July 2015

FNX MINING COMPANY INC.

VICTORIA ADVANCED EXPLORATION PROJECT

Emission Summary and Dispersion Modelling Report

Version 2.0

This report documents the compliance status of the Facility as of December 2015.

Submitted to:
FNX Mining Company Inc.
1300 Kelly Lake Road
Sudbury, Ontario
P3E 5P4

REPORT

Report Number: 1419949

Distribution:

1 copy/1 e-copy - FNX Mining Company Inc.

1 copy - Golder Associates Ltd.

Golder Associates

Document Version Control

This Emission Summary and Dispersion Modelling (ESDM) Report documents the operations at the FNX Mining Company Inc. (FNX) Victoria Advanced Exploration Project in Denison Township in Sudbury, Ontario (the Facility) and has been prepared in accordance with s.26 of Ontario Regulation 419/05 (O. Reg. 419/05) to document compliance with s. 20 of O. Reg. 419/05. The Report is a living document and should be kept up-to-date at all times. Therefore, it is necessary to have appropriate version control. This version control will allow facility personnel, compliance auditors, or the Ontario Ministry of the Environment and Climate Change (MOECC) to track and monitor ESDM Report changes over time.

As facility operations change and sources are added to or removed from the Facility, this ESDM Report will be updated as required. These changes will be documented in a Modification Log. The Modification Log is included in Appendix A. Changes listed in the Modification Log have been incorporated into the ESDM Report. When the ESDM Report is updated, the version number will be changed to correspond with the information in the Modification Log.

Version	Date	Revision Description	Prepared By	Reviewed By (Facility Contact)
1.0	April 2012	Original ESDM Report to support the ECA Application	N. Hamilton Golder Associates Ltd.	V. Felix FNX Mining Company Inc.
2.0	July 2015	Updates to operations at the site including changes to generators and comfort heating equipment, addition of a crushing plant and water treatment plant, and changes to mine ventilation exhausts Update to the current MOECC-accepted regulatory version of AERMOD and its pre-processors	D. Corelli Golder Associates Ltd	V. Felix FNX Mining Company Inc.

Executive Summary

This Emission Summary and Dispersion Modelling (ESDM) Report update was prepared to reflect modifications made by FNX Mining Company Inc. (FNX) at the Victoria Advanced Exploration Project (the Facility) under the Limited Operational Flexibility (LOF) of Environmental Compliance Approval (ECA) Number 8794-8VFJ7B, issued July 2, 2014. This ESDM Report, along with the appended Modification Log, satisfy Condition 4.1 of the ECA.

The contents of this ESDM Report satisfy the requirements of s.26 of Ontario Regulation (O.Reg.) 419/05. In addition, guidance in the Ontario Ministry of the Environment and Climate Change (MOECC) publication *Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report, Version 3.0*, dated March 2009 (ESDM Procedure Document) PIBS 3614e03 was followed, as appropriate.

The Facility includes site preparation and the installation of surface facilities and underground workings to support future mining operations. It can operate up to 24 hours per day, seven days per week, 52 weeks per year and is permitted with LOF to a maximum extraction limit of 401,500 tonnes per year. The Facility is expected to emit particulate matter and products of combustion. The North American Industry Classification System (NAICS) code that best applies to the Facility is 2122 (Metal Ore Mining).

There are no equipment or activities at the Facility that are registered on the Environmental Activity and Sector Registry (EASR) and as such all equipment and activities are approved under the ECA.

A screening level assessment was completed for the emergency equipment at the Facility using the approach outlined in the *Emergency Generator Checklist Supplement to Application for Approval, EPA s.9* PIBS 7976e, dated November, 2010. This assessment is provided Appendix E – Emergency Diesel Equipment Assessment.

The remaining equipment at the Facility is subject to s.20 of O.Reg.419/05, therefore, the Facility's assessment of compliance was performed using the current MOECC-accepted regulatory versions of the AERMOD dispersion model (v.14134) and its pre-processors.

The maximum emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with s.11 of O.Reg.419/05 and the data quality assessment follows the classification system outlined in the ESDM Procedure Document. Some of the sources were considered negligible in accordance with s.8 of O.Reg.419/05.

The modelling scenario, for the relevant averaging period, assumed operating conditions for the Facility that result in the highest concentration of each significant contaminant at a Point of Impingement (POI). A POI concentration for each significant contaminant emitted from the Facility was calculated based on the emission rate estimates and the output from the dispersion model; the results are presented in the Emission Summary Table in accordance with s.26 of O.Reg.419/05.

The POI concentrations listed in the Emission Summary Table were compared against the standards listed in Schedule 3 of O.Reg.419/05, as well as the applicable limits listed in the MOECC publication *Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality (including*

Schedule 6 of O.Reg.419 on Upper Risk Thresholds), dated April 2012 (List of MOECC POI Limits). At 82%, nitrogen oxides have the highest predicted POI concentration relative to the corresponding MOECC POI Limit.

This ESDM Report demonstrates that the Facility can operate in compliance with s.20 of O.Reg.419/05.

Table I: Emission Summary Table

Contaminant	CAS No.	Total Facility Emission Rate (g/s)	Air Dispersion Model Used	Ave. Period (hours)	Maximum POI Conc. (µg/m³)	POI Location (See Figure 8)	MOECC POI Limit (µg/m³)	Limiting Effect	Regulation /Schedule No.	Percentage of MOECC Limit (%)
Ammonia	7664-41-7	2.22E+00	AERMOD	24	32.37	POI1	100	Health	Schedule 3	32%
Carbon Monoxide	630-08-0	3.62E+00	AERMOD	½	379.75	POI2	6000	Health	Schedule 3	6%
Nitrogen Oxides	10102-44-0	4.07E+00	AERMOD	1	328.39	POI3	400	Health	Schedule 3	82%
Nitrogen Oxides	10102-44-0	4.07E+00	AERMOD	24	50.08	POI4	200	Health	Schedule 3	25%
PM	N/A	6.11E-01	AERMOD	24	5.38	POI1	120	Visibility	Schedule 3	4%
Sulphur Dioxide	7446-09-5	3.48E-01	AERMOD	1	28.89	POI2	690	Health and Vegetation	Schedule 3	<1%
Sulphur Dioxide	7446-09-5	3.48E-01	AERMOD	24	5.06	POI2	275	Health and Vegetation	Schedule 3	11%

Ministry of the Environment | Ministère de l'Environnement

Ontario

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

Company Name:	FNX Mining Company Inc.
Company Address:	1300 Kelly Lake Road, Sudbury, Ontario P3E 5P4
Location Facility	Victoria Advanced Exploration Project, Denison Township, Sudbury, Ontario

The attached Emission Summary and Dispersion Modelling Report was prepared in accordance with s.26 of O. Reg. 419/05 and the guidance in the MOECC document "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 and "Air Dispersion Modelling Guideline for Ontario" dated March 2009 and the minimum required information identified in the check-list on the reverse of this sheet has been submitted.

Company Contact:	
Name:	Vanessa Felix
Title:	Environmental Coordinator
Phone Number:	705 885-1535 x 2009
Signature:	Vanessa Felix
Date:	July 20, 2015

Technical Contact:	
Name:	Dayna Corelli
Representing:	Golder Associates Ltd.
Phone Number:	705 524-6861
Signature:	D Corelli
Date:	July 22 2015

 * This checklist is taken from the document titled "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated July, 2005

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

	Required Information			
			Submitted	Explanation/Reference
	Executive Summary and Emission Summary Table			
	1.1	Overview of ESDM Report	☒ Yes	Executive Summary
	1.2	Emission Summary Table	☒ Yes	Table 5, Page iv
1.0	**Introduction and Facility Description**			
	1.1	Purpose and Scope of ESDM Report	☒ Yes	Section 1.1
	1.2	Description of Processes and NAICS code(s)	☒ Yes	Section 1.3
	1.3	Description of Products and Raw Materials	☒ Yes	Section 1.2
	1.4	Process Flow Diagram	☒ Yes	Section 1.3, Figure 2
	1.5	Operating Schedule	☒ Yes	Section 1.4
2.0	**Initial Identification of Sources and Contaminants**			
	2.1	Sources and Contaminants Identification Table	☒ Yes	Section 2.1, Table 1
3.0	**Assessment of the Significance of Contaminants and Sources**		☒ Yes	
	3.1	Identification of Negligible Contaminants and Sources	☒ Yes	Section 3.1
	3.2	Rationale for Assessment	☒ Yes	Section 3.2
4.0	**Operating Conditions, Emission Estimating and Data Quality**			
	4.1	Description of operating conditions, for each significant contaminant that results in the maximum POI concentration for that contaminant	☒ Yes	Section 4.1
	4.2	Explanation of Method used to calculate the emission rate for each contaminant	☒ Yes	Section 4.2
	4.3	Sample calculation for each method	☒ Yes	Section 4.3
	4.4	Assessment of Data Quality for each emission rate	☒ Yes	
5.0	**Source Summary Table and Property Plan**			
	5.1	Source Summary Table	☒ Yes	Section 5.1, Table 2
	5.2	Site Plan (scalable)	☒ Yes	Section 5.1, Figure 3
6.0	**Dispersion Modelling**			
	6.1	Dispersion Modelling Input Summary Table	☒ Yes	Section 6.1, Tables 1 & 3
	6.2	Land Use Zoning Designation Plan	☒ Yes	Figure 4
	6.3	Dispersion Modelling Input and Output Files	☒ Yes	Appendix D
7.0	**Emission Summary Table and Conclusions**			
	7.1	Emission Summary Table	☒ Yes	Section 7.1, Table 5
	7.2	Assessment of Contaminants with no MOECC POI Limits	☒ Yes	Section 7.0
	7.3	Conclusions	☒ Yes	Section 8.0
	Appendices			
	Appendix A – Modification Log		☒ Yes	
	Appendix B – Emission Rate Calculations		☒ Yes	
	Appendix C – Supporting Information for Emission Rate Calculations		☒ Yes	
	Appendix D – Dispersion Modelling Files (CD Only)		☒ Yes	
	Appendix E – Emergency Diesel Equipment Assessment		☒ Yes	
			☐ Yes	
			☐ Yes	

 * This checklist is taken from the document titled “Procedure for Preparing an Emission Summary and Dispersion Modelling Report” dated July, 2005

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION AND FACILITY DESCRIPTION

FNX Mining Company Inc. (FNX) operates the Victoria Advanced Exploration Project located in Denison Township, Ontario (the Facility). The location of the Facility is presented in Figure 1 – Site Location Plan.

1.1 Purpose and Scope of ESDM Report

The Facility currently operates under Environmental Compliance Approval (ECA) with Limited Operational Flexibility No. 8794-8VFJ7B, issued on July 2, 2014. The Limited Operational Flexibility (LOF) for the Facility expires on August 6, 2023. Condition 4.1 of the ECA requires FNX to maintain the following documentation:

a) an ESDM Report that demonstrates compliance with the Performance Limits for the Facility;

b) an up-to-date log that describes each modification to the Facility; and

c) a record of the changes to the ESDM Report that documents how each Modification is in compliance with the Performance Limits specified in s.3.2 of the ECA.

This Emission Summary and Dispersion Modelling (ESDM) Report, along with the Modification Log found in Appendix A, satisfies ECA Condition 4.1.

The contents of this ESDM Report satisfy the requirements of s.26 of Ontario Regulation (O.Reg.) 419/05. In addition, guidance in the Ontario Ministry of the Environment and Climate Change (MOECC) publication *Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report, Version 3.0*, dated March 2009 (ESDM Procedure Document) PIBS 3614e03 was followed, as appropriate.

A screening level assessment was completed for the emergency equipment at the Facility using the approach outlined in the *Emergency Generator Checklist Supplement to Application for Approval, EPA s.9* PIBS 7976e, dated November, 2010. This assessment is provided in Appendix E – Emergency Diesel Equipment Assessment.

The remaining equipment at the Facility is subject to s.20 of O.Reg.419/05, therefore, the Facility's assessment of compliance was performed using the most current MOECC-accepted regulatory version of the AERMOD dispersion model (version 14134) and its pre-processors.

The information provided in this report could be used to derive proprietary information on FNX as well as production numbers at the Facility. This information is thus considered to be a trade secret and of a proprietary nature by FNX. It is therefore requested that it be held in confidence and not released to anyone outside of the review procedure without prior consent of FNX. This request relies on Section 17 of the Ontario *Freedom of Information and Protection of Individual Privacy Act*.

1.1.1 Summary of Modifications

The following modifications were made since Version 1.0 of this report:

- removal of ready mix batching activities;

- changes to the mine ventilation exhausts;
- changes to comfort heating equipment;
- changes to diesel power equipment;
- addition of crushing and material handling activities; and
- addition of a water treatment plant.

Appendix A contains a Modification Log which summarizes in more detail the changes that the ESDM Report has undergone since ESDM Report Version 1.0.

1.2 Description of Processes and North American Industry Classification System Code(s)

FNX operates an advanced exploration underground mining project. The project involves site preparation and the installation of surface facilities and underground workings to support future mining operations. The maximum material extraction limit for the Facility is 401,500 tonnes per year.

Surface operations and facilities include: shaft sinking drilling and blasting, mine ventilation installation, surface crushing operations and material handling. A water treatment plant will also be operated at the site.

There are also support operations at the Facility, namely: diesel generators to provide power, propane fired heating equipment, a maintenance shop/warehouse with some minor welding, as well as emergency back-up power equipment.

Product usages and process information are provided in detail in Appendix B – Emission Rate Calculations. Table 1 – Sources and Contaminants Identification Table contains a summary of the individual sources of emissions at the Facility.

The North American Industry Classification System (NAICS) code that best applies to the Facility is 2122 (Metal ore Mining).

1.3 Process Flow Diagram

A process flow diagram is provided in Figure 2 – Process Flow Diagram.

1.4 Operating Schedule

The Facility operates 24 hours per day, seven days a week, up to 52 weeks per year.

2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS

2.1 Sources and Contaminants Identification Table

Table 1 – Sources and Contaminants Identification Table includes all the potential emission sources at the Facility. The expected contaminants emitted from each source are also identified in Table 1. Each of the identified sources has been assigned a source reference number.

There may be general ventilation from the Facility that only discharges uncontaminated air from the workspaces or air from the workspace that may include contaminants that come from commercial office supplies, building maintenance products or supplies and activities; these types of ventilation sources are considered to be negligible and were not identified as sources at the Facility. General ventilation located in the process area that does not vent process emissions is also considered to be negligible.

3.0 ASSESSMENT OF THE SIGNIFICANCE OF CONTAMINANTS AND SOURCES

Contaminants and sources at the Facility were assessed for significance following the guidance outlined in the ESDM Procedure Document.

In accordance with s.8 of O.Reg.419/05, emission rate calculations and dispersion modelling does not have to be performed for emissions from negligible sources.

3.1 Identification of Negligible Contaminants and Sources

Sources and contaminants that are discharged from the Facility in negligible amounts were excluded from further analysis. Table 1 lists the sources and contaminants that were deemed insignificant and were not included in the modelling assessment for the Facility.

3.2 Rationale for Assessment

For each source and/or contaminant that has been deemed negligible, information required to substantiate this classification, including references to MOECC guidance where applicable, is also provided in Table 1.

4.0 OPERATING CONDITIONS, EMISSION ESTIMATING AND DATA QUALITY

4.1 Description of Operating Conditions

Section 10 of O.Reg.419/05 states that an acceptable operating condition is a scenario in which operating conditions for the Facility would result, for the relevant contaminant, in the highest concentration of the contaminant possible at the point of impingement (POI). The operating condition described in this ESDM Report meets this requirement.

The maximum emission scenario for the dispersion modelling analysis includes all significant sources at the Facility operating simultaneously at their respective maximum rates. The following table outlines the maximum rates for each significant source of emissions as assessed herein.

Source	Source ID(s)	Maximum Rate
Fresh Air Heater	FAR	1,100,000 Btu/hr propane fired
Drilling and Blasting	DB	2 blasts of 61 m² per day 161 holes drilled per day 612 kg of bulk emulsion, 231 kg of ANFO used per blast
Propane Combustion	WTP1-WTP4	1,200,000 Btu/hr total
Water Treatment Plant – Ammonia Stripper	WTP5	1,400 L/min circulation rate 100 mg/L inlet loading of ammonia 5 mg/L effluent ammonia concentration
Diesel Generators	IDGEN1-3, IDGEN5-7, GEN1	993 kW total
Rock Breaker	RBREAKER	20 tonnes/day
Crushing	PCRUSH, PSTACK	1000 tonnes/day
Material Handling	PAG_SP1, PAG_SP2	1000 tonnes/day each

The averaging periods for the maximum rates provided in the above table were selected based on the averaging periods for the MOECC POI Limits of the significant contaminants emitted from each source. The use of the above maximum rates to estimate emission rates of contaminants for each emission source results in an operating condition which satisfies section 10 of O.Reg.419/05. More details on the maximum operating rates are provided in Appendix B – Emission Rate Calculations.

4.2 Explanation of the Methods Used to Calculate Emission Rates

The maximum emission rates for each significant contaminant emitted from the significant sources were estimated in accordance with requirements of s.11 of O.Reg.419/05 and the ESDM Procedure Document. These rates and methods are summarized in Table 2 – Source Summary Table.

4.3 Sample Calculations

Sample calculations are presented in Appendix B – Emission Rate Calculations. All of the emission estimation methods are acceptable methods as outlined in the ESDM Procedure Document. Where the emission rate calculation relies on data that is not readily available, the data are provided in Appendix C – Supporting Information for Emission Rate Calculations.

4.4 Assessment of Data Quality

The data quality for each contaminant emission rate is documented in Table 2 – Source Summary Table and Appendix B – Emission Rate Calculations.

4.5 Conservatism of Emission Estimates and Operating Condition

The following assumptions were included in the development of the emission estimates and operating condition for the Facility:

- The highest emission rate that each source is capable of (i.e. maximum usage rates or throughputs) was used to characterize the emissions.
- All sources are assumed to be operating simultaneously at the corresponding maximum emission rate for the averaging period.
- All fuel-fired combustion equipment (i.e. comfort heating and power) emission rates were determined using the highest emission factor, combined with the maximum thermal heat input or engine rating for each piece of equipment.

Based on the conservative assumptions summarized above and detailed in Appendix B – Emission Rate Calculations, the emission rates listed in Table 2 are not likely to be an underestimate of the actual emission rates.

5.0 SOURCE SUMMARY TABLE AND SITE PLAN

5.1 Source Summary Table

The emission rates for each source of significant contaminants are documented in Table 2 – Source Summary Table in accordance with requirements of sub paragraph 8 of s.26(1) of O.Reg.419/05.

5.2 Site Plan

A scaled site plan is provided in Figure 3. This figure presents the following:

- the property boundary (coordinates for the property boundary are contained in the Dispersion Modelling Input File “RECEPTORS.REC” in Appendix D);
- each significant source of significant contaminants;
- the location, dimensions and elevation of every structure on the property; and
- an indication of which structures contain sensitive receptors (if applicable).

Where reasonable, the location, dimensions, and elevations of only those on-site structures that may affect the dispersion of emissions from significant sources are included.

For ease of reference, each of the sources is labelled with the source reference number in Table 2 – Source Summary Table.

6.0 DISPERSION MODELLING

Dispersion modelling was conducted in accordance with the MOECC *publication Guideline A-11: Air Dispersion Modelling Guideline for Ontario, Version, 3.0*, dated May 2015 (ADMGO) PIBS 5165e03.

The Facility is subject to s.20 of O.Reg.419/05, therefore the modelled impact to POI criteria are required to be assessed against Schedule 3 Standards using an advanced dispersion model such as AERMOD.

The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor, the AERMAP terrain pre-processor, and the BPIP building downwash pre-processor. The version of the AERMOD model which was used in this assessment is the current MOECC-accepted regulatory version. The AERMET pre-processor was not used in this assessment; however the most current version of the appropriate pre-processed MOECC meteorological dataset was used.

The following is a list of the model and pre-processors which were used in this assessment, along with the version numbers of each:

- AERMOD dispersion model (v. 14134); and
- AERMAP surface pre-processor (v. 09040).

The BPIP building downwash pre-processor (v.04272) was not used as there are no buildings that may impact the dispersion of the one point source at the site.

The dispersion modelling was conducted in accordance with the ADMGO. A general description of the input data used in the dispersion model is provided below and summarized in Table 3.

The emission rates used in the dispersion model meet the requirements of s.11(1)1 of O.Reg.419/05, which requires that the emission rate used in the dispersion model be at least as high as the maximum emission rate that the source of contaminant is reasonably capable of for the relevant contaminant. These emission rates are further described in Appendix B – Emission Rate Calculations.

There are no sensitive receptors (e.g. child care facility, health care facility, senior's residence, long-term care facility or an educational facility) located at the Facility. Therefore, same structure contamination was not considered.

6.1 Dispersion Modelling Input Summary Table

A description of the way in which the approved dispersion model was performed is included as Table 3 – Dispersion Modelling Input Summary Table. This table meets both the requirements of s.26(1)11 and sections 8-17 of O.Reg.419/05 and follows the format provided in the ESDM Procedure Document.

6.1.1 Dispersion Modelling Source Parameters

The source parameter data required for each source was determined according to the procedures provided in ADMGO. Furthermore, the dispersion modelling input parameters are summarized in Table 4 – Dispersion Modelling Source Summary Table.

There is one point source and 10 volume sources, as presented in Figure 5 – Dispersion Modelling Plan. The stack parameters used for the point source are based on the current dimensions of the shaft opening. The volume source parameters are based on the dimensions of the buildings or enclosures associated with the generators and water treatment plant. The parameters for the crushing operations are based on the equipment working layout whereas the dimensions of the material handling volume sources are based on the size of the disturbed area within the storage pile while material handling would be occurring.

6.1.2 Conservatism of Dispersion Modelling Source Parameters

The following assumptions were included in the development of the conservative dispersion model inputs for the Facility:

- most sources were modelled as volume sources, which is conservative since this model source type does not take advantage of favourable dispersion characteristics such as plume buoyancy and initial exit velocity of emissions; and
- the location of the crushing and material handling sources was chosen to be the closest possible location to the property boundary. These sources will be located further into the site for the majority of the operating time.

6.2 Land Use Zoning Designation Plan

The land use designation of the site and surrounding area is presented in Figure 4 – Land Use Zoning Designation Plan.

6.3 Coordinate System

The Universal Transverse Mercator (UTM) coordinate system, as per Section 5.2.2 of the ADMGO, was used to specify model object sources, buildings and receptors. All coordinates were defined in the North American Datum of 1983 (NAD83).

6.4 Meteorology and Surrounding Land Use

Sub paragraph 10 of s.26(1) of O.Reg.419/05 requires a description of the local land use conditions if meteorological data, as described in paragraph 2 of s.13(l) of O.Reg.419/05, was used. In this assessment, the AERMOD model was run using a MOECC pre-processed five year dispersion meteorological dataset (i.e. surface and profile files), last updated in 2015, in accordance with paragraph 1 of s.13(1) of

O.Reg.419/05. As the Facility is located in the Northern MOECC Region, the meteorological dataset for Sudbury is used. Furthermore, the land use surrounding the Facility would be characterized as rural, as illustrated in Figure 6 – 3 km Satellite Image. As a result, MOECCs "Forest" meteorological dataset is used.

6.5 Terrain

Terrain data used in this assessment was obtained from MOECC (7.5 minute format) and is illustrated in Figure 7 – Terrain Elevations. DEM files used in this assessment are:

- 04611_9.DEM;
- 04611_10.DEM;
- 04611_11.DEM
- 04612_9.DEM;
- 04612_10.DEM;
- 04612_11.DEM
- 04613_9.DEM;
- 04613_10.DEM; and
- 04613_11.DEM.

6.6 Receptors

Receptors were chosen based on recommendations provided in Section 7.1 of the ADMGO, which is in accordance with s.14 of O.Reg.419/05. Specifically, a nested receptor grid, centered around the outer edges of all the sources, was placed as follows:

a) 20 m spacing, within an area of 200 m by 200 m;

b) 50 m spacing, within an area surrounding the area described in (a) with a boundary at 300 m by 300 m outside the boundary of the area described in (a);

c) 100 m spacing, within an area surrounding the area described in (b) with a boundary at 800 m by 800 m outside the boundary of the area described in (a);

d) 200 m spacing, within an area surrounding the area described in (c) with a boundary at 1,800 m by 1,800 m outside the boundary of the area described in (a); and

e) 500 m spacing, within an area surrounding the area described in (d) with a boundary at 4,800 m by 4,800 m outside the boundary of the area described in (a).

In addition to using the nested receptor grid, receptors were also placed every 10 m along the property line in sections of the property line that are within 200 m of an emission source and every 100 m in sections of the

property line that are greater than 200 m from an emission source. Only receptors located outside of the property line were considered. The area of modeling coverage is illustrated on Figure 8 – Dispersion Modelling Receptors and POI Locations.

AERMAP did not provide an elevation for one receptor point. This receptor is located significantly far away from any of the contaminant POI locations therefore it was removed from the AERMOD input files. The coordinates for this receptor are noted in the Dispersion Modelling Input File "RECEPTORS.REC" in Appendix D.

There is no child care facility, health care facility, senior's residence, long-term care facility or an educational facility located at the Facility. As such, same structure contamination was not considered. The nearest residence is located greater than 1 km from the Facility's property line.

6.7 Building Downwash

BPIP building downwash was not used in this assessment, as building wake effects are not anticipated since most of the sources are modelled as volumes. Only the mine ventilation emissions were modelled as a point source (source ID COLLAR). As shown in Figure 3, there are no buildings in the area surrounding the source that would create building wake effects.

6.8 Averaging Periods and Conversions

Schedule 3 standards of O.Reg.419/05 apply to this Facility. Many of these standards are based on 1-hour and 24-hour averaging times, which are averaging times that are easily provided by AERMOD. In cases where a standard has an averaging period that AERMOD is not designed to predict (e.g. ½-hr or 30-day), a conversion to the appropriate averaging period would be completed using the MOECC recommended conversion factors, as documented in the ADMGO.

6.9 Dispersion Modelling Options

The options used in the AERMOD dispersion model are summarized in the table below.

Modelling Parameter	Description	Used in the Assessment?
DFAULT	Specifies that regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
AVERTIME	Time averaging periods calculated	1-hr, 24-hr
URBANOPT	Allows the model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions	No

6.10 Dispersion Modelling Input and Output Files

Electronic copies of all input and output files are provided in Appendix D – Dispersion Modelling Files on compact disc (CD) only.

Individual model runs were conducted for the following contaminants:

- Particulate matter (PM);
- Carbon monoxide (CO);
- Nitrogen oxide (NOx);
- Sulphur dioxide (SO_2); and
- Ammonia.

7.0 EMISSION SUMMARY TABLE

7.1 Emission Summary Table

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the emission rates listed in Table 2 – Source Summary Table and the output from the dispersion model. The results are presented in Table 5 – Emission Summary Table. POI locations are indicated in Figure 8 – Dispersion Modelling Receptors and POI locations.

The POI concentrations listed in Table 5 were compared against the MOECC POI Limits. At 82%, nitrogen oxides have the highest concentration relative to the corresponding MOECC POI Limit. There are no contaminants without MOECC POI Limits emitted from the Facility.

8.0 CONCLUSIONS

This ESDM Report was prepared in accordance with s.26 of O.Reg.419/05. In addition, guidance in the ESDM Procedure Document was followed, as appropriate.

The Facility is subject to s. 20 of O.Reg.419/05, contaminant emissions were assessed for their appropriate averaging periods using the AERMOD dispersion model.

All the emission rates listed in Table 2 – Source Summary Table correspond to the operating scenario which results in the maximum POI concentration from the site. For this reason and conservatisms discussed in s.4.5, the emission rates listed in Table 2 – Source Summary Table are not likely to be an underestimate of the actual emission rates.

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the calculated emission rates and the output from the dispersion model. Conservatisms in the modelling approach are discussed in s.6.1.2. The results are presented in Table 5 – Emission Summary Table.

The POI concentrations listed in the Emission Summary Table were compared against published MOECC publication *Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality (including Schedule 6 of O.Reg.419 on Upper Risk Thresholds)*, dated April 2012 (MOECC POI Limits). At 82%, nitrogen oxides have the highest predicted POI concentration relative to the corresponding MOECC POI Limit. There are no contaminants released by the Facility that are considered to be 'Contaminants with No MOECC POI Limits'.

It is assumed that the conservative emission rates, when combined with the conservative operating conditions and conservative dispersion modelling assumptions, are not likely to under predict the concentrations at a POI. Therefore, this assessment demonstrates that the Facility can operate in compliance with s.20 of O.Reg.419/05.

Report Signature Page

GOLDER ASSOCIATES LTD.

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Air Quality Specialist

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Associate/Senior Air Quality Specialist

DCC/NCH/ms

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Table 1

Sources and Contaminants Identification Table

Source Information			Expected Contaminants	Significant (Yes or No)	Modelled (Yes or No)	Rationale if Deemed Insignificant/Negligible
Source ID	Source Description or Title	General Location and Description				Reference to section of the MOE Procedure Document
COLLAR	Mine Ventilation	Collar	PM, Carbon Monoxide, Nitrogen Oxides, Sulphur Dioxide	Yes	Yes	—
DB	Drilling and Blasting	Emissions attributed to Collar	PM, Carbon Monoxide, Nitrogen Oxides, Sulphur Dioxide	Yes	Yes	—
FAR	Mine Air Heater	Emissions attributed to Collar	Products of Propane Combustion	Yes	Yes	Only Nitrogen Oxides are modelled as per Section 7.1.1 of the ESDM Procedure Document
WTP1	Water Treatment Plant Heater	Water Treatment Plant	Products of Propane Combustion	Yes	Yes	Only Nitrogen Oxides are modelled as per Section 7.1.1 of the ESDM Procedure Document
WTP2	Water Treatment Plant Heater	Water Treatment Plant	Products of Propane Combustion	Yes	Yes	Only Nitrogen Oxides are modelled as per Section 7.1.1 of the ESDM Procedure Document
WTP3	Water Treatment Plant Heater	Water Treatment Plant	Products of Propane Combustion	Yes	Yes	Only Nitrogen Oxides are modelled as per Section 7.1.1 of the ESDM Procedure Document
WTP4	Water Treatment Plant Heater	Water Treatment Plant	Products of Propane Combustion	Yes	Yes	Only Nitrogen Oxides are modelled as per Section 7.1.1 of the ESDM Procedure Document
WTP5	Water Treatment Plant Ammonia Strripper	Water Treatment Plant	Ammonia	Yes	Yes	—
IDGEN1	40 kW Individual Diesel Generator	North East Side of Main Site	Products of Diesel Combustion	Yes	Yes	—
IDGEN2	100 kW Individual Diesel Generator	North Side of Main Site	Products of Diesel Combustion	Yes	Yes	—
IDGEN3	100 kW Individual Diesel Generator	South Side of Main Site	Products of Diesel Combustion	Yes	Yes	—
IDGEN5	230 kW Individual Diesel Generator	South Side of Main Site	Products of Diesel Combustion	Yes	Yes	—
IDGEN6	100 kW Individual Diesel Generator	Construction Trailers	Products of Diesel Combustion	Yes	Yes	—
IDGEN7	200 kW Individual Diesel Generator	Construction Around Headframe	Products of Diesel Combustion	Yes	Yes	—
RBREAKER	Rock Breaker	PAG stockpile area	PM	Yes	Yes	—
PCRUSH	Primary Crusher	PAG stockpile area	PM	Yes	Yes	—
PSTACK	Stacker	PAG stockpile area	PM	Yes	Yes	—
GEN1	Primary Crusher Diesel Generator	PAG stockpile area	Products of Diesel Combustion	Yes	Yes	—
PAG_SP1	PAG Material Handling 1	PAG stockpile area	PM	Yes	Yes	—
PAG_SP2	PAG Material Handling 2	PAG stockpile area	PM	Yes	Yes	—
WELD	Maintenance Welding	Shop	PM, Metals	No	No	As per Section 7.2.1 Appendix B Table B-3 of the ESDM Procedure Document
PR1	Paved Roads	Throughout the Site	PM	Yes	No	Facility implements a BMPP as per Section 7.4 of the ESDM Procedure Document
UPR1	Unpaved Roads	Throughout the Site	PM	Yes	No	Facility implements a BMPP as per Section 7.4 of the ESDM Procedure Document
SP	Miscellaneous Overburden Stockpiles	Throughout the Site	PM	No	No	Facility implements a BMPP as per Section 7.4 of the ESDM Procedure Document
EG1	3000 ekW/3750 kVA Emergency Generator	South East Side of Main Site	Nitrogen Oxides	Yes	No	See Generator Assessment in Appendix E

Table 2
Source Summary Table

Source Identifier	Source Description	Source Location	Source Parameters					Emission Data						
			Stack Volumetric Flow Rate [Am³/s]	Stack Exit Gas Temperature [K]	Stack Inner Diameter [m]	Stack Height Above Grade [m]	Stack Height Above Roof [m]	Contaminant	CAS No.	Averaging Period	Emission Estimating Technique	Emissions Data Quality	Maximum Emission Rate [g/s]	Percentage of Overall Emissions
COLLAR	Mine Ventilation	Collar	47.19	288.50	7.60	0.00	0.00	PM	N/A	24-hr	EF	A-Average	3.30E-01	54%
								CO	630-08-0	½-hr	EF	Marginal	2.57E+00	71%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.67E-01	14%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	3.85E-03	1%
WTP1	Water Treatment Plant Heater	Water Treatment Plant	—	—	—	—	—	NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.37E-03	<1%
WTP2	Water Treatment Plant Heater	Water Treatment Plant	—	—	—	—	—	NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.37E-03	<1%
WTP3	Water Treatment Plant Heater	Water Treatment Plant	—	—	—	—	—	NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.37E-03	<1%
WTP4	Water Treatment Plant Heater	Water Treatment Plant	—	—	—	—	—	NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.37E-03	<1%
WTP5	Water Treatment Plant Ammonia Strripper	Water Treatment Plant						Ammonia	7664-41-7	24-hr	EF	Average	2.22E+00	100%
IDGEN1	40 kW Individual Diesel Generator	North East Side of Main Site	—	—	—	—	—	CO	630-08-0	½-hr	EF	Marginal	4.51E-02	1%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	2.10E-01	5%
								PM	N/A	24-hr	EF	Marginal	1.49E-02	2%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	1.39E-02	4%
IDGEN2	100 kW Individual Diesel Generator	North Side of Main Site	—	—	—	—	—	CO	630-08-0	½-hr	EF	Marginal	1.13E-01	3%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.24E-01	13%
								PM	N/A	24-hr	EF	Marginal	3.72E-02	6%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	3.46E-02	10%
IDGEN3	100 kW Individual Diesel Generator	South Side of Main Site	—	—	—	—	—	CO	630-08-0	½-hr	EF	Marginal	1.13E-01	3%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.24E-01	13%
								PM	N/A	24-hr	EF	Marginal	3.72E-02	6%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	3.46E-02	10%
IDGEN5	230 kW Individual Diesel Generator	South Side of Main Site	—	—	—	—	—	CO	630-08-0	½-hr	EF	Average	2.23E-01	6%
								NOx	10102-44-0	1-hr, 24-hr	EF	Average	2.57E-01	6%
								PM	N/A	24-hr	EF	Average	1.29E-02	2%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	7.97E-02	23%
IDGEN6	100 kW Individual Diesel Generator	Construction Trailers	—	—	—	—	—	CO	630-08-0	½-hr	EF	Marginal	1.13E-01	3%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	5.24E-01	13%
								PM	N/A	24-hr	EF	Marginal	3.72E-02	6%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	3.46E-02	10%

Source Summary Table

Source Identifier	Source Description	Source Location	Source Parameters					Emission Data						
			Stack Volumetric Flow Rate [Am³/s]	Stack Exit Gas Temperature [K]	Stack Inner Diameter [m]	Stack Height Above Grade [m]	Stack Height Above Roof [m]	Contaminant	CAS No.	Averaging Period	Emission Estimating Technique	Emissions Data Quality	Maximum Emission Rate [g/s]	Percentage of Overall Emissions
IDGEN7	200 kW Individual Diesel Generator	Construction Around Headframe	—	—	—	—	—	CO	630-08-0	½-hr	EF	Marginal	2.26E-01	6%
								NOx	10102-44-0	1-hr, 24-hr	EF	Marginal	1.05E+00	26%
								PM	N/A	24-hr	EF	Marginal	7.43E-02	12%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	6.93E-02	20%
RBREAKER	Rock Breaker	PAG stockpile area	—	—	—	—	—	PM	N/A	24-hr	EF	Marginal	6.25E-04	<1%
PCRUSH	Primary Crusher	PAG stockpile area	—	—	—	—	—	PM	N/A	24-hr	EF	Marginal	3.13E-02	5%
PSTACK	Stacker	PAG stockpile area	—	—	—	—	—	PM	N/A	24-hr	EF	Marginal	8.68E-03	1%
GEN1	Primary Crusher Diesel Generator	PAG stockpile area	—	—	—	—	—	CO	630-08-0	½-hr	EF	Average	2.16E-01	6%
								NOx	10102-44-0	1-hr, 24-hr	EF	Average	4.07E-01	5%
								PM	N/A	24-hr	EF	Average	1.25E-02	2%
								SO2	7446-09-5	1-hr, 24-hr	EF	Marginal	7.72E-02	22%
PAG_SP1	PAG Material Handling 1	PAG stockpile area	—	—	—	—	—	PM	N/A	24-hr	EF	Above Average	7.26E-03	1%
PAG_SP2	PAG Material Handling 2	PAG stockpile area	—	—	—	—	—	PM	N/A	24-hr	EF	Above Average	7.26E-03	1%

Data Quality Categories: "Above-Average"; "Average"; and "Marginal"

Table 3
Dispersion Modelling Input Summary Table

Relevant Section of the Regulation	Section Title	Summary of How the Approved Dispersion Model Was Used	Location of Supporting Documentation in ESDM Report
Section 8	Negligible Sources of Contaminants	Sources and contaminants that were considered negligible were explicitly identified, and therefore were not modelled in accordance with s.8 of O.Reg.419/05.	Section 3.0, Table 1
Section 9	Same Structure Contamination	Not applicable as the Facility does not have a child care facility, health care facility, senior's residence, long-term care facility or an education facility located at the on-site.	N/A
Section 10	Operating Conditions	See section 4.1 and Appendix B of the ESDM Report.	Section 4.0, Table 4
Section 11	Source of Contaminant Emission Rates	The emission rate for each significant contaminant emitted from a significant source was estimated, the methodology for the calculation is documented in Table 2 - Source Summary Table. See section 4.1 and section 4.2 and Appendix B of the ESDM Report for more information.	Section 4.0, Table 2
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	The Operating Conditions were estimated in accordance with s.10(1) 1 and s.11(1) 1 of O.Reg. 419 and are therefore considered to result in the highest concentration at POIs that the Facility is capable of for the contaminants emitted. See section 4.1 and section 4.2 of the ESDM Report.	Section 4.0
Section 13	Meteorological Conditions	MOECC's Regional Dataset for Sudbury, Rural was used.	N/A
Section 14	Area of Modelling Coverage (receptor locations)	Model coverage set to match MOE guidelines.	Section 6.0, Figure 8
Section 15	Stack Height for Certain New Sources of Contaminant	All stacks meet the requirements of s.15 and Good Engineering Practice	N/A
Section 16	Terrain Data	MOECC DEM files used: 04611_9.DEM, 04611_10.DEM, 04611_11.DEM, 04612_9.DEM, 04612_10.DEM, 04612_11.DEM, 04613_9.DEM, 04613_10.DEM, 04613_11.DEM	N/A
Section 17	Averaging Periods	The appropriate averaging periods (as defined by the regulatory limits outlined in Schedule 3) were modelled for each contaminant.	Section 4.0

Table 4
Dispersion Modelling Source Summary Table

POINT SOURCES

Modelling ID	Source Description	Source ID(s)	Stack Volumetric Flow Rate [m^3/s]	Stack Gas Exit Velocity [m^3/s]	Stack Exit Gas Temperature [K]	Stack Inner Diameter [m]	Stack Height Above Grade [m]	Stack Height Above Roof [m]	X Coordinate [m]	Y Coordinate [m]	Contaminant	CAS #	Maximum Emission Rate [g/s]	Averaging Period [hours]
COLLAR	Mine Ventilation	DB FAR	47.19	1.04	289	7.60	0.00	0.00	470448	5139798	PM	N/A	3.30E-01	24-hr
											CO	630-08-0	2.57E+00	½-hr
											NOx	10102-44-0	5.67E-01	1-hr, 24-hr
											SO2	7446-09-5	3.85E-03	1-hr, 24-hr

VOLUME SOURCES

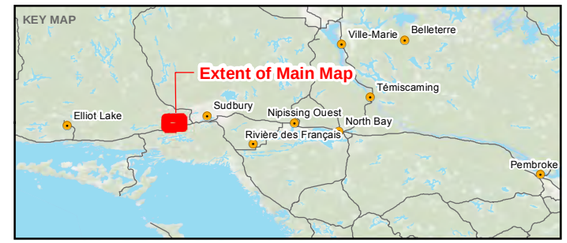
Modelling ID	Source Description	Source ID(s)	Release Height Above Grade [m]	Length of Side [m]	Volume Source Height [m]	Initial Lateral Dimension of Volume [m]	Initial Vertical Dimension of Volume [m]		X Coordinate [m]	Y Coordinate [m]	Contaminant	CAS #	Maximum Emission Rate [g/s]	Averaging Period [hours]
WTP	Water Treatment Plant	WTP1-4	3.00	23.69	6.00	5.51	2.79		470354	5139836	NOx	10102-44-0	2.15E-02	1-hr, 24-hr
											Ammonia	7664-41-7	2.22E+00	24-hr
IDGEN1	40 kW Individual Diesel Generator	IDGEN1	0.91	1.59	1.83	0.37	0.85		470461	5139980	CO	630-08-0	4.51E-02	½-hr
											NOx	10102-44-0	2.10E-01	1-hr, 24-hr
											PM	N/A	1.49E-02	24-hr
											SO2	7446-09-5	1.39E-02	1-hr, 24-hr
IDGEN2	100 kW Individual Diesel Generator	IDGEN2	0.91	1.70	1.83	0.39	0.85		470390	5140011	CO	630-08-0	1.13E-01	½-hr
											NOx	10102-44-0	5.24E-01	1-hr, 24-hr
											PM	N/A	3.72E-02	24-hr
											SO2	7446-09-5	3.46E-02	1-hr, 24-hr
IDGEN3	100 kW Individual Diesel Generator	IDGEN3	0.91	2.48	1.83	0.58	0.85		470445	5139747	CO	630-08-0	1.13E-01	½-hr
											NOx	10102-44-0	5.24E-01	1-hr, 24-hr
											PM	N/A	3.72E-02	24-hr
											SO2	7446-09-5	3.46E-02	1-hr, 24-hr
IDGEN5	230 kW Individual Diesel Generator	IDGEN5	1.44	2.63	2.88	0.61	1.34		470643	5139709	CO	630-08-0	2.23E-01	½-hr
											NOx	10102-44-0	2.57E-01	1-hr, 24-hr
											PM	N/A	1.29E-02	24-hr
											SO2	7446-09-5	7.97E-02	1-hr, 24-hr
IDGEN6	100 kW Individual Diesel Generator	IDGEN6	0.92	1.70	1.83	0.40	0.85		470434	5139737	CO	630-08-0	1.13E-01	½-hr
											NOx	10102-44-0	5.24E-01	1-hr, 24-hr
											PM	N/A	3.72E-02	24-hr
											SO2	7446-09-5	3.46E-02	1-hr, 24-hr
IDGEN7	200 kW Individual Diesel Generator	IDGEN7	1.44	2.63	2.88	0.61	1.34		470431	5139803	CO	630-08-0	2.26E-01	½-hr
											NOx	10102-44-0	1.05E+00	1-hr, 24-hr
											PM	N/A	7.43E-02	24-hr
											SO2	7446-09-5	6.93E-02	1-hr, 24-hr
CRUSHER	PAG Stockpile Area Crusher	RBREAKER PCRUSH PSTACK GEN1	1.98	6.61	3.96	1.54	1.84		470232	5140131	CO	630-08-0	2.16E-01	½-hr
											NOx	10102-44-0	4.07E-01	1-hr, 24-hr
											PM	N/A	5.30E-02	24-hr
											SO2	7446-09-5	7.72E-02	1-hr, 24-hr
PAG_SP1	PAG Material Handling 1	PAG_SP1	2.50	5.00	5.00	1.16	2.33		470279	5140140	PM	N/A	7.26E-03	24-hr
PAG_SP2	PAG Material Handling 2	PAG_SP2	2.50	5.00	5.00	1.16	2.33		470219	5140156	PM	N/A	7.26E-03	24-hr

Table 5
Emission Summary Table

Contaminant	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Averaging Period [hours]	Maximum POI Concentration [µg/m³]	POI Location [See Figure 8]	MOECC POI Limit [µg/m³]	Limiting Effect	Regulation / Schedule No.	Percentage of MOECC Limit [%]
Ammonia	7664-41-7	2.22E+00	AERMOD	24	3.24E+01	POI1	100	Health	Schedule 3	32%
Carbon Monoxide	630-08-0	3.62E+00	AERMOD	½	3.80E+02	POI2	6000	Health	Schedule 3	6%
Nitrogen Oxides	10102-44-0	4.08E+00	AERMOD	1	3.28E+02	POI3	400	Health	Schedule 3	82%
Nitrogen Oxides	10102-44-0	4.08E+00	AERMOD	24	5.01E+01	POI2	200	Health	Schedule 3	25%
PM	N/A	6.11E-01	AERMOD	24	5.38E+00	POI2	120	Visibility	Schedule 3	4%
Sulphur Dioxide	7446-09-5	3.48E-01	AERMOD	1	2.89E+01	POI2	690	Health & Vegetation	Schedule 3	<1%
Sulphur Dioxide	7446-09-5	3.48E-01	AERMOD	24	5.06E+00	POI2	275	Health & Vegetation	Schedule 3	11%

LEGEND

- Nearest Receptor
- Victoria Boundary (approximate)



NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

BASE DATA - ATLAS OF CANADA,
BASE IMAGERY - MICROSOFT BING ©2015 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 495 990 1,980
METRES

SCALE 1:50,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
SITE LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

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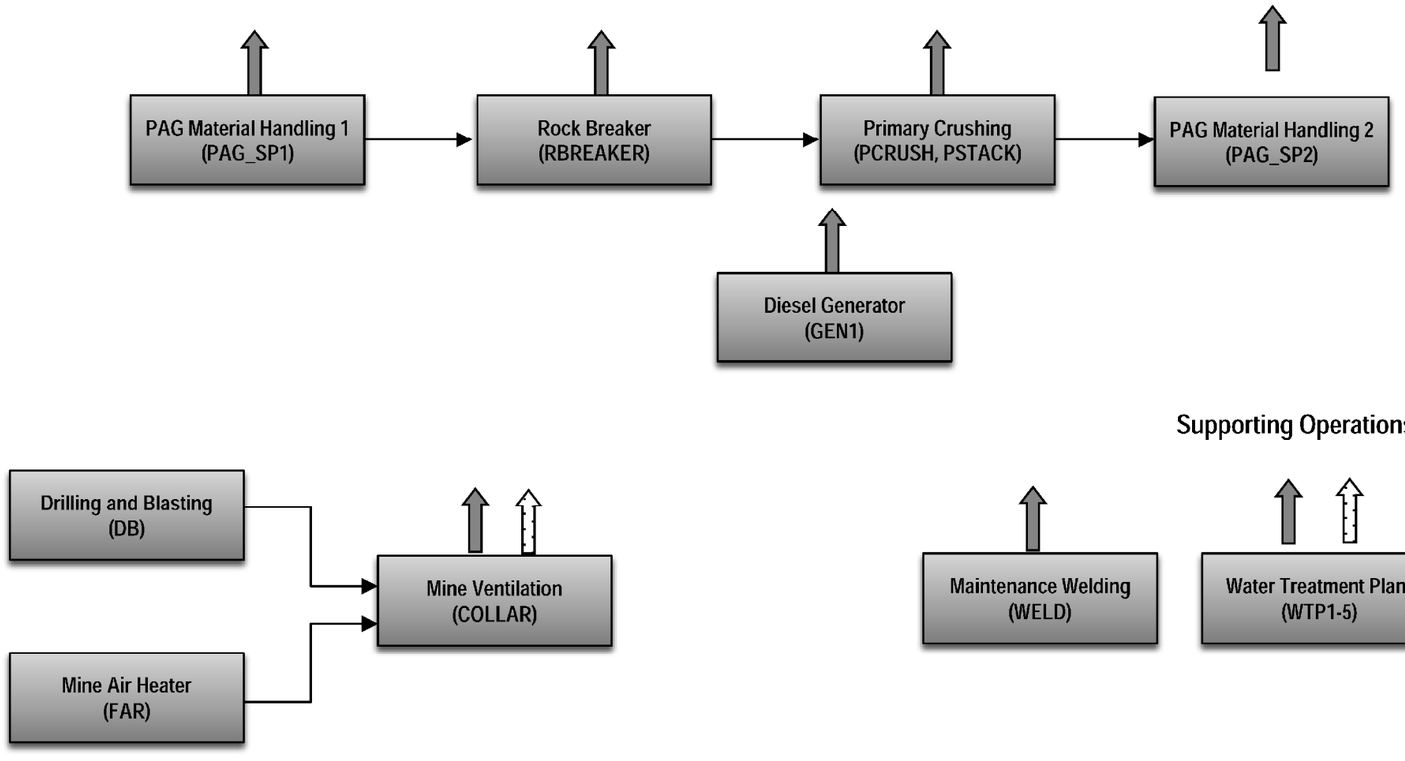

LEGEND

Process Emission

Comfort Heating Emission

NOTES

THIS SCHEMATIC REPRESENTS THE MAJOR PROCESSES TAKING PLACE AT THE FACILITY. SIMPLE PROCESSES SUCH AS FUGITIVE EMISSIONS, ETC. ARE NOT INCLUDED.

REFERENCE

BASE DATA - ATLAS OF CANADA,
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COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

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METRES

SCALE 1:31

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
PROCESS FLOW DIAGRAM

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	DCC
REVIEW	DCC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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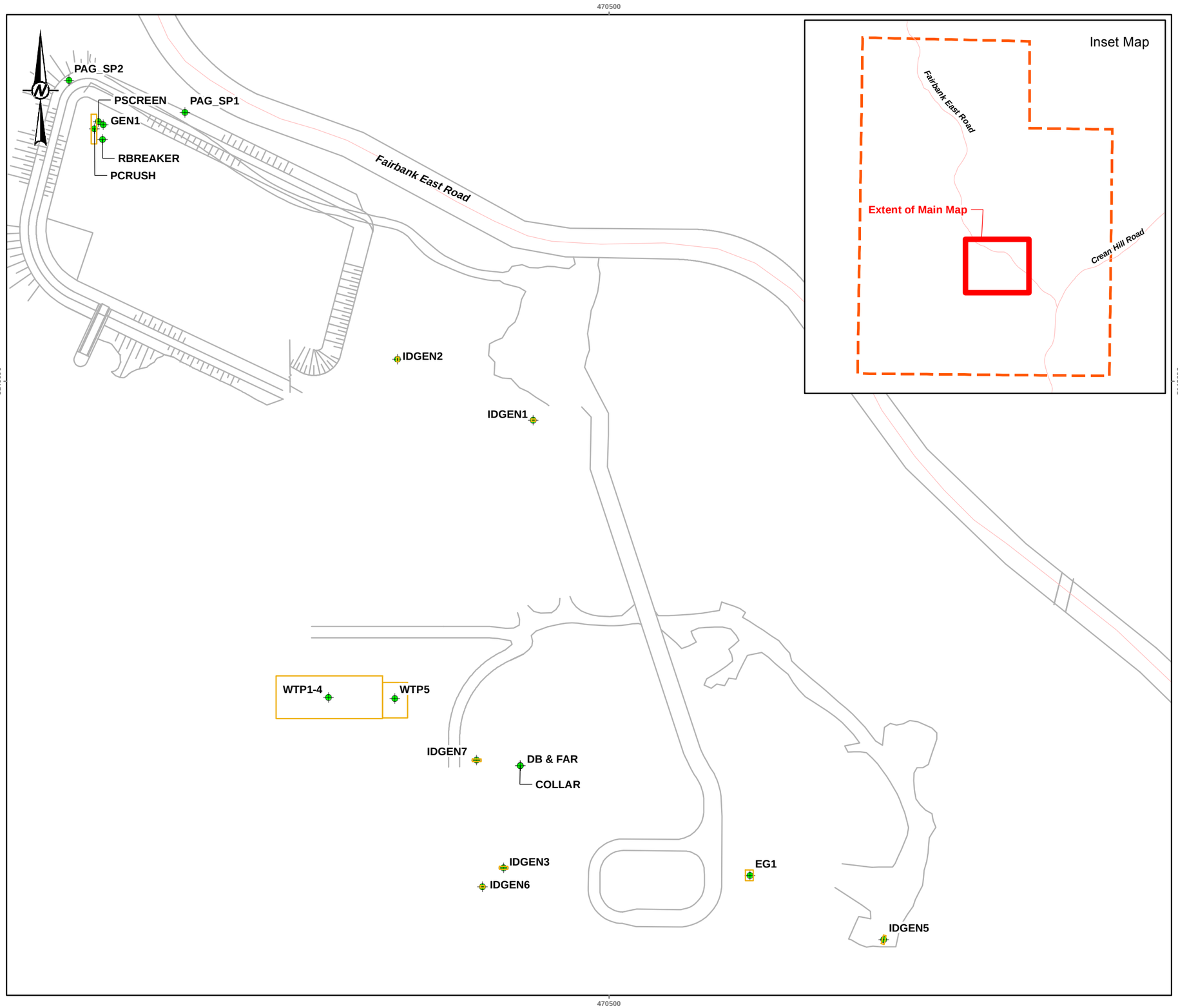

LEGEND

- Roads_City
- Modelling Boundary
- Emission Sources
- Mine Infrastructure
- Proposed Buildings / Enclosures

Source Identifier	Source Description
COLLAR	Shaft Collar
DB	Drilling and Blasting
EG1	300 ekW/3750 Kva Emergency Generator
FAR	Mine Ventilation: Fresh Air Raise
GEN1	Primary Crusher 223 kW Diesel Generator
IDGEN1	40 kW Individual Diesel Generator
IDGEN2	100 kW Individual Diesel Generator
IDGEN3	100 kW Individual Diesel Generator
IDGEN5	230 kW Individual Diesel Generator
IDGEN6	100 kW Individual Diesel Generator
IDGEN7	200 kW Individual Diesel Generator
PAG Stockpile 1	PAG Material Handling 1
PAG Stockpile 2	PAG Material Handling 2
PCRUSH	Primary Crusher
PSTACK	Stacker
RBREAKER	Rock Breaker
WTP1-4	Water Treatment Plant Heaters
WTP5	Water Treatment Plant Ammonia Stripper

NOTES

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REFERENCE

CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
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COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

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METRES
SCALE 1:2,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
SITE PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
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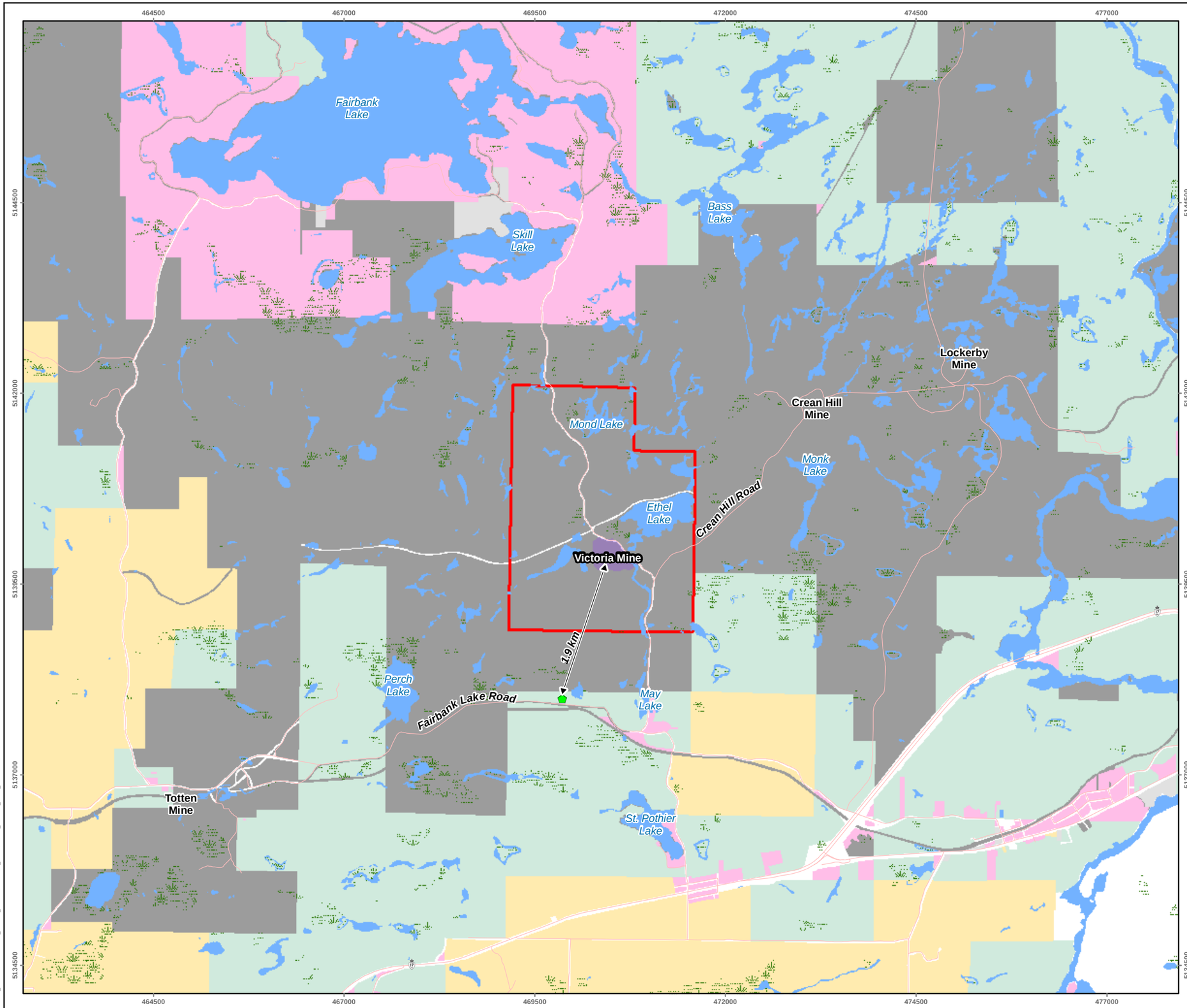

LEGEND

- Nearest Receptor
- Victoria Boundary (approximate)

Zoning

- Agricultural
- Commercial
- Industrial
- Open Space
- Residential

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

ZONING DATA (BY-LAW SCHEDULE A TO BY-LAW 2010-100Z) ACQUIRED FROM: HTTP://WWW.GREATERSUDBURY.CA/CONTENT/ZONINGBYLAWS/2010/KEYMAP2010.PDF
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COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

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METRES

SCALE 1:50,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
LAND USE

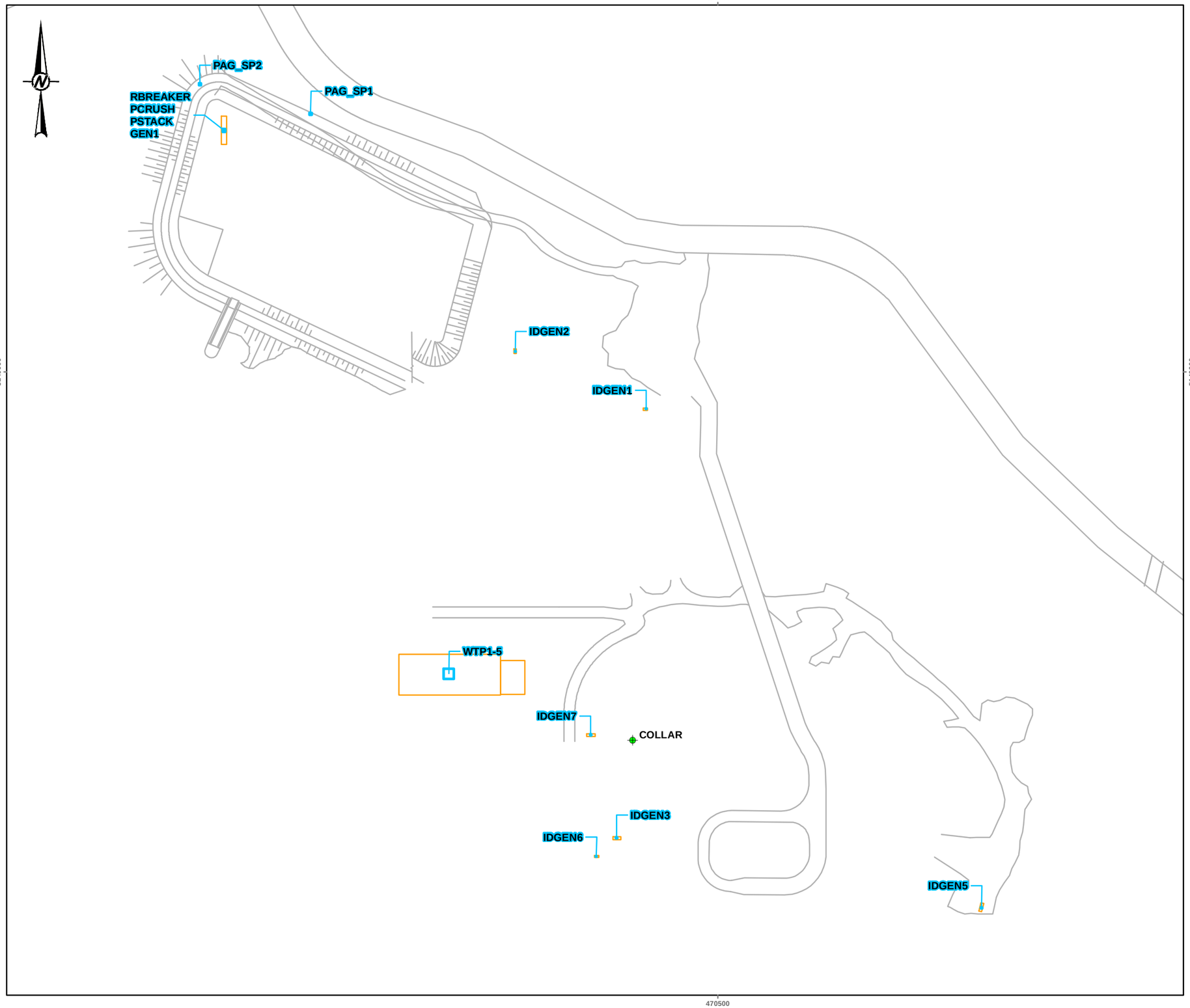
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0

Path: A:_Clients\KGHM\Victoria_Mine\99_PROJ\1419949\40_PROD\RNA\Final_Acoustic_Noise_Vibration\1419949-0001-RN-0006.mxd



LEGEND

- Point Source
- Volume Source
- Proposed Buildings / Enclosures
- Mine Infrastructure

POINT SOURCE				
Modelling ID	Source Description	Source ID(s)	X Coordinate [m]	Y Coordinate [m]
COLLAR	Mine Ventilation	DB FAR	470448	5139798

VOLUME SOURCE				
Modelling ID	*Source Description*	*Source ID(s)*	*X Coordinate [m]*	*Y Coordinate [m]*
WTP	Water Treatment Plant	WTP1-5	470354	5139836
IDGEN1	40 kW Individual Diesel Generator	IDGEN1	470461	5139980
IDGEN2	100 kW Individual Diesel Generator	IDGEN2	470390	5140011
IDGEN3	100 kW Individual Diesel Generator	IDGEN3	470445	5139747
IDGEN5	230 kW Individual Diesel Generator	IDGEN5	470643	5139709
IDGEN6	100 kW Individual Diesel Generator	IDGEN6	470434	5139737
IDGEN7	200 kW Individual Diesel Generator	IDGEN7	470431	5139803
CRUSHER	PAG Stockpile Area Crusher	RBREAKER	470232	5140131
		PCRUSH		
		PSTACK		
		GEN1		
PAG_SP1	PAG Material Handling 1	PAG_SP1	470279	5140140
PAG_SP2	PAG Material Handling 2	PAG_SP2	470219	5140156

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 1419949

REFERENCE

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 20 40 80
METRES
SCALE 1:2,107

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
DISPERSION MODELLING PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**5**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI D
25mm
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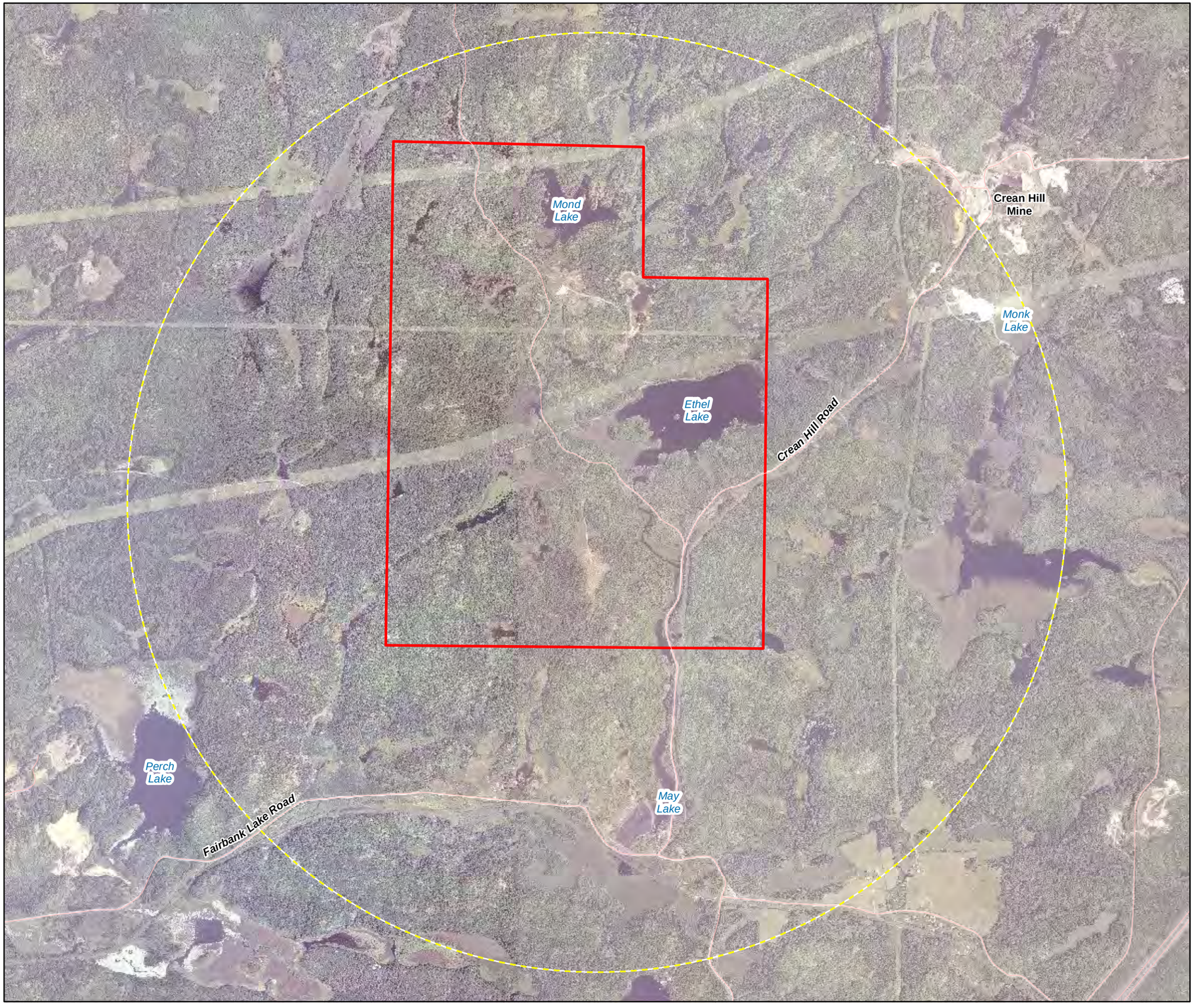


LEGEND

- 3KM Buffer
- Victoria Boundary (approximate)

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

BASE DATA - ATLAS OF CANADA,
BASE IMAGERY - MICROSOFT BING ©2015 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 245 490 980
METRES

SCALE 1:25,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
3 KM SATELLITE IMAGE

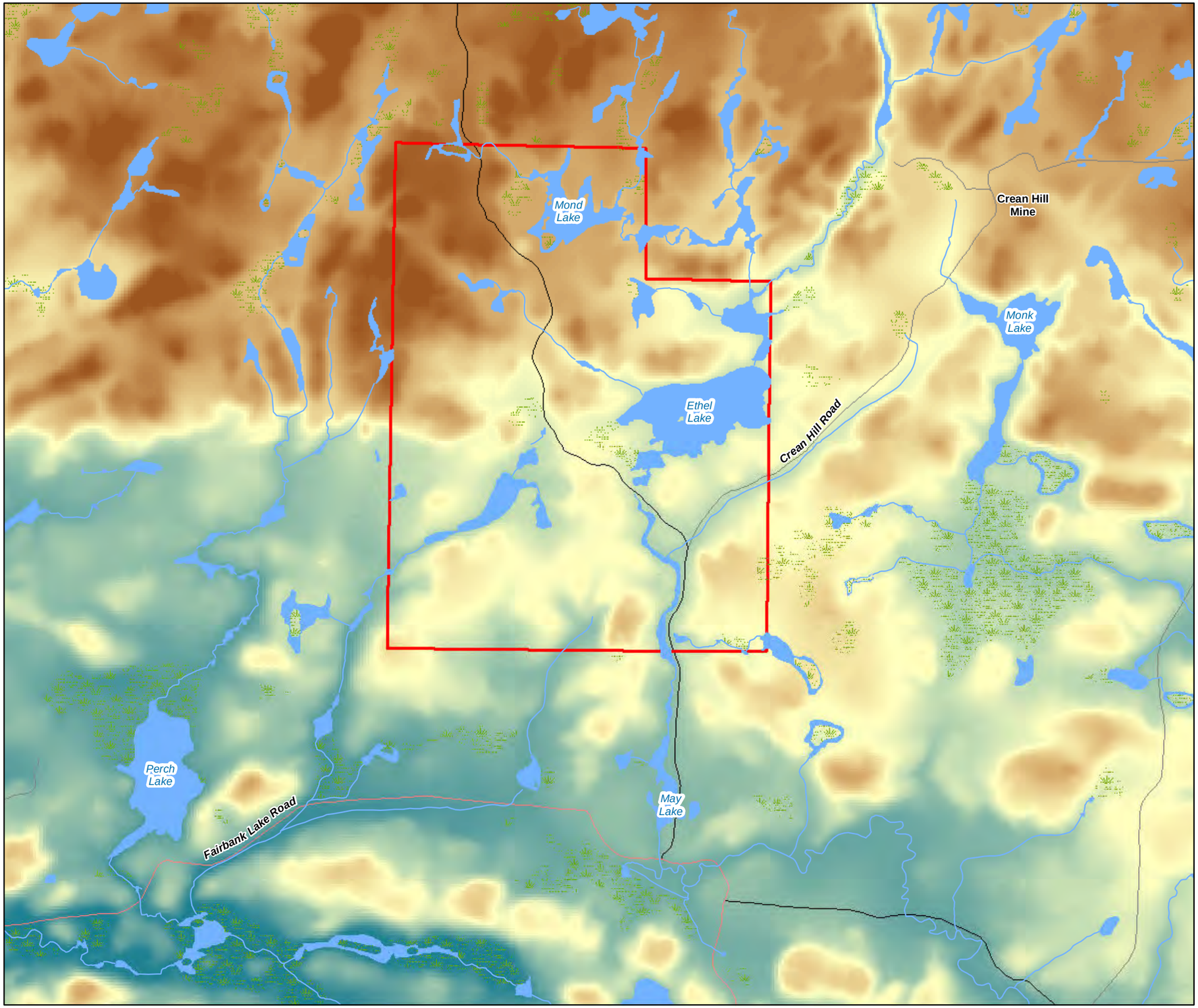
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**6**

Path: A:_Clients\KGHM\Victoria_Mine\99_PROJ\1419949\40_PROD\RNA\Acoustic_Noise_Vibration\1419949-0001-RN-009.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0



LEGEND

- Major Road
- Local Road
- Private Road

Elevation (masl)

High : 343.911

Low : 235

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 245 490 980

METRES

SCALE 1:25,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
TERRAIN ELEVATION

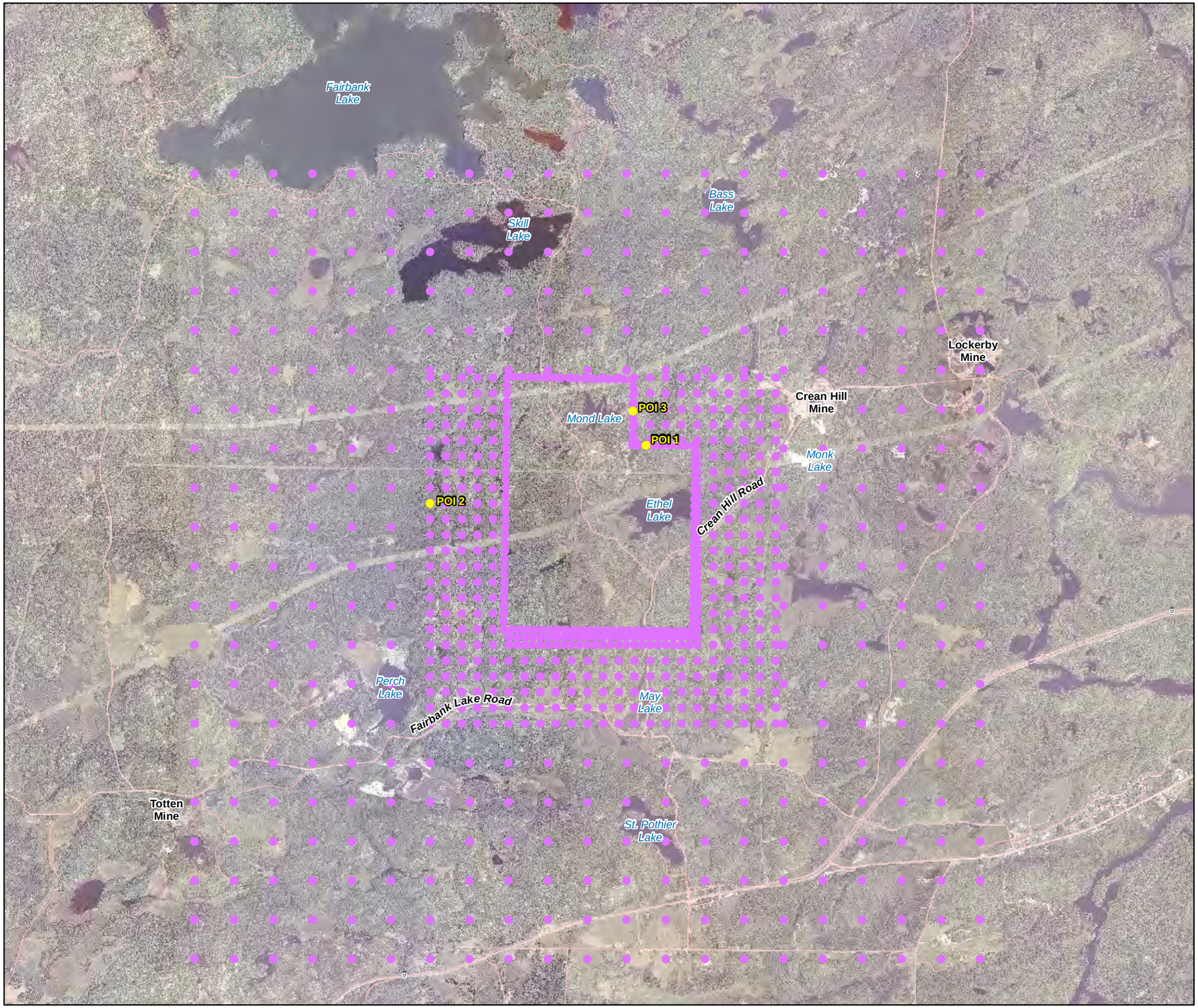
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**7**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Path: A:_Clients\KGHM\Victoria_Mine\99_PROJ\1419949\40_PROD\RNA\Fugitive_Acoustic_Noise_Vibration\1419949-0001-RN-0009.mxd



LEGEND

- POI Locations
- Receptor Grid

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

BASE DATA - ATLAS OF CANADA,
BASE IMAGERY - MICROSOFT BING ©2015 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 495 990 1,980
METRES

SCALE 1:50,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
DISPERSION MODELLING RECEPTORS AND POI LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**8**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 25mm

Path: A:_Clients\KGHM\Victoria_Mine\99_PROJ\1419949\40_PROD\RNA\r_Acoustic_Noise_Vibration\1419949-0001-RN-0007.mxd

APPENDIX A

Modification Log

The following table contains a summary of the changes that the ESDM Report has undergone since ESDM Report Version 1.0. Further details are provided in ESDM Report Table 1 – Sources and Contaminants Identification Table.

ESDM Report Version	Description of Change	Emission Summary and Dispersion Modelling Report Changes
2.0	Removal of Air Exhaust Sources (Ventilation Shaft and Production Shaft) Source IDs: RAR1a-RAR1c	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Modification to drilling and blasting activities Source IDs: DB1-3. ESDM Version 2.0 includes drilling and blasting occurring at the collar for shaft sinking Source IDs: DB	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Removal of propane-fired comfort heaters and associated buildings Source IDs: PSHF1, PSHR1, VSHF1, VSHR1, CS1, CD1-6, DPH1, CH1, SW1-2	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Removal of Upper Waste Rock Stockpile and Lower Waste Rock Stockpile Source ID: SP1 and SP2	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Removal of Ready Mix Batch Plant Source IDs: RMBP1-RMBP9	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Removal of propane-fired comfort heating source associated with ESDM Version 1.0 Water Treatment Plant Source IDs: WTP1	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Removal of Emergency Generation Equipment Diesel Fire Pump and associated Distribution Pump House propane-fired heaters Source IDs: DPH1, DPH2	EPG emission rate estimates, EPG Tables, dispersion modelling, EPG Report text. ESDM Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Location change to Emergency Generator EG1	EPG Tables, dispersion modelling, EPG Report text.
	Addition of Mine Ventilation at the Collar Source ID: COLLAR	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Addition of new Water Treatment Plant Heaters Source ID: WTP1-4	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Addition of Ammonia stripper at new Water Treatment Plant Source ID: WTP5	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text.
	Addition of Crushing Equipment Source IDs: RBREAKER, PCRUSH, PSTACK, GEN1	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text

	Addition of material handling at two PAG stockpiles Source IDs: PAG_SP1, PAG_SP2	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text
	Addition of individual diesel generators Source IDs: IDGEN1-3, IDGEN 5-7	Emission rate estimates, MOECC Tables, dispersion modelling, ESDM Report text
	Update to newer version of AERMOD and MOECC pre-processed meteorological data	Dispersion Modelling

n:\active\2014\1190 sudbury\1192\1419949 kghm 2015 esdm maintenance victoria\esdm report update\reporting\draft\app - mod log\modification log.docx

APPENDIX B

Emission Rate Calculations

Drilling and Blasting

Drilling and blasting activities occur at the shaft collar to support construction activities. A maximum of 2 blasts will occur per day. The largest area blasted will be 61 m². A total of 161 holes will be drilled; some for construction blasting and some for ground support. The emissions are discharged via mine ventilation at the collar surface.

Particulate Matter Emissions from Drilling and Blasting

An equation from Table 11.9-2, U.S. EPA AP-42 Chapter 11.9 *"Western Surface Coal Mining"* (dated 7/98) was used to calculate the fugitive dust emissions associated with blasting activities. The equation is as follows:

EF=0.00022×A^1.5×SF

where: EF = PM emission factor (kg/blast)
A = horizontal area (m²)

The particulate emission factors for drilling and blasting were taken from U.S. EPA AP-42 Chapter 11.9 *"Western Surface Coal Mining"*, Table 11.9-2 and 11.9 -4 (dated 7/98). The data quality is rated "C" or "Average".

Wet sprays are used during drilling therefore a 70% control is applied as per Table 4 in the Australian Government document *"National Pollutant Inventory Emission Estimation Technique Manual for Mining"* Version 3.1 dated January 2012. PM emissions from drilling are carried through to Table 2 as a maximum emission scenario because drilling and blasting cannot occur simultaneously.

Parameters

Source ID	DB
Source Description	Drilling and Blasting
A: Area Blasted [m²]	61
Bulk Emulsion: Usage per Blast [Mg]	0.612
ANFO: Usage per Blast [Mg]	0.231
Total Number of Blasts in 24-hr	2
Number of Holes Drilled in 24-hr	161
Drilling Control	70%

PM Emissions from Drilling and Blasting

Contaminant	CAS	EF	EF Units	ER [g/s]
PM - Blasting	N/A	$0.00022(A)^{1.5}$	kg/blast	2.43E-03
PM - Drilling	N/A	0.59	kg/hole	3.30E-01

Sample Calculation

Blasting- PM

$EF_{PM} = 0.00022(A)^{1.5}$

$ER_{PM} = 0.00022(\ 61.0\ m^2\ )^{1.5} \times \frac{kg}{blast} \times \frac{2\ blast}{24\ hour} \times \frac{1\ hour}{3600\ s} \times \frac{1000\ g}{1\ kg}$

$ER_{PM} = 2.43E\text{-}03\ \frac{g}{s}$

Drilling- PM

$ER_{PM} = \frac{0.59\ kg}{hole} \times \frac{161\ holes}{24\ hr} \times \frac{1000\ g}{kg} \times \frac{1\ hr}{3600\ s} \times (\ 100\% - 70\%\ )$

$ER_{PM} = 3.30E\text{-}01\ \frac{g}{s}$

Gaseous Emissions from Blasting

The Carbon Monoxide, Nitrogen Oxides and Sulphur Dioxide emission factors for the blasting using ANFO and emulsion explosives was obtained from the Australian NPI *"Emission estimation technique manual for Explosives detonation and firing ranges"* Version 3.0 January 2012. The data quality is rated "U" or "Unrated" for Emulsion and "D" or "Below Average" for ANFO. The emissions of Carbon Monoxide, Nitrogen Oxides and Sulphur Dioxide from the blast are estimated to occur over a 1-hr averaging period for comparison with the 1-hr standards. These 1-hr averaged emission rates are conservative when used in modelling for the 24-hr averaging period. This will result in conservative contributions to the 24-hr average POI concentrations for these contaminants.

Contaminant	CAS	Emulsion EF [kg/Mg]	ER [g/s]	ANFO EF [kg/Mg]	ER [g/s]	Total [g/s]
Carbon Monoxide	630-08-0	2.3	3.91E-01	34	2.18E+00	2.57E+00
Nitrogen Oxides	11104-93-1	0.2	3.40E-02	8	5.13E-01	5.47E-01
Sulphur Dioxide	7446-09-5	—	—	0.06	3.85E-03	3.85E-03

Sample Calculation

Blasting- Carbon Monoxide

ER_{CO} = Emission Rate for Emulsion + Emission Rate for ANFO

$$ER_{CO} = \frac{2.3\ kg}{Mg} \left| \frac{0.612\ Mg}{hr} \right| \frac{1000\ g}{kg} \left| \frac{1\ hr}{3600\ s} \right. + \frac{34\ kg}{Mg} \left| \frac{0.231\ Mg}{hr} \right| \frac{1000\ g}{kg} \left| \frac{1\ hr}{3600\ s} \right.$$

$$ER_{CO} = 3.91E\text{-}01\ \frac{g}{s} + 2.18E+00\ \frac{g}{s}$$

$$ER_{CO} = 2.57E+00\ \frac{g}{s}$$

Propane Comfort Heating Sources

Propane heaters are used for comfort heating in Water Treatment Plant and for the Mine Air Heater.

The emission rates for the propane fired heaters were calculated using emission factors from the U.S. EPA AP-42 Chapter 1.5 "*Liquefied Petroleum Gas Combustion*" (dated 7/08) and are based on the heat input rating for the heaters as shown in the table below. The data quality is rated "E" or "Marginal".

The emission rates of Nitrogen Oxide are calculated using a 1-hr averaging period and are therefore conservative when used in modelling for the 24-hr averaging period. This will result in conservative contributions to the 24-hr average POI concentrations for this contaminant.

Sample Calculation for WTP1

Btu Rating of Heater = 0.300 MMBtu/hr

U.S. EPA AP-42 Emission Factor = 13 $lb/10^3$ gal

Heat Content of Propane = 91.5 $MMBtu/10^3$ gal (from Table 1.5-1 of AP-42 EF document)

$$ER_{NOx} = \frac{0.3\ MMBtu}{hr} \times \frac{13\ lb}{1000\ gal} \times \frac{453.59\ g}{lb} \times \frac{1\ hr}{3600\ s} \times \frac{1000\ gal}{91.5\ MMBtu}$$

$$ER_{NOx} = 5.37E\text{-}03\ \frac{g}{s}$$

NOx emissions for the other sources were calculated in the same manner as above

Source ID	Building	Source Description	Btu Rating [MMBtu/hr]	NOx Emission Rate [g/s]
WTP1	Water Treatment Plant	Water Treatment Plant Heater	0.300	5.37E-03
WTP2	Water Treatment Plant	Water Treatment Plant Heater	0.300	5.37E-03
WTP3	Water Treatment Plant	Water Treatment Plant Heater	0.300	5.37E-03
WTP4	Water Treatment Plant	Water Treatment Plant Heater	0.300	5.37E-03
FAR	Emissions attributed to Collar	Mine Air Heater	1.100	1.97E-02

Ammonia Stripper
Water Treatment Plant

Ammonia is stripped from the mine water in the water treatment plant. The maximum influent ammonia concentration, the minimum effluent ammonia concentration and the capacity of the plant are used to determine the maximum possible ammonia emissions from the plant. This is a conservative assumption.

Maximum ammonia influent concentration =	100	mg/L
Minimum ammonia effluent concentration =	5	mg/L
Plant capacity =	1400	L/min

$$ER = \left(100\ \frac{mg}{L} - 5\ \frac{mg}{L}\right) \times 1400\ \frac{L}{min} \times \frac{1\ min}{60\ s} \times \frac{1\ g}{1000\ mg}$$

$$ER = 2.22E{+}00\ \frac{g}{s}$$

Note:
CAS No. for ammonia is 7664-41-7

Individual Diesel Generators IDGEN1-IDGEN7

Individual diesel generators are used for on-site power generation at various locations on site. Source GEN1 is associated with the primary crusher at the Potentially Acid-Generating (PAG) rock stockpile.

Emission factors for generators IDGEN1-IDEN4 and IDGEN6-7 were obtained from U.S. EPA AP-42 Chapter 3.3 "*Gasoline and Diesel Industrial Engines*" Table 3.3-1, section dated 10/96. The emission factor for oxides of sulphur was taken to be the emission factor for sulphur dioxide (SO_2) and the emission factor for PM10 was taken to be the emission factor for particulate matter (PM). The data is of "Marginal" quality.

The emission factors for IDGEN5 and GEN1 were taken from *Nonroad Compression-Ignition Engines -- Exhaust Emission Standards Table 1: Nonroad CI Engine Emission Standards Table 1* dated 07/10 for Tier 2 and Tier 3 engines. The data quality is assumed to be "Average."

The emission factor for oxides of sulphur obtained from U.S. EPA AP-42 Chapter 3.3 "*Gasoline and Diesel Industrial Engines*" Table 3.3-1, section dated 10/96 was taken to be the emission factor for sulphur dioxide (SO_2) in the absence of emission factors for SO_2 from

Diesel Generators <600 hp

Source ID	Power Rating [kW]	Power Rating [hp]
IDGEN1	40	54
IDGEN2	100	134
IDGEN3	100	134
IDGEN5	230	308
IDGEN6	100	134
IDGEN7	200	268

U.S. EPA AP-42 Emission Factors Generators <600hp

Contaminant	CAS #	EF [lb/hp-hr]	EF Reference
CO	630-08-0	6.68E-03	U.S. EPA AP-42
NOx	10102-44-0	3.10E-02	U.S. EPA AP-42
PM	N/A	2.20E-03	U.S. EPA AP-42
SO_2	7446-09-5	2.05E-03	U.S. EPA AP-42

Diesel Generators Tier 3 Emission Standards

Source ID	Power Rating [kW]	Power Rating [hp]
IDEGEN5	230	308

Emission Factors for IDGEN5

Contaminant	CAS #	EF [g/hp-hr]	EF Reference
CO	630-08-0	2.6	Tier 3
NOx	10102-44-0	3.0	Tier 3
PM	N/A	0.15	Tier 3
SO_2	7446-09-5	2.05E-03	U.S. EPA AP-42

Diesel Generators Tier 2 Emission Standards

Source ID	Power Rating [kW]	Power Rating [hp]
GEN1	223	299

Tier 2 Emission Factors for GEN1

Contaminant	CAS #	EF [g/hp-hr]	EF Reference
CO	630-08-0	2.6	Tier 2
NOx	10102-44-0	4.9	Tier 2
PM	N/A	0.15	Tier 2
SO_2	7446-09-5	2.05E-03	U.S. EPA AP-42

Sample Calculation for IDGEN1

$$ER_{NOx} = 54\ hp \times \frac{3.10E\text{-}02\ lb}{hp\text{-}hr} \times \frac{453.6\ g}{lb} \times \frac{1\ hr}{3600\ s}$$

$$ER_{NOx} = 2.10E\text{-}01\ g/s$$

All other contaminants for IDGEN1-4, IDGEN6-7 were calculated in a similar manner. The results are tabulated in the emission summary table below.

Sample Calculation for IDGEN5

$$ER_{NOx} = 308\ hp \times \frac{3.0\ g}{hp\text{-}hr} \times \frac{1\ hr}{3600\ s}$$

$$ER_{NOx} = 2.57E\text{-}01\ g/s$$

The contaminants CO and PM were calculated in a similar manner. The results are tabulated in the emission summary table below.

The emission rate for SO_2 was calculated as follows:

$$ER_{SO2} = 308\ hp \times \frac{2.05E\text{-}03\ lb}{hp\text{-}hr} \times \frac{453.6\ g}{lb} \times \frac{1\ hr}{3600\ s}$$

$$ER_{SO2} = 7.97E\text{-}02\ g/s$$

The results are tabulated in the emission summary table below.

Sample Calculation for GEN1

$$ER_{NOx} = 299\ hp \times \frac{4.9\ g}{hp\text{-}hr} \times \frac{1\ hr}{3600\ s}$$

ER_{NOx} = 4.07E-01 g/s

The contaminants CO and PM were calculated in a similar manner. The results are tabulated in the emission summary table below.

The emission rate for SO_2 was calculated as follows:

$$ER_{SO2} = 299\ hp \times \frac{2.05E\text{-}03\ lb}{hp\text{-}hr} \times \frac{453.6\ g}{lb} \times \frac{1\ hr}{3600\ s}$$

ER_{SO2} = 7.72E-02 g/s

The results are tabulated in the emission summary table below.

Emission Rate Summary Table

Contaminant	IDGEN1 [g/s]	IDGEN2 [g/s]	IDGEN3 [g/s]	IDGEN5 [g/s]	IDGEN6 [g/s]	IDGEN7 [g/s]	GEN1 [g/s]
CO	4.51E-02	1.13E-01	1.13E-01	2.23E-01	1.13E-01	2.26E-01	2.16E-01
NOx	2.10E-01	5.24E-01	5.24E-01	2.57E-01	5.24E-01	1.05E+00	4.07E-01
PM	1.49E-02	3.72E-02	3.72E-02	1.29E-02	3.72E-02	7.43E-02	1.25E-02
SO_2	1.39E-02	3.46E-02	3.46E-02	7.97E-02	3.46E-02	6.93E-02	7.72E-02

Primary Crushing

The facility operates a portable crushing plant to perform on-site primary crushing and stacking of Potentially Acid-Generating (PAG) rock. A rock breaker is also used for oversize material. The particulate matter (PM) emission factors were obtained from U.S. EPA AP-42 Chapter 11.19.2 "Crushed Stone Processing and Pulverized Mineral Processing" Table 11.19.2-1, section dated 8/04. The data is of "Marginal" quality. The tertiary crushing emission factors for the Rockbreaker and the Primary Crusher were conservatively used in the absence of emission factors for primary crushing.

The portable unit consists of one 9'7" discharge height conveyor for stacking. A 50% control factor has been applied to the stacker PM estimates to account for the full skirting to the head pulley.

PM Emissions from Crushing, Screening and Stacking Activities

Source ID	Source Description	Maximum Processing [tonnes/day]	EF [kg/tonne]	% Control	Emission Rate [g/s]
RBREAKER	Rockbreaker	20	0.0027	0	6.25E-04
PCRUSH	Primary Crusher	1000	0.0027	0	3.13E-02
PSTACK	Stacker	1000	0.0015	50	8.68E-03

Sample Calculation for PSTACK

ER_{PM} = Processing rate x EF x conversion factors

$$ER_{PM} = \frac{1000 \text{ tonnes}}{\text{day}} \times \frac{0.0015 \text{ kg}}{\text{tonne}} \times \frac{1000 \text{ g}}{\text{kg}} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}} \times \frac{(100 - 50)}{100}$$

$$ER_{PM} = 8.68\text{E-}03 \frac{\text{g}}{\text{s}}$$

Material Handling

Particulate Matter (PM) emissions due to material handling in stockpiles are estimated using the method described in the US EPA AP-42 Chapter 13.2.4 *"Aggregate Handling and Storage Piles"* (11/06). The emission factor has a quality rating of Above-Average.

$EF = k \times 0.0016 \times ((U/2.2)^{1.3})/(M/2)^{1.4}))$

Where:
E = Emission Factor [kg/Mg]

k = particle size multiplier
U = Mean wind speed [m/s]
M = Material moisture content [%]

Source ID		PAG_SP1	PAG_SP2
Source Description		PAG Material Handling 1	PAG Material Handling 2
Material Processing Rate [Mg/day]		1000	1000
PM EF [kg/Mg]		6.27E-04	6.27E-04
Contaminant	CAS	ER [g/s]	ER [g/s]
PM	N/A	7.26E-03	7.26E-03

Sample Calculation (for PAG_SP1)

U = 3.62 (Average wind speed from Met data used in AERMOD model)
M = 5 %
Material Processing Rate = 1000 Mg/day
k (<30 µm) = 0.74

$$EF_{PM} = 0.74 \times 0.0016 \times \left(\left(\frac{3.62}{2.2}\right)^{1.3} / \left(\frac{5}{2}\right)^{1.4}\right)$$

$EF_{PM} = 6.27E\text{-}04$ kg/Mg

$$ER_{PM} = 6.27E\text{-}04 \frac{kg}{Mg} \times 1000 \frac{Mg}{day} \times 1000 \frac{g}{kg} \times \frac{1\ day}{24\ hr} \times \frac{1\ hr}{3600\ s}$$

$ER_{PM} = 7.26E\text{-}03$ g/s

APPENDIX C

Supporting Information for Emission Rate Calculations

REPORT

ON

MINE VENT EXHAUST TESTING
FALCONBRIDGE LIMITED
FALCONBRIDGE, ONTARIO

BE Project 541-6254

Prepared for

Falconbridge Limited
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FEBRUARY 1996

TABLE OF CONTENTS

TABLES

CHARTS

APPENDICES

ACKNOWLEDGEMENTS

BOVAR Environmental would like to take this opportunity to thank Glen J. Hall, Joe Fyfe, Terry Skinner, Charlie Hazen, Nick Dale, and Jurgen Storbeck for their time and support during the November 1995 test program.

EXECUTIVE SUMMARY

BOVAR Environmental was requested by Falconbridge Limited to carry out emission testing at five mine exhausts. The objective of the testing was to determine particulate, metals, oil mist, nitrogen oxides and carbon monoxide emissions from these five sources.

Table I presents a summary of emission concentrations and emission rates for particulate, oil mist, nitrogen oxides, and carbon monoxide from the mine vent exhausts.

Table II presents the metals emission concentration summary for each mine vent and the average. Chart 1 contains average NO_x and CO concentrations per mine vent exhaust.

Table I *Summary of Emissions from Falconbridge Mine Vents*

MINE EXHAUST	Units	Strathcona	Fraser	Craig #6	Craig #2	Onaping
EXHAUST FAN OPERATING POINT	CFM	550000	350000	525000	420000	230000
	m^3/s	260	165	248	198	109
PARTICULATE Avg						
AVERAGE CONCENTRATION 8.6	mg/m^3	0.7	0.8	1.0	0.8	1.0
AVERAGE EMISSION RATE	mg/s	173	136	248	152	112
	kg/hr	0.62	0.49	0.89	0.55	0.40
	tonnes/day	0.01	0.01	0.02	0.01	0.01
OIL MIST						
CONCENTRATION 15.74	$\mu g/m^3$	18.9	16.9	10.3	22.8	9.8
EMISSION RATE	mg/s	4.9	2.8	2.5	4.5	1.1
	kg/hr	0.018	0.016	0.010	0.021	0.009
NITROGEN OXIDES (Expressed as NO)						
AVERAGE CONCENTRATION 3.16	ppm	1.9	4.1	4.35	3.35	2.1
3.94	mg/m^3	2.3	5.1	5.5	4.2	2.6
AVERAGE EMISSION RATE	g/s	0.6	0.8	1.4	0.8	0.3
	kg/hr	2.19	3.01	4.87	3.00	1.01
	tonnes/day	0.05	0.07	0.12	0.07	0.02
CARBON MONOXIDE						
AVERAGE CONCENTRATION 3.74	ppm	7.35	5.45	3.5	2.4	0
4.72	mg/m^3	8.4	6.3	4.1	2.8	0.0
AVERAGE EMISSION RATE	g/s	2.2	1.0	1.0	0.6	0.0
	kg/hr	7.89	3.74	3.66	2.01	0.0
	tonnes/day	0.19	0.09	0.09	0.05	0.0

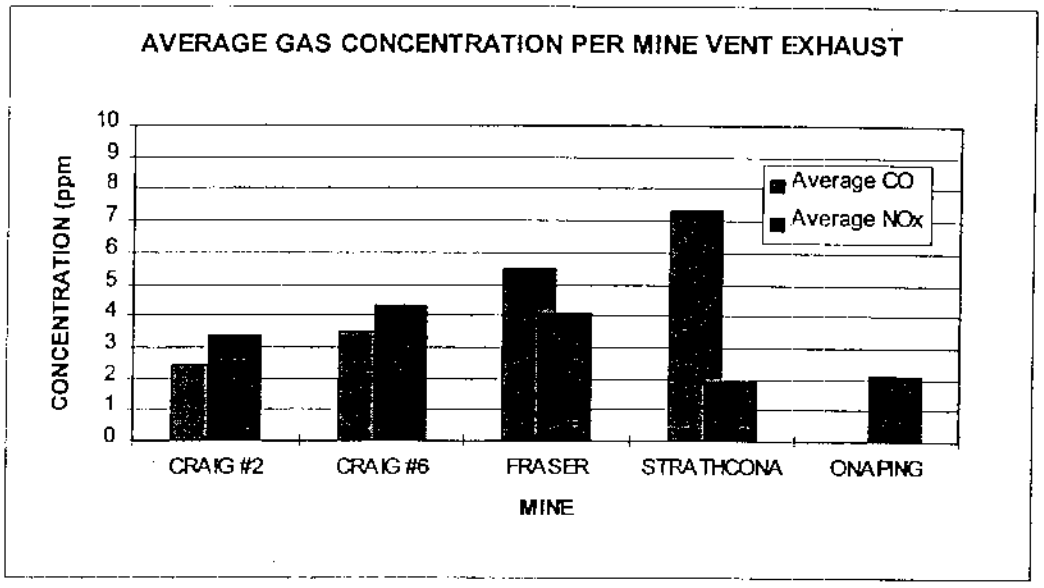
Table II *Metals Emission Concentration Summary*

Component	Emission Concentration ($\mu g/m^3$) Fraser	Emission Concentration ($\mu g/m^3$) Strathcona	Emission Concentration ($\mu g/m^3$) Craig #2	Emission Concentration ($\mu g/m^3$) Craig #6	Emission Concentration ($\mu g/m^3$) Onaping	Emission Concentration ($\mu g/m^3$) Average
Aluminum	< 64	< 59	< 151	< 98	< 89	< 92
Barium	< 0.86	< 0.76	< 1.01	< 1.07	< 0.83	< 0.90
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Boron	0.05	0.06	0.07	0.08	< 0.02	0.06
Cadmium	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01
Calcium	< 267	< 281	< 379	< 395	< 331	< 331
Chromium	< 0.27	< 0.17	0.34	< 0.33	0.45	0.31
Cobalt	0.37	0.12	0.47	0.41	1.03	0.48
Copper	1.98	3.08	2.70	2.13	2.18	2.41
Iron	37.1	17.6	31.5	19	9.9	23
Lead	0.16	< 0.04	0.20	0.33	0.32	0.21
Magnesium	< 95	< 93	< 128	< 137	< 116	< 114
Manganese	0.80	0.35	0.54	0.57	0.45	0.54
Molybdenum	< 0.27	< 0.23	< 0.47	< 0.25	< 0.58	< 0.36
Nickel	3.05	1.16	4.39	2.95	4.55	3.22
Phosphorus	< 0.91	< 0.41	< 0.47	< 0.33	< 0.24	< 0.47
Potassium	< 72.1	< 40.1	< 59	< 74	< 96	< 68
Silver	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01
Sodium	< 1005	< 1099	< 1466	< 1549	< 1295	< 1283
Vanadium	0.05	< 0.02	0.07	0.08	0.06	0.06
Zinc	< 0.91	< 0.93	< 1.49	< 1.80	< 1.35	< 1.30

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Chart I Average NO_x and CO Concentration Per Mine Vent Exhaust



1. PROGRAM DESCRIPTION

BOVAR Environmental was requested by Falconbridge Limited to perform emission testing at five mine exhausts on the Falconbridge site. The 1995 testing program included total suspended particulate, metals, oil mist, carbon monoxide (CO) and nitrogen oxides (NO_x). The test program was carried out between November 7 and November 10, 1995.

The testing strategy involved emissions monitoring while the mine was operating at under normal conditions. Two hours of sampling data were collected at each of the 5 sources listed in Table 1-1.

The scope of work included:

- measurement of total suspended particulate testing using an ASTM Method High Volume Sampling System;
- perform oil mist sampling of exhaust using a modified NIOSH Method 5026 with the high volume samples;
- perform metals analysis on TSP samples;
- perform continuous sampling for Nitrogen Oxides (NO_x) following EPA Method 7E and Carbon Monoxide (CO) following EPA Method 10; and
- preparation of a report.

The scope of work and schedule followed for the test program are summarized in Table 1-1.

Table 1-1 Test Program Schedule

Location	Test	Date	Start Time	Stop Time
Onaping Exhaust	TSP	Nov. 7/95	17:35	19:40
	OM		19:45	21:52
	CEM Test 1		19:10	21:10
	CEM Test 2	VOID		
	CEM Test 3	Nov. 8/95	12:00	13:35
Fraser Exhaust	TSP	Nov. 8/95	15:28	17:33
	OM		17:35	19:45
	CEM Test 1		16:15	17:40
	CEM Test 2		18:47	20:47
Craig Exhaust #6	TSP	Nov. 9/95	8:05	10:09
	OM		10:17	12:24
	CEM Test 1		9:12	11:12
	CEM Test 2		12:25	14:25
Craig Exhaust #2	TSP	Nov. 9/95	15:35	17:53
	OM		19:21	21:22
	CEM Test 1		15:25	17:25
	CEM Test 2		19:22	21:22
Strathcona Exhaust	TSP	Nov. 10/95	8:40	10:40
	OM		10:46	12:57
	CEM Test 1		15:25	17:25
	CEM Test 2		17:25	19:56

Note: Onaping CEM Test 2 was void due to a data logger error

TSP = particulate matter and metals

OM = oil mist

CEM = NO_x and CO

2. SAMPLING PROCEDURES

2.1 Sampling Locations and Flow Measurements

Emission testing was performed on five mines at the selected locations at the Falconbridge Mine Site. The sampling locations were limited based on the orientation of the installations and were not ideal but all efforts were made to obtain a representative sample. Due to the turbulence at these locations, it was not possible to measure velocities. Velocities were obtained from Falconbridge and are listed below.

	Cubic Feet per Minute (CFM)	Cubic Meter per Second m^3/s
Onaping Exhaust	230000	109
Fraser Exhaust	350000	165
Craig Exhaust #6	525000	248
Craig Exhaust #2	420000	198
Strathcona Exhaust	550000	260

2.2 Gas Temperature Measurements

Temperature measurements were taken simultaneously with the velocity measurements. A commercial chromel-alumel type "K" thermocouple in conjunction with a digital temperature indicator was used.

2.3 Stack Gas Composition

Exhaust gas composition was assumed to be ambient (20.9% O_2, 0% CO_2). The moisture content was also assumed to be ambient.

2.4 ASTM Method; Particulate Testing

Particulate sampling was carried out using a High Volume Stack Sampler (Radar). The particulate matter was drawn from the gas stream under approximate isokinetic conditions. Isokinetic conditions were maintained within close limits throughout the sampling period to avoid erroneous results caused by mechanical separation of coarse particles. The particulate matter was collected on preweighed filters and from rinsings (probe wash) from the collection system ahead of the filter. Particulate weight was determined in the laboratory subsequent to the test.

The filter samples (2 filters per test) were analyzed as follows: The filters were weighed then cut into small pieces. The pieces from the sample were mixed with the pieces from the acetone wash. A portion of the mixed sample was weighed and digested. The digested solutions were analyzed on the ICAP for metals. Boron was analyzed separately using a hot water leach. The results were calcuated on a per-filter basis, assuming the pieces were mixed evenly.

2.5 Modified NIOSH Method 5026, Oil Mist Testing

Oil Mist sampling was performed using a High Volume Stack Sampler (Radar). Method of Analysis performed was UV-Visible Spectrophotometry Method Number 035.

2.6 Continuous Emissions Monitoring of CO and NO_x

The concentration of the following combustion gases was monitored on a continuous basis:

- carbon monoxide (CO); and
- nitrogen oxides (NO_x).

A sample of the flue gases was drawn from a stainless steel tube, filtered to remove particulate material then transferred by a Teflon line to the gas conditioning unit and individual analyzers. The Teflon sample line was heated to at least 160°C.

Sample system bias checks were conducted prior to the tests. This involved introducing calibration gas through the complete collection system to a point of entry immediately before the filter, then to the analyzers directly. This was completed at each location.

In addition to the bias checks, the analyzers were calibrated (zero and span check) prior to each run and at the completion of each run. A CEM calibration data form was completed by the CEM operator and the information entered into the data acquisition system.

The CEM Data Acquisition System (DAS) is a PC based IBM compatible system which measures outputs in the range of 0-5 volts. Data are recorded via computerized menu systems which receives signal outputs every 2 seconds from the analyzers. The data are output every 30 seconds to a data file (floppy). Data are reduced using Lotus 1-2-3.

The QC acceptance criteria for instrument performance (as per EPA 40 CFR 60) are summarized below.

Analyzer Calibration Error	< ± 2% of analyzer span gas concentration (zero, mid and high range)
Sampling System Bias	< ± 5% of analyzer span
Zero Drift	< ± 3% of analyzer span over the period of each run
Calibration Drift	< ± 3% of analyzer span over the period of each run
Calibration Gases	± 2% accuracy

A description of the methods is provided.

METHOD 10 CARBON MONOXIDE (CO) SAMPLING

Carbon monoxide testing was performed following EPA Method 10. CO testing was conducted using a non-dispersive infrared continuous analyzer capable of measuring in the 0 to 1000 ppm range. The analyzer was calibrated at the beginning and end of each test period with 100 ppm or 200 ppm CO calibration gas to ensure proper operation. The analyzer output was recorded with the aid of a data acquisition system. Data were averaged over 30 second time periods for presentation.

The analyzer was:

Western Research Model 955

Range Selected for Testing: 0-1000 ppm

Principal of Operation: Non-Dispersive Infrared (NDIR)

METHOD 7E NITROGEN OXIDES

Nitrogen oxides testing was performed following EPA Method 7E. NO_x testing was conducted using a chemiluminescent continuous analyzer capable of measuring in the 0 - 10 ppm range. The analyzer was calibrated at the beginning and the end of each test period with a NO_x calibration gas of 49.03 ppm NO (which was diluted to 2.32 NO ppm) to ensure proper operation. The analyzer output was recorded with the aid of a data acquisition system. Data were averaged over 30 second time periods for presentation.

The analyzer was:

Thermo-Electron Model 14 B/E

Range Selected for Testing: 0-10 ppm

Principal of Operation: Chemilumanescent

3. QUALITY CONTROL

Quality control checks were performed to ensure the collection of representative samples and the generation of valid results. These checks were performed by test personnel throughout the program under the guidance of the crew leader.

QC checks included:

- Use of standardized checklists and field notebooks to ensure completeness, traceability, and comparability of the data collected.
- Field checking of forms by second person to ensure accuracy.
- Report peer review.
- Strict adherence to chain of custody procedures.
- Daily calibration before and after a test.
- Submission of field blanks.
- CEM bias and drift checks are performed and documented.

All equipment that was scheduled for field work was cleaned and checked prior to calibration. Once the equipment was calibrated, the equipment was assembled and leak checked in order to reduce problems in the field. An adequate supply of spare parts was taken into the field to minimize downtime due to equipment failure.

3.1 Calibration Procedures

Calibration of the sampling equipment was performed according to standard methods prior to the field effort.

The following calibrations were performed:

Thermocouples	-	compared to boiling water, boiling oil and freezing water and accurate to within 0.5% of actual.
Field barometer	-	checked against mercury-in-glass barometer.
CEM analyzers	-	System bias check, zero and span drift checks

3.2 Data Reduction and Reporting

All data generated were the sole responsibility of the project manager. The data were gathered and secured daily from team members. All data were reviewed upon receipt to assure completeness of sheets.

All data have been reported directly to the client in strict confidence.

4. RESULTS SUMMARY

The results are presented in summary form in the Executive Summary and in the following sections. Table 4-1 and 4-2 summarize the emission concentrations and rates for all sources tested.

Appendix 1 and 2 present the five minute averages NO_x and CO levels in graphical form. Appendix 3 contains five minute testing data for CO and NO_x in table form. Appendix 4 contains CEM instrument QC results (i.e., zero and span drifts, and system bias checks) and testing data. Appendix 5 contains field data sheets. Appendix 6 contains laboratory analysis. Appendix 7 contains sample calculations and computer outputs.

Table 4-1 Summary of Emissions from Falconbridge Mine Vents

MINE EXHAUST	Units	Strathcona	Fraser	Craig #6	Craig #2	Onaping
EXHAUST FAN OPERATING POINT	CFM	550000	350000	525000	420000	230000
	m^3/s	260	165	248	198	109
PARTICULATE						
AVERAGE CONCENTRATION	mg/m^3	0.7	0.8	1.0	0.8	1.0
AVERAGE EMISSION RATE	mg/s	173	136	248	152	112
	kg/hr	0.62	0.49	0.89	0.55	0.40
	tonnes/day	0.01	0.01	0.02	0.01	0.01
OIL MIST						
CONCENTRATION	$\mu g/m^3$	18.9	16.9	10.3	22.8	9.8
EMISSION RATE	mg/s	4.9	2.8	2.5	4.5	1.1
	kg/hr	0.018	0.016	0.010	0.021	0.009
NITROGEN OXIDES (Expressed as NO)						
AVERAGE CONCENTRATION	ppm	1.9	4.1	4.35	3.35	2.1
	mg/m^3	2.3	5.1	5.5	4.2	2.6
AVERAGE EMISSION RATE	g/s	0.6	0.8	1.4	0.8	0.3
	kg/hr	2.19	3.01	4.87	3.00	1.01
	tonnes/day	0.05	0.07	0.12	0.07	0.02
CARBON MONOXIDE						
AVERAGE CONCENTRATION	ppm	7.35	5.45	3.5	2.4	0
	mg/m^3	8.4	6.3	4.1	2.8	0.0
AVERAGE EMISSION RATE	g/s	2.2	1.0	1.0	0.6	0.0
	kg/hr	7.89	3.74	3.66	2.01	0.0
	tonnes/day	0.19	0.09	0.09	0.05	0.0

Table 4-2 Metals Emission Concentration Summary

Component	Emission Concentration ($\mu g/m^3$) Fraser	Emission Concentration ($\mu g/m^3$) Strathcona	Emission Concentration ($\mu g/m^3$) Craig #2	Emission Concentration ($\mu g/m^3$) Craig #6	Emission Concentration ($\mu g/m^3$) Onaping	Emission Concentration ($\mu g/m^3$) Average
Aluminum	< 64	< 59	< 151	< 98	< 89	< 92
Barium	< 0.86	< 0.76	< 1.01	< 1.07	< 0.83	< 0.90
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Boron	0.05	0.06	0.07	0.08	< 0.02	0.06
Cadmium	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01
Calcium	< 267	< 281	< 379	< 395	< 331	< 331
Chromium	< 0.27	< 0.17	0.34	< 0.33	0.45	0.31
Cobalt	0.37	0.12	0.47	0.41	1.03	0.48
Copper	1.98	3.08	2.70	2.13	2.18	2.41
Iron	37.1	17.6	31.5	19	9.9	23
Lead	0.16	< 0.04	0.20	0.33	0.32	0.21
Magnesium	< 95	< 93	< 128	< 137	< 116	< 114
Manganese	0.80	0.35	0.54	0.57	0.45	0.54
Molybdenum	< 0.27	< 0.23	< 0.47	< 0.25	< 0.58	< 0.36
Nickel	3.05	1.16	4.39	2.95	4.55	3.22
Phosphorus	< 0.91	< 0.41	< 0.47	< 0.33	< 0.24	< 0.47
Potassium	< 72.1	< 40.1	< 59	< 74	< 96	< 68
Silver	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01
Sodium	< 1005	< 1099	< 1466	< 1549	< 1295	< 1283
Vanadium	0.05	< 0.02	0.07	0.08	0.06	0.06
Zinc	< 0.91	< 0.93	< 1.49	< 1.80	< 1.35	< 1.30

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.
2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Chart 4-1 Average NO_x and CO Concentration Per Mine Vent Exhaust

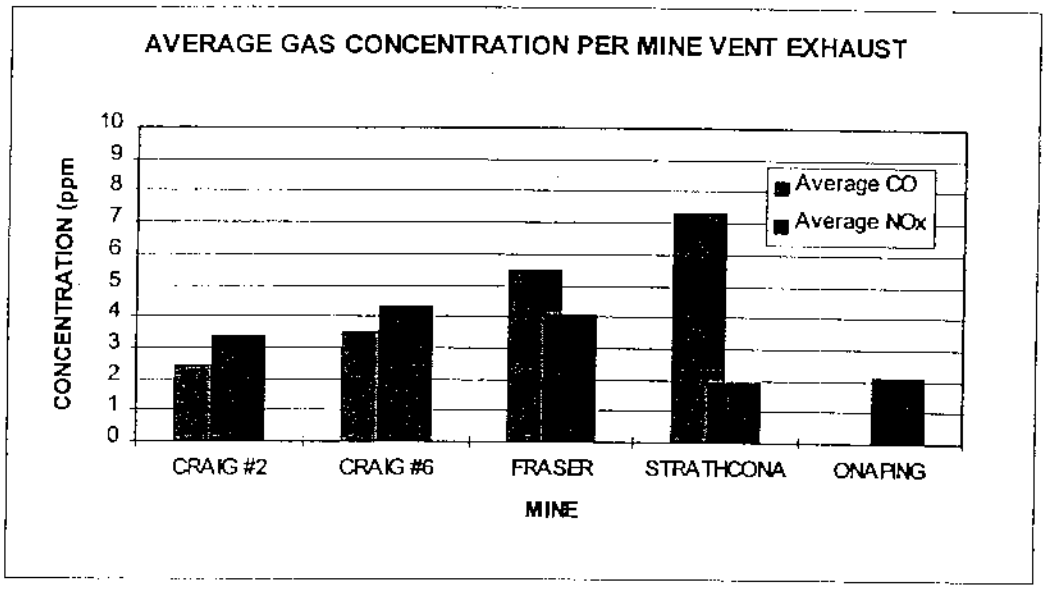


Table 4-3 Metals Emission Rate Summary

Component	Emission Rate (mg/s) Fraser	Emission Rate (mg/s) Strathcona	Emission Rate (mg/s) Craig #2	Emission Rate (mg/s) Craig #6	Emission Rate (mg/s) Onaping	Emission Rate (mg/s) Average
Aluminum	< 10.6	< 15.4	< 30	< 24.4	< 9.67	< 18
Barium	< 0.14	< 0.20	< 0.20	< 0.26	< 0.09	< 0.18
Beryllium	< 0.0009	< 0.0015	< 0.0013	< 0.0020	< 0.0007	< 0.0013
Boron	0.01	0.02	0.01	0.02	0.0026	0.01
Cadmium	< 0.0017	< 0.0029	< 0.0025	< 0.0039	< 0.0013	< 0.0025
Calcium	< 44.2	< 72.9	< 75.1	< 97.9	< 36	< 65.2
Chromium	< 0.04	< 0.05	< 0.07	< 0.08	< 0.05	< 0.06
Cobalt	0.06	0.03	0.09	0.10	0.11	0.08
Copper	0.33	0.80	0.54	0.53	0.24	0.49
Iron	6.12	4.56	6.24	4.71	1.07	4.54
Lead	0.03	< 0.01	0.04	0.08	0.03	0.04
Magnesium	< 15.7	< 24.1	< 25.4	< 33.9	< 12.6	< 22.4
Manganese	0.13	0.09	0.11	0.14	0.05	0.10
Molybdenum	< 0.04	< 0.06	< 0.09	< 0.06	< 0.06	< 0.06
Nickel	0.50	0.30	0.87	0.73	0.49	0.58
Phosphorus	0.15	< 0.11	< 0.09	< 0.08	< 0.03	< 0.09
Potassium	< 12.0	< 10.4	< 11.7	< 18.3	< 10.4	< 12.6
Silver	< 0.0017	< 0.0029	< 0.0025	< 0.0039	< 0.0013	< 0.0025
Sodium	< 166	< 285	< 291	< 384	< 140	< 253
Vanadium	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01
Zinc	< 0.15	< 0.24	< 0.29	< 0.45	< 0.15	< 0.26

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.
2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-4 Metals Summary - Craig Mine Exhaust #2

Component	Filter and Probe Wash (mg)	Emission Concentration (mg/m^3)	Emission Rate (mg/s)
Aluminum	< 22.4	< 0.15	< 30.00
Barium	< 0.15	< 0.0010	< 0.20
Beryllium	< 0.001	< 0.00001	< 0.0013
Boron	0.01	0.0001	0.01
Cadmium	< 0.0019	< 0.00001	< 0.0025
Calcium	< 56.1	< 0.38	< 75.14
Chromium	0.05	0.0003	0.07
Cobalt	0.07	0.0005	0.09
Copper	0.4	0.0027	0.54
Iron	4.66	0.03	6.24
Lead	0.03	0.0002	0.04
Magnesium	< 19	< 0.13	< 25.45
Manganese	0.08	0.0005	0.11
Molybdenum	< 0.07	< 0.0005	< 0.09
Nickel	0.65	0.0044	0.87
Phosphorus	< 0.07	< 0.0005	< 0.09
Potassium	< 8.77	< 0.06	< 11.75
Silver	< 0.0019	< 0.00001	< 0.0025
Sodium	< 217	< 1.47	< 290.63
Vanadium	0.01	0.0001	0.01
Zinc	< 0.22	< 0.0015	< 0.29

Volume Sampled = 148 m^3*

Flowrate = 713584 m^3/hr*

* At actual conditions

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-5 Metals Summary - Craig Mine Exhaust #6

Component	Filter and Probe Wash (mg)	Emission Concentration (mg/m^3)	Emission Rate (mg/s)
Aluminum	< 12	< 0.10	< 24.37
Barium	< 0.13	< 0.0011	< 0.26
Beryllium	< 0.001	< 0.00001	< 0.0020
Boron	0.01	0.0001	0.02
Cadmium	< 0.0019	< 0.00002	< 0.0039
Calcium	< 48.2	< 0.40	< 97.89
Chromium	< 0.04	< 0.0003	< 0.08
Cobalt	0.05	0.0004	0.10
Copper	0.26	0.0021	0.53
Iron	2.32	0.02	4.71
Lead	0.04	0.0003	0.08
Magnesium	< 16.7	< 0.14	< 33.92
Manganese	0.07	0.0006	0.14
Molybdenum	< 0.03	< 0.0002	< 0.06
Nickel	0.36	0.0030	0.73
Phosphorus	< 0.04	< 0.0003	< 0.08
Potassium	< 9.03	< 0.07	< 18.34
Silver	< 0.0019	< 0.00002	< 0.0039
Sodium	< 189	< 1.55	< 383.84
Vanadium	0.01	0.0001	0.02
Zinc	< 0.22	< 0.0018	< 0.45

Volume Sampled = 122 m^3*

Flowrate = 891980 m^3/hr*

* At actual conditions

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-6 Metals Summary - Fraser Mine Vent

Component	Filter and Probe Wash (mg)	Emission Concentration (mg/m^3)	Emission Rate (mg/s)
Aluminum	< 12	< 0.06	< 10.60
Barium	< 0.16	< 0.0009	< 0.14
Beryllium	< 0.001	< 0.00001	< 0.0009
Boron	0.01	0.0001	0.01
Cadmium	< 0.0019	< 0.00001	< 0.0017
Calcium	< 50	< 0.27	< 44.17
Chromium	0.05	0.0003	0.04
Cobalt	0.07	0.0004	0.06
Copper	0.37	0.0020	0.33
Iron	6.93	0.04	6.12
Lead	0.03	0.0002	0.03
Magnesium	< 17.8	< 0.10	< 15.72
Manganese	0.15	0.0008	0.13
Molybdenum	< 0.05	< 0.0003	< 0.04
Nickel	0.57	0.0030	0.50
Phosphorus	0.17	0.0009	0.15
Potassium	< 13.56	< 0.07	< 11.98
Silver	< 0.0019	< 0.00001	< 0.0017
Sodium	< 188	< 1.01	< 166.08
Vanadium	0.01	0.0001	0.01
Zinc	< 0.17	< 0.0009	< 0.15

Volume Sampled = 187 m^3*

Flowrate = 594693 m^3/hr*

* At actual conditions

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-7 Metals Summary - Strathcona Mine Vent

Component	Filter and Probe Wash (mg)	Emission Concentration (mg/m^3)	Emission Rate (mg/s)
Aluminum	< 10.2	< 0.06	< 15.39
Barium	< 0.13	< 0.0008	< 0.20
Beryllium	< 0.001	< 0.00001	< 0.00
Boron	0.01	0.0001	0.02
Cadmium	< 0.0019	< 0.00001	< 0.0029
Calcium	< 48.3	< 0.28	< 72.89
Chromium	< 0.03	< 0.0002	< 0.05
Cobalt	0.02	0.0001	0.03
Copper	0.53	0.0031	0.80
Iron	3.02	0.02	4.56
Lead	< 0.0076	< 0.00004	< 0.01
Magnesium	< 16	< 0.09	< 24.15
Manganese	0.06	0.0003	0.09
Molybdenum	< 0.04	< 0.0002	< 0.06
Nickel	0.2	0.0012	0.30
Phosphorus	< 0.07	< 0.0004	< 0.11
Potassium	< 6.91	< 0.04	< 10.43
Silver	< 0.0019	< 0.00001	< 0.0029
Sodium	< 189	< 1.10	< 285.23
Vanadium	< 0.0038	< 0.00002	< 0.01
Zinc	< 0.16	< 0.0009	< 0.24

Volume Sampled = 172 m^3*

Flowrate = 934455 m^3/hr*

* At actual conditions

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-8 Metals Summary - Onaping Mine Exhaust

Component	Filter and Probe Wash (mg)	Emission Concentration (mg/m^3)	Emission Rate (mg/s)
Aluminum	< 13.9	< 0.09	< 9.67
Barium	< 0.13	< 0.0008	< 0.09
Beryllium	< 0.001	< 0.00001	< 0.0007
Boron	< 0.0037	< 0.0000	< 0.00
Cadmium	< 0.0019	< 0.00001	< 0.0013
Calcium	< 51.7	< 0.33	< 35.97
Chromium	0.07	0.0004	0.05
Cobalt	0.16	0.0010	0.11
Copper	0.34	0.0022	0.24
Iron	1.54	0.01	1.07
Lead	0.05	0.0003	0.03
Magnesium	< 18.1	< 0.12	< 12.59
Manganese	0.07	0.0004	0.05
Molybdenum	< 0.09	< 0.0006	< 0.06
Nickel	0.71	0.0046	0.49
Phosphorus	< 0.038	< 0.0002	< 0.03
Potassium	< 15	< 0.10	< 10.44
Silver	< 0.0019	0.00001	0.0013
Sodium	< 202	< 1.29	< 140.56
Vanadium	0.01	0.0001	0.01
Zinc	< 0.21	< 0.0013	< 0.15

Volume Sampled = 156 m^3*

Flowrate = 390772 m^3/hr*

* At actual conditions

Note: 1. where the analytical value was less than the detection limit (DL) the DL was used for calculation of the emission concentration and emission rate.

2. the less than sign (<) denotes values reported are less than the analytical detection limit and/or method filter blank.

Table 4-9 Metals Summary - Filter Blank

Component	Analytical Detection Limit (mg/filter)	Filter Blank (mg/filter)	Method Filter Blank (mg/sample)
Aluminum	0.0114	6.40	12.8
Barium	0.0019	0.1200	0.240
Beryllium	0.001	<.001	0.002
Boron	0.0015	<.0015	0.003
Cadmium	0.0019	<.0019	0.004
Calcium	0.019	50.80	102
Chromium	0.0038	0.0200	0.040
Cobalt	0.0038	<.0038	0.008
Copper	0.0038	0.0200	0.040
Iron	0.0038	0.41	0.820
Lead	0.0076	<.0076	0.015
Magnesium	0.019	16.50	33
Manganese	0.0038	0.0100	0.020
Molybdenum	0.019	0.0600	0.120
Nickel	0.019	<.019	0.038
Phosphorus	0.038	<.038	0.076
Potassium	0.038	6.52	13.0
Silver	0.0019	<.0019	0.004
Sodium	0.038	196.00	392
Vanadium	0.0038	<.0038	0.008
Zinc	0.0038	0.1100	0.220

Table 4-12 AP-42 Emission Factors for Explosives Detonation

EMISSION FACTOR FOR EXPLOSIVES KG/TONNE							
	CO	Methane	NOx	NH_3	HCN	H_2S	SO_2
Black powder	85	2.1	ND	NA	NA	12	NA
Smokeless powder	38	0.6	ND	NA	NA	10	NA
Dynamite, straight	141	1.3	ND	NA	NA	3	NA
Dynamite, ammonia	32	0.7	ND	NA	NA	16	NA
Dynamite, gelatin	52	0.3	26	NA	NA	2	1
ANFO	34	NA	8	NA	NA	NA	1
TNT	398	7.2	ND	14	13	NA	NA
RDX	98	NA	ND	22	NA	NA	NA
PETN	149	NA	ND	1.3	NA	NA	NA

Source: USEPA, AP-42, Table 13.3-1
Notes: Emission Rating Factor for all of the above: "D"
NA = Not Available

4.5.12 Mine Ventilation

Generally, mine ventilation exhaust is a high volume source with very low concentrations of various species. The contaminants found in the exhaust include particulate, NOx, VOCs, NH_3 and metals which are typically from diesel combustion and blasting. Previous studies (Ciccone and Adams, 1996) for Falconbridge have shown that PM concentrations range between 0.7-1 mg/m^3, NOx levels are between 4.4 –1.9 ppm and CO levels are between 7.4 –2.4 ppm. These have been compared to other reports for different mines and all the data fall within the same range. It is suggested that with respect to estimating annual emissions from the mine ventilation raises, the emission factors in Table 4-13 be used.

The above emission factors along with the ventilation flows can be used with equations 3-1, 3-2 and 3-6 to calculate the emissions. Care must be taken to ensure that the temperature of the ventilation flow is corrected to 25°C.

Note that the above emission factors include tail-pipe emissions from the under-ground equipment. These need to be subtracted from the above emissions. On-site diesel vehicles will emit PM (assumed as PM10), CO, NOx , SO_2 and VOC's. Emission factors for various mine-site vehicles are presented in Table 4-14.

Table 4-13 Emission Factor for Mine Ventilation

CONTAMINANT	EMISSION FACTOR	UNITS
PM	0.86	mg/m^3 @ 25°C
PM_{10}	0.43	mg/m^3 @ 25°C
$PM_{2.5}$	0.22	mg/m^3 @ 25°C
Nox	3.16	ppm_v
CO	3.74	ppm_v

Source: BOVAR Environmental, 1996, Report for Falconbridge Ltd., Table 1

Note: PM_{10} and $PM_{2.5}$ assumed to be 50% and 25% of PM, respectively
NO_x is expressed as NO

Table 4-14 Mine-Site Vehicle Tail-Pipe Exhaust Emission Factors

EQUIPMENT TYPE	EMISSION FACTOR (KG/1000 LITRE DIESEL FUEL)						
	PM	CO	NO_X	SO_2	VOC	Formaldehyde	Rating
Track Type Tractor	9.8	30.6	111.4	12.1	10.7	2.4	N/A
Wheeled Tractor	18.0	104.4	169.8	12.1	25.0	4.0	N/A
Wheeled Dozer	5.8	49.9	115.7	12.3	5.3	2.3	N/A
Scraper	11.3	34.8	106.1	12.8	7.9	4.0	N/A
Grader	8.9	21.9	101.6	12.4	5.1	1.7	N/A
Off-Highway Truck	7.1	49.9	115.7	12.6	5.3	3.1	N/A
Wheeled Loader	11.5	38.5	125.2	12.2	16.9	2.8	N/A
Track type Loader	9.3	32.2	132.7	12.1	15.8	1.4	N/A

Source: Environment Australia, NPI, Emission Estimation Technique Manual for Combustion Engines Version 2.1, Section 3.4.1, Table 5.

Assuming the heating value of diesel fuel to be 38.21 MJ/L (Source: Appendix 1, Table 25 of the above document)

PM10 emission factors for these sources are identical to PM emission factors.

To obtain emission factors for PM2.5, multiply by 0.5

Arrangement shown with optional trailer

XQ230 SOUND ATTENUATED

DUAL VOLTAGE 50/60 Hz

FEATURES

EMISSIONS

- EPA Tier 3 and CARB Emissions Certified for non-road mobile applications at all 60 Hz and 50 Hz ratings

CAT C9 ATAAC DIESEL ENGINE

- Utilizes ACERT® Technology
- Reliable, rugged, durable design
- Field-proven in multiple applications worldwide
- Four-stroke-cycle diesel engine combines durability with minimum weight while providing dependability and economy
- 50/60 Hz convertibility

CAT SR4B GENERATOR

- Designed to match performance and output characteristics of diesel engines
- Permanent magnet excitation
- Segregated AC/DC, low voltage accessory box provides single point access to accessory connections

ENCLOSURE

- Made with 12-gauge steel
- Single point lifting eye
- Sound attenuated
- Convenient hand holds and steps for safe operation
- Two coat polyester powder-coated finish

ENVIRONMENTALLY FRIENDLY DESIGN

- Sound attenuated for low noise operation
- OSHA compliant safe design
- 110% spill containment for coolant and oil
- UL142 certified dual wall fuel tank

MULTI-VOLTAGE DISTRIBUTION PANEL

- Simultaneous dual voltage
- Load door safety switch
- Rust-free hinges on all doors
- Adequate space for line and plug connection without interference
- Remote start and stop contacts

SINGLE-SOURCE SUPPLIER

- Complete systems designed at Caterpillar ISO 9001:2000 certified facilities
- **Certified Prototype Tested** with torsional analysis

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Caterpillar dealer network
- With over 1,875 dealer outlets operating in 200 countries, you're never far from the Caterpillar part you need.
- 99.7% of parts orders filled within 48 hours. The best product support record in the industry.
- Caterpillar dealer service technicians are trained to service every aspect of your electric power generation system.

FACTORY INSTALLED STANDARD AND OPTIONAL EQUIPMENT

STANDARD FEATURES	
Air Inlet System	Air cleaner, dual element Turbocharger
Charging System	Battery charger Heavy duty charging alternator
Control Panel	Generator controls and monitoring Fuel tank monitoring Engine controls and monitoring Digital displays
Cooling System	Fan and belt guards Base mounted radiator Air to air aftercooling
Distribution Panel	Lockable doors Load door safety switch, (trips breaker upon door opening) Individual bus bar connections Circuit breaker with 24 VDC shunt trip Remote start/stop contacts Shore power connections
Enclosure	Sound attenuated 12-gauge steel Lockable doors Separate vented battery compartment Single point lifting Exterior oil and water drains with interior valves Hidden exterior fuel drain Hand holds and steps Powder coated finish
Fuel System	Primary fuel filter/water separator UL142 dual wall fuel tank 1667 L (440 gal) Radiator-mounted fuel cooler
Generator	Brushless, permanent magnet Coastal corrosion protection Shock mounted VR6 voltage regulator Space heater UL approved Simultaneous three-phase 480/277 and 240/139 voltage
Mounting System	Generator soft mounted to base Base contains integral fuel tank Skiddable structural steel design 110% oil and coolant spill containment
Starting System	Electric starting motor Battery set with disconnect switch Jacket water heater with thermostat, shut-off valves

OPTIONAL FEATURES	
Trailer	Full frame support Independent tandem axle trailer frame with tongue Electric actuated hydraulic brakes with rechargeable battery backup breakaway system. Overcenter mechanical parking brake Full length fenders Non-skid surface on steps Heavy duty safety chains and grab hooks Reinforced 4540 kg (10,000 lb) top wind drop jack

SPECIFICATIONS

CAT SR4B GENERATOR

Frame size 449
Type..... Permanent magnet brushless
Construction..... Single bearing, close coupled
Three-phase ..... 12 lead reconnectable
Insulation ..... Class H with coastal insulation protection
IP rating..... 22
Alignment..... Pilot shaft
Voltage regulator ..... 3-phase sensing with Volts-per-Hertz
Voltage regulation..... ± ½% steady state/± ½% no load to full load
TIF ..... Less than 50
THD ..... Less than 5%

ENGINE

C9 ATAAC, 4-stroke-cycle watercooled diesel
Bore – mm (in) 112 (4.41)
Stroke – mm (in) 149 (5.87)
Displacement – L (cu in)..... 8.8 (537)
Compression ratio 16.1:1
Aspiration..... Turbocharged AA charge cooled
Engine control ..... ADEM™ A4

CAT CONTROL PANEL – EMCP 3.2

24 Volt DC Control
NEMA 1, IP22 enclosure
Lockable hinged door
Enclosure mounted
Single location customer connector point
16 light alarm module with alarm horn
Electric fuel level gauge

Consult your Caterpillar dealer for available voltages.

TECHNICAL DATA

		XQ230			
Power Rating		**Standby**	**TMI Ref.**	**Prime**	**TMI Ref.**
60 Hz	ekW	230	DM8502	210	DM8512
50 Hz	kVA	275	DM8504		
Engine and Container Information					
Engine model		C9			
Container dimensions		see chart on page 6			
Shipping Weight (Dry)					
Unit with trailer	kg (lb)	6210 (13,690)			
Unit without trailer	kg (lb)	4980 (10,980)			
Maximum Fuel Capacity Weight					
Unit with trailer	kg (lb)	7506 (16,550)			
Unit without trailer	kg (lb)	6278 (13,840)			
Engine Lubricating Oil Capacity	L (gal)	40 (10.55)			
Engine Coolant Capacity with Radiator	L (gal)	36 (9.5)			
Fuel Tank Capacity	L (gal)	1516 (400)			
Fuel Consumption	L/hr (gal/hr)	69.2 (18.3)		64.7 (17.1)	
Fuel Consumption (75% Prime)	L/hr (gal/hr)	50.6 (13.4)			
Running Time @ 75% Prime	hours	28			
Sound Level					
Standby	dB(A)	74.72			
No load @ 7 m (23 ft)	dB(A)	70.20			
Prime	dB(A)	73.49			
Ambient Capability	Deg C (Deg F)	43 (109.4)			

RATING DEFINITIONS AND CONDITIONS

Meets or Exceeds International Specifications:

- NEMA MG1-32, IEC 60034, CSA, 98/37/EEC, 72/23/EEC, UL 508, UL142, ISO3046/1, ISO8528, 89/336/EEC

Standby – Output available with varying load for the duration of the interruption of the normal source power. Standby power in accordance with ISO8528. Fuel stop power in accordance with ISO3046/1, AS2789, DIN6271, and BS5514.

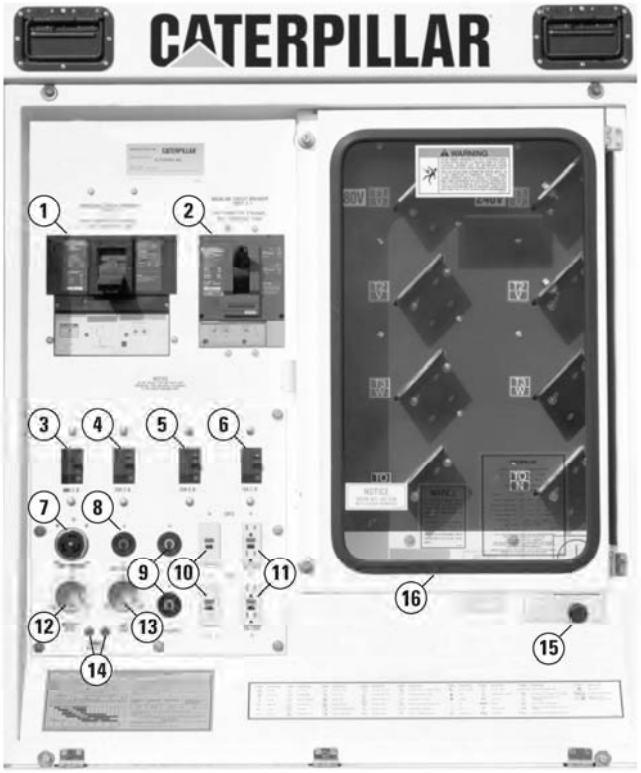
Prime – Output available with varying load for an unlimited time. Prime power in accordance with ISO8528. 10% overload power in accordance with ISO3046/1, AS2789, DIN6271, and BS5514 available on request.

Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046/1, DIN6271, and BS5514 standard conditions.

Fuel rates are based on fuel oil of 35° API [@ 16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/liter (7.001 lb/U.S. gal).

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for details.

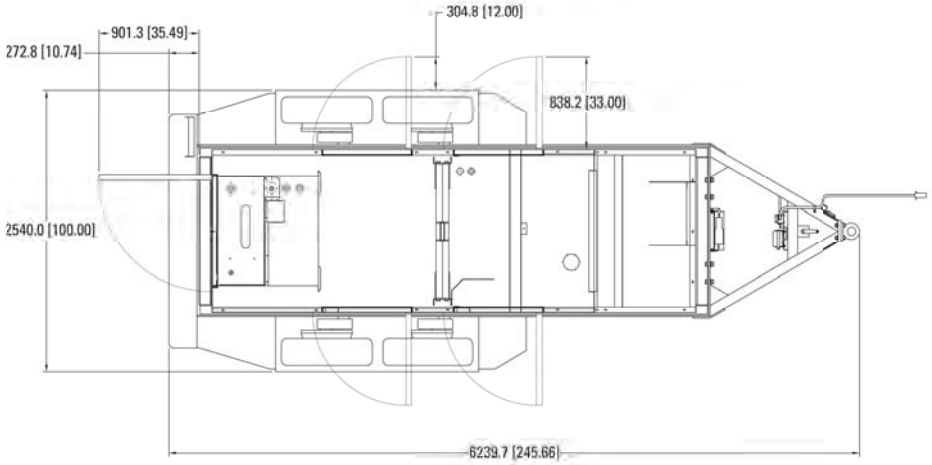
DISTRIBUTION PANEL



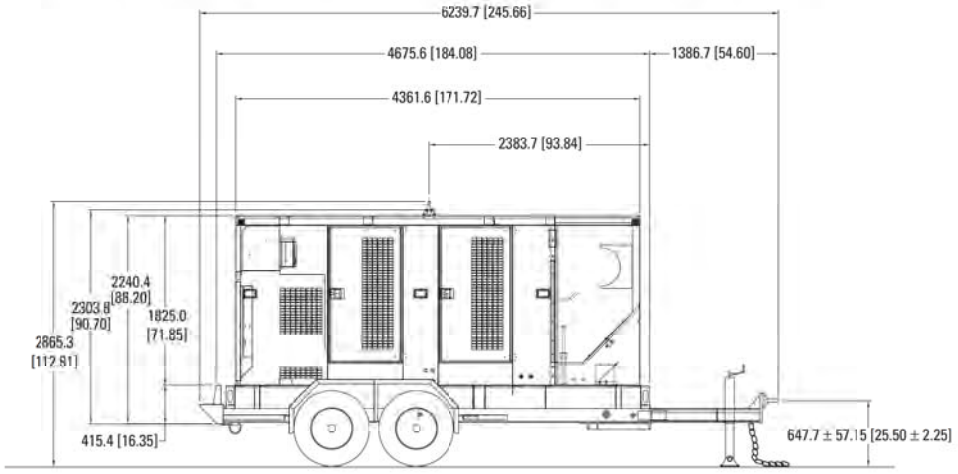
Wiring Descriptions

1. 800 amp main breaker 240V with 24V shunt trip
2. 400 amp main 480V with 24V shunt trip
3. 50 amp 240V branch breaker
4. 20 amp 240V branch breaker
5. 20 amp 120V branch breaker
6. 15 amp 120V branch breaker
7. 50 amp 240V twistlock receptacle
8. 20 amp 240V twistlock receptacle
9. 20 amp 120V twistlock receptacle (2x)
10. 20 amp 120V ground fault interrupter, (2x)
11. 15 amp 120V ground fault interrupter, duplex receptacle (2x)
12. 30 amp 120V battery charger/generator space heater receptacle
13. 30 amp 120V JWH receptacle
14. Remote start/stop contacts
15. 12.7 mm (½") ground stud
16. Dual voltage load connection bus board [6.35 mm × 101.6 mm × 101.6 mm (¼" × 4" x 4") bus bars]

CONTAINER DIMENSIONS — TOP VIEW



CONTAINER DIMENSIONS — RIGHT SIDE VIEW



Overall Dimensions				
	Package		With Trailer	
Length	4597.4 mm	181 in	6248.3 mm	246 in
Width	1498.6 mm	59 in	2540.0 mm	100 in
Height	2387.6 mm	94 in	2882.8 mm	113.5 in

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6X20 screen triple

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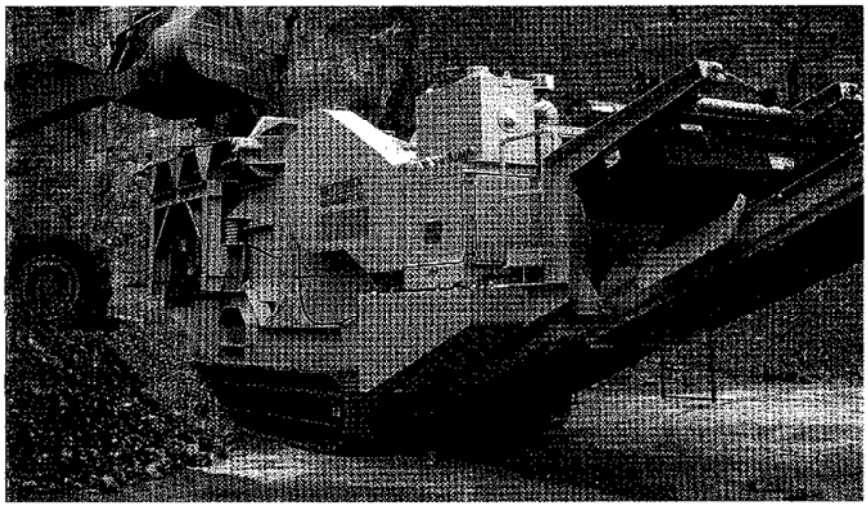
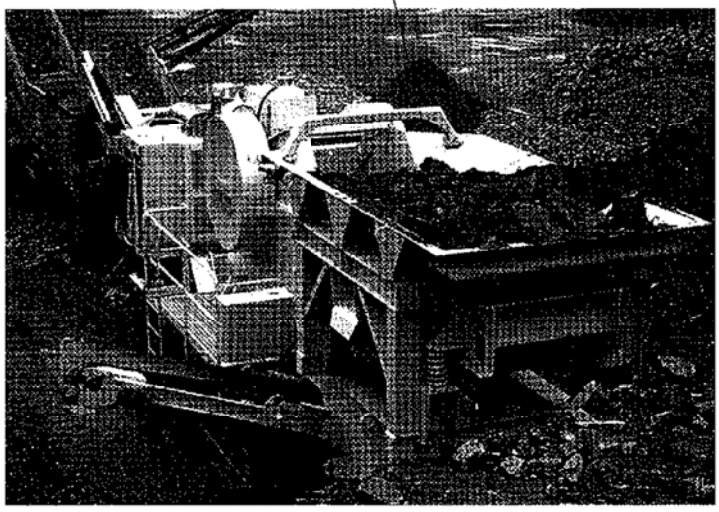
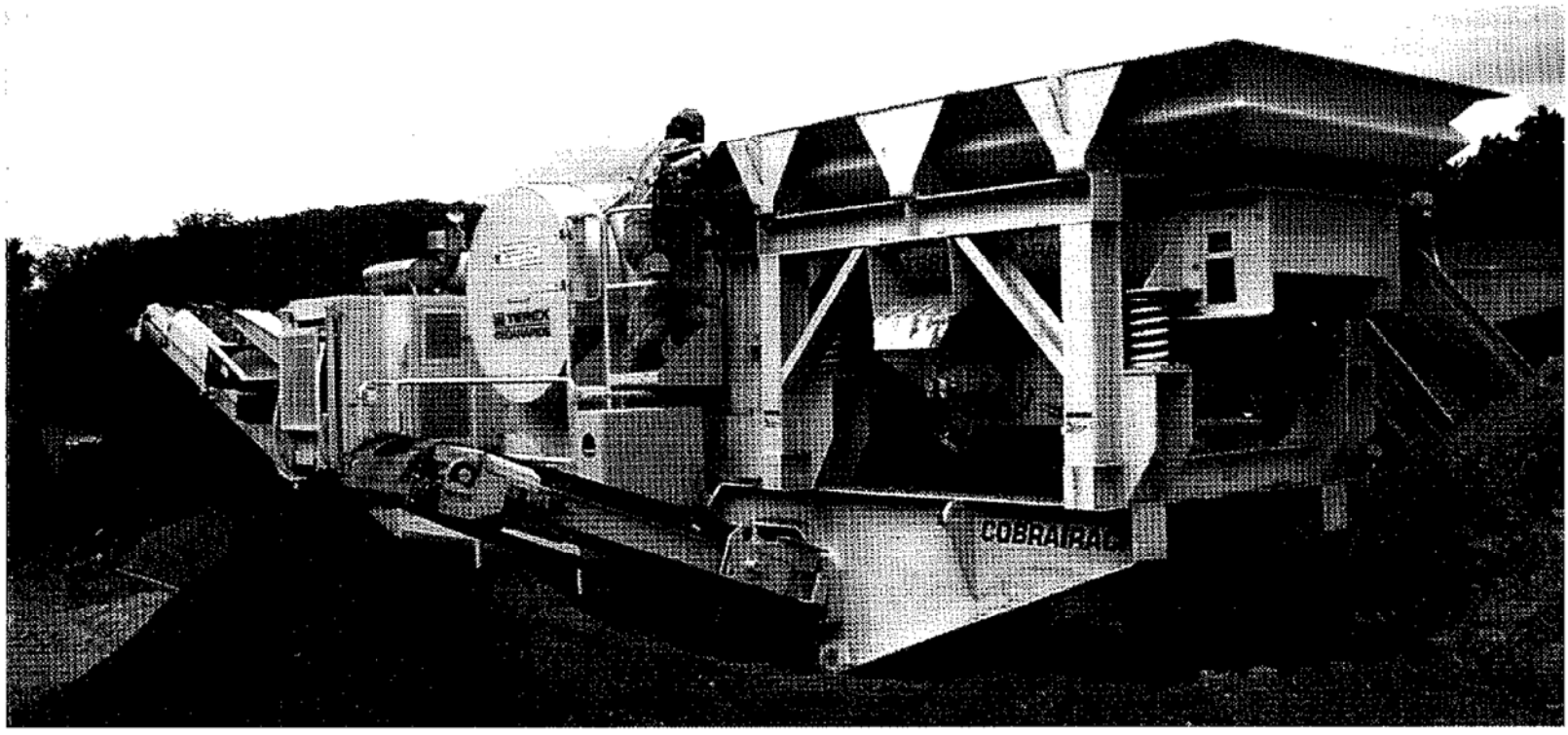
1yr 2000 hrs full warranty

11yd Taggel

CobraTrack | Track Mounted Jaw Crusher







1500

COBRATRACK

COBRATRACK 1100
LOADED WITH BENEFITS

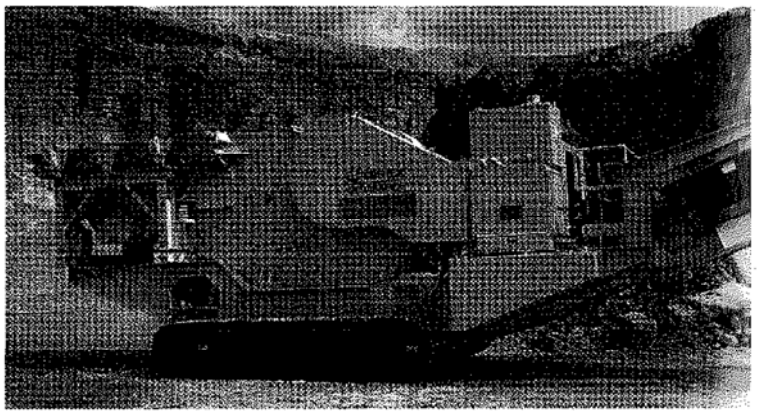
INCREASED MOBILITY
The heavy-duty track system allows you to maneuver easily and quickly on ground that won't support wheel mounted units. Ready to crush in minutes, not hours.

GREATER FLEXIBILITY
CobraTrack provides adaptability for different products and specifications.

DURABLE DESIGN - MORE UPTIME
Rugged chassis and component design assure continuous high quality output. Local distributor support and parts availability for greater uptime.

SIMPLIFIED MAINTENANCE
Convenient inspection doors, removable undercrusher conveyor, remote grease zerks and a ground level fuel tank ensure easier maintenance and less downtime.

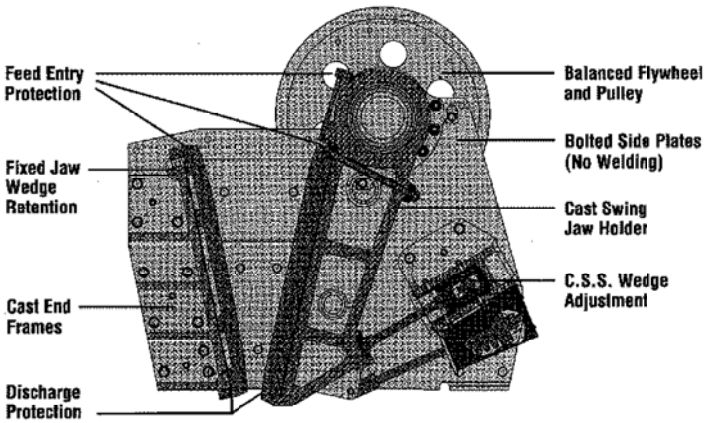
LOWER COST PER TON
More efficient production means you process more material for your investment.



SETTING
A NEW STANDARD

The CobraTrack 1100 track mounted jaw crusher brings the industry's best technology into one rugged, flexible, mobile plant. Greater flexibility, quicker setup and easier maintenance are huge CobraTrack advantages.

TEREX | Cedarapids crushers are known for rugged construction, high productivity and a greater value for investment. Our customers know that they can depend on their equipment and the strongest distributor network in the industry.

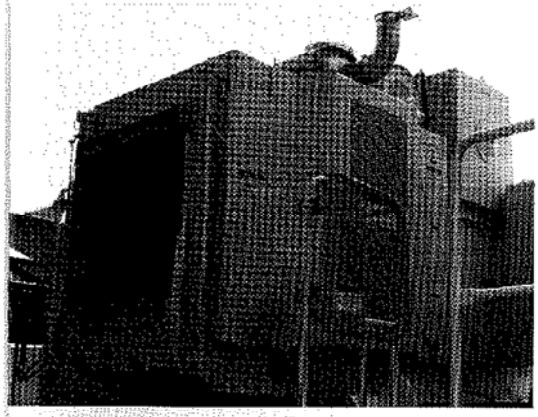


3042 JAW CRUSHER

High strength, proven durability and easy maintenance means more uptime and increased production. Full-sized jaw crusher. TEREX | Cedarapids doesn't shorten the jaw for plant mounting which is done by some in the industry.

Features

- Innovative new jaw crusher technology
- Full 30" x 42" (762 x 1067 mm) feed opening (peak-to-peak)
- High strength castings for strong but lightweight design
- Durable heavy-duty base frame
- Aggressive crushing chamber action
- Operator friendly and easy to maintain
- Hydraulic adjust for easy closed side setting changes
- Patented stationary jaw die wedge system

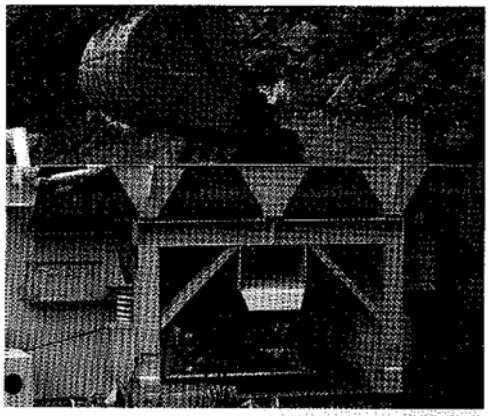


CUMMINS DIESEL ENGINE

The CobraTrack 1100 is powered by a Cummins QSL9 diesel engine. Rated at 299 hp, it has the power to handle any job.

Features

- Rated 299 horsepower (223 kW)
- Fluid coupling for increased V-belt and engine life
- Reliable cog belt design for pump drive
- Lockable enclosure with access doors
- Ground access 200 gallon fuel tank (757 L)
- Federal EPA Tier 2 compliant
- Easy access to all pumps and pump drives

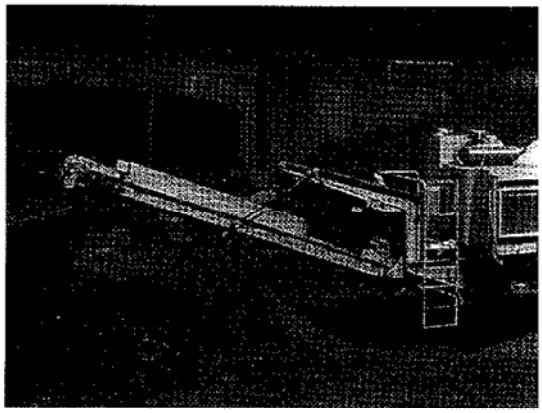


VIBRATING GRIZZLY FEEDER

This durable 4214-9 VGF provides optimum feed regulation, superior material separation and high production efficiency.

Features

- Aggressive 7/16" (11.1 mm) stroke
- Adjustable stroke angle
- Deep formed steel side sheets
- Durable high strength steel pan
- Inverted tubular pan support weldment
- ARS pan and side liners
- Adjustable 60" (1524 mm) long grizzly section
- Self-relieving tapered grizzly bar prevents plugging
- Double deck grizzly for fines/dirt removal
- Hinged screen deck for easy access & cloth change

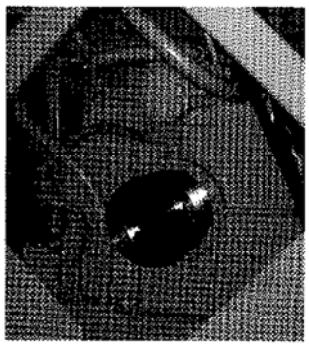


DISCHARGE CONVEYOR

This removable 42" (1067 mm) undercrusher discharge conveyor is built to last and is easily serviced and maintained.

Features

- 9'7" (2921 mm) discharge height for large stock pile
- 12" (305 mm) ground clearance for transport/operation
- Heavy-duty 12" (305 mm) rubber lagged head pulley
- 10" (254 mm) winged tail pulley
- All grease zerks at ground level
- Direct drive hydraulic motor
- Conveyor easily removes for servicing
- Easily deployed ground supports
- 18" (457 mm) clearance to jaw pitman
- Full skirting to head pulley



JAW CRUSHER DRIVE

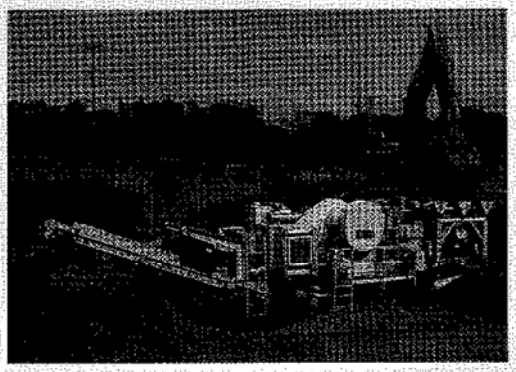
The CobraTrack 1100 jaw crusher drive system incorporates advanced technology to automatically avoid damage.

Features

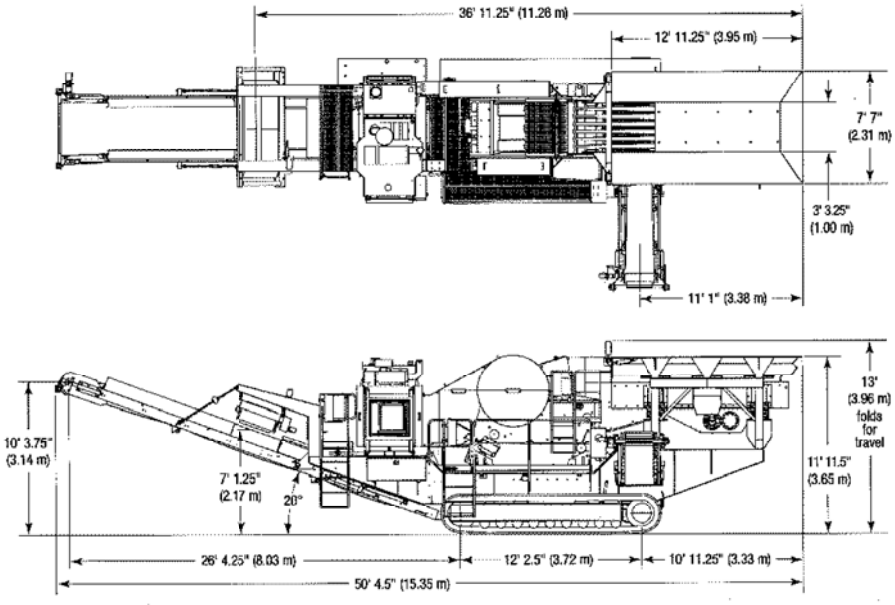
- Fluid coupling with operator controlled engage and disconnect
- No friction clutch
- Crusher can start at any engine speed
- Soft start for crusher protects engine and drive from shock
- Releases load automatically in overload condition
- Thermal and pressure auto shutdown
- Large oil cooler with bypass valve
- 10-groove 5V-belt design
- Power band belts

COBRATRACK 1100

STANDARD EQUIPMENT



- TEREX | Cedarapids 3042 overhead eccentric jaw crusher
- TEREX | Cedarapids 42" x 14' (1067 mm x 4267 mm) vibrating grizzly feeder
- "B5" track with individual hydrostatic drive motors
- 42" (1067 mm) product conveyor hydraulic drive
- 24" (610) wide side discharge bypass conveyor with 2-way bypass chute
- Cummins QSL9 power unit rated 299 hp (223 kW) @ 1800 rpm
- Plant controls with radio remote for track speed, grizzly feeder and E-stop
- Dust suppression spray system with pump, filter and atomizer nozzles
- Chassis, walkways, platforms and guards
- Optional 41" (1041 mm) long cross belt Eriez magnet with hydraulic drive



SPECIFICATIONS

Total Plant Weight
101,200 lbs (45,904 kg)

Overall Plant Length
50' 5" (15.4 m)

Overall Track Width
9' 4" (2.84 m)

Plant Operating Height
13' 0" (3.96 m)

Plant Transport Height
12' 0" (3.66 m)
plus trailer deck height

TEREX | CEDARAPIDS

Cedarapids Inc
909 17th Street NE
Cedar Rapids IA 52402
USA

TEL 319 363 3511
FAX 319 399 4871
WEB www.cedarapids.com

Form 23610 (2/05)

APPENDIX D

Dispersion Modelling Files (CD Only)

APPENDIX E

Emergency Diesel Equipment Assessment

Emergency Diesel Equipment Assessment

Introduction

A screening level assessment was completed for the Emergency Diesel Equipment at the FNX Mining Company Inc. (FNX) Victoria Advanced Exploration Project in Denison Township in Sudbury, Ontario (the Facility)) using the approach outlined in the *Emergency Generator Checklist Supplement to Application for Approval, EPA s.9* PIBS 7976e, dated November, 2010 (the EG Checklist).

The source assessed herein (the Equipment) is Source EG1 - One diesel powered emergency generator (EG) with an output power capacity of 3,000 kW (4,023 horsepower).

Source EG1 meets the criteria for a standby power source as defined in Ontario Regulation (O.Reg.) 419/05, as amended by O.Reg.516/07, thus section 20 does not apply.

This document provides supporting documentation including an assessment of the contaminants, assessment of receptors, dispersion modelling, emission summary, noise assessment and other information required by the EG Checklist as follows:

EMERGENCY GENERATOR CHECKLIST

Supporting Documentation	Included	Location
Brief description of the facility	☒	ESDM Report Section 1.2
Brief description of the intended use of the emergency generator(s)	☒	Appendix E1
Brief description of the generator(s) including fuel type and kilowatt power rating	☒	Appendix E1
Location of emergency generator(s) (e.g. indoors, outdoors in enclosure)	☒	Figure E1
Land use zoning designation plan (best available information for the area)	☒	ESDM Report Figure 4
Site Plan drawn to scale indicating the location of source(s), nearby buildings, property line and receptors	☒	Figure E1, Figure E2
Elevation Drawing drawn to scale	☒	Appendix E1
Distance to the closest sensitive receptor (e.g. child care facility, health care facility, school, senior citizen's residence)	☒	Figure E2
Distance to the closest Point of Reception and a brief description of the Point of Reception	☒	Figure E2, Emergency Diesel Equipment Assessment

Supporting Documentation	Included	Location
Noise Statement (if applicable) including supporting information	☐	The Facility is sufficiently far from the closest sensitive receptor.
Source Summary Table	☒	Table E1
Dispersion Modelling Input Data and Output Results	☒	ESDM Report Appendix D (on CD)
Emission Summary Table	☒	Table E2
Manufacturer Specification Sheets (if available)	☒	Appendix E1

Note:
Based on Emergency Generator Checklist Supplement to Application for Approval, EPA s.9 (PIBS: 4131e)

Assessment of Contaminants

The Equipment is expected to emit products of combustion; refer to Appendix E1 for detailed calculations. Nitrogen oxides are the only contaminants required to be assessed as per the EG Checklist.

The emission factor used to calculate the emission rate was taken from the manufacturer's specification sheets included in Appendix E1. Stack and/or modelling parameters are provided in Table E1 – Emergency Diesel Equipment Dispersion Modelling Source Summary Table.

Assessment of Receptors

The following table describes the receptors that were considered in this assessment. Receptors locations are shown on Figure E2.

Receptor Type	Description
Non-Sensitive	All receptors included in the nested receptor grid, as described in section 6.6 of the ESDM Report
Sensitive	Den Lou Community Centre/Hall, 26 Den Lou Road, Whitefish

Dispersion Modelling

The Equipment meets the criteria for standby power sources as defined in O.Reg.419/05, as amended by O.Reg.516/07, thus section 20 does not apply. The EG Checklist has set a screening level of 1,880 µg/m^3 for a maximum ½-hour averaging period at non-sensitive receptors and the Schedule 2 POI Standard of 500 µg/m^3 for nitrogen oxides applies at sensitive receptors. The maximum point of impingement (POI) impact was calculated

using the United States Environmental Protection Agency's AERMOD dispersion model. Dispersion Modelling was conducted in accordance with the MOE publication, *Air Dispersion Modelling Guideline for Ontario, Version 2.0*, dated March 2009, PIBS 5165e02 and as described in section 6 of the ESDM Report.

Source EG1 was represented as a point source in the dispersion modelling. Potential building wake effects on point source EG1 were considered in this assessment using the U.S. EPAs Building Profile Input Program (BPIP-PRIME), which is a pre-processor to AERMOD. The inputs to this pre-processor that were used for this assessment include the coordinates and heights of surrounding buildings and stack characteristics for point source EG1.

The PRIME plume rise algorithms include vertical wind shear calculations [important for buoyant releases from short stacks (i.e. stacks at release heights within the recirculation zones of buildings)]. The PRIME algorithm also allows for the wind speed deficit induced by the building to change with respect to the distance from the building. These factors improve the accuracy of predicted concentrations within building wake zones that form in the lee of buildings. Refer to Figure E1 which illustrates the BPIP inputs.

The one-hour concentrations predicted by the AERMOD dispersion model, after the meteorological anomalies were removed, were converted to ½-hour concentrations for direct comparison to the EG Checklist screening level limit of 1,880 µg/m³ for non-sensitive receptors and the Schedule 2 POI Standard of 500 µg/m³ for sensitive receptors. Dispersion modelling results are summarized in Table E2 – Emergency Diesel Equipment Emission Summary Table.

The resulting maximum POI concentration of 73.0 µg/m³ at the nearest receptor along the property boundary is below the EG Checklist screening level limit of 1,880 µg/m³. In addition, the resulting concentration of 18.0 µg/m³ at the nearest sensitive receptor is also below the Schedule 2 POI Standard for nitrogen oxides of 500 µg/m³.

All dispersion modelling input and output files are provided in Appendix E2 on CD.

Emissions Summary

As demonstrated in Table E2 – Emergency Diesel Equipment Emission Summary Table, the results from the dispersion modelling demonstrate that emissions resulting from testing of Source EG1 are in compliance with the screening levels set forth in the EG Checklist for sensitive and non-sensitive receptors.

Noise Assessment

Per the EG Checklist, if the emergency generator is located outdoors, in an enclosure and the combustion exhaust stack is greater than 60 m from the nearest residence or sensitive receptor, a Noise Statement is not required. Since the Equipment is located far more than 60 m from the nearest residence or sensitive receptor, a noise statement has not been prepared.

Closure

The assessment as described herein, demonstrates that the Equipment can operate in compliance with applicable MOECC criteria as set-out for emergency power generators.

Table E1
Emergency Diesel Equipment Dispersion Modelling Source Summary Table

POINT SOURCE

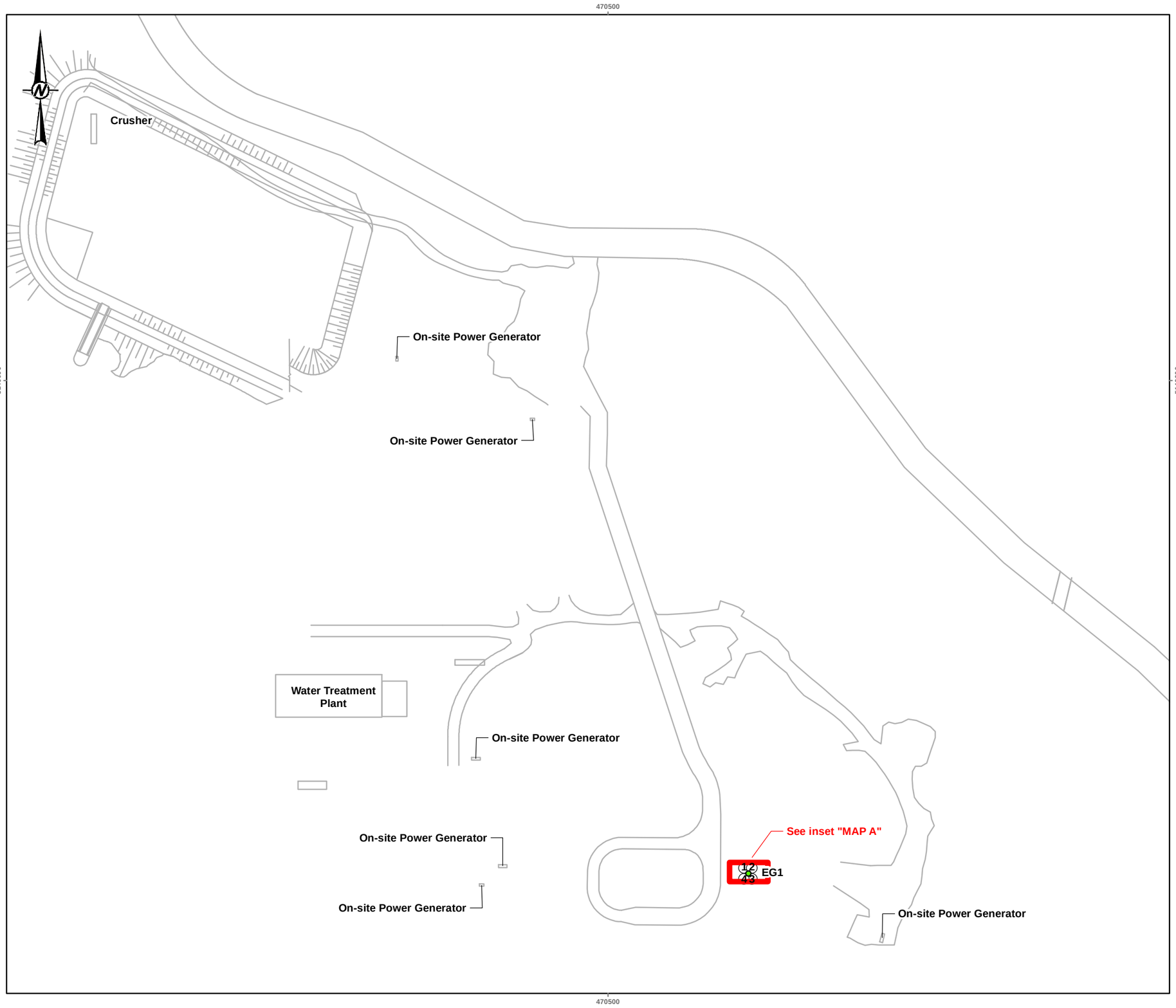
Modelling ID	Source Description	Stack Volumetric Flow Rate [Am³/s]	Stack Gas Exit Velocity [m/s]	Stack Exit Gas Temperature [K]	Stack Inner Diameter [m]	Stack Height Above Grade [m]	Stack Height Above Roof [m]	Stack UTM X	Stack UTM Y	Source NOx Emission Rate [g/s]	Averaging Period [hours]	Emission Estimating Technique	Emissions Data Quality
EG1	3 MW Emergency Generator	11.56	70.49	753.55	0.457	5.00	1.50	470573	5139743	6.02E+00	½	EF	Marginal

"EF" - Emission Factor Calculation
NOx - Nitrogen Oxide

Table E2
Emergency Diesel Equipment Emission Summary Table

Scenario Description	Contaminant	CAS No.	Averaging Period [hours]	Air Dispersion Model Used	Total Scenario Emission Rate [g/s]	Non-Sensitive Receptors			Sensitive Receptor		
						Maximum POI Concentration [µg/m³]*	MOE POI Limit [µg/m³]	Percentage of MOE POI Limit [%]	Maximum POI Concentration [µg/m³]*	MOE POI Limit [µg/m³]	Percentage of MOE POI Limit [%]
Testing of Source EG1	Nitrogen oxides	10102-44-0	½	AERMOD	6.02E+00	73.0	1880	3.9%	18.0	500	3.6%

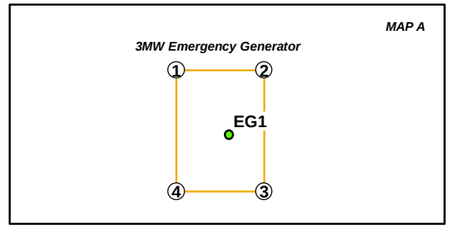
*The one hour POI concentration found using the AERMOD dispersion model was converted to a half hour value using the formula in Section 4.4 of the Air Dispersion Modelling Guideline for Ontario, July 2005.



LEGEND

- 3MW Emergency Generator
- Mine Infrastructure / Buildings

MAP A



○ Building Corners

Id	Easting	Northing
1	470571	5139746
2	470575	5139746
3	470575	5139740
4	470571	5139740

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 1419949

REFERENCE

CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 15 30 60
METRES
SCALE 1:2,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

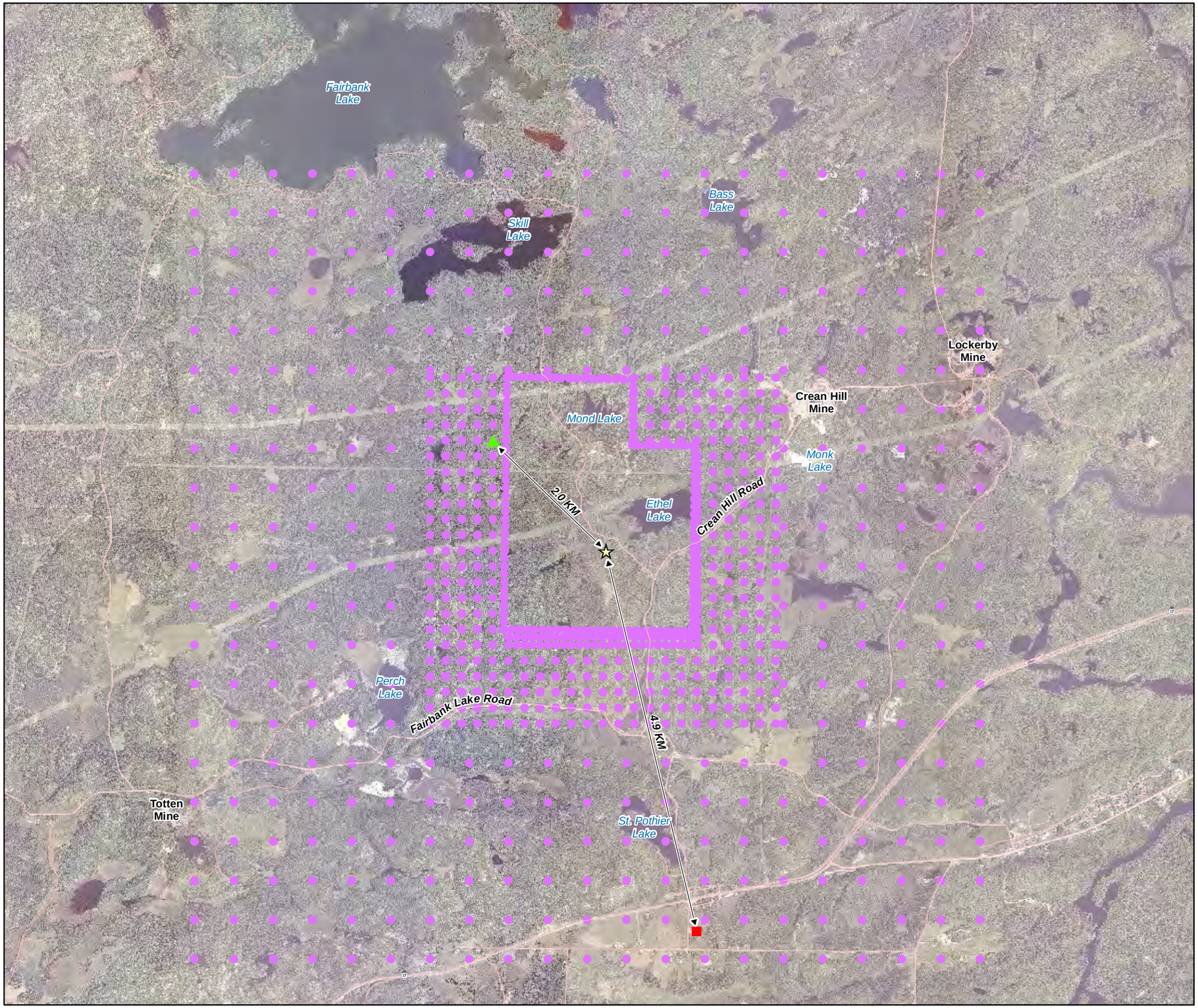
TITLE
APPENDIX E
EMERGENCY DIESEL EQUIPMENT ASSESSMENT

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**E1**



Legend

- Receptor Grid
- Sensitive Receptor
- Maximum POI Concentration - Non-Sensitive Receptors

NOTES

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO.1419949

REFERENCE

BASE DATA - ATLAS OF CANADA,
BASE IMAGERY - MICROSOFT BING ©2015 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO.
HTTPS://WWW.ONTARIO.CA/GOVERNMENT/OPEN-GOVERNMENT-LICENCE-ONTARIO
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 495 990 1,980
METRES

SCALE 1:50,000

CLIENT
KGHM INTERNATIONAL LTD

PROJECT
EMISSION SUMMARY & DISPERSION MODELLING REPORT
VICTORIA MINE

TITLE
APPENDIX E
EMERGENCY DIESEL EQUIPMENT ASSESSMENT

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-07-22
PREPARED	RRD
DESIGN	RRD
REVIEW	DC
APPROVED	NCH

PROJECT No.	PHASE	Rev.	FIGURE
1419949	1000	1	**E2**

Path: A:_Clients\KGHM\Victoria_Mine\99_PROJ\1419949\40_PROD\RNA\r_Acoustic_Noise_Vibration\1419949-0001-RN-0011.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

APPENDIX E1
Supporting Information

Emergency Diesel Equipment

Facility operations will include a diesel fired generator intended for backup power in emergency situations. The nitrogen oxides emission factor was obtained from the manufacturer specifications which are provided with this memorandum.

Equipment Information

Source ID	Description
EG1	3 MW Diesel Generator

Nitrogen Oxide Emissions

Source ID	Power Output [MW]	Power Output [HP]	Emission Factor	Emission Factor Unit	Emission Rate [g/s]
EG1	3.00	4023	5.39	g/HP-hr	6.02E+00

Sample Calculation for EG:

$$ER_{NOx} = \frac{5.39\ g}{HP\text{-}hr} \left| \frac{4023\ HP}{} \right| \frac{1\ hr}{3600\ s}$$

$$ER_{NOx} = 6.02E+00\ \frac{g}{s}$$

DIESEL GENERATOR SET

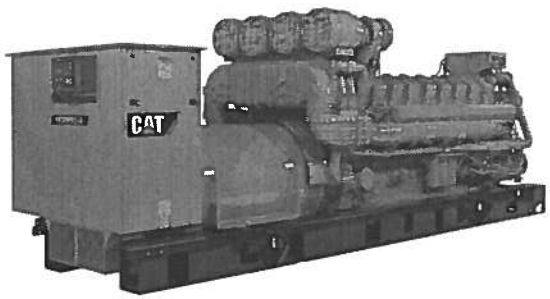


Image shown may not reflect actual package.

STANDBY
3000 ekW 3750 kVA
60 Hz 1800 rpm 4160 Volts

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.

FEATURES

FUEL/EMISSIONS STRATEGY
- Low Fuel consumption

DESIGN CRITERIA
- The generator set accepts 100% rated load in one step per NFPA 110 and meets ISO 8528-5 transient response.

FULL RANGE OF ATTACHMENTS
- Wide range of bolt-on system expansion attachments, factory designed and tested
- Flexible packaging options for easy and cost effective installation

SINGLE-SOURCE SUPPLIER
- Fully prototype tested with certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT
- Cat dealers provide extensive post sale support including maintenance and repair agreements
- Cat dealers have over 1,800 dealer branch stores operating in 200 countries
- The Cat® S•O•S℠ program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT® C175-16 DIESEL ENGINE
- Reliable and durable
- Four-stroke diesel engine combines superior performance with excellent fuel economy
- Advanced electronic engine control
- Low installation and operating cost

CAT SR5 GENERATOR
- Matched to the performance and output characteristics of Cat engines
- Industry leading mechanical and electrical design
- Industry leading motor starting capabilities
- High Efficiency

CAT EMCP 4 CONTROL PANELS
- Simple user friendly interface and navigation
- Scalable system to meet a wide range of customer needs
- Integrated Control System and Communications Gateway

STANDBY 3000 ekW 3750 kVA

60 Hz 1800 rpm 4160 Volts

FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	• Air cleaner, 4 x single element canister with service indicator(s) • Plug group for air inlet shut-off	[ ] Air cleaner, 4 x dual element with service indicator(s) [ ] Air inlet adapters
Circuit Breakers	-	(No set mounted circuit breakers available on medium or high voltage packages)
Cooling	• SCAC cooling • Jacket water and AC inlet/outlet flanges	[ ] Remote horizontal SCAC radiator [ ] Remote fuel cooler [ ] Low coolant level sensor (for remote radiators)
Crankcase Systems	• Open crankcase ventilation	[ ] Crankcase explosion relief valve
Exhaust	• Dry exhaust manifold • Bolted flange (ANSI 6" & DIN 150) with bellow for each turbo (qty 4)	[ ] Engine Exhaust Temperature Module [ ] Mufflers (15 dBA,25 dBA, or 40 dBA) [ ] Dual 16" or single 20" vertical exhaust collector [ ] Weld flange ANSI 20"
Fuel	• Primary fuel filter with water separator • Secondary fuel filters (engine mounted)	
Generator SR5	• 3 phase brushless, salient pole • IEC platinum stator RTD's • Cat digital voltage regulator (CDVR)	[ ] Space heater [ ] Oversize generators [ ] Power connection arrangement
Governor	• ADEM™ A4	[ ] Redundant shutdown
Control Panels	• EMCP 4.2	[ ] Local & remote annunciator modules [ ) Digital I/O module [ ] Generator temperature monitoring & protection [ ] Remote monitoring software [ ] Load share module
Lube	• Lubricating oil • Oil filter, filler and dipstick • Oil drain line with valves • Fumes disposal • Gear type lube oil pump • Integral lube oil cooler	[ ] Electric prelube pumps (standard for Prime and Continuous only)
Mounting	• Rails-engine / generator • Rubber anti-vibration mounts (shipped loose)	[ ] Spring type linear vibration isolator [ ] IBC vibration isolators
Starting/Charging	• Dual 24 volt electric starting motors • Batteries with rack and cables • Battery disconnect switch	[ ] Oversize batteries [ ] 75 amp charging alternator [ ] Battery chargers (20,35 or 50 Amp) [ ] Jacket water heater [ ] Redundant Electric Starter
General	• RH service (Except LH Service Oil Filter) • Paint - Caterpillar Yellow with high gloss black rails • SAE standard rotation • Flywheel and flywheel housing - SAE No. 00	[ ] Barring group- manual or air powered [ ] Factory test reports

STANDBY 3000 ekW 3750 kVA

60 Hz 1800 rpm 4160 Volts

SPECIFICATIONS

CAT GENERATOR

Frame size..... 1846
Excitation..... Permanent Magnet
Pitch..... 0.6667
Number of poles..... 4
Number of bearings..... 2
Number of Leads..... 006
Insulation..... UL 1446 Recognized Class H with tropicalization and antiabrasion
- Consult your Caterpillar dealer for available voltages
IP Rating..... IP23
Alignment..... Closed Coupled
Overspeed capability..... 125
Wave form Deviation (Line to Line)..... 5%
Voltage regulator..... 3 Phase sensing with selectible volts/Hz
Voltage regulation..... Less than +/- 1/2% (steady state)
Less than +/- 1/2% (with 3% speed change)
Telephone influence factor..... Less than 50
Harmonic Distortion..... Less than 5%

CAT DIESEL ENGINE

C175 SCAC, V-16, 4-Stroke Water-cooled Diesel
Bore..... 175.00 mm (6.89 in)
Stroke..... 220.00 mm (8.66 in)
Displacement..... 84.67 L (5166.88 in³)
Compression Ratio..... 15.3:1
Aspiration..... Turbo Aftercooled
Fuel System..... Common Rail
Governor Type..... ADEM™ A4

CAT EMCP 4 SERIES CONTROLS

EMCP 4 controls including:
- Run / Auto / Stop Control
- Speed and Voltage Adjust
- Engine Cycle Crank
- 24-volt DC operation
- Environmental sealed front face
- Text alarm/event descriptions

Digital indication for:
- RPM
- DC volts
- Operating hours
- Oil pressure (psi, kPa or bar)
- Coolant temperature
- Volts (L-L & L-N), frequency (Hz)
- Amps (per phase & average)
- ekW, kVA, kVAR, kW-hr, %kW, PF

Warning/shutdown with common LED indication of:
- Low oil pressure
- High coolant temperature
- Overspeed
- Emergency stop
- Failure to start (overcrank)
- Low coolant temperature
- Low coolant level

Programmable protective relaying functions:
- Generator phase sequence
- Over/Under voltage (27/59)
- Over/Under Frequency (81 o/u)
- Reverse Power (kW) (32)
- Reverse reactive power (kVAr) (32RV)
- Overcurrent (50/51)

Communications:
- Six digital inputs (4.2 only)
- Four relay outputs (Form A)
- Two relay outputs (Form C)
- Two digital outputs
- Customer data link (Modbus RTU)
- Accessory module data link
- Serial annunciator module data link
- Emergency stop pushbutton

Compatible with the following:
- Digital I/O module
- Local Annunciator
- Remote CAN annunciator
- Remote serial annunciator

STANDBY 3000 ekW 3750 kVA

60 Hz 1800 rpm 4160 Volts

TECHNICAL DATA

Open Generator Set - - 1800 rpm/60 Hz/4160 Volts	DM8451	
Generator Set Package Performance		
Genset Power rating @ 0.8 pf	3750 kVA	
Genset Power rating with fan	3000 ekW	
Coolant to aftercooler		
Coolant to aftercooler temp max	46 ° C	115 ° F
Fuel Consumption		
100% load with fan	806.0 L/hr	212.9 Gal/hr
75% load with fan	585.1 L/hr	154.6 Gal/hr
50% load with fan	415.3 L/hr	109.7 Gal/hr
Cooling System[1]		
Air flow restriction (system)	0.12 kPa	0.48 in. water
Engine coolant capacity	303.5 L	80.2 gal
Inlet Air		
Combustion air inlet flow rate	264.2 m³/min	9330.1 cfm
Exhaust System		
Exhaust stack gas temperature	479.4 ° C	894.9 ° F
Exhaust gas flow rate	693.7 m³/min	24497.8 cfm
Exhaust flange size (internal diameter)	150 mm	6 in
Exhaust system backpressure (maximum allowable)	6.7 kPa	26.9 in. water
Heat Rejection		
Heat rejection to coolant (total)	1370 kW	77912 Btu/min
Heat rejection to exhaust (total)	3126 kW	177775 Btu/min
Heat rejection to atmosphere from engine	274 kW	15582 Btu/min
Heat rejection to atmosphere from generator	118.5 kW	6739.1 Btu/min
Alternator[2]		
Motor starting capability @ 30% voltage dip	8350 skVA	
Frame	1846	
Temperature Rise	150 ° C	270 ° F
Emissions (Nominal)[3]		
NOx g/hp-hr	5.39 g/hp-hr	
CO g/hp-hr	.6 g/hp-hr	
HC g/hp-hr	.11 g/hp-hr	
PM g/hp-hr	.034 g/hp-hr	

[1] For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.
[2] UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40 degree C ambient per NEMA MG1-32.
[3] Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77°F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 btu/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

RATING DEFINITIONS AND CONDITIONS

Meets or Exceeds International Specifications: AS1359, CSA, IEC60034-1, ISO3046, ISO8528, NEMA MG 1-22, NEMA MG 1-33, UL508A, 72/23/EEC, 98/37/EC, 2004/108/EC

Standby - Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Standby power in accordance with ISO8528. Fuel stop power in accordance with ISO3046. Standby ambients shown indicate ambient temperature at 100% load which results in a coolant top tank temperature just below the shutdown temperature.

Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions. **Fuel rates** are based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Cat representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Cat dealer.

STANDBY 3000 ekW 3750 kVA

60 Hz 1800 rpm 4160 Volts

DIMENSIONS

Package Dimensions		
Length	6376.4 mm	251.04 in
Width	2133.0 mm	83.98 in
Height	2265.2 mm	89.18 in
Weight	19 538 kg	43,074 lb

NOTE: For reference only - do not use for installation design. Please contact your local dealer for exact weight and dimensions. (General Dimension Drawing #3269431).

Performance No.: DM8451

Feature Code: 175DE04

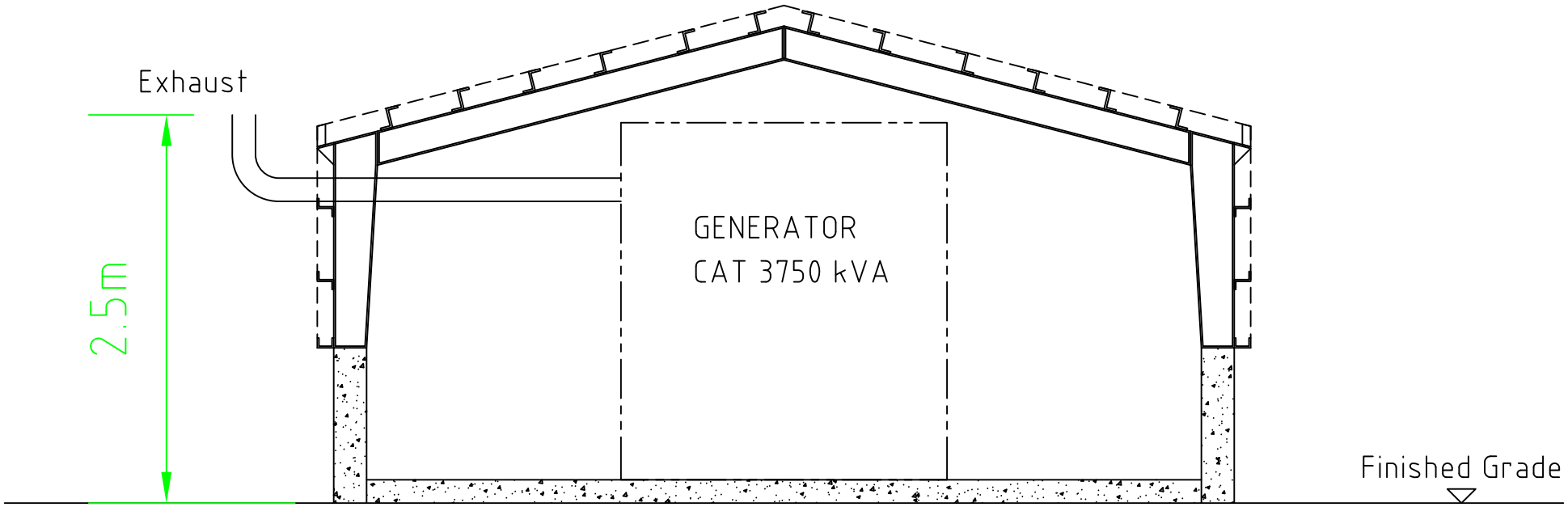
Gen. Arr. Number: 2523974

Source: U.S. Sourced

November 11 2011

19066724

www.Cat-ElectricPower.com



Victoria Advanced Exploration Project
Conceptual Drawing of
Backup Generator Enclosure

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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South America	+ 56 2 2616 2000

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