+02	2.31E-05
Uranium - U	4.20E-03	1.00E+02	4.20E-05

Table 24 Concentration of metal deposited due to ore sources- Mine Site

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.68E+02	1.00E+02	1.68E+00
Antimony - Sb	1.21E-01	1.00E+02	1.21E-03
Arsenic - As	2.89E-01	1.00E+02	2.89E-03
Chromium - Cr	1.57E+00	1.00E+02	1.57E-02
Cobalt - Co	3.88E-01	1.00E+02	3.88E-03
Copper - Cu	1.55E+01	1.00E+02	1.55E-01
Lead - Pb	2.38E-01	1.00E+02	2.38E-03
Manganese - Mn	2.80E+00	1.00E+02	2.80E-02
Mercury - Hg	2.55E-02	1.00E+02	2.55E-04
Molybdenum - Mo	1.45E-01	1.00E+02	1.45E-03
Nickel - Ni	1.38E+00	1.00E+02	1.38E-02
Selenium - Se	4.94E-02	1.00E+02	4.94E-04
Thallium - Tl	2.46E-02	1.00E+02	2.46E-04
Uranium - U	4.49E-02	1.00E+02	4.49E-04

Table 25 Concentration of metal deposited due to tailings sources- Aberdeen

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	8.83E+00	1.00E+02	8.83E-02
Antimony - Sb	1.17E-04	1.00E+02	1.17E-06
Arsenic - As	2.69E-03	1.00E+02	2.69E-05
Chromium - Cr	8.07E-02	1.00E+02	8.07E-04
Cobalt - Co	1.05E-02	1.00E+02	1.05E-04
Copper - Cu	2.00E-01	1.00E+02	2.00E-03
Lead - Pb	5.38E-04	1.00E+02	5.38E-06
Manganese - Mn	1.40E-01	1.00E+02	1.40E-03
Mercury - Hg	8.07E-05	1.00E+02	8.07E-07
Molybdenum - Mo	1.40E-02	1.00E+02	1.40E-04
Nickel - Ni	4.44E-02	1.00E+02	4.44E-04
Selenium - Se	4.48E-04	1.00E+02	4.48E-06
Thallium - Tl	1.34E-05	1.00E+02	1.34E-07
Uranium - U	1.97E-04	1.00E+02	1.97E-06

Table 26 Concentration of metal deposited due to tailings sources- Brocklehurst

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	9.15E-01	1.00E+02	9.15E-03
Antimony - Sb	1.21E-05	1.00E+02	1.21E-07
Arsenic - As	2.79E-04	1.00E+02	2.79E-06
Chromium - Cr	8.36E-03	1.00E+02	8.36E-05
Cobalt - Co	1.09E-03	1.00E+02	1.09E-05
Copper - Cu	2.08E-02	1.00E+02	2.08E-04
Lead - Pb	5.57E-05	1.00E+02	5.57E-07
Manganese - Mn	1.45E-02	1.00E+02	1.45E-04
Mercury - Hg	8.36E-06	1.00E+02	8.36E-08
Molybdenum - Mo	1.45E-03	1.00E+02	1.45E-05
Nickel - Ni	4.60E-03	1.00E+02	4.60E-05
Selenium - Se	4.64E-05	1.00E+02	4.64E-07
Thallium - Tl	1.39E-06	1.00E+02	1.39E-08
Uranium - U	2.04E-05	1.00E+02	2.04E-07

Table 27 Concentration of metal deposited due to tailings sources- Sahali

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	3.40E+00	1.00E+02	3.40E-02
Antimony - Sb	4.48E-05	1.00E+02	4.48E-07
Arsenic - As	1.03E-03	1.00E+02	1.03E-05
Chromium - Cr	3.10E-02	1.00E+02	3.10E-04
Cobalt - Co	4.04E-03	1.00E+02	4.04E-05
Copper - Cu	7.71E-02	1.00E+02	7.71E-04
Lead - Pb	2.07E-04	1.00E+02	2.07E-06
Manganese - Mn	5.38E-02	1.00E+02	5.38E-04
Mercury - Hg	3.10E-05	1.00E+02	3.10E-07
Molybdenum - Mo	5.40E-03	1.00E+02	5.40E-05
Nickel - Ni	1.71E-02	1.00E+02	1.71E-04
Selenium - Se	1.72E-04	1.00E+02	1.72E-06
Thallium - Tl	5.17E-06	1.00E+02	5.17E-08
Uranium - U	7.59E-05	1.00E+02	7.59E-07

Table 28 Concentration of metal deposited due to tailings sources- Knutsford

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.09E+01	1.00E+02	1.09E-01
Antimony - Sb	1.44E-04	1.00E+02	1.44E-06
Arsenic - As	3.32E-03	1.00E+02	3.32E-05
Chromium - Cr	9.95E-02	1.00E+02	9.95E-04
Cobalt - Co	1.29E-02	1.00E+02	1.29E-04
Copper - Cu	2.47E-01	1.00E+02	2.47E-03
Lead - Pb	6.63E-04	1.00E+02	6.63E-06
Manganese - Mn	1.72E-01	1.00E+02	1.72E-03
Mercury - Hg	9.95E-05	1.00E+02	9.95E-07
Molybdenum - Mo	1.73E-02	1.00E+02	1.73E-04
Nickel - Ni	5.47E-02	1.00E+02	5.47E-04
Selenium - Se	5.53E-04	1.00E+02	5.53E-06
Thallium - Tl	1.66E-05	1.00E+02	1.66E-07
Uranium - U	2.43E-04	1.00E+02	2.43E-06

Table 29 Concentration of metal deposited due to tailings sources- North Shore

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.66E+00	1.00E+02	1.66E-02
Antimony - Sb	2.19E-05	1.00E+02	2.19E-07
Arsenic - As	5.05E-04	1.00E+02	5.05E-06
Chromium - Cr	1.51E-02	1.00E+02	1.51E-04
Cobalt - Co	1.97E-03	1.00E+02	1.97E-05
Copper - Cu	3.76E-02	1.00E+02	3.76E-04
Lead - Pb	1.01E-04	1.00E+02	1.01E-06
Manganese - Mn	2.62E-02	1.00E+02	2.62E-04
Mercury - Hg	1.51E-05	1.00E+02	1.51E-07
Molybdenum - Mo	2.63E-03	1.00E+02	2.63E-05
Nickel - Ni	8.33E-03	1.00E+02	8.33E-05
Selenium - Se	8.41E-05	1.00E+02	8.41E-07
Thallium - Tl	2.52E-06	1.00E+02	2.52E-08
Uranium - U	3.70E-05	1.00E+02	3.70E-07

Table 30 Concentration of metal deposited due to tailings sources- West End/Downtown

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	2.29E+00	1.00E+02	2.29E-02
Antimony - Sb	3.02E-05	1.00E+02	3.02E-07
Arsenic - As	6.97E-04	1.00E+02	6.97E-06
Chromium - Cr	2.09E-02	1.00E+02	2.09E-04
Cobalt - Co	2.72E-03	1.00E+02	2.72E-05
Copper - Cu	5.20E-02	1.00E+02	5.20E-04
Lead - Pb	1.39E-04	1.00E+02	1.39E-06
Manganese - Mn	3.63E-02	1.00E+02	3.63E-04
Mercury - Hg	2.09E-05	1.00E+02	2.09E-07
Molybdenum - Mo	3.64E-03	1.00E+02	3.64E-05
Nickel - Ni	1.15E-02	1.00E+02	1.15E-04
Selenium - Se	1.16E-04	1.00E+02	1.16E-06
Thallium - Tl	3.49E-06	1.00E+02	3.49E-08
Uranium - U	5.11E-05	1.00E+02	5.11E-07

Table 31 Concentration of metal deposited due to tailings sources- Mine Site

COPC	Mass of Metal Deposited (mg/m²)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	8.54E+00	1.00E+02	8.54E-02
Antimony - Sb	1.13E-04	1.00E+02	1.13E-06
Arsenic - As	2.60E-03	1.00E+02	2.60E-05
Chromium - Cr	7.81E-02	1.00E+02	7.81E-04
Cobalt - Co	1.01E-02	1.00E+02	1.01E-04
Copper - Cu	1.94E-01	1.00E+02	1.94E-03
Lead - Pb	5.20E-04	1.00E+02	5.20E-06
Manganese - Mn	1.35E-01	1.00E+02	1.35E-03
Mercury - Hg	7.81E-05	1.00E+02	7.81E-07
Molybdenum - Mo	1.36E-02	1.00E+02	1.36E-04
Nickel - Ni	4.29E-02	1.00E+02	4.29E-04
Selenium - Se	4.34E-04	1.00E+02	4.34E-06
Thallium - Tl	1.30E-05	1.00E+02	1.30E-07
Uranium - U	1.91E-04	1.00E+02	1.91E-06

Table 32 Concentration of metal deposited due to waste rock sources- Aberdeen

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	9.84E-02	1.00E+02	9.84E-04
Antimony - Sb	4.01E-01	1.00E+02	4.01E-03
Arsenic - As	6.32E-01	1.00E+02	6.32E-03
Chromium - Cr	1.04E+01	1.00E+02	1.04E-01
Cobalt - Co	1.76E+00	1.00E+02	1.76E-02
Copper - Cu	1.58E+01	1.00E+02	1.58E-01
Lead - Pb	9.58E-01	1.00E+02	9.58E-03
Manganese - Mn	1.80E+01	1.00E+02	1.80E-01
Mercury - Hg	5.87E-02	1.00E+02	5.87E-04
Molybdenum - Mo	3.99E-01	1.00E+02	3.99E-03
Nickel - Ni	1.05E+01	1.00E+02	1.05E-01
Selenium - Se	1.32E-01	1.00E+02	1.32E-03
Thallium - Tl	5.29E-02	1.00E+02	5.29E-04
Uranium - U	1.78E-01	1.00E+02	1.78E-03

Table 33 Concentration of metal deposited due to waste rock sources- Brocklehurst

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	3.45E-03	1.00E+02	3.45E-05
Antimony - Sb	1.41E-02	1.00E+02	1.41E-04
Arsenic - As	2.22E-02	1.00E+02	2.22E-04
Chromium - Cr	3.64E-01	1.00E+02	3.64E-03
Cobalt - Co	6.18E-02	1.00E+02	6.18E-04
Copper - Cu	5.57E-01	1.00E+02	5.57E-03
Lead - Pb	3.37E-02	1.00E+02	3.37E-04
Manganese - Mn	6.33E-01	1.00E+02	6.33E-03
Mercury - Hg	2.06E-03	1.00E+02	2.06E-05
Molybdenum - Mo	1.40E-02	1.00E+02	1.40E-04
Nickel - Ni	3.70E-01	1.00E+02	3.70E-03
Selenium - Se	4.64E-03	1.00E+02	4.64E-05
Thallium - Tl	1.86E-03	1.00E+02	1.86E-05
Uranium - U	6.25E-03	1.00E+02	6.25E-05

Table 34 Concentration of metal deposited due to waste rock sources- Sahali

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.58E-02	1.00E+02	1.58E-04
Antimony - Sb	6.43E-02	1.00E+02	6.43E-04
Arsenic - As	1.01E-01	1.00E+02	1.01E-03
Chromium - Cr	1.66E+00	1.00E+02	1.66E-02
Cobalt - Co	2.82E-01	1.00E+02	2.82E-03
Copper - Cu	2.54E+00	1.00E+02	2.54E-02
Lead - Pb	1.53E-01	1.00E+02	1.53E-03
Manganese - Mn	2.88E+00	1.00E+02	2.88E-02
Mercury - Hg	9.41E-03	1.00E+02	9.41E-05
Molybdenum - Mo	6.39E-02	1.00E+02	6.39E-04
Nickel - Ni	1.69E+00	1.00E+02	1.69E-02
Selenium - Se	2.12E-02	1.00E+02	2.12E-04
Thallium - Tl	8.47E-03	1.00E+02	8.47E-05
Uranium - U	2.85E-02	1.00E+02	2.85E-04

Table 35 Concentration of metal deposited due to waste rock sources- Knutsford

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	7.74E-02	1.00E+02	7.74E-04
Antimony - Sb	3.16E-01	1.00E+02	3.16E-03
Arsenic - As	4.98E-01	1.00E+02	4.98E-03
Chromium - Cr	8.15E+00	1.00E+02	8.15E-02
Cobalt - Co	1.38E+00	1.00E+02	1.38E-02
Copper - Cu	1.25E+01	1.00E+02	1.25E-01
Lead - Pb	7.54E-01	1.00E+02	7.54E-03
Manganese - Mn	1.42E+01	1.00E+02	1.42E-01
Mercury - Hg	4.62E-02	1.00E+02	4.62E-04
Molybdenum - Mo	3.14E-01	1.00E+02	3.14E-03
Nickel - Ni	8.29E+00	1.00E+02	8.29E-02
Selenium - Se	1.04E-01	1.00E+02	1.04E-03
Thallium - Tl	4.16E-02	1.00E+02	4.16E-04
Uranium - U	1.40E-01	1.00E+02	1.40E-03

Table 36 Concentration of metal deposited due to waste rock sources- North Shore

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	6.54E-03	1.00E+02	6.54E-05
Antimony - Sb	2.67E-02	1.00E+02	2.67E-04
Arsenic - As	4.20E-02	1.00E+02	4.20E-04
Chromium - Cr	6.89E-01	1.00E+02	6.89E-03
Cobalt - Co	1.17E-01	1.00E+02	1.17E-03
Copper - Cu	1.05E+00	1.00E+02	1.05E-02
Lead - Pb	6.37E-02	1.00E+02	6.37E-04
Manganese - Mn	1.20E+00	1.00E+02	1.20E-02
Mercury - Hg	3.90E-03	1.00E+02	3.90E-05
Molybdenum - Mo	2.65E-02	1.00E+02	2.65E-04
Nickel - Ni	7.00E-01	1.00E+02	7.00E-03
Selenium - Se	8.78E-03	1.00E+02	8.78E-05
Thallium - Tl	3.51E-03	1.00E+02	3.51E-05
Uranium - U	1.18E-02	1.00E+02	1.18E-04

Table 37 Concentration of metal deposited due to waste rock sources- West End/Downtown

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.08E-02	1.00E+02	1.08E-04
Antimony - Sb	4.40E-02	1.00E+02	4.40E-04
Arsenic - As	6.93E-02	1.00E+02	6.93E-04
Chromium - Cr	1.14E+00	1.00E+02	1.14E-02
Cobalt - Co	1.93E-01	1.00E+02	1.93E-03
Copper - Cu	1.74E+00	1.00E+02	1.74E-02
Lead - Pb	1.05E-01	1.00E+02	1.05E-03
Manganese - Mn	1.97E+00	1.00E+02	1.97E-02
Mercury - Hg	6.44E-03	1.00E+02	6.44E-05
Molybdenum - Mo	4.38E-02	1.00E+02	4.38E-04
Nickel - Ni	1.15E+00	1.00E+02	1.15E-02
Selenium - Se	1.45E-02	1.00E+02	1.45E-04
Thallium - Tl	5.79E-03	1.00E+02	5.79E-05
Uranium - U	1.95E-02	1.00E+02	1.95E-04

Table 38 Concentration of metal deposited due to waste rock sources- Mine Site

COPC	Mass of Metal Deposited (mg/m^2)	Mass of Surface Horizon (kg)	Concentration of Metal (mg/kg)
	A	B	C = A × B
Aluminum - Al	1.06E-01	1.00E+02	1.06E-03
Antimony - Sb	4.33E-01	1.00E+02	4.33E-03
Arsenic - As	6.83E-01	1.00E+02	6.83E-03
Chromium - Cr	1.12E+01	1.00E+02	1.12E-01
Cobalt - Co	1.90E+00	1.00E+02	1.90E-02
Copper - Cu	1.71E+01	1.00E+02	1.71E-01
Lead - Pb	1.04E+00	1.00E+02	1.04E-02
Manganese - Mn	1.95E+01	1.00E+02	1.95E-01
Mercury - Hg	6.34E-02	1.00E+02	6.34E-04
Molybdenum - Mo	4.31E-01	1.00E+02	4.31E-03
Nickel - Ni	1.14E+01	1.00E+02	1.14E-01
Selenium - Se	1.43E-01	1.00E+02	1.43E-03
Thallium - Tl	5.71E-02	1.00E+02	5.71E-04
Uranium - U	1.92E-01	1.00E+02	1.92E-03

Step 5- Determination of Total Project-Related Metal Concentrations in Soil
Determine the increase in metal concentration due to deposition from the four sources. This is calculated by adding the concentration changes for each source as determined in Step 4. The metal concentrations in each area due to all four sources are provided in Table 39 to Table 45.

A worked example for total concentration of metal deposited in Aberdeen (for copper) due to the four deposition sources (diesel, ore, tailings, waste rock)-Project Alone Case.

$$Cs_{Ptot}\left({}^{mg}/_{kg}\right) = Cs_{PD}\left({}^{mg}/_{kg}\right) + Cs_{PO}\left({}^{mg}/_{kg}\right) + Cs_{PT}\left({}^{mg}/_{kg}\right) + Cs_{PWR}\left({}^{mg}/_{kg}\right)$$

Where:

Parameter	Description	Units
Cs_{PTot}	= Concentration of metal from the Project. Considers all four sources.	mg/kg
Cs_{PD}	= Concentration of metal from Project only- diesel sources.	mg/kg
Cs_{PO}	= Concentration of metal from Project only- ore sources.	mg/kg
Cs_{PT}	= Concentration of metal from Project only- tailings sources.	mg/kg
Cs_{PWR}	= Concentration of metal from Project only- waste rock sources.	mg/kg

Worked Example for $Cs_{\text{Project Total}}$

$$Cs_{PTot}\left(^{mg}/_{kg}\right) = Cs_{PD}\left(^{mg}/_{kg}\right) + Cs_{PO}\left(^{mg}/_{kg}\right) + Cs_{PT}\left(^{mg}/_{kg}\right) + Cs_{PWR}\left(^{mg}/_{kg}\right)$$

$$Cs_{PTot}\left(^{mg}/_{kg}\right) = 1.09E-03\left(^{mg}/_{kg}\right) + 1.49E-01\left(^{mg}/_{kg}\right) + 2.00E-03\left(^{mg}/_{kg}\right) + 1.58E-01\left(^{mg}/_{kg}\right)$$

$$Cs_{PTot}\left(^{mg}/_{kg}\right) = 3.11\text{E}-01$$

Table 39 Concentration of metal deposited due to all four sources- Aberdeen

COPC	Aberdeen				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A+B+C+D)
Aluminum - Al	0.00E+00	1.62E+00	8.83E-02	9.84E-04	1.71E+00
Antimony - Sb	0.00E+00	1.17E-03	1.17E-06	4.01E-03	5.18E-03
Arsenic - As	4.27E-04	2.79E-03	2.69E-05	6.32E-03	9.56E-03
Chromium - Cr	1.60E-04	1.52E-02	8.07E-04	1.04E-01	1.20E-01
Cobalt - Co	0.00E+00	3.74E-03	1.05E-04	1.76E-02	2.14E-02
Copper - Cu	1.09E-03	1.49E-01	2.00E-03	1.58E-01	3.11E-01
Lead - Pb	2.21E-03	2.30E-03	5.38E-06	9.58E-03	1.41E-02
Manganese - Mn	8.26E-04	2.70E-02	1.40E-03	1.80E-01	2.09E-01
Mercury - Hg	5.33E-04	2.46E-04	8.07E-07	5.87E-04	1.37E-03
Molybdenum - Mo	0.00E+00	1.40E-03	1.40E-04	3.99E-03	5.53E-03
Nickel - Ni	1.04E-03	1.33E-02	4.44E-04	1.05E-01	1.20E-01
Selenium - Se	5.87E-04	4.76E-04	4.48E-06	1.32E-03	2.39E-03
Thallium - Tl	0.00E+00	2.38E-04	1.34E-07	5.29E-04	7.66E-04
Uranium - U	0.00E+00	4.33E-04	1.97E-06	1.78E-03	2.21E-03

Table 40 Concentration of metal deposited due to all four sources- Brocklehurst

COPC	Brocklehurst				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	5.20E-02	9.15E-03	3.45E-05	6.11E-02
Antimony - Sb	0.00E+00	3.74E-05	1.21E-07	1.41E-04	1.78E-04
Arsenic - As	2.56E-05	8.93E-05	2.79E-06	2.22E-04	3.40E-04
Chromium - Cr	9.61E-06	4.87E-04	8.36E-05	3.64E-03	4.22E-03
Cobalt - Co	0.00E+00	1.20E-04	1.09E-05	6.18E-04	7.49E-04
Copper - Cu	6.57E-05	4.79E-03	2.08E-04	5.57E-03	1.06E-02
Lead - Pb	1.33E-04	7.36E-05	5.57E-07	3.37E-04	5.44E-04
Manganese - Mn	4.96E-05	8.65E-04	1.45E-04	6.33E-03	7.39E-03
Mercury - Hg	3.20E-05	7.89E-06	8.36E-08	2.06E-05	6.06E-05
Molybdenum - Mo	0.00E+00	4.48E-05	1.45E-05	1.40E-04	1.99E-04
Nickel - Ni	6.25E-05	4.25E-04	4.60E-05	3.70E-03	4.23E-03
Selenium - Se	3.52E-05	1.53E-05	4.64E-07	4.64E-05	9.74E-05
Thallium - Tl	0.00E+00	7.62E-06	1.39E-08	1.86E-05	2.62E-05
Uranium - U	0.00E+00	1.39E-05	2.04E-07	6.25E-05	7.66E-05

Table 41 Concentration of metal deposited due to all four sources- Sahali

COPC	Sahali				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	2.46E-01	3.40E-02	3.40E-02	3.14E-01
Antimony - Sb	0.00E+00	1.77E-04	4.48E-07	4.48E-07	1.78E-04
Arsenic - As	9.03E-05	4.23E-04	1.03E-05	1.03E-05	5.34E-04
Chromium - Cr	3.38E-05	2.31E-03	3.10E-04	3.10E-04	2.96E-03
Cobalt - Co	0.00E+00	5.68E-04	4.04E-05	4.04E-05	6.49E-04
Copper - Cu	2.31E-04	2.27E-02	7.71E-04	7.71E-04	2.45E-02
Lead - Pb	4.68E-04	3.49E-04	2.07E-06	2.07E-06	8.21E-04
Manganese - Mn	1.75E-04	4.10E-03	5.38E-04	5.38E-04	5.35E-03
Mercury - Hg	1.13E-04	3.74E-05	3.10E-07	3.10E-07	1.51E-04
Molybdenum - Mo	0.00E+00	2.12E-04	5.40E-05	5.40E-05	3.20E-04
Nickel - Ni	2.20E-04	2.02E-03	1.71E-04	1.71E-04	2.58E-03
Selenium - Se	1.24E-04	7.23E-05	1.72E-06	1.72E-06	2.00E-04
Thallium - Tl	0.00E+00	3.61E-05	5.17E-08	5.17E-08	3.62E-05
Uranium - U	0.00E+00	6.57E-05	7.59E-07	7.59E-07	6.72E-05

Table 42 Concentration of metal deposited due to all four sources- Knutsford

COPC	Knutsford				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	1.25E+00	1.09E-01	7.74E-04	1.36E+00
Antimony - Sb	0.00E+00	8.95E-04	1.44E-06	3.16E-03	4.05E-03
Arsenic - As	3.36E-04	2.14E-03	3.32E-05	4.98E-03	7.49E-03
Chromium - Cr	1.26E-04	1.17E-02	9.95E-04	8.15E-02	9.43E-02
Cobalt - Co	0.00E+00	2.87E-03	1.29E-04	1.38E-02	1.68E-02
Copper - Cu	8.61E-04	1.15E-01	2.47E-03	1.25E-01	2.43E-01
Lead - Pb	1.74E-03	1.76E-03	6.63E-06	7.54E-03	1.11E-02
Manganese - Mn	6.51E-04	2.07E-02	1.72E-03	1.42E-01	1.65E-01
Mercury - Hg	4.20E-04	1.89E-04	9.95E-07	4.62E-04	1.07E-03
Molybdenum - Mo	0.00E+00	1.07E-03	1.73E-04	3.14E-03	4.39E-03
Nickel - Ni	8.19E-04	1.02E-02	5.47E-04	8.29E-02	9.44E-02
Selenium - Se	4.62E-04	3.66E-04	5.53E-06	1.04E-03	1.87E-03
Thallium - Tl	0.00E+00	1.83E-04	1.66E-07	4.16E-04	5.99E-04
Uranium - U	0.00E+00	3.32E-04	2.43E-06	1.40E-03	1.73E-03

Table 43 Concentration of metal deposited due to all four sources- North Shore

COPC	North Shore				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	1.02E-01	1.66E-02	6.54E-05	1.19E-01
Antimony - Sb	0.00E+00	7.32E-05	2.19E-07	2.67E-04	3.40E-04
Arsenic - As	4.60E-05	1.75E-04	5.05E-06	4.20E-04	6.46E-04
Chromium - Cr	1.72E-05	9.54E-04	1.51E-04	6.89E-03	8.01E-03
Cobalt - Co	0.00E+00	2.35E-04	1.97E-05	1.17E-03	1.42E-03
Copper - Cu	1.18E-04	9.38E-03	3.76E-04	1.05E-02	2.04E-02
Lead - Pb	2.38E-04	1.44E-04	1.01E-06	6.37E-04	1.02E-03
Manganese - Mn	8.90E-05	1.70E-03	2.62E-04	1.20E-02	1.40E-02
Mercury - Hg	5.75E-05	1.55E-05	1.51E-07	3.90E-05	1.12E-04
Molybdenum - Mo	0.00E+00	8.77E-05	2.63E-05	2.65E-04	3.79E-04
Nickel - Ni	1.12E-04	8.34E-04	8.33E-05	7.00E-03	8.03E-03
Selenium - Se	6.32E-05	2.99E-05	8.41E-07	8.78E-05	1.82E-04
Thallium - Tl	0.00E+00	1.49E-05	2.52E-08	3.51E-05	5.01E-05
Uranium - U	0.00E+00	2.72E-05	3.70E-07	1.18E-04	1.46E-04

Table 44 Concentration of metal deposited due to all four sources- West End/Downtown

COPC	West End/Downtown				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	1.57E-01	2.29E-02	1.08E-04	1.80E-01
Antimony - Sb	0.00E+00	1.13E-04	3.02E-07	4.40E-04	5.53E-04
Arsenic - As	6.98E-05	2.70E-04	6.97E-06	6.93E-04	1.04E-03
Chromium - Cr	2.62E-05	1.47E-03	2.09E-04	1.14E-02	1.31E-02
Cobalt - Co	0.00E+00	3.63E-04	2.72E-05	1.93E-03	2.32E-03
Copper - Cu	1.79E-04	1.45E-02	5.20E-04	1.74E-02	3.26E-02
Lead - Pb	3.62E-04	2.23E-04	1.39E-06	1.05E-03	1.64E-03
Manganese - Mn	1.35E-04	2.62E-03	3.63E-04	1.97E-02	2.29E-02
Mercury - Hg	8.73E-05	2.39E-05	2.09E-07	6.44E-05	1.76E-04
Molybdenum - Mo	0.00E+00	1.35E-04	3.64E-05	4.38E-04	6.09E-04
Nickel - Ni	1.70E-04	1.29E-03	1.15E-04	1.15E-02	1.31E-02
Selenium - Se	9.60E-05	4.62E-05	1.16E-06	1.45E-04	2.88E-04
Thallium - Tl	0.00E+00	2.31E-05	3.49E-08	5.79E-05	8.10E-05
Uranium - U	0.00E+00	4.20E-05	5.11E-07	1.95E-04	2.38E-04

Table 45 Concentration of metal deposited due to all four sources- Mine Site

COPC	Mine Site				
	Project Related Increase in Concentration (mg/kg)				
	Diesel	Ore	Tailings	Waste Rock	Total
	A	B	C	D	E=(A=B+C+D)
Aluminum - Al	0.00E+00	1.68E+00	8.54E-02	1.06E-03	1.77E+00
Antimony - Sb	0.00E+00	1.21E-03	1.13E-06	4.33E-03	5.54E-03
Arsenic - As	6.07E-04	2.89E-03	2.60E-05	6.83E-03	1.04E-02
Chromium - Cr	2.28E-04	1.57E-02	7.81E-04	1.12E-01	1.29E-01
Cobalt - Co	0.00E+00	3.88E-03	1.01E-04	1.90E-02	2.30E-02
Copper - Cu	1.56E-03	1.55E-01	1.94E-03	1.71E-01	3.30E-01
Lead - Pb	3.15E-03	2.38E-03	5.20E-06	1.04E-02	1.59E-02
Manganese - Mn	1.18E-03	2.80E-02	1.35E-03	1.95E-01	2.25E-01
Mercury - Hg	7.59E-04	2.55E-04	7.81E-07	6.34E-04	1.65E-03
Molybdenum - Mo	0.00E+00	1.45E-03	1.36E-04	4.31E-03	5.90E-03
Nickel - Ni	1.48E-03	1.38E-02	4.29E-04	1.14E-01	1.29E-01
Selenium - Se	8.35E-04	4.94E-04	4.34E-06	1.43E-03	2.76E-03
Thallium - Tl	0.00E+00	2.46E-04	1.30E-07	5.71E-04	8.18E-04
Uranium - U	0.00E+00	4.49E-04	1.91E-06	1.92E-03	2.37E-03

Step 6- Determine the Future Case Metal Concentrations in Soil.
Determine the Future Case metal concentrations in soil by summing the metal concentration under Baseline Case with the predicted metal concentration increase due to the Project (output of Step 5). The Future Case concentrations in the Human Health Areas and the Mine Site are provided in Table 46 to Table 52.

A worked example for Future Case concentration of metal in Aberdeen (for copper) soil due to all four sources.

$$Cs_{FC}\left({}^{mg}/_{kg}\right) = Cs_{BC}\left({}^{mg}/_{kg}\right) + Cs_{PC}\left({}^{mg}/_{kg}\right)$$

Where:

Parameter	Description	Units
Cs_{FC}	= Future Case concentration of metal.	mg/kg
Cs_{BC}	=Baseline Case concentration of metal	mg/kg
Cs_{PC}	= Concentration of metal from Project contribution	mg/kg

Worked Example for $Cs_{\text{Future Case}}$

$$Cs_{FC}\left({}^{mg}/_{kg}\right) = Cs_{BC}\left({}^{mg}/_{kg}\right) + Cs_{PC}\left({}^{mg}/_{kg}\right)$$

$$Cs_{FC}\left({}^{mg}/_{kg}\right) = 4.40E+01\left({}^{mg}/_{kg}\right) + 3.11E-01\left({}^{mg}/_{kg}\right)$$

$$Cs_{FC}\left({}^{mg}/_{kg}\right) = 4.43E+01\left({}^{mg}/_{kg}\right)$$

Table 46 Future case metal concentration in Aberdeen soil.

COPC	Aberdeen		
	Metal Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
	A	B	C = A+B
Aluminum - Al	1.54E+04	1.71E+00	1.54E+04
Antimony - Sb	3.60E-01	5.18E-03	3.65E-01
Arsenic - As	5.56E+00	9.56E-03	5.57E+00
Chromium - Cr	4.89E+01	1.20E-01	4.90E+01
Cobalt - Co	1.20E+01	2.14E-02	1.20E+01
Copper - Cu	4.40E+01	3.11E-01	4.43E+01
Lead - Pb	5.40E+00	1.41E-02	5.41E+00
Manganese - Mn	5.64E+02	2.09E-01	5.64E+02
Mercury - Hg	4.08E-02	1.37E-03	4.22E-02
Molybdenum - Mo	1.02E+00	5.53E-03	1.02E+00
Nickel - Ni	4.37E+01	1.20E-01	4.38E+01
Selenium - Se	2.24E-01	2.39E-03	2.26E-01
Thallium - Tl	1.03E-01	7.66E-04	1.04E-01
Uranium - U	7.56E-01	2.21E-03	7.58E-01

Table 47 Future case metal concentration in Brocklehurst soil.

COPC	Brocklehurst		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.77E+04	6.11E-02	1.77E+04
Antimony - Sb	3.30E-01	1.78E-04	3.30E-01
Arsenic - As	4.92E+00	3.40E-04	4.92E+00
Chromium - Cr	4.34E+01	4.22E-03	4.34E+01
Cobalt - Co	1.35E+01	7.49E-04	1.35E+01
Copper - Cu	4.82E+01	1.06E-02	4.82E+01
Lead - Pb	1.25E+01	5.44E-04	1.25E+01
Manganese - Mn	4.83E+02	7.39E-03	4.83E+02
Mercury - Hg	3.44E-02	6.06E-05	3.45E-02
Molybdenum - Mo	1.51E+00	1.99E-04	1.51E+00
Nickel - Ni	3.73E+01	4.23E-03	3.73E+01
Selenium - Se	4.20E-01	9.74E-05	4.20E-01
Thallium - Tl	2.09E-01	2.62E-05	2.09E-01
Uranium - U	1.39E+00	7.66E-05	1.39E+00

Table 48 **Future case metal concentration in Sahali soil.**

COPC	Sahali		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.14E+04	3.14E-01	1.14E+04
Antimony - Sb	3.50E-01	1.78E-04	3.50E-01
Arsenic - As	4.40E+00	5.34E-04	4.40E+00
Chromium - Cr	4.10E+01	2.96E-03	4.10E+01
Cobalt - Co	1.07E+01	6.49E-04	1.07E+01
Copper - Cu	4.67E+01	2.45E-02	4.67E+01
Lead - Pb	7.43E+00	8.21E-04	7.43E+00
Manganese - Mn	5.26E+02	5.35E-03	5.26E+02
Mercury - Hg	3.02E-02	1.51E-04	3.04E-02
Molybdenum - Mo	1.32E+00	3.20E-04	1.32E+00
Nickel - Ni	3.82E+01	2.58E-03	3.82E+01
Selenium - Se	5.05E-01	2.00E-04	5.05E-01
Thallium - Tl	9.30E-02	3.62E-05	9.30E-02
Uranium - U	7.57E-01	6.72E-05	7.57E-01

Table 49 **Future case metal concentration in Knutsford soil.**

COPC	Knutsford		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.54E+04	1.36E+00	1.54E+04
Antimony - Sb	3.60E-01	4.05E-03	3.64E-01
Arsenic - As	5.56E+00	7.49E-03	5.56E+00
Chromium - Cr	4.89E+01	9.43E-02	4.90E+01
Cobalt - Co	1.20E+01	1.68E-02	1.20E+01
Copper - Cu	4.40E+01	2.43E-01	4.42E+01
Lead - Pb	5.40E+00	1.11E-02	5.41E+00
Manganese - Mn	5.64E+02	1.65E-01	5.64E+02
Mercury - Hg	4.08E-02	1.07E-03	4.19E-02
Molybdenum - Mo	1.02E+00	4.39E-03	1.02E+00
Nickel - Ni	4.37E+01	9.44E-02	4.38E+01
Selenium - Se	2.24E-01	1.87E-03	2.26E-01
Thallium - Tl	1.03E-01	5.99E-04	1.03E-01
Uranium - U	7.56E-01	1.73E-03	7.57E-01

Table 50 **Future case metal concentration in North Shore soil.**

COPC	North Shore		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.40E+04	1.19E-01	1.40E+04
Antimony - Sb	3.90E-01	3.40E-04	3.90E-01
Arsenic - As	5.65E+00	6.46E-04	5.65E+00
Chromium - Cr	4.78E+01	8.01E-03	4.78E+01
Cobalt - Co	1.16E+01	1.42E-03	1.16E+01
Copper - Cu	6.22E+01	2.04E-02	6.22E+01
Lead - Pb	6.65E+00	1.02E-03	6.65E+00
Manganese - Mn	5.63E+02	1.40E-02	5.63E+02
Mercury - Hg	4.62E-02	1.12E-04	4.63E-02
Molybdenum - Mo	1.21E+00	3.79E-04	1.21E+00
Nickel - Ni	4.48E+01	8.03E-03	4.48E+01
Selenium - Se	4.40E-01	1.82E-04	4.40E-01
Thallium - Tl	8.50E-02	5.01E-05	8.51E-02
Uranium - U	5.89E-01	1.46E-04	5.89E-01

Table 51 **Future case metal concentration in West End/Downtown soil.**

COPC	West End/Downtown		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.45E+04	1.80E-01	1.45E+04
Antimony - Sb	5.57E-01	5.53E-04	5.57E-01
Arsenic - As	4.17E+00	1.04E-03	4.17E+00
Chromium - Cr	4.39E+01	1.31E-02	4.39E+01
Cobalt - Co	1.39E+01	2.32E-03	1.39E+01
Copper - Cu	8.45E+01	3.26E-02	8.45E+01
Lead - Pb	3.42E+01	1.64E-03	3.42E+01
Manganese - Mn	5.43E+02	2.29E-02	5.43E+02
Mercury - Hg	7.99E-02	1.76E-04	8.00E-02
Molybdenum - Mo	1.40E+00	6.09E-04	1.40E+00
Nickel - Ni	5.59E+01	1.31E-02	5.59E+01
Selenium - Se	4.30E-01	2.88E-04	4.30E-01
Thallium - Tl	1.03E-01	8.10E-05	1.03E-01
Uranium - U	1.03E+00	2.38E-04	1.03E+00

Table 52 **Future case metal concentration in Mine Site soil.**

COPC	Mine Site		
	Project Related Increase in Concentration (mg/kg)		
	Baseline Case	Project Case	Future Case
Aluminum - Al	1.88E+04	1.77E+00	1.88E+04
Antimony - Sb	4.64E-01	5.54E-03	4.70E-01
Arsenic - As	5.84E+00	1.04E-02	5.85E+00
Chromium - Cr	6.69E+01	1.29E-01	6.70E+01
Cobalt - Co	1.57E+01	2.30E-02	1.57E+01
Copper - Cu	9.14E+01	3.30E-01	9.17E+01
Lead - Pb	5.19E+00	1.59E-02	5.21E+00
Manganese - Mn	7.98E+02	2.25E-01	7.98E+02
Mercury - Hg	4.37E-02	1.65E-03	4.53E-02
Molybdenum - Mo	1.12E+00	5.90E-03	1.12E+00
Nickel - Ni	5.77E+01	1.29E-01	5.78E+01
Selenium - Se	4.09E-01	2.76E-03	4.12E-01
Thallium - Tl	8.59E-02	8.18E-04	8.67E-02
Uranium - U	5.28E-01	2.37E-03	5.30E-01

Conclusion

Dust deposition from each of the four Project-related sources was used to predict the predicted concentrations for the Project Alone Case at the end of the Operational period of the Project. The predicted increase in metal concentration from the Project was added to the baseline concentration (also referred to as Baseline Case concentration) to estimate the final concentration at the end of the Operational period of the Project (also referred to as Future Case concentration). The Baseline Case, Project Alone Case and Future Case metal concentrations in soil were used to estimate potential health risks for human and ecological receptors.

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