

APPENDIX 6A

Emissions Inventory

Marathon Gold Mine Emissions Inventory - Operation

Developed by: C. Lyons
 Date: 11-May-20
 Project number: 121416408

Releases of particulate matter (dust) and trace metals, diesel particulate (particulate released from diesel combustion), combustion gases (NOX, SO2 and CO), NH3 and HCN from the sources associated with the operation of the gold mine are estimated in this spreadsheet. The emissions estimates have been updated to include the Berry Pit expansion. The complete list of contaminants of potential concern (COPC) expected to be released from Project sources in substantive quantities during operation are provided in the COPC and objectives worksheet. Releases of volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) are not estimated for the Project, while some releases of these compounds are expected (primarily from diesel combustion) they are not expected to be released in substantive quantities and are not typically the primary contaminants of concern expected to be released from a mine operation. The estimated contaminant releases from sources associated with the operation of the Project are expected to meet the requirements in the EIS guidelines for the Project for Atmospheric Environment.

Source details, contaminants expected to be released, estimation methodologies and operating schedules are provided in "Sources-Operation" worksheet.

Worksheets highlighted in purple contain information directly from Marathon Gold, worksheets highlighted in dark blue contain information provided by Marathon that Stantec has analyzed/modified for the purpose of estimating air contaminant releases. Worksheets highlighted in yellow contain calculations where Stantec made assumptions in absence of information from Marathon Gold, individual cells where Stantec made assumptions are also highlighted in yellow. Worksheets highlighted in light blue contain calculations for release estimates from selected processing plant sources (for Hg, NH3 and HCN). Green highlighted worksheets indicate emission sources with variable release estimates, i.e., sources with releases modelled as maximum hourly, maximum daily and annual average rates (based on expected operations as identified by Marathon Gold).

The emissions are estimated using operational information, source parameters and stack concentrations provided by Marathon Gold.

Additional details are provided in each individual worksheet.

The estimated emissions are used in the CALPUFF model. The model period covers 2017 to 2019. The model input parameters to be used directly in the CALPUFF Source set up tool Macro are provided in the "SrcTool Inputs - Model Input" worksheet.

Revision Log:

Name	Date	Comments
Chris Lyons	11-May-20	Started sheet.
Chris Lyons	June 8-11 2020	Addressed review edits - corrected CIL calc for shorter operating day, updated emission factors for mobile equipment combustion - swapped older US EPA AP-42 factors with more recent factors from ECCC, added some additional description text for clarity and other minor edits to text descriptions and
Chris Lyons	12-Jun-20	Revised area sources to limit to 4 corners, adjusted areas in the calculations accordingly. Fixed calculation error (cell reference error) in mobile equipment combustion worksheet.

Reviewed by	Date Reviewed	Comments
Mike Murphy	June 7-June 10 2020	several calcs were checked; comments were discussed with the author of the spreadsheet; and adjustments were made accordingly
Melanie Fillingham	12-Jun-20	Checked the calculations in the "Mobile Equipment Combustion" worksheet as emission factors were updated since original review. Also checked spelling and grammar throughout all worksheets.
Gillian Hatcher	22-Jul-20	Checked changes made to emissions from the processing plant, blasting and fugitives from Haul Trucks - then further discussed with Chris.

Marathon Gold Source List - Operations
Modelled Sources

Source	Expected Max Operating Year	Details	Operating Schedule	Estimation Approach	Expected Contaminants	Expected Model Source Characterization	Reference List #
Fugitive Sources							
Pits	Y3	Blasting	Blasting will be limited to daytime hours. For each pit, blasts will be every second day, so average 1 per day for the three pits combined, approximately 345 per year total.	US EPA AP-42 Ch 13.3 Explosives Detonation and 11.9 Western Surface Coal Mining and Australian NPI Emission Estimation Technique for Mining, metals based on dust and ore spec	fugitive dust, trace metals and combustion gases	Volume source	[1], [15], [20], [31]
Storage Piles	Y3	Marathon - waste rock (two storage areas/sources)	Assumed continuous in modelling - emissions due to wind erosion	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles and ore specs	fugitive dust and trace metals	Area sources	[1], [13], [20], [28]
		Marathon - top soil		not estimated/modelled - only active during construction and early in operation			
		Marathon - overburden					
		Marathon - low grade stockpile					
		Leprechaun - waste rock					
		Leprechaun - top soil		not estimated/modelled - only active during construction and early in operation			
		Leprechaun - overburden 1					
		Leprechaun - overburden 2					
		Leprechaun - low grade stock pile					
		Leprechaun - high grade stockpile					
Berry - waste rock							
TMF	Y6	tailings beaches	NA - emissions due to wind erosion - modelled on an hourly basis	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles Assumption - Metals are estimated based on combined heap leach avg specs	fugitive dust and trace metals	Area sources	[1], [13], [14]
Conveyors/transfer points/ Loading/unloading drop points at piles	Y6 - conveyor transfer rates Y3 - drop rates on stockpiles	primary crusher discharge	8-24 hours per day	US EPA AP-42 Ch 13.2.4 Aggregate	fugitive dust and trace metals	Transfer points - volume sources emissions along conveyors assumed neg - conveyors are covered inside building, emissions assumed neg. inside building, emissions assumed neg.	[1], [13], [27]
		crushed ore stock pile feed		Handling and Storage Piles and ore specs			
		semi-autogenous grinding (SAG) mill feed conveyor					
		pebble crusher conveyor 1					
		pebble crusher conveyor 2					
		pebble crusher conveyor 3					
		crushed ore stock pile discharge apron feeder 1					
		crushed ore stock pile discharge apron feeder 2					
		intensive leaching feed hopper					
		Marathon - waste rock					
Marathon - top soil	not estimated/modelled - only active during construction and early in operation						
Marathon - overburden							
Marathon - low grade stockpile							
Leprechaun - waste rock							
Leprechaun - top soil	not estimated/modelled - only active during construction and early in operation						
Leprechaun - overburden 1							
Leprechaun - overburden 2							
Leprechaun - low grade stock pile							
Leprechaun - high grade stockpile							
Berry - waste rock							
Processing Equipment	Y6	Rock Breaker Primary Crusher Pebble crusher Cyclone cluster Primary crusher grizzly screen semi-autogenous grinding (SAG) mill Trash screen 1 Trash screen 2 gravity screen 1 gravity screen 2 SAG mill trommel screen	18-22 hours per day	US EPA AP-42 Chapter 11.19.2 - Crushed Stone Processing and Pulverized Mineral Processing Australian National Pollutant Inventory document "Emission estimation technique manual for Gold Ore Processing", Version 2.0. Nevada Division of Environmental Protection (NDEP) Guidance on Emission Factors for the Mining Industry, May 31, 2017 combined and individual ore specs	fugitive dust and trace metals	Volume sources	[1], [11], [18], [25], [27]
Haul Routes/Truck exhaust	Y3 for fugitive dust and Y6 for fuel usage	CAT 777G Haul trucks - https://www.cat.com/en_US/products/new/equipment/t/off-highway-trucks/off-highway-trucks/18265926.html	Cycles (or truck trips) per year provided by Marathon Gold	US EPA AP-42 Ch 13.2.2 Unpaved Roads US EPA AP-42 Ch 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines Y3 (fugitive road dust) and Y6 (haul truck fuel consumption) activity data used to determine maximum potential air contaminant releases, as these are expected to the max years for the respective activities Austalian NPI Emission Estimation Technique for Mining	fugitive road dust and combustion gases	Segmented volume sources - representing haul routes	[1], [2], [4], [9], [12], [31]
		Berry Pit to Crusher - 91 t hauler	21,107				
		Berry Pit to Berry/Marathon LGSP - 91 t hauler	8,481				
		Berry Pit to Berry WRSF - 91 t hauler	22,603				
		Berry Pit to Berry WRSF - 132 t hauler	137,702				
		Berry Pit to Tailings Dam - 91 t hauler	38,280				
		Leprechaun Pit to Crusher - 91 t hauler	4,005				

		Leprechaun Pit to Leprecaun LGSP - 91 t hauler	2,026					
		Leprechaun Pit to Leprechaun OVBSF - 91 t hauler	4,895					
		Leprechaun Pit to Leprechaun WRSF - 91 t hauler	13,640					
		Leprechaun Pit to Leprechaun WRSF - 132 t hauler	197,435					
		Marathon Pit to Crusher - 91 t hauler	7,456					
		Marathon Pit to Berry/Marathon LGSP - 91 t hauler	3,663					
		Marathon Pit to Berry/Marathon OVBSF - 91 t hauler	5,671					
		Marathon Pit to Marathon WRSF - 91 t hauler	49,658					
		Marathon Pit to Marathon WRSF - 132 t hauler	110,307					
		High Grade Storage to Crusher - 91 t hauler	5,713					
Processing Plant Sources	Y3	Acid wash exhaust fan	4.0h /day	dust concentrations and combined ore spec	dust and trace metals	Point sources	[1], [3], [17], [19]	
		Lime dust fan	4.0h /day					
		Sodium cyanide dust fan	4.0h /day	Releases from carbon in leach (CIL) assumed to be vented here. Australian Government National Pollution Inventory (NPI) guide for gold ore processing (2006), referenced from Heath, et al. "A method for measuring HCN(g) emissions from CIP/CIL tanks." 1998.	HCN, dust and trace metals			
		Copper sulphate exhaust fan	4.0h /day	provided dust concentrations and combined ore spec - assume all dust is PM2.5 in absence of size fraction info	dust and trace metals			
		Sodium metabisulphite exhaust fan	4.0h /day					
		PAX exhaust fan	24.0h /day					
		Lime silo baghouse fan	24.0h /day					
		Drying oven extraction fan	12.0h /day					
		Elution ew extraction fan	16.0h /day	provided dust concentrations and ore spec	NH3, dust and trace metals			
		ICU ew extraction fan	16.0h /day	<i>Development and Selection of Ammonia Emission Factors</i>				
		Barring Furnace Exhaust Stack	4.0h /day	provided dust concentrations and combined ore spec Electrically heated - see "Summary of Info Received - Mechanical Equipment List" sheet this source includes a baghouse for dust control - emission limit revised in "Exhaust" worksheet	dust and trace metals			
		Stockpile Ventilation Fan	24.0h /day	provided dust concentrations and combined ore spec	dust and trace metals			
		Carbon Regeneration Kiln	16.0h /day	provided dust concentrations and combined ore spec	Hg, dust and other trace metals			
		CIL	releases related to CIL assumed from the NaCN Fan exhaust	see above (NaCN dust fan)	HCN			
Mobile Combustion Sources - Heavy Equipment								
Other Mobile Sources (heavy equipment)	Y3	Rotary Drill, Tracked, 200 mm diameter	See Mine Mobile Tab (fuel usage for mobile equipment - provided by Marathon Gold)	US EPA/Canada CEPA Tier 1, 2, 3 and 4 NOx, CO and PM Emission Standards for Off-Road Heavy-Duty Diesel Engines	combustion gases and PM	Point sources located near applicable operating areas	[1], [4], [21], [22], [23], [24], [26], [29], [30], [31]	
to be modelled (>50L/hr fuel consumption)		DTH Drill, Tracked, 144 mm diameter						Austalian NPI Emission Estimation Technique for Mining
		RC Drill, Tracked, 144mm diameter						
		Wheel Loader, 13 m3 bucket						
		Hydraulic Excavator, 15 m3 bucket						
		Hydraulic Excavator, 12 m3 bucket						
		Rigid Fram Hauler, 132 t payload						
		Rigid Fram Hauler, 91t payload						
		Track Dozer, 447 kW						
		Track Dozer, 325 kW						
		Wheel Dozer, 370 kW						

Reference List - Information provided by Marathon Gold and Published Emission Factors

- [1] Information Request responses provided by Marathon Gold: Summary_Info_Received_04262020.xlsx
- [2] Marathon - Valentine - Hauler Operating Hour and Fuel Burn Estimates - Scd10b - Valentine PFS - Peak Operating Period (Y3) - Haul Road Usage.xlsx tab: "Fleet Req", Feb 12, 2020
- [3] Mechanical Equipment List provided by Marathon Gold - 104319-MX-LST-001_RevE_27Feb20.xlsx
- [4] Mobile equipment fuel usage provided by Marathon Gold: Marathon PFS - Construction (Y-1) and Peak Operations (Y3) - Fleet Units and Fuel Burn.xls
- [5] Newfoundland and Labrador Air Pollution Control Regulations, 2004, Newfoundland and Labrador Regulation 39/04
- [6] Canadian Council of Ministers of the Environment (CCME) 2020 Canadian Ambient Air Quality Standards (CAAQS)
- [7] Ontario Ministry of Environment Conservation and Parks (MECP) - Air Contaminant Benchmark (ACB) list: standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants, March 25, 2019
- [8] US EPA AP-42 Ch 3.3 Gasoline and Diesel Industrial Engines (1996)
- [9] US EPA AP-42 Ch 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines (1996)
- [10] US EPA AP-42 Ch 11.9 Western Surface Coal Mining (1998)
- [11] US EPA AP-42 Chapter 11.19.2 - Crushed Stone Processing and Pulverized Mineral Processing (2004)
- [12] US EPA AP-42 Ch 13.2.2 Unpaved Roads (2006)
- [13] US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles (2006)
- [14] US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion (2006)
- [15] US EPA AP-42 Ch 13.3 Explosives Detonation (1995)
- [16] US EPA AP-42 Appendix A Miscellaneous Data and Conversion Factors (1985)
- [17] Development and Selection of Ammonia Emission Factors prepared for the USEPA by Battye, Battye, Overcash and Fudge in August 1994.
- [18] Australian National Pollutant Inventory document "Emission estimation technique manual for Gold Ore Processing", Version 2.0. (1998)
- [19] Australian Government National Pollution Inventory (NPI) guide for gold ore processing (2006), referenced from Heath, et al., A method for measuring HCN(g) emissions from CIP/CIL tanks. 1998.
- [20] Environment and Climate Change Canada (ECCC) National Pollutant Release Inventory (NPRI) Pits and Quarries Reporting Guide 2017.
- [21] Caterpillar D9T Dozer specifications
- [22] Caterpillar Large Wheel Loader 993K specifications
- [23] Caterpillar 777G specifications
- [24] Hitachi EX1900 12m3 Excavator specifications
- [25] Nevada Division of Environmental Protection (NDEP) Guidance on Emission Factors for the Mining Industry, May 31, 2017
- [26] Marathon Gold - Valentine PFS - Fuel Consumption based on equipment usage provided by Marathon Gold - Valentine - PFS - Mine Operations Fuel Consumption - 200602.xlsx
- [27] Conveyor transfer/drop, processing rates and operating hours provided via email - from Marathon Gold - Jared Dietrich - June 2, 2020
- [28] Environment and Climate Change Canada (ECCC) Historical Weather Data for Deer Lake (2017-2019). 2020
- [29] Canadian Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (ECCC, 2020)
- [30] Nonroad Compression-Ignition Engines - Exhaust Emission Standards (US EPA, 2016a)
- [31] Australian National Pollutant Release Inventory Emission Estimation Technique Manual for Mining, January 2012
- [32] Heavy Truck Weight and Dimension Limits for Interprovincial Operations in Canada - Task Force on Vehicle Weights and Dimensions Policy
- [33] Caterpillar 785G specifications
- [34] 200 mm drill specs
- [35] CAT 6030 Hydraulic Shovel - 15.5 m3 hydraulic excavator Exhaust dimensions approximated and net engine power
- [36] Processing plant source/building updates provided via email - from Marathon Gold - Tara Oak - May 21, 2021 (provided source update *table in Processing Srcs_rev_20210521* worksheet)
- [37] Processing plant source release parameters revisions - call with Jared Dietrich (Ausenco) June 3, 2021 - sources through side wall except (SP Fan and Drying oven) exhaust vertically

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NA

Crushing and Screening Emissions

Releases of dust and trace metals (contained in the dust) are expected from crushing and screening activities.

Releases are estimated based on operating information provided by Marathon Gold and published emission factors from the US EPA (AP-42 Chapter 11.19.2 - Crushed Stone Processing and Pulverized Mineral Processing - US EPA 2004) as well as from the Australian National Pollutant Inventory document "Emission estimation technique manual for Gold Ore Processing", Version 2.0 (AUS NPI 2006). PM2.5 emissions are estimated based on emission factors for high moisture ore (>= 4%) in Table 2.3 of the Nevada DEP Guidance on Emission Factors for the Mining Industry.

Trace metals are estimated using the total particulate matter estimates and the combined ore specs.

Crushing and screening emissions are estimated based on Y6 operating year information.

Releases are assumed to occur continuously for the dispersion modelling.

Material Processed 11,000 t/d screening and primary crushing
 4,000,000 t/a
 Pebble Crusher processing rate 2,500 t/d
 909,091 t/a
 Operating Schedule 18 hr/d (Typical primary crusher operation)
 22 hr/d (Typical pebble crusher operation)

Source	Air Contaminant	EF (kg/Mg)	Source
Primary Crusher	TSP	0.01	AUS NPI 2006
	PM10	0.004	AUS NPI 2006
	PM2.5	0.00061	Nevada DEP 2017
Grizzly Screen	TSP	0.0125	US EPA AP-42 Ch 11.19.2
	PM10	0.0043	US EPA AP-42 Ch 11.19.2
	PM2.5	0.00065	Nevada DEP 2017

Emissions factors for high moisture content ore (>4%), MC for Marathon 5%

Release Estimates

Air Contaminant	CAS#	Max Hourly Emission Rate (g/s)		
		Primary Crushing	Pebble Crusher	Screening
TSP	N/A-1	1.70	0.32	2.12
PM10	N/A-2	0.68	0.13	0.73
PM2.5	N/A-3	0.10	0.019	0.11
As	7440-38-2	1.24E-05	2.30E-06	1.55E-05
Cd	7440-43-9	1.04E-06	1.93E-07	1.30E-06
Cu	7440-50-8	1.28E-04	2.38E-05	1.60E-04
Pb	7439-92-1	3.61E-05	6.71E-06	4.51E-05
Hg	7439-97-6	3.54E-07	6.58E-08	4.42E-07
Ni	7440-02-0	1.11E-05	2.07E-06	1.39E-05
Zn	7440-66-6	4.20E-05	7.82E-06	5.26E-05
Ba	7440-39-3	3.64E-05	6.77E-06	4.55E-05
Sr	7440-24-6	4.77E-05	8.87E-06	5.96E-05
Be	7440-41-7	1.78E-07	3.31E-08	2.23E-07
Cobalt	7440-48-4	1.58E-05	2.94E-06	1.97E-05
Li	7439-93-2	2.40E-05	4.46E-06	3.00E-05
Sb	7440-36-0	2.60E-05	4.84E-06	3.25E-05
Sn	7440-31-5	4.02E-05	7.47E-06	5.02E-05
Se	7782-49-2	3.41E-05	6.35E-06	4.27E-05
Cr	7440-47-3	5.84E-05	1.09E-05	7.30E-05
Bi	7440-69-9	1.18E-05	2.20E-06	1.48E-05

Air Contaminant	CAS#	Max Daily/Annual Emission Rate (g/s)		
		Primary Crushing	Pebble Crusher	Screening
TSP	N/A-1	1.27	0.29	1.59
PM10	N/A-2	0.51	0.12	0.55
PM2.5	N/A-3	0.077	0.018	0.083
As	7440-38-2	9.29E-06	2.11E-06	1.16E-05
Cd	7440-43-9	7.79E-07	1.77E-07	9.73E-07
Cu	7440-50-8	9.59E-05	2.18E-05	1.20E-04
Pb	7439-92-1	2.71E-05	6.15E-06	3.38E-05
Hg	7439-97-6	2.65E-07	6.03E-08	3.32E-07
Ni	7440-02-0	8.36E-06	1.90E-06	1.05E-05
Zn	7440-66-6	3.15E-05	7.17E-06	3.94E-05
Ba	7440-39-3	2.73E-05	6.20E-06	3.41E-05
Sr	7440-24-6	3.58E-05	8.13E-06	4.47E-05
Be	7440-41-7	1.34E-07	3.04E-08	1.67E-07
Cobalt	7440-48-4	1.18E-05	2.69E-06	1.48E-05
Li	7439-93-2	1.80E-05	4.08E-06	2.25E-05
Sb	7440-36-0	1.95E-05	4.44E-06	2.44E-05
Sn	7440-31-5	3.01E-05	6.85E-06	3.77E-05
Se	7782-49-2	2.56E-05	5.82E-06	3.20E-05
Cr	7440-47-3	4.38E-05	9.96E-06	5.48E-05
Bi	7440-69-9	8.88E-06	2.02E-06	1.11E-05

Air Contaminant	CAS#	Annual Emissions Emission Rate (t/a)			Total
		Primary Crushing	Pebble Crusher	Screening	
TSP	N/A-1	40.0	9.09	50.0	99.1
PM10	N/A-2	16.0	3.64	17.2	36.8
PM2.5	N/A-3	2.42	0.55	2.60	5.58
As	7440-38-2	2.92E-04	6.64E-05	3.65E-04	7.23E-04
Cd	7440-43-9	2.45E-05	5.56E-06	3.06E-05	6.06E-05
Cu	7440-50-8	3.01E-03	6.85E-04	3.77E-03	7.46E-03
Pb	7439-92-1	8.50E-04	1.93E-04	1.06E-03	2.11E-03
Hg	7439-97-6	8.33E-06	1.89E-06	1.04E-05	2.06E-05
Ni	7440-02-0	2.63E-04	5.97E-05	3.28E-04	6.51E-04
Zn	7440-66-6	9.91E-04	2.25E-04	1.24E-03	2.45E-03
Ba	7440-39-3	8.57E-04	1.95E-04	1.07E-03	2.12E-03
Sr	7440-24-6	1.12E-03	2.55E-04	1.41E-03	2.78E-03
Be	7440-41-7	4.20E-06	9.55E-07	5.25E-06	1.04E-05
Cobalt	7440-48-4	3.72E-04	8.45E-05	4.65E-04	9.22E-04
Li	7439-93-2	5.65E-04	1.28E-04	7.06E-04	1.40E-03
Sb	7440-36-0	6.13E-04	1.39E-04	7.67E-04	1.52E-03
Sn	7440-31-5	9.47E-04	2.15E-04	1.18E-03	2.35E-03
Se	7782-49-2	8.05E-04	1.83E-04	1.01E-03	1.99E-03
Cr	7440-47-3	1.38E-03	3.13E-04	1.72E-03	3.41E-03
Bi	7440-69-9	2.79E-04	6.34E-05	3.49E-04	6.91E-04

Blasting Emissions

Air contaminant releases from blasting are estimated based on information provided by Marathon Gold and published emission factors (from the US EPA AP-42 Chapter 13.3 Explosives Detonation and ECCN NPRI guidance document *Pits and Quarries Reporting Guide*)

Trace metal fugitives are estimated based on the TSP release estimates and the ore specifications.

Since a portion of the PM (TSP, PM10, PM2.5 and trace metals within the PM) will not leave the pit (due to settling) retention factors are applied to sources below the surface within the pit. The retention factors applied are from the Australian National Pollutant Release Inventory Emission Estimation Technique Manual for Mining - Wings equation 1981 based on 50 m pit depth.

Ammonium Nitrate Emulsion - Fortis Extra explosive is used, therefore, AP-42 emission factors for ammonium nitrate with fuel oil (ANFO) are used.

It is assumed that blasting is split evenly between in the three pits - Marathon, Leprechaun and Berry.

Blasting is only to occur during daytime hours and for the purpose of modelling the blasting is assumed to occur at 3 pm each day. For the purpose of estimating short-term emissions, it is assumed blasting occurs over a 1-min period.

Blasting occurs at each pit once every third day, on alternate days, so a single blast occurs once per day.

Releases are modelled as volume sources, with variable releases considered using scaling emission factors in the model control file.

Emission Factors

Contaminant	EF	Units	Source
NOx	8	kg/Mg	US EPA AP-42 Ch 13.3
CO	34	kg/Mg	US EPA AP-42 Ch 13.3
SO2	1	kg/Mg	US EPA AP-42 Ch 13.3
PM	23.06	kg/Blast	ECCC NPRI Pits and Quarries Guide
PM10	0.52	scale factor (fraction of total PM)	US EPA AP-42 Ch 13.3
PM2.5	0.3	scale factor (fraction of total PM)	US EPA AP-42 Ch 13.3

Assumed Blast Schedule - for Model

Pit	Sun	Mon	Tue	Wed	Thurs	Fri	Sat
Berry Pit	1			1			1
Marathon Pit		1			1		
Leprechaun Pit			1			1	
Total						364	

Assumed and provided blasting information from Marathon Gold (based on Y3 of operation)

Total Explosives	17,500	t/a
Blasts per year	345	
Blasts per pit	115	
Explosives per blast	51.0	t
Assumed Blast Duration	1	min

Particulate Matter Pit Retention Factors

TSP	0.5
PM10	0.05
PM2.5	0.005

Release Estimates

Air Contaminant	CAS#	Release per blast (kg)			Emission Rate (g/s)									Total Annual Emissions (t/a)
		Marathon Pit	Leprechaun Pit	Berry Pit	Hourly			Daily			Annual			
					Marathon Pit	Leprechaun Pit	Berry Pit	Marathon Pit	Leprechaun Pit	Berry Pit	Marathon Pit	Leprechaun Pit	Berry Pit	
NOX	10102-44-0	408	408	408	113	113	113	4.72	4.72	4.72	2.22	2.22	2.22	141
CO	630-08-0	1,734	1,734	1,734	482	482	482	20.1	20.1	20.1	9.43	9.43	9.43	598
SO2	7446-09-5	51.0	51.0	51.0	14.2	14.2	14.2	0.590	0.590	0.590	0.277	0.277	0.277	17.6
TSP	N/A-1	11.53	11.53	11.53	3.20	3.20	3.20	0.133	0.133	0.133	0.084	0.084	0.084	3.98
PM10	N/A-2	11.53	11.53	11.53	3.20	3.20	3.20	0.133	0.133	0.133	0.084	0.084	0.084	3.98
PM2.5	N/A-3	11.53	11.53	11.53	3.20	3.20	3.20	0.133	0.133	0.133	0.084	0.084	0.084	3.98
As	7440-38-2	1.15E-04	1.15E-04	2.19E-05	3.20E-05	3.20E-05	6.09E-06	1.33E-06	1.33E-06	2.54E-07	8.41E-07	8.41E-07	1.60E-07	2.9E-05
Cd	7440-43-9	1.04E-05	1.04E-05	4.04E-07	2.88E-06	2.88E-06	1.12E-07	1.20E-07	1.20E-07	4.67E-09	7.57E-08	7.57E-08	2.94E-09	2.4E-06
Cu	7440-50-8	1.15E-03	1.15E-03	3.00E-04	3.20E-04	3.20E-04	8.33E-05	1.33E-05	1.33E-05	3.47E-06	8.41E-06	8.41E-06	2.19E-06	3.0E-04
Pb	7439-92-1	2.31E-04	4.61E-04	4.32E-05	6.41E-05	1.28E-04	1.20E-05	2.67E-06	5.34E-06	5.00E-07	1.68E-06	3.36E-06	3.15E-07	8.5E-05
Hg	7439-97-6	3.46E-06	3.46E-06	2.88E-07	9.61E-07	9.61E-07	8.01E-08	4.00E-08	4.00E-08	3.34E-09	2.52E-08	2.52E-08	2.10E-09	8.3E-07
Ni	7440-02-0	8.07E-05	1.15E-04	3.11E-05	2.24E-05	3.20E-05	8.65E-06	9.34E-07	1.33E-06	3.60E-07	5.89E-07	8.41E-07	2.27E-07	2.6E-05
Zn	7440-66-6	1.59E-04	4.04E-04	2.94E-04	4.42E-05	1.12E-04	8.17E-05	1.84E-06	4.67E-06	3.40E-06	1.16E-06	2.94E-06	2.14E-06	9.9E-05
Ba	7440-39-3	1.35E-04	4.63E-04	1.44E-04	3.74E-05	1.29E-04	4.00E-05	1.56E-06	5.36E-06	1.67E-06	9.81E-07	3.38E-06	1.05E-06	8.5E-05
Sr	7440-24-6	1.26E-04	6.96E-04	1.50E-04	3.50E-05	1.93E-04	4.16E-05	1.46E-06	8.06E-06	1.73E-06	9.19E-07	5.08E-06	1.09E-06	1.1E-04
Be	7440-41-7	1.04E-06	1.50E-06	1.10E-06	2.88E-07	4.16E-07	3.04E-07	1.20E-08	1.73E-08	1.27E-08	7.57E-09	1.09E-08	7.99E-09	4.2E-07
Cobalt	7440-48-4	5.77E-05	1.15E-04	1.49E-04	1.60E-05	3.20E-05	4.13E-05	6.67E-07	1.33E-06	1.72E-06	4.20E-07	8.41E-07	1.08E-06	3.7E-05
Li	7439-93-2	2.31E-04	2.31E-04	2.71E-05	6.41E-05	6.41E-05	7.53E-06	2.67E-06	2.67E-06	3.14E-07	1.68E-06	1.68E-06	1.98E-07	5.6E-05
Sb	7440-36-0	3.46E-04	1.15E-04	6.92E-05	9.61E-05	3.20E-05	1.92E-05	4.00E-06	1.33E-06	8.01E-07	2.52E-06	8.41E-07	5.05E-07	6.1E-05
Sn	7440-31-5	4.61E-04	3.46E-04	1.15E-05	1.28E-04	9.61E-05	3.20E-06	5.34E-06	4.00E-06	1.33E-07	3.36E-06	2.52E-06	8.41E-08	9.4E-05
Cr	7782-49-2	3.46E-04	3.46E-04	4.04E-06	9.61E-05	9.61E-05	1.12E-06	4.00E-06	4.00E-06	4.67E-08	2.52E-06	2.52E-06	2.94E-08	8.0E-05
Se	7440-47-3	6.96E-04	4.27E-04	6.80E-05	1.93E-04	1.19E-04	1.89E-05	8.05E-05	4.94E-06	7.87E-07	5.07E-06	3.11E-06	4.96E-07	1.4E-04
Bi	7440-69-9	1.15E-04	1.15E-04	1.07E-05	3.20E-05	3.20E-05	2.96E-06	1.33E-06	1.33E-06	1.23E-07	8.41E-07	8.41E-07	7.78E-08	2.8E-05

Transfer Points - Fugitive Dust Emissions Estimates

Fugitive dust releases generated from material transfer (at drop points from conveyors) are estimated based on information provided by Marathon Gold and published emission factors from the US EPA AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles.

Trace metal fugitives are estimated based on the TSP release estimates and the individual ore specs (for individual wasterock and ore storage piles) or combined ore specification (from the three pits for the conveyor drop points).

CALMET predicted meteorological data for the Project site (wind speeds) are used to estimate the releases.

Releases are assumed to occur continuously for the dispersion modelling.

Emission Factor Calculations

Average Wind Speed 5.04 m/s CALMET predicted average wind speed at project site (2017-2019), at surface level (Level01 - 10 m)
 Ore Moisture Content 5% Ore Moisture content from information provided by Marathon Gold (see Grinding Mill worksheet)

Contaminant	Emission Factor (kg/Mg)
TSP	9.66E-04
PM10	4.57E-04
PM2.5	6.92E-05

From US EPA AP-42 Ch 13.2.4

The quantity of particulate emissions generated by either type of drop operation, per kilogram (kg) of material transferred, may be estimated, with a rating of A, using the following empirical equations:

$$E = K \cdot M \cdot (U/1.5)^{1.5} \cdot \left(\frac{M}{T}\right)^{0.5} \quad (1)$$

$$E = K \cdot M \cdot (U/1.5)^{1.5} \cdot \left(\frac{M}{T}\right)^{0.5} \quad (2)$$

where:
 E = emission factor
 U = particle size multiplier (dimensionless)
 M = mass flow rate, tonnes per second (t/s) (tonnes per hour [tph])
 T = material moisture content (%)

The particle size multiplier in the equation, U, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (U) For Equation 1				
< 10 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.69	0.92	0.26	0.077

*Multiplier for < 2.5 µm taken from Reference 14.

Emissions Estimates

Ore Handling Equipment	Transfer/drop Rate (t/d)	Max Operating Hours per day	Typical Operating Hours per day	Comments
Primary crusher discharge conveyor	11,000	24	18	
Crushed ore stockpile feed conveyor	11,000	24	18	
SAG mill feed conveyor	11,000	24	22	drop point inside, conveyors covered and under vacuum
Pebble crusher conveyor 1	2,500	24	22	
Pebble crusher conveyor 2	2,500	24	22	
Pebble crusher conveyor 3	2,500	24	22	
Crushed ore stockpile discharge apron feeder 1	11,000	24	22	
Crushed ore stockpile discharge apron feeder 2	11,000	24	22	
Intensive leaching feed hopper	5.5	8	4	wet/slurry - emissions assumed neg.

Loading and Unloading drop points - Stockpiles			
Storage Pile	Add Rate	Remove Rate	Total
	kt/a	kt/a	t/d
Marathon - waste rock	17,850	0	48,904
Marathon - low grade stockpile	1,031	0	2,825
Leprechaun - waste rock	25,560	0	70,027
Leprechaun - low grade stockpile	172	0	471
Leprechaun - high grade stockpile	0	485	1,329
Berry - waste rock	18,940	0	51,890

Air Contaminant	CAS#	Emission Rate (g/s)																	Conveyor Drop Points (t/a)	Stockpile Loading/Unloading (kt/a)	Total Annual Releases (t/a)
		Conveyor Drop Points							Stockpile Loading and Unloading Drop Points												
		Primary crusher discharge conveyor	Crushed ore stockpile feed conveyor	SAG mill feed conveyor	Pebble crusher conveyor 1	Pebble crusher conveyor 2	Pebble crusher conveyor 3	Crushed ore stockpile discharge apron feeder 1	Crushed ore stockpile discharge apron feeder 2	Intensive leaching feed hopper	Marathon - waste rock	Marathon - low grade stockpile	Leprechaun - waste rock	Leprechaun - low grade stockpile	Leprechaun - high grade stockpile	Berry - waste rock					
TSP	N/A-1	0.12	0.12	0	0.028	0.028	0.028	0.12	0.12	0	0.55	0.03	0.78	0.01	0.58	18.2	61.8	80.0			
PM10	N/A-2	0.058	0.058	0	0.013	0.013	0.013	0.058	0.058	0	0.26	0.01	0.37	0.00	0.274	8.6	29.2	37.8			
PM2.5	N/A-3	8.80E-03	8.80E-03	0	2.00E-03	2.00E-03	2.00E-03	8.80E-03	8.80E-03	0	0.039	0.002	0.056	0.000	0.060	1.96E-03	4.15E-02	1.30	4.43	5.73	
As	7440-38-2	9.97E-07	9.97E-07	0	2.04E-07	2.04E-07	2.04E-07	9.97E-07	9.97E-07	0	5.47E-08	3.04E-07	7.83E-08	5.27E-08	1.49E-07	1.10E-08	1.33E-04	4.70E-04	6.03E-04		
Cd	7440-43-0	7.92E-08	7.92E-08	0	1.71E-08	1.71E-08	1.71E-08	7.92E-08	7.92E-08	0	4.97E-09	2.84E-08	7.08E-09	4.74E-09	1.34E-08	9.03E-09	1.11E-05	3.98E-05	5.09E-05		
Cu	7440-50-8	9.26E-06	9.26E-06	0	2.10E-06	2.10E-06	2.10E-06	9.26E-06	9.26E-06	0	5.47E-05	3.10E-06	7.83E-05	5.27E-07	1.49E-06	1.51E-05	1.37E-03	4.83E-03	6.20E-03		
Pb	7439-92-1	2.61E-06	2.61E-06	0	5.94E-07	5.94E-07	5.94E-07	2.61E-06	2.61E-06	0	1.09E-05	6.31E-07	3.13E-05	2.11E-07	5.94E-07	2.17E-06	3.86E-04	1.45E-03	1.83E-03		
Hg	7439-97-6	2.56E-08	2.56E-08	0	5.82E-09	5.82E-09	5.82E-09	2.56E-08	2.56E-08	0	1.64E-07	9.47E-08	2.35E-07	1.58E-09	4.46E-09	1.45E-08	3.78E-06	1.35E-05	1.73E-05		
Ni	7440-02-0	8.07E-07	8.07E-07	0	1.83E-07	1.83E-07	1.83E-07	8.07E-07	8.07E-07	0	3.83E-08	2.21E-07	7.83E-08	5.27E-08	1.49E-07	1.57E-06	1.19E-04	4.30E-04	5.49E-04		
Zn	7440-66-6	3.04E-06	3.04E-06	0	6.92E-07	6.92E-07	6.92E-07	3.04E-06	3.04E-06	0	7.54E-06	4.36E-07	2.74E-05	1.84E-07	5.20E-07	1.48E-05	4.50E-04	1.60E-03	2.05E-03		
Ba	7440-39-3	2.64E-06	2.64E-06	0	5.99E-07	5.99E-07	5.99E-07	2.64E-06	2.64E-06	0	6.38E-06	3.68E-07	3.14E-05	2.11E-07	5.96E-07	7.25E-06	3.89E-04	1.46E-03	1.85E-03		
Sr	7440-24-6	3.45E-06	3.45E-06	0	7.85E-07	7.85E-07	7.85E-07	3.45E-06	3.45E-06	0	5.97E-06	3.45E-07	4.73E-05	3.18E-07	8.97E-07	7.54E-05	5.10E-04	1.97E-03	2.48E-03		
Be	7440-11-7	1.29E-08	1.29E-08	0	2.93E-09	2.93E-09	2.93E-09	1.29E-08	1.29E-08	0	4.93E-08	2.84E-08	1.02E-07	6.85E-10	1.93E-09	5.51E-08	1.91E-06	6.97E-06	8.58E-06		
Coalt	7440-48-4	1.14E-06	1.14E-06	0	2.60E-07	2.60E-07	2.60E-07	1.14E-06	1.14E-06	0	2.73E-06	1.59E-07	7.83E-06	5.27E-08	1.49E-07	7.45E-06	1.69E-04	5.80E-04	7.49E-04		
Li	7439-93-2	1.74E-06	1.74E-06	0	3.94E-07	3.94E-07	3.94E-07	1.74E-06	1.74E-06	0	1.09E-05	6.31E-07	1.57E-05	1.05E-07	2.97E-07	1.36E-05	2.56E-04	9.14E-04	1.17E-03		
Sb	7440-36-0	1.89E-06	1.89E-06	0	4.28E-07	4.28E-07	4.28E-07	1.89E-06	1.89E-06	0	1.84E-05	9.47E-07	7.83E-06	5.27E-08	1.49E-07	3.48E-06	2.78E-04	9.10E-04	1.19E-03		
Sn	7440-31-5	2.91E-06	2.91E-06	0	6.61E-07	6.61E-07	6.61E-07	2.91E-06	2.91E-06	0	2.19E-05	1.26E-06	2.35E-05	1.58E-07	4.46E-07	5.80E-07	4.30E-04	1.51E-03	1.94E-03		
Se	7782-49-3	2.47E-06	2.47E-06	0	5.62E-07	5.62E-07	5.62E-07	2.47E-06	2.47E-06	0	2.44E-05	9.47E-07	2.35E-05	1.58E-07	4.46E-07	2.03E-07	3.65E-04	1.31E-03	1.68E-03		
Cr	7440-47-3	4.23E-06	4.23E-06	0	9.62E-07	9.62E-07	9.62E-07	4.23E-06	4.23E-06	0	3.30E-05	1.91E-06	2.98E-05	1.95E-07	5.49E-07	3.42E-06	6.25E-04	2.34E-03	2.77E-03		
Bi	7440-69-9	8.57E-07	8.57E-07	0	1.95E-07	1.95E-07	1.95E-07	8.57E-07	8.57E-07	0	5.47E-06	3.10E-07	7.83E-06	5.27E-08	1.49E-07	5.36E-07	1.27E-04	4.52E-04	5.79E-04		

Haul Truck Fugitives - Updated March 2023 - Berry PE EIS Updates

Fugitive dust from movement of haul trucks along haul routes are estimated which include releases of TSP, PM10 and PM2.5.

Total releases of combustion gases and particulate from fuel combustion in haul trucks are estimated in the "Mobile Equipment Combustion" worksheet, the release estimates are allocated along the haul routes here for input in the dispersion model.

Releases are estimated based on haul route and truck trip information provided by Marathon and published emission factors (US EPA AP-42 Ch 13.2.2 Unpaved Roads).
 Releases are estimated for the two haul truck sizes expected to used at the mine site, CAT777G and the larger CAT785G.

Since a portion of the PM (TSP, PM10, PM2.5) will not leave the pit (due to settling) retention factors are applied to sources below the surface within the pit.
 The retention factors applied are from the Australian National Pollutant Release Inventory Emission Estimation Technique Manual for Mining - Wings equation 1981 based on 50 m pit depth.
 The retention factors are applied portions of the haul routes in the immediate area of the pits.

Maximum hourly, daily and annual emissions are estimated for the modelling.

Source dimensions are estimated based on road area and haul truck dimensions. Fugitive releases along haul routes are modelled as segmented volume sources representing a line (in 100 m lengths).

Haul Route Information

Assumed Haul Route/Source ID	Description	Approx. Modelled Length (km)	No of Vrac segments	Number of Truck trips			Haul Truck Model on Route	Combustion Emissions Allocation	Location	
				Hourly	Daily	Annual				
dipt	BPT1_INPT_911	BPT (in pit) to CRS and BWRS - 91 t hauler	1300	7	123	43710	777G	20.2%	inpit	
	BPT1_INPT_1321	BPT (in pit) to CRS and BWRS - 132 t hauler	1300	20	388	137702	785G	18.3%	inpit	
	BPT2_INPT	BPT (in pit) to CRS	1300	26	-	-	-	-	inpit	
	BPT1_CRS	BPT (entrance1) to CRS	1220	24	3	59	21407	777G	4.1%	
	LST1_EVAGD	LST (entrance1) to EVAGD	770	16	2	24	8481	777G	3.7%	
	BPT1_BMWRS_911	BPT (entrance2) to BMWRS - 91 t hauler	1000	4	64	22618	777G	4.5%		
dipt	BPT1_BMWRS_1321	BPT (entrance2) to BMWRS - 132 t hauler	1000	20	388	137702	785G	14.1%		
	BPT1_BMWRS	BPT (entrance2) to BMWRS	1000	20	-	-	-	-	inpit	
	BPT1_TMF	BPT (entrance2) to LGO and TMF	1140	31	8	132	46761	777G	11.3%	
	BPT1_TMF	BPT (entrance2) to TMF	1660	33	6	108	38280	777G	11.1%	
dipt	LPT1_INPT_911	LPT (in pit) to LGO-CRS+LOVH+LWRS - 91 t hauler	1085	5	69	24365	777G	6.1%	inpit	
	LPT1_INPT_1321	LPT (in pit) to LGO-CRS+LOVH+LWRS - 132 t hauler	1085	28	556	197315	785G	21.4%	inpit	
	LPT1_INPT	LPT (in pit) to LGO-CRS+LOVH+LWRS	1085	22	-	-	-	-	inpit	
	LPT1_LGO	LPT (entrance) to LGO and CRS	1340	27	2	17	6031	777G	3.0%	
	LPT1_CRS	LPT (entrance) to CRS	2000	32	1	11	4005	777G	3.8%	
	LPT1_LOVH	LPT (entrance) to LOVH	1100	22	1	14	4895	777G	3.2%	
dipt	LPT1_LWRS_911	LPT (entrance) to LWRS - 91 t hauler	770	2	38	13640	777G	1.7%		
	LPT1_LWRS_1321	LPT (entrance) to LWRS - 132 t hauler	770	28	556	197315	785G	15.7%		
	LPT1_LWRS	LPT (entrance) to LWRS	770	16	-	-	-	-	inpit	
dipt	MPT1_INPT_911	MPT (in pit) to BMGO+HGO+MWRS - 91 t hauler	1840	11	187	66448	777G	22.0%	inpit	
	MPT1_INPT_1321	MPT (in pit) to BMGO+HGO+MWRS - 132 t hauler	1840	15	311	110307	785G	20.3%	inpit	
	MPT1_INPT	MPT (in pit) to BMGO+HGO+MWRS	1840	27	-	-	-	-	inpit	
	MPT1_MOVH	MPT (entrance) to MOVH + BMGO + CRS	875	18	4	47	16790	777G	3.9%	
	MPT1_BMGO	MPT (entrance) to BMGO + CRS	480	9	3	31	11319	777G	4.4%	
	MPT1_HGO	MPT (entrance) to HGO + CRS	1690	34	2	21	7456	777G	3.8%	
dipt	MPT1_MWRS_911	MPT (entrance) to MWRS - 91 t hauler	910	7	140	49658	777G	7.1%		
	MPT1_MWRS_1321	MPT (entrance) to MWRS - 132 t hauler	910	16	311	110307	785G	16.7%		
	MPT1_MWRS	MPT (entrance) to MWRS	910	19	-	-	-	-	inpit	
	MPT1_CRS	MPT (entrance) to CRS	11	1	-	-	-	-	inpit	
	MPT1_BMGO	MPT (entrance) to BMGO	500	3	87	31168	777G	3.7%		
				397				200%		

* Daily return trips are not additive as there is overlap between routes.

Emission Factor Calculations

Modelled Haul Routes - Updated Mar 2023

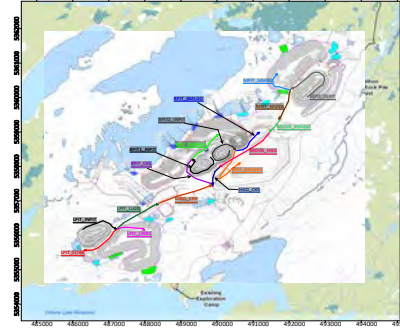


Table with 4 columns: Property, Value, Unit, and Reference. Rows include Silt content, Gross Vehicle Weight, Payload Capacity, Mean Vehicle Weight, and Assumed control factor.

From US EPA AP-42 Chapter 13.2.2

The following empirical regression can be used to estimate the quantity of particles (by size) that are typically generated from an unpaved road, per vehicle per truckload (CVT):

$$E = k \cdot W^{1.1} \cdot V^{0.7} \cdot C^{0.2}$$

and for reducing dusting on publicly accessible roads, measured by light duty vehicles, emissions may be estimated from the following equation:

$$E = \frac{k \cdot W^{1.1} \cdot V^{0.7} \cdot C^{0.2}}{(40.5)^x}$$

Where: k, x, y & z are empirical constants (Estimate 8) given below and:

- E = dust emission rate (lb/VM/T)
- W = surface material wet weight (lb)
- V = surface material volume (cu yd)
- C = surface material moisture content (%)
- x = mean vehicle speed (mph)
- z = moisture factor for 100% vehicle dust emission (leave zero and use zero)

The constant k represents y, x, z and SP are defined as an emission parameters for adjusting the regression equations to local conditions. The moisture correction factor is %WET to grams (g) per vehicle-ft-truckload (CVT) (CVT) is as follows:

$$1 \text{ lb} \cdot \% \text{WET} = 38.1 \text{ g} \cdot \text{CVT}$$

Constant	TSP*	PM10	PM2.5
k (lb/VM/T)	4.9	N/A.3	0.15
x	0.9	0.9	0.9
z	0.45	0.46	0.45

Particulate Matter	Retention Factors
TSP	0.5
PM10	0.05
PM2.5	0.005

* constant values for PM10, assumed equivalent to TSP

Emissions Estimates

Description	Source ID	Hauler	Pit retention factor applied (yes or no)	Release Height (m)	Volume Source Initial Dimensions (m)		Hourly														Annual													
					Volume Source Sigma y	Volume Source Sigma z	Emission Rate (g/s)														Emission Rate (g/s)													
							Daily						Annual								Daily						Annual							
TSP	PM10	PM2.5	Diesel PM	NOx	SO2	CO	TSP	PM10	PM2.5	Diesel PM	NOx	SO2	CO	TSP	PM10	PM2.5	Diesel PM	NOx	SO2	CO														
BPT (in pit) to CS and BWS- S11 Hauler	BPT1_INPT_S11	777G	yes	-	-	-	-	3.75	1.02	0.13	1.98	0.39	0.0038	0.96	1.28	0.75	0.08	0.30	0.18	0.0026	0.18	1.25	0.75	0.08	0.49	0.39	0.004	0.94						
BPT (in pit) to CS and BWS- 1321 Hauler	BPT1_INPT_1321	785G	yes	-	-	-	-	6.15	3.39	0.40	3.22	2.34	0.0246	1.99	4.98	2.91	0.33	3.32	2.43	0.26	2.43	4.84	2.63	0.32	3.22	2.43	0.26	2.43						
BPT (in pit) to CS and BWS- TOTAL	BPT1_INPT	-	yes	5.95	23.57	5.53	7.90	4.61	0.51	0.034	2.973	0.0057	2.973	6.26	3.65	0.41	0.033	2.498	0.0056	2.498	6.09	3.56	0.40	0.033	2.498	0.0056	2.498							
BPT (entrance) to CS	BPT_CS	777G	no	5.95	24.13	5.53	1.40	0.43	0.05	0.007	1.197	0.0038	0.31	1.16	0.36	0.04	0.007	0.184	0.00031	0.184	1.13	0.35	0.04	0.007	0.184	0.00031	0.184							
BPT (entrance) to BWS- S11 Hauler	BPT_BWS0	777G	no	5.95	23.07	5.53	0.59	0.18	0.02	0.003	0.380	0.0016	0.081	0.29	0.09	0.01	0.008	0.087	0.00016	0.087	0.29	0.09	0.01	0.008	0.087	0.00016	0.087							
BPT (entrance) to BWS- 1321 Hauler	BPT_BWS91	777G	no	-	-	-	1.53	0.47	0.05	0.006	0.715	0.0024	0.315	1.02	0.31	0.03	0.008	0.117	0.0004	0.117	0.99	0.30	0.03	0.008	0.117	0.0004	0.117							
BPT (entrance) to BWS- TOTAL	BPT_BWS	785G	no	-	-	-	9.44	2.91	0.31	0.007	1.811	0.0017	1.911	7.64	2.35	0.25	0.007	1.838	0.0016	1.838	7.43	2.29	0.25	0.007	1.838	0.0016	1.838							
BPT (entrance) to BWS- S11 Hauler	BPT_BWS0	-	no	5.95	23.73	5.53	10.98	3.38	0.36	0.025	1.126	0.0041	1.126	8.65	2.67	0.29	0.024	2.071	0.0040	2.071	8.42	2.59	0.28	0.024	2.071	0.0040	2.071							
BPT (in pit) to LGO and TMR	BPT2_INPT	777G	yes	5.95	23.53	5.53	2.37	1.38	0.16	0.009	0.682	0.0013	0.682	1.63	0.95	0.11	0.009	0.052	0.00013	0.052	1.58	0.92	0.10	0.009	0.052	0.00013	0.052							
BPT (entrance) to TMR	BPT_TMR	777G	no	5.95	23.75	5.53	3.82	1.17	0.12	0.007	1.120	0.0010	0.117	2.86	0.88	0.09	0.009	0.127	0.00010	0.127	2.78	0.86	0.09	0.009	0.127	0.00010	0.127							
LGO-CRS-LVB-HWRS- 91 t Hauler	LPT_INPT_911	777G	yes	-	-	-	1.04	0.61	0.07	0.006	0.261	0.00068	0.261	0.60	0.35	0.04	0.006	0.087	0.00001	0.087	0.59	0.34	0.04	0.006	0.087	0.00001	0.087							
LPT (in pit) to LGO-CRS-LVB-HWRS- 1321 t Hauler	LPT_INPT_1321	785G	yes	-	-	-	7.19	4.20	0.47	0.007	1.903	0.0056	1.903	5.95	3.48	0.39	0.007	2.823	0.0054	2.823	5.79	3.38	0.38	0.007	2.823	0.0054	2.823							
LPT (in pit) to LGO-CRS-LVB-HWRS- TOTAL	LPT_INPT	-	yes	5.95	23.46	5.53	8.23	4.80	0.54	0.007	3.164	0.0061	3.164	6.56	3.83	0.43	0.006	3.111	0.0060	3.111	6.38	3.72	0.42	0.006	3.111	0.0060	3.111							
LPT (entrance) to LGO and CRS	LPT_LGO	777G	no	5.95	23.46	5.53	1.03	0.32	0.03	0.007	1.146	0.0008	0.144	0.36	0.11	0.01	0.007	0.142	0.00007	0.142	0.35	0.11	0.01	0.007	0.142	0.00007	0.142							
LGO to CS	LPT_CS	777G	no	5.95	23.68	5.53	0.61	0.19	0.02	0.006	1.888	0.00017	0.088	0.29	0.09	0.01	0.006	0.088	0.00001	0.088	0.28	0.09	0.01	0.006	0.088	0.00001	0.088							
LPT (entrance) to LWRS- 91 t Hauler	LPT_LW91	777G	no	5.95	23.75	5.53	0.42	0.13	0.01	0.004	0.759	0.00011	0.019	0.24	0.07	0.01	0.004	0.019	0.00001	0.019	0.24	0.07	0.01	0.004	0.019	0.00001	0.019							
LPT (entrance) to LWRS- 1321 t Hauler	LPT_LW91	777G	no	-	-	-	0.59	0.18	0.02	0.004	0.881	0.00016	0.081	0.47	0.15	0.02	0.004	0.082	0.00001	0.082	0.46	0.14	0.01	0.004	0.082	0.00001	0.082							
LPT (entrance) to LWRS- 1321 Hauler	LPT_LW91_1321	785G	no	-	-	-	10.18	3.13	0.33	0.005	2.060	0.00040	2.060	8.43	2.60	0.28	0.005	2.004	0.00038	2.004	8.20	2.53	0.27	0.005	2.004	0.00038	2.004							
LPT (entrance) to LWRS- TOTAL	LPT_LWRS	-	no	5.95	23.16	5.53	10.77	3.31	0.35	0.005	3.143	0.00041	3.143	8.90	2.74	0.30	0.004	2.085	0.00040	2.085	8.66	2.67	0.29	0.004	2.085	0.00040	2.085							
CS-BMGLGH-MOVHS-MWRS- 91 t Hauler	MPT_INPT_911	777G	yes	-	-	-	3.93	2.29	0.25	0.005	1.099	0.00021	1.099	2.79	1.63	0.18	0.005	1.083	0.00021	1.083	2.71	1.58	0.18	0.005	1.083	0.00021	1.083							
MPT (in pit) to CS-BMGLGH-MOVHS-MWRS- 1321 Hauler	MPT_INPT_1321	785G	yes	-	-	-	7.04	4.11	0.46	0.005	2.844	0.00015	2.844	5.70	3.33	0.38	0.005	2.786	0.00013	2.786	5.55	3.24	0.37	0.005	2.786	0.00013	2.786							
MPT (in pit) to CS-BMGLGH-MOVHS-MWRS- TOTAL	MPT_INPT	-	yes	5.95	23.65	5.53	10.97	6.40	0.71	0.004	3.943	0.00076	3.943	8.49	4.96	0.56	0.004	3.869	0.00074	3.869	8.26	4.82	0.54	0.004	3.869	0.00074	3.869							
MPT (entrance) to MOVH + CRS	MPT_MOVH	777G	no	5.95	23.25	5.53	1.34	0.41	0.04	0.007	1.188	0.00019	0.140	0.66	0.20	0.02	0.006	0.180	0.00001	0.180	0.64	0.20	0.02	0.006	0.180	0.00001	0.180							
MOVH to BWS	MPT_BWS	777G	no	5.95	23.40	5.53	0.48	0.15	0.02	0.006	1.828	0.00011	0.088	0.23	0.07	0.01	0.006	0.088	0.00001	0.088	0.31	0.06	0.01	0.006	0.088	0.00001	0.088							
BMGLGH to HGO + CS	MOVH_HGO	777G	no	5.95	23.48	5.53	1.30	0.40	0.04	0.007	0.987	0.00019	0.140	0.57	0.18	0.02	0.006	0.178	0.00001	0.178	0.55	0.17	0.02	0.006	0.178	0.00001	0.178							
MPT (entrance) to MWRS- 91 t Hauler	MPT_MW91	777G	no	-	-	-	2.44	0.75	0.08	0.006	0.342	0.00006	0.342	2.04	0.63	0.07	0.006	0.137	0.00001	0.137	1.98	0.61	0.06	0.006	0.137	0.00001	0.137							
MPT (entrance) to MWRS- 1321 Hauler	MPT_MW1321	785G	no	-	-	-	6.88	2.12	0.23	0.006	1.380	0.00017	0.140	5.57	1.71	0.19	0.006	1.353	0.00016	1.353	5.41	1.67	0.18	0.006	1.353	0.00016	1.353							
MPT (entrance) to MWRS- TOTAL	MPT_MWRS	-	no	5.95	22.93	5.53	9.32	2.87	0.30	0.006	1.721	0.00013	1.721	7.60	2.34	0.25	0.006	1.491	0.00013	1.491	7.39	2.28	0.25	0.006	1.491	0.00013	1.491							
HGO + MPT to CS	HGO_CS	777G	no	5.95	22.21	5.53	0.58	0.18	0.02	0.006	2.043	0.00007	0.203	0.30	0.09	0.01	0.006	0.203	0.00001	0.203	0.29	0.09	0.01	0.006	0.203	0.00001	0.203							
TOTAL	TOTAL	-					72.13	30.31	3.30	0.212	18.40	0.035	18.40	56.93	29.28	3.58	0.207	17.96	0.03	17.96	53.55	27.65	2.91	0.207	17.96	0.03	17.96							

Mobile Equipment Release Estimates

Air contaminant releases from combustion of fuel in large mobile equipment are estimated based on fuel consumption and operational information provided by Marathon Gold and published emission factors (from the US EPA/Canada CEPA Tiered Emission Standards for Off-Road Heavy Duty Diesel Engines).

Releases are estimated for combustion products (NOx, SO2, CO and Dust - including TSP, PM10 and PM2.5).

Sources consuming >50L/hr fuel are included in the dispersion model and estimated in this sheet. Other smaller mobile sources (including smaller equipment and passenger vehicles) are not modelled as the expected air contaminant releases are not likely to contribute substantially to ground-level concentrations outside Project area, given the large property area.

Mobile equipment are represented in the model at a fixed location assumed based on site plan drawings provided by Marathon Gold. Releases are modelled as maximum hourly, daily and annual rates, based on the expected hours of operation for each piece of equipment and number of equipment operating simultaneously (which are assumed by Stantec as the whole fleet). In some cases (for the drill, loader and excavator defined below) the daily estimated release rates (scaled/pro-rated hourly rates based on provided hours of operation per day) are lower than the annual rates (in g/s - converted from the 1/4 estimates), which may be a result of the assumption that the entire fleet operates simultaneously leading to lower emissions from individual sources as the annual release estimates are based on the expected total annual hours of operation for each equipment type. In these cases the daily emissions in g/s are assumed to be consistent with the annual g/s emission rates. This is assumed in absence of a detailed breakdown of the annual operating hours and max number of equipment operating simultaneously, which would be needed to estimate the actual daily maximum emissions rates for the drill, loader and excavator.

Since a portion of the PM (TSP, PM10, PM2.5) will not leave the pit (due to settling) retention factors are applied to sources below the surface within the pit.

The retention factors applied are from the Australian National Pollutant Release Inventory Emission Estimation Technique Manual for Mining - Wings equation 1981 based on 50 m pit depth.

Exhaust gas properties (temperature and velocity) and stack dimensions (heights and diameters) are assumed/estimated (by Stantec) based on similar equipment specification and previous experience.

Emission Factors - Diesel Fuel

US EPA/Canada CEPA Tier 1, 2, 3 and 4 NOx, CO and PM Emission Standards for Off-Road Heavy-Duty Diesel Engines

Engine Power (hp)	Tier	Model Year	Emission Factors (g/hp-hr)			BSFC (lb/hp-hr)	Emission Factors (g/hp-hr)	
			NO _x *	CO	TSP		SO ₂	
			10102-44-0	630-08-0	N/A-1		7446-09-5	
2100 to <175	Tier 1	1997-2000	6.9	-	-	0.367	4.99E-03	
	Tier 2	2003-2006	4.5	3.7	0.22		4.99E-03	
	Tier 3	2007-2011	2.8	3.7	0.22		4.99E-03	
	Tier 4 transitional	2012-2013	0.3	-	0.01		4.99E-03	
175 to <300	Tier 4 final	2014+	0.3	2.6	0.01	0.367	4.99E-03	
	Tier 1	1996-2000	6.9	8.5	0.4		4.99E-03	
	Tier 2	2003-2005	4.5	2.6	0.15		4.99E-03	
	Tier 3	2006-2010	2.8	2.6	0.15		4.99E-03	
175 to <600	Tier 4 transitional	2011-2013	0.3	2.6	0.01	0.367	4.99E-03	
	Tier 4 final	2014+	0.3	2.6	0.01		4.99E-03	
	Tier 1	1996-2000	6.9	8.5	0.4		4.99E-03	
	Tier 2	2003-2005	4.5	2.6	0.15		4.99E-03	
300 to <750	Tier 3	2006-2010	2.8	2.6	0.15	0.367	4.99E-03	
	Tier 4 transitional	2011-2013	0.3	2.6	0.01		4.99E-03	
	Tier 4 final	2014+	0.3	2.6	0.01		4.99E-03	
	Tier 1	1996-2000	6.9	8.5	0.4		4.99E-03	
600 to <750	Tier 2	2003-2005	4.5	2.6	0.15	0.367	4.99E-03	
	Tier 3	2006-2010	2.8	2.6	0.15		4.99E-03	
	Tier 4 transitional	2011-2013	0.3	2.6	0.01		4.99E-03	
	Tier 4 final	2014+	0.3	2.6	0.01		4.99E-03	

NOTES:

* = not available

SOURCES:

[29] Canadian Off-Road Compression-Ignition Engine Emission Regulations (ECCC, 2005) Canadian Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (ECCC, 2020)

[30] Nonroad Compression-Ignition Engines - Exhaust Emission Standards (US EPA, 2016a)

* Particulate from diesel combustion assumed to be <1 um

Diesel HHV 0.137 MMBTU/gal from US EPA AP-42 Appendix A Misc. Data and Conversion Factors
 Diesel S Content 0.0015 %
 Assumed Diesel Engine thermal efficiency 0.4 https://www.sciencedirect.com/topics/engineering/engine-thermal-efficiency

(Table 3.3-1 Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines and Table 3.4-1 Gaseous Emission Factors for Large Stationary Diesel and All Stationary Dual-Fuel Engines)

Air Contaminant	CAS#	Uncontrolled EF (lb/MMBtu) *	
		Diesel Engines (AP-42 Ch 3.1)	Large Diesel Engines (AP-42 Ch 3.4)
NOX	10102-44-0	4.41	3.2
SO2	7446-09-5	0.29	0.001515
CO	630-08-0	0.95	0.85
TSP	N/A-1	0.31	0.1
PM10	N/A-2	0.31	0.1
PM2.5	N/A-3	0.31	0.1

Particulate Matter PM Retention Factors

TSP	0.5
PM10	0.05
PM2.5	0.005

PM2.5 factor applied since diesel PM is assumed to be PM1

Inna Yankova, April 2022:

The emission calculation from the NONROAD technical documentation includes a "Load Factor" for each equipment type. Updated the SO2 emission factor using the equation from the NONROAD model technical documentation. Corrected the annual average emission rates.

Nonroad Technical Reports | US EPA
 Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, Report No. NR-005d (EPA420-R-10-016) (July 2010)

This report documents the default annual activity, load factor, and median life values. The model uses the following equation to calculate exhaust emissions from nonroad engines. The derivation of default values for equipment population, average rated power, and emission factors are discussed in reports NR-006c, NR-009a, and NR-010F.

$$Emissions = (P_{pop}) \times (Power) \times (LF) \times (k) \times (EF)$$

where P_{pop} = Engine Population
 Power = Average Power (hp)
 LF = Load Factor (fraction of available power)
 k = Activity (hr/yr)
 EF = Emission Factor (g/hp-hr)

$$SO_2 = (BSFC * 453.6 * (1 - moisture) * HC) * 0.01 * 10000 * 2 \quad [Equation 7]$$

where SO₂ is in g/hp-hr
 BSFC is the in-use adjusted fuel consumption in lb/hp-hr
 453.6 is the conversion factor from pounds to grams
 moisture is the fraction of fuel sulfur converted to direct PM
 HC is the in-use adjusted hydrocarbon emissions in g/hp-hr
 0.01 is the conversion factor from weight percent to weight fraction
 10000 is the equidistant weight percent of sulfur in nonroad diesel fuel

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2 is the grams of SO₂ formed from 1 gram of sulfur

Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition, Report No. NR-009d IE

Equipment List

Equipment	Function	Modelled Location Stantec Assumed	Fuel Consumption gal/hr	Heat from Fuel Combustion		Assumed Output Power hp	Number of Equipment		Operating Hours/yr *	Assumed per unit Operating Hours/day	Load Factors	Notes
				MMBTU/hr	hp		Total	Operating Simultaneously				
Rotary Drill, Tracked, 200 mm diameter	Production Drilling	2 - berry pit 1 - leprechaun pit 1 - marathon pit	27.8	3.81	1494	598	-	4	24,380	17	43%	https://www.cat.com/en_MX/products/new/equipment/drills/rotary-drills/134294315741.html
DTH Drill, Tracked, 144 mm diameter	Production Drilling	1 - berry pit 2 - leprechaun pit 1 - marathon pit	13.2	1.81	712	285	-	4	19,089	14	43%	https://www.rockdrillsales.com/fulpage/uploads/files/dth%20equipment.pdf
RC Drill, Tracked, 144mm diameter	Grade Control (RC) Drilling	1 in each pit	13.2	1.81	712	285	-	3	3,125	3	43%	https://www.rockdrillsales.com/fulpage/uploads/files/dth%20equipment.pdf
Wheel Loader, 13 m3 bucket	Production Loading, Crusher Loading	1 - berry pit 1 - leprechaun pit	30.4	4.17	1637	973	-	2	8,729	12	48%	Exhaust dimensions approximated and net engine power based on CAT Large Wheel Loader 993K (https://www.cat.com/en_US/products/new/equipment/wheel-loaders/large-wheel-loaders/18366798.html)
Hydraulic Excavator, 15 m3 bucket	Production Loading	1 in each pit	48.9	6.71	2633	1530	-	3	17,461	16	53%	Exhaust dimensions approximated and net engine power based on CAT 6030 Hydraulic Shovel (https://1742.scene7.com/is/content/Caterpillar/C825901)
Hydraulic Excavator, 12 m3 bucket	Production Loading	1 - leprechaun pit 1 - marathon pit	34.4	4.71	1850	1086	-	4	19,663	14	53%	Exhaust dimensions approximated and gross engine power based on Hitachi EX1900 (https://www.hitachiconstruction.com/wp-content/uploads/2016/02/DKEX1900HT_16-01.pdf)
Rigid Fram Hauler, 132 t payload	Hauling Waste	along haul routes	41.3	5.65	2320	1450	-	23	132,780	17	59%	Exhaust dimensions approximated and gross engine power based on CAT 785G Haul Truck (https://www.finning.com/en_CA/products/new/equipment/off-highway-trucks/mining-trucks/1000033348.html)
Rigid Fram Hauler, 91t payload	Hauling Ore and Waste	along haul routes	26.5	3.62	1423	925	-	11	59,360	15	59%	Exhaust dimensions approximated and net engine power based on CAT 777G Haul Truck (https://www.cat.com/en_US/products/new/equipment/off-highway-trucks/off-highway-trucks/18265926.html)
Track Dozer, 447 kW	Waste Dump Maintenance	1 in each pit	22.5	3.08	1210	599	-	3	12,726	12	59%	Exhaust dimensions approximated based on CATD10 447kW Dozer
Track Dozer, 325 kW	Pit Support	1 - berry pit 1 - leprechaun pit	15.9	2.17	854	436	-	2	10,790	15	59%	Exhaust dimensions approximated based on CATD9 325kW Dozer
Wheel Dozer, 370 kW	Pit Support	1 - berry pit 1 - marathon pit	17.2	2.36	925	496	-	2	6,474	9	59%	Exhaust dimensions approximated based on CAT834K Wheel Dozer (https://www.finning.com/en_CA/products/new/equipment/dozers/wheel-dozers/18483684.html)

* Haul truck hours of operation are based on Year 6 (from Haul Road Usage worksheet) and other equipment is based Y3 (from Mine Mobile worksheet)

Release Estimates

Hourly (per source)

Parameter	Number of Sources Operating Simultaneously	Stack Height m	Base Elevation m	Stack Diameter m	Velocity m/s	Temperature K	Emission Rates (g/s)					
							TSP N/A-1	PM10 N/A-2	PM2.5 N/A-3	NOX 10102-44-0	SO2 7446-09-5	CO 630-08-0
Rotary Drill, Tracked, 200 mm diameter	4	3.0	See Lakes worksheet	0.152	20	723.15	7.10E-04	7.10E-04	7.10E-04	0.0214	0.0004	0.186
DTH Drill, Tracked, 144 mm diameter	4	2.0		0.102	20	723.15	3.38E-04	3.38E-04	3.38E-04	0.0102	0.0002	0.088
RC Drill, Tracked, 144mm diameter	3	2.0		0.102	20	723.15	3.38E-04	3.38E-04	3.38E-04	0.0102	0.0002	0.088
Wheel Loader, 13 m3 bucket	2	5.0		0.254	20	723.15	3.87E-03	3.87E-03	3.87E-03	0.337	0.0006	0.337
Hydraulic Excavator, 15 m3 bucket	3	5.0		0.508	20	723.15	6.72E-03	6.72E-03	6.72E-03	0.586	0.0011	0.586
Hydraulic Excavator, 12 m3 bucket	4	6.4		0.457	20	723.15	4.77E-03	4.77E-03	4.77E-03	0.416	0.0008	0.416
Rigid Fram Hauler, 132 t payload	22	3.5		0.356	20	723.15	7.13E-03	7.13E-03	7.13E-03	0.618	0.0012	0.618
Rigid Fram Hauler, 91t payload	11	3.0		0.254	20	723.15	5.08E-03	5.08E-03	5.08E-03	0.437	0.0009	0.437
Track Dozer, 447 kW	3	5.0		0.305	20	723.15	9.83E-04	9.83E-04	9.83E-04	0.029	0.0005	0.255
Track Dozer, 325 kW	2	3.0		0.203	20	723.15	7.11E-04	7.11E-04	7.11E-04	0.0214	0.0004	0.186
Wheel Dozer, 370 kW	2	3.0		0.203	20	723.15	8.09E-04	8.09E-04	8.09E-04	0.0244	0.0004	0.211
							0.058	0.058	0.058	4.431	0.013	7.016

Daily (per source)

Parameter	Number of Sources Operating Simultaneously	Stack Height m	Base Elevation m	Stack Diameter m	Velocity m/s	Temperature K	Emission Rates (g/s)					
							TSP N/A-1	PM10 N/A-2	PM2.5 N/A-3	NOX 10102-44-0	SO2 7446-09-5	CO 630-08-0
Rotary Drill, Tracked, 200 mm diameter	4	3.0	See Lakes worksheet	0.152	20	723.15	6.98E-04	6.98E-04	6.98E-04	0.021	0.0004	0.182
DTH Drill, Tracked, 144 mm diameter	4	2.0		0.102	20	723.15	3.16E-04	3.16E-04	3.16E-04	0.010	0.0002	0.083
RC Drill, Tracked, 144mm diameter	3	2.0		0.102	20	723.15	3.22E-04	3.22E-04	3.22E-04	0.010	0.0002	0.084
Wheel Loader, 13 m3 bucket	2	5.0		0.254	20	723.15	3.86E-03	3.86E-03	3.86E-03	0.336	0.001	0.336
Hydraulic Excavator, 15 m3 bucket	3	5.0		0.508	20	723.15	6.70E-03	6.70E-03	6.70E-03	0.584	0.001	0.584
Hydraulic Excavator, 12 m3 bucket	4	6.4		0.457	20	723.15	4.59E-03	4.59E-03	4.59E-03	0.400	0.001	0.400
Rigid Fram Hauler, 132 t payload	22	3.5		0.356	20	723.15	6.93E-03	6.93E-03	6.93E-03	0.601	0.001	0.601
Rigid Fram Hauler, 91t payload	11	3.0		0.254	20	723.15	4.97E-03	4.97E-03	4.97E-03	0.430	0.001	0.430
Track Dozer, 447 kW	3	5.0		0.305	20	723.15	9.51E-04	9.51E-04	9.51E-04	0.029	0.0005	0.247
Track Dozer, 325 kW	2	3.0		0.203	20	723.15	7.00E-04	7.00E-04	7.00E-04	0.021	0.0004	0.183
Wheel Dozer, 370 kW	2	3.0		0.203	20	723.15	7.97E-04	7.97E-04	7.97E-04	0.024	0.0004	0.208
							0.057	0.057	0.057	4.350	0.013	6.859

Annual (per source)

Parameter	Number of Sources Operating	Stack Height m	Base Elevation m	Stack Diameter m	Velocity m/s	Temperature K	Emission Rates (g/s)					
							TSP N/A-1	PM10 N/A-2	PM2.5 N/A-3	NOX 10102-44-0	SO2 7446-09-5	CO 630-08-0
Rotary Drill, Tracked, 200 mm diameter	4	3.0	See Lakes worksheet	0.152	20	723.15	6.98E-04	6.98E-04	6.98E-04	0.0210	0.0004	0.182
DTH Drill, Tracked, 144 mm diameter	4	2.0		0.102	20	723.15	3.16E-04	3.16E-04	3.16E-04	0.0095	0.0002	0.083
RC Drill, Tracked, 144mm diameter	3	2.0		0.102	20	723.15	3.22E-04	3.22E-04	3.22E-04	0.0097	0.0002	0.084
Wheel Loader, 13 m3 bucket	2	5.0		0.254	20	723.15	3.86E-03	3.86E-03	3.86E-03	0.336	0.001	0.336
Hydraulic Excavator, 15 m3 bucket	3	5.0		0.508	20	723.15	6.70E-03	6.70E-03	6.70E-03	0.584	0.001	0.584
Hydraulic Excavator, 12 m3 bucket	4	6.4		0.457	20	723.15	4.59E-03	4.59E-03	4.59E-03	0.400	0.001	0.400
Rigid Fram Hauler, 132 t payload	22	3.5		0.356	20	723.15	6.93E-03	6.93E-03	6.93E-03	0.601	0.001	0.601
Rigid Fram Hauler, 91t payload	11	3.0		0.254	20	723.15	4.97E-03	4.97E-03	4.97E-03	0.430	0.001	0.430
Track Dozer, 447 kW	3	5.0		0.305	20	723.15	9.51E-04	9.51E-04	9.51E-04	0.0295	0.0005	0.247
Track Dozer, 325 kW	2	3.0		0.203	20	723.15	7.00E-04	7.00E-04	7.00E-04	0.0211	0.0004	0.183
Wheel Dozer, 370 kW	2	3.0		0.203	20	723.15	7.97E-04	7.97E-04	7.97E-04	0.0240E-02	0.0004	0.208E-01
							0.057	0.057	0.057	4.350	0.013	6.859

Total Annual Emissions

Air Contaminant	CAS#	Rotary Drill, Tracked, 200 mm diameter	DTH Drill, Tracked, 144 mm diameter	RC Drill, Tracked, 144mm diameter	Wheel Loader, 13 m3 bucket	Hydraulic Excavator, 15 m3 bucket	Hydraulic Excavator, 12 m3 bucket	Rigid Fram Hauler, 132 t payload	Rigid Fram Hauler, 91t payload	Track Dozer, 447 kW	Track Dozer, 325 kW	Wheel Dozer, 370 kW	TOTAL
TSP	N/A-1	0.062	0.023	0.004	0.122	0.423	0.338	3.41	1.08	0.0450	0.0276	0.0189	5.47
PM10	N/A-2	0.062	0.023	0.004	0.122	0.423	0.338	3.41	1.08	0.0450	0.0276	0.0189	5.47
PM2.5	N/A-3	0.062	0.023	0.004	0.122	0.423	0.338	3.41	1.08	0.0450	0.0276	0.0189	5.47
NOX	10102-44-0	1.88	0.70	0.11	10.6	36.8	29.4	295	93.3	1.35	0.83	0.57	469
SO2	7446-09-5	0.013	0.013	0.0016	0.030	0.07	0.067	0.67	0.19	0.012	0.0026	0.0026	0.94
CO	630-08-0	16.3	6.1	1.0	10.6	36.8	29.4	295	93.3	11.7	7.2	4.9	492

Daily/Annual Max Emissions

Source	Source ID	Operating Schedule hrs/day	Exhaust Flow m³/s	Location (m)		Adjusted Height - height of building (h=0.3 m)* m	Frosted Stack Height m	Base Elevation m	Stack Diameter m	Velocity m/s	Temperature °C	Emission Rates (g/s)																														
				UTM X	UTM Y							TSP	PM10	PM2.5	NOx	SO2	CO	HCl	H2S	Ac	Cd	Cu	Pb	Hg	Zn	Ba	Sr	Be	Cobalt	Li	Sb	Sn	Se	Cr	Bi							
Acid wash exhaust fan	AW_EFH	4	0.89	See model input worksheet		NA	10.00	380	0.30	12.50	288.15	0.09	0.074	0.029	
Claw dust fan	CD_FAN	4	0.28	See model input worksheet		baghouse	8.78	380	0.15	16.01	288.15	0.028	0.028	0.028	
Sodium cyanide dust fan	NaCN_FAN	4	0.28	See model input worksheet		baghouse	8.75	380	0.15	16.01	288.15	0.028	0.028	0.028	
Copper sulphate exhaust fan	CS_FAN	4	0.28	See model input worksheet		baghouse	8.82	380	0.15	16.01	288.15	0.028	0.028	0.028	
Sodium metabisulphite exhaust fan	MSMBS_FAN	4	0.28	See model input worksheet		baghouse	8.02	380	0.15	16.01	288.15	0.028	0.028	0.028	
PAX exhaust fan	PAX_FAN	24	0.29	See model input worksheet		baghouse	8.91	380	0.15	16.01	288.15	0.17	0.17	0.17	
Line via baghouse fan	LHF_FAN	24	0.79	See model input worksheet		baghouse	11.75	380	0.15	16.01	288.15	0.17	0.17	0.17		
Drying oven extraction fan	DROVEN	12	0.60	See model input worksheet		NA	4.54	380	0.30	8.49	323.15	0.060	0.060	0.060		
Drying oven extraction fan	DUOVEN	16	0.60	See model input worksheet		baghouse	9.49	380	0.30	8.49	323.15	0.060	0.060	0.060		
Claw extraction fan	CD_FAN	16	0.60	See model input worksheet		baghouse	9.49	380	0.30	8.49	323.15	0.060	0.060	0.060		
Barrying Furnace Exhaust Stack	BARFURN	4	1.78	See model input worksheet		baghouse	10.00	380	0.66	11.00	353.15	0.13	0.13	0.13		
Stockpile Ventilation Fan	SP_FAN	24	5.19	See model input worksheet		NA	13.00	380	0.66	15.30	368.15	3.12	2.59	1.09		
Carbon Regeneration Kbin	COREGEN	16	0.60	See model input worksheet		NA	7.09	380	0.30	8.50	288.15	0.060	0.066	0.024	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total											4.08	3.82	1.84	0.60	0.60	0.60	1.49	0.07	2.06E-05	2.50E-06	3.06E-04	8.86E-05	1.75E-05	2.88E-05	1.01E-04	6.76E-05	1.11E-04	4.29E-07	8.80E-05	5.77E-05	6.26E-05	9.67E-05	8.22E-05	1.41E-04	2.85E-05							

Annual Emissions (t/d)

Source	TSP	PM10	PM2.5	NOx	SO2	CO	HCl	H2S	Ac	Cd	Cu	Pb	Hg	Zn	Ba	Sr	Be	Cobalt	Li	Sb	Sn	Se	Cr	Bi	
	N/A-1	N/A-2	N/A-3	10102.44.0	7446.09.5	630.08.0	74.90.8	7664.41.7	7440.38.2	7440.43.9	7440.50.8	7439.92.1	7439.97.6	7440.02.0	7440.46.6	7440.39.1	7440.24.6	7440.41.7	7440.48.4	7439.93.2	7440.36.0	7440.31.5	7782.49.2	7440.47.3	7440.69.9
Acid wash exhaust fan	3.81	3.32	0.936	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Claw dust fan	0.892	0.892	0.892	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sodium cyanide dust fan	0.892	0.892	0.892	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Copper sulphate exhaust fan	0.892	0.892	0.892	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sodium metabisulphite exhaust fan	0.892	0.892	0.892	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PAX exhaust fan	5.19	5.19	5.19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Line via baghouse fan	1.89	1.52	0.42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Drying oven extraction fan	2.52	2.52	2.52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Drying oven extraction fan	2.52	2.52	2.52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Claw extraction fan	3.81	3.81	3.81	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Barrying Furnace Exhaust Stack	0.3	0.3	0.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Stockpile Ventilation Fan	9.8	9.8	3.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Carbon Regeneration Kbin	2.52	2.09	0.83	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	22.9	13.1	5.81				49.4	2.35	9.4E-04	2.9E-05	0.7E-03	2.7E-03	5.5E-04	8.5E-04	3.2E-03	2.8E-03	3.6E-03	1.4E-03	1.2E-03	1.8E-03	3.0E-03	2.7E-03	4.6E-03	9.6E-04	

* The AW_EFH and NACN_FAN locations confirmed and release heights were increased to be above the building heights, by 0.3 m, based on discussion with Ausenco (design engineer Jarro Drelich) on July 22, 2020. During the discussion the adjacent building heights were confirmed and the release points would range between 0.3 to 0.5 m above the roof.

2023 Updated Emissions Info

Source	Emissions (tpy)		
	PM 2.5 (tpy)	NO _x	SO ₂
Carbon Regeneration Kiln - W/ Hg Abatement	0.375	2,006.03	NA
Carbon Regeneration Kiln - with Hg Abatement	0.001	2,006.03	1,706.05
Carbon Regeneration Kiln - Orig EIS Eit (Hrly)	0.432	0	9,016.05
Carbon Regeneration Kiln - Orig EIS Est (24hrs daily)	0.260	0	6,016.05
Melt Furnace Exhaust - W/ Control	2.5	NA	NA
Melt Furnace Exhaust - with Control	0.25	NA	NA
Baring Furnace - Orig EIS Est (Hrly)	2.72	0	5,676.07
Baring Furnace - Orig EIS Est (24hrs daily)	0.45	0	9,456.08
Electrowinning Exhaust Emission	NA	0.4	NA
Electrowinning Extraction Fan - Orig EIS (Hrly)	0.43	0.20	9,006.08
Electrowinning Extraction Fan - Orig EIS (24hrs daily)	0.26	0.13	6,006.08
ICU Electrowinning Extraction Fan - Orig EIS (Hrly)	0.43	0.20	9,006.08
ICU Electrowinning Extraction Fan - Orig EIS (24hrs daily)	0.26	0.13	6,006.08

System DataSheet			FLSMIDTH
Unit	Unit Purpose (Plant Location) (Component)	Assigned Number	LEAD (1/2018-2021)
System	Assigned (APP) Carbon Unit	Date Number	89797621
Code	Unit	NO _x	SO ₂
0	NO _x	NO _x	SO ₂
Design Information & Data			
0-0000	Unit Information	NO _x	SO ₂
0-0000	Unit Description	NO _x	SO ₂
0-0000	Unit Name	NO _x	SO ₂
0-0000	Unit Capacity	NO _x	SO ₂
0-0000	Unit Location	NO _x	SO ₂
0-0000	Unit Status	NO _x	SO ₂
0-0000	Unit Operator	NO _x	SO ₂
0-0000	Unit Type	NO _x	SO ₂
0-0000	Unit Material	NO _x	SO ₂
0-0000	Unit Fuel	NO _x	SO ₂
0-0000	Unit Efficiency	NO _x	SO ₂
0-0000	Unit Emission Factor	NO _x	SO ₂
0-0000	Unit Operating Hours	NO _x	SO ₂
0-0000	Unit Operating Days	NO _x	SO ₂
0-0000	Unit Operating Shifts	NO _x	SO ₂
0-0000	Unit Operating Mode	NO _x	SO ₂
0-0000	Unit Operating Status	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂
0-0000	Unit Operating Date	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂

Note: 1. Emissions subject to be updated with confirmation of availability of kg document source documents needed to be updated with confirmation of availability of kg document source

System DataSheet			FLSMIDTH
Unit	Unit Purpose (Plant Location) (Component)	Assigned Number	LEAD (1/2018-2021)
System	Assigned (APP) Carbon Unit	Date Number	89797621
Code	Unit	NO _x	SO ₂
0	NO _x	NO _x	SO ₂
Design Information & Data			
0-0000	Unit Information	NO _x	SO ₂
0-0000	Unit Description	NO _x	SO ₂
0-0000	Unit Name	NO _x	SO ₂
0-0000	Unit Capacity	NO _x	SO ₂
0-0000	Unit Location	NO _x	SO ₂
0-0000	Unit Status	NO _x	SO ₂
0-0000	Unit Operator	NO _x	SO ₂
0-0000	Unit Type	NO _x	SO ₂
0-0000	Unit Material	NO _x	SO ₂
0-0000	Unit Fuel	NO _x	SO ₂
0-0000	Unit Efficiency	NO _x	SO ₂
0-0000	Unit Emission Factor	NO _x	SO ₂
0-0000	Unit Operating Hours	NO _x	SO ₂
0-0000	Unit Operating Days	NO _x	SO ₂
0-0000	Unit Operating Shifts	NO _x	SO ₂
0-0000	Unit Operating Mode	NO _x	SO ₂
0-0000	Unit Operating Status	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂
0-0000	Unit Operating Date	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂

Note: 1. Emissions subject to be updated with confirmation of availability of kg document source

System DataSheet			FLSMIDTH
Unit	Unit Purpose (Plant Location) (Component)	Assigned Number	LEAD (1/2018-2021)
System	Assigned (APP) Carbon Unit	Date Number	89797621
Code	Unit	NO _x	SO ₂
0	NO _x	NO _x	SO ₂
Design Information & Data			
0-0000	Unit Information	NO _x	SO ₂
0-0000	Unit Description	NO _x	SO ₂
0-0000	Unit Name	NO _x	SO ₂
0-0000	Unit Capacity	NO _x	SO ₂
0-0000	Unit Location	NO _x	SO ₂
0-0000	Unit Status	NO _x	SO ₂
0-0000	Unit Operator	NO _x	SO ₂
0-0000	Unit Type	NO _x	SO ₂
0-0000	Unit Material	NO _x	SO ₂
0-0000	Unit Fuel	NO _x	SO ₂
0-0000	Unit Efficiency	NO _x	SO ₂
0-0000	Unit Emission Factor	NO _x	SO ₂
0-0000	Unit Operating Hours	NO _x	SO ₂
0-0000	Unit Operating Days	NO _x	SO ₂
0-0000	Unit Operating Shifts	NO _x	SO ₂
0-0000	Unit Operating Mode	NO _x	SO ₂
0-0000	Unit Operating Status	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂
0-0000	Unit Operating Date	NO _x	SO ₂
0-0000	Unit Operating Time	NO _x	SO ₂

Note: 1. Emissions subject to be updated with confirmation of availability of kg document source

Electrowinning Emissions

Dust, trace metals and ammonia emissions are expected from the electrowinning process. Dust and metals emissions are estimated in the "Processing Plant" worksheet, based on provided emissions info (from Marathon Gold) and provided ore specifications. Ammonia emissions are estimated using *Development and Selection of Ammonia Emission Factors* prepared for the USEPA by Battye, Battye, Overcash and Fudge, August 1994.

Emissions are estimated based on total ore processing rate. The NH3 emission rate is split between the two extraction fan exhausts serving the electrowinning process.

Ore processed 6800 t/day Y3 ore processing

Air Contaminant	CAS#	EF (kg/t)	Er (kg/hr)
Ammonia	7664-41-7	0.029	8.22

Carbon-in-Leach Circuit Emissions

Releases of HCN are expected from the CIL tanks due to volatilization of the HCN. Emissions of cyanide are expected to be released from the CIL tanks and HIC. Emissions are estimated based on the assumption that 1% of the total cyanide added to the circuit is lost through HCN volatilization, as presented in the Australian Government National Pollution Inventory (NPI) guide for gold ore processing (2006), referenced from Heath, et al. A method for measuring HCN(g) emissions from CIP/CIL tanks. 1998.

Emissions are assumed to be released from the Sodium cyanide dust fan exhaust.

NaCN consumed in CIL circuit	23.4	t/d
Operating time per day	4.0	hours

provided by Marathon Gold [1]

provided by Marathon Gold [1]

NaCN MW	49.01	kg/kgmol
HCN MW	27.03	kg/kgmol
volatilization of HCN	1	%

HCN Releases

Air Contaminants	CAS#	Er (kg/hr)
HCN	74-90-8	32.27

Carbon Regeneration Kiln Emissions

In addition to the dust (and trace metals within the dust) released from the kiln, mercury bound to the spent carbon is released in the kiln.

The mercury concentration from the provided heap leach/ore specification is in the calculation in absence of specific concentrations within the spent carbon.

The kiln is heated electrically, therefore, no combustion products are generated/released.

Kiln processing rate	300	kg/hr
Hg Concentration	0.3	ppm

Hg Releases	9.00E-05	kg/hr
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Tailings Management Facility (TMF) - Fugitive Release Estimates from Wind Erosion of Tailings Beaches

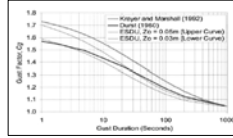
Fugitive releases of particulate matter and bound trace metals resulting from wind erosion of tailings beaches are estimated. Release estimates of particulate matter are estimated on an hourly basis using the approximate area of the tailings beaches at the end of year 3 of operation (as shown in the "Tailings Figures" worksheet), hourly CALMET predicted winds and precipitation for the Project site and published emission factors from the US EPA AP-42, Chapter 13.2.5 Industrial Wind Erosion. Trace metal releases are estimated using the TSP release estimates and the combined heap leach specification (for Marathon and Leprechaun pits) as well as tailings composition for the Berry pit.

The maximum hourly, daily and annual average emissions are estimated using the hourly release estimates to include in the dispersion model. Additionally, wind speed (WSF) emission scale factors are used in the model for consideration of hourly variable releases, where emissions only occur when wind speeds exceed the minimum threshold velocity resulting in fugitive releases from the TMF beach area.

Estimated TMF beach area = 220,431 m²

estimated based on TMF Figures (end of Year 3), see Tailings Figures worksheet and discussions with Marathon Gold - 50% of area (for end of year) is assumed wet at a given time. Area calculated using Figures and Lakes Environmental AERMOD/View Software

The Fastest Mile Wind is higher than the average hourly wind speed. A correction factor of 1.26 corresponding to 40 s averaging period to correct the hourly wind speed based on the Durst Curve (wind speed variation with averaging period)



Emissions Estimates

Air Contaminant	CAS#	Maximum Emissions						Annual Emissions (t/a) (average 2017-2019)
		g/m ² /s			g/s			
		Hourly	Daily	Annual Average	Hourly	Daily	Annual Average	
TSP	N/A-1	6.19E-03	1.54E-03	6.09E-05	789	789	13.94	348
PM10	N/A-2	3.09E-03	1.78E-03	3.03E-05	393	393	6.67	174
PM2.5	N/A-3	4.54E-04	2.66E-04	4.54E-06	60.3	60.3	1.00	26.1
As	7440-38-2	6.61E-06	4.52E-06	7.64E-10	1.72E-02	9.96E-03	1.68E-04	4.96E-03
Cr	7440-43-9	5.29E-09	3.96E-09	5.17E-11	1.18E-03	6.74E-04	1.34E-05	3.62E-06
Cu	7440-50-8	1.10E-06	8.34E-07	1.07E-08	2.43E-03	1.42E-03	3.36E-03	9.16E-02
Pb	7439-92-1	1.13E-07	8.51E-08	1.0E-09	2.48E-02	1.44E-02	2.43E-04	6.32E-03
Ni	7440-01-6	1.44E-06	1.10E-06	1.31E-11	3.06E-04	1.71E-04	2.89E-06	7.83E-03
Ni	7440-02-5	1.41E-07	1.05E-07	1.28E-09	3.15E-03	1.89E-02	3.02E-04	7.99E-03
Zn	7440-66-6	2.78E-07	1.99E-07	2.79E-09	6.07E-02	3.51E-02	6.94E-04	1.93E-02
Ba	7440-39-2	4.94E-07	3.51E-07	4.34E-09	9.24E-02	5.23E-02	9.25E-04	2.44E-02
Sr	7440-24-6	3.10E-07	1.79E-07	1.83E-09	6.83E-02	3.95E-02	6.88E-04	1.74E-02
Ba	7440-41-7	9.81E-10	5.68E-10	9.60E-12	2.18E-04	1.25E-04	2.12E-06	5.91E-09
Coalt	7440-48-4	3.39E-08	1.96E-08	3.32E-10	7.48E-03	4.33E-03	7.92E-05	1.91E-03
Li	7439-93-2	8.07E-08	4.67E-08	7.89E-10	1.78E-02	1.03E-02	1.74E-04	4.53E-03
Mo	7440-39-6	8.46E-08	4.99E-08	8.71E-10	1.86E-02	1.08E-02	1.87E-04	4.78E-03
Co	7440-31-5	1.16E-07	7.44E-08	1.31E-09	2.92E-02	1.72E-02	3.02E-04	7.61E-03
W	7727-49-2	1.51E-07	8.99E-08	1.52E-09	3.41E-02	1.99E-02	3.31E-04	8.73E-03
Cr	7440-47-3	6.96E-07	4.93E-07	6.11E-09	1.51E-01	8.76E-01	1.58E-02	3.91E-02
B	7440-69-8	5.49E-08	3.13E-08	3.97E-10	1.21E-02	7.00E-03	1.18E-04	3.08E-03

CALPUFF Wind Speed Classes

Wind Speeds (m/s) used for defining upper bound of categories for emissions scale factors
 \$ upper bounds (m/s) are entered the 6th class has no upper limit (WCAT6)
 Default: VSC (RuM): 1.54, 3.09, 5.14, 8.23, 10.8 (10:8)
 Wind Speed Class: 1 2 3 4 5
 WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80
 Based on the minimum threshold wind speed, emissions are assumed to occur for wind speed classes 5 and 6 (based on CALPUFF model default WSCAT).

Based on information from previous work, 50% of the material is assumed below 10 um.
 Threshold friction velocity and roughness height is for scrapers on coal pile taken from AP 42, Table 13.2.5.2.
 This helps account for the crusting of the material.

Anemometer Height (m) = 10
 Threshold Friction Velocity u* (m/s) = 0.62
 Roughness Height (m) = 0.06
 TSP
 u* = 0.62
 u* = 0.62
 u* = 11.70
 u* = 5.29
 Threshold friction velocity
 Fastest Mile Wind
 Threshold hourly average wind speed
 Required Information Fields
 Values only calculated when Actual Friction Vel. (u*) is greater than threshold friction velocity u*
 No wind erosion occurs, therefore set to 0

Surface Area (m²) = 220,431.00
 Average Threshold Ws (M/s Threshold Ws (m/s)

13.616999626 1324 102
 0.285 1790 1789

The following table presents the hourly emission rates for the first month of the model, the remaining period is available upon request.

Date	Assumed Fastest Mile (hourly CALMET predicted winds)	Fastest Mile u* (m/s)	Actual Friction Velocity u* (m/s)	Erosion Potential P (g/m ² /s)	TPM Emission (g/m ² /s)	PM10 Emission (g/m ² /s)	PM2.5 Emission (g/m ² /s)	Emission Rate TPM Corrected for Precip (g/s)	Emission Rate PM10 Corrected for Precip (g/s)	Emission Rate PM2.5 Corrected for Precip (g/s)	Emission Flux TPM (g/m ² /s)	Emission Flux PM10 (g/m ² /s)	Emission Flux PM2.5 (g/m ² /s)	Precip occurring 1 non occurring 0
01/01/2017 00	4.393	5.29	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 05	4.393	5.29	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 10	4.497	6.30	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 15	4.59	7.39	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 20	4.514	5.45	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 25	4.605	5.05	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 30	3.724	4.69	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 35	3.52	4.44	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 40	3.566	4.22	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 45	3.662	3.95	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 50	3.666	4.62	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 55	4.862	6.53	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 00	5.839	6.98	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 05	6.634	8.11	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 10	6.14	7.75	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 15	6.219	7.89	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0
01/01/2017 20	6.526	8.22	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0

Daily Average Emissions

Date	Emissions (g/m ² /s)		
	TSP	PM10	PM2.5
1/1/2017	0.000123058	0.000061529	0.000020509
1/2/2017	0.000123058	0.000061529	0.000020509
1/3/2017	0.000123058	0.000061529	0.000020509
1/4/2017	0.000123058	0.000061529	0.000020509
1/5/2017	0.000123058	0.000061529	0.000020509
1/6/2017	0.000123058	0.000061529	0.000020509
1/7/2017	0.000123058	0.000061529	0.000020509
1/8/2017	0.000123058	0.000061529	0.000020509
1/9/2017	0.000123058	0.000061529	0.000020509
1/10/2017	0.000123058	0.000061529	0.000020509
1/11/2017	0.000123058	0.000061529	0.000020509
1/12/2017	0.000123058	0.000061529	0.000020509
1/13/2017	0.000123058	0.000061529	0.000020509
1/14/2017	0.000123058	0.000061529	0.000020509
1/15/2017	0.000123058	0.000061529	0.000020509
1/16/2017	0.000123058	0.000061529	0.000020509
1/17/2017	0.000123058	0.000061529	0.000020509
1/18/2017	0.000123058	0.000061529	0.000020509
1/19/2017	0.000123058	0.000061529	0.000020509
1/20/2017	0.000123058	0.000061529	0.000020509

Annual Average Emissions

Year	Emissions (g/m ² /s)		
	TSP	PM10	PM2.5
2017	0.000123058	0.000061529	0.000020509
2018	0.000123058	0.000061529	0.000020509
2019	0.000123058	0.000061529	0.000020509

Emissions in tonnes/hr
 TSP PM10 PM2.5
 0 0 0
 0 0 0
 0 0 0

Mobile Equipment considered in GHG Assessment
 from 2022 FS mine and cost estimate - Provided by Marathon Gold

		Peak Operations Year (2028)				
FLEET COST SUMMARY	FUNCTION	Hourly Fuel Burn (L/SMU)	Operating Simultaneously	Hours (SMU)	Total Fuel (L)	Assumed
						Operating Hours/day
Drilling						
Rotary Drill, Tracked, 200 mm diameter	Production Drilling	105	4	24,380	2,559,900	17
DTH Drill, Tracked, 144 mm diameter	Production Drilling	50	4	19,089	954,450	14
RC Drill, Tracked, 144mm diameter	Grade Control (RC) Drilling	50	3	3,125	156,250	3
Loading						
Wheel Loader, 13 m ³ bucket	Production Loading, Crusher Loading	115	2	8,729	1,003,835	12
Hydraulic Excavator, 12 m ³ bucket	Production Loading	130	4	19,663	2,556,190	14
Hydraulic Excavator, 15 m ³ bucket	Production Loading	185	3	17,461	3,230,285	16
Hauling						
Rigid Fram Hauler, 91t payload	Hauling Ore and Waste	100	11	59,360	5,936,000	15
Rigid Fram Hauler, 132 t payload	Hauling Waste	156	22	132,780	20,713,680	17
Articulated Hauler, 36 tonnes payload	Support Hauler, Till Hauling	45	2	9,868	444,060	14
Primary Pit Support						
Motor Grader, 4.9 m blade	Haul Road Maintenance	35	3	16,104	563,640	15
Water/Gravel Truck	Water/Gravel Haul Roads	25	3	16,882	422,050	16
Track Dozer, 447 kW	Waste Dump Maintenance	85	3	12,726	1,081,710	12
Track Dozer, 325 kW	Pit Support	60	2	10,790	647,400	15
Wheel Loader, 4.5m ³ bucket	Pit Support	20	2	9,021	180,420	13
Hydraulic Excavator, 4.0 m ³ bucket	Pit Support and Back Up Loading	45	3	10,364	466,380	10
Fuel/Lube Truck	Equipment Fuel/Lube	30	3	12,948	388,440	12
Wheel Dozer, 370 kW	Pit Support	65	2	6,474	420,810	9
Hydraulic Excavator, 3.0 m ³ bucket	Pit Support, Ditching, Construction	30	2	8,632	258,960	12
Hydraulic Excavator, 1.75 m ³ bucket	Construction and Reclamation Support	30	1	4,316	129,480	12
Track Dozer, 160 kW	Construction and Reclamation Support	25	1	4,316	107,900	12
Ancillary						
Crew Shuttle	Employee Transport	7	6	6,000	42,000	3
Pickup Trucks	Staff Transportation	3	10	25,000	75,000	7
Light Plants	Pit Lighting	1	18	62,999	62,999	10
Water Pumps, 150 m ³ /hour	Pit Dewatering	30	10	34,999	1,049,970	10
On Highway Dump Truck	Utility Material Movement	10	2	3,000	30,000	5
Flatbed Picker Truck	Construction Support	10	2	3,000	30,000	5
Emergency Response Vehicle	Safety and First Aid	10	1	300	3,000	1
Mobile Maintenance Fleet						
Maintenance Trucks	Mobile Maintenance Crew and Tool Transport	7	4	8,000	56,000	6
Mobile Crane - 36 t capacity	Mobile Maintenance Material Handling	30	1	1,000	29,997	3
Float Trailer - 55 ton Capacity	Material and Equipment Transport	0	1	500	0	2
Forklift and Tire Handler	Shop Material and Tire Handling	10	2	2,000	20,000	3
Mobile Steam Cleaner	Cleaning for Mobile Maintenance	2	2	2,000	4,000	3
Scissor Lift	Maintenance Support	5	1	1,000	5,000	3
Mobile Manlift	Maintenance Support	5	1	1,000	5,000	3
Total					43,634,805	

Mobile Equipment considered in Air Quality Modelling

Equipment	Function	Fuel Consumption gal/hr	Assumed Output Power hp	Number of Equipment		Operating Hours/yr *	Assumed Operating Hours/day
				Total	Operating Simultaneously (Assumed)		
DTH Drill, Tracked, 144 mm diameter	Production Drilling	13.2	540	4	3	19,089	18
Rotary Drill, Tracked, 200 mm diameter	Production Drilling	27.7	860	4	4	24,380	17
Wheel Loader, 13 m ³ bucket	Production Loading, Crusher Loading	30.4	1040	2	2	8,729	12
Hydraulic Excavator, 12 m ³ bucket	Production Loading	34.3	1040	4	3	19,663	18
Hydraulic Excavator, 15 m ³ bucket	Production Loading	48.9	1531	3	3	17,461	16
Rigid Fram Hauler, 91 t payload	Hauling Ore and Waste	26.4	1025	11	9	59,360	19
Rigid Fram Hauler, 132 t payload	Hauling Waste	41.2	1600	22	20	132,780	19
Track Dozer, 447 kW	Waste Dump Maintenance	22.5	700	3	2	12,726	18
Track Dozer, 325 kW	Pit Support	15.9	474	2	2	10,790	15

* Hours of operation are based on 2028

Route Information

Haul Routes - 2028 provided by Marathon Gold

Haul Route	Approx. Length (m) One Way	Truck trips (cycles)			Material Hauled (tonnes)
		Hourly	Daily	Annual	
Berry Pit to Crusher	2,859	3	59	21,107	1,792,000
Berry Pit to Berry/Marathon LGSP	3,585	2	24	8,481	720,000
Berry Pit to Berry WRSF - 91 t hauler	2,701	4	64	22,603	1,919,000
Berry Pit to Berry WRSF - 132 t hauler	2,670	20	388	137,702	17,020,000
Berry Pit to Tailings Dam	4,376	6	108	38,280	3,250,000
Leprechaun Pit to Crusher	4,439	1	11	4,005	340,000
Leprechaun Pit to Leprechaun LGSP	2,855	1	6	2,026	172,000
Leprechaun Pit to Leprechaun OVBSP	1,975	1	14	4,895	372,000
Leprechaun Pit to Leprechaun WRSF - 91 t hauler	1,553	2	38	13,640	1,158,000
Leprechaun Pit to Leprechaun WRSF - 132 t hauler	2,085	28	556	197,435	24,403,000
Marathon Pit to Crusher	5,669	2	21	7,456	633,000
Marathon Pit to Berry/Marathon LGSP	3,615	1	10	3,663	311,000
Marathon Pit to Berry/Marathon OVBSP	1,502	1	16	5,671	431,000
Marathon Pit to Marathon WRSF - 91 t hauler	2,306	7	140	49,658	4,216,000
Marathon Pit to Marathon WRSF - 132 t hauler	3,017	16	311	110,307	13,634,000
High Grade Storage to Crusher	925	1	16	5,713	485,000

Ore handling and processing - Provided by Marathon Gold

Blasting - 2028

Total Explosives	17,500	t/a
Blasts per year	345	
Blasts per pit	115	
Explosives per blast	51.0	t

Material transfer and conveying - Provided by Marathon Gold

Stockpile drop points - 2028

Storage Pile	Add Rate kt/a	Remove Rate kt/a	Total t/d
Marathon - waste rock	17,850	0	48,904
Marathon/Berry - low grade stockpile	1,031	0	2,825
Berry - waste rock	18,940	0	51,890
Leprechaun - waste rock	25,560	0	70,027
Leprechaun - low grade stock pile	172	0	471
Leprechaun - high grade stockpile	0	-485	1,329

Table B-10: Total concentrations of trace elements in composite samples

Analysis	Unit	ACUCx10	B QPOR	B SED	B MD	B QTP	B LGO	B HGO	B Ore Avg	B QPOR-PAG	B SED-High SFE	B QTP-PAG	B LGO-PAG	B HGO-PAG-Zn	B OB-ML	B-QPOR_F B	B-CG_FB	B-MD_FB	B-QTP_FB	B-LGO_FB	B-HGO_FB	Ore Avg	B QPOR-PAG-CO3DP	B QTP-PAG-CO3DP	B LGO-PAG-CO3DP	B HGO-PAG-CO3DP	BL1021-24D Detox TIs	BL1021-43 Detox TIs	TMFAvg	
7439-97-6	Hg	µg/g	0.5	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.05	
#N/A	Ag	µg/g	530	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
7440-38-2	As	µg/g	48	0.97	0.93	4.6	1.1	2.7	1.1	1.9	1.4	2.4	2.7	6.2	1.5	2.2	0.81	1.4	20	1.1	1.2	1.7	1.45	1.6	0.98	4.8	1.1	2.4	8.3	
#N/A	Al	µg/g	407639	7400	10000	26000	6100	6600	6900	6750	6300	16000	5200	6400	6900	16000	12000	12000	24000	9800	8000	7900	7950	5100	5600	6800	6100	9600	9800	
7440-39-3	Ba	µg/g		22	83	18	9.8	15	10	12.5	18	39	17	22	11	64	14	41	15	12	11	9.3	10.15	16	18	18	9.8	32	27	
7440-41-7	Be	µg/g	21	0.14	0.31	0.32	0.12	0.10	0.090	0.095	0.11	0.28	0.080	0.090	0.070	0.29	0.074	0.20	0.18	0.054	0.048	0.058	0.053	0.051	0.069	0.062	0.044	0.12	0.12	
7440-69-9	Bi	µg/g		0.2	0.1	< 0.09	0.16	0.65	1.2	0.925	0.29	< 0.09	0.37	1.1	6.3	0.17	< 0.09	0.093	< 0.09	0.11	0.45	1.2	0.825	0.1	0.13	0.36	3.7	2	1.2	
#N/A	Ca	µg/g		8600	19000	24000	7500	15000	12000	13500	6300	14000	10000	12000	7400	5400	15000	27000	38000	13000	13000	13000	960	690	940	650	15000	16000	15500	
7440-43-9	Cd	µg/g	0.90	0.19	0.10	0.11	0.075	0.040	0.030	0.035	0.030	0.040	0.030	0.040	0.16	0.050	0.065	0.10	0.21	0.044	0.12	0.082	0.03	0.01	0.01	0.01	0.19	0.23	0.21	
7440-48-4	Cobalt	µg/g	173	3.5	8.2	22	4.2	21	4.8	12.9	4.1	10	18	28	6.8	16	7.4	9.9	20	3.8	5.4	4.3	4.85	13	3.9	26	6.1	6	4.4	
7440-47-3	Cr	µg/g	920	3.5	13	58	6.2	4.7	7.1	5.9	95	69	130	90	150	73	56	45	62	76	56	82	69	2.6	1.9	2.2	2.6	270	210	
7440-50-8	Cu	µg/g	280	18	42	38	26	26	26	26	15	25	13	92	13	45	26	16	31	16	73	15	44	13	8.5	150	8.3	51	650	
#N/A	Fe	µg/g	320415	17000	21000	48000	15000	31000	25000	28000	24000	31000	25000	64000	24000	39000	26000	29000	52000	23000	24000	22000	23000	27000	24000	61000	23000	26000	27000	
#N/A	K	µg/g	490	740	350	280	590	320	455	560	990	550	650	470	1600	420	630	390	400	400	310	355	500	510	570	380	1000	950	975	
7439-93-2	Li	µg/g		2.7	5.6	8	2.6	2.2	2.5	2.35	2	9	2	2	< 2	15	3.5	5	5.2	2.1	< 2	< 2	2	< 2	< 2	< 2	< 2	2.7	3	
#N/A	Mg	µg/g		2200	7200	17000	2100	2600	2800	2700	2300	12000	2200	2500	2700	11000	5300	9600	16000	3200	2900	3000	2950	2000	1600	2400	2200	3400	3600	
#N/A	Mn	µg/g	774.5	390	610	900	370	560	410	485	320	730	300	320	290	600	480	780	1000	460	440	430	435	110	110	150	130	490	500	
#N/A	Mo	µg/g	11	1.8	1.9	1.3	1.6	3.8	5.7	4.75	1.2	1.3	4.4	1.6	2.5	1.3	0.62	0.31	0.56	0.78	0.92	1.9	1.41	2.9	0.7	0.6	1.8	5.7	4.2	
7440-02-0	Ni	µg/g	470	1.3	13	20	2.2	2.6	2.8	2.7	5.7	21	6.3	5.0	6.5	29	22	16	15	2.6	4.2	3.8	4	0.82	1	2.9	1.2	71	35	
7439-92-1	Pb	µg/g	170	1.3	1.8	5.0	0.85	5.8	1.7	3.75	0.80	2.8	0.76	1.3	5.5	8.2	0.94	2.0	1.3	1.6	15	3.8	9.4	1.6	2.2	1.2	4.3	6.9	5.7	
7440-36-0	Sb	µg/g		< 6	< 6	< 6	< 6	< 6	6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	6	< 6	< 6	< 6	< 6	< 6	< 6	6	
7782-49-2	Se	µg/g	0.9	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
7440-31-5	Sn	µg/g		f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	0.7	
7440-24-6	Sr	µg/g		8.3	36	42	10	14	12	13	7.3	23	11	12	8.5	17	15	38	46	12	13	14	13.5	4.1	4.5	6.1	3.4	17	19	
#N/A	Ti	µg/g		28	33	250	27	29	48	38.5	49	87	50	29	82	1500	110	320	370	79	43	39	41	22	39	17	43	160	110	
#N/A	Tl	µg/g	9	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.046	0.024	0.01	0.01	0.01	
#N/A	U	µg/g	27	0.14	0.62	0.16	0.11	0.10	0.10	0.10	0.13	0.58	0.10	0.12	0.090	1.6	0.13	0.79	0.12	0.12	0.10	0.10	0.10	0.08	0.10	0.08	0.07	0.15	0.14	
#N/A	V	µg/g	970	7.1	26	100	8.4	7.7	9.6	8.65	3.0	26	5.0	8.0	7.0	63	20	37	100	9.8	9.3	9.8	9.55	6.6	3.2	10	7	9.8	10	
#N/A	Yttrium	µg/g		6.4	8	12	5.5	6.5	6.1	6.3	5.5	9.6	5	6.4	4.3	9.3	6.1	9.7	11	6.9	5.7	5.9	5.8	3.7	3.8	4.1	3	6.5	6	
7440-66-6	Zn	µg/g	670	26	39	75	24	25	26	25.5	17	50	13	17	18	62	44	58	85	49	31	34	32.5	14	15	20	18	40	38	

Notes:

ACUC - Average Concentration in the Upper Crust of the Earth based on Rudnick and Gao (2004);

Values exceeding 10x the Average Concentration in the Upper Crust are highlighted red with red text.

For the values less than Reportable Detection Limit (RDLs) values, 1/2 of RDLs are used to calculate statistical parameters. It is displayed with blue italic text.

Au #N/A
Cu 7440-50-8
#N/A
As 7440-38-2
Hg 7439-97-6
#N/A
#N/A
#N/A
#N/A
#N/A
Te #N/A
#N/A
#N/A
Ag #N/A
Ba 7440-39-3
Be 7440-41-7
Bi 7440-69-9
Cd 7440-43-9
Cobalt 7440-48-4
Cr 7440-47-3
Li 7439-93-2
Mo #N/A
Ni 7440-02-0
Pb 7439-92-1
Sb 7440-36-0
Se 7782-49-2
Sn 7440-31-5
Sr 7440-24-6
Ti #N/A
U, #N/A
Y, #N/A
Zn 7440-66-6

APPENDIX 6B

Contour Plots

BERRY PIT EXPANSION ENVIRONMENTAL REGISTRATION/ ENVIRONMENTAL ASSESSMENT

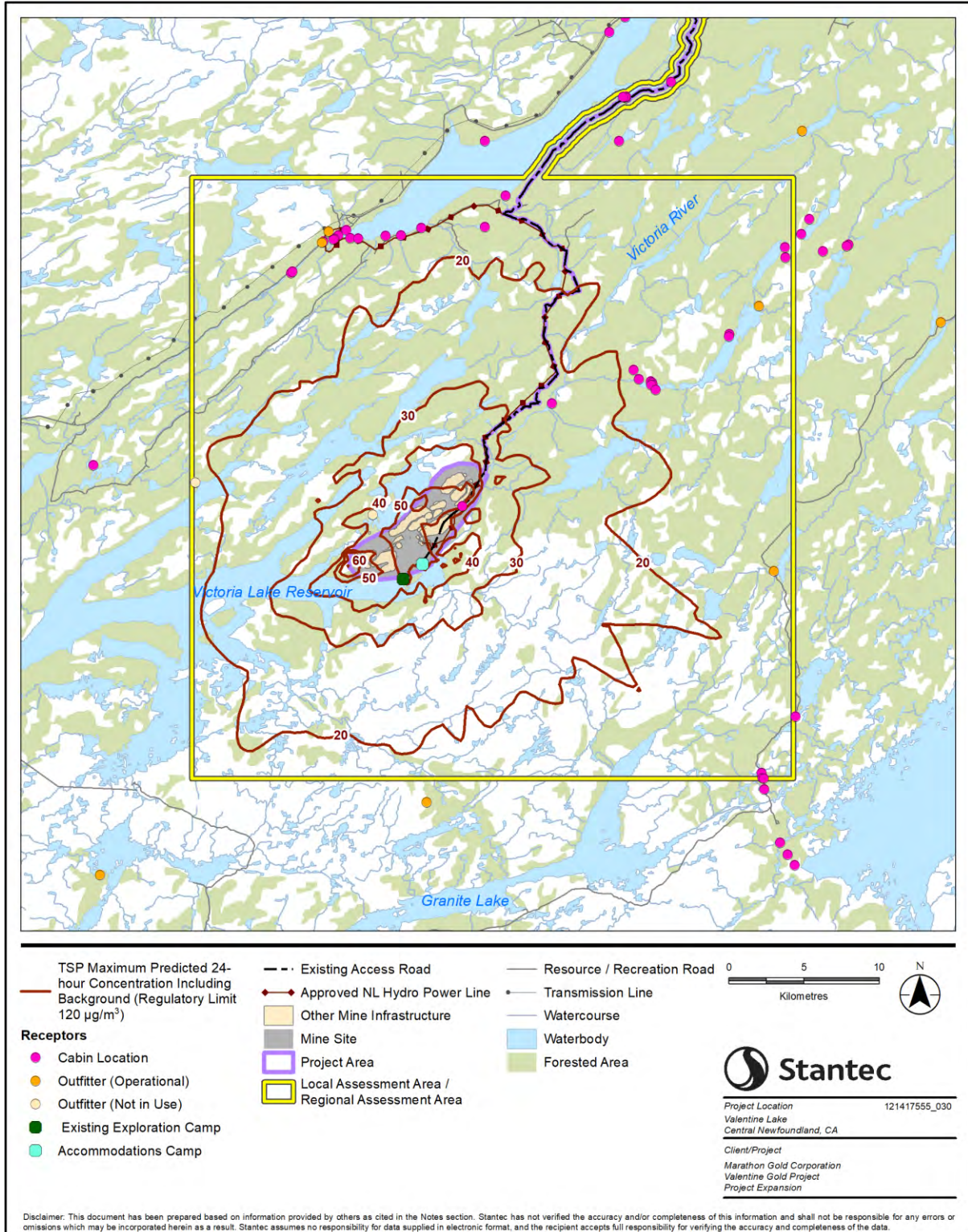


Figure B-1 Maximum Predicted 24-Hour TSP Concentrations (Including Background)



BERRY PIT EXPANSION ENVIRONMENTAL REGISTRATION/ ENVIRONMENTAL ASSESSMENT

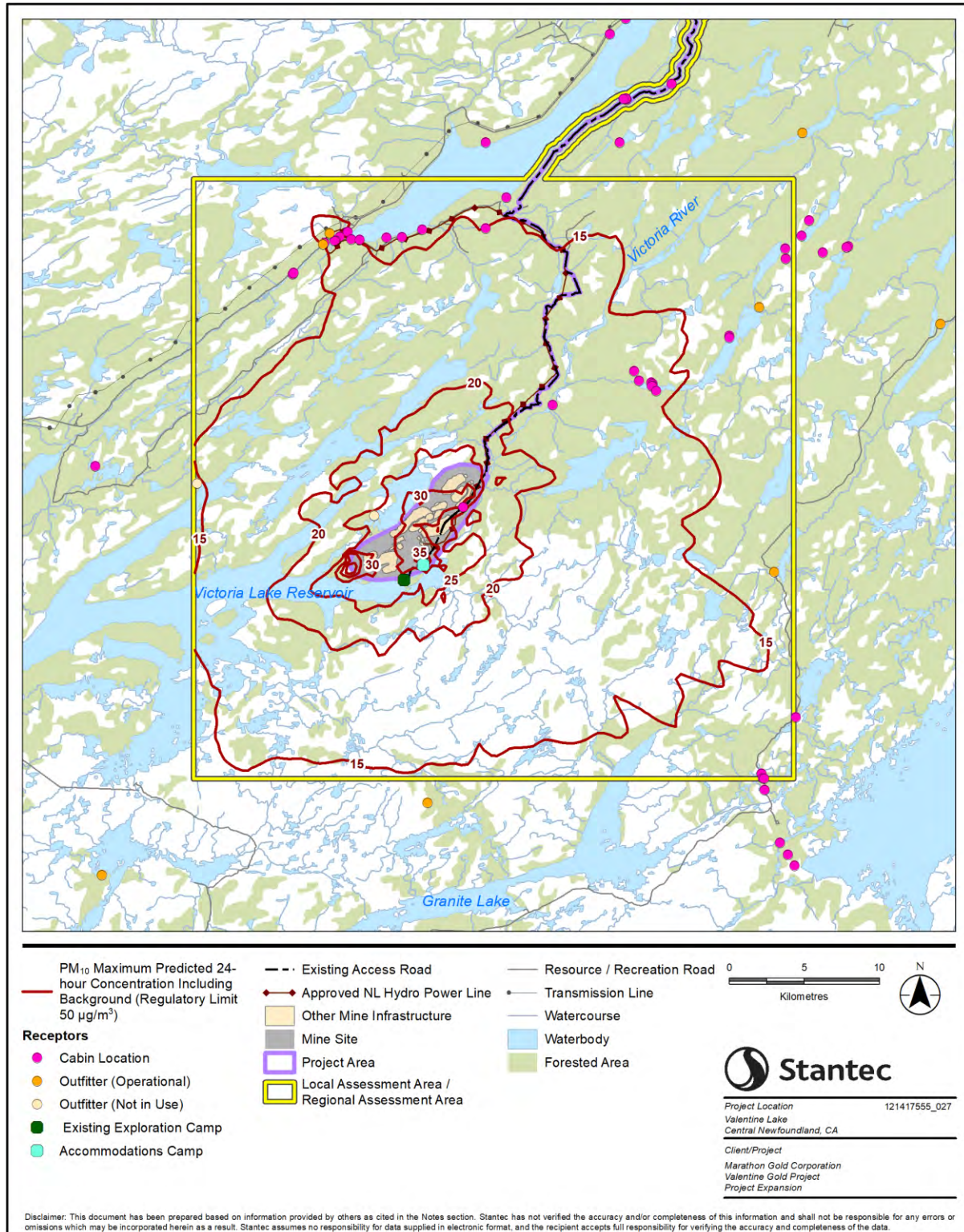


Figure B-2 Maximum Predicted 24-Hour PM₁₀ Concentrations (Including Background)



BERRY PIT EXPANSION ENVIRONMENTAL REGISTRATION/ ENVIRONMENTAL ASSESSMENT

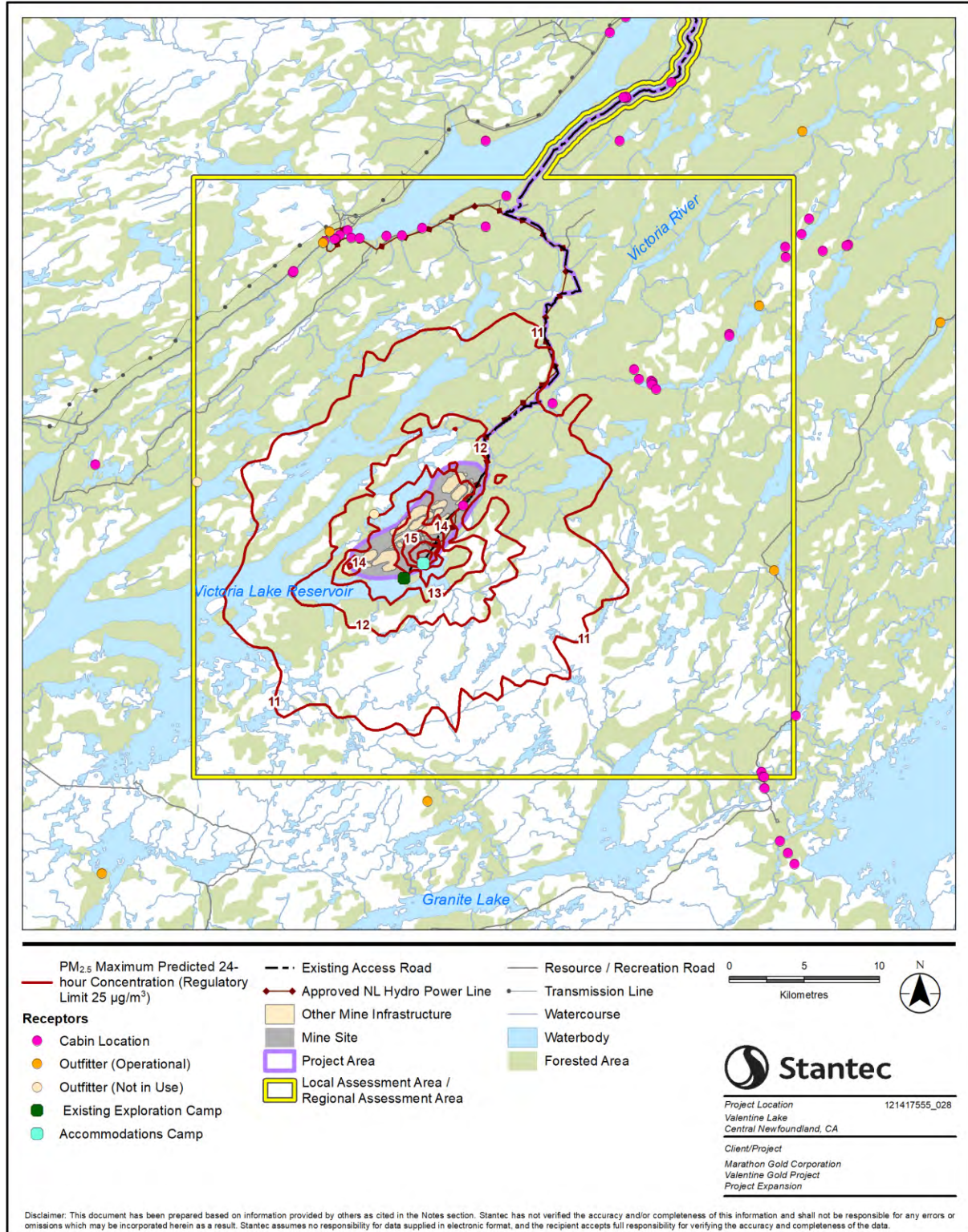


Figure B-3 Maximum Predicted 24-Hour PM_{2.5} Concentrations (Including Background)



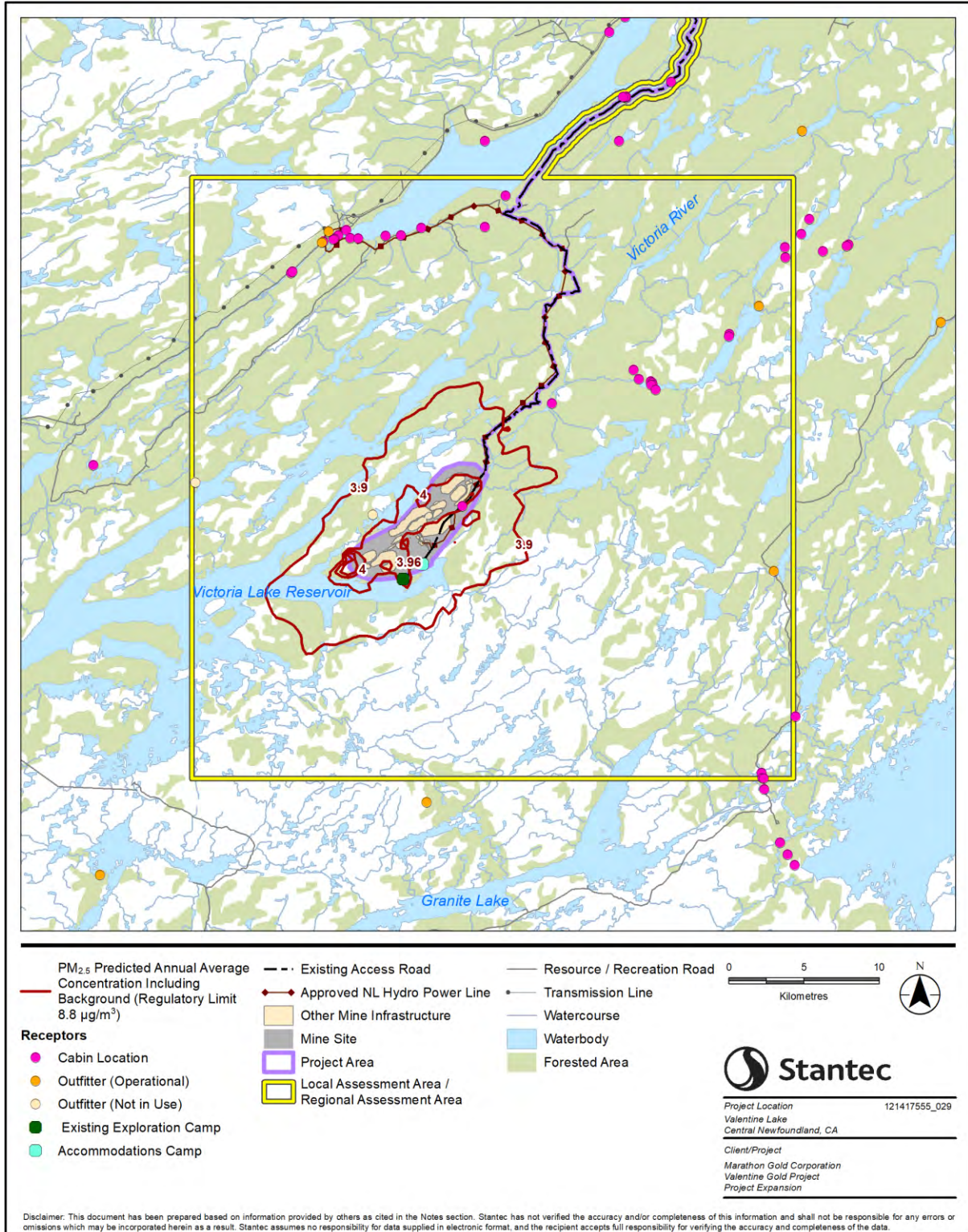


Figure B-4 Maximum Predicted Annual PM_{2.5} Concentrations (Including Background)



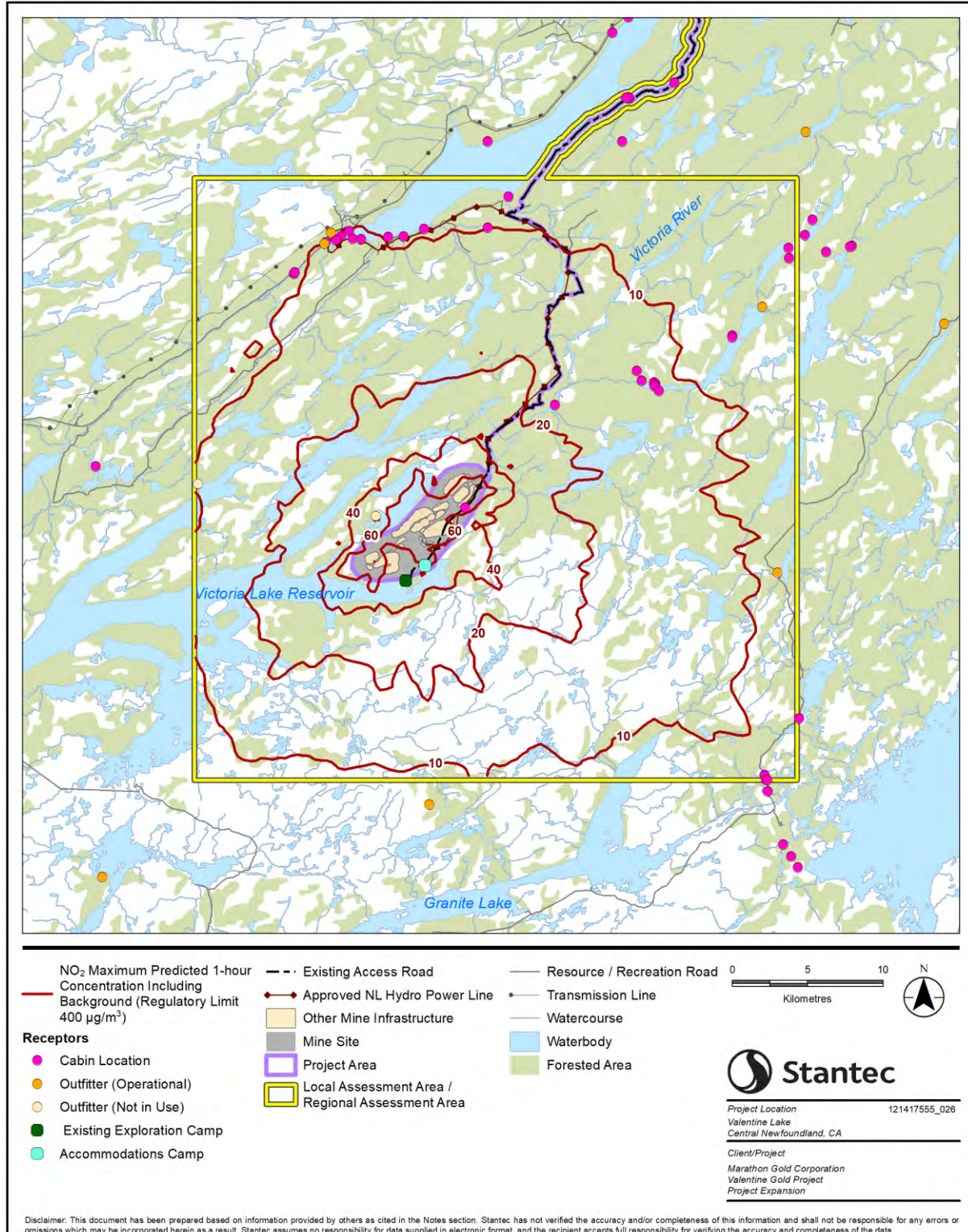


Figure B-5 Maximum Predicted 1-Hour NO₂ Concentrations (Including Background)

BERRY PIT EXPANSION ENVIRONMENTAL REGISTRATION/ ENVIRONMENTAL ASSESSMENT

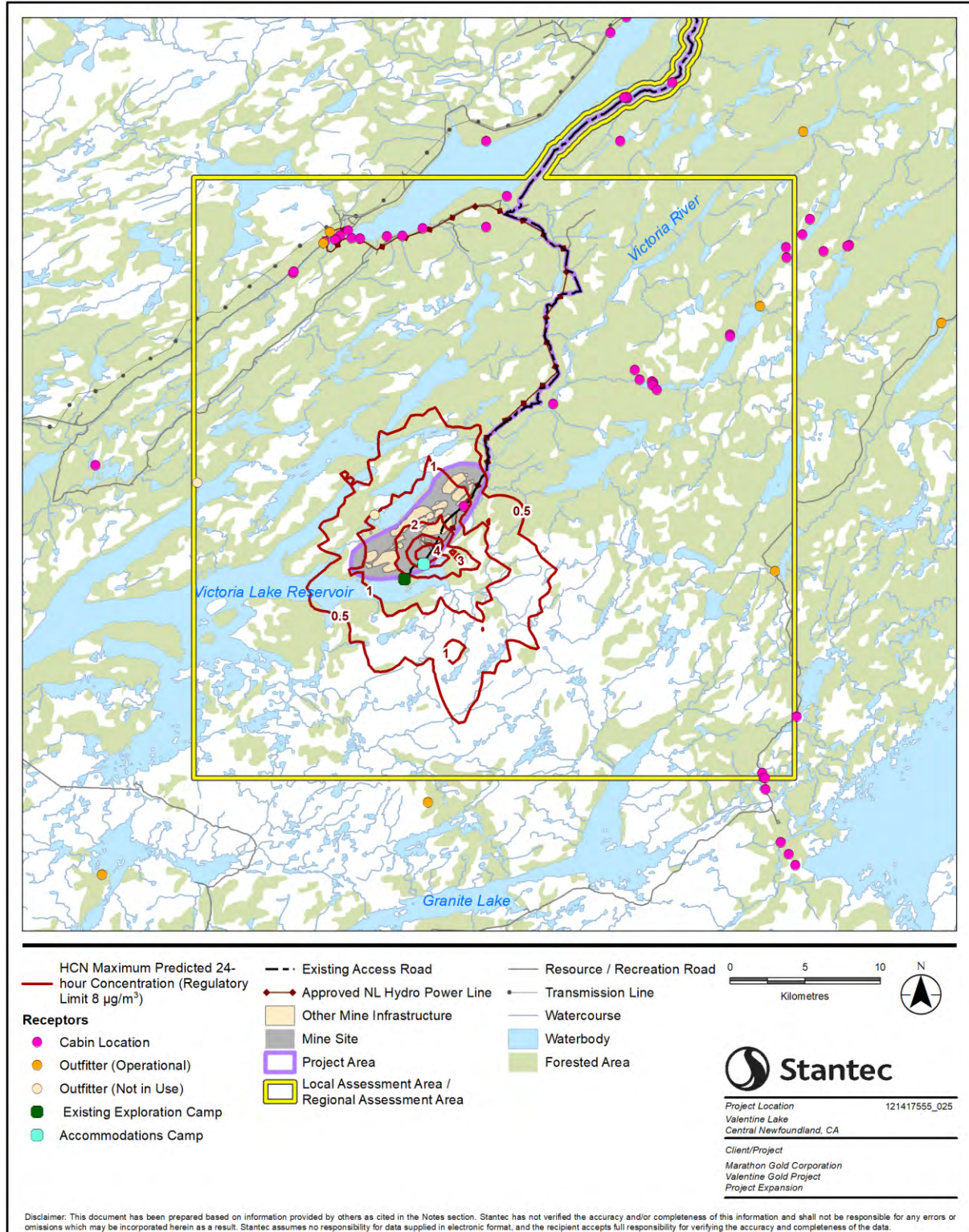


Figure B-6 Maximum Predicted 24-Hour HCN Concentrations

