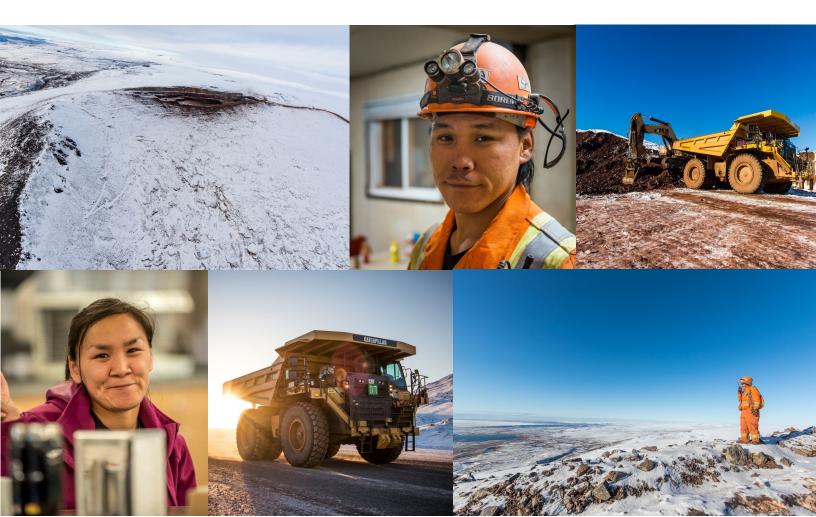


## TECHNICAL SUPPORTING DOCUMENT

Mary River Project | Phase 2 Proposal | FEIS Addendum | August 2018

**TSD 07** 

**Atmospheric Assessments** 



#### ATMOSPHERIC TECHNICAL SUPPORTING DOCUMENT SUMMARY

The Atmospheric Technical Supporting Document provides an <assessment> of the Phase 2 Proposal's effects on the atmospheric environment (including air quality, noise and vibration) and includes new information collected or published since submission of materials for the Approved Project. The Phase 2 Proposal builds on the extensive baseline studies and assessments carried out since 2011 for the larger Approved Project and is thus closely linked to the FEIS and previous addendums.

In general, air quality is evaluated by measuring concentrations of contaminants including dust (i.e., total suspended particles, particulate matter), nitrogen dioxide ( $NO_2$ ), sulphur dioxide ( $SO_2$ ), and carbon monoxide (CO), which are referred to as Criteria Air Contaminants ( $CAC_3$ ).

Construction of the railroad will increase dust emissions beyond current levels. Additional dust suppression efforts are planned to address these dust emissions which will result mainly from increased traffic on the Tote Road during the construction period, and to a lesser degree from construction at quarries and along the railway alignment. These dust suppression efforts will include additional water takes, and will be reflected in the Air Quality and Noise Abatement Management Plan. With the Phase 2 Proposal, secondary crushing will be moved from the Mine Site to Milne Port, where it will be enclosed, reducing dust emissions at the Mine Site, although total dust emissions at Milne Port will increase.

The Phase 2 Proposal is not expected to increase noise and vibration to levels that will interact substantially with human receptors due to planned mitigation and the small temporal and spatial footprint of auditory disturbance. Predicted sound levels from movement of the train along the rail corridor are expected to be minor and localized due to the intermittent and temporary nature of this source (i.e., several passes per day). Anticipated noise levels are expected to be below guidelines. Modelling results suggest noise generated at Milne Port will be noticeable at the HTO Cabin east of Milne Port. Baffinland will discuss this with the Mittimatalik Huntrs and Trappers Organization and the community of Pond Inlet.

Based on the present assessment and planned mitigation, Project activities proposed as part of the Phase 2 Proposal are not predicted to result in significant adverse residual effects on the atomospheric environment.



### RÉSUMÉ DE LA DOCUMENTATION TECHNIQUE COMPLÉMENTAIRE RELATIF À L'ATMOSPHÈRE

La documentation technique complémentaire relatif à l'atmosphère comporte une évaluation des effets de la proposition de la phase 2 sur l'environnement atmosphérique (y compris la qualité de l'air, le bruit et les vibrations) et comprend les nouveaux renseignements recueillis ou publiés depuis la soumission du matériel pour le projet approuvé. La proposition de la phase 2 est fondée sur les études préliminaires et les évaluations complètes réalisées depuis 2011 pour l'ensemble du projet approuvé et est donc étroitement à l'énoncé des incidences environnementales (EIE) et aux addendas précédents.

En général, la qualité de l'air est évaluée en mesurant les concentrations de contaminants, y compris les poussières (c.-à-d. les particules totales en suspension, les particules), le dioxyde d'azote (NO<sub>2</sub>), le dioxyde de soufre (SO<sub>2</sub>) et le monoxyde de carbone (CO), soit ce qu'on appelle les principaux contaminants atmosphériques (PCA).

La construction du chemin de fer augmentera les émissions de poussière au-delà des niveaux actuels. Des efforts supplémentaires de suppression des poussières sont prévus pour faire face à ces émissions de poussières résultant principalement de l'augmentation du trafic sur le chemin Tote au cours de la période de construction et, dans une moindre mesure, de la construction dans les carrières et le long du tracé ferroviaire. Ces efforts de suppression de la poussière comprendront des prélèvements d'eau supplémentaires et seront reflétés dans le plan de gestion de la qualité de l'air et du bruit. Avec la proposition de la phase 2, le broyage secondaire sera déplacé du site minier au port de Milne, où il sera fermé, réduisant ainsi les émissions de poussière au site minier, bien que les émissions totales de poussière au port de Milne augmenteront.

La proposition de phase 2 ne devrait pas augmenter le bruit et les vibrations à des niveaux qui interagiront sensiblement avec les récepteurs humains en raison des mesures d'atténuation prévues et de la faible empreinte temporelle et spatiale des perturbations auditives. Les niveaux sonores prévus causés par le mouvement du train le long du corridor ferroviaire devraient être minimes et localisés en raison du caractère intermittent et temporaire de cette source (c.-à-d. plusieurs passages par jour). Les niveaux de bruit anticipés devraient être inférieurs aux lignes directrices. Les résultats de la modélisation suggèrent que le bruit généré au port de Milne sera perceptible à la cabine HTO à l'est du port de Milne. Baffinland en discutera avec l'Organisation des chasseurs et trappeurs de Mittimatalik et la collectivité de Pond Inlet.

Selon la présente évaluation et les mesures d'atténuation prévues, les activités du projet proposées dans le cadre de la proposition de la phase 2 ne devraient pas entraîner d'effets résiduels négatifs importants sur l'environnement atmosphérique.



### $^{\circ}$ ታሴናል $^{\circ}$ Ј $^{\circ}$ ለታሲላጋተ $^{\circ}$ ΔЬተ $^{\circ}$ ተ $^{\circ}$ ር $^{\circ}$



## BAFFINLAND IRON MINES CORPORATION MARY RIVER PROJECT - PHASE 2 PROPOSAL







# TECHNICAL SUPPORTING DOCUMENT NO. 7 ATMOSPHERIC ASSESSMENTS

#### PREPARED FOR:

Baffinland Iron Mines Corporation #300 - 2275 Upper Middle Road East Oakville, Ontario, L6H 0C3

#### PREPARED BY:

Knight Piésold Ltd. 1650 Main Street West North Bay, ON P1B 8G5 Canada p. +1.705.476.2165 | f. +1.705.474.8095

Knight Piésold
CONSULTING
www.knightpiesold.com

# BAFFINLAND IRON MINES CORPORATION MARY RIVER PROJECT - PHASE 2 PROPOSAL

# TECHNICAL SUPPORTING DOCUMENT NO. 7 - ATMOSPHERIC ASSESSMENTS NB102-181/39-9

Rev	Description	Date
1	Incorporation of Client Comments	August 3, 2018
0	Issued in Final	June 26, 2018

### Knight Piésold Ltd.

1650 Main Street West North Bay, Ontario Canada P1B 8G5

Telephone: (705) 476-2165 Facsimile: (705) 474-8095 www.knightpiesold.com





#### **TABLE OF CONTENTS**

		PAGE
TABLE (	OF CONTENTS	1
1 – INTF	RODUCTION	1
1.1	OVERVIEW OF THE PHASE 2 PROPOSAL	1
1.2	SCOPE	4
1.3	CONSULTATION	4
	1.3.1 Air Quality	4
	1.3.2 Noise and Vibration	5
2 – AIR	QUALITY	6
2.1	BACKGROUND	_
2.2	PROJECT MONITORING	
2.3	ASSESSMENT METHODOLOGY	
2.4	EFFECTS ASSESSMENT	
	2.4.1 Increases in CACs at Milne Port	14
	2.4.2 Increases in CACs at the Mine Site	
	2.4.3 Increase in CACs along the Northern Transportation Corridor	
	2.4.4 Increases in CACs at Sensitive Receptors	21
	2.4.5 Significance of Residual Effects	22
2.5	CLIMATE CHANGE CONSIDERATIONS	
2.6	MITIGATION AND MONITORING PLAN UPDATES	23
3 – NOI	SE AND VIBRATION	28
3.1	BACKGROUND	_
3.2	PROJECT MONITORING	_
3.3	ASSESSMENT METHODOLOGY	
3.4	EFFECTS ASSESSMENT	
	3.4.1 Increase in Noise Levels during Construction and Closure	
	3.4.2 Increase in Noise Levels during Operation	
	3.4.3 Significance of Residual Effects	
3.5	CLIMATE CHANGE CONSIDERATIONS	
3.6	MITIGATION AND MONITORING PLAN UPDATES	37
4 – REF	ERENCES	38
5 – CER	RTIFICATION	40



#### **TABLES**

Table 2.1	Indicator Thresholds for Gaseous Emissions and Potential Acid Input	
Table 2.2	Indicator Thresholds for Particulate Matter	
Table 2.3	Phase 2 Proposal Interactions with Air Quality	
Table 2.4	Maximum Predicted Concentrations of Gaseous Emissions at Milne Port	
Table 2.5	Maximum Particulate Matter Concentrations at Milne Port	16
Table 2.6	Maximum Predicted Concentrations of Gaseous Emissions at the Mine Site	17
Table 2.7	Maximum Particulate Matter Concentrations at the Mine Site	18
Table 2.8	Maximum Particulate Matter Concentrations along the Northern Transportation	
	Corridor	
Table 2.9	Significance of Residual Effects on Air Quality in the LSA	25
Table 3.1	Phase 2 Proposal Interactions with Sound Levels	30
Table 3.2	Noise Modelling Scenarios for the Phase 2 Proposal	31
Table 3.3	Modelled Noise Levels at Sensitive Receptors during Operations	34
Table 3.4	Significance of Residual Effects on Noise	35
	FIGURES	
Figure 1.1	Project Location Map	2
Figure 1.2	Location of Project Activities and LSA	3
Figure 1.3	Community Concerns Regarding Air Quality	4
	APPENDICES	
Appendix A	Air Quality Model Phase 2 Proposal Mary River Project - Report	
Appendix B	Updated Environmental Air Quality Impact Assessment to Address Changes in	
	Project Description - Memorandum	
Appendix C	Updated Air Quality Assessment to Address Frequencies of Exceedances -	
	Memo	
Appendix D	Environmental Noise Phase 2 Proposal Mary River project - Report	
Appendix E	Updated Environmental Noise Impact Assessment to Address Changes in Project - Memorandum	



#### **ABBREVIATIONS**

the Project	Mary River Project
AAQS	ambient air quality standard
Baffinland	Baffinland Iron Mines Corporation
BNC	Balance Noise Criterion
CAC	Criteria Air Contaminant
EPA	Environmental Protection Agency
ERP	Early Revenue Phase
FEIS	Final Environmental Impact Statement
HTA	Hunters and Trappers Association
HTO	Hunter Trapper Organization
LSA	Local Study Area
Mtpa	million tonne per annum
NCB	Balanced Noise Criterion
NEF	Noise exposure forecast
NIRB	Nunavut Impact Review Board
PAI	potential acid input
PDA	Project Development Area
PM	Particle Matter
ppv	Peak Particle Velocity
	Permissible Sound Level
TEMMP	errestrial Environment Mitigation and Monitoring Plan
TSD	Technical Supporting Document
TSP	total suspended particulate



#### 1 - INTRODUCTION

#### 1.1 OVERVIEW OF THE PHASE 2 PROPOSAL

The Mary River Project (the Project) is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project.

In 2012, NIRB issued Project Certificate No 005 which provided approval for Baffinland to mine 18 million tonnes per annum (Mtpa) of iron ore, construct a railway to transport the ore south to a port at Steensby Inlet which operates year-round, and to ship the ore to market. The Project Certificate was subsequently amended to include the mining of an additional 4.2 Mtpa of ore, trucking this amount of ore by an existing road (the Tote Road) north to an existing port at Milne Inlet, and shipping the ore to market during the open water season. The total approved iron ore production was increased to 22.2 Mtpa (4.2 Mtpa transported by road to Milne Port, and 18 Mtpa transported by rail to Steensby Port). This is now considered the Approved Project. The 18 Mtpa Steensby rail project has not yet been constructed, however 4.2 Mtpa of iron ore is being transported north by road to Milne Port currently. Baffinland recently submitted a request for a second amendment to Project Certificate No.005 to allow for a short-term increase in production and transport of ore via road through Milne Port from the current 4.2 Mtpa to 6.0 Mtpa.

The Phase 2 Proposal (the third project certificate amendment request) involves increasing the quantity of ore shipped through Milne Port to 12 Mtpa, via the construction of a new railway running parallel to the existing Tote Road (called the North Railway). The total mine production will increase to 30 Mtpa with 12 Mtpa being transported via the North Railway to Milne Port and 18 Mtpa transported via the South Railway to Steensby Port. Construction on the North Railway is planned to begin in late 2019. Completion of construction of the North Railway is expected by 2020 with transportation of ore to Milne Port by trucks and railway ramping up as mine production increases to 12 Mtpa by 2020. Shipping from Milne Port will also increase to 12 Mtpa by 2020. Construction of the South Railway and Steensby Port will commence in 2021 with commissioning and a gradual increase in mine production to 30 Mtpa by 2024. Shipping of 18 Mtpa from Steensby Port will begin in 2025.

Phase 2 also involves the development of additional infrastructure at Milne Port, including a second ore dock. Shipping at Milne Port will continue to occur during the open water season, and may extend into the shoulder periods when the landfast ice is not being used to support travel and harvesting by Inuit. Various upgrades and additional infrastructure will also be required at the Mine Site and along both the north and south transportation corridors to support the increase in production and construction of the two rail lines.

The location of the Mary River Project within Nunavut is shown on Figure 1.1. An overview map of the Mary River Project showing the project locations relevant to the Phase 2 Proposal and the atmospheric environment local study area is shown on Figure 1.2.

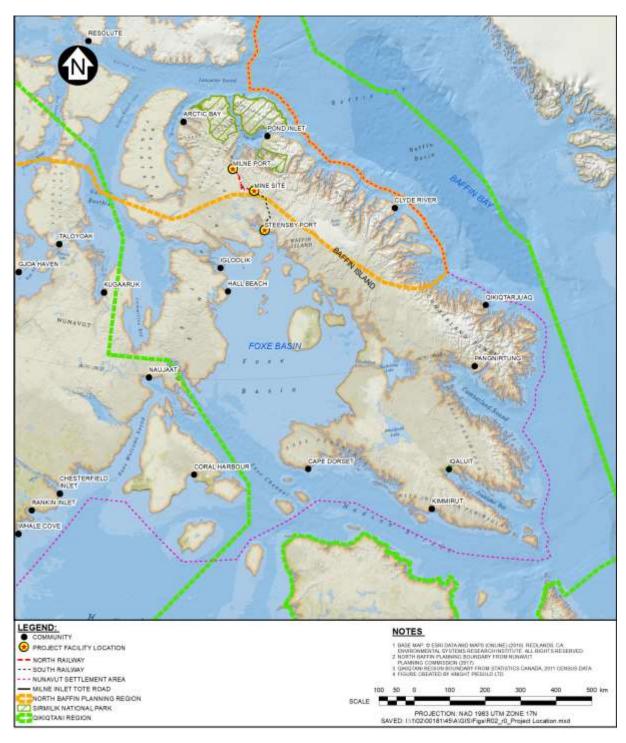


Figure 1.1 Project Location Map

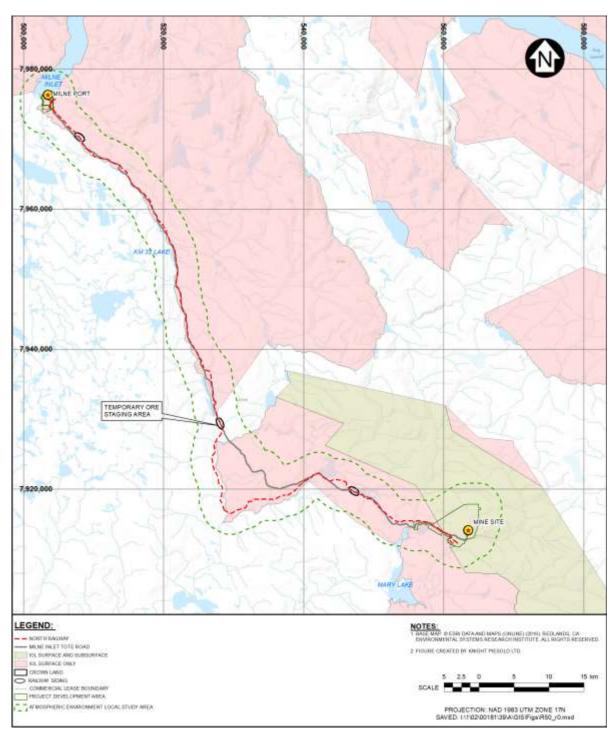


Figure 1.2 Location of Project Activities and LSA



#### 1.2 SCOPE

This Technical Supporting Document (TSD) provides an assessment of the effects of the Phase 2 Proposal on air quality and noise and vibration. Air quality modelling by RWDI (2018a,b) is presented in Appendices A and B as supporting information. Noise dispersion modelling and assessments of vibration by RWDI (2017a, 2018c) are presented in Appendices C and D.

#### 1.3 CONSULTATION

Baffinland has undertaken consultation for the Phase 2 Proposal. A detailed account of workshops and meetings undertaken for the Project is provided in TSD-2 *Phase 2 Workshop Report* and TSD-3 *Phase 2 Public Consultation Report*. The following sections document the concerns raised by stakeholders with respect to the Phase 2 Proposal.

#### 1.3.1 Air Quality

During community consultation on the Phase 2 Proposal, 15 of 865 questions or comments (1.7%) related to air quality. The majority of these related to dust, with questions on incineration coming from community members in Clyde River (Figure 1.3).

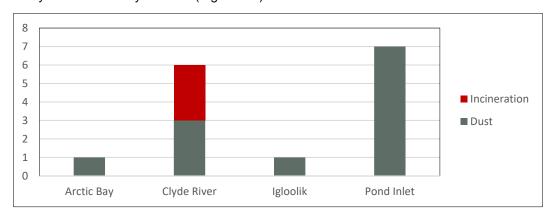


Figure 1.3 Community Concerns Regarding Air Quality

Several commenters expressed concern regarding the extent of fine red dust observed on the snow during winter:

"When I was up there in the spring we collect water from the brooks. It was covered with red dust; they should be white but they were covered with red dust. where the hunters cabin is by the port. We draw water from the creek in behind this cabin. HTO would like to be brought along to show Baffinland where the creek is and where the dust has been found." (Pond Inlet Public Meeting; Nov 22, 2016).

"Dust is a problem. Dust from the ore stockpile has been seen as far away as Bruce head. He is very concerned about dust." (Pond Inlet Hamlet Meeting; May 30, 2017).

"A lot of dust, when travelling along the tote road." (Pond Inlet Public Meeting; November 22, 2016).



One community member commented that he/she was not concerned about the dust because unlike the ore at Nanisivik, the Mine Site iron ore was not processed:

"The ore stored at Milne Inlet will not be in a building and exposed to the environment. I am not concerned about the dust because there are no chemicals attached to it because of the processing of the ore. In Nanisivik it was different because of the processing, but I am not concerned here because it is very different." (Ikajutit HTA, Arctic Bay; May 31, 2017).

Several community members brought up mitigation to reduce dust:

"Want to expand the dock at Milne. Prefer that dust collectors on the stockpile. With more stockpiles, there should be dust collectors. If there is lots of dust going to the ocean, prefer that stockpiles are indoors. Want research to be done, and want results in a timely manner. Want to know how much dust has accumulated." (Pond Inlet Public Meeting, November 22, 2016.)

"The stockpile that was mentioned in Milne Inlet, they will increase stockpile in new location, will that stockpile be covered or will it be an open stockpile?" (Pond Inlet Community Meeting, May 30, 2017).

"Will the rail cars be covered to reduce dust?" (Pond Inlet Hamlet Meeting, May 30, 2017).

"Likes the idea that the crushers are being moved but is concerned about water being impacted from the Tote Road. Is the water safe to drink?" (Pond Inlet Community Meeting, May 30, 2017).

The three incineration-related questions from Clyde River focused on understanding Baffinland's waste management practices, including which wastes are incinerated, recycled or landfilled.

#### 1.3.2 Noise and Vibration

During community consultation on the Phase 2 Proposal, 5 of 865 questions or comments (0.6%) were deemed to relate to noise and vibration. Four comments were from Clyde River and one comment was from Igloolik, and all five comments were regarding blasting, with the potential air quality impacts due to the resultant dust being the primary concern.

"When there is a blasting to extract the resources, there is an explosion. It affects small wildlife and streams and rivers are also affected by the blasting as dust and rock residue can impact the environment, can you try to decrease that impact?" (Clyde River Community Meeting, May 29, 2017).

"I can imagine that the dust would rise in the air from the blasting and fly in the wind and then go to the snow and the ocean. Many animals look for food around the shore, so those are my concerns. The animals always eat little vertebrates and what not and the dust will slowly go to the ocean so that's a concern I have." (Clyde River Community Meeting, May 29, 2017).

The issue of noise in the context of potential sensory disturbance to terrestrial wildlife was raised as a concern during review of the Approved Project.



#### 2 - AIR QUALITY

#### 2.1 BACKGROUND

Air quality is selected as a valued ecosystem component in the FEIS (Baffinland, 2012) as it has been identified as an important aspect of the environment by Inuit organizations, regulatory agencies, and other interested parties, and air quality was identified as a potential VEC in the EIS Guidelines (NIRB, 2015). Emissions from the Project activities have the potential to alter the existing air quality in the vicinity of the Project.

Air quality was assessed for the Approved Project (Baffinland, 2012; 2013) for the following Criteria Air Contaminants (CACs) as measureable parameters:

- Total Suspended Particulate (TSP): vehicle emissions and fugitive dust emissions from construction and operation of roads, rail line, and other infrastructure.
- Sulphur Dioxide (SO<sub>2</sub>) Concentrations: product of combustion from both stationary and mobile sources that use diesel fuel.
- NO<sub>2</sub> Concentrations: products of combustion, emitted from both stationary and mobile emission sources.
- CO Concentrations: carbon monoxide emissions.
- Regional Acid Deposition: SO<sub>2</sub> and oxides of nitrogen (NO<sub>x</sub>) form acidifying chemicals in the atmosphere and are removed by wet and dry deposition processes; the deposition is represented as sulphur and nitrogen deposition and potential acid input (PAI) loads.
- Particulate Matter <2.5 μm (PM<sub>2.5</sub>): Respirable particulate matter with aerodynamic diameters less than 2.5 μm; PM<sub>2.5</sub> is a product of fuel combustion and contained in dust generated by vehicle traffic and by ore processing and handling.
- **PM**<sub>10</sub>: Airborne particulate matter with aerodynamic diameters less than 10 μm. Like PM<sub>2.5</sub>, PM<sub>10</sub> is a product of fuel combustion and is contained in dust generated by the Project.
- Fugitive Dust and Metal Concentrations and Deposition: metals contained within fugitive sources of TSP that arise mainly from the mining, processing, handling, and storage of the iron ore.

The following air contaminants were identified as key issues but were not utilized as measureable parameters for the assessment of air quality, since emissions were determined to be negligible, were addressed as part of a measureable parameter, or were assessed separately:

- Ozone (O<sub>3</sub>): photochemical production of O<sub>3</sub> due to the Project was considered negligible and therefore not addressed.
- **Products of Combustion:** various hydrocarbons (volatile organic compounds and polycyclic aromatic hydrocarbons); impact of these compounds was considered adequately addressed by using NO<sub>2</sub> as a marker for all combustion products.
- Trace Contaminants from Incineration: waste can produce elevated levels of certain trace contaminants of concern, such as polycyclic aromatic hydrocarbons, dioxins and furans, acids and trace metals; Baffinland addressed incinerator emissions through best available mitigation measures, therefore these trace contaminants were not explicitly analyzed.

Local Study Areas (LSAs) were selected to illustrate the spatial distribution of concentrations and deposition patterns associated with the Project and to represent areas where air quality effects may



occur. The LSAs allow for an assessment of Project-related effects to air quality at a local, operational scale. LSAs were established at a distance of 3 km around the edge of each established Project Development Area (PDA).

Air quality dispersion modelling was conducted to predict ambient concentrations, which are compared to ambient air quality objectives or criteria. Ambient air quality objectives are typically applied to areas where there is public access (i.e., beyond the property boundary or fenceline). Due to the remote location of the Project, there is no well-defined property boundary. As such, CACs were assessed within the LSAs and in consideration of the PDA. Ambient conditions and CAC predictions are compared to and assessed against air quality criteria and indicator thresholds (acceptable levels over a given averaging period, see Table 2.1 and Table 2.2) from several Canadian jurisdictions outside of the PDA.

Mitigation measures were identified in the Approved Project to reduce CAC concentrations from point sources and fugitive emission sources at the Mine Site and Steensby Port operations; no mitigation measures were identified for the rail transport of ore.

Based on dispersion modelling, emissions of PM<sub>10</sub>, and PM<sub>2.5</sub> and TSP along with TSP deposition rates were predicted to exceed the respective indicator thresholds at the Mine Site and Steensby Port under worst-case conditions within the LSA (Baffinland, 2012). For rail operations, emissions and deposition rates for the same parameters were predicted to be less than the respective indicator thresholds for these parameters.

Concentrations of gaseous emissions were predicted to exceed indicator thresholds within the Mine Site and Steensby Port LSAs during Project operation.  $SO_2$  and CO concentrations were predicted to exceed background values but be less than indicator thresholds within the Mine Site, South Railway and Steensby Port LSAs during the operation phase. PAI loadings within the Mine Site and Steensby Port LSAs during the same Project phases were predicted to exceed background values but be less than indicator thresholds. Under worst-case conditions, predicted exceedances of indicator thresholds were within the LSA with the exception of discrete areas just beyond the development boundary (Baffinland, 2012).

In consideration of the magnitude (concentrations), extent, duration and frequency of CAC exceedances of indicator thresholds, the effects of the Approved Project to air quality were predicted to be not significant.

#### 2.2 PROJECT MONITORING

Six (6) Project Certificate conditions relate to the potential impacts of the Project on air quality, including calculations of total Project emissions from fuel consumption and gaseous monitoring. Air quality monitoring results are presented in the annual reports to NIRB (Baffinland, 2017; 2018).

Continuous gaseous emissions monitoring equipment was set up in 2014 at Milne Port and the Mine Site to monitor ambient concentrations of sulphur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>2</sub>). Continuous ambient air quality monitoring commenced in November 2014 and continued throughout 2015. Monitoring throughout 2015 concluded that all results were well below the Ambient Air Quality Standards (AAQS) set out by the Government of Nunavut (2011), resulting in the discontinuation of the monitoring program in 2016. To ensure compliance with Project Certificate Condition No. 7 and collect additional data over multiple shipping seasons, the monitoring program



resumed at Milne Port in March 2017 and at the Mine Site in November 2017, and is currently ongoing. SO<sub>2</sub> levels at Milne Port and the Mine Site have remained consistently low and have not exceeded the 1-hour or 24-hour limits. NO<sub>2</sub> levels at both sites have not exceeded the 1-hour or 24-hour limits (Baffinland, 2018).

An annual dustfall monitoring program was initiated in 2012 and is conducted along Milne Inlet Tote Road, at the Mine Site and at Milne Port. Dustfall sampling locations were chosen to represent areas of various expected dustfall deposition rates based on isopleth dispersion models and the direction of prevailing winds within the Regional Study Area, excluding areas of future infrastructure development. Baffinland currently operates 33 dustfall monitoring stations, as follows:

- Mine Site Nine dustfall samplers are located at the Mine Site: three within the Mine Site, four outside the mine footprint within low to moderate isopleth areas, and two references sites located at least 14 km from any Project infrastructure, outside of the extent of expected induced changes in dustfall.
- Milne Port Six dustfall samplers located at Milne Port: five active sites on the port site footprint
  and one reference site to the northeast of the port site and beyond the extent of induced changes
  in expected dustfall.
- Tote Road Sixteen dustfall samplers divided between two transects, a north and south transect. Eight dustfall samplers are positioned perpendicular to the Tote Road centreline at 30 m, 100 m, 1,000 m, and 5,000 m either side of the road. The prevailing wind direction is variable, often parallel to the Tote Road as opposed to perpendicular; therefore 'upwind' and 'downwind' directions from the road are not identified. Two reference dustfall samplers are located 14 km southwest of the Tote Road (one at the north site, one at the south site).

The dustfall samplers located at 30 m and 100 m from the Tote Road centreline provide an indication of the performance of dust suppression efforts. Dustfall concentrations are below or near the threshold value of 55 g/m²/year at the 100 metre distance (the range is from 46.67 g/m²/year on the transect north of the road to 60.29 g/m²/year) on the transect south of the road. Dustfall concentrations at the 1,000, and 5,000 m stations were generally below or near the method detection limit (EDI, 2018). The results of the monitoring program are contained in the 2017 Mary River Project Terrestrial Environment Annual Monitoring Report (EDI, 2018).

#### 2.3 ASSESSMENT METHODOLOGY

The Phase 2 Proposal involves the same activities as previously assessed, and will have comparable increases in CAC concentrations. Nonetheless, air quality dispersion modelling was utilized to quantitatively predict concentrations of the measurable parameter CACs.

The study area for the air quality effects assessment includes Milne Port, the northern corridor, and the Mine site (Figure 1.2). The northern corridor comprises the Tote Road and the rail line. Two spatial boundaries were used for the assessment of effects on air quality: the PDA and the LSA as shown on Figure 1.2. The primary and secondary facilities to support mining, transportation, ore and waste rock storage and shipping activities are captured within the PDAs. As there is limited public use within and adjacent to the PDAs because of the remote location of the Project, it is considered a conservative boundary. The LSA for the northern corridor is within the 10 km distance identified in the NPC conformity review.



In 2014, the North Baffin Regional Land Use Plan was amended to establish the Tote Road as a transportation corridor. The road is currently a vital transportation link for the Project and, as such, upgrades to the road have been ongoing. The Tote Road PDA encompasses the centreline to a distance of 30 m on either side to reflect the area in the Commercial Lease. Similarly, a 40 m distance on either side of the rail centreline was used for the assessment.

The temporal boundaries define the period within which the Project is expected to result in environmental or socio-economic effects. The temporal boundaries are shown below:

- Construction and commissioning (Phase 2 component): two year time frame beginning in 2019 and ending in 2021
- Operation and Maintenance: 2018 to 2035
- Closure: three year period, and
- Post Closure: until closure objectives are satisfied

A standard assessment approach was used to determine air quality effects associated with Project operations-related activities:

- Establish pre-development concentrations of CACs from baseline ambient air quality monitoring
- Determine the activity scenario at each Project site likely to represent worst-case conditions in terms of CAC concentrations
- Identify and quantify atmospheric emission sources associated with the selected activity scenarios
- Determine transport and dispersion patterns in the region using local meteorological conditions
- Predict ambient concentrations and deposition patterns using dispersion models
- Compare air quality predictions to ambient air quality and deposition thresholds
- Assess the significance of effects by identifying incremental air quality changes

The construction and closure phases associated with the Phase 2 Proposal are similar to that previously assessed in the FEIS (Volume 5, Section 2), and therefore these Project phases have not been reassessed.

In order to assess the air emissions associated with the Project, conservative assumptions about the open pit mining operations, ore storage, ore haulage and transference were made. By making these assumptions, the assessment is documenting a scenario that includes maximum emissions from the Project while still allowing for flexibility due to future Project development. The throughputs and details provided as assumptions in the modelling may not be the final design values, however, they were chosen so that the emissions calculated will be conservative.

Air quality modelling was completed for the following Phase 2 Proposal activity scenarios (Appendices A and B; RWDI, 2018a,b):

- Milne Port: An increase in ore shipping to 12 Mtpa and power generation to 22 MW
- Mine Site: An increase in production at the Mine Site to 30 Mtpa
- Northern Transportation Corridor: Construction of the North Railway connecting the Mine Site to Milne Inlet and rail operations to transport 12 Mtpa
- Northern Transportation Corridor: Short-term haulage of 12 Mtpa of ore along the southern portion of the Tote Road during Phase 2 commissioning and associated material handling activities



No changes to the proposed South Railway or Steensby Port are part of the Phase 2 Proposal, and therefore these project components were not included in the scope of activity scenarios.

A CALPUFF model was used to predict the transport, dispersion, chemical transformation, and deposition from all sources associated with the Project, in three dispersion modelling domains associated with each of the PDAs. The model was used to predict 1-h, 24-h and annual average concentration patterns (as applicable) for SO<sub>2</sub>, NO<sub>2</sub>, CO, TSP, PM<sub>10</sub> and PM<sub>2.5</sub>; and 30-day and annual average deposition patterns (as applicable) for dust and PAI. The CALPUFF model allows for the use of a three-dimensional meteorological field over the modelling domain during a given hour, however near field predictions (e.g., at a 30 m distance) cannot be accurately predicted as the CALMET model horizontal domain resolution was set at 400 m (RWDI, 2018a).

A CALMET preprocessor was used to generate three-dimensional meteorological fields for one year (2006) in the Milne Port and Mine Site meteorological domains. Terrain information for the areas surrounding Milne Port and the Mine Site was obtained from Natural Resources Canada's Canadian Digital Elevation as input into CALMET. Modelling was designed to span a representative year of meteorological conditions, to confirm that reasonably worst-case meteorological conditions would be covered: 2006 was chosen as the representative meteorological year, as hourly, three-dimensional meteorological data had already been developed for that year in the Approved Project.

Baseline ambient air quality monitoring was reviewed to establish existing background levels: ambient monitoring was conducted in July 2007 in the vicinity of the Mine Site in order to assess the background air quality where Project activities will occur (FEIS Appendix 5A). The monitoring results near the Mine Site are considered to be representative of baseline air quality in the area, including near Milne Port. The monitoring program included SO<sub>2</sub>, NO<sub>2</sub>, TSP, PM<sub>10</sub>, and dustfall. The contaminants PM<sub>2.5</sub> and CO were excluded from the program because the levels were expected to be too low to be measurable.

The models incorporate the proposed mitigation measures, such as a certain level of dust suppression, chutes on the shiploaders, etc. The exception is the locomotive engines; the models assume these are United States Environmental Protection Agency (US EPA) Tier 3 engines. All locomotives will be equipped with US EPA Tier 4 diesel engines in accordance with the new Locomotive Emissions Regulations, which came into force on June 9, 2017 (Transport Canada, 2017), and in compliance of Commitment #18 in the Final Hearing Report (NIRB, 2012). Therefore, the SO<sub>2</sub> and NO<sub>2</sub> emissions from the locomotives are overstated in the air quality models presented in Appendix A.

For air quality, a major effect can only occur if a criteria set out by provincial or federal regulators is exceeded on a frequent basis at a location where people are expected to be. This is the premise of the process that sets air quality standards. It is important to note that these criteria are exceeded frequently in urban areas due to meteorological conditions and, therefore, a single exceedance is not considered to be a major effect but must be considered in relation to the other effects criteria listed below.

The ambient air quality standards, objective and guidelines applicable to the Project, are summarized in Table 1 of Appendix A. The indicator thresholds used in this assessment are those used in the Approved Project. Thresholds for gaseous emissions CACs and PAI loads are presented in Table 2.1, and thresholds for particulate matter CACs are presented in Table 2.2.



Table 2.1 Indicator Thresholds for Gaseous Emissions and Potential Acid Input

Parameter	Unit	Reference Source	Averaging Period	Threshold
			1-hour	450
SO <sub>2</sub>	(µg/m³)	1,2	24-hour	150
			Annual	30
			1-hour	400
NO <sub>2</sub>	(µg/m³)	1,2	24-hour	200
			Annual	60
00	(ug/m3)	2	1-hour	15,000
СО	(µg/m³)	2	8-hour	6,000
Acid deposition	(keq H+/ha/year)	3	Annual	1

#### NOTES:

- 1. NUNAVUT AMBIENT AIR QUALITY STANDARDS (GOVERNMENT OF NUNAVUT, 2011).
- 2. NORTHWEST TERRITORIES AMBIENT AIR QUALITY STANDARDS (GOVERNMENT OF THE NORTHWEST TERRITORIES, 2014).
- 3. ALBERTA ENVIRONMENT, 2008.

Table 2.2 Indicator Thresholds for Particulate Matter

Parameter	Unit	Reference Source	Averaging Period	Threshold
TSP	(ua/m³)	24-hour		120
136	(µg/m³)	1,2	Annual	60
PM <sub>10</sub>	(µg/m³)	4	24-hour	50
PM <sub>2.5</sub>	(µg/m³)	1	24-hour	30
Dust deposition	(g/m²/30-d)	3, 5, 6	30-day	5.3 - 15.8
Dust deposition	(g/m²/year)	7	Annual	55

#### **NOTES:**

- 1. NUNAVUT AMBIENT AIR QUALITY STANDARDS (GOVERNMENT OF NUNAVUT, 2011).
- 2. BC AMBIENT AIR QUALITY OBJECTIVES (BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, 2016).
- 3. ALBERTA AMBIENT AIR QUALITY OBJECTIVES AND GUIDELINES (ALBERTA ENVIRONMENT AND PARKS, 2017).
- 4. ONTARIO'S AMBIENT AIR QUALITY CRITERIA (ONTARIO MINISTRY OF THE ENVIRONMENT, 2012).
- 5. RESIDENTIAL AND RECREATION AREAS PROVINCE OF ALBERTA.
- 6. COMMERCIAL AND INDUSTRIAL AREAS PROVINCE OF ALBERTA.
- 7. ONTARIO MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE (2016) AS REFERENCED IN RWDI (2017B).

Air quality standards are applicable in areas accessible to the general public or areas beyond the Project's property line. Typically, air quality effects at or beyond a Project's property lines are compared to standards and objectives. For this assessment, the PDAs, which also approximate the current Commercial Lease boundaries, are used as the property lines for Milne Port and the Mine Site. Air quality impacts are also evaluated at two Hunter Trapper Organization (HTO) cabins located near Milne Port and Mine Site, outside the PDAs. The results from within the PDA are intended to inform



potential mitigation beyond standard industrial health and safety practices, but are not considered in the evaluation of significance.

#### 2.4 EFFECTS ASSESSMENT

For the purposes of the analysis of effects on air quality, an effect is considered to be a predicted change in concentration of the indicator compound as a result of the Project activities.

The environmental effects assessment predicts and describes the likely environmental effects, mitigation measures and residual adverse effects on air quality that could reasonably be expected as a result of the Project. Potential interactions (effects pathways, or Project components or activities that contribute emissions to the atmosphere and result in a change in air quality) are identified in Table 2.3. It is noted that Project-environment interactions may vary between Project phases. Effects of the Project on the environment may occur either directly or indirectly. A direct interaction occurs when the VEC is affected by a Project component and/or activity. An indirect interaction occurs when the VEC is affected by a change in another VEC including VECs selected by other disciplines and documented in their respective TSDs. Only direct interactions are carried forward through the Air Quality Environmental Effects assessment: indirect effects on other VECs due to the changes in air quality are considered in the following TSDs:

- TSD No. 9: Vegetation Baseline and Impact Assessment
- TSD Supporting Document No. 10: Terrestrial Wildlife Baseline and Impact Assessment
- TSD No. 11: Evaluation of Exposure Potential from Ore Dusting Events in Selected VECs: Humans, Caribou and Blueberry

Interactions of the Phase 2 Proposal with air quality presented in Table 2.3 that have the potential to have a major interaction with air quality were subject to a detailed assessment using air dispersion modelling. The Air Quality Model Report presented in Appendix A presents an air quality dispersion model that evaluates most aspects of the Project (RWDI, 2018a). A subsequent amendment to that modelling report, presented in Appendix B, addresses short term haulage of 12 Mtpa during commissioning of the North Railway, the construction laydown area developed for the construction of the railway at km 57 that will be re-purposed as an ore staging area(ore will be transported by trucks to this staging area, dumped on a small 12,000 t stockpile, and loaded onto railcars by front end loaders. This trans-loading facility will remain in operation until the railway terminal at the Mine Site is fully operational), as well as increased power generation at Milne Port (RWDI, 2018b).

The results of the modelling described in Section 2.4.1 for Milne Port, Section 2.4.2 for the Mine Site, and Section 2.4.3 for the Northern Transportation Corridor. The results as related to sensitive receptors are discussed in Section 2.4.4.

12 of 40



Table 2.3 Phase 2 Proposal Interactions with Air Quality

Project Infrastructure or Activity	Level of Interaction
Mine Site	
Increase mine production rate by 7.8 Mtpa (from 22.2 Mtpa to 30 Mtpa)	2
Larger North Railway ore stockpiles	2
Relocate crushing and screening to Milne Port	2
Tote Road	
Short-term traffic increase (6 Mtpa of ore and rail construction)	2
Short-term traffic increase during commissioning (12 Mtpa)	2
Reduced road traffic once the North Railway is operational	1
North Railway	
Transport construction equipment and supplies	1
Prepare site area and construct access trail	2
Quarry, crush, screen, haul and place aggregate	2
Construct rail embankment, superstructure, bungalows, etc.	2
Install additional communication towers along corridor	1
Culvert crossings	1
Bridges with piers at four large crossings	1
Transport 12 Mtpa of ore over the railway	2
Transport of supplies and fuel over the railway	1
Conduct regular rail inspection and maintenance	1
Milne Port	
Second ore dock	1
Additional/larger ore stockpiles and ore handling facilities	1
Rail lines and maintenance facilities	1
Additional ancillary port facilities	1
Load ore on ships at an additional dock	2
Increased number of ship-to-shore fuel transfers	1
Increased number of sealift deliveries	2
Increased number of operating tug and line vessels	2
Shipping	
Increased ore carrier transits and larger vessels	2
Increased fuel tanker transits	1
Ore carrier transits during ice formation and break-up (July 1 to November 15)	1
Winter sealift	1

#### **NOTES:**

- 1. INTERACTIONS ARE RATED AS FOLLOWS:
  - 1 MINOR INTERACTION POST-MITIGATION, DISCUSSION ASSESSMENT.
  - 2 MAJOR INTERACTION SUBJECT TO DETAILED ASSESSMENT.



#### 2.4.1 Increases in CACs at Milne Port

During the construction phase (approximately three years) airborne emissions will occur during the building of the second ore dock, and the expansions of ore stock piles and ore handing facilities. Dust will be generated during the construction of the rail line and maintenance facilities, ore truck haulage and unloading which will continue until the rail line is operational, and subsequent unloading of rail cars onto the ore storage pads. There will be increased dust emissions during the loading of the current ore storage pads, stackers and conveyance of ore to vessels. Emissions from ore transport carriers, sea lift deliveries, and tug and line vessels will also increase. Point source emissions will occur from the use of diesel generators, and other combustion sources such as frost fighters and rail idling (these sources were modelled as non-buoyant area and volume sources, respectively). The secondary ore crushing and screening operation will be located at Milne Port. The crushing and screening plant will be located indoors (the current crushing and screening plant at the Mine is outdoors). Some dust will be emitted during the decommissioning and reclamation phases.

#### **Gaseous Emissions CACs**

The maximum predicted levels of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI are below their respective indicator thresholds everywhere outside the PDA (Figures D-1 to D-8 and D-15 in Appendix A), including at/near the Hunter Trapper Organization (HTO) cabin. The maximum predicted concentrations are summarized in Table 2.4

Table 2.4 Maximum Predicted Concentrations of Gaseous Emissions at Milne Port

Parameter	Unit	Averaging Period	Threshold	Maximum Concentration In the LSA	Comments
		1-hour	450	15-30	No exceedance above the threshold (even within the PDA).  Maximum SO <sub>2</sub> concentrations
SO <sub>2</sub>	μg/m³	24-hour	150	5-8	of 15- 30 μg/m³ and 5 - 8 μg/m³ occur outside the LSA periodically during the 1 hr and 24 hr
		Annual	30	0.3-1.5	averaging periods, respectively.
NO <sub>2</sub>	μg/m³	1-hour	400	200-300	No exceedance above the threshold within the LSA. Concentrations of 200 - 300 μg/m³ occur outside the LSA.
		24-hour	200	75-100	No exceedance above the threshold at any location. However, concentrations of 75 - 100 μg/m³ occur outside the LSA.
		Annual	60	15-30	No exceedance above the threshold within the LSA. However, concentrations of 15 - 30 μg/m³ occur outside the LSA.



Parameter	Unit	Averaging Period	Threshold	Maximum Concentration In the LSA	Comments
со		1-hour	15,000	150-400	No exceedance above the threshold at any locations. However, concentrations of
	μg/m <sup>3</sup>	8-hour	6,000	120-500	150 - 400 µg/m³ occur outside the LSA for the 1-hr averaging period and 120 - 500 for the 8-hr averaging period.
Acid Input	keq H+/ha/yr	Annual	1.00	ND 4`	No exceedance above the threshold within the LSA.

#### **NOTES:**

1. ND - NO EMISSIONS PREDICTED TO OCCUR WITHIN THE LSA.

The supplemental Air Quality Model Report (Appendix B; RWDI, 2018a) evaluated whether an increase in the installed capacity of power generators at Milne Port from the 16.75 MW modelled in the original model report (Appendix A; RWDI, 2018b) to the planned 22 MW represented a meaningful change. Four additional 1.35 MW generators added in the vicinity of the existing generators represent a 32% increase of power generation that would generally translate into a linear increase in emissions of contaminants (Appendix B).  $SO_2$  and CO concentrations were previously modelled well below the selected criteria. Therefore, a 32% increase of  $SO_2$  and CO emissions from the generators will translate into an increase in concentrations less than or equal to 32%, which will still be lower than the selected criteria for those contaminants. For example, the maximum predicted concentrations of  $SO_2$  over a 1-hr averaging period within the LSA was  $15-30~\mu g/m^3$ : a 32% increase results in a range of 19.8 - 39.6  $\mu g/m^3$ , well below the indicator threshold of 450  $\mu g/m^3$ .

For NO<sub>2</sub>, the predicted exceedances were mostly associated with frost fighters and generators emissions near the accommodation building. Therefore, a 32% increase of NO<sub>2</sub> emissions from the generators will translate into an increase in concentrations less or equal to 32%. This indicates that the 1-hr maximum concentration range of 200 - 300  $\mu$ g/m³ predicted within and outside the LSA would increase to 264 - 396  $\mu$ g/m³, which remains below the indicator threshold of 400  $\mu$ g/m³, and the 24-hr maximum concentration range of 75 - 100  $\mu$ g/m³ predicted within and outside the LSA would increase to 99 - 132  $\mu$ g/m³, which remains below the indicator threshold of 200  $\mu$ g/m³.

The highest predicted impacts from SO<sub>2</sub>, NO<sub>2</sub>, and CO are from the combustion emissions from frost fighters and rail idling, but concentrations are anticipated to vary seasonally, since the emissions from the frost fighters were modelled as continuous from November to April, and emissions from ships at anchor, ships at port, and tugboat operations were modelled as continuous from July to October (see Table 3 in Appendix A).

#### **Particulate Matter CACs**

The maximum predicted levels for TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and dustfall were above the indicator thresholds for all averaging periods within the LSA (Figures D-9 to D-14 in Appendix A). However, concentrations are expected to decrease in the LSA below the indicator threshold with distance from the edge of the PDA and exceedances are expected to occur infrequently at distances of 500 m and 1,000 m away from the PDA boundary (Appendix C, RWDI 2018d). Importantly, none of the indicator thresholds are exceeded at the HTO cabin.



The maximum predicted concentrations are summarized in Table 2.5. The main sources that contribute to these exceedances are fugitive dust from material handling and road dust from vehicles on the fine ore road.

Table 2.5 Maximum Particulate Matter Concentrations at Milne Port

Parameter	Unit	Averaging Period	Threshold	Maximum Concentration Within the LSA	Comments	
PM <sub>10</sub>	μg/m³	24-hour	50	> 100	Threshold exceedance contained within the LSA. The frequency of threshold exceedances at 1 km outside the PDA is 6 days/year.	
PM <sub>2.5</sub>	µg/m³	24-hour	30	>30	Threshold exceedance contained within the LSA, and the indicator threshold is predicted be exceeded only at the PDA boundary and only at a frequency of 4 days/year. No exceedances are predicted 500 m from the PDA.	
TSP	μg/m³	CD up/m³	24-hour	120	>240	Threshold exceedance contained within the LSA. The number of indicator threshold exceedances at 1 km from the PDA within the LSA is 11 days/year.
		Annual	60	>60	Threshold exceedance contained within the LSA, and the indicator threshold is predicted be exceeded only at the PDA boundary and only at a frequency of 1day/year.	
Dustfall	g/m²/30- d	30-day	5.3 to 15.8	>15.8	Threshold exceedance contained within the LSA, and the 30-day indicator threshold is predicted be exceeded only at the PDA boundary and only at a frequency of 1day/year. The indicator threshold for the annual concentration is expected to be	
	g/m²/a	Annual	55	>55	exceeded at a distance of 500 m outside of the PDA, but only at a frequency of 1 day/year.	

The main source of 24-hour exceedances that occur north of the PDA (i.e., for TSP, PM<sub>10</sub> and PM<sub>2.5</sub>) is material handling. The conveyor to the transfer point at the ship loader, and the discharge chute on the Cape size ship, in particular, lie within 50 m of the northern edge of the PDA. Exceedances of 24-hour TSP and PM<sub>10</sub> outside the PDA are the most extensive in that area, (Figures D-9 and D-11 in Appendix A) while the impact of the handling sources is lower on 24-hour PM<sub>2.5</sub> (Figure D-12 in Appendix A) because the material handled (iron lump and fines) is comprised mostly of larger particle



matter (PM) size fractions. The exceedances of 24-hour TSP and  $PM_{10}$  that are predicted to occur to the west of the PDA, are due to a combination of fugitive dust from material handling and vehicle road dust, with vehicle road dust alone predicted to exceed the 24-hr averaging period criteria threshold, a few hundred meters past the PDA.

#### 2.4.2 Increases in CACs at the Mine Site

Phase 2 construction activities that will contribute to dust emissions includes the construction of the railway and associated ore handling facilities that will replace the current loading truck ore facilities and other supporting infrastructure.,

During operations particulate and gaseous emissions will occur during the drilling and blasting of ore, haulage of waste and ore, the expansions of the ore stockpiles, continued primary crushing, the transfer of ore via stacking conveyors and loading the rail cars. The process flow diagram for the 12 Mtpa north rail operation at the Mine Site is presented as Figure 2.1 in Technical Supporting Document 2 Phase 2 Development Proposal: Project Description. Airborne emissions during mining are identified in the FEIS - Volume 5, Table 5-2.11 Emission Sources and Estimated Annual Emissions Due to the Mine Site. Minor amount of dust will be generated during the ongoing and final reclamation activities.

Emission sources at the Mine Site that were assessed in the air quality model (Appendix A) for the Phase 2 Proposal include the power generating station, waste incinerators, idling locomotives at the loading stations, mobile engine operations (drills, shovels, loaders, frost fighters, etc.), grading, dozing, drilling, blasting, excavation, ore material handling (stockpiles, reclaimer, conveyance), and vehicle road dust.

#### **Gaseous Emission CACs**

The maximum predicted concentrations of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI are below their respective indicator thresholds everywhere outside the PDA (Figures E-1 to E-8, and E-15 in Appendix A). Maximum predicted increases in gaseous CAC parameters and PAI loads within the LSA are summarized in Table 2.6.

Table 2.6 Maximum Predicted Concentrations of Gaseous Emissions at the Mine Site

Parameter	Unit	Averaging Period	Threshold	Maximum Concentration Within the LSA	Comments
со	μg/m³	1-hour	15,000	15-400	No exceedance above the threshold within the LSA.
		8-hour	6,000	120-500	
	NO <sub>2</sub> µg/m <sup>3</sup>	1-hour	400	200-300	
NO <sub>2</sub>		24-hour	200	75-100	No exceedance above the threshold within the LSA.
		Annual	60	15-30	



Parameter	Unit	Averaging Period	Threshold	Maximum Concentration Within the LSA	Comments
	μg/m³	1-hour	450	ND	The SO <sub>2</sub> plume does not
SO <sub>2</sub>		24-hour	150	ND	extend to the LSA for any of
		Annual	30	ND	the time periods.
Acid Input	keq H+/ha/a	Annual	1	0.17 - 0.25	No exceedance above threshold within the LSA.

#### **NOTES:**

The sources for gaseous emission SO2, NO2, CO and PAI at the Mine Site are from the combustion emissions from mobile equipment in the ore pit and on haul roads near the ore pit, frost fighters, generators, and rail idling.

There are no exceedances of the indicator thresholds outside the PDA. None of the gaseous emissions extend to the HTO cabin on the west side of Camp Lake.

#### **Particulate Matter CACs**

The main sources of particulate matter are road dust from vehicles on the haul roads, and fugitive dust from material handling. The maximum predicted concentrations within or just outside the LSA are summarized in Table 2.7 and shown on Figures E-9 to E-14 in Appendix A.

Table 2.7 Maximum Particulate Matter Concentrations at the Mine Site

Parameter	Unit	Averaging Period	Threshold	Maximum Concentration within the LSA	Comments
PM <sub>10</sub>	μg/m³	24-hour	50	>100	Threshold exceedance extends slightly beyond the LSA (<300m); however, within the LSA the frequency of exceedance at 1 km from the PDA is 6 days/year.
PM <sub>2.5</sub>	μg/m³	24-hour	30	>30	Threshold exceedance contained within the LSA. There are no predicted exceedances at 1 km from the edge of the PDA.
TSP	μg/m³	24-hour	120	>240	Threshold exceedance contained within the LSA. The frequency of indicator threshold exceedances at 1 km from the PDA within the LSA is 11 days/year.
		Annual	60	>60	Threshold exceedance contained within the LSA. There are no exceedances at the 1 km distance from the PDA within the LSA.

<sup>1.</sup> ND - NO EMISSIONS PREDICTED TO OCCUR WITHIN THE LSA.



Parameter	Unit	Averaging Period	Threshold	Maximum Concentration within the LSA	Comments
Dustfall	g/m²/30-d	30-day	30-day 15.8		Dustfall is expected to exceed the indicator threshold within the LSA; however, exceedances are only expected at the edge of the PDA at a frequency of 1 day/year and no exceedances are predicted at 1 km from the PDA within the LSA. Dust concentrations beyond the LSA are in the range of 1-2 g/m²/30-d.
	g/m²/a	Annual	55	>55	The annual dustfall threshold is exceeded in into the LSA but the frequency of occurrence at the edge of the PDA is only 1 day/year. Dust concentrations beyond the LSA are in the range of 5 - 10 g/m²/a.

The material handling sources at the Mine Site stockpiles and vehicle road dust along the haul roads contribute to dust and particulate emissions. The 24-hour TSP andPM<sub>10</sub> extend over 2.5 km past the PDA towards the southwest (Figures E-9 and E-11 of Appendix A). The impact is lower on 24-hour PM<sub>2.5</sub> (Figure E-12) and the exceedances only extend 300 m outside of the PDA. The exceedances of 24-hour TSP and PM<sub>10</sub> that are predicted to occur to the east of the PDA are mainly due to vehicle road dust along the haul roads leading to the pit. The annual TSP concentrations extend less than 300 m southeast of the PDA boundary and 30-day and annual dustfall are also driven mainly by vehicle road dust (Figures E-10, E-13 and E-14 of Appendix A). The exceedances of annual TSP and dustfall are limited to within 200 m of the PDA.

#### 2.4.3 Increase in CACs along the Northern Transportation Corridor

During the construction phase air borne emissions will occur during the development of the rail line, laydown areas and ongoing improvements along the Tote Road. Dust will be emitted during the extraction of quarry material by crushing, screening and haulage of rock for rail bed preparation. Ore haulage will occur during construction as well as to provide access to the railway alignment. The rail line will be commissioned in sections, which will contribute to additional dust loadings.

During operations, the Milne Tote Road traffic volumes will be limited to personnel transport between the Mine Site and Milne Port, and for deliveries such as water and fuel. Road usage will subsequently be reduced from current levels once the North Railway is operational. The operation of the North Railway will reduce the amount of dust generated along the Northern Corridor. The use of quarry material will be needed to obtain rock for ballast replacement for railway maintenance. Minor amounts of dust will be generated during the reclamation and decommissioning phase.

The PDA for the North Rail is a 40 m buffer on either side of the rail centreline, Emission sources that were modelled for the Northern Transportation Corridor included mobile engine operations round the quarry, rail bed and roads, vehicle road dust, grading, dozing, drilling and crushing, and blasting in the quarry.



#### **Gaseous Emission CACs**

Maximum predicted levels of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI were well below their respective indicator thresholds everywhere in the Northern Transportation Corridor modelling domain. For this reason, contour plots were not prepared for the gaseous emission CACs (see Appendix A section 5.3).

#### **Particulate Matter CACs**

The maximum predicted levels of TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and dustfall exceed their respective indicator thresholds along the Northern Transportation Corridor LSA. Concentration and deposition contour plots for this scenario are provided in Appendix A, as follows:

- Figures F-1 to F-6 present particulate matter and dustfall results for the Tote Road only. These
  impacts are mainly from vehicle road dust generated by ore trucks using the Tote Road.
- Figures F-7 to F-12 present particulate matter and dustfall results for sources related to railway
  construction. The predicted emissions along the transportation corridor and near the quarry are
  mainly from vehicle road dust along the rail bed road, and the predicted levels lie below the
  applicable indicator thresholds for all particulate matter species and dustfall, for all applicable
  averaging periods. The predicted emissions near the active construction area (i.e., the rail bed)
  are mainly from grading and dozing.
- Figures F-13 to F-18 present particulate matter and dustfall results for all sources combined, including construction-related sources and ore trucks using the Tote Road during commissioning. Since the predicted emissions for particulate matter and dustfall from the Tote Road are more predominant than those from the construction sources, the contours for all sources combined are very similar to those shown for only the Tote Road (i.e., Figures F-1 to F-6). The maximum predicted concentrations are summarized in Table 2.8. None of the particulate and dustfall concentrations extend beyond the Northern Corridor LSA.

Plotting the emissions from rail construction separate from ore haulage on the Tote Road allows for a better understanding of the contributing sources of each particulate matter CAC.

Additional air quality modelling was conducted to assess emissions associated with the Temporary Transfer Facility and combined road and rail activity along the Northern Transportation Corridor: the results of this analysis are presented in Appendix B (RWDI, 2018b). The Temporary Transfer Facility was relocated from its proposed location to a section of the Tote Road previously modelled in Phase 2 Proposal Environmental Air Quality assessment.

Figure 1 in Appendix B presents the layout and modelled air emission sources. Figures 2 to 7 present PM and dustfall results for the Tote Road and the Temporary Ore Transfer Facility. Road traffic emissions were doubled on the southern portion of the Tote Road and removed on the northern portion of the Tote Road going from the Temporary Ore Transfer Facility to the Milne Port. As expected for the southern part of the Tote Road, the predicted levels that lie above the applicable indicator threshold are in general limited to within 500 m to 2 km of the Tote Road or the Temporary Ore Transfer Facility and within the LSA.

Figures 8 to 13 of Appendix B present PM and dustfall results for the Tote Road and the Temporary Ore Transfer Facility (as shown on Figures 2 to 7) along with concurrent construction activities. Overall, emissions are dominated by the combined Tote Road and the Temporary Ore Transfer Facility operations, and the emissions related to construction activities are relatively less significant.



Additional dust suppression efforts are planned to address the increase in particulate matter emissions resulting from mainly increased traffic on the Tote Road, and to a lesser degree construction at quarries and along the railway alignment (Knight Piésold, 2017). This includes the establishment of an additional 13 water take locations along the Northern Transportation Corridor.

The increased CAC concentrations predicted for the Northern Transportation Corridor will be short-term, occurring over the 3-year North Railway construction phase when an increased quantity of ore will also be hauled by truck to Milne Port. Once the North Railway is operational, CAC emissions will be substantially reduced, compared to this 3-year period, as well as current early revenue phase (ERP) operations. Air quality issues related to the operating railway were assessed to be negligible (FEIS Volume 5, Section 2.6.3.2). The Tote Road will continue to be used to transport workers and some supplies between Milne Port and the Mine Site, but the traffic levels will be modest compared to current operations, and the same dust suppression efforts will continue to be applied to the road.

The maximum predicted concentrations are summarized in Table 2.8.

#### 2.4.4 Increases in CACs at Sensitive Receptors

The HTO cabins located near Milne Port and Mine Site were identified as sensitive receptors, as users of the cabins could be affected by reduced air quality. The HTO cabin near Milne Port is located approximately 600 m to the east of the north edge of the PDA. Because of the proximity of the cabin within the LSA there is some exposure to the lower levels of SO<sub>2</sub>, NO<sub>2</sub>, CO, and TSP concentrations for some of the averaging periods and for the PM<sub>10</sub> 24-hour averaging period; however, there are no exceedances of any indicator thresholds. The TSP 24-hour averaging period and PM<sub>10</sub> 24-hour averaging period indicator threshold criteria are expected to be exceeded only 26 days/year and 23 days/year, respectively, at a distance of 500 m from the PDA. The TSP annual averaging period indicator threshold criteria is not expected to be exceeded at a distance of 500 m from the PDA. Concentrations of PM<sub>2.5</sub> 24-hour averaging, dustfall, and PAI are not predicted to be elevated near the cabin. Therefore, although some of the CAC emissions are predicted to increase for short periods of time at the location of the HTO cabin near Milne Port, the emissions are not expected to affect the users of the cabin.

The HTO cabin near the Mine Site is located approximately 500 m to the south of the PDA along the Tote Road and approximately 6 km to the northwest of the Mine. No increased concentrations of  $SO_2$ ,  $NO_2$ , CO, PAI, and  $PM_{2.5}$  24-hour averaging period are predicted to occur at or near the cabin. Concentrations are predicted to be in the lower modelled ranges for the annual and 24-hour averaging periods for TSP and the 24 -hour averaging period for  $PM_{10}$  at the cabin. The frequency of indicator exceedance is predicted to be 26 days/year for the 24-hour TSP and 23 days/year for the 24-hour  $PM_{10}$  concentrations at 500 m from the PDA; therefore, it is reasonable to expect that concentrations less than the indicator criteria will occur less frequently. Therefore, although some of the CAC emissions are predicted to increase for short periods of time at the location of the HTO cabin near the Mine Site, the emissions are not expected to affect the users of the cabin.

Road watering mitigation will potentially reduce PM<sub>10</sub> concentrations at the HTO cabin to below indicator thresholds. Concentrations will be monitored, and additional mitigation measures will be considered, including moving the cabin, if air quality impacts are noted.



Table 2.8 Maximum Particulate Matter Concentrations along the Northern Transportation Corridor

Parameter	Unit	Averaging Period	Threshold	Maximum Concentration within LSA	Comments
PM <sub>10</sub>	µg/m³	24-hour	50	>100	Threshold exceedance contained within the LSA. The frequency of indicator threshold exceedance at 1 km from the PDA within the LSA is 29 days/year.
PM <sub>2.5</sub>	µg/m³	24-hour	30	>30	Threshold exceedance contained within the LSA. Occasional exceedances centred around quarries. No exceedances are predicted to occur 1 km from the edge of the PDA within the LSA.
	µg/m³	24-hour	120	>240	Threshold exceedance contained within the LSA. The predicted frequency of threshold indicator exceedances at 1 km from the PDA within the LSA is 6 days/year.
TSP		Annual	60	>60	Threshold exceedance contained within the LSA. The predicted frequency of threshold indicator exceedances at 500 m from the PDA within the LSA is 1 day/year; no exceedances are predicted at 1 km from the PDA.
Dustfall	g/m²/30-d	30-day	15.8	>15.8	Threshold exceedance contained within the LSA. There are no predicted exceedances at 1 km from the edge of the PDA, and the indicator criteria are only expected to be exceeded at the PDA boundary 12 days/year.
	g/m²/a	Annual	55	>55	Threshold exceedance contained within the LSA. There are no predicted exceedances at 1 km from the PDA boundary.

#### 2.4.5 Significance of Residual Effects

For the purposes of the analysis of effects on air quality, an effect is considered to be a predicted change in concentration of the indicator compound as a result of the Project activities, and include any change in concentration, not just those that exceed an indicator threshold. Residual effects are those



that remain after the implementation of mitigation measures, and, therefore are the expected consequences of the Project on the VECs. Residual effects of air quality are assessed outside the project footprint, represented by the PDA, which corresponds to the areas covered by Baffinland's tenure. The significance of the residual effects of the Project on the air quality VEC are assessed in the LSA that surrounds the PDA.

As for all VECs, the significance of adverse residual effects of the Project on the air quality VEC were assessed by considering the following five criteria:

- Magnitude: size or degree of the effect
- Geographic Extent: spatial scale of the effect
- Duration: temporal scale of the cause of the effect
- Frequency: rate at which the effect occurs, and
- Degree of Reversibility: ability to return to pre-Project conditions

In addition to an assessment of the significance of a residual effect based on these criteria, the certainty or likelihood that the effect will occur is also considered. An evaluation of the predicted residual effects to air quality as a result of the Phase 2 Proposal is summarized in Table 2.9. These residual effects are likely to occur, and the certainty of the effects assessment is moderate.

#### **Milne Port**

- Predicted concentrations of NO<sub>2</sub>, and CO, and predicted depositions of PAI for all relevant averaging periods
- Predicted concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub>, and predicted dustfall for all relevant averaging periods

#### Mine Site

- Predicted concentrations of SO<sub>2</sub>, NO<sub>2</sub>, and CO, and predicted depositions of PAI for all relevant averaging periods
- Predicted concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub>, and predicted dustfall for all relevant averaging periods

#### **Northern Transportation Corridor**

 Predicted concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub>, and predicted dustfall for all relevant averaging periods

The residual effects to air quality from the Phase 2 Proposal are predicted to be not significant.

#### 2.5 CLIMATE CHANGE CONSIDERATIONS

Anticipated changes to the climate in the study area are described by Baffinland (2017). These changes are not expected to interact with the Project's effects to air quality.

#### 2.6 MITIGATION AND MONITORING PLAN UPDATES

The Air Quality and Noise Abatement Management Plan (Baffinland, 2016a) outlines mitigation measures for air quality and monitoring parameters. The mitigation measures incorporated into the air quality dispersion modelling are integral to the Project design, with the exception of dust suppression. Baffinland plans to increase its dust suppression efforts along the Tote Road and North Railway



alignment during the construction phase, and additional water take locations have been identified for this purpose (Knight Piésold, 2017). The Air Quality and Noise Abatement Management Plan will be updated to incorporate the additional dust suppression efforts.

The air quality monitoring program described in the Air Quality and Noise Abatement Management Plan (Baffinland, 2016a), along with the dustfall monitoring program described in the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP; Baffinland, 2016c) will be adequate to monitor the effects of the Phase 2 Proposal. Each of the monitoring programs will be reviewed to determine if any minor modifications or additional stations will be required. The updated plan shall be provided to the NIRB for review and comment at least 60 days prior to commencement of construction activities.



Table 2.9 Significance of Residual Effects on Air Quality in the LSA

		Residual		Qualifiers				
Residual Effect	Magnitude	Extent	Frequency	Duration	Reversibility	Significance of Residual Effect	Probability (Likelihood of the Effect Occurring)	Certainty (Confidence in the Effects Prediction)
Milne Port - Particulate matter (TSP, PM <sub>10</sub> and PM <sub>2.5</sub> ) emissions due to port operations	Level III Exceedance within LSA	Level II  Measurable changes extend beyond the LSA	Level II Effect will occur continuously but with limited frequency at 1 km from the PDA within the LSA.	Level II Effect will occur during operations	Level I Effect is reversible after the activity ceases	Not Significant	Effect will occur	Moderate
Milne Port - Dust Deposition - Deposition due to port operations	Level II Predicted to exceed the indicator thresholds within LSA	Level I Measurable changes are confined to the LSA in areas adjacent to PDA	Level II Effect will occur continuously but with limited frequency at 1 km from the PDA within the LSA.	Level III Deposition will occur during operations	Level II Deposition effects are partially reversible	Not Significant	Effect will occur	Moderate
Milne Port - Gaseous emissions CO, NO <sub>2</sub> loading due to port operations	Level I Above background values and below indicator thresholds	Level III Changes predicted beyond PDA	Level III CO, (NO2) Effect will occur continuously	Level II CO, (NO2) Effect will occur during operations	Level I Effect is fully reversible after the activity ceases	Not Significant	Effect will occur	Moderate
Milne Port - Gaseous emissions PAI loading due to port operations	Level I No changes predicted within LSA	Level I No changes predicted beyond PDA	Level I Effect not anticipated to occur in LSA	Level II Effect will occur during operations	Level I Effect is fully reversible after the activity ceases	Not Significant	Effect will occur	Moderate



		Residual		Qualifiers				
Residual Effect	Magnitude	Extent	Frequency	Duration	Reversibility	Significance of Residual Effect	Probability (Likelihood of the Effect Occurring)	Certainty (Confidence in the Effects Prediction)
Milne Port - Gaseous emissions SO <sub>2</sub>	Level I Above Background values and below indicator thresholds	Level I Measurable changes are confined to small areas within the LSA	Level II Effect will occur continuously	Level II Effect will occur during operations	Level I Effect is fully reversible after the activity ceases	Not Significant	Effect will occur	Moderate
Mine Site - Particulate matter (PM 10, PM 2.5, TSP) emissions due to mine operations	Level II Predicted to exceed indicator thresholds	Level III  Measureable changes extend beyond the LSA	Level II Effect will occur continuously but with limited frequency at 1 km from the PDA within the LSA.	Level II Effect will occur during operations	Level I Effect is fully reversible after the activity ceases	Not Significant	Effect will occur	Moderate
Mine Site - Dustfall deposition due to port operations	Level II Deposition is predicted to exceed the indicator threshold	Level III Measureable changes occur beyond the LSA	Level III Effect will occur continuously	Level II Deposition will occur during operations	Level II Deposition effects are partially reversible	Not Significant	Effect will occur	Moderate
Mine Site - Gaseous emissions, CO, NO2, SO2 and PAI loading due to mine operations	Level I Emissions above background but less than the indicator threshold	Level I Measurable changes are confined to the LSA	Level II	Level II Effect will occur during operations	Level I Effect is reversible after the activity ceases	Not Significant	Effect will occur	Moderate



		Residual Effect Evaluation Criteria						Qualifiers	
Residual Effect	Magnitude	Extent	Frequency	Duration	Reversibility	Significance of Residual Effect	Probability (Likelihood of the Effect Occurring)	Certainty (Confidence in the Effects Prediction)	
Northern Transportation Corridor - Particulate matter (TSP, PM10 and 2.5) emissions due to tote road use and rail construction	Level II Emissions are above the indicator thresholds	Level II  Measurable changes are confined to the LSA	Level I Effect will occur continuously	Level II Effect will persist for the duration of the Project phase	Level I Effect is reversible after the activity ceases	Not Significant	Effect will occur	Moderate	
Northern Transportation Corridor - Dustfall deposition due to tote road use and rail construction	Level II Deposition is above the indicator thresholds	Level I Measurable changes are confined to the LSA	Level II Effect will occur during road haulage	Level I Most of the Predicted effects will occur during the construction phase. Level II during operations.	Level II Deposition effects are partially reversible	Not Significant	Effect will occur	Moderate	

#### NOTES:

- 1. MAGNITUDE: 1 (LEVEL I) = A CHANGE THAT IS LESS THAN THRESHOLD VALUES; 2 (LEVEL II) = A CHANGE THAT IS GREATER THAN THRESHOLD VALUES AND OR THAT RESULTS IN A CHANGE THAT IS MEASURABLE BUT ALLOWS RECOVERY IN ONE OR TWO GENERATIONS; 3 (LEVEL III) = A CHANGE THAT IS AN ORDER OF MAGNITUDE GREATER THAN THRESHOLD VALUES; INCLUDES CONSIDERATION OF ENVIRONMENTAL SENSITIVITY (IE THE HTO CABINS) AND OR REDUCED POPULATION SIZE OR OTHER LONG- LASTING EFFECTS.
- 2. EXTENT: 1 (LEVEL I) = CONFINED TO THE LSA; 2 (LEVEL II) = BEYOND THE LSA.
- 3. FREQUENCY: 1 (LEVEL I) = INFREQUENT (RARELY OCCURRING); 2 (LEVEL II) = FREQUENT (INTERMITTENTLY OCCURRING); 3 (LEVEL III) = CONTINUOUS.
- 4. **DURATION:** 1 (LEVEL I) = SHORT-TERM, (EFFECT LAST FOR YEARS); 2 (LEVEL II) = MEDIUM-TERM FOR THE LIFE OF THE OPERATION; 3 (LEVEL III) = LONG-TERM (BEYOND THE LIFE OF THE PROJECT) OR PERMANENT.
- 5. **REVERSIBILITY:** 1 (LEVEL I) = FULLY REVERSIBLE AFTER ACTIVITY IS COMPLETE; 2 (LEVEL II) = PARTIALLY REVERSIBLE AFTER ACTIVITY IS COMPLETE; 3 (LEVEL III) = NON-REVERSIBLE AFTER THE ACTIVITY IS COMPLETE.
- 6. THE LEVEL OF SIGNIFICANCE OF AN EFFECT WAS ASSIGNED BY USING THE RESIDUAL EFFECT EVALUATION CRITERIA. OVERALL, ALL AIR QUALITY EFFECTS ARE CONSIDERED TO BE IMMEDIATELY REVERSIBLE, AND THE SINGLE VC, AIR QUALITY, IS CONSIDERED TO BE OF HIGH VALUE TO LOCAL RESIDENTS. THE MAGNITUDE EXTENT IS EVALUATED WITHIN OR BEYOND THE LSA, SINCE THE PDA IS THE LOCATION OF THE EMISSIONS SOURCES. THEREFORE, THE EFFECTS CRITERIA (I.E., MAGNITUDE, GEOGRAPHIC EXTENT, AND FREQUENCY) ARE COMBINED TO IDENTIFY THE LEVEL OF SIGNIFICANCE FOR AIR QUALITY.



### 3 - NOISE AND VIBRATION

### 3.1 BACKGROUND

The existing noise environment in the Project area was described in the FEIS (Baffinland, 2012) and FEIS Addendum (Baffinland, 2013). The potential noise effects from the Approved Project were evaluated for the construction and closure phases qualitatively, and the operation phase was evaluated quantitatively using noise modelling to predict environmental sound levels. Modelling results were compared to the Directive 038 Guidelines (Alberta Energy Regulator, 2007). Nunavut does not have established environmental noise levels, and so the Alberta guidelines have been used to assess noise effects for similar projects in Nunavut and the Northwest Territories. The assessment concentrated on comparisons with guideline limits and effects on human receptors, as effects on other biophysical components such as wildlife, vegetation and human health were addressed separately by the appropriate disciplines.

During construction of the Approved Project, noise levels at some locations were estimated to be moderate to loud, with the potential for noise to extend out to 1.5 km from the PDA (Baffinland, 2012; 2013). During Operations the maximum sound levels at 1.5 km from the Mine Site PDA was predicted to be 45 Leq (1-hour) dBA and the indoor sound level at the Worker Accommodation Building was predicted to be Balance Noise Criterion (NCB) 29 (Baffinland, 2012; 2013).

Noise modelling was also conducted for the Milne Port PDA (Baffinland, 2013). Construction activities at Milne Port were deemed to have the potential to generate noise that would be audible out to 1.5 km from the facility. Noise levels at some locations within the construction area were predicted to be moderate to loud, which could affect the aesthetic use of the eastern end of the beach by residents of Pond Inlet or other communities, if or when they seek to use the area for camping during the operation phase (Baffinland, 2013). The effect was anticipated to be not significant. During operations the maximum sound levels at 1.5 km from the Milne Port PDA was predicted to be 40 Leq (1-hour), dBA and the indoor sound level at the worker accommodation building was predicted to be NCB 42 (Baffinland, 2013). Predicted average hourly sound levels from truck traffic along the Tote Road was expected to be minor. The significance of residual noise effects (increase in noise levels) was rated as not significant.

Vibration effects were assessed in the Approved Project. A qualitative vibration assessment was conducted for the construction or closure phases, in consideration of the intermittent and temporary nature of the work. The vibration assessment conducted for the operation phase characterized vibration emissions, established vibration criteria, selected receptors of concern, and predicted operation phase vibrations using screening level models. The key indicator used in the vibration assessment was peak vibration levels.

Construction activities at the Mine Site, Milne Port, Steensby Port, and the North Railway were qualitatively assessed to have the potential to generate perceptible vibration levels extending outwards from blasting activities; however, since there no vibration-sensitive environmental receptors were identified, effects were not anticipated. The duration of effect was rated as short-term, the frequency of effect was rated as occasional and the effect was rated as reversible.

Maximum predicted vibration levels at the Mine Site during operation were predicted as 2.5 mm/s peak particle velocity (ppv) at 1.5 km from the PDA and at the Worker Accommodation Building. No major



sources of vibration were associated with Milne Port or Steensby Port operations. Due to the temporary and short duration nature of vibration along the Milne Inlet Tote Road truck traffic and South Railway use, vibration effects were not anticipated.

### 3.2 PROJECT MONITORING

Five (5) PC conditions relate to the potential impacts of the Project on noise and vibration.

Noise and vibration monitoring is undertaken by Baffinland annually, with the results reported in the company's annual reports to NIRB (Baffinland, 2017; 2018). Noise monitoring is undertaken inside the accommodation buildings at the Mine Site and Milne Port, in accordance with Term and Condition No. 14 of Project Certificate No. 005 (NIRB, 2014).

Noise and vibration monitoring at the Mine Site and Milne Port accommodations is scheduled annually by Baffinland Health and Safety staff. Monitoring uses a sound meter with microphone and a vibration pad with meter set-up in different rooms and wings of accommodation buildings at both sites. The noise equipment used by Baffinland runs continuously for two 12-hour periods (the vibration equipment runs for two 10-hour periods) in each room with calibration of the instruments occurring before and after use as well as between the periods. Monitoring is conducted once per summer and once per winter season.

In June 2017, one room at the Mine Site and one room at the Port site were tested for noise and vibration. During this time, noise monitoring was conducted in each room for two 12-hour periods representing the day and night shifts worked at the sites with vibration monitoring conducted in each room for 10 hours during the day and night. Due to equipment malfunctions and availability that were not resolved before the end of 2017, scheduled winter noise and vibration monitoring was unable to be conducted in 2017.

Based upon the single monitoring event, the average noise level inside the Milne Port accommodation building in 2017 (Baffinland, 2018) was similar to average noise level recorded in 2015 (41.7 dBA; Baffinland, 2016b) and below the average noise level recorded in 2016 (50.3 dBA; Baffinland, 2017). Average noise levels at the Mine Site in 2017 were lower than the two previous years (34.8 and 30.6 dBA in 2015 and 2016, respectively). Vibration levels in both 2015 and 2016 were generally too low to register on the equipment.

In 2018, Baffinland is implementing additional QA/QC measures to its noise and vibration monitoring program to ensure testing is completed. This will include conducting five (5) samples at the Mine site and five (5) samples at Port site, twice per calendar year (summer and winter).

## 3.3 ASSESSMENT METHODOLOGY

The current assessment utilizes the same approach, modelling methodology and indicator thresholds as the previous assessments (Baffinland, 2012; 2013).

The predicted Project lifecycle was reviewed to determine the most intensive year of activity for noise emissions for each Project site. Once the worst-case scenario at each of the Mine Site, Northern Transportation Corridor and Milne Port were identified, the following steps were undertaken:

- Identify and quantify noise emission sources
- Establish existing sound levels



- Predict levels from worst-case operations
- · Compare the predicted noise modelling results to the guideline limits

Sound levels were modelled using a computerized version of the ISO 9613 international standard noise model. Potential effects for the Mine Site and Milne Port Construction phase were assessed qualitatively. Noise exposure forecasts (NEFs) for aircraft noise were predicted using NEFCalc, a software package developed by Transport Canada (2018).

The previous vibration assessment was not updated for the Phase 2 Proposal since the previous assessment predicted and subsequent monitoring has confirmed that vibration effects are negligible, and the Phase 2 Proposal will not introduce any new major sources of vibration (RWDI, 2017a).

### 3.4 EFFECTS ASSESSMENT

Interactions of the Phase 2 Proposal with noise (i.e., sources of increased sound levels) are presented in Table 3.1. Those interactions assessed to have a major interaction with noise were subject to a detailed assessment using noise modelling. A Noise Modelling Report presented in Appendix D presents noise modelling that evaluates most aspects of the Project (RWDI, 2017a). A subsequent amendment to that modelling report, presented in Appendix E, addresses the short-term haulage of 12 Mtpa of ore along the southern portion of the Tote Road to the Temporary Ore Transfer Facility, as well as increased power generation at Milne Port (RWDI, 2018c). Noise modelling results, characterization or residual effects, and significance rating of the residual effects are presented in the sections that follow.

Table 3.1 Phase 2 Proposal Interactions with Sound Levels

Project Infrastructure or Activity	Level of Interaction
Mine Site	
Increase mine production rate by 7.8 Mtpa (from 22.2 Mtpa to 30 Mtpa)	2
Replace trucking operation ore stockpiles and truck loading facilities/equipment with larger ore stockpiles and rail loading facilities (with secondary crushing relocated to Milne Port)	2
Tote Road	
Short-term traffic increase associated with increased ore haulage to 6 Mtpa and to support rail construction	2
Short-term traffic increase to Temporary Transfer Station (12 Mtpa)	2
Reduced road traffic once the North Railway is operational	1
North Railway	
Transport construction equipment and supplies	1
Prepare site area and construct access trail	1
Quarry, crush, screen, haul and place aggregate	2
Construct rail embankment, superstructure, bungalows, etc.	2
Install additional communication towers along corridor	1
Construct permanent culvert crossings (and temporary culvert crossings at two bridge locations)	1
Construct bridges with piers at four large crossings (the same crossings with bridges along the Tote Road)	1



Project Infrastructure or Activity	Level of Interaction
Transport 12 Mtpa of ore over the railway	2
Transport of supplies and fuel over the railway	1
Conduct regular inspection and maintenance of the railway	1
Milne Port	
Construct second ore dock (includes pile driving but no blasting or dredging)	1
Construct additional ore stockpiles and material handling facilities	1
Construct railway lines, rail maintenance facilities	1
Construct ancillary port facilities (additional fuel storage, etc.)	1
Load ore on ships at two docks at a higher combined transfer rate	2
Increased number of ship-to-shore fuel transfer by the floating hose method	1
Increased number of sealift vessels unloaded by barge or at freight dock	2
Increased number of tug and line vessels operating at the docks	2
Shipping	
Increased ore carrier transits to and from Milne Port during open water, a portion of which are larger vessels (capesize)	1
Increased vessel anchoring at assigned anchorages	1
Increased fuel tanker transits to and from Milne Port during open water	1
Vessel transits to and from Milne Port during the periods of ice formation and ice break-up (July 1-November 15).	1
Winter sealift	1

## **NOTES:**

- 1. INTERACTIONS ARE RATED AS FOLLOWS:
  - 1 MINOR INTERACTION POST-MITIGATION, DISCUSSION ASSESSMENT.
  - 2 MAJOR INTERACTION SUBJECT TO DETAILED ASSESSMENT.

Based on the above interactions, noise modelling scenarios were established to evaluate noise effects from the Phase 2 Proposal (Table 3.2). The same LSAs that were used in the air quality effects assessment were selected to illustrate the spatial distribution of changes in sound levels associated with the Project. The LSAs allow for an assessment of Project-related effects at a local, operational scale. LSAs were established at a distance of 3 km around the edge of each established PDA.

Table 3.2 Noise Modelling Scenarios for the Phase 2 Proposal

Scenario	Location	Year	Description of Activities
1	Mine Site	2030	Operation Phase: Operating at the maximum production rate of 30 Mtpa in a year when the waste rock stripping ratio is at its highest (the maximum equipment is being operated)
2	Milne Port	2024	Operation Phase: Operating at the maximum throughput of 12 Mtpa
3a	Northern Transportation	2019	Construction Phase: Railway construction in full swing and 6 Mtpa of ore is being transported by truck to Milne Port
3b	Corridor	2024	Operation Phase: 12 Mtpa of ore is being transported by rail
4	Aircraft	2026	Operation/South Railway Construction: Maximum number of flights of 1342

31 of 40



Scenario	Location	Year	Description of Activities
5	Temporary Ore Transfer Facility	2021	Temporary road haul of 12 Mtpa of ore over southern section of Northern Transportation Corridor, operation of Temporary Ore Transfer Facility and northern section of Northern Transportation Corridor

The results of the effects assessment are summarized in the following sections for the Construction and Operation phases.

## 3.4.1 Increase in Noise Levels during Construction and Closure

An increase in sound levels associated with the construction phase is assessed below. Decommissioning activities in the closure phase will be similar to that of the construction phase.

#### 3.4.1.1 Mine Site

Construction activities at the Mine Site will be modest, limited to installation of the ore stockpiles and loading facilities associated with the North Railway, followed by decommissioning of the trucking operation ore loading facilities and stockpiles. The noise generated by these activities will be less than that previously assessed for the original construction phase (RWDI, 2017a).

#### 3.4.1.1 Milne Port

In addition to current operations at the port, the following construction activities have the potential to create noise (RWDI, 2017a):

- Preparation of lay down areas or work areas
- Construction of Project facilities: access roads, railway and associated infrastructure from the Mine
   Site to Milne Port, secondary crushing and screening facilities, and additional loading dock
- Development of existing aggregate sources for rock, sand and gravel

There is the potential for perceptible construction noise to extend out to 1.5 km from the Milne Port PDA into the LSA, but the duration is rated as short-term, frequency is occasional, and effect is rated as reversible. Overall, the effect is anticipated to be not significant. Construction noise is exempt from AER Directive 038, since although noise levels may be high they are considered temporary. The Directive does recommend that mitigation measures be implemented to reduce noise effects on nearby residences. The following measures would be applicable for Milne Port (RWDI, 2017a):

- Confirm that all internal combustion engines are fitted with appropriate muffler systems
- Utilize acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise

## 3.4.1.2 Northern Transportation Corridor

Sound levels of 40 dBA are predicted to extend into the LSA to a distance of approximately 2.5 km along the Northern Transportation Corridor during construction when rail bed construction, tote road operations, and quarry extraction overlap. The following mitigation measures are recommended:

- Confirm that all internal combustion engines are fitted with appropriate muffler systems
- Where possible, take advantage of local topography to screen noise emissions



Construction activities will be localized, the duration is rated as short-term, frequency is occasional, and effect is rated as reversible.

Supplemental modelling was completed to evaluate noise levels from a temporary ore haulage and transfer operation that may occur in 2021 for 1 to 2 years (RWDI, 2018c). The noise model accounts for short-term road transportation between the Mine Site and the Temporary Ore Transfer Facility, and rail transportation between the Temporary Ore Transfer Facility and Milne Port. Road traffic levels are doubled from the previously modelled 6.3 Mtpa to 12 Mtpa, and trains are modelled with a frequency of 6 per 24-hour period.

For summer operations, the impacts of the transfer site will extend into the LSA, as they are predicted to be 50 dBA at approximately 1,000 m from the site, and 45 dBA approximately 630 m from the site. For winter operation, these distances are reduced by approximately 50 m.

Average road noise is predicted to extend into the LSA, with 50 dBA predicted at a distance of 350 m from the center of the road, and 45 dBA at 305 m from the center of the road, with very little difference between summer and winter conditions. For rail, 50 dBA impacts are predicted at a distance of 65 m from track centre, and 45 dBA at 180 m from track centre. Again, little difference is predicted between summer and winter conditions.

Figures 1 and 2 of Appendix E presents noise contours indicating predicted noise impacts from the road, rail and Temporary Ore Transfer Facilities, for summer and winter conditions, respectively.

For rail only operation, worst case noise levels are predicted to be less than 30 dBA, 1.5 km from the PDA of the Northern Transportation Corridor.

### 3.4.2 Increase in Noise Levels during Operation

#### 3.4.2.1 Mine Site

Worst case noise levels associated with Mine Site operations and incorporating mitigation features in the design were predicted to extend into the LSA as follows:

- 17 to 46 dBA, 1.5 km from the PDA
- 33 to 35 dBA at the HTO Cabin

The predicted worst case noise levels exceed the Permissible Sound Level (PSL) of 40 dBA (1-hour average) in areas beyond the 1.5 kilometre limit; however, the PSL guidelines are intended to be protective of humans in nearby dwellings. The noise level is below the PSL at the HTO Cabin, the only off-site receptor meeting the definition of a "dwelling".

Plots of LEQ(1) sound levels for summer and winter operations at the Mine Site are provided on Figure 5 and Figure 6 of Appendix D. These indicate that within the LSA sound levels are generally expected to be within the 50-55 dBA range in areas adjacent to the PDA, with sound levels of 40-45 dBA extending slightly past the LSA boundary to the southeast of the Mine Site in summer. These values are also applicable to winter conditions, except that increased sound levels are not predicted to occur outside of the LSA.



#### 3.4.2.2 Milne Port

Worst case noise levels associated with Milne Port operations and incorporating mitigation features in the design were predicted as:

- 26 to 44 dBA, 1.5 km from the PDA
- ≤50 dBA during the summer and 48 dBA during winter months at the HTO cabin

The predicted worst case noise levels exceed the PSL of 40 dBA (1-hour average) at the HTO Cabin. These elevated levels will be noticeable, and have a potential to cause sleep disturbance at the HTO Cabin in its current location; Baffinland may consider discussing this impact with the Mittimatalik HTO or community members to determine if this is a material impact to land users, and potential mitigation measures. These mitigation measures may include re-locating the cabin to an area outside the area of disturbance.

Plots of Leg(1) sound levels for summer and winter operations at Milne Port are provided on Figure 7 and Figure 8 of Appendix D. These indicate that within the LSA sound levels are generally expected to be within the 55 - 60 dBA range in areas adjacent to the PDA, up to 55 dBA within 1.5 km of the PDA, and primarily 40 - 45 dBA within the LSA in both the summer and winter. Sound levels are expected to be below 40 dBA outside of the LSA.

#### 3.4.2.1 Aircraft

Table 3.3

According to Transport Canada, land exposed to NEF 30 and greater are typically subject to development restrictions. The primary mitigation of aircraft noise is adherence to the 600 m minimum flight altitude requirements specified in land use permits (contingent to safety concerns).

#### 3.4.3 Significance of Residual Effects

The modelled noise levels at the sensitive receptors in the LSA (RWDI, 2017a) are summarized in Table 3.3.

Modelled Noise Levels at Sensitive Receptors during Operations

Modelling Leastion	Seasonal Se	ound Level
Modelling Location	Summer	Winter
1.5 km from PDA	20 - 46 L <sub>EQ</sub> (1 hr) dBA	17 - 44 L <sub>EQ</sub> (1 hr) dBA
HTO Cabin	35 L <sub>EQ</sub> (1 hr) dBA	33 L <sub>EQ</sub> (1 hr) dBA
	Milne Port	
1.5 km from PDA	33 - 47 L <sub>EQ</sub> (1 hr) dBA	31 - 45 L <sub>EQ</sub> (1 hr) dBA
HTO Cabin	50 L <sub>EQ</sub> (1 hr) dBA	48 L <sub>EQ</sub> (1 hr) dBA

Residual effects (those that remain following implementation of mitigation measures) are characterized based on magnitude in relation to indicator thresholds; geographic extent; duration; frequency; and reversibility of effects. The criteria for each of these categories are the same that were used in Volume 2, Section 3 of the FEIS. The overall rating of significance then takes into consideration certainty and probability of occurrence: the residual effects characterization is presented in Table 3.4.



Table 3.4 Significance of Residual Effects on Noise

		Residual	Effect Evalua	ation Criteria			Qua	Qualifiers	
Residual Effect	Magnitude	Extent	Frequency	Duration	Reversibility	Significance of Residual Effect	Probability (Likelihood of the Effect Occurring)	Certainty (Confidence in the Effects Prediction)	
Milne Port Construction - Increase in noise levels 1.5 km outside PDA	Level II Predicted to exceed indicator threshold	Level I Confined to the LSA	Level III Frequent or continuous	Level I Effect is short-term (construction phase)	Level I fully reversible	Not significant	High	High	
Northern Transportation Corridor Construction - Increase in noise levels 40 dBA to a distance of approximately 2.5 km	Level II Predicted to exceed indicator threshold	Level I Confined to the LSA	Level III Frequent or continuous	Level II Effect will persist for the duration of the Project	Level I fully reversible	Not significant	High	High	
Mine Site Operations - increase in noise levels > 40 dBA PSL beyond 1.5 km	Level II Predicted to exceed indicator threshold	Level II Extends beyond the LSA in summer	Level III Frequent or continuous	Level II Effect will persist for the duration of the Project	Level I fully reversible	Not significant	High	High	
Milne Port Operations - increase in noise levels > 40 dBA PSL at HTO Cabin	Level II Predicted to exceed indicator threshold	Level I Confined to the LSA	Level III Frequent or continuous	Level II Effect will persist for the duration of the Project	Level I fully reversible	Not significant	High	High	



		Residual	Effect Evalua	Evaluation Criteria Qualifiers				lifiers
Residual Effect	Magnitude	Extent	Frequency	Duration	Reversibility	Significance of Residual Effect	Probability (Likelihood of the Effect Occurring)	Certainty (Confidence in the Effects Prediction)
Northern Transportation Corridor Operations - Increase in noise levels 1.5 km outside PDA <30 dBA	Level I Predicted to remain below indicator threshold	Level I Confined to the LSA	Level III Frequent or continuous	Level II Effect will persist for the duration of the Project	Level I fully reversible	Not significant	High	High
Aircraft Operations - Increase in noise levels between NEF 25 and NEF 30	Level I Predicted to remain below indicator threshold	Level I Confined to the LSA	Level III Frequent or continuous	Level II Effect will persist for the duration of the Project	Level I fully reversible	Not significant	High	High



## 3.5 CLIMATE CHANGE CONSIDERATIONS

Anticipated changes to the climate in the study area are described by Baffinland (2017). These changes are not expected to interact with the Project's noise emissions.

## 3.6 MITIGATION AND MONITORING PLAN UPDATES

The noise monitoring program described in the Air Quality and Noise Abatement Management Plan (Baffinland, 2016a) will be adequate to monitor the effects of the Phase 2 Proposal.



#### 4 - REFERENCES

- Alberta Environment and Parks, 2017. Alberta Ambient Air Quality Objectives and Guidelines Summary AEP Air Policy, No. 2. June 29. Copyright: 2016 Government of Alberta.
- Alberta Environment, 2008. *Alberta Acid Deposition Management Framework*. February. ISBN: 978-07785-6726-4.
- Alberta Energy Regulator, 2007. *Directive 038: Noise Control February 16, 2007 Effective June 17, 2013.* Retrieved from: http://www.aer.ca/documents/directives/Directive038.pdf.
- Baffinland Iron Mines Corporation (Baffinland), 2012. *Mary River Project Final Environmental Impact Statement*.
- Baffinland Iron Mines Corporation (Baffinland), 2013. Mary River Project Addendum to Final Environmental Impact Statement for the Early Revenue Phase.
- Baffinland Iron Mines Corporation (Baffinland), 2016a. *Air Quality and Noise Abatement Management Plan.* March 14. Ref. No. BAF-PH1-830-P16-0002.
- Baffinland Iron Mines Corporation (Baffinland), 2016b. 2015 Annual Report to the Nunavut Impact Review Board.
- Baffinland Iron Mines Corporation (Baffinland), 2016c. *Terrestrial Environment Mitigation and Monitoring Plan.* March 14. Ref. No. BAF-PH1-830-P16-0027, Rev 1.
- Baffinland Iron Mines Corporation (Baffinland), 2017. 2016 Annual Report to the Nunavut Impact Review Board Project Certificate No. 005. March 31.
- Baffinland Iron Mines Corporation (Baffinland), 2018. 2017 Annual Report to the Nunavut Impact Review Board Project Certificate No. 005. March 31.
- British Columbia Ministry of Environment, 2016, *BC Ambient Air Quality Objectives Updated December 16, 2016.* Provincial Air Quality Objective Information Sheet. Retrieved from: http://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/agotable.pdf.
- Environmental Dynamics Inc. (EDI), 2018. 2017 Mary River Project Terrestrial Environment Annual Monitoring Report. March. Whitehorse, Yukon. Ref. No. 17Y0152:06.
- Government of Nunavut, 2011. *Environmental Guideline for Ambient Air Quality*. Retrieved from: <a href="http://www.gov.nu.ca/environment/documents/ambient-air-quality-2011">http://www.gov.nu.ca/environment/documents/ambient-air-quality-2011</a>.
- Government of the Northwest Territories, 2014. *Guideline for Ambient Air Quality Standards in the Northwest Territories*. February. Department of Environment and Natural Resources.
- Knight Piésold Ltd. (Knight Piésold), 2017. Baffinland Iron Mines Corporation Mary River Project -Phase 2 Proposal - Technical Supporting Document No. 8 - Surface Water Assessment. June 26. North Bay, Ontario. KP Ref. No. 102-181/39-8, Rev. 2.
- Nunavut Impact Review Board (NIRB), 2012. Final Hearing Report for the Mary River Project Baffinland Iron Mines Corporation. September 14. NIRB File No.: 08MN053.



- Nunavut Impact Review Board (NIRB), 2014. NIRB Project Certificate No. 005. In the matter of the Nunavut Land Claims Agreement, Nunavut Land Claims Agreement Act, S.C., 1993, c. 29, Article 12, Part 5 and In the matter of an application by Baffinland Iron Mines Corporation for development of the Mary River Project Proposal in the Qikiqtani Region of Nunavut. May 28.
- Nunavut Impact Review Board (NIRB), 2015. *Amended EIS Guidelines for the Mary River Phase 2 Project Proposal.* NIRB File No. 07MN053.
- Ontario Ministry of the Environment, 2012. *Ontario's Ambient Air Quality Criteria*. April. Standards Development Branch. PIBS# 657e01.
- Ontario Ministry of the Environment and Climate Change, 2016. Ontario's Ambient Air Quality Criteria.
- RWDI AIR Inc. (RWDI), 2017a. Environmental Noise Phase 2 Proposal Mary River Project, Baffin Island, Nunavut. September 26. RWDI Ref. No. 1402090.
- RWDI AIR Inc. (RWDI), 2017b. Air Quality Model Phase 2 Proposal Mary River Project, Baffin Island, Nunavut. August 22. RWDI Ref. No. 1402090.
- RWDI AIR Inc. (RWDI), 2018a. Air Quality Model Phase 2 Proposal Mary River Project, Baffin Island, Nunavut. March 21. RWDI Ref. No. 1402090.
- RWDI AIR Inc. (RWDI), 2018b. Updated Environmental Air Quality Impact Assessment to Address Changes in Project Description Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal Technical Supporting Document 7. June 16. RWDI Ref. No. #1402090.
- RWDI AIR Inc. (RWDI), 2018c. Updated Environmental Noise Impact Assessment to Address Changes in Project Description Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal Technical Supporting Document 7. June 16. RWDI Ref. No. #1402090.
- RWDI AIR Inc. (RWDI), 2018d. Frequencies of Exceedances Baffinland Iron Corporation Mary River Project. July 30. RWDI Ref. No. #1402090.
- Transport Canada, 2017. *Overview of the Locomotive Emissions Regulations*. Retrieved from: https://www.tc.gc.ca/eng/railsafety/overview-locomotive-emisions-regulations.html.
- Transport Canada, 2018. *Noise Exposure Forecast and Related Programs NEF. Program*. Retrieved from: <a href="http://www.tc.gc.ca/en/services/aviation/operating-airports-aerodromes/managing-noise/exposure-forecast.html">http://www.tc.gc.ca/en/services/aviation/operating-airports-aerodromes/managing-noise/exposure-forecast.html</a>.



## **5 - CERTIFICATION**

This report was prepared and reviewed by the undersigned.

Prepared:

Stephanie Eagen, R.P.Bio. Senior Environmental Scientist

Reviewed:

Richard Cook, P.Geo.(Ltd.)

Specialist Environmental Scientist | Associate

This report was prepared by Knight Piésold Ltd. for the account of BAFFINLAND IRON MINES CORPORATION. Report content reflects Knight Piésold's best judgement based on the information available at the time of preparation. Any use a third party makes of this report, or any reliance on or decisions made based on it is the responsibility of such third parties. Knight Piésold Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Any reproductions of this report are uncontrolled and might not be the most recent revision.

Approval that this document adheres to Knight Piésold Quality Systems:



### **APPENDIX A**

AIR QUALITY MODEL PHASE 2 PROPOSAL MARY RIVER PROJECT - REPORT

(Pages A-1 to A-144)

## REPORT



# AIR QUALITY MODEL PHASE 2 PROPOSAL MARY RIVER PROJECT

BAFFIN ISLAND, NUNAVUT

# ADDENDUM NO. 2 TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT

RWDI #1402090 July 31, 2018

### **SUBMITTED TO**

## Megan Lord-Hoyle

Director Corporate Sustainability Baffinland Iron Mines Corporation Suite 300, 2275 Upper Middle Road East Oakville, ON L6H 0C3

#### Sara Wallace

Senior Associate, Env't Scientist Stantec 102-40 Highfield Park Drive Dartmout, N.S. B3A 0A3

### **SUBMITTED BY**

Alain Carriere, B.A., Dipl. Ecotox. Senior Project Manager / Associate <u>alain.carriere@rwdi.com</u>

Mike Lepage. M.Sc., ACM, CCM Senior Consultant / Principal mike.lepage @rwdi.com

#### **RWD**

600 Southgate Drive, Guelph, Canada, N1G 4P6 T: 519.823.1311 F: 519.823.1316

This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately. ® RWDI name and logo are registered trademarks in Canada and the United States of America.



## **TABLE OF CONTENTS**

	INTRODUCTION	I
1.1	Background	1
	1.1.1 Current Operations	1
	1.1.2 Phase 2 Proposal Overview	1
1.2	Objectives	2
1.3	Ambient Air Quality Standards and Objectives	2
2	ASSESSMENT SCOPE	4
3	EMISSION SOURCES	5
3.1	Milne Port	5
3.2	Mine Site	5
3.3	Northern Transportation Corridor	6
3.4	Insignificant Sources	6
4	MODELLING METHODOLOGY	12
5	RESULTS	17
5.1	Milne Port	17
5.2	Mine Site	
5.3	Northern Transportation Corridor	
6	CONCLUSIONS	
7	REFERENCES	
LIS	T OF TABLES	
Table ′	1: Ambient Air Quality Standards and Objectives	3
	2: Air Quality Effects Assessment Approach	
	3: Short Term Emission Rates for Major Sources for Milne Port	
	4: Short Term Emission Rates for Major Sources for the Mine Site	
	5: Short Term Emission Rates for Major Sources for the Northern Transportation Corridor	
	6: Measured Baseline Concentrations from the FEIS	
	7: Summary of Exceedances of Applicable Thresholds for Milne Port and the Mine Site	
Table 8	8: Summary of Exceedances of Applicable Thresholds for the Northern Transportation Corridor	22

RWDI#1402090 July 31, 2018



## LIST OF FIGURES

- Figure 1: Major Emission Sources Milne Port Figure 2: Major Emission Sources – Mine Site
- Figure 3: Major Emission Sources Northern Transportation Corridor
- Figure 4: Model Domains and Receptor Grid Milne Port Figure 5: Model Domains and Receptor Grid Mine Site
- Figure 6: Model Domains and Receptor Grid Northern Transportation Corridor

## **APPENDICES**

## **A EMISSION SOURCES**

## A.1 Milne Port Operations

- A.1.1 Fugitive Dust Emissions from Baghouses
- A.1.2 Combustion Emissions from Generators
- A.1.3 Combustion Emissions from Incinerators
- A.1.4 Combustion Emissions from Ore Carrier Ships
- A.1.5 Combustion Emissions from Tug Boats
- A.1.6 Combustion Emissions from Diesel Equipment
- A.1.7 Fugitive Dust Emissions from Bulldozing
- A.1.8 Fugitive Dust Emissions from Material Handling
- A.1.9 Combustion Emissions from Train Idling
- A.1.10 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads
- A.1.11 Fugitive Dust Emissions from Grading

## A.2 Mine Site Operations

- A.2.1 Fugitive Dust Emissions from Baghouses
- A.2.2 Combustion Emissions from Generators
- A.2.3 Combustion Emissions from Incinerators
- A.2.4 Combustion Emissions from Diesel Equipment
- A.2.5 Dust Emissions from Blasting
- A.2.6 Fugitive Dust Emissions from Bulldozing
- A.2.7 Fugitive Dust Emissions from Drilling
- A.2.8 Fugitive Dust Emissions from Material Handling
- A.2.9 Combustion Emissions from Train Idling
- A.2.10 Fugitive Dust Emissions from Crushing
- A.2.11 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads
- A.2.12 Fugitive Dust Emissions from Grading

RWDI#1402090 July 31, 2018



## A.3 Northern Transportation Corridor

- A.3.1 Combustion Emissions from Diesel Equipment
- A.3.2 Dust Emissions from Blasting
- A.3.3 Fugitive Dust Emissions from Drilling
- A.3.4 Fugitive Dust Emissions from Crushing
- A.3.5 Fugitive Dust Emissions from Bulldozing
- A.3.6 Fugitive Dust Emissions from Grading
- A.3.7 Fugitive Dust Emissions from Material Handling
- A.3.8 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads

## **Source Summary Tables A1 to A8**

## **Additional Attachments for Appendix A**

- **B** CALMET
- **B.1** Technical Model Options
- **B.2** Model Domains
- **B.3** Prognostic Meteorology
- **B.4** Terrain, Land Use and Geophysical Parameters
- C CALPUFF
- **C.1** Technical Model Options
- **C.2** Model Domains and Receptor Locations
- **C.3** Terrain and Elevations
- C.4 Building Effects
- C.5 Dry and Wet Deposition
- C.6 NO<sub>X</sub> to NO<sub>2</sub> Chemistry
- D CONTOUR PLOTS FOR MILNE PORT
- **E** CONTOUR PLOTS FOR THE MINE SITE
- F CONTOUR PLOTS FOR THE NORTHERN TRANSPORTATION CORRIDOR

RWDI#1402090 July 31, 2018



# **VERSION HISTORY**

Index	Date	Pages	Author
1	July 14, 2017	All	Jyotsna Kashyap
2	August 9, 2017	All	Jyotsna Kashyap
3	August 22, 2017	All	Jyotsna Kashyap
4	February 15, 2018	All	Alain Carriere
5	March 21, 2018	All	Jyotsna Kashyap
6	July 31, 2018	All	Martin Gauthier

RWDI#1402090 July 31, 2018



## 1 INTRODUCTION

## 1.1 Background

## 1.1.1 Current Operations

The Mary River Project is an operating open pit iron ore mine located on northern Baffin Island in the Qikiqtani Region of Nunavut. The operating Mine Site is connected to a port at Milne Inlet (Milne Port) via the 100-km long Milne Inlet Tote Road. Future but yet undeveloped components of the Project include a South Railway connecting the Mine Site to a future port at Steensby Inlet (Steensby Port).

Project Certificate No 005 currently authorizes Baffinland Iron Mines Corporation (Baffinland) to mine up to 22.2 million tonnes per annum (Mtpa) of iron ore from Deposit No. 1. Of this, the Company may transport up to 18 Mtpa of ore by rail to Steensby Port for year-round shipping through Foxe Basin and Hudson Strait, i.e. the original project proposal described in the Final Environmental Impact Statement (FEIS; Baffinland, 2012), and transport up to 4.2 Mtpa of ore by truck to Milne Port for open water shipping, i.e. the Early Revenue Phase ERP). To date, Baffinland has been operating the 4.2 Mtpa ERP.

## 1.1.2 Phase 2 Proposal Overview

Baffinland is seeking a second amendment to its Project Certificate No. 005 to allow the Company to implement its Phase 2 Proposal. The Phase 2 Proposal consists of a near-term expansion of the 4.2 Mtpa ERP operation to 12 Mtpa, followed by the subsequent additional development of the originally approved 18 Mtpa South Rail operation. The Phase 2 Project will involve the following components and activities:

- An increase in mining production over time from 4.2 Mtpa to 12 Mtpa, and eventually to 30 Mtpa
- Further development of the Northern Transportation Corridor which includes:
  - Tote Road upgrades
  - o Construction of a North Railway (North Rail) adjacent to the Tote Road
  - o Increased truck transits on the Tote Road until the North Rail is operational
  - Construction of a rail terminal at Milne Port for unloading of ore
  - Construction of a maintenance facility and construction camp mid-way along the northern transportation corridor
- Further development of the Milne Port area which includes:
  - o A second ore dock capable of berthing cape size vessels
  - o A freight dock
  - Relocation of secondary crushing and screening from the Mine Site to Milne Port

A rail maintenance facility

RWDI#1402090 July 31, 2018



- Changes to shipping activities which include:
  - o An increase in shipping transits through Northern Shipping Route during the open-water season
  - An extension of the shipping season into early ice conditions up to when the landfast ice is being used by Inuit, approximately mid-November

No changes to the proposed South Railway or Steensby Port site are proposed as part of the Phase 2 Proposal.

## 1.2 Objectives

The following air contaminants are assessed in this air quality dispersion modelling assessment:

- sulphur dioxide (SO<sub>2</sub>),
- nitrogen oxide (NO<sub>X</sub> as NO<sub>2</sub>),
- carbon monoxide (CO),
- total suspended particulates (TSP) matter;
- particulate matter (PM<sub>10</sub>)
- respirable particulate matter (PM<sub>2.5</sub>)
- dust deposition; and
- acid deposition or potential acid input (PAI).

The purpose of this report is to update the FEIS to include impacts from the following Project scenarios:

- Milne Port: Ore shipping from Milne Inlet at a rate of 12 Mtpa, instead of the current maximum of 4.2 Mtpa;
- Mine Site: Potential future production at the Mine Site of 30 Mtpa, instead of approximately 22 Mtpa assessed previously; and
- Northern Transportation Corridor: The construction of a north railway connecting the Mine Site to Milne Inlet; this includes emissions associated with the interim haulage of 6 Mtpa of ore along the Tote Road during the rail construction period.

This assessment updates the air quality modelling to reflect these scenarios and compares the maximum predicted concentrations and depositions to the applicable ambient indicator thresholds.

## 1.3 Ambient Air Quality Standards and Objectives

The ambient air quality standards, objective and guidelines applicable to the Project, are summarized in Table 1; the indicator thresholds used in this assessment are the same as those in the FEIS.

Air quality standards are applicable in areas accessible to the general public or areas beyond the Project's property line. Typically, air quality effects at or beyond a Project's property line are compared to standards and objectives. For this assessment, the Potential Development Areas (PDAs), which also match current or proposed Commercial Lease boundaries, are used as the property lines for Milne Port and the Mine Site. Air quality impacts are also evaluated at two Hunter Trapper Organization (HTO) cabins located near Milne Port and Mine Site, outside the PDAs. Inside the PDAs, impacts are evaluated at a number of sensitive receptors located near the accommodation buildings at Milne Port and the Mine Site. There is no property line, and no sensitive receptors, applied to the transportation corridor site.

RWDI#1402090 July 31, 2018



**Table 1: Ambient Air Quality Standards and Objectives** 

Parameter	Averaging Period	Units	Nunavut Ambient Air Quality Standards <sup>[1]</sup>	North West Territories Ambient Air Quality Standards <sup>[2]</sup>	Provincial Objectives <sup>[3]</sup>	Indicator Threshold <sup>[8]</sup>
	1-hour	µg/m³	450	450	-	450
SO <sub>2</sub>	24-hour	μg/m³	150	150	-	150
	annual	µg/m³	30	30	-	30
	1-hour	µg/m³	400	400	-	400
NO <sub>2</sub>	24-hour	μg/m³	200	200	-	200
	annual	μg/m³	60	60	-	60
60	1-hour	μg/m³	-	15,000	-	15,000
СО	8-hour	μg/m³	-	6,000	-	6,000
TCD	24-hour	μg/m³	120	120	-	120
TSP	annual	μg/m³	60	60	-	60
PM <sub>10</sub>	24-hour	μg/m³	-	-	50 <sup>[4]</sup>	50
PM <sub>2.5</sub>	24-hour	μg/m³	30	28	-	30
Dust Deposition	30-day	g/m²/30-day	-	-	5.3 to 15.8 <sup>[5]</sup>	5.3 to 15.8
	annual	g/m²/year	-	-	55 <sup>[6]</sup>	55
Acid Deposition	annual	keq H+/ha/year	-	-	1 <sup>[7]</sup>	1

#### Notes:

- [1] Government of Nunavut (2011)
- [2] Government of Northwest Territories (NWT) (2014)
- [3] Provincial Objectives are only provided for contaminants and averaging periods where no Nunavut or NWT standards are available
- [4] British Columbia Ministry of the Environment (2016)
- [5] Alberta Environment and Parks (2016)
- [6] Ontario Ministry of the Environment and Climate Change (2016)
- [7] The critical deposition load for low sensitivity receptors, Alberta Environment and Parks (2008)
- [8] Indicator Thresholds are from Nunavut standards where available, or otherwise the most stringent available



# 2 ASSESSMENT SCOPE

A standard assessment approach was used to determine the potential effects of the Project. This approach is outlined in Table 2.

**Table 2: Air Quality Effects Assessment Approach** 

Component	Description
Study areas	Two Local Study Areas (LSAs) were defined, around Milne Port and the Mine Site, shown in Figure 1 and Figure 2 in Section 3.4, respectively. Two meteorological domains were defined, around Milne Port and the Mine Site, respectively. The section of Northern Transportation Corridor that was studied lies near Milne Port, and falls within the port meteorological domain.  Three computational model domains were defined for dispersion modelling, one for each of the scenarios considered in this assessment: Milne Port, the Mine Site, and the Northern Transportation Corridor.
Emission sources	Atmospheric emission sources associated with each of the Project sites were identified and quantified. Stack and fugitive source parameters were characterized, such as location, physical characteristics, flow conditions, and pollutant emission rates. This task was completed using manufacturer specifications, published emission factors, and project design information.
Terrestrial and meteorological characterization	Digital terrain data were used to account for elevation changes in the study areas. The nature of the surface affects the local meteorology, and thereby affects deposition and predicted concentrations of pollutants. The CALMET preprocessor was used to generate three-dimensional meteorological fields for one year (2006) in the Milne Port and Mine Site meteorological domains.
Dispersion Modelling	The CALPUFF model was used to predict the transport, dispersion, chemical transformation, and deposition from all sources associated with the Project, in each of the three dispersion modelling domains. The model was used to predict 1-h, 24-h and annual average concentration patterns (as applicable) for SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP, PM <sub>10</sub> and PM <sub>2.5</sub> ; and 30-day and annual average deposition patterns (as applicable) for dust and PAI.
Baseline ambient air quality	Baseline ambient air quality monitoring was reviewed to establish existing background levels.

RWDI#1402090 July 31, 2018



## **3 EMISSION SOURCES**

The air emission sources for the three Project scenarios are summarized below. Detailed source information, including locations, source parameters, and emission rates, are provided in Appendix A, Sections A.1, A.2 and A.3 respectively for Milne Port, the Mine Site, and the Northern Transportation Corridor.

## 3.1 Milne Port

The following sources were assessed for operations at Milne Port:

- Secondary crushing, screening and Rail Car Unloading treated with Baghouses or dust collectors;
- Power generating station;
- Waste incinerator;
- Ships and tug boats in Milne Inlet;
- Locomotives idling at the train loading station;
- Mobile engine operations around the port and on roads, including dozers, graders, loaders, trucks, frost fighters and other equipment;
- Vehicle road dust;
- Grading and dozing operations; and
- Ore stockpiles (lump and fines) including stacker/reclaimer and conveyance, i.e. material handling systems.

The major sources are shown in Figure 1. Short term emission rates and operating hours, as modelled, are presented in Table 3.

## 3.2 Mine Site

The following sources were assessed for operations at the Mine Site:

- Power generating station;
- Waste incinerators;
- Locomotives idling at the train loading station;
- Mobile engine operations in the pits and on roads, including drills, shovels, loaders, trucks, frost fighters and other equipment;
- Vehicle road dust;
- Open-pit mine operations including grading, dozing, drilling, blasting, excavation, trucking and crushing; and
- Ore stockpiles (lump and fines) including stacker/reclaimer and conveyance, i.e. material handling systems.

RWDI#1402090 July 31, 2018



The major sources are shown in Figure 2. Short term emission rates and operating hours, as modelled, are presented in Table 4.

## 3.3 Northern Transportation Corridor

The following sources, associated with construction activities for the North Railway, and the haulage of 6Mtpa of ore along Tote Road, were assessed along the Northern Transportation Corridor:

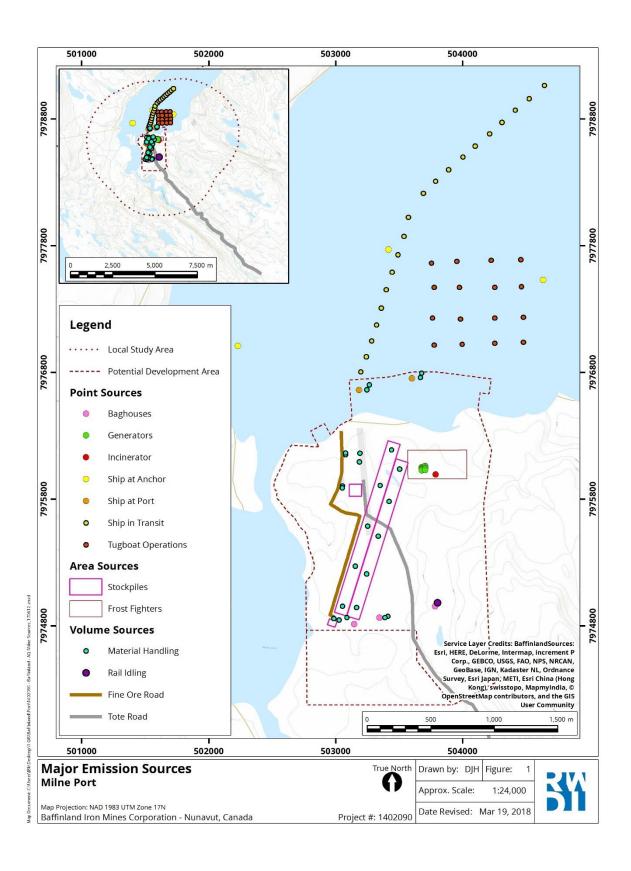
- Mobile engine operations around the quarry, rail bed, and on roads, including dozers, graders, loaders, trucks, and other equipment;
- Vehicle road dust;
- Grading, dozing, drilling and crushing operations in the quarry and rail bed;
- Blasting in the quarry; and
- Material handling sources in the quarry and rail bed.

The major sources are shown in Figure 3. Short term emission rates and operating hours, as modelled, are presented in Table 5.

## 3.4 Insignificant Sources

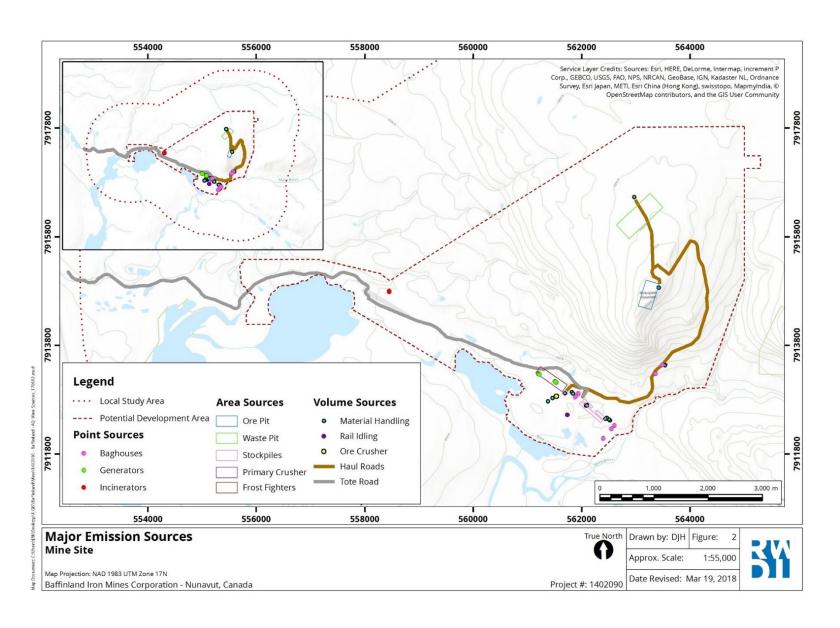
For the purposes of this assessment, several small sources of emissions were deemed insignificant; and therefore, not included in the assessment. Combustion emissions from blasting were deemed insignificant due to the short duration and low frequency of the blasts. Combustion emissions from trains in transit were deemed insignificant because the trains are present only briefly at any location along their routes. Wind erosion of the stockpiles was also deemed insignificant. The particles in the stockpiles are expected to be of a large size fraction; therefore, the material has low potential of wind entrainment (i.e. becoming a source of wind erosion); the minimum wind speed for erosion to occur was calculated to be 10 m/s. The winds onsite were analyzed for the modelling period, and it was determined that wind speeds were higher than 10 m/s for only four hours in a year at Milne Port and less than fifty hours in a year at the Mine Site; i.e. the wind speeds were rarely high enough for wind erosion to be an important emission source. Finally, in modelling emissions from vehicle traffic on the Tote Road in the Milne Port and Mine Site scenarios, the dominant source of road dust was predicted to be road grading operations. Dust from the light traffic expected on the Tote Road (pick up trucks, buses, and fuel trucks) was deemed insignificant in comparison and was ignored.





RWDI#1402090 July 31, 2018





RWDI#1402090 July 31, 2018



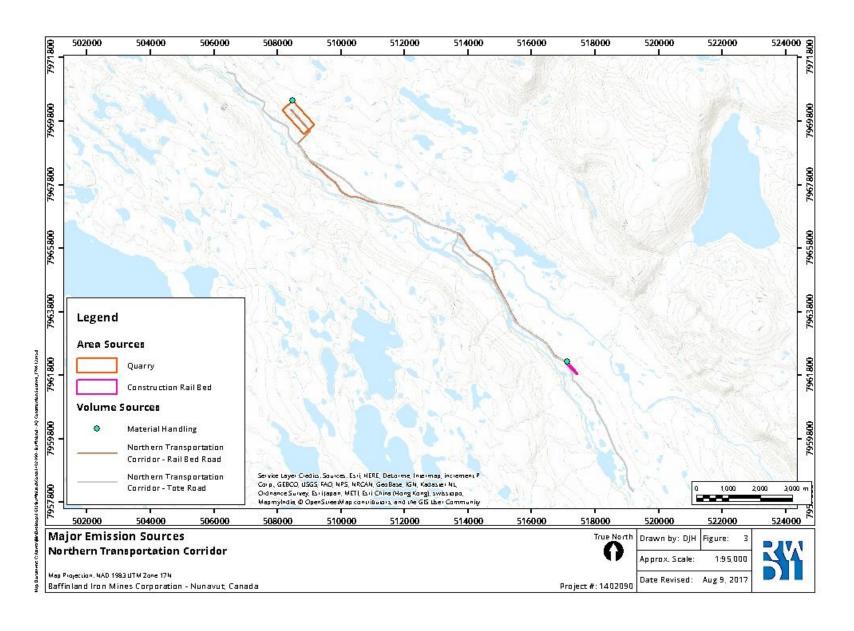




Table 3: Emission Rates for Major Sources for Milne Port

		Emission Rates (g/s)						
Source Type	Operating Hours Modelled	SO <sub>2</sub>	NOx	со	TSP	<b>PM</b> <sub>10</sub>	PM <sub>2.5</sub>	
	Po	int Source	es					
Baghouses	Continuous	n/a	n/a	n/a	0.581	0.581	0.261	
Generators	Continuous	< 0.001	33.892	6.631	0.442	0.442	0.442	
Incinerator	Every day 4am till midnight	< 0.001	0.054	0.003	0.022	0.022	0.022	
Ship at Anchor	Continuous from July to October	1.200	10.625	0.688	0.694	0.694	0.625	
Ship at Port	Continuous from July to October	0.800	7.083	0.458	0.463	0.463	0.417	
Ship in Transit	For 8 hours every day from July to October	3.395	30.057	1.945	1.963	1.963	1.768	
Tugboat Operations	Continuous from July to October	0.013	42.500	2.750	2.775	2.775	2.500	
	Ar	ea Source	S					
Stockpiles <sup>[1]</sup>	Continuous	0.001	0.472	0.031	0.373	0.282	0.046	
Frost Fighters	Continuous from November to April	0.019	1.097	0.509	0.052	0.052	0.050	
	Vol	ume Sourc	es					
Material Handling <sup>[2]</sup>	Continuous	n/a	n/a	n/a	19.442	6.855	0.902	
Rail Idling	Continuous	0.065	0.775	0.334	0.042	0.042	0.042	
Fine Ore Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates and equipment type (e.g., grading was assumed to occur only for 1 hour per day)	< 0.001	0.046	0.021	11.081	2.867	0.237	
Modelled Section of Tote Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates and equipment type (e.g., grading was assumed to occur only for 1 hour per day)	< 0.001	0.033	0.014	6.994	4.197	0.218	

#### Notes:

<sup>[1]</sup> Emissions from diesel equipment operating around the stockpiles were modelled within this area source.

<sup>[2]</sup> The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 3.3 m/s; see Appendix A for more details.

<sup>[3]</sup> Section of Tote Road modelled was 11.0 km long, see Figure 1 and Appendix A for more details



Table 4: Emission Rates for Major Sources for the Mine Site

Source Type	Operating Hours Modelled	Emission Rates (g/s)							
		SO <sub>2</sub>	NOx	СО	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>		
	Po	int Source	es						
Baghouses	Continuous	n/a	n/a	n/a	0.833	0.833	0.375		
Generators	Continuous	0.011	69.199	5.752	0.389	0.389	0.389		
Incinerators	Every day 4am till midnight	n/a	0.121	0.006	0.048	0.048	0.048		
	Α	rea Source	es						
Ore Pit	Continuous, with activity levels based on annual tonnages and equipment sizes, and/or anticipated utilization rates.	0.014	5.626	0.326	10.690	5.637	0.412		
Waste Pit	Continuous, with activity levels based on annual tonnages and equipment sizes, and/or anticipated utilization rates	< 0.001	0.036	0.016	0.367	0.275	0.040		
Stockpiles <sup>[1]</sup>	Continuous	< 0.001	0.138	0.009	0.003	0.003	0.003		
Primary Crusher <sup>[1]</sup>	Continuous	< 0.001	0.036	0.016	0.367	0.275	0.040		
Frost Fighters <sup>[1]</sup>	Continuous from November to April	0.021	1.208	0.541	0.057	0.057	0.055		
	Vol	ume Sour	ces						
Material Handling <sup>[2]</sup>	Continuous	n/a	n/a	n/a	37.252	13.134	1.727		
Rail Idling	Continuous	0.065	0.775	0.334	0.042	0.042	0.042		
Ore Crusher <sup>[1]</sup>	Continuous	< 0.001	0.029	0.013	0.279	0.029	0.005		
Haul Roads	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates and equipment type (e.g., grading was assumed to occur only for 1 hour/day).	0.055	22.679	1.311	234.59	63.288	5.413		
Modelled Section of Tote Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates and equipment type (e.g., grading was assumed to occur only for 1 hour/day).	0.002	0.099	0.043	40.647	24.390	1.264		

#### Notes:

<sup>[1]</sup> Emissions from diesel equipment operating nearby were modelled as part of this source, with activity levels based on annual tonnages and equipment sizes.

<sup>[2]</sup> The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 3.3 m/s; see Appendix A for more details.

<sup>[3]</sup> Section of Tote Road modelled was 11.4 km long, see Figure 2 and Appendix A for more details.



Table 5: Emission Rates for Major Sources for the Northern Transportation Corridor

Source Type	Operating Hours Modelled	Emission Rates (g/s)						
Source Type		SO <sub>2</sub>	NOx	СО	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>	
	Area Sources							
Quarry <sup>[1]</sup>	Continuous	0.003	0.166	0.062	0.614	0.300	0.024	
Rail Bed <sup>[2]</sup>	Continuous	0.003	0.163	0.074	1.088	0.723	0.076	
	Volume Sources							
Material Handling <sup>[3]</sup>	Continuous	n/a	n/a	n/a	0.069	0.024	0.003	
Rail Bed Road	Continuous	0.005	2.764	0.129	6.958	1.578	0.183	
Modelled Section of Tote Road <sup>[4]</sup>	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates and equipment type (e.g., grading was assumed to occur only for 1 hour per day).	0.011	0.647	0.389	155.749	46.449	3.509	

#### Notes:

- [1] Emissions from diesel equipment, blasting, and processing are included here; blasting occurs once per day and 275 days per year
- [2] Emissions from aggregate trucks, diesel equipment, dozing, and grading are included here.
- [3] The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 2.7 m/s; see Appendix A for more details.
- [4] Section of Tote Road modelled was 19.9 km long; see Figure 3 and Appendix A for more details.

## **4 MODELLING METHODOLOGY**

The air quality modelling was designed to span a representative year of meteorological conditions, to ensure that reasonably worst-case meteorological conditions would be covered. The year 2006 was chosen as the representative meteorological year, as hourly, 3-D meteorological data had already been developed for that year, as part of the air quality study for the original FEIS.

The emission sources listed in Section 3 were modelled as point sources, area sources or volume sources, as shown in Figures 1, 2 and 3. Emissions from baghouses, generators, incinerators, ships and tug boats were modelled as point sources, and building downwash was incorporated in the model for any point sources located on or adjacent to buildings or structures. Emissions from grading, dozing and drilling operations around the sites, and blasting, were modelled as area sources. Emissions from mobile engines operating around the different sites, and crushing, were also generally modelled as area sources (and in some cases as volume sources). Emissions from idling train locomotives, mobile engines along the roads, vehicle road dust, grading along the roads, and material handling operations, were modelled as volume sources. The source parameters used in the modelling are discussed in detail in Appendix A.

<sup>&</sup>lt;sup>1</sup> Combustion emissions only. Emissions of dioxins, furans and mercury are expected to meet Nunavut and/or Federal guidelines for waste incinerators. This, through implementation of appropriate waste management programs and SOPs, possibly including source testing programs.

RWDI#1402090 July 31, 2018



The CALMET and CALPUFF dispersion modelling system was used to predict maximum concentrations and depositions of the contaminants of concern (as defined in Section 1.2) due to emissions from the three Project scenarios. CALMET is a meteorological model that develops hourly three-dimensional meteorological fields of wind and temperature, which are used to drive pollutant transport within CALPUFF (Scire et. al., 2000). CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model. It simulates the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and deposition (Scire et. al., 2000). The CALMET model versions 6.334 and 6.4.0, and CALPUFF model version 6.262 were used for this assessment.

The CALMET meteorological domains and CALPUFF computational domains for Milne Port and the Mine Site are shown in Figure 4 and Figure 5, respectively. The CALMET and CALPUFF domains for the Northern Transportation Corridor are shown in Figure 6 (the meteorological domain for this scenario is the same as that for Milne Port). The receptor grids used in CALPUFF for the three scenarios are also included in the figures.

CALPUFF was run with the MESOPUFF II chemistry scheme, which accounts for the chemical transformation of SO<sub>2</sub> and NO<sub>X</sub> into SO<sub>4</sub>, NO<sub>3</sub> and HNO<sub>3</sub>. In order to predict dustfall and acid deposition, dry and wet deposition of PM, all sulphur species and all nitrogen species were enabled in CALPUFF, for all sources. This also leads to better estimates of the concentrations of suspended PM, SO<sub>2</sub> and NO<sub>2</sub>. The ozone limiting method (OLM) was used to convert NO<sub>X</sub> to NO<sub>2</sub>. Detailed model inputs and methods for CALMET and CALPUFF are described in Appendix B and Appendix C, respectively.

The model outputs from CALPUFF were processed using the models POSTUTIL (version 1.641) and CALPOST (version 6.221). Maximum predicted concentrations and depositions were obtained for SO<sub>2</sub>, NO<sub>2</sub>, CO, TSP, PM<sub>10</sub>, PM<sub>2.5</sub>, dust, and PAI, for the 1- hour, 8-hour, 24-hour, 30-day and annual averaging periods (as applicable), in order to make comparisons to the indicator thresholds listed in Table 1.

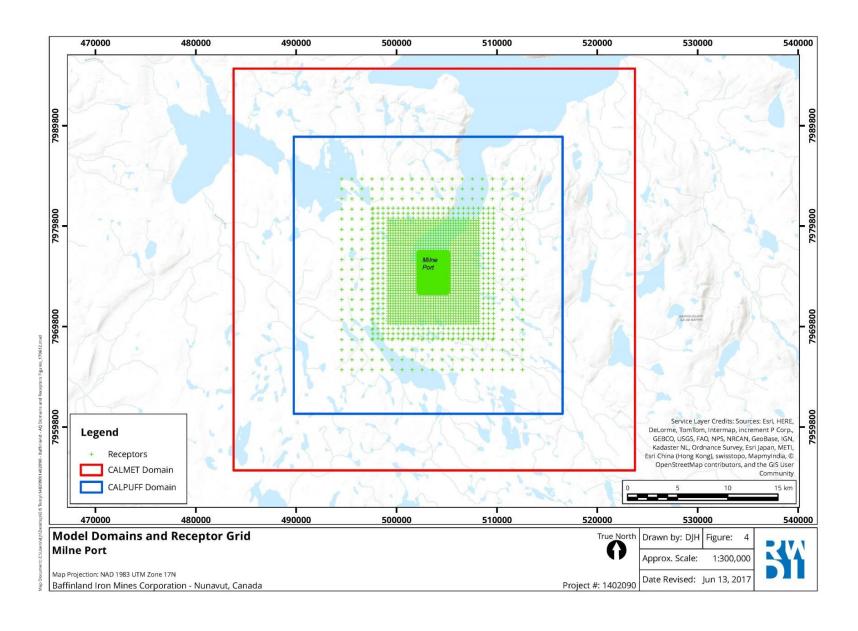
As discussed in the FEIS, ambient monitoring was conducted in July 2007 in the vicinity of the Mine Site, in order to assess the background air quality where Project activities will occur. The monitoring results near the Mine Site are considered to be representative of baseline air quality in the area, including near Milne Port. The monitoring program included the following contaminants: SO<sub>2</sub>, NO<sub>2</sub>, TSP, PM<sub>10</sub>, and dustfall. The contaminants PM<sub>2.5</sub> and CO were excluded from the program because the levels were expected to be too low to be measurable. The results are summarized in Table 6. These baseline concentrations are very low compared to the corresponding thresholds, and they were not applied to the results of the dispersion modelling.

**Table 6: Measured Baseline Concentrations from the FEIS** 

Parameter	Baseline Concentration or Deposition	Units
30-day SO <sub>2</sub>	0.262	μg/m³
30-day NO <sub>2</sub>	0.188	μg/m³
24-hour TSP	7.0	μg/m³
24-hour PM <sub>10</sub>	3.8	μg/m³
30-day Dustfall	0.0398	g/m²/30-day

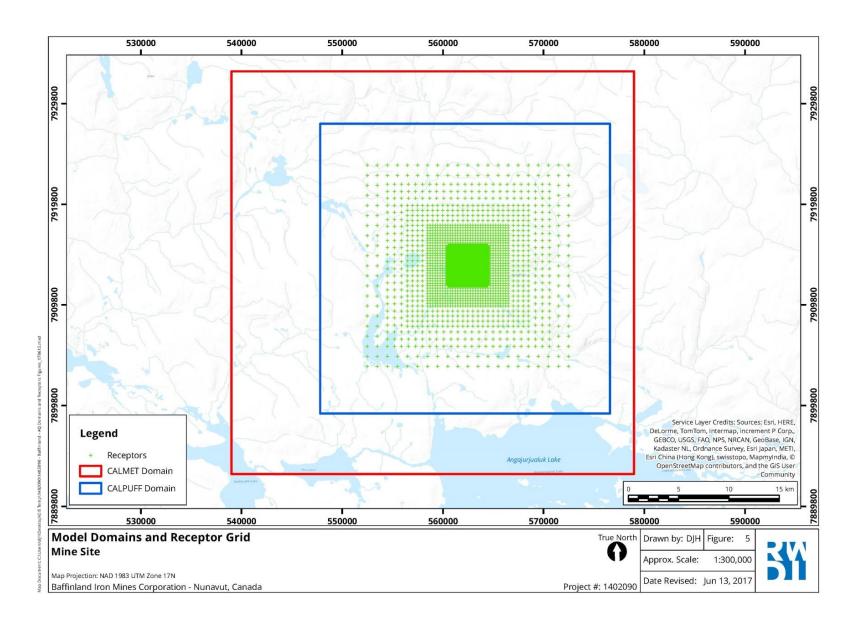
RWDI#1402090 July 31, 2018





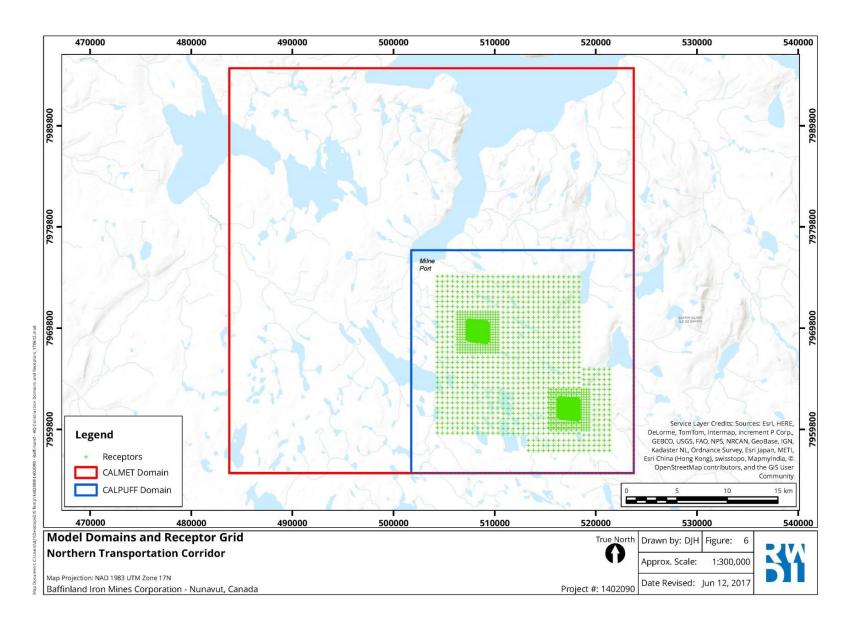
RWDI#1402090 July 31, 2018





RWDI#1402090 July 31, 2018





RWDI#1402090 July 31, 2018



## 5 RESULTS

## 5.1 Milne Port

Concentration and deposition contour plots for all of the modelled contaminants are provided in Appendix D, Figures D-1 to D-15 for this scenario. The Milne Port LSA and PDA are indicated on the figures. The indicator thresholds for each contaminant are shown on the figures, and the isopleths of concentrations and depositions that lie above the thresholds are illustrated in dark blue. A number of sensitive receptors near the accommodation building (ACC) are shown, and highlighted in the insets. The location of the Hunter Trapper Organization (HTO) cabin is also shown, outside the PDA.

The maximum predicted levels of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI are below their respective indicator thresholds everywhere outside the PDA (Figures D-1 to D-8, and D-15), including at/near the HTO cabin. The highest predicted impacts for these contaminants are from the combustion emissions from frost fighters and rail idling, which were modelled as non-buoyant area and volume sources, respectively.

The maximum predicted levels of TSP,  $PM_{10}$ ,  $PM_{2.5}$  and dustfall exceed their respective indicator thresholds outside the PDA (Figures D-9 to D-14), but not at the HTO cabin. The main sources that contribute to these exceedances are fugitive dust from material handling, and road dust from vehicles on the fine ore road.

The main source of 24-hour exceedances that occur north of the PDA (i.e. for TSP, PM<sub>10</sub> and PM<sub>2.5</sub>) is material handling. The conveyor to the transfer point at the ship loader, and the discharge chute on the Cape size ship lie within 50 m of the northern edge of the PDA. Exceedances of 24-hour TSP and PM<sub>10</sub> outside the PDA are the most extensive in that area, with the dark blue contours extending over 2 km past the PDA towards the north (Figures D-9 and D-11). Since the material handled (iron lump and fines) is comprised mostly of larger PM size fractions, the impact of the handling sources is lower on 24-hour PM<sub>2.5</sub> (Figure D-12) and the exceedances only extend 500 m north of the PDA. The exceedances of 24-hour TSP and PM<sub>10</sub> that are predicted to occur to the west of the PDA, are due to a combination of fugitive dust from material handling, and vehicle road dust. Vehicle road dust alone was predicted to cause 24-hour exceedances of these contaminants that extend up to a few hundred meters past the PDA towards the west. The exceedances of annual TSP, and 30-day and annual dustfall, are driven mainly by vehicle road dust (Figures D-10, D-13 and D-14). The exceedances of annual TSP and dustfall are limited to within 200 m of the PDA.

Inside the PDA, predicted levels of the different contaminants are of concern near the ACC. The maximum predictions of 1-hour and annual NO<sub>2</sub> (Figures D-4 and D-6), 24-hour PM<sub>10</sub> (Figure D-11), and 24-hour PM<sub>2.5</sub> (Figure D-12) exceed their indicator thresholds at some or all of the ACC receptors. The maximum predicted level of 24-hour TSP (Figure D-9) exceeds its indicator threshold at receptors that lie within 50 m of the ACC, towards the west. The maximum predicted concentrations of all of the other contaminants and averaging periods are below their respective thresholds near the ACC. Predicted concentrations of NO<sub>2</sub> and PM<sub>2.5</sub> near the ACC are mainly due to the frost fighters. Predicted concentrations of PM<sub>10</sub> and TSP near the ACC are mainly due to vehicle road dust from the fine ore road.

RWDI#1402090 July 31, 2018



# 5.2 Mine Site

Concentration and deposition contour plots for all of the modelled contaminants are provided in Appendix E, Figures E-1 to E-15 for this scenario. The Mine Site LSA and PDA are indicated on the figures. The indicator thresholds for each contaminant are shown on the figures, and the isopleths of concentrations and deposition values that lie above the thresholds are illustrated in dark blue. A number of sensitive receptors near the ACC are shown, and highlighted in the insets. The location of the HTO cabin is also shown, outside the PDA.

As in the case of Milne Port, the maximum predicted levels of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI are below their respective indicator thresholds everywhere outside the PDA (Figures E-1 to E-8, and E-15), including at/near the HTO cabin. The highest predicted impacts for these contaminants at the Mine Site are from the combustion emissions from mobile equipment in the ore pit and on haul roads near the ore pit, frost fighters, generators, and rail idling.

As in the case of Milne Port, the maximum predicted levels of TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and dustfall exceed their respective indicator thresholds outside the PDA (Figures E-9 to E-14), but not at the HTO cabin. The main sources that contribute to these exceedances are road dust from vehicles on the haul roads, and fugitive dust from material handling.

The potential production assessed at the Mine Site in this Phase 2 report is 30 Mtpa, compared to the 22.2 Mtpa ERP. However, the Phase 2 modelling results indicate overall lower impacts compared to the ERP. This can mostly be attributed to the assumption of a 66% emission control factor applied to fugitive dust emissions from vehicles travelling on unpaved roads, i.e. on the ore pit and waste dump haul routes. Previously, no dust suppression was assumed; and the predictions were higher. Additionally, some of the excessively conservative modelling assumptions made previously regarding the mine pit operations, eg. those for dozing, were revised; and fugitive dust emissions on the Tote Road were excluded from the modelling; these factors also contributed to lower impacts in the Phase 2 predictions.

The material handling sources at the Mine Site stockpiles lie within 1 km of the southern edge of the PDA, and are the main cause, in combination with vehicle road dust along the haul roads near the stockpiles, of the exceedances of 24-hour TSP, PM<sub>10</sub> and PM<sub>2.5</sub> that occur south of the PDA. Exceedances of 24-hour TSP and PM<sub>10</sub> extend over 2.5 km past the PDA towards the southwest (Figures E-9 and E-11). As in the case of Milne Port, the impact is lower on 24-hour PM<sub>2.5</sub> (Figure E-12) and the exceedances only extend 300 m outside of the PDA. The exceedances of 24-hour TSP and PM<sub>10</sub> that are predicted to occur to the east of the PDA, are mainly due to vehicle road dust along the haul roads leading to the pit. Vehicle road dust alone was predicted to cause 24-hour exceedances of these contaminants that extend over 500 m past the PDA towards the east. The exceedances of annual TSP, and 30-day and annual dustfall, are also driven mainly by vehicle road dust (Figures E-10, E-13 and E-14). The exceedances of annual TSP and dustfall are limited to within 200 m of the PDA.

Inside the PDA, predicted levels of the different contaminants are of concern near the ACC. The maximum predictions of 24-hour TSP (Figure E-9), 24-hour  $PM_{10}$  (Figure E-11), and annual dustfall (Figure E-14) exceed their indicator thresholds at some or all of the ACC receptors. The maximum predictions of 1-hour and annual  $NO_2$  (Figures E-4 and E-6), annual TSP (Figure E-10), 24-hour  $PM_{2.5}$  (Figure E-12), and 30-day dustfall (Figure E-13), exceed their indicator thresholds at receptors that lie within 150 m of the ACC, towards the south. The maximum predicted concentrations of all of the other contaminants and averaging periods are below their respective

RWDI#1402090 July 31, 2018



thresholds near the ACC. Predicted levels of TSP,  $PM_{10}$  and dustfall near the ACC are mainly due to material handling and vehicle road dust. Predicted concentrations of  $PM_{2.5}$  near the ACC are mainly due to frost fighters and material handling. Predicted concentrations of  $NO_2$  near the ACC are mainly due to frost fighters and generators.

# **5.3 Northern Transportation Corridor**

Concentration and deposition contour plots for this scenario, which represent an interim situation during construction of the northern railroad, are provided in Appendix F, Figures F-1 to F-18. The indicator thresholds for each contaminant are shown on the figures, and the isopleths of concentrations and depositions that lie above the thresholds are illustrated in dark blue. Contours have only been presented for PM species (i.e. TSP, PM<sub>10</sub> and PM<sub>2.5</sub>) and dustfall, since the maximum predicted levels of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI were well below their respective indicator thresholds everywhere in the modelling domain.

Figures F-1 to F-6 present PM and dustfall results for the Tote Road only; these impacts are mainly from vehicle road dust generated by ore trucks using the Tote Road. The dark blue contours for 24-hour TSP and PM<sub>10</sub> (i.e. levels that lie above the applicable indicator thresholds) extend a few hundred meters away from Tote Road (Figures F-1 and F-3), along the entire length that was modelled. In some segments, the blue contours extend up to 1.3 km for 24-hour TSP and 1.8 km for 24-hour PM<sub>10</sub>. Predicted levels of annual TSP and annual dustfall (Figures F-2 and F-6) that lie above the applicable indicator threshold are limited to within 600 m of Tote Road. Predicted levels of 24-hour PM<sub>2.5</sub> and 30-day dustfall (Figures F-4 and F-5) that lie above the applicable indicator thresholds are limited to within 300 m of Tote Road.

Figures F-7 to F-12 present PM and dustfall results for sources related to railway construction. The predicted impacts along the transportation corridor and near the quarry are mainly from vehicle road dust along the rail bed road, and the predicted levels lie below the applicable indicator thresholds for all PM species and dustfall, for all applicable averaging periods. The predicted impacts near the active construction area (i.e. the rail bed) are mainly from grading and dozing. Maximum 24-hour levels of PM<sub>10</sub> exceed the indicator threshold at distances up to 1 km away from the construction area (Figure F-9). For other PM species and dustfall, the potential for levels above the indicator thresholds is limited to shorter distances.

Figures F-13 to F-18 present PM and dustfall results for all sources combined, including construction-related sources and ore trucks using the Tote Road. Since the predicted impacts for PM and dustfall from Tote Road are more dominant than those from the construction sources, the contours for all sources combined are very similar to those shown for only the Tote Road (i.e. Figures F-1 to F-6).

RWDI#1402090 July 31, 2018



# 6 CONCLUSIONS

Air quality assessments for operations at Milne Port and the Mine Site, and for the North Rail Construction along the Northern Transportation Corridor, were conducted using the CALMET/CALPUFF dispersion modelling system. The dispersion model's predicted effects were compared against applicable thresholds and evaluated for each of the three scenarios.

Predicted concentrations of SO<sub>2</sub>, NO<sub>2</sub>, and CO, and predicted depositions of PAI, are within the applicable thresholds outside the Potential Development Area (PDA) at both Milne Port and the Mine Site, for all relevant averaging periods. Predicted concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub>, and predicted dustfall exceed the applicable thresholds outside the PDA at both Milne Port, and the Mine Site, for all relevant averaging periods.

The elevated exposure levels for PM and dustfall outside the Milne Port and Mine Site PDAs are heavily influenced by fugitive dust from material handling, and vehicle road dust along roads. Vehicle road dust is also the main contributor to predicted impacts from trucking along the Tote Road and rail construction for the Northern Transportation Corridor. Grading and dozing are also predicted to be important sources of emissions near the active construction area.

Table 7 provides a summary of all exceedances of applicable thresholds, for Milne Port and the Mine Site, outside their respective PDAs, and near the accommodation buildings (ACC) at each site.

Table 8 provides a summary of all exceedances of applicable thresholds, for the Northern Transportation Corridor. Exceedances due to Tote Road Only, and Construction Sources Only, are summarized. Since the predicted impacts for PM and dustfall from Tote Road are more dominant than those from the construction sources, exceedances predicted due to all sources combined are very similar to those predicted due to only the Tote Road.

RWDI#1402090 July 31, 2018



Table 7: Summary of Exceedances of Applicable Thresholds for Milne Port and the Mine Site

		Milne Po	ort	Mine Site			
Contaminant	Averaging Period	At or Near Outside PDA Accommodat ion Buildings		Outside PDA	At or Near Accommodation Buildings		
	1-hour						
SO <sub>2</sub>	24-hour	None	None	None	None		
	Annual						
	1-hour		Exceedances at ACC		Exceedances within 150 m of ACC		
$NO_2$	24-hour	None	None	None	-		
	Annual		Exceedances at ACC		Exceedances within 150 m of ACC		
CO	1-hour	None	None	None	None		
	8-hour	None	None	None	None		
TSP	24-hour	Exceedances extend to over 2 km outside the PDA	Exceedances within 50 m of ACC	Exceedances extend to over 2.5 km outside the PDA	Exceedances at ACC		
	Annual	Exceedances limited to within 200m of the PDA	None	Exceedances limited to within 200m of the PDA	Exceedances within 150 m of ACC		
PM <sub>10</sub>	24-hour	Exceedances extend to over 2 km outside the PDA	Exceedances at ACC	Exceedances extend to over 2.5 km outside the PDA	Exceedances at ACC		
PM <sub>2.5</sub>	24-hour	Exceedances limited to within 500m of the PDA	Exceedances at ACC	Exceedances limited to within 300m of the PDA	Exceedances within 150 m of ACC		
Dustfall	30-day Exceedances limited to within 200m of		None	Exceedances limited to within	Exceedances within 150 m of ACC		
	Annual	the PDA		200m of the PDA	Exceedances at ACC		
PAI	Annual	None	None	None	None		

Notes:

There are no exceedances of any contaminants at the HTO Cabins near Milne Port and the Mine Site

RWDI#1402090 July 31, 2018



Table 8: Summary of Exceedances of Applicable Thresholds for the Northern Transportation Corridor

	Averaging	Northern Transportation Corridor					
Contaminant	Period	Tote Road Only	Construction Sources Only				
TSP	24-hour	Exceedances extend a few hundred meters from the road, up to a maximum of 1.3 km	Exceedances within a few hundred meters of the construction rail bed				
	Annual	Exceedances within 600 m of the road					
PM <sub>10</sub>	24-hour	Exceedances extend a few hundred meters from the road, up to a maximum of 1.8 km	Exceedances extend up to 1 km away from construction rail bed				
PM <sub>2.5</sub>	24-hour	Exceedances within 300 m of the road	Exceedances within a few hundred meters of the construction rail bed				
Ductfall	30-day	Exceedances within 300 m of the road	Exceedances at a few receptors within 100m of the construction rail bed				
Dustfall	Annual	Exceedances within 600 m of the road	Exceedances within a few hundred meters of the construction rail bed				

#### Notes:

There are no exceedances of SO<sub>2</sub>, NO<sub>2</sub>, CO and PAI anywhere in the modelling domain

There are no exceedances along the Rail Bed Road or near the Quarry, due to the Construction Sources Only

The exceedance contours for All Sources Combined are similar to those for Tote Road Only but extend up to a few hundred meters farther from the road for some contaminants and averaging periods. There is no PDA and there are no sensitive receptors that were evaluated for the Northern Transportation Corridor

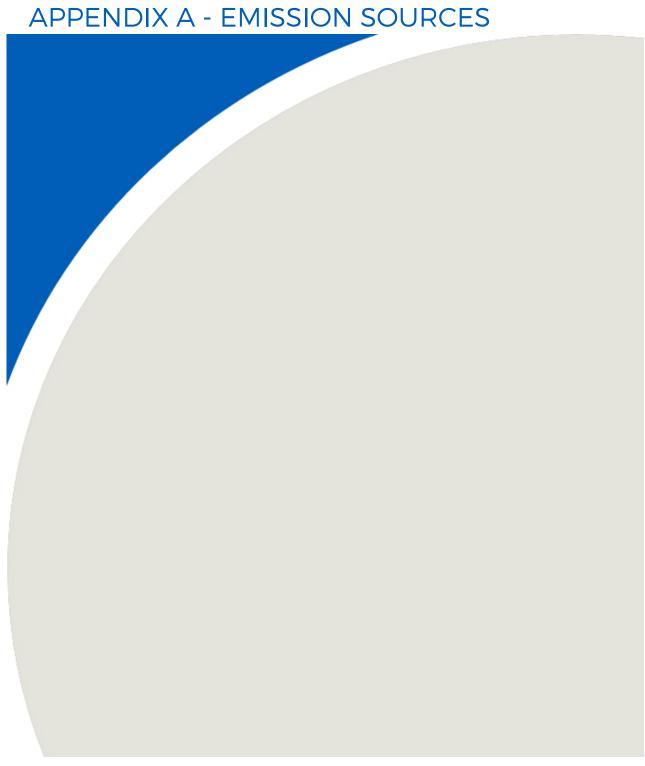
RWDI#1402090 July 31, 2018



# 7 REFERENCES

- 1. Albert Environment and Parks (AEP), (2/1/2008), Alberta Ambient Air Quality Objectives and Guidelines Summary
- 2. AEP, (6/1/2016), Alberta Ambient Air Quality Objectives and Guidelines Summary
- 3. Baffinland Iron Mines Corporation, (2/1/2012), Mary River Project Final Environmental Impact Statement Volume 5 Atmospheric Environment
- 4. B.C. Ministry of Environment (B.C. MOE), (12/16/2016), British Columbia Ambient Air Quality Objectives
- 5. B.C. MOE, (11/1/2015), British Columbia Air Quality Dispersion Modelling Guideline
- 6. Government of Newfoundland and Labrador, (9/18/2012), Guideline for Plume Dispersion Modelling
- 7. Government of Nunavut, (10/1/2011), Environmental Guideline for Ambient Air Quality
- 8. Government of the Northwest Territories, (2/1/2014), *Guideline for Ambient Air Quality Standards in the Northwest Territories*
- 9. International Maritime Organization, (1997), Marine Engine Regulations, Tier I Protocol
- 10. National Resources Canada, (Accessed 2017), *Canadian Digital Elevation Model (CDEM)* Retrieved from http://geogratis.gc.ca/site/eng/extraction
- 11. National Stone, Sand & Gravel Association, (2004), Modelling Fugitive Dust Sources
- 12. Ontario Ministry of the Environment and Climate Change, (12/9/2016), Ontario's Ambient Air Quality Criteria
- 13. Scire J.S, F.R. Robe, M.E. Ferneau, and R.J. Yamartino, Earth Tech Inc., (2000), *A User's Guide for the CALMET Meteorological Model*
- 14. Scire J.S, F.R. Robe, M.E. Ferneau, and R.J. Yamartino, Earth Tech Inc., (2000), *A User's Guide for the CALPUFF Dispersion Model*
- 15. United States Environmental Protection Agency (U.S. EPA), (8/1/1982), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 11.24: Metallic Minerals Processing
- 16. U.S. EPA, (10/1/1996), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 3.4: Large Stationary Diesel and All Stationary Dual-fuel Engines
- 17. U.S. EPA, (10/1/1998), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 11.9: Western Surface Coal Mining
- 18. U.S. EPA, (2004), Regulations for Emissions from Nonroad Vehicles and Engines, Emissions from heavy equipment with compression-ignition (diesel) engines
- 19. U.S. EPA, (8/1/2004), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing
- 20. U.S. EPA, (11/1/2006), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 13.2.2: Unpaved Roads
- 21. U.S. EPA, (11/1/2006), AP-42: Compilation of Air Emission Factors, Volume I, Fifth Edition, Chapter 13.2.4: Aggregate Handling and Storage Piles
- 22. U.S. EPA, (2008), Regulations for Emissions from Locomotives







# A.1 MILNE PORT OPERATIONS

# A.1.1 Fugitive Dust Emissions from Baghouses

#### A.1.1.1 Emission Factors

• All emission parameters were taken from the FEIS

#### A.1.1.2 Base Quantities

• There are three baghouses at various locations of Milne Site

#### A.1.1.3 Source Parameters

- Modelled as point sources
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A1 (Source IDs BHOUS1 to BHOUS3)
- Source summary tables are included at the end of this appendix

#### A.1.1.4 Emission Controls

• Not applicable

#### A.1.1.5 Schedule of Operations

• Assumed to be continuous

#### A.1.2 Combustion Emissions from Generators

#### A.1.2.1 Emission Factors

- AP-42 Ch. 3.4 (U.S. EPA, 1996) was used to calculate SO<sub>2</sub> emissions
- Manufacturer specification sheet for Cummins QSK50 was used to calculate NOx, CO and PM<sub>2.5</sub> emissions (attached at the end of this appendix)
- All particulate matter was assumed to be in the PM<sub>2.5</sub> size fraction
- Diesel sulphur content is assumed to be 15 ppm

#### A.1.2.2 Base Quantities

- Milne Inlet has 12 generators; five continuous generators with a power rating of 1.37 MW and five generators with a power rating of 2 MW; and two standby generators of 1.37 MW
- Only the continuous generators were modelled



#### A.1.2.3 Source Parameters

- Modelled as point sources
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A1 for the 1.37 MW and 2.00 MW generators (Source IDs GEN1 to GEN5 and NGEN1 to NGEN5 respectively)
- Source parameters were based on parameters used in the FEIS, equipment drawings provided by the client (Cummins QSK50) and generator specification sheets for similar models (CAT 3512B and CAT 3516C, attached at the end of this appendix), to those that will be used
- Source summary tables are included at the end of this appendix

#### A.1.2.4 Emission Controls

• Regulatory emission tier adhered to by the manufacturer

#### A.1.2.5 Schedule of Operations

• The 10 generators modelled were assumed to operate continuously

#### A.1.3 Combustion Emissions from Incinerators

# A.1.3.1 Emission Factors

- Emission estimates were calculated based on the emission rates used in the FEIS; the previous emission rates were scaled using 2013 stack testing results for Milne (attached at the end of this appendix)
- Sulphur dioxide (SO<sub>2</sub>) emission rates are based on 15 ppm fuel sulphur content

# A.1.3.2 Base Quantities

One incinerator operating at 2,000 kg/day

#### A.1.3.3 Source Parameters

- Modelled as a point source
- Stack height, diameter, velocity, and temperature, and emission rates, are provided in Table A1 (Source ID INCIN)
- Stack height and diameter were based on an emissions report provided to RWDI by HATCH from vendor (Emission Compliance Survey Monitoring Report, A.Lanfranco & Associates Inc., February 2014)
- Velocity and temperature were obtained from similar size equipment at Steensby port
- Source summary tables are included at the end of this appendix

#### A.1.3.4 Emission Controls

• No emission controls were assumed

#### A.1.3.5 Schedule of Operations

Every day from 4 am to midnight



# A.1.4 Combustion Emissions from Ore Carrier Ships

#### A.1.4.1 Emission Factors

- Ore Carrier ships meet International Maritime Organization (IMO, 1997) Tier I requirements for NOx
- Sulphur dioxide (SO<sub>2</sub>) emission rates are based on 0.5 % fuel sulphur content in the auxiliary generator when carriers are in port and in the main engines when the ship is in transit

# A.1.4.2 Base Quantities

- Panamax vessels with a capacity of 70,000 dry weight tonne and Cape Size vessels with a capacity of 230,000 dry weight tonnes will transport 12 Mtpa to market
- Each Ship will be equipped with one 0.75 MW "hotel power" generator
- The Panamax assumed engine size is 13 MW while the Cape size ship is 16 MW. When in transit, the 16 MW was used for the emission calculations
- Two ships may be loading simultaneously while operating hotel power generators
- Three ships can be anchored and operating hotel power generators
- The vessels will each require about 16 MW propulsion in open water at 13 knots with 15 % sea margin
- The transit path was divided into two segments of 1.5 km length each, and the time in transit though the segments was combined with g/kWh emission factors to calculate the emission rates for ship engines in transit

#### A.1.4.3 Source Parameters

- Modelled as point sources at anchor, port and in transit; the ships in transit were modelled as a series of
   10 point sources in each of the two segments modelled along the transit path
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A1 for ship engines at anchor and port (Source IDs ANCH1 to ANCH3 and PGEN1 & PGEN2), and ship engines during transit (Source IDs SHIP01 1 to SHIP01 10 and SHIP02 1 to SHIP02 10)
- Stack parameters are approximate based on similar size equipment; they are included in the modelling based on best available information
- Source summary tables are included at the end of this appendix

#### A.1.4.4 Emission Controls

• IMO Tier I requirements for NO<sub>x</sub> and 0.5 % fuel sulphur content

#### A.1.4.5 Schedule of Operations

- Only during Summer months (July to October)
- Ships at port and anchor were assumed to operate continuously during the summer months, while ships in transit were assumed to operate for eight hours every day within the local study area at Milne Inlet



# A.1.5 Combustion Emissions from Tug Boats

#### A.1.5.1 Emission Factors

- All the vessels are IMO Tier I compliant for NOx
- Sulphur dioxide (SO<sub>2</sub>) emission rates are based on 0.5 % fuel sulphur content

# A.1.5.2 Base Quantities

• Three tugboats will operate at 3 MW during summer.

#### A.1.5.3 Source Parameters

- Modelled as 16 point sources spread out in the area where the tugboat operations occur
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A1 (Source ID TUG01\_1 to TUG01\_16)
- Tugboats parameters were based on best available information and plans from vendors that were reviewed for Steensby Port for the FEIS.
- Source summary tables are included at the end of this appendix

#### A.1.5.4 Emission Controls

• IMO Tier I requirements for NO<sub>X</sub> and 0.5 % fuel sulphur content

# A.1.5.5 Schedule of Operations

- Continuous during Summer months (July to October)
- On days when the hours of operation are expected to be less than 24 hours, 24-hour operations were assumed any way, to ensure a worst-case prediction of maximum hourly pollutant levels

# A.1.6 Combustion Emissions from Diesel Equipment

#### A.1.6.1 Emission Factors

- The generation of NO<sub>X</sub>, CO and PM<sub>2.5</sub> from the combustion of diesel fuel in diesel engines was considered
- U.S. EPA Tier III Non-Road CI standards were used to calculate emission rates for the off-road fleet (U.S. EPA, 2004)
- 97 % of the engine PM emissions were assumed to be in the PM<sub>2.5</sub> size fraction
- SO<sub>2</sub> emissions was based on fuel sulphur content of 15 ppm

# A.1.6.2 Base Quantities

• The equipment fleet at Milne Port includes the following:



Equipment	Model	Quantity	Power Rating (kW)	Average Vehicle Weight (tonnes)
Front End Loaders	CAT 988K	4	579	50
Ore Haul Truck	CAT 740	2	365	54
Track Dozer	D9	1	343	53
Fuel Tanker	CAT 906	1	55	6
Front End Loaders	CAT 950	1	365	54
Front End Loaders	CAT 930	1	119	14
Excavators	Rubber Tired CAT 322D	1	123	22
Articulated Truck	CAT 740	2	365	54
Track Dozer	CAT D6	1	192	22
Grader	CAT 16M	2	243	31
Container Handler – Rough Terrain	Diesel - Kalmar RT240 assumed to be representative.	4	298	54
Passenger Transfer Bus	Diesel School Bus - up to 48 passengers	3	194	50
Passenger Transfer Bus	Diesel School Bus - up to 24 passengers	1	194	50
	Diesel - Freightliner M2 106 assumed to be	_		
Diesel Fuel Truck	representative.	2	261	50
Frost Fighters	Frost Fighters-Diesel	100	103	NA

Note: Average Vehicle Weights have been provided if they were used in emissions calculations; NA = Not Applicable

#### A.1.6.3 Source Parameters

- Emissions from diesel equipment were divided up between:
  - Stockpile and Frost Fighter area sources (Source IDs FINE1, FINE2, LUMP1, LUMP2, and FROST1, source parameters and emission rates given in Table A2); and
  - Fine Ore Road and Tote Road volume sources (Source IDs STKPRD and TOTEML, source parameters and emission rates in Table A3). Note: since vehicle traffic on-site dominates that along Tote Road, only 11.0 km along Tote Road was modelled.
- Source summary tables are included at the end of this appendix

#### A.1.6.4 Emission Controls

• U.S. EPA Tier III Non-Road CI standards for NO<sub>X</sub> (U.S. EPA, 2004)

#### A.1.6.5 Schedule of Operations

- Emissions modelled over the stockpiles were assumed to be continuous
- Frost Fighters were assumed to operate continuously from November to April
- Activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates were applied to emissions modelled over the roads



# A.1.7 Fugitive Dust Emissions from Bulldozing

# A.1.7.1 Emission Factors

• PM emissions from dozing operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

# A.1.7.2 Base Quantities

- One track dozer (D9) will be operating at stockpiles
- Material silt content of 1.2 % based on bulk sampling conducted by RWDI
- Moisture content of 2 % was assumed

#### A.1.7.3 Source Parameters

- Emissions were modelled as part of the Stockpiles area sources (Source IDs LUMP1 & LUMP2 in Table A2)
- Source summary tables are included at the end of this appendix

#### A.1.7.4 Emission Controls

No emission controls were assumed for dozing

#### A.1.7.5 Schedule of Operations

Assumed to be continuous

# A.1.8 Fugitive Dust Emissions from Material Handling

#### A.1.8.1 Emission Factors

• PM emissions from bulk material handling operations were estimated using AP-42 13.2.4 (U.S. EPA, 2006)

# A.1.8.2 Base Quantities

- Moisture content of 2 % was assumed
- Emissions were calculated based on the following hourly material handled for each source:

Source ID	Process	Hourly Material Handled (Mg)
VOL001	Conveyor to ROM stockpile discharge chute	1667
VOL002	FEL loading of ROM stockpile material to conveyor for crusher/screening	1667
VOL003	Conveyor to fine stockpile discharge chute	389
VOL004	FEL dumping fine material from stockpile to CAT 740 truck	389
VOL005	Truck unloading to fine stockpile conveyor	389
VOL006	FEL loading fine from stockpile to stacker conveyor	389
VOL007	Stacker to discharge chute on fine stockpile	389
VOL008	Reclaimer to conveyor	1167



Source ID	Process	Hourly Material Handled (Mg)
VOL009	conveyor to transfer point at ship loader	1167
VOL010	Discharge chute on Panamax ship	1167
VOL011	Screen building conveyor to stacker	1278
VOL012	Stacker to discharge chute on lump ore stockpile	1278
VOL013	Reclaimer to conveyor	3833
VOL014	conveyor to transfer point at ship loader	3833
VOL015	Discharge chute on Cape Size ship	3833

#### A.1.8.3 Source Parameters

- Modelled as volume sources with time-varying emissions based on hourly wind speed
- Source parameters and emission rates provided in Table A3 (Source IDs VOL001 to VOL015)
- Emission rates provided in Table A3 are for an average wind speed over the modelling period of 3.3 m/s
- Source parameters estimated based on initial plume created by each handling source, following guidance provided in the document Modelling Fugitive Dust Sources (National Stone, Sand & Gravel Association, 2004)
- Source summary tables are included at the end of this appendix

#### A.1.8.4 Emission Controls

No emission controls were assumed

#### A.1.8.5 Schedule of Operations

- Most handling sources were assumed to operate continuously
- Handling sources associated with loading ships were assumed to operate continuously from July to October

# A.1.9 Combustion Emissions from Train Idling

#### A.1.9.1 Emission Factors

• Idling emissions were taken from a study conducted by RWDI 95-288T-6

# A.1.9.2 Base Quantities

• The train engine is assumed to operate at approximately 18 bhp when at idle

#### A.1.9.3 Source Parameters

- Modelled as volume source
- Source parameters and emission rates provided in Table A3 (Source ID RLML\_IDLE)
- Source parameters estimated based on initial plume emerging from locomotive stack



#### A.1.9.4 Emission Controls

• Tier 3 standards were used for emission calculation

# A.1.9.5 Schedule of Operations

• Two locomotives were assumed to be idling continuously

# A.1.10 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads

#### A.1.10.1 Emission Factors

• Emission factors for unpaved industrial roads from AP-42 13.2.2 (U.S. EPA, 2006) were used to calculate PM emissions

#### A.1.10.2 Base Quantities

- Two 38 US ton CAT 740 haul trucks transport material along the Fine Ore Road. They each have a payload of 44 US ton when full, i.e. a loaded weight of 82 US ton. Therefore, the average weight of these trucks along the Fine Ore Road, accounting for the fact that they return empty, is 60 US ton or 54 metric tonnes
- Each truck makes 194 traffic passes per day along the Fine Ore Road (1.72 km long), based on the total material transported, which is 2.8 Mtpa.
- Mean vehicle speed is 30 km/hour
- A silt content of 5.2 % was applied based on measurements made previously, during bulk sampling
- Moisture content of 1.3 % was assumed

#### A.1.10.3 Source Parameters

- Modelled as volume sources along the length of the Fine Ore Road
- Source parameters and emission rates provided in Table A3 (Source ID STKPRD)
- Source summary tables are included at the end of this appendix

#### A.1.10.4 Emission Controls

• CaCl<sub>2</sub> Applied; 66 % control assumed

#### A.1.10.5 Schedule of Operations

• Assumed to be continuous

# A.1.11 Fugitive Dust Emissions from Grading

#### A.1.11.1 Emission Factors

PM emissions from grading operations were estimated using AP-42 11.9 (U.S. EPA, 1998)



#### A.1.11.2 Base Quantities

- One grader (CAT 16M) will be operating within the modelling domain, along the Fine Ore Road and the Tote Road
- The estimated mean vehicle speed is 30 km/hour

#### A.1.11.3 Source Parameters

- Modelled as volume sources along the Fine Ore Road and the Tote Road. Note: since vehicle traffic onsite dominates that along Tote Road, only 11.0 km along Tote Road was modelled.
- Source parameters and emission rates provided in Table A3 (Source IDs STKPRD and TOTEML)
- Source summary tables are included at the end of this appendix

#### A.1.11.4 Emission Controls

• A 66 % control was assumed for dust emissions

#### A.1.11.5 Schedule of Operations

• Assumed to operate for one hour every day in the modelling domain

# A.2 MINE SITE OPERATIONS

# A.2.1 Fugitive Dust Emissions from Baghouses

#### A.2.1.1 Emission Factors

- All emission parameters were taken from the FEIS
- Only PM was assumed to be emitted

# A.2.1.2 Base Quantities

• There are seven baghouses at various locations of Mine Site

#### A.2.1.3 Source Parameters

- Modelled as point sources
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A4 (Source IDs BGHOUS1, SCBAG1, TTRST1 to TTRST4 and TRLST1)
- Source summary tables are included at the end of this appendix

#### A.2.1.4 Emission Controls

Not applicable



#### A.2.1.5 Schedule of Operations

Assumed to be continuous

#### A.2.2 Combustion Emissions from Generators

#### A.2.2.1 Emission Factors

- AP-42 Ch. 3.4 (U.S. EPA, 1996) was used to calculate SO<sub>2</sub> emissions
- Manufacturer specification sheet for Cummins QSK50 was used to calculate NO<sub>X</sub>, CO and PM<sub>2.5</sub> emissions (attached at the end of this appendix)
- All particulate matter was assumed to be in the PM<sub>2.5</sub> size fraction
- Diesel sulphur content is assumed to be 15 ppm

#### A.2.2.2 Base Quantities

- Mary River has six generators (four operating, one standby and one backup) of 1.35 MW power rating and five generators (three operating, one standby and one backup) of 6.00 MW power rating
- Only the continuous generators were modelled

#### A.2.2.3 Source Parameters

- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A4 for the 1.35 MW and 6.00 MW generators (Source IDs GEN1 to GEN4 and PWST1 to PWST3 respectively)
- Source parameters were based on parameters used in the FEIS, equipment drawings provided by the client (Cummins QSK50) and a generator specification sheet for a similar model (CAT 3512B, attached at the end of this appendix), to the models that will be used
- Source summary tables are included at the end of this appendix

#### A.2.2.4 Emission Controls

Regulatory emission tier adhered to by the manufacturer

#### A.2.2.5 Schedule of Operations

The seven generators modelled were assumed to operate continuously

#### A.2.3 Combustion Emissions from Incinerators

#### A.2.3.1 Emission Factors

- Emission estimates were calculated based on the emission rates used in the FEIS; the previous emission rates were scaled using 2013 stack testing results for the Mine Site (attached at the end of this appendix)
- Sulphur dioxide (SO<sub>2</sub>) emission rates are based on 15 ppm fuel sulphur content



#### A.2.3.2 Base Quantities

Two incinerators each burning 2,000 kg/day

#### A.2.3.3 Source Parameters

- Modelled as a point source
- Stack heights, diameters, velocities, and temperatures, and emission rates, are provided in Table A4 (Source IDs INCIN1 & INCIN2)
- Average flow rate of 4 m<sup>3</sup>/s (240 m<sup>3</sup>/min) and exhaust temperature of 1200°C, were based on the information provided by the selected vendor in the Technical Data Sheet (Doc. No. H337697-PM406-D118219)
- Source summary tables are included at the end of this appendix

#### A.2.3.4 Emission Controls

• No emission controls were assumed

# A.2.3.5 Schedule of Operations

• Every day from 4 am to midnight

# A.2.4 Combustion Emissions from Diesel Equipment

#### A.2.4.1 Emission Factors

- The generation of NOx, CO and PM<sub>2.5</sub> from the combustion of diesel fuel in diesel engines was considered
- U.S. EPA Tier III Non-Road CI standards were used to calculate emission rates for the off-road fleet (U.S. EPA, 2004)
- 97 % of the engine PM emissions were assumed to be in the PM<sub>2.5</sub> size fraction
- SO<sub>2</sub> emissions was based on fuel sulphur content of 15 ppm

#### A.2.4.2 Base Quantities

• The equipment fleet at the Mine Site includes the following:

Equipment	Model	Quantity	Power Rating (kW)	Average Vehicle Weight (tonnes)	
Haul Trucks	CAT 793	28	1976	275	
Production Blasthole Drill	CAT MD6290	7	403	NA	
Hydraulic Face Shovel Excavator	CAT 6060FS	5	2240	NA	
Hydraulic Front End Loader	CAT 994K	1	1377	NA	
Front End Loaders	CAT 988	3	432	50	



Equipment	Model	Quantity	Power Rating (kW)	Average Vehicle Weight (tonnes)
Front End Loaders	CAT 992	4	676	110
Track Dozer	CAT D9	2	350	48
Track Dozer	CAT D10	4	571	70
Backhoe	CAT 345B	1	216	45
Wheel Dozer	CAT 834	1	419	48
Support Drills	Atlas Copco D9-11	3	163	NA
Grader	CAT 16H/M	2	243	31
Grader	CAT 24 M	1	397	31
Container Handler – Rough Terrain	Diesel - Kalmar RT240 assumed to be representative.	4	298	54
Passenger Transfer Bus	Diesel Type C School Bus - up to 78 passengers	3	194	15
Diesel Fuel Truck	Diesel - Freightliner M2 106 assumed to be representative.	2	261	50
Freight Haul Tractor / Trailer	Diesel - CAT CT660 assumed to be representative.	15	410	36
Frost Fighters	Frost Fighters-Diesel	100	103	NA
Pickup Trucks	Ford F250 - Diesel	90	175	2
Cube Vans	Ford F550 - Diesel	24	176	2
Maintenance, Fuel/Lube, Mechanics, Service Trucks	Ford F250 - Diesel	16	177	2

Note: Average Vehicle Weights have been provided if they were used in emissions calculations; NA = Not Applicable

#### A.2.4.3 Source Parameters

- Emissions from diesel equipment were divided up between:
  - Ore Pit, Waste Pit, Stockpiles, Primary Crusher, and Frost Fighter area sources (Source IDs PIT, WASTE, PROD1, PRIMCRUSH, FROST\_winter and FROST\_yr, source parameters and emission rates given in Table A5; FROST\_winter includes emissions from frost fighters which only operate during winter months and FROST\_yr includes emissions from other diesel equipment that operate in the same area as the frost fighters, but operate all year);
  - Ore Crusher and Rail Car Loading volume sources (Source IDs CRUSHFEL and VOL14FEL, source parameters and emission rates in Table A6); and
  - Haul Road and Tote Road volume sources (Source IDs HAUL and TOTEMR, source parameters and emission rates in Table A6). Note: since vehicle traffic on-site dominates that along Tote Road, only 11.4 km along Tote Road was modelled.
- Source summary tables are included at the end of this appendix

#### A.2.4.4 Emission Controls

• U.S. EPA Tier III Non-Road CI standards for NOx (U.S. EPA, 2004)



#### A.2.4.5 Schedule of Operations

• Activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates were applied; in particular, Frost Fighters were assumed to operate continuously from November to April.

# A.2.5 Dust Emissions from Blasting

#### A.2.5.1 Emission Factors

PM emissions from blasting operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

#### A.2.5.2 Base Quantities

• Total area blasted per blast hole averages 72 m<sup>2</sup>, with an average of 43 blast holes per blast. Average area blasted per blast is 3,096 m<sup>2</sup>.

#### A.2.5.3 Source Parameters

- Emissions were modelled over the Ore Pit area source (Source ID BLAST, source parameters and emission rates given in Table A5)
- Source summary tables are included at the end of this appendix

#### A.2.5.4 Emission Controls

No emission controls were assumed

# A.2.5.5 Schedule of Operations

• One blast per day and 275 days per year.

# A.2.6 Fugitive Dust Emissions from Bulldozing

#### A.2.6.1 Emission Factors

PM emissions from dozing operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

#### A.2.6.2 Base Quantities

- Four dozers will be operating in the ore pit, one in the waste rock pit and one near the primary crusher
- Material silt content of 1.2 % based on bulk sampling conducted by RWDI
- Moisture content of 2 % was assumed

#### A.2.6.3 Source Parameters

• Emissions were modelled over the Ore Pit, Waste Pit and Primary Crusher area sources (Source IDs PIT, WASTE and PRIMCRUSH, source parameters and emission rates given in Table A5)



• Source summary tables are included at the end of this appendix

#### A.2.6.4 Emission Controls

No emission controls were assumed

#### A.2.6.5 Schedule of Operations

Assumed to be continuous

# A.2.7 Fugitive Dust Emissions from Drilling

#### A.2.7.1 Emission Factors

- PM emissions from drilling were estimated using AP-42 11.19.2 (U.S. EPA, 2004)
- Wet drilling emission factors are used since there are no dry drilling emission factors.

# A.2.7.2 Base Quantities

• Processing 78,000,000 tonnes per year of ore and waste

#### A.2.7.3 Source Parameters

- Emissions were modelled over the Ore Pit area source (Source ID PIT, source parameters and emission rates given in Table A5)
- Source summary tables are included at the end of this appendix

#### A.2.7.4 Emission Controls

• Drills were assumed to be equipped with either wet suppression or a dust collector

# A.2.7.5 Schedule of Operations

Assumed to be continuous

# A.2.8 Fugitive Dust Emissions from Material Handling

#### A.2.8.1 Emission Factors

• PM emissions from bulk material handling operations were estimated using AP-42 13.2.4 (U.S. EPA, 2006)

# A.2.8.2 Base Quantities

- Moisture content of 2 % was assumed
- Emissions were calculated based on the following hourly material handled for each source:



Source ID	Process	Hourly Material Handled (Mg)
VOL001	Tripper Conveyor to Diverter Gate	2500
VOL002	Diverter Gate Chute to conveyor drop operation	1250
VOL003	Diverter Gate Chute to mobile stacker	1250
VOL004	Mobile Stacker to stockpile drop operation	1250
VOL005	Tripper Conveyor to Mobile Stacker/Reclaimer drop	2500
VOL006	Mobile Stacker/Reclaimer to Stockpile	2500
VOL007	Stockpile to Mobile Stacker/Reclaimer Operation	2500
VOL008	Mobile Stacker/Reclaimer from Stockpile to Conveyor	2500
VOL009	Stockpile to Mobile Reclaimer Operation	1250
VOL010	Mobile Reclaimer to Conveyor drop	1250
VOL011	Haul trucks dumping at Steensby crusher	2500
VOL012	Trucks dumping at ROM pile	1667
VOL013	Crusher conveyor dropping material onto ROJ pile	1667
VOL014	FEL dumping into rail cars	1667
VOL015	Shovel dumping into trucks at pit	10833
VOL016	Trucks dumping at the waste rock pile	6667

#### A.2.8.3 Source Parameters

- Modelled as volume sources with time-varying emissions based on hourly wind speed
- Source parameters and emission rates provided in Table A6 (Source ID VOL001 to VOL016)
- Emission rates provided in Table A6 are for an average wind speed over the modelling period of 3.3 m/s
- Source parameters estimated based on initial plume created by each handling source, following guidance provided in the document Modelling Fugitive Dust Sources (National Stone, Sand & Gravel Association, 2004)
- Source summary tables are included at the end of this appendix

# A.2.8.4 Emission Controls

• No emission controls were assumed

#### A.2.8.5 Schedule of Operations

• Assumed to be continuous

# A.2.9 Combustion Emissions from Train Idling

#### A.2.9.1 Emission Factors

Idling emissions were taken from a study conducted by RWDI 95-288T-6



# A.2.9.2 Base Quantities

• The train engine is assumed to operate at approximately 18 bhp when at idle

#### A.2.9.3 Source Parameters

- Modelled as volume source
- Source parameters and emission rates provided in Table A6 (Source ID RLMR\_IDLE)
- Source summary tables are included at the end of this appendix

#### A.2.9.4 Emission Controls

Tier 3 standards were used for emission calculation

#### A.2.9.5 Schedule of Operations

• Two locomotives are assumed to be idling continuously

# A.2.10 Fugitive Dust Emissions from Crushing

#### A.2.10.1 Emission Factors

PM emissions from primary crushing were estimated using AP-42 11.24 (U.S. EPA, 1982)

#### A.2.10.2 Base Quantities

- Outdoor processing of 12,000,000 tonnes per year of ore and waste for shipment to Milne Port
- Low moisture ore processing option was selected
- It should be noted that this crushing operation will occur to the northwest of the stockpiles, and is different from the operations that will at the Primary Crusher (located farther east, on the route to the pit), which processes 18,000,000 tonnes per year of material that will go to Steensby Port; the primary crusher will be enclosed in a building with a baghouse; dust emissions for this case have been accounted for under the baghouse at the primary crusher (Source ID BGHOUS1 in Table A4)

# A.2.10.3 Source Parameters

- Emissions were modelled over the Ore Crusher volume source (Source ID CRUSHFEL, source parameters and emission rates given in Table A6)
- Source summary tables are included at the end of this appendix

#### A.2.10.4 Emission Controls

Emission factor for low moisture ore

# A.2.10.5 Schedule of Operations

Assumed to be continuous



# A.2.11 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads

#### A.2.11.1 Emission Factors

• AP-42 13.2.2 (U.S. EPA, 2006) was used to calculate PM emissions

#### A.2.11.2 Base Quantities

- Twenty-eight 183 US ton CAT 793 haul trucks transport material along the Haul Roads. They each have a
  payload of 240 US ton when full, i.e. a loaded weight of 423 US ton. Therefore, the average weight of
  these trucks along the Haul Roads, accounting for the fact that they return empty, is 303 US ton or 275
  metric tonnes
- The Haul Roads are divided into a number of different segments. Each truck makes 75 traffic passes per day between the ore pit and the crushers (10.84 km long) based on transporting 12 Mtpa and 18 Mtpa to the two crushers; 80 traffic passes per day between the ore and waste pits (1.72 km long) based on transporting 48 Mtpa along that route; and 101 traffic passes per day along the Haul Road from the crusher to stockpiles (2.07 km long) based on transporting 12 Mtpa of material along that route.
- Mean vehicle speed is 30 km/hour
- A silt content of 5.2 % was applied based on measurements taken previously, during bulk sampling
- Moisture content of 1.3 % was assumed

#### A.2.11.3 Source Parameters

- Modelled as volume sources along the length of the Haul Roads
- Source parameters and emission rates provided in Table A6 (Source ID HAUL)
- Source summary tables are included at the end of this appendix

#### A.2.11.4 Emission Controls

• Water and CaCl<sub>2</sub>; 66 % control assumed

#### A.2.11.5 Schedule of Operations

Assumed to be continuous

# A.2.12 Fugitive Dust Emissions from Grading

#### A.2.12.1 Emission Factors

PM emissions from grading operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

#### A.2.12.2 Base Quantities

- Three graders (CAT 16H/M and CAT 24M) will be operating within the modelling domain, along the Haul Roads and the Tote Road
- The mean vehicle speed is 30 km/hour



# A.2.12.3 Source Parameters

- Modelled as volume sources along the Haul Roads and the Tote Road. Note: since vehicle traffic on-site
  dominates that along Tote Road, only 11.4 km along Tote Road was modelled.
- Source parameters and emission rates provided in Table A6 (Source IDs HAUL and TOTEMR)
- Source summary tables are included at the end of this appendix

#### A.2.12.4 Emission Controls

A 66 % control was assumed for dust emissions

#### A.2.12.5 Schedule of Operations

• Assumed to operate for one hour every day in the modelling domain

# A.3 NORTHERN TRANSPORTATION CORRIDOR

# A.3.1 Combustion Emissions from Diesel Equipment

#### A.3.1.1 Emission Factors

- The generation of NOx, CO and PM<sub>2.5</sub> from the combustion of diesel fuel in diesel engines was considered
- U.S. EPA Tier III Non-Road CI standards were used to calculate emission rates for the off-road fleet (U.S. EPA, 2004)
- 97 % of the engine PM emissions were assumed to be in the PM<sub>2.5</sub> size fraction
- SO<sub>2</sub> emissions was based on fuel sulphur content of 15 ppm

### A.3.1.2 Base Quantities

• The equipment fleet considered under the Northern Transportation Corridor includes the following:

Equipment	Model	Quantity	Power Rating (kW)	Average Vehicle Weight (tonnes)
Excavator	CAT 345	1	257	45
Bulldozer	D9 Dozer	3	350	48
Grader	CAT 16	1	243	31
Compactor	CAT 988	1	432	50
Haul Truck	CAT 773	12	578	75
Drill	Rock Drill	6	163	NA
Loader	CAT 988	4	432	50
Crusher/Screening Plant	Turbo 950	1	265	NA
Stacker	TBD (Large)	1	NA	NA
Freight Haul Tractor /	Diesel - Freightliner M2			
Trailer	106	10	475	127



Equipment	Model	Quantity	Power Rating (kW)	Average Vehicle Weight (tonnes)
Diesel fuel and other				
goods truck	CAT CT660	12	261	41
Grader	CAT 16	1	243	31
Frost fighters	Frost fighters-diesel	10	103	NA

Note: Average Vehicle Weights have been provided if they were used in emissions calculations; NA = Not Applicable

#### A.3.1.3 Source Parameters

- Emissions from diesel equipment were divided up between:
  - Quarry and Rail Bed area sources (Source IDs QUARRY\_D, QUARRY\_F, BED\_D and BED\_F, source
    parameters and emission rates given in Table A7; Frost Fighters emissions are included in the
    sources QUARRY\_F and BED\_F); and
  - Rail Bed Road and Tote Road volume sources (Source IDs RAILBCONS and TOTECONS, source parameters and emission rates in Table A8). Note: the section of the Tote Road modelled was 19.9 km, extending past the Quarry and Rail Bed for a few kilometres.
- Source summary tables are included at the end of this appendix

#### A.3.1.4 Emission Controls

• U.S. EPA Tier III Non-Road CI standards for NO<sub>X</sub> (U.S. EPA, 2004)

### A.3.1.5 Schedule of Operations

- Most equipment assumed to be continuous
- Frost Fighters assumed to operate from November to April

# A.3.2 Dust Emissions from Blasting

#### A.3.2.1 Emission Factors

• PM emissions from blasting operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

#### A.3.2.2 Base Quantities

• Total area blasted per blast hole averages 72 m<sup>2</sup>, with an average of 6 blast holes per blast. Average area blasted per blast is 432 m<sup>2</sup>.

#### A.3.2.3 Source Parameters

- Emissions were modelled over the Quarry area source (Source ID QUARRY\_B, source parameters and emission rates given in Table A7)
- Source summary tables are included at the end of this appendix



#### A.3.2.4 Emission Controls

• No emission controls were assumed

# A.3.2.5 Schedule of Operations

• One blast per day and 275 days per year.

# A.3.3 Fugitive Dust Emissions from Drilling

#### A.3.3.1 Emission Factors

- PM emissions from drilling were estimated using AP-42 11.19.2 (U.S. EPA, 2004)
- Wet drilling emission factors are used since there are no dry drilling emission factors.

#### A.3.3.2 Base Quantities

• Processing 2,102,400 tonnes per year of aggregate

#### A.3.3.3 Source Parameters

- Emissions were modelled over the Quarry area source (Source ID QUARRY\_P, source parameters and emission rates given in Table A7)
- Source summary tables are included at the end of this appendix

#### A.3.3.4 Emission Controls

• No emission controls were assumed

# A.3.3.5 Schedule of Operations

• Assumed to be continuous

# A.3.4 Fugitive Dust Emissions from Crushing

#### A.3.4.1 Emission Factors

• PM emissions from primary crushing were estimated using AP-42 11.24 (U.S. EPA, 1982)

### A.3.4.2 Base Quantities

- Processing 2,102,400 tonnes per year of ore and waste
- Low moisture ore processing option was selected



#### A.3.4.3 Source Parameters

- Emissions were modelled over the Quarry area source (Source ID QUARRY\_P, source parameters and emission rates given in Table A7)
- Source summary tables are included at the end of this appendix

# A.3.4.4 Emission Controls

• Emission factor for low moisture ore

# A.3.4.5 Schedule of Operations

• Assumed to be continuous

# A.3.5 Fugitive Dust Emissions from Bulldozing

#### A.3.5.1 Emission Factors

PM emissions from dozing operations were estimated using AP-42 11.9 (U.S. EPA, 1998)

#### A.3.5.2 Base Quantities

- Three dozers will be operating in the construction area rail bed
- Material silt content of 3.8 %
- Moisture content of 7.9 % was assumed

#### A.3.5.3 Source Parameters

- Emissions were modelled over the Rail Bed area source (Source ID BED\_Doz, source parameters and emission rates given in Table A7)
- Source summary tables are included at the end of this appendix

#### A.3.5.4 Emission Controls

• No emission controls were assumed

#### A.3.5.5 Schedule of Operations

• Assumed to be continuous

# A.3.6 Fugitive Dust Emissions from Grading

#### A.3.6.1 Emission Factors

PM emissions from grading operations were estimated using AP-42 11.9 (U.S. EPA, 1998)



#### A.3.6.2 Base Quantities

- One grader (CAT 16) will be operating along the Rail Bed Road and the Tote Road. Note: the section of the Tote Road modelled was 19.9 km, extending past the Quarry and Rail Bed for a few kilometres.
- The mean vehicle speed is 10 km/hour along the Rail Bed Road and 30 km/hour along the Tote Road

#### A.3.6.3 Source Parameters

- Emissions from diesel equipment were divided up between:
  - o Rail Bed area source (Source ID BED\_grad, source parameters and emission rates in Table A7)
  - Tote Road volume source (Source ID TOTECONS, source parameters and emission rates in Table A8)
- Source summary tables are included at the end of this appendix

#### A.3.6.4 Emission Controls

• A 66% control was assumed for dust emissions on the Tote Road

#### A.3.6.5 Schedule of Operations

• Assumed to operate continuously in the Rail Bed and for only one hour every day along the Tote Road.

# A.3.7 Fugitive Dust Emissions from Material Handling

#### A.3.7.1 Emission Factors

PM emissions from bulk material handling operations were estimated using AP-42 13.2.4 (U.S. EPA, 2006)

#### A.3.7.2 Base Quantities

- Moisture content of 2 % was assumed
- Emissions were calculated based on the following hourly material handled for each source:

Source ID	Process	Hourly Material Handled (Mg)
VOL001	Crusher conveyor dropping material onto pile	34
VOL002	FEL dumping into haul trucks	34
VOL003	Haul trucks dumping material at rail bed area	34

#### A.3.7.3 Source Parameters

- Modelled as volume sources with time-varying emissions based on hourly wind speed
- Source parameters and emission rates provided in Table A8 (Source ID VOL001 to VOL003)
- Emission rates provided in Table A8 are for an average wind speed over the modelling period of 2.7 m/s



- Source parameters estimated based on initial plume created by each handling source, following guidance provided in the document Modelling Fugitive Dust Sources (National Stone, Sand & Gravel Association, 2004)
- Source summary tables are included at the end of this appendix

#### A.3.7.4 Emission Controls

No emission controls were assumed

### A.3.7.5 Schedule of Operations

Assumed to be continuous

# A.3.8 Fugitive Dust Emissions from Vehicles travelling on Unpaved Roads

#### A.3.8.1 Emission Factors

- Dust generation from vehicular activity on the Rail Bed and Tote Roads was considered
- AP-42 13.2.2 (U.S. EPA, 2006) was used to calculate PM emissions

#### A.3.8.2 Base Quantities

- Twelve 52.3 US ton CAT 773 haul trucks transport material along the Rail Bed Road. They have a payload
  of 61 US ton when full, i.e. a loaded weight of 113.3 US ton. Therefore, the average weight, accounting for
  the fact that the trucks return empty, is 83 US ton or 75 metric tonnes. All trucks combined make 30
  passes per day along the Rail Bed Road, based on the total material transported, which is 300,000 tonnes
  per annum.
- Ten 70 US ton freight haul tractor-trailers transport material along the Tote Road. They have a payload of 140 US ton when full, i.e. a loaded weight of 210 US ton. Therefore, the average weight, accounting for the fact that the trucks return empty, is 140 US ton or 127 metric tonnes. Each truck makes 30 passes per day, based on the total material transported, which is 6 Mtpa.
- Twelve diesel fuel trucks with an average weight of 45 US ton or 41 metric tonnes, travel along the Tote Road. All trucks combined make 44 passes per day.
- Mean vehicle speed along the Rail Bed Road is 30 km/hour and along the Tote Road the mean speed is
   65 km/hour
- A silt content of 5.2% was applied based on bulk sampling
- Moisture content of 1.3 % was assumed
- Short term emission rates were developed based on annual material transported in a year

# A.3.8.3 Source Parameters

- Modelled as volume sources along the length of the Rail Bed and Tote Roads. Note: the section of the Tote Road modelled was 19.9 km, extending past the Quarry and Rail Bed for a few kilometres.
- Source parameters and emission rates provided in Table A8 (Source IDs RAILBCONS and TOTECONS)



- Source parameters estimated based on initial plume created by the movement of vehicles along the road
- Source summary tables are included at the end of this appendix

# A.3.8.4 Emission Controls

• CaCl<sub>2</sub> Applied; 66% control assumed

# A.3.8.5 Schedule of Operations

• Assumed to be continuous

Table A1: Source Parameters and Emission Rates for Point Sources Modelled at Milne Port

	Operating			итм х	<b>UTM Y</b>	Stack	Stack Inner	Exit	Exhaust		Short Te	rm Emis	sion Rate	es (g/s)	
Source Type	Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
		BHOUS1	Rail Car Unloading Station Baghouse	503.785	7974.954	19.0	1.3	18.6	293	n/a	n/a	n/a	0.247	0.247	0.111
Baghouses	Continuous	BHOUS2	Crusher Baghouse	503.346	7974.865	44.0	1.0	21.2	293	n/a	n/a	n/a	0.167	0.167	0.075
		BHOUS3	Screening Plant Baghouse	503.147	7974.816	44.0	1.0	21.2	293	n/a	n/a	n/a	0.167	0.167	0.075
		GEN1	Power Plant 1.37MW-1	503.680	7976.052	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		GEN2	Power Plant 1.37MW-2	503.680	7976.046	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		GEN3	Power Plant 1.37MW-3	503.680	7976.039	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		GEN4	Power Plant 1.37MW-4	503.679	7976.033	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
Caparators	Continuous	GEN5	Power Plant 1.37MW-5	503.680	7976.029	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
Generators	Continuous	NGEN1	Power Plant 2.0MW-1	503.705	7976.063	4.8	0.5	48.4	737	< 0.001	4.029	0.788	0.053	0.053	0.053
		NGEN2	Power Plant 2.0MW-2	503.705	7976.055	4.8	0.5	48.4	737	< 0.001	4.029	0.788	0.053	0.053	0.053
		NGEN3	Power Plant 2.0MW-3	503.706	7976.047	4.8	0.5	48.4	737	< 0.001	4.029	0.788	0.053	0.053	0.053
		NGEN4	Power Plant 2.0MW-4	503.705	7976.039	4.8	0.5	48.4	737	< 0.001	4.029	0.788	0.053	0.053	0.053
		NGEN5	Power Plant 2.0MW-5	503.705	7976.031	4.8	0.5	48.4	737	< 0.001	4.029	0.788	0.053	0.053	0.053
Incinerator	Every day 4am till midnight	INCIN	Incinerator Stack	503.790	7975.995	15.2	0.8	5.7	1196	< 0.001	0.054	0.003	0.022	0.022	0.022
	Continuous	ANCH1	Anchor location 1	503.417	7977.770	30.0	0.5	35.9	601	0.400	3.542	0.229	0.231	0.231	0.208
Ship at Anchor	from July to October	ANCH2	Anchor location 2	502.231	7977.010	30.0	0.5	35.9	601	0.400	3.542	0.229	0.231	0.231	0.208
Baghouses  Generators  Incinerator  Ship at Anchor  Ship at Port  Ship in Transit	October	ANCH3	Anchor location 3	504.637	7977.530	30.0	0.5	35.9	601	0.400	3.542	0.229	0.231	0.231	0.208
Ship at Port	Continuous from July to	PGEN1	Auxiliary engine ship1	503.186	7976.662	30.0	0.5	35.9	601	0.400	3.542	0.229	0.231	0.231	0.208
Ship at Port from	October	PGEN2	Auxiliary engine ship2	503.603	7976.754	30.0	0.5	35.9	601	0.400	3.542	0.229	0.231	0.231	0.208
		SHIP01_1	Ship in transit 1	503.200	7976.803	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP01_2	Ship in transit 1	503.242	7976.925	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP01_3	Ship in transit 1	503.285	7977.049	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP01_4	Ship in transit 1	503.324	7977.174	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP01_5	Ship in transit 1	503.360	7977.307	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
	For 8 hours	SHIP01_6	Ship in transit 1	503.399	7977.452	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
Chin in Transit	every day	SHIP01_7	Ship in transit 1	503.445	7977.592	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
Snip in Transit	from July to	SHIP01_8	Ship in transit 1	503.492	7977.729	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
	October	SHIP01_9	Ship in transit 1	503.539	7977.873	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP01_10	Ship in transit 1	503.574	7978.025	30.0	1.9	34.0	523	0.240	2.125	0.138	0.139	0.139	0.125
		SHIP02_1	Ship in transit 2	503.691	7978.213	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052
		SHIP02_2	Ship in transit 2	503.789	7978.307	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052
		SHIP02_3	Ship in transit 2	503.891	7978.400	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052
		SHIP02_4	Ship in transit 2	504.004	7978.498	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052

Source Type	Operating Hours Modelled	Hours Source ID		итм х	UTM Y	Stack	Stack Inner	Exit	Exhaust	Short Term Emission Rates (g/s)							
			Emission Source	(km) (km)		Height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>		
		SHIP02_5	Ship in transit 2	504.101	7978.588	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		SHIP02_6	Ship in transit 2	504.215	7978.681	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		SHIP02_7	Ship in transit 2	504.312	7978.775	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		SHIP02_8	Ship in transit 2	504.418	7978.869	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		SHIP02_9	Ship in transit 2	504.527	7978.962	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		SHIP02_10	Ship in transit 2	504.648	7979.064	30.0	1.9	34.0	523	0.099	0.880	0.057	0.057	0.057	0.052		
		TUG01_1	Tug Emission	503.757	7977.661	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
	Continuous from July to	TUG01_2	Tug Emission	503.956	7977.676	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_3	Tug Emission	504.226	7977.683	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_4	Tug Emission	504.460	7977.690	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_5	Tug Emission	503.778	7977.470	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_6	Tug Emission	503.977	7977.470	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_7	Tug Emission	504.254	7977.470	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
Tugboat Operations		TUG01_8	Tug Emission	504.467	7977.477	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
rugboat Operations	October	TUG01_9	Tug Emission	503.764	7977.228	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_10	Tug Emission	503.984	7977.221	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_11	Tug Emission	504.254	7977.228	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_12	Tug Emission	504.481	7977.235	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_13	Tug Emission	503.778	7977.015	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_14	Tug Emission	503.998	7977.022	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_15	Tug Emission	504.254	7977.030	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		
		TUG01_16	Tug Emission	504.481	7977.037	10.0	0.8	27.5	623	< 0.001	2.656	0.172	0.173	0.173	0.156		

Table A2: Source Parameters and Emission Rates for Area Sources Modelled at Milne Port

Source Type	Operating	Source ID	Emission Source	UTM X UTM Y	Release			Short Term Emission Rates (g/s)							
	Hours Modelled			(km)	(km)	Height (m)	Area (m²)	Sigma-Z (m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>	
Stockpiles	Continuous	FINE1	Front end loader at initial fines stockpile	502.973	7974.823	3.0	3200	0.5	< 0.001	0.113	0.005	0.002	0.002	0.002	
		FINE2	Front end loader at final fines stockpile	503.156	7975.870	3.0	9420	0.5	< 0.001	0.113	0.005	0.002	0.002	0.002	
		LUMP1	Reclaim dead lump stockpile capacity	503.250	7975.571	3.0	141463	0.5	< 0.001	0.134	0.015	0.185	0.140	0.022	
		LUMP2	Reclaim dead lump stockpile capacity	503.331	7975.484	3.0	129364	0.5	< 0.001	0.113	0.005	0.184	0.139	0.021	
Frost Fighters	Continuous from November to April	FROST1	Frost fighters	503.801	7976.074	1.0	105224	0.5	0.019	1.097	0.509	0.052	0.052	0.050	
Dozing	Continuous		Emissions were included in LUMP1, LUMP2												

Table A3: Source Parameters and Emission Rates for Volume Sources Modelled at Milne Port

Source Type	Operating Hours	Source ID	Emission Source	итм х	<b>UTM Y</b>	Release Height (m)	Sigma-Y (m)	Sigma- Z (m)	Short Term Emission Rates (g/s)						
Source Type	Modelled	30urce ib	Emission source	(km)	(km)				SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>	
		VOL001	Conveyor to ROM stockpile discharge chute	503.413	7974.877	10.0	0.7	0.7	n/a	n/a	n/a	1.419	0.500	0.066	
		VOL002	FEL loading of ROM stockpile material to conveyor for crusher/screening	503.388	7974.866	3.0	1.0	0.7	n/a	n/a	n/a	1.419	0.500	0.066	
		VOL003	Conveyor to fine stockpile discharge chute	503.029	7974.848	10.0	0.7	0.7	n/a	n/a	n/a	0.331	0.117	0.015	
		VOL004	FEL dumping fine material from stockpile to CAT740 truck	502.987	7974.857	3.0	1.0	0.7	n/a	n/a	n/a	0.331	0.117	0.015	
	Continuous	VOL05A	Truck unloading to fine stockpile conveyor	503.080	7976.150	3.0	1.0	0.7	n/a	n/a	n/a	0.166	0.058	0.008	
		VOL05B	Truck unloading to fine stockpile conveyor	503.056	7975.905	3.0	1.0	0.7	n/a	n/a	n/a	0.166	0.058	0.008	
		VOL06A	FEL loading fine from stockpile to stacker conveyor	503.079	7976.164	3.0	1.0	0.7	n/a	n/a	n/a	0.166	0.058	0.008	
		VOL06B	FEL loading fine from stockpile to stacker conveyor	503.054	7975.890	3.0	1.0	0.7	n/a	n/a	n/a	0.166	0.058	0.008	
		VOL007	Stacker to discharge chute on fine stockpile	503.192	7976.162	30.0	0.7	1.2	n/a	n/a	n/a	0.331	0.117	0.015	
	Continuous from July to October	VOL008	Reclaimer to conveyor	503.188	7976.095	20.0	0.7	0.7	n/a	n/a	n/a	0.993	0.350	0.046	
		VOL009	conveyor to transfer point at ship loader	503.247	7976.666	10.0	0.7	0.2	n/a	n/a	n/a	0.993	0.350	0.046	
		VOL010	Discharge chute on Panamax ship	503.267	7976.703	20.0	0.7	0.7	n/a	n/a	n/a	0.993	0.350	0.046	
Material		VOL011	Screen building conveyor to stacker	503.090	7974.866	3.0	0.7	0.2	n/a	n/a	n/a	1.088	0.384	0.050	
Handling <sup>[1]</sup>	Continuous	VOL12A	Stacker to discharge chute on lump ore stockpile	503.166	7974.946	30.0	0.7	0.7	n/a	n/a	n/a	0.218	0.077	0.010	
		VOL12B	Stacker to discharge chute on lump ore stockpile	503.244	7975.212	30.0	0.7	0.7	n/a	n/a	n/a	0.218	0.077	0.010	
		VOL12C	Stacker to discharge chute on lump ore stockpile	503.337	7975.507	30.0	0.7	0.7	n/a	n/a	n/a	0.218	0.077	0.010	
		VOL12D	Stacker to discharge chute on lump ore stockpile	503.421	7975.783	30.0	0.7	0.7	n/a	n/a	n/a	0.218	0.077	0.010	
		VOL12E	Stacker to discharge chute on lump ore stockpile	503.504	7976.038	30.0	0.7	0.7	n/a	n/a	n/a	0.218	0.077	0.010	
	Continuous	VOL13A	Reclaimer to conveyor	503.056	7974.955	20.0	0.7	0.7	n/a	n/a	n/a	0.653	0.230	0.030	
		VOL13B	Reclaimer to conveyor	503.155	7975.272	20.0	0.7	0.7	n/a	n/a	n/a	0.653	0.230	0.030	
		VOL13C	Reclaimer to conveyor	503.252	7975.587	20.0	0.7	0.7	n/a	n/a	n/a	0.653	0.230	0.030	
	from July to	VOL13D	Reclaimer to conveyor	503.351	7975.908	20.0	0.7	0.7	n/a	n/a	n/a	0.653	0.230	0.030	
	October	VOL13E	Reclaimer to conveyor	503.443	7976.189	20.0	0.7	0.7	n/a	n/a	n/a	0.653	0.230	0.030	
		VOL014	conveyor to transfer point at ship loader	503.669	7976.760	10.0	0.7	0.2	n/a	n/a	n/a	3.264	1.151	0.151	
		VOL015	Discharge chute on Cape Size ship	503.679	7976.794	20.0	0.7	0.7	n/a	n/a	n/a	3.264	1.151	0.151	
Rail Idling	Continuous	RLML_IDLE	Milne Port Rail Idling Volume Source	503.804	7974.983	3.7	0.6	1.7	0.065	0.775	0.334	0.042	0.042	0.042	
Fine Ore Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or	STKPRD	Mobile Equipment	502.992 to 503.044	7974.871 to 7976.34	2.6	9.2	2.4	< 0.001	0.046	0.021	0.002	0.002	0.002	
	anticipated utilization														

Source Type	Operating Hours Modelled	Source ID	Emission Source	UTM X UTM Y		Release Height	Sigma-Y	Sigma-	Short Term Emission Rates (g/s)						
		Source ID		(km)	(km) (km)	(m)	(m)	Z (m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>	
	rates														
	Continuous	•	Vehicle Road Dust	-					n/a	n/a	n/a	9.998	2.217	0.202	
	For 1 hour every day		Grading Dust						n/a	n/a	n/a	1.081	0.648	0.033	
Tote Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	TOTEML	Mobile Equipment	503.218 to 509.857	7975.954 to 7968.061	4.3	7.4	4.0	< 0.001	0.033	0.014	0.002	0.002	0.002	
	For 1 hour every day		Grading Dust						n/a	n/a	n/a	6.992	4.195	0.217	

Note:

<sup>[1]</sup> The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 3.3 m/s.

Table A4: Source Parameters and Emission Rates for Point Sources Modelled at the Mine Site

	Operating					Stack	Stack	Exit	Exhaust		Short Ter	rm Emiss	ion Rate	s (g/s)	
Source Type	Hours Modelled	Source ID	Emission Source	UTM X (km)	UTM Y (km)	Height (m)	Inner Diameter (m)	Velocity (m/s)	Temperature (K)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	<b>PM</b> <sub>10</sub>	PM <sub>2.5</sub>
		BGHOUS1	Primary Crusher Plant Baghouse	563.490	7913.434	25.0	1.6	18.4	293	n/a	n/a	n/a	0.371	0.371	0.167
		SCBAG1	Secondary Crusher Baghouse	563.367	7913.273	44.0	1.0	21.2	293	n/a	n/a	n/a	0.167	0.167	0.075
		TTRST1	Transfer Tower Building 5130.101	562.604	7912.317	25.0	0.5	59.0	293	n/a	n/a	n/a	0.114	0.114	0.051
Baghouses	Continuous	TTRST2	Transfer Tower 5130.102 Building Baghouse	562.552	7912.259	25.0	0.6	19.6	293	n/a	n/a	n/a	0.056	0.056	0.025
		TTRST3	Transfer Tower 5130.103 Baghouse	561.889	7912.850	20.0	0.6	11.0	293	n/a	n/a	n/a	0.035	0.035	0.016
		TTRST4	Transfer Tower 5130.104 Baghouse	561.940	7912.907	20.0	1.3	2.5	293	n/a	n/a	n/a	0.035	0.035	0.016
		TRLST1	Train Loading Building Baghouse	562.401	7912.081	42.0	0.6	20.1	293	n/a	n/a	n/a	0.057	0.057	0.026
		GEN1	Power Plant 1.35MW-1	561.201	7913.273	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		GEN2	Power Plant 1.35MW-2	561.209	7913.268	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		GEN3	Power Plant 1.35MW-3	561.216	7913.262	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
Generators	Continuous	GEN4	Power Plant 1.35MW-4	561.222	7913.258	4.8	0.5	32.3	749	< 0.001	2.750	0.538	0.036	0.036	0.036
		PWST1	Power Plant 6MW-1	561.508	7913.129	30.0	1.0	15.4	613	0.004	19.400	1.200	0.082	0.082	0.082
		PWST2	Power Plant 6MW-2	561.533	7913.111	30.0	1.0	15.4	613	0.004	19.400	1.200	0.082	0.082	0.082
		PWST3	Power Plant 6MW-3	561.500	7913.074	30.0	1.0	15.4	613	0.004	19.400	1.200	0.082	0.082	0.082
In sin austa	Every day	INCIN1	Incinerator Stack	558.449	7914.780	11.0	0.8	7.6	1473	< 0.001	0.061	0.003	0.024	0.024	0.024
Incinerators	4am till midnight	INCIN2	Incinerator Stack	558.452	7914.795	11.0	0.8	7.6	1473	< 0.001	0.061	0.003	0.024	0.024	0.024

Table A5: Source Parameters and Emission Rates for Area Sources Modelled at the Mine Site

				итм х	UTM Y	Release		Sigma-Z		Short Te	erm Emi:	ssion Rat	es (g/s)	
Source Type	Operating Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	Area (m²)	(m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
Ore Pit	Continuous, with activity levels based on annual tonnages and equipment sizes, and/or anticipated utilization rates.	PIT	Ore pit	563.235	7914.727	3.0	125387	0.5	0.014	5.626	0.326	0.163	0.163	0.096
	For 1 hour per day and 275 days per year	BLAST	Ore pit	563.235	7914.727	4.3	125387	4.0	n/a	n/a	n/a	10.527	5.474	0.316
Waste Pit	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	WASTE	Waste pit	563.069	7916.178	3.0	298153	0.5	< 0.001	0.036	0.016	0.367	0.275	0.040
Stockpiles	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	PROD1	Product Stockpile 1	562.112	7912.721	3.0	9867	0.5	< 0.001	0.138	0.009	0.003	0.003	0.003
Primary Crusher	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	PRIMCRUSH	Dozer at Steensby primary crusher	563.559	7913.444	3.0	1191	0.5	< 0.001	0.036	0.016	0.367	0.275	0.040
Frost Fighters	Continuous from November to April, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	FROST_winter	Frost fighters	561.441	7913.177	1.0	90319	0.5	0.019	1.097	0.491	0.052	0.052	0.050
Other Diesel Engines	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	FROST_yr	Other diesel engines near camp	561.441	7913.177	1.0	90319	0.5	0.002	0.111	0.050	0.005	0.005	0.005
Dozing	Continuous			Em	iissions were	included in Pl	T, WASTE, PRIM	ICRUSH						
Drilling	Continuous				Emis	sions were inc	luded in PIT							

Table A6: Source Parameters and Emission Rates for Volume Sources Modelled at the Mine Site

Source Type	Operating	Caurea IB	Facinity Course	UTM X	<b>UTM Y</b>	Release	Sigma-	Sigma-		Short 1	Term Emi	ssion Rate	s (g/s)	
	Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	Y (m)	Z (m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
		VOL001	Tripper Conveyor to Diverter Gate	562.522	7912.412	9.3	0.7	0.7	n/a	n/a	n/a	2.129	0.751	0.099
		VOL002	Diverter Gate Chute to conveyor drop operation	562.504	7912.429	2.0	0.7	0.7	n/a	n/a	n/a	1.064	0.375	0.049
		VOL003	Diverter Gate Chute to mobile stacker	562.466	7912.455	9.5	0.7	0.7	n/a	n/a	n/a	1.064	0.375	0.049
		VOL004	Mobile Stacker to stockpile drop operation	562.439	7912.437	13.5	0.7	0.7	n/a	n/a	n/a	1.064	0.375	0.049
		VOL005	Tripper Conveyor to Mobile Stacker/Reclaimer drop	562.086	7912.694	9.0	0.7	0.7	n/a	n/a	n/a	2.129	0.751	0.099
		VOL006	Mobile Stacker/Reclaimer to Stockpile	562.093	7912.699	15.0	0.7	0.7	n/a	n/a	n/a	2.129	0.751	0.099
		VOL007	Stockpile to Mobile Stacker/Reclaimer Operation	562.081	7912.691	15.0	0.7	0.7	n/a	n/a	n/a	2.129	0.751	0.099
Make with the matter of 11	Cartiana	VOL008	Mobile Stacker/Reclaimer from Stockpile to Conveyor	562.099	7912.683	2.0	0.7	0.7	n/a	n/a	n/a	2.129	0.751	0.099
Material Handling <sup>[1]</sup>	Continuous	VOL009	Stockpile to Mobile Reclaimer Operation	561.817	7912.930	15.0	0.7	0.7	n/a	n/a	n/a	1.064	0.375	0.049
		VOL010	Mobile Reclaimer to Conveyor drop	561.844	7912.906	2.0	0.7	0.7	n/a	n/a	n/a	1.064	0.375	0.049
		VOL011	Haul trucks dumping at Steensby crusher	563.536	7913.430	4.5	1.0	0.7	n/a	n/a	n/a	2.129	0.751	0.099
		VOL012	Trucks dumping at ROM pile	561.690	7912.911	4.5	1.0	0.7	n/a	n/a	n/a	1.419	0.500	0.066
		VOL013	Crusher conveyor dropping material onto ROJ pile	561.463	7912.825	10.0	0.7	0.7	n/a	n/a	n/a	1.419	0.500	0.066
		VOL014	FEL dumping into rail cars	561.380	7912.766	3.0	1.0	0.7	n/a	n/a	n/a	1.419	0.500	0.066
		VOL015	Shovel dumping into trucks at pit	563.421	7914.860	4.5	1.0	0.7	n/a	n/a	n/a	9.224	3.252	0.428
		VOL016	Trucks dumping at the waste rock pile	562.974	7916.531	4.5	1.0	0.7	n/a	n/a	n/a	5.676	2.001	0.263
Rail Idling	Continuous	RLMR_IDLE	Mary River Rail Idling Volume Source	561.734	7912.512	3.7	0.6	1.7	0.065	0.775	0.334	0.042	0.042	0.042
Ore Crusher	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	CRUSHFEL	crusher for Milne material - tailpipe emiss from FEL	561.535	7912.860	3.0	1.0	1.4	< 0.001	0.029	0.013	0.279	0.029	0.005
Rail Car Loading	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	VOL14FEL	FEL dumping into railcars	561.380	7912.766	3.0	1.0	1.4	0.001	0.526	0.025	0.009	0.009	0.008
Haul Roads	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or	HAUL	Mobile Equipment	561.722 to 562.993	7912.962 to 7916.476	5.5	20.0	5.1	0.055	22.679	1.311	0.389	0.389	0.378

Source Type	Operating			итм х	<b>UTM Y</b>	Release	Sigma-	Sigma-		Short 1	erm Emi	ssion Rates	s (g/s)	
	Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	Y (m)	Z (m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
	anticipated utilization rates													
	Continuous		Vehicle Road Dust						n/a	n/a	n/a	205.196	45.495	4.136
	For 1 hour every day		Grading Dust						n/a	n/a	n/a	29.006	17.404	0.899
Tote Road	Continuous, with activity levels based on annual tonnages, equipment sizes, and/or anticipated utilization rates	TOTEMR	Mobile Equipment	562.018 to 552.512	7912.839 to 7915.167	4.3	7.4	4.0	0.002	0.099	0.043	0.005	0.005	0.005
	For 1 hour every day		Grading Dust						n/a	n/a	n/a	40.642	24.385	1.260

#### Note:

<sup>[1]</sup> The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 3.3 m/s.

Table A7: Source Parameters and Emission Rates for Area Sources Modelled for the Northern Transportation Corridor

Source	Operating			итм х	UTM Y	Release	Area	Sigma-	Short Term Emission Rates (g/s)					
Туре	Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	(m²)	Z (m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
	Cantinuaus	QUARRY_D	Quarry area diesel equipment	508.660	7969.924	3.0	450285	0.5	0.002	0.111	0.037	0.009	0.005	0.004
	Continuous	QUARRY_F	Quarry area frost fighters	508.660	7969.924	1.0	450285	0.5	< 0.001	0.055	0.026	0.005	0.003	0.003
Quarry	For 1 hour per day and 275 days per year	QUARRY_B	Quarry area blasting	508.660	7969.924	4.3	450285	4.0	n/a	n/a	n/a	0.549	0.285	0.016
	Continuous	QUARRY_P	Quarry area processing - drilling and crushing	508.660	7969.924	1.0	450285	0.5	n/a	n/a	n/a	0.051	0.007	< 0.001
		BED_D	Rail bed diesel equipment	517.266	7962.035	3.0	29963	0.5	0.002	0.107	0.048	0.010	0.005	0.005
D-11 D-4	Constitution	BED_F	Rail bed area frost fighters	517.266	7962.035	1.0	29963	0.5	< 0.001	0.055	0.026	0.005	0.003	0.003
Rail Bed	Continuous	BED_Doz	Rail bed area dozing	517.266	7962.035	2.0	29963	1.0	n/a	n/a	n/a	0.476	0.357	0.050
		BED_grad	Rail bed area grading	517.266	7962.035	1.0	29963	0.5	n/a	n/a	n/a	0.597	0.358	0.019

Table A8: Source Parameters and Emission Rates for Volume Sources Modelled for the Northern Transportation Corridor

	Operating			итм х	UTM Y	Release		Sigma-Z		-	Emission	Rates (g/s	5)	
Source Type	Hours Modelled	Source ID	Emission Source	(km)	(km)	Height (m)	Sigma-Y (m)	(m)	SO <sub>2</sub>	NO <sub>X</sub>	со	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
		VOL001	Crusher conveyor dropping material onto pile	508.489	7970.445	10.0	0.7	0.7	n/a	n/a	n/a	0.023	0.008	0.001
Material Handling <sup>[1]</sup>	Continuous	VOL002	FEL dumping into haul trucks	508.489	7970.445	3.0	1.0	0.7	n/a	n/a	n/a	0.023	0.008	0.001
		VOL003	Haul trucks dumping material at rail bed area	517.119	7962.239	4.5	1.0	0.7	n/a	n/a	n/a	0.023	0.008	0.001
Rail Bed Road	Continuous	RAILBCONS	Mobile Equipment	508.429 to 517.419	7970.165 to 7961.857	5.5	7.4	5.1	0.005	2.764	0.129	0.045	0.045	0.044
	Continuous		Vehicle Road Dust						n/a	n/a	n/a	6.913	1.533	0.139
Take Based	Continuous	TOTECONS	Mobile Equipment	506.415	7971.347	4.2	7.4	4.0	0.011	0.647	0.389	0.031	0.031	0.030
Tote Road	Continuous	TOTECONS	Vehicle Road Dust	to 519.209	to 7958.154	4.3	7.4	4.0	n/a	n/a	n/a	124.277	27.554	2.505
	For 1 hour per day		Grading Dust						n/a	n/a	n/a	31.442	18.865	0.975

Note

<sup>[1]</sup> The material handling emissions depend on hourly wind speeds and the emission rates provided here are based on an average wind speed of 2.7 m/s.



2013 EPA Tier 2 Exhaust Emission

**Compliance Statement** 1500DQGAF

**Stationary Emergency** 60 Hz Diesel Generator Set

#### Compliance Information:

The engine used in this generator set complies with Tier 2 emissions limit of U.S. EPA New Source Performance Standards for stationary emergency engines under the provisions of 40 CFR 60 Subpart IIII when tested per ISO8178 D2.

Engine Manufacturer:

**EPA Certificate Number:** 

Effective Date: Date Issued:

EPA Engine Family (Cummins Emissions Family):

Cummins Inc

DCEXL050.AAD-025

05/01/2012 05/01/2012

DCEXL050.AAD (D283)

**Engine Information:** 

Model:

QSK50-G5 NR2

Engine Nameplate HP:

4 Cycle, 60°V, 16 Cylinder Diesel Type:

Aspiration: Turbocharged and CAC

Emission Control Device:

Electronic Control

Bore:

6.25 in. (159 mm)

Stroke: Displacement: 6.25 in. (159 mm) 3067cu. in. (50.2 liters)

Compression Ratio:

15.0:1

Diesel Fuel Emission Limits

D2 Cycle Exhaust Emissions	Gram	Grams per BHP-hr			s per kl	per kWm-hr	
	NOx + NMHC	<u>co</u>	<u>PM</u>	NOx +	co	PM	
Test Results - Diesel Fuel (300-4000 ppm Sulfur)	4.6	0.9	0.06	6.1	1.2	0.08	
EPA Emissions Limit	4.8	2.6	0.15	6.4	3.5	0.20	
Test Results - CARB Diesel Fuel (<15 ppm Sulfur)	4.2	0.9	0.05	5.6	1.2	0.07	
CARB Emissions Limit	4.8	2.6	0.15	6.4	3.5	0.20	

The CARB emission values are based on CARB approved calculations for converting EPA (500 ppm) fuel to CARB (15 ppm) fuel. Test Methods: EPA/CARB Nonroad emissions recorded per 40CFR89 (ref. ISO8178-1) and weighted at load points prescribed in Subpart E. Appendix A for Constant Speed Engines (ref. ISO8178-4, D2)

Diesel Fuel Specifications: Cetane Number: 40-48, Reference: ASTM D975 No. 2-D.

Reference Conditions: Air Inlet Temperature: 25°C (77°F), Fuel Inlet Temperature: 40°C (104°F). Barometric Pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains H2O/lb) of dry air; required for NOx correction, Restrictions: Intake Restriction set to a maximum allowable limit for clean filter; Exhaust Back Pressure set to a maximum allowable limit.

Tests conducted using alternate test methods, instrumentation, fuel or reference conditions can yield different results. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.



# Diesel generator set QSK50 series engine

1135 kW-1500 kW 60 Hz EPA emissions

#### Description

Cummins Power Generation commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary standby and prime power applications.

#### **Features**

**Cummins® heavy-duty engine** - Rugged 4-cycle, industrial diesel delivers reliable power, low emissions and fast response to load changes.

**Alternator** - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads and fault clearing short-circuit capability.





**Permanent magnet generator (PMG)** - Offers enhanced motor starting and fault clearing short-circuit capability.

Control system - The PowerCommand<sup>®</sup> digital control is standard equipment and provides total genset system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry<sup>™</sup> protective relay, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance.

**Cooling system** - Standard and enhanced integral set-mounted radiator systems, designed and tested for rated ambient temperatures, simplifies facility design requirements for rejected heat.

**NFPA** - The genset accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

**Warranty and service** - Backed by a comprehensive warranty and worldwide distributor network.

	Standby rating	Prime rating	Continuous rating	Emissions compliance	Data sheets
Model	60 Hz kW (kVA)	60 Hz kW (kVA)	60 Hz kW (kVA)	EPA	60 Hz
DQGAE	1250 (1563)	1135 (1419)	1000 (1250)	EPA Tier 2	D-3488
DQGAF	1500 (1875)	1365 (1706)	1100 (1375)	EPA Tier 2	D-3489

#### **Generator set specifications**

Governor regulation class	ISO 8528 Part 1 Class G3
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
Radio frequency emissions compliance	IEC 801.2 through IEC 801.5; MIL STD 461C, Part 9

#### **Engine specifications**

Bore	159 mm (6.25 in)
Stroke	159 mm (6.25 in)
Displacement	50.3 litres (3067 in <sup>3</sup> )
Configuration	Cast iron, V 16 cylinder
Battery capacity	1800 amps minimum at ambient temperature of 0 °C (32 °F)
Battery charging alternator	55 amps
Starting voltage	24 volt, negative ground
Fuel system	Cummins' Modular Common Rail System
Fuel filter	Two stage spin-on fuel filter and water separator system. Stage 1 has a three element 7 micron filter and Stage 2 has a three element 3 micron filter.
Air cleaner type	Dry replaceable element
Lube oil filter type(s)	Four spin-on, combination full flow filter and bypass filters
Standard cooling system	High ambient cooling system

#### Alternator specifications

Design	Brushless, 4 pole, drip proof, revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible disc
Insulation system	Class H
Standard temperature rise	125 °C standby / 105 °C prime
Exciter type	PMG (permanent magnet generator)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform total harmonic distortion	< 5% no load to full linear load, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50 per NEMA MG1-22.43
Telephone harmonic factor (THF)	<3

#### Available voltages

#### 60 Hz line-neutral/line-line

- 220/380 • 240/416
- 255/440
- 277/480 • 347/600
- 2400/4160

Note: Consult factory for other voltages.

#### Generator set options and accessories

#### Engine

- 208/240/480 V thermostatically controlled coolant heater for ambient above and below 4.5 °C (40 °F) Dual 120/208/240/480 V
- 300 W lube oil heaters
- ☐ Heavy duty air cleaner Triplex fuel filter

#### Alternator

- ☐ 80 °C rise
- 105 °C rise
- ☐ 125 °C rise
- ☐ 150 °C rise
- ☐ 120/240 V 300 W anticondensation heater
- □ Increased motor starting capabilities

#### Control panel

- PowerCommand 3.3
- ☐ Multiple language support ☑ 120/240 V 100 W control
- anti-condensation heater Exhaust pyrometer
- Ground fault indication
- Remote annunciator panel Paralleling relay package
- Shutdown alarm relay
- package Audible engine shutdown
- alarm AC output analog meters (bargraph

#### **Exhaust system**

- ☐ Industrial grade exhaust silencer
- ☐ Residential grade exhaust silencer
- Critical grade exhaust silencer
- ☐ Exhaust packages

#### **Cooling system**

- ☐ Remote cooling
- ☐ Enhanced high ambient temperature (50 °C)

#### Generator set

Battery

Is silencer supplied by Cummins or Vibra Sil ?.

- Battery charger
- ☐ Bottom entry chute
- ☐ Circuit breaker skid mounted up to 3000 Amp
- ☐ Circuit breaker auxiliary and trip
- contacts ☐ IBC and OSHPD seismic
- certification ☐ In-skid AVM
- LV and MV entrance box
- ☐ Manual language English, French and Spanish
- □ Spring isolators
- 2 year warranty
- ☐ 5 year warranty
- ☐ 10 year major components warranty

Note: Some options may not be available on all models - consult factory for availability.

#### PowerCommand 3.3 Control System



An integrated microprocessor based generator set control system providing voltage regulation, engine protection, alternator protection, operator interface and isochronous governing. Refer to document S-1570 for more detailed information on the control.

**AmpSentry** – Includes integral AmpSentry protection, which provides a full range of alternator protection functions that are matched to the alternator provided.

**Power management** – Control function provides battery monitoring and testing features and smart starting control system.

**Advanced control methodology** – Three phase sensing, full wave rectified voltage regulation, with a PWM output for stable operation with all load types.

**Communications interface** – Control comes standard with PCCNet and Modbus interface.

Regulation compliant – Prototype tested: UL, CSA and CE compliant.

**Service** - InPower<sup>TM</sup> PC-based service tool available for detailed diagnostics, setup, data logging and fault simulation.

**Easily upgradeable** – PowerCommand controls are designed with common control interfaces.

**Reliable design** – The control system is designed for reliable operation in harsh environment.

Multi-language support

#### **Operator panel features**

#### Operator/display functions

- Displays paralleling breaker status
- · Provides direct control of the paralleling breaker
- 320 x 240 pixels graphic LED backlight LCD
- Auto, manual, start, stop, fault reset and lamp test/panel lamp switches
- Alpha-numeric display with pushbuttons
- LED lamps indicating genset running, remote start, not in auto, common shutdown, common warning, manual run mode, auto mode and stop

#### **Paralleling control functions**

- · First Start Sensor System selects first genset to close to bus
- Phase Lock Loop Synchronizer with voltage matching
- · Sync check relay
- · Isochronous kW and kVar load sharing
- · Load govern control for utility paralleling
- · Extended Paralleling (baseload/peak shave) Mode
- Digital power transfer control, for use with a breaker pair to provide open transition, closed transition, ramping closed transition, peaking and base load functions,

#### Alternator data

- · Line-to-neutral and line-to-line AC volts
- · 3-phase AC current
- Frequency
- · kW, kvar, power factor kVA (three phase and total)

#### Engine data

- DC voltage
- · Engine speed
- · Lube oil pressure and temperature
- · Coolant temperature
- · Comprehensive FAE data (where applicable)

#### Other data

- · Genset model data
- · Start attempts, starts, running hours, kW hours
- Load profile (operating hours at % load in 5% increments)
- · Fault history
- Data logging and fault simulation (requires InPower)

#### Standard control functions

#### Digital governing

- · Integrated digital electronic isochronous governor
- Temperature dynamic governing

#### Digital voltage regulation

- · Integrated digital electronic voltage regulator
- 3-phase, 4-wire line-to-line sensing
- · Configurable torque matching

#### **AmpSentry AC protection**

- AmpSentry protective relay
- Over current and short circuit shutdown
- Over current warning
- · Single and three phase fault regulation
- Over and under voltage shutdown
- Over and under frequency shutdown
- · Overload warning with alarm contact
- · Reverse power and reverse var shutdown
- Field overload shutdown

#### **Engine protection**

- Battery voltage monitoring, protection and testing
- Overspeed shutdown
- · Low oil pressure warning and shutdown
- · High coolant temperature warning and shutdown
- · Low coolant level warning or shutdown
- Low coolant temperature warning
- · Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Cranking lockout
- Sensor failure indication
- · Low fuel level warning or shutdown
- Fuel-in-rupture-basin warning or shutdown
- Full authority electronic engine protection

#### **Control functions**

- · Time delay start and cool down
- · Real time clock for fault and event time stamping
- · Exerciser clock and time of day start/stop
- · Data logging
- Cycle cranking
- Load shed
- · Configurable inputs and outputs (4)
- · Remote emergency stop

#### **Options**

Auxiliary output relays (2)

#### Emergency standby power (ESP):

Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

#### Limited-time running power (LTP):

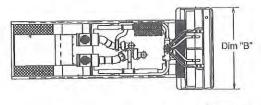
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

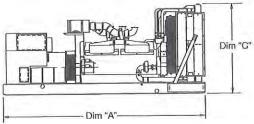
#### Prime power (PRP):

Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

#### Base load (continuous) power (COP):

Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789. DIN 6271 and BS 5514.





This outline drawing is for reference only. See respective model data sheet for specific model outline drawing number.

#### Do not use for installation design

Model	Dim "A" mm (in.)	Dim "B" mm (in.)	Dim "C" mm (in.)	Set Weight* dry kg (lbs)	Set Weight* wet kg (lbs)
DOGAE	6381 (251)	2285 (90)	2474 (97)	11293 (24897)	11926 (26292)
DQGAF	6381 (251)	2285 (90)	2474 (97)	11551 (25465)	12184 (26861)

\*Note: Weights represent a set with standard features. See outline drawings for weights of other configurations.

#### Codes and standards

Codes or standards compliance may not be available with all model configurations - consult factory for availability.



This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.



The generator set is available listed to UL 2200 for all 60 Hz low voltage models, Stationary Engine Generator Assemblies. The PowerCommand control is Listed to UL 508 - Category NITW7 for U.S. and Canadian usage. Circuit breaker assemblies are UL 489 Listed for 100% continuous operation and also UL 869A Listed Service Equipment.



The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins Power Generation products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.

U.S. EPA

Engine certified to Stationary Emergency U.S. EPA New Source Performance Standards, 40 CFR 60 subpart IIII Tier 2 exhaust emission levels. U.S. applications must be applied per this EPA regulation.



All low and medium voltage models are CSA certified to product class 4215-01.

International Building Code The genset package is certified for seismic application in accordance with the following International Building Code: IBC2000, IBC2003, IBC2006, and IBC2009.

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

North America 1400 73rd Avenue N.E. Minneapolis, MN 55432 USA

Phone 763 574 5000 Fax 763 574 5298

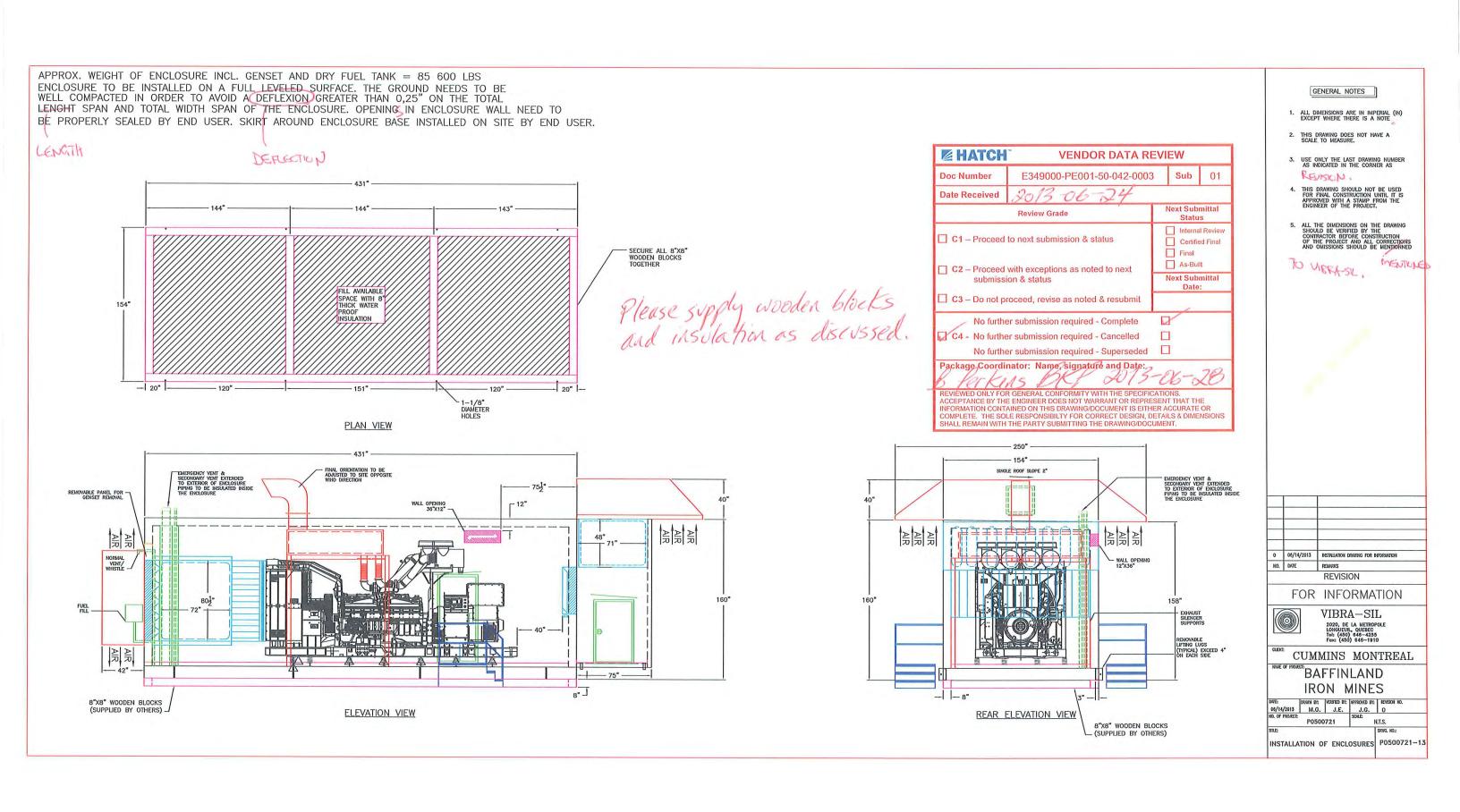
#### Our energy working for you."

©2012 Cummins Power Generation Inc. All rights reserved.

Cummins Power Generation and Cummins are registered trademarks of Cummins Inc. PowerCommand, AmpSentry, InPower and "Our energy working for you." are trademarks of Cummins Power Generation. Other company, product, or service names may be trademarks or service marks of others. Specifications are subject to change without notice.

S-1614a (8/12)





# ELECTRIC POWER - Technical Spec Sheet STANDARD

3516C

2050 ekW/ 2562 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor



Rating Type: CONTINUOUS

Emissions: U.S. EPA Certified for Stationary Emergency Use Only (Tier 2 Nonroad Equivalent Emission Standards)

3516C

2050 ekW/ 2562 kVA 60 Hz/ 1800 rpm/ 480 V



Image shown may not reflect actual configuration

	Metric	English
Package Performance		
	2050 6	ol/\//
Genset Power Rating with Fan @ 0.8 Power Factor		
Genset Power Rating	2562	I
Aftercooler (Separate Circuit)	N/A	N/A
Fuel Consumption		
100% Load with Fan	549.3 L/hr	145.1 gal/hr
75% Load with Fan	435.6 L/hr	115.1 gal/hr
50% Load with Fan	316.8 L/hr	83.7 gal/hr
25% Load with Fan	188.9 L/hr	49.9 gal/hr
Cooling System¹		
Engine Coolant Capacity	233.0 L	61.6 gal
Inlet Air		
Combustion Air Inlet Flow Rate	183.8 m³/min	6491.7 cfm
Max. Allowable Combustion Air Inlet Temp	47 ° C	117 ° F
Exhaust System		
<u> </u>	400.0 % 0	000 5 % 5
Exhaust Stack Gas Temperature	463.6 ° C	866.5 ° F
Exhaust Gas Flow Rate	476.5 m³/min	16826.7 cfm
Exhaust System Backpressure (Maximum Allowable)	6.7 kPa 27.0 in. wate	

# ELECTRIC POWER - Technical Spec Sheet STANDARD



2050 ekW/ 2562 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor



Rating Type: CONTINUOUS Emissions: U.S. EPA Certified for Stationary Emergency
Use Only (Tier 2 Nonroad Equivalent Emission Standards)

Heat Rejection		
Heat Rejection to Jacket Water	739 kW	42021 Btu/min
Heat Rejection to Exhaust (Total)	2092 kW	118949 Btu/min
Heat Rejection to Aftercooler	619 kW	35176 Btu/min
Heat Rejection to Atmosphere from Engine	145 kW	8229 Btu/min
Heat Rejection to Atmosphere from Generator	94 kW	5368 Btu/min

Alternator <sup>2</sup>	
Motor Starting Capability @ 30% Voltage Dip	6419 skVA
Current	3082 amps
Frame Size	1842
Excitation	PM
Temperature Rise	105 ° C

Emissions (Nominal) <sup>3</sup>		
NOx	2038.1 mg/Nm³	4.6 g/hp-hr
CO	124.8 mg/Nm³	0.3 g/hp-hr
HC	49.2 mg/Nm³	0.1 g/hp-hr
PM	11.0 mg/Nm³	0.0 g/hp-hr

#### **DEFINITIONS AND CONDITIONS**

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

# ELECTRIC POWER - Technical Spec Sheet STANDARD

3516C

2050 ekW/ 2562 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor



Rating Type: CONTINUOUS Emissions: U.S. EPA Certified for Stationary Emergency
Use Only (Tier 2 Nonroad Equivalent Emission Standards)

#### **Applicable Codes and Standards:**

AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200, NFPA37, NFPA70, NFPA99, NFPA110, IBC, IEC60034-1, ISO3046, ISO8528, NEMA MG1-22, NEMA MG1-33, 2006/95/EC, 2006/42/EC, 2004/108/EC.

Note: Codes may not be available in all model configurations. Please consult your local Cat Dealer representative for availability.

**CONTINUOUS:**Output available with non-varying load for an unlimited time. Average power output is 70-100% of the continuous power rating. Typical peak demand is 100% of continuous rated ekW for 100% of operating hours.

Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions

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

www.Cat-ElectricPower.com

Performance No.: DM8268-03

Feature Code: 516DE8F

Generator Arrangement: 3723052

Date: 01/05/2017

Source Country: U.S.

The International System of Units (SI) is used in this publication. CAT, CATERPILLAR, their respective logos, ADEM, EUI, S•O•S, "Caterpillar Yellow" and the "Power Edge" trade dress, as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.

#### **DIESEL GENERATOR SET**





Image shown may not reflect actual package.

# PRIME 1360 ekW 1700 kVA 60 Hz 1800 rpm 480 Volts

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

#### **FEATURES**

#### **FUEL/EMISSIONS STRATEGY**

• Low Fuel consumption

#### **DESIGN CRITERIA**

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

#### **FULL RANGE OF ATTACHMENTS**

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

#### SINGLE-SOURCE SUPPLIER

Fully prototype tested with certified torsional vibration analysis available

#### **WORLDWIDE PRODUCT SUPPORT**

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

#### **CAT® 3512B TA DIESEL ENGINE**

- · Reliable, rugged, durable design
- Field-proven in thousands of applications worldwide
- Four-stroke-cycle diesel engine combines consistent performance and excellent fuel economy with minimum weight

#### **CAT SR5 GENERATOR**

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

#### **CAT EMCP 4 CONTROL PANELS**

- · Simple user friendly interface and navigation
- Scalable system to meet a wide range of customer needs
- Integrated Control System and Communications Gateway

60 Hz 1800 rpm 480 Volts



# FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	Single element canister type air cleaner	[] Dual element & heavy duty air cleaners
	Service indicator	[] Air inlet adapters & shut-off
Cooling	Radiator with guard	[] Radiator duct flange
	Coolant drain line with valve	[] Jacket water heater
	Fan and belt guards	
	Cat® Extended Life Coolant*	
Exhaust	Dry exhaust manifold	[] Mufflers and Silencers
	Flanged faced outlets	[] Stainless steel exhaust flex fittings
		[] Elbows, flanges, expanders & Y adapters
Fuel	Secondary fuel filters	[] Water separator
	Fuel priming pump	[] Duplex fuel filter
	Flexible fuel lines	
	• Fuel cooler*	
Generator	Class H insulation	[] Oversize & premium generators
	Cat digital voltage regulator (CDVR) with kVAR/PF	[] Winding temperature detectors
	control, 3-phase sensing	[] Bearing temperature detectors
	Reactive droop	[] Anti-condensation heaters
Power Termination	Bus bar (NEMA or IEC mechanical lug holes)	[] Circuit breakers, UL listed, 3 pole with shunt
	Top cable entry	trip,100% rated, manual or electrically operated []
		Circuit breakers, IEC compliant, 3 or 4 pole with shunt
		trip, manual or electrically operated
		[] Bottom cable entry
		[] Power terminations can be located on the right, left
	ADELATIVA	and/or rear as an option.
Governor	• ADEM™ 3	[] Load share module
Control Panels	• EMCP 4.2	[] Option for right or left mount UIP
	User Interface panel (UIP) - wall mounted	[ ] Local & remote annunciator modules
	AC & DC customer wiring area (right side)	[ ] Digital I/O Module
	Emergency stop pushbutton	[] Generator temperature monitoring & protection
		[] Remote monitoring software
Lube	Lubricating oil and filter	[ ] Oil level regulator
	Oil drain line with valves	[] Deep sump oil pan
	• Fumes disposal	[] Electric & air prelube pumps
	Gear type lube oil pump	[] Manual prelube with sump pump
		[] Duplex oil filter
Mounting	• Rails - Engine / generator / radiator mounting	[] Isolator removal
	Rubber anti-vibration mounts (shipped loose)	[] Spring-type vibration isolator (shipped loose)
ai. (a		[] IBC Isolators
Starting/Charging	• 24 volt starting motor(s)	[] Battery chargers (5 or 10 amp)
	Batteries with rack and cables	[] 45 amp charging alternator
	Battery disconnect switch	[] Oversize batteries
		[] Ether starting aid
		[] Heavy duty starting motors
		[ ] Barring device (manual)

60 Hz 1800 rpm 480 Volts



#### **SPECIFICATIONS**

#### **CAT GENERATOR**

Cat Generator
Frame size
ExcitationInternal Excitation
Pitch
Number of poles4
Number of bearings Single bearing
Number of Leads006
InsulationUL 1446 Recognized Class H with
tropicalization and antiabrasion InsulationClass F with tropicalization and antiabrasion
- Consult your Caterpillar dealer for available voltages
IP RatingIP23
AlignmentPilot Shaft
Overspeed capability125
Wave form Deviation (Line to Line)002.00
Voltage regulator3 Phase sensing with selectible
volts/Hz Voltage regulationLess than +/- 1/2% (steady state)
Less than +/- 1% (no load to full load)
Telephone influence factorLess than 50
Harmonic DistortionLess than 5%

#### **CAT DIESEL ENGINE**

3512B TA, V-12, 4-Stroke Water-	cooled Diesel
Bore	170.00 mm (6.69 in)
Stroke	190.00 mm (7.48 in)
Displacement	51.80 L (3161.03 in <sup>3</sup> )
Compression Ratio	14.0:1
Aspiration	TA
Fuel System	Electronic unit injection
Governor Type	ADEM3

#### **CAT EMCP 4 SERIES CONTROLS**

#### EMCP 4 controls including:

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

#### Digital indication for:

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

#### Warning/shutdown with common LED indication of:

- Low oil pressure
- High coolant temperature
- Overspeed
- Emergency stop
- Failure to start (overcrank)
- Low coolant temperature
- Low coolant level

#### Programmable protective relaying functions:

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

#### Communications:

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

#### Compatible with the following:

- Digital I/O module
- Local Annunciator
- Remote CAN annunciator
- Remote serial annunciator

60 Hz 1800 rpm 480 Volts



#### **TECHNICAL DATA**

Open Generator Set 1800 rpm/60 Hz/480 Volts		DM8205
Low Fuel Consumption		
Generator Set Package Performance		
Genset Power rating @ 0.8 pf	1700 kVA	
Genset Power rating with fan	1360 ekW	
Coolant to aftercooler		
Coolant to aftercooler temp max	90 ° C	194 ° F
Fuel Consumption		
100% load with fan	372.3 L/hr	98.4 Gal/hr
75% load with fan	272.1 L/hr	71.9 Gal/hr
50% load with fan	192.8 L/hr	50.9 Gal/hr
Cooling System <sup>1</sup>		
Air flow restriction (system)	0.12 kPa	0.48 in. water
Air flow (max @ rated speed for radiator arrangement)	1501 m³/min	53007 cfm
Engine Coolant capacity with radiator/exp. tank	305.8 L	80.8 gal
Engine coolant capacity	156.8 L	41.4 gal
Radiator coolant capacity	149.0 L	39.4 gal
Inlet Air		
Combustion air inlet flow rate	120.7 m³/min	4262.5 cfm
Exhaust System		
Exhaust stack gas temperature	476.5 ° C	889.7 ° F
Exhaust gas flow rate	318.9 m³/min	11261.9 cfm
Exhaust flange size (internal diameter)	203.2 mm	8.0 in
Exhaust system backpressure (maximum allowable)	6.7 kPa	26.9 in. water
Heat Rejection		
Heat rejection to coolant (total)	620 kW	35259 Btu/min
Heat rejection to exhaust (total)	1412 kW	80300 Btu/min
Heat rejection to aftercooler	299 kW	17004 Btu/min
Heat rejection to atmosphere from engine	143 kW	8132 Btu/min
Heat rejection to atmosphere from generator	65.6 kW	3730.7 Btu/min
Alternator <sup>2</sup>		
Motor starting capability @ 30% voltage dip	4350 skVA	
Frame	1447	
Temperature Rise	125 ° C	225 ° F
Lube System		
Sump refill with filter	310.4 L	82.0 gal
Emissions (Nominal) <sup>3</sup>		
NOx g/hp-hr	9.42 g/hp-hr	
CO g/hp-hr	1.43 g/hp-hr	
HC g/hp-hr	.43 g/hp-hr	
PM g/hp-hr	.09 g/hp-hr	

<sup>&</sup>lt;sup>1</sup> For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.

<sup>2</sup> UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40 degree C ambient per NEMA MG1-32.

temperature rise is based on a 40 degree C ambient per NEMA MG1-32.

³ Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77°F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 btu/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

60 Hz 1800 rpm 480 Volts



#### RATING DEFINITIONS AND CONDITIONS

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

Prime - Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year. Prime power in accordance with ISO3046. Prime ambients shown indicate ambient temperature at 100% load which results in a coolant top tank temperature just below the alarm temperature.

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

60 Hz 1800 rpm 480 Volts



#### **DIMENSIONS**

Package Dimensions			
Length 5240.6 mm 206.32 in			
Width	2286.0 mm	90 in	
Height	2342.0 mm	92.2 in	
Weight	9072 kg	20,000 lb	

NOTE: For reference only - do not use for installation design. Please contact your local dealer for exact weight and dimensions. (General Dimension Drawing #3466669).

Performance No.: DM8205

Feature Code: 512DE6P

Gen. Arr. Number: 2523804

Source: U.S. Sourced

August 05 2011

www.Cat-ElectricPower.com

© 2011 Caterpillar All rights reserved.

Materials and specifications are subject to change without notice. The International System of Units (SI) is used in this publication.

CAT, CATERPILLAR, their respective logos, "Caterpillar Yellow," the "Power Edge" trade dress, as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.

6

SUMMARY

The following table presents the triplicate test averages for the listed parameters from the EcoWaste Gasifier/Incinerator stacks on October 1, 2 and 3, 2013 and December 13, 14 and 16, 2013.

PARAMETER	Mila	ne Inlet	Mary River	CWS Emission Limits
Particulate (mg/Rm³ @ 11% O <sub>2</sub> ) Particulate (Kg/hr)		24.8 0.078	31.4 0.087	N/A N/A
Hg (ug/Rm <sup>3</sup> @ 11% O <sub>2</sub> ) Hg (g/hr)		<b>0.52</b> 0.0016	1.3 0.0032	<b>20</b> N/A
Flowrate (Rm3/min) *	41.4	(37.7)*	38.9 (36.0)*	N/A
PARAMETER	Milne	Inlet	Mary River	CWS Emission Limits
	Run 1	Runs 2		Limits
PCDD & PCDF TEQ (pg/Rm3 @11% O2)	271	23.8	33.2	80

## \* PCDD Flowrate results

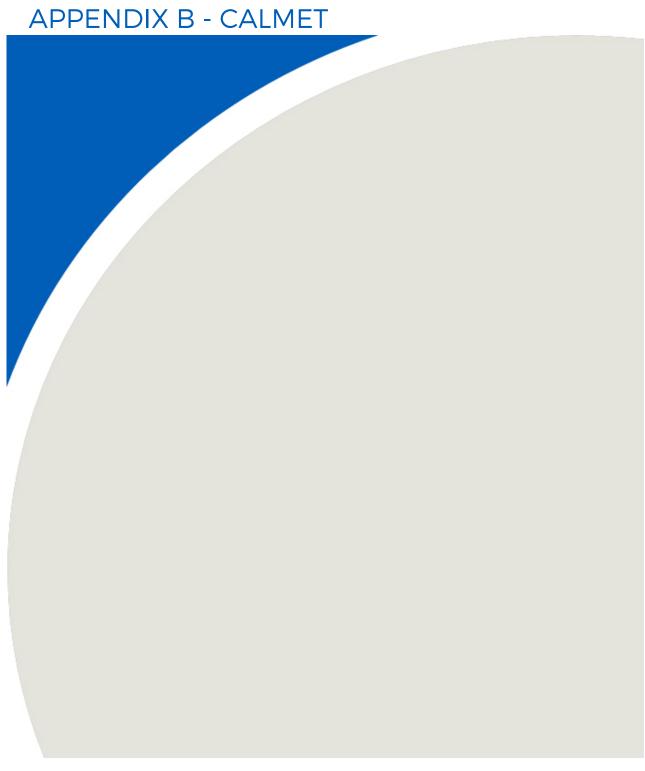
N/A = not applicable See Tables 1 and 2 for individual results

Note: values presented in boldface are results which have CWS permitted limits.

Concentrations and flowrates are expressed at standard conditions of 25°C and 101.3 "KPa (dry).

Rm3 = reference cubic meter







# **B.1 TECHNICAL MODEL OPTIONS**

Following the Guideline for Plume Dispersion Modelling in Newfoundland and Labrador (Government of Newfoundland and Labrador, 2012), most of the switches in CALMET were set to the model defaults, where defaults were applicable. Others were set based on site specific characteristics. CALMET was run in the No Observation (NOOBS) Mode, i.e. the switch NOOBS = 2; no surface, overwater, or upper air observations were used. The model was initialized using MM5 prognostic meteorological model output. The model switches for input groups 5 and 6 are listed in Table B1 and Table B2, respectively. Switches for both model domains, Milne Port and the Mine Site, have been included in the tables.

Table B1: CALMET Switch Settings Group 5 - Wind Field Options and Parameters

		Modelled		
Parameter	Default	Milne Port	Mine Site	Comments
IWFCOD	1	1	1	Default
IFRADJ	1	1	1	Default
IKINE	0	0	1	Selected for site specific
IOBR	0	1	1	Selected for site specific
ISLOPE	1	1	1	Default
IEXTRP	-4	1	1	No extrapolation due to NOOBS mode
ICALM	0	0	0	Default
BIAS	NZ*0	0,0,0,0,0,0,0	0,0,0,0,0,0,0	N/A for NOOBS mode
RMIN2	4	4	4	Default
IPROG	0	14	14	Winds from MM5 are used as initial guess field
IGFMET	0	0	0	Default
LVARY	F	Т	Т	N/A for NOOBS mode
RMAX1	No default	12	12	N/A for NOOBS mode
RMAX2	No default	12	12	N/A for NOOBS mode
RMAX3	No default	12	12	N/A for NOOBS mode
RMIN	0.1	0.1	0.1	Default
TERRAD	No default	30	15	ldentified from main terrain features
R1	No default	12	12	N/A for NOOBS mode
R2	No default	12	12	N/A for NOOBS mode
RPROG	No default	0	0	N/A since IPROG = 14



RWDI#140209 0 March 21,

Parameter	Default	Modelled		Comments
DIVLIM	0.000005	0.000005	0.000005	Default
NITER	50	50	50	Default
NSMTH	2, (mxnz-1)*4	2, 7, 7, 14, 14, 28, 28, 28	2, 7, 7, 14, 14, 28, 28, 28	Default
NINTR2	99	99, 99, 99, 99, 99, 99, 0	99, 99, 99, 99, 99, 99, 0	Default
CRITFN	1	1	1	Default
ALPHA	0.1	0.1	0.1	Default
FEXTR2	NZ*0	0.,0.,0.,0.,0.,0.,0.	0.,0.,0.,0.,0.,0.,0.	Default
NBAR	0	0	0	Default
KBAR	NZ	8	8	Default
XBBAR	No default	0	0	N/A since NBAR = 0
YBBAR	No default	0	0	N/A since NBAR = 0
XEBAR	No default	0	0	N/A since NBAR = 0
YEBAR	No default	0	0	N/A since NBAR = 0
IDIOPT1	0	0	0	Default
ISURFT	-1	-1	-1	Default
IDIOPT2	0	0	0	Default
IUPT	-1	-1	-1	Default
ZUPT	200	200	200	Default
IDIOPT3	0	0	0	Default
IUPWND	-1	-1	-1	Default
ZUPWND	1., 1000.	1.,1000.	1.,1000.	Default
IDIOPT4	0	0	0	Default
IDIOPT5	0	0	0	Default

Table B2: CALMET Switch Settings Group 6 - Mixing Height, Temperature and Precipitation Parameters

Parameter	Default -	Mod	elled	Comments	
		Milne Port	Mine Site	Comments	
CONSTB	1.41	1.41	1.41	Default	
CONSTE	0.15	0.15	0.15	Default	
CONSTN	2400	2400	2400	Default	
CONSTW	0.16	0.16	0.16	Default	
FCORIOL	0.0001	0.0001	0.0001	Default	



RWDI#1402090 March 21, 2018

Parameter	Default	Modelled		Comments	
IAVEZI	1	1	1	Default	
MNMDAV	1	1	1	Default	
HAFANG	30	30	30	Default	
ILEVZI	1	1	1	Default	
IMIXH	1	1	1	Default	
THRESHL	0.05	0.05	0.05	Default	
THRESHW	0.05	0.05	0.05	Default	
ITWPROG	2	1	2	Used prognostic lapse rates	
ILUOC3D	16	16	16	Default	
DPTMIN	0.001	0.001	0.001	Default	
DZZI	200	200	200	Default	
ZIMIN	50	50	50	Default	
ZIMAX	3000	3000	3000	Default	
ZIMINW	50	50	50	Default	
ZIMAXW	3000	3000	3000	Default	
ICOARE	10	10	10	Default	
DSHELF	0	0	0	Default	
IWARM	0	0	0	Default	
ICOOL	0	0	0	Default	
IRHPROG	0	1	1	Used prognostic RH data	
ITPROG	0	2	2	Used prognostic temperature data	
IRAD	1	1	1	Default	
TRADKM	500	30	30	Selected for site specific	
NUMTS	5	2	2	N/A for NOOBS mode	
IAVET	1	1	1	Default	
TGDEFB	-0.0098	-0.0098	-0.0098	Default	
TGDEFA	-0.0045	-0.0045	-0.0045	Default	
JWAT1	No default	999	999	No over-water temperature interpolation used	
JWAT2	No default	999	999	No over-water temperature interpolation used	
NFLAGP	2	2	2	Default	
SIGMAP	100	100	100	Default	
CUTP	0.01	0.01	0.01	Default	



# **B.2 MODEL DOMAINS**

The meteorological domains for Milne Port and the Mine Site were both 40 km x 40 km, and are shown Figure 4 and Figure 5 of the main report, respectively. The horizontal domain resolution was set at 400 m. Eight layers were chosen in the vertical direction, with the tops of the layers set as 20 m, 40 m, 80 m, 180 m, 320 m, 700 m, 1500 m, and 3000 m above ground level.

## **B.3 PROGNOSTIC METEOROLOGY**

Wind fields produced by Version 3.7.4 of the PSU/NCAR mesoscale model (known as MM5) were incorporated into CALMET as an initial guess field (Scire et al., 2000). MM5 is a limited-area, nonhydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulations by solving the fundamental equations of atmospheric motions. When included in this way, the module in CALMET adjusts the initial guess field for kinematic effects of terrain, slope flows, and terrain blocking effects using the finer scaled CALMET terrain data to produce a modified wind field. Initial and boundary conditions for MM5 were derived from the National Center for Atmospheric Research (NCAR) analysis output at a 36-km resolution. MM5 was executed using a 2-way nested paradigm; refining the horizontal grid at each nesting from 36 km down to 12 km. The vertical grid structure is comprised of 32 layers from the ground to 50 mb (approx. 10 km), with 15 levels in the lowest 2000 m. Once the model domain and grid were defined, RWDI acquired and prepared the requisite input data (geophysical fields, initial and boundary conditions, etc.) needed to run MM5.

# B.4 TERRAIN, LAND USE AND GEOPHYSICAL PARAMETERS

Terrain information for the areas surrounding Milne Port and the Mine Site was obtained from Natural Resources Canada's Canadian Digital Elevation Model (CDEM) which has a resolution of 15 m. Land use in both of the CALMET domains is mixed. Both domains are characterized mainly by barren land or tundra, water, and perennial ice/snow. The terrain elevation and land use information used as input into the CALMET model are illustrated for the Milne Port and Mine Site domains in Figure B-1 and Figure B-2 below, respectively.

The CALMET model requires gridded geophysical parameters including surface roughness length, albedo, Bowen ratio, soil heat flux, vegetation leaf area index, and anthropogenic heat flux. Two seasons were specified:

Summer: July to OctoberWinter: November to June



RWDI#1402090 March 21, 2018

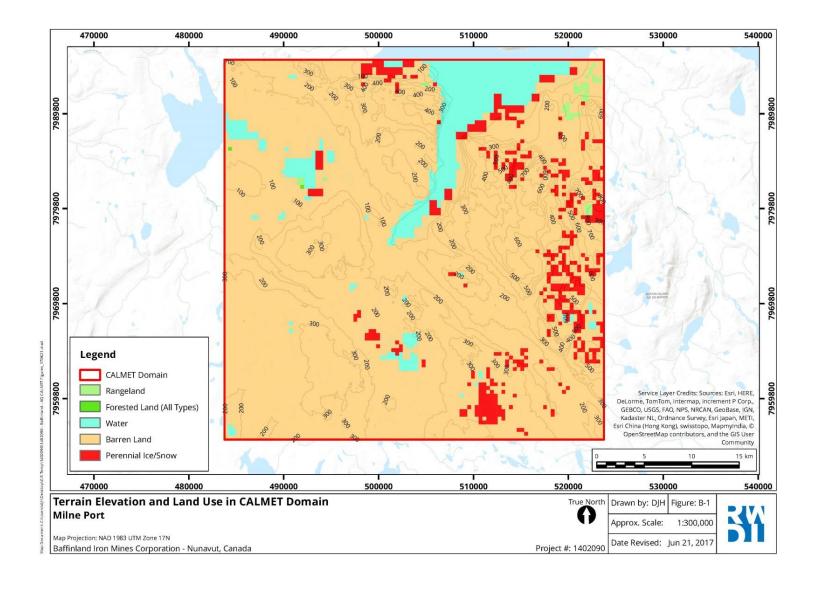
All geophysical parameters were defined by land cover characterization type and seasonal category based on CALMET defaults and guidance in the British Columbia Air Quality Dispersion Modelling Guideline (B.C. Ministry of Environment, 2015), shown in Table B3.

**Table B3: Main Land Use Categories and Associated Geophysical Parameters** 

Season	Land Use Category	Surface Roughness	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (fraction)	Leaf Area Index
	Water	0.001	0.1	0.1	1	0	0
Summer	Barren Land or Tundra Perennial Ice/Snow	0.05	0.2	1.5 0.5	0.15 0.15	0	0
	Water	0.002	0.7	0.5	0.15	0	0
Winter	Barren Land or Tundra Perennial	0.05	0.6	0.5	0.15	0	0.05
	Ice/Snow	0.2	0.7	0.5	0.15	0	0

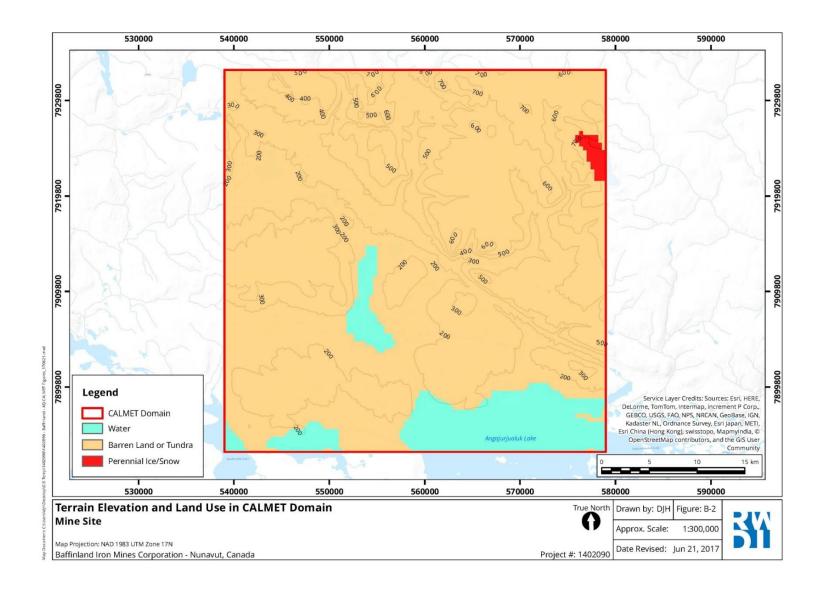






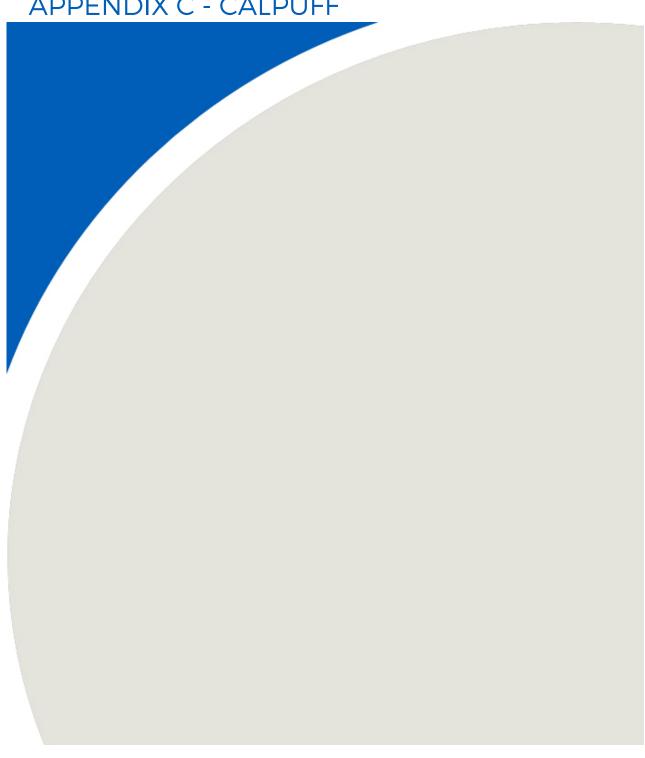


RWDI#1402090 March 21, 2018





# APPENDIX C - CALPUFF





# C.1 TECHNICAL MODEL OPTIONS

All of the switches in CALPUFF were selected following the Guideline for Plume Dispersion Modelling in Newfoundland and Labrador (Government of Newfoundland and Labrador, 2012). The switches for input group 2 (technical options) are listed in Table C1. These switches apply to all three modelled scenarios: Milne Port, Mine Site, and North Railway Construction.

CALPUFF was run with the MESOPUFF II chemistry scheme, which accounts for the chemical transformation of  $SO_2$  and  $NO_X$  into  $SO_4$ ,  $NO_3$  and  $HNO_3$ . In order to predict dustfall and acid deposition, dry and wet deposition of PM, all sulphur species and all nitrogen species were enabled in CALPUFF, for all sources. This also leads to better estimates of the concentrations of suspended PM,  $SO_2$  and  $NO_2$ . Deposition is discussed further in Section C.5.

**Table C1: CALPUFF Switch Settings Group 2 - Technical Options** 

Parameter	Default	Modelled	Comments	
MGAUSS	1	1	Default	
MCTADJ	3	3	Default	
MCTSG	0	0	Default	
MSLUG	0	0	Default	
MTRANS	1	1	Default	
MTIP	1	0 or 1	Stack tip downwash modelled only for vertical release stacks	
MBDW	1	2	PRIME method was used for BPIP	
MSHEAR	0	0	Default	
MSPLIT	0	0	Default	
MCHEM	1	1	Default	
MAQCHEM	0	0	Default	
MWET	1	1	Wet removal modelled	
MDRY	1	1	Dry deposition modelled	
MTILT	0	0	Default	
MDISP	3	2	Dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)	
MTURBVW	3	3	Default	
MDISP2	3	3	Default	
MTAULY	0	0	Default	
MTAUADV	0	0	Default	
MCTURB	1	1	Default	

March 21, 2018



Parameter	Default	Modelled	Comments	
MROUGH	0	0	Default	
MPARTL	1	1	Default	
MTINV	0	0	Default	
MPDF	0	1	PDF is used for dispersion under convective conditions	
MSGTIBL	0	0	Default	
MBCON	0	0	Default	
MSOURCE	0	0	Default	
MFOG	0	0	Default	
MREG	1	0	No checks versus regulatory values are made	

# C.2 MODEL DOMAINS AND RECEPTOR LOCATIONS

The computational grid domains for the Milne Port, Mine Site and Construction scenarios were set to 26 km  $\times$  27 km, 28 km  $\times$  28 km and 21 km  $\times$  21 km, respectively, and are shown in Figure 4, Figure 5 and Figure 6 of the main report.

The following receptor spacing was used for Milne Port:

- 20 m spacing within an area 500 m x 1.7 km centered around the center of the domain
- 50 m spacing within 3 km x 4.2 km
- 250 m spacing within 9 km x 10.2 km
- 500 m spacing within 12 km x 13 km
- 1000 m spacing within 18 km x 19 km

The following receptor spacing was used for the Mine Site:

- 50 m spacing within 4 km x 4 km of the center of the domain
- 250 m spacing within 8 km x 8 km
- 500 m spacing within 12 km x 12 km
- 700 m spacing within 16 km x 16 km
- 1000 m spacing within 20 km x 20 km

The following receptor spacing was used for the Construction Scenario:

- 50 m spacing within 2 km x 2 km of the Tote road segments near the quarry and the rail bed
- 250 m spacing within 4 km x 4 km
- 500 m spacing within 17 km x 17 km

APPENDIX C - CALPUFF ADDENDUM NO. 2 TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT AIR QUALITY MODEL PHASE 2 PROPOSAL MARY RIVER PROJECT RWDI#1402090 March 21, 2018



# C.3 TERRAIN AND ELEVATIONS

Terrain information for the area surrounding the Goose Property was obtained from Natural Resources Canada's Canadian Digital Elevation Model (CDEM) which has a resolution of 15 m. The elevation data were applied in the estimation of base elevations for sources, buildings and receptors, to help the CALPUFF dispersion model account for changes in elevations of the surrounding terrain.

# C.4 BUILDING EFFECTS

The Building Profile Input Program (BPIP) was used to calculate the aerodynamic effects of buildings on emissions from point sources, such as stacks. Output from the BPIP model was used in the CALPUFF dispersion model.

The following buildings were included in the modelling at Milne Port: the waste management facility, emergency response building, accommodation buildings, a number of tanks, and the bodies of the ships while they are at berth and anchor.

The following buildings were included in the modelling at the Mine Site: the primary and secondary crusher buildings, transfer tower buildings, power houses, train loading building, waste management building, and a number of tanks.

No buildings were included in the modelling for the Construction Scenario, as there were no sources that were modelled as point sources.

# C.5 DRY AND WET DEPOSITION

Dustfall is calculated from the dry and wet deposition of particulates: this includes emitted PM, and secondary PM formed from  $SO_4$  and  $NO_3$ . The methodology outlined in the Guideline for Plume Dispersion Modelling in Newfoundland and Labrador was used for modelling emitted PM. PM size fractions of size 0  $\mu$ m to 2.5  $\mu$ m (PM<sub>1</sub>), 2.5  $\mu$ m to 10  $\mu$ m (PM<sub>2</sub>) and 10  $\mu$ m to 30  $\mu$ m (PM<sub>3</sub>) were modelled separately in CALPUFF, because different size fractions are associated with different deposition rates. The particle density of PM was assumed to be 5 g/cm<sup>3</sup> at Milne Port and the Mine Site, and 2 g/cm<sup>3</sup> for the North Railway Construction scenario. Depositions of particles were modelled using the parameters included in Table C2. These parameters were taken from the Guideline for Plume Dispersion Modelling in Newfoundland and Labrador (Government of Newfoundland and Labrador, 2012) and the CALPUFF User's Guide (Scire et.al., 2000).

Acid deposition is calculated from the dry and wet deposition of the particulate  $SO_4$  and  $NO_3$ , and the gases  $SO_2$ ,  $NO_X$ , and  $HNO_3$  (only dry deposition of  $NO_X$ ). The deposition parameters for the particles are in Table C2, and the deposition parameters for the gases are in Table C3. These parameters were taken from the CALPUFF User's Guide (Scire et.al., 2000).



To calculate acid deposition, the resulting mass deposition for each sulphur and nitrogen species was divided by its molecular weight to convert it to a molar quantity. It was then factored to represent the corresponding number of hydrogen ions that would occur in a water solution with that species. The resulting values for all species, for both wet and dry deposition, were then summed to determine the total potential acid input (PAI), expressed in terms of keq/ha/yr where keq refers to the number of equivalent hydrogen ions (1 keq = 1 kmol H+).

**Table C2: Dry and Wet Deposition Parameters of Particles** 

		Dry D	eposition	Wet Deposition		
Species	Mass Me	an Size (µm)	Geometric	Liquid Precipitation	Frozen Precipitation	
Species	Milne Port and Mine SIte	North Railway Construction	Standard Deviation (µm)	Scavenging Coefficient (s <sup>-1</sup> )	Scavenging Coefficient (s <sup>-1</sup> )	
SO <sub>4</sub>	0.48		2.0	1.00E-04	3.00E-05	
NO <sub>3</sub>	0.48		2.0	1.00E-04	3.00E-05	
PM <sub>1</sub>	2.86 1.79		0	1.00E-04	3.00E-05	
PM <sub>2</sub>	11.25	7.09	0	1.00E-04	3.00E-05	
PM <sub>3</sub>	44.79	28.31	0	1.00E-04	3.00E-05	

**Table C3: Dry and Wet Deposition Parameters of Gases** 

Species			Dry Depo	Wet Deposition			
	Diffusivity (cm²/s)	Alpha Star	Reactivity	Mesophyll Resistance (s/cm)	Henry's Law Coefficient (dimensionless)	Liquid Precipitation Scavenging Coefficient (s <sup>-1</sup> )	Frozen Precipitation Scavenging Coefficient (s <sup>-1</sup> )
SO <sub>2</sub>	0.1509	1000	8	0	0.04	3.00E-05	0.00E+00
NOx	0.1656	1	8	5	3.5	-	-
HNO <sub>3</sub>	0.1628	1	18	0	0.00000008	6.00E-05	0.00E+00

# C.6 NO<sub>X</sub> TO NO<sub>2</sub> CHEMISTRY

 $NO_X$  emissions from combustion sources are comprised of NO and  $NO_2$ . Typically, the primary emissions are predominantly in the form of NO with reactions in the atmosphere resulting in the conversion of NO to  $NO_2$ . The ozone limiting method (OLM), used in this assessment, assumes that the conversion of NO to  $NO_2$  is mainly driven by reaction with tropospheric ozone,  $O_3$ . The hourly average concentration of ozone was assumed to be 0.05 ppm and the daily average concentration (applied to the annual period as well) was assumed to be 0.026 ppm. These are the same values that were used in the FEIS. The 0.026 ppm value corresponds to the 30-day

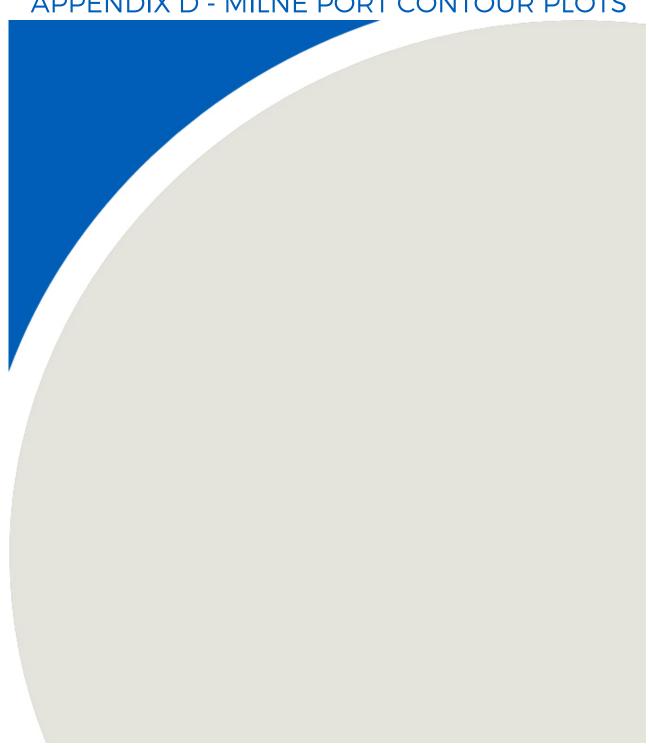
March 21, 2018

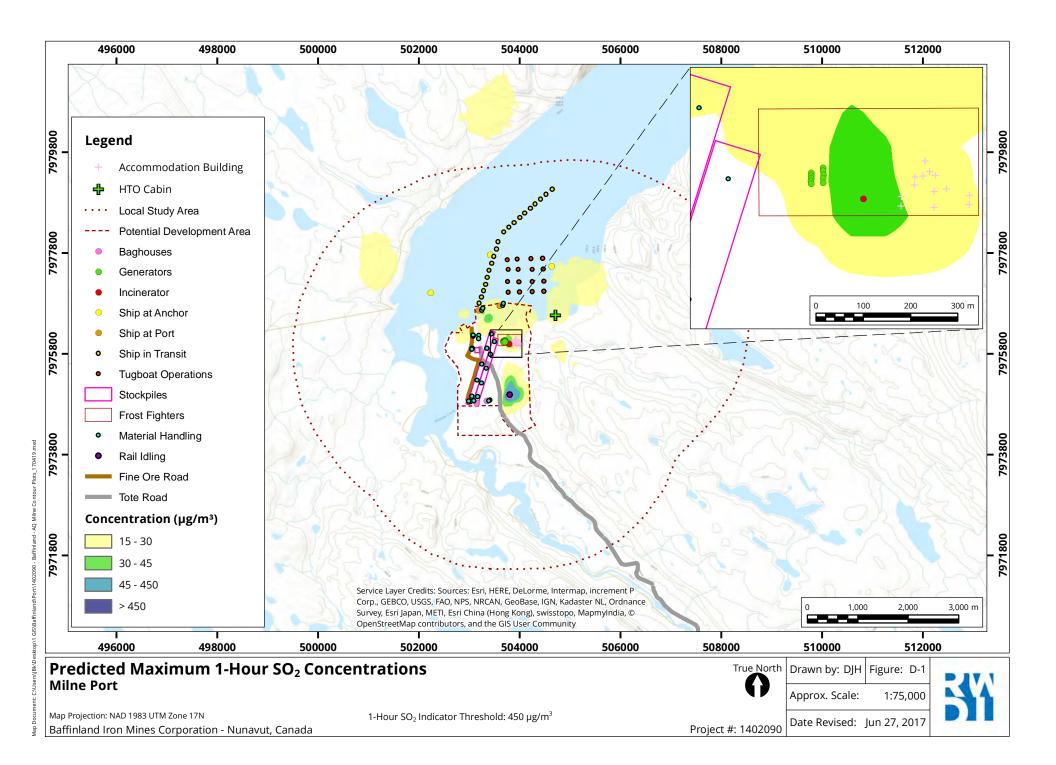


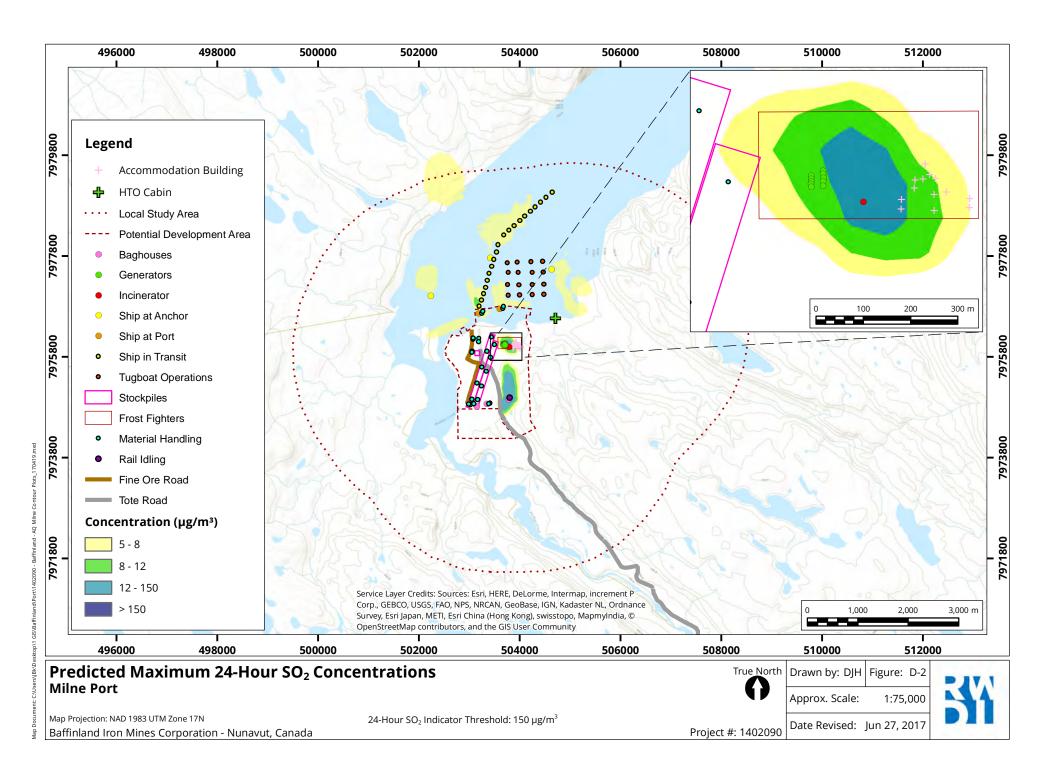
ozone baseline measured concentrations. To be conservative when applying the ozone limiting method to obtain the maximum 1hr NO2 concentrations, a recommended value of 0.05 ppm from Alberta Environment (Alberta Environment, Air Quality Model Guideline, May 2009) was selected.

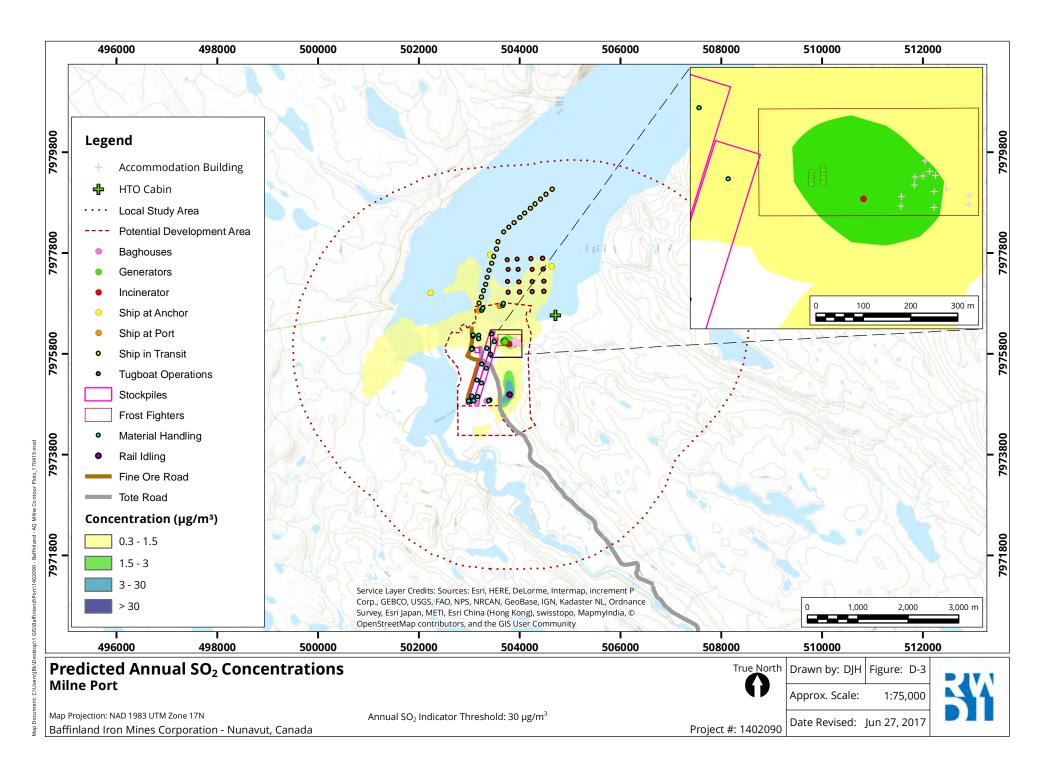


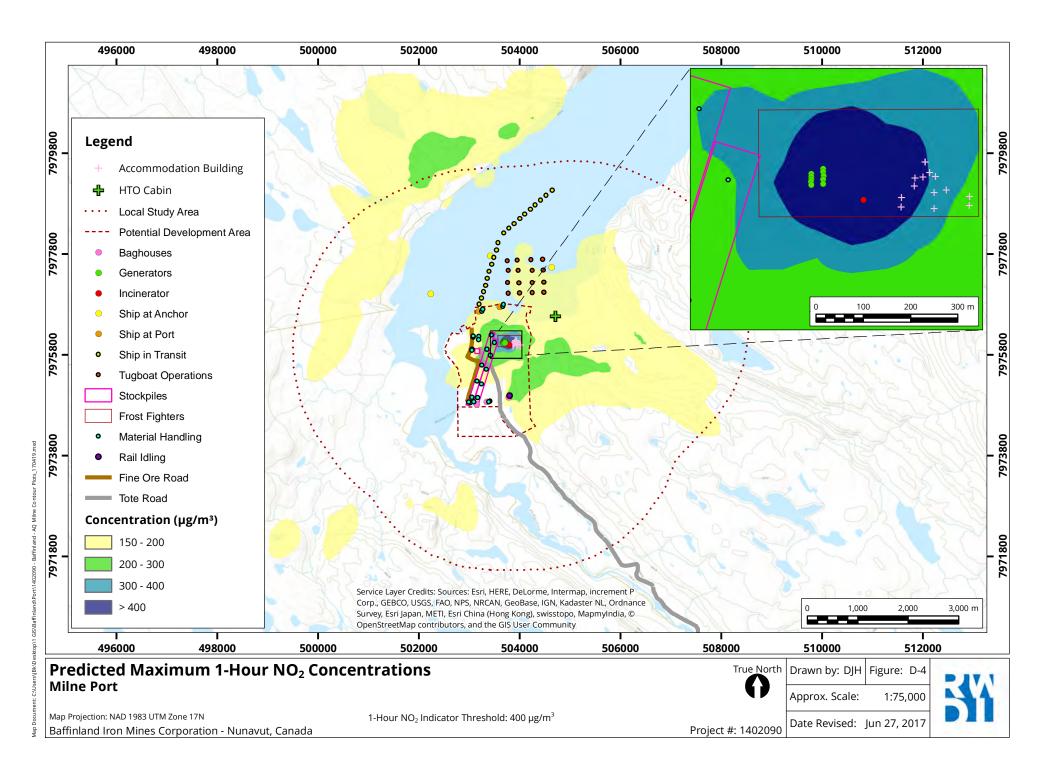
# APPENDIX D - MILNE PORT CONTOUR PLOTS

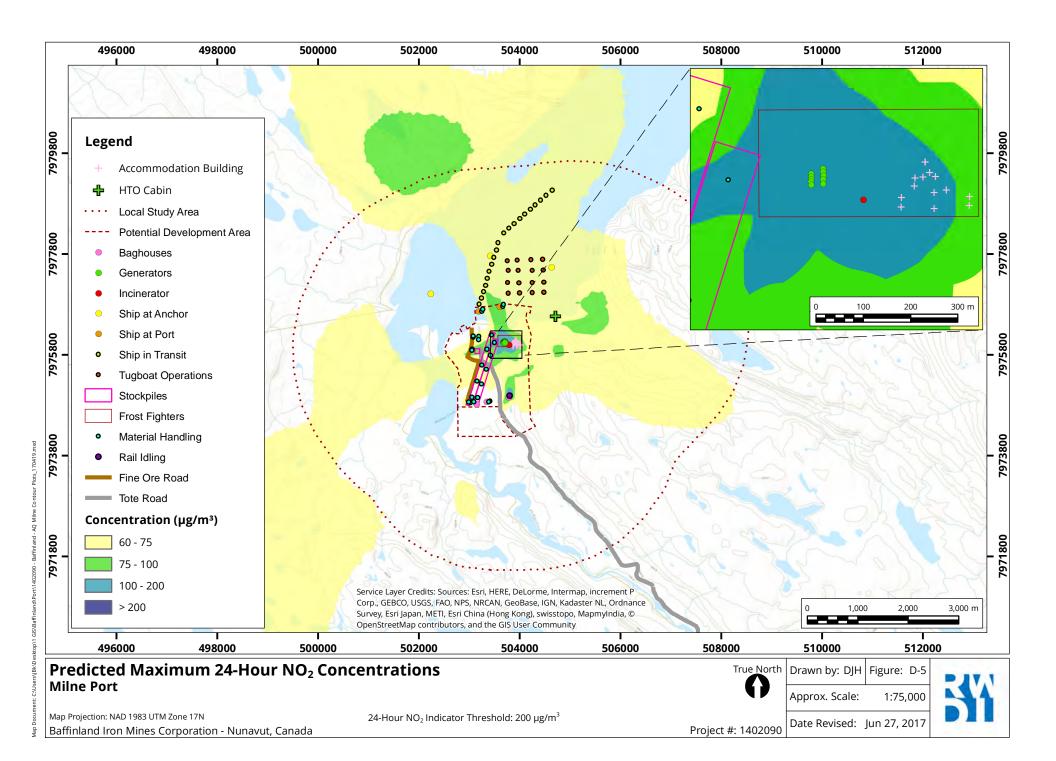


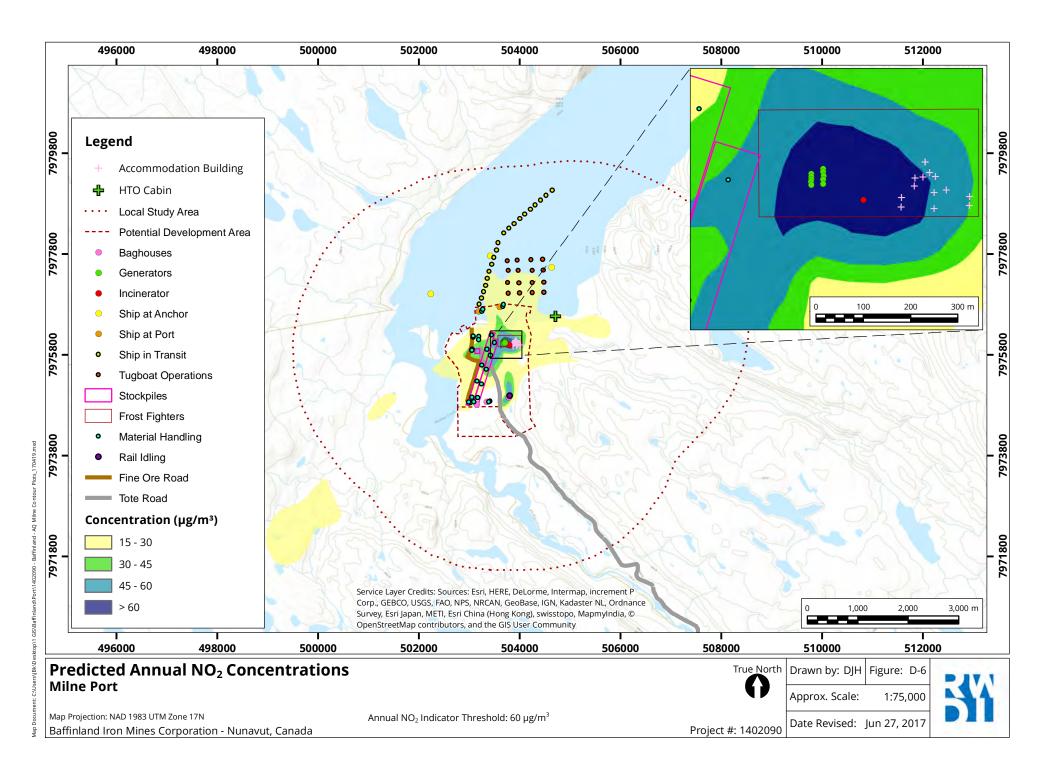


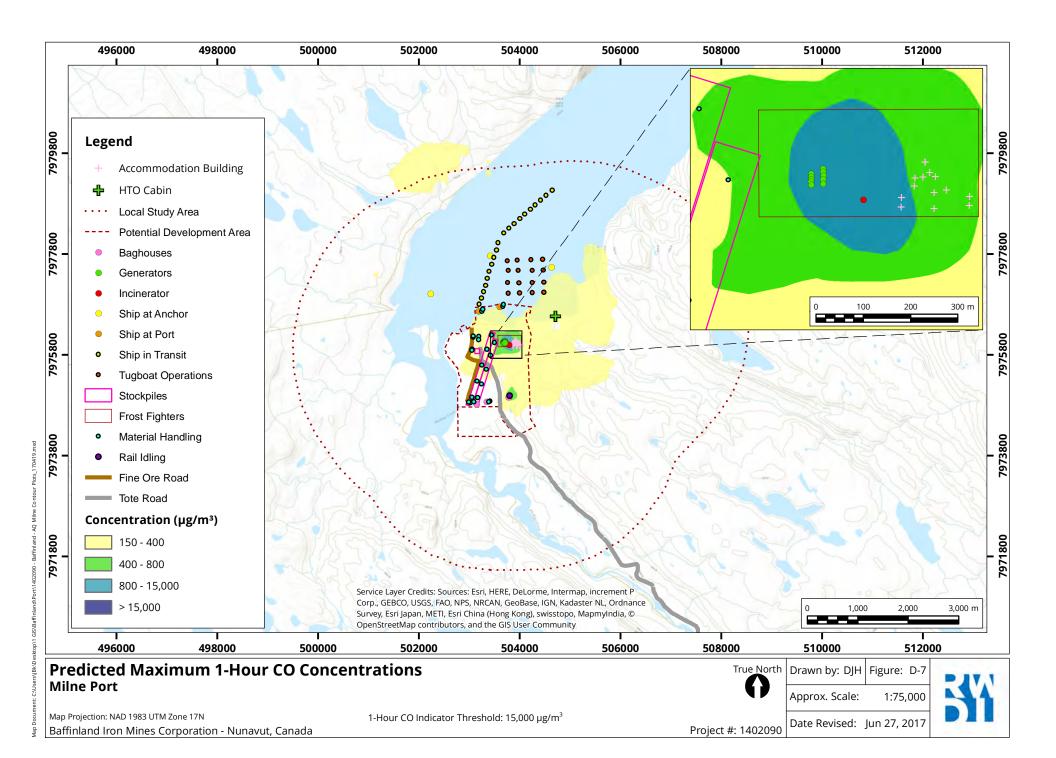


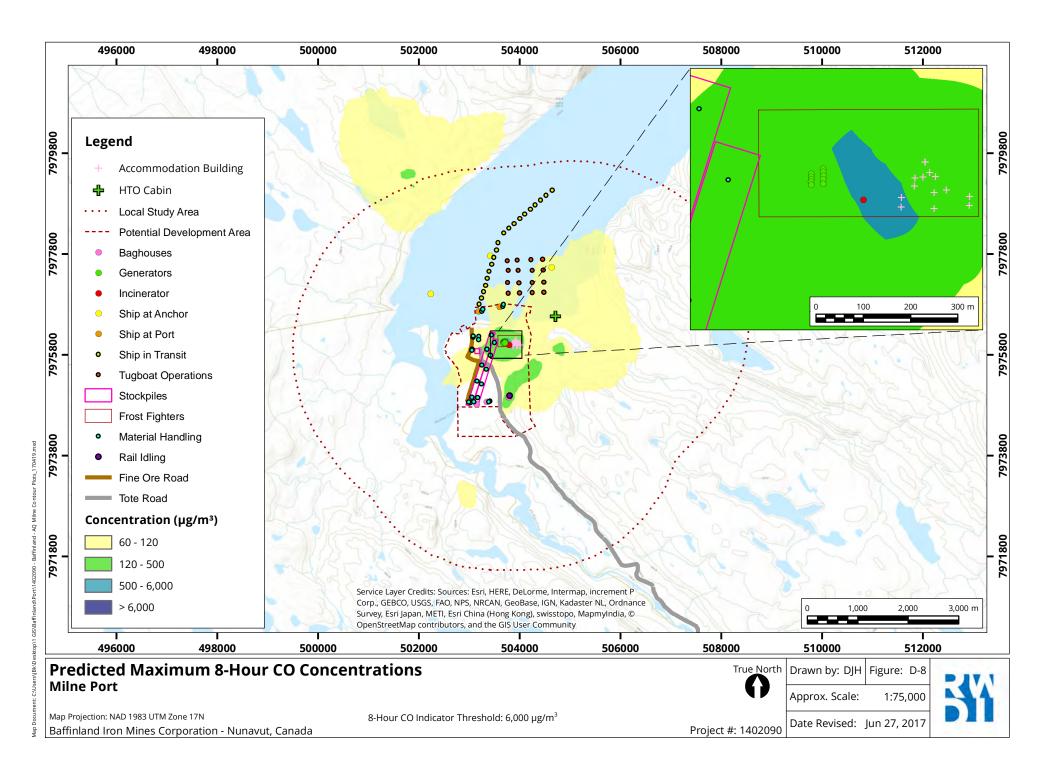


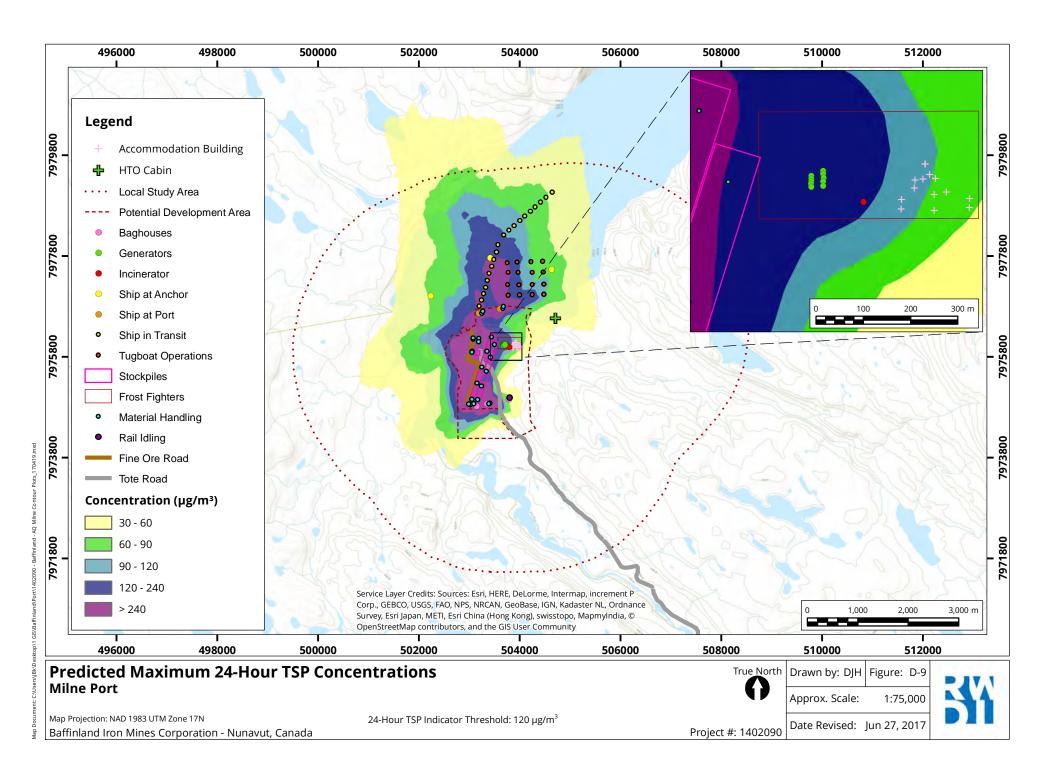


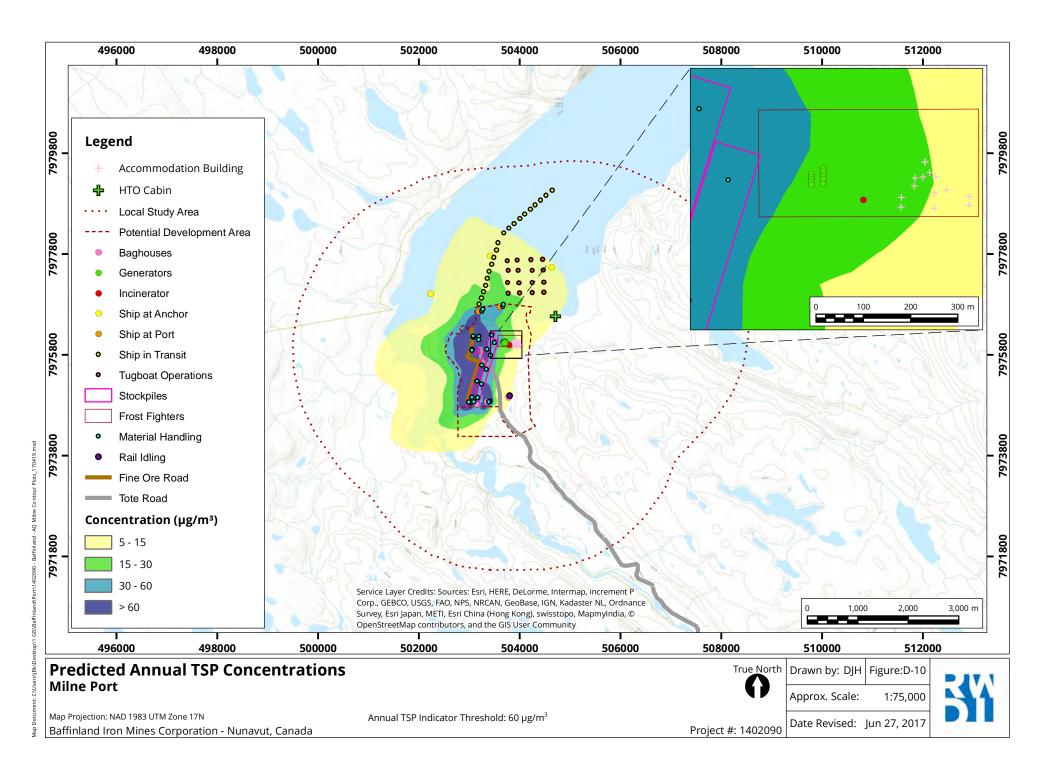


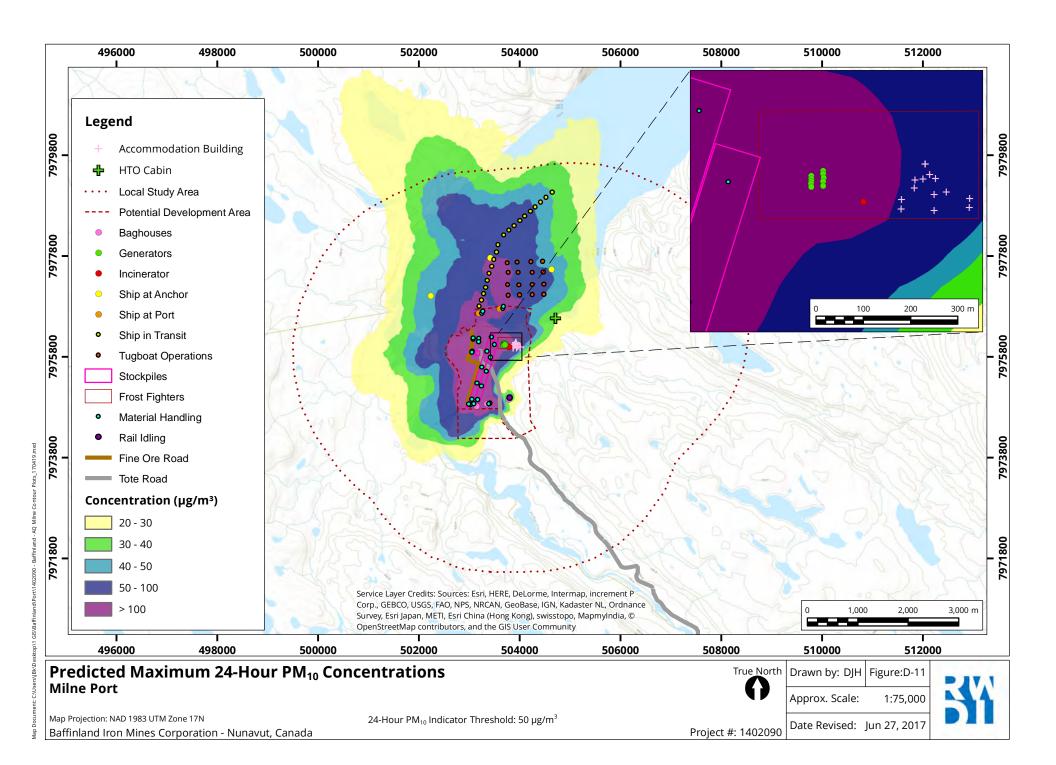


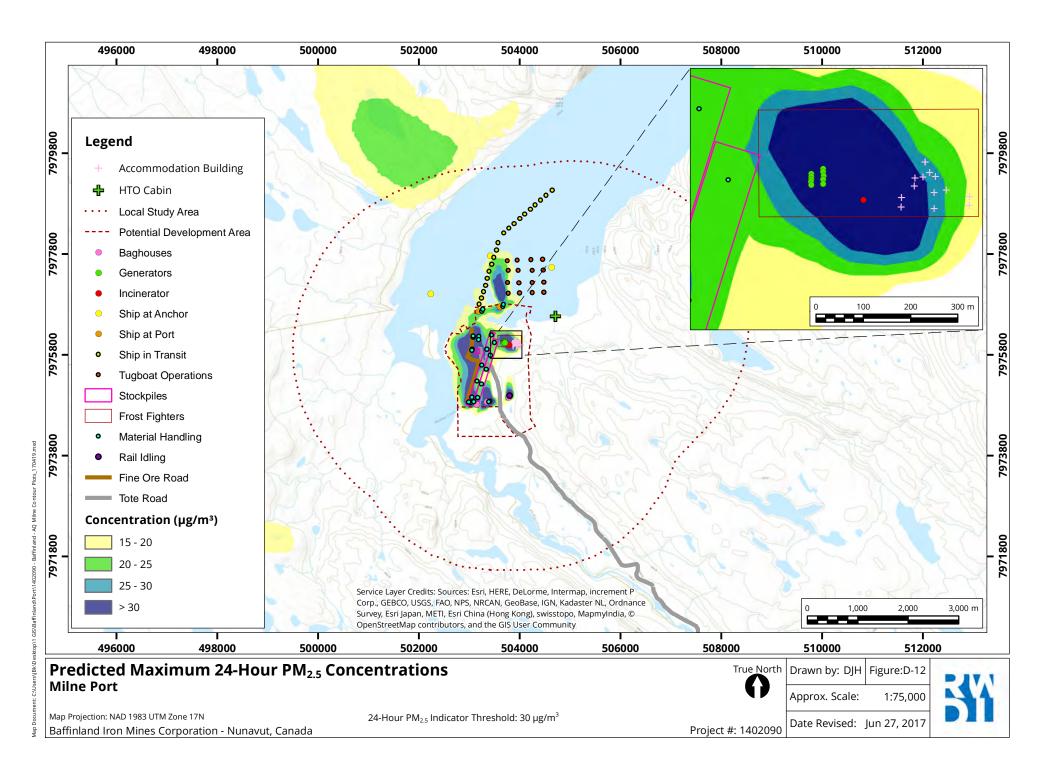


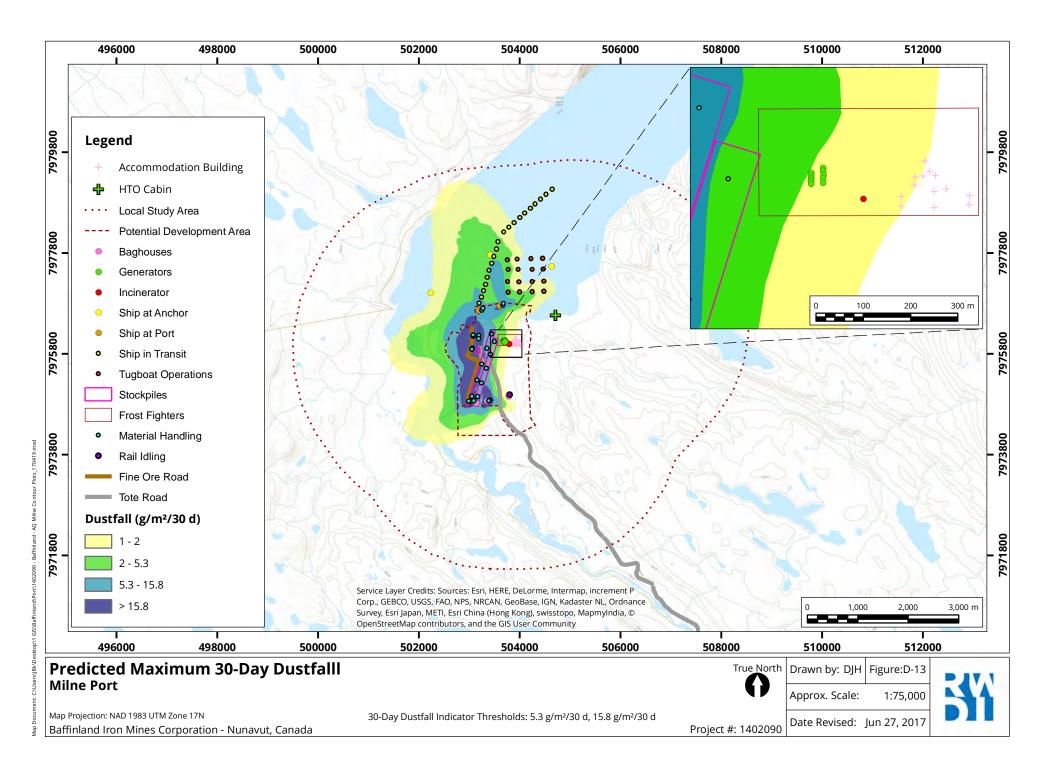


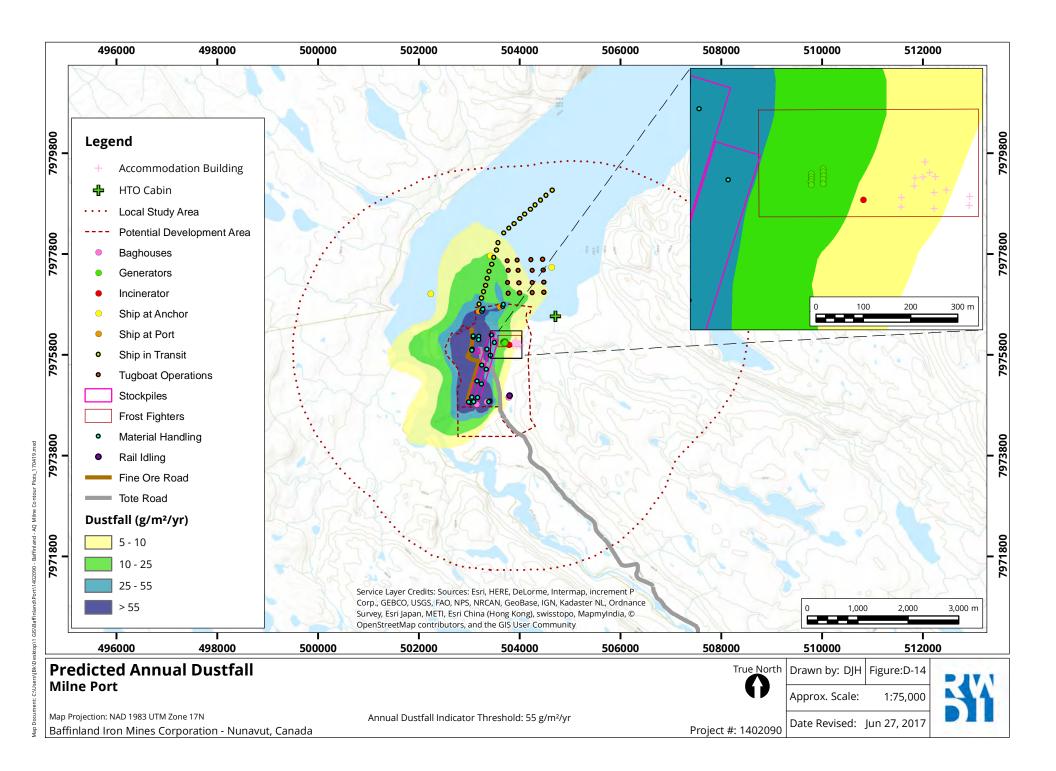


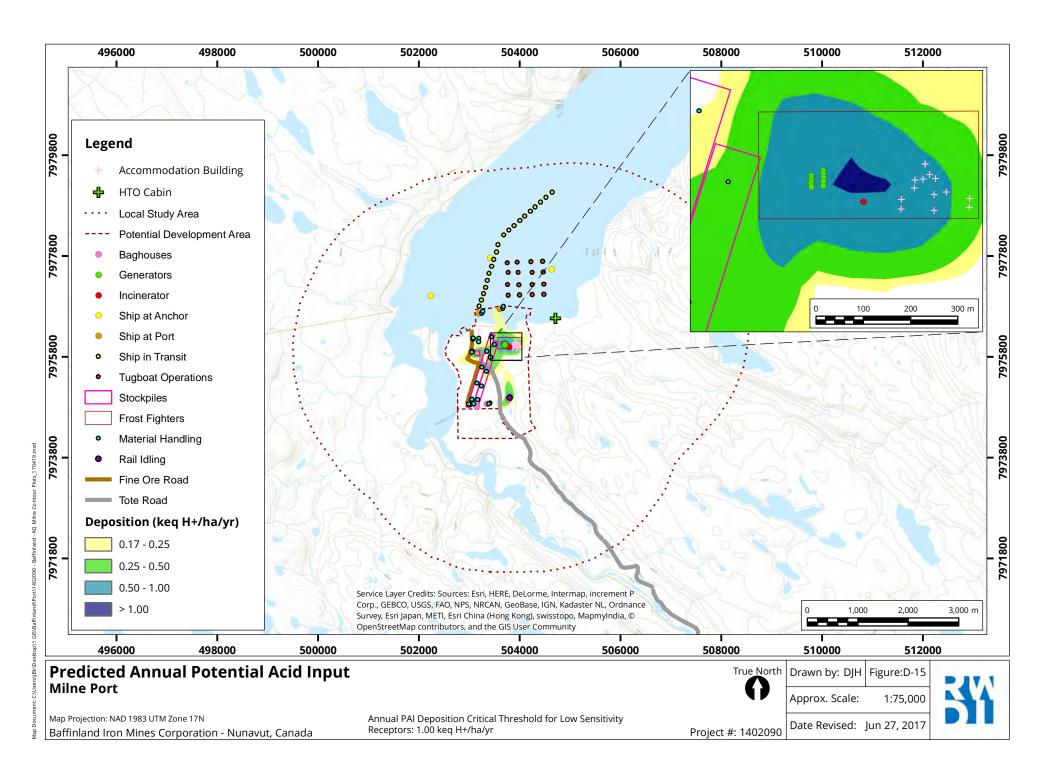




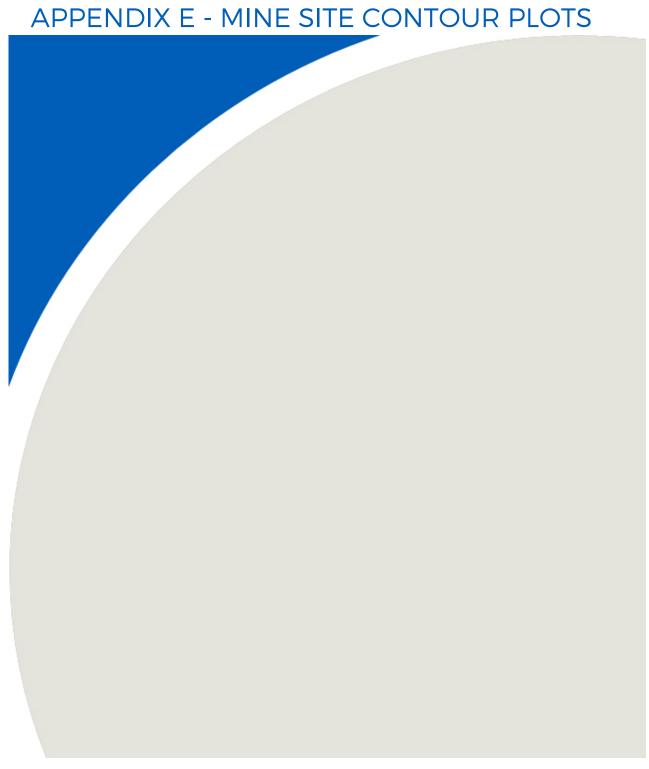


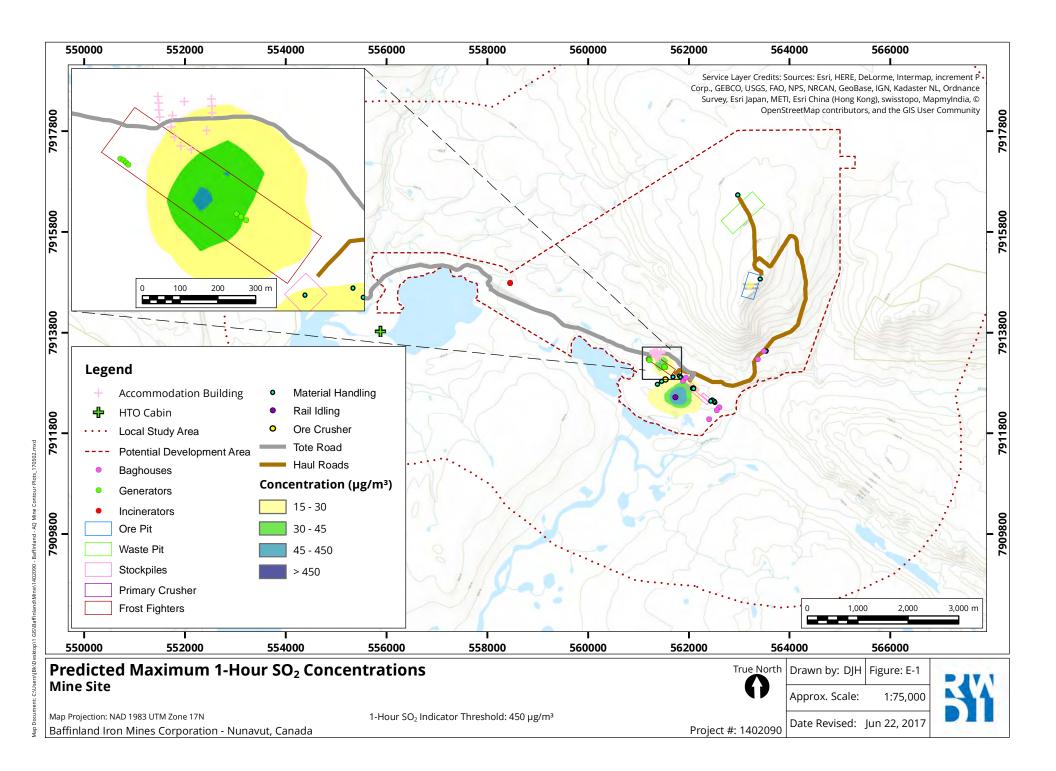


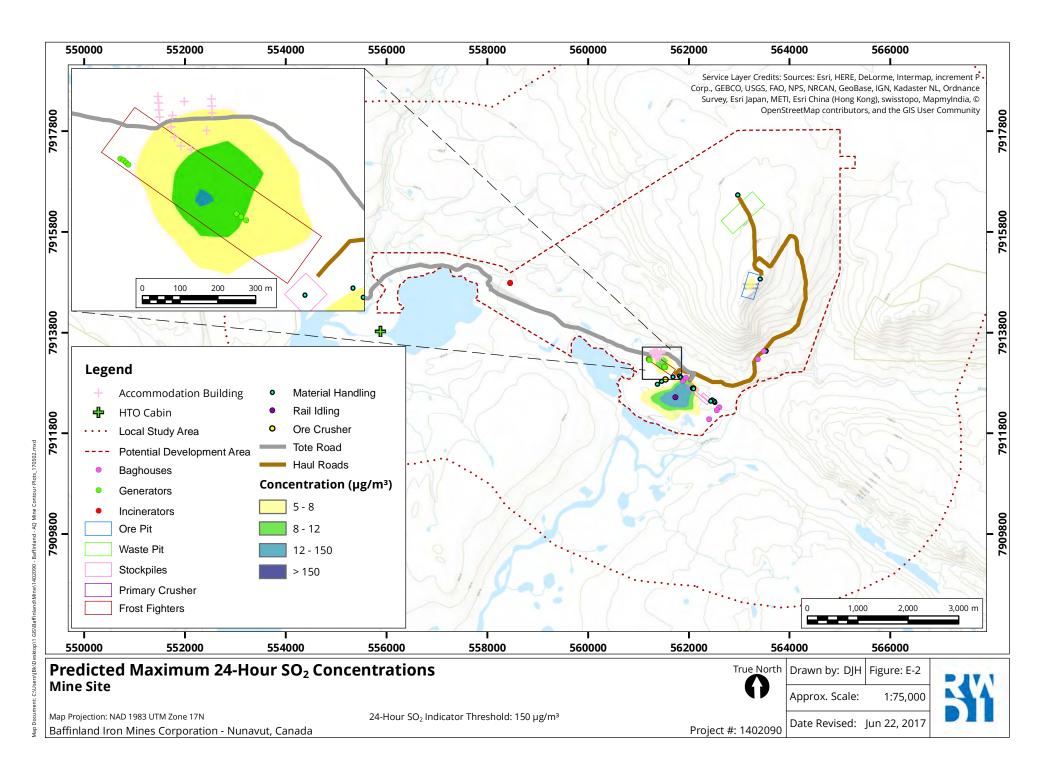


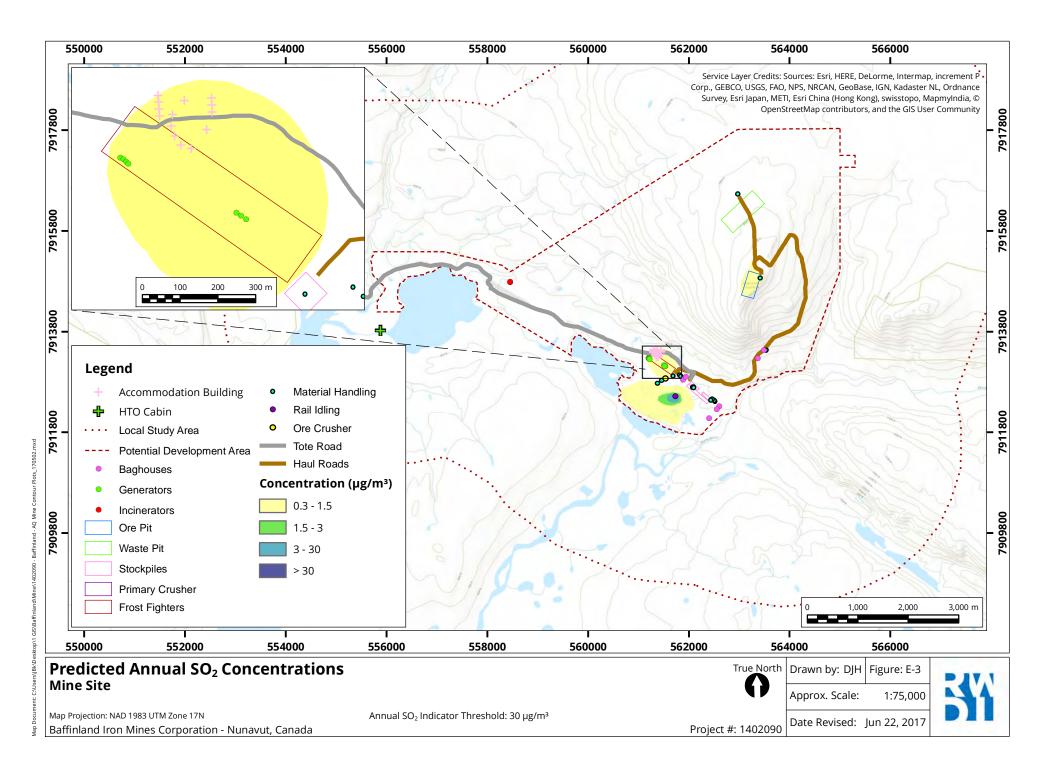


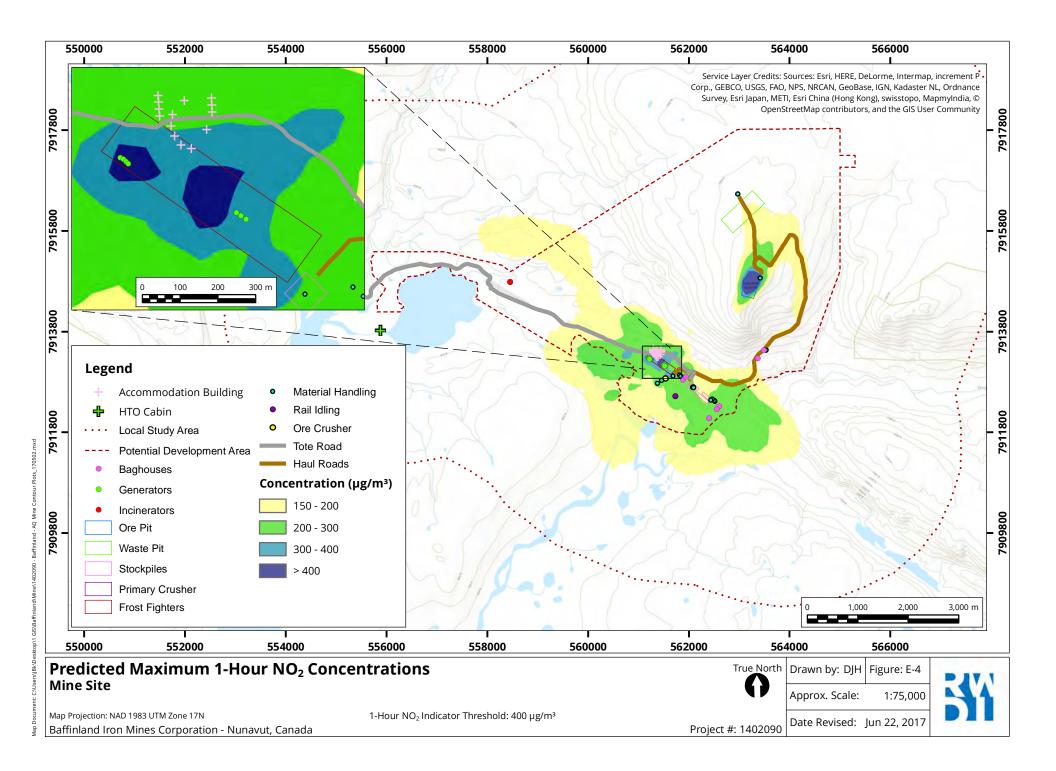


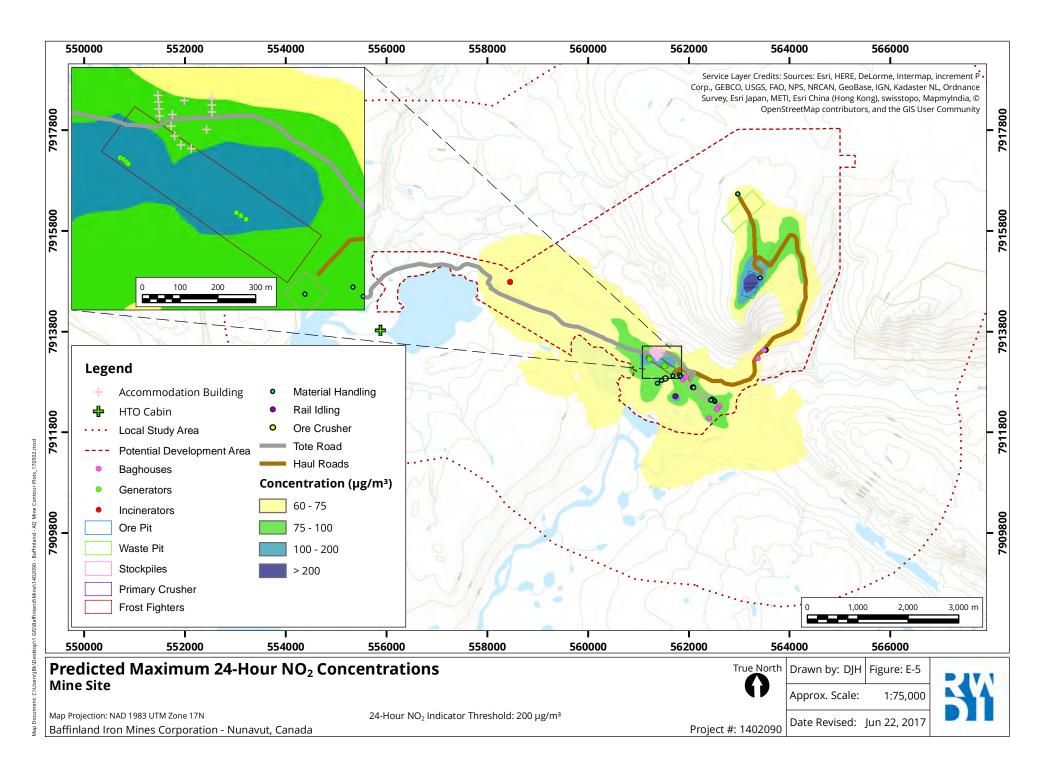


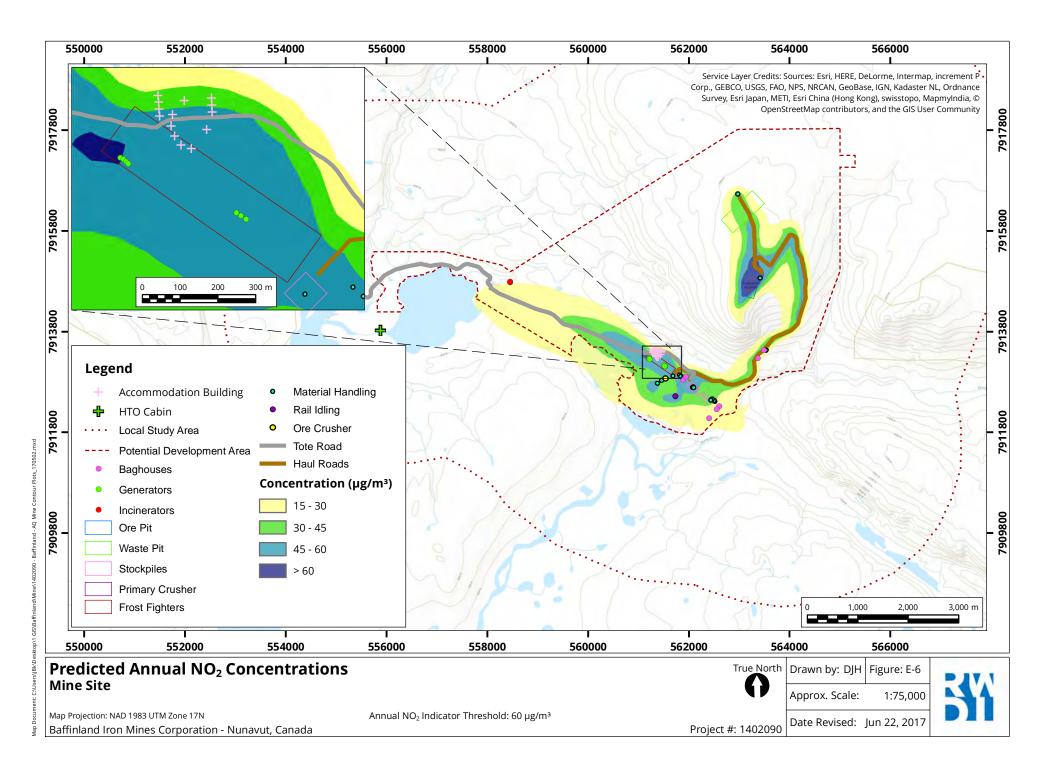


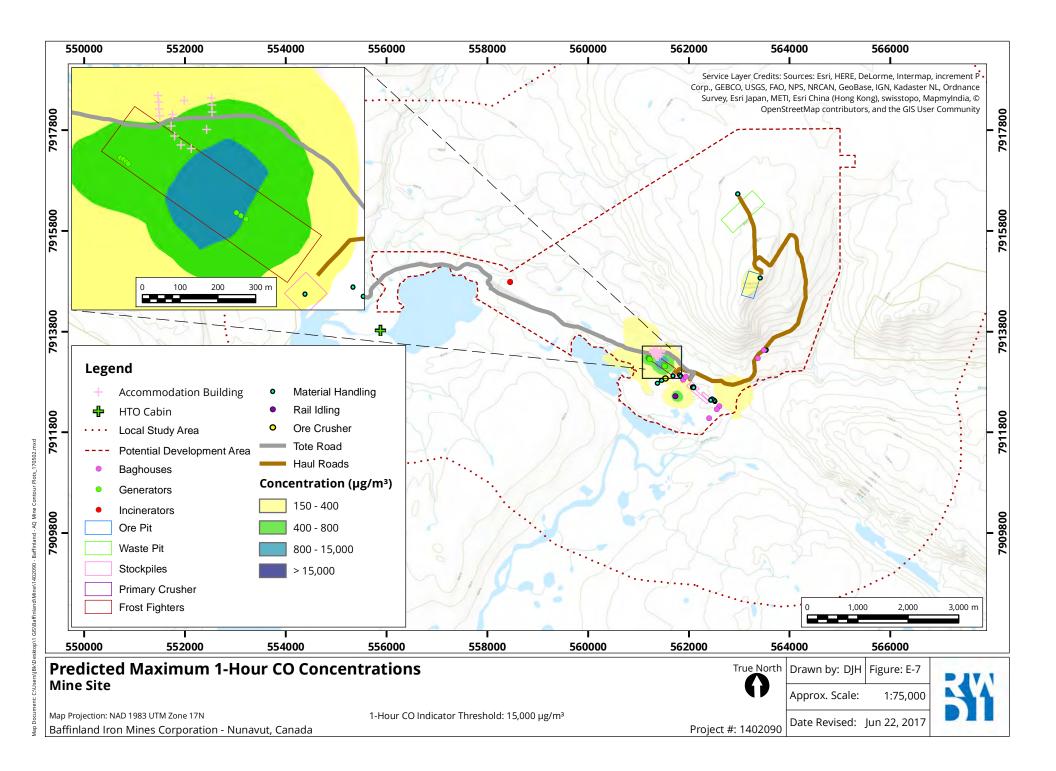


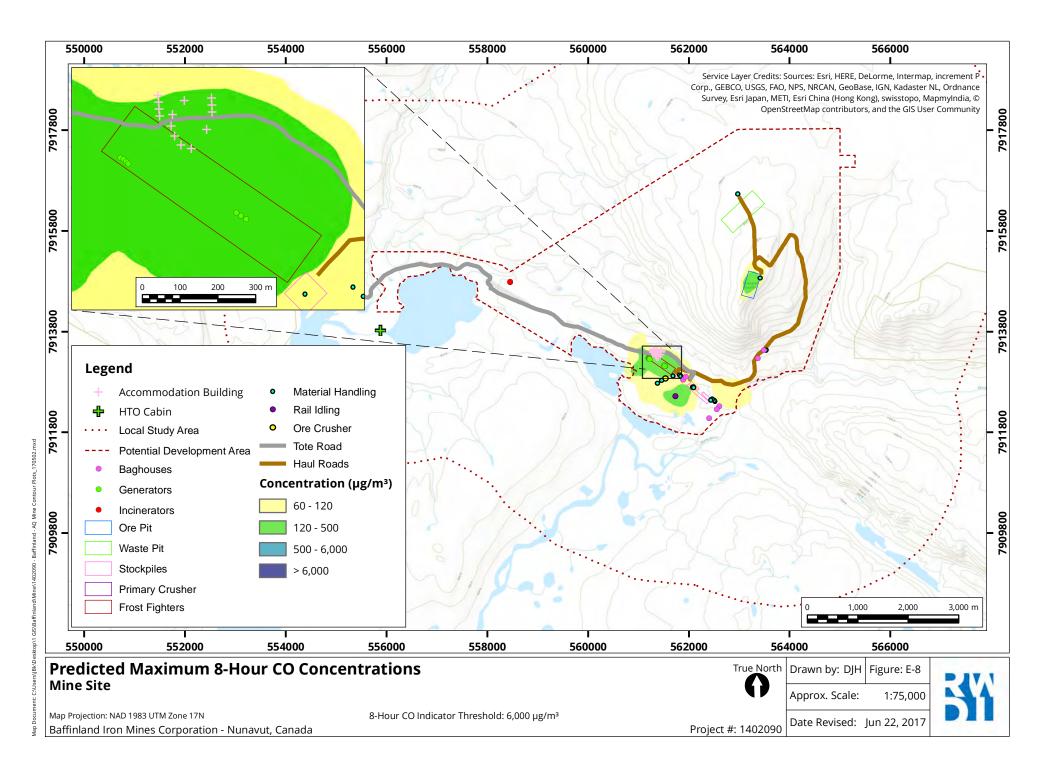


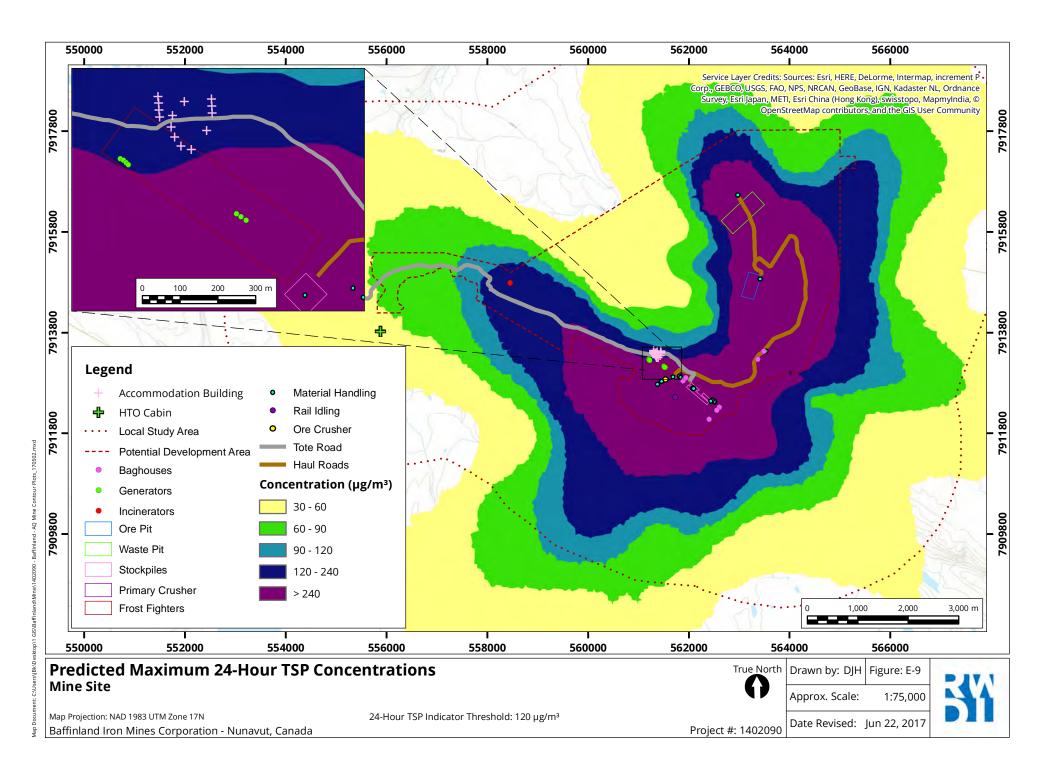


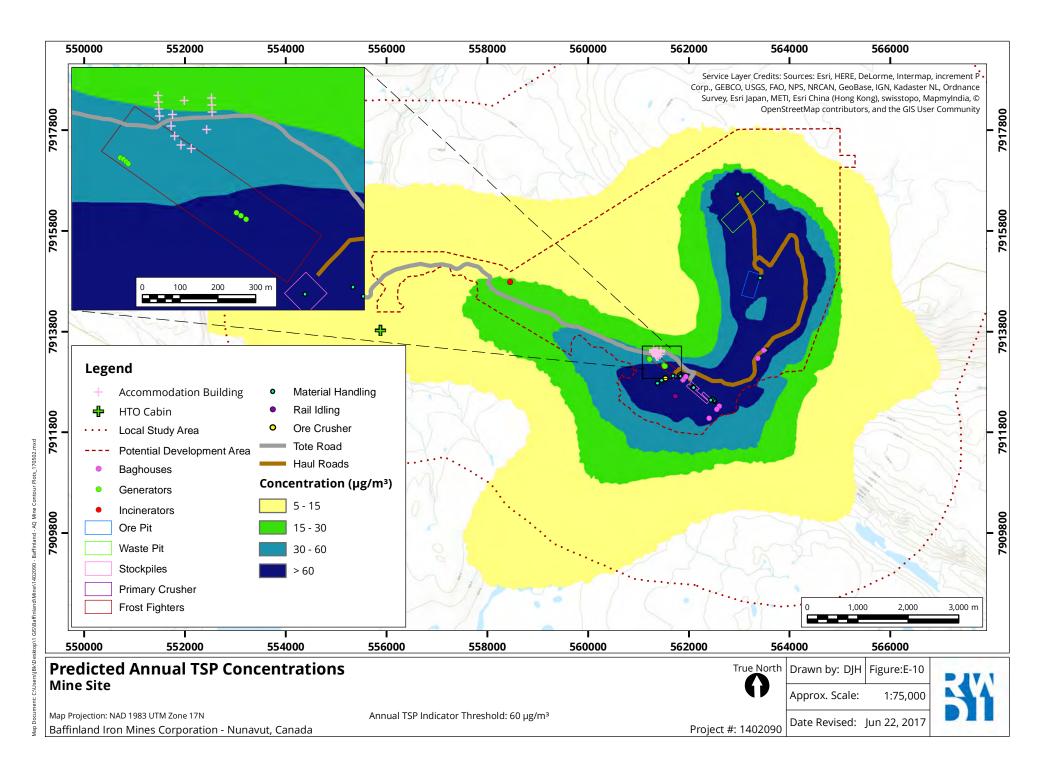


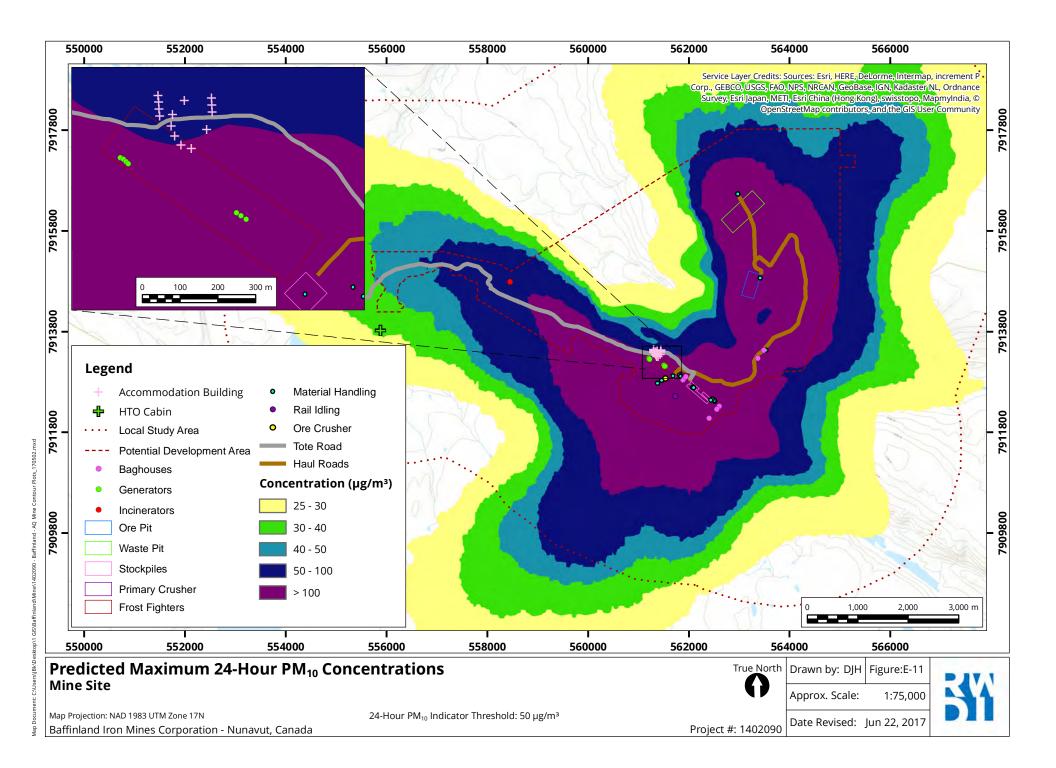


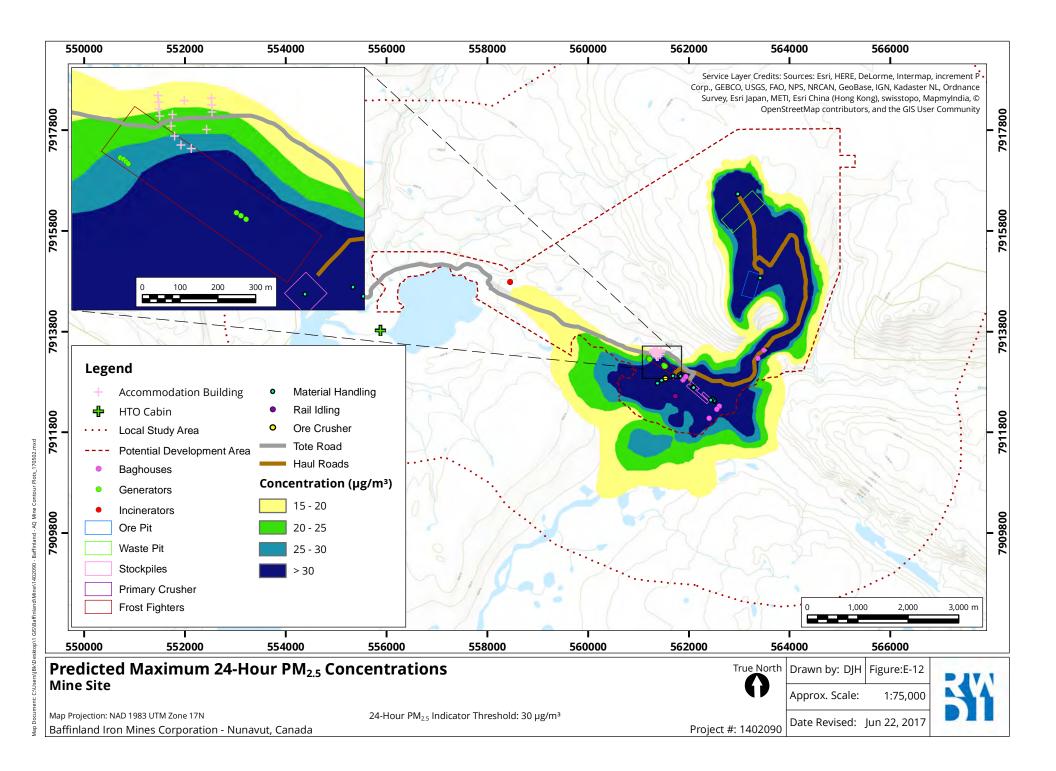


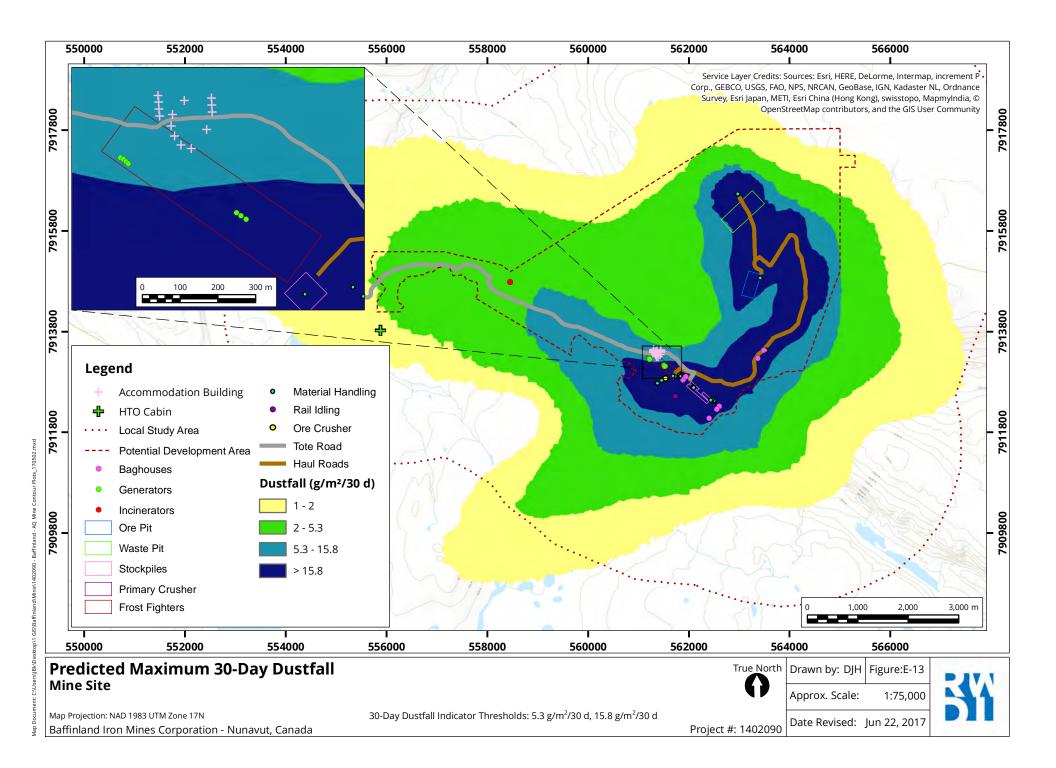


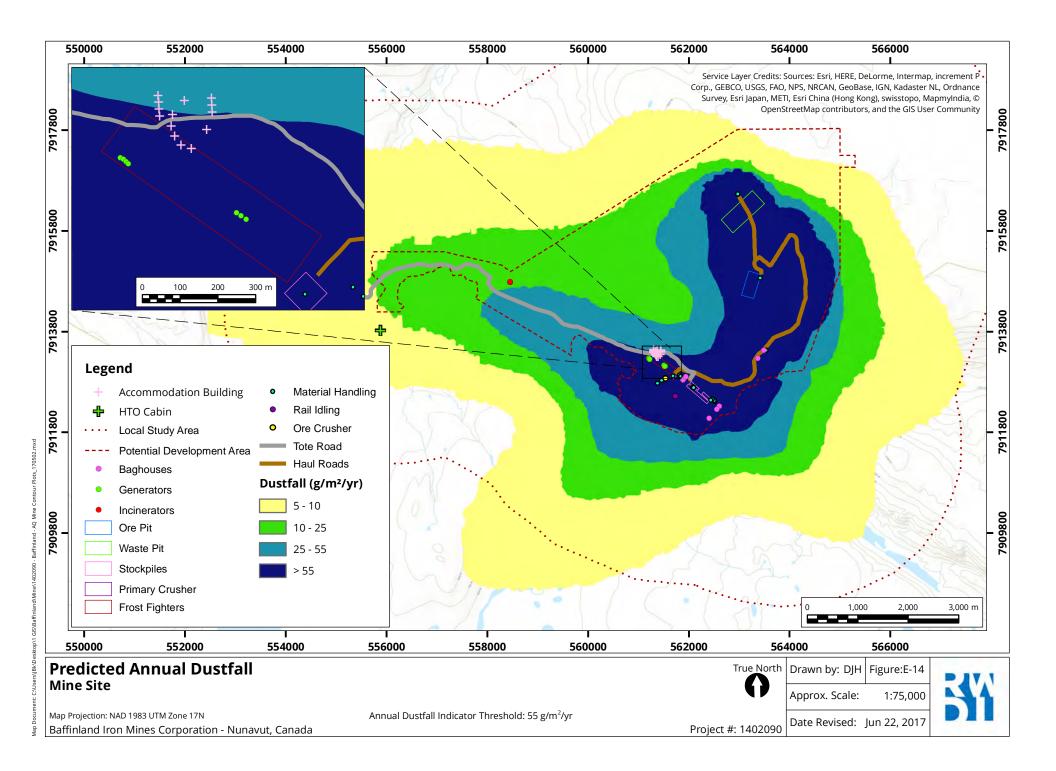


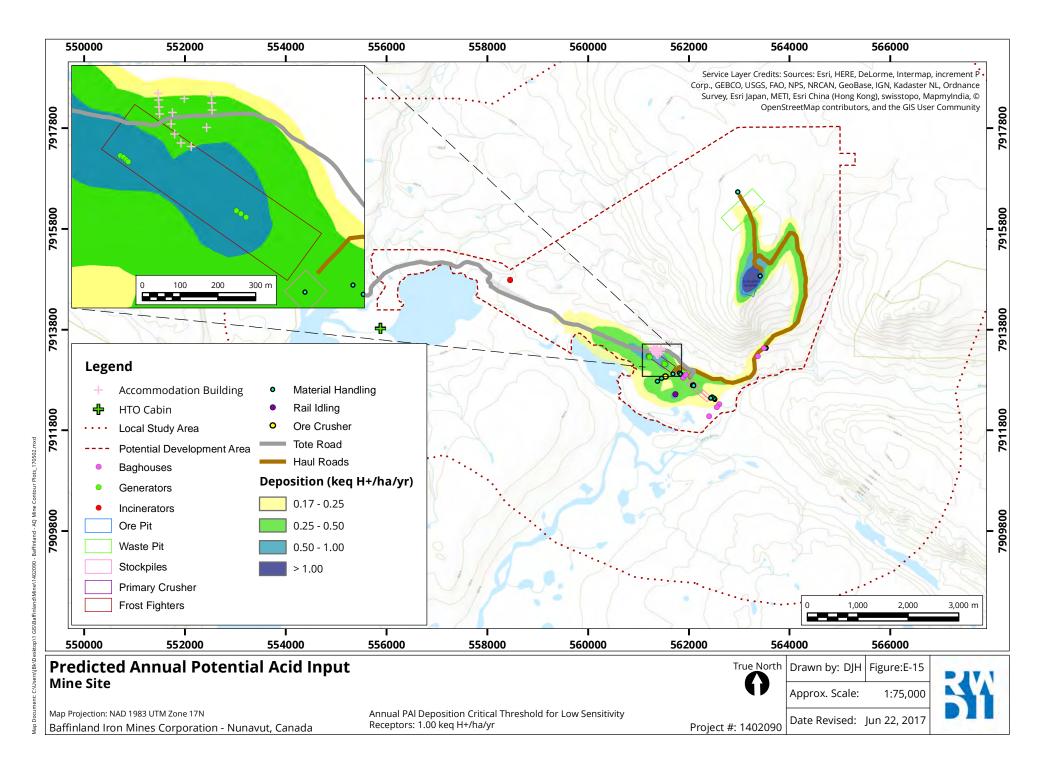






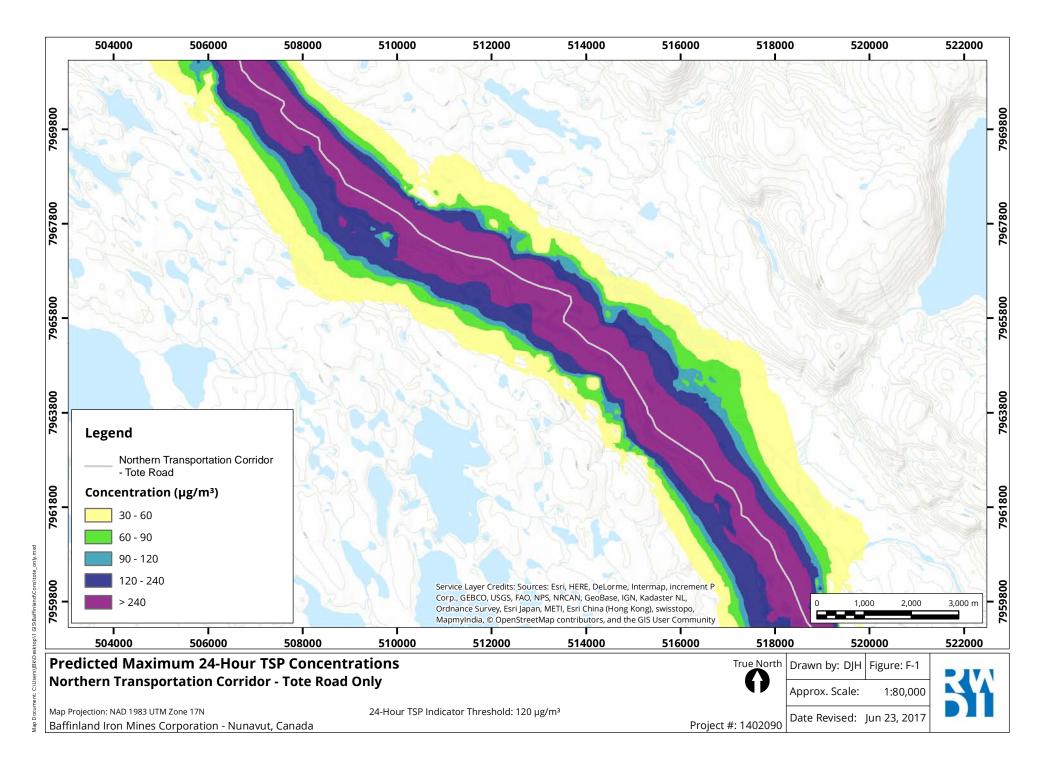


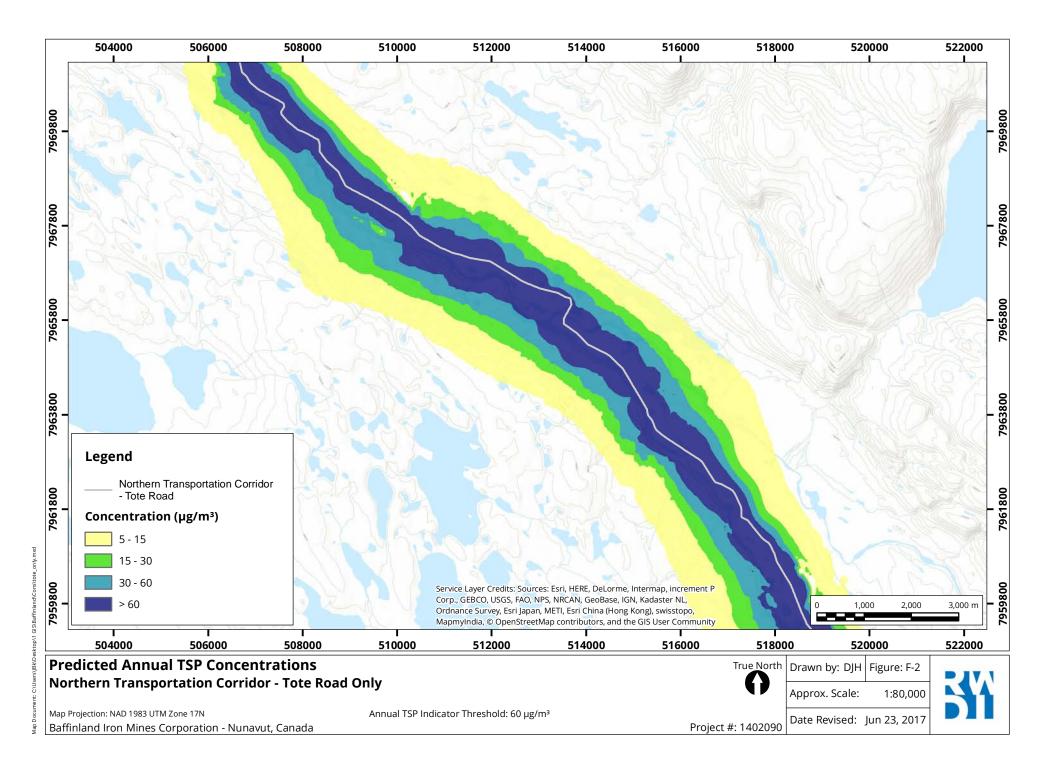


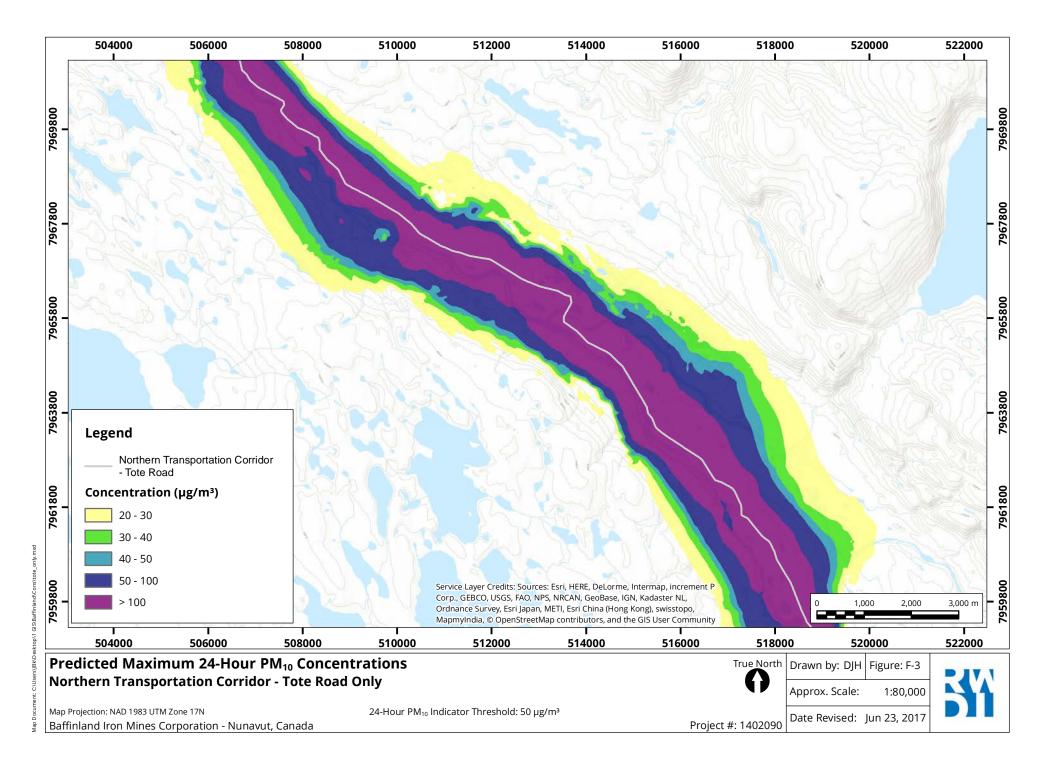


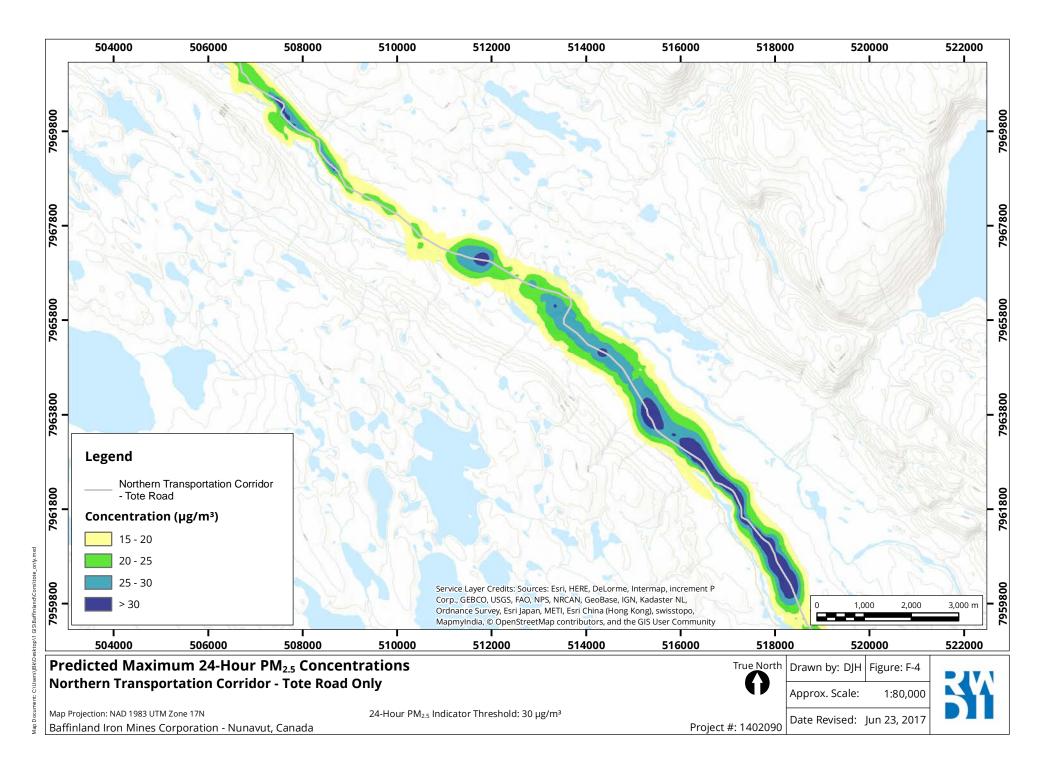


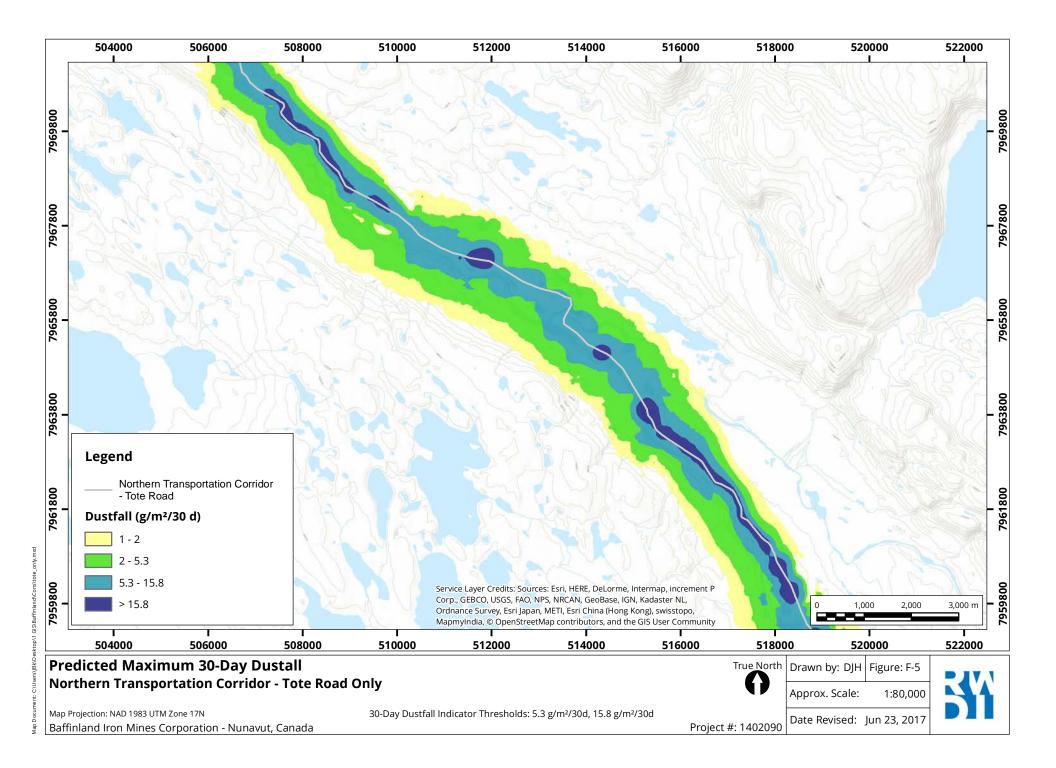
## APPENDIX F - NORTHERN TRANSPORTATION CORRIDOR CONTOUR PLOTS

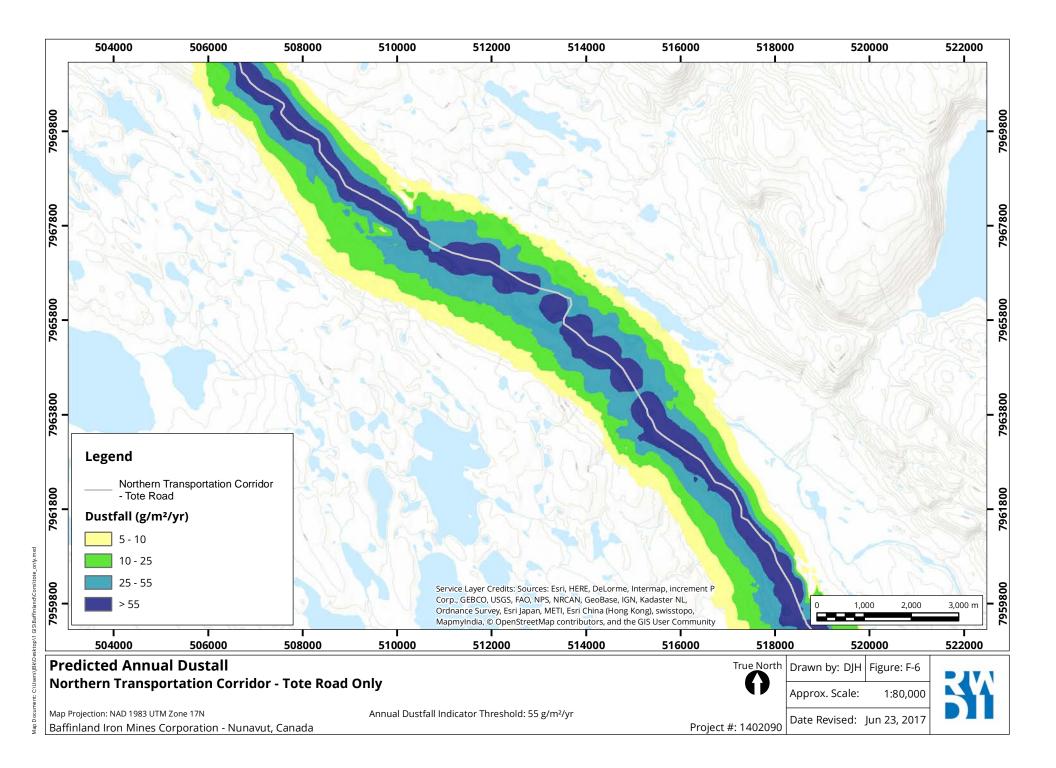


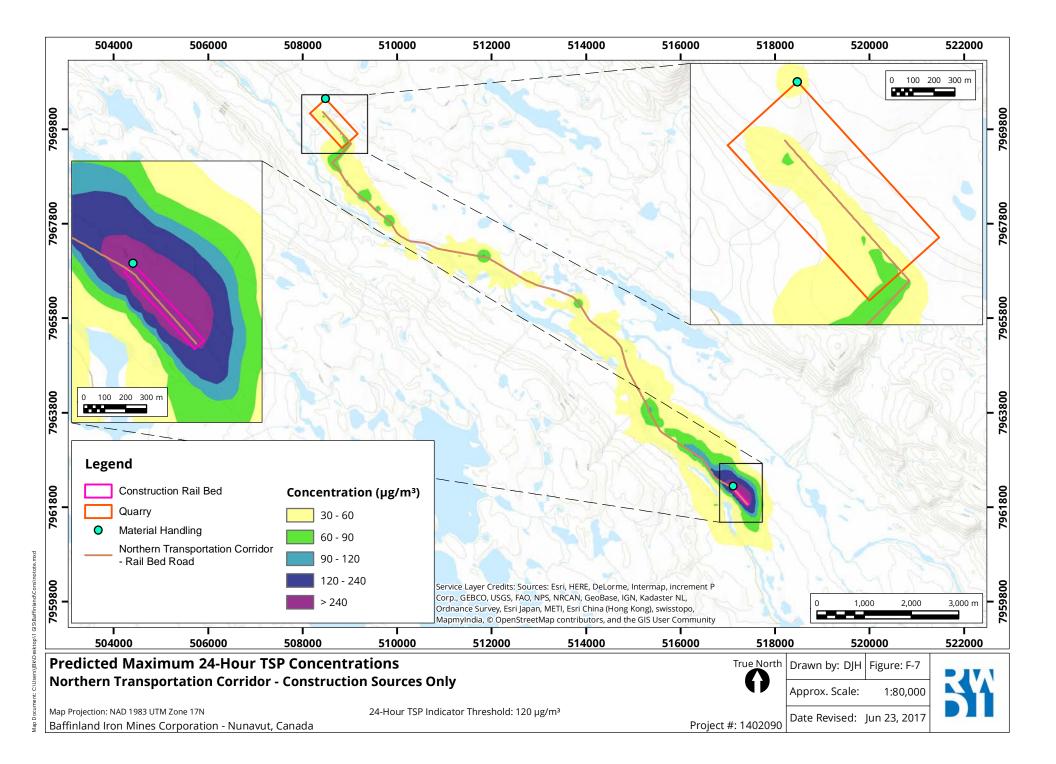


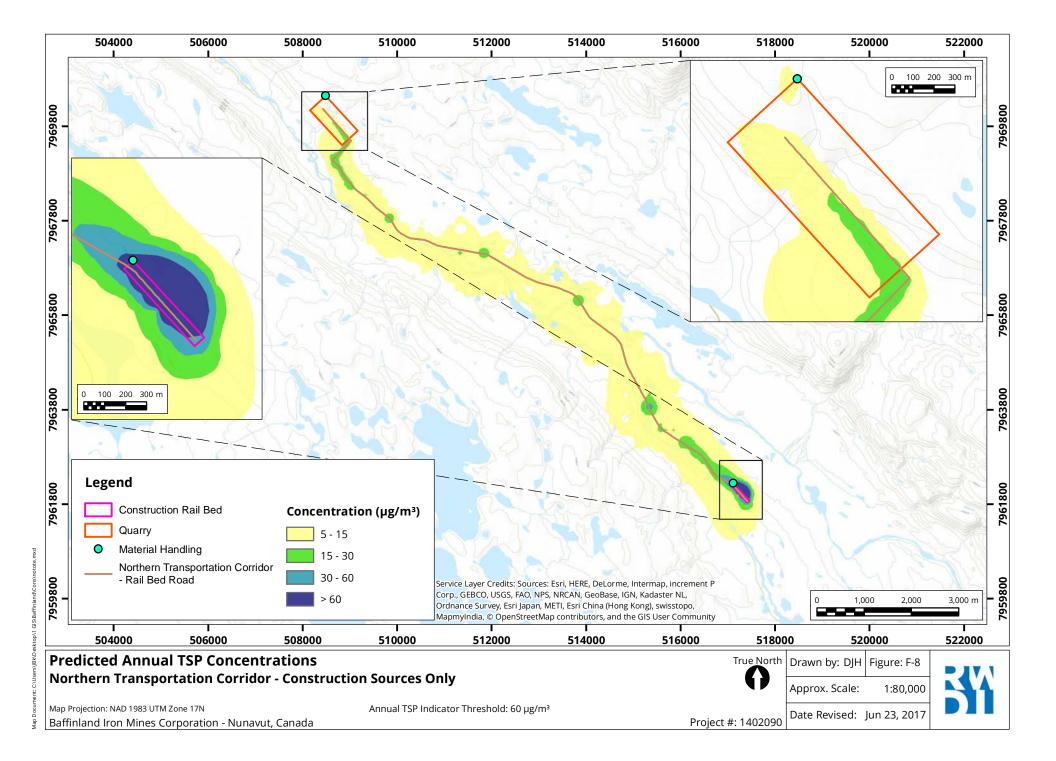


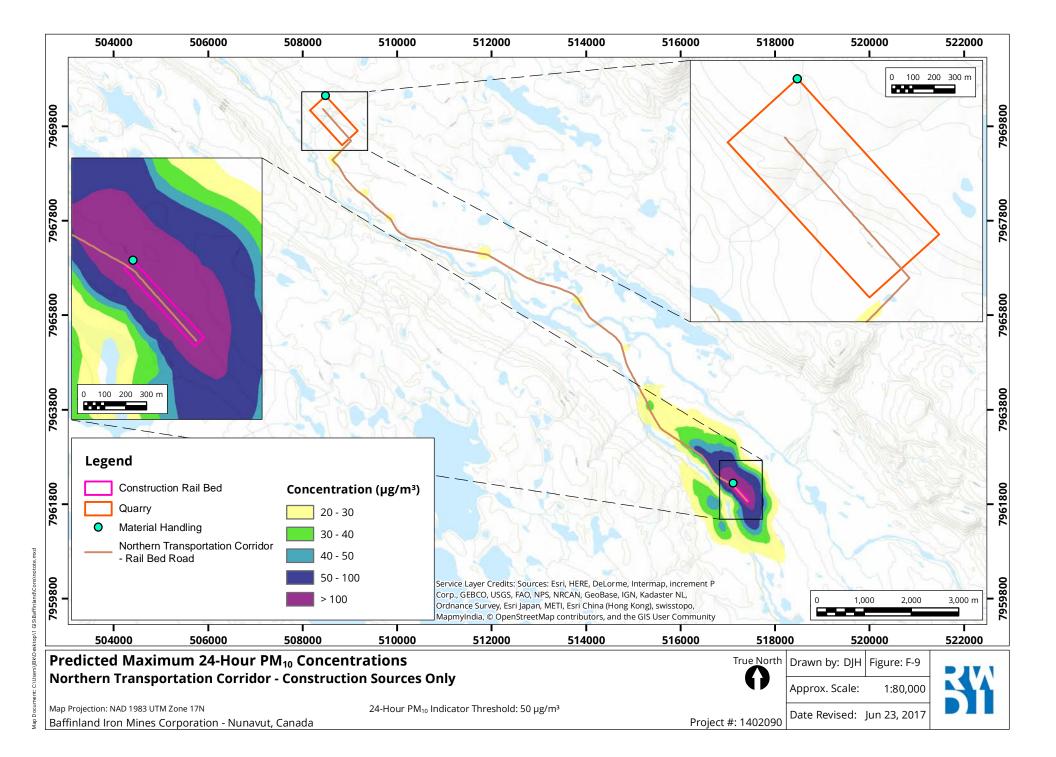


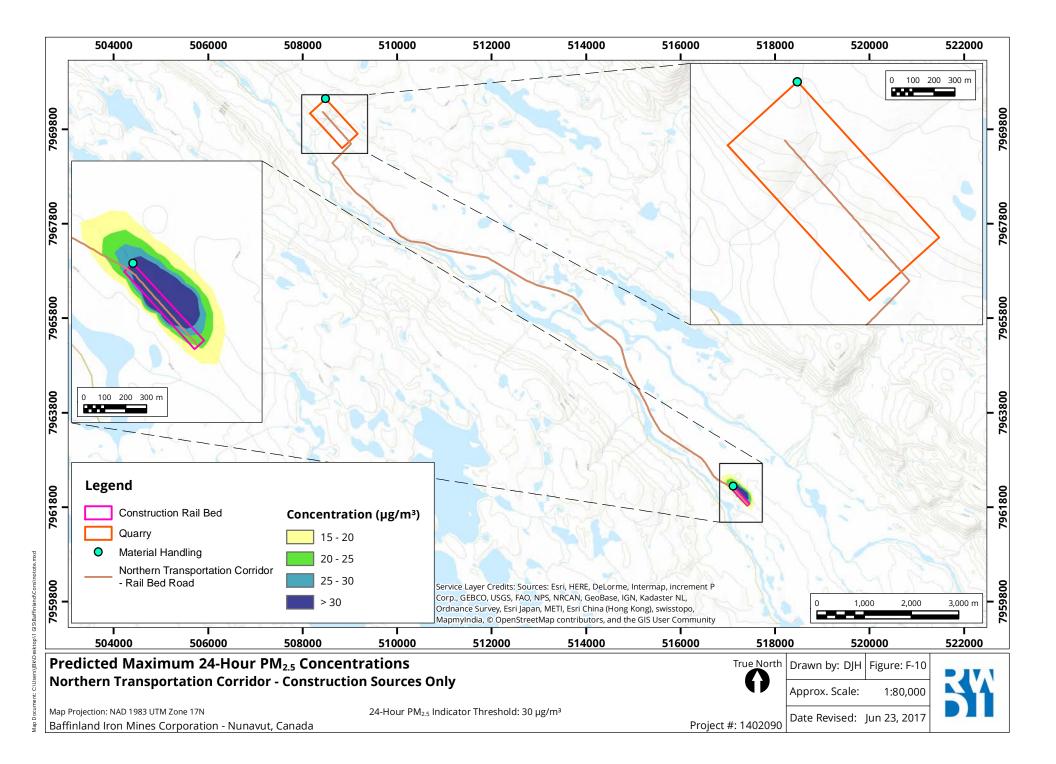


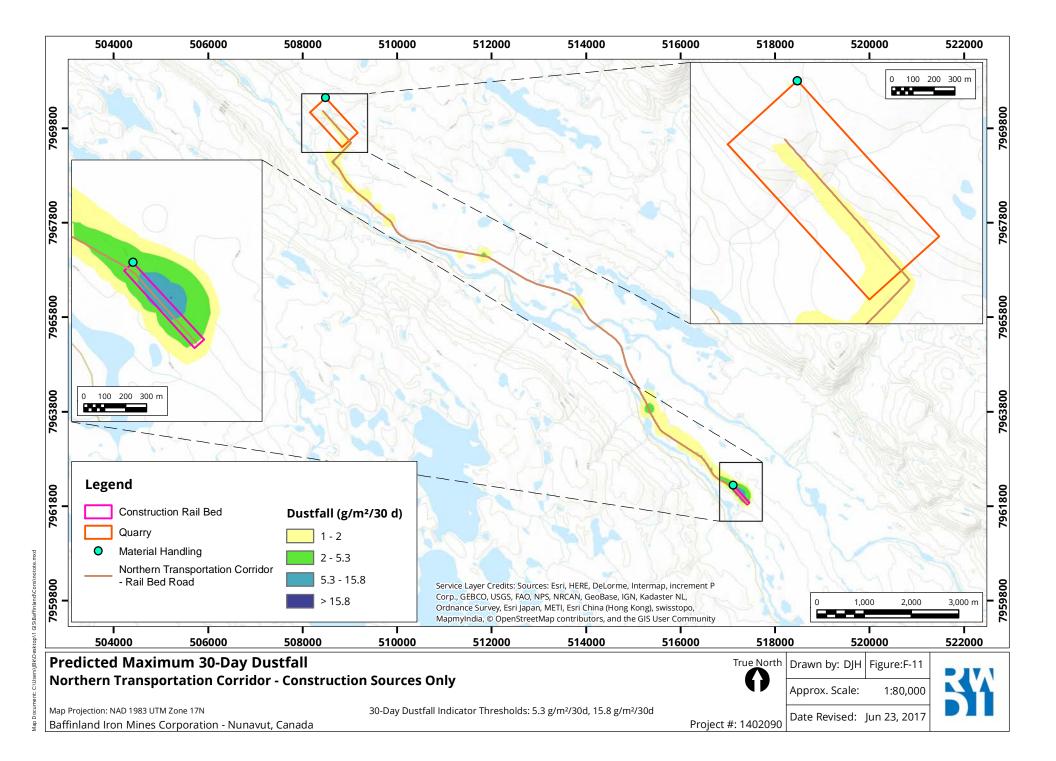


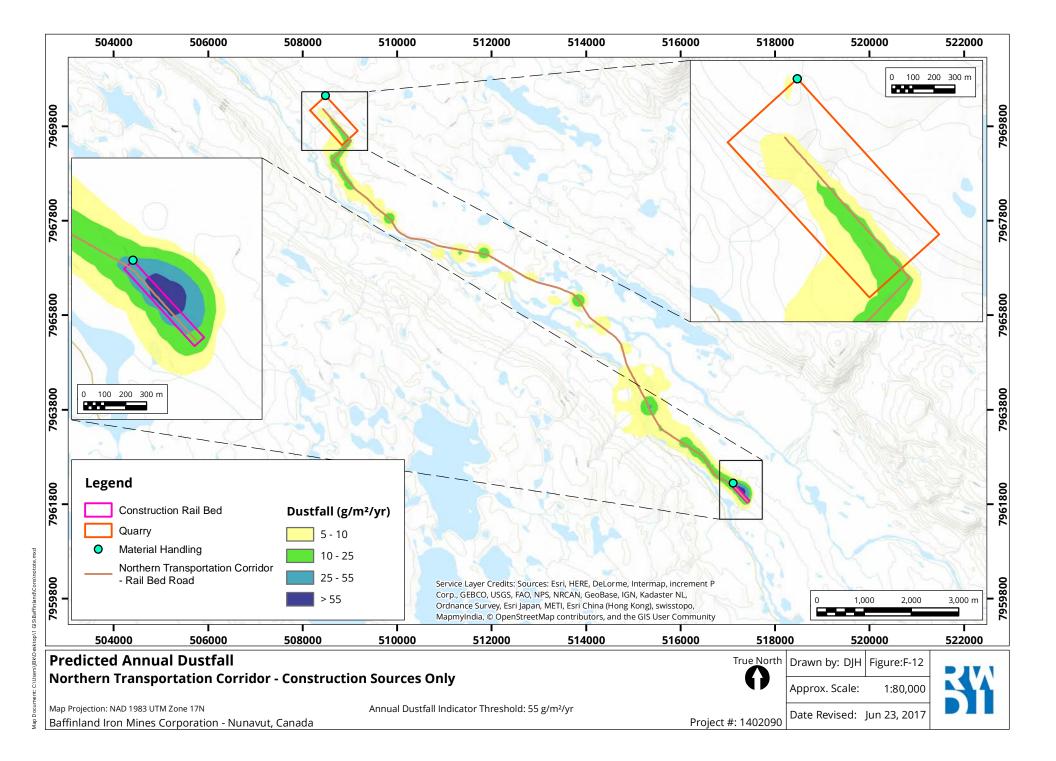


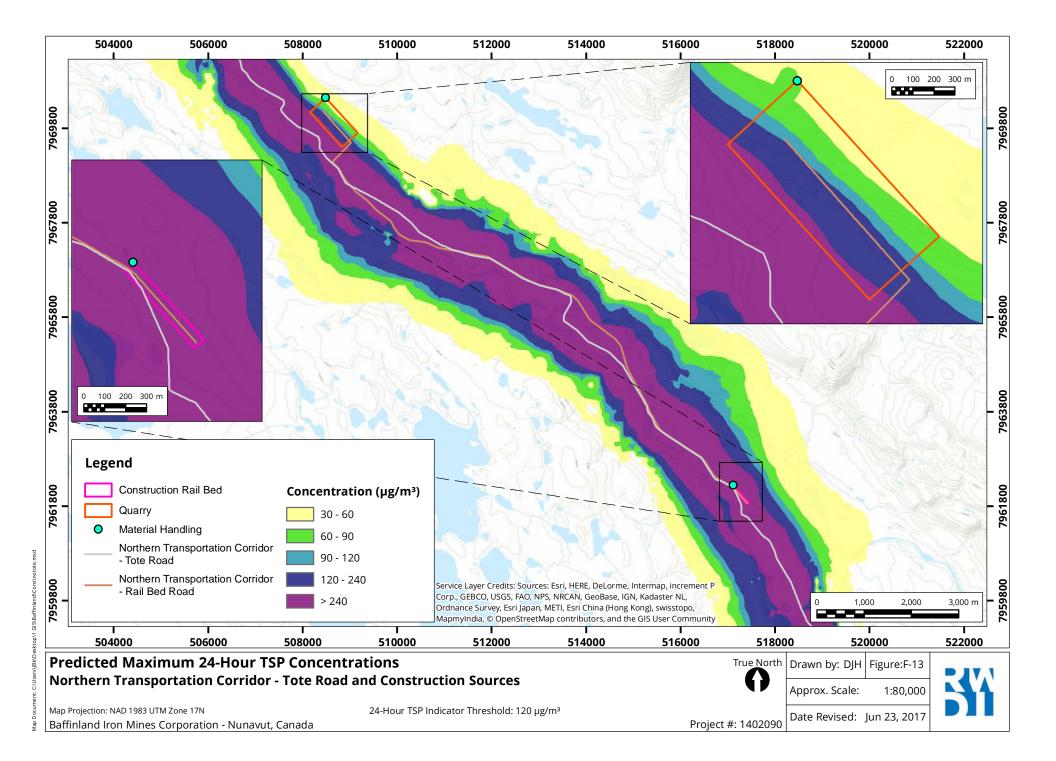


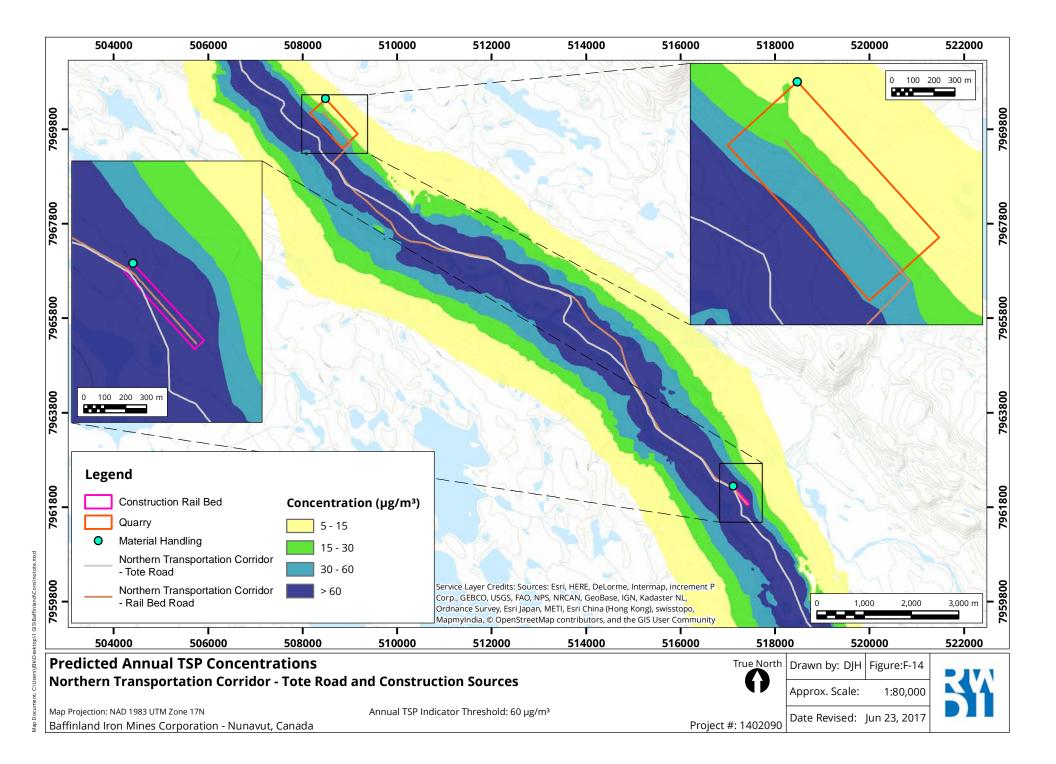


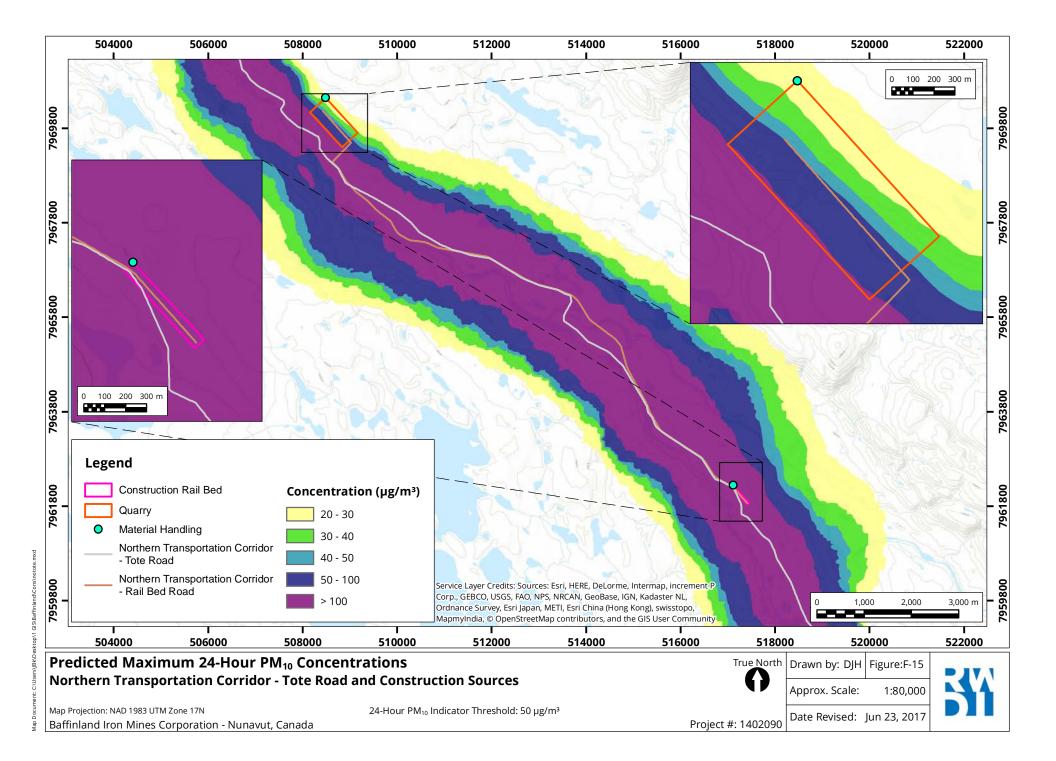


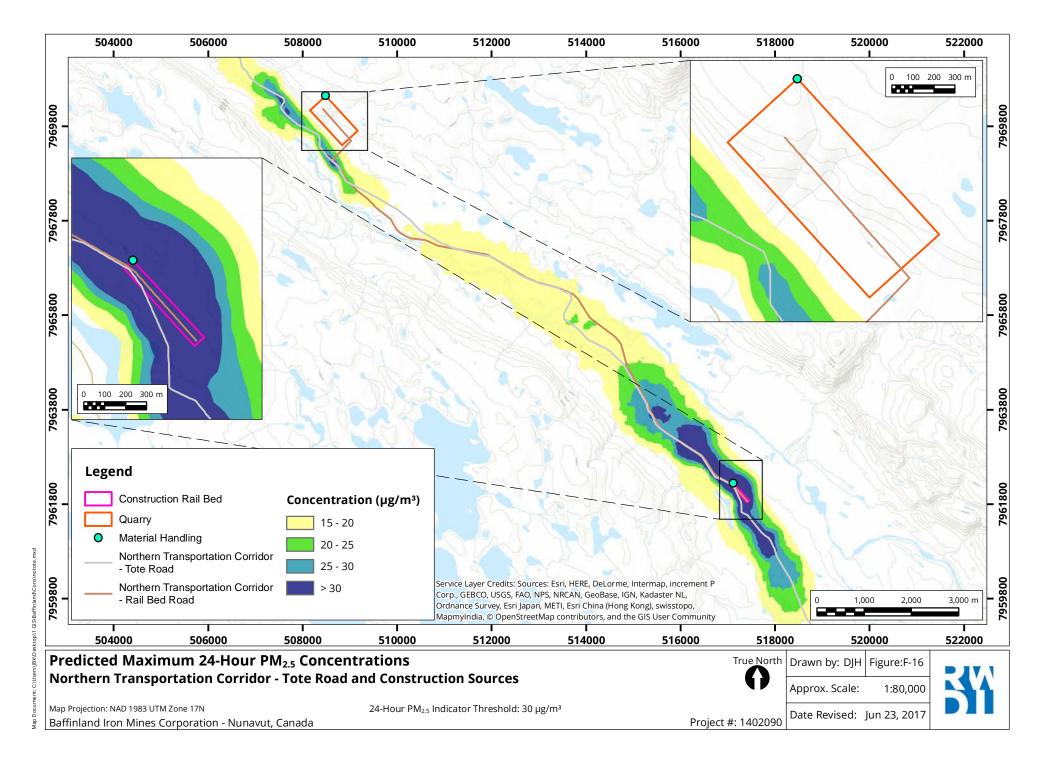


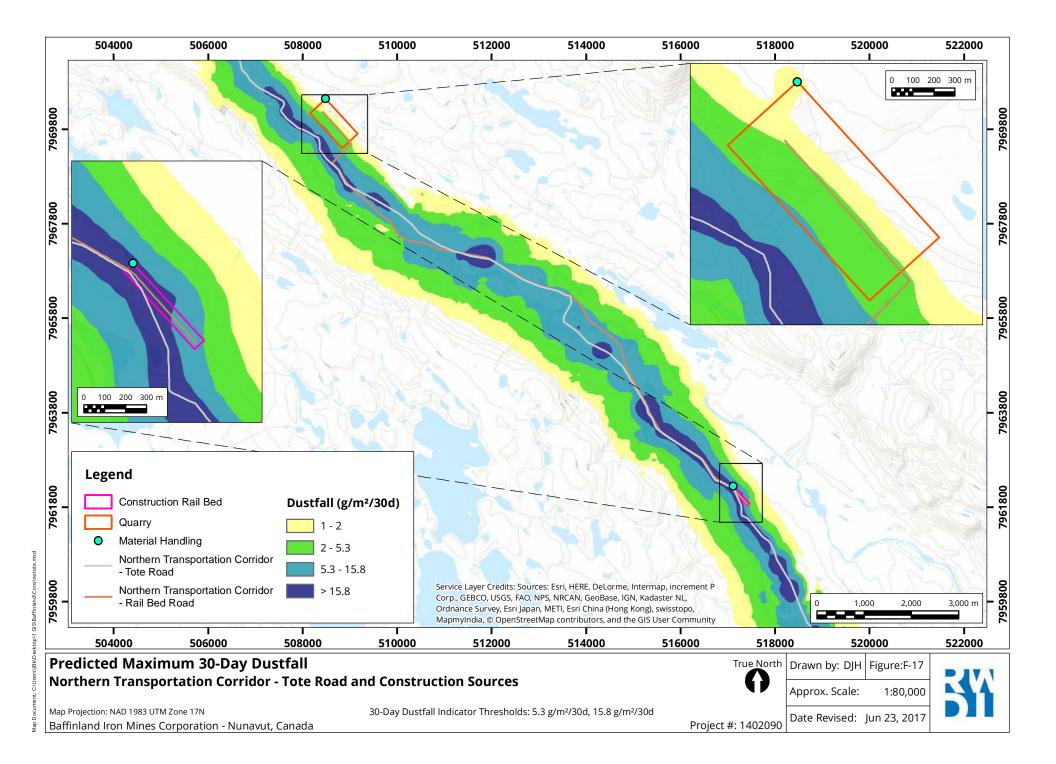


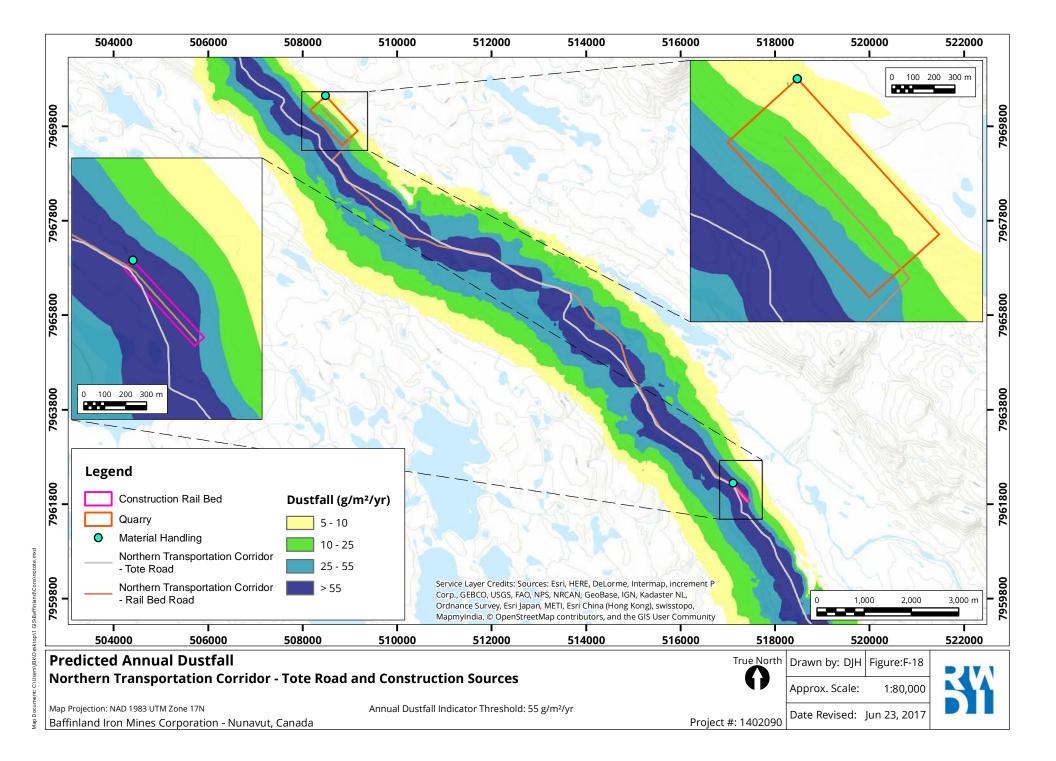














## **APPENDIX B**

UPDATED ENVIRONMENTAL AIR QUALITY IMPACT ASSESSMENT TO ADDRESS CHANGES IN PROJECT DESCRIPTION - MEMORANDUM

(Pages B-1 to B-16)



600 Southgate Drive Guelph, ON NIG 4P6 Canada Tel: +1.519.823.1311 Fax: +1.519.823.1316

E-mail: solutions@rwdi.com

# MEMORANDUM

DATE:	2018-07-30	RWDI Reference No.: 1402090			
TO:	Sara Wallace	EMAIL: sara.wallace@baffinland.com			
CC:	Lou Kamermans	EMAIL: lou.kamermans@baffinland.com			
CC:	Alain Carriere	EMAIL: alain.carriere@rwdi.com			
FROM:	Martin Gauthier	EMAIL: martin.gauthier@rwdi.com			
RE:	Updated Environmental Air Quality Impact Assessment to Address Changes in Project Description Baffinland Iron Mines Corporation Mary River Project – Phase 2 Proposal Technical Supporting Document 7				

Dear Sara,

In the Phase 2 Proposal Environmental Air Quality report, dated March 21, 2018, analysis was presented showing the predicted air quality contours from the construction of the Northern Transportation Corridor between Milne Port and the Mine Site. The analysis has been updated to account for a proposed temporary transfer site, and combined road and rail activity. Consideration has been given to a proposal to increase the power generation capacity at Milne Port, and an analysis has been done to address any changes in environmental noise impacts resulting from this change.

# NORTHERN TRANSPORTATION CORRIDOR

The updated analysis for the Northern Transportation Corridor presents predicted air quality impact of increased traffic on the Tote road, material handling activities at a Temporary Transfer Facility and construction activities. The Temporary Transfer Facility was relocated from its proposed location to a section of the Tote road previously modelled in Phase 2 Proposal Environmental Air Quality assessment. The major sources are shown in Figure 1.

For the purposes of this assessment, only the major dust emissions sources were considered. Combustion emissions (e.g., NO<sub>X</sub>, SO<sub>2</sub>) from the diesel generator and tailpipe emissions from loaders, locomotives and tractor-trailer trucks were not considered as there are no receptors of concern.

Road traffic emissions were doubled on the southern portion of the Tote road and removed on the northern portion of the Tote road going from the Temporary Transfer Facility to the Milne Port.



Sara Wallace Baffinland Iron Mines Corporation RWDI#1402090 July 30, 2018

Figures 2 to 7 present PM and dustfall results for the Tote Road and the Temporary Transfer Facility. As expected for the southern part of the Tote Road, the predicted levels that lie above the applicable indicator threshold are in general limited to within 500 m to 2 km of the Tote Road or the Temporary Transfer Facility.

Figures 8 to 13 present PM and dustfall results for the Tote Road, the Temporary Transfer Facility and construction activities. Overall, environmental impacts are dominated by the combined effect of the Tote Road and the Temporary Transfer Facility operations, and the impacts related to construction activities is relatively less significant.

# MILNE PORT GENERATORS

The March 21, 2018 report included modelling of 10 generators at Milne Port; five each of 1.35 and 2 MW units for a total of 16.75 MW of power generation capacity. It is understood that additional generators will be required at Milne Port to meet a capacity of 22 MW. If an additional four 1.35 MW generators were added in the vicinity of the existing generators, this represents a 32% increase of power generation that would generally translate into a linearly increase in emissions of contaminants.

 $SO_2$  and CO concentrations were previously modelled well below the selected criteria. Therefore, a 32% increase of  $SO_2$  and CO emissions from the generators will translate into an increase in concentrations less or equal to 32% that will still be lower than the selected criteria for those contaminants.

For NO<sub>2</sub> and PM<sub>2.5</sub>, the predicted exceedances were mostly associated with frost fighters and generators emissions near the accommodation building. Therefore, a 32% increase of NO<sub>2</sub> and PM<sub>2.5</sub> emissions from the generators will translate into an increase in concentrations less or equal to 32%. For both NO<sub>2</sub> and PM<sub>2.5</sub>, the area where the selected air quality criteria are exceeded could potentially cover the entire group of sensitive receptors placed at the accommodation building.

Yours truly,

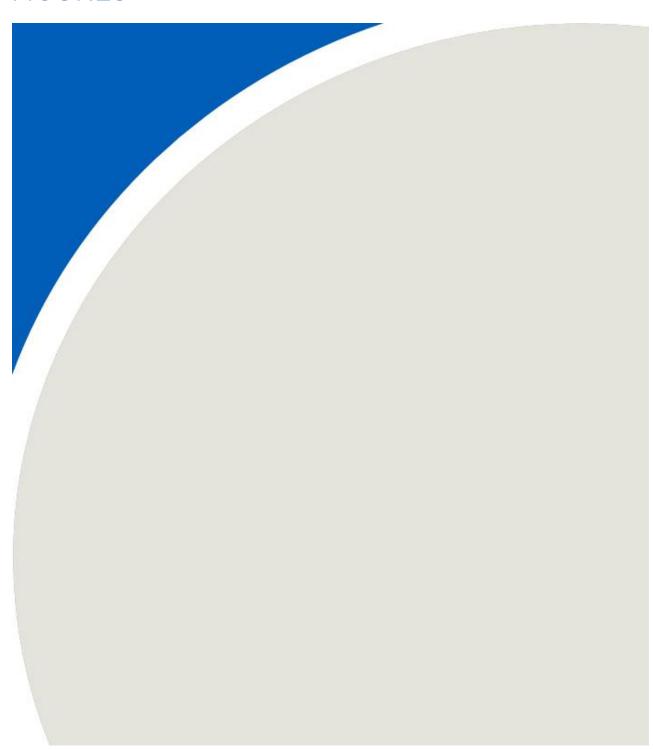
RWDI

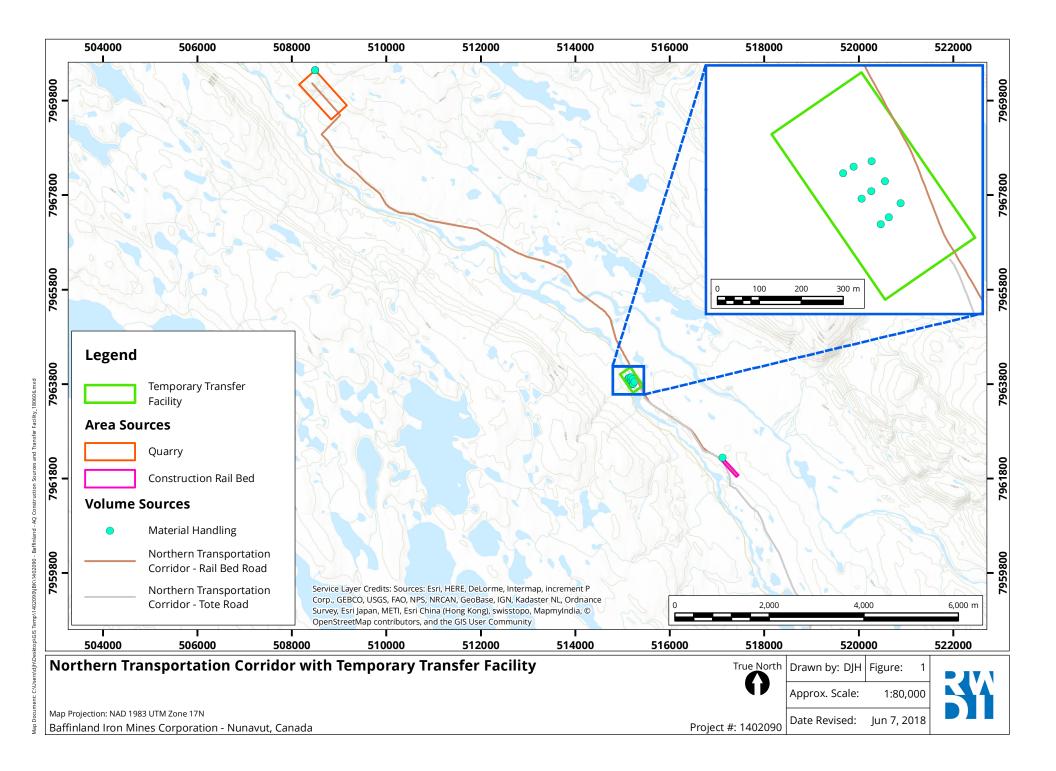
Martin Gauthier, M. Sc., ACM Technical Director, Meteorologist

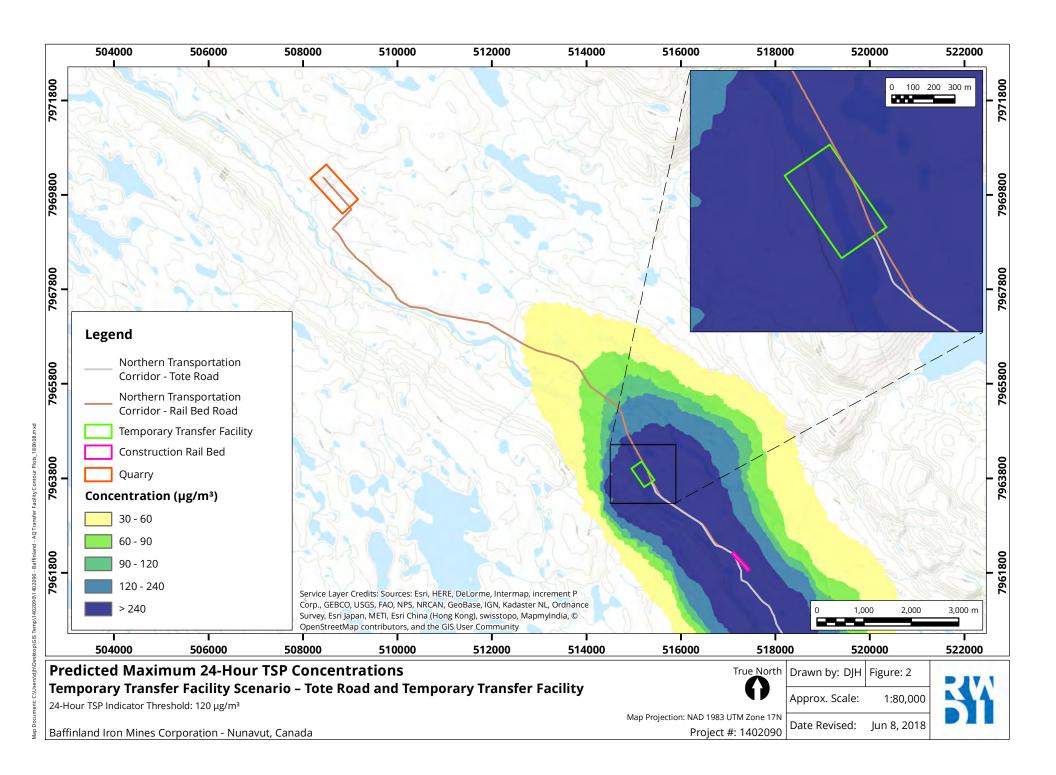
MG/klm Attach.

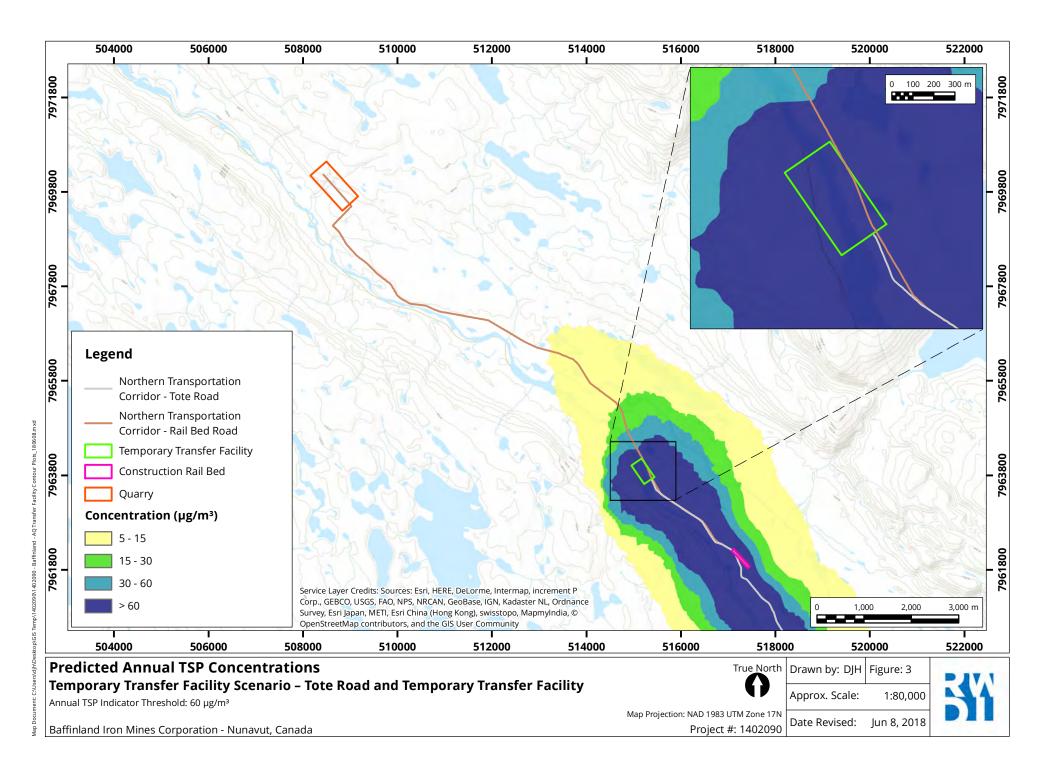


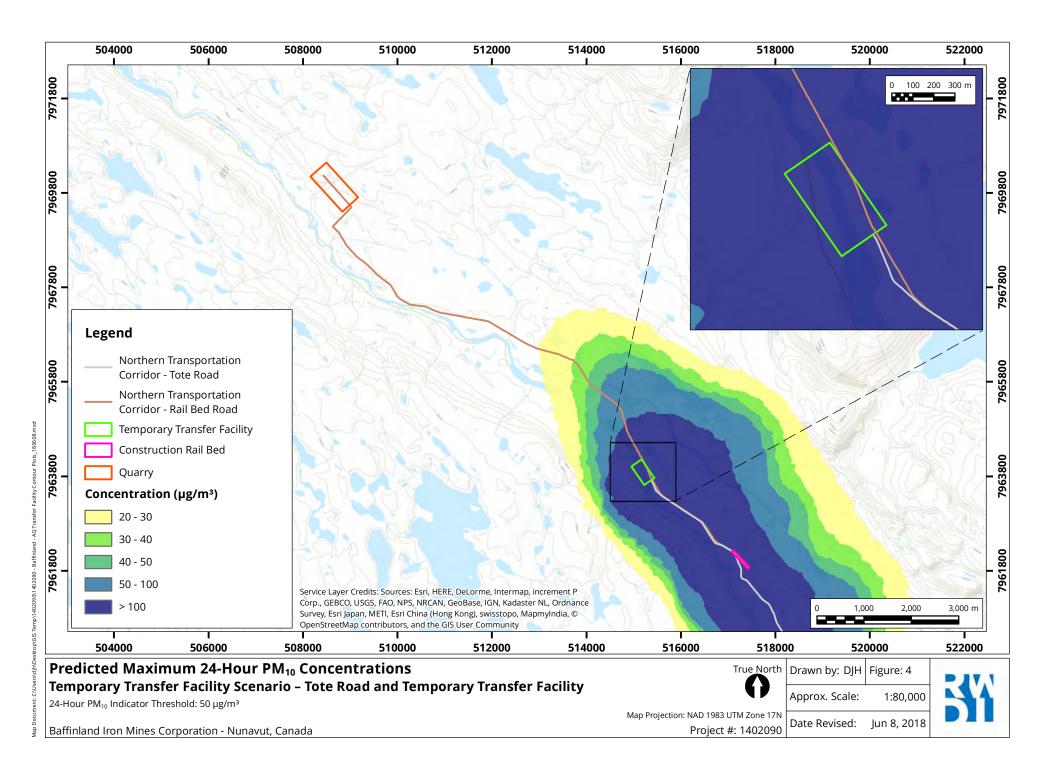
# FIGURES

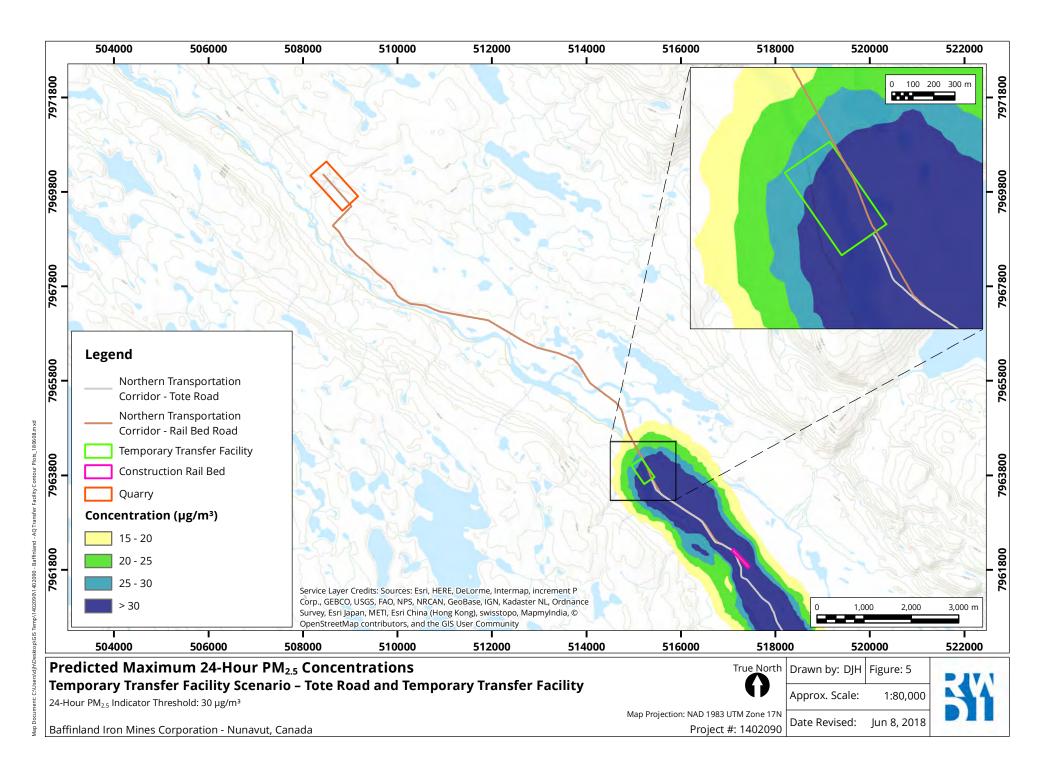


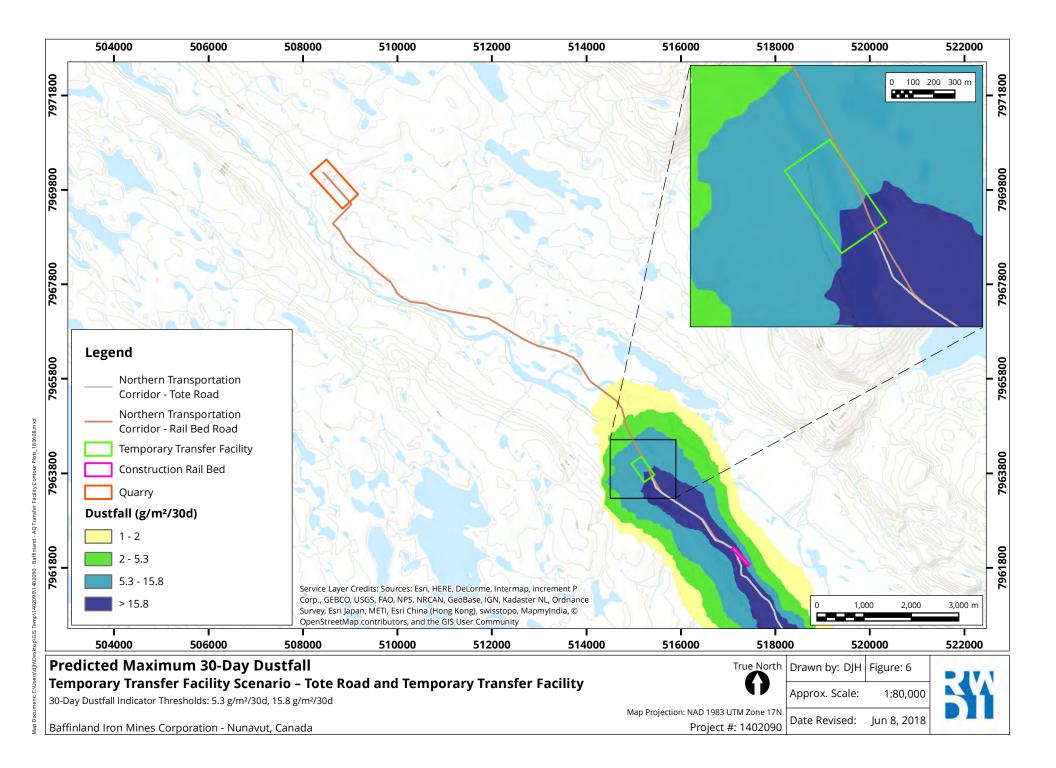


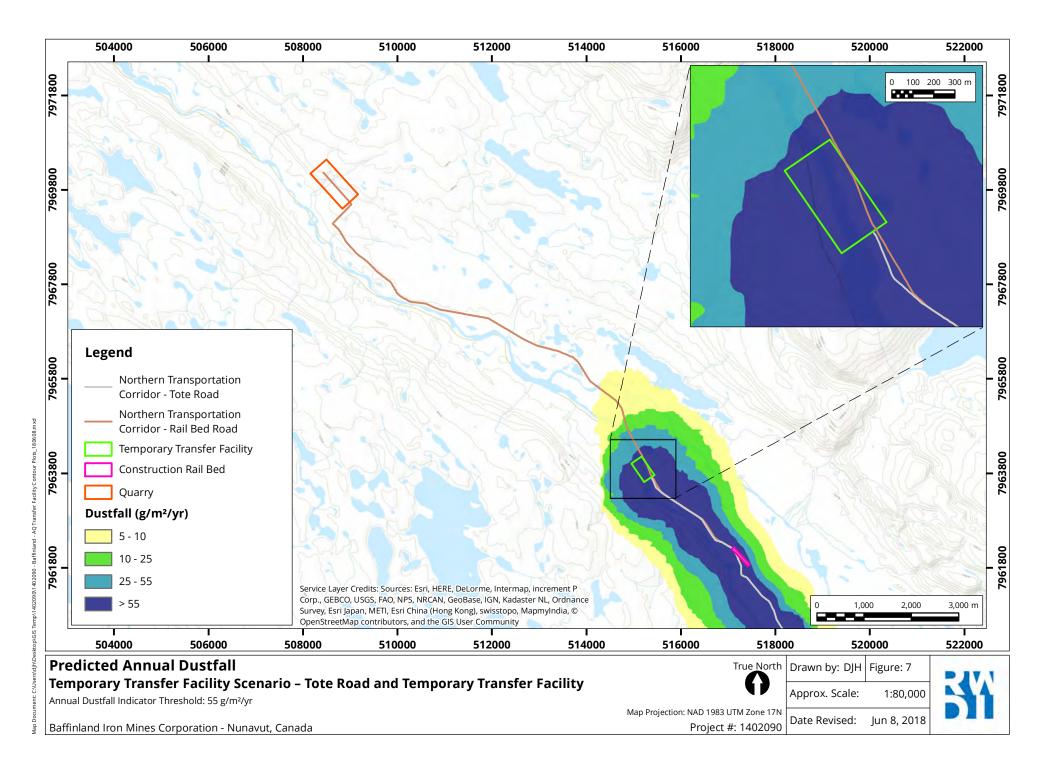


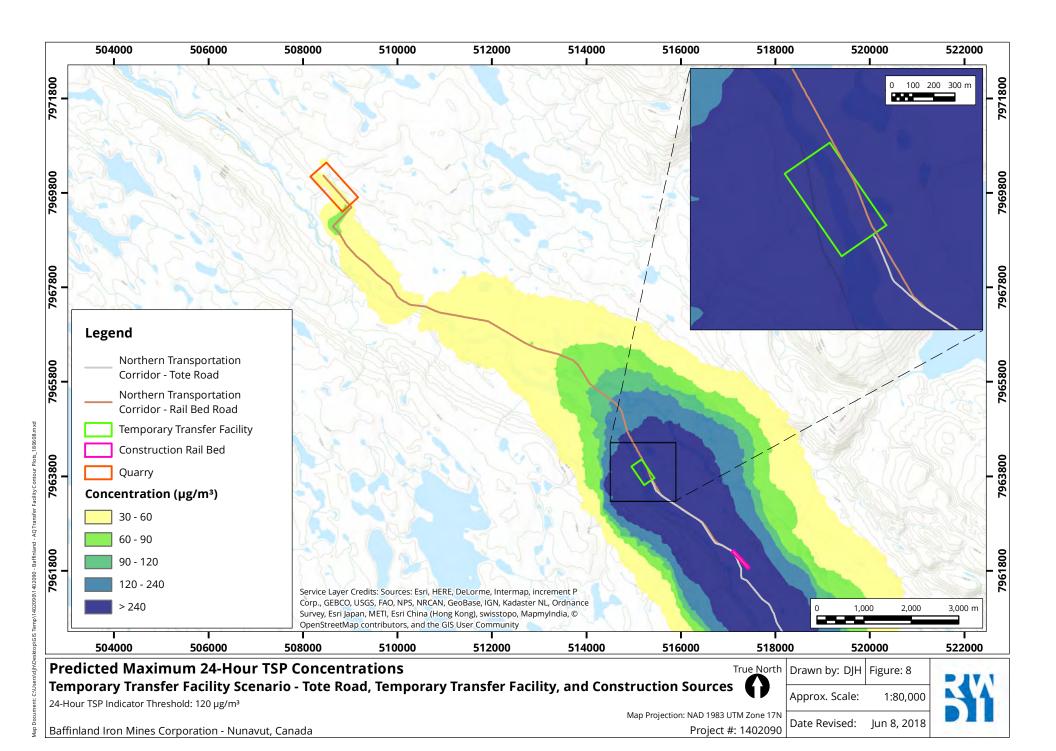


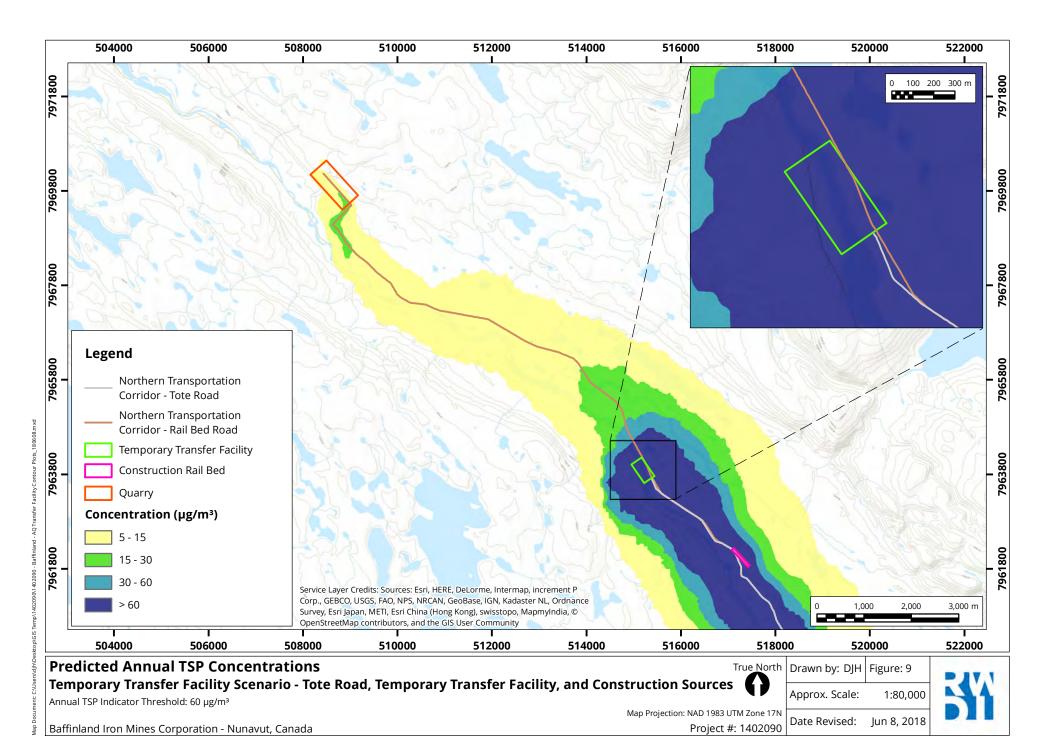


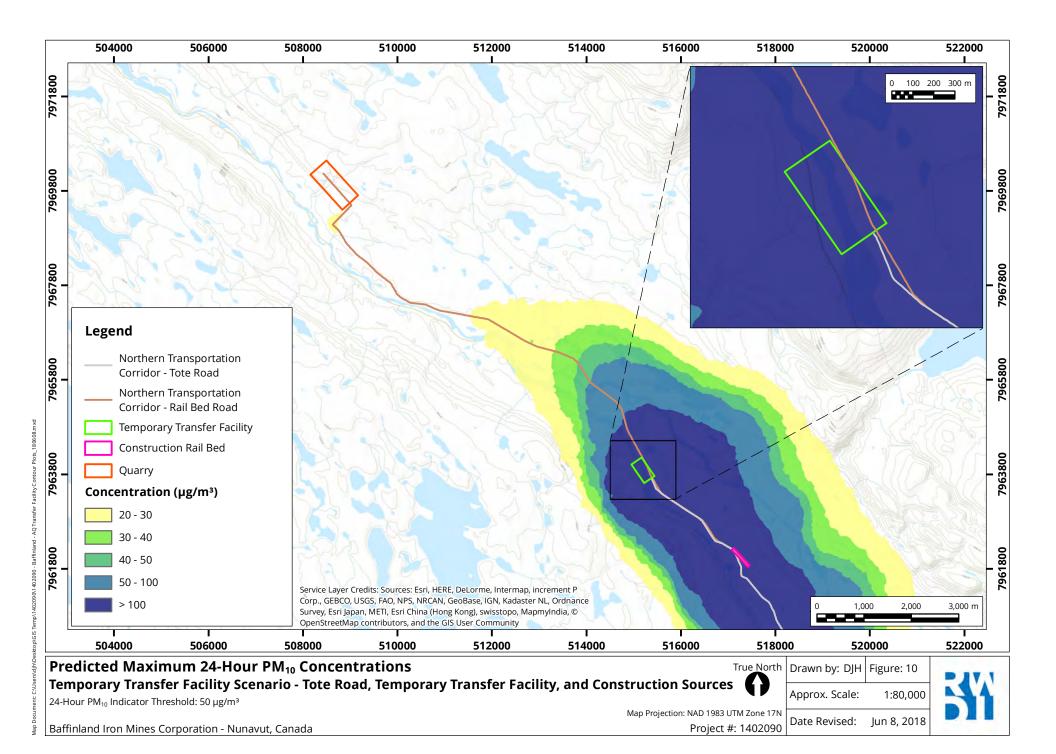


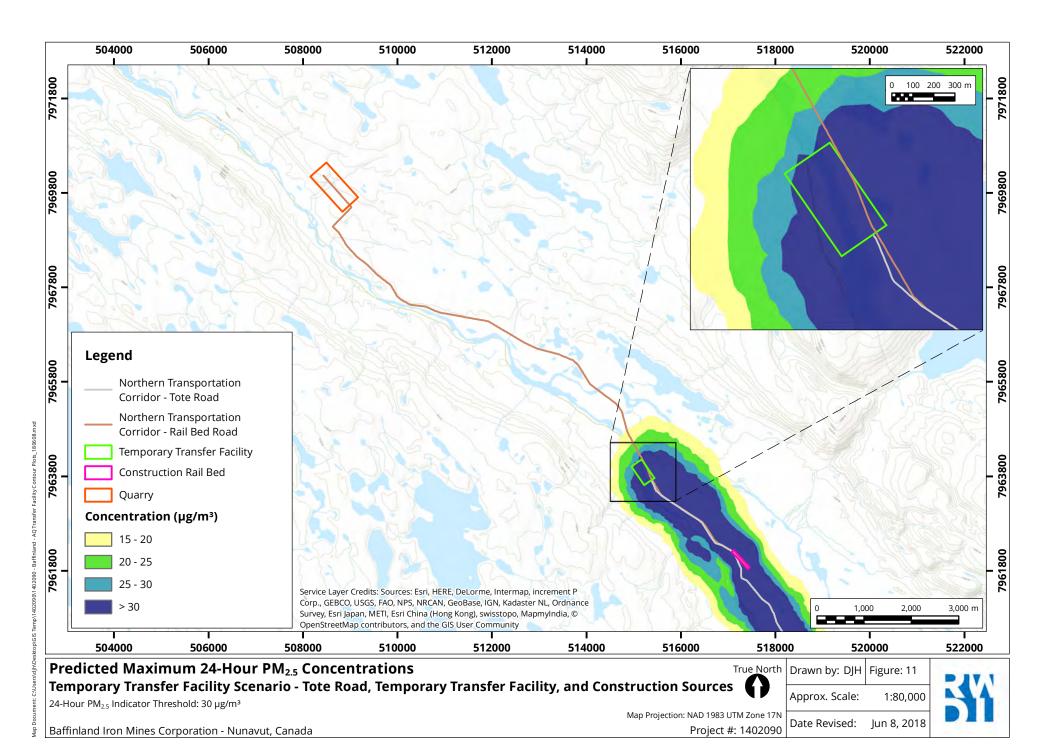


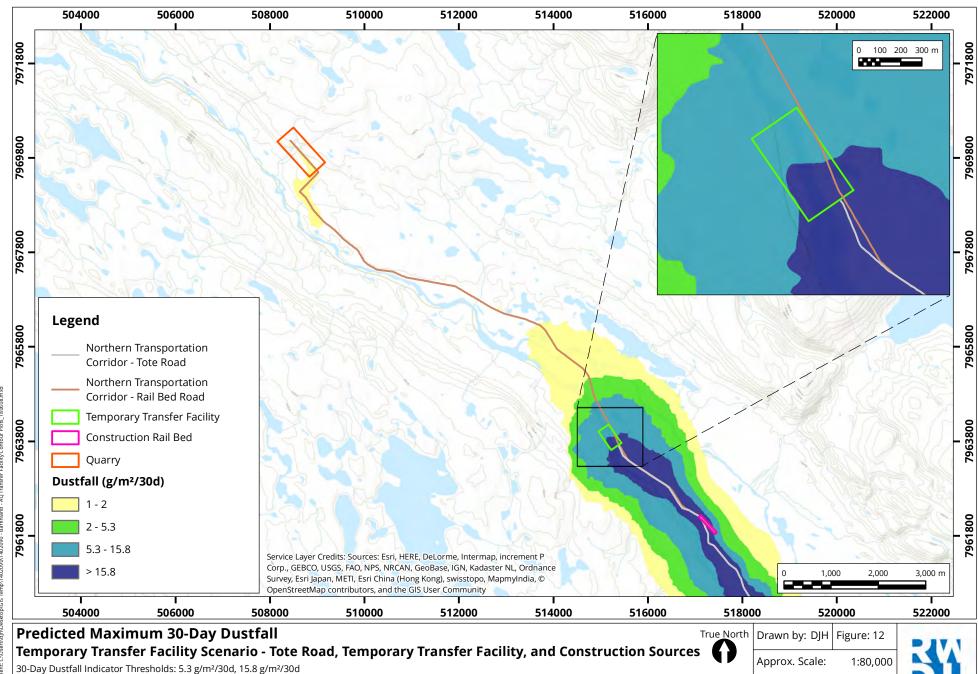












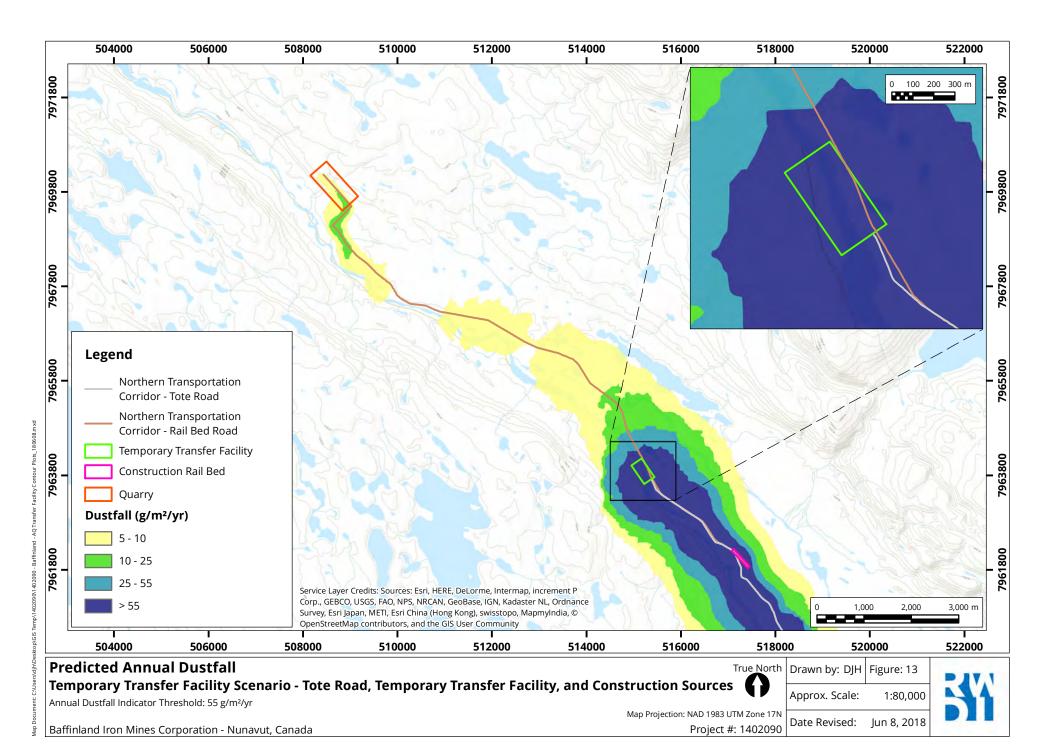
Map Projection: NAD 1983 UTM Zone 17N

Project #: 1402090

Date Revised: Jun 8, 2018

Map Document: C.\Users\dih\Desktop\GIS Temp\1402090\1402090 - Baffinlar

Baffinland Iron Mines Corporation - Nunavut, Canada





## **APPENDIX C**

UPDATED AIR QUALITY ASSESSMENT TO ADDRESS FREQUENCIES OF EXCEEDANCES - MEMO

(Pages C-1 to C-3)



600 Southgate Drive Guelph ON Canada NIG 4P6 Tel: +1.519.823.1311 Fax: +1.519.823.1316

E-mail: solutions@rwdi.com

# MEMORANDUM

DATE:	2018-07-30	RWDI Reference No.: 1402090
то:	Sara Wallace	EMAIL: sara.wallace@baffinland.com
CC:	Richard Cook	EMAIL: rcook@knightpiesold.com
СС	Alain Carriere	EMAIL: alain.carriere@rwdi.com
FROM:	Martin Gauthier	EMAIL: martin.gauthier@rwdi.com
RE:	Frequencies of Exceedances Baffinland Iron Corporation Mary River Project	

This short memo provides the predicted maximum concentrations for PM<sub>2.5</sub>, PM<sub>10</sub>, TSP and dustfall beyond the PDA as well as some frequency analysis results. Table 1, 2 and 3 show frequencies of exceedances of selected criteria at the Mine Site, the Milne Port and the Northern Transportation Corridor Site, respectively. Those tables show the maximum predicted values outside the PDA referred as the maximum point of impingement (MPOI) as well as the frequency of exceedances at distances of 0,500 and 1000 m from the MPOI. In all cases, the MPOI location falls on the boundary of the PDA.

As an example, table 1 shows that the maximum predicted value for TSP-24hr outside the PDA is 1109  $\mu g/m^3$  and the criterion of 120  $\mu g/m^3$  was predicted to be exceeded 98 times in one year. At distances of 500 m and 1000 m from the MPOI and perpendicular to the boundary of the PDA, the number of exceedances are predicted to be 26 and 11, respectively.

With the exceptions of PM10 – 24hr and TSP-24hr, the frequency of exceedances is equal to 0 at distance of 1 km from the MPOI or PDA.

There was no exceedances modelled at the Hunter Trapper Organization (HTO) cabins located near Milne Port and Mine Site.





Table 1: Frequency of exceedances of selected criteria outside the PDA at the Mine Site

					Frequency at distance [2]		
Pollutant	Period	MPOI [1]	Criterion	units	0 m	500 m	1000 m
PM <sub>2.5</sub>	24 hr	54	30	μg/m³	4	0	0
PM <sub>10</sub>	24 hr	402	50	μg/m³	41	23	6
TSP	24 hr	1109	120	μg/m³	98	26	11
TSP	Annual	82	60	μg/m³	1	0	0
Dustfall	30 days	21	15.8	g/m² per 30 days	1	0	0
Dustfall	Annual	144	55	g/m²/year	1	1	0

Note:

- [1] The MPOI is the maximum point of impingement outside the Proposed Development Area
- [2] Frequency expresses as number of time the selected criterion is exceeded for the selected period in one year

**Table 2**: Frequency of exceedances of selected criteria outside the PDA at the Milne Site

					Frequency at distance [2]		
Pollutant	Period	MPOI [1]	Criterion	units	0 m	500 m	1000 m
PM <sub>2.5</sub>	24 hr	85	30	μg/m³	6	0	0
PM <sub>10</sub>	24 hr	633	50	μg/m³	22	7	6
TSP	24 hr	1718	120	μg/m³	18	5	1
TSP	Annual	98	60	μg/m³	1	0	0
Dustfall	30 days	25	15.8	g/m² per 30 days	4	0	0
Dustfall	Annual	151	55	g/m²/year	1	0	0

Note:

- [1] The MPOI is the maximum point of impingement outside the Proposed Development Area
- [2] Frequency expresses as number of time the selected criterion is exceeded for the selected period in one year



**Table 3:** Frequency of exceedances of selected criteria outside the PDA at the Northern Transportation Corridor Site

					Frequency at distance [2]		
Pollutant	Period	MPOI [1]	Criterion	units	0 m	500 m	1000 m
PM <sub>2.5</sub>	24 hr	88	30	μg/m³	59	0	0
PM <sub>10</sub>	24 hr	845	50	μg/m³	338	54	29
TSP	24 hr	1523	120	μg/m³	353	75	6
TSP	Annual	503	60	μg/m³	1	1	0
Dustfall	30 days	42	15.8	g/m² per 30 days	12	0	0
Dustfall	Annual	342	55	g/m²/year	1	0	0

## Note:

- [1] The MPOI is the maximum point of impingement outside the Proposed Development Area
- [2] Frequency expresses as number of time the selected criterion is exceeded for the selected period in one year

Yours truly,

**RWDI** 

Martin Gauthier, M. Sc., ACM Technical Director, Meteorologist

MG/klm Attach.



## **APPENDIX D**

**ENVIRONMENTAL NOISE PHASE 2 PROPOSAL MARY RIVER PROJECT - REPORT** 

(Pages D-1 to D-47)

## **REPORT**



# ENVIRONMENTAL NOISE PHASE 2 PROPOSAL MARY RIVER PROJECT

BAFFIN ISLAND, NUNAVUT

RWDI #1402090 September 26, 2017

#### **SUBMITTED TO**

#### Adam Grzegorczyk

adam.grzegorczyk@baffinland.com
Baffinland Iron Mines Corporation
2275 Upper Middle Road East,
Suite 300
Oakville, ON L6H 0C3

#### **Richard Cook**

rcook@knightpiesold.com Knight Piésold Ltd. 1650 Main St. W., North Bay, ON P1B 8G5

#### **SUBMITTED BY**

#### **Alain Carriere**

Senior Project Manager / Associate <a href="mailto:alain.carriere@rwdi.com">alain.carriere@rwdi.com</a>

#### Kyle Hellewell, P.Eng.

Senior Engineer kyle.hellewell@rwdi.com

#### **RWDI**

600 Southgate Drive, Guelph, Canada, N1G 4P6 T: 519.823.1311 F: 519.823.1316

## TABLE OF CONTENTS

1	INTRODUCTION		
1.1	Back	kground	1
	1.1.1	Current Operations	1
	1.1.2	Phase 2 Proposal Overview	1
1.2	Obje	ectives	2
1.3	Noise	e Limits	2
	1.3.1	General Format of D038	2
	1.3.2	Dwellings	3
	1.3.3	Road, Rail, and Air Traffic	6
	1.3.4	Construction	6
1.4	Vibra	ation	6
2	ASS	ESSMENT METHODOLOGY	6
2.1	Base	eline Summary	8
	2.1.1	Baseline Monitoring Locations	8
	2.1.2	Baseline Noise Environment	8
	2.1.3	Baseline Vibration Environment	9
2.2	Mod	elling Methodology	9
	2.2.1	Selection of Worst-Case Modelling Year	9
	2.2.2	Project Noise Emissions	10
	2.2.3	Modelling	10
3	RES	ULTS	12
3.1	Cons	struction	12
	3.1.1	Mine Site	12
	3.1.2	Milne Port	12
	3.1.3	Northern Transportation Corridor	13
3.2	Oper	ration	17
	3.2.1	Mine Site	
	3.2.2	Milne Port	
	3.2.3	Northern Transportation Corridor	
	3.2.4	Aircraft	30
4	DEF	FRENCES	33

## LIST OF TABLES

Table 1:	Noise Assessment Approach
Table 2:	Baseline Noise Monitoring Results9
Table 3:	Worst-Case Modelling Years10
Table 4:	Modelling Parameters Used in the Analysis11
Table 5:	Mine Site Modelled Noise Levels - Operation Phase
Table 6:	Mine Site Modelled Indoor Noise Levels - Operation Phase
Table 7:	Milne Site Modelled Noise Levels - Operation Phase23
Table 8:	Milne Site Modelled Indoor Noise Levels - Operation Phase
LIST	OF FIGURES
Figure 1	: Mine Site Layout showing HTO Cabin, PDA, and Source Locations4
	: Milne Port Layout showing HTO Cabin, PDA, and Source Locations5
Figure 3	: Noise Contour Plot – Northern Transportation Corridor – Summer Conditions15
Figure 4	: Noise Contour Plot – Northern Transportation Corridor – Winter Conditions
Figure 5	: Noise Contour Plot – Mine Site – Summer Conditions20
Figure 6	: Noise Contour Plot – Mine Site – Winter Conditions21
Figure 7	: Noise Contour Plot – Milne Port – Summer Conditions25
Figure 8	: Noise Contour Plot – Milne Port – Winter Conditions26
Figure 9	: Approximate Rail Noise Levels vs. Distance from Rail Centre-line27
Figure 1	0: Noise Contour Plot – Northern Transportation Corridor – Summer Conditions28
Figure 1	1: Noise Contour Plot – Northern Transportation Corridor – Winter Conditions29
Figure 1	2: Mine Site Noise Exposure Forecast – Eastward Takeoffs31
Figure 1	3: Mine Site Noise Exposure Forecast – Westward Takeoffs

### LIST OF APPENDICES

Appendix A: Noise Metrics

Appendix B: Noise Source Summaries

## **VERSION HISTORY**

Index	Index Date		Author
1	June 19, 2017	All	Gillian Redman
1.1	September 26, 2017	2	Gillian Redman

### 1 INTRODUCTION

### 1.1 Background

**September 26, 2017** 

#### 1.1.1 Current Operations

The Mary River Project is an operating open pit iron ore mine located on northern Baffin Island in the Qikiqtani Region of Nunavut. The operating Mine Site is connected to a port at Milne Inlet (Milne Port) via the 100-km long Milne Inlet Tote Road. Future but yet undeveloped components of the Project include a South Railway connecting the Mine Site to a future port at Steensby Inlet (Steensby Port).

Project Certificate No 005 currently authorizes Baffinland to mine up to 22.2 million tonnes per annum (Mtpa) of iron ore from Deposit No. 1. Of this, the Company may transport up to 18 Mtpa of ore by rail to Steensby Port for year-round shipping through Foxe Basin and Hudson Strait (the original project proposal described in the FEIS), and transport up to 4.2 Mtpa of ore by truck to Milne Port for open water shipping (the Early Revenue Phase; ERP). To date, Baffinland has been operating the 4.2 Mtpa ERP.

### 1.1.2 Phase 2 Proposal Overview

Baffinland is seeking a second amendment to its Project Certificate No. 005 to allow the Company to implement its Phase 2 Proposal. The Phase 2 Proposal consists of a near-term expansion of the 4.2 Mtpa ERP operation to 12 Mtpa, followed by the subsequent additional development of the originally approved 18 Mtpa South Rail operation. The Phase 2 Project will involve the following components and activities:

- An increase in mining production over time from 4.2 Mtpa to 12 Mtpa, and eventually to 30 Mtpa
- Further development of the Northern Transportation Corridor which includes:
  - Tote Road upgrades
  - Construction of a North Railway (North Rail) adjacent to the Tote Road
  - o Increased truck transits on the Tote Road until the North Rail is operational
  - Construction of a rail terminal at Milne Port for unloading of ore
  - Construction of a maintenance facility and construction camp mid-way along the northern transportation corridor
- Further development of the Milne Port area which includes:
  - o A second ore dock capable of berthing cape size vessels
  - A freight dock
  - o Relocation of secondary crushing and screening from the Mine Site to Milne Port
  - A rail maintenance facility

- Changes to shipping activities which include:
  - An increase in shipping transits through Northern Shipping Route during the open-water season
  - An extension of the shipping season into early ice conditions up to when the landfast ice is being used by Inuit, approximately mid-November

No changes to the Steensby Port site are occurring as part of Phase 2 Proposal.

### 1.2 Objectives

The purpose of this report is to update the FEIS to include:

- An increase in ore shipping from Milne Inlet to 12 Mtpa;
- An increase in production at the Mine Site to 30 Mtpa; and
- The construction of a north railway connecting the Mine Site to Milne Inlet.

This assessment updates the noise modelling to reflect these changes and compares the predicted sound levels to the applicable sound level limits. It should be noted that operations at Steensby Port remain unchanged from the FEIS and are therefore not discussed in this report.

#### 1.3 Noise Limits

Nunavut has no regulations or guidelines that address environmental noise levels. However, noise has been previously addressed for this project using the Alberta Energy Regulator (AER) Directive 038 guidelines (AER, 2007).

Projects in the Territories, have typically adopted the Alberta Energy Regulator (AER) Directive 038 guidelines (AER, 2007) as indicative of what is generally considered acceptable with respect to noise levels from industrial activities in remote areas. In the absence of specific guidelines for Nunavut, the AER Directive 038 guidelines were adopted as the guidelines for this assessment.

#### 1.3.1 General Format of D038

D038 sets out Permissible Sound Levels (PSLs) that must be met at all dwellings surrounding a project. These limits apply to operational noise only. The cumulative sound level from all energy related (in this case Project-related) development in the area is measured or predicted. This is called the Comprehensive Sound Level (CSL), and is compared to the PSL. The CSL includes ambient sound levels.

The base PSL value is an average 1-hour sound level ( $L_{EQ}$  (1)) of 40 dBA, which is based on a typical rural or remote Ambient Sound Level (ASL) of 35 dBA, plus a 5 dB allowance for the industrial activity. Research conducted by Alberta Environment showed that, in general, people tolerate sound from energy facilities of up to 5 dB above the ambient sound environment. Additional information on noise metrics assessed is provided in Appendix A – Noise Metrics.

RWDI#1402090 September 26, 2017

The PSL may be increased to account for the presence of other industrial and transportation noise sources, such as road and rail traffic, and for the population density of developed areas.

In remote pristine areas, an ambient sound level adjustment based on measured existing sound levels, may be applied; this may reduce the PSL at these locations.

The CSL from the Project (facility noise plus ambient) must meet a PSL of 40 dBA  $L_{EQ}$  (Night) at dwellings, and at 1.5 km from the facility fence line. In this assessment, the only dwellings located closer than the 1.5 km facility "fence line" are two Hunter Trapper Organization (HTO) cabins. This limit applies to Project-related activities at the Mine Site and Milne Port.

The "fence line" is not defined for facilities such as those at the Baffinland sites, where there is no fence or other fixed facility boundary. This assessment uses the potential disturbed area (PDA) as a proxy for the fence line. Thus, the PSL for these facilities is 40 dBA at 1.5 km from the PDA. The PDA for the Mine Site and Milne Port and the locations of the existing HTO cabins are included in Figure 1 and Figure 2, respectively.

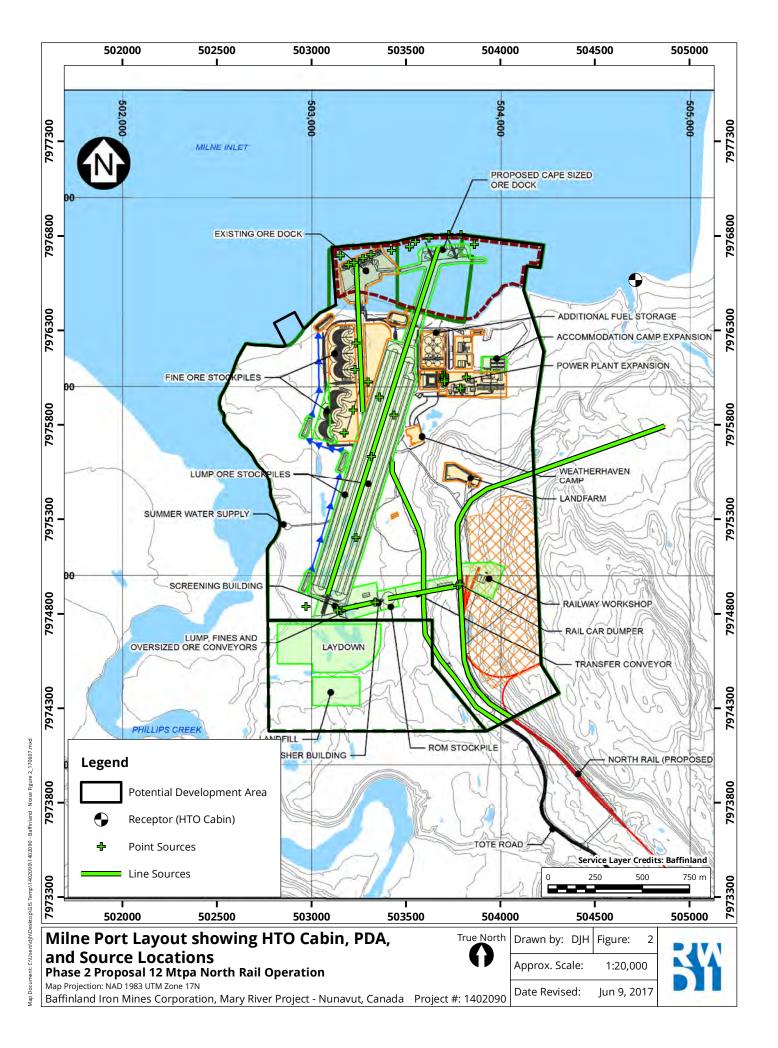
#### 1.3.2 Dwellings

A dwelling is defined in D038 as permanently or seasonally-occupied residences, including trailer parks and campgrounds in regular and consistent use. Worker residences, dormitories and construction camps are specifically excluded. The HTO cabin near the Mine Site is located on the west side of Camp Lake, opposite the Mine Site. The cabin was constructed by Baffinland during mine construction to replace a historic cabin within the Mine Site that was lost due to mine development. While the replacement cabin is located near to both the Mine Site and the Milne Inlet Tote Road, it was the preferred location selected by the Mittimatalik Hunters and Trappers Organization (MHTO). The MHTO wished to have a cabin located near to the Mine Site with close access to the Milne Inlet Tote Road. At Milne Port there is an HTO cabin located to the east of the site. The HTO cabin dates back to the exploration activities in the early 1960s, and as such, the cabin is in poor condition and is used more as a refuge than a place to stay. However, the beach in front of the cabin is the location where community members and hunters bring their boats to shore in the open water season. Both of these meet the D038 definition of a dwelling as noise-sensitive receptors and are considered in the noise assessment.

Although work camps are specifically excluded from the requirements of D038, worker health demands an adequate sleep environment. Interior levels can be characterized using Balanced Noise Criterion (NCB) curves. The NCB method was developed by Beranek (Beranek, 1989). Beranek recommends a range of NCB 25 to NCB 40 for bedrooms, hotels, and buildings with similar uses.

If required, mitigation measures may be specified, including but not limited to:

- Relocation of the dwellings;
- Reorientation of the dwellings;
- Berms or noise barriers near the dwellings; and
- Upgraded building construction such as upgraded windows and mandatory air conditioning.



September 26, 2017

#### 1.3.3 Road, Rail, and Air Traffic

D038 provides no guidance on noise from road and rail traffic sources outside of the facility boundaries (road and rail noise within the boundary of a facility is generally included in the modeled noise sources).

Noise from these sources will be intermittent in nature, occurring only when a vehicle passes by. They will be remote from any stationary human receptors, although caribou hunters can be expected to be travelling through the area. While specific guideline limits are not established, predictions of noise from these sources are provided for other disciplines to use in their assessments.

D038 provides no guidance for noise from air traffic. Federal regulations exist for average sound levels at airports, but those are not appropriate to a remote airstrip with limited traffic. According to Transport Canada, land exposed to Noise Exposure Forecast (NEF) contours NEF 30 and greater are typically subject to development restrictions. Noise from aircraft will be intermittent and will be remote from all human receptors outside of the Mine Site, and Milne Port. Noise from aircraft ground operations has not been assessed.

#### 1.3.4 Construction

D038 noise guideline limits do not apply to construction activities. Instead, good management practices are required to reduce the potential for effects. These are discussed further in Section 3.1.

#### 1.4 Vibration

The vibration assessment conducted in the FEIS remains relevant to this assessment. At the Mine Site and Milne Port, no changes in the equipment are expected to change the results of the previous vibration assessment. Construction activities at the Mine Site, Milne Port, Steensby Port, and South Rail have the potential to generate perceptible vibration levels that extend outwards from blasting activities; however, since there are no vibration-sensitive environmental receptors, significant effects are not anticipated. Vibration during the Operations Phase at the Mine Site are expected to be minor, with the exception of blasting at the pit working face, where levels are predicted to be potentially perceptible but not of concern. There are no major sources of vibration associated with Milne Port or Steensby Port operations, and therefore no notable effects are expected. Vibration from truck traffic along the Milne Inlet Tote Road and rail traffic on the South Rail will be intermittent and temporary, so significant effects are not anticipated. The vibration assessment for the North Rail will be the same as the South Rail vibration assessment.

### 2 ASSESSMENT METHODOLOGY

A standard assessment approach was used to determine the potential effects of the Project. This approach is outlined in Table 1 and included the following tasks:

• Review predicted project lifecycle, and determine worst-case year for noise emissions for each site;

- Identify and quantify noise emission sources (for Mine Site, Milne Inlet, and the Northern Transportation Corridor);
- Use baseline monitoring results to establish existing sound levels;
- Use noise models to predict levels from worst-case operations; and
- Compare the predicted noise modelling results to the guideline limits.

Effects during the Construction and Closure and Reclamation phases were assessed qualitatively. The Operations Phase was assessed quantitatively for the Mine Site, Milne Inlet, and the Northern Transportation Corridor.

**Table 1: Noise Assessment Approach** 

Component	Description	
Establishment of Noise Guideline Limits	Guideline limits for noise were established based on a review of the relevant guidelines.	
Review of Baseline Noise Environment	An baseline monitoring program was undertaken to establish baseline noise conditions in the absence of the Project.	
Establishment of Year of Worst-Case Noise Emissions	The Project description was reviewed to determine the year corresponding to the worst-case impacts for noise based on activities and equipment quantities.	
Noise Emission Characterization	Facility designs were reviewed to identify equipment and activities that have the potential to generate significant levels of noise and vibration. Predictable worst-case scenarios for noise and vibration effects from the Project were developed for locations of equipment, timing and intensity of operations, etc. Noise emission data for significant sources were then determined, based on manufacturer's data, measurements of existing/similar equipment, or engineering estimates using published emission factors.	
Noise Modelling Approach	Noise effects from summer and winter conditions were modelled using a computerized version of the ISO 9613 international standard noise model.	

The impacts during the Closure and Reclamation phases were assessed qualitatively. The impacts during the Construction phase was assessed qualitatively for the Mine Site and Milne Port, but quantitatively for the Northern Transportation Corridor. The Operations Phase was assessed quantitatively for the Mine Site, Milne Port, and the Northern Transportation Corridor.

### 2.1 Baseline Summary

**September 26, 2017** 

A detailed baseline assessment conducted in 2007 is documented in a baseline noise assessment report which was included as Appendix 5D-1 of the FEIS. The basic procedure to establish baseline noise levels consisted of:

- Conducting measurements and recording sound levels at Milne Inlet, and the Mine Site;
- Validating the data based on the recordings and weather information; and
- Calculating the resulting validated sound level data.

In the absence of specific requirements for Nunavut, the noise measurement requirements of Alberta Energy Regulator (AER) Directive 038: Noise Control (AER, 2007) were followed. Where additional guidance on equipment and measurement techniques was required guidance was drawn from the Ontario Ministry of the Environment Publications NPC-103 (MOE, 1977).

#### 2.1.1 Baseline Monitoring Locations

Sound level meters were operated for approximately 10 days in July 2007 near the Mine Site, and Milne Port. The locations were chosen to ensure minimal effect from exploration activities underway at the time. Effects from frequent low-flying aircraft were unavoidable, but were excluded during analysis. Distances of approximately 2 km from the exploration activities at the Milne site and approximately 1 km from the exploration activities at the Milne Port site was found to be sufficient to prevent interference from noise caused by most other human activity.

#### 2.1.2 Baseline Noise Environment

The Local Study Areas, because of their remote locations, are not presently influenced by any existing permanent anthropogenic noise sources. The only anthropogenic noise in the Project area at the time of the baseline monitoring came from the existing mineral exploration, baseline environmental data collection activities and the occasional traditional use of the area by hunters, trappers and fishermen.

Atmospheric noise levels in remote areas are typically low, ranging from about 25 to 40 dBA, similar to those measured for the Mine Site, and Milne Port.

September 26, 2017

Table 2 shows measured ambient noise values for each site. At these levels, noise would be described as faint.

**Table 2: Baseline Noise Monitoring Results** 

Site	L <sub>EQ</sub> (24 h)	L <sub>EQ</sub> (Day, 15h)	L <sub>EQ</sub> (Night, 9h)	Minimum L <sub>EQ</sub> (1 h)	Maximum L <sub>EQ</sub> (1 h)
	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)
Mine Site	25	25	26	20	34
Milne Port	30	31	29	21	35

Noise observed at all sites consists mainly of wind, insect, and small animal and bird noise. Flowing water and breaking waves contribute to the baseline noise levels the Milne Port site. Differences observed between daytime and night-time sound levels are generally small, and are attributed mainly to very low level noise from human activity that could not be screened out.

#### 2.1.3 Baseline Vibration Environment

As there are no anthropogenic sources of vibration in the area other than Baffinland-related activities, baseline vibration measurements were judged unnecessary.

### 2.2 Modelling Methodology

#### 2.2.1 Selection of Worst-Case Modelling Year

As the activities at each site vary from year-to-year, different worst-case years were chosen to assess the worst-case scenario for each site. The worst-case year and its associated operations for each site are outlined below in Table 3.

**Table 3: Worst-Case Modelling Years** 

Site	Year	Activities
Mine Site	2030	30 Mtpa of extraction using maximum quantity of mine equipment.
Milne Port	2024	12 Mtpa of ore shipped to Milne Port by north railway. Ore crushing facility operating. Second ore dock and ship loader operating.
Northern Transportation Corridor - Operations	2024	Transportation of 12 Mtpa by rail from the Mine Site to Milne Port.
Northern Transportation Corridor - Construction	2019	6 Mtpa shipped from the Mine Site to Milne Port on the existing Tote Road. 0.3 Mtpa shipped from the Mine Site to construction areas on the existing Tote Road. Construction of the North Railway.
Aircraft	2026	Maximum forecasted number of flights of 1342.

#### 2.2.2 Project Noise Emissions

Initial phases of the project have been constructed, but many other parts have not yet been constructed. There are therefore limited direct measures of Project noise emissions. Where direct measurements were not possible, noise emissions were estimated based on engineering data for the proposed equipment, obtained from:

- Manufacturer's data for specific equipment, where available;
- Previously measured data of similar equipment from previous studies;
- Published engineering estimates from textbooks; and
- Data from published prediction models.

Activities with corresponding locations and utilization rates were collected from the Project Description and Project engineering staff. Manufacturer's data on file for similar equipment was used where appropriate.

Appendix B provides technical details regarding the noise source emission inventory for the Mine Site, and Milne Port.

#### 2.2.3 Modelling

On- and Off-site sound levels were modelled using Cadna/A, a software implementation of the internationally recognized ISO 9613 environmental noise propagation algorithms (ISO, 1993 & 1996). Cadna/A is produced by Datakustik GmbH. The modelling took into account the following factors:

- Source sound power level and directivity;
- Distance attenuation;
- Source-receptor geometry, including heights and elevations;
- Barrier effects of the buildings and surrounding topography;
- Ground and air (atmospheric) attenuation; and
- Meteorological effects on noise propagation.

The ISO 9613 algorithms are the current international standard for airborne noise propagation, and are widely used in noise assessments in Canadian jurisdictions. Modelling parameters have been selected to conform to the ISO standard, as presented below in Table 4.

**Table 4: Modelling Parameters Used in the Analysis** 

Modelling Parameters	Value Used in the Analysis
Ground Absorption	0.8 (summer) / 1.0 (winter)
Temperature	8° C (summer) / -30° C (winter)
Relative Humidity	70 %
Effective Stability Class (per ISO 9613)	E
Barrier Parameters	
Include Ground Absorption over Barrier?	No
Negative Path Length Allowed?	Yes
Barrier Lateral Diffraction Distances	3000 m
Reflection Parameters	
Order of Refection	0
Reflection Loss	n/a
Reflection Search Distances	n/a

Summer and winter conditions were modelled. Temperatures represent the mean maximum temperature for June-July-August, and the mean minimum temperature for November December-January, respectively, based on climate normals measured at Mary River for 2005 to 2007. Noise emissions of the Mine Site and Milne Port will be greatest during the spring and fall seasons when shipping is occurring at Milne Port, and winter equipment is in operation.

The ground attenuation factor G is one of the most important parameters. In the ISO 9613 algorithms, G is a value ranging from 0 to 1, with 1 being perfectly absorptive, and 0 being perfectly reflective. RWDI's selection of 0.8 for summer conditions takes into account the presence of vegetation and exposed rock. RWDI's selection of 1.0 for winter conditions takes into account the presence of snow cover. The selection of the values is also based on RWDI's experience and review of the results of previous studies where modelling and measurements were conducted. The ISO 9613 equations are known to under predict the effects of ground absorption over long distances, resulting in slightly conservative over-predictions.

### 3 RESULTS

#### 3.1 Construction

A detailed noise modelling assessment was not conducted for the Construction Phase of the Mine Site or Milne Port because of the intermittent and temporary nature of activities, and the absence of detailed information on construction activities. During site visits by RWDI personnel it was noted that typical construction equipment was present at the sites. Therefore, a typical qualitative assessment of construction noise was used to assess the potential effects for the Mine Site and Milne Port.

A noise modelling assessment was completed for the Construction Phase of the North Railway of the Northern Transportation Corridor. The effects from the construction were assessed based on:

- · Quantities and utilizations of equipment used for different stages of construction; and
- Locations of guarries that will be used during the construction of the North Railway.

#### 3.1.1 Mine Site

The effect of the construction of the North Railway, and additional infrastructure at the Mine Site associated with the railway and increased production volume will not significantly change the effects of construction as assessed under the FEIS. Therefore, the construction assessment included in the FEIS remains unchanged.

#### 3.1.2 Milne Port

#### 3.1.2.1 Activities, Equipment and Schedule

Construction activities with the potential for noise emissions include:

- Preparation of lay down areas or work areas;
- Construction of project facilities;
- Construction of access roads;
- Construction of the railway and associated infrastructure from the Mine Site to Milne Port;

Construction of secondary crushing and screening facilities;

RWDI#1402090 September 26, 2017

- Construction of an additional loading dock; and
- Development of existing aggregate sources for rock, sand and gravel.

#### 3.1.2.2 Estimate of Noise Effects

The following noise emissions are expected at the Mine Site during construction:

- Noise levels at some locations may be moderate to loud depending on proximity to the sources. There is a potential for perceptible construction noise to extend out to 1.5 km from the PDA.
- The duration of effect is short-term. The frequency of effect is occasional and the effect is reversible. The effect is anticipated to be insignificant after implementation of the mitigation measures described below.

#### 3.1.2.3 Recommended Noise Controls

Construction noise effects are temporary, and therefore higher noise levels are generally acceptable; this is why construction noise is exempt from AER Directive 038 (AER 2007). However, D038 recommends that, where feasible, mitigation measures be used to minimize noise effects on nearby residents. Among the various measures recommended in D038, the following are applicable in the present case:

- Ensure that all internal combustion engines are fitted with appropriate muffler systems; and
- Take advantage of acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise.

Where feasible, temporary construction accommodations should be sited to avoid potential construction noise effects.

#### 3.1.3 Northern Transportation Corridor

#### 3.1.3.1 Activities, Equipment and Schedule

Construction activities for construction of the North Railway as part of the Northern Transportation Corridor with the potential for noise emissions include:

- Construction of the rail bed for the North Railway;
- Transportation of 300 kt of aggregate material for construction activities while the existing 6 Mtpa of material on the tote road to Milne Port for shipment continues; and
- Aggregate extraction at quarries within the Northern Transportation Corridor, including: drilling, loading, and crushing/screening.

#### 3.1.3.2 Construction Noise Levels

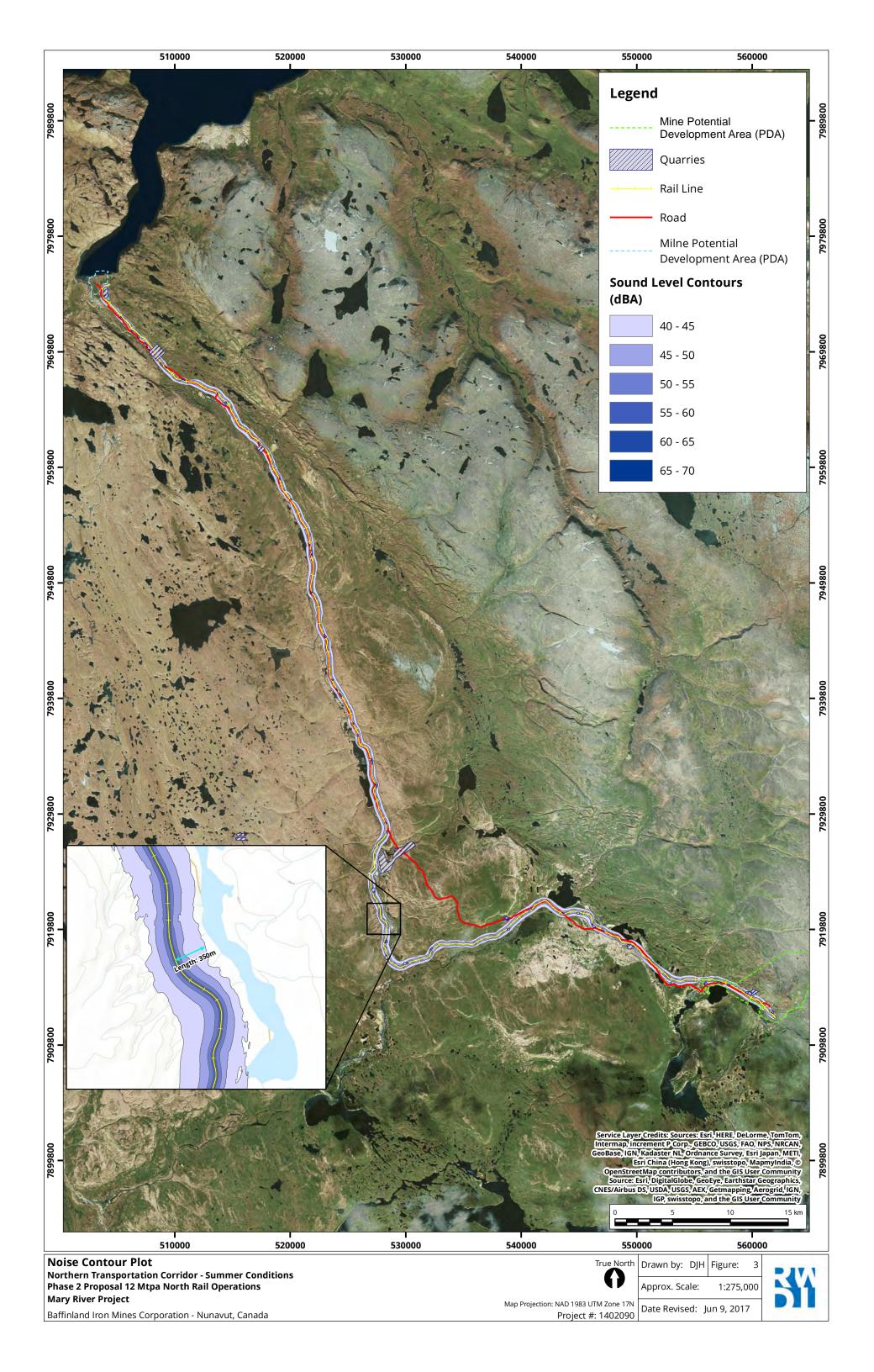
Worst case predicted construction noise levels of the Northern Transportation Corridor construction are provided for summer and winter conditions in Figure 3 and Figure 4, respectively. Insets in Figure 3 and 4 show the worst-case impacts for:

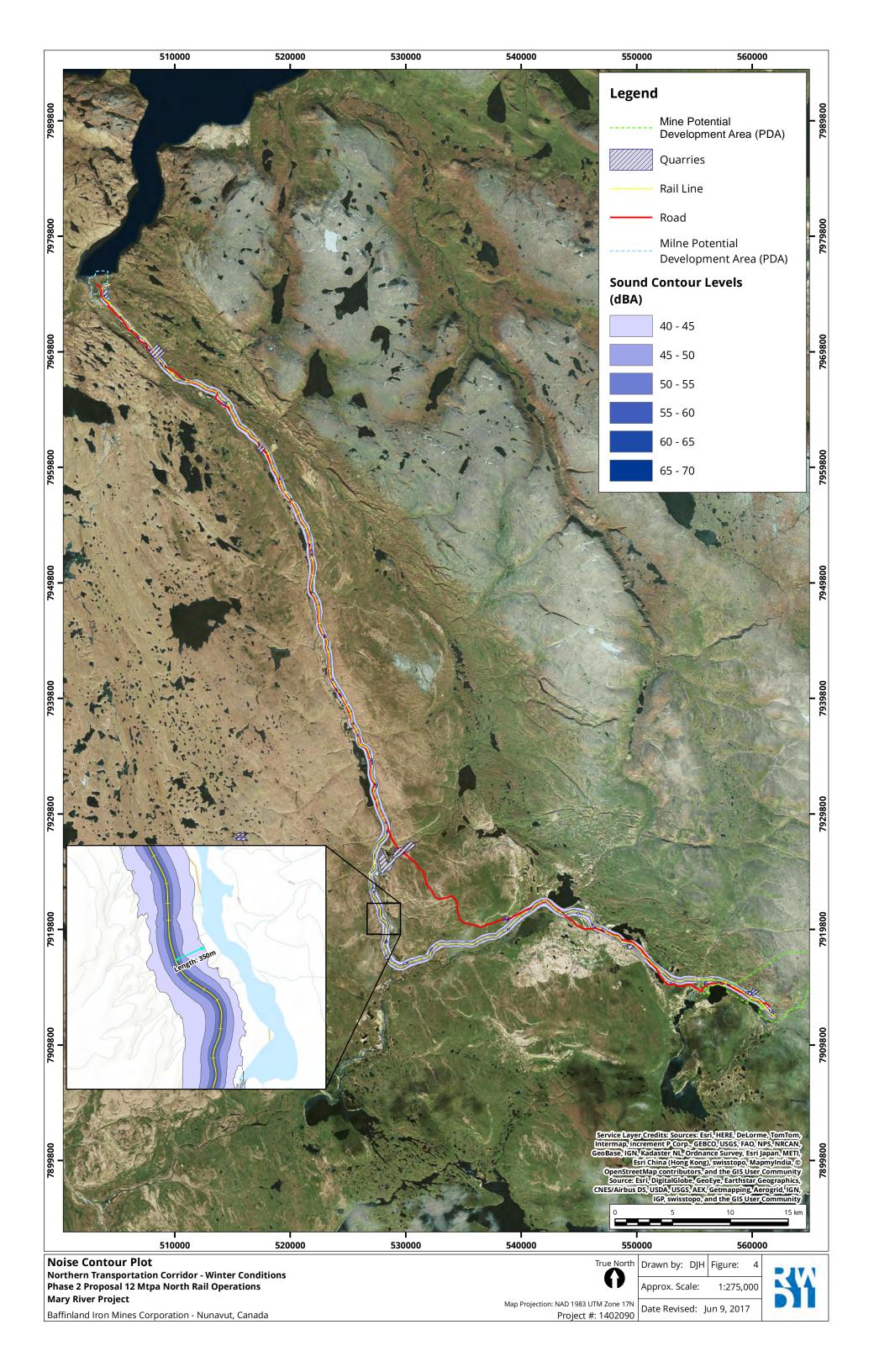
• The tote road alone:

RWDI#1402090 September 26, 2017

- The tote road with construction of the North Railway; and
- The tote road with construction of the North Railway, and material extraction at quarries.

In locations where rail bed construction, tote road operations, and quarry extraction overlap, noise contours of 40 dBA extend out approximately 2.5 km. These figures illustrate the maximum impact that is expected at any point along the corridor; it should be noted that construction will not occur along the entire length of the Northern Transportation Corridor simultaneously. Construction activities will be localized and the effect is short-term. The frequency of effect is occasional and the effect is reversible. To reduce the effect mitigation measures described below should be implemented.





#### 3.1.3.3 Recommended Noise Controls

Construction noise effects are temporary, and therefore higher noise levels are generally acceptable to affected residents; this is why construction noise is exempt from AER Directive 038 (AER 2007). However, D038 recommends that, where feasible, mitigation measures be used to minimize noise effects on nearby residents. Among the various measures recommended in D038, the following are applicable in the present case:

- Ensure that all internal combustion engines are fitted with appropriate muffler systems;
- Where possible, take advantage of local topography to screen noise emissions; and
- Limit operations to daytime only, where possible.

Where feasible, temporary construction accommodations should be sited to avoid potential construction noise effects.

### 3.2 Operation

#### 3.2.1 Mine Site

#### 3.2.1.1 Description of Operations

The following activities have the potential for local noise effects and were considered in the assessment:

- Open-pit mine operations including drilling, blasting, grading and dozing;
- Crushing, screening, and conveying operations;
- Mobile engine operations including drills, shovels, loaders, trucks;
- Mine haul trucks:
- Ore stockpiling including stacker/reclaimer and conveyance systems;
- Power generation, including a series of generators, with boilers providing emergency backup heat;
- · Railway activities, specifically the loading of railcars and operation of locomotive engines; and
- Waste incineration.

Ancillary equipment which is relatively minor compared with other operations have not been assessed. This includes equipment such as pickup trucks, cube vans, emergency vehicles, mobile cranes, ambulances, water trucks, etc. The noise emission level estimates applied in the noise assessment are provided in Appendix B.

#### 3.2.1.2 Noise Mitigation Measures

A number of noise mitigation measures have been incorporated into the design. The following features have been included in the assessment:

- Dust collectors are enclosed or vent into enclosures;
- Rotary rail dumpers are enclosed; and
- Exhaust stacks and air inlets for the power generators will include silencers (mufflers).

#### 3.2.1.3 Operational Noise Levels

Worst case predicted operational noise levels of the 30 Mtpa Phase 2 operations are summarized in Table 5. Graphical representation of  $L_{EQ}$  (1) sound levels during summer and winter operations is provided in Figure 5 and Figure 6, respectively. Predicted operational noise levels inside the worker accommodation building (with windows closed) are represented by a Balanced Noise Criterion (NCB) level, and are summarized in Table 6.

Table 5: Mine Site Modelled Noise Levels - Operation Phase

Modelling Parameters	Seasonal Sound Level at Location (L <sub>EQ</sub> (1), dBA)		
	Summer	Winter	
1.5 km from PDA	20 to 46	17 to 44	
Worker Accommodation Building	47 to 67	47 to 66	
HTO Cabin	35	33	

Sound levels inside the worker accommodation building represented by NCB levels. NCB levels are calculated based on building construction detail. To calculate the NCB levels, building drawings were provided by Baffinland. Their construction drawings showed the following for sleeping quarters:

- One double pane window with 7/8" glazing approximately 0.9 m x 1.2 m;
- Walls with 29 ga steel, 0.5" studs with 12" mm spacing, 7/16" Oriented Strand Board (OSB), R-20 fiberglass insulation, and ½" gypsum board.
- Roof with membrane, 5/8" plywood, 0.5" studs with 12" mm spacing, R-40 cellulose insulation, and ½" gypsum board.

The NCB calculations took this into account along with approximate room dimensions of 3.3 m  $\times$  3.3 m  $\times$  2.9 m. Worst-case assumptions were made for room finishes of linoleum and ½" gypsum wall and ceiling board.

Sound levels inside the worker accommodation building represented by NCB levels. NCB levels are calculated based on building construction detail. To calculate the NCB levels, building drawings were provided by Baffinland. There construction drawings showed the following for sleeping quarters:

- One double pane window with 7/8" glazing approximately 0.9 m x 1.2 m;
- Walls with 29 ga steel, 0.5" studs with 12" mm spacing, 7/16" Oriented Strand Board (OSB), R-20 fiberglass insulation, and ½" gypsum board.
- Roof with membrane, 5/8" plywood, 0.5" studs with 12" mm spacing, R-40 cellulose insulation, and ½" gypsum board.

The NCB calculations took this into account along with approximate room dimensions of 3.3 m  $\times$  3.3 m  $\times$  2.9 m. Worst-case assumptions were made for room finishes of linoleum and ½" gypsum wall and ceiling board.

Table 6: Mine Site Modelled Indoor Noise Levels - Operation Phase

Modelling Parameters	Maximum Seasonal So (Balanced Noi Summer		
Worker Accommodation Building	NCB 38	NCB 36	

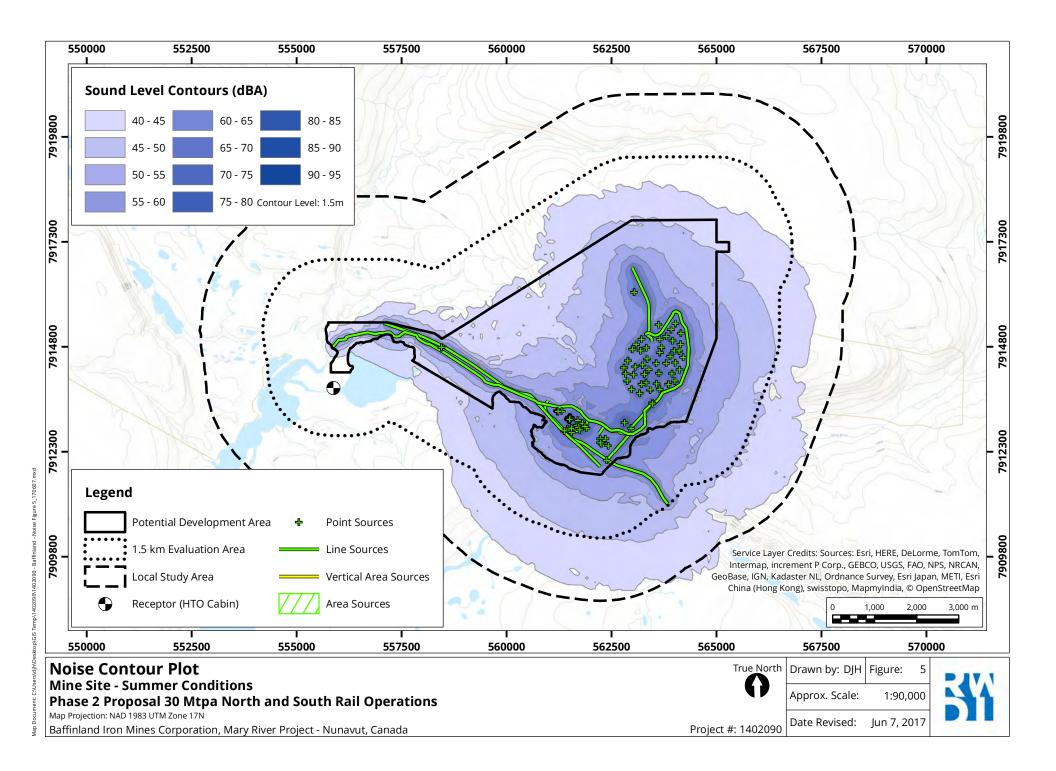
#### 3.2.1.4 Conclusions

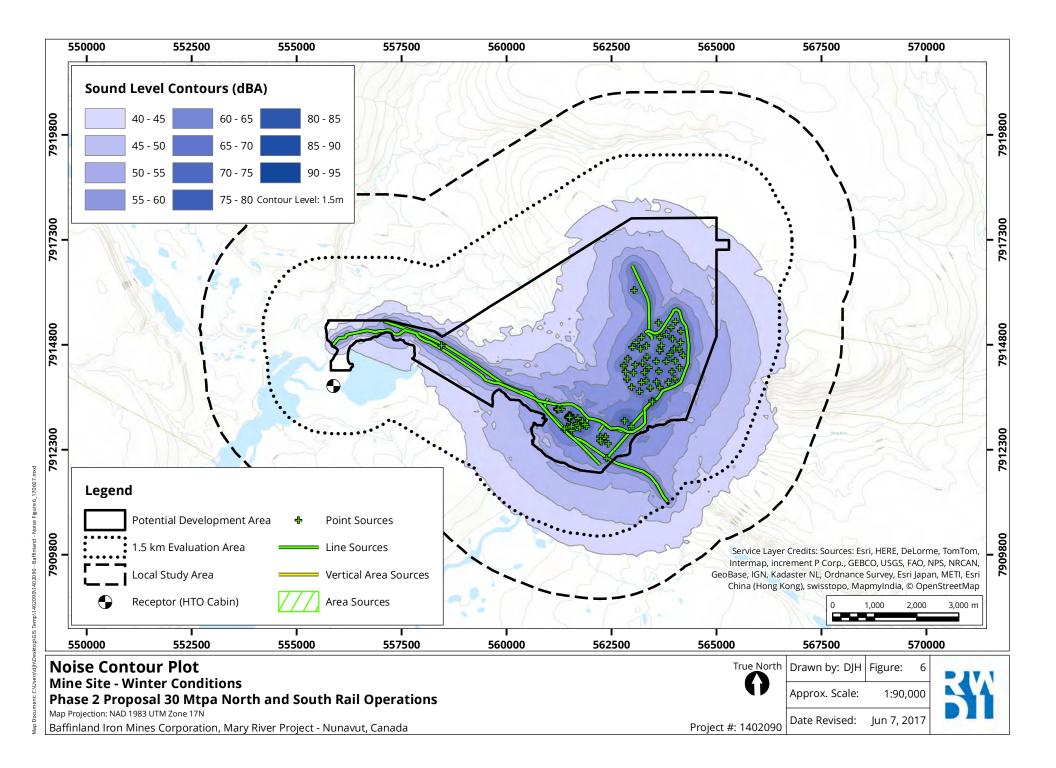
The results of the noise assessment for the Mine Site can be summarized as follows:

- Mitigation features have been incorporated into the design;
- Predicted worst case noise levels range from 17 to 46 dBA, 1.5 km from the PDA;
- Predicted worst case noise levels range from 33 to 35 at the HTO Cabin; and
- Predicted worst case noise levels range from 47 dBA to 67 dBA at the accommodation building.

The predicted worst-case NCB rating is NCB 38 in summer for the accommodations building. This is below the recommended level of NCB 40.

As shown in Figures 5 and 6, the predicted worst case noise levels exceed the Permissible Sound Level (PSL) of 40 dBA (1-hour average) in areas beyond the 1.5 kilometre limit. This is expected based on previous noise assessments of operations of similar size and complexity. As noted in Section 1.3, however, the PSL established by the AER Directive 038 guidelines are intended to be protective of humans in nearby dwellings. In this case, the only receptor meeting the definition of a "dwelling" is the HTO Cabin; predicted noise at that receptor is below the PSL. It should be noted that the results of the noise modelling have also been taken into consideration by the various ecological experts who have assessed potential impacts on ecological receptors.





September 26, 2017

#### 3.2.2 Milne Port

#### 3.2.2.1 Description of Operations

The following activities have the potential for local noise effects and were considered in the assessment:

- Railway activities, specifically the unloading of railcars and operation of locomotive engines;
- Crushing, screening, and conveying operations;
- Mobile engine operations including dozers, loaders, and trucks;
- Mine haul trucks;
- Ore stockpiling and ship loading including stacker/reclaimer and conveyance systems;
- Power generation, including a series of generators, with boilers providing emergency backup heat;
- Ship loading, specifically ships operating on hotel power and tug boat movements; and
- Waste incineration.

Ancillary equipment which is relatively minor compared with other operations have not been assessed. This includes equipment such as pickup trucks, cube vans, emergency vehicles, mobile cranes, ambulances, water trucks, etc. The noise emission level estimates applied in the noise assessment are provided in Appendix B.

#### 3.2.2.2 Noise Mitigation Measures

Exhaust stacks and air inlets and exhausts for the power generators will include silencers (mufflers).

#### 3.2.2.3 Operational Noise Levels

Worst-case predicted operational noise levels for Milne Port are summarized in Table 7. Graphical representation of summer and winter operations is provided in Figure 7 and Figure 8, respectively. Predicted operational noise levels inside the worker accommodation building (with windows closed) are represented by a Balanced Noise Criterion (NCB) level, and are summarized in Table 8.

Table 7: Milne Site Modelled Noise Levels - Operation Phase

Modelling Parameters	Seasonal Sound Level at Location (L <sub>EQ</sub> (1-hour), dBA)		
	Summer	Winter	
1.5 km from PDA	33 to 47	31 to 45	
Worker Accommodation Building	51 to 69	51 to 70	
HTO Cabin	50	48	

Sound levels inside the worker accommodation building represented by NCB levels. NCB levels are calculated based on building construction detail. To calculate the NCB levels, building drawings were provided by Baffinland. There construction drawings showed the following for sleeping quarters:

• One double pane window with 7/8" glazing approximately 0.9 m x 1.2 m;

- Walls with 29 ga steel, 2"x8" studs, 7/16" Oriented Strand Board (OSB), R-20 fiberglass insulation, and ½" gypsum board.
- Roof with membrane, 5/8" plywood, 2"x8" studs, R-40 cellulose insulation, and ½" gypsum board.

The NCB calculations took this into account along with approximate room dimensions of 3.3 m x 3.3 m x 2.9 m. Worst-case assumptions were made for room finishes of linoleum and  $\frac{1}{2}$ " gypsum wall and ceiling board.

Sound levels inside the worker accommodation building represented by NCB levels. NCB levels are calculated based on building construction detail. To calculate the NCB levels, building drawings were provided by Baffinland. There construction drawings showed the following for sleeping quarters:

- One double pane window with 7/8" glazing approximately 0.9 m x 1.2 m;
- Walls with 29 ga steel, 2"x8" studs, 7/16" Oriented Strand Board (OSB), R-20 fiberglass insulation, and ½" gypsum board.
- Roof with membrane, 5/8" plywood, 2"x8" studs, R-40 cellulose insulation, and ½" gypsum board.

The NCB calculations took this into account along with approximate room dimensions of 3.3 m x 3.3 m x 2.9 m. Worst-case assumptions were made for room finishes of linoleum and  $\frac{1}{2}$ " gypsum wall and ceiling board.

**Table 8: Milne Site Modelled Indoor Noise Levels - Operation Phase** 

Modelling Parameters	Maximum Seasonal Sound Level at Location (Balanced Noise Criterion)	
	Summer	Winter
Worker Accommodation Building	NCB 34	NCB 33

The predicted worst case NCB rating is NCB 34 at the accommodations building. This is below the recommended level of NCB 40.

#### 3.2.2.4 Conclusions

The results of the noise assessment for the Milne Port site can be summarized as follows:

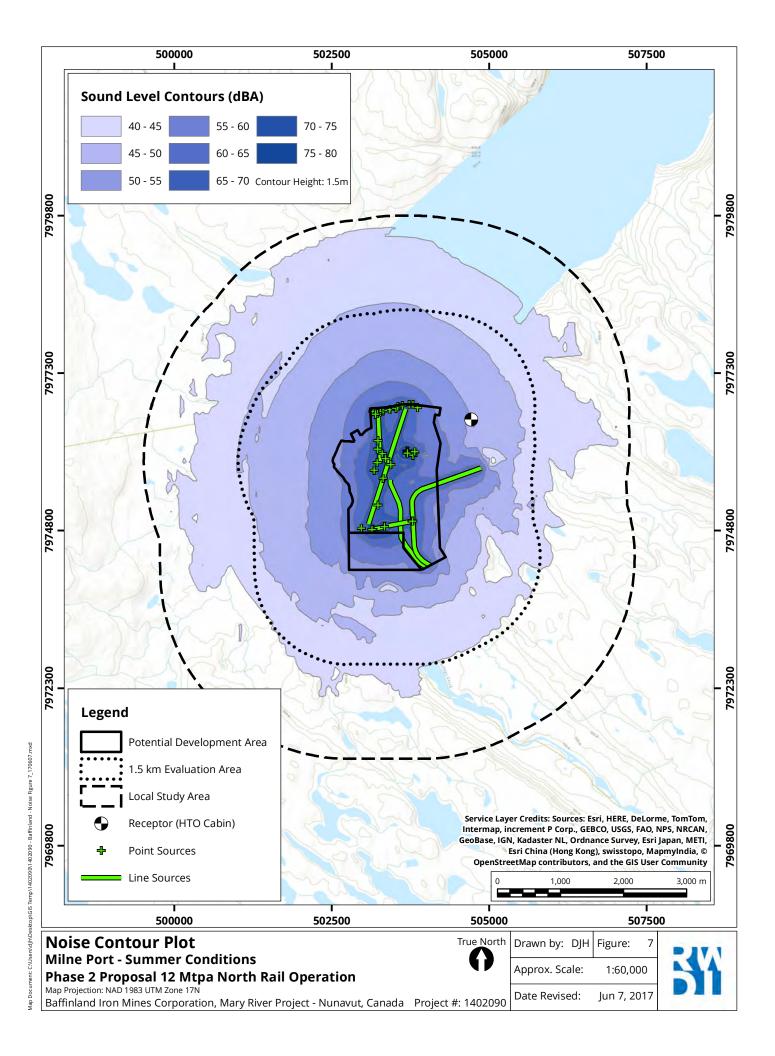
- Mitigation features will be incorporated into the design of the accommodation building to attenuate noise;
- Predicted worst case noise levels range from 26 to 44 dBA, 1.5 km from the PDA;
- The predicted worst case NCB rating is NCB 34 at the accommodations building. This is below the recommended level of NCB 40; and
- The predicted worst case noise level at the HTO cabin, where hunters and community members have occasionally camped, is equal to or less than 50 dBA during the summer and 48 dBA during winter months.

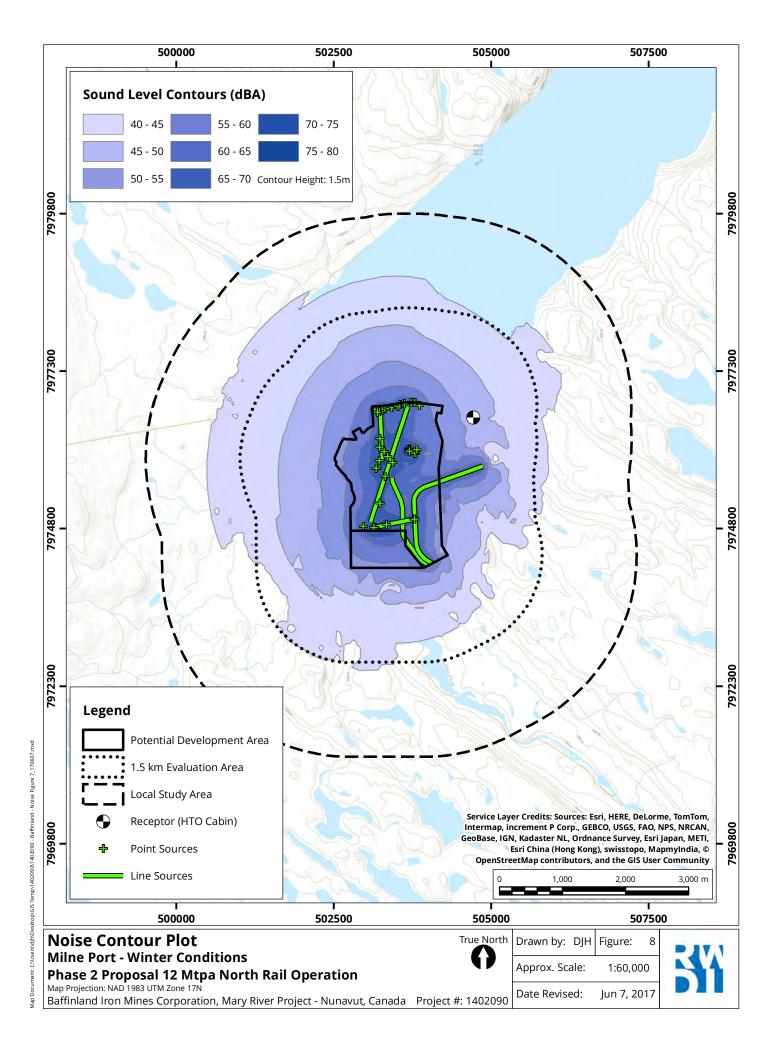
RWDI#1402090 September 26, 2017

As shown in Figures 7 and 8, the predicted worst case noise levels exceed the Permissible Sound Level (PSL) of 40 dBA (1-hour average) in areas beyond the 1.5 kilometre limit. This is expected based on previous noise assessments of operations of similar size and complexity. As noted in Section 1.3, however, the PSL established by the AER Directive 038 guidelines are intended to be protective of humans in nearby dwellings. In this case, the only receptor meeting the definition of a "dwelling" is the HTO Cabin, and the predicted worst case noise level at that receptor is above the PSL.

Hunters or community members camping near the HTO cabin to the east of the port site will likely hear noise from the Project. The maximum predicted noise level of 50 dBA is equivalent to the ambient noise level from human activity in an urban centre during the daytime. Due to proximity of the camping location to the ocean, it's likely that this area experiences ambient sound levels higher than other areas in the region, but lower than 50 dBA. These elevated levels will be noticeable, and have a potential to cause sleep disturbance. There would likely be no practical mitigation measures to reduce the noise impacts to levels below the PSL at the HTO Cabin in its current location. Baffinland may wish to consider discussing this impact with the Mittimatalik HTO or community members to determine if this is a material impact to land users, and potential mitigation measures.

It should be noted that the results of the noise modelling have also been taken into consideration by the various ecological experts who have assessed potential impacts on ecological receptors.





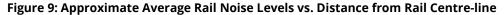
#### 3.2.3 Northern Transportation Corridor

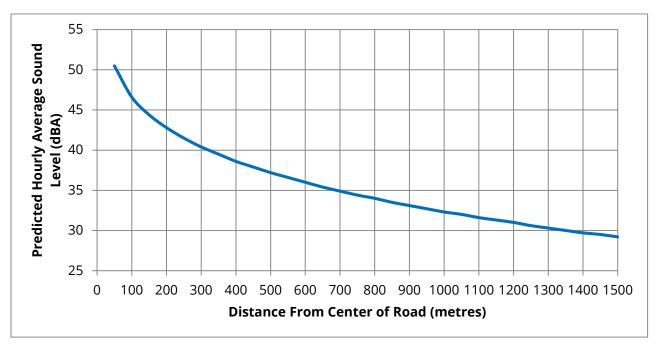
#### 3.2.3.1 Description of Operations

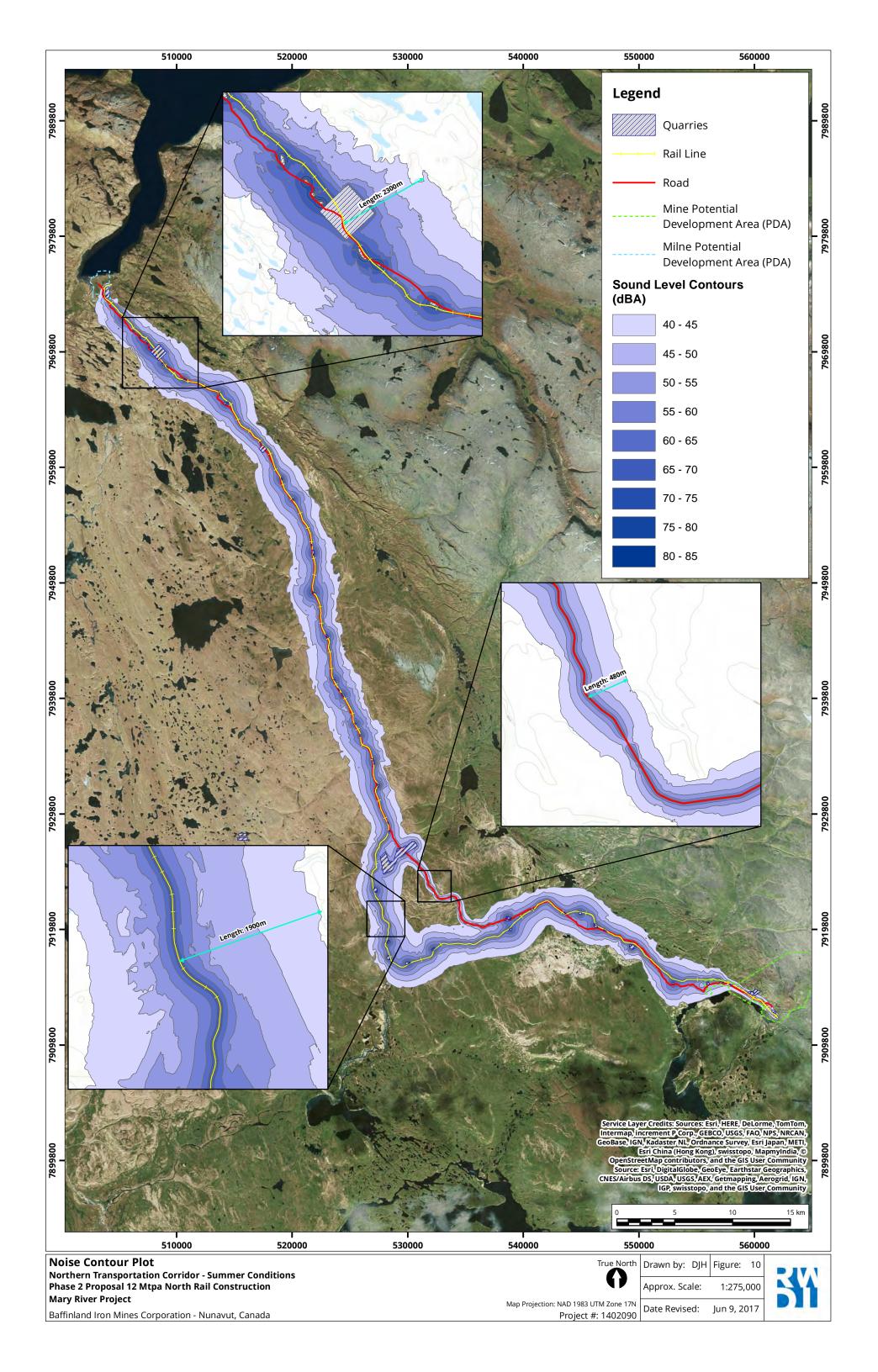
The existing Milne Port Tote Road connects Milne Port to the Mine Site and allows for the transportation of ore by haul truck. During the construction phase, a railway will be built to transport ore from the Mine Site to Milne Port. Following the construction of the rail, the Tote Road will continue to have a reduced level of vehicle traffic (such as transportation of fuel), however, all ore will be transported by rail.

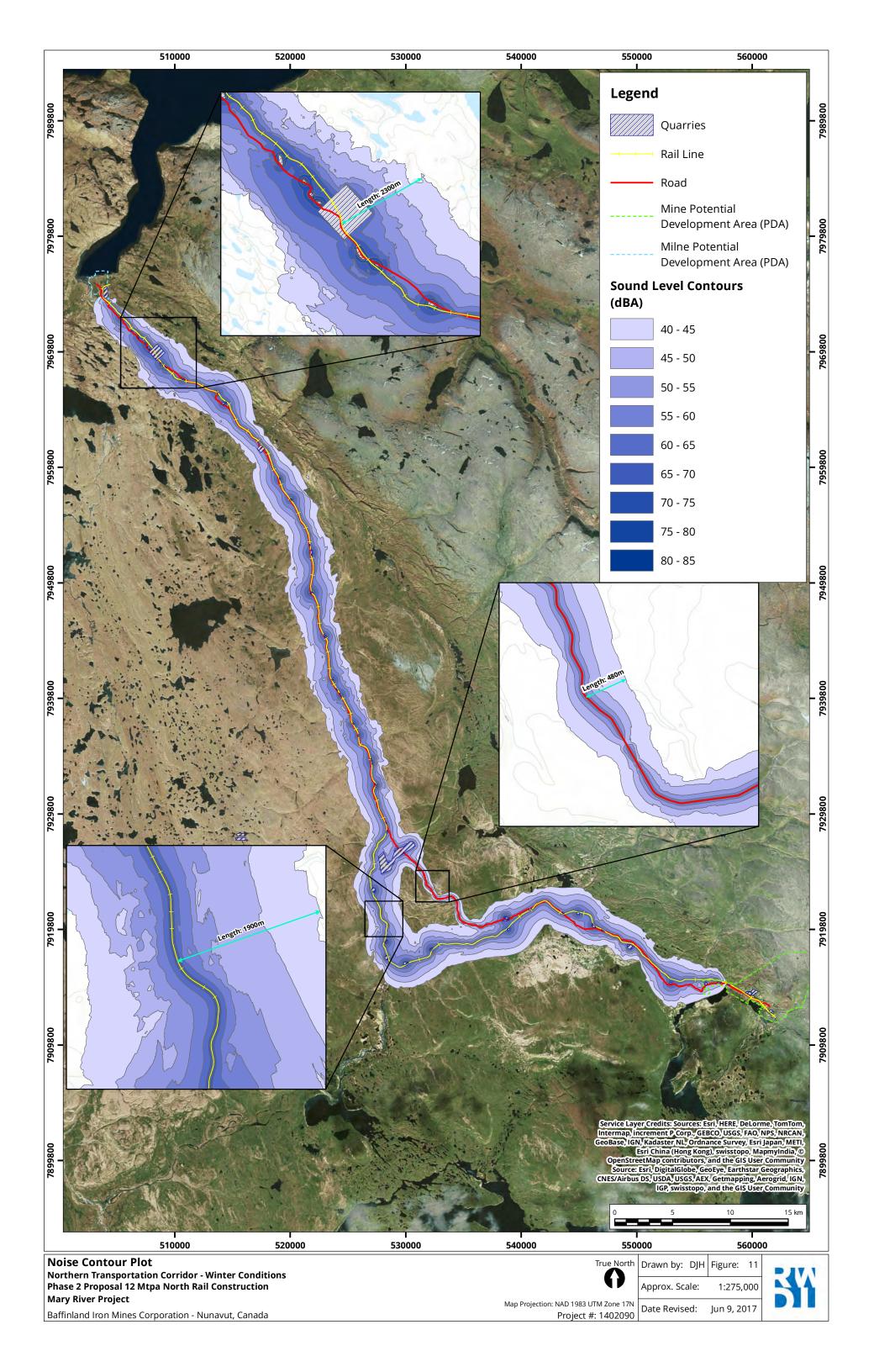
#### 3.2.3.2 Operational Noise Levels

Anticipated hourly average noise levels (LEQ(1-hour)) from railway operations were calculated using the ISO 9613 environmental noise propagation algorithms (ISO, 1993 & 1996) and are shown in Figure 9. Graphical representation of summer and winter operations is provided in Figure 10 and Figure 11, respectively. The average hourly sound levels assume a single train passby during the course of an hour. While D038 and most other limits are specified on an average basis. It should be noted that sound levels during a passby event will be significantly higher than the average levels presented in Figure 9.









RWDI#1402090 September 26, 2017

#### 3.2.3.3 Conclusions

The results of the noise assessment for the Northern Transportation Corridor can be summarized as follows:

Predicted worst case noise levels are predicted to be less than 30 dBA, 1.5 km from the PDA.

#### 3.2.4 Aircraft

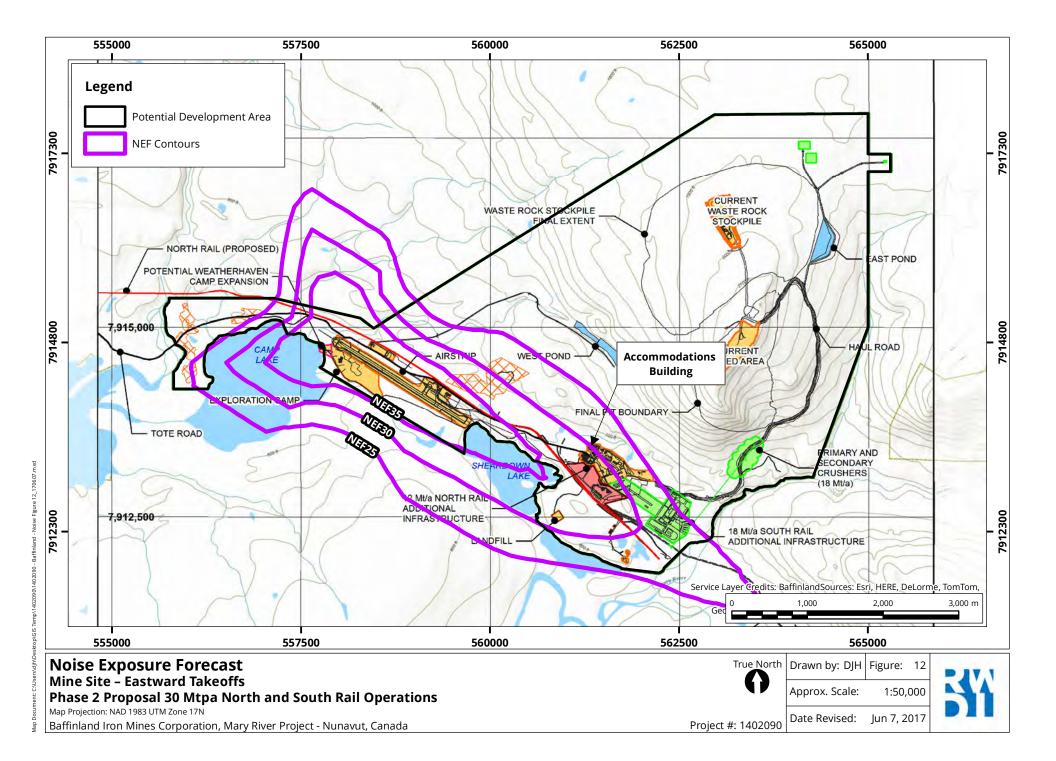
#### 3.2.4.1 Description of Operations

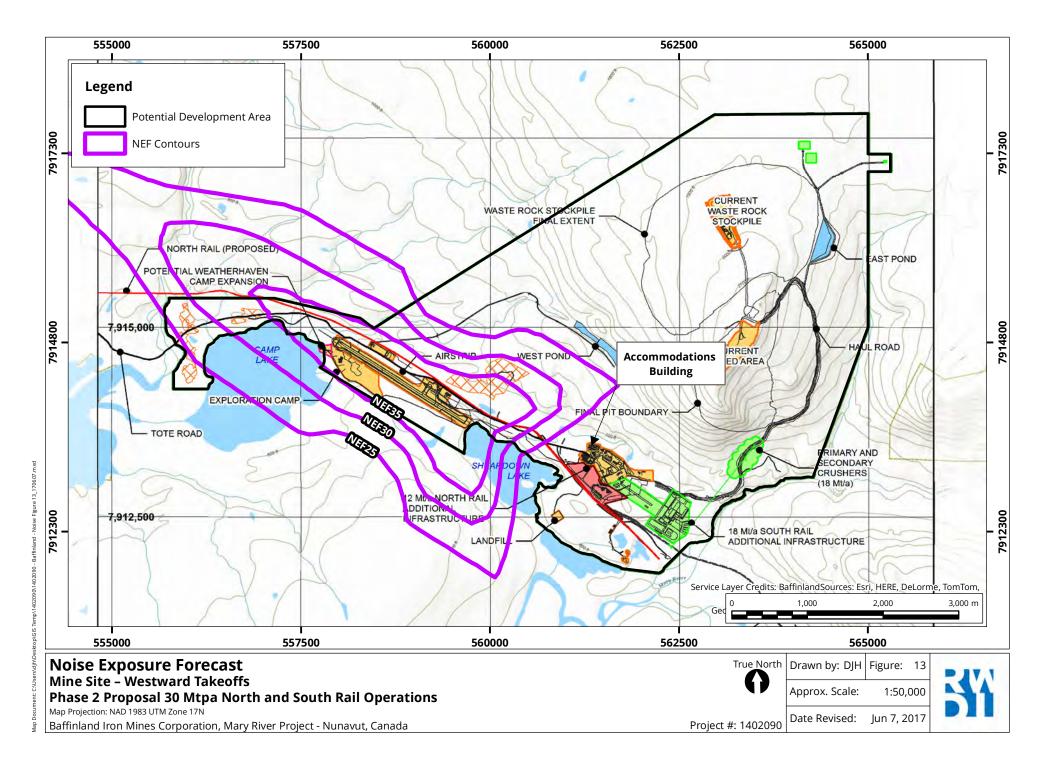
The operation of airstrips during construction and for emergency purposes were not assessed as part of this assessment. During the Operation Phase, the Mine Site airstrip will be the primary location of aircraft activities, while the other airstrips will be used for incidental or emergency flights. There will be an estimated 1342 flights in 2026 to and from the Mine Site during operations.

#### 3.2.4.2 Operational Noise Levels

Noise exposure forecasts (NEFs) for aircraft noise were predicted using NEFCalc, a software package developed by Transport Canada. Based on total annual flight prediction and historical data, it was estimated that there would be two Boeing 737 flights and two Dornier 228 flights per day. Preliminary modelling of the Dornier flights indicated that they were not significantly affecting the noise levels.

According to Transport Canada, land exposed to Noise Exposure Forecast (NEF) contours NEF 30 and greater are typically subject to development restrictions. As a conservatism, contours have therefore been shown for a Zone of Influence starting at NEF 25. Contours are shown for takeoffs for each direction. It is assumed that aircraft will not execute turns below an elevation of 650 m. NEF forecasts are shown in Figure 12 and Figure 13 for Eastward and Westward aircraft takeoffs respectively, from the Mine Site.





RWDI#1402090 September 26, 2017

#### 3.2.4.3 Recommended Noise Control Measures

The primary mitigation of aircraft noise is adherence to the 600 m minimum flight altitude requirements specified in land use permits (contingent to safety concerns). The Aeronautical Information Manual, RAC section 1.14 and 1.15 provides guidance on flying near wildlife and birds. The intent is to achieve voluntary compliance with the recommended minimums rather than be restrictive and place a pilot in non-compliance with a regulation or legal requirement due to outside influences such as weather. This is mainly applicable to smaller fixed-wing aircraft and helicopters moving between construction sites. Aircraft noise disturbance will be concentrated within a circle around each Project site.

All flights over National Parks will maintain a minimum altitude of 2000 feet when possible. Parks Canada will be provided with regular flight schedules (and updates in the case of a substantial change) that can be used to brief visitors.

It will be ensured that, where applicable, all aircraft serving the project will have current noise certification.

#### 3.2.4.4 Conclusions

The results of the noise assessment for the aircraft at the Mine Site can be summarized as follows:

 Predicted worst case noise levels at the accommodations building are predicted to be between NEF 25 and NEF 30.

## 4 REFERENCES

- 1. Alberta Energy Regulator (AER), (2/16/2007), Directive 038: Noise Control Retrieved from http://www.eub.ca
- 2. Beranek, L. L.. (1/1/1989), Noise and Vibration Control Revised Edition, Institute of Noise Control Engineering
- 3. International Organization for Standardization (ISO), (1/1/1993), ISO Standard ISO-9613-1: Acoustics Attenuation of Sound During Propagation Outdoors. Part 1 Calculation of the Absorption of Sound by the Atmosphere
- 4. International Organization for Standardization (ISO), (1/1/1996), ISO Standard ISO-9613-2: Acoustics Attenuation of Sound during propagation outdoors. Part 2 General method of calculation

rwdi.com Page 33

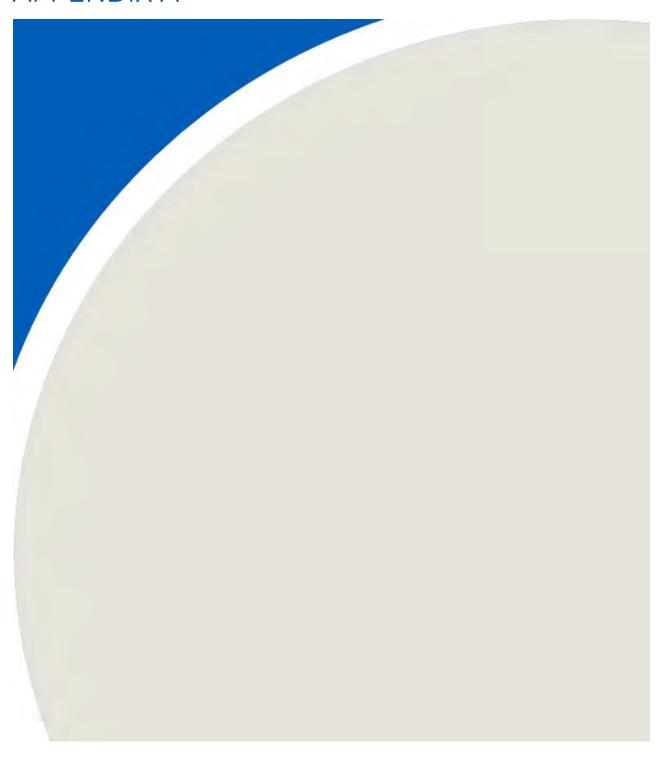
ADDENDUM NO. 2 TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT ENVIRONMENTAL NOISE PHASE 2 PROPOSAL MARY RIVER PROJECT RWDI#1402090
September 26, 2017

RWDI aims to accommodate. If you require this document in a different format in order to aid accessibility, please contact the sender of this document, email solutions@rwdi.com or call +1.519.823.1311

rwdi.com Page 34



# APPENDIX A





600 Southgate Drive Guelph, ON NIG 4P6 Canada Tel: +1.519.823.1311 Fax: +1.519.823.1316

E-mail: solutions@rwdi.com

## Appendix A - Noise Metrics

Environmental sound levels vary continuously over time. To account for both daily and short-term variations in sound levels, several single numerical descriptors have been developed based on large-scale psycho acoustic studies of annoyance with environmental noise. These allow sound monitoring to be conducted for a constantly varying sound environment over an extended period, with the results described as a single number that accurately describes the environment.

The single number descriptor commonly used in most international standards for environmental sound measurements is the energy equivalent sound level (LEQ); expressed in dBA, this is the energy averaged, A-weighted sound level for the complete measurement interval. It is the steady, continuous sound level over a given period that has the same acoustic energy as the actual varying sound levels occurring over the same period in the measured environment. The LEQ is one of the most common and useful predictors of human response to noise, and is the one used in the majority of to environmental noise criteria. The A-weighting accounts for the frequency content of the measured sound based on a frequency response similar to that heard by the human ear.

The descriptors specific to this study are:

- The 24-hour A-weighted energy equivalent sound level, LEQ (24), referred to as the daily sound level;
- The 15-hour A-weighted energy equivalent sound level, LEQ Day or LEQ (15), referred to as the daytime sound level;
- The 9-hour A-weighted energy equivalent sound level, LEQ Night or LEQ (9), referred to as the night-time sound level; and
- The 1-hour A-weighted energy equivalent sound level, LEQ (1), referred to as the hourly sound level.

Ranges of typical sound levels are presented in Table 1.

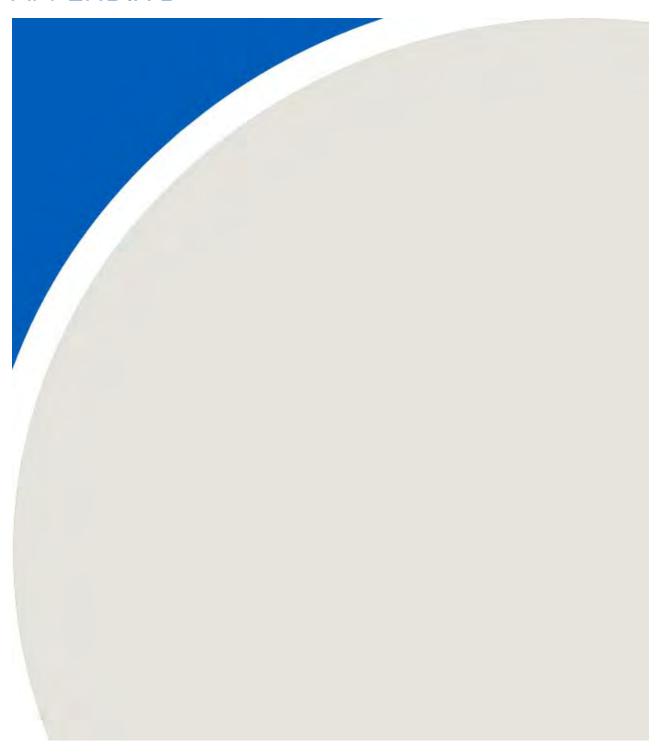


Table 1: Typical Ranges of Commonly Encountered Sound Levels

Modelling Parameters	dBA	Common Noise Sources					
bo	120	Threshold of pain					
Deafening	115	Maximum noise level at a hard rock concert					
eafe	110	Accelerating motorcycle at 1 m					
	105	Loud auto horn at 3 m					
-	100	Dance club; maximum human vocal output at 1 m					
Louc	95	Jackhammer at 15 m					
Very Loud	90	Inside a noisy factory					
>	85	Heavy truck pass-by at 15 m					
	80	School cafeteria; noisy bar					
<b>9</b>	75	Near edge of major highway; inside automobile travelling at 60 km/h					
Loud	70	Vacuum cleaner at 1.5 m					
	65	Normal human speech, i.e., an un raised voice, at 1 m					
Ø	60	Typical background noise levels in a large department store; hair dryer					
Moderate	55	Running tap water					
Mod	50	Clothes dryer; air conditioner					
	45	Typical background office noise level caused by HVAC; flowing stream					
	40	Typical background noise level in a library; EUB guideline for noise at 1.5 km					
Faint	35	Average whisper; typical quiet outdoors					
<u> </u>	30	Broadcast studio					
	25						
	20	Deep woods on a calm day					
int	15						
Very Faint	10						
\ \	5	Human breathing					
	0	Threshold of hearing, i.e., quietest sound that can be heard					



# APPENDIX B



### **Table B1: Noise Source Summary**

Mine Site, Baffinland, 1402090

Notes to Table:

1. Sound Power Level Data Source:

- Man = Manufacturer's Data

- Hist = Historical Data on File at RWDI

- Mea = Measured Directly

- EC = Engineering Calcs based on specifications

- Same ### - same type as source no. ###

2. Source type indicates Cadna/A modelling methodology. For Point, Line, and Area sources, PWLs represent

the overall level for the entire source. Where source type is Mobile Equipment, the source is modelled as a moving

point source, and PWL is calculated from a single-vehicle passby.

Source ID	Source Description	Sound Power Level
		(dBA)
MR_Backhoe01	Mary River - Backhoe 1	110
MR_Dozer01	Mary River - Dozer 1 Waste Rock Pile	116
MR_Dozer02	Mary River - Dozer 2 Ore Pit	116
MR_Dozer03	Mary River - Dozer 3 Ore Pit	116
MR_Dozer04	Mary River - Dozer 4 Ore Pit	116
MR_Dozer05	Mary River - Dozer 5 Steensby Crusher	116
MR_Drill01	Mary River - Production Blasthole Drill 1	123
MR_Drill02	Mary River - Production Blasthole Drill 2	123
MR_Drill03	Mary River - Production Blasthole Drill 3	123
MR_Drill04	Mary River - Production Blasthole Drill 4	123
MR_Drill05	Mary River - Production Blasthole Drill 5	123
MR_Drill06	Mary River - Production Blasthole Drill 6	123
MR_Drill07	Mary River - Production Blasthole Drill 7	123
MR_Drill08	Mary River - Support Drill 8	123
MR_Drill09	Mary River - Support Drill 9	123
MR_Drill10	Mary River - Support Drill 10	123
MR_FF01	Mary River - 25 Frost Fighters Group 1 (50 at camp)	116
MR_FF02	Mary River - 25 Frost Fighters Group 2 (50 at utilities)	116
MR_Gen01	Mary River - Cummins Generator 01 (6 generators, 2 on standby)	108
MR_Gen02	Mary River - Cummins Generator 02 (6 generators, 2 on standby)	108
MR_Gen03	Mary River - Cummins Generator 03 (6 generators, 2 on standby)	108
MR_Gen04	Mary River - Cummins Generator 04 (6 generators, 2 on standby)	108
MR_HT_01	Mary River - Mine Truck 01 (CAT 793) Idling (destination waste rock)	121
MR_HT_02	Mary River - Mine Truck 02 (CAT 793) Idling (destination waste rock)	121
MR_HT_03	Mary River - Mine Truck 03 (CAT 793) Idling (destination waste rock)	121
MR_HT_04	Mary River - Mine Truck 04 (CAT 793) Idling (destination waste rock)	121
MR_HT_05	Mary River - Mine Truck 05 (CAT 793) Idling (destination waste rock)	121
MR_HT_06	Mary River - Mine Truck 06 (CAT 793) Idling (destination waste rock)	121
MR_HT_07	Mary River - Mine Truck 07 (CAT 793) Idling (destination waste rock)	121
MR_HT_08	Mary River - Mine Truck 08 (CAT 793) Idling (destination waste rock)	121
MR_HT_09	Mary River - Mine Truck 09 (CAT 793) Idling (destination waste rock)	121
MR_HT_10	Mary River - Mine Truck 10 (CAT 793) Idling (destination waste rock)	121
MR_HT_11	Mary River - Mine Truck 11 (CAT 793) Idling (destination waste rock)	121
MR_HT_12	Mary River - Mine Truck 12 (CAT 793) Idling (destination waste rock)	121
MR_HT_13	Mary River - Mine Truck 13 (CAT 793) Idling (destination waste rock)	121
MR_HT_14	Mary River - Mine Truck 14 (CAT 793) Idling (destination waste rock)	121
MR_HT_15	Mary River - Mine Truck 15 (CAT 793) Idling (destination waste rock)	121
MR_HT_16	Mary River - Mine Truck 16 (CAT 793) Idling (destination Steensby crusher)	121
MR_HT_17	Mary River - Mine Truck 17 (CAT 793) Idling (destination Steensby crusher)	121
MR_HT_18	Mary River - Mine Truck 18 (CAT 793) Idling (destination Steensby crusher)	121
MR_HT_19	Mary River - Mine Truck 19 (CAT 793) Idling (destination Steensby crusher)	121

	1/1 Octave Band Sound Power Level Data if available (dB)						a		Source Type [1]	PWL Data Source [2]	Height Above Grade	Above for point sources			
31.5	63	125	250	500	1000	2000	4000	8000			(m)	X	Y	Z	
103.9	106.8	117.4	109.3	110.0	102.5	99.6	93.6	88.6	Point Mea		3.0	562351	7912616	206	
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Mea	3.0	563042	7916102	597	
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MR_Dozer01	3.0	563386	7914262	541	
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MR_Dozer01	3.0	563021	7914134	635	
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MR_Dozer01	3.0	562995	7914736	647	
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MR_Dozer01	3.0	563465	7913475	329	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Mea	3.0	563322	7913946	494	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	562792	7914306	614	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563629	7914170	490	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563650	7914664	582	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563283	7914143	541	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563165	7913692	495	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563088	7914851	662	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point	Same MR_Drill01	3.0	563951	7914943	556	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point Same MR_Drill01		3.0	563896	7914569	541	
114.7	119.9	122.5	121.9	119.4	115.8	115.9	112.3	107.9	Point Same MR_Drill01		3.0	563938	7914162	474	
									Point Man		2.0	561316	7913268	197	
									Point Same MR_FF01		2.0	561699	7913046	202	
									Point Man		3.0	561201	7913273	195	
									Point	Same MR_Gen01	3.0	561209	7913268	195	
									Point	Same MR_Gen01	3.0	561216	7913262	195	
									Point	Same MR_Gen01	3.0	561222	7913258	195	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Mea	4.0	563328	7914778	687	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	562885	7914469	629	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563685	7914784	588	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563211	7914986	667	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563620	7915324	658	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563214	7913910	556	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	562977	7913786	553	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564005	7913985	429	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564013	7914420	533	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564143	7914863	527	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564022	7915357	562	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564151	7915119	539	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564118	7914254	479	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563570	7913919	438	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	562873	7913983	595	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563647	7914983	614	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563918	7915209	582	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	563989	7914712	540	
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Point	Same MR_HT_01	4.0	564202	7914551	490	

Source ID	Source Description	Sound Power Level
		(dBA)
MR_HT_20	Mary River - Mine Truck 20 (CAT 793) Idling (destination Steensby crusher)	121
MR_HT_21	Mary River - Mine Truck 21 (CAT 793) Idling (destination Steensby crusher)	121
MR_HT_22	Mary River - Mine Truck 22 (CAT 793) Idling (destination Milne crusher)	121
MR_HT_23	Mary River - Mine Truck 23 (CAT 793) Idling (destination Milne crusher)	121
MR_HT_24	Mary River - Mine Truck 24 (CAT 793) Idling (destination Milne crusher)	121
MR_HT_25	Mary River - Mine Truck 25 (CAT 793) Idling (destination Milne crusher)	121
MR_Incinerator01	Mary River - Incinerator 1	91
MR_Incinerator02	Mary River - Incinerator 2	91
MR_Loader01	Mary River - Loader 01 Ore Pit	112
MR_Loader02	Mary River - Loader 02 Milne Crushing	112
MR_Loader03	Mary River - Loader 03 Milne Crushing	112
MR_Loader04 MR_Loader05	Mary River - Loader 04 Milne Crushing  Mary River - Loader 05 Milne Train Loading	112
MR_Loader06	Mary River - Loader 05 Millie Train Loading  Mary River - Loader 06 Milne Train Loading	112
MR_Loader07	Mary River - Loader 00 Millie Train Loading  Mary River - Loader 07 Milne Train Loading	112
MR_Loader08	Mary River - Loader 07 While Train Loading  Mary River - Loader 08 Milne Train Loading	112
MR MilnePri Cru1	Mary River - Milne Primary Crusher 1	121
MR_MilnePri_Cru2	Mary River - Milne Primary Crusher 2	121
MR_MilnePri_Cru3	Mary River - Milne Primary Crusher 3	121
MR_PH_chlr1	Mary River Powerhouse - Chiller	110
MR_PH_chlr3	Mary River Powerhouse - Chiller	110
MR_PH_chlr4	Mary River Powerhouse - Chiller	110
MR_PH_chlr5	Mary River Powerhouse - Chiller	110
MR_PH_Gen_exh1	Mary River Powerhouse Generator - Exhaust	151
MR_PH_Gen_exh3	Mary River Powerhouse Generator - Exhaust	151
MR_PH_Gen_exh4	Mary River Powerhouse Generator - Exhaust	151
MR_PH_Gen_exh5	Mary River Powerhouse Generator - Exhaust	151
MR_PH_intake1	Mary River Powerhouse - Intake Air Unit	111
MR_PH_intake2	Mary River Powerhouse - Intake Air Unit	111
MR_PH_intake3	Mary River Powerhouse - Intake Air Unit	111
MR_PH_intake4	Mary River Powerhouse - Intake Air Unit	111
MR_PH_intake5	Mary River Powerhouse - Intake Air Unit	111
MR_PH_Lou1	Mary River Powerhouse - Roof Louvres	121
MR_PH_Lou2	Mary River Powerhouse - Roof Louvres	121
MR_PH_Lou3	Mary River Powerhouse - Roof Louvres	121
MR_PH_Lou4 MR_PH_Lou5	Mary River Powerhouse - Roof Louvres	121 121
MR_Pri_Cru	Mary River Powerhouse - Roof Louvres  Mary River - Steensby Primary Crusher Vent	121
MR_Pri_Scr	Primary Screening Tower Vents	124
MR_Rail_LO_Milne	Mary River - Milne Rail Loadout	110
MR_Rail_LO_Steensby	Mary River - Steensby Rail Loadout	110
MR_Reclaimer01	Mary River - Reclaimer 1	111
MR_Reclaimer02	Mary River - Reclaimer 2	111
MR_Sec_Cru_V1	Mary River - Secondary Crusher Conveyor Vents	126
MR_Shovel01	Mary River - Shovel 1	120
MR_Shovel02	Mary River - Shovel 2	120
MR_Shovel03	Mary River - Shovel 3	120
MR_Shovel04	Mary River - Shovel 4	120
MR_Shovel05	Mary River - Shovel 5	120
MR_Stacker01	Mary River - Lump Mobile Stacker 1 (2400-SK-004)	103
MR_Stacker02	Mary River - Fines Mobile Stacker (2400-SK-002)	103
MR_Stacker03	Mary River - Lump Mobile Stacker 2 (2400-SK-005)	103
MR_2100_CV_002	Conveyor from 2100-TT-001 to 2100-TT-002	96
MR_2200_CV_002	Conveyor from 2200-TT-001 to 2200-TT-002	96
MR_2200_CV_009	Conveyor from 2200-TT-001 to 2200-TT-002	96
MR_2300_CV_005	Conveyor from 2200-TT-002 to 2300-TT-001	96

1.15	Page 2 of 3 linates
1966   1257   1276   1217   1207   1139   1110   1957   1943   Point Sume MR_HT_0    4-0   563564   791-141   1966   1257   1276   1217   1207   1139   1110   1057   1043   Point Sume MR_HT_0    4-0   563564   791-141   1166   1257   1276   1217   1207   1139   1110   1057   1043   Point Sume MR_HT_0    4-0   563564   791-141   1166   1257   1276   1217   1207   1159   1110   1057   1043   Point Sume MR_HT_0    4-0   563564   791-141   1166   1257   1276   1217   1207   1159   1110   1057   1043   Point Sume MR_HT_0    4-0   563564   791-141   1166   1257   1276   1217   1207   1159   1110   1057   1043   Point Sume MR_HT_0    4-0   563564   791-141   1067	Z
Hofe   16.77   27.6   121.7   20.7   11.5   11.0   10.57   00.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791415   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791416   11.0   10.57   10.43   Point   Same MR, HT 01   4.0   663564   791416   10.0   79140   7	533
1166   1257   1276   1217   1207   1339   1110   1057   104.3   Point   Same MR_HT_01   4.0   563834   791390     1168   1257   1276   1217   1207   1139   1110   1057   104.3   Point   Same MR_HT_01   4.0   563235   791436     88.0   80.0   82.0   92.0   840   81.0   77.0   72.0   Point   Same MR_HT_01   4.0   563235   791436     88.0   80.0   82.0   92.0   840   81.0   77.0   72.0   Point   Same MR_Incincatar01   13.8   55840   791478     88.0   80.0   82.0   92.0   840   81.0   77.0   72.0   Point   Same MR_Incincatar01   13.8   55840   791478     88.0   80.0   82.0   92.0   840   81.0   77.0   72.0   Point   Same MR_Incincatar01   13.8   55842   791478     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   563190   791270     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   563190   791280     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561465   791285     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561465   791285     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561465   791285     109.3   106.2   116.3   112.7   1079   1071   102.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561465   791285     109.3   106.2   116.3   112.7   1079   1071   107.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561465   791285     109.3   106.2   116.3   112.7   1079   1071   107.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561467   791281     109.3   106.2   116.3   112.7   1079   1071   107.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561467   791281     109.3   106.2   116.3   112.7   1079   1071   107.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561467   791281     119.3   110.2   110.3   112.7   107.9   107.1   107.7   96.4   94.2   Point   Same MR_Loadef01   3.0   561467   791281     119.3   110.2   110.3   112.7   107.9   10	549
1166   1257   1276   1217   1207   1339   1110   1057   1043   Point   Same MR_HT_01   4.0   50234   791415   1061   1276   1217   1207   1339   1101   1057   1043   Point   Same MR_HT_01   4.0   50234   791415   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501807   791285   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501807   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501807   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501807   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501805   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501865   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501865   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501865   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501865   791280   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501487   791281   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501487   791281   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501487   791281   1093   1062   1163   1127   1079   1071   1077   96.4   94.2   Point   Same MR_Loadeful   3.0   501487   791281   1093	442
116.6   125.7   127.6   127.6   127.7   120.7   113.9   111.0   105.7   104.3     Point   Same MR_HT_01   4.0   \$562.52   791.436   791.436   88.0   86.0   82.0   92.0   84.0   81.0   77.0   72.0   Point   Same MR_Lincinerator01   13.8   \$5584.9   791.478   791.47	418
88.0   86.0   82.0   92.0   84.0   81.0   77.0   72.0	625
S80   8.60   82.0   2.02   8.40   8.10   79.4   7	590
1993   196.2   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561807   791286   1993   196.2   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561807   791286   1993   1962   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561807   791286   1993   1962   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561807   791286   1993   1962   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561867   791286   1993   1962   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561487   791286   1993   1962   116.3   112.7   197.9   197.1   192.7   96.4   94.2   Point Same MR_Loader01   3.0   561487   791285   1993   1962   116.3   112.7   197.9   197.1   102.7   96.4   94.2   Point Same MR_Loader01   3.0   561487   791285   1993   1962   116.3   112.7   197.9   197.1   102.7   96.4   94.2   Point Same MR_Loader01   3.0   561537   791285   1993   1962   116.3   112.7   107.9   197.1   102.7   96.4   94.2   Point Same MR_Minchen_Cru1   3.0   561537   791285   1994   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point Same MR_Minchen_Cru1   6.0   561730   791285   111.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point Same MR_Minchen_Cru1   6.0   561730   791285   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_Minchen_Cru1   6.0   561730   791285   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_PH_chirl   3.4   561498   791305   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_PH_chirl   3.4   561497   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_PH_chirl   3.4   561497   791306   111.0   116.0   115.0   115.0   115.0   110.0   105.0   130.0   150.0   135.0   Point Same MR_PH_chirl   3.4   561497   791306   111.1   106.0   107.5   107.1   104.9   10	188
1993   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561897   791298   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561865   791290   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561865   791290   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561846   791288   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561446   791288   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561446   791288   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561547   791281   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561537   791285   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561537   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Mea   6.0   561676   791293   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MinePri_Crul   6.0   561703   791288   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MinePri_Crul   6.0   561703   791286   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561482   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561482   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561488   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561488   791306   111.1   106.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0	188
1993   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561905   791286   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561865   791286   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561466   791288   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561487   791286   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561487   791286   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561537   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_Loader01   3.0   561537   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePri_Cru1   6.0   561739   791285   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MilnePri_Cru1   6.0   561739   791285   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MP_H_Chirl   3.4   561485   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MP_H_Chirl   3.4   561485   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MP_H_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_Chirl   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9	683
109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561865   791298   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561446   791285   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561446   791285   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561549   791276   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561549   791276   107.1   107.2   96.4   94.2   Point   Same MR_Loader01   3.0   561549   791276   107.1   107.2   96.4   94.2   Point   Same MR_Meacr01   3.0   561549   791276   107.1   107.2   96.4   94.2   Point   Same MR_Meacr01   3.0   561549   791276   107.1   107.1   107.7   107.7   106.7   Point   Mea   0.0   561676   791293   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MinePri_Cru1   6.0   561676   791293   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MinePri_Cru1   6.0   561673   791286   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_ChiL1   3.4   561492   791306   111.0   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_ChiL1   3.4   561492   791306   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Cen_exhl   15.2   561500   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Cen_exhl   15.2   561500   791307   108.8   108.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_Loader01   5.1   561502   791307   108.5   105.5   105.5   102.0   99.0   Point   Same MR_PH_Loader01   5.1   561502   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loader01   5.1   561502   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.	196
109.3   106.2   116.3   11.27   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561446   791285   109.3   106.2   116.3   11.27   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561447   791285   109.3   106.2   116.3   11.27   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561487   791281   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561549   791276   109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561547   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Mea   6.0   561676   791293   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilinePri_Cru1   6.0   561703   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilinePri_Cru1   6.0   561703   791285   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Man & EC   3.4   51643   791307   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MH_E, thit   3.4   561492   791306   117.0   116.0   115.	202
109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point   Same MR_Loader01   3.0   561487   791281	201
109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point Same MR_LoaderOl   3.0   561549   791276	193
109.3   106.2   116.3   112.7   107.9   107.1   102.7   96.4   94.2   Point Same MR_Loader01   3.0   561537   791285   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point Same MR_MilnePri_Cru1   6.0   561703   791288   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point Same MR_MilnePri_Cru1   6.0   561703   791288   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_MilnePri_Cru1   3.4   561485   791307   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_PH_Lchlr   3.4   561485   791305   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point Same MR_PH_Lchlr   3.4   561485   791305   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point Man & EC   15.2   561497   791305   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point Same MR_PH_Gen_exhl   15.2   561498   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0	193
114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Mea   6.0   561676   791293     114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePh_Cru1   6.0   561703   791282     114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePh_Cru1   6.0   561703   791282     111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Man & EC   3.4   561463   791305     111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561482   791306     111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561492   791306     111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561498   791305     117.0   116.0   115.0   115.0   119.0   125.0   130.0   130.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561476   791309     117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307     117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307     117.0   116.0   115.0   115.0   119.0   125.0   130.1   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307     117.0   116.0   115.0   115.0   115.0   115.0   103.5   102.0   99.0   Point   Same MR_PH_Imakel   5.1   561502   791312     98.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_Imakel   5.1   561528   791310     98.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_Imakel   5.1   561528   791310     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561489   791311     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561489   791310     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same	199
114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePri_Cru1   6.0   561703   791282   111.1   106.1   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_MilnePri_Cru1   3.4   561483   791307   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561485   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561492   791306   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Man & EC   15.2   561476   791309   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561499   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561500   791307   107.1   107.1   107.0   1	193
111.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePri_Cru1   6.0   561739   791282   791306   791307   791282   791307   791282   791306   791307   791282   791307   791307   791307   791282   791307	198
111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561463   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561485   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chirl   3.4   561492   791306   117.0   116.0   115.0   1	198
111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561492   791306   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_chlr1   3.4   561498   791305   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_cen_exh1   15.2   561476   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exh1   15.2   561499   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exh1   15.2   561501   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exh1   15.2   561501   791307   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_Gen_exh1   15.2   561500   791307   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561502   791312   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561528   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_intakel   5.1   561528   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561509   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561509   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561509   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561509   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561519   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561519   79130	201
111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561492   791306   111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlr1   3.4   561498   791305   117.0   116.0   115.0   11	197
111.1   106.0   107.5   107.1   104.9   101.7   98.9   96.0   Point   Same MR_PH_chlrl   3.4   561498   791305   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561476   791309   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   115.0   115.0   115.0   115.0   115.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   115.0   115.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   115.0   115.0   105.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Man & EC   5.1   561497   791312   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561502   791312   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561518   791311   108.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_intakel   5.1   561523   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561494   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561549   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118	197
117.0   116.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561476   791309   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   196.5   105.5   105.5   103.5   102.0   99.0   Point   Same MR_PH_Gen_exhl   15.2   561502   791312   198.8   109.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561502   791312   198.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561523   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_intakel   5.1   561528   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561494   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   Same MR_MinePri_Crul   0.0   562964   791286   112.	197
117.0   116.0   115.0   119.0   125.0   130.0   150.0   135.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561499   791307   117.0   116.0   115.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307   117.0   116.0   115.0   115.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561500   791307   117.0   116.0   115.0	197
117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561501   791307     117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561500   791307     117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561500   791307     117.0   118.0   118.0   118.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exhl   15.2   561500   791307     117.0   118.0   118.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561497   791312     118.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561518   791311     118.8   118.5   117.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_intakel   5.1   561528   791310     118.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561494   791310     118.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309     108.5   119.5   118.5   110.1   110.1   110.1   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0   110.0	209
117.0   116.0   115.0   115.0   119.0   125.0   130.0   150.0   135.0   Point   Same MR_PH_Gen_exh1   15.2   561500   791307   98.8   109.8   108.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561502   791312   98.8   109.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561518   791311   98.8   109.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561518   791311   98.8   109.8   108.8   107.5   106.5   103.5   102.0   99.0   Point   Same MR_PH_intakel   5.1   561523   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561494   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561549   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561544   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MinePri_Crul   0.0   563473   791344   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   EC   3.5   562386   791210   119.8   119.8   119.8   119.8   110.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_RinePri_Crul   20.0   56304   791432   119.8   119.8   119.8   110.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   110.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   110.8   110.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   79146	209
98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Man & EC         5.1         561497         791312           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561502         791312           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561518         791310           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561523         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561498         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3	209
98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561502         791312           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561518         791312           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561523         791310           98.8         109.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561523         791310           108.5         119.5         118.5	199
98.8         109.8         108.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intake1         5.1         561518         791311           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intake1         5.1         561523         791310           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intake1         5.1         561523         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Man & EC         0.3         561489         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561494         791310           108.5         119.5         118.5         118.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8	199
98.8         109.8         108.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561523         791310           98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561528         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Man & EC         0.3         561489         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561494         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561514         791309           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul	200
98.8         109.8         108.8         108.8         107.5         106.5         103.5         102.0         99.0         Point         Same MR_PH_intakel         5.1         561528         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Man & EC         0.3         561489         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561494         791310           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561509         791309           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561514         791309           108.5         119.5         118.5         118.5         118.5         118.5         118.5         118.5         118.5         118.6         116.3         111.7 <t< td=""><td>200</td></t<>	200
108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Man & EC   0.3   561489   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561494   791310   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561509   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561514   791309   108.5   119.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Loul   0.3   561519   791309   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePri_Crul   10.0   563473   791344   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   EC   3.5   561379   791279   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   EC   3.5   562386   791210   104.0   106.9   117.4   109.4   110.2   103.6   101.2   95.5   89.7   Point   Same MR_Reclaimer01   3.0   562260   791248   119.2   122.6   122.7   121.2   121.6   121.0   120.0   116.5   111.5   Point   Same MR_MilnePri_Crul   20.0   563433   791450   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   563064   791432   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   110.8   110.8   110.8   110.8   110.8   110.8   110.8   110.8   110	200
108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Lou1   0.3   561494   791310   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Lou1   0.3   561509   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Lou1   0.3   561514   791309   108.5   119.5   118.5   118.5   117.3   116.3   113.3   111.9   108.8   Point   Same MR_PH_Lou1   0.3   561519   791309   114.4   117.8   117.9   116.4   116.8   116.2   115.2   111.7   106.7   Point   Same MR_MilnePri_Cru1   10.0   563473   791344   112.5   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   EC   3.5   561379   791279   112.5   115.8   110.2   109.1   109.9   104.1   99.8   94.6   95.8   Point   EC   3.0   562289   791210   104.0   106.9   117.4   109.4   110.2   103.6   101.2   95.5   89.7   Point   Same MR_Reclaimer01   3.0   562260   791248   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   563064   791432   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8   119.8   119.8   116.8   117.6   115.2   112.3   108.2   107.4   Point   Same MR_Shovel01   3.0   564106   791469   119.8	206
108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561509         791309           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561514         791309           108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Loul         0.3         561519         791309           114.4         117.8         117.9         116.4         116.8         116.2         115.2         111.7         106.7         Point         Same MR_MilnePri_Crul         10.0         563473         791344           121.6         125.6         121.9         116.1         118.7         118.0         118.6         115.4         110.1         Point         Mea         2.0         562964         791286           112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         Same MR_Rail_LO_Milne         3.5 <td>206</td>	206
108.5         119.5         118.5         118.5         117.3         116.3         113.3         111.9         108.8         Point         Same MR_PH_Lou1         0.3         561519         791309           114.4         117.8         117.9         116.4         116.8         116.2         115.2         111.7         106.7         Point         Same MR_PH_Lou1         0.3         561519         791309           121.6         125.6         121.9         116.1         118.7         118.0         118.6         115.4         110.1         Point         Mea         2.0         562964         791248           112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         EC         3.5         561379         791279           112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         Same MR_Rail_LO_Milne         3.5         562386         791210           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         Same MR_Reclaimer01         3.0         562260<	206
114.4         117.8         117.9         116.4         116.8         116.2         115.2         111.7         106.7         Point         Same MR_MilnePri_Cru1         10.0         563473         791344           121.6         125.6         121.9         116.1         118.7         118.0         118.6         115.4         110.1         Point         Mea         2.0         562964         791286           112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         EC         3.5         561379         791279           12.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         Same MR_Rail_LO_Milne         3.5         562386         791210           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         Same MR_Reclaimer01         3.0         562289         791256           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         Same MR_Reclaimer01         3.0 <td< td=""><td>206</td></td<>	206
121.6   125.6   121.9   116.1   118.7   118.0   118.6   115.4   110.1   Point   Mea   2.0   562964   791286	206
112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         EC         3.5         561379         791279           112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         Same MR_Rail_LO_Milne         3.5         562386         791210           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         EC         3.0         562289         791256           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         Same MR_Reclaimer01         3.0         562260         791248           119.2         122.6         122.7         121.2         121.6         121.0         120.0         116.5         111.5         Point         Same MR_MilnePri_Crul         20.0         562809         791299           119.8         119.8         116.8         117.6         115.2         112.3         108.2         107.4         Point         Same MR_Shovel01         3.0         563064         7	328
112.5         115.8         110.2         109.1         109.9         104.1         99.8         94.6         95.8         Point         Same MR_Rail_LO_Milne         3.5         562386         791210           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         EC         3.0         562289         791256           104.0         106.9         117.4         109.4         110.2         103.6         101.2         95.5         89.7         Point         Same MR_Reclaimer01         3.0         562289         791256           119.2         122.6         122.7         121.2         121.6         121.0         120.0         116.5         111.5         Point         Same MR_MilnePri_Crul         20.0         562809         791299           119.8         119.8         116.8         117.6         115.2         112.3         108.2         107.4         Point         Same MR_Shovel01         3.0         563064         791432           119.8         119.8         116.8         117.6         115.2         112.3         108.2         107.4         Point         Same MR_Shovel01         3.0         563064         791432<	267
104.0       106.9       117.4       109.4       110.2       103.6       101.2       95.5       89.7       Point       EC       3.0       562289       791256         104.0       106.9       117.4       109.4       110.2       103.6       101.2       95.5       89.7       Point       Same MR_Reclaimer01       3.0       562289       791248         119.2       122.6       122.7       121.2       121.6       121.0       120.0       116.5       111.5       Point       Same MR_MilnePri_Crul       20.0       562809       791299         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       563064       791432         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       563064       791432         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       564106       791469	193
104.0       106.9       117.4       109.4       110.2       103.6       101.2       95.5       89.7       Point       Same MR_Reclaimer01       3.0       562260       791248         119.2       122.6       122.7       121.2       121.6       121.0       120.0       116.5       111.5       Point       Same MR_MilnePri_Cru1       20.0       562809       791299         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Man       3.0       563343       791450         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       563064       791432         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       564106       791469	197
119.2       122.6       122.7       121.2       121.6       121.0       120.0       116.5       111.5       Point       Same MR_MilnePri_Cru1       20.0       562809       791299         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Man       3.0       563343       791450         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       563064       791432         119.8       119.8       116.8       117.6       115.2       112.3       108.2       107.4       Point       Same MR_Shovel01       3.0       564106       791469	205
119.8     119.8     116.8     117.6     115.2     112.3     108.2     107.4     Point     Man     3.0     563343     791450       119.8     119.8     116.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     563064     791432       119.8     119.8     116.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     564106     791469       119.8     119.8     110.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     564106     791469	211
119.8     119.8     116.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     563064     791432       119.8     119.8     116.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     564106     791432       2     119.8     119.8     119.8     110.8     117.6     115.2     112.3     108.2     107.4     Point     Same MR_Shovel01     3.0     564106     791469	296
119.8 119.8 116.8 117.6 115.2 112.3 108.2 107.4 Point Same MR_Shovel01 3.0 564106 791469	600
	657
	518
119.8 119.8 116.8 117.6 115.2 112.3 108.2 107.4 Point Same MR_Shovel01 3.0 563802 791505	591
119.8 119.8 116.8 117.6 115.2 112.3 108.2 107.4 Point Same MR_Shovel01 3.0 563651 791378	389
113.1 111.8 106.9 100.4 99.3 100.2 94.7 87.5 82.3 Point Mea 3.0 562421 791244	211
113.1 111.8 106.9 100.4 99.3 100.2 94.7 87.5 82.3 Point Same MR_Stacker01 3.0 562228 791261.	204
113.1 111.8 106.9 100.4 99.3 100.2 94.7 87.5 82.3 Point Same MR_Stacker01 3.0 562232 791251	209
Line EC Varies	+
Line Same MR_2100_CV_002 Varies	+
Line         Same MR_2100_CV_002         Varies         -         -           Line         Same MR_2100_CV_002         Varies         -         -	+
Line Same MIN_2100_C v_002 values	

Source ID	Source Description	Sound Power Level
		(dBA)
MR_2300_CV_012	Conveyor from 2300-TT-001 to 2300-TT-002 to Rail Load Out	96
MR_CV_ROMtoROJ_01	Conveyor from ROM Stockpile to ROJ Stockpile	96
MR_CV_ROMtoROJ_01	Conveyor from ROM Stockpile to ROJ Stockpile	96
MR_CV_ROMtoROJ_01	Conveyor from ROM Stockpile to ROJ Stockpile	96
MR_HR_Dozer_06	Mary River Haul Route - Dozer Snow Removal	116
MR_HR_Graders	Mary River Haul Route - Graders	115
MR_HR_MinetoMilneROM	Mary River Haul Route - Mine to Milne ROM Stockpile	121
MR_HR_MinetoSCrusher	Mary River Haul Route - Mine to Steensby Crusher	121
MR_HR_St_Stockpile	Haul Route - Steensby Crusher to Stockpile	121
MR_HR_WasteRock	Mary River Haul Route - Mine to Waste Rock Area	121
MR_M_Train	Mary River Milne Train	116
MR_M_Train_Th	Mary River Milne Train Knuckle Thump	122
MR_S_Train	Mary River Steensby Train	115
MR_S_Train_Th	Mary River Steensby Train Knuckle Thump	123
MR_PH_Roof	Power House - Roof	108
MR_PH_W	Power House - West Face	100
MR_PH_N	Power House - North Face	102
MR_PH_S	Power House - South Face	103
MR_PH_E	Power House - East Face	94

	1/1 Octave Band Sound Power Level Data if available (dB)						a		Source Type [1]	PWL Data Source [2]	Height Above Grade	Above for point sources		
31.5	63	125	250	500	1000	2000	4000	8000			(m)	X	Y	Z
									Line	Same MR_2100_CV_002	Varies	-	-	-
			$\setminus$	$\setminus$		$\setminus$			Line	Same MR_2100_CV_002	Varies	-	-	-
			$\setminus$	$\setminus$		$\setminus$			Line	Same MR_2100_CV_002	Varies	-	-	-
			$\setminus$	$\setminus$		$\setminus$			Line	Same MR_2100_CV_002	Varies	-	-	-
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Mobile Equipment	Same MR_Dozer01	2.5	-	-	-
113.8	115.8	113.5	109.9	109.6	110.4	108.4	104.5	101.9	Mobile Equipment Mea		2.5	-	-	-
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Mobile Equipment Mea		2.5	-	-	-
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Mobile Equipment	Same MR_HR_MinetoMilneROM	2.5	-	-	-
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Mobile Equipment	Same MR_HR_MinetoMilneROM	2.5	-	-	-
116.6	125.7	127.6	121.7	120.7	113.9	111.0	105.7	104.3	Mobile Equipment	Same MR_HR_MinetoMilneROM	2.5	-	-	-
123.6	118.8	114.9	119.4	113.2	107.9	107.1	103.3	100.3	Mobile Equipment	Hist	3.5	-	-	-
123.3	127.2	122.7	116.2	116.6	116.6	115.2	112.7	112.5	Mobile Equipment	Hist	1.0	-	-	-
122.6	117.8	113.9	118.4	112.2	106.9	106.1	102.3	99.3	Mobile Equipment	Hist	3.5	-	-	-
124.3	128.2	123.7	117.2	117.6	117.6	116.2	113.7	113.5	Mobile Equipment	Same MR_M_Train_Th	1.0	-	-	-
120.7	127.7	121.7	107.7	91.6	89.6	83.6	83.2	79.1	Area	Hist	12.0	-	-	-
112.6	119.6	113.6	99.6	83.4	81.4	75.4	74.9	70.8	Vert Area	Man & EC	Varies	-	-	-
114.9	121.9	115.9	101.9	85.7	83.7	77.7	77.2	73.2	Vert Area	Man & EC	Varies	-	-	-
116.3	123.3	117.3	103.3	87.0	85.0	79.0	78.5	74.5	Vert Area	Man & EC	Varies	-	-	-
107.0	114.0	108.0	94.0	77.7	75.7	69.7	69.3	65.2	Vert Area	Man & EC	Varies	-	-	-

### **Table B.2: Noise Source Summary**

Milne Port, Baffinland, 1402090

2.

Notes to Table:

1. Sound Power Level Data Source:

- Man = Manufacturer's Data

- EC = Engineering Calcs based on specifications

- Mea = Measured Directly

- Same ### - same type as source no. ###

- Hist = Historical Data on File at RWDI

Source type indicates Cadna/A modelling methodology. For Point, Line, and Area sources, PWLs represent the overall level for the entire source. Where source type is Mobile Equipment, the source is modelled as a moving

point source, and PWL is calculated from a single-vehicle passby.

Source ID	Source Description	Sound Power Level
		(dBA)
MI_1.35MW_gen1	Milne generator 1 - 1.35 MW	113
MI_1.35MW_gen2	Milne generator 2 - 1.35 MW	113
MI_1.35MW_gen3	Milne generator 3 - 1.35 MW	113
MI_1.35MW_gen4	Milne generator 4 - 1.35 MW	113
MI_1.35MW_gen5	Milne generator 5 - 1.35 MW	113
MI_2MW_gen1	Milne generator 1 - 2 MW	115
MI_2MW_gen2	Milne generator 2 - 2 MW	115
MI_2MW_gen3	Milne generator 3 - 2 MW	115
MI_2MW_gen4	Milne generator 4 - 2 MW	115
MI_2MW_gen5	Milne generator 5 - 2 MW	115
MI_Cru	Milne Secondary Crusher	121
MI_CVM_CrutoScr	Milne Conveyor Motor - Crusher to Screeners	102
MI_CVM_RDtoROM	Milne Conveyor Motor - Rail Dump to ROM Stockpile	102
MI_DZ_1	Milne Dozer (CAT D9) - Lump stockpile	116
MI_FEL_1	Milne Front End Loader (CAT 998) - Initial fines stockpile	112
MI_FEL_2	Milne Front End Loader (CAT 998) - Final fines stockpile	112
MI_FEL_3	Milne Front End Loader (CAT 998) - Lump stockpile	112
MI_FEL_4	Milne Front End Loader (CAT 998) - Lump stockpile	112
MI_FF	Milne Frost Fighters	119
MI_Incinerator_1	Milne - Incinerator	91
MI_Rail_Unload	Milne - Rail Unloading	110
MI_Reclaim_Lump_01	Milne - Lump Reclaimer/Stacker	116
MI_Scr	Milne Screeners	119
MI_Ship_Power01	Milne ship power	104
MI_Ship_Power02	Milne ship power	104
MI_Ship_Power03	Milne ship power	104
MI_Ship_Power04	Milne ship power	104
MI_Shipload01	Milne ship loading	110
MI_Shipload02	Milne ship loading	110
MI_Shipload03	Milne ship loading	110
MI_Shipload04	Milne ship loading	110
MI_Stacker_Fines_01	Milne - Fines Stacker 1	116
MI_Stacker_Fines_02	Milne - Fines Stacker 2	116
MI_Stacker_Fines_03	Milne - Fines Stacker 3	116
MI_Stacker_Fines_04	Milne - Fines Stacker 4	116

	1/1 Octave Band Sound Power Level Data if available (dB)						a		Source Type [1]	PWL Data Source [2]	Height Above Grade  Source Co-ordinates for point sources (m)			
31.5	63	125	250	500	1000	2000	4000	8000			(m)	X	Y	Z
121.2	126.1	111.1	112.6	106.4	109.4	104.7	99.3	94.5	Point	Mea	1.5	503697	7976064	17.4
121.2	126.1	111.1	112.6	106.4	109.4	104.7	99.3	94.5	Point	Same MI_1.35MW_gen1	1.5	503697	7976055	17.4
121.2	126.1	111.1	112.6	106.4	109.4	104.7	99.3	94.5	Point	Same MI_1.35MW_gen1	1.5	503698	7976048	17.4
121.2	126.1	111.1	112.6	106.4	109.4	104.7	99.3	94.5	Point	Same MI_1.35MW_gen1	1.5	503698	7976039	17.4
121.2	126.1	111.1	112.6	106.4	109.4	104.7	99.3	94.5	Point	Same MI_1.35MW_gen1	1.5	503698	7976032	17.4
122.9	127.8	112.8	114.3	108.1	111.1	106.4	101.0	96.2	Point	Mea & EC	2.0	503705	7976063	18.0
122.9	127.8	112.8	114.3	108.1	111.1	106.4	101.0	96.2	Point	Mea & EC	2.0	503705	7976055	18.0
122.9	127.8	112.8	114.3	108.1	111.1	106.4	101.0	96.2	Point	Mea & EC	2.0	503706	7976047	18.0
122.9	127.8	112.8	114.3	108.1	111.1	106.4	101.0	96.2	Point	Mea & EC	2.0	503705	7976039	18.0
122.9	127.8	112.8	114.3	108.1	111.1	106.4	101.0	96.2	Point	Mea & EC	2.0	503705	7976031	18.0
114.4	117.8	117.9	116.4	116.8	116.2	115.2	111.7	106.7	Point	Hist	20.0	503338	7974863	35.5
89.6	89.6	92.6	94.6	97.6	97.6	96.6	91.6	83.6	Point	Point EC 1.0 5		503156	7974819	15.8
89.6	89.6	92.6	94.6	97.6	97.6	96.6	91.6	83.6	Point EC		1.0	503774	7974951	49.9
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Hist	3.0	503437	7975851	18.7
109.3	106.2	116.3	112.7	107.9	107.1	102.7	96.4	94.2	Point	Hist	3.0	502973	7974839	17.2
109.3	106.2	116.3	112.7	107.9	107.1	102.7	96.4	94.2	Point	Same MI_FEL_1	3.0	503301	7976028	17.6
109.3	106.2	116.3	112.7	107.9	107.1	102.7	96.4	94.2	Point	Same MI_FEL_1	3.0	503361	7975948	17.9
109.3	106.2	116.3	112.7	107.9	107.1	102.7	96.4	94.2	Point	Same MI_FEL_1	3.0	503236	7975205	18.6
				/					Point	Man	2.0	503820	7976053	20.0
	88.0	86.0	82.0	92.0	84.0	81.0	77.0	72.0	Point	Man	5.8	503790	7975995	24.5
112.5	115.8	110.2	109.1	109.9	104.1	99.8	94.6	95.8	Point	Hist	3.0	503787	7974958	52.7
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MI_DZ_1	10.0	503318	7975633	26.0
116.8	120.8	117.1	111.3	113.9	113.2	113.8	110.6	105.3	Point	Hist	2.0	503138	7974820	16.7
	115.0	116.0	104.0	96.0	95.0	94.0	86.0	79.0	Point	Hist	7.0	503315	7976701	7.0
	115.0	116.0	104.0	96.0	95.0	94.0	86.0	79.0	Point	Same MI_Ship_Power01	7.0	503273	7976681	7.0
	115.0	116.0	104.0	96.0	95.0	94.0	86.0	79.0	Point	Same MI_Ship_Power01	7.0	503728	7976807	7.0
	115.0	116.0	104.0	96.0	95.0	94.0	86.0	79.0	Point	Same MI_Ship_Power01	7.0	503792	7976806	7.0
112.5	115.8	110.2	109.1	109.9	104.1	99.8	94.6	95.8	Point	Same MI_Rail_Unload	2.0	503227	7976659	2.0
112.5		110.2	109.1	109.9	104.1	99.8	94.6	95.8	Point	Same MI_Rail_Unload	2.0	503195	7976647	2.0
112.5	115.8	110.2	109.1	109.9	104.1	99.8	94.6	95.8	Point	Same MI_Rail_Unload	2.0	503552	7976770	2.0
112.5	115.8	110.2	109.1	109.9	104.1	99.8	94.6	95.8	Point	Same MI_Rail_Unload	2.0	503623	7976789	2.0
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MI_DZ_1	3.0	503174	7975759	18.3
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MI_DZ_1	3.0	503221	7975879	18.9
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MI_DZ_1	3.0	503231	7976093	18.3
113.8	117.9	115.0	107.2	110.1	112.6	109.6	105.6	99.9	Point	Same MI_DZ_1	3.0	503237	7976233	17.4

Source ID	Source Description	Sound Power Level
		(dBA)
MI_Tug_01	Milne - Tug Boat Idling	100
MI_Tug_02	Milne - Tug Boat Idling	100
MI_Tug_03	Milne - Tug Boat Idling	100
MI_Tug_04	Milne - Tug Boat Idling	100
M_Train_KT	Milne Train Knuckle Thump	122
MI_CNV_SL_CD	Milne Conveyor from Lump Stockpile to Cape Sized Dock	93
MI_CNV_SL_ED	Milne Conveyor from Fines Stockpile to Existing Dock	93
MI_CV_CrutoScr	Milne Conveyor - Secondary Crusher to Screener	93
MI_CV_RDtoROM	Milne Conveyor - Rail Dump to ROM Stockpile	93
MI_ToteRd_Graders	Milne Tote Road - Graders	115
MI_Train	Milne Train	116

Source Ty	1/1 Octave Band Sound Power Level Data if available (dB)											
	8000	4000	2000	1000	500	250	125	63	31.5			
Poin	75.1	82.1	90.4	96.3	96.8	100.9	104.4	107.8	111.8			
Poin	75.1	82.1	90.4	96.3	96.8	100.9	104.4	107.8	111.8			
Poin	75.1	82.1	90.4	96.3	96.8	100.9	104.4	107.8	111.8			
Poin	75.1	82.1	90.4	96.3	96.8	100.9	104.4	107.8	111.8			
Mobile Equ	112.5	112.7	115.2	116.6	116.6	116.2	122.7	127.2	123.3			
Line												
Line						$\setminus$						
Line												
Line					$\setminus$	$\setminus$	$\setminus$	$\setminus$				
Mobile Equ	101.9	104.5	108.4	110.4	109.6	109.9	113.5	115.8	113.8			
Mobile Equ	100.3	103.3	107.1	107.9	113.2	119.4	114.9	118.8	123.6			

Source Type [1]	PWL Data Source [2]	Height Above Grade	Page 2 of 2 Source Co-ordinates for point sources (m)					
		(m)	X	Y	Z			
Point	Mea	5.0	503153	7976694	5.0			
Point	Same MI_Tug_01	5.0	503424	7976722	5.0			
Point	Same MI_Tug_01	5.0	503519	7976741	5.0			
Point	Same MI_Tug_01	5.0	503863	7976755	5.0			
Mobile Equipment	Hist	1.0	-	-	-			
Line	EC	Varies	-	-	-			
Line	EC	Varies	-	-	-			
Line	EC	Varies	-	-	-			
Line	EC	Varies	-	-	-			
Mobile Equipment	Hist	2.5	-	-	-			
Mobile Equipment	Hist	3.5	-	-	-			



#### **APPENDIX E**

UPDATED ENVIRONMENTAL NOISE IMPACT ASSESSMENT TO ADDRESS CHANGES IN PROJECT - MEMORANDUM

(Pages E-1 to E-5)



600 Southgate Drive Guelph, ON NIG 4P6 Canada Tel: +1.519.823.1311 Fax: +1.519.823.1316

E-mail: solutions@rwdi.com

# MEMORANDUM

DATE:	2018-06-18	RWDI Reference No.: 1402090
то:	Sara Wallace	EMAIL: sara.wallace@baffinland.com
CC:	Lou Kamermans	EMAIL: lou.kamermans@baffinland.com
cc:	Alain Carriere	EMAIL: alain.carriere@rwdi.com
FROM:	Kyle Hellewell	EMAIL: kyle.hellewell@rwdi.com
RE:	Updated Environmental Noise Impact Assessment to Address Changes in Project Description Baffinland Iron Mines Corporation Mary River Project – Phase 2 Proposal Technical Supporting Document 7	

Dear Sara,

In the Phase 2 Proposal Environmental Noise report, dated September 26, 2017, analysis was presented showing the predicted noise contours from the operation of the Northern Transportation Corridor between Milne Port and the Mine Site. The analysis has been updated to account for a proposed temporary transfer site, and combined road and rail activity. Consideration has been given to a proposal to increase the power generation capacity at Milne Port, and an analysis has been done to address any changes in environmental noise impacts resulting from this change.

### NORTHERN TRANSPORTATION CORRIDOR

The updated analysis for the Northern Transportation Corridor presents predicted sound levels from operational noise only. Construction sound levels are not expected to change materially from those presented in the September 26, 2017 report. The model accounts for road transportation between the Mine Site and the Temporary Transfer Facility, and rail transportation between the Temporary Transfer Facility and Milne Port. Road traffic levels are doubled from the previously modelled 6.3 Mtpa to 12 Mtpa, and trains are modelled with a frequency of 6 per 24-hour period.



Sara Wallace Baffinland Iron Mines Corporation RWDI#1402090 June 18, 2018

The Temporary Transfer Facility is understood to be serviced by 6 front end loaders (CAT 988 or similar), and to have a single power generator. The power generator was assumed to be similar to the 1.35 mW generators previously modelled at Milne Port. The only other significant sources of noise anticipated at the transfer facility are trucks idling. Based on drawing H353004-30000-224-271-0029-0001 dated 2017/02/03, a total of 12 idling trucks were included (3 at piles, and 9 in the staging area).

For Summer operations, the impacts of the transfer site are predicted to be 50 dBA at approximately 1000 m from the site, and 45 dBA approximately 630 m from the site. For winter operation these distances are reduced by approximately 50 m.

Average road noise is predicted to be 50 dBA at a distance of 350 m from the center of the road, and 45 dBA at 305 m from the center of the road, with very little difference between summer and winter conditions. For rail, 50 dBA impacts are predicated at a distance of 65 m from track centre, and 45 dBA at 180 m from track centre. Again, little difference is predicted between summer and winter conditions.

Figures 1 and 2 show noise contours indicating predicted noise impacts from the road, rail and Temporary Transfer Facilities – for summer and winter conditions, respectively.

# MILNE PORT GENERATORS

The September 26, 2017 report included modelling of 10 generators at Milne Port; five each of 1.35 and 2 MW units for a total of 16.75 MW of power generation capacity. It is understood that additional generators will be required at Milne Port to meet a capacity of 22 MW. If an additional four 1.35 MW generators were added in the vicinity of the existing generators the increase in sound level at the HTO Cabin (the nearest point of reception) has been calculated to be less than 0.3 dB, resulting in no perceptible change to the predicted sound levels from our previous modelling.

Yours truly,

RWDI

We Hellewell, P.Eng. Senior Noise Engineer

KAH/klm Attach.



# FIGURES

