Environmental and Social Impact Assessment for the Troilus Mine Project

ACOUSTIC ENVIRONMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS

LIST OF APPENDICES

Acronyms and abbreviations

%HA	Highly annoyed
VC	Valued Component
dBA	A weighted Decibel
dB	Decibel
SADF	Summer average daily flow
ESIA	Environmental and Social Impact Assessment
FTA	Federal transit administration
INSPQ	Institut national de la santé publique du Québec
LQE	Environment Quality Act
MDDEP	Ministry of Sustainable Development, Environment and Parks
MELCCFP	Ministry of Environment, the Fight Against Climate Change, Wildlife and Parks
MTMD	Ministry of Transport and Sustainable Mobility
NDQ	Nord-du-Québec
PDA	Project Development Area
LSA	Local Study Area
RSA	Regional Study Area

9. Acoustic Environment

To clarify notions of sound, it should be remembered that sound is a variation in air pressure observed in the environment in which it propagates (see glossary in appendix 9.1 of this report). Sound levels are measured and expressed on a logarithmic scale in decibels (dBA). Table 9.1 below, published in the guide *Meilleures pratiques d'aménagement pour prévenir les effets du bruit environnemental sur la santé et la qualité de vie* from the Institut national de la santé publique du Québec (INSPQ), shows the sound levels associated with different noise sources and the human response expected when exposed to such levels.

Table 9.1 Scale of Sound Levels and Human Reactions (INSPQ, 2018)

Noise event	Sound level (in dBA)[a]	Human Reactions
Jackhammer; shot in hunter's ear	130	Pain
Emergency vehicle siren	120	Onset of pain
Amplified music show; nightclub	110	Bearable for a short period, maximum vocal effort to be understood
Jackhammer at 10 m; motorcycle	100	
Lawnmower; alarm; heavy truck on freeway, 10 m away, at 80 km/h	90	
Alarm clock; 2 cars on freeway, 10 m away, at 80 km/h; many factories; noisy restaurants	80 - 85	Difficult conversation, sensation of loud noise
Busy street; vacuum cleaner	70	Uncomfortable to hold a telephone conversation
Normal conversation	55 - 60	
Moderate rain; washing machine	50	Beginning of disturbance (nuisance)
Library; refrigerator; quiet street at night	40	Place perceived as peaceful
Quiet room; low-voiced conversation	30	Feeling of calm
Light wind in the trees	20	Feeling of great calm
No perceptible sound	0	Hearing threshold

Note: a: Sound level rounded to 1 dBA, ref: 2 x 10-5 Pa.

9.1 Scope of Assessment

9.1.1 Regulatory and Policy Setting

The project must comply with local (regional government of Eeyou Istchee Baie-James), provincial and federal regulations. To this end, the reference texts presented below determine the requirements applicable to the project regarding the acoustic environment.

9.1.1.1 Local

There are no specific (quantitative) local noise regulations. Consequently, no local regulations will be taken into consideration when establishing noise requirements.

9.1.1.2 Provincial

In order to assess the extent to which noise may affect the well-being of a population, Directive 019 (2025) from the Ministry of Environment, the Fight Against Climate Change, Wildlife and Parks (MELCCFP) y is the tool commonly used to analyze mining projects requiring ministerial authorization under the Environment Quality Act (Q -2) (LQE), including projects subject to the environmental impact assessment and review procedure under the James Bay and Northern Québec Agreement. Section 3.4.1 “Niveau sonore maximal admissible” of Directive 019 states that stationary sources of noise must be assessed in accordance with the requirements of instruction note 98-01 (NI 98-01) on noise from MELCCFP NI 98-01 (MELCCFP, 2006) establishes noise criteria for the review of projects subject to noise impact assessment. These criteria indicate the hourly average sound levels for the day and night periods that must not be exceeded for the uses permitted by the municipal zoning by-law. These maximum sound levels are as follows:

- The residual noise level (existing noise without the noise from the project's mining activities).
- The maximum level permitted according to zoning and time of day, as mentioned in table 9.2

Table 9.2 Directive 019 on Noise Criteria (from NI 98-01)

Zone	Noise Limits (dBA - ref. 2x10-5 Pa) *	
	Daytime (7 a.m. to 7 p.m.)	Night period (7 p.m. to 7 a.m.)
I	45	40
II	50	45
III	55 (50 if residential)	50
IV	70 (55 if residential)	70 (50 if residential)

Note: * Hourly average of noise emitted by the mining activity, excluding residual noise.

Zoning categories are defined as follows:

- I: Area intended for isolated or semi-detached single-family housing, schools, hospitals or other establishments providing educational, health or convalescent services. Area for an existing housing in an agricultural zone.
- II: Area intended for multi-unit housing, mobile home parks, institutions or campgrounds.
- III: Area intended for commercial uses or recreational parks. However, the night-time noise level applies only within the property limits of establishments used for residential purposes. In all other cases, the maximum daytime noise level also applies at night.
- IV: Area intended for industrial or agricultural purposes. However, on the site of an existing housing in an industrial zone and established in accordance with municipal by-laws in force at the time of its construction, the criteria are 50 dBA at night and 55 dBA during the day.

NI 98-01 stipulates that corrective terms must be added to measured or predicted noise levels. These corrective terms concern the presence of tonal noise, impact noise, disruptive noise or low-frequency noise.

Furthermore, in the case of blasting operations, section 2.4.2 "Vibrations et bruit lors d'un sautage" of Directive 019 stipulates that a self-monitoring system must be set up, and that all blasting operation monitoring data must be kept for at least two years.

Where no point of impact is located within 1 km of the mine site:

- The maximum permissible ground vibration speeds due to blasting operations are those shown in the table below.
- For an open-pit mine, the maximum air pressure threshold at any dwelling, if applicable, is 128 linear decibels.

Table 9.3 Maximum Authorized Speeds for Ground Vibration Frequencies

Ground vibration frequency (hertz)	Maximum permissible speed (mm/s)
Frequency ≤ 15	12,7
15 < frequency ≤ 20	19,0
20 < frequency ≤ 25	23,0
25 < frequency ≤ 30	30,5
30 < frequency ≤ 35	33,0
35 < frequency ≤ 40	38,0
Frequency > 40	50,0

If a point of impact (other than a dwelling or mining camp owned by the mine operator) is located within 1 km of open-pit mining operations:

- The maximum authorized ground vibration velocity due to blasting operations at the point of impact is 12.7 mm/s.
- The maximum air pressure threshold at any dwelling is 128 linear decibels.

The 2015 MELCCFP “Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction” limit noise levels at the nearest residential receptors to 55 dB or the initial noise level (highest level) during the day and 45 dB or the initial noise level (highest level) in the evening and at night.

9.1.1.3 Federal

Federal noise requirements are contained in the document “*Guidance for Evaluating Human Health Effects in Impact Assessment: Noise”* (Health Canada, 2023). Like provincial requirements, federal requirements apply to receptor points likely to be impacted by industrial activities and are assessed by 24-hour periods. In this case, the reference index at federal level is the *Level Day-night* (Ldn) index, which considers day and night (7 a.m. to 7 a.m.) noise levels, to which a penalty of +10 dBA is added for night-time noise levels.

The percentage of people highly annoyed (% HA) by noise is then assessed in accordance with ISO 1996-1: 2003 and compared with the reference level without contribution from the noise source. A difference of more than 6.5% between the reference index and the index assessed with the project triggers the implementation of mitigation measures to reduce the impact of the noise source.

Provincial and federal requirements apply at the receiving point, not at the source, and the suggested sound levels depend on the existing ambient noise level without the project. It is therefore necessary to adequately characterize the acoustic environment in all areas where it could be modified by Troilus Gold Corp (Troilus) activities.

Finally, the transport of materials or people on regional roads is generally not part of the noise attributable to the project but rather belongs to road noise. However, cumulative impacts, particularly those related to increased road traffic and trucking, can be assessed on an indicative basis by following the methodology of the Ministère des Transports et de la Mobilité durable (MTMD) policy on road noise. In addition, the MELCCFP’s” Position ministérielle provisoire sur l'acceptabilité du bruit émis en phase d'exploitation par les projets de transport routier et ferroviaire” will be used to assess the impact of road transport on the Troilus mine access road and the Route du Nord.

This temporary Ministerial Position stipulates that:

"For mobile sources, specifically noise from road traffic and passing trains, the MELCCFP recommends an approach with two levels of acceptability criteria:

1) **Relative impact criterion**: Each section of the project is deemed acceptable if it presents little or no impact of the $LAeq_{24h}$ of the Noise Impact Evaluation Grid of “Politique sur le bruit routier” (MTQ, 1998) for road noise or if it presents no impact of the L_{dn} of the Guide (Federal Transit Administration [FTA], 2018) for rail noise. However, other impact assessment methods may be admissible, subject to prior approval by MELCCFP.

2) **Maximum impact criterion**: Each section of the project is deemed acceptable:
   - If it presents sound levels L_{den} and L_{night}, below the World Health Organization Guidelines (World Health Organization [WHO], 2018), i.e. the criteria of 53 dB L_{den}[1] and 45 dB L_{night} for sound levels produced by road traffic (specific noise) and the criteria of 54 dB L_{den}[2] and 44 dB L_{night} for sound levels produced by rail traffic (specific noise) or
   - If it presents a specific sound level that does not increase the initial ambient sound level, for the same statistical indicators.

   These acoustic levels are assessed at receptors with a sensitive residential or public facility use[3] ."

The maximum impact criterion is assessed over three distinct periods: daytime (7 a.m. to 7 p.m.), evening (7 p.m. to 11 p.m.) and nighttime (11 p.m. to 7 a.m.). Penalties apply for the evening and night periods, i.e. +5 dBA and +10 dBA respectively. Once the penalties have been applied, the logarithmic average of the three periods gives the sound level L_{den}. (dBA).

9.1.2 Impact of Consultation and Engagement

From the outset of the project, Troilus engaged in a process of consultation and communication with the project's various stakeholders, as presented in section 4 of the Environmental and Social Impact Assessment (ESIA) report.

Table 9.4 presents the main comments received from land users, stakeholders and members of the Cree and Jamesian communities in relation to the acoustic environment, and how these comments have been addressed in this section.

The main concerns raised by indigenous communities related to the potential impact of noise on hunting activities and their comfort in camps located near the mine. Potential impacts of vibrations were also raised.

Table 9.4 Summary of Key Information, Indigenous Knowledge, and Concerns for the Project Related to Acoustic Environment

Topic	Key Information, Indigenous Knowledge and Concerns	Influence on the Assessment	Where information is Addressed in the ESIA
Noise	Land users have expressed concerns about: • Noise from former mining facilities and their impact on hunting. • Current noise (heavy vehicles, back-up alarms, continuous unloading of materials, 24 hours a day) and its impact on users of the main camp located near the mine (Lake A).	• Troilus undertakes to carry out sound monitoring measurements at the nearest sensitive receptors during key phases of the project. • Vibration and overpressure monitoring will also be	Sections 9.4.1.2, 17.4.1.2, 17.4.1.3 and 30.2.14.4
Vibration	Land users have expressed concerns about:		Section 9.4.2.2 and 30.2.11

[1] Within 2 dB of the L_{den} of the projected ambient noise, according to our analysis, this criterion would tend towards the spirit of application of the LAeq24h of the low impact curve of the MTQ Policy.
[2] Within 1 dB of the projected ambient noise L_{den}, according to our analysis, this criterion would tend towards the spirit of applying the $L_{(dn)}$ of the zero-impact curve of the FTA Guide $L_{(dn)}$ is respected.
[3] Refer to the definitions in the Règlement sur les carrières et sablières (Q-2, r. 7.1)

Topic	Key Information, Indigenous Knowledge and Concerns	Influence on the Assessment	Where information is Addressed in the ESIA
	• Vibration impact in the main camp located near the mine (Lake A) and cabins that vibrate during blasting.	carried out during blasting operations. • Troilus undertakes to relocate the camp located near the lake as soon as construction activities begin.	

9.1.3 Potential Impacts, Pathways and Measurable Parameters

Table 9.5 Potential Impacts, Impacts Pathways and Measurable Parameters for Acoustic Environment

Valued Component	Potential impact	Pathway	Measurable parameters
Acoustic Environment	Change in ambient noise level	• Construction, operation, decommissioning and closure activities could result in changes to the acoustic environment due to increased noise levels, which could cause disturbance to land users.	• Sound pressure level measurement: - A-weighted equivalent continuous noise level: $L_{(Aeq,1)\ (h)}$day / $L_{(Aeq,1)\ (h)}$night; $L_{(Aeq,12)\ (h)}$day/$L_{(Aeq)\ (,3)\ (h)}$evening. - Sound pressure level day L_d, night L_n and index $L_{(dn)}$. • Change in the percentage of people severely annoyed (% HA).
	Change in vibration levels	• Disturbance of nearby receptors. Low-frequency vibrations (and noise resulting from vibrations) exceeding the limit of perceptibility. • Risk of damage to dwellings.	• Noise level per event (blasting): $L_{eq,T}$ in linear dB related to vibration detection. • Vibration level per event (blasting): Maximum event vibration velocity in millimetres per second (peak-to-peak value).

9.1.4 Boundaries

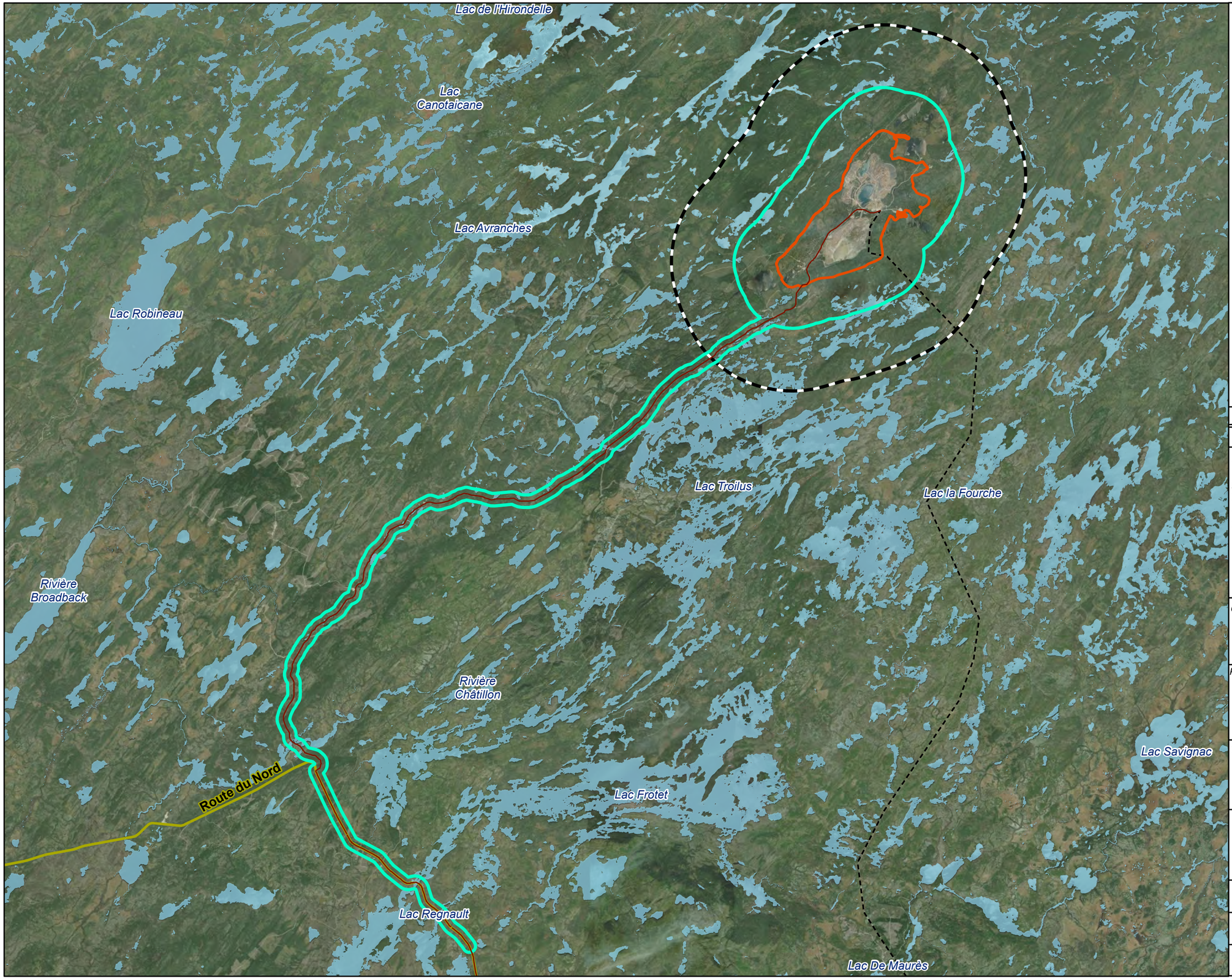
9.1.4.1 Spatial boundaries

The Project Development Area (PDA) encompasses the project footprint and represents the area of physical disturbance attributable to project construction, operation and decommissioning and closure. The PDA includes pits, overburden piles, haul roads, ore stockpiles, buildings, plant and other infrastructure required for mining activities.

The Local Study Area (LSA) associated with acoustic environment encompasses the boundaries of the site where the direct impacts of the project can be predicted or measured with a reasonable level of accuracy and confidence. It comprises two zones:

- The first zone corresponds to a 2 km perimeter around the PDA.
- The second zone incorporates the 300-metre stretch on either side of the mine road right-of-way up to its intersection with Route du Nord.

The Regional Study Area (RSA), for acoustic climate, corresponds to a 5 km perimeter around the PPDA.



LÉGENDE / LEGEND

Composante de projet / Project Component

- Zone de développement du projet / Project Area
- Zone d'étude locale / Local Study Area
- Zone d'étude régionale / Regional Study Area

Infrastructure

- Ligne de transport d'énergie privée / Private Power Transmission Line

Réseau routier / Road

- Réseau routier / Road
- Route du Nord

Hydrologie / Hydrology

- Étendue d'eau / Waterbody

RÉV.	DESCRIPTION	DD/MM/YY	BY	VERIF.
0				

RÉFÉRENCES/REFERENCES

Base Map: Bing, 06 June 2023

NOTES

1:175 000 — 0 — 3 000 — 6 000 m

ÉCHELLE (m) / SCALE (m)

LES DIMENSIONS DE CETTE ÉCHELLE DOIVENT ÊTRE UTILISÉES À TITRE D'INFORMATION SEULEMENT / *THE DIMENSIONS OF THIS SCALE ARE FOR INFORMATION PURPOSES ONLY*

N / W / E / S

CLIENT

Troilus Gold Corp.

PROJET/PROJECT

Étude d'impact sur l'environnement et le milieu social pour le projet de mine Troilus / Environmental and Social Impact Assessement for the Troilus Mine Project

TITRE/TITLE

Zones d'étude du climat sonore / Acoustic Environment Study Areas

BluMetric Environnement — Stantec

NO. PROJET / PROJECT NO.	DATE	
240433/167040485	06/ 02/ 2025	
CONÇU / CHECKED: L. Esseghaïer	RÉVISÉ / VERIFIED: J. Massicotte	
DESSINÉ / DRAWN: R. Tulloch	Carte no: 9.1	ED./REV.: 0

\\ca0119-ppfss01\projets_partages\167040485\GO\6_Geomatique\2_Carto\4_APRX\167040485_C0006_REV0_ZoneAcoustique_20240821\167040485_C0006_REV0_ZoneAcoustique_20240821_RT.aprx

1500 rue du Collège - Suite 200, Saint-Laurent (Québec) H4L 5G6, TEL: (514) 844-7199, FAX: (514) 841-9111, Courriel: montreal@blumetric.ca, Web: http://www.blumetric.ca

9.1.4.2 Temporal Boundaries

The temporal boundary of the assessment includes all phases of the project, from the start of construction to the end of closure. According to the current project schedule, the project phases include:

- Construction (year -3 to -1).
- Operation.
  - Operating phase 1 (years 1 to 21): processing with ore extraction
  - Operating phase 2 (year 22): processing without ore extraction
- Decommissioning and closure.
  - Active closure (years 22 to 24)
  - Passive closure (year 24+).

Refer to Chapter 3 of the ESIA (Project Description) for a detailed description of activities planned during each phase.

As part of the acoustic environment study, two scenarios were considered to assess the temporal limits of the project, i.e. years -1 (construction) and 6 (operation). The two scenarios were chosen considering factors such as the number of equipment, the amount of ore extraction and the site elevations (pit, piles, roads, etc.). Year 6 is the year in which pit operations will be closest to the surface, with the greatest number of equipment and the greatest quantity of ore extracted. During the operating years, the mine will be operational 24 hours a day, with two 12-hour shifts (day and night).

9.1.5 Residual Impact Characterization

Table 9.6 Characterization of Residual Impacts on acoustic environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	Long-term trend of the residual impact	**Positive -** increase in area (ha) of wildlife habitat including species at risk, decrease in mortality risk, increase in wildlife movement. **Adverse -** decrease in surface area (ha) of wildlife habitats, including that of species at risk, an increase in the risk of mortality, a decrease in wildlife movement. **Neutral** - no net change in measurable parameters for the Valued Component (VC) compared with the baseline.

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Low -** Noise and vibration measured during mining activities below regional and provincial criteria. **Moderate** - Noise and vibration measured during daytime mining activities slightly above regional and provincial criteria. **High -** Noise and vibration measured during mining activities above regional and provincial criteria.
Geographic Extent	The geographic area in which a residual impact occurs	**LSA -** residual impacts extend to the LSA **RSA -** residual impacts extend to the RSA
Timing	Considers when the residual impact is expected to occur, where relevant to the VC.	**No sensitivity** – timing does not affect VC. **Moderate sensitivity**– timing may affect VC during lower sensitivity period, but the effects are manageable with proper planning and mitigation measures. **High sensitivity** – residual effects occur during high sensitivity period.
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual impact can no longer be measured or otherwise perceived	**Short term -** the residual impact is limited to the construction or closure phase. **Medium-term -** the residual impact extends throughout the construction, operation and closure phases. **Long term -** at the end of the closure phase, there will be no residual impact on the acoustic environment. Noise being an intrinsic aspect of human activity, the absence of one condition the absence of the other.
Frequency	Identifies how often the residual impact occurs and how often during the project or in a specific phase	**Single event** **Multiple irregular event -** occurs at irregular intervals. Particularly blasting. **Multiple regular event -** occurs at regular intervals. In particular, all mining activities other than blasting. **Continuous** – occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible** - the residual impact is likely to be reversed after completion of the activity and reclamation. **Irreversible** – the residual impact is unlikely to be reversed

9.2 Existing Conditions

This section provides a summary of acoustic conditions in the study area under existing conditions without the project. Residual noise assessments were carried out and are presented in the ESIA.

No vibratory sources have been identified in the PDA and surrounding area. No vibration measurements were therefore carried out for this project.

9.2.1 Methods

Residual noise measurements were carried out to characterize the acoustic environment in the study area. The 48-hour series of sound measurements was carried out on October 17 and 18, 2024. Three sound level meters (measurement points) were installed in the vicinity of the mine. Measurement points R1 to R3 represent the main camps. Because of the proximity of point R1 to the future mining installations and considering that this camp will be relocated far from its current position, the assessment of the acoustic environment at this point was carried out only for the current situation (without the project). Point R2 is located approximately 280 m from the mine access road and 330 m from an outfitter. Consequently, points R2 and R3 are categorized as Type I zones as presented in the regulations section. Point R3 is the furthest from the mine and is located near the Route du Nord. The results of these measurements were used as references to characterize the acoustic environment prior to the mining project.

9.2.2 Overview

The project is in Eeyou Istchee territory, managed by the regional government of Eeyou Istchee Baie-James in the Nord-du-Québec (NDQ) administrative region. The study area is predominantly forested. Noise levels recorded during measurements show low noise levels. Noise is generated by wildlife and wind in the leaves. For point R3, traffic on the Route du Nord is the main source of noise.

9.3 Project Interactions with the Valued Component

Table 9.7 identifies, for each potential impact, the activities are likely to interact with the Valued Component (VC) and result in the identified impact. These interactions are indicated by a checkmark or a dash and are discussed in detail in section 9.4, in the context of pathways, standard and project-specific mitigation and enhancement measures, and residual impacts.

Table 9.7 Project Interaction with Acoustic Environment

Physical Activities	Impacts	
	Noise	Vibration
Construction		
Labour, equipment and materials transport to the site.	√	√
Vehicles and equipment operation and maintenance within the PDA.	√	√
Tree cutting, vegetation clearing, soil stripping and earthworks.	√	√
Handling and use of explosives, including blasting	√	√
Construction of temporary and permanent buildings, including wastewater treatment system and drinking water collection and distribution system.	√	√

Physical Activities	Impacts	
	Noise	Vibration
Construction of mining infrastructures such as stockpiles, pits and the raising of tailings management facility.	√	√
Construction of roads and preparation of construction surfaces including the crushing of material used for construction. Relocation of a section of the access road and power line.	√	√
Construction of water management systems including ditches, diversion channel, sedimentation ponds and the water treatment plant.	√	√
Construction of water management systems including ditches, diversion channel, sedimentation ponds and the water treatment plant.	√	√
Dewatering of natural water bodies and pits, lowering water level in tailings management facility and management of contact water.	√	√
Diversion of Bibou Creek (CE2).	√	√
Management of waste materials, including hazardous waste.	-	-
Purchases of goods and services.	-	-
Employment and expenditures		
Operation		
Labour, equipment and materials transport to the site.	√	√
Vehicles and equipment operation and maintenance within the PDA.	√	√
Handling and use of explosives, including blasting.	√	√
Ore extraction from pits including drilling and hauling of waste rock.	√	√
Ore, waste rock and tailings storage.	√	√
Ore processing including conveyor, crushing, loading and hauling on site.	√	√
Transportation of concentrate to a smelter or a wharf.	√	√
Management and treatment of water on the mine site and to the environment, including drainage and contact water.	√	√
Progressive reclamation of disturbed areas.	√	√
Management of waste materials, including hazardous waste.	√	√
Purchases of goods and services.	-	-
Employment and expenditures	-	-
Restoration and closure		
Labour, equipment and materials transport to the site.	√	√

Physical Activities	Impacts	
	Noise	Vibration
Vehicles and equipment operation and maintenance within the PDA.	√	√
Decommissioning, dismantling and disposal of buildings and equipment.	√	√
Pits flooding, surface and groundwater management.	√	√
Reclamation of disturbed areas, including earthworks, placement of overburden and revegetation.	√	√
Management of waste materials, including hazardous waste.	√	√
Purchases of goods and services.	-	-
Employment and expenditures.	-	-

Notes:
√ = Possible interaction
- = No interaction

9.4 Assessment of Residual Impact on Acoustic Environment

The residual impacts of the project on the acoustic environment associated with mine activities are presented in the following sections. This section describes the techniques and methods used to assess the project's impacts on noise and vibration. Further details on the assessment and modelling are presented in the Acoustic environment Technical Report in Appendix H.2 of the ESIA.

9.4.1 Noise Impact

9.4.1.1 Project Pathways

The assessment of potential impacts on the noise and vibration climate related to the construction and operation phases of the project includes the following elements:

- Carrying out an inventory of environmental components in the study area.
- Assessing the existing sound climate in the study area by conducting sound surveys at receptor points in sensitive areas.
- Using the above sound surveys, establish the noise criteria applicable to the project in each sensitive area.
- Carry out sound propagation simulations to estimate noise levels that could be generated by mine activities during the construction and operation phases.
- Compare estimated noise levels with noise criteria and propose mitigation measures where necessary.

A computer model of the project was implemented using CadnaA sound propagation software (version 2025) published by Datakustik GmbH (Datakustik 2025) to determine the noise contribution of project activities at receptor points in residential areas and at the project property boundary. The general layout of the facilities is based on information supplied by Troilus, including the location and dimensions of buildings, the location of indoor and outdoor noise sources, ventilation openings, the location of the property boundary, etc.

Two years was chosen for the simulations: year -1 of construction and year 6 of operation. The two years were chosen considering such factors as the amount of equipment units, the amount of ore extraction and the site elevations (pit, piles, roads, etc.). Year 6 is the year in which the mine will have the highest level of activity, with the most equipment and the greatest quantity of ore extracted. During the operating years, the mine will operate 24 hours a day on two 12-hour shifts (day and night).

A list of the mine's equipment and quantities during mining operations has been provided by Troilus Mine. Support equipment such as service trucks (welding, mechanical, etc.) are not included in the simulations. As their noise contributions are low compared to other project noise sources, their noise influences on overall activities are negligible. The sound power levels of the equipment considered are taken from the data sheets supplied by the manufacturers or obtained from Stantec's past experience with similar equipment when measurement data were not available.

The following activities/types of noise were considered during the construction phase an -1 contributing to the noise environment in the area:

- Land clearing (shovels, trucks).
- Pit work (drills, loaders, trucks).
- Material storage (loaders, bulldozers).
- Roadwork (graders and water trucks).
- Pumps, screens, excavators.

For the Year 6 operating phase, the following activities/types of noise contributing to the noise environment in the area were considered:

- Pit work (drills, loaders, trucks).
- Material storage (loaders, bulldozers).
- Roadwork (graders and water trucks).
- Pumps, screens, excavators:
- Plant and crushers.

For year -1, at the provincial level, simulations were made in relation to the "Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel" (MELCCFP, 2015). The results were compared with the requirements for Day (7 a.m. to 7 p.m.) $L_{AR,12\,h}$, Evening (7 p.m. to 10 p.m.) $L_{AR,\,1\,h}$and Night (10 p.m. to 7 a.m.) $L_{AR,\,1\,h}$.

For Year 6, at the provincial level, simulations were carried out in line with MELCCFP Directive 019 (February 2025 version). The results were compared with the requirements for Daytime (7 a.m. to 7 p.m.) $L_{eq,1\ h}$and Nighttime (10 p.m. to 7 a.m.) $L_{(eq)\ (,\ 1\ h)}$.

At federal level, simulations were carried out in accordance with the “Guidelines for Human Health Effects Assessment in Impact Assessment: Noise” (Health Canada, 2023). Federal requirements apply to the operation and construction phases. Appendix F of the same publication provides for a corrective term of +10 dBA to be applied to project noise in quiet areas when the existing daytime noise level is less than 45 dBA and the existing night-time noise level is less than 35 dBA.

For road noise assessment, the MELCCFP's “Position ministérielle provisoire sur l'acceptabilité du bruit émis en phase d'exploitation par les projets de transport routier et ferroviaire“ will be used. Simulation results were compared with the two levels of acceptability criteria, the Relative Impact Criterion and the Maximum Impact Criterion. In the present study, road activities on the Route du Nord and the mine access road were considered during the daytime period (7 a.m.-7 p.m.) only.

The noise generated by access road maintenance activities was assessed for both construction (year -1) and operation (year 6) phases. For this assessment, two types of equipment were considered: a grader (CAT 16) and a water truck (CAT 777).

Passage frequency for the construction period evaluated over 12 hours ($L_{(Aeq)\ (,\ 12\ h)}$) is one round trip (two passes at receptor points) per day for the grader and 2 round trips (four passes at receptor points) per day for the water truck. For the operating period evaluated over one hour ($L_{(Aeq)\ (,\ 1\ h))}$, the grader and water truck make one pass each. The grader and water truck operate only during daylight hours.

Since access road maintenance activities will take place during both phases of the project (construction and operation), the noise contribution of this work has been added to that of mine construction and operation activities.

With regard to freight and employee transportation activities, the number of road trips for the mine project was provided by Troilus. The annual quantity for the movement of consumables, equipment and concentrates was reduced to a daily average for each weekday. For employee movements, the annual quantity has been reduced to a weekly average. Employee trips are made on one day of the week, given that work shifts are weekly.

The volume of vehicle traffic on the access road without the mining project was considered negligible. Thus, the assessment of existing road noise on the Route du Nord is not carried out in this study. Noise impact is therefore assessed in relation to the residual noise levels measured in the area, i.e. at point R2 of the noise surveys.

For the Route du Nord, the noise impact of the project is assessed by comparing the existing acoustic environment (existing traffic volume without the project) and the projected acoustic environment (existing traffic volume plus the number of project vehicles). The existing traffic volume (without the project) on Route du Nord represented by the Summer Average Daily Flow (SADF) was considered in the simulations. Based on the information obtained, we considered the year 2029 as year -1 (construction) and the year 2035 as year 6 (operation). The number of trips (mine haulage) was added to the DJME to estimate road noise on the Route du Nord.

All simulation results for road activities were compared to road noise criteria.

9.4.1.2 Mitigation and Enhancement Measures

Regarding noise impacts, the results of the noise simulations carried out shows no exceedance of the criteria to be met. According to the scenarios for years -1 (construction) and 6 (operation), no mitigation measures are required. Transportation activities on the Route du Nord and access road were assessed for the daytime period (7 a.m.-7 p.m.). As the road noise criteria are different for the night period (7 p.m. - 7 a.m.), the results could differ if transportation takes place during this period. However, the equipment used will have to be kept in good working order and maintained regularly to avoid an increase in the noise generated.

However, the following mitigation measures can be adopted:

- Noise monitoring should be carried out at the sensitive receptors closest to the mine during each phase of the project, construction (year -1) and operation (year +6).
- Whenever possible, choose equipment that generates the lowest noise levels, and use silencers whenever possible.
- Respect travel speeds during transportation activities.

9.4.1.3 Project Residual Impact

Mine operations will generate noise in the environment. However, according to simulations, noise levels generated by mine activities comply with current noise requirements. Access road maintenance work and road haulage also meet noise requirements. These simulations were carried out by adopting conservative scenarios using the maximum amount of noise sources (equipment) in operation at the same time. The simulation models were implemented using CadnaA (Version 2025) sound propagation software, and calculations were carried out in accordance with ISO 9613 parts 1 and 2, entitled implemented in the software. These calculations consider conditions favourable to noise propagation (such as a 1 to 5 m/s headwind, blowing from the noise source towards the receiver).

Construction

Results compared to provincial requirements for the year -1 construction period are presented in Table 9.8. Note that the daytime results for points P1 to P4 and P6 are the sum of the noise contribution from mine noise activities and access road work.

Table 9.8 Results of Simulated Noise Levels for Year -1 (provincial)

Receiving point	Noise requirements (dBA)		Simulated noise levels (dBA)[a]		Exceedance Yes/No	
	Day $L_{(eq)\ (12\ h)}$	Night $L_{(eq)\ (1\ h)}$	Day $L_{(eq)\ (12\ h)}$	Night $L_{(eq)\ (1\ h)}$	Day	Night
P1	55	45	38	35	No	No
P2	55	45	38	30	No	No
P3	55	45	28	20	No	No
P4	55	45	28	20	No	No
P5	55	45	< 20	< 20	No	No
P6	55	45	29	< 20	No	No

Note: a: Sound level rounded to 1 dBA, ref: 2 x 10^{-5}Pa.

Results compared to federal requirements for the year -1 construction period are shown in Table 9.9.

Table 9.9 Results of Simulated Noise Level for Year -1 (federal)

Receiving point	Residual				Project			Residual + Project			
	Noise level dBA[a]			%HA	Noise level dBA[a]			$L_{(dn)\ (24\ h)}$ dBAa	%HA	Deviation	Compliant
	L_d (7 h-22 h)	L_n (22 h-7 h)	$L_{(dn)\ (24\ h)}$		L_d (7 h-22 h)	L_n (22 h-7 h)	L_{dn} (24 h)				
P1	40	33	41	0,7 [b]	45[c]	45[c]	51	51	2,6	2,1	Yes
P2	40	33	41	0,7 [b]	40[c]	40[c]	47	48	1,7	1	Yes
P3	40	33	41	0,7 [b]	30[c]	30[c]	36	42	0,8	0,1	Yes
P4	40	33	41	0,7 [b]	30[c]	30[c]	36	42	0,8	0,1	Yes
P5	46	39	47	1,5	20	20	26	47	1,6	0,1	Yes
P6	40	33	41	0,7 [b]	30[c]	30[c]	36	43	0,8	0,1	Yes

Notes: a: Sound level rounded to 1 dBA, ref: 2 x 10^{-5}Pa.
b: The reference index used is that of R2 (sound measurements), which is representative of the study area. Maximum index retained of R2 before leading to the implementation of mitigation measures to reduce the impact of the noise source.
c: Includes the addition of +10 dB corresponding to the quiet zone according to federal requirements.

Operation

The results compared with provincial requirements for the operating period corresponding to year 6 are presented in Table 9.10. Note that the results for the daytime period for points P1 to P4 and P6 are the sum of the noise contribution from mine noise activities and roadwork on the access road.

Table 9.10 Results of Simulated Noise Levels for Year 6 (provincial)

Receiving point	Noise requirements (dBA)		Simulated noise levels (dBA)[a]		Exceedance Yes/No	
	Day $L_{(Aeq)\ (1\ h)}$	Night $L_{(Aeq)\ (1\ h)}$	Day $L_{(Aeq)\ (1\ h)}$	Night $L_{(Aeq)\ (1\ h)}$	Day	Night
P1	50	45	42	37	No	No
P2	50	45	43	32	No	No
P3	45	40	33	20	No	No
P4	50	45	33	22	No	No
P5	45	40	< 20	< 20	No	No
P6	50	45	< 32	< 20	No	No

Note: a: Sound level rounded to 1 dBA, ref. 2 x 10^{-5}Pa.

Results compared to federal requirements for the operating period corresponding to year 6 are presented in Table 9.11.

Table 9.11 Results of Simulated Noise Levels for Year 6 (federal)

Receiving point	Residual				Project			Residual + Project			
	Noise level dBA[a]			%HA	Noise level dBA[a]			$L_{(dn)\ (24\ h)}$ dBA[a]	%HA	Deviation	Compliant
	L_d (7 h-22 h)	L_n (22 h-7 h)	$L_{(dn)}$ (24 h)		L_d (7 h-22 h)	L_n (22 h-7 h)	$L_{(dn)}$ (24 h)				
P1	40	33	41	0,7 [b]	47[c]	47[c]	53	53	3,4	2,7	Yes
P2	40	33	41	0,7 [b]	42[c]	42[c]	48	49	2	1,3	Yes
P3	40	33	41	0,7 [b]	30[c]	30[c]	36	43	0,8	0,1	Yes
P4	40	33	41	0,7 [b]	32[c]	32[c]	38	43	0,9	0,2	Yes
P5	46	39	47	1,5	20	20	26	47	1,6	0,1	Yes
P6	40	33	41	0,7 [b]	30[c]	30[c]	36	43	0,8	0,1	Yes

Notes: a: Sound level rounded to 1 dBA, ref: 2 x 10^{-5}Pa.
b: The reference index used is that of R2 (sound measurements), which is representative of the study area. Maximum index retained of R2 before leading to the implementation of mitigation measures to reduce the impact of the noise source.
c: Includes the addition of +10 dB corresponding to the quiet zone under federal regulations.

Transport activities (road noise)

For road transport activities (goods and employees), the results at receptor points P1 to P4 and P6 compared with the relative impact criterion for the operating period year -1 are presented in Table 9.12.

Table 9.12 Relative Noise Impact of Transport Activities: Years -1 (access road)

Receiving point	Residual noise measured $L_{(Aeq24h)}$ (dBA)[a]	Road contribution $L_{(Aeq24h)}$ (dBA)[a]	Projected noise level $L_{(Aeq24h)}$ (dBA)[(a)]	Variation in noise level (dBA)[a]	Noise impact (MTMD evaluation grid)
P1	38	34	40	2	Low
P2		38	41	3	Low
P3		29	39	1	Low
P4		27	39	1	Low
P6		27	39	1	Low

Note: a Noise level rounded to 1 dBA, ref. 2 x 10^{-5}Pa.

For road transport activities (goods and employees), the results for points P1 to P4 and P6 compared with the relative impact criterion for the operating period year 6 are presented in table 9.13.

Table 9.13 Relative Noise Impact of Transport Activities: Year 6 (access road)

Receiving point	Residual noise measured $L_{(Aeq24h)}$ (dBA)[a]	Road contribution $L_{(Aeq24h)}$ (dBA)[a]	Projected noise level $L_{(Aeq24h)}$ (dBA)[(a)]	Variation in noise level (dBA)[a]	Noise impact (MTMD evaluation grid)
P1	38	33	40	2	Low
P2		37	41	3	Low
P3		28	39	1	Low
P4		26	39	1	Low
P6		26	39	1	Low

Note: a Noise level rounded to 1 dBA, ref. 2 x 10^{-5}Pa.

For road transport activities (goods and employees), the results at point P5 compared with the relative impact criterion for the operating period years -1 and 6 are presented in table 9.14. The results for noise levels without the project consider existing traffic flows (without the project) on Route du Nord.

Table 9.14 Relative Noise Impact of Transport Activities: Years -1 and 6 (Route du Nord)

Receiving point	Without project $L_{(Aeq24h)}$ (dBA)[a]	With project $L_{(Aeq)(,24)(h)}$ (dBA)[(a)]	Variation in noise level (dBA)[a]	Noise impact (MTMD evaluation grid)
Road transport-Construction phase year -1 (2029)				
P5	49	51	2	Low
Road transport-Operation phase year 6 (2035)				
P5	50	51	1	Low

Note: a: Noise level rounded to 1 dBA, ref. 2 x 10^{-5}Pa.

For road transport activities (goods and employees), the results at points P1 to P6 compared with the maximum impact criterion for the operating period years -1 and 6 are presented in Table 9.15.

Table 9.15 Comparison Results with maximum impact criterion 24 h period

Receiving point	Measured residual noise $L_{(den)}$ (dBA)[a]	Calculated sound pressure level L_{den}(dBA)[a]	Noise criterion $L_{(den)}$ (dBA)	Sound criterion exceeded dB $L_{(den)}$ (dBA)
Construction phase (year -1)				
P1	42	34	53	No
P2	42	38		No
P3	42	29		No
P4	42	27		No
P5	47	52		No
P6	42	27		No
Operating phase (year 6)				
P1	42	33	53	No
P2	42	37		No
P3	42	28		No
P4	42	26		No
P5	47	53		No
P6	42	26		No

Note: a: Sound level rounded to 1 dBA, ref. 2 x 10^{-5}Pa.

Results obtained from acoustic simulations show that noise levels from mine activities, both under construction and in operation, do not exceed applicable noise criteria. However, noise from these activities could be audible at receptor points P1 and P2 when noise and residual noise levels are lower than the mine's noise contribution.

Closing

Mine activities during project closure are expected to generate less noise than activities during the construction phase (no pit mining, no construction activities). Thus, the noise assessment for the construction phase may be representative of the noise assessment for the closure phase. The closure phase is expected to generate noise levels in line with the noise criteria applicable to the project. As a result, the noise generated during this period is not considered a major issue for the project. Once the closure work has been completed, ambient noise levels will return to those measured prior to the project.

Summary

The impact of the project on the existing acoustic climate in the LSA and RSA is considered to be of low amplitude, of long duration and reversible after the end of project activities. Noise impact will occur continuously during construction and operation activities, and discontinuously during transportation activities or access road maintenance work. The extent of noise impact is limited to a few potentially sensitive locations.

9.4.2 Vibration Impacts

9.4.2.1 Project Pathways

No existing sources of vibration have been identified in the vicinity of the project. At the present stage of the study, it is not possible to quantitatively assess vibration at receptor points. The lack of information such as the loads used and the blasting pattern does not allow an adequate assessment. During blasting activities, section 3.4.3.1 “Programme de surveillance des vibrations au sol et des surpressions d’air” of Directive 019 stipulates that:

"A program for monitoring ground vibration velocities and air overpressures during blasting must be implemented for all stages of the mining cycle, including the exploration and development stages and the mine construction and operation stages”.

During the construction and operating phases, the sources of impact likely to disturb the vibration environment are as follows:

- Construction phase: preparation and layout of access roads and facilities, transportation and traffic.
- Operating phase: mine operations and transportation.
- Closure phase: general dismantling and transportation activities could generate a low impact on the vibration climate during construction.

9.4.2.2 Mitigation and Enhancement Measures

With regard to vibration impacts, the nearest receptor point is located approximately 3.5 km from the mine. During initial blasting, vibration measurements should be taken at the nearest receptor points to quantify vibration levels. Monitoring system data, such as blasting operation tracking data (vibration velocities, ground vibration frequencies, air pressures, blasting patterns), must be kept in a dedicated logbook for a period of two years.

However, certain mitigation measures can be adopted:

- Blasting operations must be optimized to minimize the quantity of explosive to be detonated simultaneously, to ensure that vibrations at the nearest receptors are barely perceptible.
- Blasting must be carried out during daylight hours and at set times.
- Use electronic detonators to ensure high precision of delays between charges of explosives and better control of detonation.
- Follow a mining protocol optimized to limit major seismic events, adapting it as necessary.

9.4.2.3 Project Residual Impact

Analyses of blasting plans and blasting vibration results will provide a quantitative assessment of residual impacts.

Given the distance between the mining facilities and the nearest receptors, residual impacts are expected to be low, short-lived and reversible once project activities have ceased. Vibration impacts will occur only occasionally during construction and operation activities.

During the closure phase, activities could generate slight vibrations. The overall impact will be positive due to the cessation of blasting activities.

9.4.3 Summary of Project Residual Impacts

Table 9.16 summarizes the residual impacts on noise and vibration.

Table.91 Project Residual Impacts on Acoustic Environment

Residual Impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Change in sound environment	C	A	L	RSA	MS	ST	C	R
	O	A	L	RSA	MS	LT	C	R
	D	P	NMC	RSA	MS	ST	C	R
Change in vibration environment	C	A	L	LSA	MS	ST	IR	R
	O	A	L	LSA	MS	LT	IR	R
	D	P	NMC	LSA	MS	ST	IR	R

Project Phase
C: Construction
O: Operation
D: Decommissioning and closure

Direction:
P: Positive
A: Adverse

Magnitude:
NMC: No Measurable Change
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LSA: Local Study Area
RSA: Regional Study Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

9.5 Confidence in predictions

The assessment of impacts on the acoustic environment was carried out using the results of noise levels measured before the start of project construction and operation (Residual Noise) and the results of simulations of noise propagation in the environment. Confidence in the prediction of impacts is considered high, since the simulations were carried out using conservative scenarios and calculation methods favouring the propagation of noise from source to sensitive receptors. Also, the assumptions used consider a maximum of equipment operating at the same time on the site.

9.6 References

Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. Available online: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact assessment-manual-fta-report-no-0123_0.pdf

Institut national de la santé publique du Québec 2018, Meilleurs pratiques d'aménagement pour prévenir les effets du bruit environnemental sur la santé et la qualité de vie. Available online: https://www.inspq.qc.ca/sites/default/files/publications/2450_meilleures_pratiques_amenagement_effets_bruit_environnemental.pdf

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec (MELCCFP). 2006. Note d'instruction des plaintes sur le bruit et exigences aux entreprises qui le génèrent. Available online: Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent - Note d'instructions (gouv.qc.ca)

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec (MELCCFP). 2015. Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel. https://www.environnement.gouv.qc.ca/publications/note-instructions/98-01/lignes-directrices-construction.pdf

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec (MELCCFP). 2025. Directive 019 sur l'industrie minière (February 13, 2025). Available online: https://www.environnement.gouv.qc.ca/milieu_ind/directive019/directive-019-2025.pdf

Ministère de l'Environnement, de la Lutte contre les changements climatiques du Québec (MELCC). 2021. Position ministérielle provisoire sur l'acceptabilité du bruit émis en phase d'exploitation par les projets de transport routier et ferroviaire,

Ministère des Transports du Québec (MTQ). 1998. Politique sur le bruit routier. Available online: https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/transports/ministere-des-transports/publications-amd/Politiques_ministerielles/PO_politique_bruit.pdf

Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP). 2012. Directive 019 sur l'industrie minière. Available online: https://www.environnement.gouv.qc.ca/milieu_ind/directive019/directive019-2012.pdf

World Health Organization (WHO). 2018. Guidelines on environmental noise in the European Region. Available online: https://www.euro.who.int/fr/publications/abstracts/environmental-noise-guidelines-for-the-european-region-2018

Health Canada. 2023. Conseil pour l'évaluation des effets sur la santé humaine dans le cadre d'une évaluation d'impact : Bruit. Available online: https://publications.gc.ca/collections/collection_2024/sc-hc/H129-54-3-2023-fra.pdf. (consulted from December 2023 to March 2024)

Appendix 9.1 Glossary

A-weighting:	Used to adjust the measured sound level specific to each frequency band to the sensitivity of the human ear.
Level L_{eq}:	Equivalent continuous noise level. Parameter allowing dynamic fluctuations in noise level to be taken into account. The equivalent continuous noise level corresponds to the continuous noise level with the same sound energy as the discontinuous noise. Expressed in dB, it is also frequently A-weighted and presented as $L_{(Aeq)}$ (dBA).
Sound pressure level	Overall sound pressure levels are expressed in dBA, the reference for which is 20 µPa.
Residual noise:	The sum of environmental noise from various sources at a given place and time in the absence of specific noise.
Specific noise:	Environmental noise from the source under study in a given place and period.
Ambient noise:	Set of usual noises from various sources at a given time and place. Composed of residual noise and specific noise.
Initial noise:	Ambient noise before any modification of an existing situation.
Stationary source:	Any company operating a process (industry, manufacturing, etc.) consisting of all noise-generating elements (fixed or mobile equipment) located on the same site, where the sum of individual noises constitutes the total contribution attributable to the source. Noise from the movement of vehicles or mobile equipment on the site of a fixed source is attributable to that source. However, this noise is part of road noise as soon as the traffic is outside the boundaries of the fixed source.
Corrective term	Any quantity that is added to a measured or predicted sound level in order to take account of certain acoustic characteristics;
Impact noise:	Noise of short duration where a sudden increase in sound level is perceived over a short period of time (impact noise can be produced by mechanical or pneumatic impacts, collisions, percussions, shocks, detonations, explosions, etc.);
Assessment sound level:	Any measured or predicted sound level at which a term
Tonal noise:	Noise characterized by a single-frequency component or narrow-band components that emerge audibly from the ambient noise;
L_{dn}	Represents the equivalent acoustic level over a day (for Level Day-night), plus a penalty of 10 dB(A) to noise levels measured at night (10 p.m. - 7 a.m.)
L_{den}:	Represents the equivalent acoustic level over a day (for Level Day-evening-night), added with a penalty of +5 dB(A) to noise levels measured in the evening (7 p.m. to 11 p.m.) and +10 dB(A) to levels measured at night (11 p.m. - 7 a.m.)
L_{night}:	Represents the equivalent sound level during the night period
Evaluation point:	Precise location from which an assessment is made.