

**DATE** March 15, 2017**PROJECT No.** Doc 616 - 1663489**TO** Manon Turmel  
Anigo Eagle Mines Ltd. | Meliadine Division**CC** Lasha Young (Golder Associates Ltd.)**FROM** Victor Young**EMAIL** victor\_young@golder.com**PREDICTIVE NOISE EFFECTS ASSESSMENT: CONSTRUCTION OF THE RANKIN INLET BY-PASS ROAD  
AND ASSOCIATED ACTIVITIES IN ITIVIA QUARRY**

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**1.0 EXECUTIVE SUMMARY**

Agnico Eagle Mines Ltd. is developing the Meliadine Gold Mine near Rankin Inlet, Nunavut. Agnico Eagle plans to construct a By-Pass Road to divert mine-related traffic around the hamlet of Rankin Inlet. Agnico Eagle expects that construction of the Rankin Inlet By-Pass Road will run from April 2017 through October 2017. A model-based noise assessment was conducted for construction of the By-Pass Road. The results of the By-Pass Road noise assessment are presented in this technical memorandum.

For the duration of construction activities, modelling suggests that construction noise will likely be difficult to perceive against baseline noise levels in most parts of Rankin Inlet. During early stages of construction, when activities will occur near the southern/eastern end of the By-Pass Road, modelling suggests that construction noise will likely be noticeable in southern parts of Rankin Inlet but at a level that is unlikely to be disturbing either indoors or outdoors. Once construction activities move farther along the By-Pass Road, modelling suggests that construction noise will likely be difficult to perceive against baseline noise levels anywhere in Rankin Inlet.

Agnico Eagle plans to conduct regular noise monitoring to verify and validate the modelling results presented in this technical memorandum. If significant noise effects are observed during the monitoring program, then appropriate mitigation and management measures will be implemented.



## 2.0 INTRODUCTION

Agnico Eagle Mines Ltd. (Agnico Eagle) is developing the Meliadine Gold Mine (the Mine) near Rankin Inlet, Nunavut. In support of the mining operations, Agnico Eagle plans to construct a By-Pass Road to divert mine-related traffic around the hamlet of Rankin Inlet. Agnico Eagle expects that construction of the Rankin Inlet By-Pass Road will run from April 2017 through October 2017. Agnico Eagle expects that aggregate and other raw materials for construction of the Rankin Inlet By-Pass Road will be extracted from the nearby Itivia Quarry. For the sake of brevity, construction of the Rankin Inlet By-Pass Road and associated activities in Itivia Quarry will hereafter be referred to as the Project.

Agnico Eagle has asked Golder Associates Ltd. (Golder) to assess potential noise effects from the Project using a predictive computer model. This technical memorandum presents the results of Golder's predictive noise effects assessment for the Project. In particular, this technical memorandum:

- provides background information on past noise work completed (Section 2);
- summarizes relevant results (i.e., baseline noise measurements and model predictions) from past noise work completed (Section 3);
- describes the modelling methodology used to predict Project noise levels (Section 4);
- identifies noise emissions estimates used to represent Project equipment (Section 5);
- presents model-predicted Project noise levels at receptors within the hamlet of Rankin Inlet (Section 6); and
- assesses potential Project noise effects using criteria and thresholds that are consistent with past noise work completed (Section 7).

## 3.0 BACKGROUND

In April 2014, Agnico Eagle submitted a Final Environmental Impact Statement (FEIS) for the Mine to the Nunavut Impact Review Board (NIRB). Volume 5 of the FEIS includes an assessment of potential noise effects (Agnico Eagle 2014). To support the FEIS, baseline noise levels were measured at a number of receptors in and around the hamlet of Rankin Inlet (Agnico Eagle 2014). Results from the FEIS baseline noise study are summarized in Section 3 of this technical memorandum.

Potential Mine-related noise effects at receptors within the hamlet of Rankin Inlet were modelled as part of the FEIS (Agnico Eagle 2014). Relevant model predictions from the FEIS are summarized in Section 3 of this technical memorandum. For all receptors within the hamlet of Rankin Inlet, the FEIS predicts negligible magnitude noise effects that are considered to be not significant (Agnico Eagle 2014). However, the FEIS is primarily concerned with potential noise effects resulting from operation of the Mine and does not quantitatively assess potential noise effects resulting from construction because operational noise was assumed to be greater and of longer duration. In particular, the FEIS does not include a model-based assessment of potential noise effects from construction of the Rankin Inlet By-Pass Road or from associated activities in the Itivia Quarry.

The assessment of potential Project noise effects described in this technical memorandum was conducted in general accordance with the assessment methods used in the FEIS (Agnico Eagle 2014). In particular, the Project noise effects assessment estimated noise emissions from Project equipment, used a computer model to quantify the contribution from Project equipment to cumulative noise levels at representative receptor locations within the

hamlet of Rankin Inlet, and assessed the magnitude and significance of potential Project noise effects using criteria and thresholds taken from the FEIS.

#### **4.0 EXISTING BASELINE DATA AND MODELLING RESULTS**

To support the FEIS, a baseline noise monitoring program was conducted in and around the hamlet of Rankin Inlet from July 28 through July 31, 2012. Baseline noise levels were monitored for a minimum of 24 hours at five receptor locations. For the duration of the monitoring program, energy equivalent sound levels were logged over one-minute averaging periods ( $L_{eq,1min}$ ) in A-weighted decibels (dBA). Following the monitoring program, raw  $L_{eq,1min}$  data samples were used to calculate energy equivalent sounds levels for the daytime period ( $L_{eq,day}$ ), the nighttime period ( $L_{eq,night}$ ), and the full 24-hour monitoring period ( $L_{eq,24}$ ). The FEIS defines daytime as the period from 7 am to 11 pm and nighttime as the period from 11 pm to 7 am (Agnico Eagle 2014). The FEIS definition of daytime and nighttime was adopted for the Project noise effects assessment, as well.

Table 1 identifies the locations in and around the hamlet of Rankin Inlet used as receptors during the 2012 baseline program. Table 1 also summarizes the results of the 2012 baseline noise monitoring program (Agnico Eagle 2014).

**Table 1: Results from 2012 Baseline Noise Monitoring in Rankin Inlet**

Receptor	Description	Universal Transverse Mercator Coordinates [NAD83, Zone 15]		Measured Baseline Noise Level <sup>(a)</sup> [dBA]		
		Easting [m]	Northing [m]	Daytime [L <sub>eq,day</sub> ]	Nighttime [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]
M1 (also identified as NPOR022)	north side of Rankin Inlet; northwest of the intersection of Kingaaq Ave and Tugak St; approximately 2.0 km from By-Pass Road and 2.4 km from Itivia Quarry	546460	6965866	55	48	54
M2 (also identified as NPOR023)	west side of Rankin Inlet; west of Ekusik St and north of the airport; approximately 1.0 km from By-Pass Road and 1.7 km from Itivia Quarry	545832	6965009	54	45	52
M3 (also identified as NPOR025)	south side of Rankin Inlet; south of the intersection of Inukshuk St and Tiktaq St; approximately 700 m from By-Pass Road and 800 m from Itivia Quarry	546327	6964295	62	46	61
M4 (also identified as NPOR024)	central Rankin Inlet; north side of Mivvik Ave between Inulik St and Attami St; approximately 1.3 km from By-Pass Road and 1.2 km from Itivia Quarry	546709	6964775	64	52	63
M5	Rankin Inlet port; south end of Itivia St; approximately 400 m from By-Pass Road and 100 m from Itivia Quarry	546439	6963541	54	45	53

<sup>(a)</sup> Values taken directly from Table 5.5-4 of the FEIS (Agnico Eagle 2014).

As part of the FEIS, a computer model of Mine operations was developed and used to predict noise levels at relevant receptors. The FEIS indicates that the following equipment has the potential to influence noise levels within the hamlet of Rankin Inlet during operation of the Mine:

- loaders, operating at the Rankin Inlet port; and
- transport trucks travelling along the Rankin Inlet By-Pass road.

Table 2 presents model predictions of the noise contribution from operation of the Mine at receptors located within the hamlet of Rankin Inlet. The results presented in Table 2 represent the noise contribution from Mine operations in isolation and have been taken directly from the FEIS (Agnico Eagle 2014). The FEIS did not assess potential noise effects at M5, since this receptor is not located in a populated area.



**Table 2: Mine Operation Noise Level Predictions**

Receptor	Predicted Mine Operation Noise Level <sup>(a)</sup> [dBA]		
	Daytime [ $L_{eq,day}$ ]	Nighttime [ $L_{eq,night}$ ]	24-Hour [ $L_{eq,24}$ ]
M1 (also identified as NPOR022)	19.8	19.8	19.8
M2 (also identified as NPOR023)	32.4	32.4	32.4
M3 (also identified as NPOR025)	39.6	39.6	39.6
M4 (also identified as NPOR024)	27.1	27.1	27.1

<sup>(a)</sup> Predicted noise contribution from Mine operations in isolation (i.e., not including the contribution from other noise sources); values taken directly from Table 5.5-8 of the FEIS (Agnico Eagle 2014).

The FEIS characterizes the magnitude of potential noise effects based on changes to baseline noise levels. In particular, the FEIS compares cumulative noise levels, which include noise from operation of the Mine, to baseline case noise levels, and characterizes the magnitude of noise effects as negligible, low, moderate, or high using the following definitions:

- negligible – increase from baseline noise levels up to 3 dBA (hardly perceptible);
- low – increase from baseline noise levels up to 6 dBA (noticeable);
- moderate – increase from baseline noise levels up to 10 dBA (readily noticeable); and
- high – increase from baseline noise levels greater than 10 dBA (disturbing).

The FEIS definition of effects magnitude was adopted for the Project noise effects assessment, as well.

Table 3 presents a summary of the noise effects magnitude classification from the FEIS (Agnico Eagle). As indicated in Table 3, for all receptors within the hamlet of Rankin Inlet, operation of the Mine is predicted to increase noise levels by less than 3 dBA compared to baseline noise levels. As such, the FEIS classifies the magnitude of noise effects as negligible for all receptors within the hamlet of Rankin Inlet. Because the magnitude of noise effects is found to be negligible, the Mine FEIS further concludes that noise effects from the Mine are not significant (Agnico Eagle 2014). However, as mentioned previously, the FEIS does not include a model-based assessment of potential noise effects from construction of the Rankin Inlet By-Pass Road or from associated activities in the Itivia Quarry.

**Table 3: Mine Operation Noise Effects Assessment**

Receptor	Baseline Noise Level [dBA]			Mine Operation Noise Level [dBA]			Cumulative Noise Level <sup>(a)</sup> [dBA]			Increase from Baseline [dBA]			Magnitude of Effect	Typical Human Response
	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]	Day	Night	24-Hour		
M1	55	48	54	19.8	19.8	19.8	55.0	48.0	54.0	0.0	0.0	0.0	negligible	hardly perceptible
M2	54	45	52	32.4	32.4	32.4	54.0	45.2	52.0	0.0	0.2	0.0	negligible	hardly perceptible
M3	62	46	61	39.6	39.6	39.6	62.0	46.9	61.0	0.0	0.9	0.0	negligible	hardly perceptible
M4	64	52	63	27.1	27.1	27.1	64.0	52.0	63.0	0.0	0.0	0.0	negligible	hardly perceptible

<sup>(a)</sup> Logarithmic sum of baseline noise level and Mine operation noise level.

## 5.0 PROJECT MODELLING METHODOLOGY

For consistency with the Mine FEIS and in accordance with standard industry practice, computer models of the Project were developed using the ISO 9613-2 propagation standard (ISO 1996). Inputs to the computer models consisted of source emissions in the form of octave-band sound power levels and environmental conditions – such as ground cover, temperature, humidity, and wind conditions – that are known to impact noise propagation (Table 4). Noise source emissions for the Project are discussed in detail in Section 5.

**Table 4: Environmental Inputs to Computer Models of the Project**

Parameter	Model Setting	Description/Notes
Standard	ISO 9613-2 (ISO 1996)	Models treated noise sources, noise attenuation, and noise propagation in accordance with this standard.
Source Types	Area source; Line source	Area sources were used to model noise emissions from Itivia Quarry and from the Project construction site. A line source was used to model traffic back-and-forth between Itivia Quarry and the Project construction site.
Ground Factor	0.0 – Bodies of water 0.5 – Elsewhere	These values represent acoustic properties of the ground in accordance with ISO 9613-2. A value of 0.0 represents hard/reflective ground. A value of 1.0 represent porous/absorptive ground.
Temperature / Humidity	10 degrees Celsius / 70% relative humidity	These are typical default values for ISO 9613-2 intended to represent nighttime summer conditions.
Wind Conditions	1 m/s to 5 m/s from source to receptor	These represent default ISO 9613-2 wind conditions – moderate temperature inversion, wind from source to receptor 100% of the time.
Terrain	Terrain considered	Terrain features were considered at a horizontal spatial resolution of 5 m.

When calculating noise levels at receptors, the ISO 9613-2 propagation standard used the environmental inputs listed in Table 4 to account for four noise attenuation mechanisms:

- geometric divergence;
- atmospheric absorption;
- ground absorption; and
- screening by barriers.

Geometric divergence accounts for the fact that a given noise source radiates a finite amount of acoustic energy and as this finite amount of energy propagates into the environment it is spread over a larger and larger area (i.e., the surface of an ever-expanding sphere). This geometric spreading means that the farther away a receptor is located from a source, the less energy will be received (i.e., the lower the observed noise level).

Atmospheric absorption accounts for the fact that acoustic energy associated with a given noise source is absorbed via interaction with molecules in the air through which it propagates. Attenuation effects associated with atmospheric absorption are most substantial at high frequencies, but can be important at lower frequencies for large propagation distances.

Ground absorption accounts for the fact that each time the acoustic energy emitted by a noise source interacts with the ground, some of it is absorbed. The amount of energy absorbed depends on the type of ground surface: during interactions with hard ground, very little energy is absorbed but during interactions with porous ground, a substantial amount of energy is absorbed. As a result, if all other factors are held constant, observed noise levels associated with sources operating in an area of hard ground will be higher than observed noise levels associated with sources operating in an area of porous ground.

Screening by barriers accounts for the fact that a physical object (either terrain-based or anthropogenic) placed between a noise source and receptor will tend to block some of the acoustic energy and so serve to reduce observed noise levels.

According to the ISO 9613-2 standard, the overall accuracy of the propagation algorithm used in the Project computer models is  $\pm 3$  dB for distances between source and receptor up to 1 km. The accuracy for propagation distances greater than 1 km is not stated in the standard. Model accuracy also depends on the accuracy of the noise emissions inputs, which is often  $\pm 2$  dB. Accounting for both these sources of uncertainty, the overall accuracy of the noise level predictions presented in the Project noise assessment is expected to be  $\pm 3.6$  dB.

Conservative assumptions regarding propagation conditions and were made to account for the level of uncertainty inherent in the noise level predictions. Most importantly, each receptor was assumed to be downwind from each source 100% of the time. Because downwind conditions tend to enhance noise propagation, this assumption is conservative and likely overestimates noise effects of the Project.

## 6.0 PROJECT NOISE EMISSIONS

Noise sources associated with the Project will consist of mechanical equipment and explosive blasting. For consistency with the Mine FEIS (Agnico Eagle 2014), the present technical memorandum is focussed on potential noise effects from mechanical equipment. Golder understands that potential effects from explosive blasting will be discussed in a separate technical memorandum, which is being prepared by Agnico Eagle.

Mechanical equipment required for the Project consists of the following:

- one rock drill (Terex Hydra-Trac R30C or equivalent), which will operate within Itivia Quarry, 24 hours per day;
- one rock crusher (Elrus CH660 or equivalent), which will operate within Itivia Quarry during the daytime period;
- one loader (CAT 980 or equivalent), which will operate within Itivia Quarry, 24 hours per day;
- one excavator (CAT 345 or equivalent), which will operate at the active construction site along the By-Pass Road, 24 hours per day;
- one dozer (CAT D8 or equivalent), which will operate at the active construction site along the By-Pass Road, 24 hours per day;
- one compactor (CAT CCS9 or equivalent), which will operate at the active construction site along the By-Pass Road, 24 hours per day;
- two haul trucks (CAT 740 or equivalent), which will travel back-and-forth along the By-Pass Road between Itivia Quarry and the active construction site, 24 hours per day; and

- four pickup trucks (Ford F250 or equivalent), which will travel back-and-forth along the By-Pass Road between Itivia Quarry and the active construction site, 24 hours per day.

Noise emissions from Project equipment were estimated using a combination of vendor data sheets and professional experience. Noise emissions estimates for individual pieces of Project equipment are presented in Table 5 in the form of octave-band sound power levels. Where appropriate, noise emissions values from Table 5 include the contribution from a back-up alarm.

In the computer models, noise emissions from individual pieces of Project equipment were combined to create three composite sources:

- an area source representing Itivia Quarry;
- an area source representing the active construction site; and
- a line source representing equipment travelling back-and-forth between Itivia Quarry and the active construction site.

Noise emissions for these three composite sources are presented in Table 6 in the form of octave-band sound power levels.

**Table 5: Project Equipment Noise Emissions Estimates**

Equipment	Quantity	Location	Octave-Band Sound Power Level Per Unit [dBZ]								Total Sound Power Level Per Unit [dBA]	
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz		8 kHz
rock crusher	1 – daytime 0 – nighttime	quarry	117.2	119.5	121.8	119.9	113.5	113.8	111.7	111.0	105.3	119.5
loader <sup>(a)</sup>	1		113.4	115.5	116.7	110.1	110.7	111.8	106.3	100.7	94.9	114.9
rock drill	1		103.9	111.9	119.9	104.9	105.9	106.9	105.9	102.9	100.9	112.6
compactor <sup>(b)</sup>	1	active construction site	124.0	117.0	110.1	104.3	105.1	104.8	102.3	109.0	89.4	112.5
dozer <sup>(a)</sup>	1		96.8	103.5	116.1	107.8	104.6	110.6	101.8	95.8	88.5	112.4
excavator <sup>(c)</sup>	1		106.5	108.8	109.8	103.7	104.0	107.8	100.0	94.3	88.7	109.8
haul truck <sup>(b)</sup>	2	between quarry and active construction site	121.0	118.0	115.0	105.3	107.1	106.0	101.3	95.3	91.3	110.1
pickup truck <sup>(b)</sup>	4		85.1	95.1	99.6	93.8	90.2	103.0	90.3	84.2	79.1	103.6

<sup>(a)</sup> Includes noise contribution from a back-up alarm operating 50% of the time.

<sup>(b)</sup> Includes noise contribution from a back-up alarm operating 10% of the time.

<sup>(c)</sup> Includes noise contribution from a back-up alarm operating 25% of the time.

**Table 6: Noise Emissions Estimates for Composite Project Sources**

Composite Source	Source Type	Octave-Band Sound Power Level [dBZ]									Total Sound Power Level [dBA]
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
quarry - daytime	area	118.9	121.5	124.7	120.5	115.8	116.4	113.6	112.0	106.9	121.4
quarry – nighttime	area	113.9	117.1	121.6	111.2	111.9	113.0	109.1	104.9	101.9	116.9
active construction site	area	124.1	117.8	117.8	110.4	109.4	113.1	106.2	109.3	93.7	116.4
between quarry and construction site	line	124.0	121.0	118.2	108.9	110.3	112.0	104.9	98.9	94.8	114.7

## 7.0 PROJECT MODELLING RESULTS

. Project noise levels have been modelled for three snapshots during the seven-month period of April to October 2017. In particular:

- modelling Snapshot 1 considers noise effects early in the Project, when active construction activities will occur near the southern/eastern end of the By-Pass Road and construction materials will be extracted from the southwestern section of the Itivia Quarry;
- modelling Snapshot 2 considers noise effects partway through the Project, when construction activities will occur near the western end of the Rankin Inlet airport runway and construction materials will be extracted from the central section of the Itivia Quarry; and
- modelling Snapshot 3 considers noise effects late in the Project, when active construction activities will occur near the northern/western end of the By-Pass Road and construction materials will be extracted from the central section of the Itivia Quarry.

Table 7 presents predicted Project noise levels for each of the three modelling snapshots identified above. Project noise levels are presented for each of the four Rankin Inlet receptors considered in the Mine FEIS (Agnico 2014). Project noise levels are also presented for an additional receptor, RA, located at southern edge of the hamlet of Rankin Inlet, south of the junction of Signiq St and Tapiq Ave, approximately 700 m from By-Pass Road, and approximately 500 m from Itivia Quarry. Receptor RA represents the location within the hamlet of Rankin Inlet where Project noise effects are likely to be greatest. Although not co-located with M3, baseline noise levels at RA are likely to be consistent with measurements taken at M3 during the 2012 field program (see Table 1 of this technical memorandum).

Figure 1 and Figure 2 present daytime and nighttime Project noise contours for modelling Snapshot 1. Figure 3 and Figure 4 present daytime and nighttime Project noise contours for modelling Snapshot 2. Figure 5 and Figure 6 present daytime and nighttime Project noise contours for modelling Snapshot 3. The noise level predictions presented in Table 7 and Figures 1 through 6 represent the noise contribution from the Project in isolation.

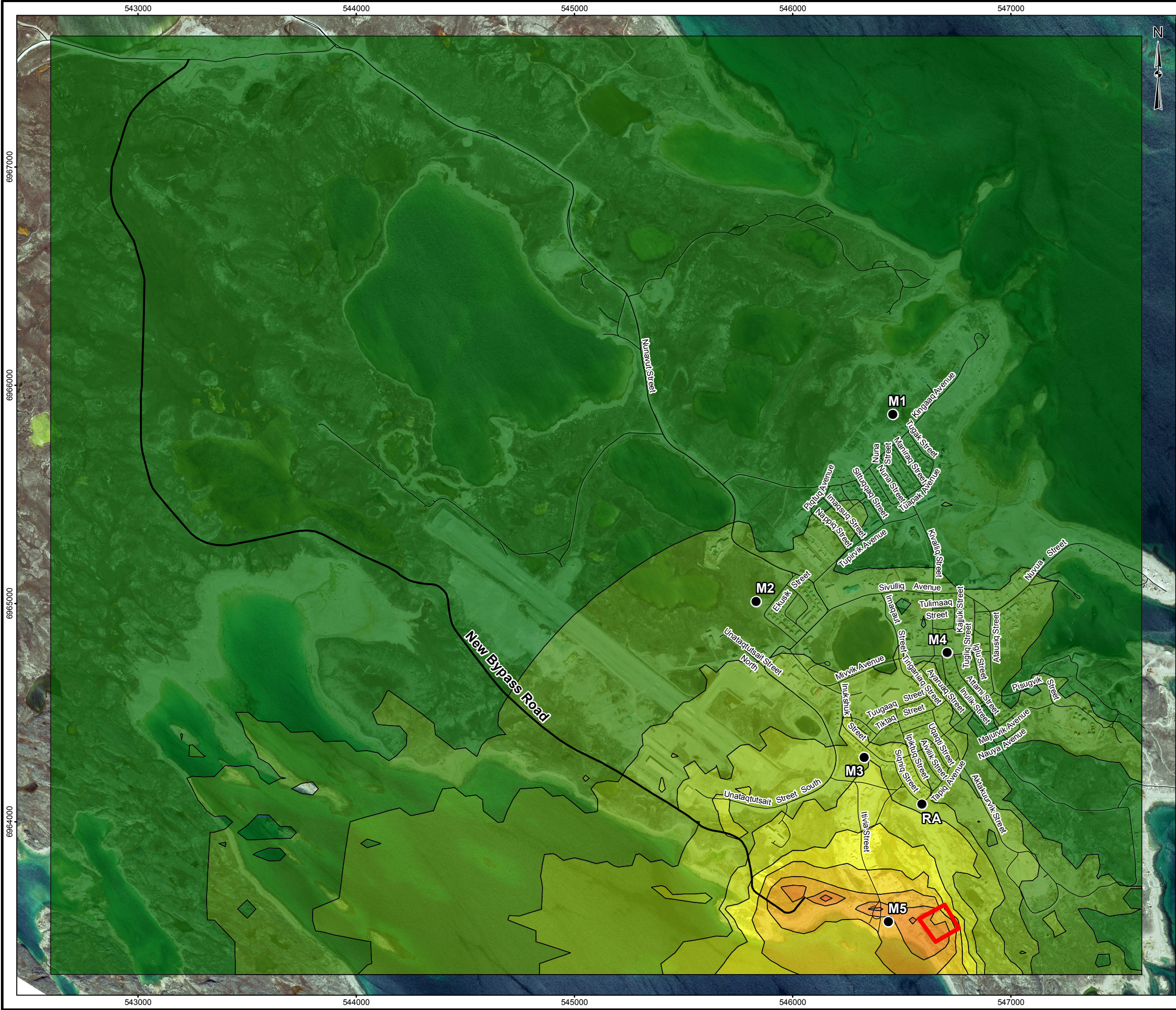
**Table 7: Predicted Project Noise Levels**

Receptor	Predicted Project Noise Level <sup>(a)</sup> [dBA]								
	Modelling Snapshot 1			Modelling Snapshot 2			Modelling Snapshot 3		
	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]	Day [L <sub>eq,day</sub> ]	Night [L <sub>eq,night</sub> ]	24-Hour [L <sub>eq,24</sub> ]
M1	32.9	30.5	32.2	25.8	25.0	25.5	25.2	24.3	24.9
M2	37.2	34.9	36.6	34.7	34.6	34.7	30.3	30.0	30.2
M3	48.3	45.6	47.6	39.0	38.7	38.9	36.2	35.7	36.0
M4	38.7	36.1	38.0	30.0	29.3	29.8	28.1	26.9	27.7
RA	48.4	46.1	47.8	38.3	37.8	38.1	35.9	34.9	35.6

<sup>(a)</sup> Predicted noise contribution from the Project in isolation (i.e., not including the contribution from other noise sources).



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**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ▭ ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

**PROJECT**

AGNICO EAGLE

**TITLE**

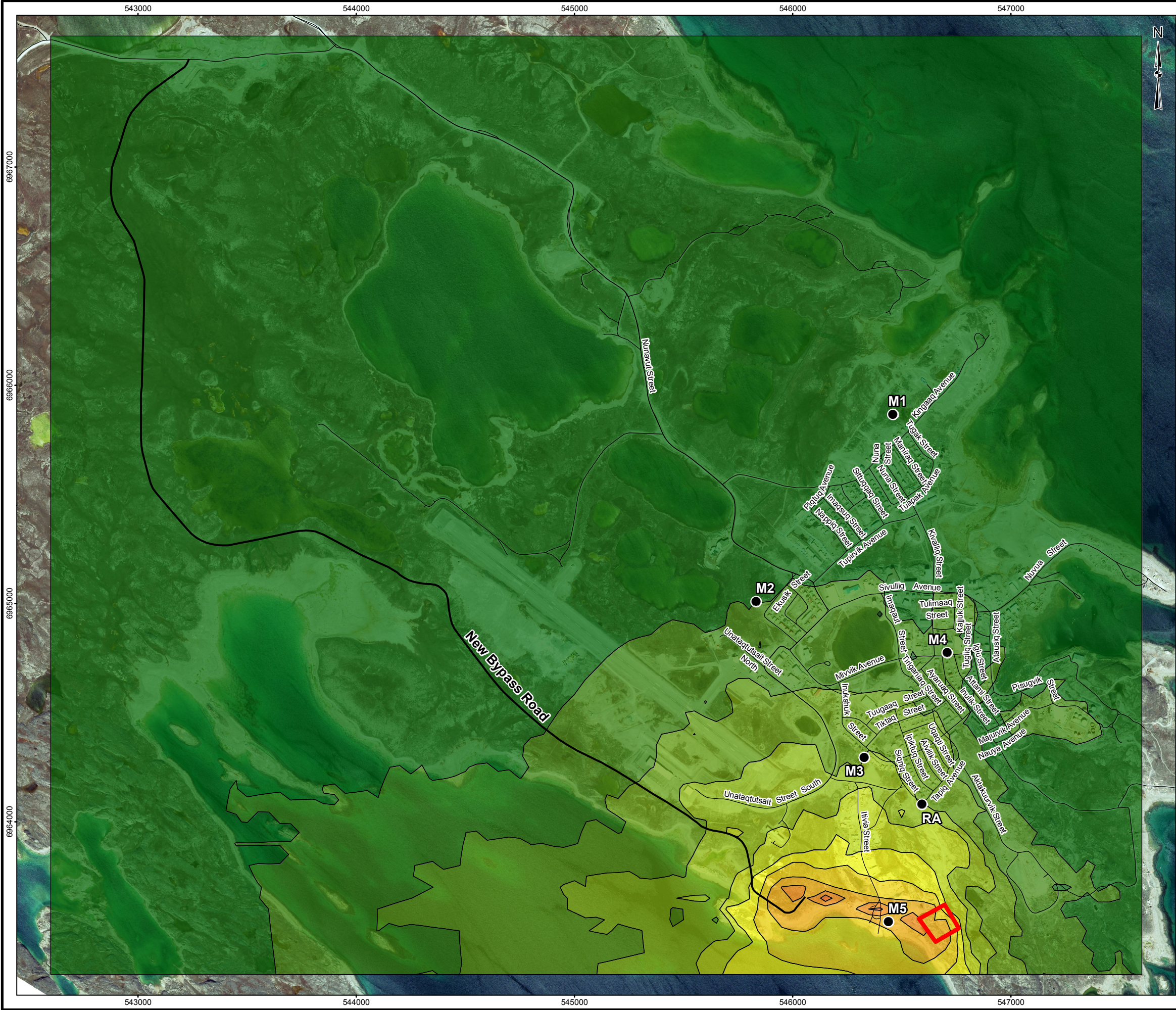
PROJECT NOISE LEVELS (DAYTIME) -  
MODELLING SNAPSHOT 1

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 1**



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**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ▭ ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

350 0 350  
METRES

PROJECT

AGNICO EAGLE MINES LIMITED  
MELIADINE GOLD MINE  
NUNAVUT

TITLE

**PROJECT NOISE LEVELS (NIGHTTIME) -  
MODELLING SNAPSHOT 1**

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 2**



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**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

**PROJECT****AGNICO EAGLE**

**AGNICO EAGLE MINES LIMITED  
MELIADINE GOLD MINE  
NUNAVUT**

**TITLE**

**PROJECT NOISE LEVELS (DAYTIME) -  
MODELLING SNAPSHOT 2**

**Golder Associates**

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 3**



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**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ▭ ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

**PROJECT**

**AGNICO EAGLE**

AGNICO EAGLE MINES LIMITED  
MELIADINE GOLD MINE  
NUNAVUT

**TITLE**

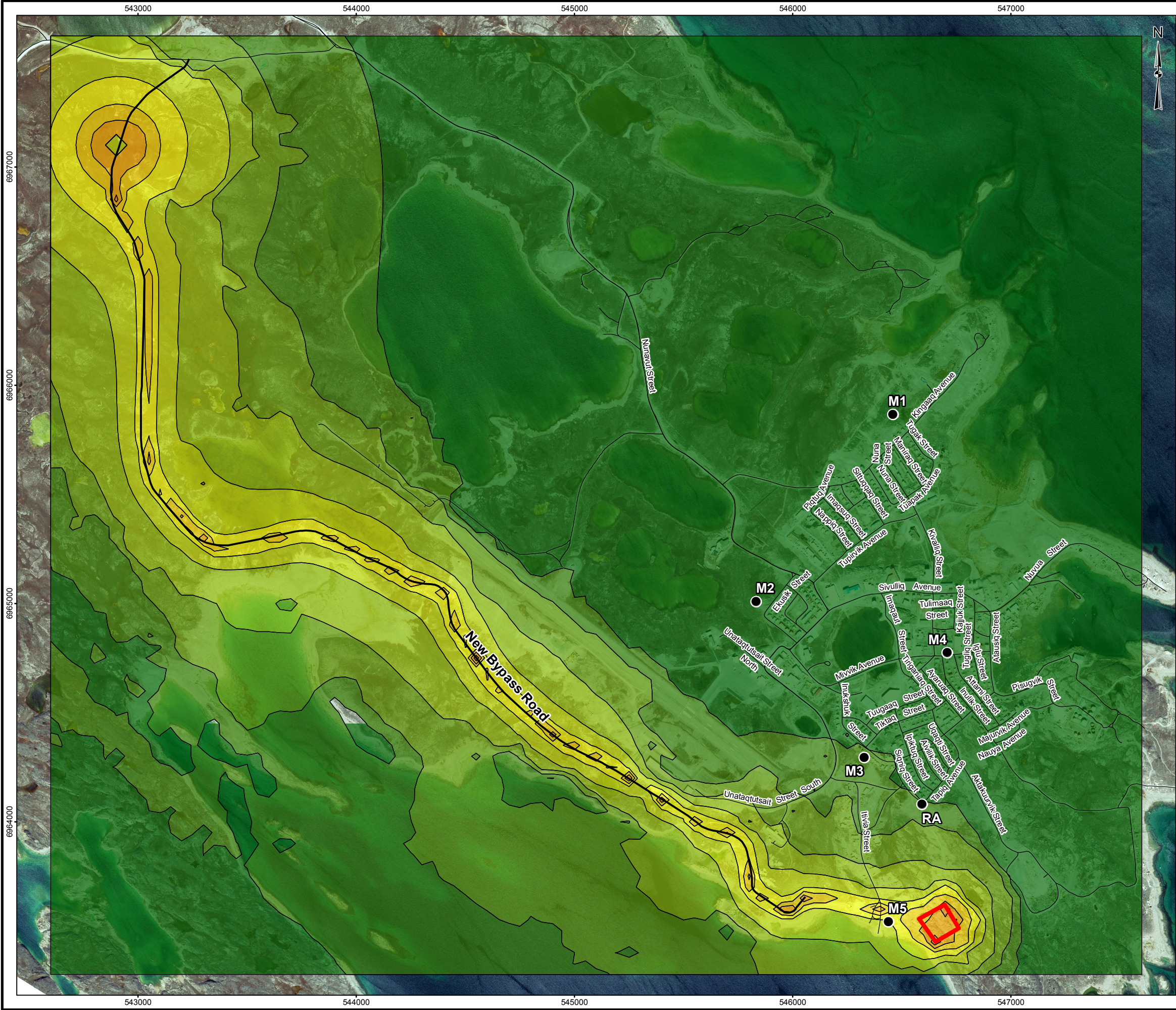
**PROJECT NOISE LEVELS (NIGHTTIME) -  
MODELLING SNAPSHOT 2**

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 4**



Y:\bunaby\CAD-GIS\Client\Agnico\_Eagle\_Mines\_Ltd\Meliadine\_Gold\_Project\09\_Project\_Noise\_Contours\_Daytime\_Snapshot\_3.mxd



**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

**PROJECT**

**AGNICO EAGLE**

AGNICO EAGLE MINES LIMITED  
MELIADINE GOLD MINE  
NUNAVUT

**TITLE**

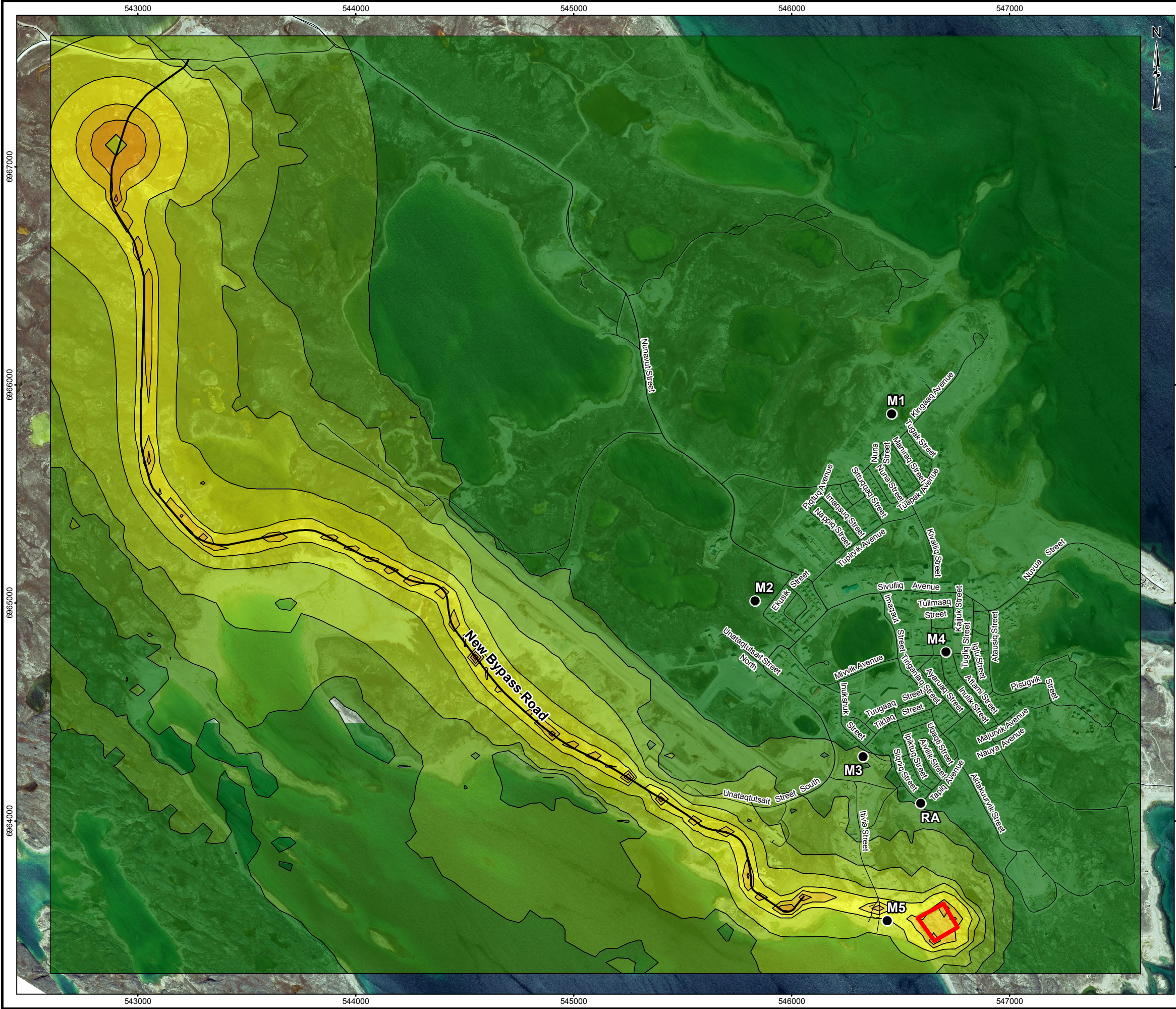
**PROJECT NOISE LEVELS (DAYTIME) -  
MODELLING SNAPSHOT 3**

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 5**



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**LEGEND**

- NOISE RECEPTOR
- ROAD - NEW BYPASS
- ROAD - EXISTING
- ITIVIA QUARRY (APPROXIMATE LOCATION)

**PROJECT NOISE LEVEL CONTOURS (dBA)**

< 35	whisper / remote area with light wind	
35 - 40	light rainfall	
40 - 45	refrigerator	
45 - 50	existing nighttime noise level in most of Rankin Inlet (outdoor)	
50 - 55	existing daytime noise level in most of Rankin Inlet (outdoor)	
55 - 60	normal conversation	
60 - 65	ringing telephone	
65 - 70	alarm clock	
70 - 75	singing	
75 - 80	barking dog	

**REFERENCE**

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.  
DATUM: NAD 83 PROJECTION: UTM ZONE 15

350 0 350  
METRES

**PROJECT**

**AGNICO EAGLE**  
MELIADINE GOLD MINE  
NUNAVUT

**TITLE**  
**PROJECT NOISE LEVELS (NIGHTTIME) -  
MODELLING SNAPSHOT 3**

PROJECT NO.	1663489	FILE No.	
DESIGN	VY 09 Mar. 2017	SCALE AS SHOWN	REV. 0
GIS	MH 09 Mar. 2017		
CHECK	VY 14 Mar. 2017		
REVIEW	AF 14 Mar. 2017		

**FIGURE: 6**



## 8.0 PROJECT EFFECTS ASSESSMENT

For each receptor, the Project effects assessment focused on the specific modelling snapshot during which Project noise levels were predicted to be greatest. Table 7 indicates that Project noise levels at all receptors will be greatest during modelling Snapshot 1.

Table 8 presents a summary of the Project noise effects magnitude classification. Table 9 indicates that nighttime noise levels at RA are predicted to increase by more than 3 dBA (but less than 6 dBA) as a result of the Project. As such, the magnitude of the Project noise effect at RA is characterized as low (noticeable). Table 9 indicates that daytime and nighttime noise levels will not increase by more than 3 dBA for any of the other receptors as a result of the Project. As such, the magnitude of the Project noise effect at these receptors is characterized as negligible (hardly perceptible).

For the duration of Project construction activities (i.e., April to October 2017), modelling suggests that Project noise will likely be difficult to perceive against baseline noise levels in most parts of Rankin Inlet. During early stages of Project construction, when active construction activities will occur near the southern/eastern end of the By-Pass Road (i.e., modelling Snapshot 1), modelling suggests that Project noise will likely be noticeable in southern parts of Rankin Inlet but at a level that is unlikely to be disturbing either indoors or outdoors. Once active construction activities move farther along the By-Pass Road (i.e., modelling Snapshot 2 and Snapshot 3), modelling suggests that Project noise will likely be difficult to perceive against baseline noise levels anywhere in Rankin Inlet.

Magnitude is only one of several criteria the Mine FEIS uses to assess the significance of noise effects. When assessing the overall significance of effects, the Mine FEIS also considers geographic extent, timing and duration, frequency, and degree of irreversibility.

Based on the criteria definitions provided in the Mine FEIS, all of the Project noise effects would be considered:

- moderate in geographic extent, since the relevant receptors are all located within the Local Study Area (LSA) for the Mine FEIS;
- short/low in time and duration, since Project noise effects will be confined to construction and last less than three years;
- high in frequency, since Project noise effects will occur regularly and frequently; and
- low in degree of irreversibility, since Project noise effects will be readily/immediately reversible.

The Mine FEIS indicates that any noise effects with negligible or low magnitude can be considered not significant (Agnico Eagle 2014). A summary of the significance determination for Project noise effects is presented in Table 9.

**Based on definitions taken from the Mine FEIS, Project noise effects can be considered not significant at all receptors within the hamlet of Rankin Inlet.**

Agnico Eagle plans to conduct regular noise monitoring to verify and validate the Project noise effects assessment presented in this technical memorandum. If significant Project noise effects are observed during the noise monitoring program, then appropriate mitigation and management measures will be implemented.

**Table 8: Project Noise Effects Assessment – Magnitude**

Receptor	Baseline Noise Level [dBA]			Project Noise Level [dBA]			Cumulative Noise Level <sup>(a)</sup> [dBA]			Increase from Baseline [dBA]			Magnitude of Effect	Typical Human Response
	Day [Leq,day]	Night [Leq,night]	24-Hour [Leq,24]	Day [Leq,day]	Night [Leq,night]	24-Hour [Leq,24]	Day [Leq,day]	Night [Leq,night]	24-Hour [Leq,24]	Day	Night	24-Hour		
M1	55	48	54	32.9	30.5	32.2	55.0	48.1	54.0	0.0	0.1	0.0	negligible	hardly perceptible
M2	54	45	52	37.2	34.9	36.6	54.1	45.4	52.1	0.1	0.4	0.1	negligible	hardly perceptible
M3	62	46	61	48.3	45.6	47.6	62.2	48.8	61.2	0.2	2.8	0.2	negligible	hardly perceptible
M4	64	52	63	38.7	36.1	38.0	64.0	52.1	63.0	0.0	0.1	0.0	negligible	hardly perceptible
RA	62 <sup>(b)</sup>	46 <sup>(b)</sup>	61 <sup>(b)</sup>	48.4	46.1	47.8	62.2	49.1	61.2	0.2	3.1	0.2	low	noticeable

<sup>(a)</sup> Logarithmic sum of baseline noise level and Project noise level.

<sup>(b)</sup> The baseline noise level at RA is assumed to be comparable to the baseline noise level measured at M3.

**Table 9: Project Noise Effects Assessment - Significance**

Receptor	Effects Criteria <sup>(a)</sup>					Conclusion <sup>(b)</sup>
	Magnitude	Geographic Extent	Timing and Duration	Frequency	Degree of Irreversibility	
M1	negligible	moderate	short/low	high	low	not significant
M2	negligible	moderate	short/low	high	low	not significant
M3	negligible	moderate	short/low	high	low	not significant
M4	negligible	moderate	short/low	high	low	not significant
RA	low	moderate	short/low	high	low	not significant

<sup>(a)</sup> Effects criteria and category definitions taken directly from Table 5.5-2 and Table 5.5-3 of the Mine FEIS (Agnico Eagle 2014).

<sup>(b)</sup> Significance of effect determined in accordance with methods described in Section 5.5.3.6 of the Mine FEIS (Agnico Eagle 2014).

## 9.0 CLOSURE

We trust that the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.



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Acoustic Scientist

VY/AF/vm



Andrew Faszter, BSc, INCE, PEng  
Senior Acoustical Engineer

[https://golderassociates.sharepoint.com/sites/10438g/shared documents/4000 air quality, noise and vibration monitoring/noise modelling memo/doc 616-1663489\\_meliadine\\_bypassroad\\_noisemodellingmemo\\_draft.docx](https://golderassociates.sharepoint.com/sites/10438g/shared%20documents/4000%20air%20quality,%20noise%20and%20vibration%20monitoring/noise%20modelling%20memo/doc%20616-1663489_meliadine_bypassroad_noisemodellingmemo_draft.docx)



## 10.0 REFERENCES

Agnico Eagle (Agnico Eagle Mines Ltd.). 2014. *Final Environmental Impact Statement (FEIS) – Meliadine Gold Project, Nunavut. Volume 5.0 Atmospheric Environment and Impact Assessment*. Dated April 2014.

ISO (International Organization for Standardization). 1996. *ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*. Dated December 15, 1996.