# Meliadine Extension

## Air Quality Modelling Study

December 2021

Project No.: 0602390-3

*The business of sustainability*

## Signature Page

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## Air Quality Modelling Study

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# EXECUTIVE SUMMARY

Agnico Eagle Mines (Agnico Eagle) operates the Meliadine Gold Mine (the Meliadine Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut.

The Meliadine Mine received Project Certificate No. 006 from the Nunavut Impact Review Board (NIRB) in 2015. This included the approval of five deposits at Meliadine Mine, specifically Tiriganiaq, F Zone, Wesmeg, Pump, and Discovery. To date, a portion of the NIRB-approved footprint has been constructed.

Agnico Eagle is proposing to extend the existing mine and will be seeking an amendment to Project Certificate No. 006 for the Meliadine Extension (the Project). The Meliadine Extension involves new underground mining of the Tiriganiaq deposit (Tiriganiaq-Wolf), F Zone, Pump, and Discovery and open pit areas (Pump, F Zone and Discovery deposits), and would extend the life of mine (LOM) by 11 years and mine closure would move from 2032 to 2043. An air quality modelling study (AQMS) was conducted to inform the assessment of potential air quality effects for the proposed Project.

The AQMS used the CALPUFF air dispersion model (version 7.2.1) to predict the resulting ambient air quality due to emissions associated with Scenarios 1, 2 and 3 (no wind farm, 50% of power provided by wind farm, and 75% of power provided by wind farm).

These model scenarios are different from those in the modelling for the 2014 Final Environmental Impact Statement (FEIS). For the 2014 FEIS, there were six scenarios, where each deposit combined with Tiriganiaq was assessed separately. In the current modelling, mining is assumed to happen in three surface pits and five underground areas because the three scenarios are all based on the worst-case year (2030).

The air contaminants modelled were nitrogen oxides ($NO_x$) and sulphur dioxide ($SO_2$). Contaminants were compared against relevant ambient air quality standards, objectives, and guidelines (SOGs) for Canada, which are more stringent and more recent than those for Nunavut, as shown below in the appropriate section of the report.

The CALPUFF model used Canadian Digital Elevation Model data (Government of Canada 2021) obtained in a gridded format at 20 m horizontal resolution. CALMET used 30 m resolution land use data from the Landsat satellite. The meteorological data inputs consisted of Pennsylvania State University/ National Center for Atmospheric Research Mesoscale Model version 5 (MM5) model output files.

The emissions inventory was built using a number of information sources, calculations and assumptions. The primary source of information about air emissions was Agnico Eagle Operations and Permitting groups. At the time of preparing the emissions inventory, the most up-to-date information as of August 2021 was used.

Where input data uncertainties were identified, the air quality modelling incorporates conservative assumptions that are based on regulatory guidance. The use of conservative assumptions can lead to conservative model predictions and therefore the results of the model study are interpreted with the understanding that the predicted effects are likely overestimated.

The predicted ambient air quality results are compared against relevant SOGs for both ambient air quality contaminants. The results found that concentrations of nitrogen dioxide ($NO_2$) and $SO_2$ are not predicted to exceed the relevant thresholds for all three modelled scenarios.

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AQMS | Air quality modelling study |
| ARM | Ambient Ratio Method (for converting predicted $NO_x$ concentrations to $NO_2$) |
| AWAR | All-Weather Access Road |
| BC AQMG | British Columbia Air Quality Dispersion Modelling Guideline |
| BC MOE | British Columbia Ministry of Environment (the former name of ENV, see below) |
| BPIP-PRIME | Building Profile Input Program for the PRIME algorithm (building downwash software) |
| CAAQS | Canadian Ambient Air Quality Standards |
| CDEM | Canadian Digital Elevation Model |
| EF | Emission Factor |
| ENV | Ministry of Environment and Climate Change Strategy |
| FEIS | Final Environmental Impact Statement |
| g/s | Grams per second |
| g/s/m | Grams per second per linear metre (for emissions from a road source) |
| g/VKT | Grams per vehicle kilometre travelled |
| km | Kilometre |
| LOM | Life Of Mine |
| Meliadine Extension | Meliadine Mine Extension Project |
| Meliadine Mine | Meliadine Gold Mine |
| MM5 | Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model version 5 (a meteorological model) |
| MOVES2014b | US EPA Motor Vehicle Emission Simulator version 2014b |
| NIRB | Nunavut Impact Review Board |
| NO | Nitrogen oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Nitrogen oxides |
| NPC | Nunavut Planning Commission |
| QA/QC | Quality assurance / quality control |
| $SO_2$ | Sulphur dioxide |
| SOGs | Air quality Standards, Objectives and Guidelines |
| SRTM | Shuttle Radar Topography Mission (a source of digital elevation data) |
| VEC | Valued ecosystem component |
| VSEC | Valued socio-economic component |

# 1. INTRODUCTION

## 1.1 Project Background

Agnico Eagle operates the Meliadine Gold Mine (the Meliadine Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut (Figure 1.1-1).

The Meliadine Mine received Project Certificate No. 006 from the Nunavut Impact Review Board (NIRB) on February 26, 2015. This included the approval of five deposits at Meliadine Mine, specifically Tiriganiaq, F Zone, Wesmeg, Pump, and Discovery. To date, a portion of the NIRB-approved footprint has been constructed.

Agnico Eagle is proposing to extend the mine and will be seeking an amendment to Project Certificate No. 006 for the Meliadine Extension (the Project). The Meliadine Extension involves new underground mining of the Tiriganiaq deposit (Tiriganiaq-Wolf), F Zone, Pump, and Discovery and open pit areas (Pump, F Zone and Discovery deposits), and would extend the life of mine (LOM) by 11 years and mine closure would move from 2032 to 2043. Additional personnel (i.e., 205 employees) would be required to support the Meliadine Extension and the camp capacity would be increased accordingly. In addition, Agnico Eagle is assessing the benefits of installing a wind farm that, depending on its size, could provide 25% to 75% of the mine's required power.

This report presents the results of air quality modelling to support the assessment of potential air quality effects in the Final Environmental Impact Statement (FEIS) Addendum for the Meliadine Extension completed by Agnico Eagle. This air quality modelling does not represent the current mine configuration; the Meliadine Extension represents the proposed future configuration of the mine. The Site Study Area (the project footprint and mine infrastructure, including the area covered by the Meliadine Extension) used for the air quality modelling study (AQMS), is shown in Figure 1.1-2.

## 1.2 Objectives

The objectives of this report are to:

- summarize existing ambient air quality conditions in the Meliadine Extension area;
- describe the methodology used for the AQMS;
- identify the sources of nitrogen oxides ($NO_x$) and sulphur dioxide ($SO_2$) associated with the Meliadine Extension and present an emissions inventory;
- predict the change in ambient air quality based on air dispersion modelling; and
- compare the results to relevant ambient air quality standards, objectives and guidelines (SOGs).

## 1.3 Modelling Limitations and Uncertainty

There is inherent uncertainty associated with scientific modelling. Air dispersion models can predict atmospheric concentrations to a reasonable degree of accuracy but the accuracy is highly dependent on the overall modelling approach and the accuracy of the model inputs, which include model parameters, meteorological data, terrain data, land use data, and air emissions inventory data.

Where input data uncertainties were identified, the air quality modelling incorporates conservative assumptions that are based on regulatory guidance, and professional judgement and experience. Assumptions used in the AQMS to account for uncertainties are described in the report. The use of conservative assumptions can lead to conservative model predictions and therefore the results of the AQMS are interpreted with the understanding that the predicted effects are likely overestimated.

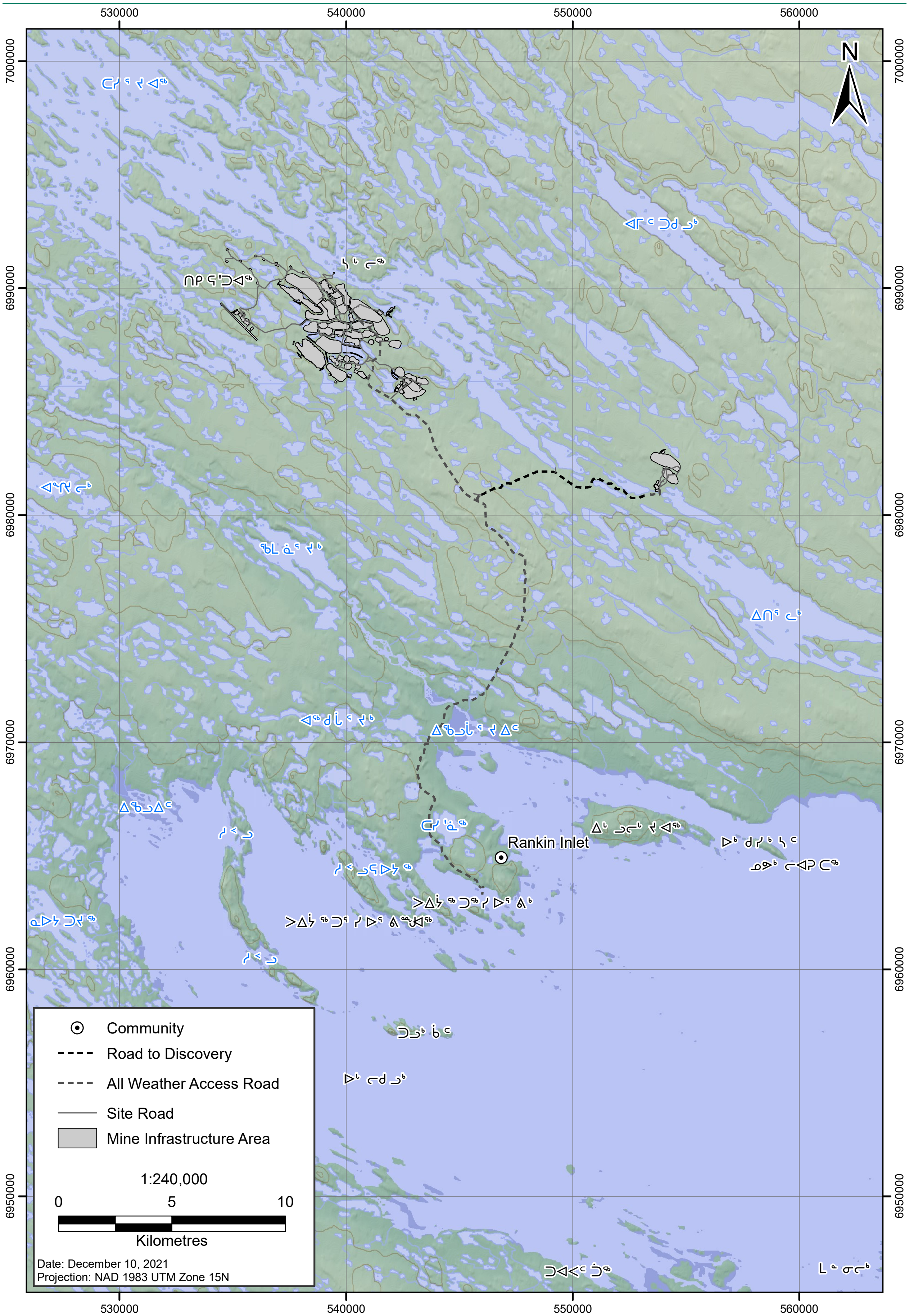


**Figure 1.1-1: Meliadine Extension - Project Location**

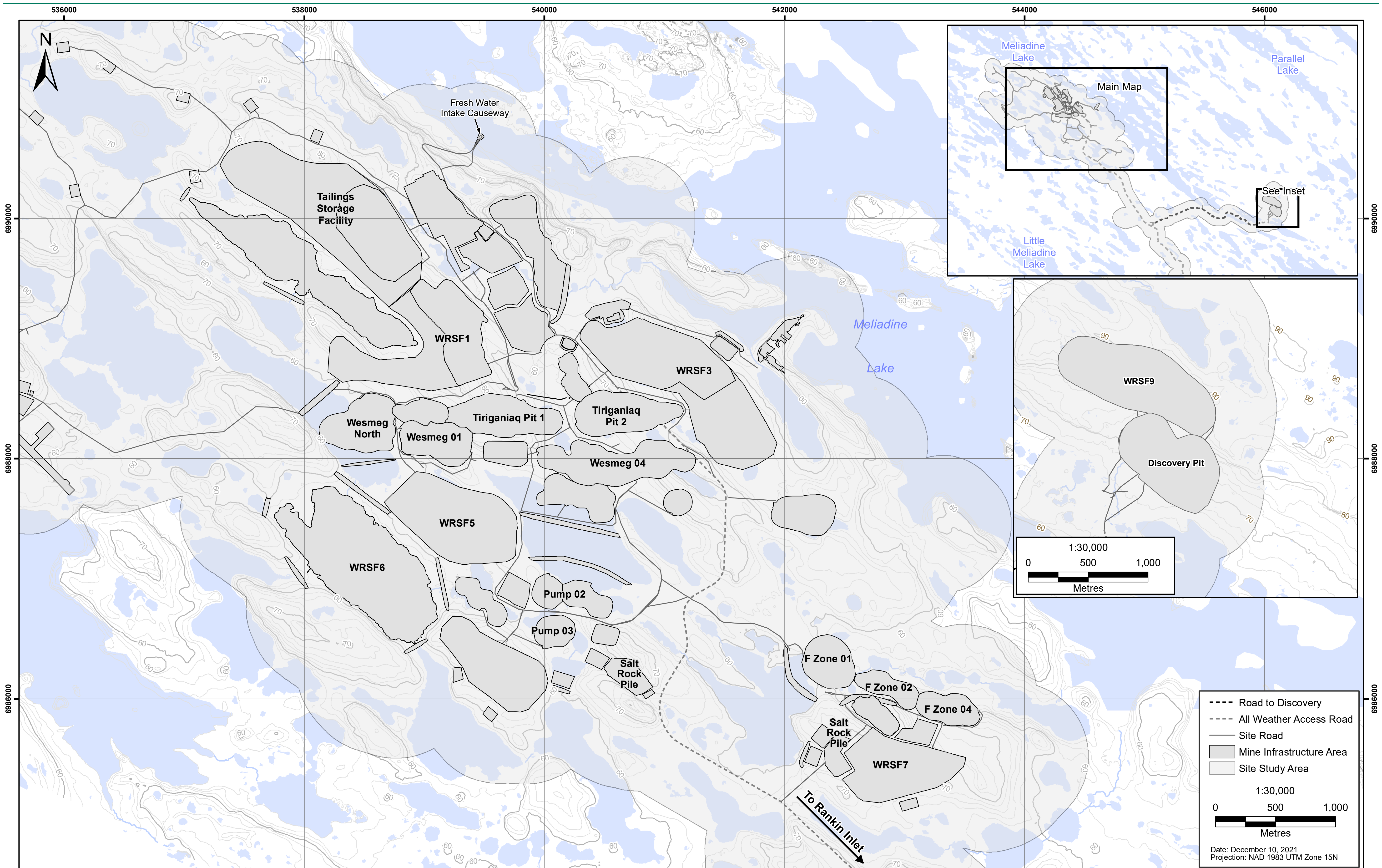


**Figure 1.1-2: Site Study Area and Meliadine Mine Infrastructure**

# 2. MODELLING STUDY SCOPE

## 2.1 Approach

Standard air dispersion modelling techniques were applied to predict the potential air quality effects associated with the Meliadine Extension. Air dispersion modelling considers the interaction of existing and future emission sources and takes into account meteorological conditions, terrain elevation, and land use.

The AQMS follows the BC Ministry of Environment and Climate Change Strategy (ENV)'s BC Air Quality Dispersion Modelling Guideline (BC MOE 2015) because the Government of Nunavut has not issued a Guideline for that purpose. Settings and inputs that were used in the modelling conducted for the Meliadine Mine FEIS (Agnico Eagle 2014) are used in the AQMS, where possible and reasonable.

## 2.2 Modelling Scenarios

The following assessment cases were considered and modelled:

- Scenario 1 – assumes that no power is provided by the proposed wind farm; four site generators are running continuously.
- Scenario 2 – assumes that 50% of power is provided by the wind farm; two site generators are running continuously.
- Scenario 3 – assumes that 75% of power is provided by the wind farm; one site generator is running continuously.

These model scenarios are different from those in the modelling for the 2014 FEIS, which did not consider the potential addition of a wind farm. For the 2014 FEIS, there were six scenarios, where each deposit combined with Tiriganiaq was assessed separately. In the current modelling, mining is assumed to happen in three surface pits and five underground areas because the three scenarios are all based on the worst-case year (2030).

## 2.3 Spatial Boundaries

Spatial boundaries of the AQMS were chosen in order to identify maximum air quality impacts due to the different scenarios as well as the spatial distribution of predicted air quality. The boundaries were also sized such that ambient air contaminant levels are anticipated to approach baseline air contaminant levels within the boundaries.

The CALPUFF modelling domain (Figure 2.3-1) is the area in which potential effects from the Project on air quality are most likely to occur. The CALPUFF domain is a rectangle 43 km east-west by 48 km north-south, encompassing the Meliadine Mine and the hamlet of Rankin Inlet. This domain is larger than the CALPUFF domain (35 km by 35 km) in the 2014 FEIS modelling (Agnico Eagle 2014). A larger CALPUFF domain was used for the Meliadine Extension modelling in order to expand the area in which predicted concentrations are available for the purposes of assessing potential impacts.

Additional information about the spatial boundaries is included in Section 4.5.

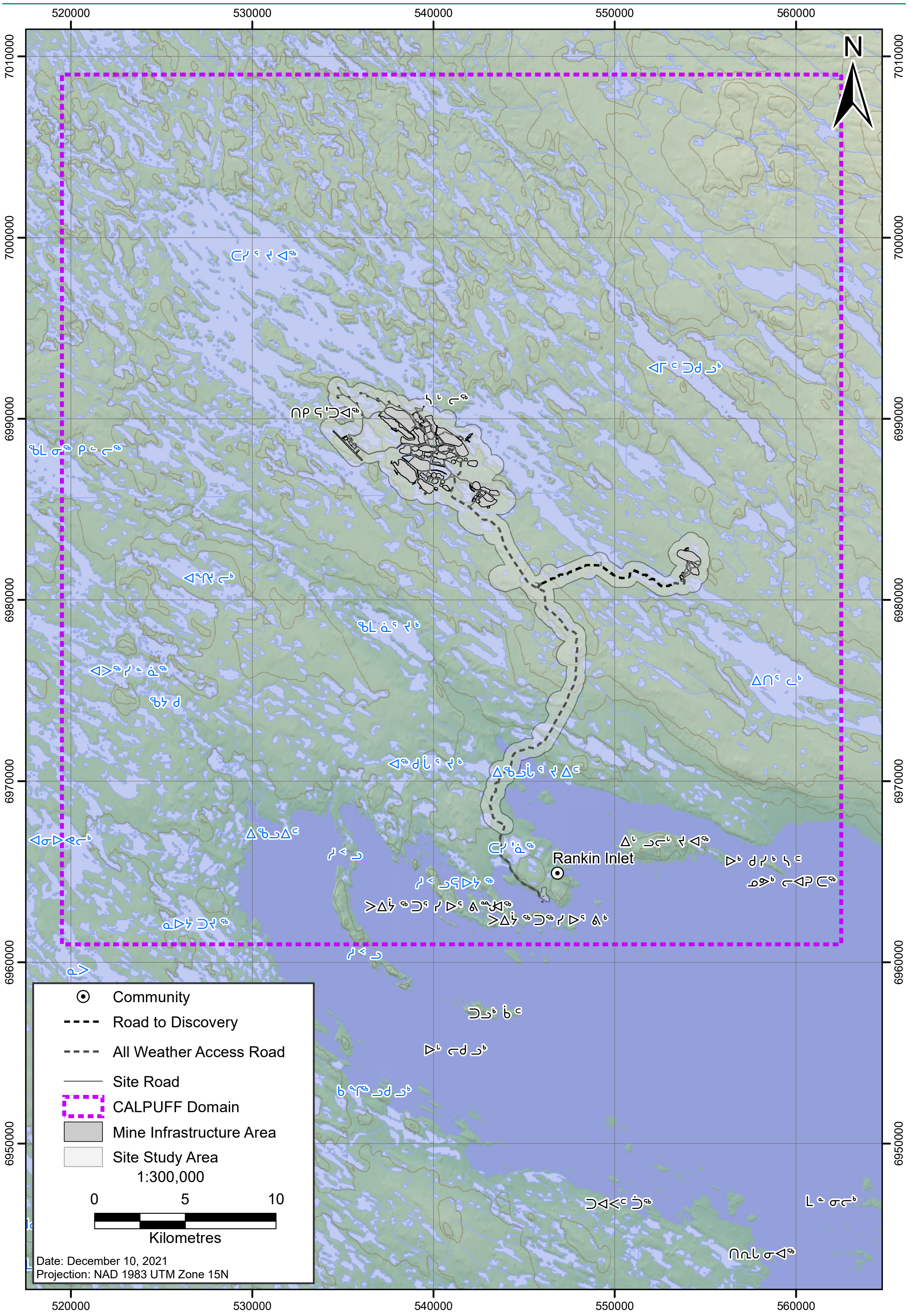


**Figure 2.3-1: Spatial Boundaries for the Meliadine Extension Air Quality Modelling Study**

## 2.4 Temporal Boundaries

The modelling used available LOM data from 2030. The AQMS temporal boundaries were chosen to model the year with the maximum total amount of material (overburden, tailings, waste rock, salt rock, and ore combined) moved, and therefore the highest anticipated total air emission rates during the projected LOM plan (as of August 2021). Based on the projected LOM plan, 2030 was found to have the highest total amount of material moved, and thus was assumed to have the highest annual air emissions. The resulting ambient concentrations of modelled contaminants during 2030 is expected to be higher than during the closure, post-closure and care and maintenance periods. Therefore, only the 2030 operation period was modelled in the AQMS to model the highest emission rates.

For the Meliadine Extension, ambient air quality was modelled using five full years of meteorological data in order to account for seasonal meteorological conditions, seasonal air emissions, and to assess the required averaging periods to compare against relevant ambient air quality SOGs. The modelled meteorological data files used in the AQMS were the same as those in the 2014 FEIS modelling (Agnico Eagle 2014).

Additional information about the temporal boundaries is included in Section 4.5.

## 2.5 Air Contaminants

The AQMS predicted results for the following air contaminants:

- nitrogen oxides ($NO_x$);
- nitrogen dioxide ($NO_2$) resulting from emissions of $NO_x$; and
- sulphur dioxide ($SO_2$).

Ambient air quality contaminants are described in Table 2.5-1.

**Table 2.5-1: Description of Air Contaminants Used as Ambient Air Quality Indicators**

| Air Contaminant Chemical Species | Description |
|---|---|
| $NO_x$ | $NO_x$ gas is a product of fuel combustion and primarily consists of nitrogen monoxide (NO) and $NO_2$. The gases are emitted with exhaust from combustion engines, power generation, and products from blasting operations. NO can be converted to $NO_2$ in the atmosphere. $NO_x$ emissions can also be converted to nitric acid in the atmosphere, which contributes to acid deposition. $NO_2$ can be harmful to humans at high concentrations. |
| $SO_2$ | Fossil fuels contain a small amount of organic sulphur compounds. During fuel combustion, the sulphur is oxidized and emitted as $SO_2$ gas with the combustion exhaust. In the atmosphere, $SO_2$ can further oxidize to sulphate particles, which contribute to acid deposition. $SO_2$ can be harmful to humans at high concentrations. |

# 3. AIR QUALITY STANDARDS, OBJECTIVES, AND GUIDELINES

The AQMS incorporates the Nunavut Ambient Air Quality Standards (Government of Nunavut 2011) and SOGs from the federal government (Government of Canada 2017a and 2017b).

The ambient air quality SOGs for $NO_2$ and $SO_2$ are summarized in Table 3-1. The model results were compared to the 2025 Canadian Ambient Air Quality Standards (CAAQS) because they are more stringent and more recent than the Nunavut standards.

**Table 3-1: Ambient Air Quality Standards, Objectives, and Guidelines for $NO_2$ and $SO_2$**

| Contaminant | Averaging Period | Objectives/Standards (µg/m$^3$) | | |
|---|---|---|---|---|
| | | Federal CAAQS[a,b] | | Nunavut[c] |
| | | 2020 | 2025 | |
| $NO_2$ | 1-hour | 113[d] | 79[d] | 400 |
| | 24-hour | N/A | N/A | 200 |
| | Annual | 32[e] | 22.5[e] | 60 |
| $SO_2$ | 1-hour | 183[f] | 170[f] | 450 |
| | 24-hour | N/A | N/A | 150 |
| | Annual | 13[g] | 10.5[g] | 30 |

Sources: [a] Government of Canada 2017a, [b] Government of Canada 2017b, and [c] Government of Nunavut 2011.

*Notes:*

*[d] Canadian Ambient Air Quality Standard is 113 µg/m$^3$ from December 2017 through December 2024 and 79 µg/m$^3$ as of January 2025 (Government of Canada 2017a); compliance based on a three-year average of the annual 98$^{th}$ percentile of the daily 1-hour maximum concentration (D1HM).*

*[e] Canadian Ambient Air Quality Standard is 32 µg/m$^3$ from December 2017 through December 2024 and 22.5 µg/m$^3$ as of January 2025 (Government of Canada 2017a); compliance based on a one-calendar-year average of all the 1-hour average concentrations.*

*[f] Canadian Ambient Air Quality Standard is 183 µg/m$^3$ from October 2017 through December 2024 and 170 µg/m$^3$ as of January 2025 (Government of Canada 2017b); compliance based on a three-year average of the annual 99$^{th}$ percentile of the daily-maximum 1-hour average concentrations.*

*[g] Canadian Ambient Air Quality Standard is 13 µg/m$^3$ from October 2017 through December 2024 and 10.5 µg/m$^3$ as of January 2025 (Government of Canada 2017b); compliance based on a one-calendar-year average of all the 1-hour average concentrations.*

# 4. MODELLING METHODOLOGY

## 4.1 Existing Ambient Air Quality

Existing ambient air quality represents the ambient air quality conditions in the area of the Meliadine Mine due to non-mine sources. Background concentrations were not added to the modelled concentrations. Due to the remote nature of the site it was assumed that background concentrations of $NO_x$ and $SO_2$ were negligible.

## 4.2 Model Selection

The AQMS was completed using the CALPUFF air dispersion model (version 7; Exponent 2021) to simulate the resulting ambient air quality from Meliadine Extension emission sources. The CALPUFF model was chosen for the following reasons:

- It is a non-steady state Lagrangian puff model suitable for local scale (within 10 km of emission source), regional scale (10 to 50 km from emission source) and long-range transport (50 to 200 km from emission source) applications;
- It is capable of modelling the interaction between source emissions where those emissions are transported for more than an hour, by keeping track of emissions on a time and space varying basis;
- It has the capability of modelling road sources with an algorithm specifically designed to account for the shape and elevation of each segment of the road;
- It can model meteorologically complex situations such as land and sea breezes, complex terrain effects, and recirculation; and
- It was used and accepted as AQ modelling for the 2014 FEIS for the Meliadine Mine.

The latest non-beta version of the CALPUFF modelling system (version 7.2.1, Level 150618) was used because it aligns with the recommendations from ENV (BC MOE 2015).

There are many modular components that make up the CALPUFF modelling system (e.g., pre-processors, core models, post-processors, utilities), each with their own name and version number. For simplicity in this report, the overall CALPUFF modelling system will simply be referred to as “CALPUFF”, rather than referring to individual modules. The exception is the CALMET pre-processor (it prepares meteorological inputs for CALPUFF) which is explicitly referenced.

## 4.3 Model Configuration

The CALPUFF model uses a variety of input data and parameters, including terrain elevation, land use and meteorological datasets specific to the Meliadine Mine area. The model used air emission inventories specific to mine operations and the Meliadine Extension operation activities. These emission inventories were calculated using the information available at the time (August 2021), along with a variety of different published emission factors (see Section 5).

Emissions originate from three different types of modelled sources: point (with a defined stack or vent), volume (where emissions occur across an area, at heights above ground level, such as blasting in surface pits), and road (emissions due to vehicle exhaust); source characterizations are described further in Section 5. To provide a better understanding of the major contributors to predicted impacts, each source was modelled individually and a post-processor was used that reads and combines the binary output files produced by CALPUFF to determine overall total modelled concentration for the various contaminants and averaging times. The post-processor identifies maximum concentrations and identifies the specific source contributions to the total. Each source was modelled with base (1-hour) emission rates for each contaminant, and the post-processor was used to scale the model output as necessary for longer averaging periods (i.e., 24-hour, annual). This approach provides an efficient and flexible methodology for processing CALPUFF output, and has been tested against the CALPUFF post processors to ensure accuracy.

## 4.4 Model Grids

### *4.4.1 Meteorological Grid*

The meteorological grid is used to define the three-dimensional spatial area where meteorological conditions are modelled. The horizontal meteorological grid used for the AQMS was 51 km (north to south) by 46 km (east to west) and was centred approximately on the middle of the Meliadine Mine. The horizontal dimensional meteorological grid spacing was 0.5 km. There were 10 vertical layers above the surface used for the meteorological grid. The bottom heights of each cell layer were: 0, 20, 50, 100, 200, 400, 800, 1,200, 1,600 and 2,200 m, with the last cell having a top height of 3,000 m.

The AQMS used the CALMET output files (i.e. meteorological data) from the 2014 FEIS AQ modelling for the Meliadine Mine, for which the grid size, spacing and vertical layers had been chosen to be appropriate for the terrain characteristics and meteorological conditions of the Meliadine Mine regional area.

### *4.4.2 Computational Grid*

The computational grid is used to define the three dimensional spatial area where simulated puffs are released and advected by the CALPUFF model. The AQMS used a 43 km east-west by 48 km north-south rectangle, which is larger than the 35 km by 35 km computational grid that was used in the Meliadine Mine 2014 FEIS modelling.

### *4.4.3 Sampling Grid*

The sampling grid is used to define the spatial area were receptors are placed for calculation of air contaminant concentrations. Both gridded and discrete sensitive receptors were used in the AQMS. Receptor spacing and development is discussed in Section 4.6.

## 4.5 Model Domains

### *4.5.1 Spatial Domains*

The AQMS spatial domain (study area) was established based on the “zone of influence” beyond which potential air contaminant concentrations from the Meliadine Mine are expected to diminish to near background levels. The AQMS spatial domain and receptor locations are shown in Figure 4.5-1.

### *4.5.2 Temporal Domains*

The temporal boundaries include modelling air emissions and ambient air quality during 2030. The current LOM plan states that 2030 is the year with a maximum total amount of material (overburden, tailings, waste rock, salt rock, and ore combined) being moved. Most of the point sources have fixed emission rates. Other main air emission sources at the Meliadine Mine (roads, pits, vent raises, and portals) will have higher emission rates with higher amounts of material moved.

Ambient air quality modelling predictions were not completed for the closure and post-closure periods. The air emissions during these phases in the LOM will be lower than the air emissions during the operation phase. The resulting ambient concentrations of $NO_x$ and $SO_2$ are therefore expected to be lower during the closure and post-closure periods than during the operation period.

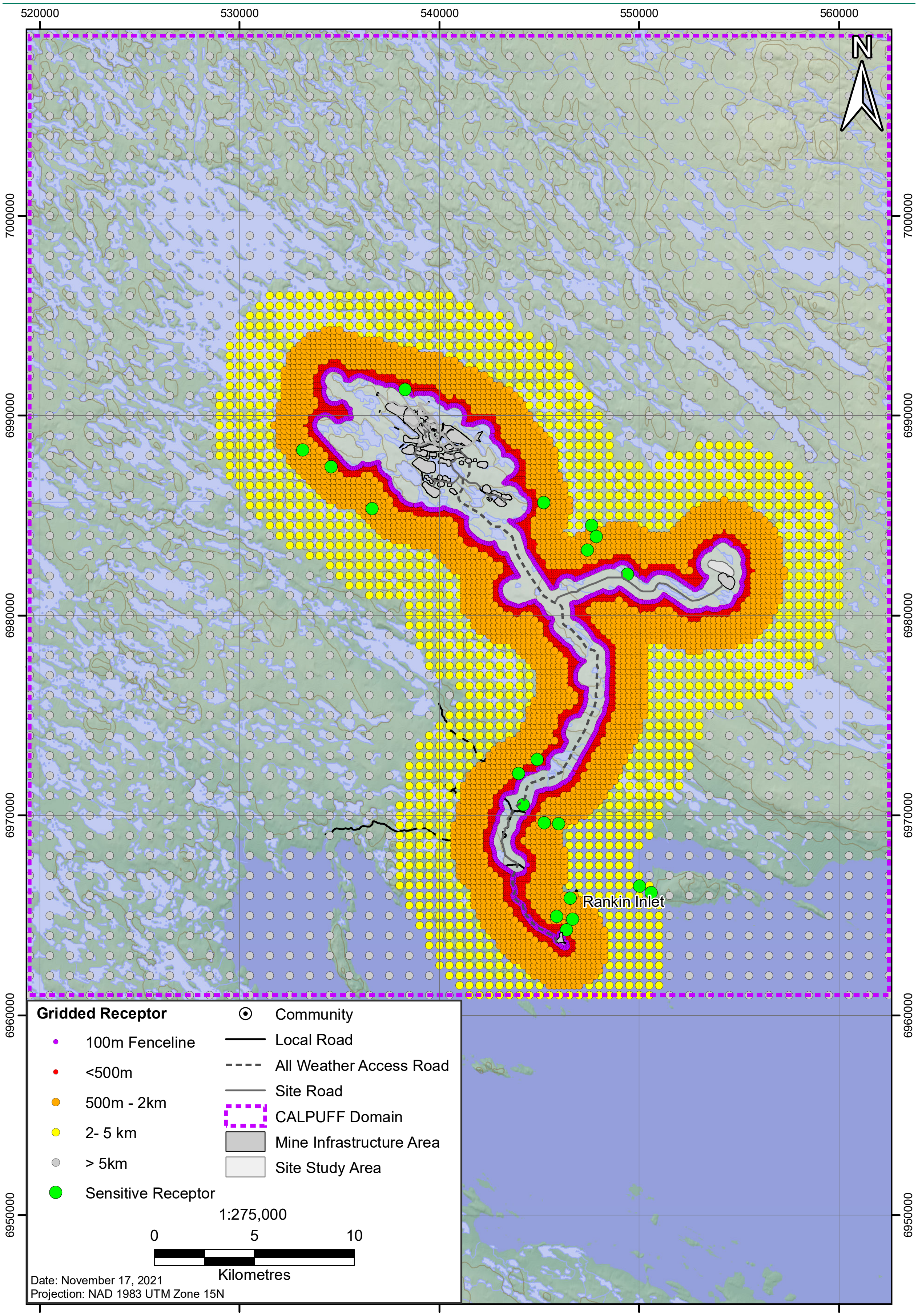


**Figure 4.5-1: CALPUFF Model Spatial Domain and Receptor Locations**

## 4.6 Model Receptors

In air dispersion modelling, concentrations of the modelled species are predicted at a set of locations (UTM points, each with an elevation above sea level). These locations are called receptors. The air quality model used a combination of gridded receptors and discrete sensitive receptors.

### *4.6.1 Gridded Receptors*

Nested grids of receptors are often used in air dispersion modelling, with denser receptor grids closer to the emission sources and less dense grids farther away. The purpose of this approach is to better resolve the highest predicted concentrations, which tend to occur closer to the emission sources. Beyond a distance of 500 m from the Site Study Area, the gridded receptor spacing followed the specifications in the BC Air Quality Dispersion Modelling Guideline (BC AQMG, BC MOE 2015):

- 100 m spacing along the perimeter of the Site Study Area; (BC AQMG specifies 20 m spacing);
- 100 m spacing within 500 m of the Site Study Area; (BC AQMG specifies 50 m spacing);
- 250 m spacing within 2 km of the Site Study Area (follows BC AQMG);
- 500 m spacing within 5 km of the Site Study Area (follows BC AQMG); and
- 1,000 m spacing beyond 5 km of the Site Study Area (follows BC AQMG).

Because of the large size of the Site Study Area, which includes the road to the Discovery pit and the AWAR to Rankin Inlet, the 20 m and 50 m grids were adjusted to 100 m spacing. This resulted in a total of 12,295 receptors, whereas using the BC AQMG spacing for all grids would have produced over 30,000 receptors. The modelled receptor grid is shown in Figure 4.5-1.

As discussed above in Section 2.3, the receptor grid (and therefore the CALPUFF domain) in the current assessment was larger than in the 2014 FEIS, in order to expand the area in which predicted concentrations are available for the purposes of assessing potential impacts.

### *4.6.2 Discrete Sensitive Receptors*

Discrete sensitive receptors were used to model the air quality at specific locations of interest to human health in the Meliadine Mine area. The results at these receptors are used to inform components of the FEIS Addendum for the Meliadine Extension such as the Human Health Effects Assessment. The sensitive receptors in the current assessment are different from those in the 2014 FEIS; they have been updated to account for current locations of cabins. Generally the updated sensitive receptors are closer to the mine site compared to the 2014 FEIS. Discrete sensitive receptor locations in the current assessment are shown in Figure 4.5-1 and are tabulated in Appendix A.

## 4.7 Model Input Data

### *4.7.1 Terrain Elevation Data*

Terrain elevation data used in the modelling were Canadian Digital Elevation Model (CDEM), obtained in a gridded format at 20 m horizontal resolution (Government of Canada 2021). These data were used to interpolate elevations of the modelled sources and receptors. The CALMET output files from the 2014 FEIS modelling were produced using elevation data from the Shuttle Radar Topography Mission (SRTM; Agnico Eagle 2014).

### 4.7.2 Land Use Data

Land use data at 30 m resolution from the Landsat satellite were input to CALMET using the CTGPROC land use pre-processor (Agnico Eagle 2014).

### 4.7.3 Meteorological Data

The CALMET processor was used to create CALPUFF-ready inputs which consist of hourly values of surface parameters (e.g. stability category, mixing depth, air temperature) and profiles of wind speed and direction at each grid cell throughout the modelling domain. CALMET used the output of a meteorological model, the Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model version 5 (MM5), as the primary input. The years 2006 through 2010 were used (Agnico Eagle 2014).

The MM5 meteorological data covered an area of approximately 50 km (north to south) by 50 km (east to west) with a horizontal resolution of 4 km. Upper air data required by the model were also provided by the MM5 dataset.

### 4.7.4 CALMET QA/QC

The quality assurance and quality control process (QA/QC) for the CALMET output is described, with plots, in the 2014 FEIS modelling report (Agnico Eagle 2014).

### 4.7.5 Existing Ambient Air Quality

Existing ambient air quality data in the form of background values were not added to the model results (see Section 4.1), due to the remote nature of the site and to be as consistent as possible (within reason) with the 2014 FEIS modelling.

### 4.7.6 Emission Sources

Emission sources used as part of the model input are discussed in Section 5.

### 4.7.7 Model Parameters

The list of parameters (or switches) used to run CALPUFF are included in Appendix B. Parameters were chosen based on professional judgement, experience and guidance from the BC AQMG (BC MOE 2015).

### 4.7.8 Nitrogen Oxides and Nitrogen Dioxide

$NO_x$ emissions were included as model input in the emissions inventory and resulting ambient $NO_x$ concentrations were predicted. Ambient $NO_2$ concentrations were calculated from the predicted ambient $NO_x$ concentrations using the Ambient Ratio Method (ARM), the Rural curve in Figure A-1 (ENV 2021). The ARM Rural curve uses hourly NO and $NO_2$ observations from at least one year of representative monitoring data from five sites. The ARM Rural curve provides:

- a lower $NO_x$ limit of 56.4 µg/m$^3$ (up to 56.4 µg/m$^3$ of $NO_x$, the $NO_2/NO_x$ ratio = 0.9);
- an upper $NO_x$ limit of 316.7 µg/m$^3$ (above 316.7 µg/m$^3$ of $NO_x$, the $NO_2/NO_x$ ratio = 0.2); and
- a curve describing the upper envelope of the scatterplot of the $NO_2/NO_x$ ratio vs $NO_x$ (between 56.4 µg/m$^3$ and 316.7 µg/m$^3$ of $NO_x$). The equation of the curve is:

$$NO_2/NO_x = -1.4534E\text{-}14(NO_x)^6 + 2.0910E\text{-}11(NO_x)^5 - 1.1639E\text{-}8(NO_x)^4 + 3.1248E\text{-}06(NO_x)^3 - 4.0219E\text{-}04(NO_x)^2 + 1.8014E\text{-}02(NO_x) + 0.70908$$

The curve is shown in Figure 4.7-1.

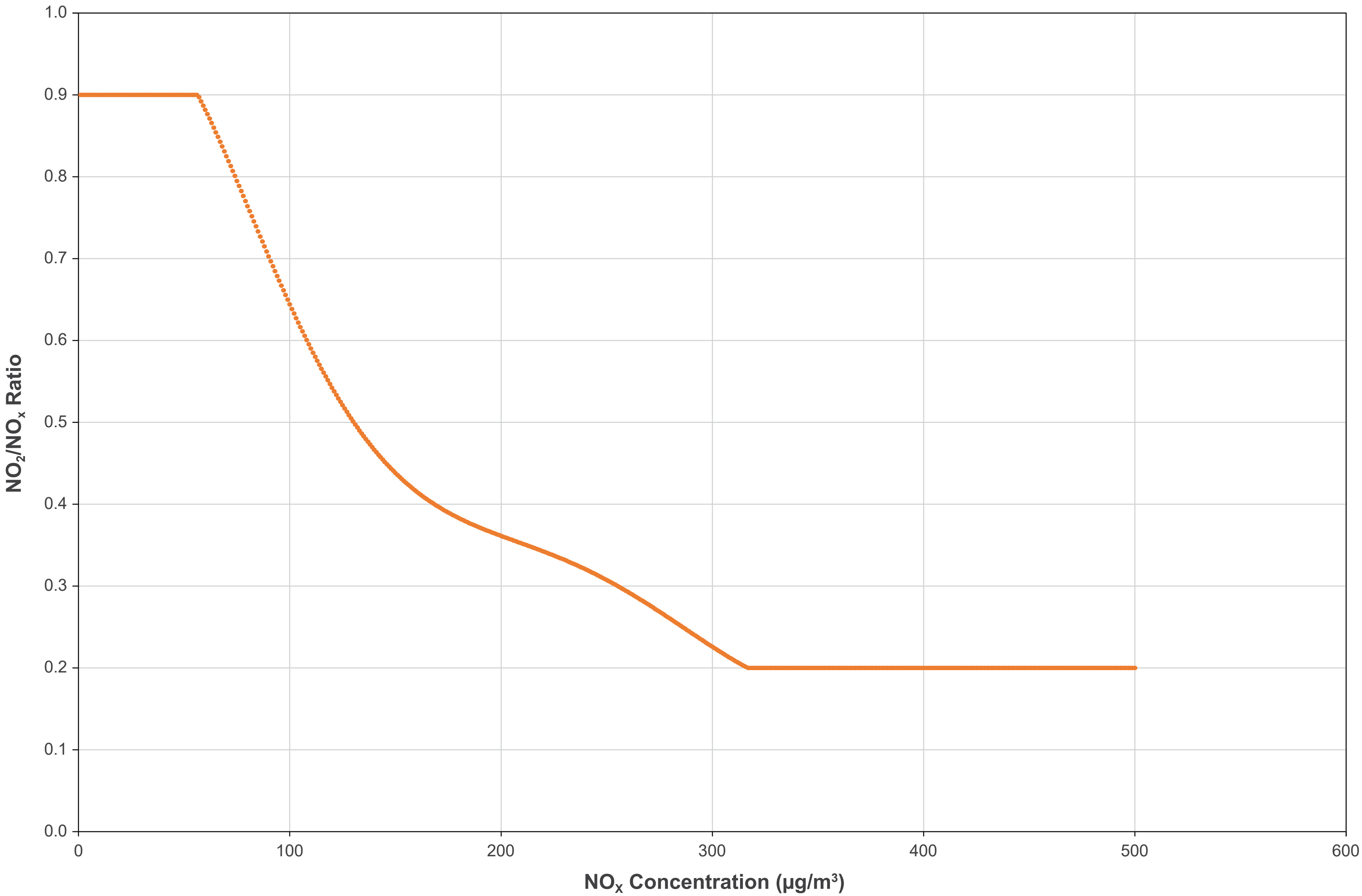


**Figure 4.7-1: Relationship of $NO_2/NO_x$ Ratio to $NO_x$ Concentration (µg/m$^3$), BC MOE Ambient Ratio Method Rural Curve**

# 5. EMISSIONS INVENTORY

An emissions inventory was prepared for the AQMS that was used to calculate inputs for the air dispersion model. The objective of the emissions inventory was to estimate maximum air emissions of air contaminants from the Meliadine Extension components and activities during 2030.

The emissions inventory for the AQMS was built using a number of information sources, calculations and assumptions. The primary source of information about air emissions was Agnico Eagle.

Details about the methods used to quantify the Meliadine Mine's air emissions are provided in Appendix C. The emissions inventory is tabulated in Appendix D.

## 5.1 Emissions Inventory Scenarios

The total emission rates of each modelled contaminant are summarized by source group in Table 5.1-1, for Scenario 1. Note that these rates cannot be used to calculate total annual emissions because some sources, such as the incinerator, underground blasting, and surface blasting are not active 24 hours per day.

**Table 5.1-1: Emissions Summary, Scenario 1**

| Source Group (units) | $NO_x$ | $SO_2$ |
|---|---|---|
| Generators, Incinerator, Gensets (g/s) | 6.83E+01 | 4.33E-02 |
| Vent Raises, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Portals, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Vent Raises, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Portals, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Volume Sources, Surface Blasting emissions (g/s) | 1.27E+00 | 0 |
| Road Sources (g/s/m) | 9.55E-05 | 1.96E-06 |

The total emission rates of each modelled contaminant are summarized by source type in Table 5.1-2, for Scenario 2.

**Table 5.1-2: Emissions Summary, Scenario 2**

| Source Group (units) | $NO_x$ | $SO_2$ |
|---|---|---|
| Generators, Incinerator, Gensets (g/s) | 3.63E+01 | 3.41E-02 |
| Vent Raises, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Portals, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Vent Raises, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Portals, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Volume Sources, Surface Blasting emissions (g/s) | 1.27E+00 | 0 |
| Road Sources (g/s/m) | 9.55E-05 | 1.96E-06 |

The total emission rates of each modelled contaminant are summarized by source type in Table 5.1-3, for Scenario 3.

**Table 5.1-3: Emissions Summary, Scenario 3**

| Source Group (units) | $NO_x$ | $SO_2$ |
|---|---|---|
| Generators, Incinerator, Gensets (g/s) | 2.04E+01 | 2.95E-02 |
| Vent Raises, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Portals, UG Mobile emissions (g/s) | 5.60E-02 | 1.44E-03 |
| Vent Raises, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Portals, UG Blasting emissions (g/s) | 2.84E-01 | 0 |
| Volume Sources, Surface Blasting emissions (g/s) | 1.27E+00 | 0 |
| Road Sources (g/s/m) | 9.55E-05 | 1.96E-06 |

## 5.2 Common Assumptions

Where input data uncertainties existed, conservative assumptions following regulatory guidance, professional judgement and experience were used. The use of conservative assumptions can lead to conservative model predictions and therefore the results from the model study are interpreted with the understanding that the predicted effects are likely overestimated.

Common assumptions used to prepare the emissions inventory are listed below.

- Unless specified, all emissions are generated at a constant rate at all times of the year.
- The US EPA Motor Vehicle Emission Simulator version 2014b (MOVES2014b; US EPA 2018) was used to generate emission factors for all mobile equipment.

Additional assumptions specific to each emission source type are described in Section 5.4 and in Appendix C.

## 5.3 Emission Scaling Factors

For the purpose of modelling the maximum 1-hour and annual average ambient air concentrations used to compare against the relevant ambient air quality SOGs (see Section 3), emission scaling factors were not used to adjust model output. This was because real-world emissions that are not approximately continuous were modelled in CALPUFF with variable emission rates (i.e. emissions were modelled during only the hours, days, or months when a given source was active).

For most emission sources, it was assumed that emissions were generated continuously for the purpose of modelling the maximum 1-hour ambient air quality (i.e., the 1-hour emission scaling factor is 1.0). For blasting, the total amount of emissions calculated to be released within a one hour period were divided equally over the one hour period. In these cases, the resulting adjusted emission rate will account for the sub-hourly emissions and therefore a 1-hour emission scaling factor of 1.0 was used.

## 5.4 Emission Sources

Air emissions associated with the Meliadine Mine and the Meliadine Extension are outlined in this section. The current assessment modelled the Meliadine Extension, but because it is an extension of the existing mine, as opposed to a completely new or separate mine, the Extension has some sources in common with the existing mine. For example, as stated below in Section 5.4.1, some emission information came from stack test reports.

Sources were categorized and modelled as CALPUFF point, volume, or road sources. The CALPUFF road source type was first introduced in CALPUFF version 7, which was released in June 2015.

### 5.4.1 Point Sources

Air emission sources emitted by a fixed stack were modelled as CALPUFF point sources.

The 16 point sources included in the modelling were identified and characterized based on information provided by Agnico Eagle. See Appendix D for a list of the point sources modelled.

The characteristics of each stack and the sources of information used to inform each stack characteristic are listed in Appendix C. Some information was provided by Agnico Eagle without additional details about the source of the information (e.g., information could be from as-built specifications, measured data, or estimated data).

The modelled emission species for each stack and the sources of information used to determine each stack's emission species are included in Appendix C.

The most recent stack test reports were used to inform some of the stack information (see Appendix C, Tables C2.3-2 and C2.3-4).

Emission rate references for $NO_x$ and $SO_2$ are listed in Appendix C, Table C2.3-4.

Emissions from point sources can be subject to plume downwash, a phenomenon in which sufficiently high buildings that are located sufficiently close to a stack can disrupt airflow around them, entraining the plume and drawing it down to ground level, causing high ground-level concentrations near the stack. To account for this in the modelling, the Building Profile Input Program for the PRIME algorithm (BPIP-PRIME) was used. Stack heights and locations, and building heights and locations, are input to BPIP-PRIME, which assesses the potential downwash effect (if any) of each building on each stack. The output from BPIP-PRIME was then used as part of the CALPUFF input files. A list of the 13 buildings that were input to BPIP-PRIME is provided in Appendix E.

#### 5.4.1.1 Underground Mobile Emissions

Emissions from underground vehicles were modelled as emissions from vent raises and portals, both of which were modelled as point sources. Each underground mining area was associated with one vent raise and one portal. The emissions for each area were divided evenly between the applicable vent raise and portal. Point source emission parameters (e.g. stack height, stack diameter, exit velocity) were either provided by Agnico Eagle, or sufficient data were provided to enable the calculation of the parameters. Exit velocities were calculated for the portals, but because their orientation is nearly horizontal as opposed to vertical, it was assumed that they decline 10 degrees from the horizontal and then calculated the vertical component of their exit velocity for use as the exit velocity of the modelled point source.

#### 5.4.1.2 Underground Blasting Emissions

Point sources (vent raises and portals) were used to model emissions from underground blasting. Underground blasting was modelled at the following areas:

- Tiriganiaq Underground, one blast per day during January through August, and October, 5 pm – 6 pm;
- Pump Underground, one blast per day during September and November, 5 pm – 6 pm; and
- Discovery Underground, one blast per day during December, 5 pm – 6 pm.

Each underground mining area was associated with one vent raise and one portal. The emissions for each area were divided evenly between the applicable vent raise and portal.

Agnico Eagle stated that underground blasts in 2030 will occur at the locations and times listed above and that underground blasting will occur seven days per week. For the annual underground blasting emissions inventory, it was assumed there are seven blasts per week, site-wide. The modelling used emission rates (in g/s) calculated based on total annual emissions divided by seven underground blasts per week.

In order to calculate emissions from the use of the emulsion for blasting product, blasting emissions for $NO_x$ and $SO_2$ in each area were calculated using emission factors obtained by Agnico Eagle from the supplier. In Appendix C, Table C2.3-5 describes the input data used for the emissions inventory calculations.

### 5.4.2 Volume Sources

Volume sources were used to model emissions from surface blasting, meaning blasting in pits. Surface blasting was modelled at the following pits:

- Wesmeg WN01, one blast every Wednesday, Thursday, and Friday, 5 pm – 6pm;
- Pump 03, one blast every Tuesday, 5 am – 6 am; and
- F Zone 01, one blast every Monday, 5 am – 6 am.

Blasting activities inside the pits were modelled with one volume source in each pit, located approximately in the centre of the pit.

Agnico Eagle stated that surface blasts in 2030 will occur during the days and times listed above, and that surface blasting will occur five days per week. For the 2030 surface blasting emissions inventory, it was assumed that there are five blasts per week, site-wide. The modelling used emission rates (in g/s) calculated based on total annual emissions divided by five surface blasts per week.

In order to calculate emissions from the use of the emulsion for blasting product, blasting emissions for $NO_x$ and $SO_2$ in each pit were calculated using emission factors obtained by Agnico Eagle from the supplier. In Appendix C, Table C2.4-1 describes the input data used for the emissions inventory calculations.

### 5.4.3 Road Sources

CALPUFF road sources were used to model tailpipe emissions along specific roads from specific equipment categories and activities. Emission rates of $NO_x$ and $SO_2$ were modelled using the MOVES2014b emissions model (US EPA 2018), which classifies vehicles as either OnRoad (highway-legal vehicles such as pickup trucks and long-distance cargo trucks) or NonRoad (non-highway vehicles such as mine haul trucks, bulldozers, graders, and man lifts).

Mobile equipment information for OnRoad and NonRoad equipment for both the surface and underground fleets was provided by Agnico Eagle, including details of equipment type, equipment model number, active status and usage area. For simplicity and with the aim of being slightly conservative, all OnRoad and NonRoad mobile units were assumed to have a 2020 engine manufacture year; because the modelled year of emissions was 2030, this means that all units were assumed to be 10 years old.

Tailpipe emission factors for OnRoad and NonRoad equipment are described in Sections 5.4.3.1 and 5.4.3.2.

#### 5.4.3.1 On-road Equipment Emission Factors

On-road vehicle emissions were calculated using MOVES2014b, using the OnRoad module. All model configuration parameters are listed in Appendix C, Table C2.5-1 for the OnRoad module run.

The engine load factors and utilization rates for on-road equipment are incorporated into the OnRoad module and the emission rate factor output is in units of grams per vehicle kilometre travelled (g/VKT).

The on-road equipment that was modelled with CALPUFF road sources included:

- pickup trucks;
- transport buses (assigned as light commercial trucks in MOVES2014b output); and
- transport and fuel trucks (assigned as single unit long-haul trucks in MOVES2014b output).

#### *5.4.3.2 Non-road Equipment Emission Factors*

Non-road vehicle emissions were calculated using MOVES2014b, using the NonRoad module. All model configuration parameters are listed in Appendix C, Table C2.5-2 for the NonRoad module run.

The non-road equipment that was modelled as CALPUFF road sources included:

- mine haul trucks;
- loaders;
- backhoes;
- bulldozers;
- skidsteers;
- forklifts;
- telehandlers;
- manlifts; and
- cranes.

Unlike the OnRoad module, the engine load factors and equipment utilization rates for non-road equipment are not incorporated in the emission rate factor output (g/s units). Engine load factor ratings for non-road equipment were taken from US EPA *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling* (2010). The utilization rate (operating hours per year) for all mobile units was provided by Agnico Eagle.

#### *5.4.3.3 Tailpipe Emissions*

Tailpipe emission factors for OnRoad equipment (g/VKT) and NonRoad equipment (g/s) were converted to the same units of g/VKT. NonRoad equipment emission factors in g/VKT were calculated by:

$$EF\left(\frac{g}{VKT}\right) = vehicle\ emission\ rate\ \left(\frac{g}{s}\right) * \frac{length\ of\ each\ road\ transit\ (km)}{vehicle\ speed\ (\frac{km}{h})} * \frac{1}{length\ of\ each\ road\ transit\ (km)}$$

Tailpipe emission rates for the CALUFF road source (g/s/m) were then calculated for each modelled road segment by:

$$Road\ source\ emission\ rate\ \left(\frac{g}{s\ m}\right) = vehicle\ emission\ rate\ \left(\frac{g}{VKT}\right) * road\ segment\ length\ (km) * number\ of\ one\ way\ vehicle\ transits\ per\ hour * time\ unit\ conversion * distance\ unit\ conversion$$

The modelled road segments, distances, speeds, and vehicle types are listed in Appendix C, Table C2.5-3, and references are listed in Appendix C, Table C2.5-4.

For haul truck traffic, the emissions for each road segment were calculated based on the known amount of material (overburden, tailings, waste rock, salt rock, and ore) transported to different areas of the mine (e.g., crusher location and waste rock locations). Appendix C, Table C2.5-5 summarizes the 2030 material movement amounts based on Agnico Eagle's LOM data.

# 6. MODELLING RESULTS

Predicted ambient air quality results are presented for three modelled cases:

- Scenario 1 – 0% of required power from the wind farm.
- Scenario 2 – 50% of required power from the wind farm.
- Scenario 3 – 75% of required power from the wind farm.

Results are presented by using the 99th or 98th percentile (according to the relevant ambient air quality SOGs) predicted contaminant concentration for each applicable averaging period. The results include gridded and discrete sensitive receptors that were on or outside of the Site Study Area (see Section 4.6). Results from the sensitive receptors are presented separately, in Appendix A.

In the Discovery area of the mine, some receptors are located approximately 430 m east of the Discovery vent raise. Because of the close proximity of the receptors to the emission source, most of the maximum predicted concentrations are located along the east side of the Discovery area, even though the total emissions from this area are lower than from other Meliadine Mine areas. The location of the predicted maxima in the Discovery area is a function of the relatively short distance for dispersion (430 m); it is not an indicator of high emissions from Discovery.

For Scenarios 1, 2 and 3, the modelling represents the year of peak planned Meliadine Mine emissions (2030), and for all three cases it incorporates a number of conservative assumptions (see Section 5). The use of conservative assumptions can lead to conservative model predictions and therefore the model results are interpreted with the understanding that the predicted effects are likely overestimated.

The model results are represented below, in Figure 6-1. No concentration isopleths are shown because there were no modelled concentrations above the 2020 or 2025 CAAQS or Nunavut Standards for $NO_2$ or $SO_2$.

The following air contaminants and averaging periods are presented in the results tables and in Figure 6-1:

- 1-hour and annual $NO_2$; and
- 1-hour and annual $SO_2$.

## 6.1 Scenario 1

The maximum predicted ambient air contaminant concentrations for Scenario 1 are summarized in Table 6.1-1. The highest ambient concentrations were located within 1 km of the Site Study Area. There were no predicted concentrations above the 2020 or 2025 CAAQS for $NO_2$ or $SO_2$.

## 6.2 Scenario 2

The maximum predicted ambient air contaminant concentrations for Scenario 2 are summarized in Table 6.1-1; they were similar to those for Scenario 1. The highest ambient concentrations were located within 1 km of the Site Study Area. There were no predicted concentrations above the 2020 or 2025 CAAQS for $NO_2$ or $SO_2$.

## 6.3 Scenario 3

The maximum predicted ambient air contaminant concentrations for Scenario 3 are summarized in Table 6.1-1; again they were similar to those for Scenario 1. The highest ambient concentrations were located within 1 km of the Site Study Area. There were no predicted concentrations above the 2020 or 2025 CAAQS for $NO_2$ or $SO_2$.

## Table 6.1-1: Maximum Predicted $NO_2$ and $SO_2$ Concentrations

| | | $NO_2$ (µg/m$^3$)[(a)] | | $SO_2$ (µg/m$^3$)[(a)] | |
|---|---|---|---|---|---|
| | | 1-hour Average[(b)] | Annual Average | 1-hour Average[(c)] | Annual Average |
| 2020 CAAQS[(d)] | | 113 | 32 | 183 | 13 |
| 2025 CAAQS[(d)] | | 79 | 22.5 | 170 | 10.5 |
| Scenario 1 | Maximum Predicted Concentration [% of 2025 CAAQS] | 76.9 [97%] | 13.3 [59%] | 48.8 [29%] | 1.7 [17%] |
| | Location of Maximum Predicted Concentration | N of Mine Plant | E of Discovery | E of Discovery | E of Discovery |
| Scenario 2 | Maximum Predicted Concentration [% of 2025 CAAQS] | 76.4 [97%] | 13.1 [58%] | 48.8 [29%] | 1.7 [17%] |
| | Location of Maximum Predicted Concentration | E of Discovery | E of Discovery | E of Discovery | E of Discovery |
| Scenario 3 | Maximum Predicted Concentration [% of 2025 CAAQS] | 76.4 [97%] | 13.0 [58%] | 48.8 [29%] | 1.7 [17%] |
| | Location of Maximum Predicted Concentration | E of Discovery | E of Discovery | E of Discovery | E of Discovery |

*Notes:*

*(a) Background concentrations are not included, as stated in Section 4.1.*

*(b) The 1-hour $NO_2$ value uses the annual 98th percentile of the daily 1-hour maximum (D1HM), averaged over the three modelled years.*

*(c) The 1-hour $SO_2$ value uses the annual 99th percentile of the daily 1-hour maximum (D1HM), averaged over the three modelled years.*

*(d) See Section 3 for a description of the relevant SOGs.*


**Figure 6-1: 1-hour and Annual $NO_2$ and $SO_2$ Predicted Concentrations, Scenarios 1, 2, and 3**

# 7. SUMMARY

The AQMS used the CALPUFF air dispersion model (version 7.2.1) to predict the resulting ambient air quality due to emissions associated with Scenarios 1, 2 and 3.

The air contaminants modelled were $NO_2$ and $SO_2$. Contaminants were compared to relevant ambient air quality SOGs for Canada, which are more stringent and more recent than those for Nunavut.

The predicted ambient air quality results were compared against relevant SOGs for both ambient air quality contaminants. The results showed that concentrations of $NO_2$ and $SO_2$ were not predicted to exceed the relevant thresholds for all three modelled scenarios (no wind farm, 50% of power provided by wind farm, and 75% of power provided by wind farm).

# 8. REFERENCES

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# APPENDIX A DISCRETE SENSITIVE RECEPTOR LOCATIONS AND AMBIENT AIR QUALITY PREDICTIONS

## Appendix A: Discrete Sensitive Receptor Locations and Ambient Air Quality Predictions

| Receptor ID | Description | UTM Coordinates, Zone 15V | | Scenario 1 | | | | Scenario 2 | | | | Scenario 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $NO_2$ (µg/m$^3$) | | $SO_2$ (µg/m$^3$) | | $NO_2$ (µg/m$^3$) | | $SO_2$ (µg/m$^3$) | | $NO_2$ (µg/m$^3$) | | $SO_2$ (µg/m$^3$) | |
| | | Easting (m) | Northing (m) | 1 Hour Average | Annual Average | 1 Hour Average | Annual Average | 1 Hour Average | Annual Average | 1 Hour Average | Annual Average | 1 Hour Average | Annual Average | 1 Hour Average | Annual Average |
| *Background value included in results:* | | | | *none* | *none* | *none* | *none* | *none* | *none* | *none* | *none* | *none* | *none* | *none* | *none* |
| SR_006 | Present Day Cabin | 538285 | 6991299 | 68.5 | 3.2 | 17.0 | 0.14 | 65.0 | 2.1 | 17.0 | 0.14 | 61.7 | 1.6 | 17.0 | 0.14 |
| SR_007 | Present Day Cabin Tatty's | 533152 | 6988279 | 63.1 | 1.2 | 6.1 | 0.05 | 46.6 | 0.8 | 6.1 | 0.05 | 32.6 | 0.6 | 6.1 | 0.05 |
| SR_010 | Present Day Cabin Peter's | 545225 | 6985656 | 61.1 | 2.1 | 7.4 | 0.06 | 45.8 | 1.3 | 7.4 | 0.06 | 39.8 | 0.9 | 7.4 | 0.06 |
| SR_012 | Present Day Cabin Barney Tootoo's | 547622 | 6984512 | 54.9 | 1.5 | 5.5 | 0.05 | 38.1 | 0.9 | 5.5 | 0.05 | 34.3 | 0.7 | 5.5 | 0.05 |
| SR_014 | Present Day Cabin | 549401 | 6982060 | 44.0 | 1.3 | 4.7 | 0.06 | 32.9 | 0.9 | 4.7 | 0.06 | 31.5 | 0.7 | 4.7 | 0.06 |
| SR_015 | Iqalugaarjuup Nunanga Territorial Park | 544890 | 6972788 | 30.5 | 1.4 | 3.1 | 0.09 | 25.4 | 1.1 | 3.1 | 0.09 | 22.7 | 0.9 | 3.1 | 0.09 |
| SR_016 | Iqalugaarjuup Nunanga Territorial Park | 543963 | 6972096 | 29.1 | 1.2 | 3.0 | 0.08 | 24.7 | 1.0 | 3.0 | 0.08 | 21.1 | 0.8 | 3.0 | 0.08 |
| SR_017 | Present Day Cabin Tommy's | 544203 | 6970536 | 26.6 | 1.1 | 2.5 | 0.07 | 22.7 | 0.9 | 2.5 | 0.07 | 19.1 | 0.7 | 2.5 | 0.07 |
| SR_018 | Present Day Cabin Ugjuk's | 545247 | 6969620 | 22.7 | 1.0 | 2.2 | 0.06 | 18.6 | 0.8 | 2.2 | 0.06 | 16.6 | 0.7 | 2.2 | 0.06 |
| SR_019 | Present Day Cabin Angutetuark's | 545976 | 6969572 | 21.4 | 1.1 | 2.1 | 0.06 | 17.1 | 0.8 | 2.1 | 0.06 | 15.5 | 0.7 | 2.1 | 0.06 |
| SR_020 | Present Day Cabin Ollie's | 550012 | 6966463 | 17.8 | 0.9 | 1.5 | 0.05 | 13.7 | 0.7 | 1.5 | 0.05 | 11.8 | 0.6 | 1.5 | 0.05 |
| SR_021 | Present Day Cabin Nattar's | 550596 | 6966144 | 18.0 | 0.9 | 1.5 | 0.05 | 14.0 | 0.7 | 1.5 | 0.05 | 11.8 | 0.6 | 1.5 | 0.05 |
| SR_022 | Rankin Inlet Receptor | 546542 | 6965844 | 18.9 | 0.9 | 1.6 | 0.06 | 15.2 | 0.7 | 1.6 | 0.06 | 13.4 | 0.6 | 1.6 | 0.06 |
| SR_023 | Rankin Inlet Receptor | 545878 | 6964944 | 20.1 | 0.9 | 1.7 | 0.05 | 16.6 | 0.7 | 1.7 | 0.05 | 13.9 | 0.6 | 1.7 | 0.05 |
| SR_024 | Rankin Inlet Receptor | 546669 | 6964799 | 18.2 | 0.9 | 1.6 | 0.05 | 14.6 | 0.7 | 1.6 | 0.05 | 12.7 | 0.6 | 1.6 | 0.05 |
| SR_025 | Rankin Inlet Receptor | 546369 | 6964272 | 19.6 | 0.9 | 1.6 | 0.05 | 15.7 | 0.7 | 1.6 | 0.05 | 13.5 | 0.6 | 1.6 | 0.05 |
| SR_026 | Present Day Cabin | 534577 | 6987444 | 64.7 | 1.3 | 7.4 | 0.07 | 52.9 | 1.0 | 7.4 | 0.07 | 46.3 | 0.8 | 7.4 | 0.07 |
| SR_027 | Present Day Cabin | 536626 | 6985350 | 65.1 | 1.9 | 10.6 | 0.10 | 55.9 | 1.4 | 10.6 | 0.10 | 53.9 | 1.1 | 10.6 | 0.10 |
| SR_028 | Present Day Cabin | 547398 | 6983260 | 46.3 | 1.5 | 5.4 | 0.06 | 37.0 | 1.0 | 5.4 | 0.06 | 36.4 | 0.8 | 5.4 | 0.06 |
| SR_029 | Present Day Cabin | 547844 | 6983936 | 52.7 | 1.5 | 5.2 | 0.05 | 38.5 | 0.9 | 5.2 | 0.05 | 34.1 | 0.7 | 5.2 | 0.05 |

# APPENDIX B CALPUFF PARAMETERS

# Appendix B: CALPUFF Parameters

| Parameter | Description | Value |
|---|---|---|
| METRUN | Run all periods in met data file? (0 = no, 1 = yes) | 0 |
| IBYR | Starting year | 2010 |
| IBMO | Starting month | 1 |
| IBDY | Starting day | 1 |
| IBHR | Starting hour | 0 |
| IBMIN | Starting minute | 0 |
| IBSEC | Starting second | 0 |
| IEYR | Ending year | 2010 |
| IEMO | Ending month | 12 |
| IEDY | Ending day | 31 |
| IEHR | Ending hour | 23 |
| IEMIN | Ending minute | 0 |
| IESEC | Ending second | 0 |
| ABTZ | Base time zone | UTC-0500 |
| NSECDT | Length of modeling time-step (seconds) | 3600 |
| NSPEC | Number of chemical species modeled | 2 |
| NSE | Number of chemical species to be emitted | 2 |
| ITEST | Stop run after SETUP phase (1 = stop, 2 = run) | 2 |
| MRESTART | Control option to read and/or write model restart data | 0 |
| NRESPD | Number of periods in restart output cycle | 0 |
| METFM | Meteorological data format<br>(1 = CALMET, 2 = ISC, 3 = AUSPLUME, 4 = CTDM, 5 = AERMET) | 1 |
| MPRFFM | Meteorological profile data format (1 = CTDM, 2 = AERMET) | 1 |
| AVET | Averaging time (minutes) | 60 |
| PGTIME | PG Averaging time (minutes) | 60 |
| IOUTU | Output units for binary output files (1 = mass, 2 = odour, 3 = radiation) | 1 |
| MGAUSS | Near field vertical distribution (0 = uniform, 1 = Gaussian) | 1 |
| MCTADJ | Terrain adjustment method<br>(0 = none, 1 = ISC-type, 2 = CALPUFF-type, 3 = partial plume path) | 3 |
| MCTSG | Model subgrid-scale complex terrain? (0 = no, 1 = yes) | 0 |
| MSLUG | Near-field puffs modeled as elongated slugs? (0 = no, 1 = yes) | 0 |
| MTRANS | Model transitional plume rise? (0 = no, 1 = yes) | 1 |
| MTIP | Apply stack tip downwash to point sources? (0 = no, 1 = yes) | 1 |
| MRISE | Plume rise module for point sources (1 = Briggs, 2 = numerical) | 1 |
| MTIP_FL | Apply stack tip downwash to flare sources? (0 = no, 1 = yes) | 0 |
| MRISE_FL | Plume rise module for flare sources (1 = Briggs, 2 = numerical) | 2 |

| Parameter | Description | Value |
|---|---|---|
| MBDW | Building downwash method (1 = ISC, 2 = PRIME) | 2 |
| MSHEAR | Treat vertical wind shear? (0 = no, 1 = yes) | 0 |
| MSPLIT | Puff splitting allowed? (0 = no, 1 = yes) | 0 |
| MCHEM | Chemical transformation method (0 = not modeled, 1 = MESOPUFF II, 2 = Userspecified, 3 = RIVAD/ARM3, 4 = MESOPUFF II for OH, 5 = half-life, 6 = RIVAD w/ISORROPIA, 7 = RIVAD w/ISORROPIA CalTech SOA) | 0 |
| MAQCHEM | Model aqueous phase transformation? (0 = no, 1 = yes) | 0 |
| MLWC | Liquid water content flag | 1 |
| MWET | Model wet removal? (0 = no, 1 = yes) | 0 |
| MDRY | Model dry deposition? (0 = no, 1 = yes) | 0 |
| MTILT | Model gravitational settling (plume tilt)? (0 = no, 1 = yes) | 0 |
| MDISP | Dispersion coefficient calculation method (1 = PROFILE.DAT, 2 = Internally, 3 = PG/MP, 4 = MESOPUFF II, 5 = CTDM) | 2 |
| MTURBVW | Turbulence characterization method (only if MDISP = 1 or 5) | 3 |
| MDISP2 | Missing dispersion coefficients method (only if MDISP = 1 or 5) | 3 |
| MTAULY | Sigma-y Lagrangian timescale method | 0 |
| MTAUADV | Advective-decay timescale for turbulence (seconds) | 0 |
| MCTURB | Turbulence method (1 = CALPUFF, 2 = AERMOD) | 1 |
| MROUGH | PG sigma-y and sigma-z surface roughness adjustment? (0 = no, 1 = yes) | 0 |
| MPARTL | Model partial plume penetration for point sources? (0 = no, 1 = yes) | 1 |
| MPARTLBA | Model partial plume penetration for buoyant area sources? (0 = no, 1 = yes) | 1 |
| MTINV | Strength of temperature inversion provided in PROFILE.DAT? (0 = no - compute from default gradients, 1 = yes) | 0 |
| MPDF | PDF used for dispersion under convective conditions? (0 = no, 1 = yes) | 1 |
| MSGTIBL | Sub-grid TIBL module for shoreline? (0 = no, 1 = yes) | 0 |
| MBCON | Boundary conditions modeled? (0 = no, 1 = use BCON.DAT, 2 = use CONC.DAT) | 0 |
| MSOURCE | Save individual source contributions? (0 = no, 1 = yes) | 0 |
| MFOG | Enable FOG model output? (0 = no, 1 = yes - PLUME mode, 2 = yes - RECEPTOR mode) | 0 |
| MREG | Regulatory checks (0 = no checks, 1 = USE PA LRT checks) | 0 |
| CSPEC | Species included in model run | NOX |
| CSPEC | Species included in model run | SO2 |
| PMAP | Map projection system | UTM |
| FEAST | False easting at projection origin (km) | 0.0 |
| FNORTH | False northing at projection origin (km) | 0.0 |
| IUTMZN | UTM zone (1 to 60) | 15 |
| UTMHEM | Hemisphere (N = northern, S = southern) | N |
| RLAT0 | Latitude of projection origin (decimal degrees) | 0.00N |

| Parameter | Description | Value |
|---|---|---|
| RLON0 | Longitude of projection origin (decimal degrees) | 0.00E |
| XLAT1 | 1st standard parallel latitude (decimal degrees) | 30N |
| XLAT2 | 2nd standard parallel latitude (decimal degrees) | 60N |
| DATUM | Datum-region for the coordinates | NAR-B |
| NX | Meteorological grid - number of X grid cells | 92 |
| NY | Meteorological grid - number of Y grid cells | 102 |
| NZ | Meteorological grid - number of vertical layers | 10 |
| DGRIDKM | Meteorological grid spacing (km) | 0.5 |
| ZFACE | Meteorological grid - vertical cell face heights (m) | 0, 20, 50, 100, 200, 400, 800, 1200, 1600, 2200, 3000 |
| XORIGKM | Meteorological grid - X coordinate for SW corner (km) | 519 |
| YORIGKM | Meteorological grid - Y coordinate for SW corner (km) | 6958 |
| IBCOMP | Computational grid - X index of lower left corner | 1 |
| JBCOMP | Computational grid - Y index of lower left corner | 1 |
| IECOMP | Computational grid - X index of upper right corner | 92 |
| JECOMP | Computational grid - Y index of upper right corner | 102 |
| LSAMP | Use sampling grid (gridded receptors) (T = true, F = false) | F |
| IBSAMP | Sampling grid - X index of lower left corner | 1 |
| JBSAMP | Sampling grid - Y index of lower left corner | 1 |
| IESAMP | Sampling grid - X index of upper right corner | 2 |
| JESAMP | Sampling grid - Y index of upper right corner | 2 |
| MESHDN | Sampling grid - nesting factor | 1 |
| ICON | Output concentrations to CONC.DAT? (0 = no, 1 = yes) | 1 |
| IDRY | Output dry deposition fluxes to DFLX.DAT? (0 = no, 1 = yes) | 0 |
| IWET | Output wet deposition fluxes to WFLX.DAT? (0 = no, 1 = yes) | 0 |
| IT2D | Output 2D temperature data? (0 = no, 1 = yes) | 0 |
| IRHO | Output 2D density data? (0 = no, 1 = yes) | 0 |
| IVIS | Output relative humidity data? (0 = no, 1 = yes) | 0 |
| LCOMPRS | Use data compression in output file (T = true, F = false) | T |
| IQAPLOT | Create QA output files suitable for plotting? (0 = no, 1 = yes) | 0 |
| IPFTRAK | Output puff tracking data? (0 = no, 1 = yes use timestep, 2 = yes use sampling step) | 0 |
| IMFLX | Output mass flux across specific boundaries? (0 = no, 1 = yes) | 0 |
| IMBAL | Output mass balance for each species? (0 = no, 1 = yes) | 0 |
| INRISE | Output plume rise data? (0 = no, 1 = yes) | 0 |
| ICPRT | Print concentrations? (0 = no, 1 = yes) | 0 |

| Parameter | Description | Value |
|---|---|---|
| IDPRT | Print dry deposition fluxes? (0 = no, 1 = yes) | 0 |
| IWPRT | Print wet deposition fluxes? (0 = no, 1 = yes) | 0 |
| ICFRQ | Concentration print interval (timesteps) | 1 |
| IDFRQ | Dry deposition flux print interval (timesteps) | 1 |
| IWFRQ | Wet deposition flux print interval (timesteps) | 1 |
| IPRTU | Units for line printer output (e.g., 3 = ug/$m^3$ - ug/$m^2$/s, 5 = odor units) | 3 |
| IMESG | Message tracking run progress on screen (0 = no, 1 and 2 = yes) | 2 |
| LDEBUG | Enable debug output? (0 = no, 1 = yes) | F |
| IPFDEB | First puff to track in debug output | 1 |
| NPFDEB | Number of puffs to track in debug output | 1000 |
| NN1 | Starting meteorological period in debug output | 1 |
| NN2 | Ending meteorological period in debug output | 10 |
| NHILL | Number of terrain features | 0 |
| NCTREC | Number of special complex terrain receptors | 0 |
| MHILL | Terrain and CTSG receptor data format (1 = CTDM, 2 = OPTHILL) | 2 |
| XHILL2M | Horizontal dimension conversion factor to meters | 1 |
| ZHILL2M | Vertical dimension conversion factor to meters | 1 |
| XCTDMKM | X origin of CTDM system relative to CALPUFF system (km) | 0.0 |
| YCTDMKM | Y origin of CTDM system relative to CALPUFF system (km) | 0.0 |
| RCUTR | Reference cuticle resistance (s/cm) | 30 |
| RGR | Reference ground resistance (s/cm) | 10 |
| REACTR | Reference pollutant reactivity | 8 |
| NINT | Number of particle size intervals for effective particle deposition velocity | 9 |
| IVEG | Vegetation state in unirrigated areas<br>(1 = active and unstressed, 2 = active and stressed, 3 = inactive) | 1 |
| MOZ | Ozone background input option (0 = monthly, 1 = hourly from OZONE.DAT) | 1 |
| BCKO3 | Monthly ozone concentrations (ppb) | 12*80 |
| MNH3 | Ammonia background input option (0 = monthly, 1 = from NH3Z.DAT) | 0 |
| MAVGNH3 | Ammonia vertical averaging option<br>(0 = no average, 1 = average over vertical extent of puff) | 1 |
| BCKNH3 | Monthly ammonia concentrations (ppb) | 12*10 |
| RNITE1 | Nighttime $SO_2$ loss rate (%/hr) | 0.2 |
| RNITE2 | Nighttime $NO_x$ loss rate (%/hr) | 2 |
| RNITE3 | Nighttime $HNO_3$ loss rate (%/hr) | 2 |
| MH2O2 | $H_2O_2$ background input option (0 = monthly, 1 = hourly from H2O2.DAT) | 1 |
| BCKH2O2 | Monthly $H_2O_2$ concentrations (ppb) | 12*1 |
| RH_ISRP | Minimum relative humidity for ISORROPIA | 50 |
| SO4_ISRP | Minimum $SO_4$ for ISORROPIA | 0.4 |

| Parameter | Description | Value |
|---|---|---|
| BCKPMF | SOA background fine particulate (ug/m**3) | 12*1 |
| OFRAC | SOA organic fine particulate fraction | 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 |
| VCNX | SOA VOC/NOX ratio | 12*50 |
| NDECAY | Half-life decay blocks | 0 |
| SYTDEP | Horizontal puff size for time-dependent sigma equations (m) | 550 |
| MHFTSZ | Use Heffter equation for sigma-z? (0 = no, 1 = yes) | 0 |
| JSUP | PG stability class above mixed layer | 5 |
| CONK1 | Vertical dispersion constant - stable conditions | 0.01 |
| CONK2 | Vertical dispersion constant - neutral/unstable conditions | 0.1 |
| TBD | Downwash scheme transition point option<br>(<0 = Huber-Snyder, 1.5 = Schulman-Scire, 0.5 = ISC) | 0.5 |
| IURB1 | Beginning land use category for which urban dispersion is assumed | 10 |
| IURB2 | Ending land use category for which urban dispersion is assumed | 19 |
| ILANDUIN | Land use category for modeling domain | 20 |
| Z0IN | Roughness length for modeling domain (m) | 0.25 |
| XLAIIN | Leaf area index for modeling domain | 3 |
| ELEVIN | Elevation above sea level (m) | 0 |
| XLATIN | Meteorological station latitude (deg) | -999.0 |
| XLONIN | Meteorological station longitude (deg) | -999.0 |
| ANEMHT | Anemometer height (m) | 10 |
| ISIGMAV | Lateral turbulence format (0 = read sigma-theta, 1 = read sigma-v) | 1 |
| IMIXCTDM | Mixing heights read option (0 = predicted, 1 = observed) | 0 |
| XMXLEN | Slug length (met grid units) | 1 |
| XSAMLEN | Maximum travel distance of a puff/slug (met grid units) | 1 |
| MXNEW | Maximum number of slugs/puffs release from one source during one time step | 10 |
| MXSAM | Maximum number of sampling steps for one puff/slug during one time step | 10 |
| NCOUNT | Number of iterations used when computing the transport wind for a sampling step that includes gradual rise | 2 |
| SYMIN | Minimum sigma-y for a new puff/slug (m) | 1 |
| SZMIN | Minimum sigma-z for a new puff/slug (m) | 1 |
| SZCAP_M | Maximum sigma-z allowed to avoid numerical problem in calculating virtual time or distance (m) | 5,000,000 |
| SVMIN | Minimum turbulence velocities sigma-v (m/s) | 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 |

| Parameter | Description | Value |
|---|---|---|
| SWMIN | Minimum turbulence velocities sigma-w (m/s) | 0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016 |
| CDIV | Divergence criterion for dw/dz across puff (1/s) | 0, 0 |
| NLUTIBL | TIBL module search radius (met grid cells) | 4 |
| WSCALM | Minimum wind speed allowed for non-calm conditions (m/s) | 0.5 |
| XMAXZI | Maximum mixing height (m) | 3000 |
| XMINZI | Minimum mixing height (m) | 50 |
| TKCAT | Emissions scale-factors temperature categories (K) | 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315 |
| PLX0 | Wind speed profile exponent for stability classes 1 to 6 | 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 |
| PTG0 | Potential temperature gradient for stable classes E and F (deg K/m) | 0.02, 0.035 |
| PPC | Plume path coefficient for stability classes 1 to 6 | 0.5, 0.5, 0.5, 0.5, 0.35, 0.35 |
| SL2PF | Slug-to-puff transition criterion factor (sigma-y/slug length) | 10 |
| FCLIP | Hard-clipping factor for slugs (0.0 = no extrapolation) | 0 |
| NSPLIT | Number of puffs created from vertical splitting | 3 |
| IRESPLIT | Hour for puff re-split | 0,0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0,0,1, 0,0,0,0,0,0 |
| ZISPLIT | Minimum mixing height for splitting (m) | 100 |
| ROLDMAX | Mixing height ratio for splitting | 0.25 |
| NSPLITH | Number of puffs created from horizontal splitting | 5 |
| SYSPLITH | Minimum sigma-y (met grid cells) | 1 |
| SHSPLITH | Minimum puff elongation rate (SYSPLITH/hr) | 2 |
| CNSPLITH | Minimum concentration (g/m$^3$) | 0 |
| EPSSLUG | Fractional convergence criterion for numerical SLUG sampling integration | 0.0001 |
| EPSAREA | Fractional convergence criterion for numerical AREA source integration | 1E-006 |
| DSRISE | Trajectory step-length for numerical rise integration (m) | 1 |
| HTMINBC | Minimum boundary condition puff height (m) | 500 |
| RSAMPBC | Receptor search radius for boundary condition puffs (km) | 10 |
| MDEPBC | Near-surface depletion adjustment to concentration (0 = no, 1 = yes) | 1 |

*Notes:*

*The model parameters in this table were extracted from one of the Scenario 1 CALPUFF.inp files. Many CALPUFF.inp files were used for this assessment.*

# APPENDIX C AIR EMISSIONS INVENTORY METHODOLOGY

# Appendix C: Air Emissions Inventory Methodology

## 1. INTRODUCTION

The purpose of this appendix is to summarize the CALPUFF air emissions inventory methodology that was used to model the Meliadine Gold Mine Extension (the Meliadine Extension), operated by Agnico Eagle Mines Limited (Agnico Eagle).

## 2. EMISSION INVENTORY METHODOLOGY

The Meliadine Extension emissions were calculated using information from the following sources, in priority order:

1. Meliadine Extension infrastructure and activity information provided by Agnico Eagle (e.g., mining rates, mobile equipment fleet inventory, building dimensions).
2. Meliadine Extension infrastructure and activity information available from public sources (e.g., satellite imagery and online photos of the mine).

### 2.1 Common Assumptions

The following common assumptions were used:

- Unless specified, all emissions are generated at a constant rate at all times of the year.
- The US EPA Motor Vehicle Emission Simulator version 2014b (MOVES2014b, US EPA 2018) was used to generate emission factors for all mobile equipment.

### 2.2 Emission Scaling Factors and Variable Emission Rates

For the purpose of modelling the maximum 1-hour and annual average ambient air concentrations, emission scaling factors were not used. This was because real-world emissions that are not approximately continuous were modelled in CALPUFF with variable emission rates.

For most emission sources, it was assumed that emissions were generated continuously for the purpose of modelling the maximum 1-hour ambient air quality (i.e., the 1-hour emission scaling factor is 1.0). For blasting, the total amount of emissions calculated to be released within a one hour period were divided equally over the one hour period. In these cases, the resulting adjusted emission rate will account for the sub-hourly emissions and therefore a 1-hour emission scaling factor of 1.0 was used.

### 2.3 Point Sources

The list of Point Source stacks included in the modelling were those identified during discussions between ERM and Agnico Eagle. Table C2.3-1 lists the Point Source stacks modelled.

The characteristics of each stack are listed in Table C2.3-1. The information used to inform each stack characteristic is listed in Table C2.3-2. Reference cells that are labelled with “Provided by Agnico Eagle” were provided to ERM without additional details about the source of the information (e.g., information could be from as-built specifications, measured data, or estimated data).

Modelled emission species for each stack are listed in Table C2.3-3. The information used to inform each stack emission species is listed in Table C2.3-4.

The most recent stack test reports were used to inform some of the stack information (see Tables C2.3-2 and C2.3-4; Consulair 2020; Wärtsilä 2018).

Emission rate references for $NO_x$ and $SO_2$ are listed in Table C2.3-4.

### *2.3.1 Underground Blasting*

Point sources (vent raises and portals) were used to model emissions from underground blasting. Underground blasting was modelled at the following areas:

- Tiriganiaq Underground, one blast per day during January through August, and October, 5 pm – 6 pm;
- Pump Underground, one blast per day during September and November, 5 pm – 6 pm; and
- Discovery Underground, one blast per day during December, 5 pm – 6 pm.

Each underground mining area was associated with one vent raise and one portal. The emissions for each area were divided evenly between the applicable vent raise and portal.

Agnico Eagle stated that underground blasts in 2030 will occur at the locations and times listed above (ERM selected which months to model blasting for each area, to come as close as possible to the correct number of blasts per area), and that underground blasting will occur seven days per week. For the annual underground blasting emissions inventory, it was assumed there are seven blasts per week, site-wide. The modelling used emission rates (in g/s) calculated based on total annual emissions divided by seven underground blasts per week.

In order to calculate emissions from the use of the emulsion for blasting product, blasting emissions for $NO_x$ and $SO_2$ in each area were calculated using emission factors obtained by Agnico Eagle from the supplier (0.25 kg of $NO_x$ emitted per tonne of product detonated, and no $SO_2$ emissions; Dyno 2019). Table C2.3-5 describes the input data used for the emissions inventory calculations.

## 2.4 Volume Sources

Volume sources were used to model emissions from surface blasting, meaning blasting in pits. Surface blasting was modelled at the following pits:

- Wesmeg WN01, one blast every Wednesday, Thursday, and Friday, 5 pm – 6 pm;
- Pump 03, one blast every Tuesday, 5 am – 6 am; and
- F Zone 01, one blast every Monday, 5 am – 6 am.

Blasting activities inside the pits were modelled with one volume source in each pit, located approximately in the centre of the pit.

Agnico Eagle stated that surface blasts in 2030 will occur during the days and times listed above, and that surface blasting will occur five days per week. For the 2030 surface blasting emission inventory, it was assumed that there are five blasts per week, site-wide. The modelling used emission rates (in g/s) calculated based on total annual emissions divided by five surface blasts per week.

In order to calculate emissions from the use of the emulsion for blasting product, blasting emissions for $NO_x$ and $SO_2$ in each pit were calculated using emission factors obtained by Agnico Eagle from the supplier (0.25 kg of $NO_x$ emitted per tonne of product detonated, and no $SO_2$ emissions; Dyno 2019). Table C2.4-1 describes the input data used for the emission inventory calculations.

### Table C2.3-1: Point Source Stack Characteristics

| Source Description | UTM Easting (m) | UTM Northing (m) | Stack Height (m above ground) | Exit Temperature (Kelvin) | Stack Diameter (m) | Exit Velocity (m/s) | Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Site Generator 1 of 4 (#374 aka Unit 1)[(a)] | 539203 | 6990014 | 40.0 | 505.2 | 1.02 | 16.7 | 13.5 |
| Site Generator 2 of 4 (#376 aka Unit 3)[(b)] | 539200 | 6990022 | 40.0 | 470.2 | 1.02 | 16.0 | 13.0 |
| Site Generator 3 of 4 (#377 aka Unit 4)[(c)] | 539194 | 6990035 | 40.0 | 498.2 | 1.02 | 17.0 | 13.8 |
| Site Generator 4 of 4 (#378 aka Unit 5)[(d)] | 539190 | 6990045 | 40.0 | 509.2 | 1.02 | 18.0 | 14.6 |
| Incinerator | 539393 | 6989830 | 11.1 | 1172.2 | 0.80 | 8.6 | 4.9 |
| gen set 500 kW at 600 V, Discovery | 553721 | 6981510 | 2.0 | 791.4 | 0.20 | 21.7 | 2.2 |
| gen set 500 kW at 600 V, Pump | 540416 | 6986160 | 2.0 | 791.4 | 0.20 | 21.7 | 2.2 |
| gen set 500 kW at 600 V, F Zone | 542412 | 6985960 | 2.0 | 791.4 | 0.20 | 21.7 | 2.2 |
| VR-W, mobile emissions, ventilation raise at Wesmeg | 540687 | 6988138 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| VR-T, mobile emissions, ventilation raise at Tiriganiaq | 539466 | 6987929 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| VR-WN, mobile emissions, ventilation raise at Wesmeg WN01 | 538844 | 6987937 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| VR-PW, mobile emissions, west ventilation raise at Pump | 539455 | 6986656 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| VR-DE, mobile emissions, east ventilation raise at Discovery | 554713 | 6981436 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| PRT-T mobile emissions, new portal near Tiriganiaq | 539937 | 6988798 | 1.0 | 280.9 | 5.00 | 0.7 | 81.5 |
| PRT-P, mobile emissions, portal at Pump | 540440 | 6986209 | 1.0 | 280.9 | 5.00 | 0.7 | 81.5 |
| PRT-D, mobile emissions, portal at Discovery | 554068 | 6981483 | 1.0 | 280.9 | 5.00 | 0.7 | 81.5 |
| BL-VR-T; blasting, Tiriganiaq Underground, vent raise[(e)] | 539466 | 6987929 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| BL-VR-PW; blasting, Pump Underground, vent raise[(e)] | 539455 | 6986656 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| BL-VR-DE; blasting, Discovery Underground, vent raise[(e)] | 554713 | 6981436 | 5.0 | 280.9 | 4.00 | 6.5 | 81.5 |
| BL-PRT-T; blasting, Tiriganiaq Underground, portal[(e)] | 539937 | 6988798 | 1.0 | 280.9 | 5.00 | 0.7 | 81.5 |
| BL-PRT-P; blasting, Pump Underground, portal[(e)] | 540440 | 6986209 | 40.0 | 280.9 | 5.00 | 0.7 | 81.5 |
| BL-PRT-D; blasting, Discovery Underground, portal[(e)] | 554068 | 6981483 | 40.0 | 280.9 | 5.00 | 0.7 | 81.5 |

*Notes:*

[(a)] *Source active for Scenario 1 only.*

[(b)] *Source active for Scenario 1 only.*

[(c)] *Source active for Scenarios 1 and 2 only.*

[(d)] *Source active for Scenarios 1, 2, and 3.*

[(e)] *The underground blasting sources are co-located with the vent raises and portals indicated. They were modelled as separate sources because mobile emissions were assumed to be continuous, whereas blasting emissions are only active at certain times.*

### Table C2.3-2: Point Source Stack Characteristic References

| Source Description | UTM Coordinates | Stack Height | Exit Temperature | Stack Diameter | Exit Velocity | Discharge Rate |
|---|---|---|---|---|---|---|
| Site Generator 1 of 4 (#374 aka Unit 1) | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | January 2018 stack test report |
| Site Generator 2 of 4 (#376 aka Unit 3) | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | January 2018 stack test report |
| Site Generator 3 of 4 (#377 aka Unit 4) | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | January 2018 stack test report |
| Site Generator 4 of 4 (#378 aka Unit 5) | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | January 2018 stack test report |
| Incinerator | Provided by Agnico Eagle | Provided by Agnico Eagle | September 4, 2020 stack test report | Provided by Agnico Eagle | September 4, 2020 stack test report | September 4, 2020 stack test report |
| gen set 500 kW at 600 V, Discovery | Provided by Agnico Eagle | Provided by Agnico Eagle | Manufacturer's spec sheet | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Manufacturer's spec sheet |
| gen set 500 kW at 600 V, Pump | Provided by Agnico Eagle | Provided by Agnico Eagle | Manufacturer's spec sheet | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Manufacturer's spec sheet |
| gen set 500 kW at 600 V, F Zone | Provided by Agnico Eagle | Provided by Agnico Eagle | Manufacturer's spec sheet | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Manufacturer's spec sheet |
| VR-W, mobile emissions, ventilation raise at Wesmeg | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| VR-T, mobile emissions, ventilation raise at Tiriganiaq | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| VR-WN, mobile emissions, ventilation raise at Wesmeg WN01 | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| VR-PW, mobile emissions, west ventilation raise at Pump | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| VR-DE, mobile emissions, east ventilation raise at Discovery | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| PRT-T mobile emissions, new portal near Tiriganiaq | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |
| PRT-P, mobile emissions, portal at Pump | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |
| PRT-D, mobile emissions, portal at Discovery | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |
| BL-VR-T; blasting, Tiriganiaq Underground, vent raise | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| BL-VR-PW; blasting, Pump Underground, vent raise | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| BL-VR-DE; blasting, Discovery Underground, vent raise | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Calculated from stack discharge rate and diameter | Provided by Agnico Eagle |
| BL-PRT-T; blasting, Tiriganiaq Underground, portal | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |
| BL-PRT-P; blasting, Pump Underground, portal | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |
| BL-PRT-D; blasting, Discovery Underground, portal | Provided by Agnico Eagle | Provided by Agnico Eagle | Provided by Agnico Eagle | Estimated from photos provided by Agnico Eagle | Calculated from stack discharge rate and diameter; the vertical component of the angular exit velocity was used | Provided by Agnico Eagle |

## Table C2.3-3: Point Source Stack Emission Species

| Source Description | $NO_x$ | $SO_2$ |
|---|---|---|
| Site Generator 1 of 4 (#374 aka Unit 1) | X | X |
| Site Generator 2 of 4 (#376 aka Unit 3) | X | X |
| Site Generator 3 of 4 (#377 aka Unit 4) | X | X |
| Site Generator 4 of 4 (#378 aka Unit 5) | X | X |
| Incinerator | X | X |
| gen set 500 kW at 600 V, Discovery | X | X |
| gen set 500 kW at 600 V, Pump | X | X |
| gen set 500 kW at 600 V, F Zone | X | X |
| VR-W, mobile emissions, ventilation raise at Wesmeg | X | X |
| VR-T, mobile emissions, ventilation raise at Tiriganiaq | X | X |
| VR-WN, mobile emissions, ventilation raise at Wesmeg WN01 | X | X |
| VR-PW, mobile emissions, west ventilation raise at Pump | X | X |
| VR-DE, mobile emissions, east ventilation raise at Discovery | X | X |
| PRT-T mobile emissions, new portal near Tiriganiaq | X | X |
| PRT-P, mobile emissions, portal at Pump | X | X |
| PRT-D, mobile emissions, portal at Discovery | X | X |
| BL-VR-T; blasting, Tiriganiaq Underground, vent raise | X | - |
| BL-VR-PW; blasting, Pump Underground, vent raise | X | - |
| BL-VR-DE; blasting, Discovery Underground, vent raise | X | - |
| BL-PRT-T; blasting, Tiriganiaq Underground, portal | X | - |
| BL-PRT-P; blasting, Pump Underground, portal | X | - |
| BL-PRT-D; blasting, Discovery Underground, portal | X | - |

*Notes:*
*"X" = species included and emission rate calculated*
*Dash "-" = species not emitted by this source*

### Table C2.3-4: Point Source Stack Emission Rate References

| Source Description | $NO_x$ | $SO_2$ |
|---|---|---|
| Site Generator 1 of 4 (#374 aka Unit 1) | January 2018 stack test report. | Calculated from fuel consumption rate |
| Site Generator 2 of 4 (#376 aka Unit 3) | January 2018 stack test report. | Calculated from fuel consumption rate |
| Site Generator 3 of 4 (#377 aka Unit 4) | January 2018 stack test report. | Calculated from fuel consumption rate |
| Site Generator 4 of 4 (#378 aka Unit 5) | January 2018 stack test report. | Calculated from fuel consumption rate |
| Incinerator | September 4, 2020 stack test report | Calculated from fuel consumption rate |
| gen set 500 kW at 600 V, Discovery | Manufacturer’s spec sheet | Calculated from fuel consumption rate |
| gen set 500 kW at 600 V, Pump | Manufacturer’s spec sheet | Calculated from fuel consumption rate |
| gen set 500 kW at 600 V, F Zone | Manufacturer’s spec sheet | Calculated from fuel consumption rate |
| VR-W, mobile emissions, ventilation raise at Wesmeg | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| VR-T, mobile emissions, ventilation raise at Tiriganiaq | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| VR-WN, mobile emissions, ventilation raise at Wesmeg WN01 | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| VR-PW, mobile emissions, west ventilation raise at Pump | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| VR-DE, mobile emissions, east ventilation raise at Discovery | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| PRT-T mobile emissions, new portal near Tiriganiaq | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| PRT-P, mobile emissions, portal at Pump | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| PRT-D, mobile emissions, portal at Discovery | Calculated from MOVES2014b output for the mobile fleet | Calculated from MOVES2014b output for the mobile fleet |
| BL-VR-T; blasting, Tiriganiaq Underground, vent raise | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |
| BL-VR-PW; blasting, Pump Underground, vent raise | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |
| BL-VR-DE; blasting, Discovery Underground, vent raise | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |
| BL-PRT-T; blasting, Tiriganiaq Underground, portal | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |
| BL-PRT-P; blasting, Pump Underground, portal | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |
| BL-PRT-D; blasting, Discovery Underground, portal | Calculated from emission factor provided by Agnico Eagle | Emission factor of zero provided by Agnico Eagle |

## Table C2.3-5: Underground Blasting, Calculation Inputs

| Underground Area | Parameter | Units | Value | Reference |
|---|---|---|---|---|
| Site-wide | Amount of emulsion for blasting product used in 2030 | kg/year | 2,986,489 | Provided by Agnico Eagle |
| | Number of blasts in 2030 | blasts/year | 365 | Agnico Eagle states that there is 1 blast per day, 7 days a week. |
| | Total ore extracted in 2030 | tonnes/year | 2,304,465 | Provided by Agnico Eagle |
| | Total waste rock extracted in 2030 | tonnes/year | 1,209,051 | Provided by Agnico Eagle |
| | Total material (ore+waste rock) blasted in 2030 | tonnes/year | 3,513,516 | Calculated |
| Tiriganiaq | Amount of emulsion for blasting product used in 2030 | kg/year | 744,577 | Calculated using the site-wide total multiplied by the ratio of pit material blasted vs site-wide material blasted |
| | Number of blasts in 2030 | blasts/year | 91 | Calculated using the site-wide total multiplied by the ratio of pit material blasted vs site-wide material blasted |
| | Total material (ore+waste rock+overburden) blasted in 2030 | tonnes/year | 871,850 | Provided by Agnico Eagle |
| Wesmeg | Amount of emulsion for blasting product used in 2030 | kg/year | 1,268,235 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 155 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock) blasted in 2030 | tonnes/year | 1,545,548 | Provided by Agnico Eagle |
| Wesmeg WN01 | Amount of emulsion for blasting product used in 2030 | kg/year | 229,101 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 28 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock) blasted in 2030 | tonnes/year | 149,092 | Provided by Agnico Eagle |

| Underground Area | Parameter | Units | Value | Reference |
|---|---|---|---|---|
| Pump | Amount of emulsion for blasting product used in 2030 | kg/year | 490,930 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 60 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock) blasted in 2030 | tonnes/year | 525,434 | Provided by Agnico Eagle |
| Discovery | Amount of emulsion for blasting product used in 2030 | kg/year | 253,647 | Estimated using the site-wide rate multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 31 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock) blasted in 2030 | tonnes/year | 421,592 | Provided by Agnico Eagle |

## Table C2.4-1: Surface Blasting, Calculation Inputs

| Pit | Parameter | Units | Value | Reference |
|---|---|---|---|---|
| Site-wide | Amount of emulsion for blasting product used in 2030 | kg/year | 4,765,410 | Provided by Agnico Eagle |
| | Number of blasts in 2030 | blasts/year | 260 | Agnico Eagle states that there is 1 blast per day, 5 days a week |
| | Total ore extracted in 2030 | tonnes/year | 1,227,191 | Provided by Agnico Eagle |
| | Total waste rock extracted in 2030 | tonnes/year | 8,313,774 | Provided by Agnico Eagle |
| | Total overburden extracted in 2030 | tonnes/year | 2,432,426 | Provided by Agnico Eagle |
| | Total material (ore+waste rock+overburden) blasted in 2030 | tonnes/year | 11,973,391 | Calculated |
| Wesmeg WN01 | Amount of emulsion for blasting product used in 2030 | kg/year | 2,859,246 | Calculated using the site-wide total multiplied by the ratio of pit material blasted vs site-wide material blasted |
| | Number of blasts in 2030 | blasts/year | 156 | Calculated using the site-wide total multiplied by the ratio of pit material blasted vs site-wide material blasted |
| | Total material (ore+waste rock+overburden) blasted in 2030 | tonnes/year | 7,872,561 | Provided by Agnico Eagle |
| Pump 01 and Pump 03[(a)] | Amount of emulsion for blasting product used in 2030 | kg/year | 953,082 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 52 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock+overburden) blasted in 2030 | tonnes/year | 1,566,185 | Provided by Agnico Eagle |
| F Zone 01 | Amount of emulsion for blasting product used in 2030 | kg/year | 953,082 | Estimated using the site-wide rate multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Number of blasts in 2030 | blasts/year | 52 | Estimated using the site-wide total multiplied by the ratio of pit ore extracted vs site-wide ore extracted |
| | Total material (ore+waste rock+overburden) blasted in 2030 | tonnes/year | 2,534,645 | Provided by Agnico Eagle |

*Notes:*

[a] *For simplicity, all Pump 01 and Pump 03 blasts were modelled at the Pump 03 pit.*

## 2.5 Road Sources

CALPUFF road sources were used to model tailpipe emissions ($NO_x$ and $SO_2$) along specific roads from specific equipment categories and activities.

Mobile equipment information for OnRoad and NonRoad equipment for both the surface and underground fleets was provided by Agnico Eagle, including details of equipment type, equipment model number, active status and usage area. For simplicity and with the aim of being slightly conservative, all OnRoad and NonRoad mobile units were assumed to have a 2020 engine manufacture year; because the modelled year of emissions was 2030, this means that all units were assumed to be 10 years old.

Tailpipe emission factors for OnRoad and NonRoad equipment are described in Sections 2.5.1 and 2.5.2.

### *2.5.1 OnRoad Equipment Emission Factors*

OnRoad vehicle emissions were calculated using the MOVES2014b emissions model (US EPA 2018), using the OnRoad module. All model configuration parameters are listed in Table C2.5-1 for the OnRoad module run.

**Table C2.5-1: MOVES2014b OnRoad Module Setup**

| Section | Sub-section | Values Used | Comments |
|---|---|---|---|
| Scale | Model | ▪ OnRoad | |
| | Domain/Scale | ▪ National | |
| | Calculation Type | ▪ Inventory | |
| Time Spans | Time Aggregation Level | ▪ Annual | |
| | Years | ▪ 2030 | This represents the MOVES2014b simulation year, not the engine's year of manufacture. |
| | Months | ▪ All | |
| | Days | ▪ All | |
| | Hours | ▪ All | |
| Geographic Bounds | Region | ▪ County | |
| | Selections | ▪ Alaska – Yukon-Koyukuk Census Area | |
| On Road Vehicle Equipment | Selections | Diesel Fuel:<br>▪ Combination and single unit long-haul and short-haul trucks<br>▪ Light commercial trucks<br>▪ Passenger trucks<br>Gasoline Fuel:<br>▪ Passenger trucks | Only emission factors for gas passenger trucks, diesel light commercial trucks, and diesel single unit long-haul trucks were used for the emissions inventory. |
| Road Type | Selected Road Types | ▪ Off-Network<br>▪ Rural Unrestricted Access | Only rural unrestricted access roads (i.e., rural non-highway) were used for the emissions inventory. |

| Section | Sub-section | Values Used | Comments |
|---|---|---|---|
| Pollutants and Processes | Selections | Running Exhaust emission process:<br>■ Oxides of Nitrogen ($NO_X$)<br>■ Nitrogen Oxide (NO)<br>■ Nitrogen Dioxide ($NO_2$)<br>■ Sulfur Dioxide ($SO_2$)<br>■ Total Energy Consumption<br>Crankcase Running Exhaust emission process:<br>■ Oxides of Nitrogen ($NO_X$)<br>■ Nitrogen Oxide (NO)<br>■ Nitrogen Dioxide ($NO_2$)<br>■ Sulfur Dioxide ($SO_2$)<br>Extended Idle Exhaust emission process:<br>■ Oxides of Nitrogen ($NO_X$)<br>■ Nitrogen Oxide (NO)<br>■ Nitrogen Dioxide ($NO_2$)<br>■ Sulfur Dioxide ($SO_2$)<br>■ Total Energy Consumption<br>Auxiliary Power Exhaust emission process:<br>■ Oxides of Nitrogen ($NO_X$)<br>■ Nitrogen Oxide (NO)<br>■ Nitrogen Dioxide ($NO_2$)<br>■ Sulfur Dioxide ($SO_2$)<br>■ Total Energy Consumption | The following species were used in the emissions inventory:<br>■ $NO_X$; and<br>■ $SO_2$. |
| Manage Input Data Sets | Database | ■ Left blank | This is left blank so that the model uses the default National inventory input database. |
| Rate of Progress | Compute Rate-of-Progress Emissions? | ■ Unchecked | |
| General Output | Units | ■ Grams<br>■ Joules<br>■ Kilometres | |
| | Activity | ■ All options checked | |
| Output Emission Details | Always | ■ Time: Year<br>■ Location: County<br>■ Pollutant: Checked | |
| | On Road/ Off Road | ■ All available options checked except regulatory class | |
| | For All Vehicle/ Equipment Categories | ■ All available options checked | |
| Advanced Performance Features | Selections | ■ All default values (unchecked) | |

| Section | Sub-section | Values Used | Comments |
|---|---|---|---|
| Post Processing | Data Included | MOVES2014b output includes the following for all vehicles, for 1 year:<br>■ Vehicle engine years 2000 to 2030<br>■ Total distance travelled<br>■ Total source hours operating<br>■ Road type usage<br>■ Total emissions for each pollutant (grams) | Emission factors for each vehicle type and each engine year were calculated in grams per vehicle kilometre travelled (VKT).<br>These values were then applied to specific OnRoad vehicle types and specific engine years from the Meliadine Extension mobile equipment fleet. This provides an emission factor (g/VKT) for each OnRoad vehicle that incorporates engine age and wear. |

The engine load factors and utilization rates for OnRoad equipment are incorporated into the OnRoad module and the emission rate factor output is in units of grams per vehicle kilometre travelled (g/VKT).

The OnRoad equipment that was modelled with CALPUFF road sources included:

- pickup trucks;
- transport buses (assigned as light commercial trucks in MOVES2014b output); and
- transport and fuel trucks (assigned as single unit long-haul trucks in MOVES2014b output).

### *2.5.2 NonRoad Equipment Emission Factors*

NonRoad vehicle emissions were calculated using the MOVES2014b emissions model, using the NonRoad module. All model configuration parameters are listed in Table C2.5-2 for the NonRoad module run.

**Table C2.5-2: MOVES2014b NonRoad Module Setup**

| Section | Sub-section | Values Used | Comments |
|---|---|---|---|
| Scale | Model | ■ NonRoad | |
| | Domain/Scale | ■ National | |
| | Calculation Type | ■ Inventory | |
| Time Spans | Time Aggregation Level | ■ Day | Can’t change. |
| | Years | ■ 2030 | This represents the MOVES2014b simulation year, not the engine’s year of manufacture. |
| | Months | ■ May | Chosen to represent average annual climate conditions. |
| | Days | ■ Weekdays | Only the emission rate factor is of interest (grams/second) so this selection does not matter. |
| | Hours | ■ n/a | Can’t change. |
| Geographic Bounds | Region | ■ County | |
| | Selections | ■ Alaska – Yukon-Koyukuk Census Area | |

| Section | Sub-section | Values Used | Comments |
|---|---|---|---|
| NonRoad Vehicle Equipment | Selections | NonRoad Diesel Fuel:<br>▪ Commercial sector<br>▪ Construction sector<br>▪ Industrial sector<br>▪ Underground mining sector | All of the Meliadine Extension equipment inventory falls into these sectors. |
| Road Type | Selected Road Types | ▪ NonRoad | Can't change. |
| Pollutants and Processes | Selections | Running exhaust emission process:<br>▪ Oxides of Nitrogen ($NO_X$)<br>▪ Sulfur Dioxide ($SO_2$) | The following species were used in the emissions inventory:<br>▪ $NO_X$; and<br>▪ $SO_2$. |
| Manage Input Data Sets | Database | ▪ Left blank | This is left blank so that the model uses the default National inventory input database. |
| Rate of Progress | Compute Rate-of-Progress Emissions? | ▪ Unchecked | |
| General Output | Units | ▪ Grams<br>▪ Joules<br>▪ Kilometres | |
| Output Emission Details | Always | ▪ Time: 24-Hour Day<br>▪ Location: County<br>▪ Pollutant: Checked | |
| | On Road/Off Road | ▪ All available options checked | |
| | For All Vehicle/ Equipment Categories | ▪ All available options checked except Fuel Subtype | |
| Advanced Performance Features | Selections | ▪ All default values (unchecked) | |
| Post Processing | Data Included | MOVES2014b output includes the following for all mobile equipment:<br>▪ Equipment type<br>▪ Horsepower bin ranges<br>▪ Vehicle engine years 1981 to 2030. Not all equipment types and horsepower bins include all years<br>▪ Total emission rate factors for each pollutant (grams per horsepower per hour) | The emission rate factors were applied to specific NonRoad equipment types, specific horsepower bins and specific engine years from the Meliadine Extension mobile equipment fleet. Load factors and equipment utilization factors (operating hours per year) were also applied.<br>The result is emission factors in units of g/s for each piece of NonRoad equipment. |

The only NonRoad equipment that was modelled as CALPUFF road sources is the fleet of off highway mine haul trucks.

The non-road equipment that was modelled as CALPUFF road sources included:

- mine haul trucks;
- loaders;
- backhoes;
- bulldozers;
- skidsteers;
- forklifts;
- telehandlers;
- manlifts; and
- cranes.

Unlike the OnRoad module, the engine load factors and equipment utilization rates for NonRoad equipment are not incorporated in the emission rate factor output (g/s units). Engine load factor ratings for NonRoad equipment were taken from US EPA *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling* (2010). The utilization rate (operating hours per year) for all mobile units was provided by Agnico Eagle.

### 2.5.3 Tailpipe Emissions

Tailpipe emission factors for OnRoad equipment (g/VKT) and NonRoad equipment (g/s) were converted to the same units of g/VKT. NonRoad equipment emission rates in g/VKT were calculated by:

Tailpipe emission factors for OnRoad equipment (g/VKT) and NonRoad equipment (g/s) were converted to the same units of g/VKT. NonRoad equipment emission factors in g/VKT were calculated by:

$$EF\left(\frac{g}{VKT}\right) = vehicle\ emission\ rate\left(\frac{g}{s}\right) * \frac{length\ of\ each\ road\ transit\ (km)}{vehicle\ speed\ (\frac{km}{h})} * \frac{1}{length\ of\ each\ road\ transit\ (km)}$$

Tailpipe emission rates for the CALUFF road source (g/s/m) were then calculated for each modelled road segment by:

$$Road\ source\ emission\ rate\left(\frac{g}{s\ m}\right) = vehicle\ emission\ rate\left(\frac{g}{VKT}\right) * road\ segment\ length\ (km) * number\ of\ one\ way\ vehicle\ transits\ per\ hour * time\ unit\ conversion * distance\ unit\ conversion$$

The modelled road segments, distances, speeds, and equipment work areas are listed in Table C2.5-3, and references are listed in Table C2.5-4.

For haul truck traffic, the emissions for each road segment were calculated based on the known amount of material (overburden, tailings, waste rock, salt rock, and ore) transported to different areas of the mine (e.g., crusher location and waste rock locations). Table C2.5-5 summarizes the 2030 material movement amounts based on Agnico Eagle’s life of mine data.

## Table C2.5-3: Road Source Characteristics

| Road Segment Description | Equipment Work Area | Speed (km/h) | Approx. Distance Travelled, 1-Way Trip (km) | Time for a Vehicle to Travel a 1-Way Trip (s) |
|---|---|---|---|---|
| Wesmeg WN01 pit to the crusher + Wesmeg WN01 pit to the closest WRSF | Industrial | 20 | 2.5 | 447 |
| | Pit | 40 | | 223 |
| Pump 01 pit to the crusher + Pump 01 pit to the closest WRSF + Pump 03 pit to the crusher | Industrial | 20 | 3.0 | 535 |
| | Pit | 40 | | 267 |
| F Zone 01 pit to the crusher | Industrial | 20 | 4.0 | 718 |
| | Pit | 40 | | 359 |
| F Zone 01 pit to the closest WRSF | Industrial | 20 | 1.3 | 239 |
| | Pit | 40 | | 120 |
| Pump Underground to the Pump Salt Rock Pile | UG+SURF | 20 | 0.7 | 128 |
| Discovery Salt Rock Pile to Discovery Underground | UG+SURF | 20 | 0.6 | 102 |
| Tiriganiaq, Wesmeg, and Wesmeg WN01 Undergrounds to the crusher + Wesmeg and Wesmeg WN01 Undergrounds to WRSF1 | UG+SURF | 20 | 1.1 | 202 |
| Surface Tailings from dewatering (church) to TSF + Tiriganiaq Underground to WRSF3 | Industrial | 20 | 0.8 | 144 |
| | Pit | 40 | | 72 |
| | UG+SURF | 20 | | 144 |
| Pump Underground to the crusher + TSF to Pump Underground | UG+SURF | 20 | 4.3 | 771 |
| Pump 03 pit to the closest WRSF | Industrial | 20 | 0.5 | 99 |
| | Pit | 40 | | 49 |
| Discovery Underground to the crusher | UG+SURF | 20 | 19.4 | 3,486 |
| All Weather Access Road (AWAR) | AWAR | 40 | 31.9 | 2,871 |

## Table C2.5-4: Road Source Characteristics References

| Road Segment Description | Equipment Work Area | Speed (km/h) | Approx. Distance Travelled, 1-Way Trip (km) | Time for a Vehicle to Travel a 1-Way Trip (s) |
|---|---|---|---|---|
| Wesmeg WN01 pit to the crusher + Wesmeg WN01 pit to the closest WRSF | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| Pump 01 pit to the crusher + Pump 01 pit to the closest WRSF + Pump 03 pit to the crusher | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| F Zone 01 pit to the crusher | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| F Zone 01 pit to the closest WRSF | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| Pump Underground to the Pump Salt Rock Pile | UG+SURF | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| Discovery Salt Rock Pile to Discovery Underground | UG+SURF | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| Tiriganiaq, Wesmeg, and Wesmeg WN01 Undergrounds to the crusher + Wesmeg and Wesmeg WN01 Undergrounds to WRSF1 | UG+SURF | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| Surface Tailings from dewatering (church) to TSF + Tiriganiaq Underground to WRSF3 | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| | UG+SURF | Provided by Agnico Eagle | | Calculated from speed and road length |
| Pump Underground to the crusher + TSF to Pump Underground | UG+SURF | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| Pump 03 pit to the closest WRSF | Industrial | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| | Pit | Provided by Agnico Eagle | | Calculated from speed and road length |
| Discovery Underground to the crusher | UG+SURF | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |
| All Weather Access Road (AWAR) | AWAR | Provided by Agnico Eagle | Measured from drawings provided by Agnico Eagle | Calculated from speed and road length |

### Table C2.5-5: 2030 Material Movement (tonnes)

| Location | Ore from Location | Waste Rock from Location | Overburden from Pit | Material to/from Salt Rock Piles | Waste Rock Required for Backfill Underground | Total Tailings Stored in TSF | Tailings Returned Underground as Backfill |
|---|---|---|---|---|---|---|---|
| Wesmeg WN01 Pit | 1,067,839 | 6,804,723 | 0 | N/A | N/A | N/A | N/A |
| Pump 01 Pit | 60,556 | 367,926 | 244,113 | N/A | N/A | N/A | N/A |
| Pump 03 Pit | 80,453 | 488,816 | 324,321 | N/A | N/A | N/A | N/A |
| F Zone 01 Pit | 18,344 | 652,309 | 1,863,992 | N/A | N/A | N/A | N/A |
| Salt Rock Pile 1 (Pump) | N/A | N/A | N/A | 479,970 | N/A | N/A | N/A |
| Salt Rock Pile 3 (Disc.) | N/A | N/A | N/A | -273,163 | N/A | N/A | N/A |
| Tiriganiaq Underground | 1,837,408 | 729,082 | N/A | N/A | 300,906 | N/A | N/A |
| Pump Underground | 45,465 | 479,970 | N/A | N/A | 0 | N/A | N/A |
| Discovery Underground | 421,592 | 0 | N/A | N/A | 273,163 | N/A | N/A |
| Site Wide (Tailings) | N/A | N/A | N/A | N/A | N/A | 2,339,819 | 762,681 |

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# APPENDIX D AIR EMISSIONS INVENTORY

## Appendix D-1: Point Sources, Characteristics and Air Emissions

| Stack Description | UTM Coordinates, Zone 15V | | Base Elevation (masl) | Emission Release Height (Stack Height) (m) | Stack Tip Inside Diameter (m) | Stack Tip Exit Velocity (m/s) | Stack Exit Temperature (K) | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|---|---|
| | Easting (m) | Northing (m) | | | | | | $SO_2$ | $NO_x$ |
| Site Generator 1 of 4 (#374 aka Unit 1)[(a)] | 539203 | 6990014 | 65.6 | 40.0 | 1.02 | 16.7 | 505.2 | 1.6E+01 | 4.6E-03 |
| Site Generator 2 of 4 (#376 aka Unit 3)[(b)] | 539200 | 6990022 | 65.7 | 40.0 | 1.02 | 16.0 | 470.2 | 1.6E+01 | 4.6E-03 |
| Site Generator 3 of 4 (#377 aka Unit 4)[(c)] | 539194 | 6990035 | 65.8 | 40.0 | 1.02 | 17.0 | 498.2 | 1.6E+01 | 4.6E-03 |
| Site Generator 4 of 4 (#378 aka Unit 5)[(d)] | 539190 | 6990045 | 65.9 | 40.0 | 1.02 | 18.0 | 509.2 | 1.7E+01 | 4.6E-03 |
| Incinerator | 539393 | 6989830 | 64.2 | 11.1 | 0.80 | 8.6 | 1172.2 | 2.2E-01 | 2.4E-02 |
| gen set 500 kW at 600 V, Discovery | 553721 | 6981510 | 61.4 | 2.0 | 0.20 | 21.7 | 791.4 | 1.2E+00 | 4.4E-04 |
| gen set 500 kW at 600 V, Pump | 540416 | 6986160 | 59.5 | 2.0 | 0.20 | 21.7 | 791.4 | 1.2E+00 | 4.4E-04 |
| gen set 500 kW at 600 V, F Zone | 542412 | 6985960 | 57.7 | 2.0 | 0.20 | 21.7 | 791.4 | 1.2E+00 | 4.4E-04 |
| VR-W, mobile emissions, ventilation raise at Wesmeg | 540687 | 6988138 | 63.0 | 5.0 | 4.00 | 6.5 | 280.9 | 6.2E-03 | 1.6E-04 |
| VR-T, mobile emissions, ventilation raise at Tiriganiaq | 539466 | 6987929 | 61.9 | 5.0 | 4.00 | 6.5 | 280.9 | 3.3E-03 | 8.4E-05 |
| VR-WN, mobile emissions, ventilation raise at Wesmeg WN01 | 538844 | 6987937 | 56.8 | 5.0 | 4.00 | 6.5 | 280.9 | 6.8E-04 | 1.8E-05 |
| VR-PW, mobile emissions, west ventilation raise at Pump | 539455 | 6986656 | 57.0 | 5.0 | 4.00 | 6.5 | 280.9 | 1.4E-02 | 3.7E-04 |
| VR-DE, mobile emissions, east ventilation raise at Discovery | 554713 | 6981436 | 65.7 | 5.0 | 4.00 | 6.5 | 280.9 | 3.1E-02 | 8.1E-04 |
| PRT-T mobile emissions, new portal near Tiriganiaq | 539937 | 6988798 | 64.7 | 1.0 | 5.00 | 0.7 | 280.9 | 1.0E-02 | 2.6E-04 |
| PRT-P, mobile emissions, portal at Pump | 540440 | 6986209 | 59.9 | 1.0 | 5.00 | 0.7 | 280.9 | 1.4E-02 | 3.7E-04 |
| PRT-D, mobile emissions, portal at Discovery | 554068 | 6981483 | 62.5 | 1.0 | 5.00 | 0.7 | 280.9 | 3.1E-02 | 8.1E-04 |
| BL-VR-T; blasting, Tiriganiaq Underground, vent raise[(e)] | 539466 | 6987929 | 61.9 | 5.0 | 4.00 | 6.5 | 280.9 | 2.8E-01 | 0 |

| Stack Description | UTM Coordinates, Zone 15V | | Base Elevation (masl) | Emission Release Height (Stack Height) (m) | Stack Tip Inside Diameter (m) | Stack Tip Exit Velocity (m/s) | Stack Exit Temperature (K) | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|---|---|
| | Easting (m) | Northing (m) | | | | | | $SO_2$ | $NO_x$ |
| BL-VR-PW; blasting, Pump Underground, vent raise[e] | 539455 | 6986656 | 57.0 | 5.0 | 4.00 | 6.5 | 280.9 | 2.8E-01 | 0 |
| BL-VR-DE; blasting, Discovery Underground, vent raise[e] | 554713 | 6981436 | 65.7 | 5.0 | 4.00 | 6.5 | 280.9 | 2.8E-01 | 0 |
| BL-PRT-T; blasting, Tiriganiaq Underground, portal[e] | 539937 | 6988798 | 64.7 | 1.0 | 5.00 | 0.7 | 280.9 | 2.8E-01 | 0 |
| BL-PRT-P; blasting, Pump Underground, portal[e] | 540440 | 6986209 | 59.9 | 1.0 | 5.00 | 0.7 | 280.9 | 2.8E-01 | 0 |
| BL-PRT-D; blasting, Discovery Underground, portal[e] | 554068 | 6981483 | 62.5 | 1.0 | 5.00 | 0.7 | 280.9 | 2.8E-01 | 0 |

*Notes:*

[a] *Source active for Scenario 1 only.*

[b] *Source active for Scenario 1 only.*

[c] *Source active for Scenarios 1 and 2 only.*

[d] *Source active for Scenarios 1, 2, and 3.*

[e] *The underground blasting sources are co-located with the vent raises and portals indicated. They were modelled as separate sources because mobile emissions were assumed to be continuous, whereas blasting emissions are only active at certain times.*

## Appendix D-2: Underground Non-road Vehicle Fleet, Characteristics and Air Emissions

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Compressor | UG | Diesel | 44 | 0.43 | 3504 | 5.3E-03 | 8.1E-06 |
| Compressor | UG | Diesel | 155 | 0.43 | 3504 | 1.2E-03 | 2.6E-05 |
| Compressor | UG | Diesel | 125 | 0.43 | 7300 | 2.1E-03 | 4.3E-05 |
| Compressor | UG | Diesel | 125 | 0.43 | 7300 | 2.1E-03 | 4.3E-05 |
| Compressor | UG | Diesel | 580 | 0.43 | 1475 | 1.3E-03 | 4.1E-05 |
| Compressor | UG | Diesel | 305 | 0.43 | 105 | 4.9E-05 | 1.5E-06 |
| Concrete | UG+SURF | Diesel | 275 | 0.59 | 364 | 2.1E-04 | 6.6E-06 |
| Concrete | UG+SURF | Diesel | 138 | 0.43 | 94 | 3.0E-05 | 6.2E-07 |
| Concrete | UG+SURF | Diesel | 160 | 0.43 | 753 | 2.8E-04 | 5.7E-06 |
| Emulsion | UG+SURF | Diesel | 275 | 0.43 | 3504 | 1.5E-03 | 4.6E-05 |
| Emulsion | UG+SURF | Diesel | 275 | 0.43 | 3504 | 1.5E-03 | 4.6E-05 |
| Emulsion | UG+SURF | Diesel | 275 | 0.59 | 1924 | 1.1E-03 | 3.5E-05 |
| Emulsion | UG+SURF | Diesel | 275 | 0.59 | 1635 | 9.4E-04 | 3.0E-05 |
| Emulsion | UG+SURF | Diesel | 275 | 0.59 | 940 | 5.4E-04 | 1.7E-05 |
| Haul Truck | UG+SURF | Diesel | 409 | 0.59 | 3506 | 3.0E-03 | 9.5E-05 |
| Haul Truck | UG+SURF | Diesel | 409 | 0.59 | 2175 | 1.9E-03 | 5.9E-05 |
| Haul Truck | UG+SURF | Diesel | 409 | 0.59 | 4101 | 3.5E-03 | 1.1E-04 |
| Haul Truck | UG+SURF | Diesel | 409 | 0.59 | 3506 | 3.0E-03 | 9.5E-05 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3192 | 4.6E-03 | 1.5E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3908 | 5.6E-03 | 1.8E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3389 | 4.9E-03 | 1.5E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3576 | 5.2E-03 | 1.6E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3746 | 5.4E-03 | 1.7E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3559 | 5.1E-03 | 1.6E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 4061 | 5.9E-03 | 1.9E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 4468 | 6.4E-03 | 2.0E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3503 | 5.1E-03 | 1.6E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 2675 | 3.9E-03 | 1.2E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 2887 | 4.2E-03 | 1.3E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3559 | 5.1E-03 | 1.6E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3559 | 5.1E-03 | 1.6E-04 |
| Haul Truck | UG+SURF | Diesel | 691 | 0.59 | 3559 | 5.1E-03 | 1.6E-04 |

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 3597 | 1.5E-03 | 4.7E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 372 | 1.6E-04 | 4.9E-06 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 1632 | 6.8E-04 | 2.1E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 2090 | 8.7E-04 | 2.7E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 148 | 0.43 | 2555 | 8.7E-04 | 1.8E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 148 | 0.43 | 1796 | 6.1E-04 | 1.3E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 1913 | 8.0E-04 | 2.5E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 1913 | 8.0E-04 | 2.5E-05 |
| Men Carrier & Cassette Truck | UG | Diesel | 275 | 0.43 | 1913 | 8.0E-04 | 2.5E-05 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 39 | 6.0E-06 | 1.5E-07 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 1901 | 2.9E-04 | 7.2E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 2551 | 3.9E-04 | 9.7E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 1875 | 2.9E-04 | 7.1E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 1671 | 2.6E-04 | 6.3E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 348 | 5.4E-05 | 1.3E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 1649 | 2.5E-04 | 6.2E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 2174 | 3.4E-04 | 8.2E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 2551 | 3.9E-04 | 9.7E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 348 | 5.4E-05 | 1.3E-06 |
| Scissor Lift | UG | Diesel | 138 | 0.21 | 1671 | 2.6E-04 | 6.3E-06 |
| Scoop | UG | Diesel | 343 | 0.59 | 2740 | 2.0E-03 | 6.2E-05 |
| Scoop | UG | Diesel | 343 | 0.59 | 1812 | 1.3E-03 | 4.1E-05 |
| Scoop | UG | Diesel | 343 | 0.59 | 2463 | 1.8E-03 | 5.6E-05 |
| Scoop | UG | Diesel | 343 | 0.59 | 2303 | 1.7E-03 | 5.2E-05 |
| Scoop | UG | Diesel | 250 | 0.59 | 238 | 1.2E-04 | 3.9E-06 |
| Scoop | UG | Diesel | 165 | 0.59 | 1307 | 6.8E-04 | 1.4E-05 |
| Scoop | UG | Diesel | 369 | 0.59 | 2707 | 2.1E-03 | 6.6E-05 |
| Scoop | UG | Diesel | 369 | 0.59 | 3479 | 2.7E-03 | 8.5E-05 |
| Scoop | UG | Diesel | 369 | 0.59 | 3095 | 2.4E-03 | 7.5E-05 |

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Scoop | UG | Diesel | 416 | 0.59 | 3795 | 3.3E-03 | 1.0E-04 |
| Scoop | UG | Diesel | 416 | 0.59 | 3895 | 3.4E-03 | 1.1E-04 |
| Service Vehicle | UG | Diesel | 25 | 0.21 | 550 | 3.4E-04 | 5.8E-07 |
| Service Vehicle | UG | Diesel | 246 | 0.59 | 754 | 3.9E-04 | 1.2E-05 |
| Service Vehicle | UG | Diesel | 216 | 0.59 | 3622 | 1.6E-03 | 5.2E-05 |
| Service Vehicle | UG | Diesel | 216 | 0.59 | 3622 | 1.6E-03 | 5.2E-05 |
| Service Vehicle | UG | Diesel | 74 | 0.59 | 1488 | 5.3E-03 | 8.1E-06 |
| Service Vehicle | UG | Diesel | 102 | 0.59 | 1484 | 4.8E-04 | 1.0E-05 |
| Service Vehicle | UG | Diesel | 128 | 0.43 | 2044 | 6.0E-04 | 1.2E-05 |
| Service Vehicle | UG | Diesel | 128 | 0.43 | 3331 | 9.8E-04 | 2.0E-05 |
| Service Vehicle | UG | Diesel | 128 | 0.43 | 3331 | 9.8E-04 | 2.0E-05 |
| Telehandler | UG+SURF | Diesel | 125 | 0.21 | 974 | 1.4E-04 | 3.3E-06 |
| Telehandler | UG+SURF | Diesel | 142 | 0.21 | 678 | 1.1E-04 | 2.6E-06 |
| Telehandler | UG+SURF | Diesel | 125 | 0.21 | 1270 | 1.8E-04 | 4.4E-06 |
| Telehandler | UG+SURF | Diesel | 125 | 0.21 | 974 | 1.4E-04 | 3.3E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 696 | 8.2E-05 | 2.0E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1325 | 1.6E-04 | 3.8E-06 |
| Tractor | UG | Diesel | 86 | 0.21 | 141 | 6.9E-05 | 3.7E-07 |
| Tractor | UG | Diesel | 95 | 0.21 | 702 | 3.8E-04 | 2.0E-06 |
| Tractor | UG | Diesel | 95 | 0.21 | 253 | 1.4E-04 | 7.3E-07 |
| Tractor | UG | Diesel | 95 | 0.21 | 302 | 1.6E-04 | 8.8E-07 |
| Tractor | UG | Diesel | 86 | 0.21 | 500 | 2.4E-04 | 1.3E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2301 | 2.7E-04 | 6.7E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1781 | 2.1E-04 | 5.2E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 788 | 9.3E-05 | 2.3E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 618 | 7.3E-05 | 1.8E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 853 | 1.0E-04 | 2.5E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1035.6 | 1.2E-04 | 3.0E-06 |
| Tractor | UG | Diesel | 100 | 0.21 | 518 | 5.8E-05 | 1.4E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 512 | 6.1E-05 | 1.5E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 454 | 5.4E-05 | 1.3E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2331 | 2.8E-04 | 6.8E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2048 | 2.4E-04 | 5.9E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1800 | 2.1E-04 | 5.2E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1446 | 1.7E-04 | 4.2E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1979 | 2.3E-04 | 5.7E-06 |

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Tractor | UG | Diesel | 106 | 0.21 | 2067 | 2.4E-04 | 6.0E-06 |
| Tractor | UG | Diesel | 68 | 0.21 | 662 | 7.6E-04 | 1.4E-06 |
| Tractor | UG | Diesel | 68 | 0.21 | 1547 | 1.8E-03 | 3.2E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2097 | 2.5E-04 | 6.1E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2553 | 3.0E-04 | 7.4E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 294 | 3.5E-05 | 8.5E-07 |
| Tractor | UG | Diesel | 106 | 0.21 | 1705 | 2.0E-04 | 4.9E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 962 | 1.1E-04 | 2.8E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 147 | 1.7E-05 | 4.3E-07 |
| Tractor | UG | Diesel | 106 | 0.21 | 2048 | 2.4E-04 | 5.9E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2048 | 2.4E-04 | 5.9E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 2048 | 2.4E-04 | 5.9E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1979 | 2.3E-04 | 5.7E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1979 | 2.3E-04 | 5.7E-06 |
| Tractor | UG | Diesel | 106 | 0.21 | 1979 | 2.3E-04 | 5.7E-06 |

## Appendix D-3: Underground On-road Vehicle Fleet, Characteristics and Air Emissions

| Equipment Category | Equipment Work Area | Fuel Type | Make and Model | Mine Unit # | km/year | Emission Rate (g/km) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE15 | 51,905 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE17 | 101,150 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE18 | 80,885 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE30 | 68,110 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE31 | 115,395 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE32 | 27,545 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE33 | 105,210 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE34 | 30,590 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE38 | 55,615 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE18 | 80,885 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE18 | 80,885 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE30 | 68,110 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE30 | 68,110 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE30 | 68,110 | 2.0E-01 | 2.5E-03 |
| Men Carrier & Cassette Truck | UG+SURF | Diesel | Toyota HZJ79 | 65VSE30 | 68,110 | 2.0E-01 | 2.5E-03 |
| Service Vehicle | UG+SURF | Diesel | Toyota HZJ79 | 65VSE14 | 2,415 | 2.0E-01 | 2.5E-03 |

## Appendix D-4: Surface Non-road Vehicle Fleet, Characteristics and Air Emissions

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Backhoe | PIT | Diesel | 93 | 0.21 | 1022 | 5.4E-04 | 2.9E-06 |
| Backhoe | PIT | Diesel | 117 | 0.21 | 1244 | 1.6E-04 | 4.0E-06 |
| Backhoe | PIT | Diesel | 242 | 0.21 | 5583 | 1.0E-03 | 3.7E-05 |
| Backhoe | PIT | Diesel | 23 | 0.21 | 1133 | 6.5E-04 | 1.1E-06 |
| Compactor | PIT | Diesel | 156 | 0.59 | 3189 | 1.6E-03 | 3.3E-05 |
| Compactor | PIT | Diesel | 156 | 0.59 | 3889 | 1.9E-03 | 4.0E-05 |
| Container Handler | INDUSTRIAL | Diesel | 365 | 0.43 | 2496 | 1.4E-03 | 4.3E-05 |
| Container Handler | INDUSTRIAL | Diesel | 365 | 0.43 | 2879 | 1.6E-03 | 5.0E-05 |
| Crane | INDUSTRIAL | Diesel | 100 | 0.43 | 1000 | 1.2E-03 | 5.3E-06 |
| Crane | INDUSTRIAL | Diesel | 65 | 0.43 | 1000 | 2.3E-03 | 3.4E-06 |
| Crane | INDUSTRIAL | Diesel | 330 | 0.43 | 1000 | 5.0E-04 | 1.6E-05 |
| Crane | INDUSTRIAL | Diesel | 320 | 0.43 | 1000 | 4.9E-04 | 1.5E-05 |
| Crane | INDUSTRIAL | Diesel | 340 | 0.43 | 1000 | 5.2E-04 | 1.6E-05 |
| Dozer | PIT | Diesel | 258 | 0.59 | 4248 | 2.3E-03 | 7.2E-05 |
| Dozer | PIT | Diesel | 125 | 0.59 | 5113 | 2.0E-03 | 4.2E-05 |
| Forklift | INDUSTRIAL | Diesel | 51 | 0.59 | 2524 | 6.2E-03 | 9.5E-06 |
| Forklift | INDUSTRIAL | Diesel | 46 | 0.59 | 2524 | 5.5E-03 | 8.6E-06 |
| Forklift | INDUSTRIAL | Diesel | 86 | 0.59 | 2524 | 3.5E-03 | 1.6E-05 |
| Grader | AWAR | Diesel | 237 | 0.43 | 3867 | 1.4E-03 | 4.4E-05 |
| Haul Truck | PIT | Diesel | 476 | 0.59 | 6344 | 6.3E-03 | 2.0E-04 |
| Haul Truck | PIT | Diesel | 476 | 0.59 | 7181 | 7.1E-03 | 2.3E-04 |
| Haul Truck | PIT | Diesel | 476 | 0.59 | 7845 | 7.8E-03 | 2.5E-04 |
| Haul Truck | PIT | Diesel | 476 | 0.59 | 7836 | 7.8E-03 | 2.5E-04 |
| Haul Truck | PIT | Diesel | 476 | 0.59 | 6210 | 6.2E-03 | 2.0E-04 |
| Heater Trailer | INDUSTRIAL | Diesel | 19 | 0.43 | 1000 | 9.7E-04 | 1.4E-06 |
| Heater Trailer | INDUSTRIAL | Diesel | 19 | 0.43 | 1000 | 9.7E-04 | 1.4E-06 |
| Heater Trailer | INDUSTRIAL | Diesel | 19 | 0.43 | 1000 | 9.7E-04 | 1.4E-06 |
| Heater Trailer | INDUSTRIAL | Diesel | 19 | 0.43 | 1000 | 9.7E-04 | 1.4E-06 |
| Heater Trailer | INDUSTRIAL | Diesel | 19 | 0.43 | 1000 | 9.7E-04 | 1.4E-06 |
| Loader | PIT | Diesel | 230 | 0.59 | 2610 | 1.3E-03 | 4.0E-05 |
| Loader | PIT | Diesel | 230 | 0.59 | 2678 | 1.3E-03 | 4.1E-05 |
| Loader | PIT | Diesel | 425 | 0.59 | 4467 | 4.0E-03 | 1.3E-04 |
| Loader | PIT | Diesel | 102 | 0.59 | 1146 | 3.7E-04 | 7.7E-06 |
| Loader | PIT | Diesel | 580 | 0.59 | 4937 | 6.0E-03 | 1.9E-04 |

| Equipment Category | Equipment Work Area | Fuel Type | Power (hp) | Load Factor (fraction of power) | Operating Hours per Year | Emission Rate (g/s) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Loader | PIT | Diesel | 580 | 0.59 | 3766 | 4.6E-03 | 1.4E-04 |
| Loader | PIT | Diesel | 580 | 0.59 | 7101 | 8.6E-03 | 2.7E-04 |
| Loader | PIT | Diesel | 580 | 0.59 | 6938 | 8.4E-03 | 2.7E-04 |
| Loader | PIT | Diesel | 357 | 0.59 | 3489 | 2.6E-03 | 8.2E-05 |
| Loader | PIT | Diesel | 357 | 0.59 | 1937 | 1.4E-03 | 4.6E-05 |
| Loader | PIT | Diesel | 231 | 0.59 | 1544 | 7.5E-04 | 2.4E-05 |
| Manlift | INDUSTRIAL | Diesel | 75 | 0.21 | 2524 | 3.2E-03 | 5.8E-06 |
| Manlift | INDUSTRIAL | Diesel | 75 | 0.21 | 2524 | 3.2E-03 | 5.8E-06 |
| Manlift | INDUSTRIAL | Diesel | 75 | 0.21 | 2524 | 3.2E-03 | 5.8E-06 |
| Manlift | INDUSTRIAL | Diesel | 75 | 0.21 | 2524 | 3.2E-03 | 5.8E-06 |
| Manlift | INDUSTRIAL | Diesel | 74 | 0.21 | 2524 | 3.2E-03 | 5.7E-06 |
| Mule | INDUSTRIAL | Diesel | 17 | 0.59 | 500 | 5.8E-04 | 8.4E-07 |
| Mule | INDUSTRIAL | Diesel | 17 | 0.59 | 500 | 5.8E-04 | 8.4E-07 |
| Mule | INDUSTRIAL | Diesel | 25 | 0.59 | 500 | 8.8E-04 | 1.3E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 92 | 0.59 | 1000 | 1.5E-03 | 6.8E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 110 | 0.59 | 1000 | 3.5E-04 | 7.3E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 74 | 0.59 | 1000 | 3.5E-03 | 5.4E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 67 | 0.59 | 1280 | 4.1E-03 | 6.3E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 67 | 0.59 | 1122 | 3.6E-03 | 5.5E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 67 | 0.59 | 668 | 2.1E-03 | 3.3E-06 |
| Skidsteer | INDUSTRIAL | Diesel | 98 | 0.59 | 1023 | 1.6E-03 | 7.4E-06 |
| Snowblower | INDUSTRIAL | Diesel | 325 | 0.43 | 1500 | 7.4E-04 | 2.3E-05 |
| Snowmobile | AWAR | Diesel | 142 | 0.59 | 700 | 3.1E-04 | 6.6E-06 |
| Snowmobile | AWAR | Diesel | 142 | 0.59 | 700 | 3.1E-04 | 6.6E-06 |
| Telehandler | INDUSTRIAL | Diesel | 111 | 0.21 | 1373 | 1.7E-04 | 4.2E-06 |
| Telehandler | INDUSTRIAL | Diesel | 111 | 0.21 | 1166 | 1.4E-04 | 3.6E-06 |
| Telehandler | INDUSTRIAL | Diesel | 121 | 0.21 | 2524 | 3.4E-04 | 8.4E-06 |
| Telehandler | INDUSTRIAL | Diesel | 121 | 0.21 | 2524 | 3.4E-04 | 8.4E-06 |
| Telehandler | INDUSTRIAL | Diesel | 121 | 0.21 | 2524 | 3.4E-04 | 8.4E-06 |
| Telehandler | INDUSTRIAL | Diesel | 121 | 0.21 | 2524 | 3.4E-04 | 8.4E-06 |
| Telehandler | INDUSTRIAL | Diesel | 74 | 0.21 | 1875 | 2.4E-03 | 4.2E-06 |
| Telehandler | INDUSTRIAL | Diesel | 74 | 0.21 | 3173 | 4.0E-03 | 7.2E-06 |
| Telehandler | INDUSTRIAL | Diesel | 74 | 0.21 | 1398 | 1.8E-03 | 3.2E-06 |

## Appendix D-5: Surface On-road Vehicle Fleet, Characteristics and Air Emissions

| Equipment Category | Equipment Work Area | Fuel Type | Make and Model | Mine Unit # | km/year | Emission Rate (g/km) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Bus | AWAR | Diesel | Blue Bird Vision SL | 65BUS04 | 10,160 | 1.7E-01 | 2.4E-03 |
| Bus | AWAR | Diesel | Ford E450 | 65BUS01 | 10,160 | 1.7E-01 | 2.4E-03 |
| Bus | AWAR | Diesel | Ford Transit | 65VSE19 | 10,160 | 1.7E-01 | 2.4E-03 |
| Bus | AWAR | Diesel | Ford Transit | 65VSE20 | 10,160 | 1.7E-01 | 2.4E-03 |
| Pickup | AWAR | Gasoline | Chevrolet Suburban | 65PCK01 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Chevrolet Express 3500 | 65PCK07 | 308 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F550 | 65PCK02 | 7,284 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK03 | 9,388 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK04 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F350 | 65PCK05 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK06 | 14,348 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK11 | 8,100 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK12 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK13 | 11,512 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK14 | 4,264 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK15 | 17,804 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK16 | 9,300 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK17 | 3,700 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK18 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK19 | 9,724 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK20 | 22,752 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK21 | 13,512 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK22 | 16,500 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK23 | 13,500 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK24 | 3,836 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK25 | 11,764 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK26 | 6,688 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK27 | 12,272 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK28 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK29 | 8,532 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK30 | 12,504 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK31 | 10,704 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK32 | 10,504 | 2.0E-01 | 2.5E-03 |

| Equipment Category | Equipment Work Area | Fuel Type | Make and Model | Mine Unit # | km/year | Emission Rate (g/km) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $NO_x$ | $SO_2$ |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK33 | 1,444 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK34 | 9,892 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK35 | 8,068 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK36 | 12,960 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK37 | 4,932 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK38 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK39 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK40 | 6,700 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK41 | 16,516 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK42 | 5,780 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK43 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK44 | 16,268 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK46 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK49 | 14,648 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK50 | 1,976 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK51 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK52 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK53 | 34,852 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK54 | 4,260 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK55 | 10,160 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK56 | 1,320 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK57 | 8,244 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F250 | 65PCK58 | 9,580 | 2.0E-01 | 2.5E-03 |
| Pickup | AWAR | Gasoline | Ford F350 | 65VSE23 | 10,160 | 2.0E-01 | 2.5E-03 |
| Service Truck | PIT | Diesel | Ford F750 | 65TRK04 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Freightliner FL80 | 65TRK02 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Kenworth C500 | 65TRK01 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Kenworth T800 | 65TRK11 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Kenworth T800 | 65TRK12 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Kenworth T800 | 65TRK14 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | INDUSTRIAL | Diesel | Kenworth T400 | 65TRK21 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Mack DM690S | 65TRK03 | 10,160 | 4.6E-01 | 3.7E-03 |
| Service Truck | PIT | Diesel | Peterbilt 348 | 65TRK13 | 10,160 | 4.6E-01 | 3.7E-03 |

## Appendix D-6: Blasting, Characteristics and Air Emissions

| Blasting Source | Number of Blasts per Year | Amount of Blasting Product per Year (kg/y) | Amount of Blasting Product per Blast (kg/blast) | Explosives Used | Emission Rate (g/s), Adjusted over a 1 h Emission Period (assumes 1 blast during the hour) | |
|---|---|---|---|---|---|---|
| | | | | | $NO_x$ | $SO_2$ |
| Tiriganiaq Underground | 274 | 2,241,912 | 8,182 | Emulsion for blasting product | 5.7E-01 | 0 |
| Pump Underground | 60 | 490,930 | 8,182 | Emulsion for blasting product | 5.7E-01 | 0 |
| Discovery Underground | 31 | 253,647 | 8,182 | Emulsion for blasting product | 5.7E-01 | 0 |
| Wesmeg WN01 Pit | 156 | 2,859,246 | 18,328 | Emulsion for blasting product | 1.3E+00 | 0 |
| Pump 03 Pit | 52 | 953,082 | 18,328 | Emulsion for blasting product | 1.3E+00 | 0 |
| F Zone Pit | 52 | 953,082 | 18,328 | Emulsion for blasting product | 1.3E+00 | 0 |

## Appendix D-7: Roads, Characteristics and Air Emissions

| Road Segment Description | Equipment Work Area | Speed (km/h) | Approx. Distance Travelled, 1-Way Trip (km) | Tailpipe Emission Rate for CALPUFF Road Source Type (g/s/m) | |
|---|---|---|---|---|---|
| | | | | $NO_x$ | $SO_2$ |
| Wesmeg WN01 pit to the crusher + Wesmeg WN01 pit to the closest WRSF | Industrial | 20 | 2.5 | 3.1E-05 | 7.7E-07 |
| | Pit | 40 | | | |
| Pump 01 pit to the crusher + Pump 01 pit to the closest WRSF + Pump 03 pit to the crusher | Industrial | 20 | 3.0 | 8.4E-06 | 9.9E-08 |
| | Pit | 40 | | | |
| F Zone 01 pit to the crusher | Industrial | 20 | 4.0 | 6.1E-06 | 3.0E-08 |
| | Pit | 40 | | | |
| F Zone 01 pit to the closest WRSF | Industrial | 20 | 1.3 | 1.4E-05 | 2.7E-07 |
| | Pit | 40 | | | |
| Pump Underground to the Pump Salt Rock Pile | UG+SURF | 20 | 0.7 | 1.6E-06 | 4.7E-08 |
| Discovery Salt Rock Pile to Discovery Underground | UG+SURF | 20 | 0.6 | 8.9E-07 | 2.7E-08 |
| Tiriganiaq, Wesmeg, and Wesmeg WN01 Undergrounds to the crusher + Wesmeg and Wesmeg WN01 Undergrounds to WRSF1 | UG+SURF | 20 | 1.1 | 7.3E-06 | 2.2E-07 |
| Surface Tailings from dewatering (church) to TSF + Tiriganiaq Underground to WRSF3 | Industrial | 20 | 0.8 | 1.4E-05 | 2.7E-07 |
| | Pit | 40 | | | |
| | UG+SURF | 20 | | | |
| Pump Underground to the crusher + TSF to Pump Underground | UG+SURF | 20 | 4.3 | 2.6E-06 | 7.9E-08 |
| Pump 03 pit to the closest WRSF | Industrial | 20 | 0.5 | 8.6E-06 | 1.1E-07 |
| | Pit | 40 | | | |
| Discovery Underground to the crusher | UG+SURF | 20 | 19.4 | 1.4E-06 | 4.1E-08 |
| All Weather Access Road (AWAR) | AWAR | 40 | 31.9 | 1.8E-07 | 3.2E-09 |

# APPENDIX E BUILDINGS INCLUDED IN BUILDING DOWNWASH ASSESSMENT

# Appendix E: Buildings Included in Building Downwash Assessment

| Building Name | UTM Coordinates, Zone 15V (approx. center of building) | | Building Height (m) |
|---|---|---|---|
| | Easting (m) | Northing (m) | |
| 6-Million Diesel Tank | 539368 | 6989925 | 7.0 |
| Power Plant | 539215 | 6990040 | 14.4 |
| Electrical House West | 539185 | 6990075 | 7.1 |
| Site Services Shop | 539155 | 6990090 | 7.1 |
| MSB | 539035 | 6990160 | 13.5 |
| Washbay | 539070 | 6990100 | 8.5 |
| Core Shack / Assay Lab | 539070 | 6990040 | 8.5 |
| Tailing Dewatering (Church) | 539070 | 6989985 | 14.4 |
| Process Plant | 539150 | 6989965 | 36.0 |
| Oxygen Plant | 539165 | 6989850 | 5.0 |
| Ore Silo | 539205 | 6989825 | 36.0 |
| Crusher | 539265 | 6989690 | 24.4 |
| Incinerator Building | 539395 | 6989830 | 7.5 |

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