APPENDIX F
AIR QUALITY TECHNICAL SUPPORT DOCUMENT

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TECHNICAL MEMORANDUM

Project No. TC121522

Date **December 2014**

Subject **Côté Gold Project**
Amended Environmental Impact Statement / Final Environmental Assessment Report
Addendum to Appendix F – Air Quality Technical Support Document

1.0 INTRODUCTION

This addendum to Appendix F – Air Quality Technical Support Document (TSD) has been prepared to address comments received from Aboriginal groups, government reviewers, and interested stakeholders on the Environmental Impact Statement (EIS) / Draft Environmental Assessment (EA) Report.

Comments submitted to IAMGOLD have been provided, responded to and tracked in Appendix Z of the Amended EIS / Final EA Report. Comments that request additional information to support the TSD have been addressed through this Addendum to the Air Quality TSD. Comments which require more information or greater clarification are generally focused on the following technical areas:

- prediction of fugitive dust effects from the tailings management facility (TMF);
- prediction of construction phase effects;
- determination of baseline air quality;
- Ontario Regulation 419/05 (O.Reg. 419) and Ambient Air Quality dispersion modelling scenarios;
- potential effects of emissions from aggregate pits;
- dispersion modelling of non-continuous sources;
- dispersion modelling of particulate matter with wet and dry deposition / plume depletion;
- sample calculations for key sources;
- effect summary for combined background and Project effects; and
- air quality monitoring program.

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2.0 PREDICTION OF FUGITIVE DUST EFFECTS FROM THE TMF

The Ministry of the Environment and Climate Change (MOECC) and Canadian Environment Assessment Agency (CEAA) provided Comments #63, #120, #438, #517 and #520 (Appendix Z) requesting further information and assessment of potential dust emissions from the TMF. In the TSD, the effects of the TMF were considered to be minor and no detailed assessment was undertaken. The following provides a more detailed assessment of the dust emissions from the TMF to demonstrate that the level of assessment undertaken in the TSD was appropriate.

The proposed TMF will be located approximately 3 kilometres (km) north of the open pit and it will be surrounded by four lakes. There are a number of private cottages, which are the closest sensitive receptors, located approximately 1.1 and 1.6 km from the TMF, and there is a concern that the cottages may be affected by fugitive dust from the TMF. Effective dust management will be required to minimize any potential for effects.

Though the tailings management plan developed for the site will minimize any dust emissions, a conservative, quantitative assessment of fugitive dusts was undertaken in order to predict the potential fugitive dust effects at these sensitive receptors. The analysis considered 24-hour average TSP, PM_{10}, and $PM_{2.5}$ emission rates from the TMF, established minimum dust control efficiencies of the mitigation measures and dispersion modelling with AERMOD to predict the potential effects of dust at the sensitive points of reception. Receptors located along the extent of the IAMGOLD TMF boundary were also considered.

Although the quantitative assessment provides a very conservative estimate of the frequency of potential effects, the dust management at the TMF will be monitored through routine inspections and assessment to ensure appropriate mitigation is in place.

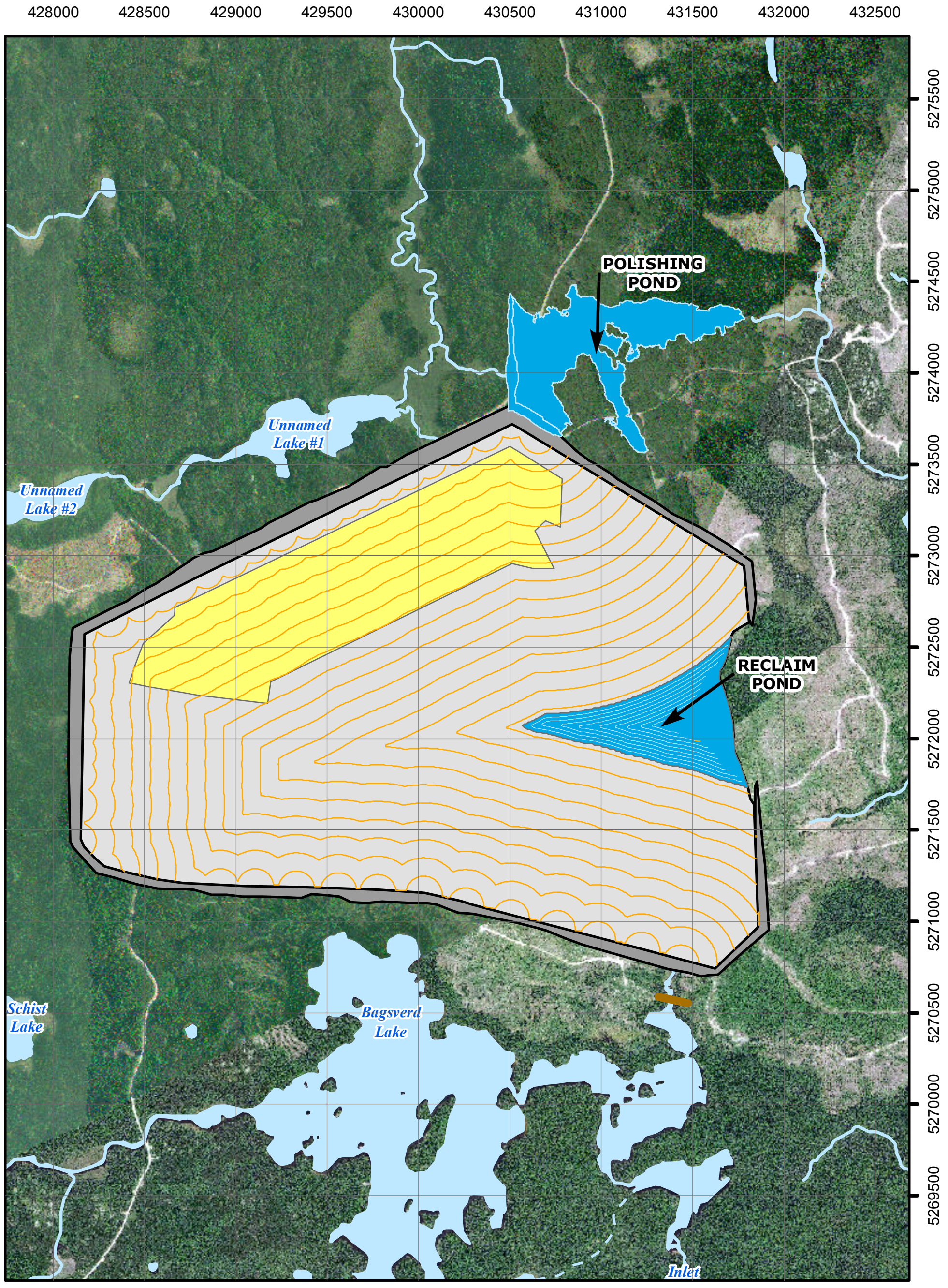
2.1 Identification of Dust Management Areas and Staging of TMF

The preliminary TMF design identified five stages of tailings deposition, with an area of dust management (i.e., dry tailings) identified in Stages 2 to 4. Tailings deposition will alternate between the north and south halves of the TMF to allow for construction of containment dam raises. Figure 1a illustrates Stages 2 through 5 of the tailings deposition at the TMF.

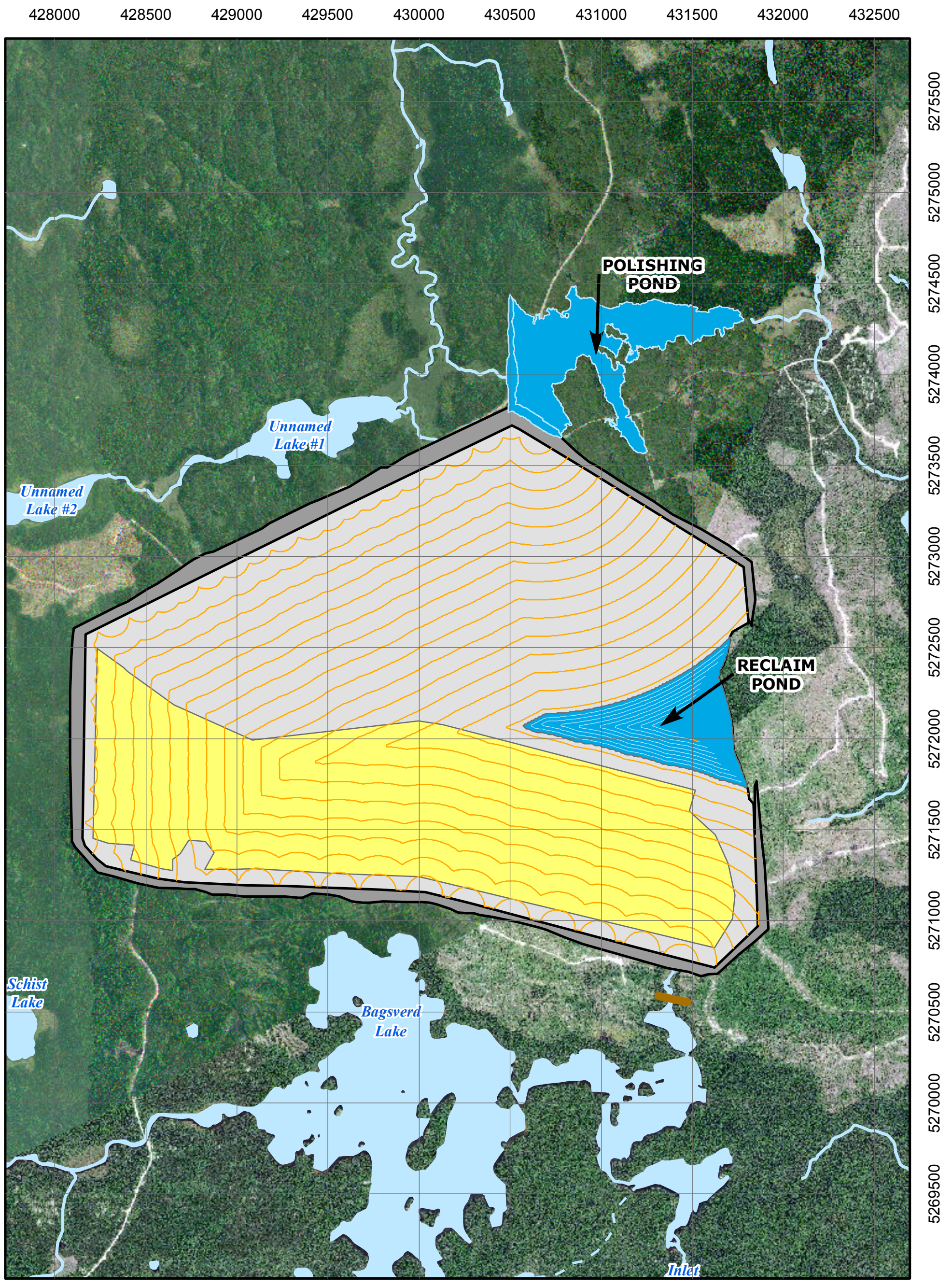
The area where tailings are actively being deposited was not considered as an area susceptible to wind erosion as the deposition is a wet process. The continuous deposition of these wet tailings will not generate dust.

In the areas of dust management (i.e., no active deposition), the tailings surface can dry and may eventually be prone to wind erosion. It is important to note that tailing surfaces will typically cake and provide very little erodible particulate unless the surface is disturbed. These dry areas were considered for the dispersion modelling.

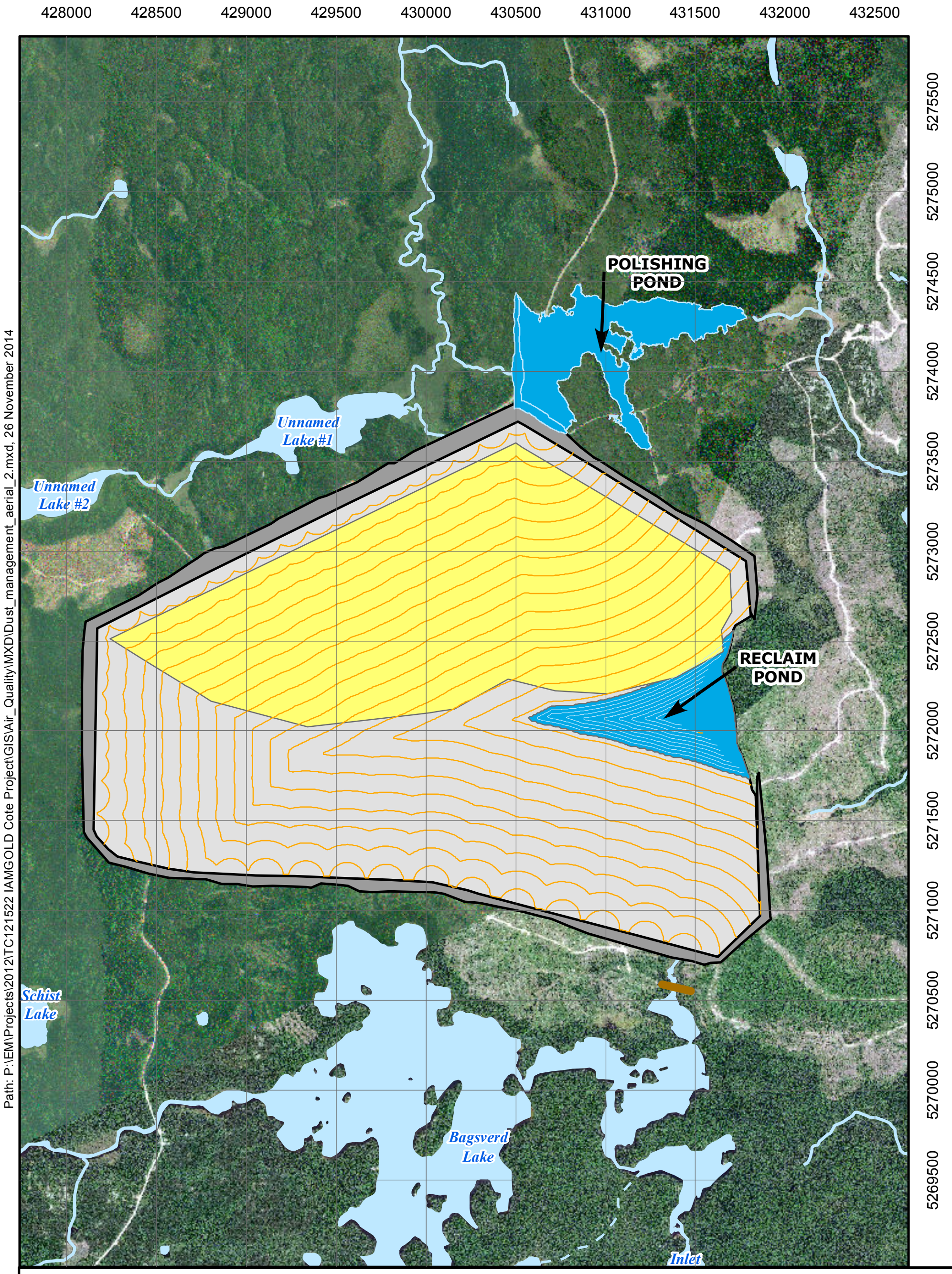
TMF2 - STAGE 2 END OF YEAR 2



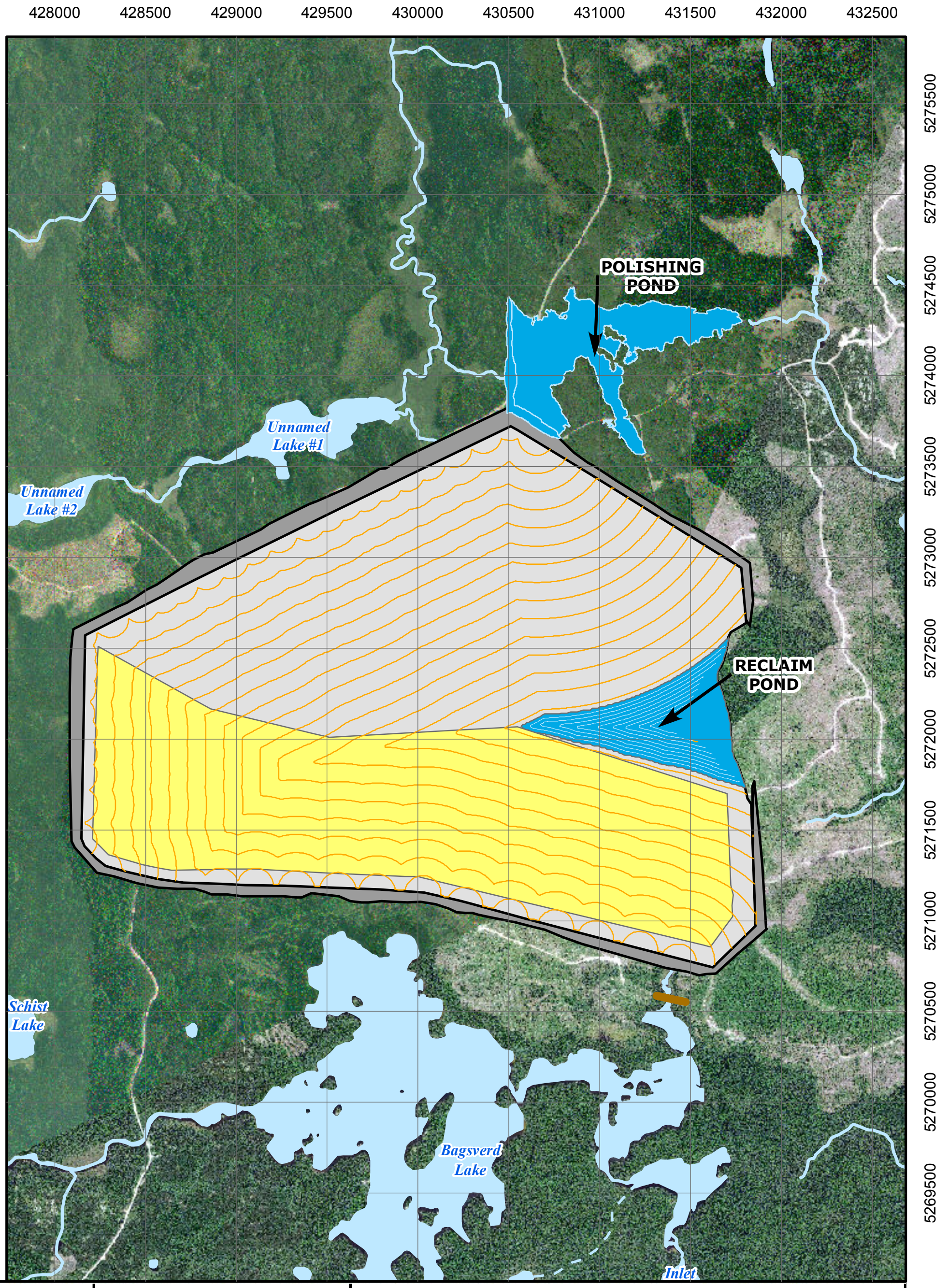
TMF3 - STAGE 3 END OF YEAR 5



TMF4 - STAGE 4 END OF YEAR 9



TMF5 - STAGE 5 END OF YEAR 13



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LEGEND

- Area of Dust Management
- Area of Active Tailings Deposition
- Tailings Dam
- Polishing Pond
- Reclaim Pond
- Realignment Dam
- Existing Waterbodies

0 0.5 1 2 3 4 Kilometres

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)

Datum: NAD83
Projection: UTM Zone 17N

N W E S

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TAILINGS DEPOSITION STAGING AND DUST MANAGEMENT PLAN

PROJECT N°: TC121522	**FIGURE: 1a**
SCALE: 1:40,000	DATE: December 2014

2.2 Estimation of Emission Rates (TSP, PM_{10}, $PM_{2.5}$)

No Ontario or Canadian emission factors are available for tailings emissions. The Australian methodology manual for mining (Australian Government, 2012) provides a factor of 0.4 kilograms (kg) / hectare (ha) / hour (h) for TSP and 0.2 kg/ha/h for PM_{10}. The Australian factor is an extension of work done by the United States Environmental Protection Agency (U.S. EPA) and is considered by MOECC to be appropriate for assessing dust emissions for Environmental Compliance Approvals (ECAs). The $PM_{2.5}$ fraction of 7.5% of total particulate was recommended in the U.S. EPA document detailing control of open fugitive dust sources (EPA,1996a).

2.3 Dust Control Measures for TMF

Dust control at the TMF will be detailed in the Fugitive Dust Best Management Practices Plan as per Chapter 10 of the EA report.

This Fugitive Dust Best Management Practices Plan will detail physical and chemical barrier options for dust management, and will recommend that field trials be carried out during the early years of mine operation to establish the most appropriate and effective method.

The Fugitive Dust Best Management Practices Plan will suggest that the use of watering dry tailings for dust control can be up to 90% effective, vegetation can be close to 100% effective once the site is fully rehabilitated, and physical barriers like fencing can be up to 75% effective.

A summary of the potential dust control efficiencies for various control measures is provided in Table 1a.

Table 1a: TMF Dust Control Measures and Control Efficiencies

Control Measure	Control Efficiency	Reference
Apply dust suppressants to stabilize disturbed area after cessation of disturbance	84%	WRAP: CARB, April 2002.
Apply gravel to stabilize disturbed open areas	84%	WRAP: Estimated to be as effective as chemical dust suppressants.
Primary rehabilitation	30%	Australian EET for Fugitive Emissions, Version 2.0 Table 6
Vegetation established but not demonstrated to be self-sustaining - weed control and grazing control	40%	Australian EET for Fugitive Emissions, Version 2.0 Table 6
Secondary rehabilitation	60%	Australian EET for Fugitive Emissions, Version 2.0 Table 6
Revegetation	90-100%	Australian EET for Fugitive Emissions, Version 2.0 Table 6
Physical barrier (fencing)	75%	CEMI Fugitive Dust Best Practices Manual Guidance Documents, 2010

Based upon the information available in the literature, a control efficiency of 85% was applied to the particulate emission rates from all of the dry areas of the TMF; it is likely that dust control measures would achieve appreciably greater control efficiency and that many dry areas would be at 100%; however 85% was used as a conservative estimate for the purposes of the assessment. It should also be noted that two or more control measures may be applied concurrently to achieve an even higher overall control efficiency.

It should also be noted that the proposed TMF is located within an area of low topography with higher ground along the east and south sides providing some natural topographic containment. The tailings dam and elevated surroundings will help to reduce the wind speeds that the TMF open area is exposed to, which will in turn reduce the quantity of dust re-entrainment. The modelling assessment did not take these factors into account.

2.4 Dispersion Modelling Setup

The dust management areas were modelled as ground level area sources; each of the four areas depicted in Figure 1a are modelled as polygons. TMF2 corresponds to the dust management area in Stage 2, TMF3 corresponds to the dust management area in Stage 3 and so forth. Source groups were defined in order to assess each dust management area individually, as well as each dust management area with all other Project sources.

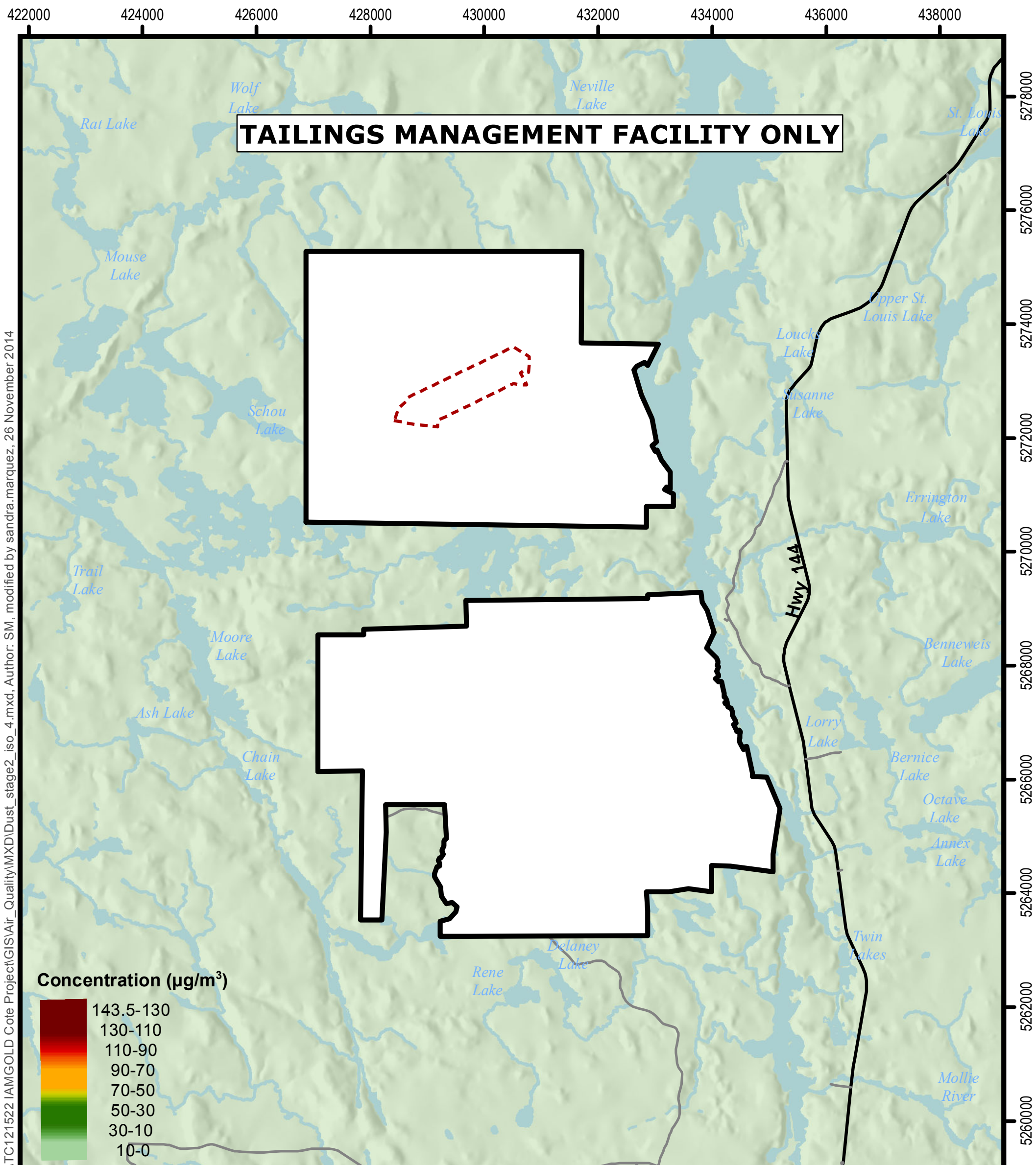
The particle size distribution used for the TMF was developed using the emission factors published by the US EPA, and are summarized in the Table 2a.

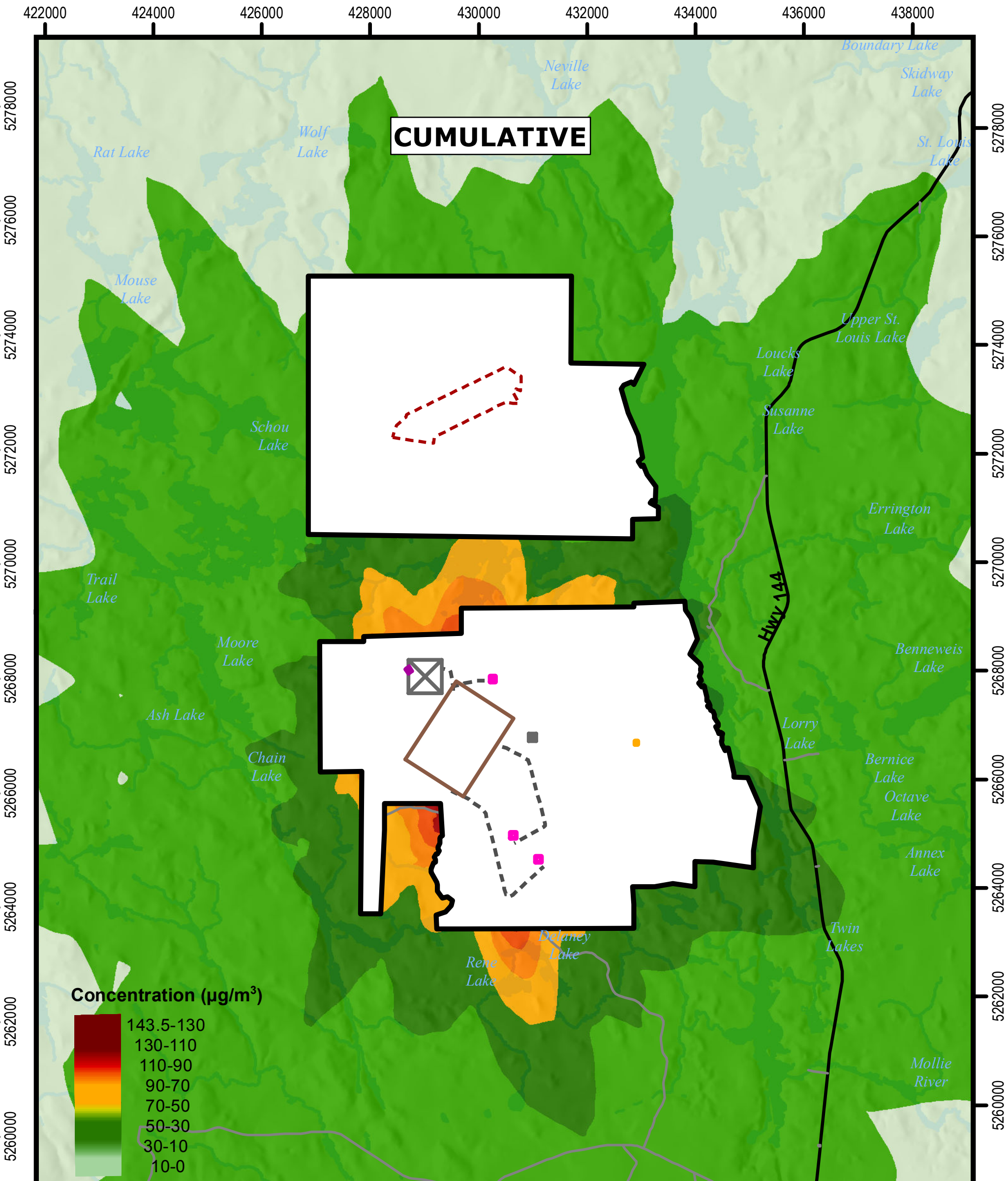
Table 2a: Particle Size Distribution and Particle Density for TMF

Particle Diameter	Mass Fraction	Particle Density (g/cm^3)
1.6	0.075	2.6
6.9	0.425	2.6
30.2	0.50	2.6

2.5 Results

The TMF was modelled in isolation of all other sources to ascertain the effect of wind erosion on particulate emissions from dust management areas. The following figures (2a, 3a, 4a and 5a) depict the resultant PM10 concentration isopleths for each of the four phases of TMF development. Each figure presents both the modelled results for TMF and the combined effect of the TMF with all other Project sources, which are shown side by side to illustrate the relative magnitude of the modelled PM10 results from the TMF.





LEGEND

Model Boundary

TMF Area of Dust Management

EMISSION SOURCES

Landfill

Leach

Material Handling

Haul Roads

Processing Plant

Pit

NOTE:
Concentration isopleths represent modelled results and do not include background.

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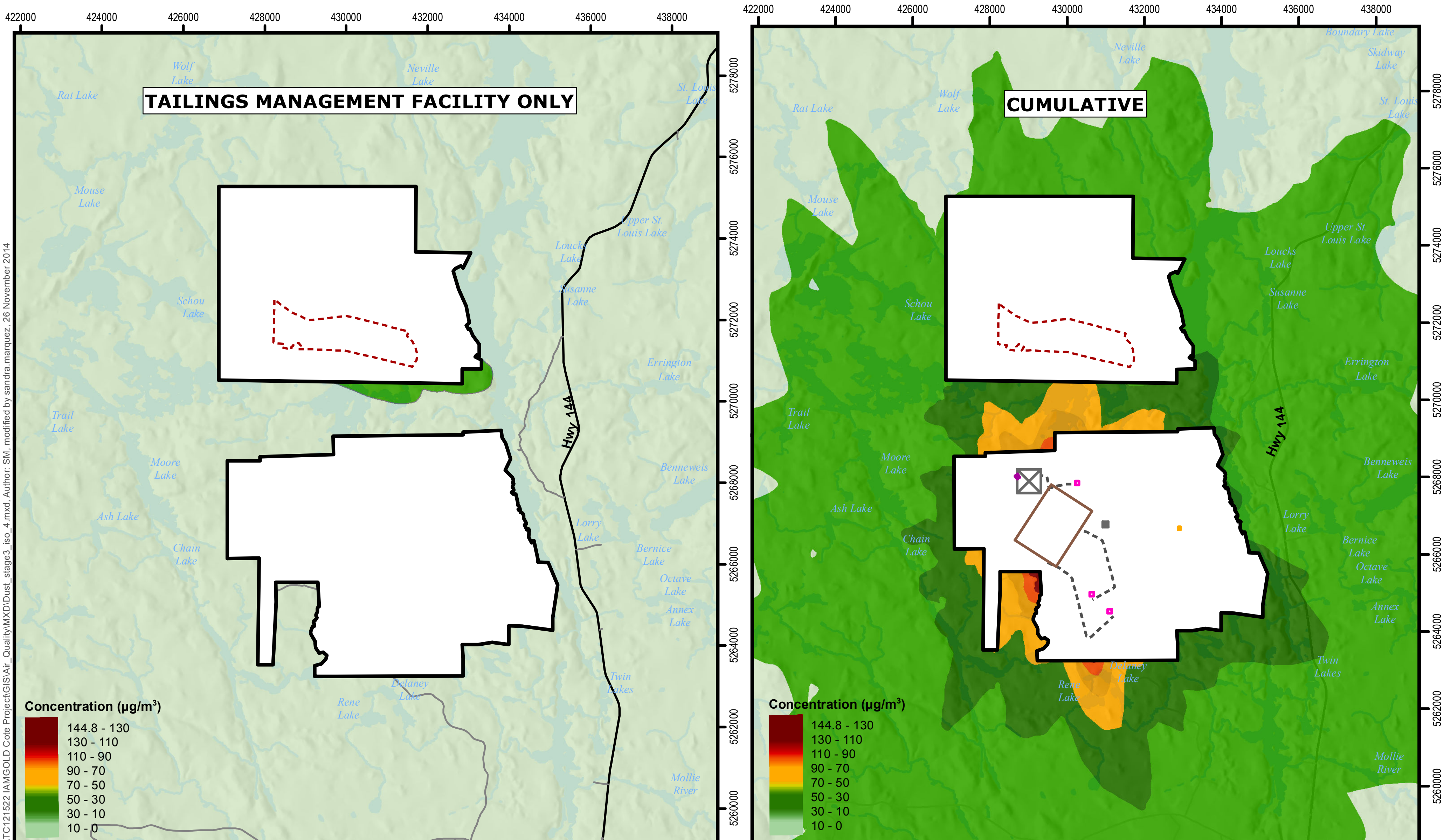
CÔTÉ GOLD PROJECT

Stage 2 PM10 Isopleths

Datum: NAD83
Projection: UTM Zone 17N

0 2 4 8 12 16 20 Kilometres

PROJECT N°: TC121522	FIGURE: 2a
SCALE: 1:130,000	DATE: December 2014



LEGEND

Model Boundary

TMF Area of Dust Management

EMISSION SOURCES

Landfill

Leach

Material Handling

Haul Roads

Processing Plant

Pit

NOTE:
Concentration isopleths represent modelled results and do not include background.

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CÔTÉ GOLD PROJECT

Stage 3 PM10 Isopleths

Datum: NAD83
Projection: UTM Zone 17N

PROJECT N°: TC121522

FIGURE: 3a

SCALE: 1:130,000

DATE: December 2014

0 2 4 8 12 16 20 Kilometres

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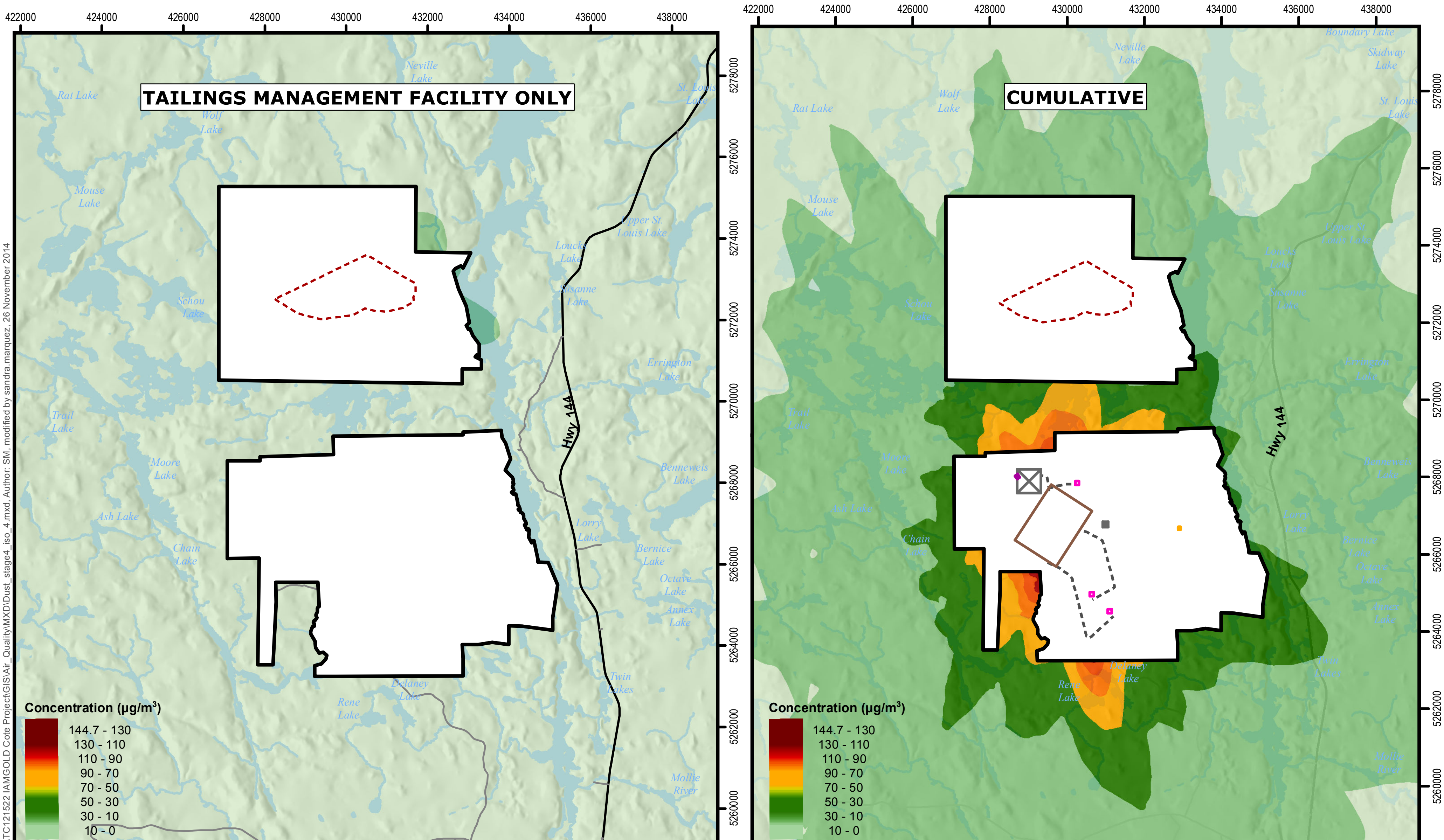

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LEGEND

- Model Boundary
- TMF Area of Dust Management

EMISSION SOURCES

- Landfill
- Leach
- Material Handling
- Haul Roads
- Processing Plant
- Pit

NOTE:
Concentration isopleths represent modelled results and do not include background.

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CÔTÉ GOLD PROJECT

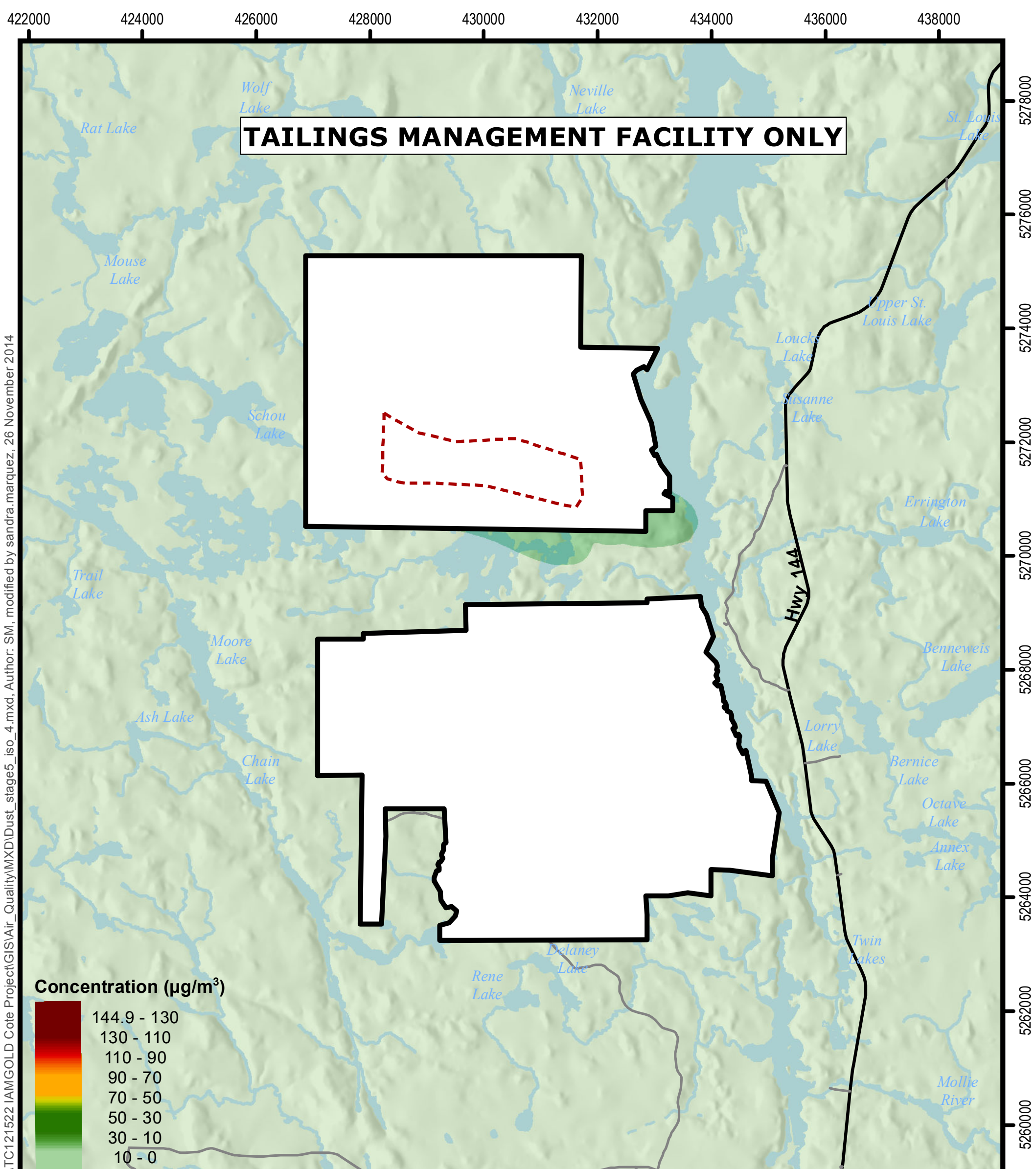
Stage 4 PM10 Isopleths

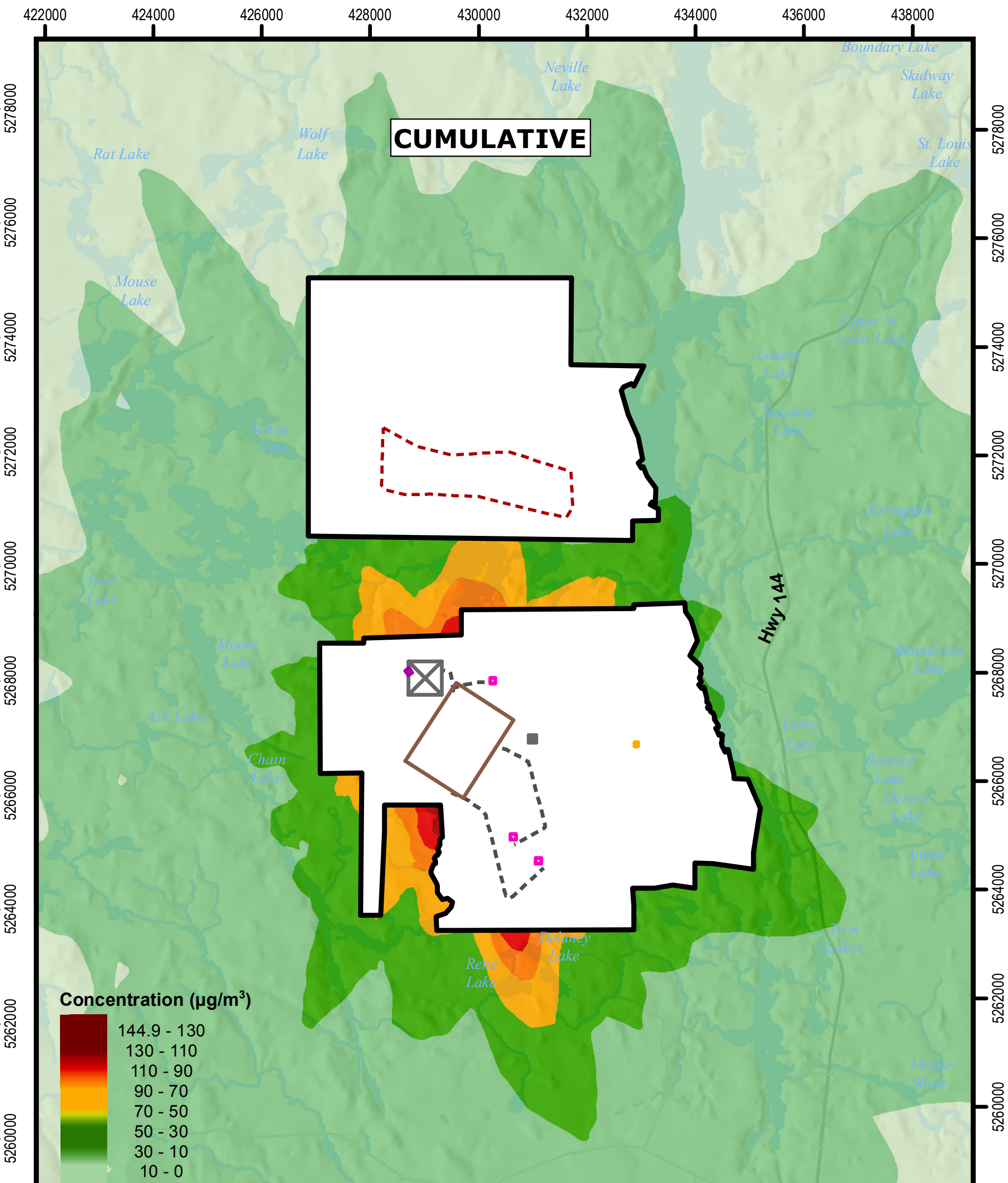
Datum: NAD83
Projection: UTM Zone 17N

N W E S

0 2 4 8 12 16 20 Kilometres

PROJECT N°: TC121522	**FIGURE: 4a**
SCALE: 1:130,000	DATE: December 2014





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LEGEND

- Model Boundary
- TMF Area of Dust Management

EMISSION SOURCES

- Landfill
- Leach
- Material Handling
- Haul Roads
- Processing Plant
- Pit

NOTE:
Concentration isopleths represent modelled results and do not include background.

Datum: NAD83
Projection: UTM Zone 17N

0 2 4 8 12 16 20 Kilometres

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CÔTÉ GOLD PROJECT

Stage 5 PM10 Isopleths

PROJECT N^{o}: TC121522	**FIGURE: 5a**
SCALE: 1:130,000	DATE: December 2014

As can be seen from Figures 2a to 5a, the maximum concentrations from the TMF as the sole source (i.e., no consideration of other sources) occurs at different locations, resulting in the combined (i.e., all sources considered) maximum concentrations (i.e., the effect of TMF operations) having an overall minimal effect. This trend was similar for PM and $PM_{2.5}$. Furthermore, Table 3a highlights the minimal change in 24-hr off-property concentrations when the TMF is modelled with all other Project sources.

Table 3a: Summary of TMF Modelled Concentrations Off-Property

Compound	Criterion (AAQC or CAAQS)	Maximum Modelled Concentration (without TMF)	Maximum Modelled Concentration (with TMF)	% Change	Background Concentration	Maximum Modelled (with TMF) + Background Concentration
TSP	120	197.4 μg/m^3	197.6 μg/m^3	↑ 0.1%	37 μg/m^3	234.6 μg/m^3
PM_{10}	50	112.7 μg/m^3	113.0 μg/m^3	↑ 0.3%	13.9 μg/m^3	126.9 μg/m^3
$PM_{2.5}$	28	30.4 μg/m^3	30.8 μg/m^3	↑ 1.3%	9.8 μg/m^3	40.6 μg/m^3

Note:
μg/m^3 micrograms per cubic metre

Modelling was also performed at sensitive receptor locations where no exceedances were observed. The findings of the TMF modelling assessment in isolation are presented in Table 4a. Results are presented for the 24-hr averaging period.

Table 4a: Summary of Modelled Concentrations at Sensitive Receptors (TMF Only)

Compound	Criterion (AAQC or CAAQS)	Maximum Modelled Concentration at Sensitive Receptor	Background Concentration	Maximum Modelled + Background Concentration
TSP	120	8.2 μg/m^3	37 μg/m^3	45.2 μg/m^3
PM_{10}	50	8.0 μg/m^3	13.9 μg/m^3	21.9 μg/m^3
$PM_{2.5}$	28	1.8 μg/m^3	9.8 μg/m^3	11.6 μg/m^3

The following table (Table 5a) presents 24-hr concentrations at the most affected sensitive receptor for all sources excluding the TMF.

Table 5a: Summary of Modelled Concentrations at Sensitive Receptors (Mine Only)

Compound	Criterion (AAQC or CAAQS)	Maximum Modelled Concentration at Sensitive Receptor	Background Concentration	Maximum Modelled + Background Concentration
TSP	120	45.2 μg/m^3	37 μg/m^3	82.2 μg/m^3
PM_{10}	50	33.2 μg/m^3	13.9 μg/m^3	47.1 μg/m^3
$PM_{2.5}$	28	11.5 μg/m^3	9.8 μg/m^3	21.3 μg/m^3

The findings of the TMF modelling assessment in combination with other mine and ore processing activities are presented in Table 6a. Results are presented for the 24-hr averaging period.

Table 6a: Summary of Modelled Concentrations at Sensitive Receptors

Compound	Criterion (AAQC or CAAQS)	Maximum Modelled Concentration at Sensitive Receptor	Background Concentration	Maximum Modelled + Background Concentration
TSP	120	47.5 μg/m^3	37 μg/m^3	84.5 μg/m^3
PM_{10}	50	35.4 μg/m^3	13.9 μg/m^3	49.3 μg/m^3
$PM_{2.5}$	28	12.0 μg/m^3	9.8 μg/m^3	21.8 μg/m^3

Comparing the maximum concentrations in Tables 5a and 6a, emissions from the TMF are relatively low contributors to the overall effect. All maximum concentrations for all size fractions are below their respective AAQC or CAAQS, even with the background concentration taken into account. The highest percent of criteria is PM_{10} at 98.6% of the AAQC. The low level of effect shown as a result of modelling the TMF, supports the TSD conclusions that the TMF does not contribute appreciably to the air quality effects. Effects and conclusions in the TSD are not changed as a result of the more detailed TMF assessment.

3.0 PREDICTION OF CONSTRUCTION PHASE EFFECTS

In this section responses are provided to MOECC's Comment #120 and CEAA's Comment #438. The comment received from the MOECC and CEAA requested that air quality effects of the construction phase of the Project be modelled to predict potential effects. In the TSD, construction effects were considered to be appreciably less than potential effects during operations. As such, detailed modelling was not warranted. The following provides a more detailed discussion of construction activities and a comparison to operating activities and effects.

A detailed construction schedule and the final selection of construction equipment has not yet been developed; therefore it is currently not possible to prepare a realistic and accurate modelling scenario of the construction phase.

Due to the nature of open pit mining, the sources of particulate emissions during construction are similar to those used in pit development and mining during the operations phase; however at reduced levels of activity. Much of the construction activity is focused on key infrastructure such as construction of the ore processing plant, the housing complex, channel realignments, and the transmission line; site development on the larger scale occurs over time in support of the mine plan.

In the traffic component of the EA, it was stated that there will be a total number of 6,000 vehicles travelling to and from the Project site over the 24 month construction period. This is an average of eight vehicles daily making 16 vehicle trips along the main site access road. Of these eight vehicles, three would normally be heavy equipment loads and five would be shuttle buses transporting workers to and from site.

Comparatively, in the operations phase there will be up to 33 dedicated haul trucks making up to 148 round trips per hour along site roads during the operations phase. Dust emissions increase with vehicle weight. The higher number of vehicle trips during the operations phase, with significantly heavier operational haul trucks, results in significantly higher emissions. Therefore the maximum road dust effects modelled during the operations phase is appreciably higher than would occur during the construction.

Since particulate emissions are proportional to the quantities of material handled and total distances travelled by site vehicles, the resultant emissions and modelled off-site effects for particulate would consequently be much less during construction than in any of the years when the mine is operational. Therefore modelling the maximum emissions scenario for the operations phase encompasses the effects of all phases of the Project.

For NOx, blasting in the pit was the dominant influence on the hourly modelling scenario during operations. For the 24-hour average NOx modelling scenario, NOx emissions from haul trucks and construction equipment in the pit were the major sources contributing to the maximum modelled off-site effects. As discussed above, since the total quantity of material (ore, overburden, and mine rock) handled on a daily basis during the operations phase is appreciably greater that that during the construction phase, the required equipment fleet for construction is smaller, resulting in lower overall NOx emissions and lower air quality effects off-site during construction.

A comparison of the activity data for the construction phase, operations phase, and the maximum emission scenario modelled, is provided in Table 7a; Table 8a summarizes the projected mine fleet by year, as well as the projected fuel consumption.

Table 7a: Construction and Operations Phase Activity Levels

	Construction Phase 2014	Maximum Operations Phase
Material Movements (Annual)		
• Ore	0	24,000,000
• Overburden	9,600,000	4,800,000
• Mine Rock	0	>100,000,000
• Total Material Movements	9,600,000	>130,000,000
Truck and Vehicle Movements		
• Construction Materials and Employees	8 round trips per day on site access road	Not included – not appreciable compared to haul truck movements
• Haul Trucks	5 round trips per hour (overburden)	148 round trips per hour (ore, overburden, and mine rock)
Fuel Consumption	14,062 kL	64,622 kL

Note:
kL thousand litres

An ECA will be sought from the MOECC for both the development (construction) and operations phases of the Project. Construction activities are not addressed specifically in an ECA, but specific sources (e.g. generators) used during the development phase will be included.

A Fugitive Dust Best Management Practices Plan (BMP Plan) will be prepared to cover both the construction and operations phases. The BMP Plan will be submitted to the MOECC for review as a component of the application package for an ECA, and will comprehensively address dust mitigation measures for point and fugitive sources of dust.

Table 8a: Projected Mine Fleet and Fuel Consumption

Period Name	Totals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Start Time		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Duration	14.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3
Equipment Requirements																
Major Equipment																
Mining Truck (313t)	8	15	22	24	27	30	32	33	27	19	20	25	19	11	5	8
Water/Sand Truck (113.6kL)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Electric Hydraulic Shovel (40m³)	—	2	2	2	2	2	2	2	2	2	2	2	2	1	—	—
Wheel Loader (40m³)	2	2	3	3	3	3	3	3	2	2	2	-	-	1	1	2
Rotary Drill (ϕ270mm/15m)	4	7	8	9	9	9	8	8	6	4	4	5	3	1	—	4
Pre-Split Drill (ϕ140mm)	1	1	2	2	2	2	2	2	2	1	1	2	2	1	—	1
Track-Type Tractor (646 hp)	4	4	5	6	6	6	6	6	6	6	6	4	4	3	—	4
Wheel Dozer (904 hp)	-	2	2	2	2	2	2	2	2	2	2	2	2	1	—	-
Motor Grader (16ft)	2	2	3	3	3	3	3	3	3	3	2	2	2	1	—	2
Excavator (49t)	2	2	2	2	2	2	2	2	2	2	2	2	1	1	—	2
Excavator (85t)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Support Equipment																
Cable Handler 40t Art. Truck	2	2	2	2	2	2	2	2	2	2	2	2	1	1	—	2
Mech. Service Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Welder Service Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
GET Service Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Tire Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Boom Truck 26t	1	1	1	2	2	2	2	2	2	2	1	1	1	1	—	1
Crane 150t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Fuel & Lube 40t Art. Truck	1	2	2	2	2	2	2	2	2	2	2	2	1	1	—	1
Pick-up Truck	8	12	16	16	16	16	16	16	16	16	16	12	8	8	—	8
Pit Bus	2	2	2	2	2	2	2	2	2	2	2	1	1	1	—	2
Lowboy 160t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Light Towers	6	8	8	8	8	8	8	8	8	8	8	8	6	6	—	6
Stemming 40t Art. Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	1
Emulsion Truck	2	3	3	3	3	3	3	3	3	3	3	3	2	1	—	2

Period Name	Totals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Start Time		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Duration	14.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3
Fuel Consumption																
Fuel expenditures (k$)	590,535	14,062	26,995	44,085	46,540	50,187	57,150	63,102	64,622	52,786	32,025	38,752	48,311	36,994	14,643	281
Fuel price ($/L)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fuel consumption (kL)	590,535	14,062	26,995	44,085	46,540	50,187	57,150	63,102	64,622	52,786	32,025	38,752	48,311	36,994	14,643	281
Fuel consumption rate (L/t moved)	0.61	0.31	0.41	0.46	0.47	0.50	0.58	0.65	0.69	0.77	0.65	0.83	0.99	1.10	0.68	0.04
Fuel as % of costs	25%	12%	20%	22%	24%	24%	26%	26%	28%	28%	24%	28%	29%	29%	26%	5%

Notes:

t	tonne
kL	thousand litres
mm	millimetre
m	metre
m^3	cubic metre
hp	horse power
ft	feet

4.0 DETERMINATION OF BASELINE AIR QUALITY

In this section, responses are provided to MOECC's Comment #116 and CEAA's Comment #436. Further clarification of baseline air quality parameters was requested by both MOECC and CEAA. The following provides further detail and clarification of the baseline data.

The baseline concentrations and their derivation were summarized in the Baseline Report: Air Quality and the Technical Support Document (TSD): Air Quality of the Draft Environmental Assessment Report.

The baseline concentrations for each of the substances identified as significant in the air quality assessment are presented in Table 9a, along with a description of how the concentration was established. The baseline concentrations were developed in Tables 4-2 to 4-6 of the Air Quality TSD as the Level 1 magnitude for the effects assessment Indicators.

Table 9a: Study Area Baseline Concentrations

Compound	CAS Number	Averaging Time	Baseline Concentration ($\mu g/m^3$)	Reference for Baseline Concentration
Total Suspended Particulate TSP	n/a	24 hour	37	90th percentile of 2013 on-site baseline sampling
		Annual	21.4	Geometric mean of 2013 on-site baseline sampling
PM_{10}	n/a	24 hour	13.9	Mean of 2013 on-site baseline sampling
$PM_{2.5}$	n/a	24 hour	9.8	Average of 5 years of hourly $PM_{2.5}$ data at Sault Ste. Marie and Sudbury
		Annual	4.2	Average of 5 years of 90th percentile $PM_{2.5}$ data at Sault Ste. Marie and Sudbury
Nitrogen Oxides NOx	10102-44-0	1 hour, 24 hour	26.2	90th percentile of 2007 to 2011 monitoring data at Sudbury and North Bay
Carbon Monoxide CO	630-08-0	1 hour, 8 hour	insignificant	No significant baseline CO expected at rural location
Sulfur Dioxide SO_2	7446-09-5	1 hour, 24 hour	6.0	90th percentile of 2007 to 2011 monitoring data at Sudbury and Sault Ste. Marie
		Annual	3.7	Average of 2007 to 2011 monitoring data at Sudbury and Sault Ste. Marie
Hydrogen Cyanide HCN	74-90-8	24 hour	0.18	Northern hemisphere's non-urban troposphere (Cicerone and Zellner,1983; Jaramillo et al., 1989)
Calcium Oxide CaO	1305-78-8	24 hour	0.12 (as Ca)	Mean of Background Air Quality Data 2005 to 2009, Algoma, ON
Copper Sulphate $CuSO_4$	7758-99-8	24 hour	0.036 (as Cu)	Mean of 2013 on-site baseline sampling

Compound	CAS Number	Averaging Time	Baseline Concentration (µg/m^3)	Reference for Baseline Concentration
Arsenic As	7440-38.2	24 hour	0.0018	½ method detection limit (MDL) (all 2013 on-site baseline samples were less than MDL)
Chromium Cr	7440-47-3	24 hour	0.0009	Mean of 2013 on-site baseline sampling
Mercury Hg	7439-97-6	24 hour	0.0024	MOECC Monitoring at Mississauga, ON (2002)
Magnesium Mg	1309-48-4	24 hour	0.074	Mean of 2013 on-site baseline sampling
Manganese Mn	1336-36.3	24 hour	0.0055	Mean of 2013 on-site baseline sampling
Nickel Ni	7440-02-0	24 hour	0.0014	Mean of 2013 on-site baseline sampling
Lead Pb	10099-74-8	24 hour	0.0013	Mean of 2013 on-site baseline sampling
		30 day		
Titanium Ti	7440-32-6	24 hour	0.0063	Mean of 2013 on-site baseline sampling
Zinc Zn	7440-66-6	24 hour	0.0073	Mean of 2013 on-site baseline sampling

5.0 DISPERSION MODELLING SCENARIOS (AAQC AND O.REG. 419)

In this section responses are provided to MOECC's Comment #327 and CEAA's Comment #439. Both requested greater clarity on sources and modelling undertaken for comparison against Ambient Air Quality Criteria and permitting standards under O.Reg. 419.

A summary of the sources modelled as part of the Maximum Emission Scenario is presented in Table 10a for the modelling conducted for comparison with the AAQC and for Scenario 2 in which the modelled Point of Impingement concentrations are compared with the O.Reg. 419 standards and guidelines.

As shown in Table 10a, all sources were considered in Scenario 1; Scenario 2 considered all sources except for road dust and tailpipe emissions as required by O.Reg. 419.

Table 10a: Dispersion Modelling Scenarios

Source	Source ID	Description	Scenario 1: Modelling for Comparison with AAQC	Scenario 2: Modelling for Comparison to O.Reg. 419 Standards and Guidelines
Drill	PIT	Open Pit Mining - Drilling	Yes	Yes
Blast	PIT	Open Pit Mining - Blasting	Yes	Yes
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	Yes	Yes
In Pit Road	PIT	Open Pit Mining - Haul trucks	Yes	No
Haul Roads	Roads (various)	Road Emissions	Yes	No
Dozers/Graders	PIT	Dozers and Graders in pit	Yes	Yes
Concrete 1	BATCH1	Batch Plant 1	Yes	Yes
BagHouse2	BH2 - under crushed ore pile	baghouse for conveyor drop under stockpile feed conveyor	Yes	Yes
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	Yes	Yes
UnloadMRE	Mine Rock East	Drop at Mine Rock	Yes	Yes
DozerMRE	Mine Rock East	Dozer at Mine Rock	Yes	Yes
UnloadMRW	Mine Rock West	Drop at Mine Rock	Yes	Yes
DozerMRW	Mine Rock West	Dozer at Mine Rock	Yes	Yes
UnloadOre	ORE	Ore stockpile unloading	Yes	Yes
DozerOre	OREDoz	Dozer at Ore stockpile	Yes	Yes

Source	Source ID	Description	Scenario 1: Modelling for Comparison with AAQC	Scenario 2: Modelling for Comparison to O.Reg. 419 Standards and Guidelines
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	Yes	Yes
BagHouse1	BH1 PCRUSH	baghouse for crusher	Yes	Yes
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	Yes	Yes
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	Yes	Yes
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor	Yes	Yes
Leach	LEACH	Leach Tanks - LT1 to LT8	Yes	Yes
Space Heaters	SPACEHEAT	space heating in process building	Yes	Yes
Induction Furnaces	IND1	scrubber to control emissions	Yes	Yes
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	Yes	Yes
Scrubber lime slaker	LS1	scrubber for lime slaker	Yes	Yes
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	Yes	Yes
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	Yes	Yes
CN-Dest 1	HCND1	CN Destruction Tank 1	Yes	Yes
Emergency Generators 1 to 5	EGEN1, EGEN2, EGEN3, EGEN4, EGEN5	Emergency Diesel Generator 1 to 5	Yes	Yes
FirePump1	FP1	Diesel Fire Pump 1	Yes	Yes

6.0 POTENTIAL EFFECTS OF EMISSIONS FROM AGGREGATE PITS

In this section a response is provided to MOECC's Comment #148 relating to the inclusion and effect of emissions from the on-site aggregate pits. In the TSD the emissions from the aggregate pits were considered to be minimal and not contribute to the overall off-site effect.

The two borrow pits identified as sources of aggregate materials for road and berm construction were approved as part of ECA Number 3939-8BBSZC issued January 27, 2011 for Trelawney Mining and Exploration Inc. for the Chester Project. As such, it was demonstrated that potential off-site effects of the crushing and screening activities in these pits were compliant with the standards set out in Ontario Regulation 419/05. The location of the two aggregate pits is presented in Figure 1-2 of the Amended EIS/Final EA Report.

A summary of the maximum annual volume of aggregate removed during construction from the two Pits is provided in Table 11a, with a comparison to the volume considered in the Maximum Emission Scenario; the combined annual material removed from both pits is approximately 10% of the total material accounted for in the operations phase. During actual operations, the pits will be used only for obtaining maintenance materials.

Aggregate Pit #1 is located within 600 m of the eastern property boundary. The setback is further than that of the Open Pit, the ore processing area, or the haul roads connecting the Open Pit to the Mine Rock Area. As a result of the greater setback from the property boundary and the lower emission rates, the off-site effect of Aggregate Pit #1 during construction would be appreciably lower than that of the other sources considered in the Maximum Emission Scenario.

Aggregate Pit #3 is located in the centre of the property, at a distance of more than 2.5 km from any boundary; therefore off-site effects from Pit #3 will be minimal.

Table 11a: Material Movements in Aggregate Pits during Construction

Material	Aggregate Pit #1	Aggregate Pit #3	Effects Assessment (TSD)
Ore	n/a	n/a	9,885,037 m^3
Overburden	n/a	n/a	5,794,377 m^3
Mine Rock	n/a	n/a	28,806,455 m^3
Rip-Rap	22,100 m^3	0	n/a
Granular "A" Road Construction	13,180 m^3	3,500 m^3	n/a
Blanket filter (sand and gravel)	114,800 m^3	14,800 m^3	n/a

Material	Aggregate Pit #1	Aggregate Pit #3	Effects Assessment (TSD)
Bedding sand	251,700 m^3	64,700 m^3	n/a
Total Material Movements	401,780 m^3	83,000 m^3	44,485,868 m^3

The crushers and screen plant are planned to be operated a maximum of 10 hours per day, for a maximum of 100 tonnes per hour (1000 tonnes per day) of crushed materials.

The crushing and screening facilities are equipped with water sprays to control dust emissions. The maximum emission rate for each crusher and screen plant was determined to be 1.4 g/s (grams per second; material drop, primary crushing, secondary crushing, screening, and material drop into trucks with water spray control), which is approximately 1% of the total mining and ore processing facilities emission rate of 114.5 g/s; particulate emissions from the aggregate pits were therefore considered to be minor in comparison to the blasting, haul truck road dust, and material handling of ore, overburden, and mine rock.

A summary of the emission rates is provided in Table 12a.

Table 12a: Particulate Emissions from Aggregate Pits

Source	Emission Factor	Material Handling Rate	Emission Rate
Material drop in crusher	0.005 kg/tonne	100 tonnes/hr	0.14 g/s
Primary Crushing	0.01 kg/tonne		0.28 g/s
Secondary Crushing	0.03 kg/tonne		0.83 g/s
Screening	0.0011 kg/tonne		0.031 g/s
Material drop in trucks	0.005 kg/tonne		0.14 g/s
Total Emission Rate			1.42 g/s
Aggregate Emission Rate of Mining and Ore Processing Facilities in ESDM			114.5 g/s

Notes:
The emission rate of particulate matter from crushing and screening activities was estimated using AP-42 emission factors for primary and secondary crushing (AP-42 section 11.24 with high moisture (> 4%)), material transfer (AP-42 section 11.24 with high moisture (> 4%)) and screening (AP-42 section 11.19) with controlled water spray.
kg/tonne - kilograms per tonne

The assessment above confirms that the emissions from the aggregate pits are minimal and do not contribute to off-site effects.

7.0 DISPERSION MODELLING OF NON-CONTINUOUS SOURCES

In this section a response is provided to MOECC's Comment #329 requesting further clarification of the modelling approach to address operational activities that are not continuous and occur only at specific times during the day (e.g., blasting).

Emissions factors were scaled in order to allow for the dispersion modelling to account for blasting over the course of one hour. Blasting occurs during the middle of the day when meteorological conditions are most favorable for good atmospheric dispersion.

The scaling was done for TSP, PM_{10}, $PM_{2.5}$, NOx, CO, and SO_2 from the Open Pit source (Table 13a).

The scaling factor of 1.0 was assigned to open pit emissions for the hour when blasting would occur; all other hours were assigned the 'no blasting' scaling factor (i.e., the emission from the open pit were lower during the other hours).

The scaling factor differed for the modelling scenarios conducted for the environmental assessment and for the O.Reg 419 assessment since the O.Reg 419 assessment does not include road dust or mobile fuel combustion as emission sources.

Table 13a: Scaling Factors for Variable Emissions from Open Pit (by Hour of Day)

	Emissions Scenario	PM	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2
Open Pit 1-hour Average Emission Rate (g/s)	Hour with Blasting	99.71	51.85	2.99	96.58	510	31
	Hour with No Blasting (AAQC)	73.28	20.59	2.56	61.71	66	0.11
	Hour with No Blasting (O.Reg. 419)	5.94	n/a	n/a	0	0	0
Scaling Factor	Hour with Blasting	1.0	1.0	1.0	1.0	1.0	1.0
	Hour with No Blasting (AAQC)	0.735	0.397	0.856	0.639	0.130	0.0035
	Hour with No Blasting (O.Reg 419)	0.060	n/a	n/a	0	0	0

The scaling factor was calculated as the ratio of the total emission rate from Open Pit sources in the absence of blasting to the total emission rate during a blast. Using total particulate as an example, the scaling factor of 0.735 is the ratio of Open Pit emissions in the absence of blasting (73.28 g/s) to the rate during blasting (99.71 g/s); 73.28/99.71=0.735.

8.0 DISPERSION MODELLING OF PARTICULATE MATTER WITH WET AND DRY DEPOSITION / PLUME DEPLETION

In this section a response is provided to MOECC's Comment #334 requesting further clarification on the parameters used to assess the deposition of particulate matter as a result of gravitation settling and airborne dust removal through precipitation.

The particle size distributions and particle density data used for the open pit, the ore processing plant, and for the unpaved haul roads and material handling are summarized in Table 14a. As no specific Canadian data is available, the size distributions were developed based on relevant U.S EPA AP42 data.

Table 14a: Particle Size Distribution and Particle Density

Sources	Source Description / Type	Particle Diameter (µm)	Mass Fraction	Particle Density (g/cm^3)
OPIT	Open Pit	1.6	0.03	2.6
		6.9	0.49	2.6
		30.2	0.48	2.6
CBP	Concrete Batch Plant	6.3	0.4	2.6
		30.2	0.6	2.6
Mill	Crushing & Process at Mill	1.6	0.09	2.6
		6.9	0.24	2.6
		30.2	0.67	2.6
ORE_MH MRE_MH ORE_MH	Material Handling	1.6	0.03	2.6
		6.9	0.28	2.6
		30.2	0.69	2.6
MRE_HR MRW_HR OREMILL_HR ORESP_HR ORE_HR	Haul Roads	1.6	0.03	2.6
		6.9	0.28	2.6
		30.2	0.69	2.6

Notes:
µm micrometres
g/cm^3 grams per cubic centimetre

9.0 SAMPLE CALCULATIONS FOR KEY SOURCES

In this section, responses are provided to MOECC's Comment #67, #68 and CEAA's Comment #440 requesting example calculations for a number of key emission sources (generators, crushing and material handling). The following provides example calculation for these sources.

9.1 Diesel Generator

For all criteria air contaminants, except SO_2, the emission rates for the diesel generator were developed using the manufacturer's specifications for the units. The emission rates from the manufacturers were provided in units of lb/hr.

In the case of SO_2, the U.S. EPA AP-42 Emission Factors were used for diesel engines. The U.S. EPA factor does not account for changes in sulphur content of fuel and is a single emission factor based on older allowable sulphur in fuel content.

It was determined that the use of the SO_2 emission factors for large stationary engines (EPA, 1996a), would be more appropriate as they take into account the low sulphur content of the diesel fuel (15 parts per million; ppm) used at the site. The emissions were subsequently updated. Changes to air quality were minimal.

A sample calculation for the 2.5 megawatt diesel generator is provided:

Emission Rate (g/s) = Emission Factor (pounds (lb)/(horsepower-hour) hp-hr) x hp-hr rating x 454 g/lb ÷ 3600 s/hr

Where the Emission Factor = 0.0089x Sulphur Content (%)
= 0.0089 x 0.0015% (15 ppm)
= 0.0000121 lb/hp-hr

And the hp rating = fuel usage (gallons (gal)/hr) x SG (lb/gal) x heating value (British thermal units; BTU/lb) ÷ 7000 BTU/hp-hr
= 172 gal/hr x 7 lb/gal x 18,390 BTU/lb ÷ 7,000 BTU/hp-hr
= 3,164 hp-hr

Emission Rate (g/s) = 0.0000121 lb/hp-hr x 3,164 hp-hr x 454 g/lb ÷ 3,600 s/hr
= 0.0048 g/s

9.2 Crushing

Baghouses will control particulate emissions from both the primary and secondary crushing. The emission rates were estimated using the recommended, very conservative outlet concentration of 20 mg/m^3 (MOECC) for a baghouse dust collector. A sample calculation for the secondary crusher is provided:

Emission Rate (g/s) = Exhaust Flow Rate x Outlet Concentration
= 9.4 m^3/s x 20 mg/m^3 ÷ 1,000 mg/g
= 0.19 g/s

9.3 Haul Truck Loading and Material Handling

Metallic minerals processing (EPA, 1996b) emission factors for high moisture ore (>4%) were used for haul truck loading and material handling. Factors for uncontrolled handling of TSP and PM_{10} are published in Table 11.24-1 (EPA, 1996b); the factor for $PM_{2.5}$ was estimated using the particle size distribution published in the National Pollutant Release Inventory Toolbox for aggregate handling transfer points. The material handling will be mainly controlled by water dust suppression which could provide up to 90% control efficiency. The control efficiency of only 75% was conservatively applied for PM emission rate calculations.

A sample calculation for total particulate matter is provided:

Emission Rate (g/s) = Emission Factor x Loading Rate x (100% - Control Efficiency)
= 0.005 kg/Mg x 13,447 Mg/hr x (100% - 75%) x 1,000 g/Mg ÷ 3,600 s/hr
= 4.67 g/s

10.0 EFFECT SUMMARY FOR COMBINED BACKGROUND AND PROJECT EFFECTS

In this section a response is provided to CEAA's Comment #521 requesting a consolidated table showing the effects of both background and Project effects.

Table 15a presents the total effect (modelled concentration + background concentration) of the Project on the most effected sensitive receptor. The percentage (%) of criteria for each compound was calculated using the additive concentration of modelled and background concentrations.

The results shown in the table indicate that modelled effects concentrations at the sensitive receptors are all below relevant air quality criteria.

Table 15a: Emission Summary Table at Most Effected Sensitive Receptor

Compounds	CAS Number	Facility Emission Rate (g/s)	Maximum Modelled Concentration at Sensitive Receptor (µg/m³)	Background Concentration (µg/m³)	Ontario AAQC (µg/m³)	Averaging Period (hr - unless noted otherwise)	Limiting Effect	% of Criteria
Total Particulate (TSP)	NA	114.53	47.5	37.0	120	24	visibility	70.4%
		114.53	5.2	21.4	60	annual		44.3%
PM_{10}	NA	36.01	35.4	13.9	50	24	health	98.6%
$PM_{2.5}$	NA	6.88	12.0	9.8	25	24	health	87.2%
		6.88	1.0	4.2	8.8	annual		58.7%
Nitrogen Dioxide	10102-44-0	199.68	149	26.2	400	1	health	43.7%
		98.36	31.6	26.2	200	24		28.9%
Carbon Monoxide	630-08-0	611.55	914	790	36,200	1	health	4.7%
		120.67	251	790	15,700	8		6.6%
Sulfur Dioxide	7446-09-5	6.34	7.8	6.0	275	24	health and vegetation	5.0%
		36.40	80.7	6.0	690	1		12.6%
		6.34	0.5	3.7	55	annual		7.7%
Hydrogen Cyanide	74-90-8	1.01	2.2	0.18	8	24	health	30.1%
Calcium Oxide (CaO)	1305-78-8	0.17	1.8	0.12	10	24	corrosion	19.5%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	0.5	0.036	20	24	Limit established by Certified Toxicologist	2.8%
Magnesium	1309-48-4	3.37	1.40	0.07	120	24	particulate	1.2%
Manganese - in $PM_{2.5}$	7439-96-5	6.50E-03	1.1E-02	5.5E-03	0.1	24	health	16.8%
- in PM_{10}		3.40E-02	3.3E-02	5.5E-03	0.2	24		19.5%
- in TSP		1.06E-01	4.4E-02	5.5E-03	0.4	24		12.4%

Compounds	CAS Number	Facility Emission Rate (g/s)	Maximum Modelled Concentration at Sensitive Receptor (µg/m³)	Background Concentration (µg/m³)	Ontario AAQC (µg/m³)	Averaging Period (hr - unless noted otherwise)	Limiting Effect	% of Criteria
Nickel - in TSP	7440-02-0	6.39E-03	2.7E-03	1.4E-03	0.2	24	health	2.0%
			2.9E-04	1.4E-03	0.04	annual		4.2%
Nickel - in PM_{10}		2.05E-03	2.0E-03	1.4E-03	0.1	24		3.4%
			2.0E-04	1.4E-03	0.02	annual		8.0%
Arsenic	7440-38-2	4.82E-04	2.0E-04	1.8E-03	0.3	24	health	0.7%
Chromium	7440-47-3	2.13E-02	2.2E-05	9.0E-04	0.5	24	health	1.9%
Mercury	7439-97-6	1.12E-05	8.8E-03	2.4E-03	2	24	health	0.1%
Lead	7439-92-1	6.73E-04	4.7E-06	1.3E-03	0.2	30 day	health	0.7%
		6.73E-04	4.4E-05	1.3E-03	0.5	24		0.3%
Titanium	7440-32-6	6.00E-01	2.8E-04	6.3E-03	120	24	particulate	0.2%
Zinc	7440-66-6	9.14E-03	2.5E-01	7.3E-03	120	24	particulate	0.01%

11.0 AIR QUALITY MONITORING PROGRAM

An air quality monitoring program will be established in consultation with the MOECC to ensure that it is appropriate and protective of ambient air quality at the Project site, which is remote and has few proximate permanent receptors.

The monitoring will be carried out through the construction and operations phases of the Project.

It is expected that the monitoring will include TSP and metals on the TSP size fraction (as required by MOECC), dustfall, and passive monitoring for NO_2 and SO_2. The monitoring of TSP would allow for reasonable estimates of the PM_{10} and $PM_{2.5}$ concentrations to be made, since these are fractions of the TSP.

The monitoring of TSP will provide an effective measure of fugitive dust management and mitigation measures, as these are the particle size fractions that are of primary concern from material handling, mining activities, and road dust. In contrast, $PM_{2.5}$ is predominantly emitted from combustion sources. For this reason tracking PM_{10} and $PM_{2.5}$ as consistent fractions of TSP is a reasonable approach.

The air monitoring program will be a required condition of the Provincial ECA, and the final selection of target parameters and station locations will be done as part of the ECA approval process with the MOECC.

12.0 CONCLUDING REMARKS

The responses above clarify a number of key issues raised by reviewers. All of the responses provide clarification and further detail of technical issues. No changes were made to the TSD as a result of these comments and/or clarifications. The overall conclusions of the TSD remain unchanged.

13.0 REFERENCES

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CÔTÉ GOLD PROJECT
TECHNICAL SUPPORT DOCUMENT:
AIR QUALITY

FINAL

Submitted to:
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February 2014

TC121522

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GLOSSARY AND ABBREVIATIONS

AAQC	Ambient Air Quality Criteria
AERMOD	MOE approved air quality dispersion model
AMEC	AMEC Environment & Infrastructure
ANFO	Ammonium-nitrate/fuel oil
CCME	Canadian Council of Ministers of the Environment
CEAA, 2012	Canadian Environmental Assessment Act, 2012
cm	Centimetres
CO_2	Carbon dioxide
DBMP	Dust Best Management Plan
EA	Environmental Assessment
EIS	Environmental Impact Statement
GHGs	Greenhouse gases
IPCC	In-pit crushing and conveying
km	Kilometre
km/h	Kilometres per hour
kV	Kilovolt
L	Litres
m	Metre
m^3	Cubic metres
m^3/yr	Cubic metres per year
m^3/d	Cubic metres per day
m^3/s	Cubic metres per second
mg/kg	Milligrams per kilogram
mm	Millimetre
Mm^3	Million cubic metres
MOE	Ministry of the Environment
MRA	Mine Rock Areas
Mt	Million tonnes (metric)
ng/m^3	Nanogram (one-billionth of a gram) per cubic
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PM	Particulate material
$PM_{2.5}$, PM_{10}	Particles less than 2.5 or 10 micrometers in diameter
POI	Point of impingement
ppb	Parts per billion
ppm	Parts per million
SO_2	Sulphur dioxide
Tpd or t/d	Metric tonnes per day
TMF	Tailings Management Facility
TSP	Total Suspended Particulate (particles typically less the 44 µm)
UTM	Universal Transverse Mercator
°C	Degrees Celsius
µm	Micrometre (one millionth of a metre)
µg/g	Micrograms (one-millionth of a gram) per gram
µg/m^3	Micrograms (one-millionth of a gram) per cubic metre

EXECUTIVE SUMMARY

The Côté Gold Project (the Project) is an advanced stage gold exploration project located in the Chester and Neville Townships, District of Sudbury, in northeastern Ontario, approximately 20 kilometres (km) southwest of Gogama, 130 km southwest of Timmins, and 200 km northwest of Sudbury (see Figure 1). IAMGOLD proposes to construct, operate and eventually rehabilitate a new open pit gold mine on the property.

AMEC has completed a study of the potential air quality effects of the Project as a technical support document (TSD) in support of the environmental assessment (EA). The air quality effects study requires quantification of the potential air emissions from site activities, the prediction of off-site effects using dispersion modelling, and the comparison of the results to applicable air quality criteria in order to determine whether potential adverse effects on the environment and human health exist. Air emissions sources from the Project include the open pit (including blasting), the ore processing plant, the concrete batch plant, site roadways, and ore, overburden, and mine rock handling activities.

AERMOD, a Gaussian dispersion model, was considered to be the most appropriate model for assessment as it is capable of handling multiple sources of varying types such as point, area, and volume sources. The input data required for AERMOD includes five years of local, hourly meteorological data, terrain elevations for the site and vicinity, and the characteristics of the buildings and emission sources at the Project site. The model uses these input parameters to predict the resultant air concentrations at off-site locations (receptors), and is capable of predicting these effects for each of the relevant averaging times.

The findings of the air quality assessment are as follows:

- during the operations phase, there is a potential for an occasional exceedance of the total particulate (TSP), PM_{10} and $PM_{2.5}$ ambient air quality criteria (AAQC). These modelled results in excess of the desirable ambient air quality were found at the property boundary where there is no current human activity, and where there are no human receptors;
- at all sensitive receptors, the AAQC are met for all parameters, even with the inclusion of the background concentrations;
- the cumulative concentrations (Project plus background) for nitrogen oxides, sulphur oxides, carbon monoxide, calcium oxide and key metals are all below desirable AAQC at all off-site locations, including at all sensitive receptors; and
- all modelled concentrations for emissions expected to be released during the operations phase of the Project were below applicable Schedule 3 standards of Ontario Regulation 419/05 demonstrating that the Project meets all air quality requirements for an air permit in Ontario.

Air quality predictions determined that particulate matter levels for TSP, PM_{10}, and $PM_{2.5}$ exceeded AAQC in a small area proximate to the Project site boundary. For $PM_{2.5}$, it was determined that the AAQC was exceeded one day per year (0.3%). PM_{10} exceeded the AAQC less than 4% of the time per year, and TSP exceeded less than 2% of the time. At each of the sensitive receptors (cottages) located within the local study area, the particulate matter was below the AAQCs and, in some cases, below current baseline levels.

All other key indicators were determined to be below the AAQCs and, in several cases, below current baseline levels in the local study area during mine operation.

These findings are based upon the implementation of effective mitigation and operational controls that will be implemented including:

- a fugitive dust best management plan (DBMP) which will be prepared for the construction and operation phase to identify all potential sources of fugitive dusts, outline mitigative measures that will be employed to control dust generation, and detail the inspection and recordkeeping required to demonstrate that fugitive dusts are being effectively managed. The DBMP will be consistent with industry best management practices and Ontario MOE requirements, to ensure that these management practices and active mitigation are effective in mitigating the activities which may generate fugitive dusts;
- a blasting plan to control the emissions of particulate and NO_x and to restrict blasting to specific hours of the day where the meteorological conditions are favourable and atmospheric dispersion is optimized;
- a preventive maintenance program will be employed that encompasses all emission control equipment, diesel-fired engines (vehicle, equipment, and standby power generating), and all processes with the potential for significant environmental effects; and
- air emissions from diesel combustion associated with mobile heavy equipment operations will be controlled through use of low sulphur diesel and the use of equipment that meets Transport Canada off road vehicle emission requirements.

The proposed measures are based on current international best management practices, are predictably effective and are not prone to failure. The DBMP will include opportunities for adaptive management, in which the intensity of the control measures may need to be increased if site inspections and monitoring indicates that current measures are insufficient to prevent off-site dust effects. Use of low sulphur diesel is also predictably effective for reducing sulphur emissions from on-site diesel fuel consumption.

An ambient air monitoring program is recommended to demonstrate continued compliance with O. Reg. 419/05 standards for particulate matter (TSP and $PM_{2.5}$), metals, and nitrogen oxides.

1.0 INTRODUCTION AND PROJECT OVERVIEW

The Côté Gold Project (the Project) is an advanced stage gold exploration project located in the Chester and Neville Townships, District of Sudbury, in northeastern Ontario, approximately 20 kilometres (km) southwest of Gogama, 130 km southwest of Timmins, and 200 km northwest of Sudbury (see Figure 1). IAMGOLD proposes to construct, operate and eventually rehabilitate a new open pit gold mine on the property.

This technical support document (TSD) has been prepared by AMEC and is one in a series of technical reports to support the environmental assessment (EA) for the Project.

1.1 Overview of the Project

The proposed site layout places the required mine-related facilities in close proximity to the open pit, to the extent practicable. The proposed site layout is presented in Figure 2, showing the approximate scale of the Côté Gold Project. The site plan will be refined further as a result of ongoing consultation activities, land purchase agreements and engineering studies.

As part of the proposed development of the Project, several water features will be fully or partially overprinted. These include Côté Lake, portions of Three Duck Lakes, Clam Lake, Mollie River/Chester Lake system and Bagsverd Creek. As a consequence, these water features will need to be realigned for safe development and operation of the open pit.

The major proposed Project components are expected to include:

- open pit;
- ore processing plant;
- maintenance garage, fuel and lube facility, warehouse and administration complex;
- construction and operations accommodations complex;
- explosives manufacturing and storage facility (emulsion plant);
- various stockpiles (low-grade ore, overburden and mine rock area (MRA)) in close proximity to the open pit;
- concrete batch plant;
- aggregate extraction with crushing and screening plants;
- Tailings Management Facility (TMF);
- on-site access roads and pipelines, power infrastructure and fuel storage facilities;
- potable and process water treatment facilities;
- domestic and industrial solid waste handling facilities (landfill);
- water management facilities and drainage works, including watercourse realignments; and

- transmission line and related infrastructure.

1.2 Air Quality

AMEC has completed a study of the potential air quality effects of the Project. The air quality study requires the prediction of off-site effects using dispersion modelling, and the comparison of the results to applicable air quality criteria in order to determine whether potential adverse effects on the environment and human health exist.

The objectives of the air quality effects prediction study are as follows:

- identify the key substances that are expected to be emitted in significant quantities during the construction, operation, closure and post-closure phases;
- prepare estimates of the air emissions from the significant sources identified for the various phases;
- employ dispersion modelling to predict the resultant air quality effects on ambient air in the vicinity;
- detail mitigative measures, if required, to reduce emission rates such that resultant off-site air quality effects are below ambient air quality standards and regulatory standards of Ontario Ambient Air Quality Criteria (AAQC) and Ontario Regulation 419/05 respectively; and
- provide a discussion of the significance of potential air quality effects.

The air quality effects prediction study also presents a forecast for greenhouse gas (GHG) emissions as a result of the Project. The GHG Assessment Report for the Project is presented as a separate study in Appendix V.

2.0 METHODOLOGY

2.1 Spatial Boundaries

2.1.1 Regional Study Area

The air quality regional study area is defined as an area that extends approximately 10 km from the main Project emission sources, as illustrated in Figure 3. It is not expected that the effects of the Project would be measurable beyond the regional study area.

2.1.2 Local Study Area

The local study area generally corresponds to the area in the vicinity of the Project where most the air quality effects of the Project are expected to occur, and can be predicted or measured with a reasonable degree of accuracy. For the air quality assessment, the local study area is defined as an area that extends approximately 5 km from the main Project emission sources (see Figure 4). The local study area also includes a 1 km buffer on either side of the selected transmission line alignment.

2.2 Temporal Boundaries

The temporal boundaries of the EA will span all phases of the Project:

- construction;
- operations;
- closure; and
- post-closure.

2.3 Selection of Effects Assessment Indicators

Ambient air quality may be affected by one or more of the Project components, and the effects assessment indicators selected are detailed in Table 2-1. The indicators are the predicted off-site ground level air concentrations for each of the compounds deemed relevant, in terms of the aggregate site-wide emission rate and the resultant modelled concentration being greater than the existing baseline.

The magnitude of air quality effects is determined by comparing the incremental air concentrations against existing conditions at the Project site and study areas (i.e., the modelled effects for the indicators are less than the established baseline concentrations[1] and the respective AAQCs). Where the incremental air concentrations may exceed the existing conditions outside the study area, the frequency of those exceedances in that area are also considered in establishing an overall effect level.

[1] For HCN, no relevant baseline data was available. For this compound, 5% of the MOE standard was used for effects assessment.

In Ontario, the AAQCs have been developed as objectives or targets to be protective of the potential effects of exposure to a contaminant such as human health effects, vegetation, soil and water contamination, soiling, and corrosion.

Where effects assessment indicator levels are predicted to be greater than the AAQCs or other air quality guidelines; it is imperative to consider the frequency of exceedance for the affected areas in any discussion as the modelled effects are conservatively derived from the highest predicted hour or day over a five-year period at the maximum operating conditions for the site.

The effects assessment indicators selected for the air quality and the rationale for selection of these indicators is presented in Table 2-1.

Table 2-1: Effects Assessment Indicators Selected for Air Quality

Effect Assessment Indicator	Rationale for Selection
Total suspended particulate matter ($PM_{tot.}$), PM_{10} and fine particulate matter ($PM_{2.5}$)	Indicators selected are the key emissions expected from the Project.
Sulphur oxides (SO_x), mainly as sulphur dioxide (SO_2)	
Nitrogen dioxide (NO_2)	
Key metals (for example arsenic, manganese)	
Volatile Organic Compounds (VOCs)	
Hydrogen cyanide (HCN)	

2.4 Prediction of Effects

2.4.1 Methodology

AMEC has completed an assessment of the potential air quality effects of this proposed Project in accordance with generally accepted methodologies.

The prediction of effects involved the following distinct steps:

- identify the significant emissions sources associated with the Project operations phase;
- identify the key compounds emitted to the atmosphere from the identified sources;
- determine the baseline ambient air quality conditions in the absence of the Project for each of the key compounds emitted;
- identify the relevant regulatory air quality standards and criteria, and establish the appropriate assessment criteria for the site in Ontario, noting that for some of the

parameters there may be more than one applicable limit depending upon the averaging time;

- estimate the air emission rates for each of the key compounds using appropriate estimation methods and established data sources;
- prepare a source summary table that identifies sources at the Project site which may release one or more of the key compounds emitted to the atmosphere in considerable quantities and the corresponding compounds and emission rates;
- perform the air dispersion modelling using the U.S. Environmental Protection Agency (US EPA) AERMOD model, an approved dispersion model under Ontario Regulation (O. Reg.) 419/05; and
- compare the dispersion modelling output to the assessment criteria, comparing predicted off-site effects on ambient air quality with the corresponding air quality standard or criterion.

2.4.2 Dispersion Model Selection

AERMOD, a sixth generation Gaussian dispersion model, was considered to be the most appropriate model for assessment as it is capable of handling multiple sources of varying types such as point and area sources, and the effects of building downwash on dispersion. The input data required for AERMOD includes five years of local, hourly meteorological data, terrain elevations for the site and vicinity, and the characteristics of the buildings and emission sources at the Project site. The model uses these input parameters to predict the resultant air concentrations at offsite locations (receptors), and is capable of predicting these effects for each of the relevant averaging times.

The meteorological data used for the AERMOD modelling consisted of five years (2005 to 2009) of surface and upper air meteorological data provided by the Ontario Ministry of the Environment (MOE) from the Sudbury station and a station located in White Lake, Michigan, respectively.

Although the immediate area surrounding the proposed facility does not have significant topographical features such as mountains, valleys, or canyons, the topography was included in the AERMOD modelling. NAD-83 digital elevation model files were available for the Project site area.

2.4.3 Dispersion Modelling Data Set

Wind is a critical parameter in the dispersion of contaminants. The wind direction determines the primary direction of dispersion. At low wind speeds (or calm conditions), concentrations tend to be higher due to poor mixing and dispersion. Increasing wind speed has the effect of decreasing air concentrations of contaminants through enhanced dispersion and mixing. For particulates, this enhanced dispersion can be offset by increased emissions of particulates due to wind erosion and reduced settling.

The AERMOD dispersion modelling was run using five years of surface and upper air meteorological data provided by the Ontario Ministry of the Environment (MOE) from the Sudbury station and a station located in White Lake, Michigan (2005-2009) since only one year of site-specific data was available.

The MOE provided a site specific data set based on Sudbury Ontario (Station 6068150) for surface parameters such as wind speed, wind direction and precipitation (2005 to 2009). The Upper Air data used for the modelling assessment was a data set for White Lake, Michigan (Station 726320), as provided by the MOE. It should be noted that the MOE modifies wind speed data in a modelling meteorological data set to replace all calm conditions with low wind speeds. As such, the meteorological data set used for dispersion modelling does not show any calm conditions resulting in higher modelled concentrations.

Digital terrain data (30 m resolution) for the facility and surrounding area was obtained from the MOE (2013) website.

3.0 ATMOSPHERIC EMISSIONS AND APPLICABLE CRITERIA

The air quality effects prediction study requires comparing the results of the dispersion modelling to applicable air quality criteria in order to determine whether there are potential adverse effects on the environment and human health. Various regulatory agencies set specific target Ambient Air Quality Criteria (AAQC) to be protective of human health and the environment, including Ontario and Canada. The MOE have set AAQCs and also facility-specific point of impingement (POI) air quality standards (O. Reg. 419/05) for various parameters, including most of the key substances identified for this air quality effects prediction. The AAQCs are set to determine a desirable concentration for a location, inclusive of all sources and background. The Ontario Regulation 419/05 standards are used only for facility specific emissions to determine compliance. In many cases, the AAQC criteria and the O. Reg. 419/05 standards are numerically the same.

Dispersion modelling was conducted for each compound, and for each averaging time. These references consider the ambient air quality standard, or limit, to be the maximum concentration at offsite locations (the receptors) where potential effects and compliance are assessed. The O. Reg. 419/05 standards are used to determine compliance levels for a facility to obtain MOE approval. The Ontario AAQC levels are not compliance standards, but set to provide guidance for acceptable ambient air quality in Ontario.

Ontario Regulation 419/05 standards and Ontario AAQC limits used for the effects prediction include limits for different averaging times, depending upon the substance.

Federal air quality criteria exist as well, established by the Canadian Council of Ministers of the Environment (CCME) and the Federal government. The federal criteria are detailed in the *Canadian Environmental Protection Act* (CEPA), and the Canada Wide Standards (CWS) for particulate matter (respirable particulate matter, $PM_{2.5}$), set by the CCME[2].

The air quality standards and guidelines applicable to this Project are discussed for each emitted compound or group of compounds in the following sections.

[2] The CWS of 30 µg/m^3 is calculated as the 98 percentile over 3 years of daily data. As such, the standard is met, if the 30 µg/m^3 is exceeded no more than 22 days over the 3 years.

3.1 Air Pollutants Associated with Gold Mining and Ore Processing

Emissions to the atmosphere of the following compounds are anticipated from the Project activities:

- oxides of nitrogen (NO_x), reported as nitrogen dioxide (NO_2);
- carbon monoxide (CO);
- sulphur dioxide (SO_2) resulting from sulphur in the diesel fuel;
- total Suspended Particulates (TSP);
- fine particulate matter less than 10 microns: PM_{10};
- fine particulate matter less the 2.5 microns: $PM_{2.5}$;
- hydrogen cyanide (HCN);
- calcium oxide;
- copper sulphate;
- volatile organic compounds (VOCs), and
- metals.

Although VOCs are released as a by-product of fuel combustion from the emergency generators, on-site equipment, and vehicles, the overall VOC emissions from these sources are expected to be very minor; this was confirmed with dispersion modelling which predicted that off-site VOC effects during the running of a diesel generator would be well below the level that the MOE considers as *de minimus*. Therefore, only the speciated VOCs present as constituents of landfill gases during the closure phase have been considered in the assessment. Mitigation measures include an engine maintenance program for the generators, trucks, and mobile equipment which will minimize fuel use and combustion emissions, thereby reducing potential air quality effects.

3.1.1 Nitrogen Oxides

There are more than six forms of oxides of nitrogen; nitric oxide (NO) and nitrogen dioxide (NO_2) are the predominant forms found in air emissions and the most significant air pollutants. NO is a colourless gas and NO_2 is a red-brown gas and contributes to the formation of photochemical smog. Only NO, NO_2 and N_2O are found in considerable amounts in the atmosphere. Collectively they are known as NO_x and are expressed as the equivalent mass concentration of NO_2.

Nitrogen dioxide (NO_2) acts as an acute irritant and in equal concentration is more injurious than NO. Increased airway resistance is experienced at a concentration of 1 parts per million (ppm) for 15 minutes. NO does not remain stable for long periods in the atmosphere, and oxidizes to NO_2 over time. NO_2 in the atmosphere is considered a harmful air pollutant and therefore Environment Canada and the MOE have set AAQC. There are no AAQC for NO or N_2O, though the latter is a greenhouse gas and ozone depleter. In the atmosphere, NO_2 is hydrolyzed to form HNO_3 or nitric acid, a compound estimated to form 40% of acid rain.

Emissions of NO_x are of concern in locations where, in the presence of sunlight, they combine with man-made or natural VOCs to form photochemical smog, containing ozone. In locations where there are already significant existing emissions of NO_x and volatile organic compounds, particularly in warm summer months, smog conditions that last days or weeks can be detrimental to human health, crop and vegetation growth and health.

Since NO_2 has adverse effects at much lower concentrations than NO, and NO converts to NO_2 in ambient air, the standard and AAQC for nitrogen oxides is based on the health effects of NO_2. In the assessment of ambient air quality, NO_2, not NO_x, is the reference contaminant; NO_x AAQCs and Schedule 3 standards with 1-hour and 24-hour averaging times should only be compared to monitored NO_2 data.

The AAQC for NO_2 are set as 400 µg/m^3 for a 1-hour averaging time, and 200 µg/m^3 for a 24-hour averaging time. The AAQC considers all sources of NO_x emissions. Ontario Regulation 419/05 Schedule 3 sets standards for total nitrogen oxides at 400 µg/m^3 for a 1-hour averaging time, and 200 µg/m^3 for a 24-hour averaging times.

The O. Reg. 419/05 standards are based upon potential health effects of exposure to NO_2, but conservatively set for total NO_x under the regulation. Mobile sources are not considered as part of the O. Reg. 419/05 assessment for compliance.

3.1.2 Carbon Monoxide

CO is a colourless, odourless, tasteless gas, which is produced primarily through the combustion of fossil fuels as a result of incomplete combustion. Over 75% of the CO produced in Ontario is from the transportation sector and 25% is due to the combined effect of power generation, buildings, heating and industrial operations. Exposures at 100 ppm or greater can be dangerous to human health, and larger exposures can lead to significant toxicity of the central nervous system and heart.

The O. Reg. 419/05 CO standard is for the one half-hour averaging time; AAQC exist for the 1-hour and 8-hour averaging times. The O. Reg. 419/05 standards and AAQC for CO are all based upon potential health effects.. CO is generally not considered to be a key pollutant from surface mining operations; it is more significant for underground mines where potential worker exposure is of concern.

3.1.3 Sulphur Oxides

Sulphur oxides, or SO_x, comprise sulphur dioxide (SO_2), sulphur trioxide (SO_3) and solid sulphate forms. SO_2 is a non-flammable, non-explosive colourless gas. In connection with fuel burning, where the majority is in the form of SO_2, SO_x is normally expressed in terms of the equivalent mass concentration of SO_2 and sometimes as total sulphur. Sulphur oxide (SO) has an odour threshold limit of 0.47 to 3.0 ppm, and has pungent irritating odour above 3 ppm. SO_x compounds are significant contributors to acid rain and also precursors to the formation of secondary fine particulate matter.

SO_2 is irritating to the eyes and respiratory system above 5 ppm (exposure for 10 minutes), in the form of higher airway resistance. The effects of SO_2 on human health with respect to the short term (acute) respiratory effects have been extensively studied. No clear evidence of long term or chronic effects is apparent.

O. Reg. 419/05 air quality standards for SO_2 have been set for the 1-hour and 24-hour averaging times, with equivalent AAQCs. In addition, Ontario has an annual AAQC of 55 µg/m^3 for SO_2. The standards and AAQC are based upon potential health effects of SO_2, as well as potential effects on vegetation.

3.1.4 Particulate Matter

Particulate matter, which consists primarily of fugitive dusts, is generated from a variety of activities at mine sites, including crushing, screening, and material handling activities. Airborne particles are categorized as primary (being emitted directly from the source into the atmosphere) and secondary (being formed in part by chemical and physical transformations). Particles can be chemically inert or active. Even if inert, they may adsorb chemically active substances or they may combine to form chemically active species.

It has been generally accepted since the 1970s that there is an association between respiratory health and high levels of particulate pollution. What has not been clear until more recently is that adverse health effects also occur at ambient concentrations that are routinely experienced today in North America and Western Europe. Historically, the standards were developed for the full range of particle sizes that stay airborne (typically particles less than 44 micrometres (µm)) to be protective of visibility impairment. As the scientific data evolved, it was found that the correlation between health effects and particulate was stronger at smaller particle sizes. Standards were then developed for particles with diameters of less than 10 µm and, more recently, those standards have been superseded by standards for particles sizes less than 2.5 µm.

Total suspended particulates (TSP) are generally considered to be in the particle size range of up to 44 µm in aerodynamic diameter, and includes the smaller particle size fractions PM_{10} and $PM_{2.5}$. It is emphasized that that these particle size fractions are not separate compounds, nor are they additive. The smaller particle sizes are a subset of the large particulate matter size fractions. The standard and AAQC for total particulate matter of 120 µg/m^3 (24-hour averaging time) is based upon potential effects on visibility.

The PM_{10} size fraction is also generally associated with dusts generated by mechanical activities and road dust. MOE has not set an AAQC for PM_{10}. In the AAQC listing (MOE, 2012b), MOE suggest value for PM_{10} of 50 µg/m^3 for the 24-hour averaging time, and identified as an 'interim' AAQC.

Respirable particle $PM_{2.5}$, with particles sizes less than 2.5 micron in diameter, are produced during the combustion of fuels for power generation and equipment operation. The federal criteria are detailed in the Canadian Environmental Protection Act (CEPA), and the Canada Wide Standards (CWS) for particulate matter (respirable particulate matter, $PM_{2.5}$) set by the CCME[3]. Based upon the CWS, Ontario has established an AAQC level of 30 µg/m^3 for a 24-hour averaging time. New Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ will come into effect in 2015, to replace the current CWSs, and are set at 28 µg/m^3 for the 24-hour averaging time, and 10 µg/m^3 for the annual averaging time. The MOE considers a single facility contribution to ambient air of 25 µg/m^3 (MOE, 2012b) as a reasonable target to be protective of ambient air quality levels.

3.1.5 Other Parameters Associated with Ore Mining and Processing

A number of other potentially excess parameters have been considered in the air quality effects prediction study that may be released from the mining or ore processing stages of the Project. These parameters include: hydrogen cyanide, copper sulphate, and the metal species present in the ore.

Ore processing will be carried out using a conventional whole ore cyanidation for gold recovery, which involves the use of sodium cyanide. Cyanide, in the form of hydrogen cyanide is fugitively emitted from the leach tanks. In-plant cyanide destruction using the SO_2/Air treatment process will be used, minimizing cyanide release to the tailings management facility. The O. Reg. 419/05 standard for hydrogen cyanide is based upon the potential for this substance to cause both acute and chronic health impacts.

Copper sulphate does not have a standard under O. Reg. 419/05, nor does it have an AAQC. A criterion of 20 µg/m^3 was established by a certified toxicologist to be protective of health.

Several metal species are present in the processed ore, and are subsequently emitted as trace constituents of the particulate matter. The following were considered in the assessment due to their potential presence in significant concentrations above crustal background, or are generally of interest for most mining projects:

- arsenic (As);
- chromium (Cr);
- mercury (Hg);
- magnesium (Mg);

[3] The CWS of 30 µg/m^3 is calculated as the 98 percentile over 3 years of daily data. As such, the standard is met, if the 30 µg/m^3 is exceeded no more than 22 days over the 3 years.

- manganese (Mn);
- nickel (Ni);
- lead (Pb);
- titanium; and
- zinc (Zn).

Calculations supporting the inclusion of these metals are provided in Appendix III. These metals all have criteria in Ontario based upon potential health impacts under O. Reg. 419/05 based on metals in total suspended particulate (TSP). As well, a number of these metals have AAQC values based on different particle size fractions (i.e., the metal content in $PM_{2.5}$ or PM_{10}).

A summary of the regulatory limits for the target parameters is provided in Table 3-1; the O. Reg. 419/05 Standards and Guidelines, and the Ontario Ambient Air Quality Criteria (AAQCs) for all applicable averaging times are shown.

Table 3-1: Ontario Air Quality Standards and AAQCs

Parameter	Averaging Time	Ontario Air Quality (µg/m^3)	
		O. Reg. 419/05 POI Standards	Ambient Air Quality Criteria
Nitrogen Oxides (as NO_2)	1 hr	400	400
	24 hr	200	200
Sulphur Dioxide SO_2	1 hr	690	690
	24 hr	275	275
	Annual	—	55
Carbon Monoxide CO	0.5 hr	6,000	—
	1 hr	—	36,200
	8 hr	—	15,700
TSP	24 hr	120	120
	Annual	—	60
PM_{10}	24 hr	—	50 (Interim)
$PM_{2.5}$	24 hr	—	25
	Annual	—	8.8
Hydrogen Cyanide	24 hr	8	8
Calcium Oxide	24 hr	10	10
Copper Sulphate	24 hr	—	20 [2]
Arsenic	24 hr	0.3	0.3
Chromium	24 hr	0.5	0.5

Parameter	Averaging Time	Ontario Air Quality ($\mu g/m^3$)	
		O. Reg. 419/05 POI Standards	Ambient Air Quality Criteria
Mercury	24 hr	2	2
Magnesium	24 hr	120	120
Manganese	24 hr	0.4	0.4 in TSP 0.2 in PM_{10} 0.1 in $PM_{2.5}$
Nickel	24 hr	—	0.2 in TSP 0.1 in PM_{10}
	Annual	0.04	0.04 in TSP 0.02 in PM_{10}
Lead	24 hr	0.5	0.5
	30-day	0.2	0.2
Titanium	24 hr	—	120
Zinc	24 hr	120	120

"—" indicates that there is no standard for the respective averaging period.

[1] MOE points out these are not set AAQCs, but these are based on Canadian Council for Ministers of the Environment - Canada Ambient Air Quality Standards (CAAQS)

[2] The 24-hour average criterion for copper sulphate (20 $\mu g/m^3$) was derived by a certified toxicologist.

4.0 EXISTING ENVIRONMENTAL CONDITIONS

4.1 Meteorological Data

The climate in the study area may be described as humid continental, with warm and often hot summers and long, cold, snowy winters (Koppen, 2013). The meteorological conditions in the study area are detailed in the air quality baseline report (see Appendix I).

In the baseline report, wind data, as Climate Normals for the three proximate weather stations were provided as representative for the site: According to the Environment Canada Climate Normals for Timmins, ON (ID 6020379), the winds are predominantly from the N or S and the average wind speed in this region ranges from 9.8 to 13.5 km/h, with the highest average wind in fall and spring, and the lowest mean wind speed in summer (6.8 km/h).

A meteorological station has also been collecting data at the Côté Gold site since 2012; the average wind speed over this period was 8.3 km/hr and the wind was predominantly from northerly and southerly directions (see Figure 5).

4.2 Air Quality

Background air quality at the Côté Gold area is expected to be good, given the absence of nearby large urban centres and industrial sources. Air quality in the Côté Gold area is influenced by long range transport of air emissions from the south and also by natural sources, such as volatile organic emissions from vegetation and forest fires.

4.2.1 Monitoring Networks

Baseline air quality data for air pollutants anticipated from the operations associated with gold mining and ore processing was obtained from a number of sources, including the Environment Canada National Air and Pollution Surveillance (NAPS) Network, Environment Canada Atmospheric Environment Service's Canadian Air and Precipitation Monitoring Network (CAPMoN), and from data collected at an on-site air monitoring station.

The Environment Canada National Air and Pollution Surveillance (NAPS) Network operates a number of monitoring stations across the country. The NAPS network reports background air chemistry data that is collected for various gases, particulate matter (PM), as well as various VOCs and semi-volatile organic compounds (SVOCs). Three NAPS stations operate within a reasonable distance from the Côté Gold site, including Sudbury, Sault Ste. Marie, and North Bay (see Table 4-1). The NAPS stations also constitute part of the Ontario Ministry of Environment (MOE) Continuous Ambient Air Monitoring Network and are Air Quality Health Index stations.

Table 4-1: Environment Canada NAPS / MOE Air Quality Monitoring Stations

Station	Station ID	Latitude (N)	Longitude (W)
Sudbury	77219	46°28'32.5"	80°57'46.6"
Sault Ste Marie	71078	46°31'59.5"	84°18'35.7"
North Bay	75010	46°19'23.5"	79°26'57.4"

The air quality at the urban sites in Sudbury, Sault Ste. Marie, and North Bay are more influenced by urban populations relative to the remote Côté Gold Project site; the data for these stations is therefore considered to be conservative when used as baseline.

Regional background air quality and precipitation quality is also monitored at stations operated as part of the Environment Canada Atmospheric Environment Service's Canadian Air and Precipitation Monitoring Network (CAPMoN). CAPMoN provides air chemistry and precipitation chemistry data for chloride, calcium, magnesium, sulphate, sodium, ammonium, potassium, sulphur dioxide, nitrate and nitric acid concentrations.

4.2.2 Air Quality Monitoring at Côté Gold

Air quality monitoring equipment was installed at the Project site at the beginning of May 2013 to measure baseline concentrations of TSP (including metals), PM_{10}, sulphur dioxide, and nitrogen oxides for comparison to the long-term data. Sampling was conducted over a period of approximately three months, from May 5 through August 8, 2013. The air sampling methodologies followed the MOE requirements described in its 'Operations Manual for Air Quality Monitoring in Ontario' (hereafter called the Manual), published in March, 2008. The Sudbury office of the MOE conducted a field audit of the site on July 13, 2013. The MOE audit found no issues with the site or equipment operation.

Air concentrations of TSP and PM_{10} were measured using high-volume (Hi-Vol) samplers on a 1-in-6 day sampling schedule. The concentrations of SO_2 and NO_2 were measured using passive samplers, with monthly samples collected over the same three-month time period. All the TSP filters were also analyzed for a standard set of metals.

4.2.3 Particulate Matter

A summary of the TSP and PM_{10} data collected during the on-site air monitoring program between May 4 and August 7, 2013, is provided in Table 4-2; a total of ten samples were collected during this period which represents a limited dataset intended only to supplement the published air quality data available for Sudbury and Sault Ste. Marie. A summary of available background TSP, PM_{10}, and $PM_{2.5}$ air quality data collected by the MOE and Environment Canada is provided in Tables 4-3 and 4-4. TSP is no longer routinely monitored at either NAPS or MOE stations, therefore the most recent five-year dataset for Sudbury was included (1991-1995).

Table 4-2: Background Particulate Matter at the Côté Gold Project

Parameter	24 hr AAQC (µg/m³)	Station	Average Concentration (µg/m³)	90th Percentile 24 hr average (µg/m³)
TSP	120	Côté Gold	23.1 (arithmetic mean) 21.4 (geometric mean)	37.0
PM_{10}	50*		13.9	20.6

Sample Size = 15
* Ontario Interim AAQC

Table 4-3: Background TSP at Sudbury, 1991 to 1995

Parameter	24 hr AAQC (µg/m³)	Station	Measure	1991	1992	1993	1994	1995
TSP (µg/m³)	120	Sudbury	Arithmetic Mean	39	34	35	34	40
			Geometric Mean	34	30	31	31	37
			90th Percentile	68	57	55	53	68

Table 4-4: Background PM_{10} and $PM_{2.5}$ at MOE Stations

Parameter	24 hr AAQC (µg/m³)	Station	Measure	2007	2008	2009	2010	2011
PM_{10} (µg/m³)	50 (interim)	Sudbury	Average	19.3	15.8	13.7	13.5	10.5
			90th Percentile	33	28	23	33	18
$PM_{2.5}$ (µg/m³)	30 µg/m³ (CWS)	Sudbury	Average	4.9	4.1	3.4	3.6	4.0
			90th Percentile	12	9	8	9	9
		Sault Ste. Marie	Average	5.3	4.4	3.8	3.8	4.4
			90th Percentile	13	10	9	9	10

4.2.4 Nitrogen Dioxide and Sulphur Dioxide

Ambient NO_2 concentrations measured at North Bay and Sault Ste. Marie for the five year period 2007-2011 are presented in Table 4-5. For SO_2, concentrations measured at Sault Ste. Marie and Sudbury for the five year period 2007-2011 are presented. These are considered representative background concentrations.

The background concentrations measured at Côté Gold by passive sampler are also presented in Table 4-5. For comparison, the data from the passive samplers at the Côté Gold site indicate levels for sulphur dioxide of up to 0.5 µg/m^3 (0.2 ppb), and 0.4 to 0.8 µg/m^3 (0.2 to 0.4 ppb) for NO_2. The data is consistent with the MOE and NAPs monitoring data.

Table 4-5: Background NO_2 and SO_2 at MOE Stations and On-Site

Parameter	Standard / AAQCs		Station	Measure	2007	2008	2009	2010	2011	2013
	24-hour	1-hour								
SO_2 ppb	100 ppb (275 µg/m^3)	250 ppb (690 µg/m^3)	Côté Gold	Average	—	—	—	—	—	0.1
			Sudbury	Average	2.3	2.0	1.1	1.3	1.5	—
				90th Percentile	4	3	2	2	2	—
			Sault Ste. Marie	Average	1.8	1.2	0.6	0.7	0.8	—
				90th Percentile	3	3	1	1	1	—
NO_2 ppb	100 ppb (200 µg/m^3)	200 ppb (400 µg/m^3)	Côté Gold	Average	—	—	—	—	—	0.3
			Sault Ste. Marie	Average	5.0	5.5	5.1	5.5	5.3	—
				90th Percentile	11	12	11	6	12	—
			North Bay	Average	7.4	7.5	8.2	7.6	7.4	—
				90th Percentile	17	18	20	7	17	—

— = no data

4.2.5 Other Contaminants Associated with Gold Mining

The baseline air sampling at Côté Gold included analysis of the total suspended particulate collected to quantify the metals concentrations; a summary of the measured concentrations for common metals is provided in Table 4-6. The air monitoring data for the Côté Gold Project also includes elemental sulphur and the sulphate ion (SO_4).

Table 4-6: Background Metals, Sulphur, and Particulate SO_4 at the Côté Gold Project

Station	Parameter	24 hr AAQC (µg/m^3)	Detection Limit (µg/m^3)	Average Concentration (µg/m^3)	Maximum Concentration (µg/m^3)
Côté Gold	Arsenic (As)	0.3	0.0036	< MDL	< MDL
	Cadmium (Cd)	0.025	0.0012	< MDL	< MDL
	Chromium (Cr)	0.0007	0.0012	0.0009	0.0029
	Copper (Cu)	50	0.0012	0.036	0.055
	Iron Oxide (Fe_2O_3)	25	0.0061	0.062	1.94
	Magnesium (Mg)	n/a	0.012	0.074	0.251
	Manganese (Mn)	0.4	0.0006	0.0055	0.012
	Nickel (Ni)	0.2	0.0018	0.0014	0.0059
	Lead (Pb)	0.5	0.0018	0.0013	0.0030
	Sulphur (S)	—	0.0150	0.357	0.95
	Titanium (Ti)	120	0.0006	0.0063	0.029
	Zinc (Zn)	120	0.003	0.0073	0.012
	Sulphate SO_4	—	0.045	1.07	2.86

4.2.6 Baseline Summary

The air quality baseline documents the meteorological conditions and air quality of the study area located in a remote part of northern Ontario, in the absence of the Côté Gold Project. The study area meteorology is well described using the 30-year Climate Normals for the three nearest Environment Canada weather stations located at Timmins, Sudbury, and Sault Ste. Marie.

There are no significant nearby anthropogenic sources of air emissions. Air quality in the area is however influenced by long range transport of air emissions from the south and also by natural sources, such as volatile organic emissions from vegetation or particulate from natural fires. Air quality at the urban sites in Sudbury, Sault Ste. Marie, and North Bay is more influenced by urban populations relative to the remote Côté Gold Project site. The data for these stations is therefore considered to be conservative when used as baseline for the study area, and has been supplemented by on-site air quality monitoring for TSP, PM_{10}, metals, NO_2, and SO_2.

5.0 PREDICTION OF EFFECTS

5.1 Construction Phase

The construction phase of the Project will include site preparation and construction of Project infrastructure. Construction phase effects will be less, and of shorter duration than those predicted for the operational phase. As a result, the effects prediction considered the sources of air emissions that are associated with the operations phase of the Côté Gold Project. As well, to be conservative, the maximum operating scenario; was developed based on the maximum material and truck movements which are predicted to occur during Year 7 of the operations phase. Other operational years are expected to have lower emissions and effects.

Activities carried out during the construction phase use similar mining equipment as the operations phase, and particulate matter (dust) is the major emission. The construction emissions will be managed through a dust best management plan (DBMP). The DBMP will include practices to minimize dust emissions (e.g., watering, travel area surface management) and a complaint response plan.

Air quality effects associated with transmission line construction will be limited to heavy equipment operation during the short-term construction phase; therefore no air quality prediction specific to transmission line construction was undertaken.

It is, therefore, reasonable to assess the operations phase as the worst-case in terms of potential air quality effects.

5.2 Operations Phase

5.2.1 Sources of Air Emissions

The following emission sources were identified for the Project and included in the dispersion modelling:

- emissions from blasting;
- material handling in the open pit;
- dust from crushing;
- road dust emissions (re-entrained dust);
- dust from managing mine rock, ore and overburden; and
- exhaust from back-up power generation.

In addition, air emissions from gold processing (for example hydrogen cyanide and SO_2) were also modelled. NO_x emissions occur from the blasting, combustion of propane for process plant heating, and from the testing of back-up generators.

Fugitive dust emissions from the tailings management facility (TMF) were not quantitatively assessed; measures to control dust from the TMF are required to eliminate the potential for dusting from the large exposed area. The mitigation measures will be detailed in the Dust Best Management Plan (DBMP). The DBMP will be developed based on a series of mitigation measures provided in Appendix IV.

Key operating, mine and plant parameters used to develop the appropriate emissions factors are summarized in Appendix II. As well, material movement projections for the site are provided in Appendix II. As a very conservative approach and to ensure any potential variation in material movement was captured, the maximum modelling scenario considered the maximum movements for each activity (i.e., ore from pit, mine rock from pit, stockpile management) over the entire life of the facility. This will result in an over-prediction of emissions and air quality effects for material handling operations (e.g., road dust emissions).

The emission estimates from the operations phase of the Project have been presented in the form of Source Summary and Emission Summary tables (see Appendix II), which include data on all emission sources at the facility that may discharge one or more of the target contaminants, data quality, source of the emission data and percent of total emissions for each source, for each contaminant. The locations of the emission sources at the Project site are shown in Figure 6.

A summary of the emission calculation methodologies, emission factors used, and the associated calculations, are provided in Appendix III. Calculations are shown for all emission sources, including roadways, generators, material handling and mill operations. In accordance with the AAQC and O. Reg. 419/05 requirements, appropriate sources were modelled. For example, the road dust and mobile NO_x were not modelled for the O. Reg. 419/05 assessment (MOE, 2009b), but were included in the AAQC assessment. The AAQC assessment considered total NO_x emissions, but in order to compare against the ambient NO_2 standard, the model was run using the appropriate U.S. EPA NO to NO_2 atmospheric chemistry algorithms.

Emissions from offsite, purchased power generation have not been included in the air quality assessment.

5.2.2 Operating Scenarios and Modelling Runs

The prediction of effects encompasses the sources of air emissions that are associated with the operation phase of the Project.

For the purposes of this study, it was assumed that the Project will be operating under the maximum emission scenario, which included the operation of one of the four diesel generators, one fire pump, crushing and screening, ore processing, vehicular traffic, and open pit mining all operating at maximum activity rates. The actual open pit and ore processing emissions will be less than the modelled scenario. As noted previously, a very conservative approach was taken to capture potential variation in material movement. The maximum material movement modelling scenario considered the maximum movements for each activity (i.e., ore from pit, mine rock from pit, stockpile management) over the life of the Project. The modelled results will over-predict the emissions and air quality effects for material handling operations (e.g., road dust emissions).

The dispersion model was used to predict the off-site effects (in µg/m^3) of CO, NO_X, NO_2, PM, SO_2, and the other key parameters at each receptor point, for each of the relevant averaging times. The location of the maximum off-site effects for a given pollutant is termed the maximum POI (O. Reg. 419/05). As well, a number of nearby sensitive receptors were identified. The sensitive receptors and their locations are provided in Table 5-1. The air quality at each of these receptors was assessed.

Table 5-1: Sensitive Receptor Description and Location

Receptor ID	Description	UTM Coordinates (x(m),y(m))	
POR01	Cottage Residence 01	425,272	5,270,116
POR02	Cottage Residence 02	427,208	5,270,696
POR03	Cottage Residence 03	424,479	5,272,888
POR04	Cottage Residence 04	426,138	5,277,193
POR05	Cottage Residence 05	433,492	5,276,634
POR06	Cottage Residence 06	433,143	5,273,836
POR07	Cottage Residence 07	434,190	5,270,489
POR08	Cottage Residence 08	433,981	5,269,514

In accordance with the Air Dispersion Modelling Guideline for Ontario (MOE, 2009a), when determining the maximum 1-hour average concentrations, the eight highest hours per modelling year were discarded in order to remove the effects of potential meteorological anomalies on the modelling results. For the prediction of the 24-hour average concentrations, the first highest 24-hour average per modelling year was discarded as a meteorological anomaly.

Modelling was completed to allow for comparison against both the AAQC limits and O. Reg. 419/05 standards and guidelines. For several of the target parameters, this required separate runs as the AAQC assessment included emissions from mobile sources, while the O. Reg. 419/05 assessment considered stationary sources only. The O. Reg. 419/05 results are presented to demonstrate if the operation of the site can be compliant with Ontario permitting standards; a necessary requirement to obtain an Environmental Compliance Approval for the site.

5.2.3 Results

The results of the dispersion modelling are presented in Tables 5-2 and 5-4 as the maximum off-property modelled concentrations. Table 5-2 presents the aggregate site-wide emission rates for all contaminants from all sources (mobile and stationary), with comparison to the Ontario AAQC. As well, Table 5-4 presents the aggregate site-wide emission rates for all contaminants from stationary sources only, with comparison to the O. Reg. 419/05 Standards. The maximum modelled concentration at a sensitive receptor is also presented in Table 5-3.

The modelling output is depicted in Figures 7 to 15, with the predicted ambient concentration isopleths (lines of equal concentration) for PM_{tot}, PM_{10}, $PM_{2.5}$ (both maximum 24-hour and annual), hydrogen cyanide (HCN), NO_2 (both 24 and 1-hour), arsenic and manganese as a representative metal contaminants. The shapes of the isopleths indicate the location of effects, which vary with direction and distance, as a result of source locations, meteorological conditions and receptor elevation. The model assesses the effect of topography on dispersion; therefore nearby receptors at elevated heights typically have higher concentrations than receptors at the same distance from a source, but located at lower elevation.

Table 5-2: Emission Summary Table with Comparison to Ontario AAQCs

Compounds	CAS Number	Facility Emission Rate (g/s)	Model Used	Modelled POI Concentration (µg/m³)	Averaging Period (hr - unless noted otherwise)	Ontario AAQC (µg/m³)	Limiting Effect	% of Criteria
Total Particulate (TSP)	NA	114.53	AERMOD	197	24	120	visibility	164.5%
		114.53	AERMOD	21.4	annual	60		35.7%
PM_{10}	NA	36.01	AERMOD	113	24	50	health	225.4%
$PM_{2.5}$	NA	6.88	AERMOD	30.4	24	25	health	121.6%
		6.88	AERMOD	3.8	annual	8.8		43.6%
Nitrogen Dioxide	10102-44-0	199.68	AERMOD	304	1	400	health	75.9%
		98.36	AERMOD	101	24	200		50.6%
Carbon Monoxide	630-08-0	611.55	AERMOD	2636	1	36200	health	7.3%
		120.67	AERMOD	1683	8	15700		10.7%
Sulfur Dioxide	7446-09-5	6.34	AERMOD	36.4	24	275	health and vegetation	13.2%
		36.40	AERMOD	165	1	690		23.9%
		6.34	AERMOD	4.7	annual	55		8.5%
Hydrogen Cyanide	74-90-8	1.01	AERMOD	7.6	24	8	health	95.2%
Calcium Oxide (CaO)	1305-78-8	0.17	AERMOD	8.7	24	10	corrosion	86.7%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	AERMOD	2.5	24	20	Limit established by Certified Toxicologist	12.4%
Magnesium	1309-48-4	3.37	AERMOD	5.92	24	120	particulate	4.9%
Manganese - in $PM_{2.5}$	7439-96-5	6.50E-03	AERMOD	2.87E-02	24	0.1	health	28.7%
- in PM_{10}		3.40E-02	AERMOD	1.07E-01	24	0.2		53.3%
- in TSP		1.06E-01	AERMOD	1.87E-01	24	0.4		46.6%
Nickel - in TSP	7440-02-0	6.39E-03	AERMOD	1.12E-02	24	0.2	health	5.6%
			AERMOD	1.22E-03	annual	0.04		3.0%
Nickel - in PM_{10}		2.05E-03	AERMOD	6.42E-03	24	0.1		6.4%
			AERMOD	7.07E-04	annual	0.02		3.5%
Arsenic	7440-38-2	4.82E-04	AERMOD	0.001	24	0.3	health	0.3%
Chromium	7440-47-3	2.13E-02	AERMOD	0.037	24	0.5	health	7.5%
Mercury	7439-97-6	1.12E-05	AERMOD	1.97E-05	24	2	health	0.0%
Lead	7439-92-1	6.73E-04	AERMOD	2.58E-04	30 day	0.2	health	0.1%
		6.73E-04	AERMOD	1.18E-03	24	0.5		0.2%
Titanium	7440-32-6	6.00E-01	AERMOD	1.06E+00	24	120	particulate	0.9%
Zinc	7440-66-6	9.14E-03	AERMOD	1.61E-02	24	120	particulate	0.01%

Table 5-3: Emission Summary Table with Maximum Concentration at Sensitive Receptor

Compounds	CAS Number	Facility Emission Rate (g/s)	Receptor ID	Maximum Modelled Concentration at Sensitive Receptor (µg/m^3)	Ontario AAQC (µg/m^3)	Averaging Period (hr - unless noted otherwise)	Limiting Effect	% of Criteria
Total Particulate (TSP)	NA	114.53	POR08	33.8	120	24	visibility	28.1%
		114.53	POR08	4.0	60	annual		6.6%
PM_{10}	NA	36.01	POR02	23.8	50	24	health	47.7%
$PM_{2.5}$	NA	6.88	POR07	11.4	25	24	health	45.6%
		6.88	POR08	0.8	8.8	annual		8.6%
Nitrogen Dioxide	10102-44-0	199.68	POR08	149	400	1	health	37.2%
		98.36	POR08	31.6	200	24		15.8%
Carbon Monoxide	630-08-0	611.55	POR08	914	36200	1	health	2.5%
		120.67	POR07	251	15700	8		1.6%
Sulfur Dioxide	7446-09-5	6.34	POR02	7.8	275	24	health and vegetation	2.8%
		36.40	POR02	80.7	690	1		11.7%
		6.34	POR08	0.5	55	annual		0.9%
Hydrogen Cyanide	74-90-8	1.01	POR07	2.2	8	24	health	27.9%
Calcium Oxide (CaO)	1305-78-8	0.17	POR02	1.8	10	24	corrosion	18.3%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	POR02	0.5	20	24	Limit established by Certified Toxicologist	2.6%
Magnesium	1309-48-4	3.37	POR08	0.99	120	24	particulate	0.8%
Manganese - in $PM_{2.5}$	7439-96-5	6.50E-03	POR07	1.1E-02	0.1	24	health	10.8%
- in PM_{10}		3.40E-02	POR02	2.3E-02	0.2	24		11.3%
- in TSP		1.06E-01	POR08	3.1E-02	0.4	24		7.8%
Nickel - in TSP	7440-02-0	6.39E-03	POR08	1.9E-03	0.2	24	health	0.9%
			POR08	2.2E-04	0.04	annual		0.6%
Nickel - in PM_{10}		2.05E-03	POR02	1.4E-03	0.1	24		1.4%
			POR08	1.5E-04	0.02	annual		0.7%
Arsenic	7440-38-2	4.82E-04	POR08	1.4E-04	0.3	24	health	0.05%
Chromium	7440-47-3	2.13E-02	POR08	6.3E-03	0.5	24	health	1.3%
Mercury	7439-97-6	1.12E-05	POR08	3.3E-06	2	24	health	0.0002%
Lead	7439-92-1	6.73E-04	POR07	3.1E-04	0.2	30 day	health	0.2%
		6.73E-04	POR08	2.0E-04	0.5	24		0.04%
Titanium	7440-32-6	6.00E-01	POR08	1.8E-01	120	24	particulate	0.1%
Zinc	7440-66-6	9.14E-03	POR08	2.7E-03	120	24	particulate	0.002%

Table 5-4: Emission Summary Table with Comparison to Ontario Regulation 419/05 Standards and Guidelines

Compound	CAS Number	Facility Emission Rate (g/s)	Dispersion Model Used	Modelled POI Concentration (µg/m^3)	Averaging Period (hr - unless noted otherwise)	Ontario Regulation 419/05 POI Limit (µg/m^3)	Limiting Effect	Ontario Regulation 419/05 Schedule	% of Criteria
Total Particulate (TSP)	NA	114.53	AERMOD	37.18	24	120	visibility	3	31.0%
Nitrogen Oxides (as NO_2)	10102-44-0	98.36	AERMOD	53.43	24	200	health	3	26.7%
		199.68	AERMOD	240	1	400		3	60.1%
Carbon Monoxide	630-08-0	611.55	AERMOD	976	0.5	6000	health	3	16.3%
Sulfur Dioxide	7446-09-5	6.34	AERMOD	35.63	24	275	health and vegetation	3	13.0%
		36.40	AERMOD	162	1	690		3	23.4%
Hydrogen Cyanide	74-90-8	1.01	AERMOD	7.61	24	8	health	3	95.2%
Calcium Oxide (CaO)	1305-78-8	0.17	AERMOD	8.67	24	10	corrosion	3	86.7%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	AERMOD	2.48	24	20	Limit established by Certified Toxicologist		12.4%
Manganese	7439-96-5	0.11	AERMOD	1.87E-01	24	0.4	health	Guideline	46.6%
Magnesium	1309-48-4	3.37	AERMOD	5.92	24	120	particulate	3	4.9%
Arsenic	7440-38-2	4.82E-04	AERMOD	8.49E-04	24	0.3	health	Guideline	0.3%
Chromium	7440-47-3	2.13E-02	AERMOD	3.75E-02	24	0.5	health	Guideline	7.5%
Mercury	7439-97-6	1.12E-05	AERMOD	1.97E-05	24	2	health	3	0.001%
Nickel	7440-02-0	6.39E-03	AERMOD	1.22E-03	annual	0.04	vegetation	3	3.0%
Lead	7439-92-1	6.73E-04	AERMOD	1.18E-03	24	0.5	health	3	0.2%
		6.73E-04	AERMOD	2.58E-04	30 day	0.2		3	0.1%
Zinc	7440-66-6	9.14E-03	AERMOD	1.61E-02	24	120	particulate	3	0.01%

5.2.3.1 Ontario Regulation 419/05 Compliance

Ontario Regulation 419/05 air quality standards are used to assess emissions from all stationary (non-mobile) sources of air pollution related to the Project, and by regulatory requirement and guidance, exclude background and other non-Project emissions sources.

The Emission Summary Table (see Table 5-4) summarizes the site-wide emission rates for all non-mobile sources and the modelled results for all compounds compared to the respective single facility O. Reg. 419/05 standards. The table demonstrates that all compounds are well below the appropriate O. Reg. 419/05 standards and as a result, meets the modelling requirements for a future Environmental Compliance Approval for the site.

Of the 15 compounds listed in the Emission Summary Table (see Table 5-4), all the predicted POI concentrations are below the corresponding O. Reg. 419/05 standard. At 95%, hydrogen cyanide has the highest concentration relative to the corresponding MOE POI Standard (24-hour Averaging Time). As illustrated in the HCN Isopleth (see Figure 11), there is a limited area between the operations area and the TMF in which the predicted HCN effects approach the MOE standard; at all other locations the POI concentration is well below the standard.

The modelled POI concentration for all metals was less than 50% of the applicable Standard. Manganese was found to be the most significant, at 46.6% of the O. Reg. 419 standard of 0.4 $\mu g/m^3$ for the 24-hour averaging time.

As a result of the assessment, the Project meets all air quality standards to allow the MOE to grant approval in the form of an Environmental Compliance Approval (ECA).

5.2.3.2 Ambient Air Quality

The Project was also compared against the Ontario AAQCs. The AAQCs are set as air quality objectives, or desirable air quality, and are used to consider all sources as well as background air quality. As such, the AAQCs are not standards

Table 5-2 provides a summary of results of the full AAQC assessment. The table results do not include background, but do include all site emission sources (stationary and mobile).The specific air quality results at the maximum of the sensitive receptors in the study area are shown in Table 5-3.

Fugitive dusts have the highest potential for causing offsite effects unless rigorous and effective mitigation is implemented at the various sources. As summarized in Table 5-2, TSP, PM_{10}, and $PM_{2.5}$ show potential exceedances at the property boundary for the Project, but not at any sensitive receptors.

The modelling indicates that it is possible that the air concentrations at the property boundary could potentially exceed the Ontario ambient air quality criteria for TSP, as well as the criteria for the fine particle sizes PM_{10} and $PM_{2.5}$.

An analysis of the frequency of AAQC exceedances was performed to determine how many days out of the five-year modelling period had predicted 24-hour average concentrations greater than the respective AAQC. For $PM_{2.5}$, it was determined that the AAQC was exceeded one day per year (0.3%). PM_{10} exceeded the AAQC less than 4% of the time per year, and TSP exceeded less than 2%.

In reviewing both the site and regional air quality monitoring data, the following background levels were considered reasonable for the Project area: TSP 21 $\mu g/m^3$, PM_{10} 14 ug/m^3, and $PM_{2.5}$ 10 $\mu g/m^3$. If the cumulative effect of adding these background levels to the modelled effects from site emissions (see Table 5-2) is considered, the combined concentration is below the AAQC for each of the size fractions at all sensitive receptors.

Total particulate, PM_{10}, and $PM_{2.5}$ are predicted to occasionally exceed the MOE 120 $\mu g/m^3$ AAQC. These predicted levels for particulate matter should be considered in the context of the conservative nature of the emission rate estimates (all sources active at maximum all the time, activity levels for all years at the maximum year of operations) and the conservative modelling (worst-case meteorological conditions over five years of meteorological data). The modelled concentrations for particulate are at a level that is also typical of many sites in Ontario. The potential area of exceedance is located at the boundary with a property that has no current human activity, and where there are no human receptors. Modelled particulate concentrations at all other locations outside the Project site, including at all sensitive receptors, are all well below single facility criteria, and even with inclusion of the background are well below MOE AAQC.

The predicted maximum concentrations of total NO_x (as NO_2), HCN, and key metals at the property line or on property that is not currently under the control of IAMGOLD were below the respective MOE AAQC. Even when the background concentrations developed in Section 4.2 are added to these contaminants, the resulting levels are still below the desirable ambient air quality criteria set by MOE and Environment Canada. The results at the sensitive receptors, even with background levels included, are significantly lower and well below the AAQCs. Incremental air concentrations exceed existing conditions beyond the extent of the study area for 1-hour total NO_x (as NO_2), 24-hour HCN, and 24-hour manganese. However, the frequency of incremental concentrations outside of the study area above background levels are 0.9%, 0.3%, and 0.5% on average in any given year, respectively. These frequencies are considered very small and as a result, insignificant.

The dominant source of SO_2 emissions is the cyanide destruction system located within the process plant. The 24-hour average concentrations were predicted to be below MOE criteria at all off property locations. Even with the inclusion of background levels of SO_2, SO_2 is still significantly below AAQC.

In the leaching process, the pH is maintained above 10.5 to minimize HCN releases; however some HCN emissions will occur from processing the ore. Dispersion modelling found that the HCN emissions were below the air quality standard for HCN at all off property locations. The maximum was found to be 95% of the AAQC.

There were no exceedances of CO or NO_2 predicted off property, as all ground level air concentrations were determined to be lower than the respective AAQC for all averaging times. Even with the inclusion of background levels of CO and NO_2, both compounds are still below their respective AAQCs.

Earth crustal levels of certain metals will be present in the particulate matter that is generated as fugitive dust on the site and dispersed offsite. The dust is assumed to have the same metals composition as the mine rock used in road construction and the unprocessed ore. Trace metals are also likely to be released from various ore processing activities such as crushing, conveying and ore handling. The measures that are designed to control fugitive dust releases and effects will also serve to control the emission and deposition of metals that are a component of the dust.

For the key metals identified (As, Cr, Hg, Mg, Mn, Ni, Ti, Pb, Zn), the maximum offsite effects were estimated through speciation of the particulate matter (fugitive dust), assuming that the dust is of the same composition as the ore or mine rock. Using the maximum of the 90^{th} percentile concentration of these metals in the mine rock and ore, the predicted offsite concentrations for the key metals were all less than their respective AAQCs, even with the inclusion of background levels.

5.2.3.3 Effects Indicator Levels

The prediction of air quality determined that particulate matter levels for TSP, PM_{10}, and $PM_{2.5}$ exceeded AAQC in a small area proximate to the Project site boundary. For $PM_{2.5}$, it was determined that the AAQC was exceeded one day per year (0.3%). PM_{10} exceeded the AAQC less than 4% of the time per year (approximately 14 days), and TSP exceeded less than 2% of the time (approximately 7 days). At each of the sensitive receptors (cottages) located within the local study area, the particulate matter was below the AAQCs.

All other key indicators were determined to be below the AAQCs and, in several cases, the modelled incremental amounts are below current baseline levels in the local study area during mine operation.

5.3 Closure Phase

Activities in the active closure phase are similar to those that occur during the construction phase, and use similar mining equipment. The DBMP will include practices to minimize dust emissions during the active closure phase (e.g., watering, travel area surface management) and a complaint response plan.

Air quality effects will be bounded by the operations phase. No specific closure phase air quality assessment was completed.

5.4 Post-Closure Phase

The post-closure phase is predominantly a monitoring activity, with occasional repair and maintenance. There is no significant equipment use. No air quality effects are expected from these activities. The only emissions that will be at a maximum during the post-closure phase (i.e., higher than during operations) are the gas emissions from the landfill site.

During the construction and operations phase, solid waste generated by on-site personnel will be sent to a landfill site. The landfill site is proposed to accept non-hazardous solid waste during both construction which is expected to last 2 years and during operation which is estimated to be 15 years. Table 5-5 presents a summary of the landfill design data used to estimate the waste generation rates.

Table 5-5: Landfill Site Parameters

Description	Data
Waste generation rate	1.85 t/capita/year mine staff.
Operation life of the facility	2 years construction 15 years operation
Site Population	1,500 during mine construction 600 during mine operation
Total waste volume disposed during Project construction and operation	22,200 tonnes
Waste density (non-hazardous solid waste)	0.7 t/m^3
Total tonnage of waste disposed at the landfill site	29,200 tonnes
Estimated waste depth	6 m
Estimated Landfill areas	50 m x 50 m

The EPA's Scholl Canyon first order decay model was used to estimate the landfill gas generated at the landfill site based on the projected waste tonnage to be disposed at the landfill. This model uses two parameters including the methane generation rate (k) and potential methane generation capacity (Lo) to estimate methane emissions. The parameter k determines the rate of methane generation for the mass of waste in the landfill. The higher the value of k, the faster the methane generation rate increases and then decays over time. This parameter depends on the moisture content of the waste mass; availability of the nutrients to break down the waste to form methane and carbon dioxide; pH and temperature of the waste mass. The National Inventory Report 1990 – 2009, prepared by Environment Canada, recommends a k of 0.04/yr for Ontario.

The methane Lo parameter depends only on the type and composition of waste placed in the landfill, and in particular the ratio between decomposable and non-decomposing waste. The higher the fraction of organic matter present, the higher the value of Lo. A typical Lo value of 120 m^3/tonne is appropriate for landfill sites associated with mine camps that have moderately decomposable waste as recommended in the Landfill Gas Generation Assessment – Table 5.1, Procedure Guidelines, prepared by the British Columbia Ministry of the Environment.

The Scholl Canyon model also provides values for speciated VOCs typically found in municipal landfills. The model indicates VOC emissions increasing over the operating lifetime of the landfill and through closure. Following closure landfill emissions will continue and gradually increase to a maximum in about 2030. The emissions decrease after that time. The quantities of landfill waste and landfill gas generated do not trigger any requirement for a landfill gas collection system. The effects assessment was done for the maximum year (2031) of emissions. All other years, (including during operations) are expected to have lower potential air quality effects.

The emissions from the landfill were modelled using the accepted AERMOD air dispersion model and data files discussed in Section 2.4. Table A1 in Appendix II provides a summary of the air quality modelling results for the landfill. All compounds are significantly below either respective criteria or the *de minimus* concentration provided by Ontario MOE (MOE, 2009b). The maximum level is 3.4% of the MOE's conservative screening level for bromodichloromethane.

6.0 MITIGATION MEASURES

The principal air quality elements of concern emitted from the Côté Gold Project site will be dust and associated metals associated with the following sources:

- road dust associated with haul trucks transporting mine rock and ore from the pit;
- dust from material handling at overburden, ore and mine rock stockpiles;
- dust from the primary crusher;
- dust from the exposed area of the tailings management facility (TMF); and
- dust from mining activities within the open pit (drilling, blasting and loading of haul trucks).

A fugitive dust best management plan (DBMP) will be prepared for the construction and operation phase to identify all potential sources of fugitive dusts, outline mitigation measures that will be employed to control dust generation, and detail the inspection and record keeping required to demonstrate that fugitive dusts are being effectively managed. The DBMP will be consistent with industry best management practices and Ontario MOE requirements, to ensure that these management practices and active mitigations are effective in mitigating the activities which may generate fugitive dusts.

Dust emissions from roads and mineral stockpiles will be controlled through the application of water sprays. At full production, two water trucks with water sprays and cannons will be at site for this purpose. Alternatively, surfactant applications, such as calcium chloride, will be used to control dust, particularly on roads, provided that such applications are acceptable to the MOE. Water cannon sprays discharged by mobile trucks will be employed to control dust emissions from stockpiles and aggregate handling activities. If the operations and fugitive dust best management practices plan require further mitigation, dedicated water sprays at active stockpile areas will be employed. At closure, all exposed dust sources will be vegetated and progressive reclamation will be used wherever practicable to better control dust emissions from the mineral waste stockpiles and tailings management area.

All site roadways will be maintained in good condition, with regular inspections and timely repairs completed to minimize the silt loading on the roads. The road maintenance procedures will be incorporated into the DBMP plan.

The facility and emission points will be designed to allow for good atmospheric dispersion, and dust control equipment such as bag houses, bin vents, and water sprays, will be utilized where necessary to prevent excessive emissions at the crusher and process plant.

Blasting also results in significant emissions for particulate and NO_x. NO_x is generated from the blast, but can be minimized by reducing the water penetration of the set charges. The blasting plan will minimize the length of time the blasting material is allowed to sit in a drill hole before blasting. As well, blasting will be limited to a set time on any specific blast day. The time will be developed to ensure optimal emission dispersion and ensure the lowest off-site effects on air quality.

A preventive maintenance program will be employed that encompasses all pollution control equipment, diesel-fired engines (vehicle, equipment, and standby power generating), and all processes with the potential for significant environmental effects.

Air emissions from diesel consumption associated with mobile heavy equipment operations will be controlled through use of:

- low sulphur diesel;
- equipment meeting Transport Canada off road vehicle emission requirements; and
- effective equipment maintenance.

The proposed dust control measures are based on current international best management practices, are predictably effective and are not prone to failure. The DBMP will include opportunities for adaptive management, in which the intensity of the control measures may need to be increased if site inspections and monitoring indicate that current measures are insufficient to prevent offsite dust effects. Use of low sulphur diesel is also predictably effective for reducing sulphur emissions from on site diesel fuel consumption.

A summary of mitigation measures for each of the construction, operations, and closure phases is provided in Table 6-1.

Table 6-1: Summary of Mitigation Measures

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Construction	Fugitive Dust Emissions	Dust Best Management Plan (DBMP)	The DBMP will ensure effective fugitive dust management to mitigate potential off-site effects of the particulate matter and trace metals present on the particulate. The DBMP will detail the following measures: watering frequency, visual monitoring, inspection, record keeping, responsibility, training, complaint response, and corrective actions. The site will have two water trucks with water sprays and cannons; should weather conditions not permit watering, other MOE approved suppressants (such as calcium chloride) will be used. If further mitigation is required at specific locations (e.g., active stockpiles), dedicated water sprays will be employed. Travel surfaces will be maintained to minimize silt (fine material).	Maintain air quality below Ontario Regulation 419/05 standards for total suspended particulate (TSP) and metals at off-site receptors.
Construction	Exhaust from generators, trucks and mobile equipment	Engine Maintenance program	A preventive maintenance program will be employed that encompasses all pollution control equipment and diesel-fired engines.	Maintain air quality below Ontario ambient air quality criteria (AAQC) for NO_2, SO_2, CO, and particulate matter at off-site receptors.
Construction	Exhaust from trucks and off-road mobile equipment	Equipment compliant with Transport Canada vehicle emission requirements	Emission reductions achieved through the use of current equipment that complies with Transport Canada's off-road engine emission criteria.	Transport Canada Off-Road Compression - Ignition Engine Emission Regulations (SOR/2005-32)

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Construction	Sulphur dioxide (SO_2) emissions from diesel fuel use	Use of low sulphur fuel (15 ppm sulphur)	Low sulphur fuels will be used in off-road diesel engines; this will reduce the sulphur dioxide emissions from all sources and the resultant off-site air concentrations.	Environment Canada Sulphur in Diesel Fuel Regulation limiting fuel sulphur content *to* less than 15 ppm for off-road engines (SOR/2002-254)
Operations	Fugitive Dust Emissions	Dust Best Management Plan (DBMP)	The DBMP will ensure effective fugitive dust management to mitigate potential off-site effects of the particulate matter and trace metals present on the particulate. The DBMP will detail the following measures: watering frequency, visual monitoring, inspection, record keeping, responsibility, training, complaint response, and corrective actions. The site will have two water trucks with water sprays and cannons; should weather conditions not permit watering, other MOE approved suppressants (such as calcium chloride) will be used. If further mitigation is required at specific locations (e.g., active stockpiles), dedicated water sprays will be employed. Travel surfaces will be maintained to minimize silt (fine material).	Maintain air quality below Ontario Regulation 419/05 standards for TSP and metals at off-site receptors. DBMP will be part of MOE Environmental Compliance Approval.
Operations	Dust from TMF	TMF Dust Best Management Plan (DBMP)	Controlling dust from the TMF is required to eliminate off-site dust. As a large exposed area, control methods must eliminate potential for dusting to occur.	Maintain air quality below Ontario Regulation 419/05 standards for TSP and metals at off-site receptors.

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Operations	Exhaust from generators, trucks and mobile equipment	Engine Maintenance program	A preventive maintenance program will be employed that encompasses all pollution control equipment and diesel-fired engines.	Maintain air quality below Ontario ambient air quality criteria (AAQC) for NO_2, SO_2, CO, and particulate matter at off-site receptors.
Operations	Exhaust from trucks and off-road mobile equipment.	Equipment compliant with Transport Canada vehicle emission requirements	Emission reductions achieved through the use of current equipment that complies with Transport Canada's off-road engine emission criteria.	Transport Canada Off-Road Compression - Ignition Engine Emission Regulations (SOR/2005-32)
Operations	SO_2 emissions from diesel fuel use	Use of low sulphur fuel (15 ppm sulphur)	Low sulphur fuels will be used in off-road diesel engines; this will reduce the sulphur dioxide emissions from all sources and the resultant off-site air concentrations.	Environment Canada Sulphur in Diesel Fuel Regulation limiting fuel sulphur content to less than 15 ppm for off-road engines (SOR/2002-254)
Operations	Particulate Emissions from drilling operations	Control measures provided by equipment supplier plus water suppression	Mitigation measures are required to prevent off-site effects of TSP and metals, through the use of equipment with dust control and water application.	Compliance with Ontario Regulation 419/05 standards for TSP and metals at off-site receptors.
Operations	Blasting emissions Poor dispersion during specific hours Increased emissions due to specific operational conditions	Blasting schedule will restrict blasting to between 1:00 PM and 2:00 PM. Manufacturer's recommended guidelines regarding water infiltration and time of explosives usage	Mitigation measures required to prevent off-site effects of TSP, metals and NO_x. Meteorological conditions leading to poor air dispersion have been identified during parts of the day; blasting to occur between 1:00 PM and 2:00 PM only. Nitrogen oxides (NO_x) emissions may increase if emulsion is left in boreholes for extended period of time due to infiltration of water.	Compliance with Ontario Regulation 419/05 air quality standards for NO_x, TSP, and metals at off-site receptors.

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Operations	Hydrogen cyanide (HCN) emissions from tailings	HCN destruction at the mill	HCN emissions from TMF eliminated, as sulphur dioxide will be used to destroy HCN at the mill before tailings are released to the TMF.	Compliance with Ontario Regulation 419/05 air quality standard for HCN at off-site receptors.
Operations	Material handling at the ore processing plant	Baghouses	Mitigation measures to control dust emissions from crushing (primary and secondary) and reclaim from feed stockpiles are required to prevent off-site effects of TSP and metals. All crushing and reclaim from stockpiles for crushed materials are to be controlled by baghouses. A maintenance plan will ensure baghouses are functioning properly.	Compliance with Ontario Regulation 419/05 air quality standards for TSP at off-site receptors.
Operations	Particulate emissions from lime silo	Baghouse	Mitigation measures are required to control dust during lime delivery to the silos to prevent off-site effects of TSP. Lime silo vents are to be controlled by baghouses. A maintenance plan will ensure baghouses are functioning properly.	Compliance with Ontario Regulation 419/05 air quality standards for TSP at off-site receptors.
Operations	Emissions from lime slaker	Wet scrubber	Mitigation measures are required to control emissions from the lime slaker to prevent off-site effects of TSP. Emissions from the lime slaker are to be controlled by a wet scrubber. A maintenance plan and a scrubber solution flow alarm will ensure scrubbers are functioning properly.	Compliance with Ontario Regulation 419/05 air quality standard for TSP at off-site receptors.

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Operations	Particulate from dry material handling in ore processing plant (flocculants, copper sulphate)	Baghouse	Mitigation measures are required to control emissions from handling and mixing of dry chemicals. Mixing and handling areas are to be controlled by baghouses. A maintenance plan will ensure baghouses are functioning properly.	Compliance with Ontario Regulation 419/05 air quality standard for TSP at off-site receptors.
Operations	Emissions from induction furnace	Wet scrubber	Emissions from the furnace are to be controlled with a wet scrubber. A maintenance plan and scrubber solution flow alarms will ensure scrubbers are functioning properly.	Compliance with Ontario Regulation 419/05 air quality standard for TSP at off-site receptors.
Operations	SO_2 emissions from HCN destruction	Closed loop delivery	To control emissions during delivery, SO_2 is to be delivered to the site as a pressurized liquid with a return line from the tank to the truck used to prevent filling losses; SO_2 gases displaced from the tank will be captured in the truck.	Compliance with Ontario Regulation 419/05 air quality standard for SO_2 at off-site receptors.
Operations	Emissions from on-site emergency generators	Testing of units one at a time during day-time hours.	Mitigation measures are required to control NO_x and TSP emissions from the generators. Testing one unit at a time will reduce short term emissions, and testing will be conducted during the day when meteorological conditions promote better air dispersion.	Maintain air quality below Ontario Regulation 419/05 air quality standards for TSP and NO_x at off-site receptors. Testing schedule will be part of MOE Environmental Compliance Approval.

Project Phase	Issue / Concern / Interaction	Mitigation Measure	Description / Commitment	Standard
Closure	Fugitive Dust Emissions	Dust Best Management Plan	The DBMP will ensure effective fugitive dust management to mitigate potential off-site effects of the particulate matter and trace metals present on the particulate. The DBMP will detail the following measures: watering frequency, visual monitoring, inspection, record keeping, responsibility, training, complaint response, and corrective actions. The site will have two water trucks with water sprays and cannons; should weather conditions not permit watering, other MOE approved suppressants (such as calcium chloride) will be used. If further mitigation is required at specific locations (e.g., active stockpiles), dedicated water sprays will be employed. Travel surfaces will be maintained to minimize silt (fine material).	Maintain air quality at property line below Ontario Regulation 419/05 standards for TSP and metals at off-site receptors.
Closure	Exhaust from generators, trucks and mobile equipment	Engine Maintenance program	A preventive maintenance program will be employed that encompasses all pollution control equipment and diesel-fired engines.	Maintain air quality below Ontario ambient air quality criteria (AAQC) for NO_2, SO_2, CO, and particulate matter at off-site receptors.
Closure	Exhaust from trucks and off-road mobile equipment.	Equipment compliant with Transport Canada vehicle emission requirements	Emission reductions achieved through the use of current equipment that complies with Transport Canada's off-road engine emission criteria.	Transport Canada Off-Road Compression - Ignition Engine Emission Regulations (SOR/2005-32)

7.0 RECOMMENDED MONITORING

An ambient air monitoring program is recommended to demonstrate continued compliance with the O. Reg. 419/05 standards for particulate matter (TSP), metals, and nitrogen oxides.

Details of the recommended monitoring are provided in Table 7-1.

Table 7-1: Recommended Ambient Air Monitoring

Parameter	Monitoring Method	Standard	Frequency / Timeframe	Location
Total Suspended Particulates (TSP)	High Volume (hi-vol) samplers	O. Reg. 419/05 air quality standard for TSP (24-hr averaging time).	One sample every 6 days.	Three locations (to be determined), triangulating the site to provide upwind/downwind assessment.
Metals	Analysis of hi-vol TSP sample collected (filter)	O. Reg. 419/05 air quality standards for metals. The metals to be monitored will be identified in the Ambient Monitoring Plan that will be submitted to the MOE prior to initiating the monitoring program.	Select TSP filters (highest loading) to be analysed monthly.	Same as TSP hi-vol samplers.
NO_x/SO_2	Passive samplers	Screening Level to be established based upon Alberta's proposed Air Monitoring Directive and Ontario's AAQC for other averaging times.	Monthly samples.	Co-located with the hi-vol samplers.

8.0 CONCLUSIONS

This air quality effects prediction study report has been prepared in support of the EA for the IAMGOLD Côté Gold Project, a proposed new open pit gold mine. During all phases of the Project, the facility will be operated in accordance with all regulatory requirements, which include the requirements of Environmental Compliance Approvals (Air).

The findings of the air quality assessment were as follows:

- during the operational phase, there is a potential for an occasional exceedance of the total particulate (TSP), PM_{10} and $PM_{2.5}$ AAQC. These modelled results in excess of the desirable ambient air quality were found at the property boundary of the Project where there is no current human activity, and where there are no human receptors;
- at all sensitive receptors, the AAQC are met for all parameters, even with the inclusion of the background concentrations;

  the cumulative concentrations (Project plus background) for nitrogen oxides, sulphur oxides, carbon monoxide, calcium oxide and key metals are all below desirable AAQC at all off-site locations, including at all sensitive receptors; and
- all modelled concentrations for substances released during the operation phase of the Project were below applicable Schedule 3 standards of O. Reg. 419 demonstrating that the Project meets all air quality requirements for an air permit in Ontario.

In order to meet the modelled levels of emissions, the site must undertake the following mitigation and operational controls:

- A fugitive dust best management plan (DBMP) will be prepared for the construction and operation phase to identify all potential sources of fugitive dusts, outline mitigative measures that will be employed to control dust generation, and detail the inspection and recordkeeping required to demonstrate that fugitive dusts are being effectively managed. The DBMP will be consistent with industry best management practices and Ontario MOE requirements, to ensure that these management practices and active mitigation are effective in mitigating the activities that may generate fugitive dusts.
  - Dust emissions from roads and mineral stockpiles will be controlled through the application of water sprays. At full production, two water trucks with water sprays and cannons will be at site for this purpose. Alternatively, surfactant applications, such as calcium chloride, will be used to control dust, particularly on roads, provided that such applications are acceptable to the MOE. Water cannon sprays discharged by mobile trucks will be employed to control dust emissions from stockpiles and aggregate handling activities. If the operations and fugitive dust best management practices plan require further mitigation, dedicated water sprays at active stockpile areas will be employed. At closure, all exposed dust sources will be vegetated and progressive reclamation will be used wherever practicable to better control dust emissions from the mineral waste stockpiles and tailings management area.

  - All site roadways will be maintained in good condition, with regular inspections and timely repairs completed to minimize the silt loading on the roads. The road maintenance procedures will be incorporated into the DBMP plan.
  - The facility and emission points will be designed to allow for good atmospheric dispersion, and dust control equipment such as bag houses, bin vents, and water sprays, will be utilized where necessary to prevent excessive emissions at the crusher and process plant.
- A blasting plan to control the emissions of particulate and NOx and to restrict blasting to specific hours of the day where the meteorological conditions are favourable and atmospheric dispersion is optimized.
- A preventive maintenance program will be employed that encompasses all pollution control equipment, diesel-fired engines (vehicle, equipment, and standby power generating), and all processes with the potential for significant environmental effects.
  - Air emissions from diesel consumption associated with mobile heavy equipment operations will be controlled through use of low sulphur diesel, equipment meeting Transport Canada off road vehicle emission requirements; and effective equipment maintenance.

The proposed dust control measures are based on current international best management practices, are predictably effective and are not prone to failure. The DBMP will include opportunities for adaptive management, in which the intensity of the control measures may need to be increased if site inspections and monitoring indicate that current measures are insufficient to prevent offsite dust effects. Use of low sulphur diesel is also predictably effective for reducing sulphur emissions from on site diesel fuel consumption.

The prediction of air quality determined that particulate matter levels for TSP, PM_{10}, and $PM_{2.5}$ exceeded AAQC in a small area proximate to the Project site boundary. For $PM_{2.5}$, it was determined that the AAQC was exceeded one day per year (0.3%). PM_{10} exceeded the AAQC less than 4% of the time per year, and TSP exceeded less than 2% of the time. At each of the sensitive receptors (cottages) located within the local study area, the particulate matter was below the AAQCs and, in some cases, below current baseline levels.

All other key effects assessment indicators were determined to be below the AAQCs and, in several cases, below current baseline levels in the local study area during mine operation.

9.0 REFERENCES

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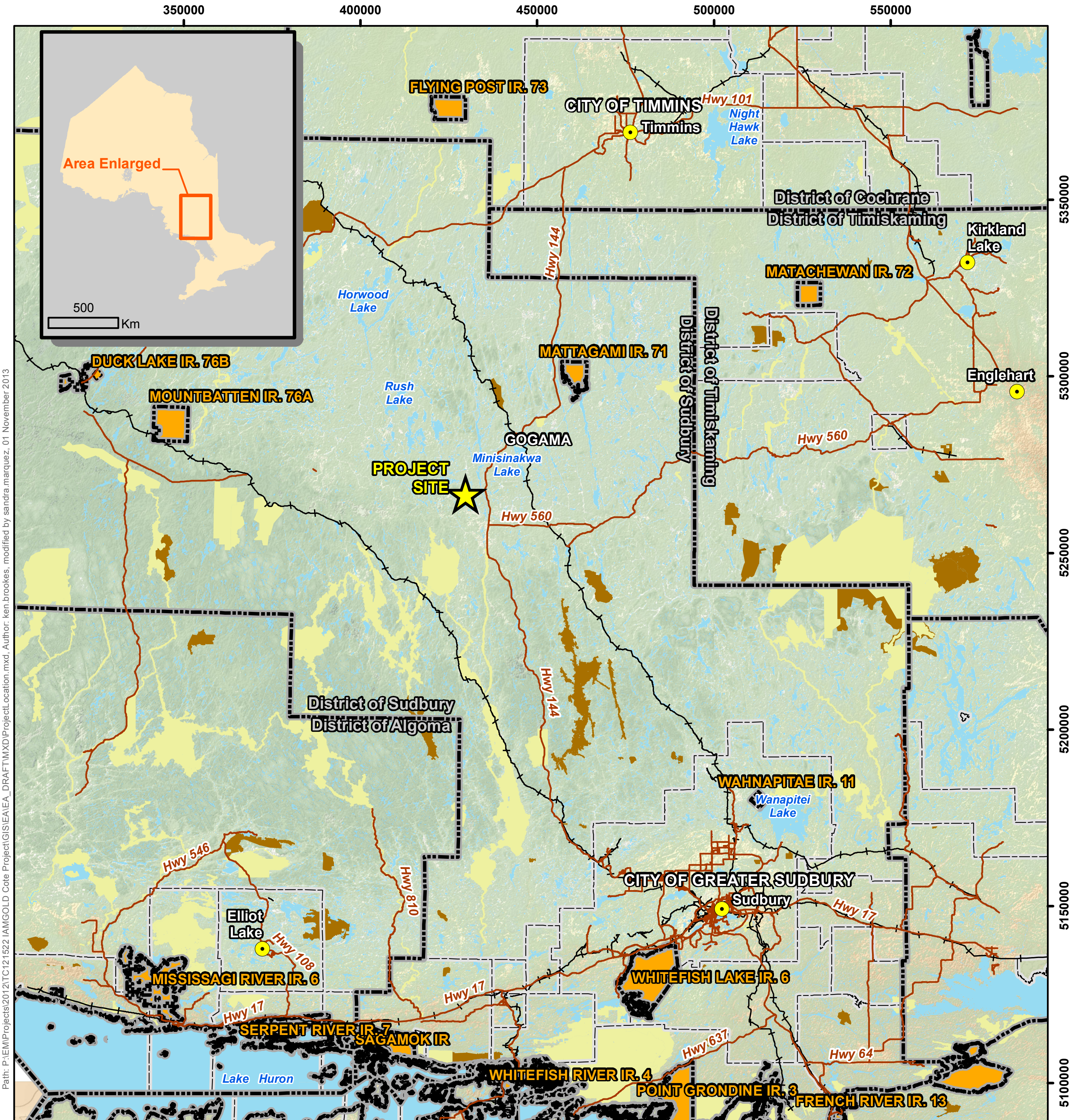
FIGURES



LEGEND

- Project Site Location
- Regional Communities
- Major Roads
- Railway
- Lower Tier Municipality Boundary
- Upper Tier Municipality Boundary
- First Nation Reserve
- Conservation Reserve (Regulated)
- Provincial Park
- Waterbody / Large Watercourse
- Wooded Area

NOTES:
- All base data on this map was extacted from Land Information Ontario, MNDM, OBM Ontario Digital Geospatial Database and Ontario Road Network Database.

Datum: NAD83
Projection: UTM Zone 17N

0 20 40 60 80 100 Kilometres

N S W E

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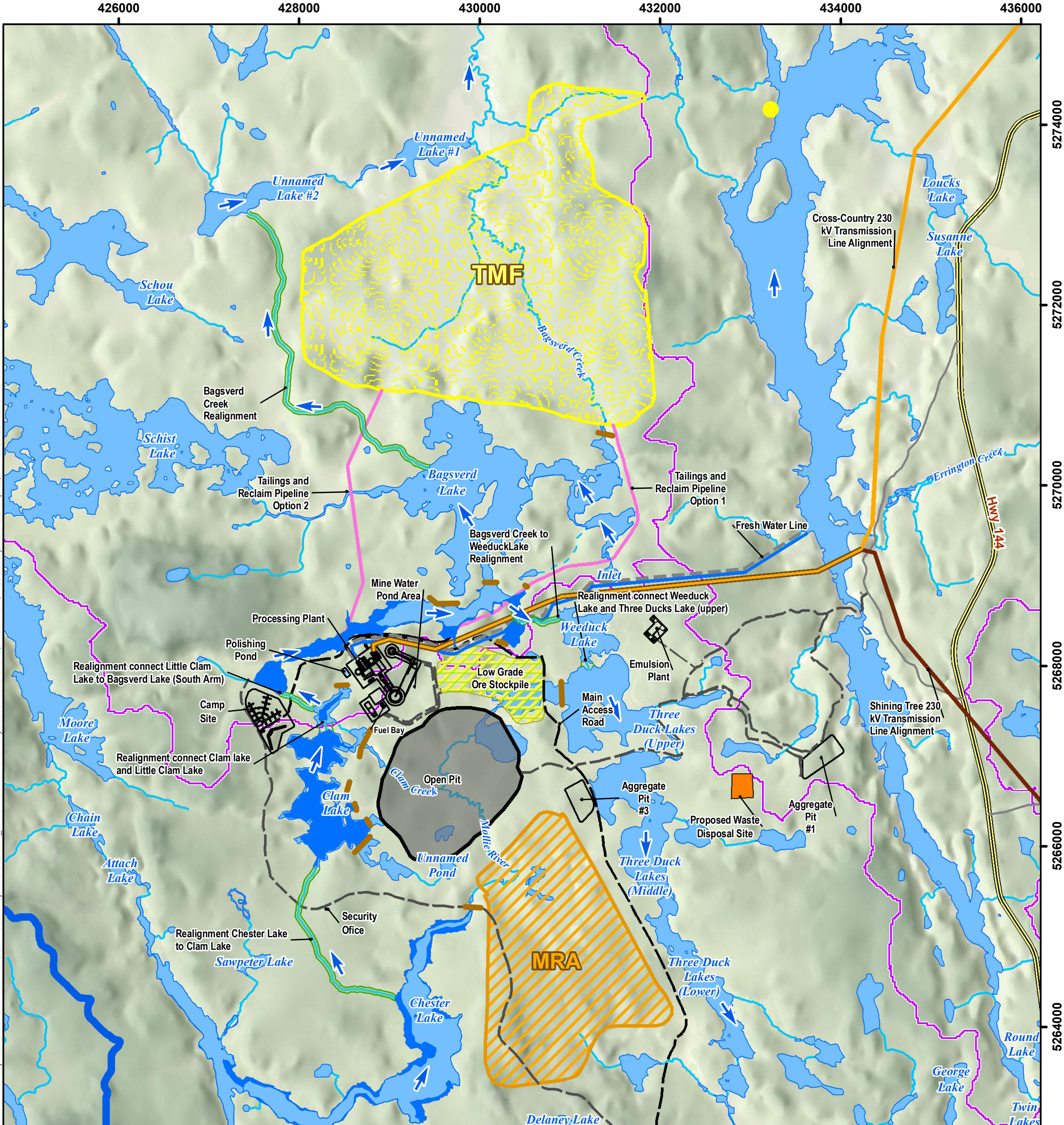
CÔTÉ GOLD PROJECT

Project Location

PROJECT N°: TC121522	FIGURE: 1
SCALE: 1:1,450,000	DATE: December 2013



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Highway
- Local Road
- Subwatershed Boundary
- Wooded Area
- Open Pit
- Potential Discharge Location
- Facilities
- Dam
- Main Access Road
- Access Road
- Cross-Country 230 kV Transmission Line Alignment
- Shining Tree 230 kV Transmission Line Alignment
- Tailings and Reclaim Pipeline
- Fresh Water
- Water Realignment
- Proposed Water Flow Direction
- Proposed Lake Area
- Polishing Pond
- Low Grade Ore Stockpile
- Proposed Mine Rock Area (MRA)
- Proposed Tailings Management Facility (TMF)
- Proposed Landfill

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- TMF and subwatershed provided by Golder Associates.
- Watercourse realignment and proposed lake area provided by Calder Engineering.
- Surface infrastructure, open pit, landfill, MRA and transmission lines provided by IAMGOLD.
- Mesomikenda Lake is preferred discharge option, but others are being investigated.

Datum: NAD83
Projection: UTM Zone 17N

0 1 2 3 4 5 Kilometres

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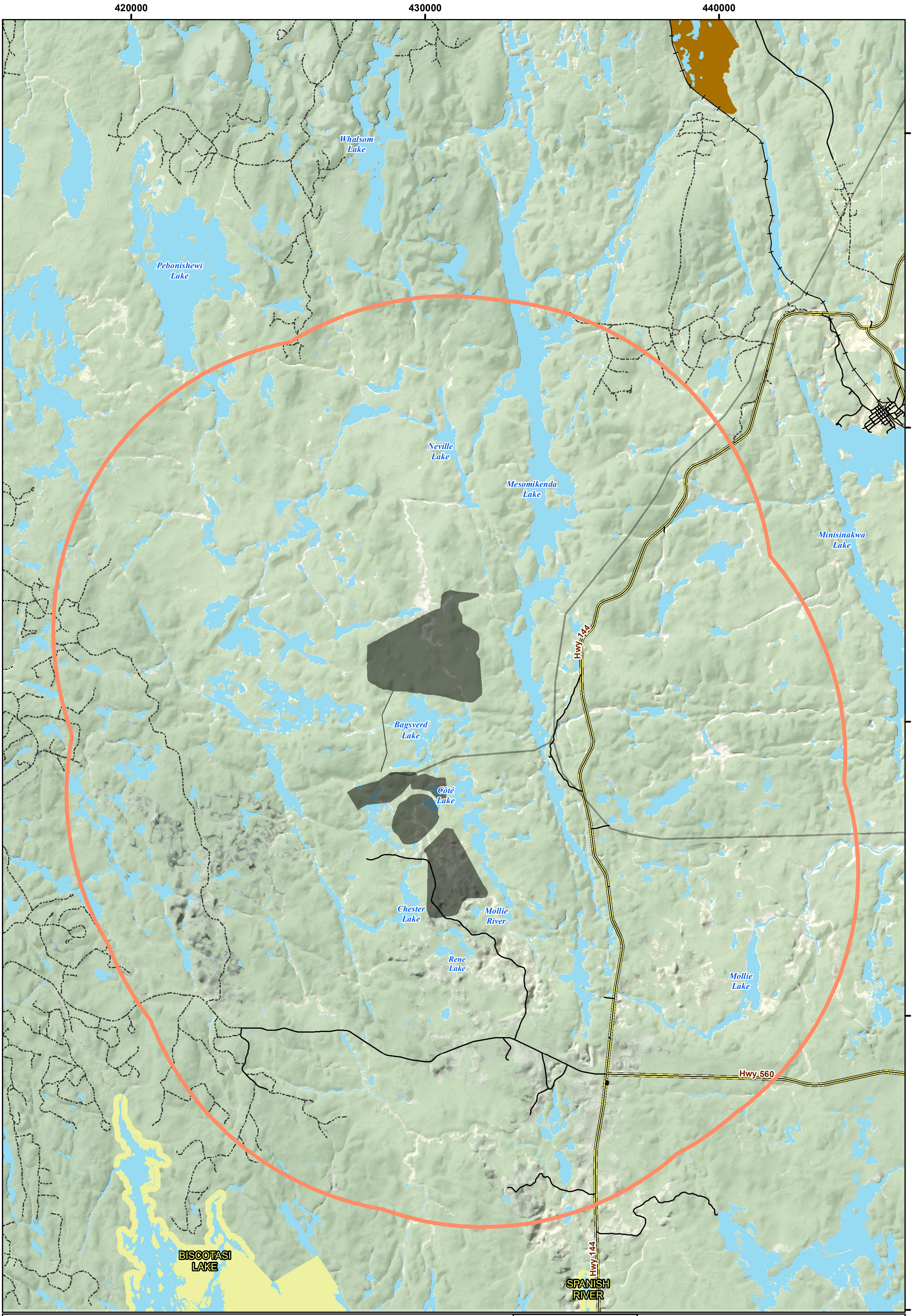
CÔTÉ GOLD PROJECT

Preliminary Site Plan

PROJECT N°: TC121522	FIGURE: 2
SCALE:1:57,000	DATE: December 2013



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LEGEND

- Proposed Site Facilities
- Regional Study Area
- Waterbody / Large Watercourse
- WoodedArea
- Railway
- Highway/Expressway
- Local Road
- Resource / Recreation Road
- First Nation Reserve
- Provincial Park
- Conservation Reserve (Regulated)

NOTES:
- All base data on this map was extracted from Land Information Ontario, MNDM, OBM Ontario Digital Geospatial database and Ontario Road Network Database.

Datum: NAD83
Projection: UTM Zone 17N

0 4 8 12 16 Kilometres

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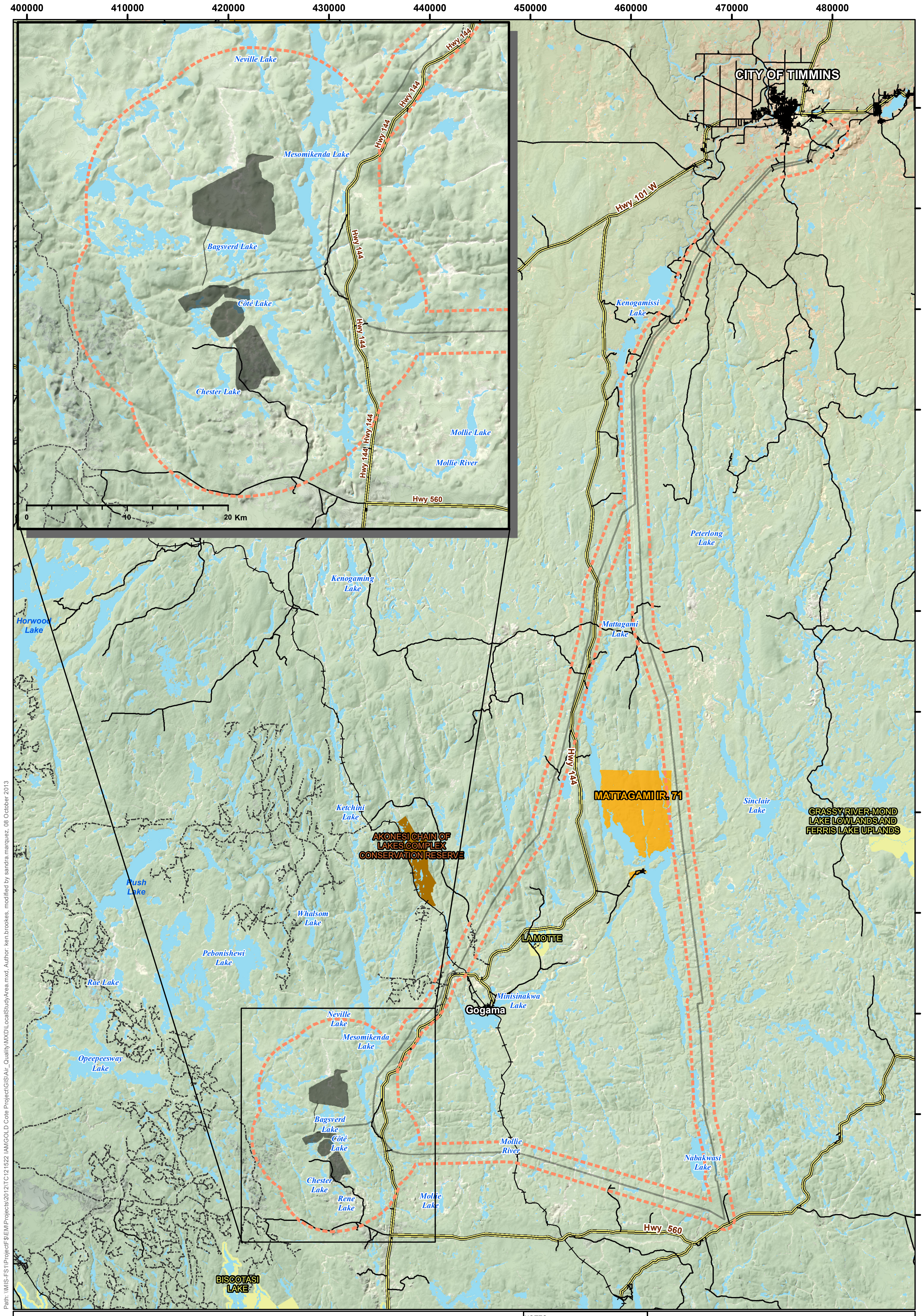
CÔTÉ GOLD PROJECT

Regional Study Area

DRAFT

PROJECT Nº: TC121522 | FIGURE: 3

SCALE: 1:120,000 | DATE: October 2013



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LEGEND

- Proposed Site Facilities
- Local Study Area
- Waterbody / Large Watercourse
- WoodedArea
- Railway
- Highway/Expressway
- Local Road
- Resource / Recreation Road
- First Nation Reserve
- Provincial Park
- Conservation Reserve (Regulated)

NOTES:
- All base data on this map was extracted from Land Information Ontario, MNDM, OBM Ontario Digital Geospatial database and Ontario Road Network Database.

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CÔTÉ GOLD PROJECT

Local Study Area

DRAFT

Datum: NAD83
Projection: UTM Zone 17N

0 10 20 30 40 Kilometres

PROJECT N°: TC121522

FIGURE: 4

SCALE: 1:350,000

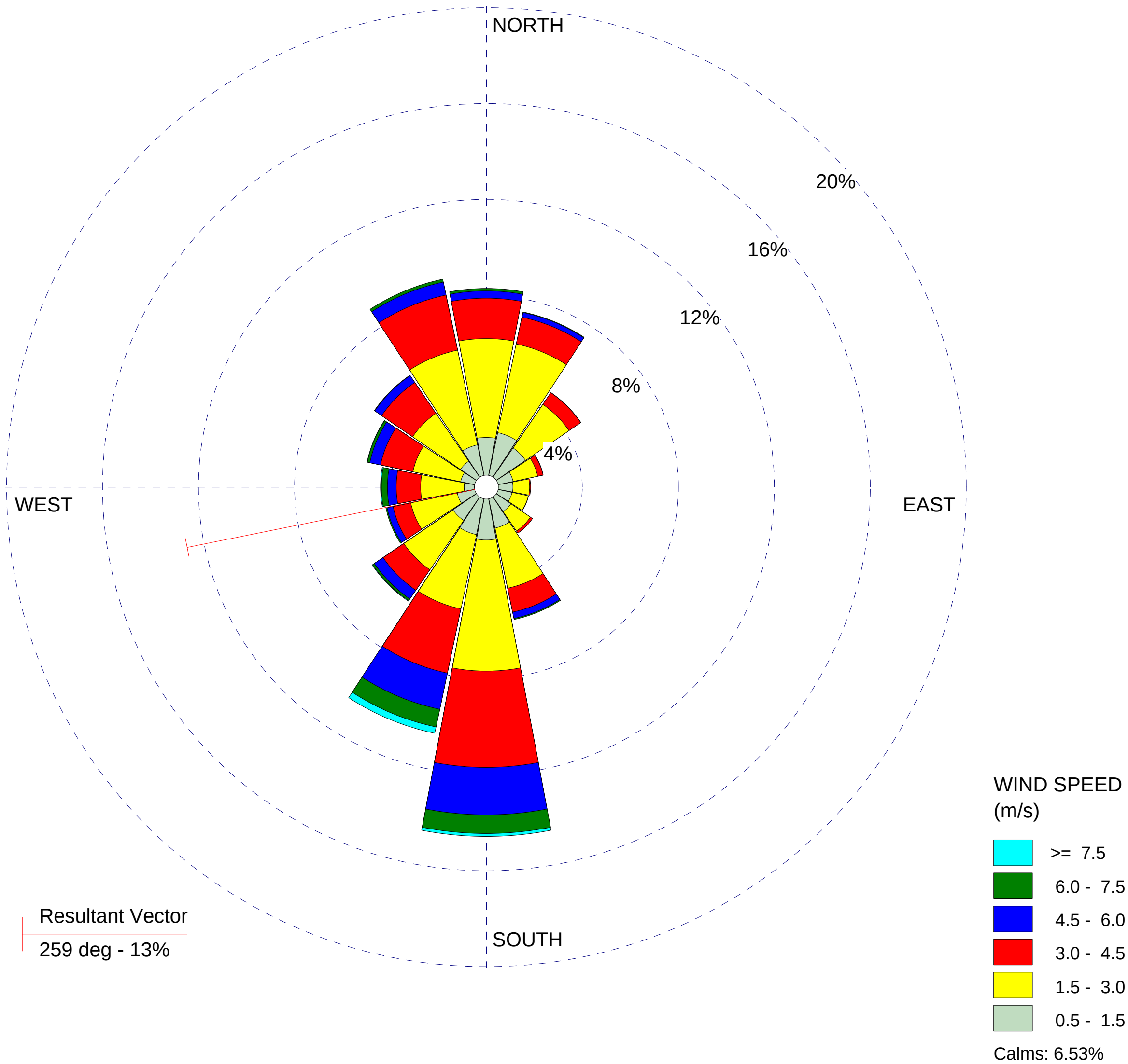
DATE: October 2013

WIND ROSE PLOT:

IAMGOLD COTE GOLD PROJECT

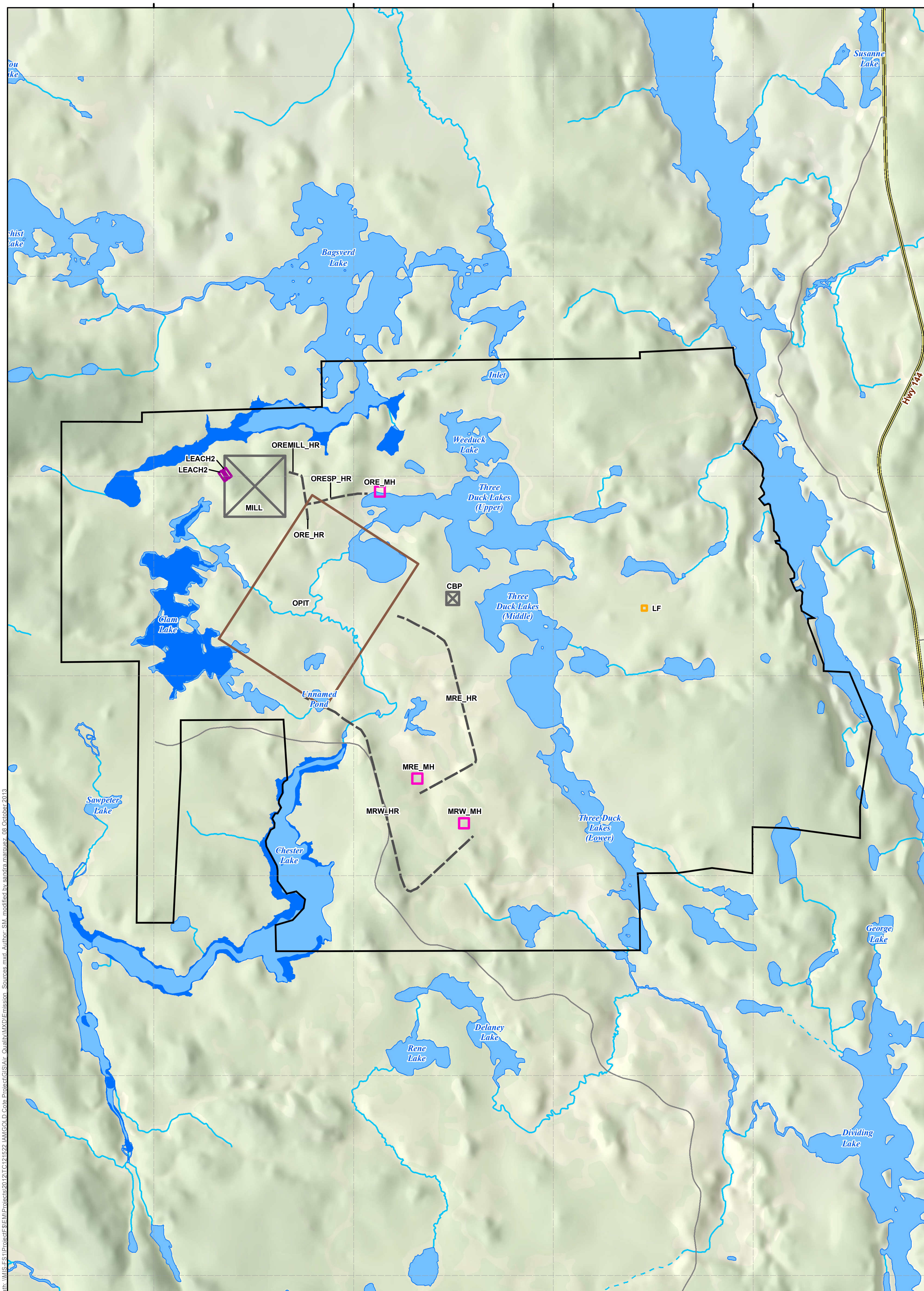
DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Wind Rose Local Met Station	**Start Date: 5/17/2012 - 09:00** **End Date: 5/22/2013 - 09:00**	**AMEC**	
	CALM WINDS: **6.53%**	TOTAL COUNT: **8881 hrs.**	amec
	AVG. WIND SPEED: **2.33 m/s**	DATE: **7/18/2013**	PROJECT NO.: **TC121522**

WRPLOT View - Lakes Environmental Software



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent

Emission Sources

- Landfill
- Leach
- Matterial Handling
- Processing Plant
- Pit
- Haul Roads

Label	Feature Name
LEACH1	Leach Tanks
LEACH2	Leach Tanks
LF	Landfill
CBP	Concrete Batch Plant
MILL	Crushing & Process at Mill
MRW_MH	Mine Rock Area West - Material Handling
MRE_MH	Mine Rock Area East - Material Handling
ORE_MH	Low Grade Ore Stockpile - Material Handling
OPIT	Open Pit
ORESP_HR	Ore to stockpile from mill/stock split
OREMILL_HR	Ore to mill from mill/stock split
MRW_HR	MR to Stockpile. West area
MRE_HR	MR to Stockpile. East area
ORE_HR	Ore to mill/stock split

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 0.5 1 2 3 4 5 Kilometres

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CÔTÉ GOLD PROJECT

Emission Sources

DRAFT

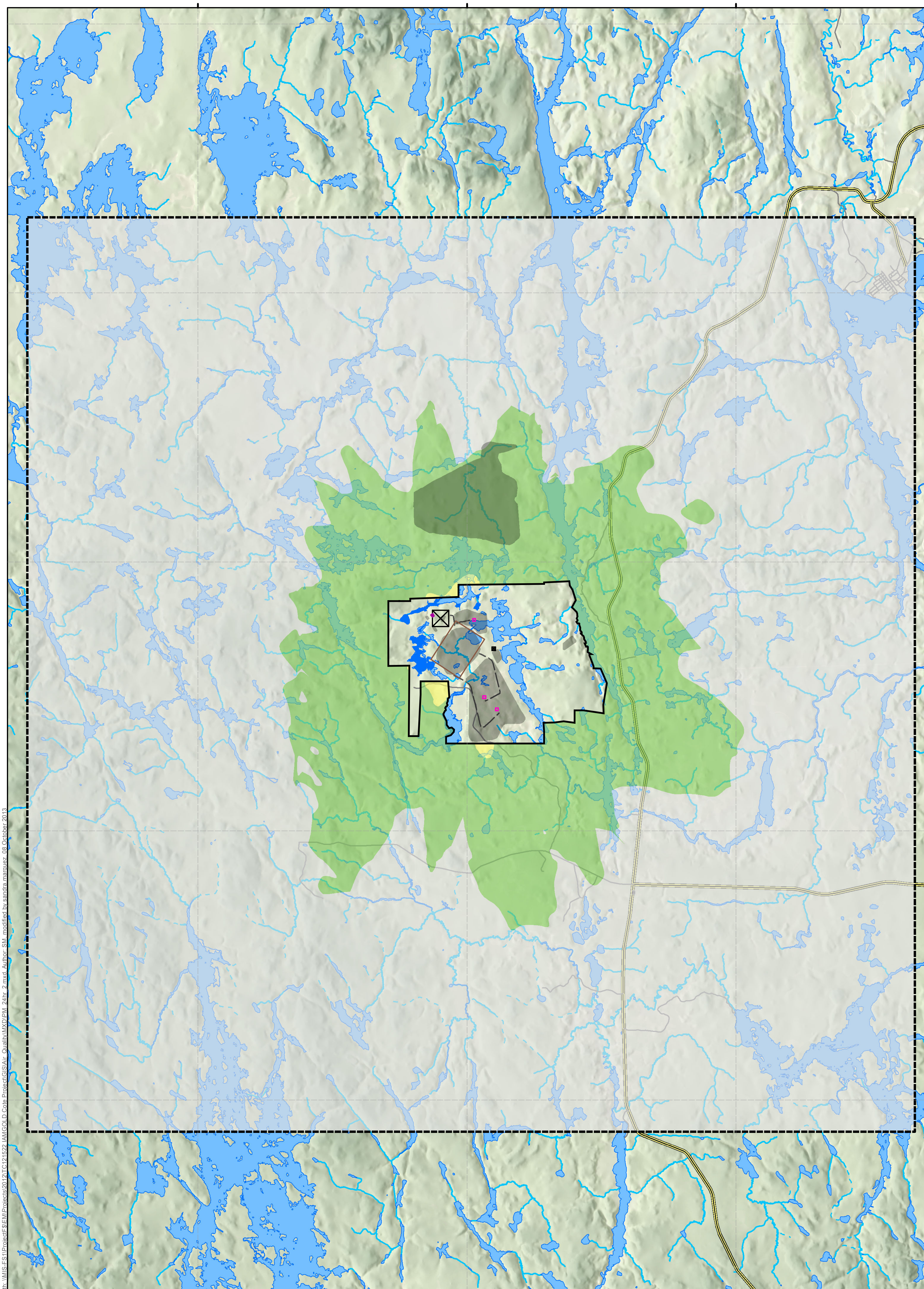
PROJECT Nº: TC121522

FIGURE: 6

SCALE: 1:35,000

DATE: October 2013

Path: \\MIS_FS1\Project\FS\EM\Projects\2012\TC121522 IAMGOLD Cote Project\GIS\Air Quality\MXD\Emission_Sources.mxd Author: SM, modified by sandra.marquez 08 October 2013



Path: \\MIS-FS1\Projects\EM\Projects\2012\TC121522 IAMGOLD Cote Project\GIS\Air Quality\MXD\PM_24hr_2.mxd Author: SM modified by sandra.marquez 08 October 2013

LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (<21.4 g/m^3)
- Level 2 (21.4 μg/m^3- 120μg/m^3)
- Level 3 (>120μg/m^3)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

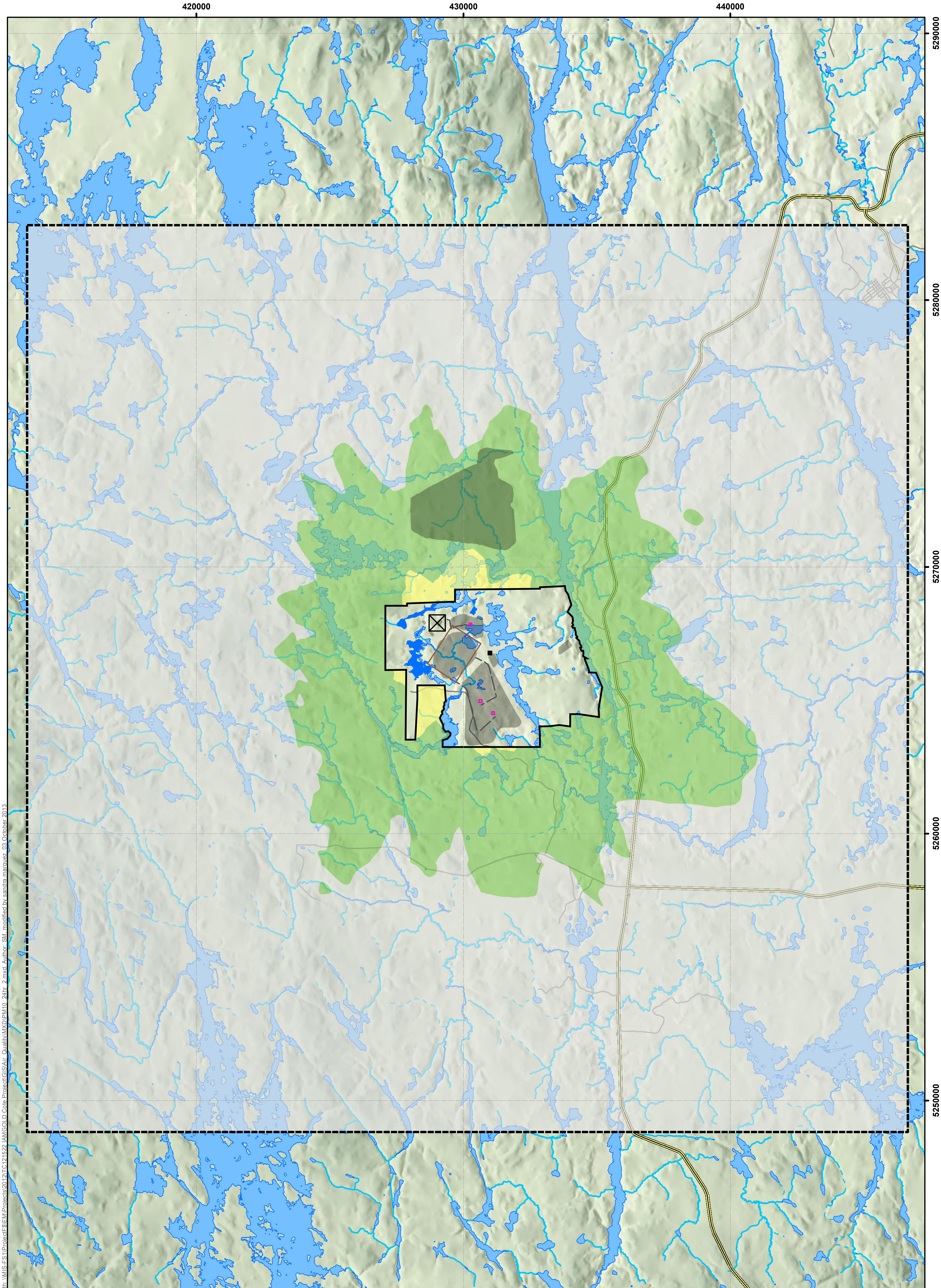
IAMGOLD CORPORATION amec

CÔTÉ GOLD PROJECT

Total Suspended Particulate Matter Isopleth (24-Hour Averaging Time)

DRAFT

PROJECT N^o: TC121522	**FIGURE: 7**
SCALE: 1:130,000	DATE: October 2013



Path: \\MIS-FS1\Project\EMI\Projects\2012\TC121522 IAMGOLD Cote Project\GIS\Air Quality\MXD\PM10_24hr_2.mxd Author: SM modified by sandra marquez, 03 October 2013

LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (<13.9 g/m^3)
- Level 2 (13.9 µg/m^3- 50 µg/m^3)
- Level 3 (> 50µg/m^3)

0 2.5 5 10 15 20 Kilometres

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

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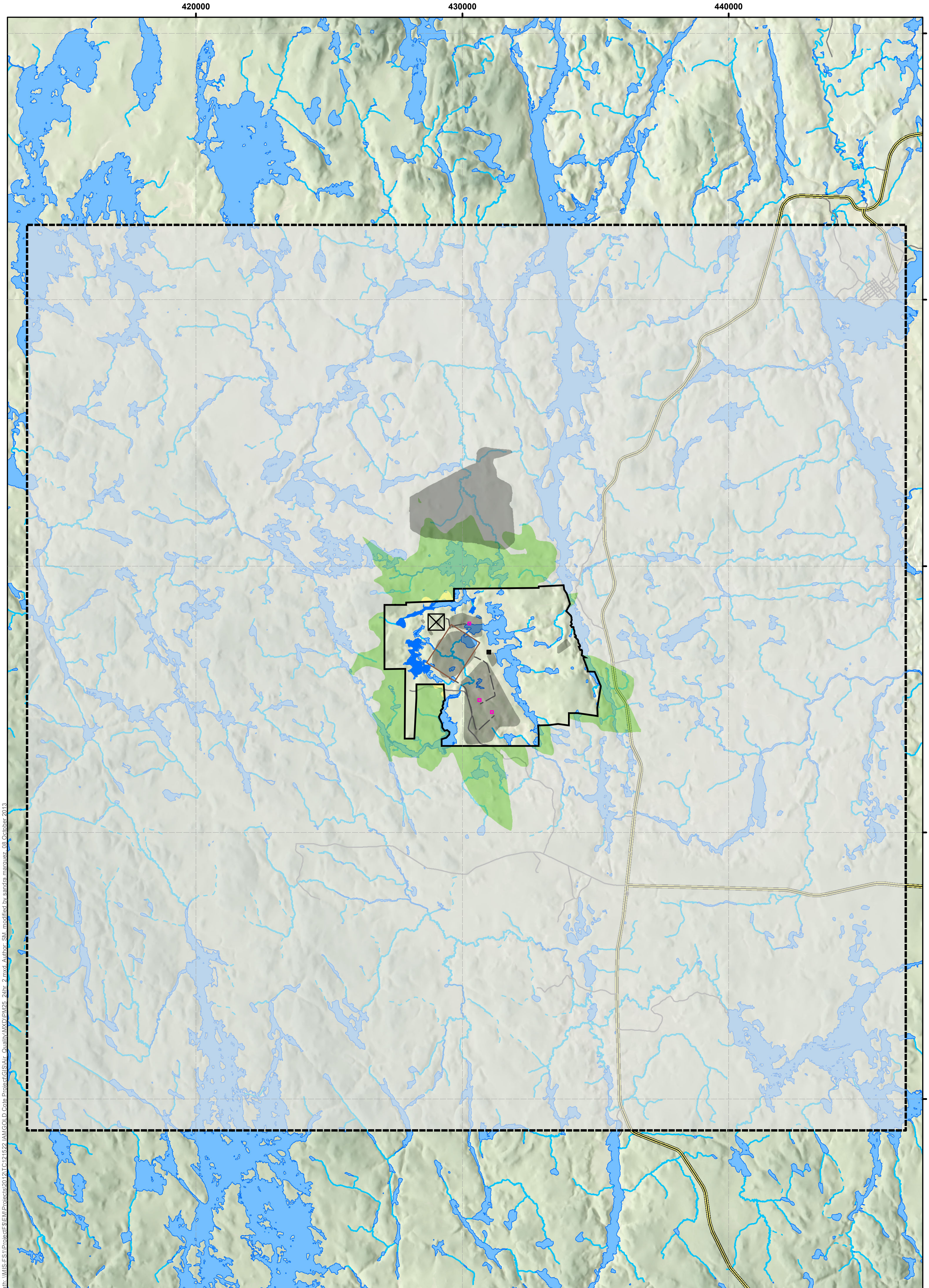
CÔTÉ GOLD PROJECT

Particulate Matter PM10 Isopleth (24-Hour Averaging Time)

DRAFT

PROJECT N^o: TC121522	**FIGURE: 8**
SCALE: 1:130,000	DATE: October 2013



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 9.8μg/m³)
- Level 2 (9.8μg/m³ - 25μg/m³)
- Level 3 (> 25μg/m³)

0 2.5 5 10 15 20 Kilometres

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

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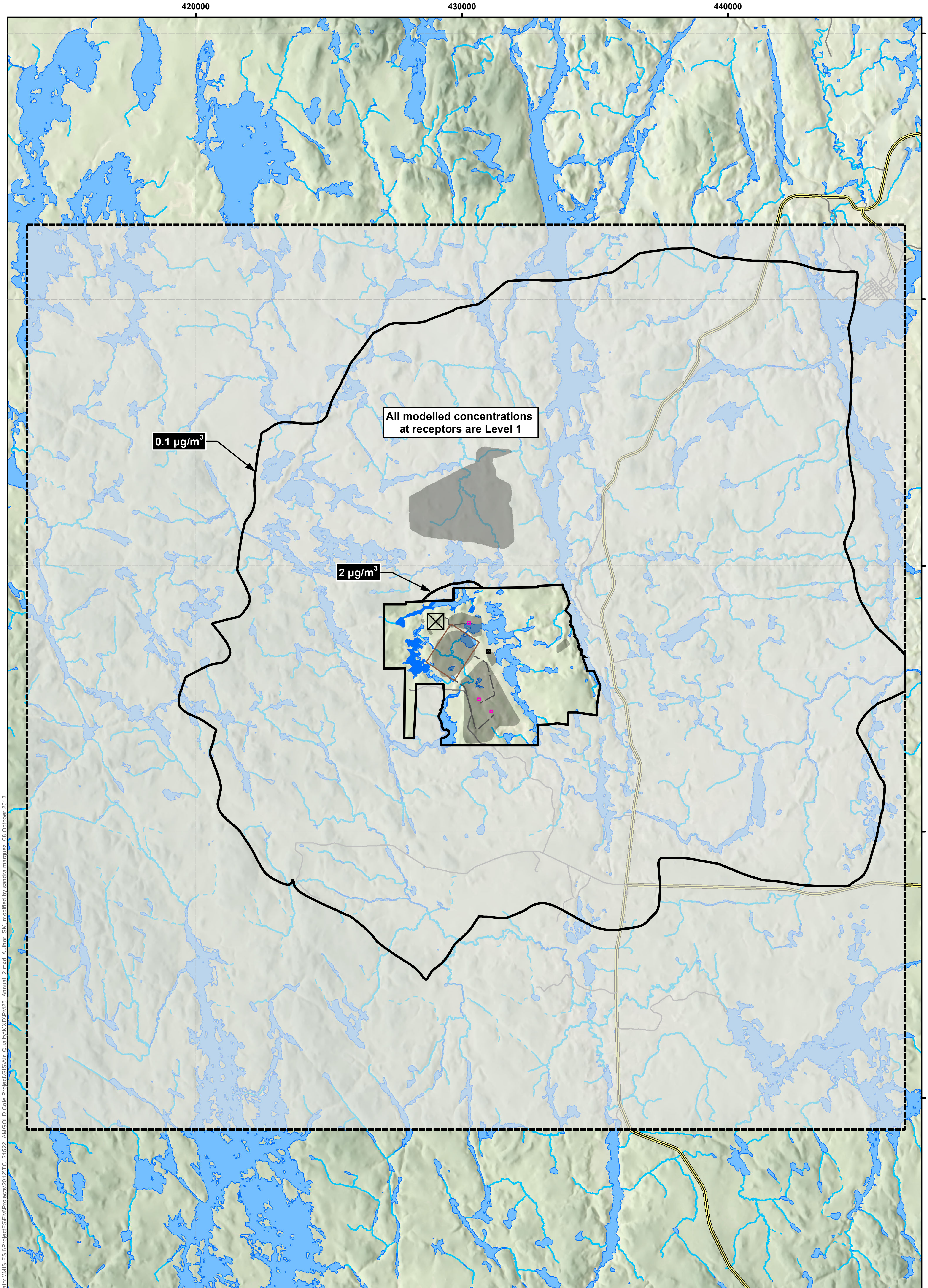
CÔTÉ GOLD PROJECT

DRAFT

Particulate Matter PM2.5 Isopleth (24-Hour Averaging Time)

PROJECT Nº: TC121522	**FIGURE: 9**
SCALE: 1:130,000	DATE: October 2013



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 4.2µg/m³)
- Level 2 (4.2µg/m³ - 8.8µg/m³)
- Level 3 (> 8.8µg/m³)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

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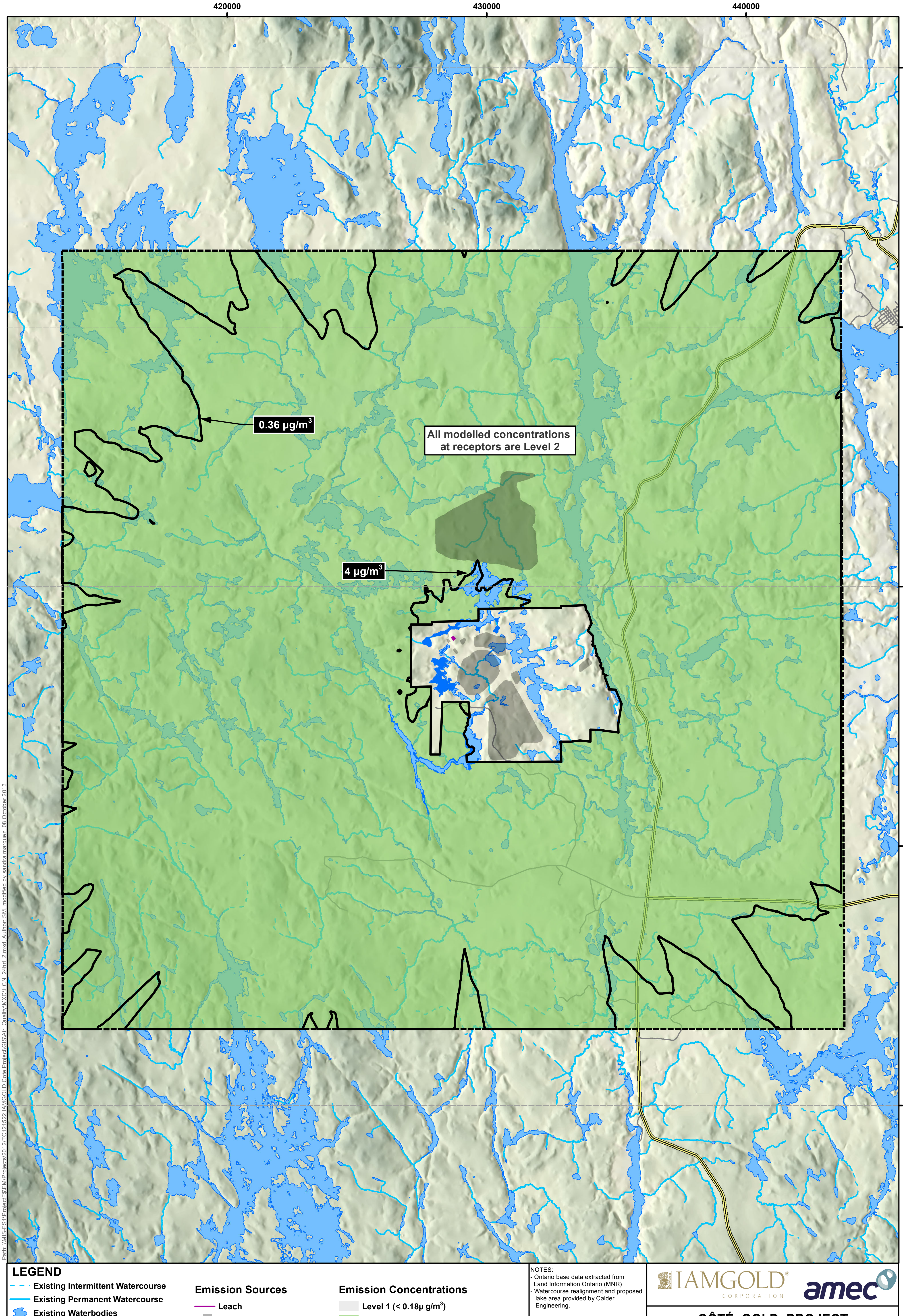
CÔTÉ GOLD PROJECT

Particulate Matter PM2.5 Isopleth (Annual Average)

DRAFT

PROJECT Nº: TC121522	FIGURE: 10
SCALE: 1:130,000	DATE: October 2013



LEGEND
- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources
- Leach
- Proposed Site Facilities

Emission Concentrations
- Level 1 (< 0.18µ g/m³)
- Level 2 (0.18µg/m³ - 8µg/m³)
- Level 3 (> 8µg/m³)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

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CÔTÉ GOLD PROJECT

Hydrogen Cyanide Isopleth (24-Hour Averaging Time)

DRAFT

PROJECT N°: TC121522

FIGURE: 11

SCALE: 1:130,000

DATE: October 2013

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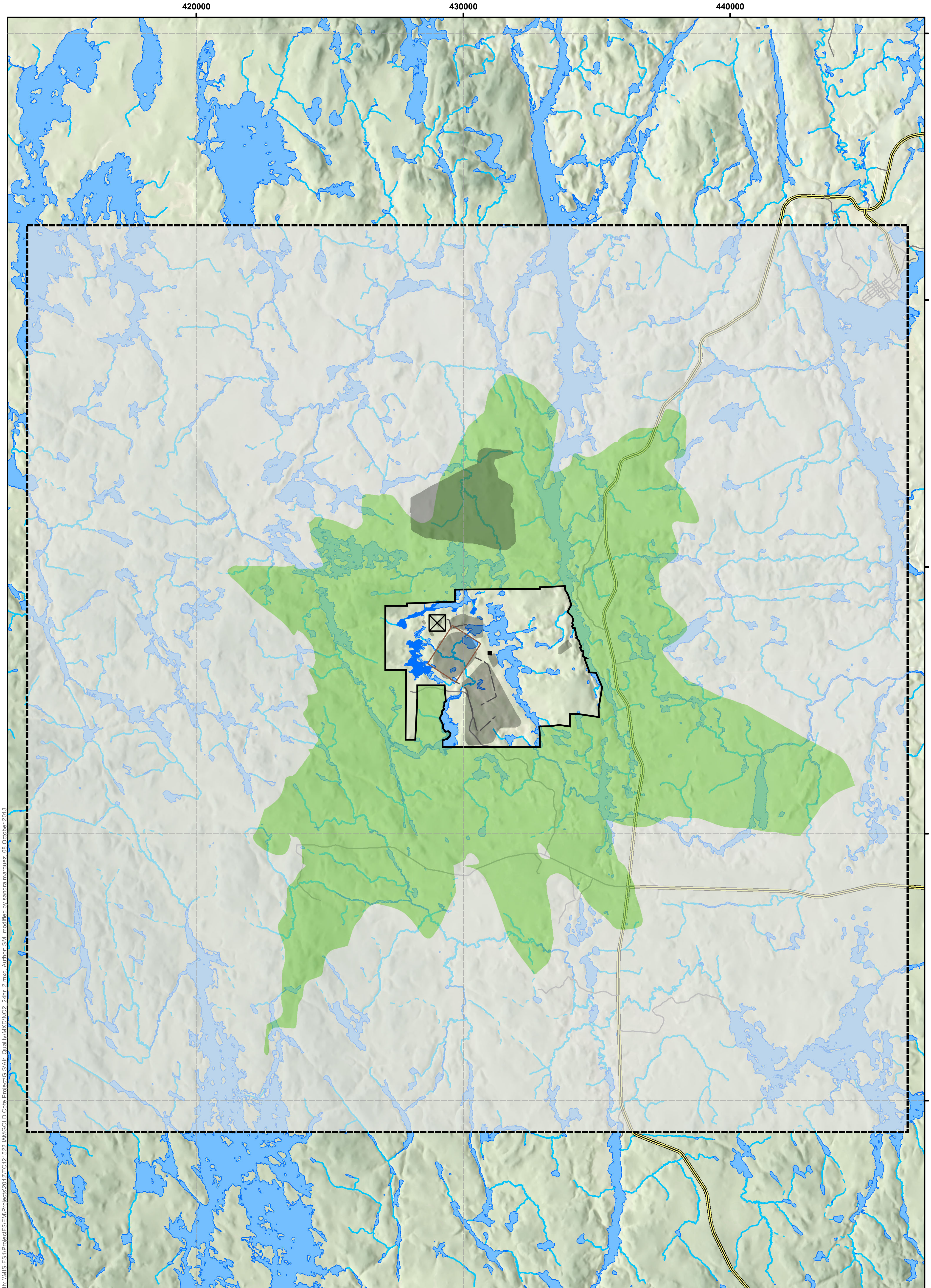


LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 24.6µg/m³)
- Level 2 (24.6µg/m³ - 200µg/m³)
- Level 3 (> 200µg/m³)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

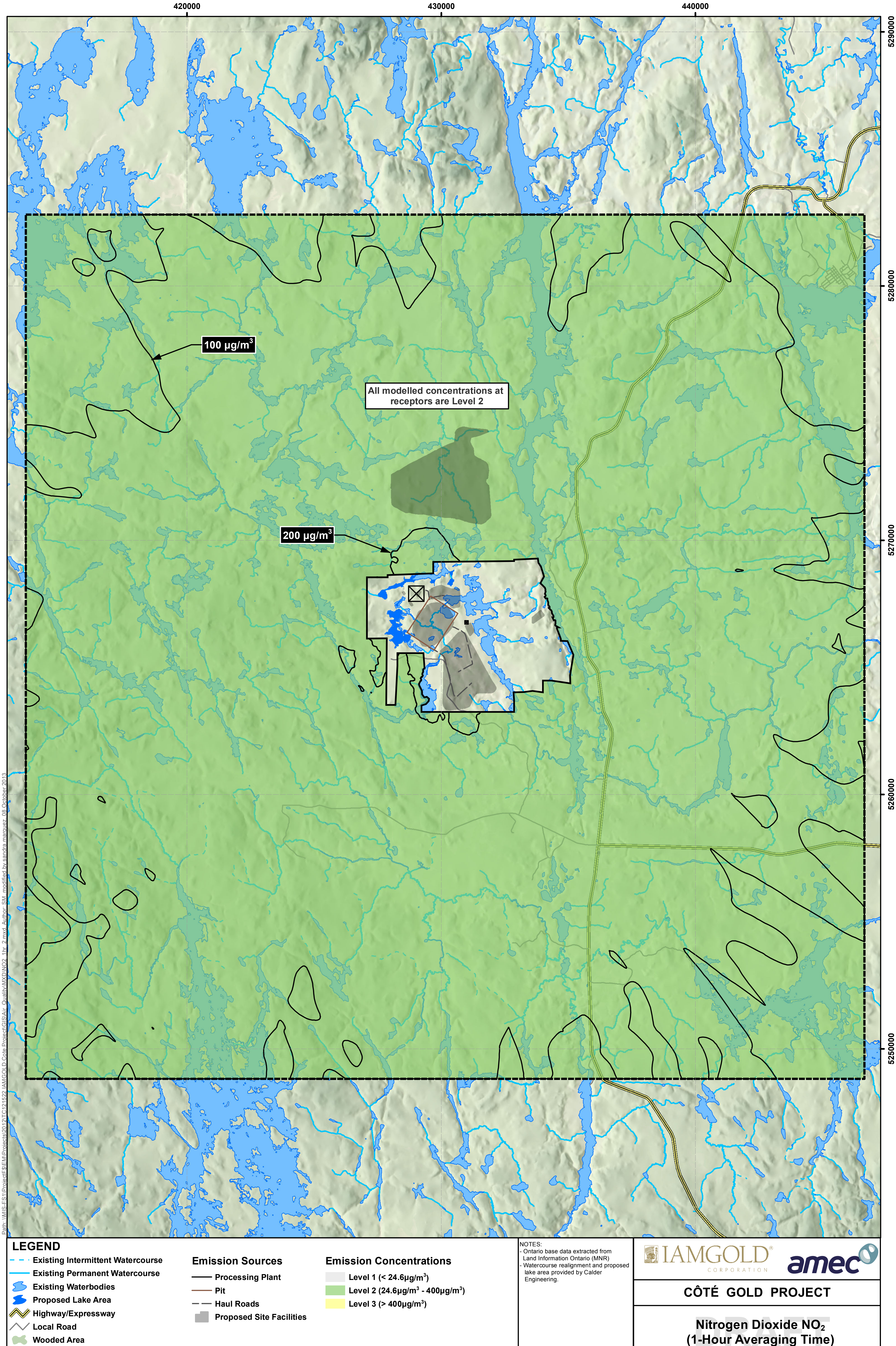
0 2.5 5 10 15 20 Kilometres

IAMGOLD CORPORATION amec

CÔTÉ GOLD PROJECT

Nitrogen Dioxide NO_2
(24-Hour Averaging Time)

PROJECT Nº: TC121522	FIGURE: 12
SCALE: 1:130,000	DATE: October 2013



Path: \\MIS-FS1\Projects\SEM\Projects\2012\TC121522 IAMGOLD Cote Project\GIS\Air Quality\MXD\NO2_1hr_2.mxd Author: SM modified by sandra marquez 08 October 2013

LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 24.6µg/m^3)
- Level 2 (24.6µg/m^3 - 400µg/m^3)
- Level 3 (> 400µg/m^3)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

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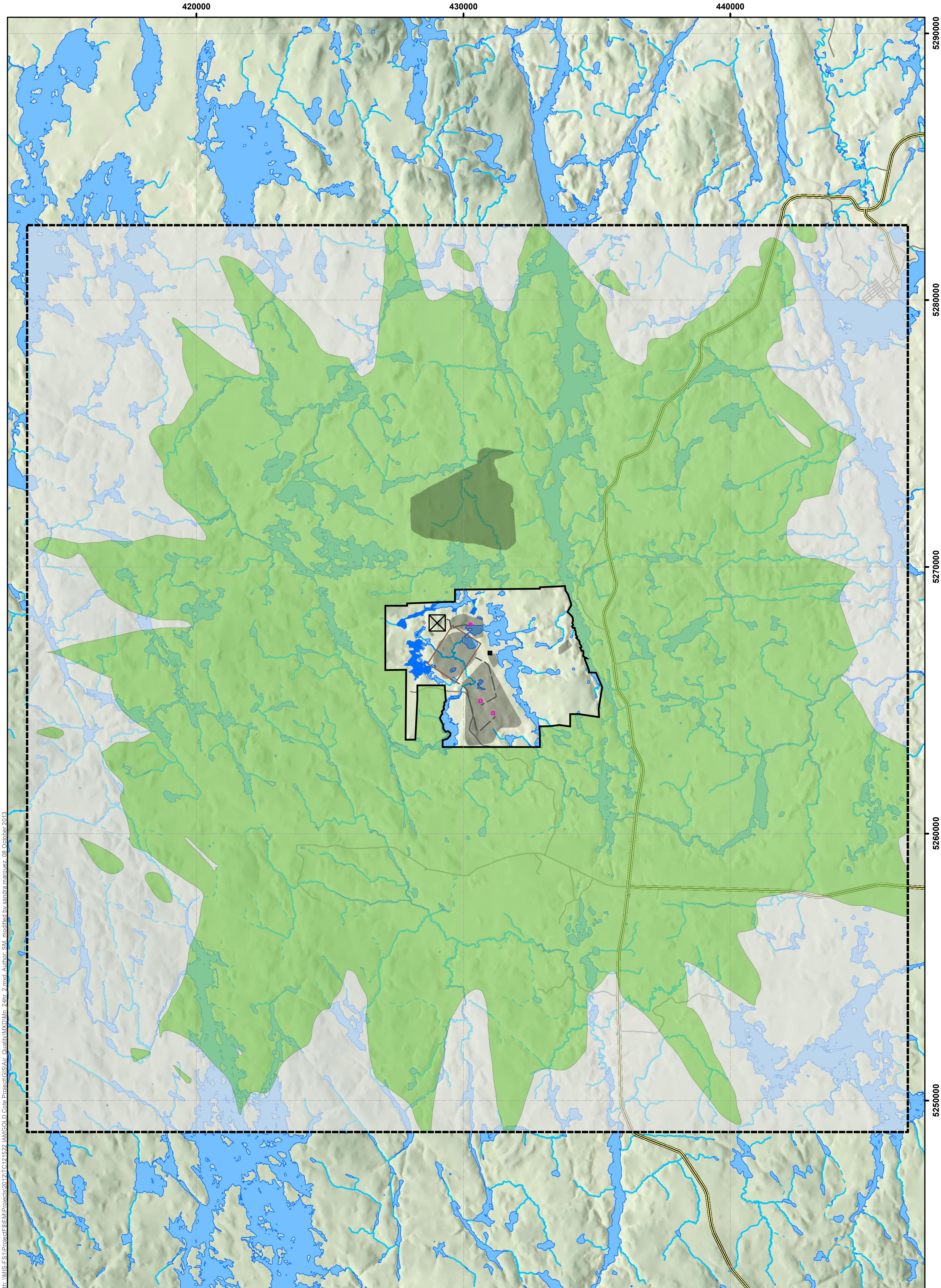
CÔTÉ GOLD PROJECT

Nitrogen Dioxide NO_2 (1-Hour Averaging Time)

PROJECT N°: TC121522	FIGURE: 13
SCALE: 1:130,000	DATE: October 2013



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LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 0.0055μg/m³)
- Level 2 (0.0055μg/m³ - 0.2μg/m³)
- Level 3 (> 0.2μg/m³)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- TMF and subwatershed provided by Golder Associates.
- Watercourse realignment and proposed lake area provided by Calder Engineering.
- Surface infrastructure, open pit, landfill, MRA and transmission lines provided by IAMGOLD.
- Mesomikenda Lake is preferred discharge option, but others are being investigated.
- MNR landfill location extracted from LIO, MNR

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

N W E S

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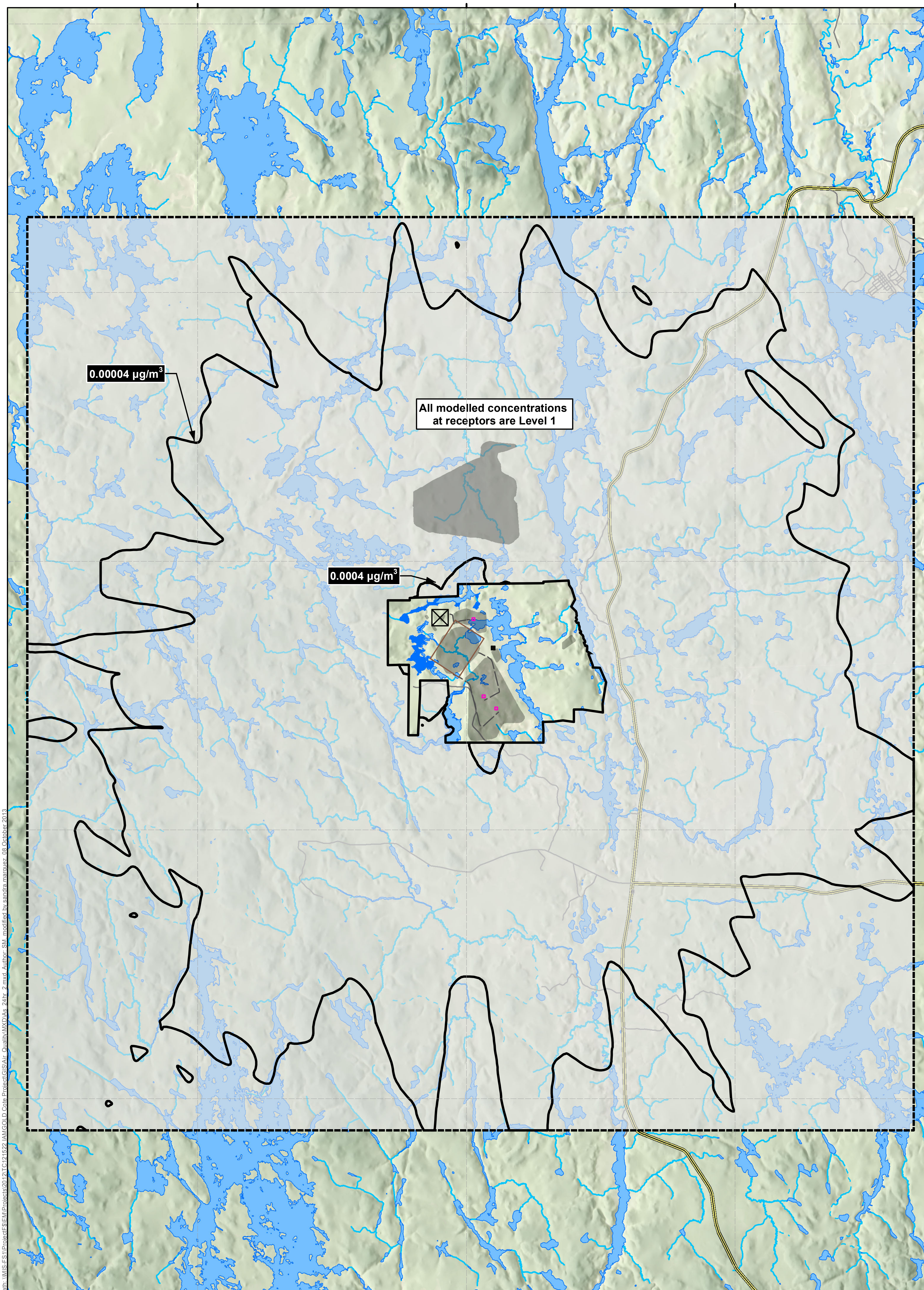
CÔTÉ GOLD PROJECT

Manganese Isopleth (24-Hour Averaging Time)

DRAFT

PROJECT N°: TC121522	**FIGURE: 14**
SCALE: 1:130,000	DATE: October 2013



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Proposed Lake Area
- Highway/Expressway
- Local Road
- Wooded Area
- Modelling Property Extent
- Dispersion Modelling Extent

Emission Sources

- Material Handling
- Processing Plant
- Pit
- Haul Roads
- Proposed Site Facilities

Emission Concentrations

- Level 1 (< 0.0018µg/m³)
- Level 2 (0.0018µg/m³ - 0.3µg/m³)
- Level 3 (> 0.3µg/m³)

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- Watercourse realignment and proposed lake area provided by Calder Engineering.

Datum: NAD83
Projection: UTM Zone 17N

0 2.5 5 10 15 20 Kilometres

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CÔTÉ GOLD PROJECT

DRAFT

Arsenic Isopleth (24-Hour Averaging Time)

PROJECT Nº: TC121522	**FIGURE: 15**
SCALE: 1:130,000	DATE: October 2013

APPENDIX I:
Air Quality Baseline Report

Côté Gold Project
TSD - Air Quality
February 2014
Project #TC121522

CÔTÉ GOLD PROJECT
BASELINE REPORT
AIR QUALITY
FINAL VERSION

Submitted to:
IAMGOLD Corporation
401 Bay Street, Suite 3200
Toronto, Ontario
M5H 2Y4

Submitted by:
AMEC Environment & Infrastructure
a Division of AMEC Americas Limited
160 Traders Blvd., Suite 110
Mississauga, Ontario
L4Z 3K7

December 2013

TC121522

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GLOSSARY AND ABBREVIATIONS

AAQC	Ministry of the Environment (Ontario) Ambient Air Quality Criteria (2012)
AMEC	AMEC Environment & Infrastructure
masl	metres above sea level
CAAQS	Canadian Ambient Air Quality Standard
CAPMoN	Canadian Air and Precipitation Monitoring Network
CCME	Canadian Council of Ministers of the Environment
cm	centimetres
CO_2	Carbon dioxide
CWS	Canada-Wide Standard
GHGs	Greenhouse gases
IDF	Intensity, duration, and frequency
km	kilometre
km/h	kilometres per hour
NAPS	National Air and Pollution Surveillance
m	metres
m^3	cubic metres
m^3/yr	cubic metres per year
m^3/s	cubic metres per second
mg/kg	milligrams per kilogram
MDL	Method Detection Limit
mm	millimetre
MOE	Ontario Ministry of the Environment
Mt	Million tonnes (metric)
N	North
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_3	Ozone
PM	Particulate Matter
$PM_{2.5}$, PM_{10}	Particulate Matter less than 2.5 or 10 micrometers in diameter
ppb	parts per billion
ppm	parts per million
SO_2	Sulphur dioxide
SVOC	Semi-Volatile Organic Compound
tpd or t/d	Metric tonnes per day
TSP	Total Suspended Particulates
UTM	Universal Transverse Mercator
°C	degrees Celsius
µg/m^3	micrograms (one-millionth of a gram) per cubic metre
VOC	Volatile Organic Compound
W	West

1.0 INTRODUCTION

IAMGOLD Corporation (IAMGOLD) is planning to develop the Côté Gold Project (the Project) located approximately 20 kilometres (km) southwest of Gogama, 130 km southwest of Timmins, and 200 km northwest of Sudbury (see Figure 1).

This document is one of a series of physical, biological and human environment baseline reports to describe the current environmental conditions at the Project site. These baseline reports are written with the intent to support the Environmental Assessment (EA) process.

1.1 Overview of the Côté Gold Project

IAMGOLD is planning to construct, operate and eventually reclaim a new open pit gold mine at the Côté Gold Project site.

The proposed site layout places the required mine-related facilities in close proximity to the open pit, to the extent practicable. The proposed site layout is presented in Figure 2 showing the approximate scale of the Côté Gold Project. The site plan will be refined further as a result of ongoing consultation activities, land purchase agreements and engineering studies.

As part of the proposed development of the Project, several water features will be fully or partially overprinted. These include Côté Lake, portions of Three Duck Lakes, Clam Lake, Mollie River/Chester Lake system and Bagsverd Creek. As a consequence, these water features will need to be realigned for safe development and operation of the open pit.

The major proposed Project components are expected to include:

- open pit;
- ore processing plant;
- maintenance garage, fuel and lube facility, warehouse and administration complex;
- construction and operations accommodations complex;
- explosives manufacturing and storage facility (emulsion plant);
- various stockpiles (low-grade ore, overburden and mine rock area (MRA) in close proximity to the open pit;
- aggregate extraction with crushing and screening plants;
- concrete batch plant;
- Tailings Management Facility (TMF);
- on-site access roads and pipelines, power infrastructure and fuel storage facilities;
- potable and process water treatment facilities;
- domestic and industrial solid waste handling facilities (landfill);

- water management facilities and drainage works, including watercourse realignments; and
- transmission line and related infrastructure.

1.2 Scope of Work

The objective of this report is to provide a representative background air quality data set for use as Project baseline information.

The background air quality data set includes the following components:

- a summary of representative long-term meteorological data for the regional study area;
- identification of the most likely parameters of concern from the construction and operation phases of the Project (particulate matter (PM) and associated metals, nitrogen oxides, and sulphur oxides);
- a summary of regional air quality data, as measured by Environment Canada at the National Air and Pollution Surveillance (NAPS) Network and Canadian Air and Precipitation Monitoring Network (CAPMoN) stations located proximate to the regional study area; and
- a summary of the air monitoring and meteorological data collected at the Project site.

1.3 Study Areas

1.3.1 Regional Study Area

The air quality regional study area is defined as an area that extends approximately 10 km from the main Project emission sources. It is not expected that the potential air quality effects of the Project would be measurable beyond the regional study area.

1.3.2 Local Study Area

The local study area generally corresponds to the Project site and the area in its vicinity where most of the air quality effects have potential to occur, and can be predicted or measured with a reasonable degree of accuracy. For the air quality baseline, the local study area is defined as an area that extends approximately 5 km from the Project site and associated emission sources. The local study area also includes a 1 km buffer on either side of the selected transmission line alignment.

2.0 METHODOLOGY AND SOURCES OF BASELINE AIR QUALITY DATA

2.1 Meteorological Data

AMEC has developed a summary of the baseline climate conditions based on published sources. These sources of information provide the best longer term record for planning and design purposes. At present, there is an operating weather station at the Côté Gold Project site (as of May, 2012) and site-specific information is available.

Climate data was obtained from the Environment Canada Climate Normals (1971-2000). Three climate stations are located within 250 km of the site, and include Timmins, Sudbury, and Sault Ste. Marie (see Table 2-1). The nearest station is in Timmins, approximately 130 km from the site. Climate Normals for precipitation, temperature, wind speed, and wind direction were obtained for these three stations. The locations of the stations relative to the Project site are shown in Figure 3.

Table 2-1: Environment Canada Weather Stations

Station	Latitude (N)	Longitude (W)	Elevation (masl)
Timmins A	48° 34’	81° 22’	295
Sudbury A	46° 37’	80° 47’	348
Sault Ste Marie A	46° 29’	84° 30’	192

Source: Environment Canada (2013).

2.2 Baseline Air Quality

2.2.1 Air Quality Parameters from Gold Mining and Ore Processing

Baseline data for air quality parameters anticipated from operations associated with gold mining and ore processing was obtained from a number of sources, including the Environment Canada NAPS Network and CAPMoN, and from data collected at an on-site air monitoring station (see Figure 3).

The NAPS Network operates a number of monitoring stations across the country. The NAPS Network reports background air chemistry data that is collected for various gases, particulate matter (PM), as well as various volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Three NAPS stations operate within a reasonable distance of the Project site, including Sudbury, Sault Ste. Marie, and North Bay (see Table 2-2). The NAPS stations also constitute part of the Ontario Ministry of Environment (MOE) Continuous Ambient Air Monitoring Network and are Air Quality Health Index stations.

Table 2-2: Environment Canada NAPS / MOE Air Quality Monitoring Stations

Station	Station ID	Latitude (N)	Longitude (W)
Sudbury	77219	46°28'32.5"	80°57'46.6"
Sault Ste Marie	71078	46°31'59.5"	84°18'35.7"
North Bay	75010	46°19'23.5"	79°26'57.4"

Source: Environment Canada (2013).

The air quality at the urban sites in Sudbury, Sault Ste. Marie, and North Bay are more influenced by urban populations relative to the remote Côté Gold Project site; the data for these stations is therefore considered to be conservative when used as baseline conditions.

Regional background air quality and precipitation quality is also monitored at stations operated as part of the Environment Canada Atmospheric Environment Service's CAPMoN. CAPMoN provides air chemistry and precipitation chemistry data for chloride, calcium, magnesium, sulphate, sodium, ammonium, potassium, sulphur dioxide, nitrate and nitric acid concentrations.

2.2.2 Air Quality Monitoring

Air quality monitoring equipment was installed at the Project site by the meteorological station at the beginning of May, 2013 to measure baseline concentrations of total suspended particles (TSP, including metals; see Figure 3), PM_{10}, sulphur dioxide, and nitrogen oxides for comparison to the long-term data. Sampling was conducted over a period of approximately three months, from May 5 to August 8, 2013. The air sampling methodologies followed the Ministry of Environment (MOE) requirements described in its Operations Manual for Air Quality Monitoring in Ontario (the Manual; 2008). For quality assurance (QA), the Sudbury office of the MOE conducted a field audit of the site on July 13, 2013. The MOE audit found no issues with the site or equipment operation.

Air concentrations of total suspended particulates (TSP) and PM_{10} were measured using high-volume (Hi-Vol) samplers on a 1-in-6 day sampling schedule. The concentrations of SO_2 and NO_2 were measured using passive samplers, with monthly samples collected over the same three-month time period. All the TSP filters were also analyzed for a standard set of metals. The air sampling station is depicted in Photograph 2-1.

Photograph 2-1: Air Quality Monitoring Station at Project Site Meteorological Station

3.0 RESULTS

Results obtained from the regional meteorological stations are representative of conditions over the regional study area, and take into account the local study area sections along the proposed transmission line alignments that extend up to the City of Timmins. Data collected from the meteorological station at the Project site are representative of conditions over the local study area.

3.1 Meteorological Data

The climate in the regional study area may be described as humid continental, with warm and often hot summers and long, cold, snowy winters (Koppen, 2013). A description of aspects of the regional climate is given in the following sections, including precipitation, temperature and wind speed and direction. Climate is further described in the report prepared by Golder Associates (2013) titled: Hydrology and Climate Baseline Report Côté Gold Project - Revised Draft Report.

3.1.1 Precipitation

On average, 831 mm of precipitation occurs annually in Timmins, with 558 mm of this total falling as rain. Most precipitation occurs in the summer months and the Canadian Climate Normals show an extreme precipitation event of 87.6 mm of daily rainfall. The monthly mean precipitation is summarized in Table 3-1.

Table 3-1: Monthly Mean Precipitation (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Timmins	53.9	36.6	59.4	52.8	69.2	89.4	91.5	82.0	88.3	76.8	69.6	61.9
Sudbury	12.5	7.1	29.8	47.0	75.9	77.7	76.6	90.7	101.2	76.8	47.6	13.7
Sault Ste.Marie	71.3	41.1	60.1	68.5	63.1	78.4	76.8	84.7	96.5	86.7	85.7	75.9

Source: Environment Canada (2013).

The Ministry of Transportation (MTO) provides a tool which interpolates intensity, duration and frequency (IDF) data published by Environment Canada for any location in Ontario (Ministry of Transportation, 2010). The IDF return event quantities are provided for Gogama, Ontario (site closest to the Project) and are presented in Table 3-2 and Table 3-3.

Table 3-2: Annual Maximum Rainfall Depth for Gogama, Ontario (mm)

Return Period (year)	Storm Duration								
	5 min	10 min	15 min	30 min	1 hr	2 hr	6 hr	12 hr	24 hr
2	7.7	10.9	13.0	16.5	20.0	24.4	33.5	39.7	46.1
5	10.1	13.8	16.8	20.0	23.6	2635	33.6	37.1	43.4

Return Period (year)	Storm Duration								
	5 min	10 min	15 min	30 min	1 hr	2 hr	6 hr	12 hr	24 hr
10	11.8	15.7	18.7	23.8	31.7	39.3	57.5	66.7	75.5
25	12.2	17.3	21.6	31.9	39.2	49.9	65.0	72.8	84.8
50	13.4	19.3	24.1	35.9	44.6	56.5	72.7	71.2	94.8
100	14.8	21.4	26.7	40.0	49.4	63.0	80.5	89.5	105.0

Notes: min: minutes; hr: hours.
Source: Ministry of Transportation (2013; IDF Curve Lookup).

Table 3-3: Annual Maximum Rainfall Intensity for Gogama, Ontario (mm/h)

Return Period (year)	Storm Duration								
	5 min	10 min	15 min	30 min	1 hr	2 hr	6 hr	12 hr	24 hr
2	92.4	65.4	52.0	33.0	20.0	12.2	5.6	3.3	1.9
5	121.2	82.8	67.2	40.0	23.6	13.3	5.6	3.1	1.8
10	141.6	94.2	74.8	47.6	31.7	19.7	9.6	5.6	3.1
25	146.4	103.8	86.4	63.8	39.2	25.0	10.8	6.1	3.5
50	160.8	115.8	96.4	71.8	44.6	28.3	12.1	6.8	4.0
100	177.6	128.4	106.8	80.0	49.4	31.5	13.4	7.5	4.4

Notes: min: minutes; hr: hours.
Source: Ministry of Transportation (2013; IDF Curve Lookup).

3.1.2 Temperature

The mean annual temperature and precipitation in the area of the Project site is best described by the 1971 to 2000 Canadian Climate Normals for Timmins and Sudbury. Mean monthly temperatures for the regional climate stations are shown in Table 3-4.

Table 3-4: Mean Monthly Temperature (°C)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Timmins	-17.5	-14.4	-7.7	1.2	9.6	14.7	17.4	15.7	10.3	4.2	-4.0	-13.2
Sudbury	-13.6	-11.4	-5.3	3.1	11.3	16.2	19	17.7	12.3	5.8	-1.5	-9.5
Sault Ste. Marie	-10.5	-9.7	-4.4	3.1	10	14.5	17.6	17.2	12.8	7.0	0.5	-6.3

Source: Environment Canada (2013).

3.1.3 Wind Speed and Direction

Wind data, as Climate Normals for the three proximate weather stations, are available from the National Climate Data and Information Archive (Environment Canada, 2013). According to the Environment Canada Climate Normals for Timmins (ID 6020379), the winds are predominantly from the north or south and the average wind speed in this region ranges from 9.8 km/h to 13.5 km/h, with the highest average wind in the fall and spring, and the lowest mean wind speed in the summer (6.8 km/h). At the Sudbury station, the winds are predominantly from the south or southwest in summer and from the north in winter. The average monthly wind speed in this region ranges from 13.2 km/h to 17.4 km/h. Meteorological data was also collected at the meteorological station at the Project site (local study area). Wind speed and direction data from the Project site are shown as a wind rose in Graphic 3-1 (wind rose for August 2, 2012 to August 13, 2013 – Côté Gold Project Site Meteorological Station.). A wind rose for the meteorological data used for the dispersion modelling from the Sudbury Airport (1996-2000) has been provided as an inset to Graphic 3-1 for comparison, bearing in mind that the on-site wind data is for a limited period (August, 2012 to August, 2013).

A summary of the Climate Normal wind speed and wind direction data is provided in Table 3-5 and Table 3-6, for the 30-year period from 1971 to 2000 (Environment Canada, 2013).

Table 3-5: Mean Monthly Wind Speed (km/h)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Timmins	12.3	12.3	13.4	13.5	12.4	11.5	10.3	9.8	11.2	12.3	12.5	11.8
Sudbury	16.6	16.1	17.2	17.4	15.9	14.8	13.5	13.2	14.6	16.0	16.7	16.0
Sault Ste. Marie	14.3	12.6	14.1	14.5	13.4	12.0	11.0	10.7	12.5	14.2	15.6	15.0

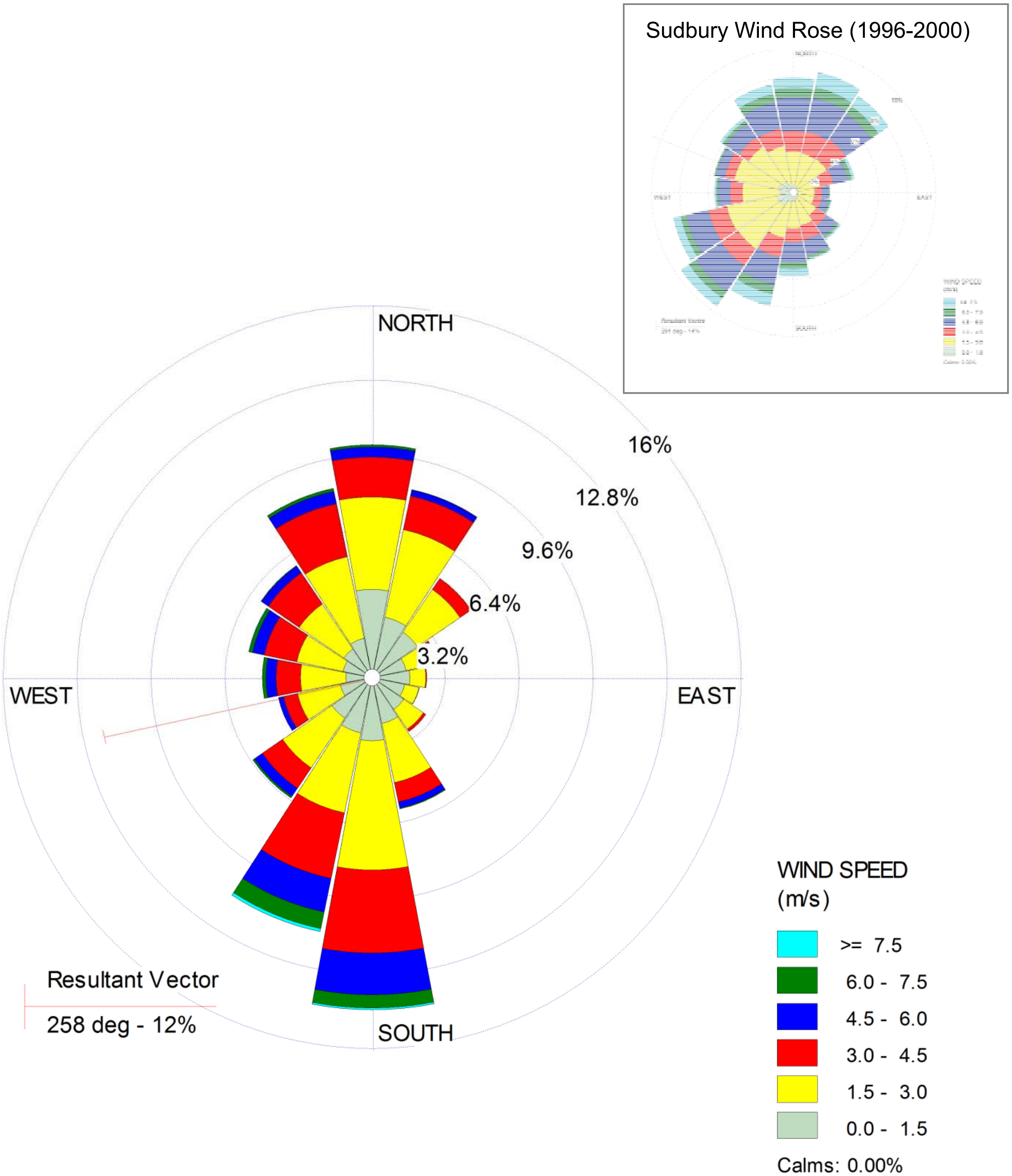
Source: Environment Canada (2013).

Table 3-6: Most Frequent Monthly Wind Direction

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Timmins	W	NW	NW	NW	N	S	S	S	S	S	S	S
Sudbury	SW	N	N	N	N	SW	SW	SW	S	S	SW	NW
Sault Ste. Marie	E	E	W	W	W	W	W	W	NW	E	E	E

Source: Environment Canada (2013).

Graphic 3-1: Wind Rose Diagram for Côté Gold Project Site (August, 2012 to August, 2013) with Sudbury Wind Rose Inset



3.2 Air Quality

Background air quality in the regional study area is expected to be good, given the absence of nearby large urban centres and industrial sources. However, air quality will be influenced by long range transport of air emissions from the south and also by natural sources, such as VOC emissions from vegetation and forest fires.

The baseline air quality data for the following significant emissions anticipated from the Project is detailed in the following sections:

- particulate matter, including TSP, PM_{10}, and $PM_{2.5}$;
- oxides of nitrogen (NO_x), reported as NO_2;
- carbon monoxide (CO);
- sulphur dioxide (SO_2) resulting from sulphur in diesel fuel; and
- metals.

3.2.1 Particulate Matter

Particulate matter (PM) associated with the Project will consist primarily of fugitive dusts, generated from blasting, aggregate crushing, screening, and material handling activities.

Airborne particles are categorized as primary (being emitted directly from the source into the atmosphere) and secondary (being formed in part by chemical and physical transformations). Particles can be chemically inert or active; even if inert, they may adsorb chemically active substances or they may combine to form chemically active species.

It has been generally accepted since the 1970s that there is an association between respiratory health and high levels of airborne particulates. What has not been clear until more recently is that adverse health effects also occur at ambient concentrations that are routinely experienced today in North America and Western Europe. Historically, the standards were developed for the full range of particle sizes that stay airborne (typically particles less than 44 µm). These standards were developed to be protective of visibility impairment. As the scientific data evolved, it was found that the correlation between health effects and particulates was stronger with smaller particle sizes. Standards were then developed for particles with diameters of less than 10 µm (PM_{10}) and, more recently, those standards have been superseded by standards for particle diameters of less than 2.5 µm ($PM_{2.5}$).

Total suspended particulates (TSP) are generally considered to be in the particle size range of up to 44 µm in aerodynamic diameter, and includes the smaller particle size fractions PM_{10} and $PM_{2.5}$. It is emphasized that these particle size fractions are not separate compounds, nor are they additive. The smaller particle sizes are a subset of the large particulate matter size fractions. The standard and Ambient Air Quality Criteria (AAQC) for total PM of 120 µg/m^3 (24-hour averaging time) is based upon potential effects on visibility.

The PM_{10} size fraction is also generally associated with dusts generated by mechanical activities and road dust. The AAQC for PM_{10} is 50 µg/m^3 for the 24-hour averaging time, and is currently identified as an 'interim' AAQC.

Respirable particle $PM_{2.5}$, with particle sizes less than 2.5 µm in diameter, are produced during the combustion of fuels for power generation and equipment operation. The federal criteria are detailed in the *Canadian Environmental Protection Act* (CEPA), and the Canada-Wide Standards (CWS) for particulate matter (respirable particulate matter, $PM_{2.5}$) were set by the CCME[1]. Based upon the CWS, Ontario has established an AAQC level of 30 µg/m^3 for a 24-hour averaging time. New Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ will come into effect in 2015, to replace the current CWS, and are set at 28 µg/m^3 for the 24-hour averaging time, and 10 µg/m^3 for the annual averaging time.

A summary of the TSP and PM_{10} data collected during the on-site air monitoring program between May 4 and August 7, 2013 is provided in Table 3-7; the samples collected during this period represent a limited dataset intended only to supplement the published air quality data available for Sudbury and Sault Ste. Marie. A summary of available background TSP, PM_{10}, and $PM_{2.5}$ air quality data collected by the MOE and Environment Canada is provided in Table 3-8 and Table 3-9. TSP is no longer routinely monitored at either NAPS or MOE stations, therefore the most recent five-year dataset for Sudbury was included (1991-1995).

Table 3-7: Background Particulate Matter (PM) at the Project Site

Station	Parameter	24 hr AAQC* (µg/m^3)	Average Concentration (µg/m^3)	90th Percentile 24-hr average (µg/m^3)
Côté Gold	TSP	120	23.1 (arithmetic mean)	37.0
			21.4 (geometric mean)	
	PM_{10}	50*	13.9	20.6

*Ontario Interim AAQC; Sample Size = 15.

Table 3-8: Background TSP at Sudbury, 1991 to 1995

Parameter	24 hr AAQC (µg/m^3)	Station	Measurement	1991	1992	1993	1994	1995
TSP (µg/m^3)	120	Sudbury	Arithmetic Mean	39	34	35	34	40
			Geometric Mean	34	30	31	31	37
			90th Percentile	68	57	55	53	68

[1] The CWS of 30 µg/m^3 is calculated as the 98 percentile over 3 years of daily data. As such, the standard is met if the 30 µg/m^3 is exceeded no more than 22 days over 3 years.

Table 3-9: Background PM_{10} and $PM_{2.5}$ at MOE Stations

Parameter	24 hr AAQC ($\mu g/m^3$)	Station	Measurement	2007	2008	2009	2010	2011
PM_{10} ($\mu g/m^3$)	50 (Ontario Interim AAQC)	Sudbury	Average	19.3	15.8	13.7	13.5	10.5
			90th Percentile	33	28	23	33	18
$PM_{2.5}$ ($\mu g/m^3$)	30 $\mu g/m^3$ (CWS)	Sudbury	Average	4.9	4.1	3.4	3.6	4.0
			90th Percentile	12	9	8	9	9
		Sault Ste. Marie	Average	5.3	4.4	3.8	3.8	4.4
			90th Percentile	13	10	9	9	10

3.2.2 Nitrogen Oxides

There are more than six forms of oxides of nitrogen; nitric oxide (NO) and nitrogen dioxide (NO_2) are the predominant forms found in air emissions and the most significant air pollutants. NO is a colourless gas and NO_2 is a red/brown gas that contributes to the formation of photochemical smog. Only NO, NO_2 and nitrous oxide (N_2O) are found in significant amounts in the atmosphere. Collectively, they are known as nitrogen oxides (NO_x) and are expressed as the equivalent mass concentration of NO_2.

NO_2 acts as an acute irritant and in equal concentration is more injurious than NO. Increased airway resistance is experienced at a concentration of 1 ppm for 15 minutes. NO does not remain stable for long periods in the atmosphere, and oxidizes to NO_2 over time.

NO_2 in the atmosphere is considered a harmful air pollutant and therefore Environment Canada and the Ontario MOE have set AAQC for this form of nitrogen. There are no AAQC for NO or N_2O, though the latter is a greenhouse gas and ozone depleter. In the atmosphere, NO_2 is hydrolysed to form HNO_3 or nitric acid, a compound estimated to form 40% of acid rain.

Emissions of nitrogen oxides are of concern in locations where, in the presence of sunlight, they combine with man-made or natural VOCs to form photochemical smog, containing ozone. In locations where there are already significant existing emissions of NO_x and VOCs, particularly in warm summer months, smog conditions that last days or weeks can be detrimental to human health, crop and vegetation growth and health.

Since NO_2 has adverse effects at much lower concentrations than NO, and NO converts to NO_2 in ambient air, the standard and AAQC for nitrogen oxides is based on the health effects of NO_2. In the assessment of ambient air quality, NO_2, not NO_x, is the reference compound. In assessing NO_x effects for ambient air quality effects, AAQCs should only be compared to monitored nitrogen dioxide (NO_2) data. MOE has conservatively determined that for assessing compliance for a facility, total NO_x emissions are to be considered as NO_2 with Ontario Regulation (O. Reg.) 419 Schedule 3 standards with 1-hour and 24-hour averaging times for total NO_x expressed as NO_2. The AAQC and O. Reg. 419/05 Schedule 3 standards for NO_2 (though determined differently) are equivalent, at 400 μg/m^3 (200 ppb) for a 1-hour averaging time, and 200 μg/m^3 (100 ppb) for a 24-hour averaging time. These standards are based upon potential health effects of exposure to NO_x.

Ambient NO_2 concentrations measured at North Bay and Sault Ste. Marie for the five year period 2007-2011 are presented in Table 3-10; these are considered representative background concentrations for the regional study area.

For comparison, the data from the passive samplers at the Project site indicate levels for NO_2 that range from 0.4 μg/m^3 to 0.8 μg/m^3 (0.2 ppb to 0.4 ppb). The data are consistent with the MOE and NAPS monitoring data.

3.2.3 Sulphur Oxides

Sulphur oxides, or SO_x, comprise sulphur dioxide (SO_2), sulphur trioxide (SO_3) and solid sulphate forms. Sulphur dioxide is a non-flammable, non-explosive colourless gas. In connection with fuel burning, where the majority is in the form of SO_2, SO_x is normally expressed in terms of the equivalent mass concentration of SO_2 and sometimes as total sulphur. Sulphur oxide has an odour threshold limit of 0.47 ppm to 3.0 ppm, and has a pungent irritating odour above 3 ppm. SO_x compounds are significant contributors to acid rain and are also precursors to the formation of secondary fine particulate matter.

SO_2 is irritating to the eyes and respiratory system above 5 ppm (exposure for 10 minutes), in the form of higher airway resistance. The effects of SO_2 on human health with respect to the short-term (acute) respiratory effects have been extensively studied. No clear evidence of long term or chronic effects is apparent.

Air quality standards for SO_2 have been set for the 1-hour and 24-hour averaging times, with equivalent AAQCs, as summarized in Table 3-10. In addition, Ontario has an annual AAQC of 55 μg/m^3 for SO_2. The standards and AAQC are based upon potential health effects of SO_2, as well as potential effects on vegetation.

Ambient SO_2 concentrations measured at Sault Ste. Marie and Sudbury for the five year period 2007-2011 are presented in Table 3-10; these are considered representative background concentrations for the regional study area. The background concentrations measured at the on-site Côté Gold station by passive sampler are also presented in Table 3-10.

Table 3-10: Background NO_2 and SO_2 at MOE Stations and Project Site Station

Parameter	Standard / AAQCs		Station	Measurement	2007	2008	2009	2010	2011	2013
	24-hour	1-hour								
NO_2 ppb	100 ppb (200 µg/m^3)	200 ppb (400 µg/m^3)	Côté Gold	Average	—	—	—	—	—	0.3
			Sault Ste. Marie	Average	5.0	5.5	5.1	5.5	5.3	—
				90th Percentile	11	12	11	6	12	—
			North Bay	Average	7.4	7.5	8.2	7.6	7.4	—
				90th Percentile	17	18	20	7	17	—
SO_2 ppb	100 ppb (275 µg/m^3)	250 ppb (690 µg/m^3)	Côté Gold	Average	—	—	—	—	—	0.1
			Sudbury	Average	2.3	2.0	1.1	1.3	1.5	—
				90th Percentile	4	3	2	2	2	—
			Sault Ste. Marie	Average	1.8	1.2	0.6	0.7	0.8	—
				90th Percentile	3	3	1	1	1	—

Note: — = no data
Source: Environment Canada (2013); AMEC data (2013).

For comparison, the data from the passive samplers at the on-site Côté Gold station indicate levels for SO_2 of up to 0.5 μg/m^3 (0.2 ppb). The data is consistent with the MOE and NAPS monitoring data.

3.2.4 Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless, tasteless gas, which is produced primarily through the combustion of fossil fuels as a result of incomplete combustion. Over 75% of the CO produced in Ontario is from the transportation sector, while 25% is due to the combined effect of power generation, buildings, heating and industrial operations. Exposures at 100 ppm or greater can be dangerous to human health, and larger exposures can lead to significant toxicity of the central nervous system and heart. The O. Reg. 419/05 CO standard is for a ½-hour averaging time; AAQC exist for the 1-hour and 8-hour averaging times. The standards and AAQC for CO are all based upon potential health effects.

Carbon monoxide (CO) is generally not considered to be a key pollutant from above-ground mining operations (such as the Côté Gold Project) or for discussions of off-site effects; it is more significant for underground mines where worker exposure is of concern.

3.2.5 Other Parameters Associated with Ore Mining and Processing

Several metal species are present in the ore, and are subsequently emitted as trace constituents of the PM during processing. A number of these metals have AAQCs in Ontario based upon potential health impacts for the 24-hour averaging time; a few have AAQCs for the 30-day and annual averaging times as well. Standards are currently in effect for cadmium, mercury, magnesium, nickel, lead, and zinc under O. Reg. 419/05.

The baseline air sampling at the on-site Côté Gold station included analysis of the total suspended particulate collected to quantify the metals concentrations; a summary of the measured concentrations for common metals is provided in Table 3-11. The air monitoring data for the Project site also includes elemental sulphur and sulphate ion (SO_4) concentrations. A number of the metals are reported as not-detected (ND); these metals are analyzed as part of the air monitoring program but have not been present in measureable quantities with the standard air sampling methodologies employed.

Representative ambient monitoring data is not available for hydrogen cyanide for the regional study area; the background concentration was therefore assumed to be equal to that of hydrogen cyanide in the northern hemisphere's non-urban troposphere, which ranges from 160 ppt to 166 ppt, or 0.18 μg/m^3 (Cicerone and Zellner, 1983; Jaramillo et al., 1989).

For mercury, the only reasonable data available for a baseline concentration was the ambient concentration measured by the MOE in Mississauga, Ontario in 2002 (0.0024 μg/m^3).

Table 3-11: Background Metals, Sulphur, and Particulate SO_4 at the Project Site

Station	Parameter	24 hr AAQC (µg/m^3)	Detection Limit (µg/m^3)	Average Concentration (µg/m^3)	Maximum Concentration (µg/m^3)
Côté Gold	Arsenic (As)	0.3	0.0036	< MDL	< MDL
	Cadmium (Cd)	0.025	0.0012	< MDL	< MDL
	Chromium (Cr)	0.0007	0.0012	0.0009	0.0029
	Copper (Cu)	50	0.0012	0.036	0.055
	Iron Oxide (Fe_2O_3)	25	0.0061	0.062	1.94
	Magnesium (Mg)	n/a	0.012	0.074	0.251
	Mercury	2	n/a	0.0024	n/a
	Manganese (Mn)	0.4	0.0006	0.0055	0.012
	Nickel (Ni)	0.2	0.0018	0.0014	0.0059
	Lead (Pb)	0.5	0.0018	0.0013	0.0030
	Sulphur (S)	-	0.0150	0.357	0.95
	Titanium (Ti)	120	0.0006	0.0063	0.029
	Zinc (Zn)	120	0.003	0.0073	0.012
	Sulphate SO_4	-	0.045	1.07	2.86

The metal concentrations cited are in the TSP fraction.
Mercury concentration based upon 2002 MOE data, not the on-site air sampling.

3.3 Air and Precipitation Chemistry

Regional background air quality and precipitation quality is also monitored at stations operated as part of the Environment Canada Atmospheric Environment Service's CAPMoN. CAPMoN provides air chemistry and precipitation chemistry data for chloride, calcium, magnesium, sulphate, sodium, ammonium, potassium, sulphur dioxide, nitrate and nitric acid concentrations. Air quality and precipitation quality data for the Algoma station is summarized in Table 3-12 and Table 3-13. Algoma is located approximately 200 km southwest of the Project site.

Table 3-12: Mean Annual Regional Background Air Quality Data 2005 to 2009, Algoma, ON

Parameter ($\mu g/m^3$)	Measurement	2005	2006	2007	2008	2009	Maximum for Period
Nitric Acid (HNO_3)	Average	0.826	0.657	0.627	0.573	0.448	9.3
	90^{th} Percentile	2.118	1.571	1.636	1.594	1.183	
Sulphur Dioxide (SO_2)	Average	1.534	1.411	1.211	1.141	0.81	23.9
	90^{th} Percentile	4.039	3.852	3.245	3.005	2.118	
Calcium (Ca^{2+})	Average	0.151	0.132	0.132	0.106	0.102	2.45
	90^{th} Percentile	0.404	0.327	0.367	0.266	0.274	
Chloride (Cl^-)	Average	0.018	0.02	0.019	0.021	0.018	0.56
	90^{th} Percentile	0.04	0.051	0.038	0.054	0.043	
Potassium (K^+)	Average	0.036	0.042	0.035	0.03	0.027	0.52
	90^{th} Percentile	0.092	0.101	0.081	0.063	0.062	
Magnesium (Mg^{2+})	Average	0.033	0.028	0.032	0.025	0.022	0.53
	90^{th} Percentile	0.082	0.067	0.094	0.059	0.057	
Sodium (Na^+)	Average	0.044	0.038	0.043	0.054	0.038	0.62
	90^{th} Percentile	0.099	0.088	0.109	0.138	0.108	
Ammonium (NH_4^+)	Average	0.695	0.555	0.563	0.52	0.453	8.06
	90^{th} Percentile	1.988	1.421	1.622	1.327	1.229	
Nitrate (NO_3)	Average	0.536	0.608	0.436	0.506	0.479	13.56
	90^{th} Percentile	1.226	1.443	1.173	1.298	1.107	
Sulphate (SO_4^{2-})	Average	1.971	1.394	1.566	1.339	1.129	24.00
	90^{th} Percentile	4.655	3.361	4.583	3.107	2.527	

Source: Environment Canada (2013).

Table 3-13: Mean Regional Background Precipitation Quality Data 2007 to 2011, Algoma, ON

Parameter	Mean Concentration	Maximum for Period
pH	5.01	6.87
Hydrogen ion (mg/L)	0.017	0.33
Sulphate (mg/L)	1.53	30.12
Nitrate (mg/L)	2.04	38.38
Chloride (mg/L)	0.12	1.75
Ammonium (mg/L)	0.62	8.08
Sodium (mg/L)	0.068	2.01
Calcium (mg/L)	0.32	7.79
Magnesium (mg/L)	0.054	1.98
Potassium (mg/L)	0.044	1.68

Source: Environment Canada (2013).

4.0 SUMMARY

This air quality baseline report documents the existing meteorological conditions and air quality of the regional and local study area prior to development of the proposed Côté Gold Project, which is located in a remote part of Northern Ontario near the town of Gogama.

The regional study area meteorology is well described using the 30-year Climate Normals for the three nearest Environment Canada weather stations located at Timmins, Sudbury, and Sault Ste. Marie.

There are no significant nearby anthropogenic sources of air emissions, and no significant emissions currently from the Project site. Air quality in the Project area would, however, be influenced by long range transport of air emissions from the south and also by natural sources, such as volatile organic emissions from vegetation or natural fires.

Air quality at the urban sites in Sudbury, Sault Ste. Marie, and North Bay is more influenced by urban populations relative to the remote Project site. The data for these stations is therefore considered to be conservative when used as baseline conditions for the regional study area, and has therefore been supplemented by on-site air quality monitoring for key parameters, including TSP, PM_{10}, metals, NO_2, and SO_2 (representative of the existing air quality in the local study area).

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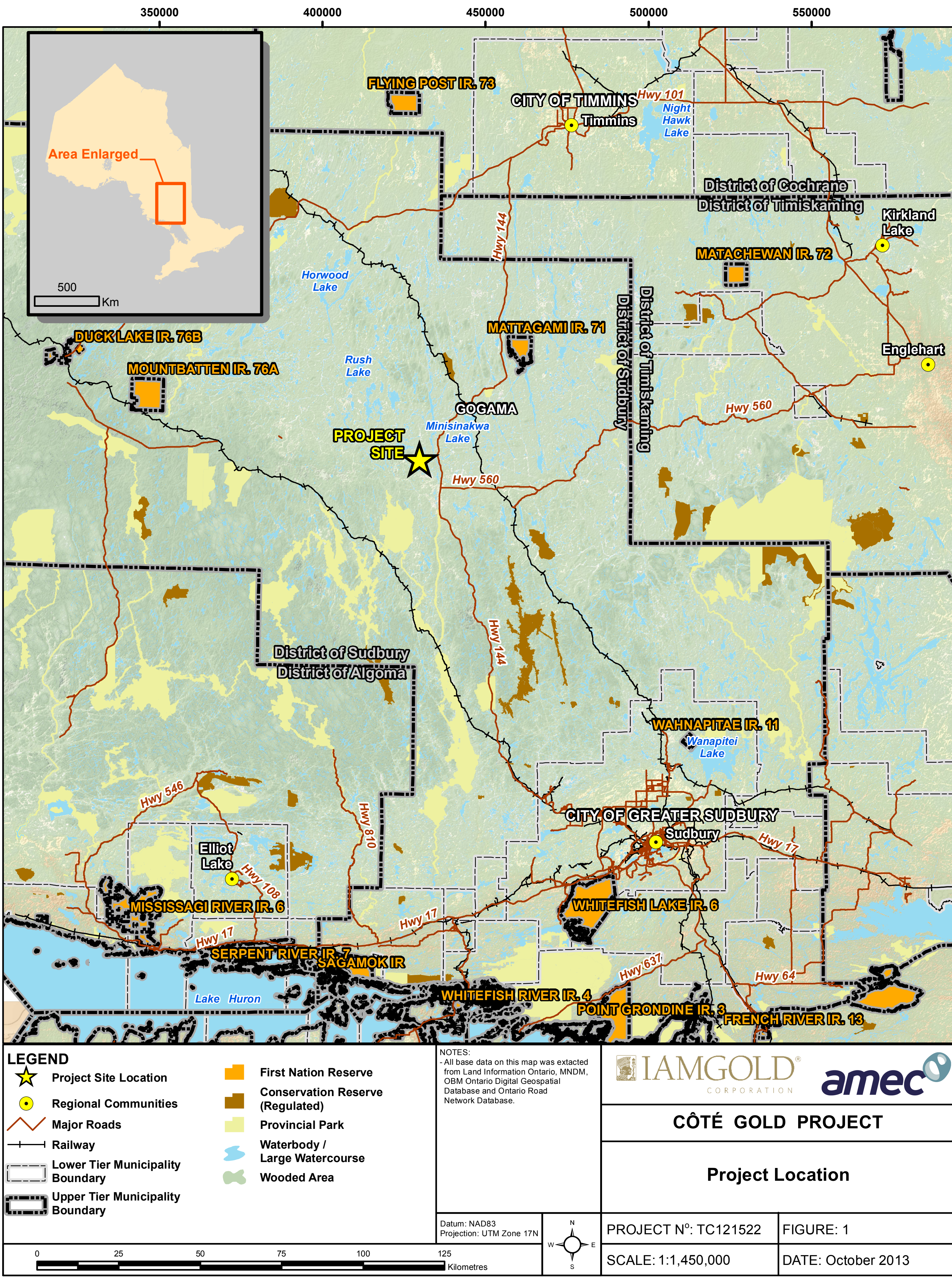
FIGURES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MATACHEWAN IR. 72
Horwood Lake
Hwy 144
District of Timiskaming
District of Sudbury
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MOUNTBATTEN IR. 76A
Rush Lake
MATTAGAMI IR. 71
Englehart
GOGAMA
Minisinakwa Lake
PROJECT SITE
Hwy 560
Hwy 560
District of Sudbury
District of Algoma
Hwy 144
WAHNAPITAE IR. 11
Wanapitei Lake
Hwy 546
Hwy 810
CITY OF GREATER SUDBURY
Sudbury
Hwy 17
Elliot Lake
Hwy 108
MISSISSAGI RIVER IR. 6
WHITEFISH LAKE IR. 6
Hwy 17
Hwy 17
SERPENT RIVER IR. 7
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WHITEFISH RIVER IR. 4
POINT GRONDINE IR. 3
FRENCH RIVER IR. 13
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LEGEND
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Regional Communities
Major Roads
Railway
Lower Tier Municipality Boundary
Upper Tier Municipality Boundary
First Nation Reserve
Conservation Reserve (Regulated)
Provincial Park
Waterbody / Large Watercourse
Wooded Area
NOTES:
- All base data on this map was extacted from Land Information Ontario, MNDM, OBM Ontario Digital Geospatial Database and Ontario Road Network Database.
IAMGOLD CORPORATION
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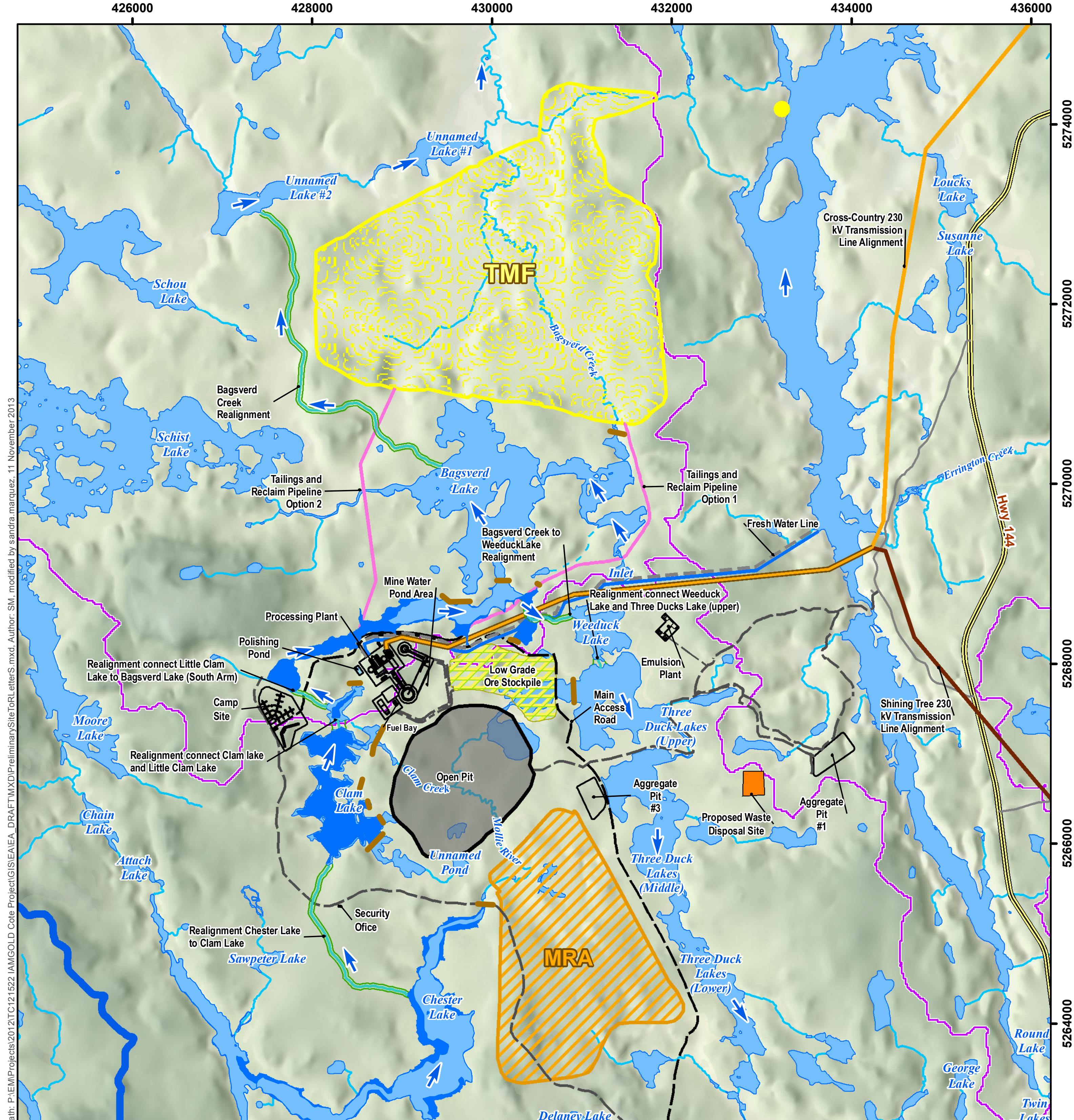
CÔTÉ GOLD PROJECT
Project Location
Datum: NAD83
Projection: UTM Zone 17N
N
W
E
S
PROJECT N°: TC121522
FIGURE: 1
SCALE: 1:1,450,000
DATE: October 2013
0
25
50
75
100
125
Kilometres



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Highway
- Local Road
- Subwatershed Boundary
- Wooded Area
- Open Pit
- Potential Discharge Location
- Facilities
- Dam
- Main Access Road
- Access Road
- Cross-Country 230 kV Transmission Line Alignment
- Shining Tree 230 kV Transmission Line Alignment
- Tailings and Reclaim Pipeline
- Fresh Water
- Water Realignment
- Proposed Water Flow Direction
- Proposed Lake Area
- Polishing Pond
- Low Grade Ore Stockpile
- Proposed Mine Rock Area (MRA)
- Proposed Tailings Management Facility (TMF)
- Proposed Landfill

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- TMF and subwatershed provided by Golder Associates.
- Watercourse realignment and proposed lake area provided by Calder Engineering.
- Surface infrastructure, open pit, landfill, MRA and transmission lines provided by IAMGOLD.
- Mesomikenda Lake is preferred discharge option, but others are being investigated.

Datum: NAD83
Projection: UTM Zone 17N

N E S W

0 1 2 3 4 5 Kilometres

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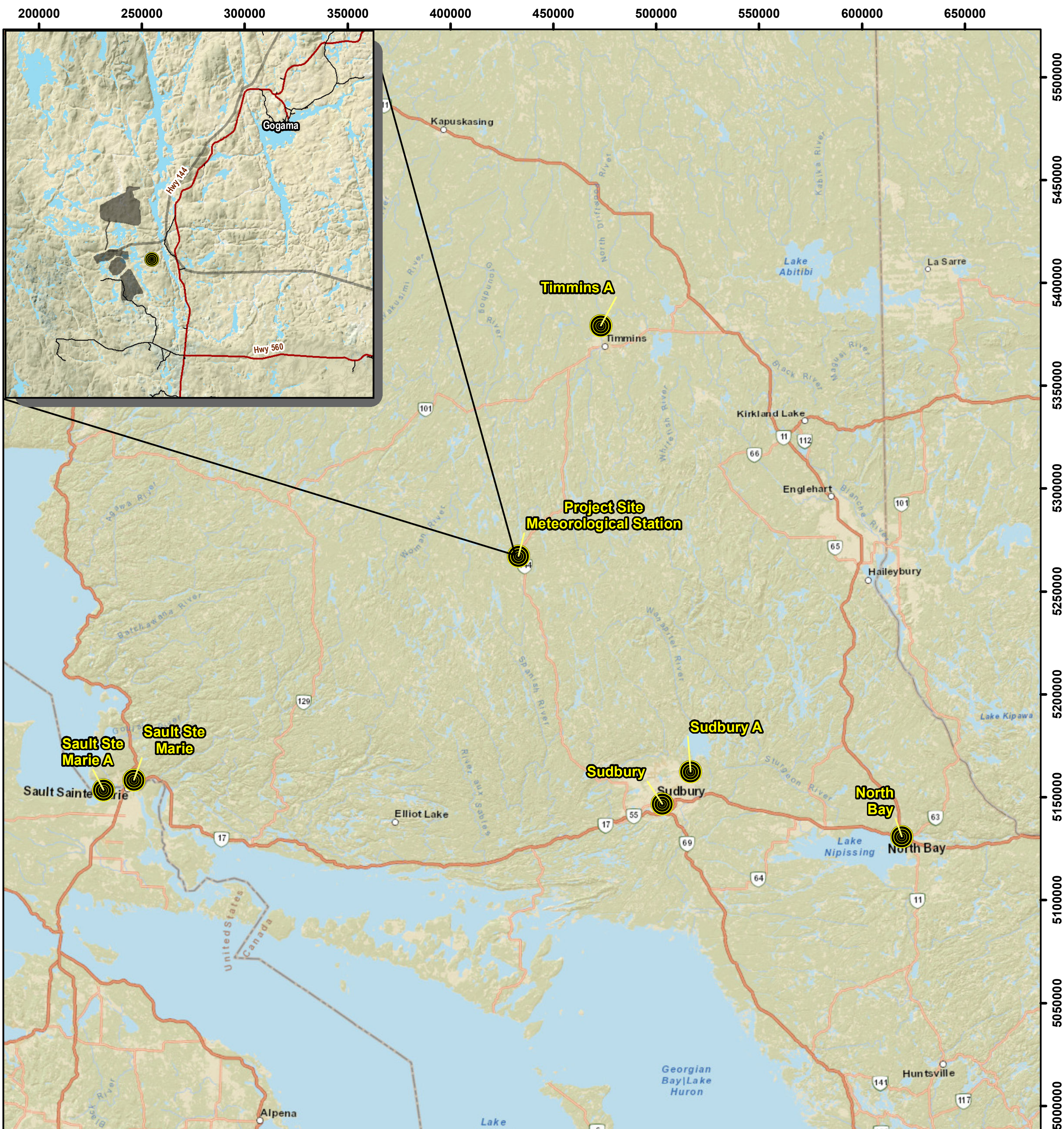
CÔTÉ GOLD PROJECT

Preliminary Site Plan

PROJECT N°: TC121522	FIGURE: 2
SCALE:1:57,000	DATE: December 2013



Path: \\MIS-FS1\ProjectF$\EM\Projects\2012\TC121522 IAMGOLD Cote Project\GIS\Air_Quality\MXD\meteo_stations.mxd, Author: ken.brookes, modified by sandra.marquez, 25 October 2013

LEGEND

Meteorological Stations

NOTES:
- Imagery from ESRI online services
- NAPS / Environment Canada weather stations (2013)
- Project Site Meteorological Station installed in May, 2012.

0 40 80 120 160 200 Kilometres

Datum: NAD83
Projection: UTM Zone 17N

N W E S

IAMGOLD CORPORATION

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CÔTÉ GOLD PROJECT

NAPS / Environment Canada Weather and Project Meteorological Stations

PROJECT N°: TC121522	FIGURE: 3
SCALE: 1:2,500,000	DATE: December 2013

APPENDIX A:
QUALITY BASELINE AND BACKGROUND MONITORING DATA

IAMGOLD CORPORATION

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IAMGOLD Weather Station Monitoring Results for TSP and Metals (May, June, July 2013)

(results expressed in µg/m^3)

Date	TSP	As	Cd	Cr	Co	Cu	Fe(Fe_2O_3)	Pb	Mg	Mn	Ni	Se	S	Ti	V	Zn	SO_4	Hg	HCN
May 4, 2013	29	0.0018	0.0006	0.0006	0.0006	0.0514	1.2662	0.0019	0.251	0.0113	0.0021	0.0031	0.508	0.0117	0.0006	0.0111	1.524	(2002 MOE)	
May 10, 2013	13	0.0018	0.0006	0.0029	0.0006	0.0311	0.3638	0.0009	0.056	0.0027	0.0009	0.0031	0.359	0.0003	0.0006	0.0107	1.077		
May 16, 2013	15	0.0018	0.0006	0.0017	0.0006	0.0122	0.4766	0.0030	0.066	0.0033	0.0009	0.0031	0.151	0.0003	0.0006	0.0046	0.453		
May 22, 2013	9	0.0018	0.0006	0.0006	0.0006	0.0203	0.1210	0.0009	0.006	0.0019	0.0009	0.0031	0.126	0.0003	0.0006	0.0043	0.378		
May 28, 2013	42	0.0018	0.0006	0.0006	0.0006	0.0463	0.7247	0.0009	0.132	0.0096	0.0059	0.0031	0.710	0.0069	0.0006	0.0092	2.130		
June 2, 2013	22	0.0018	0.0006	0.0006	0.0006	0.0198	0.1249	0.0009	0.006	0.0026	0.0009	0.0031	0.132	0.0003	0.0006	0.0115	0.396		
June 4, 2013	32	0.0018	0.0006	0.0006	0.0006	0.0259	0.4456	0.0009	0.006	0.0039	0.0009	0.0031	0.244	0.0003	0.0006	0.0110	0.732		
June 15, 2013	21	0.0018	0.0006	0.0006	0.0006	0.0261	0.6289	0.0009	0.006	0.0059	0.0009	0.0031	0.153	0.0109	0.0006	0.0062	0.459		
June 21, 2013	25	0.0018	0.0006	0.0006	0.0006	0.0468	0.3638	0.0029	0.006	0.0044	0.0009	0.0031	0.954	0.0003	0.0006	0.0094	2.862		
June 27, 2013	18	0.0018	0.0006	0.0019	0.0006	0.0530	0.3187	0.0009	0.006	0.0045	0.0009	0.0031	0.147	0.0003	0.0006	0.0039	0.441		
July 3, 2013	inv																		
Geometric mean	21.4	0.0018	0.0006	0.0008	0.0006	0.0330	0.4553	0.0012	0.0289	0.0046	0.0012	0.0031	0.2361	0.0015	0.0006	0.0066	0.7084		
Arithmetic mean	23.1	0.0018	0.0006	0.0009	0.0006	0.0357	0.6218	0.0013	0.0739	0.0055	0.0014	0.0031	0.3567	0.0063	0.0006	0.0073	1.0701		
Max. concentration	42.0	0.0018	0.0006	0.0029	0.0006	0.0545	1.9430	0.0030	0.2510	0.0120	0.0059	0.0031	0.9540	0.0287	0.0006	0.0122	2.8620		
Min. concentration	9.0	0.0018	0.0006	0.0006	0.0006	0.0122	0.1210	0.0009	0.0060	0.0019	0.0009	0.0031	0.0470	0.0003	0.0006	0.0032	0.1410		
90th percentile	37.0	0.0018	0.0006	0.002	0.0006	0.053	1.468	0.0025	0.2385	0.0115	0.0021	0.0031	0.920	0.018	0.00	0.0113	2.759		
90th percentile (2002 MOE)																		0.0024	
95th percentile	42.0	0.0018	0.0006	0.002	0.0006	0.053	1.738	0.0029	0.2510	0.0117	0.0031	0.0031	0.930	0.026	0.00	0.011675	2.790		
Standard*	120	n/a	0.025*	n/a	n/a	50	25	0.5	n/a	n/a	2	n/a	n/a	120	2	120	n/a		
No. > Sch. 3 value*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Guideline	n/a	0.3	n/a	1.5	0.1	n/a	n/a	n/a	n/a	2.5	n/a	10	n/a	n/a	n/a	n/a	n/a		
No. > guideline	n/a	0	n/a	0	0	n/a	n/a	n/a	n/a	0	n/a	0	n/a	n/a	n/a	n/a	n/a		
No. of valid samples	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16		
No. samples < mdl	0	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16		
Detection limit	3	0.0036	0.0012	0.0012	0.0012	0.0012	0.0061	0.0018	0.0120	0.0006	0.0018	0.0061	0.0150	0.0006	0.0012	0.003	0.045		
Half detection limit	1.5	0.0018	0.0006	0.0006	0.0006	0.0006	0.0031	0.0009	0.0060	0.0003	0.0009	0.0031	0.0075	0.0003	0.0006	0.0015	0.023		
% < detection limit	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
% valid data	107	106.667	106.667	106.667	106.667	106.667	106.7	106.667	106.667	106.667	106.667	106.667	106.667	106.667	106.667	106.6666667	106.67		
BASELINE CONCENTRATION (µg/m^3)	21.4	0.0018	0.0006	0.0009	0.0006	0.0357	0.6218	0.0013	0.0739	0.0055	0.0014	0.0031	0.3567	0.0063	0.0006	0.0073	1.0701	0.0024	0.1800

Notes:

All non detectable results were reported as 1/2 the detection limit

* O. Reg.419/05 schedule 3, 24-hour standard effective February 1, 2013

n/r: Statistics not reported due to high % of values < detection limit

Total Fe expressed as Fe_2O_3 All S assumed to be in SO_4 form

July 3 and 9: Sampler ran twice

References for Other Concentrations Cited

Mercury: Baseline Concentration - 2002 MOE measurements in at Mississauga General Hospital (90th percentile; 2002)

City	ID	Location	Valid h	10%	30%	50%	70%	90%	99%	Mean	Maximum		# of Times Above Criteria
											1 h	24 h	
Mississauga	46110	Mississauga General Hospital	6605	1.50	1.69	1.81	1.97	2.40	3.79	1.91	26.06	3.43	0

Unit: ng/m^3
Hg 1-hour AAQC = 5000 ng/m^3

HCN: Baseline Concentration as reported by Cicerone and Zellner (1983) in northern hemisphere non-urban troposphere.

Summary of MOE Measurements at Copper Cliff (Sudbury) and Sault Ste. Marie, 2002

	Cd				Cr			
	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline
Copper Cliff	ins.	0.100	0.100	0.100	ins.	0.001	0.009	0.008
Sault Ste. Marie	0.115	0.100	0.200		0.020	0.014	0.043	

	Cu				Mn			
	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline
Copper Cliff	ins.	0.110	0.554	0.099	ins.	0.001	0.011	0.091
Sault Ste. Marie	0.125	0.088	0.220		0.226	0.180	0.522	

	Ni				Pb			
	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline
Copper Cliff	ins.	0.046	0.502	0.026	ins.	0.010	0.020	0.010
Sault Ste. Marie	0.008	0.005	0.022		0.010	0.010	0.020	

	V			
	Mean	50th Percentile (Median)	90th Percentile	2002 Baseline
Copper Cliff	ins.	0.001	0.001	0.004
Sault Ste. Marie	0.014	0.007	0.035	

Côté Gold Project Baseline Monitoring
IAMGOLD Weather Station Monitoring Results for PM_{10} (May, June, July 2013)
(results expressed in µg/m³)

Date	PM_{10}
May 4, 2013	14
May 10, 2013	6
May 16, 2013	7
May 22, 2013	7
May 28, 2013	18
June 3, 2013	13
June 4, 2013	21
June 15, 2013	15
June 21, 2013	20
June 27, 2013	14
July 3, 2013	
July 9, 2013	
July 15, 2013	
July 21, 2013	
July 27, 2013	
Geometric mean	12.4
Arithmetic mean	13.5
Max. concentration	21.0
Min. concentration	6.0
90th percentile	20.1
95th percentile	20.6
AAQC	50*
Number > AAQC	0
No. of valid samples	10
No. samples < mdl	0
Detection limit	3
Half detection limit	1.5
% < detection limit	0
% valid data	67

Notes:
All non detectable results were reported as 1/2 the detection limit
* Interim 24-hour criterion
** Effective April 2012
n/r: Statistics not reported due to high % of values < detection limit

Monitoring Results for Passive SO_2 and NO_2 (2013)
(results expressed in ppb)

Month	Exposure Period	IAMGOLD Weather Station	
		SO_2	NO_2
May	May 8 to June 6	0.2	0.4
June	June 6 to July 11	0.05	0.3
July	July 11 to August 8	0.05	0.2
Arithmetic mean	—	0.1	0.3
Max. concentration	—	0.2	0.4
Min. concentration	—	<0.1	0.2
No. of valid samples	—	3	3
% Valid data	—	100	100
Detection limit	—	0.1	0.1
Half detection limit	—	0.05	0.05

Notes: Non detectable results reported as 1/2 the detection limit

Sudbury Lisgar Street TSP Sampling Results (1991 to 1995)
(results expressed in µg/m³)

Year	No. of samples	Percentiles			Maximum	Arithmetic Mean	Geometric Mean
		50	90	99			
1991	48	33	68	92	105	39.0	34.3
1992	57	29	57	90	90	34.0	29.5
1993	55	30	55	116	118	35.1	30.7
1994	53	33	53	74	77	34.3	31.2
1995	56	34	68	95	96	40.4	37.0

Note: MOE Sampling Station

Sudbury Lisgar Street PM_{10} Sampling Results (2000 to 2011)
(results expressed in µg/m^3)

Year	No. of samples	Percentiles			Maximum	Arithmetic Mean	Geometric Mean
		50	90	99			
2007	46	15	33	54	62	19.3	16.9
2008	44	15	28	48	56	15.8	12.2
2009	42	12	23	47	49	13.7	10.9
2010	51	8	33	47	48	13.5	8.9
2011	55	10	18	29	34	10.5	8.1

Note: MOE Sampling Station

Sault Ste Marie and Sudbury $PM_{2.5}$ Sampling Results (2007 to 2011)
(results expressed in µg/m^3)

Year	No. of samples	Percentiles		Arithmetic Mean	Maximum 1-hr	Maximum 24-hr
		50	90			
2007	S.S. Marie	3	13	5.3	50	33
2008	S.S. Marie	3	10	4.4	41	20
2009	S.S. Marie	3	9	3.8	30	25
2010	S.S. Marie	3	9	3.8	31	18
2011	S.S. Marie	3	10	4.4	46	29
2007	Sudbury	3	12	4.9	46	32
2008	Sudbury	2	9	4.1	42	23
2009	Sudbury	2	8	3.4	27	13
2010	Sudbury	2	9	3.6	31	16
2011	Sudbury	3	9	4	38	22

Note: MOE Air Quality Index Stations

PM2.5 Baseline Concentrations:

Annual Average:	4.2	µg/m^3	(average of 5 years of hourly $PM_{2.5}$ data at S.S.Marie and Sudbury)
24-hr Average:	9.8	µg/m^3	(average of 5 years of 90th percentile $PM_{2.5}$ data at S.S.Marie and Sudbury)

Sault Ste Marie and Sudbury SO_2 Sampling Results (2007 to 2011)

(results expressed in ppb)

Year	No. of samples	Percentiles			Mean	Maximum 1-hr	Maximum 24-hr
		50	90	99			
2007	S.S. Marie	1	3	18	1.8	82	11
2008	S.S. Marie	0	3	14	1.2	52	8
2009	S.S. Marie	0	1	16	0.6	47	12
2010	S.S. Marie	0	1	16	0.7	52	8
2011	S.S. Marie	0	1	17	0.8	54	11
2007	Sudbury	1	4	38	2.3	352	31
2008	Sudbury	0	3	35	2.0	213	31
2009	Sudbury	0	2	22	1.1	131	22
2010	Sudbury	0	2	26	1.3	372	44
2011	Sudbury	0	2	25	1.5	113	18

Note: MOE Air Quality Index Stations

Sault Ste Marie and North Bay NO_2 Sampling Results (2007 to 2011)
(results expressed in ppb)

Year	No. of samples	Percentiles		Mean
		90	99	
2007	North Bay	17	38	7.4
2008	North Bay	18	40	7.5
2009	North Bay	20	43	8.2
2010	North Bay	7	17	7.6
2011	North Bay	17	43	7.4
2007	S.S. Marie	11	25	5.0
2008	S.S. Marie	12	24	5.5
2009	S.S. Marie	11	26	5.1
2010	S.S. Marie	6	11	5.5
2011	S.S. Marie	12	25	5.3

Note:
MOE Air Quality Index Stations

APPENDIX II:
Emission Summary Tables

Table II-1-A: Emission Summary Table with Comparison to Ontario Ambient Air Quality Criteria (AAQC)

Compounds	CAS Number	Facility Emission Rate (g/s)	Model Used	Modelled POI Concentration (µg/m^3)	Averaging Period (hr - unless noted otherwise)	Ontario AAQC (µg/m^3)	Limiting Effect	% of Criteria
Total Particulate (TSP)	NA	114.53	AERMOD	197	24	120	visibility	164.5%
		114.53	AERMOD	21.4	annual	60		35.7%
PM_{10}	NA	36.01	AERMOD	113	24	50	health	225.4%
$PM_{2.5}$	NA	6.88	AERMOD	30.4	24	25	health	121.6%
		6.88	AERMOD	3.8	annual	8.8		43.6%
Nitrogen Dioxide	10102-44-0	199.68	AERMOD	304	1	400	health	75.9%
		98.36	AERMOD	101	24	200		50.6%
Carbon Monoxide	630-08-0	611.55	AERMOD	2636	1	36200	health	7.3%
		120.67	AERMOD	1683	8	15700		10.7%
Sulfur Dioxide	7446-09-5	6.34	AERMOD	36.4	24	275	health and vegetation	13.2%
		36.40	AERMOD	165	1	690		23.9%
		6.34	AERMOD	4.7	annual	55		8.5%
Hydrogen Cyanide	74-90-8	1.01	AERMOD	7.6	24	8	health	95.2%
Calcium Oxide (CaO)	1305-78-8	0.17	AERMOD	8.7	24	10	corrosion	86.7%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	AERMOD	2.5	24	20	Limit established by Certified Toxicologist	12.4%
Magnesium	1309-48-4	3.37	AERMOD	5.92	24	120	particulate	4.9%
Manganese - in $PM_{2.5}$	7439-96-5	6.50E-03	AERMOD	2.87E-02	24	0.1	health	28.7%
- in PM_{10}		3.40E-02	AERMOD	1.07E-01	24	0.2		53.3%
- in TSP		1.06E-01	AERMOD	1.87E-01	24	0.4		46.6%
Nickel - in TSP	7440-02-0	6.39E-03	AERMOD	1.12E-02	24	0.2	health	5.6%
			AERMOD	1.22E-03	annual	0.04		3.0%
Nickel - in PM_{10}		2.05E-03	AERMOD	6.42E-03	24	0.1		6.4%
			AERMOD	7.07E-04	annual	0.02		3.5%
Arsenic	7440-38-2	4.82E-04	AERMOD	0.001	24	0.3	health	0.3%
Chromium	7440-47-3	2.13E-02	AERMOD	0.037	24	0.5	health	7.5%
Mercury	7439-97-6	1.12E-05	AERMOD	1.97E-05	24	2	health	0.001%
Lead	7439-92-1	6.73E-04	AERMOD	2.58E-04	30 day	0.2	health	0.1%
		6.73E-04	AERMOD	1.18E-03	24	0.5		0.2%
Titanium	7440-32-6	6.00E-01	AERMOD	1.06E+00	24	120	particulate	0.9%
Zinc	7440-66-6	9.14E-03	AERMOD	1.61E-02	24	120	particulate	0.01%

"insignificant" in % of criteria indicates that the compound concentration is less than 0.1 µg/m^3.
As per ESDM "contaminants without MOE POI limits, impacts can be considered insignificant.

The modelled concentrations account for meteorological anomalies, as per MOE Guidance, except for CO where the maximum concentration was reported.

* the POI limit for copper sulphate cited was developed by certified toxicologist.

** $PM_{2.5}$: The current Canada Wide Standard is 30 µg/m^3. MOE has provided a 25 µg/m^3 single facility guideline to account for cumulative impacts

Table II-1-B: Emission Summary Table with Comparison to Ambient Air Quality Criteria (AAQC) - At Sensitive Receptors

Compounds	CAS Number	Facility Emission Rate (g/s)	Receptor ID	Maximum Modelled Concentration at Sensitive Receptor ($\mu g/m^3$)	Ontario AAQC ($\mu g/m^3$)	Averaging Period (hr - unless noted otherwise)	Limiting Effect	% of Criteria
Total Particulate (TSP)	NA	114.53	POR08	33.8	120	24	visibility	28.1%
		114.53	POR08	4.0	60	annual		6.6%
PM_{10}	NA	36.01	POR02	23.8	50	24	health	47.7%
$PM_{2.5}$	NA	6.88	POR07	11.4	25	24	health	45.6%
		6.88	POR08	0.8	8.8	annual		8.6%
Nitrogen Dioxide	10102-44-0	199.68	POR08	149	400	1	health	37.2%
		98.36	POR08	31.6	200	24		15.8%
Carbon Monoxide	630-08-0	611.55	POR08	914	36200	1	health	2.5%
		120.67	POR07	251	15700	8		1.6%
Sulfur Dioxide	7446-09-5	6.34	POR02	7.8	275	24	health and vegetation	2.8%
		36.40	POR02	80.7	690	1		11.7%
		6.34	POR08	0.5	55	annual		0.9%
Hydrogen Cyanide	74-90-8	1.01	POR07	2.2	8	24	health	27.9%
Calcium Oxide (CaO)	1305-78-8	0.17	POR02	1.8	10	24	corrosion	18.3%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	POR02	0.5	20	24	Limit established by Certified Toxicologist	2.6%
Magnesium	1309-48-4	3.37	POR08	0.99	120	24	particulate	0.8%
Manganese - in $PM_{2.5}$	7439-96-5	6.50E-03	POR07	1.1E-02	0.1	24	health	10.8%
- in PM_{10}		3.40E-02	POR02	2.3E-02	0.2	24		11.3%
- in TSP		1.06E-01	POR08	3.1E-02	0.4	24		7.8%
Nickel - in TSP	7440-02-0	6.39E-03	POR08	1.9E-03	0.2	24	health	0.9%
			POR08	2.2E-04	0.04	annual		0.6%
Nickel - in PM_{10}		2.05E-03	POR02	1.4E-03	0.1	24		1.4%
			POR08	1.5E-04	0.02	annual		0.7%
Arsenic	7440-38-2	4.82E-04	POR08	1.4E-04	0.3	24	health	0.05%
Chromium	7440-47-3	2.13E-02	POR08	6.3E-03	0.5	24	health	1.3%
Mercury	7439-97-6	1.12E-05	POR08	3.3E-06	2	24	health	0.0002%
Lead	7439-92-1	6.73E-04	POR07	3.1E-04	0.2	30 day	health	0.2%
		6.73E-04	POR08	2.0E-04	0.5	24		0.04%
Titanium	7440-32-6	6.00E-01	POR08	1.8E-01	120	24	particulate	0.1%
Zinc	7440-66-6	9.14E-03	POR08	2.7E-03	120	24	particulate	0.002%

"insignificant" in % of criteria indicates that the compound concentration is less than 0.1 $\mu g/m^3$.
As per ESDM "contaminants without MOE POI limits, impacts can be considered insignificant.

The modelled concentrations account for meteorological anomalies, as per MOE Guidance, except for CO where the maximum concentration was reported.

* the POI limit for copper sulphate cited was developed by certified toxicologist.

** $PM_{2.5}$: The current Canada Wide Standard is 30 $\mu g/m^3$. MOE has provided a 25 $\mu g/m^3$ single facility guideline to account for cumulative impacts

Table II-1-C: Emission Summary Table with Comparison to Ontario Regulation 419/05 Standards and Guidelines

Compound	CAS Number	Facility Emission Rate (g/s)	Dispersion Model Used	Modelled POI Concentration (μg/m^3)	Averaging Period (hr - unless noted otherwise)	Ontario Regulation 419/05 POI Limit (μg/m^3)	Limiting Effect	Ontario Regulation 419/05 Schedule	% of Criteria
Total Particulate (TSP)	NA	114.53	AERMOD	37.18	24	120	visibility	3	31.0%
Nitrogen Oxides (as NO_2)	10102-44-0	98.36	AERMOD	53.43	24	200	health	3	26.7%
		199.68	AERMOD	240	1	400		3	60.1%
Carbon Monoxide	630-08-0	611.55	AERMOD	976	0.5	6000	health	3	16.3%
Sulfur Dioxide	7446-09-5	6.34	AERMOD	35.63	24	275	health and vegetation	3	13.0%
		36.40	AERMOD	162	1	690		3	23.4%
Hydrogen Cyanide	74-90-8	1.01	AERMOD	7.61	24	8	health	3	95.2%
Calcium Oxide (CaO)	1305-78-8	0.17	AERMOD	8.67	24	10	corrosion	3	86.7%
Copper Sulphate ($CuSO_4$)	7758-99-8	0.05	AERMOD	2.48	24	20	Limit established by Certified Toxicologist		12.4%
Manganese	7439-96-5	0.11	AERMOD	1.87E-01	24	0.4	health	Guideline	46.6%
Magnesium	1309-48-4	3.37	AERMOD	5.92	24	120	particulate	3	4.9%
Arsenic	7440-38-2	4.82E-04	AERMOD	8.49E-04	24	0.3	health	Guideline	0.3%
Chromium	7440-47-3	2.13E-02	AERMOD	3.75E-02	24	0.5	health	Guideline	7.5%
Mercury	7439-97-6	1.12E-05	AERMOD	1.97E-05	24	2	health	3	0.001%
Nickel	7440-02-0	6.39E-03	AERMOD	1.22E-03	annual	0.04	vegetation	3	3.0%
Lead	7439-92-1	6.73E-04	AERMOD	1.18E-03	24	0.5	health	3	0.2%
		6.73E-04	AERMOD	2.58E-04	30 day	0.2		3	0.1%
Zinc	7440-66-6	9.14E-03	AERMOD	1.61E-02	24	120	particulate	3	0.01%

"insignificant" in % of criteria indicates that the compound concentration is less than 0.1 μg/m^3.
As per ESDM "contaminants without MOE POI limits, impacts can be considered insignificant.

The modelled concentrations account for meteorological anomalies, as per MOE Guidance, except for CO where the maximum concentration was reported.

* the POI limit for copper sulphate cited was developed by certified toxicologist.

** $PM_{2.5}$: The current Canada Wide Standard is 30 μg/m^3. MOE has provided a 25 μg/m^3 single facility guideline to account for cumulative impacts

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Table II-1-D: Emission Summary Table for On-Site Landfill

Landfill Gas Constituent	CAS Number	Emissions as Constituents of Landfill Gas: Mg/year (from Landgem Model)	g/s	Flux g/s/m²*	MOE Schedule**	Average Time	Ontario AAQC or Reg 419/05 Criteria µg/m³	Maximum POI Concentration µg/m³	% of Criteria
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	7.566E-04	2.4E-05	9.6E-09	3	24	115000	4.3E-04	3.7E-07
1,1,2,2-Tetrachloroethane	79-34-5	2.182E-03	6.9E-05	2.8E-08	No standard or JSL	24	0.1	1.2E-03	1.2E+00
1,1-Dichloroethane (ethylidene dichloride)	75-34-3	2.807E-03	8.9E-05	3.6E-08	3	24	165	1.6E-03	9.6E-04
1,1-Dichloroethene (vinylidene chloride)	75-35-4	2.291E-04	7.3E-06	2.9E-09	3	24	10	1.3E-04	1.3E-03
1,2-Dichloroethane (ethylene dichloride)	107-06-2	4.794E-04	1.5E-05	6.1E-09	3	24	2	2.7E-04	1.4E-02
1,2-Dichloropropane (propylene dichloride)	78-87-5	2.403E-04	7.6E-06	3.0E-09	Guideline	24	2400	1.4E-04	5.7E-06
2-Propanol (isopropyl alcohol)	71-23-8	3.551E-02	1.1E-03	4.5E-07	Guideline	24	16000	2.0E-02	1.3E-04
Acetone	67-64-1	4.804E-03	1.5E-04	6.1E-08	3	24	11880	2.7E-03	2.3E-05
Acrylonitrile	107-13-1	3.950E-03	1.3E-04	5.0E-08	3	24	0.6	2.2E-03	3.7E-01
Benzene	71-43-2	1.015E-02	3.2E-04	1.3E-07	3	Annual	0.45	5.7E-03	1.3E+00
Bromodichloromethane	75-27-4	6.001E-03	1.9E-04	7.6E-08	No standard or JSL	24	0.1	3.4E-03	3.4E+00
Butane	106-97-8	3.434E-03	1.1E-04	4.4E-08	JSL	24	7600	1.9E-03	2.6E-05
Carbon disulfide	75-15-0	5.217E-04	1.7E-05	6.6E-09	Guideline	24	330	2.9E-04	8.9E-05
Carbon monoxide	630-08-0	4.633E-02	1.5E-03	5.9E-07	3	0.5	6000	2.6E-02	4.4E-04
Carbon tetrachloride	56-23-5	7.271E-06	2.3E-07	9.2E-11	3	24	2.4	4.1E-06	1.7E-04
Carbonyl sulfide	463-58-1	3.478E-04	1.1E-05	4.4E-09	JSL	24	3.2	2.0E-04	6.1E-03
Chlorobenzene	108-90-7	3.325E-04	1.1E-05	4.2E-09	Guideline	1	3500	1.1E-03	3.2E-05
Chlorobenzene	108-90-7	3.325E-04	1.1E-05	4.2E-09	Guideline	10 min	4500	1.9E-04	4.2E-06
Chlorodifluoromethane	75-45-6	1.328E-03	4.2E-05	1.7E-08	Guideline	24	350000	7.5E-04	2.1E-07
Chloroethane (ethyl chloride)	75-00-3	9.910E-04	3.1E-05	1.3E-08	3	24	5600	5.6E-04	1.0E-05
Chloroform	67-66-3	4.232E-05	1.3E-06	5.4E-10	3	24	1	2.4E-05	2.4E-03
Chloromethane	74-87-3	7.159E-04	2.3E-05	9.1E-09	3	24	320	4.0E-04	1.3E-04
Dichlorobenzene	95-50-1	3.647E-04	1.2E-05	4.6E-09	Guideline	1	30500	1.2E-03	4.0E-06
Dichlorodifluoromethane	75-71-8	2.286E-02	7.2E-04	2.9E-07	Guideline	24	500000	1.3E-02	2.6E-06
Dichlorofluoromethane	75-43-4	3.162E-03	1.0E-04	4.0E-08	No standard or JSL	24	0.1	1.8E-03	1.8E+00
Dichloromethane (methylene chloride)	75-09-2	1.405E-02	4.5E-04	1.8E-07	3	24	220	7.9E-03	3.6E-03
Dimethyl sulfide (methyl sulfide)	75-18-3	5.726E-03	1.8E-04	7.3E-08	Guideline	10 min	30	3.2E-03	1.1E-02
Ethane	74-84-0	3.162E-01	1.0E-02	4.0E-06	JSL	24	4800	1.8E-01	3.7E-03
Ethanol	64-17-5	1.470E-02	4.7E-04	1.9E-07	Guideline	1	19000	4.9E-02	2.6E-04
Ethyl mercaptan (ethanethiol)	75-08-1	1.688E-03	5.4E-05	2.1E-08	No standard or JSL	24	0.1	9.5E-04	9.5E-01
Ethylbenzene	100-41-4	5.770E-03	1.8E-04	7.3E-08	3	24	1000	3.3E-03	3.3E-04
Ethylene dibromide	106-93-4	2.220E-06	7.0E-08	2.8E-11	Guideline	24	3	1.3E-06	4.2E-05
Fluorotrichloromethane	75-69-4	1.234E-03	3.9E-05	1.6E-08	Guideline	24	6000	7.0E-04	1.2E-05
Hexane	110-54-3	6.721E-03	2.1E-04	8.5E-08	3	24	7500	3.8E-03	5.1E-05
Hydrogen sulfide	7783-06-4	1.450E-02	4.6E-04	1.8E-07	3	24	7	8.2E-03	1.2E-01
Hydrogen sulfide	7783-06-4	1.450E-02	4.6E-04	1.8E-07	3	10 min	13	8.2E-03	6.3E-02
Mercury (total)	7439-97-6	6.874E-07	2.2E-08	8.7E-12	3	24	2	3.9E-07	1.9E-05
Methyl ethyl ketone	78-93-3	6.049E-03	1.9E-04	7.7E-08	3	24	1000	3.4E-03	3.4E-04
Methyl isobutyl ketone	108-10-1	2.249E-03	7.1E-05	2.9E-08	Guideline	24	1200	1.3E-03	1.1E-04
Methyl mercaptan		1.421E-03	4.5E-05	1.8E-08	3	10 min	13	8.0E-04	6.2E-03
Pentane - VOC	109-66-0	2.813E-03	8.9E-05	3.6E-08	JSL	24	4200	1.6E-03	3.8E-05
Perchloroethylene (tetrachloroethylene)	127-18-4	7.250E-03	2.3E-04	9.2E-08	3	24	360	4.1E-03	1.1E-03
Propane	74-98-6	5.730E-03	1.8E-04	7.3E-08	JSL	24	7200	3.2E-03	4.5E-05
t-1,2-Dichloroethene	156-60-5	3.207E-03	1.0E-04	4.1E-08	Guideline	24	105	1.8E-03	1.7E-03
Toluene	108-88-3	1.851E-01	5.9E-03	2.3E-06	Guideline	24	2000	1.0E-01	5.2E-03
Trichloroethylene (trichloroethene)	79-01-6	4.347E-03	1.4E-04	5.5E-08	3	24	12	2.5E-03	2.0E-02
Vinyl chloride	75-01-4	5.391E-03	1.7E-04	6.8E-08	3	24	1	3.0E-03	3.0E-01
Xylenes	1330-20-7	1.505E-02	4.8E-04	1.9E-07	3	24	730	8.5E-03	1.2E-03

* Landfill Area (m^2) 2500

** In cases where there is no criteria, the MOE insignificance value of 0.1 µg/m³ was used.

Model Results based on 1 g/m²/s: 262109 µg/m³ - 1 hour; 44569 µg/m³ - 24 hour

Table II-2: Source and Contaminant Identification Table

Source Information				Expected Contaminants	Included in Model?
Source	Source Label*	Source Description	General Location		Significant (Yes or No?)
Drill	PIT	Open Pit Mining - Drilling	Open Pit	TSP, metals	Yes
Blast	PIT	Open Pit Mining - Blasting	Open Pit	TSP, NO_x, CO,SO_2, metals	Yes
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	Open Pit	TSP, metals	Yes (TSP, Metals)
In Pit Road	PIT	Open Pit Mining - Haul trucks	Open Pit	TSP, metals	Yes (Metals)
Haul Roads	Roads (various)**	Road Emissions	On-site roads	TSP, metals	Yes (Metals)
Dozers/Graders in pit	PIT	Dozers and Graders in pit	Open Pit	TSP, metals	Yes (TSP, Metals)
Concrete 1	BATCH1	Batch Plant 1	Concrete Batch Plant	TSP	Yes (TSP)
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	Reclaim & Handling	TSP, metals	Yes (TSP)
ReclaimORE	RECLAIMORE	Discharge to stockpile	Reclaim & Handling	TSP, metals	Yes (TSP)
UnloadMRE	Mine Rock East area	Drop at Mine Rock	Mine Rock Stockpile - East	TSP, metals	Yes (TSP)
DozerMRE	Mine Rock East area	Dozer at Mine Rock	Mine Rock Stockpile -East	TSP, metals	Yes (TSP)
UnloadMRW	Mine Rock West area	Drop at Mine Rock	Mine Rock Stockpile - West	TSP, metals	Yes (TSP)
DozerMRW	Mine Rock West area	Dozer at Mine Rock	Mine Rock Stockpile -West	TSP, metals	Yes (TSP)
UnloadOre	ORE	Ore stockpile unloading	Ore Stockpile	TSP, metals	Yes (TSP)
DozerOre	OREDoz	Dozer at Ore stockpile	Ore Stockpile	TSP, metals	Yes (TSP)
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	Primary Crushing	TSP, metals	Yes (TSP)
BagHouse1	BH1 PCRUSH	baghouse for crusher	Primary Crushing	TSP, metals	Yes (TSP)
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	Secondary Crushing	TSP, metals	Yes(TSP)
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	2ndary Reclaim & Handling	TSP,metals	Yes(TSP)
ReclaimORE2	RECLAIMORE2	discharge to stockpile	2ndary Reclaim & Handling	TSP, metals	Yes(TSP)
Grind 1	Grind	Grinding Section	Gold Recovery Area		No: wet process, no emissions
Grind 2	Concentrator	Gravity Concentrator/Vibrating screen	Gold Recovery Area		No: wet process, no emissions
Thick 1	Preleach Thickener	Pre-leach Thickener	Gold Recovery Area		No: wet process, no emissions
Thick 2	Pre-detox Thickener	Pre-detox Thickener	Gold Recovery Area		No: wet process, no emissions
Leach	LEACH	Leach Tanks - LT1 to LT8	Gold Recovery Area	HCN	Yes
SpaceHeat	SPACEHEAT	space heating in process building	Process building	NO_x	Yes
CIP	LEACH	CIP Process	Gold Recovery Area	HCN	included in Leach tank emissions
Acid Wash	EF1	exhaust fan from acid wash and dilute acid tank	Gold Recovery Area	Nitric Acid	No: Insignificant - dilute solution
NaOH Neutral	VENT1	exhaust vent from neutralization tank	Gold Recovery Area	NaOH	No: Insignificant - dilute solution

Table II-2: Source and Contaminant Identification Table

Source Information				Expected Contaminants	Included in Model?
Source	Source Label*	Source Description	General Location		Significant (Yes or No?)
Barren soln/cold	EF2	exhaust fan for barren soln tank and cold strip tank	Gold Recovery Area	neutral soln	No: Insignificant - dilute solution
C-reactivation kilns	EF3, EF4	exhaust fan for carbon reactivation kiln 1	Gold Recovery Area	electric kiln no emissions	No: no significant emissions
Electrowin	EF5, EF6	refinery exhaust fan for some electrowinning cells and pregnant soln tank	Gold Recovery Area	HCN emissions accounted for in leach emissions	No: no significant emissions
Induction Furances	IND1	scrubber to control emissions	Gold Recovery Area	TSP	Yes (TSP)
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	Gold Recovery Area	TSP, CaO	Yes (TSP, CaO)
Scrubber lime slaker	LS1	scrubber for lime slaker	Gold Recovery Area	TSP, CaO	Yes (TSP, CaO)
Flocculant Dust	FLOC1	flocculant handling cartridge filter	Gold Recovery Area	TSP, Pb Nitrate	Yes (TSP, Pb nitrate)
CuSO4 filter	EF11$CuSO_4$	$CuSO_4$ dust filter	Gold Recovery Area	$CuSO_4$	Yes (TSP, $CuSO_4$)
NaOH Tanks	EF9	caustic storage tanks	Gold Recovery Area	NaOH	No: insignificant - Low VP
SO_2 Tanks	Vent 4, Vent 5	SO_2 storage tank vent	Gold Recovery Area	SO_2	No: closed loop transfer only.
Nitric Storage	EF10	Nitric acid tank passive vent	Gold Recovery Area	NaOH	No: insignificant - Low VP
CN-Dest 1	HCND1	CN Destruction Tank 1	Gold Recovery Area	SO_2	Yes (SO_2)
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	Plant Site	Combustion by-products	One generator modelled during testing. Only one unit is tested at a time. Largest 2.5 MW assumed
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2	Plant Site	Combustion by-products	
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3	Plant Site	Combustion by-products	
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4	Plant Site	Combustion by-products	
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5	Plant Site	Combustion by-products	
FuelTank1	FT1	Fire Pump Fuel Tank 1	Plant Site	VOCs	No: Minor tank filling emissions
FirePump1	FP1	Diesel Fire Pump 1	Plant Site	Combustion by-products	Pump modelled during testing.
Diesel Storage	Diesel	DIESEL FUEL STORAGE TANKs	Fuel Island or Plant Site	VOCs	No: Minor tank filling emissions
Gasoline Day	GT1	GASOLINE STORAGE TANK	Fuel Island or Plant Site	VOCs	No: Minor tank filling emissions
Diesel Day	DDT1	DIESEL DAY TANK	Fuel Island or Plant Site	VOCs	No: Minor tank filling emissions
Other Fuel	OFT	OTHER FUEL TANKS	Fuel Island or Plant Site	VOCs	No: Minor tank filling emissions
Combined Diesel/Gas	GDMISC	diesel / gasoline tank	Fuel Island or Plant Site	VOCs	No: Minor tank filling emissions

sources identified as significant and modelled
Note: all TSP includes TSP, PM_{10}, and $PM_{2.5}$
** Haul Road IDs as per Table III-5

Table II-3: Source Summary - Emissions (g/s)

Source	Source ID	Description	Model ID	Emissions (g/s)											
				PM	PM10	PM2.5	NOx		CO		SO_2		HCN	$CuSO_4$	CaO
				24-hr	24-hr	24-hr	1-hr	24-hr	1-hr	8-hr	1-hr	24-hr	24-hr	24-hr	24-hr
TOTAL				114.5	36.0	6.88	199.7	98.4	611.6	120.7	36.4	6.34	1.01	0.05	0.17
Drill	PIT	Open Pit Mining - Drilling	OPIT	0.27	0.14	0.14									
Blast	PIT	Open Pit Mining - Blasting	OPIT	4.15	2.16	0.12	96.58	4.02	510	21.2	31.4	1.3			
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	OPIT	4.67	1.9	0.5									
In Pit Road	PIT	Open Pit Mining - Haul trucks	OPIT	67.3	17.8	1.8	43.91	42.08	43.91	42.08	0.07	0.07			
Haul Roads	Roads (various)**	Road Emissions	OREMILL_HR, ORE_HR, ORESP_HR, MRE_HR, MRW_HR	25.7	6.8	0.7	32.35	32.35	32.35	32.35	0.05	0.05			
Dozers/Graders in pit	PIT	Dozers and Graders in pit	OPIT	1.0	0.8	0.1	17.80	17.06	22.40	22.40	0.04	0.04			
Concrete 1	BATCH1	Batch Plant 1	CBP	0.528	0.234	0.038									
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	MILL	0.57	0.57	0.57									
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	MILL	1.59	0.63	0.18									
UnloadMRE	Mine Rock East area	Drop at Mine Rock	MRE_MH	1.56	0.62	0.18									
DozerMRE	Mine Rock East area	Dozer at Mine Rock	MRE_MH	0.38	0.28	0.04	0.94	0.94	1.05	1.05	0.0018	0.0018			
UnloadMRW	Mine Rock West area	Drop at Mine Rock	MRW_MH	1.56	0.62	0.18									
DozerMRW	Mine Rock West area	Dozer at Mine Rock	MRW_MH	0.38	0.28	0.04	0.94	0.94	1.05	1.05	0.0018	0.0018			
UnloadOre	ORE	Ore stockpile unloading	ORE_MH	0.28	0.11	0.03									
DozerOre	OREDoz	Dozer at Ore stockpile	ORE_MH	0.25	0.19	0.03	0.048	0.048	0.42	0.42	0.00072	0.00072			
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	MILL	0.79	0.32	0.09									
BagHouse1	BH1 PCRUSH	baghouse for crusher	MILL	0.19	0.19	0.19									
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	MILL	0.19	0.19	0.19									
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	MILL	0.57	0.57	0.57									
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor	MILL	1.59	0.63	0.18									
Leach	LEACH	Leach Tanks - LT1 to LT8	LEACH1, LEACH2										1.01		
SpaceHeat	SPACEHEAT	space heating in process building	HEAT				0.65	0.65							
Induction Furances	IND1	scrubber to control emissions	MILL	0.71	0.71	0.71									
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	MILL	0.047	0.05	0.05									0.047
Scrubber lime slaker	LS1	scrubber for lime slaker	MILL	0.1180	0.12	0.12									0.1179869
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	MILL	0.0472	0.05	0.05									
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	MILL	0.047	0.05	0.05								0.047	
CN-Dest 1	HCND1	CN Destruction Tank 1	MILL								4.88	4.88			
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	MILL	0.0504	0.0504	0.0504	6.0672	0.2528	0.7390	0.0924	0.0018	0.0001			
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2		only one operating during testing; largest unit assumed											
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3													
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4													
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5													
FirePump1	FP1	Diesel Fire Pump 1	MILL	0.018	0.018	0.018	0.400	0.02	0.08	0.003	0.000	0.00001			

Table II-3: Source Summary - Emissions (g/s)

Source	Source ID	Description	Model ID	Emissions (g/s)								
				As	Cr	Hg	Mg	Mn	Ni	Pb	Ti	Zn
				24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr
TOTAL				4.82E-04	2.13E-02	1.12E-05	3.37E+00	1.06E-01	6.39E-03	6.73E-04	6.00E-01	9.14E-03
Drill	PIT	Open Pit Mining - Drilling	OPIT	1.17E-06	5.19E-05	2.73E-08	8.19E-03	2.58E-04	1.56E-05	1.64E-06	1.46E-03	2.23E-05
Blast	PIT	Open Pit Mining - Blasting	OPIT	1.79E-05	7.89E-04	4.15E-07	1.25E-01	3.93E-03	2.37E-04	2.49E-05	2.22E-02	3.39E-04
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	OPIT	2.01E-05	8.87E-04	4.67E-07	1.40E-01	4.41E-03	2.66E-04	2.80E-05	2.50E-02	3.81E-04
In Pit Road	PIT	Open Pit Mining - Haul trucks	OPIT	2.90E-04	1.28E-02	6.73E-06	2.02E+00	6.36E-02	3.84E-03	4.04E-04	3.60E-01	5.49E-03
Haul Roads	Roads (various)**	Road Emissions	OREMILL_HR, ORE_HR, ORESP_HR, MRE_HR, MRW_HR	1.10E-04	4.88E-03	2.57E-06	7.70E-01	2.42E-02	1.46E-03	1.54E-04	1.37E-01	2.09E-03
Dozers/Graders in pit	PIT	Dozers and Graders in pit	OPIT	4.31E-06	1.90E-04	1.00E-07	3.01E-02	9.47E-04	5.71E-05	6.01E-06	5.36E-03	8.17E-05
Concrete 1	BATCH1	Batch Plant 1	CBP	2.27E-06	1.00E-04	5.28E-08	1.58E-02	4.99E-04	3.01E-05	3.17E-06	2.83E-03	4.30E-05
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	MILL	2.44E-06	1.08E-04	5.66E-08	1.70E-02	5.35E-04	3.23E-05	3.40E-06	3.03E-03	4.62E-05
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	MILL	6.82E-06	3.01E-04	1.59E-07	4.76E-02	1.50E-03	9.04E-05	9.51E-06	8.48E-03	1.29E-04
UnloadMRE	Mine Rock East area	Drop at Mine Rock	MRE_MH	6.70E-06	2.96E-04	1.56E-07	4.68E-02	1.47E-03	8.88E-05	9.35E-06	8.34E-03	1.27E-04
DozerMRE	Mine Rock East area	Dozer at Mine Rock	MRE_MH	1.62E-06	7.14E-05	3.76E-08	1.13E-02	3.55E-04	2.14E-05	2.26E-06	2.01E-03	3.06E-05
UnloadMRW	Mine Rock West area	Drop at Mine Rock	MRW_MH	6.70E-06	2.96E-04	1.56E-07	4.68E-02	1.47E-03	8.88E-05	9.35E-06	8.34E-03	1.27E-04
DozerMRW	Mine Rock West area	Dozer at Mine Rock	MRW_MH	1.62E-06	7.14E-05	3.76E-08	1.13E-02	3.55E-04	2.14E-05	2.26E-06	2.01E-03	3.06E-05
UnloadOre	ORE	Ore stockpile unloading	ORE_MH	1.19E-06	5.26E-05	2.77E-08	8.31E-03	2.62E-04	1.58E-05	1.66E-06	1.48E-03	2.26E-05
DozerOre	OREDoz	Dozer at Ore stockpile	ORE_MH	1.08E-06	4.76E-05	2.51E-08	7.52E-03	2.37E-04	1.43E-05	1.50E-06	1.34E-03	2.04E-05
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	MILL	3.41E-06	1.51E-04	7.93E-08	2.38E-02	7.49E-04	4.52E-05	4.76E-06	4.24E-03	6.46E-05
BagHouse1	BH1 PCRUSH	baghouse for crusher	MILL	8.12E-07	3.59E-05	1.89E-08	5.66E-03	1.78E-04	1.08E-05	1.13E-06	1.01E-03	1.54E-05
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	MILL									
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	MILL									
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor	MILL									
Leach	LEACH	Leach Tanks - LT1 to LT8	LEACH1, LEACH2									
SpaceHeat	SPACEHEAT	space heating in process building	HEAT									
Induction Furances	IND1	scrubber to control emissions	MILL	3.04E-06	1.35E-04	7.08E-08	2.12E-02	6.69E-04	4.04E-05	4.25E-06	3.79E-03	5.77E-05
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	MILL	2.03E-07	8.97E-06	4.72E-09	1.42E-03	4.46E-05	2.69E-06	2.83E-07	2.52E-04	3.85E-06
Scrubber lime slaker	LS1	scrubber for lime slaker	MILL	5.07E-07	2.24E-05	1.18E-08	3.54E-03	1.11E-04	6.73E-06	7.08E-07	6.31E-04	9.62E-06
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	MILL	2.03E-07	8.97E-06	4.72E-09	1.42E-03	4.46E-05	2.69E-06	2.83E-07	2.52E-04	3.85E-06
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	MILL	2.03E-07	8.97E-06	4.72E-09	1.42E-03	4.46E-05	2.69E-06	2.83E-07	2.52E-04	3.85E-06
CN-Dest 1	HCND1	CN Destruction Tank 1	MILL									
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	MILL	2.17E-07	9.58E-06	5.04E-09	1.51E-03	4.77E-05	2.88E-06	3.03E-07	2.70E-04	4.11E-06
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2										
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3										
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4										
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5										
FirePump1	FP1	Diesel Fire Pump 1	MILL	7.59E-08	3.35E-06	1.77E-09	5.30E-04	1.67E-05	1.01E-06	1.06E-07	9.45E-05	1.44E-06

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Table II-4: Source Summary - Data Quality and Estimating Methods

Source	Source ID	Description	Estimating Method and Data Quality: TSP/PM10/PM2.5	NOx	CO	SO2	CaO	HCN	Metals
Drill	PIT	Open Pit Mining - Drilling	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Blast	PIT	Open Pit Mining - Blasting	Australian NPI Emission Factor C Rating Average	Vendor data from NIOSH	Vendor data from NIOSH	AP-42 Emission Factor D Rating Marginal	NA	NA	NA
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
In Pit Road	PIT	Open Pit Mining - Haul trucks	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Haul Roads	Roads (various)**	Road Emissions	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Dozers/Graders in pit	PIT	Dozers and Graders in pit	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Concrete 1	BATCH1	Batch Plant 1	AP-42 Emission Factors (Plant Wide) B to E Rating Below Average	NA	NA	NA	NA	NA	NA
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	Emission Factor Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	Emission Factor Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
UnloadMRE	Mine Rock East area	Drop at Mine Rock	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
DozerMRE	Mine Rock East area	Dozer at Mine Rock	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
UnloadMRW	Mine Rock West area	Drop at Mine Rock	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
DozerMRW	Mine Rock West area	Dozer at Mine Rock	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
UnloadOre	ORE	Ore stockpile unloading	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
DozerOre	OREDoz	Dozer at Ore stockpile	AP-42 Emission Factor B Rating Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
BagHouse1	BH1 PCRUSH	baghouse for crusher	Emission Factor Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	Emission Factor Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	Emission Factor Above Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor	AP-42 Emission Factor C Rating Average	NA	NA	NA	NA	NA	Engineering Calculation Average quality
	Leach	Leach Tanks - LT1 to LT8	NA	NA	NA	NA	NA	Australian NPI Emission Factor C Rating Average	NA
SpaceHeat	SPACEHEAT	space heating in process building	NA	AP-42 Emission Factor E Rating Marginal	NA	NA	NA	NA	NA
Induction Furances	IND1	scrubber to control emissions	Engineering Estimate Marginal Quality	NA	NA	NA	NA	NA	NA
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	Emission Factor Above Average	NA	NA	NA	Emission Factor Above Average	NA	NA
Scrubber lime slaker	LS1	scrubber for lime slaker	Engineering Estimate Marginal Quality	NA	NA	NA	Engineering Estimate Marginal Quality	NA	NA
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	Emission Factor Above Average	NA	NA	NA	NA	NA	Mass Balance Above Average
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	Engineering Estimate Marginal Quality	NA	NA	NA	NA	NA	Mass Balance Above Average
CN-Dest 1	HCND1	CN Destruction Tank 1	NA	NA	NA	Engineering Calculation Average Data Quality	NA	NA	NA
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA

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Table II-4: Source Summary - Data Quality and Estimating Methods

Source	Source ID	Description	Estimating Method and Data Quality: TSP/PM10/PM2.5	NOx	CO	SO2	CaO	HCN	Metals
FirePump1	FP1	Diesel Fire Pump 1	certified engine emissions Above Average	certified engine emissions Above Average	certified engine emissions Above Average	AP-42 Emission Factor D Rating Marginal	NA	NA	NA

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Table II-5: Source Summary - Percent by Source

Source	Source ID	Description	% of Emissions by Source and Contaminant											
			PM	PM_{10}	$PM_{2.5}$	NO_x		CO		SO_2		HCN	$CuSO_4$	CaO
			24-hr	24-hr	24-hr	1-hr	24-hr	1-hr	24-hr	1-hr	24-hr	24-hr	24-hr	24-hr
Drill	PIT	Open Pit Mining - Drilling	0.2	0.4	2.1									
Blast	PIT	Open Pit Mining - Blasting	3.6	6.0	1.8	48.4	4.1	83.3	17.6	86.1	20.6			
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	4.1	5.2	7.7									
In Pit Road	PIT	Open Pit Mining - Haul trucks	58.8	49.5	25.9	22.0	42.8	7.2	34.9	0.2	1.1			
Haul Roads	Roads (various)**	Road Emissions	22.4	18.9	9.9	16.2	32.9	5.3	26.8	0.1	0.8			
Dozers/Graders in pit	PIT	Dozers and Graders in pit	0.9	2.1	1.5	8.9	17.3	3.7	18.6	0.1	0.6			
Concrete 1	BATCH1	Batch Plant 1	0.5	0.6	0.5									
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	0.5	1.6	8.2									
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	1.4	1.8	2.6									
UnloadMRE	Mine Rock East area	Drop at Mine Rock	1.4	1.7	2.6									
DozerMRE	Mine Rock East area	Dozer at Mine Rock	0.3	0.8	0.6	0.5	1.0	0.2	0.9	0.005	0.03			
UnloadMRW	Mine Rock West area	Drop at Mine Rock	1.4	1.7	2.6									
DozerMRW	Mine Rock West area	Dozer at Mine Rock	0.3	0.8	0.6	0.5	1.0	0.2	0.9	0.005	0.03			
UnloadOre	ORE	Ore stockpile unloading	0.2	0.3	0.5									
DozerOre	OREDoz	Dozer at Ore stockpile	0.2	0.5	0.4	0.02	0.05	0.1	0.3	0.002	0.01			
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	0.7	0.9	1.3									
BagHouse1	BH1 PCRUSH	baghouse for crusher	0.2	0.5	2.7									
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher	0.2	0.5	2.7									
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor	0.5	1.6	8.2									
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor	1.4	1.8	2.6									
Leach	LEACH	Leach Tanks - LT1 to LT8										100.0		
SpaceHeat	SPACEHEAT	space heating in process building				0.3	0.7							
Induction Furances	IND1	scrubber to control emissions	0.6	2.0	10.3									
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	0.04	0.13	0.69									28.6
Scrubber lime slaker	LS1	scrubber for lime slaker	0.1	0.3	1.7									71.4
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	0.0	0.1	0.7									
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	0.0	0.1	0.7								100.0	
CN-Dest 1	HCND1	CN Destruction Tank 1								13.4	76.9			
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	0.0	0.1	0.7	3.0	0.3	0.1	0.1	0.005	0.001			
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2												
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3												
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4												
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5												
FuelTank1	FT1	Fire Pump Fuel Tank 1												
FirePump1	FP1	Diesel Fire Pump 1	0.015	0.049	0.256	0.2	0.02	0.01	0.00	0.00	0.0001			
			100	100	100	100	100	100	100	100	100	100	100	100

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Table II-5: Source Summary - Percent by Source

Source	Source ID	Description	% of Emissions by Source and Contaminant								
			As	Cr	Hg	Mg	Mn	Ni	Pb	Tl	Zn
			24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr	24-hr
Drill	PIT	Open Pit Mining - Drilling	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Blast	PIT	Open Pit Mining - Blasting	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Load	PIT	Open Pit Mining - Load Haul Truck (Shovel)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
In Pit Road	PIT	Open Pit Mining - Haul trucks	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Haul Roads	Roads (various)**	Road Emissions	22.9	22.9	22.9	22.9	22.9	22.9	22.9	22.9	22.9
Dozers/Graders in pit	PIT	Dozers and Graders in pit	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Concrete 1	BATCH1	Batch Plant 1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
BagHouse2	BH2 - under crushed ore pile	Baghouse for conveyor drop under stockpile feed conveyor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ReclaimORE	RECLAIMORE	Discharge to stockpile& Discharge to Conveyor	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
UnloadMRE	Mine Rock East area	Drop at Mine Rock	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DozerMRE	Mine Rock East area	Dozer at Mine Rock	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
UnloadMRW	Mine Rock West area	Drop at Mine Rock	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DozerMRW	Mine Rock West area	Dozer at Mine Rock	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
UnloadOre	ORE	Ore stockpile unloading	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DozerOre	OREDoz	Dozer at Ore stockpile	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Unload Crusher	CRUSH	Fugitive Primary Crusher Feed	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
BagHouse1	BH1 PCRUSH	baghouse for crusher	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Baghouse3	BH3 2ndCrush	baghouse for secondary crusher									
Baghouse4	BH4 - under crushed 2nd ore pile	baghouse for conveyor drop under stockpile feed conveyor									
ReclaimORE2	RECLAIMORE2	discharge to stockpile& Discharge to Conveyor									
Leach	LEACH	Leach Tanks - LT1 to LT8									
SpaceHeat	SPACEHEAT	space heating in process building									
Induction Furances	IND1	scrubber to control emissions	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Lime Baghouse	BH11 Lime	exhaust for lime bin dust collector	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Scrubber lime slaker	LS1	scrubber for lime slaker	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Flocculant Dust collector	FLOC1	flocculant handling cartridge filter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CuSO4 filter	EF11CuSO4	CuSO4 dust filter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CN-Dest 1	HCND1	CN Destruction Tank 1									
Emerg Gen 1	EGEN1	Emergency Diesel Generator 1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Emerg Gen 2	EGEN2	Emergency Diesel Generator 2									
Emerg Gen 3	EGEN3	Emergency Diesel Generator 3									
Emerg Gen 4	EGEN4	Emergency Diesel Generator 4									
Emerg Gen 5	EGEN5	Emergency Diesel Generator 5									
FuelTank1	FT1	Fire Pump Fuel Tank 1									
FirePump1	FP1	Diesel Fire Pump 1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
			100	100	100	100	100	100	100	100	100

Table II-6 - List of Primary Emissions Control Equipment

Dust Collectors

Source ID	Source Description	Make & Model	Flowrate (acfm)	Flowrate (m3/s)
BH1 PCRUSH	Primary Crusher Baghouse	Not yet identified. Will be consistent with specifications	20000	9.4
BH2 - under crushed ore pile	Baghouse at under feed from stockpile (2)	Not yet identified. Will be consistent with specifications	40000	18.9
BH3 2ndCrush	Secondary Crusher	Not yet identified. Will be consistent with specifications	20000	9.4
BH4 - under crushed 2nd ore pile	Baghouse at under feed from stockpile (2)	Not yet identified. Will be consistent with specifications	60000	28.3
BH11 Lime	Lime silo dust collection	Not yet identified. Will be consistent with specifications	5000	2.4
EF11CuSO4	CuSO4	baghouse control	5000	2.4
FLOC1	Flocculant Dust collector	Dry, shaker cartridge type, 70 ft2	5000	2.4

Wet Scrubbers

Source ID	Source Description	Make & Model	Flowrate (acfm)	Flowrate (m3/s)
LS1	Lime Slaking	wet srubber	5000	2.4
IND1	Furnace Exhaust	wet srubber	10000	4.7

Table II-7: AERMOD Dispersion Modelling Source Parameters

Volume Sources

Source ID	X Coord. [m]	Y Coord. [m]	Release Height [m]	Side Length [m]	Building Height [m]	Initial Lateral Dimension [m]	Initial Vertical Dimension [m]	Description
CBP	430992.1	5266774.4	10	130	-	30.23	4.65	Concrete Batch Plant
MILL	429012.2	5267898.3	24	610.29	-	141.93	11.16	Crushing & Process at Mill

Area Sources

Source ID	X Coord. [m]*	Y Coord. [m]*	Release Height [m]	X Side Length [m]	Y Side Length [m]	Angle from North [deg]	Initial Vertical Dimension [m]	Description
LEACH1	428709.5	5267948.0	23.3	33	103.5	-34.81	-	Leach Tanks
LEACH2	428753.8	5267979.2	23.3	33	103.5	-34.81	-	Leach Tanks
LF	432883.9	5266652.9	2	50	50	0	-	Landfill
MRW_MH	431054.4	5264475.8	35	100	100	0	-	Mine Rock Area West - Material Handling
MRE_MH	430588.2	5264922.4	35	100	100	0	-	Mine Rock Area East - Material Handling
ORE_MH	430212.6	5267795.5	11	100	100	0	-	Low Grade Ore Stockpile - Material Handling

* south west corner of source

Open Pit Source

Source ID	X Coord. [m]	Y Coord. [m]	Release Height [m]	X Side Length [m]	Y Side Length [m]	Angle from North [deg]	Pit Volume [m^3]	Description
OPIT	428651.9	5266371.6	74.4	1265	1715	32.65	322843142	Open Pit

Roadways (Line Sources)

Road Segment	ID	Length (km)
Bottom of pit to MR/Mill split	PIT1_HR	3.1
MR/Mill split to Mill (edge of pit)	PIT2_HR	3.1
MR/Mill split to MRE/MRW split	PIT3_HR	1.0
MRE/MRW split to MRW (edge of pit)	PIT4_HR	1.9
MRE/MRW split to MRE (edge of pit)	PIT5_HR	1.6
Ore to mill/stock split	ORE_HR	0.2
Ore to mill from mill/stock split	OREMILL_HR	0.4
Ore to stockpile from mill/stock split	ORESP_HR	0.6
MR to Stockpile. East area	MRE_HR	2.4
MR to Stockpile. West area	MRW_HR	3.2

Table II-8: Frequency Analysis for Total Suspended Particulate (TSP)

Year	Maximum No. of Exceedances
2005	6
2006	3
2007	1
2008	2
2009	2
Five-Year Total	14

DATE	Receptor Co-ordinates (m)		No. of Exceedances at Receptor
	X	Y	
2005	429297	5265562	6
2005	429289	5265554	6
2005	429289	5265534	6
2006	429297	5265562	3
2006	429289	5265554	3
2006	429269	5265554	3
2006	429289	5265534	3
2006	429249	5265554	3
2006	429269	5265534	3
2006	429229	5265554	3
2006	429209	5265554	3
2006	429289	5265514	3
2006	429249	5265534	3
2006	429189	5265554	3
2007	427849	5266014	1
2007	427849	5266114	1
2007	429349	5268714	1
2007	429449	5268714	1
2007	429249	5268714	1
2007	429549	5268714	1
2007	429149	5268714	1
2007	429349	5268814	1
2007	429449	5268814	1
2008	429297	5265562	2
2008	429289	5265554	2
2008	429289	5265534	2
2008	429269	5265554	2
2008	429289	5265514	2
2008	429289	5265494	2
2008	429269	5265534	2
2008	429249	5265554	2
2008	429269	5265514	2
2008	429289	5265474	2
2008	429249	5265534	2
2008	429269	5265494	2
2008	429249	5265514	2
2008	429269	5265474	2
2008	429289	5265454	2
2008	429289	5265434	2
2008	428849	5268714	2
2008	428749	5268714	2
2008	428949	5268714	2
2009	429297	5265562	2
2009	429289	5265554	2

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Table II-9: Frequency Analysis for PM_{10}

Year	Maximum No. of Exceedances
2005	16
2006	10
2007	7
2008	7
2009	9
Five-Year Total	49

DATE	Receptor Co-ordinates (m)		No. of Exceedances at Receptor
	X	Y	
2005	429267	5265561	16
2005	429269	5265554	16
2005	429277	5265561	16
2005	429287	5265562	16
2005	429289	5265494	16
2005	429289	5265514	16
2005	429289	5265534	16
2005	429289	5265554	16
2005	429297	5265562	16
2005	429298	5265552	16
2005	429299	5265542	16
2005	429299	5265532	16
2005	429300	5265522	16
2005	429300	5265512	16
2005	429301	5265502	16
2005	429302	5265493	16
2005	429302	5265483	16
2005	429303	5265473	16
2005	429304	5265463	16
2006	429277	5265561	10
2006	429287	5265562	10
2006	429289	5265534	10
2006	429289	5265554	10
2006	429297	5265562	10
2006	429298	5265552	10
2006	429299	5265542	10
2006	429299	5265532	10
2007	429297	5265562	7
2007	429298	5265552	7
2008	429247	5265561	7
2008	429249	5265554	7
2008	429257	5265561	7
2008	429267	5265561	7
2008	429269	5265514	7
2008	429269	5265534	7
2008	429269	5265554	7
2008	429277	5265561	7
2008	429287	5265562	7
2008	429289	5265474	7
2008	429289	5265494	7
2008	429289	5265514	7
2008	429289	5265534	7
2008	429289	5265554	7
2008	429297	5265562	7
2008	429298	5265552	7
2008	429299	5265542	7
2008	429299	5265532	7
2008	429300	5265522	7
2008	429300	5265512	7
2008	429301	5265502	7
2008	429302	5265493	7
2008	429302	5265483	7
2008	429303	5265473	7
2008	429304	5265463	7
2008	429304	5265453	7
2008	429305	5265443	7
2008	428997	5268672	7
2008	429007	5268673	7
2008	429017	5268673	7
2008	429027	5268673	7
2008	429037	5268674	7
2008	429047	5268674	7
2008	429057	5268674	7
2008	429067	5268674	7
2008	429097	5268675	7
2008	429106	5268676	7
2008	429116	5268676	7
2008	429126	5268676	7
2008	429136	5268677	7
2008	429146	5268677	7
2008	429156	5268677	7
2008	429166	5268678	7
2009	429167	5265561	9
2009	429169	5265554	9
2009	429177	5265561	9
2009	429187	5265561	9
2009	429189	5265534	9
2009	429189	5265554	9
2009	429197	5265561	9
2009	429207	5265561	9
2009	429209	5265514	9
2009	429209	5265534	9
2009	429209	5265554	9
2009	429217	5265561	9
2009	429227	5265561	9
2009	429229	5265494	9
2009	429229	5265514	9
2009	429229	5265534	9
2009	429229	5265554	9
2009	429237	5265561	9
2009	429247	5265561	9
2009	429249	5265474	9
2009	429249	5265494	9
2009	429249	5265514	9
2009	429249	5265534	9
2009	429249	5265554	9
2009	429257	5265561	9
2009	429267	5265561	9
2009	429269	5265454	9
2009	429269	5265474	9
2009	429269	5265494	9
2009	429269	5265514	9
2009	429269	5265534	9
2009	429269	5265554	9
2009	429277	5265561	9
2009	429287	5265562	9
2009	429289	5265454	9
2009	429289	5265474	9
2009	429289	5265494	9
2009	429289	5265514	9
2009	429289	5265534	9
2009	429289	5265554	9
2009	429297	5265562	9
2009	429298	5265552	9
2009	429299	5265542	9
2009	429299	5265532	9
2009	429300	5265522	9
2009	429300	5265512	9
2009	429301	5265502	9
2009	429302	5265493	9
2009	429302	5265483	9
2009	429303	5265473	9
2009	429304	5265463	9
2009	429304	5265453	9
2009	429305	5265443	9

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Table II-10: Frequency Analysis for $PM_{2.5}$

Year	Maximum No. of Exceedances
2005	1
2006	1
2007	1
2008	1
2009	0
Five-Year Total	4

DATE	Receptor Co-ordinates (m)		No. of Exceedances at Receptor
	X	Y	
2005	429297	5265562	1
2005	429298	5265552	1
2005	429057	5268674	1
2005	429216	5268679	1
2005	429047	5268674	1
2006	428967	5268671	1
2006	429683	5268724	1
2006	428957	5268671	1
2006	429136	5268677	2
2006	429564	5268690	2
2006	429574	5268690	2
2007	429296	5268682	1
2007	429286	5268681	1
2007	429276	5268681	1
2007	429305	5268682	1
2007	430294	5269156	1
2007	430145	5269154	1
2008	428698	5268663	1
2008	428689	5268663	1
2008	428708	5268663	1
2008	429277	5265561	1
2008	429302	5265493	1
2008	429302	5265483	1

APPENDIX III:
Emission Calculations

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Table III-1: Generator Sets (Emergency Generators for Operations Phase) and FirePump

Gen Sets (2)	2 x 1.5 MW	**Source ID: Gen1 and Gen 2**
Emission data taken from Specification Sheets		
Fuel Use:	105	gallons per hour
	7.001	lbs/US gallon (density (from CAT Spec sheet))
	735.1	lbs/hour
	18390.0	BTU/lb fuel (from CAT spec sheet)
	13518581	BTU/hour
	7000	BTU/hp-hour (from U.S EPA AP-42)
Hp per unit	1931	hp-hr

	from U.S. EPA AP 42	from Cat spec sheet			
	SO_x	NO_x	PM	CO	
	g/hp-hr	lb/hour	lb/hour	lb/hour	
Factor lb/hour	2.05E-03	28.98	0.2	3.95	lb/hour spec sheet
Emission rate (g/s):	**0.001**	**3.65**	**0.03**	**0.50**	**g/s**
Dimensions (m)	W	L	H		
	12.1	2.4	4.3	cat unit trailer w chasis from web site	

Gen Sets (1)	1 x 250 kw	**Source ID: Gen 3**
Emission data taken from Specification Sheet Appendix G		
Fuel Use:	19	gallons per hour
	7.001	lbs/US gallon (density (from CAT Spec sheet))
	133.0	lbs/hour
	18390.0	BTU/lb fuel (from CAT spec sheet)
	2446219	BTU/hour
	7000	BTU/hp-hour (from AP-42)
Hp	349	hp-hr
	250	kw-hr

	from U.S. EPA AP 42	from Cat spec sheet			
	SO_x	NO_x	PM	CO	
Factor lb/hour	2.05E-03	3.17	0.14	0.6	lb/hour spec sheet
Emission rate (g/s):	**0.00020**	**0.40**	**0.018**	**0.076**	**g/s**
Dimensions (m)	W	L	H		
	1.50	5.10	2.60	rental unit - enclose (Cat 300 kw website)	

Gen Sets (1)	1 x 2.5 MW	**Source ID: Gen 4**
Emission data taken from Specification Sheet Appendix G		
Fuel Use:	172	gallons per hour
	7.001	lbs/US gallon (density (from CAT Spec sheet))
	1204.2	lbs/hour
	18390.0	BTU/lb fuel (from CAT spec sheet)
	22144723	BTU/hour
	7000	BTU/hp-hour (from AP-42)
Hp	3164	hp-hr

	from U.S. EPA AP 42	from Cat spec sheet			
	SO_x	NO_x	PM	CO	
Factor lb/hour	2.05E-03	48.11	0.4	5.86	lb/hour spec sheet
Emission rate (g/s):	**0.00180**	**6.07**	**0.050**	**0.739**	**g/s**
Dimensions (m)	W	L	H		
	12.1	2.4	4.3	cat unit trailer w chasis from website (1.5 MW unit)	

Firepump 1	engine assumed same as generator set above (same horsepower engine)				
Size	350 HP				
	from U.S. EPA AP 42	from Cat spec sheet for 250 kw gen			
	SO_x	NO_x	PM	CO	
Factor lb/hour	2.05E-03	3.17	0.14	0.6	g/hp-hour
Emission rate (g/s):	**0.00020**	**0.40**	**0.018**	**0.076**	**g/s**

Note: For combustion sources $PM_{2.5}$ = PM_{10} = TSP

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Table III-2: Drilling and Blasting

Drilling emissions

	40	holes per shift				
	2	shifts				
		Emission Factors				
	TSP	PM_{10}	$PM_{2.5}$			
uncontrolled	0.59	0.31	0.31	kg/hole	AP-42, Table 11.9-4	C-rating
control level assumed	50	50	50	%	$PM_{10/2.5}$: NPRI based on Mojave Desert report	
emission rate (g/s)	**2.73E-01**	**1.44E-01**	**1.44E-01**			

Blasting - Particulate

Reference Australian NPI for Mining v 3.1 Table 2 (2012)

EF(kg/blast) = 0.00022 $A^{1.5}$ C-Rating

A (blast area) 13,859 m^2

Emission Rate = 358.9 kg/blast

358.9 kg/day

	TSP	**PM_{10}**	**$PM_{2.5}$**
Emission rate (24 hour) (g/s)	**4.15**	**2.16**	**0.12**

$PM_{2.5}$ Emission = 0.03 x TSP emission rate (NPRI - Env Canada)

PM_{10} Emission = 0.52 x TSP emission rate (Australian NPI V3.1)

Blasting NO_x, CO, and SO_2

Reference: Data provided by Supplier..steel pipe comparable to site use

Emulsion per blast 112,887 kg from Key Data sheet

	NO_x	CO	SO_2	
Rating	NA	NA	D	
Emission factor	3.08	16.25	1.0	g/kg (emulsion)
Emission per blast	347693	1834421	112887	g/blast
Emisison rate (one hour)	**96.6**	**509.6**	**31.4**	g/s
Emission rate (24-hour)	**4**	**21**	**1**	g/s

Note: NO_x and CO emission factors are provied by the manufacturer (more conservative)

SO_2 emission factor is based on US EPA AP-42 Table 13.3-1 for Explosives Detonation

NA - Not available

Manufacturer's Emission Factors

Det within	NO_x l/kg	NO_x gm/kg	NO_x lb/ton	NO_2 l/kg	NO_2 gm/kg	NO_2 lb/ton
Steel pipe	1.50	3.08	6.16	0.50	1.03	2.05
sheet metal	2.50	5.14	10.27	0.90	1.85	3.70
sheet metal	3.00	6.16	12.32	1.30	2.67	5.34
AVERAGE			9.59			3.70

Det within	CO l/kg	CO gm/kg	CO lb/ton
Steel pipe	13.00	16.26	32.51
sheet metal	14.00	17.51	35.01
sheet metal	21.00	26.26	52.52
AVERAGE			40.01

Emission Factors from Blasting Suppliers (July 8, 2013) *(unsupported)*

Species	**L/kg**	**g/mol**	**g/kg**
CO	0.01468	28.01	0.02
CO_2	89.36	44.01	163.49
H_2	0.0561	2.02	0.00
NH_3	0.114	17.03	0.08
H_2O	611.4	18.02	458.01
N_2	262.2	28.02	305.42
NO	2.169	30.01	2.71
O_2	1.137	32	1.51
SO_2	0.0129	64.07	0.03
Na_2CO_3	0.00326	105.99	0.01

PV=nRT

PV = (m/M) * RT

m = MPV/RT

$R = 0.0820575 \ \frac{L\ atm}{Kmol}$

Table III-3: Material Handling

Crushing and Screening

Reference: ESDM Procedure Document Table C-1 (March 2009)

Crushing Capacity 3,000 tonnes/hour

	Flowrate (m^3/s)	Concentration (mg/m^3)
Secondary Crusher	9.4	20
Under Pile Control	28.3	20

Using Dust Collector Outlet Loading	TSP	PM_{10}	$PM_{2.5}$	
Primary Crusher Emissions	0.19	0.19	0.19	g/s
Under Pile Control	0.57	0.57	0.57	g/s

Material Loading and Unloading, and Drops at Stockpiles

Reference: AP 42 - Section 11.24 (based on high moisture > 4%)

Activity Data:

Material Handling			
	2,283	tonnes/hour	(ore to mill)
	8,977	tonnes/hour	(mine rock- total- 2 areas)
	1,389	tonnes/hour	(overburden)
	798	tonnes/hour	(ore to stockpile)
	3,000	tonnes/hour	(ore processing)

Emission Factors:

		Uncontrolled			Control Efficiency (water spray or enclosed drop)	Controlled
	SCC	kg/Mg (kg/tonne)	Size Fraction	EPA Rating		kg/Mg
Material Transfer	3-03-024-08	0.005	TSP	C	75%	0.00125
		0.002	PM_{10}	C	75%	0.0005
		0.00057	$PM_{2.5}$	NA	75%	0.00014

The material transfer is used for all conveyor drops, stock pile drops, ore dumps and other locations where material is allowed to fall freely, as per AP42 - Section 11.24.

	Emission Rate (g/s)		
	TSP	*PM_{10}*	*$PM_{2.5}$*
Open Pit Mining - Load Haul Truck (Shovel)	4.67	1.87	0.53
Fugitive Primary Crusher Feed	0.79	0.32	0.09
Mine Rock East area	1.56	0.62	0.18
Mine Rock West area	1.56	0.62	0.18
Ore Processing	1.04	0.42	0.12
Overburden	0.48	0.19	0.05
Ore stockpile unloading	0.28	0.11	0.03

Table III-4: HCN Emissions

HCN Emissions from Leaching Process

Based on Australian NPI (version 2) Dec. 2006

HCN emission from page 28

E (kg of CN) = (0.013 * aqueous concentration of NaCN in tank +0.46) * area of tank * time * 0.96/1000 (equation 1)

aqueous concentration of HCN = concentration as mg/L of NaCN in tank * 10 ^ (9.2 - pH) (equation 2)

The leach process will be operated at a pH of 10.5 to 11, and the target NaCN concentration is 1000 ppm.
The HCN emissions for the scenario with 1000 ppm NaCN in solution was used to ensure estimates are conservative.

	Concentrate Leach			Source of Data
pH = pH in the leach/adsorption tank	> 10.5	> 10.5	> 10.5	Process Design
[NaCN] = Concentration (as mg/l) of NaCN in the leach/adsorption tank	500	350	250	Estimated
[HCN(aq)] = [NaCN] x $10^{(9.2 - pH)}$	25.06	17.54	12.53	calculated from equation (2)
A = Surface area (m2) of the leach/adsorption tank	201	201	201	Process Design
T = Period of emissions (hours)	24	24	24	Process Design
E = Emission of CN (kg) per tank per day	3.64	3.19	2.89	calculated from equation (1)
E = emission of CN g/s per tank	**0.042**	**0.037**	**0.033**	= kg*1000/24/60/60
Total Emissions for Leach circuit overall (g/s)	1.01	0.885	0.80	Total = E (g/s per tank) x number of tanks

Table III-5: Road Dust Emissions (Haul Roads)

Table 1: Particulate Emission Coefficients for Truck Traffic on Unpaved Industrial Roads from AP42 (Chapter 13.2 - Unpaved Roads; Nov 2006)

Constant	Expressed Units	PM_{30} (TPM)[3]	PM_{10}	$PM_{2.5}$	US EPA Data Quality
k	lb/VMT [(1)]	4.9	1.5	0.15	B
a	-	0.7	0.9	0.9	B
b	-	0.45	0.45	0.45	B
Conversion	lb/VMT to g/VKT	281.9	281.9	281.9	

Notes:

1. "lb/VMT" means pounds pre vehicle mile travelled.
2. "g/VKT" means grams per vehicle kilomtre
3. TPM means total particulate matter

Table 2: Fixed Haul Road Segments

Road Source ID Segment	Route or Area Description	Road Dimensions: Distance (km)	Road Dimensions: Length (m)	Total VKT per hour per segment	Uncontrolled kg/hour: TPM Emission Rate	Uncontrolled kg/hour: PM_{10} Emission Rate	Uncontrolled kg/hour: $PM_{2.5}$ Emission Rate	Uncontrolled (g/s): TPM Emission per segment	Uncontrolled (g/s): PM_{10} Emission Rate	Uncontrolled (g/s): $PM_{2.5}$ Emission Rate	Controlled (g/s): TPM Emission per segment	Controlled (g/s): PM_{10} Emission Rate	Controlled (g/s): $PM_{2.5}$ Emission Rate
PIT1_HR	Bottom of pit to MR/Mill split	3.117	3116.7	125.27	847.2	224.3	22.4	235.34	62.29	6.23	35.301	9.344	0.934
PIT2_HR	MR/Mill split to Mill (edge of pit)	3.092	3091.5	31.75	214.7	56.8	5.7	59.64	15.79	1.58	8.946	2.368	0.237
PIT3_HR	MR/Mill split to MRE/MRW split	0.973	973.2	29.12	197.0	52.1	5.2	54.71	14.48	1.45	8.207	2.172	0.217
PIT4_HR	MRE/MRW split to MRW (edge of pit)	1.894	1894.3	28.34	191.7	50.7	5.1	53.25	14.09	1.41	7.987	2.114	0.211
PIT5_HR	MRE/MRW split to MRE (edge of pit)	1.636	1635.7	24.47	165.5	43.8	4.4	45.98	12.17	1.22	6.897	1.825	0.183
ORE	Ore to mill/stock split	0.156	155.7	1.60	10.8	2.9	0.3	3.00	0.80	0.08	0.451	0.119	0.012
OREMILL	Ore to mill from mill/stock split	0.422	422.2	3.21	21.7	5.8	0.6	6.04	1.60	0.16	0.905	0.240	0.024
ORESP	Ore to stockpile from mill/stock split	0.626	626.4	1.67	11.3	3.0	0.3	3.13	0.83	0.08	0.469	0.124	0.012
MRE	MR to Stockpile. East area	2.433	2432.6	36.40	246.2	65.2	6.5	68.38	18.10	1.81	10.257	2.715	0.271
MRW	MR to Stockpile. West area	3.221	3220.7	48.19	325.9	86.3	8.6	90.53	23.96	2.40	13.579	3.594	0.359

	TPM	PM10	PM2.5
Total	93.00	24.62	2.46
Total (in-pit)	67.337	17.82	1.78
Total (outside pit)	25.66	6.79	0.68

Table III-5: Road Dust Emissions (Haul Roads)

Table 3: Truck Details

	Tonnes per hour	Load per Truck (tonnes)	Round Trips per hour	Vehicle Weight Empty (tonnes)	Vehicle Weight Loaded (tonnes)	Mean Vehicle Weight (tonnes)	TPM Emission Factor lb/VKT	PM_{10} Emission Factor lb/VKT	$PM_{2.5}$ Emission Factor lb/VKT	TPM Emission Factor kg/VKT	PM_{10} Emission Factor kg/VKT	$PM_{2.5}$ Emission Factor kg/VKT
Total material out from bottom of pit	12,058	300	40	276.0	576.0	288.0				6.76	1.79	0.18
imperial units						317.2	24.0	6.4	0.6			
MR/Mill split to Mill (edge of pit)	3,081	300	10									
imperial units												
MR/Mill split to MRE/MRW split	8,977	300	30									
imperial units												
MRE/MRW split to MRW (edge of pit)	4,489	300	15									
imperial units												
MRE/MRW split to MRE (edge of pit)	4,489	300	15									
imperial units												
Ore to mill/stock split metric units	3,081	300	10	276.0	576.0	288.0				6.76	1.79	0.18
imperial units						317.2	24.0	6.4	0.6			
Ore to Drop at Process metric units	2,283	300	8	276.0	576.0	288.0				6.76	1.79	0.18
imperial units						317.2	24.0	6.4	0.6			
Ore to Drop at Stockpile metric units	798	300	3	276.0	576.0	288.0				6.76	1.79	0.18
imperial units						317.2	24.0	6.4	0.6			
WR to Stockpile	8,977	300	30	276.0	576.0	288.0				6.76	1.79	0.18
imperial units						317.2	24.0	6.4	0.6			

Road Emission Assumptions (needed for AP42)

Mean Silt Content	5.8	%	based on AP42 Chapter 13.2 for taconite mining
Assumed average speed of trucks	50	km/hour	31.1 miles/hour (not used in calculations)
Assumed Control Efficiency	85	%	based on watering, vehicle speed, lack of silt, dust suppressant

Sample Calculation Segment PIT1-HR:

Step 1: Caculation of lb/VKT (from AP42 - Chapter 13.2.2)

E (lb/vkt) (for TSP) = k x (silt %/12)^a x (mean weight/3)^b (see values for k, a, b above)

= 4.9 x (5.8/12) ^ 0.7 x (317/3) ^ 0.45 = 24 lb/VKT (in Table 3)

Step 2: convert to kg/VKT

E (kg/VKT) = 281.9 g/VKT x 24 lb/vkt /1000 g/kg = 6.76 kg/VKT (this is shown in Table 3)

Step 3: total VKT is obtained from distance travlled x number of round trips per hour.

Total VKT - 3117 m x 40 trips per hour/ 1000 m/km = 125 VK T travelled in an hour. (Table 2)

note: trips per hour is calculed from total tonnes per hour divided by load per truck

Step 4

Total emission rate (kg/hour) = 125 VKT/hour x 6.76 kg/VKT = 847 kg/hour (Table 2)

Step 5

Uncontrolled emission rate (g/s) = 847 kg/hour x 1000 g/kg / 3600 s/hour = 235 g/s (Table 2)

Step 6:

Table III-6: Concrete Batching

Reference: US EPA AP-42 Chapter 11.12 Concrete Batching rating ranges frm E to B

Activity Data:

	Concrete Processing Rate	
	m^3/hr	cubic yard per hour
Batch Plant 1	80	104.6

Emission Factors:	Uncontrolled		Controlled	
	PM (lb/yd^3)	PM_{10} (lb/yd^3)	PM (lb/yd^3)	PM_{10} (lb/yd^3)
Aggregate delivery to ground storage (3-05-011-21)	0.0064	0.0031	0.0064	0.0031
Sand delivery to ground storage (3-05-011-22)	0.0015	0.0007	0.0015	0.0007
Aggregate transfer to conveyor (3-05-011-23)	0.0064	0.0031	0.0064	0.0031
Sand transfer to conveyor (3-05-011-24)	0.0015	0.0007	0.0015	0.0007
Aggregate transfer to elevated storage (3-05-011-04)	0.0064	0.0031	0.0064	0.0031
Sand transfer to elevated storage (3-05-011-05)	0.0015	0.0007	0.0015	0.0007
Cement delivery to Silo (3-05-011-07 controlled)	0.0002	0.0001	0.0002	0.0001
Cement supplement delivery to Silo (3-05-011-17 controlled)	0.0003	0.0002	0.0003	0.0002
Weigh hopper loading (3-05-011-08)	0.0079	0.0038	0.0079	0.0038
Truck mix loading (3-05-011-10)	0.1393	0.03892	0.007952	0.00224

Emission Rates:	Batch Plant 1 - Controlled Emissions		
	PM	PM_{10}	$PM_{2.5}$
Aggregate delivery to ground storage (3-05-011-21)	0.084	0.041	0.007
Sand delivery to ground storage (3-05-011-22)	0.020	0.009	0.001
Aggregate transfer to conveyor (3-05-011-23)	0.084	0.041	0.007
Sand transfer to conveyor (3-05-011-24)	0.020	0.009	0.001
Aggregate transfer to elevated storage (3-05-011-04)	0.084	0.041	0.007
Sand transfer to elevated storage (3-05-011-05)	0.020	0.009	0.001
Cement delivery to Silo (3-05-011-07 controlled)	0.003	0.001	0.0002
Cement supplement delivery to Silo (3-05-011-17 controlled)	0.004	0.003	0.0004
Weigh hopper loading (3-05-011-08)	0.104	0.050	0.008
Truck mix loading (3-05-011-10)	0.105	0.030	0.005
Total:	0.528	0.234	0.038

*PM2.5 not specifically calculated in AP42: Table 11.12-3 ratio of PM10/PM2.5 used to estimate emission

Table III-7: Mill Process and Misc Sources

CN Destruction

Excess SO_2 from CN Destruction

Use of SO_2	1,170	kg/hour	(see Key Data sheet)
Percent Excess	3	%	excess assumed to ensure reaction complete
Emission Rate	9.75	g/s	

Lime Bin Baghouse

Reference: ESDM Procedure Document Table C-1 (March 2009)

Controlled by baghouse. Data Quality "AA"

Flowrate	5000	acfm		
	2.36	am^3/s		
PM Concentration	20	mg/m^3		
Emission Rate	PM (g/s)	PM_{10}	$PM_{2.5}$	
	0.0472	0.0472	0.0472	g/s

Induction Furnace

Furnaces controlled with wet scrubber--- emission based on engineering estimate

Assumed concentration	75	mg/m^3	(estimated maximum)
Flowrate from scrubber	4.72	am^3/s	
Emission Rate (per furnace)	0.35		
Emission Rate (total)	0.71	g/s	assumed same for PM_{10} and $PM_{2.5}$

Lime Slaker

Slaker controlled by wet scrubber --- emission based on engineering estimate

Assumed concentration	50	mg/m^3	(estimated maximum)
Flowrate from scrubber	2.36	am^3/s	(assumed 1600 cfm)
Emission Rate (per slaker)	0.12		
Emission Rate (total)	0.24	g/s	assumed same for PM_{10} and $PM_{2.5}$

CuSO4 Scrubber

Reference: ESDM Procedure Document Table C-1 (March 2009)

Controlled by baghouse. Data Quality "AA"

$CuSO_4$ mixing controlled baghouse

Assumed concentration	20.00	mg/m^3	
Flowrate from scrubber	2.36	am^3/s	
Emission Rate	0.047	g/s	assumed same for PM_{10} and $PM_{2.5}$

Flocculant

Reference: ESDM Procedure Document Table C-1 (March 2009)

Controlled by baghouse. Data Quality "AA"

Flowrate	5000	acfm	
	2.36	am^3/s	
PM Concentration	20	mg/m^3	
Emission Rate	PM (g/s)		
	0.0472	g/s	assumed same for PM_{10} and $PM_{2.5}$

Propane Heating in Process building

Maximum propane use	1500 L/hour			
	48.3 MMBTU/hour	All propane assumed to be used in process building		
	as per ESDM guidance only Nox is considered from NG or propane combustion			
Emission Factors	NO_x		AP42	e-rating
lb/1000 gallon	13			
Emission Rate:	=L/hour x 0.264 gallon/L x EF x 454 g/lb / 1000 /3600 sec/hour			
g/s	0.65			

Table III-8: Ore / Rock Handling at Stockpiles (Dozers)

Bulldozersr at Rock / Ore Stockpiles					
Reference:	US EPA AP-42 Table 11.9-2				
Equation:					
EF(kg/hour) = k*2.6*silt^1.2*moisture^-1.3, k = 1 for TSP					
Silt	5.9	assumed AP42 Taconite mining)			
Moisture	4	assumed			
EF (kg/hour)	3.61		EPA Rating		
TSP	ER (g/s)	1.00	B		
Control Efficiency	75	%	assumed based on watering and BMP		
	0.75	scaling factor for PM10			
	0.105	scaling factor for PM2.5			
Number of Dozers					
	Mine Rock East	1.5	key data	but split between areas	
	Overburden	0	key data		
	Mine Rock West	1.5	key data		
	Ore Stock Pile	1	key data		
	In Pit	4	key data		
		TSP	PM_{10}	$PM_{2.5}$	
Emissions:	Mine Rock East	0.38	0.28	0.04	g/s
	Overburden	0.00	0.00	0.00	g/s
	Mine Rock West	0.38	0.28	0.04	g/s
	Ore Stock Pile	0.25	0.19	0.03	g/s
	In Pit	1.00	0.75	0.11	g/s

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Table III-9: Metal Content of Mine Rock and Ore

Crustal Abundance

	Hg	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li
Unit	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**
Average Crustal Abundance*	0.085	0.075	82,300	1.8	425	3	0.0085	41,500	0.15	25	102	60	56300	20,850	20
Ten Times Average Crustal Abundance*	0.85	0.75	823000	18	4250	30	0.085	415000	1.5	250	1020	600	563000	208500	200
Method Detection Limit	0.01	0.01	0.01	1	5	0.1	0.02	0.01	0.01	0.1	1	0.5	0.01	0.01	1

All Rock Samples Summary

	Hg	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li
Number of Samples	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106
Min	0.050	0.010	21000	0.50	9.8	0.23	0.090	1800	0.020	0.94	27	2.3	2200	460	2.0
Max	0.10	1.3	97000	48	580	2.3	1.7	68000	2.3	45	370	1340	100000	32000	63
Average	0.072	0.31	62340	2.8	200	1.0	0.17	24817	0.20	11	129	138	31464	10456	12
Median	0.050	0.25	62000	1.5	165	1.0	0.090	18000	0.16	5.6	120	51	21500	9450	10
Standard Deviation	0.025	0.23	10673	5.5	150	0.33	0.24	17334	0.23	12	62	226	25885	6545	9.3
10th Percentile	0.050	0.085	52500	0.50	48	0.63	0.090	8050	0.045	1.8	73	15	7150	3300	4.0
90th Percentile	0.10	0.57	74500	4.3	450	1.4	0.32	52500	0.31	35	190	345	71500	18000	27

Concentration in ug/ug															
90th Percentile	1.E-07	5.7.E-07	7.E-02	4.E-06	5.E-04	1.E-06	3.E-07	5.E-02	3.E-07	4.E-05	2.E-04	3.E-04	7.E-02	2.E-02	3.E-05

Screening

assume maximum TSP concentration (i.e. at standard) 120 ug/m^3

insignificant as per ESDM Guidance V3 0.1 ug/m^3

scaling of maximum TSP x concentration

NOTE: compounds that are also at or below the average crustal levels have been screened out as background

	Hg	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li
average	8.60E-06	3.72E-05	7.48E+04	3.34E-04	2.40E-02	1.25E-04	2.08E-05	2.98E+04	2.38E-05	1.36E-03	1.54E-02	1.66E-02	3.78E+04	1.25E+04	1.47E-03
90%ile	6.00E-06	3.00E-05	7.44E+04	1.80E-04	1.98E-02	1.20E-04	1.08E-05	2.16E+04	1.92E-05	6.66E-04	1.44E-02	6.12E-03	2.58E+04	1.13E+04	1.20E-03
Insign	8.60E-05	3.72E-04	7.48E+05	3.34E-03	2.40E-01	1.25E-03	2.08E-04	2.98E+05	2.38E-04	1.36E-02	1.54E-01	1.66E-01	3.78E+05	1.25E+05	1.47E-02
if > 1	6.00E-05	3.00E-04	7.44E+05	1.80E-03	1.98E-01	1.20E-03	1.08E-04	2.16E+05	1.92E-04	6.66E-03	1.44E-01	6.12E-02	2.58E+05	1.13E+05	1.20E-02
Crustal	1.01E-04	4.96E-04	9.09E-01	1.86E-04	5.65E-05	4.15E-05	2.45E-03	7.18E-01	1.58E-04	5.42E-05	1.51E-04	2.76E-04	6.71E-01	6.02E-01	7.35E-05

if >1, then above MOE "insignficant" value only carried forward if above crustal value as well

Compound Carried Forward: Considered a "KEY" metal (often a concern with public) or above insignficant level and above crustal average.

Table III-9: Metal Content of

Crustal Abundance

Unit	Mg µg/g	Mn µg/g	Mo µg/g	Ni µg/g	Pb µg/g	Sb µg/g	Se µg/g	Sn µg/g	Sr µg/g	Ti µg/g	Tl µg/g	U µg/g	V µg/g	Y µg/g	Zn µg/g
Average Crustal Abundance*	23,300	950	1.2	84	14	0.20	0.05	2.3	370	565	0.85	2.7	120	33	70
Ten Times Average Crustal Abundance*	233000	9500	12	840	140	2.0	0.5	23	3700	5650	8.5	27	1200	330	700
Method Detection Limit	0.01	2	0.05	0.5	0.2	0.05	1	0.3	0.5	0.01	0.02	0.05	1	0.05	1

All Rock Samples Sumı

	Mg	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	Y	Zn
Number of Samples	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106
Min	380	40	0.10	1.6	0.56	0.80	0.70	0.50	20	590	0.020	0.061	1.0	4.2	3.1
Max	50000	1400	21	200	50	1.5	6.9	9.5	450	10000	0.33	4.2	250	71	590
Average	12022	355	1.3	24	3.7	0.81	0.79	3.1	117	2688	0.10	1.3	51	22	40
Median	5900	200	0.90	8.3	2.3	0.80	0.70	2.5	94	1900	0.090	1.3	22	21	23
Standard Deviation	12204	344	2.1	36	5.9	0.068	0.61	2.1	82	2035	0.074	0.67	64	10	62
10th Percentile	1950	75	0.40	2.5	1.0	0.80	0.70	0.85	43	905	0.025	0.35	2.0	11	9.1
90th Percentile	30000	945	2.0	57	6.0	0.80	0.85	5.9	220	5350	0.22	1.9	170	35	82

Concentration in ug/ug															
90th Percentile	3.E-02	9.E-04	2.E-06	6.E-05	6.E-06	8.E-07	9.E-07	6.E-06	2.E-04	5.E-03	2.E-07	2.E-06	2.E-04	4.E-05	8.E-05

Screening

	Mg	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	Y	Zn
average	1.44E+04	4.26E-02	1.53E-04	2.92E-03	4.45E-04	9.68E-05	9.51E-05	3.68E-04	1.41E-02	3.23E+03	1.24E-05	1.55E-04	6.14E-03	2.69E-03	4.78E-03
90%ile	7.08E+03	2.40E-02	1.08E-04	9.90E-04	2.70E-04	9.60E-05	8.40E-05	3.00E-04	1.12E-02	2.28E+03	1.08E-05	1.56E-04	2.58E-03	2.52E-03	2.76E-03
Insign	1.44E+05	4.26E-01	1.53E-03	2.92E-02	4.45E-03	9.68E-04	9.51E-04	3.68E-03	1.41E-01	3.23E+04	1.24E-04	1.55E-03	6.14E-02	2.69E-02	4.78E-02
if > 1	7.08E+04	2.40E-01	1.08E-03	9.90E-03	2.70E-03	9.60E-04	8.40E-04	3.00E-03	1.12E-01	2.28E+04	1.08E-04	1.56E-03	2.58E-02	2.52E-02	2.76E-02
Crustal	6.19E-01	4.48E-05	1.27E-04	3.47E-05	3.18E-05	4.84E-04	1.90E-03	1.60E-04	3.80E-05	5.71E+00	1.46E-05	5.73E-05	5.12E-05	8.14E-05	6.83E-05

if >1, then above MOE "insignfica

Compound Carried Forward:

Table III-10: Material Movement by Year

	Maximum Year	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
OPEN-PIT (OP)									
Ore Mine to Mill tonnes	20 000 000	226 717 452		12 646 595	20 000 000	19 134 242	18 157 679	19 257 488	20 000 000
Ore Mine to Ore Stockpile	6 986 150	34 019 807	4 669 728	1 303 277	4 840 197	1 404 620	1 305 274	1 708 598	6 986 150
Overburden tonnes	12 168 191	22 734 290	12 168 191	747 793	3 889 564				5 371 452
Mine Rock tonnes	78 641 622	654 644 326	28 962 814	49 453 514	68 017 692	77 501 544	78 641 622	77 003 610	64 359 996
Overburden and Mine Rock	78 641 622	677 378 616	41 131 005	50 201 307	71 907 256	77 501 544	78 641 622	77 003 610	69 731 448
Total From Pit	98 104 575		45 800 732	64 151 179	96 747 453	98 040 407	98 104 575	97 969 696	96 717 597

based LP data May 14, 2013 *all data in upper block from JP; rest calculated*

Truck Movements to specific areas

PER YEAR

	Maximum Year	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Mine to Mill	133333	1511450		84311	133333	127562	121051	128383	133333
Mine to Stockpile	46574	226799							
Overburden	648970	1212495	648970	39882	207443				286477
Mine Rock	524277	4364296	193085	329690	453451	516677	524277	513357	429067

PER DAY

	Round Trips ("loads x 2")		365	days					
Mine to Mill	365			231	365	349	332	352	365
Mine to Stockpile	128								
Overburden	1778		1778	109	568				785
Mine Rock	1436		529	903	1242	1416	1436	1406	1176

PER HOUR

	Round Trips		22	hours per day					
Mine to Mill	16.6			10.5	16.6	15.9	15.1	16.0	16.6
Mine to Stockpile	5.8								
Overburden	80.8		80.8	5.0	25.8				35.7
Mine Rock	65.3		24.0	41.1	56.5	64.3	65.3	63.9	53.4

Volume Per Year (m3)

(density found in F0 - Key Data)

	Maximum Year	Total	1	2	3	4	5	6	7
Mine to Mill	7 326 007	83 046 686		4 632 452	7 326 007	7 008 880	6 651 164	7 054 025	7 326 007
Mine to Stockpile	2 559 029	12 461 468	1 710 523	477 391	1 772 966	514 513	478 123	625 860	2 559 029
Overburden	5 794 377	10 825 852	5 794 377	356 092	1 852 173				2 557 834
Mine Rock	28 806 455	239 796 457	10 609 089	18 114 840	24 914 905	28 388 844	28 806 455	28 206 451	23 575 090

Cumulative (m3)

Mine to Mill	28 806 455			4 632 452	11 958 460	18 967 340	25 618 504	32 672 529	39 998 536
Mine to Stockpile			1 710 523	2 187 914	3 960 879	4 475 392	4 953 515	5 579 375	8 138 404
Overburden			5 794 377	6 150 469	8 002 642	8 002 642	8 002 642	8 002 642	10 560 476
Mine Rock			10 609 089	28 723 930	53 638 835	82 027 679	110 834 134	139 040 585	162 615 675
Mine Rock and Overburden			16 403 466	34 874 398	61 641 477	90 030 321	118 836 776	147 043 227	173 176 151

Ore Mined			4 669 728	13 949 872	24 840 197	20 538 863	19 462 953	20 966 086	26 986 150

Table III-10: Material Movement by Year

OPEN-PIT (OP)	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Ore Mine to Mill tonnes	17 890 518	19 895 272	15 162 131	15 415 011	20 000 000	20 000 000	9 158 518
Ore Mine to Ore Stockpile	749 867	802 419			4 748 511	5 501 166	
Overburden tonnes	557 289						
Mine Rock tonnes	72 835 865	47 692 398	29 493 223	26 943 934	24 074 064	8 140 544	1 523 507
Overburden and Mine Rock	73 393 154	47 692 398	29 493 223	26 943 934	24 074 064	8 140 544	1 523 507
Total From Pit	92 033 538	68 390 089	44 655 353	42 358 945	48 822 575	33 641 710	10 682 024

based LP data May 14, 2013

Truck Movements to specific area

PER YEAR

Mine to Mill	119270	132635	101081	102767	133333	133333	61057
Mine to Stockpile							
Overburden	29722						
Mine Rock	485572	317949	196621	179626	160494	54270	10157

PER DAY

Mine to Mill	327	363	277	282	365	365	167
Mine to Stockpile							
Overburden	81						
Mine Rock	1330	871	539	492	440	149	28

PER HOUR

Mine to Mill	14.9	16.5	12.6	12.8	16.6	16.6	7.6
Mine to Stockpile							
Overburden	3.7						
Mine Rock	60.5	39.6	24.5	22.4	20.0	6.8	1.3

Volume Per Year (m3)

	8	9	10	11	12	13	14
Mine to Mill	6 553 303	7 287 645	5 553 894	5 646 524	7 326 007	7 326 007	3 354 768
Mine to Stockpile	274 677	293 927			1 739 381	2 015 079	
Overburden	265 376						
Mine Rock	26 679 804	17 469 743	10 803 378	9 869 573	8 818 339	2 981 884	558 061

Cumulative (m3)

Mine to Mill	46 551 839	53 839 484	59 393 378	65 039 903	72 365 910	79 691 917	83 046 686
Mine to Stockpile	8 413 081	8 707 007	8 707 007	8 707 007	10 446 389	12 461 468	12 461 468
Overburden	10 825 852	10 825 852	10 825 852	10 825 852	10 825 852	10 825 852	10 825 852
Mine Rock	189 295 479	206 765 222	217 568 600	227 438 173	236 256 511	239 238 396	239 796 457
Mine Rock and Overburden	200 121 331	217 591 074	228 394 452	238 264 025	247 082 364	250 064 248	250 622 309

Ore Mined	18 640 385	20 697 691	15 162 131	15 415 011	24 748 511	25 501 166	9 158 518

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Table III-11: Road Emissions (Tailpipe)

Tier 4 engine classes and exhaust emission standards

http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=0CBF3BCC-1&offset=6&toc=show#tableAsterisk

Power (kW)	Model years	PM g/kW hr	NO_x g/kW hr	NMHC g/kW hr	NO_x+NMHC g/kW hr	CO g/kW hr
<8 (1)(5)	2012+	0.4	-	-	7.5	8
<8 (2)(5)	2012+	0.6	-	-	7.5	8
≥8<19 (5)	2012+	0.4	-	-	7.5	6.6
≥19<37	2013+	0.03	-	-	4.7	5.5
≥37<56	2013+	0.03	-	-	4.7	5
≥56<130	2014+	0.02	0.4	0.19	-	5
≥130<560	2014+	0.02	0.4	0.19	-	3.5
75<560 (3)	2015+	0.04	3.5	0.19	-	3.5
<560 (4)	2015+	0.03	0.67	0.19	-	3.5

http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=0a57ac29b59ade8455648e60e739a181&rgn=div5&view=text&node=40:34.0.1.1.5&idno=40#40:34.0.1.1.5.2.1.1

Table 1 of § 1039.101—Tier 4 Exhaust Emission Standards After the 2014 Model Year, g/kW-hr [1]

Maximum engine power	Application	PM	NO_x	NMHC	NO_x+NMHC	CO
kW < 19	All	[2] 0.40			7.5	[3] 6.6
19 ≤ kW < 56	All	0.03			4.7	[4] 5.0
56 ≤ kW < 130	All	0.02	0.4	0.19		5
130 ≤ kW ≤ 560	All	0.02	0.4	0.19		3.5
kW > 560	All except generator sets	0.04	3.5	0.19		3.5
	Generator sets	0.03	0.67	0.19		3.5

[1] Note that some of these standards also apply for 2014 and earlier model years. This table presents the full set of emission standards that

[2] See paragraph (c) of this section for provisions related to an optional PM standard for certain engines below 8 kW.

[3] The CO standard is 8.0 g/kW-hr for engines below 8 kW.

[4] The CO standard is 5.5 g/kW-hr for engines below 37 kW.

Table III-11: Road Emissions (Tailpipe)

Mining Equipment

Equipment Description	kW	Equipment Distribution				NO_x Emission Rate (g/s)				CO Emission Rate (g/s)				SO_2 Emission Rate (g/s)			
		Pit	MRA	Quarry	Ore	Pit	MRA	Quarry	Ore	Pit	MRA	Quarry	Ore	Pit	MRA	Quarry	Ore
Diesel drive Shovels (Hitachi EX8000)	2900	2				5.64				5.64				9.51E-03			
Blast Hole Drill - CAT 6420	597	9				5.22				5.22				9.21E-03			
Wheel Loader (L-1850)	1491	3				4.35				4.35				7.33E-03			
Track Dozer (CAT D11T)	634		3				1.85				1.85E+00				3.16E-03		
Track Dozer (CAT D10T)	433	3			1	0.14			4.81E-02	1.26			0.42	2.16E-03			7.20E-04
Wheel Dozer (854K)	674	2				1.31				1.31				2.24E-03			
Motor Grader (CAT 16M)	248	2	1			0.06	0.03			0.48	2.41E-01			8.24E-04	4.12E-04		
Water Truck / Sand Truck (CAT 777)	704	1				0.68				0.68				1.10E-03			
Air Track Drill	287	2				0.06				0.56				9.84E-04			
Excavator (CAT 390)	390	3		1		0.13		4.33E-02		1.14		0.38		1.92E-03		6.40E-04	
Articulated Trucks	361	5		5		0.20		2.01E-01		1.75		1.75		2.83E-03		2.83E-03	
					Totals	17.80	1.88	0.24	0.048	22.40	2.09	2.13	0.42	3.81E-02	3.57E-03	3.47E-03	7.20E-04

Haul Trucks

Haul Truck Engine kW (CAT 795)	2377
Total # Trucks	33

Road Segment	ID	Length	# Trucks	NO_x (g/s)	CO (g/s)	SO_2 (g/s)
Bottom of pit to MR/Mill split	PIT1_HR	3.1167	5	1.16E+01	1.16E+01	1.86E-02
MR/Mill split to Mill (edge of pit)	PIT2_HR	3.0915	5	1.16E+01	1.16E+01	1.86E-02
MR/Mill split to MRE/MRW split	PIT3_HR	0.9732	2	4.62E+00	4.62E+00	7.45E-03
MRE/MRW split to MRW (edge of pit)	PIT4_HR	1.8943	4	9.24E+00	9.24E+00	1.49E-02
MRE/MRW split to MRE (edge of pit)	PIT5_HR	1.6357	3	6.93E+00	6.93E+00	1.12E-02
Ore to mill/stock split	ORE_HR	0.1557	1	2.31E+00	2.31E+00	3.72E-03
Ore to mill from mill/stock split	OREMILL_HR	0.4222	1	2.31E+00	2.31E+00	3.72E-03
Ore to stockpile from mill/stock split	ORESP_HR	0.6264	1	2.31E+00	2.31E+00	3.72E-03
MR to Stockpile. East area	MRE_HR	2.4326	5	1.16E+01	1.16E+01	1.86E-02
MR to Stockpile. West area	MRW_HR	3.2207	6	1.39E+01	1.39E+01	2.23E-02

Summary

Description	Model ID	NO_x (g/s)	CO (g/s)	SO_2 (g/s)
Total Haul Roads (In Pit)	OPIT	4.39E+01	4.39E+01	7.07E-02
Total Equipment (In Pit)	OPIT	1.78E+01	2.24E+01	3.81E-02
Total Haul Roads (Outside Pit)	ORE_HR,OREMILL_HR,ORESP_HR,MRE_HR,MRW_HR	3.24E+01	3.24E+01	5.21E-02
Mine Rock Area Equipment (East)	MRE_MH	9.38E-01	1.05E+00	1.79E-03
Mine Rock Area Equipment (West)	MRW_MH	9.38E-01	1.05E+00	1.79E-03
Low Grade Ore Area Equipment	ORE_MH	4.81E-02	4.21E-01	7.20E-04
	Total	9.60E+01	1.01E+02	1.65E-01

APPENDIX IV:
Tailings Dust Management Technical Memorandum

TECHNICAL MEMORANDUM

TO Javier Masmela, IAMGOLD **DATE** October 22, 2013

CC Ken Bocking, Golder Associates Ltd.

FROM Darrin Johnson, Golderr Associates Ltd. **PROJECT No.** 13-1118-0017 (13000)

COTE GOLD PROJECT – TAILINGS DUST MANAGEMENT
DOC 013

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has developed a Pre-Feasibility Study (PFS) level design of a Tailings Management Facility (TMF) for the Côté Gold Project located near Gogama, Ontario (the Project). The Côté Gold Project will consist of an open pit mine, Tailing Management Facility (TMF), Mine Rock Area (MRA), water management ponds, water realignment dams, process plant and ancillary facilities. Fugitive dust sources at the Côté Gold Project could include:

- Tailings management facility (TMF);
- Unpaved roads;
- Drilling and/or blasting in the open pit;
- Dumping of mine rock;
- Material processing (crushing and screening);
- Material handling (loaders, conveyors and transfer points); and
- Material storage (ore and mine rock stockpiles).

There are several private cottages on Lake Mesomikenda east of the Côté Gold Project that could potentially be receptors to fugitive dust leaving the site. Fugitive dust can cause health problems, impair visibility, and have other negative environmental consequences. This technical memorandum outlines potential dust management mitigation measures that IAMGOLD may want to consider implementing at the Cote Gold Project to reduce fugitive dust emissions. The focus of this memorandum is on tailings dust management during the operating life of the mine (i.e., operations rather than at closure). Mitigation of other fugitive dust sources will be carried out using Best Management Practices (BMPs) commonly employed at mine operations. For example, the following dust mitigation BMPs are proposed for the Côté Gold Project:

- Roads will be regularly sprayed with water and/or dust control product to reduce dust generation from vehicle traffic; and
- Material crushing will be carried out indoors and/or with dust control systems.

As the Project advances towards development and operation, a more detailed dust management plan should be prepared in accordance Ontario Ministry of Environment "Technical Bulletin - Review of Approaches to Manage Industrial Fugitive Dust Sources" of the *Procedure for Preparing an Emission Summary and Dispersion*

Modelling Report (MOE, 2004) and other applicable regulatory requirements. Prediction, characterization and dispersion modelling of fugitive dust is not part of our current scope of work. A dust management plan should include the following information:

- sources of fugitive dust emissions associated with the facility;
- composition and size distribution of the fugitive dust particulate, including an analysis of the metals composition of the various dust sources;
- description of how fugitive dust can be controlled from each significant source and proposed best management practices (BMPs) for the facility;
- schedule for implementing the dust management plan;
- requirements for training of personnel on dust mitigation measures;
- inspection and maintenance procedures for dust mitigation measures and equipment; and
- monitoring and record-keeping requirements to verify and document ongoing compliance.

2.0 BACKGROUND

The proposed TMF will be located approximately 3 km north of the open pit and it will be bounded by four lakes: 1) Bagsverd Lake to the south; 2) Mesomikenda Lake to the east; 3) a small unnamed lake located to the north; and 4) Schist Lake located to the Southwest. The proposed TMF is located within an area of low topography with higher ground along the east and south sides providing some natural topographic containment. Tailings contained within the TMF will likely be susceptible to wind erosion and generate dust that could migrate off-site, if no dust mitigation measures are implemented. Air quality studies being carried out by others to support the Environmental Assessment and approval of the Project indicate that off-site migration of tailings dust could have a negative impact on the environment. Due to the proximity of the TMF to adjacent cottages on Lake Mesomikenda, an effective dust management plan will have to be implemented.

Tailings will be discharged onto beaches in the TMF as a slurry at 50% solids (by mass). The tailings will tend to segregate with the larger particles settling first near the point of deposition and the smaller particles travelling further. Grain size distribution test results indicate that the tailings consist of about 60% particles that are silt-sized or finer (i.e., finer than 0.075 mm) and about 40% fine sand (i.e., 0.075 to 0.5 mm). A tailings grain size distribution curve is given on Figure 1. Dry, fine-grained tailings particles will be susceptible to wind erosion and will require ongoing mitigation to ensure that erosion is reduced and dust is controlled, both during operations and after closure. Dust generation should not occur where there is active tailings deposition because the tailings will continuously be covered by a fresh layer of wet tailings. However, because of the large size of the TMF, there will always be some inactive areas where tailings are not being discharged. Mitigation measures will be required on the inactive areas to reduce dust generation.

3.0 DUST MITIGATION OPTIONS

Some of the potential mitigation measures that could be used to manage tailings wind erosion and dust generation are outlined below. It is recommended that, during the early years of TMF operation, field trials and monitoring be carried out with one or more of these dust mitigation techniques to develop a successful dust management program. The following is a summary of some potential dust mitigation options for the Côté Gold Project.

Physical Barriers

This type of dust control method uses objects or materials to form a physical cap over the tailings and to prevent the wind from picking up the smaller particles below. Physical barriers may include the following:

- **Granular Cap:** a layer of crushed rock or coarse-grained granular material that is less prone to wind erosion can be placed above the tailings. A granular cap can prevent the underlying fine-grained tailings particles from being lifted off the ground during gusts of wind.
- **Baffles:** objects can be placed on the tailings surface intended to disrupt the flow of airborne particles. The rule of thumb for baffle spacing is a 1:6 ratio between the height of the objects and the distance between them in order to keep dust contained by the baffles. Objects that could be used as baffles could include boulders, old haul truck tires, snow fencing, etc. The close spacing required for baffles to be effective makes this dust mitigation impracticable for the size of the Cote Gold TMF. However, snow fencing with wider spacing may be an effective dust mitigation option during the winter to encourage/maintain snow cover on the tailings and to prevent exposure of freeze dried tailings.
- **Vegetation:** plant growth reduces erosion because the roots act as a binder below the surface and because the plants act as a baffle above the surface by blocking the flow path of airborne particles. Vegetation can be established by seeding the tailings surface. Related methods that have been used include: injecting algae into the tailings stream to produce a biological cover, using straw blankets to form a cap over tailings and encourage seed germination, or disked-in straw (straw pushed into the tailings) to act as a baffle and to encourage seed germination. Once roots are established, the tailings surface will be even more resistant to wind and water erosion. Field trials can be carried out to determine if the addition of organic mulch or other amendments is required and to develop an optimal seeding method. The field trials would also determine which types of plants are most suitable for direct vegetation of the tailings surface (e.g., Kentucky blue grass, Perennial Ryegrass). Establishment of a vegetation cover on the tailings surface is the proposed method to reduce wind and water erosion after closure.
- **Irrigation:** This would involve regular spraying of inactive tailings surfaces with water to keep the tailings surface wet. Wet tailings are held together at the surface by capillary forces. The moisture level in the tailings can be maintained by regularly spraying the tailings. Irrigation can be achieved by hand spraying from fire hoses, water trucks, or using an array of pipelines and sprinklers.

Chemical Barriers

Chemical barriers include materials that are used to create a binder surface layer that is resistant to wind erosion. Chemical barriers include the following:

- **Chemical binding agents:** These are sprayed on the tailings surface either by truck or aerially by plane or helicopter. The binding agent will mix with exposed tailings particles at surface to form a cohesive, sealed capping layer that can be effective for several months up to 2 years depending on the specific agent and site conditions. Examples include: pine resin emulsion, calcium chloride, Coherex, Entac, etc. The following is a sample of chemical binding agents that can be used to prevent erosion of tailings:

    a) PolyRAP T-PRO® 500 is a polymer-based spray that achieves dust control by binding fine-grained particles, such as dry mine tailings, together. When topically applied to tailings, it helps to strengthen and seal the upper layer of the material.

    b) Hydra-Guard is a product created and produced by New Waste Concepts Inc. Hydra-Guard is designed to reduce water infiltration and erosion. Much like PolyRAP, Hydra-Guard binds small particles to each other to reduce the potential for erosion. The resulting cohesion between the particles is very effective at preventing soil or tailings erosion.

    c) ENTAC, manufactured by Enssolution, is a tall-oil pitch emulsion derived from the process of pulping pine trees. It is different from PolyRAP and Hydra-Guard in that it is derived from coniferous trees rather than being produced from water-based polymers. Tall-oil pitch is a by-product of the wood pulp manufacturing process.

- **Cemented tailings:** cement can be mixed with the discharged tailings at a concentration of 1% (by dry mass) to create a thin layer of cemented tailings that are resistant to wind erosion. Other less expensive binders such as lime, slag or fly ash could also be used to reduce the amount of Portland cement required. To prevent wind from eroding the inactive TMF areas, a 0.2 m thick cemented tailings layer would be discharged to the TMF to 'cap' the tailings. An in-line or batch mixer would add the binder materials to the tailings before they are discharged into the TMF. Slag, a by-product of the smelting process, contains mostly metal oxides and silicon dioxide. When hydrated, ground slag reacts to form a bond similar to cement. Slag is commonly mixed with Portland cement in a ratio of 9 parts ground slag to 1 part cement. The cemented tailings would be discharged to an active TMF area prior to discontinuing deposition in that area to create a wind erosion resistant layer. Mix testing would be required to develop optimal “binder to tailings” and “slag to cement” ratios.

4.0 EXPERIENCE WITH DUST MITIGATION AT OTHER MINES

4.1 Freeport-McMoRan Sierrita Mine

The Freeport-McMoRan Sierrita copper and molybdenum mine is located in Arizona. To reduce the production of dust at this facility, Freeport-McMoRan employs several dust mitigation strategies. One of the ways they mitigate tailings dust generation is by regularly wetting the tailings surface where it is lacking moisture and susceptible to dusting. Other dust mitigation methods at Sierrita Mine include strategic deposition of wet tailings, spraying dust suppressant material on dry tailings, and vegetation. In addition, the mine carries out ongoing monitoring of environmental conditions to predict the potential for dust generation and to guide mitigation efforts.

4.2 Freeport-McMoRan Cerro Verde Mine

The Freeport-McMoRan Cerro Verde copper and molybdenum mine is located in Peru. Water is used at the Cerro Verde mine to control dust and to maintain air quality around mining operations. Photograph 1 illustrates perimeter and internal irrigation sprinklers used for tailings dust control at the TMF.

Photograph 1 – Irrigation Dust Control at Cerro Verde Mine

4.3 Vale Copper Cliff Tailings Management Facility

Vale's Copper Cliff tailings management facility uses vegetation, water irrigation and chemical binders to manage dust. Application of chemical binders for tailings dust control typically occurs twice a year. The aerial dust control program to prevent tailings dust from blowing into surrounding areas involves the spraying of a clear, non-toxic and biodegradable dust suppressing product. Photograph 2 illustrates the application of dust suppressant with a helicopter at the Copper Cliff tailings management facility.

4.4 Aughinish Alumina Mine

The Aughinish alumina mine is located in Ireland. Water is used at the Aughinish mine to control dust from the bauxite tailings area. Photograph 3 shows an irrigation sprinkler used for tailings dust control at the Aughinish mine. The sprinkler heads are located about 3 m above the tailings surface, which rises at a rate of about 1 m per year.

Photograph 2 – Aerial Spraying of Dust Suppressant at the Copper Cliff Tailings Area

Photograph 3 – Irrigation Dust Control at the Aughinish Alumina Mine

5.0 PROPOSED TAILINGS DUST MANAGEMENT APPROACH

Tailings deposition within the Côté Gold TMF will alternate between the north and south halves of the TMF to facilitate construction of containment dam raises. This will influence the approach to dust mitigation. Dust mitigation will begin on the inactive tailings area (i.e., north half of the TMF) at the beginning of Stage 2 when tailings deposition moves to the south half of the TMF as shown on Figure 2. As the active tailings deposition area alternates between the north and south halves of the TMF, dust mitigation measures will need to be implemented on the inactive areas. (Continuous deposition of wet tailings in the active area should be enough to control dust generation there.) However, in order to achieve successful dust management, it will be necessary to implement dust mitigation measures on inactive TMF areas throughout the mine operating period.

To identify the most effective dust management approach, it is recommended that field trials and monitoring be carried out during the early years of mine operation. Air quality monitoring around the TMF will be necessary throughout the life of the mine to confirm that tailings dust impacts are being adequately controlled. Through a combination of field trials and air quality monitoring, it should be possible to develop an effective and economic dust management plan for the Côté Gold TMF.

To effectively mitigate tailings dust generation, it will be important to predict the potential for dust production using a combination of weather forecasts, past events, and sound judgment. Monitoring staff should strive to gain an understanding of the site-specific behaviour of the tailings at the Côté Gold TMF to ensure the implemented dust mitigation measures are as effective and efficient as possible. It may be necessary to use a combination of mitigation measures and have the ability to implement additional or contingency dust mitigation measures, if/when required. For example, it may be necessary to spray polymer on certain areas of the TMF where vegetation cannot be easily established. Or during the winter, it may be necessary to erect snow fencing in areas where wind has exposed tailings to encourage snow drifting and prevent dust generation.

According to published references on dust control effectiveness, the use of water for dust control can be up to 90% effective, vegetation can be close to 100% effective, and physical barriers like fencing can be up to 75% effective. Based on this information, snow fencing alone should not be relied upon for dust mitigation. However, snow fencing may be a valuable contingency measure for use during the winter to encourage snow drifting and prevent tailings exposure and freeze drying. We were not able to find published information on the effectiveness of sprayed polymer or cemented tailings for dust suppression.

6.0 COMPARATIVE COST ESTIMATES

Table 1 (below) provides a summary of estimated approximate costs to implement dust mitigation on inactive tailings areas within the TMF over expected 12 year the life of mine. Total costs assume that one-time dust mitigation measures (e.g., vegetation, polymer spraying, or cemented tailings) will be implemented immediately at the end of each TMF stage (e.g., after switching deposition from the north to south sides of the TMF). Dust mitigation measures will be established on the inactive TMF area while tailings are discharged from perimeter dam crests in the active deposition area. The irrigation option includes capital costs for installation of a sprinkler pipeline network over the entire TMF, pump operating costs, and for the raising of the sprinkler heads at the end of each TMF stage. The approximate cost to implement dust migitaiton per squar metre is also presented in

Table 1. Estimated dust mitigation costs do not include air quality monitoring and should be considered preliminary for planning and discussion purposes only.

Table 1: Dust Mitigation Comparative Cost Estimates

Method	Total Cost (Note 1)	Unit Cost ($/m2)	Notes / Assumptions
Snow Fencing	$ 2,000,000	$0.11	100 m spacing, new fencing for each stage, excluding final stage (included in closure costs)
Thin Cemented Tailings Layer (1% binder – slag and Portland cement)	$ 4,000,000	$0.22	0.2 m thick cemented tailings layer for each stage, excluding final stage (included in closure costs)
Irrigation with Sprinklers	$ 8,000,000	$1.04	pipeline and sprinkler installation over entire TMF, 3 m risers every stage, pump electricity costs @ 4 hrs per day on inactive area
Sprayed Polymer	$ 9,000,000	$0.47	applied to inactive area for each stage, excluding final stage (included in closure costs)
Vegetation	$ 10,000,000	$0.56	seed/vegetate inactive area for each stage, excluding final stage (included in closure costs)
Thin Cemented Tailings Layer (1% binder – Portland cement only)	$ 12,000,000	$0.67	0.2 m thick cemented tailings layer for each stage, excluding final stage (included in closure costs)

Notes:
1) Cost estimates are based on implementing dust mitigation on inactive areas at the end of each TMF stage.

7.0 RECOMMENDATIONS AND CONCLUSION

Several potential dust mitigation options have been identified that could potentially be effective for the Côté Gold TMF. Comparative costs to implement various dust mitigation measures over the life of mine have been estimated and indicate that water irrigation may be slightly more economical than using sprayed polymer or establishing vegetation for dust mitigation on inactive tailings areas. However, application of water for dust control requires constant maintenance and monitoring compared to other options that are more passive after the measure has been successfully implemented (e.g., vegetation). Furthermore, irrigation cannot be carried out during winter conditions and would likely have to be combined with snow fencing to provide year-round dust mitigation. Although irrigation has been used at other mine sites to control tailings dust generation, it may not be suitable for the Côté Gold Project. The use of snow fencing on its own is considered to be the least effective option, but it may be a useful winter contingency measure in combination with other dust mitigation options. If vegetation can be established on an inactive tailings area by seeding in the spring immediately after moving the active tailings deposition area, it has the advantage that it should continue to control dusting during the winter. Sprayed polymers and cemented tailings should also provide year-round dust mitigation.

It is recommended that field trials be carried out during the early years of mine operation to identify a preferred dust mitigation approach. For planning purposes, it is recommended that $1M per year be budgeted for dust mitigation at the Côté Gold TMF. This should allow implementation of a combination of the above mitigation measures to reduce tailings dust generation from the TMF.

8.0 REFERENCES

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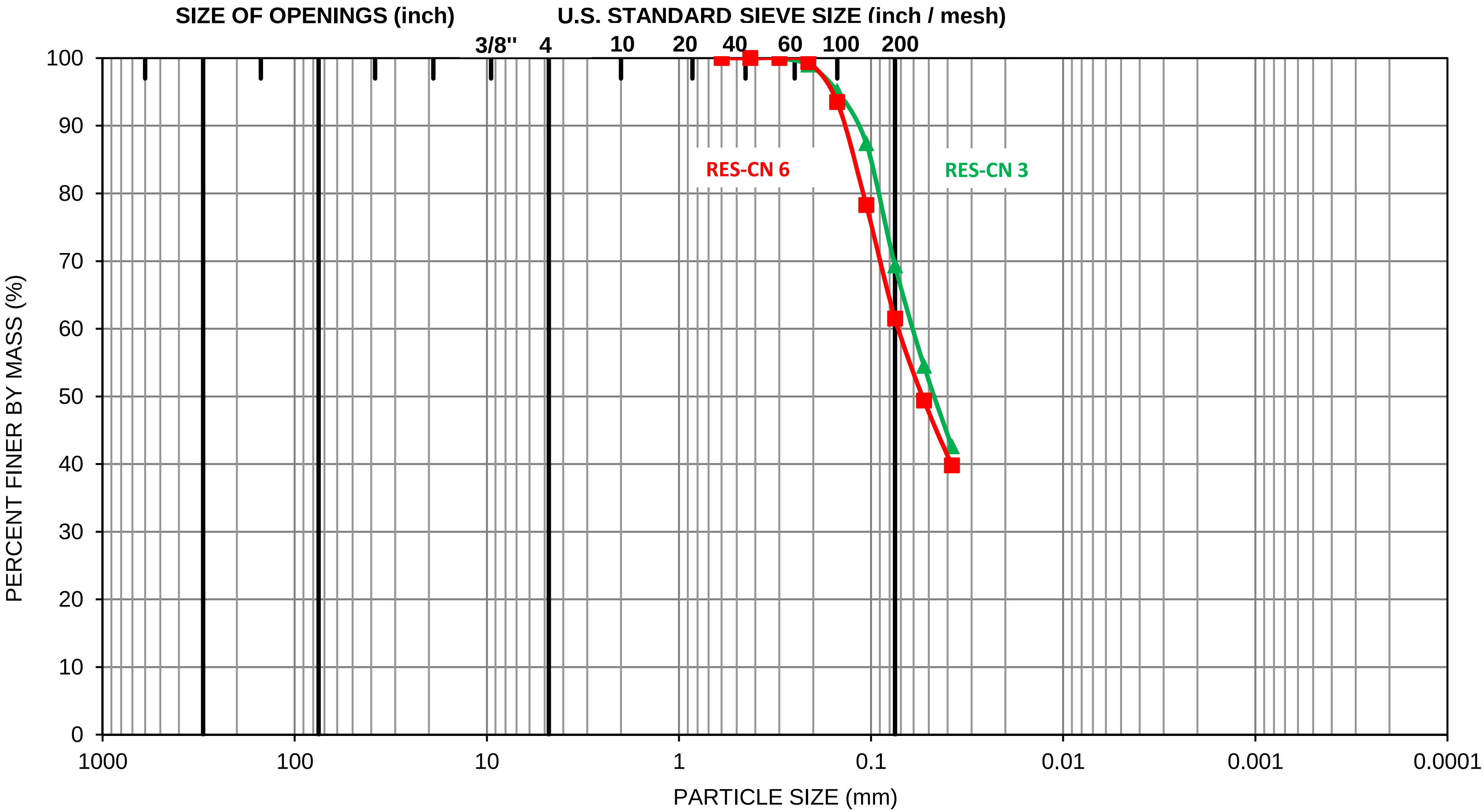
Vale (Vale, 2013b), “The Environment: Copper Cliff Smelter Fugitive Dust Controls”, viewed 25 September, 2013, http://www.vale.com/canada/EN/aboutvale/communities/health-safety-environment/our-environment/air-quality/sudbury-air-quality/particulate-emissions-control/Documents/VAL995M_FugitiveDustproof2.pdf

Attachments:

Figure 1 – Tailings grain size distribution
Figure 2 – Tailings Deposition Staging and Dust Management Plan
Figure 3 – Conceptual Irrigation Dust Management Plan
Appendix A – Dust Suppression Product Information
Appendix B – Cote Gold Tailings Dust Management Presentation

N:\Active\2013\1118\13-1118-0017 - IAMGOLD-COTE GOLD\13000 Dust Management Plan\13040 - Technical Memo Preparation\13-1118-0017_DOC013_Tailings Dust Management Plan_18OCT2013.docx



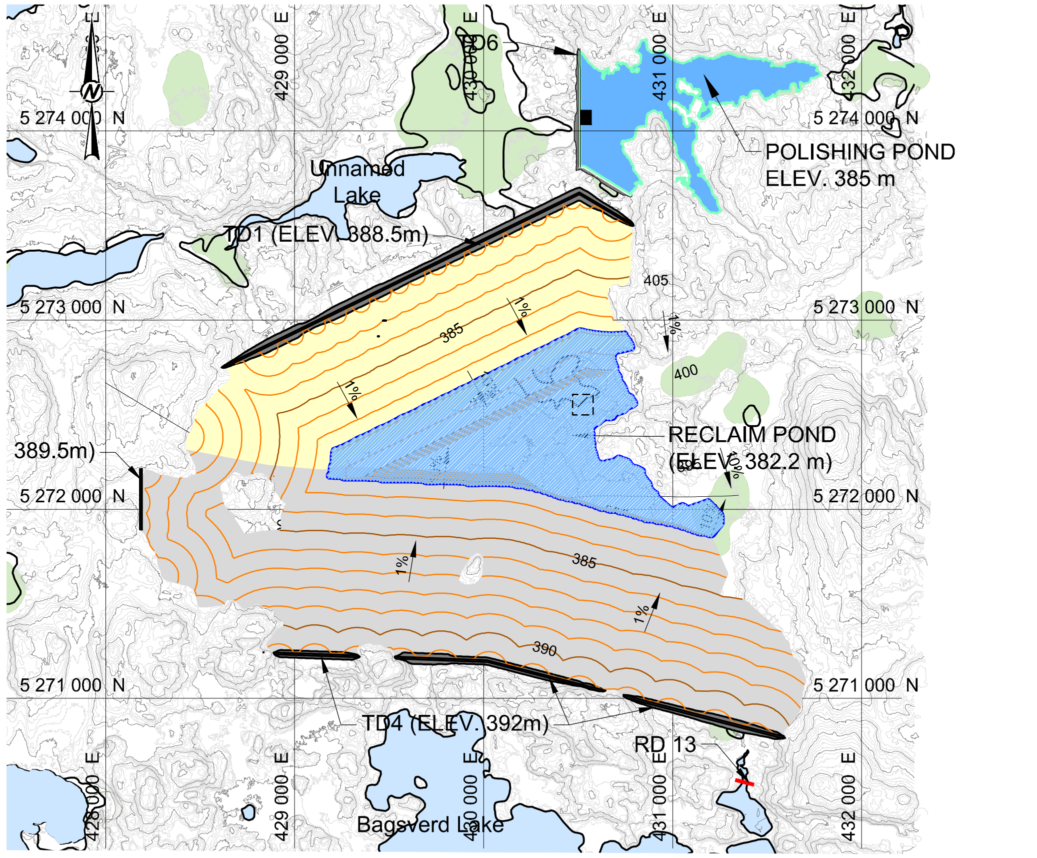
Boulder Size	Cobble Size	Coarse	Fine/Medium	Coarse	Medium	Fine	Silt	Clay
		Gravel Size		Sand Size				

TAILINGS PARTICLE SIZE DISTRIBUTION

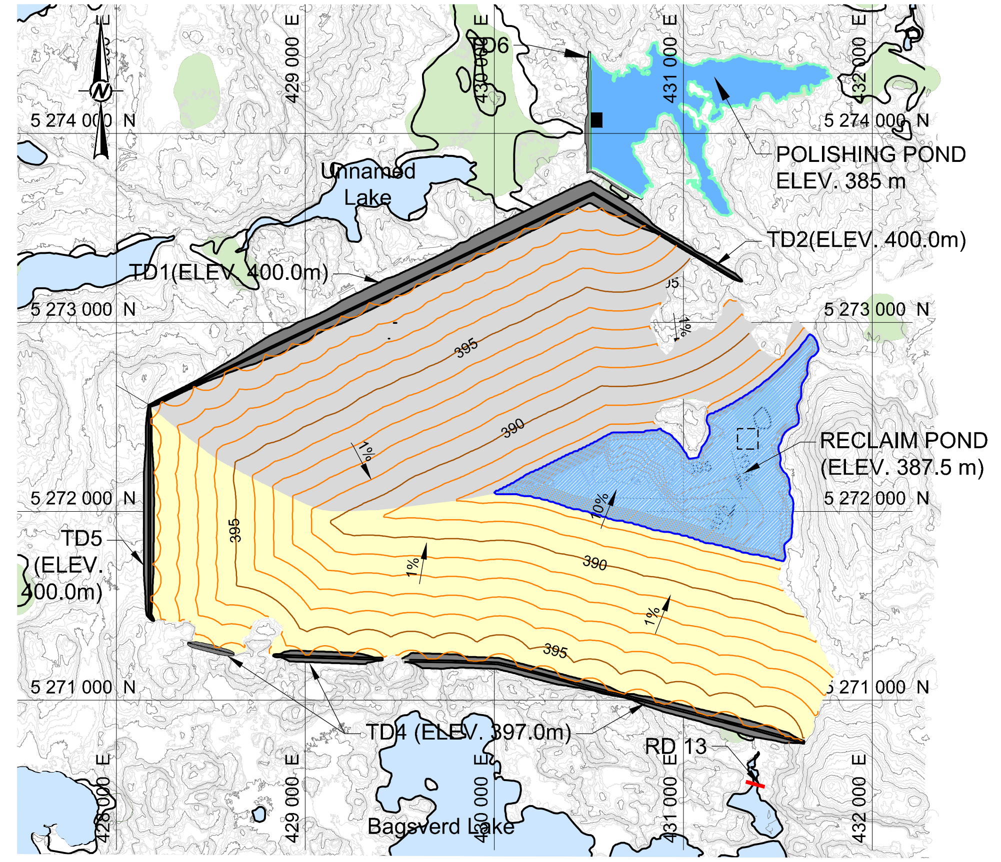
PROJECT NO: 13-1118-0017		DATE:	Sept. 2013
BY:	RM	REVIEW:	DCJ

IAMGOLD Cote Gold Project

FIGURE 1



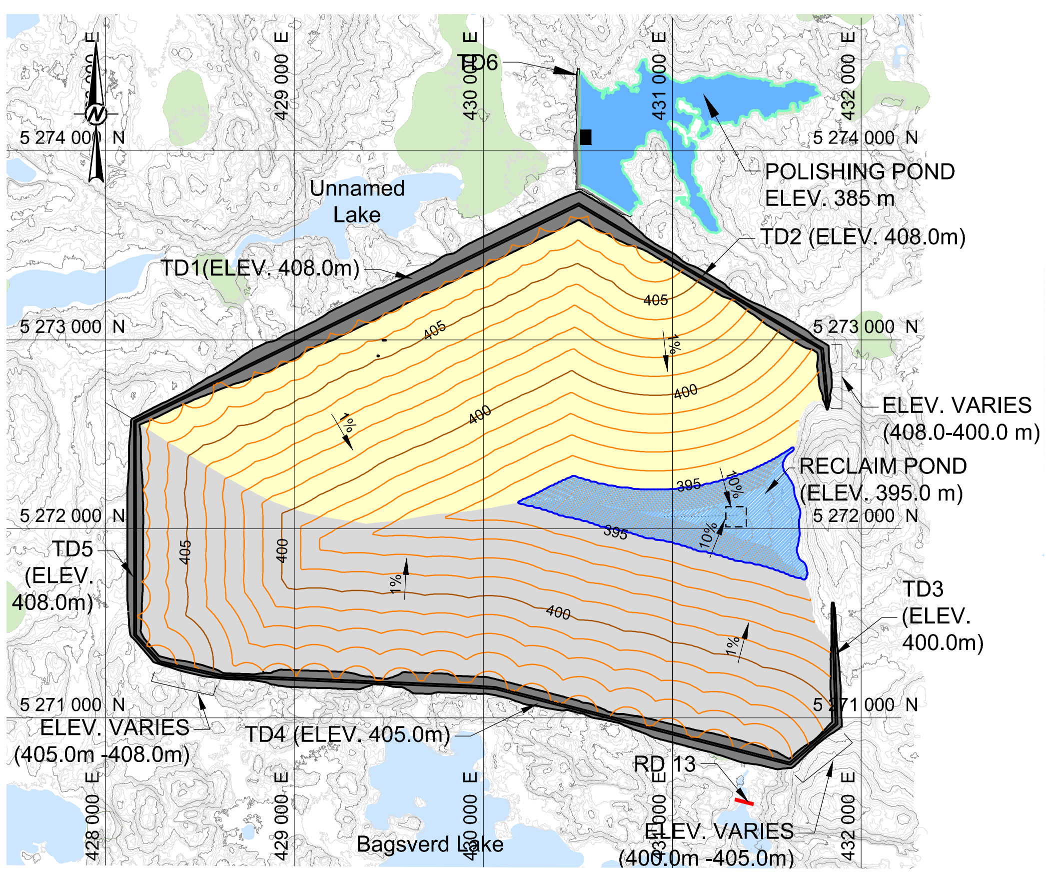
STAGE 2 - END OF YEAR 2



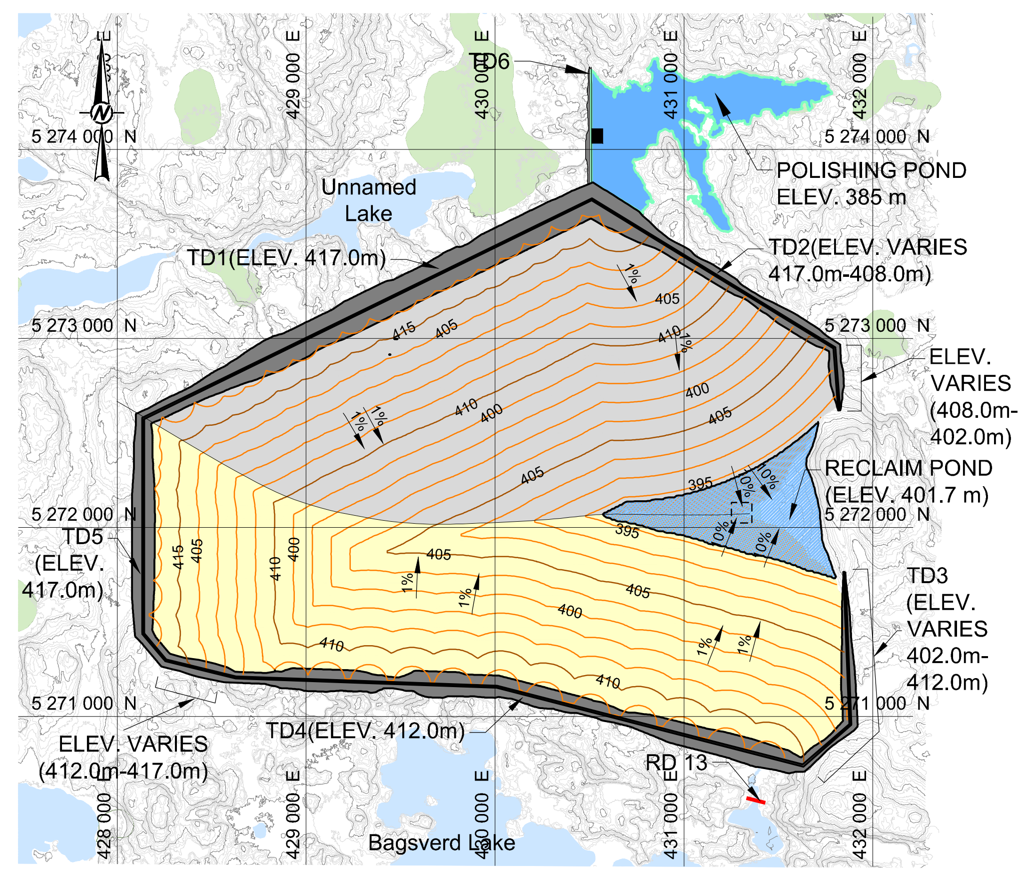
STAGE 3 - END OF YEAR 5

LEGEND

- POLISHING POND
- RECLAIM POND
- TAILINGS DAM (TD)
- POLISHING POND PUMP STATION
- AREA OF ACTIVE TAILINGS DEPOSITION
- REALIGNMENT DAM (RD)
- LAKES
- WETLANDS
- RECLAIM BARGE
- AREA OF DUST MANAGEMENT



STAGE 4 - END OF YEAR 9



STAGE 5 - END OF YEAR 13

0 800 1,600 2,400
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2013-09-30	FOR CLIENT REVIEW	AJ	LL	DCJ	KAB

PROJECT
IMAGOLD CORPORATION
CÔTÉ GOLD PROJECT

TITLE
TAILINGS DEPOSITION STAGING AND DUST MANAGEMENT PLAN

Golder Associates

PROJECT No.		1311180017	FILE No.	1311180017JA002
DESIGN	AJ	2013-09-30	SCALE	SCALE
CADD	LL	2013-09-30	FIGURE	
CHECK	DCJ	2013-09-30		2
REVIEW	KAB	2013-09-30		

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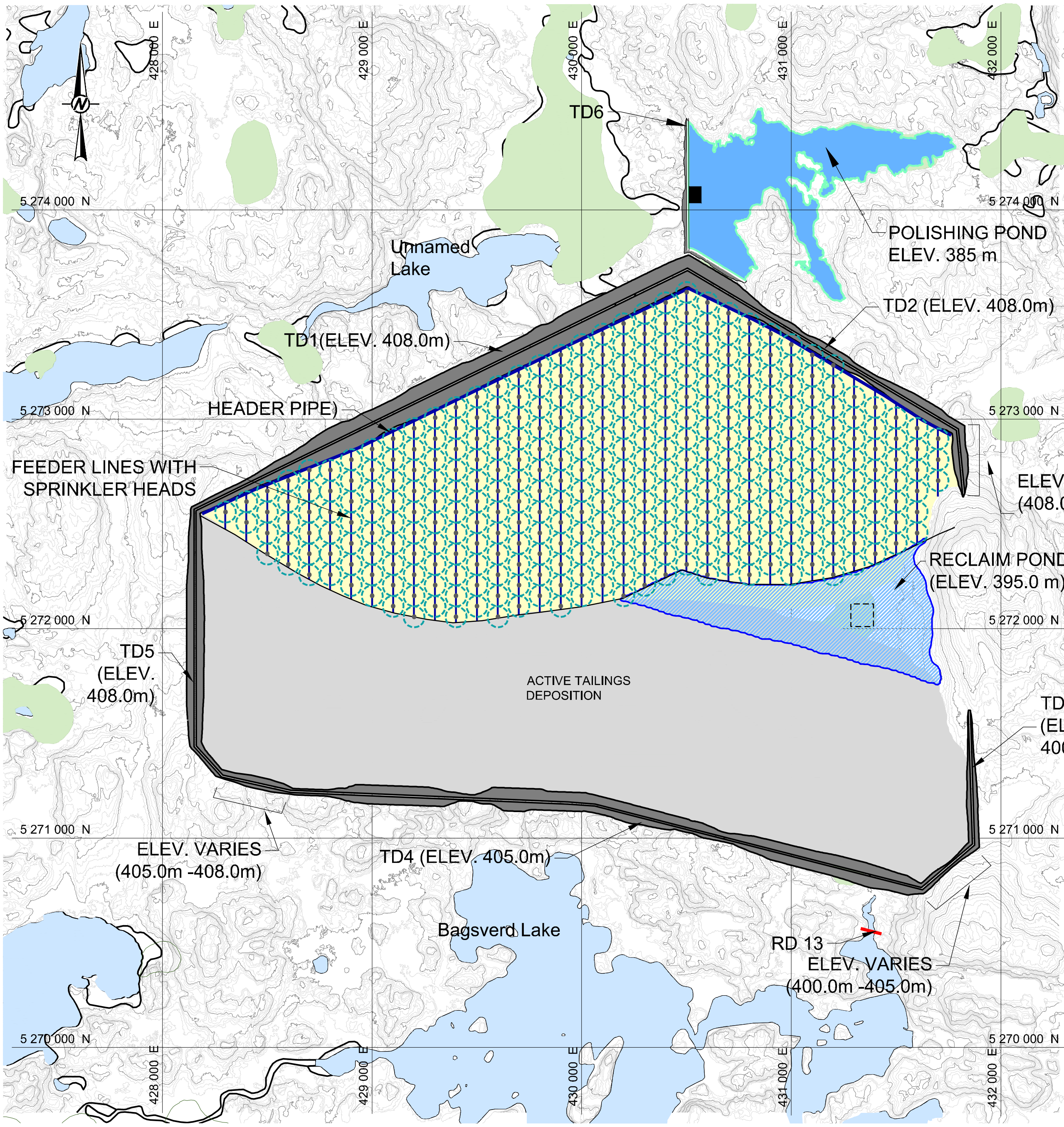

STAGE 4 - END OF YEAR 9

0 600 1,200 1,800

SCALE METRES

LEGEND

- POLISHING POND
- RECLAIM POND
- TAILINGS DAM (TD)
- POLISHING POND PUMP STATION
- AREA OF ACTIVE TAILINGS DEPOSITION
- PIPE AND SPRINKLERS
- LAKES
- WETLANDS
- RECLAIM BARGE
- AREA OF DUST MANAGEMENT

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2013-09-30	FOR CLIENT REVIEW	AJ	LL	DCJ	KAB

PROJECT

IMAGOLD CORPORATION
CÔTÉ GOLD PROJECT

TITLE

CONCEPTUAL IRRIGATION DUST MITIGATION PLAN

Golder Associates

PROJECT No.		1311180017	FILE No. 1311180017JA003
DESIGN	AJ	2013-09-30	SCALE SCALE
CADD	LL	2013-09-30	FIGURE
CHECK	DCJ	2013-09-30	3
REVIEW	KAB	2013-09-30	

Methodology for Treatment of Tailings using T.O.P.

KBM RESOURCES GROUP

T.O.P. TALL OIL PITCH

Enssolutions' Tall Oil Pitch is extremely effective at suppressing dust releases from mine tailings. By forming a water and wind-proof barrier, this membrane also minimizes oxidative reactions and contaminant leaching.

Manual Application with Fire Hoses

Evenly coat entire surface with 12% solids TOP Emulsion - 0.50 litres per square metre. Disperse emulsion into air above surface so that it rains down in small drops.

Daily Beach Head Maintenance

By mixing Enssolutions' T.O.P. at 2.5% solids with paper mash in a hydroseeder, a bonded mat may be applied to form a temporary cover. This will last 3 to 6 months depending on the thickness of the applied layer. The same effect can also be achieved without the paper or as an add-on to a straw cover program.

Slope Erosion Control

To prevent erosion on slopes, apply T.O.P. to produce a water proof coating which will shed water. It is important to ensure that the emulsion is applied over the crown of the slope to ensure that water does not get in behind the slope seal.

Aerial Spray Application

When the area is too large for manual application, or the surface is not accessible aerial application allows for quick, accurate delivery of T.O.P.

Spray Trailer Ground Application

Custom designed ground application spray trailer allows metered single pass application. Ideal for small to medium applications with the option of simultaneous broadcast seeding.

Spray bar applications in aerial delivery modes are available with both helicopter and fixed wing aircraft. In each case, the spray patterns are controlled by a GPS navigation system. This means the spray can be turned on and off in flight and it allows for complicated coverage areas including non-contiguous sections. This saves money by specifically targeting problem areas.

HydraGuard

☆ ConCover 180 ☆ ConCover SW ☆ ProGuard SB ☆ ProGuard IIB ☆ ProGuard IIB+ ☆ SuperSeal 40 ☆ SuperPlus SW ☆

DESIGNED FOR USE AS:

- An additive for ConCover 180 and ConCover SW
- Low cost alternative to plastic scrim or seamed geotextile (which can cost 10-15x more)
- Added to ConCover 180 to provide a low cost, easily repaired method of reducing the volatilization of gases emanating from areas of temporary soil cover
- Improves the gas impermeability of ConCover 180, reducing the amount of oxygen that can be sucked through the surface
- With ConCover SW, improves ability to shed water on exterior slopes to control erosion

NWC New Waste Concepts
www.nwci.com
email : info@nwci.com
1.877.736.6924

PRODUCT DESCRIPTION

HydraGuard is a propriety NWC liquid formulation of polymers and other cross-link chemistries that enhance durability of ConCover and ProGuard products. HydraGuard is available in a 275 gallon (1040 liter) plastic flexible tote. Cost per square foot ranges from 1-2 cents (USD) or 10.7 – 21.5 cents (USD) per square meter depending upon application method HydraGuard can be applied either topically after the initial application of the ConCover SW or 180 product, or it can be mixed with either of the products as they are being blended.

APPLICATION & USAGE

Topical Application of HydraGuard

HydraGuard applied topically results in a polymeric film over the surface of the cover product that resists water penetration. When topically applying the product, 10-15% of the final solution is HydraGuard. Mix the product, and then lightly spray the combined mixture on the surface of the previously applied cover material.

Mixing HydraGuard with Cover Material

NWC recommends that HydraGuard be added first, as water is put into the tank. With ConCover 180, 10%- 15% of the liquid should be HydraGuard. One of the advantages of pre-mixing it with the cover material is that no re-coating is necessary.

Côté Gold Project

Tailings Dust Management Options

Why is a Tailings Dust Management Plan required?

- Tailings are composed of fine-grained material (silt and sand)
- Easily picked up and blown off-site by wind
- Dust causes problems with visibility and has environmental consequences
- Dust mitigation measures will be required on inactive TMF areas

Dust Management Options

- Vegetation
- Irrigation/water misters
- Sprayed binding agents
- Snow fencing
- Rockfill baffles/cover
- Cemented tailings layer

Golder Associates

Irrigation of Tailings

Irrigation of Tailings

- Rows of piping on tailings
- Sprinkler heads a specified distance apart
- Pump water from reclaim pond to feeder pipeline on dam crests around perimeter of TMF
- Rows of secondary piping and sprinkler heads from perimeter
- Irrigation system can be automated to turn on when required or on a timer
- Moistened tailings won't create dust
- Has been used successfully at several mine sites

Sprayed Polymer

Golder Associates

Sprayed Polymer

- Manufactured/purchased as a concentrate in totes
- Diluted with water to required concentration
- Distributed over tailings with low pressure tracked tank truck sprayer, crop duster airplane, or on foot with hoses extending from a tank truck on dam crest
- Fine tailings adhere to each other and are not susceptible to wind erosion or dust generation

Cemented Tailings Layer

Golder Associates

Cemented Tailings Layer

- Mix a cement binder with tailings being discharged to TMF before moving active discharge area
- Discharge a thin layer (0.2 m) of cemented tailings to create a wind/dust resistant barrier
- Portland cement mixed with other binder materials including slag, fly ash, and/or silica fume (materials and mix ratios to be determined by testing)
- Assume cement & slag binder (1% by dry mass) mixed with tailings to create low strength cemented tailings layer

Vegetation

- Spread seed and mulch directly onto tailings surface (with either hydroseeding equipment or low-pressure farm equipment)
- Vegetation acts as a physical barrier to prevent wind erosion of fine tailings particles
- Vegetation root matrix also helps to hold tailings in place
- Establish vegetation each spring on inactive TMF areas
- Will need field trials to determine type of seed, organic amendments and methodology

Comparative Dust Mitigation Costs

Dust Mitigation Method	Total Cost	Unit Cost ($/m^2)	Notes / Assumptions
Snow Fencing	$ 2,000,000	$ 0.11	100 m spacing, new fencing for each stage
Thin Cemented Tailings Layer (1% binder – slag and Portland cement)	$ 4,000,000	$ 0.22	0.2 m thick cemented tailings layer for each stage
Irrigation with Sprinklers	$ 8,000,000	$ 1.04	pipeline and sprinkler installation over entire TMF, 3 m risers every stage, pump electricity costs @ 4 hrs per day on inactive area
Sprayed Polymer	$ 9,000,000	$ 0.47	applied to inactive area for each stage
Vegetation	$ 10,000,000	$ 0.56	seed/vegetate inactive area for each stage
Thin Cemented Tailings Layer (1% binder – Portland cement only)	$ 12,000,000	$ 0.67	0.2 m thick cemented tailings layer for each stage

Notes:

1) Cost estimates are based on implementing dust mitigation on inactive areas at the end of each TMF stage.
2) All cost estimates exclude dust mitigation for final TMF stage, which are included in closure costs.

Tailings Deposition and Dust Management

1. Dust management is only required on inactive TMF areas.
2. Areas with active tailings deposition will continuously be covered with fresh, wet tailings that should not generate dust.
3. Dust management will begin at the end of Stage 1 (Year 1) on the North half of the TMF (or beginning of Stage 2 when active tailings deposition moves to the South side of TMF).
4. Dust management/mitigation will alternate between the North and South halves of the TMF over the mine operating life.
5. Prior to closure (end of Stage 4) the inactive tailings surface will be vegetated to control dust (as outlined in the closure plan).

APPENDIX V:
Côté Gold Project Greenhouse Gas Assessment Report

Côté Gold Project
TSD - Air Quality
February 2014
Project #TC121522

CÔTÉ GOLD PROJECT
GREENHOUSE GAS
ASSESSMENT REPORT

FINAL

Submitted to:
IAMGOLD Corporation
401 Bay Street, Suite 3200
Toronto, Ontario
M5H 2Y4

Submitted by:
AMEC Environment & Infrastructure,
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January 2014

TC121522

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GLOSSARY AND ABBREVIATIONS

AMEC	AMEC Environment & Infrastructure
CCME	Canadian Council of Ministers of the Environment
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	CO_2 equivalent
EPGs	Emergency power generators
GHG	Greenhouse gas
GRI	Global Reporting Initiative
GWP	Global Warming Potential
ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
k	Methane generation rate
km	Kilometre
km/h	Kilometres per hour
Lo	Potential methane generation capacity
m	Metre
m^3	Cubic metres
m^3/yr	Cubic metres per year
m^3/s	Cubic metres per second
mg/kg	Milligrams per kilogram
mm	Millimetre
MMm^3	Million cubic metres
MOE	Ministry of the Environment
MRA	Mine Rock Area
Mt	Million tonnes (metric)
MW	Megawatt
MWh	Megawatt-hour
N_2O	Nitrous oxide
ppb	Parts per billion
ppm	Parts per million
tpd	Metric tonnes per day
t/m^3	Tonne per cubic metre
TMF	Tailings Management Facility
°C	Degrees Celsius
µg/g	Micrograms (one-millionth of a gram) per gram
µg/m^3	Micrograms (one-millionth of a gram) per cubic metre

1.0 INTRODUCTION

IAMGOLD Corporation (IAMGOLD) is planning to develop the Côté Gold Project (the Project) located approximately 20 kilometres (km) southwest of Gogama, 130 km southwest of Timmins, and 200 km northwest of Sudbury (see Figure 1).

This report has been prepared by AMEC to support the environmental assessment (EA) for the Project.

1.1 Overview of the Côté Gold Project

IAMGOLD is planning to construct, operate and eventually reclaim a new open pit gold mine at the Côté Gold Project site (see Figure 1).

The proposed site layout places the required mine-related facilities in close proximity to the open pit, to the extent practicable. The proposed site layout is presented in Figure 2 showing the approximate scale of the Project. The site plan will be refined further as a result of ongoing consultation activities, land purchase agreements and engineering studies.

As part of the proposed development of the Project, several water features will be fully or partially overprinted. These include Côté Lake, portions of Three Duck Lakes, Clam Lake, Mollie River/Chester Lake system and Bagsverd Creek. As a consequence, these water features will need to be realigned for safe development and operation of the open pit.

The major proposed Project components are expected to include:

- open pit;
- ore processing plant;
- maintenance garage, fuel and lube facility, warehouse and administration complex;
- construction and operations accommodations complex;
- explosives manufacturing and storage facility (emulsion plant);
- various stockpiles (low-grade ore, overburden and mine rock area (MRA)) in close proximity to the open pit;
- aggregate extraction with crushing and screening plants;
- tailings management facility (TMF);
- on-site access roads and pipelines, power infrastructure and fuel storage facilities;
- potable and process water treatment facilities;
- domestic and industrial solid waste handling facilities (landfill);
- water management facilities and drainage works, including watercourse realignments; and

- transmission line and related infrastructure.

1.2 Scope of Work – Greenhouse Gas Emission

This report documents the methods, data and assumptions that have been used to evaluate the greenhouse gas (GHG) emissions from the Project. The scope of work included:

- definition of the GHG reporting framework and organizational boundaries using established reporting protocols;
- quantification of GHG emissions from the Project using approved methodologies as defined above; and
- comparison to provincially and federally reported GHG emissions to determine Project significance.

It is important to note that the data used to estimate the GHG emissions are based on the Project description and preliminary fuel use or other data available at the time of writing. This information may significantly overestimate the actual GHG emissions so any requirements of future Project reporting program requirements must be validated once actual fuel consumption and landfill data is available.

2.0 PROJECT INFORMATION

2.1 GHG Assessment Framework

The GHG Protocol (WBCSD/WRI 2004) has been adopted by the Global Reporting Initiative (GRI) and provides guidance for preparing corporate or Project GHG inventories and general procedures for estimating GHG emissions. This is built on the following concepts:

- relevance – to ensure the inventory appropriately reflects the GHG emissions of the company;
- completeness – to account for and report on all GHG emission sources and activities within the chosen inventory boundary and to disclose any specific exclusions;
- consistency – to use consistent methodologies to allow for meaningful comparisons of emissions over time;
- transparency – disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used; and
- accuracy – ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions and that uncertainties are reduced as far as practicable.

The GHG Protocol also introduces the concept of direct and indirect emissions and scopes for GHG emission inventory under three broad categories, as follows:

- Scope 1 – Direct GHG emissions: Carbon emissions occurring from sources that are owned or controlled by the company (e.g., emissions from combustion in owned or controlled boilers, furnaces and vehicles, process and fugitive emissions, transportation of material onsite).
- Scope 2 – Electricity indirect GHG emissions: Carbon emissions from the generation of purchased electricity, heat or steam consumed by the company.
- Scope 3 – Other indirect GHG emissions: Carbon emissions which are a consequence of a company's activities, but occur from sources not owned or controlled by the company (e.g., emissions from waste, the extraction and production of purchased materials; and employee travel to and from work).

According to the GHG Protocol, an operational boundary defines the scope of direct and indirect emissions for operations that fall within a company’s established organizational boundary. The selected operational boundary is then uniformly applied to identify and categorize included emissions for each of the Project phases.

In Canada, GHG emissions for select facilities and operations above certain thresholds are required to be reported to Environment Canada for annual emissions great than 50,000 tonnes CO_2 equivalent (CO_2e) and to the Ontario MOE for annual emissions greater than 25,000 tonnes CO_2e under Ontario Regulation (O. Reg.) 452/09. Each of these organizations has developed consistent methodologies for GHG emission quantification and these have been followed in this analysis. It is important to note that whereas the Environment Canada reporting requirements for GHG include mobile sources, the Ontario MOE requirements do not consider mobile sources.

2.2 Project Study Boundary

An organizational boundary for the GHG assessment was developed for the Project using an operational control approach and is based on source categories from the GHG Protocol (2004) as required under the GHG reporting guidelines for O. Reg. 452/09 and Environment Canada. These are shown in Table 2-1.

Table 2-1: Source Categories Included in Assessment

Source Category	O. Reg. 452/09	Environment Canada	Included in EA
Scope 1 – Direct emissions	Required	Required	Yes
Scope 2- Indirect – purchased energy	Optional	Optional	Yes
Scope 3 – Other indirect	No	No	No

For this Project, GHG emissions Scope 1 (direct) and Scope 2 (purchased electricity) have been included. These are defined as those GHG emissions produced as a direct result of an activity (including auxiliary activities) occurring within the operational Project boundary and that are owned or controlled by the company.

The Scope 1 GHG emission sources considered in this report include:

- annual consumption of fuel (diesel or gasoline) by primary mining equipment (e.g., excavators, loaders, bulldozers, drilling equipment and dump trucks) and support equipment (e.g., service trucks);
- annual emissions from diesel gensets during construction;
- annual emissions from blasting activities;
- emissions from an on-site solid waste landfill;
- relevant processing plant sources;
- space and comfort heating; and
- emissions from on-site emergency power generators (EPGs) and fire pump.

Scope 2 emissions include purchased electricity.

Criteria for emission significance as well as estimation methods for those sources considered as significant are discussed in Section 3.0.

3.0 QUANTIFICATION METHODS

These follow the framework as noted in Section 2.1.

3.1 Definitions

The following definitions have been used in this assessment:

Carbon dioxide equivalent (CO_2e): A unit of measure used to allow the addition of, or the comparison between, gases that have different global warming potentials (GWPs). Since many GHGs exist and their GWPs vary, the emissions are added in a common unit, CO_2e. To express GHG emissions in units of CO_2e, the quantity of a given GHG (expressed in units of mass) is multiplied by its global warming potential.

Global warming potential (GWP): Calculated as the ratio of the time-integrated radiative forcing (i.e., the amount of heat-trapping potential, measured in units of power per unit of area, e.g. watts per square meter) that would result from the emission of 1 kg of a given GHG to that from the emission of 1 kg of CO_2. For the Project the 100-year GWP values have been used and values for GHGs arising from this Project are shown in Table 3-1 (Environment Canada, 2012).

Table 3-1: Global Warming Potentials

Greenhouse Gas	Formula	CAS Number	100 year GWP
Carbon dioxide	CO_2	124-38-9	1
Methane	CH_4	74-82-8	21
Nitrous Oxide	N_2O	10024-97-2	310

Direct emissions: Releases from sources that are located within the Project boundary and that are owned or controlled by the company.

Emergency generator: A stationary combustion device, such as a reciprocating internal combustion engine or turbine that serves solely as a secondary source of mechanical or electrical power whenever the primary energy supply is disrupted or discontinued during power outages or natural disasters that are beyond the control of the person of a facility.

Total facility emissions: Emissions calculated as the sum total mass of each of the gases or gas species multiplied by their respective global warming potential (GWP).

3.2 Emissions Sources

The Intergovernmental Panel on Climate Change (IPCC) suggests that the most effort on quantifying emissions should be spent on those sources that are the most critical that is, those that make up the largest quantity, are responsible for the greatest increase or decrease, or have the highest level of uncertainty associated with them. Using the organizational boundary as defined in Section 2.1, the emissions sources assessed in the study are shown in Table 3-2. Details on the calculation methodology used for the various source categories follow.

Table 3-2: Included GHG Emissions Sources

Source	Equipment	Carbon Source
Mine Fleet	Major equipment (excavators, loads, drilling equipment and dump trucks) and support equipment	Diesel fuel
Blasting	Explosives	Emulsion
Heating	Space and comfort heating	Propane
Emergency equipment	Diesel generators, fire pump	Diesel fuel
Waste	Solid waste sent to onsite landfill	Material decay
Purchased electricity	Estimated electricity purchased during all phases	Average Ontario emissions

3.2.1 Mine Fleet Emissions

This category refers to any direct releases of CO_2, CH_4 and N_2O resulting from fuel combustion in machinery used for the on-site (i.e., at the facility) transportation of substances, materials or products used in the production process (Environment Canada, 2012). For this assessment a fuels-based approach was used. The proponent provided a detailed list of primary and support equipment to be used for construction and operation in mining and materials transport on site, together with an expected annual diesel fuel use per unit equipment in each category. The total fuel-based GHG emission is calculated as:

$$CO_2e \text{ emissions (tonnes; t)} = CO_2 \text{ (t)} + CH_4 \text{ (t)} \times GWP(CH_4) + N_2O \text{ (t)} \times GWP(N_2O)$$

Where the relevant GWP are taken from Table 3-1 and the individual components are calculated from the total annual fuel consumption and a volume based fuel emission factor (e.g., kg CO_2 / kL fuel) for each GHG component and each type of fuel used.

$$\text{GHG component emission (tonnes)} = \text{Annual fuel use (kL)} \times \text{EF (kg/kL)}/1000$$

Where:

EF is the volume based fuel emission factor.

3.2.2 Blast Emissions

Explosive to be used in the Project is emulsion and included carbon containing compounds which are assumed to be fully oxidized to carbon dioxide in the explosive detonation. This leads to the release of greenhouse gases. The characteristic activity level used is the annual mass of explosive emulsion used (in tonnes).

$$\text{GHG emission (tonnes)} = M_{eb} \times EF$$

Where:

M_{eb} is the average mass of blast emulsion per year (tonnes/year); and

EF is the emission factor in tonnes CO_2e per tonne emulsion used.

The CO_2 emission factor for the proposed emulsion were received from the blasting emulsion supplier and listed at 0.163 tonne CO_2 per tonne blast emulsion. This number compares favourably with an older emission factor of 0.17 tonne CO_2 per tonne blast emulsion used in other national reporting (Commonwealth of Australia, 2008) and has been used in the calculation.

3.2.3 Space and Comfort Heating Emissions

The approach used for the determination of GHGs from space or comfort heating sources is also a fuel based approach. The heating systems are propane based and the proponent has supplied projected annual fuel usage numbers. These have been used with the appropriate emission factors (propane) and the methodology of Section 3.2 to determine both the component and total GHG emissions.

3.2.4 Emergency Equipment

The site is equipped with emergency equipment consisting of four emergency generators and one diesel powered fire pump (see Table 3-3) which are all tested weekly. It is noted that while not all such equipment will be tested simultaneously, the total emissions have been totalled over a typical year.

It was assumed that the emergency generators and fire pump were tested once a week for one hour at an 80% load, therefore the load factor is equal to 0.8.

Table 3-3: Emergency Equipment

Equipment	Rating (kW)
Generators	
GEN1	1,500
GEN2	1,500
GEN3	250
GEN4	2,500
Fire pump	261

3.2.5 Solid Waste Emissions

Solid waste generated by onsite personnel will be sent to a landfill site. The landfill site is proposed to accept non-hazardous solid waste during both mine construction which is expected to last 2 years and also during mine operation which is estimated to be 15 years.

Table 3-4 presents a summary of the landfill design data used to estimate the waste generation rates.

Table 3-4: Landfill Site Parameters

Description	Data
Operation life of the facility	2 years mine construction 15 years mine operation
Site Population	1,500 during mine construction 600 during mine operation
Total waste disposed during: Construction / operation Closure (demolition)	22,200 tonnes 7,000 tonnes
Waste density (non-hazardous solid waste) Waste density (demolition waste)	0.7 tonnes/m^3 1.5 tonnes/m^3
Total tonnage of waste disposed at the landfill site	29,200 tonnes

The Scholl Canyon first order decay model was used to estimate the landfill gas generated at the landfill site based on the projected waste tonnage to be disposed at the landfill. This model uses two parameters including the methane generation rate (k) and potential methane generation capacity (Lo) to estimate methane emissions. The parameter k determines the rate of methane generation for the mass of waste in the landfill. The higher the value of k, the faster the methane generation rate increases and then decays over time. This parameter depends on the moisture content of the waste mass; availability of the nutrients to break down the waste to form methane and carbon dioxide; pH and temperature of the waste mass. The National

Inventory Report 1990 – 2009, prepared by Environment Canada, recommends a k of 0.04/yr for Ontario.

The methane Lo parameter depends only on the type and composition of waste placed in the landfill and in particular the ratio between decomposable and non-decomposing waste. The higher the fraction of organic matter present, the higher the value of Lo. A typical Lo value of 120 m^3/tonne is appropriate for landfill sites associated with mine camps that have moderately decomposable waste as recommended in the Landfill Gas Generation Assessment – Table 5.1, Procedure Guidelines, prepared by the British Columbia Ministry of the Environment (2009).

The Scholl Canyon model indicates annual landfill GHG contributions from CO_2 and CH_4 increasing over the operating lifetime of the landfill and through closure. Following closure landfill contributions to GHGs will continue, peaking at 5,264 tonnes CO_2e in the year following mine closure and then gradually decreasing. At no time does the amount of landfill waste and landfill gas generated trigger any requirement for a landfill gas collection system.

3.2.6 Emissions from Purchased Electricity

It has been determined that Project electric energy requirements during construction will be met from a mixture of onsite diesel gensets supplemented by purchased power as this comes available. During operations the estimated annual demand will be 915,000 MWh reducing to 12,000 MWh during the closure period.

The average emission factor for power generated in the province of Ontario is 110 g CO_2e per kilowatt-hour (kWh) of electrical energy required (Environment Canada, 2013a). While this factor is expected to decrease over the life of the Project as the Ontario generation mix moves further away from fossil fuel, it has been conservatively applied throughout.

The maximum annual emission from purchased electricity (Year 8) will therefore be 100,650 tonnes CO_2e.

4.0 RESULTS

Table 4-1 presents the estimated Scope 1 and Scope 2 GHG emissions for the Project, including all sources specified in Section 3.0, for the maximum total emission year which has been determined as Year 8.

Table 4-1: GHG Emissions for Maximum Emission Year – All Sources

GHG	Emissions (tonnes CO_2e)
Methane (CH_4)	271
Nitrous Oxide (N_2O)	8,112
Carbon dioxide (CO_2)	277,436
Total	285,818

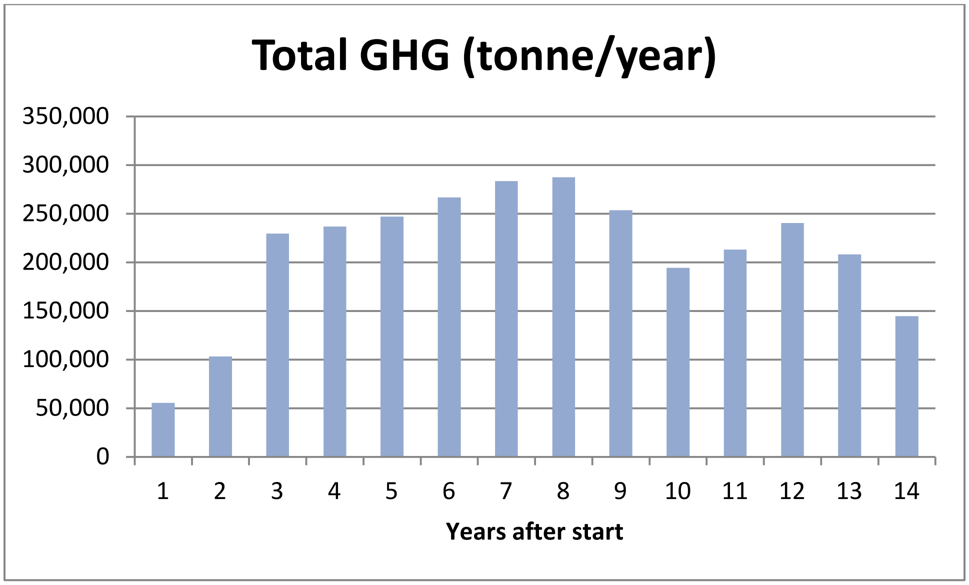
In Table 4-2 these have been broken down into the percentage contribution from the six source categories. The most significant contributor to Project GHG emissions (63.1%) is related to exhaust emissions from the mine fleet with purchased electricity accounting for an additional 35.2%. Emissions from blasting are responsible for 1.6% and the remaining sources combined total only 0.1% of the total emission.

Table 4-2: Percentage Contribution by Source Group All Sources

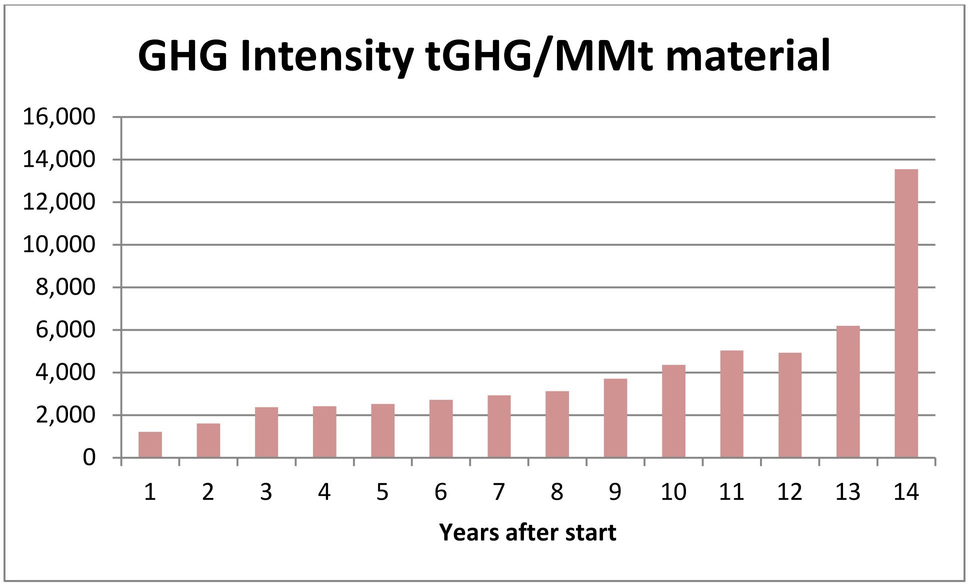
GHG	Percentage Contribution
Mine Fleet	63.1
Process	<0.1
Blasting	1.6
Emergency equipment	0.1
Landfill	<0.1
Purchased electricity	35.2

The annual variation of total calculated Project GHG is shown in Graphic 4-1. As can be seen, the maximum total annual emission occurs in Year 8. After this year the annual amount of material moved from the pit begins to diminish as does the level of fleet activity; ore is being recovered for processing from a stockpile closer to the mill. The relation between total GHG and extracted material is indicted in Graphic 4-2 which shows the GHG emission intensity as a ratio of the annual material extracted.

Graphic 4-1: Project Annual GHG from all Sources



Graphic 4-2: Project Annual Emission Intensity



5.0 DISCUSSION AND CONCLUSIONS

Maximum annual Project emissions will be 285,818 tonnes CO_2e in Year 8 of the Project. To put this in perspective, in 2011, just over one third (36%) of Canada's greenhouse gas (GHG) emissions came from 539 facilities. The total emissions reported by those facilities was 254 megatonnes (Mt) CO_2e out of a total Canada-wide emission of 702 Mt CO_2e (Environment Canada, 2013a) with the remainder coming from miscellaneous transportation, agriculture, waste and other sources.

Once approved, the Project may have GHG reporting responsibilities under various regulatory GHG Reporting Programs. These programs include:

- Ontario's GHG Emissions Reporting Regulation (O. Reg. 452/09); and
- Government of Canada GHG Emissions Reporting Program (Environment Canada under CEPA).

6.0 MITIGATION MEASURES

Given that the Project GHG direct emissions are primarily due to mine fleet and blasting, mitigation measures would be related to these two activities. In addition GHG-related activities would also be associated with minimizing the use of purchased electricity (Scope 2) emissions through the use of energy (electricity) conservation measures to the extent possible.

Measures to mitigate the Project's energy use and therefore GHG emissions from mine fleet activities may include:

- mining equipment and vehicles will be regularly maintained and serviced to maximize operational efficiency;
- the use of lower emission equipment and fuels will be investigated;
- the distances vehicles travel on site will be minimized to the extent possible by mine planning; and
- energy consumption will be monitored and GHG emissions calculated annually to identify opportunities to reduce emissions.

Control of GHG emissions from blasting cannot be achieved through energy efficiency measures. Reductions in GHG emissions may be achieved through optimizing blasting operations to minimize rehandling of material.

7.0 SUMMARY

This Report documents the regulatory framework, Project boundaries, quantification methods, data and assumptions that were used to estimate the GHG emissions for the Project. Based on the estimated GHG emissions the following comparison can be made:

- The total emissions from the Project will be above the GHG reporting requirements under the federal and provincial reporting programs and some point during the Project lifetime. It should be noted that input data used to estimate the emissions is conservatively based on current operating assumptions and may overestimate the actual emissions in any given year. Regulatory reporting requirements should therefore be assessed on a year by year basis once actual consumption data is available.
- The total emissions from the Project represent 285 kilotonne CO_2e, representing 0.17% of Ontario's GHG inventory for 2011 or 0.04% of the Canadian GHG inventory for that same year.

Since the predicted greenhouse gas emissions from this Project are insignificant in comparison to Canadian and global emissions the Project will have virtually no impact on current estimates of future global climate change.

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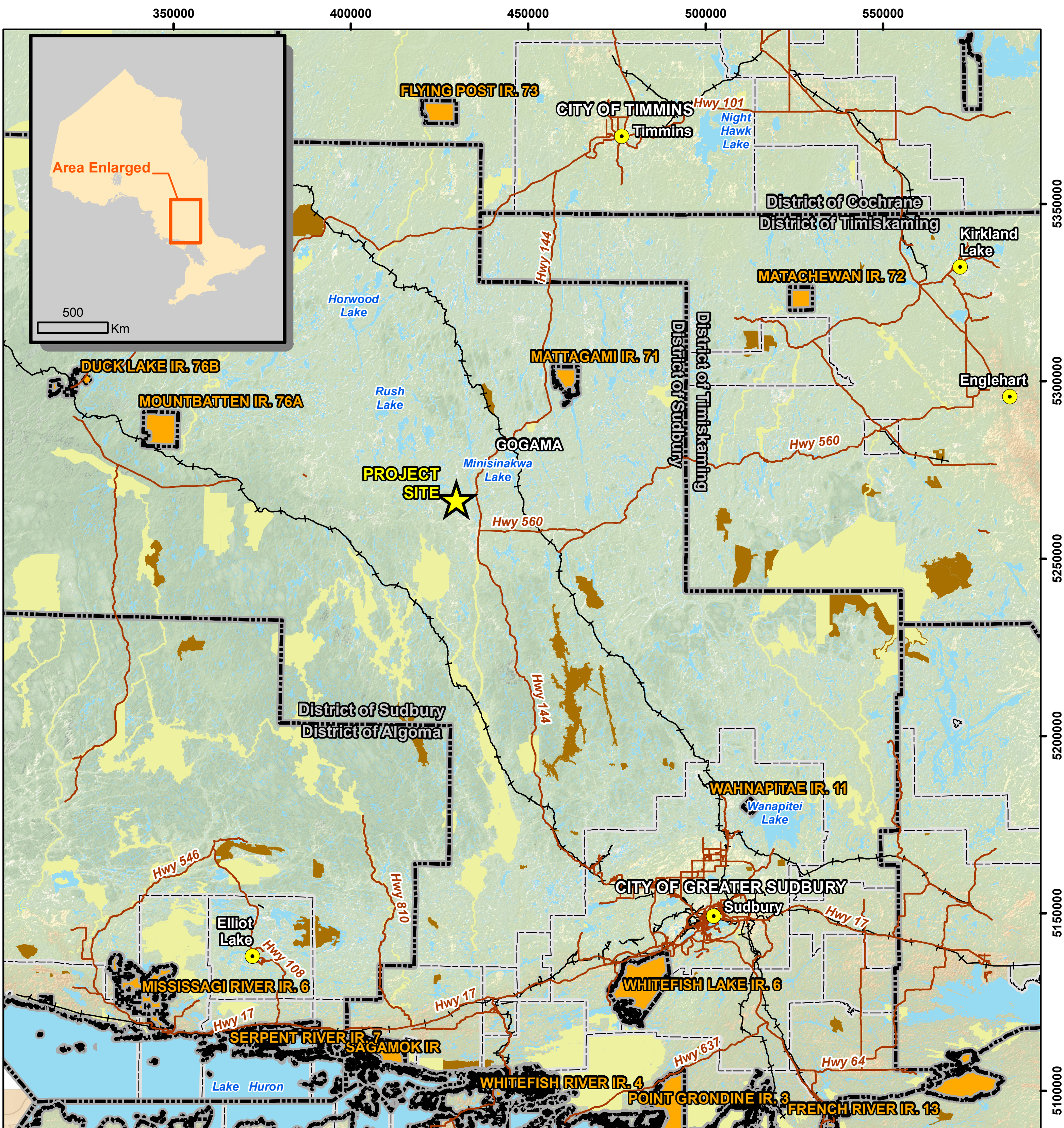
FIGURES



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LEGEND

- Project Site Location
- Regional Communities
- Major Roads
- Railway
- Lower Tier Municipality Boundary
- Upper Tier Municipality Boundary
- First Nation Reserve
- Conservation Reserve (Regulated)
- Provincial Park
- Waterbody / Large Watercourse
- Wooded Area

NOTES:
- All base data on this map was extacted from Land Information Ontario, MNDM, OBM Ontario Digital Geospatial Database and Ontario Road Network Database.

Datum: NAD83
Projection: UTM Zone 17N

0 20 40 60 80 100 Kilometres

N E S W

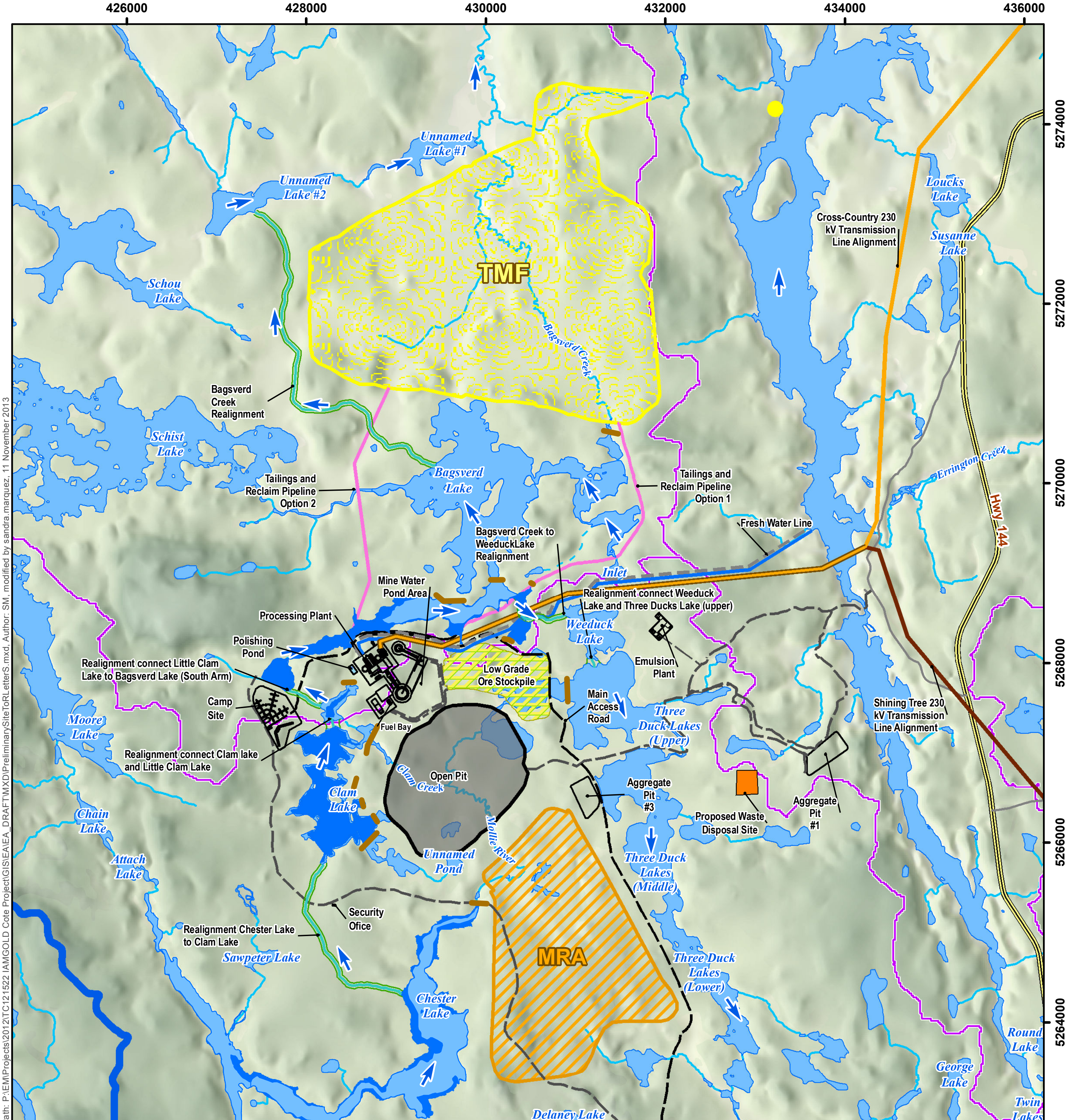
IAMGOLD CORPORATION

amec

CÔTÉ GOLD PROJECT

Project Location

PROJECT N^{o}: TC121522	FIGURE: 1
SCALE: 1:1,450,000	DATE: December 2013



LEGEND

- Existing Intermittent Watercourse
- Existing Permanent Watercourse
- Existing Waterbodies
- Highway
- Local Road
- Subwatershed Boundary
- Wooded Area
- Open Pit
- Potential Discharge Location
- Facilities
- Dam
- Main Access Road
- Access Road
- Cross-Country 230 kV Transmission Line Alignment
- Shining Tree 230 kV Transmission Line Alignment
- Tailings and Reclaim Pipeline
- Fresh Water
- Water Realignment
- Proposed Water Flow Direction
- Proposed Lake Area
- Polishing Pond
- Low Grade Ore Stockpile
- Proposed Mine Rock Area (MRA)
- Proposed Tailings Management Facility (TMF)
- Proposed Landfill

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR)
- TMF and subwatershed provided by Golder Associates.
- Watercourse realignment and proposed lake area provided by Calder Engineering.
- Surface infrastructure, open pit, landfill, MRA and transmission lines provided by IAMGOLD.
- Mesomikenda Lake is preferred discharge option, but others are being investigated.

0 1 2 3 4 5 Kilometres

Datum: NAD83
Projection: UTM Zone 17N

N E S W

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CÔTÉ GOLD PROJECT

Preliminary Site Plan

PROJECT N°: TC121522	FIGURE: 2
SCALE:1:57,000	DATE: December 2013