4.3 Noise and Vibration

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Introduction

Discussion of the potential impacts from Project-related noise and vibration is not specifically required by current Romanian guidance for EIA structure and contents (see Ministerial Order 863, Ministry of Waters and Environmental Protection, Annex 2.II, "Structure of the Report on the Environmental Impacts Assessment study").[a] However, the management of potential noise and vibration impacts to the workforce and to the residents of nearby communities are key considerations in the design, planning, and implementation of all modern mining operations, as it affects the health and well-being of the workforce, the quality of life of the residents of nearby communities, and (where vibration is concerned) the physical integrity of potentially sensitive structures. RMGC also recognises that Romanian noise regulations are highly protective of residential dwellings. For these reasons, RMGC is committed to properly managing the noise and vibration impacts associated with all phases of the Roşia Montană Project. In fulfilling this commitment, RMGC retained an independent consultant [Alliance Acoustical Consultants, Inc. (AAC)] to assist in the estimation of the potential noise and vibration impacts of the Project and in the identification of potential mitigative measures, best management practices (BMPs), and best available technologies (BATs) that will be employed to:

- minimise or, where possible, eliminate potentially harmful or nuisance-level noise and vibration impacts to the surrounding communities and sensitive receptors or structures; and

- provide safe and healthful working conditions for all mineworkers that are consistent with international norms for the management of workplace noise and vibration.

Workforce impacts are in general readily mitigated by hearing protection programmes; use of solid acoustical barriers or shielding and other noise limiting devices on major (mobile and stationary) mechanical sources of noise; and the use of personal protective equipment to guard against hearing loss and other deleterious health effects. Ambient noise and vibration impacts, however, may vary widely based on the proximity of residential receptors or sensitive structures to the noise or vibration source. Additionally, the perception of nuisance impacts (i.e., the point at which noise or vibration disrupts the normal course of daily life) is very subjective, varying widely based on the personal perception of individual receptors. RMGC will therefore implement an aggressive noise and vibration monitoring and management programme that involves continuing communication with local residents and the consideration of stakeholder viewpoints in the continual refinement of the Project's noise and vibration management practices.

It must be emphasised that the Roşia Montană Project is located in a historical mining district, and habitation and other land uses have been largely unplanned and uncontrolled for many decades. As a consequence, the industrial zone established for the Project reflects an extremely complex land use situation and required many months of negotiation before regulatory approval was granted. The outer boundary of the industrial zone approved for the project is very close to (and in some cases abuts) existing village structures and residences. In addition, several protected zones have been established in the interior of the Project site. Although primarily established to protect culturally and historically significant structures, the conditions of the RMGC permit require that residential use be allowed within these protected zones. The resulting proximity of human receptors and potentially sensitive structures to industrial noise and vibration sources is a major challenge that RMGC has addressed in the management approach described in this Section.

The following paragraphs provide general information on mining-related noise and vibration, as well as applicable regulatory requirements, sources, and potential impacts applicable to the construction, operation, and decommissioning/closure phases of the Roşia Montană Project. An initial summary of anticipated environmental impacts, proposed mitigative measures, and governing management plans is provided in **Table 4.3.1**; additional details are provided in Sections 4.3.6 and 4.3.7.

1 General Characteristics of Mining-related Noise and Vibration

The sources of noise and vibration impacts that are anticipated from mining-related activities at the Roşia Montană Project are typical for a large, modern, open-pit mining operation located in mountainous terrain. The nature and quantity of such sources will vary with differing Project phases, but include:

- operation of motorised vehicles for transportation of personnel, materials, and equipment to, from, and within the Project site;
- drilling and blasting operations within the Project's industrial protection zone boundary, to support quarrying operations in the construction phase and excavation of ore from the pits during mine operation;
- operation of mobile and stationary motorised equipment within the Project boundary, which will typically include haul trucks, excavators, bulldozers, loaders, drill rigs, aggregate crushers, conveyor systems, and emergency generators;
- operation of major items of ore beneficiation equipment (e.g., gyratory crushers, grinding mills, separators, conveyors) in the mill or processing plant; and
- periodic operation of various auditory safety signals, alarms, or sirens (e.g., vehicle backup alarms, blast warning and all-clear sirens).

Potential receptors for mining-related noise and vibration typically include the mining workforce, the human population outside of the Project boundaries or within protected areas, and buildings or structures that are potentially sensitive to vibration-induced damage. Mitigative measures for such sources that are typically implemented by most major mining operations mining operations include:

- establishment of project buffer zones or setbacks from habitations and sensitive receptor locations, to maximise distance between sources and receptors;
- a comprehensive workplace hearing and vibration protection programme tailored to the noise and vibration characteristics of individual job descriptions, in order to protect the health and well-being of the workforce;

industrial and administrative controls over noise and vibration sources and implementation of monitoring programmes and feedback processes to minimise the hearing and vibration protection needs of the workforce, nuisance impacts to the.
human population outside of the Project concession, and vibration-induced damage to sensitive structures.

With regard to the latter point, it should be noted that in modern open-pit mining operations, special attention is paid to the optimisation of blasting operations to maximise localised rock breakage within the ore body of interest, while minimising non-productive noise, vibration, and flyrock effects. This optimisation need is driven by:

- the need to minimise the potential for noise, vibration, and airborne dust impacts within and outside of the Project concession;
- basic workforce safety considerations (to minimise the potential for accidents and other intrinsic dangers involved in working with explosives); and

Project economics (to keep blasting costs at a practical minimum that still supports a viable production rate).

Operational blasting tests will therefore be conducted and optimised blasting plans developed for each major rock body of interest, including the sandstone (Piriul Porcului) and andesite (Sulei) quarries developed in the construction phase, and the various ore bodies that will be excavated during the operational phase of the Project. The blasting plans so developed will be subject to continual refinement and improvement via the blast vibration monitoring and feedback processes described in Section 4.3.6.3 and Section 4.3.7.

Table 4.3.1: Summary of Potential Noise and Vibration Impacts,Mitigative Measures, and Applicable Management Plans

Potential Impact	Mitigation Measures[1]	Applicable Management Plans
Construction, operation, and decommissioning/closure phases		
Transient nuisance impacts to local residents in adjacent communities as well as habitations inside protected zone boundaries from non-blasting Project-related noise and vibration, including: • motorised sources (e.g. workforce traffic; onsite vehicular transportation; transportation/delivery of materials, equipment, and waste materials; haulage of topsoil, ore, and waste rock; emergency generator usage; and routine operation of mobile and stationary heavy machinery); • backup alarms or warning sirens; and • other non-blasting related noise from construction/demolition activities	• Continuing consultation with local residents with regard to noise/vibration impacts • Optimal setback of locations for the haul and access roads, process plant, stockpiles, TMF, and other project features from residential areas or habitations, to the extent possible given the constraints and various requirements of the Urbanism Certificate • Installation of earthen berms or bunds as permanent noise control barriers in sensitive locations of the Project • Avoidance of steep grades on haul and access roads in mine design, subject to the constraints and various requirements of the Urbanism Certificate • Monitoring of ambient noise and vibration impacts and initiation of corrective/ preventive action where required[1] • Specification of acoustically protective process plant equipment and incorporation of acoustically protective features in process plant design, including: – Minimisation of storage, handling, and off-loading pile heights – Minimisation of drop distance for conveyor	Noise and Vibration Management Plan (**ESMS Plans, Plan E**) Environmental and Social Monitoring Plan (**ESMS Plans, Plan O**) Public Consultation and Disclosure Plan (**ESMS Plans, Plan K**) Annual Mining Plan (see Section 4.6.1, Roşia Montană Project Environmental and Social Management Plan (**ESMS Plans, Plan A**) As above

[1] See **Table 4.3.16** for a list of BAT options that may be applied to address specific predicted or monitored conditions.

[2] See **Table 4.3.5** for identification of major equipment items for which BAT acoustical treatments will be purchased from the vendor.

Potential Impact	Mitigation Measures[1]	Applicable Management Plans
As above	systems – Acoustical cladding for material bins – Fall dampening systems on collection bins – Acoustic shielding or enclosure of crusher systems – Acoustic shielding or enclosure of conveyor systems – Acoustic shielding or enclosure of pump or compressor trains – Installation of major rotating or vibration equipment inside acoustically shield plant buildings – Vibration isolation mounting on fixed machinery and major piping/ductwork systems – Establishment of a noise test facility in vehicle maintenance areas • Purchase of haul trucks, bulldozers, and other major equipment items in accordance with current EU standards, to the extent possible, with acoustically shielded engines and other engineered features designed to reduce their acoustical footprint; addition of after-market acoustical shielding to address additional mitigation needs, as required[2] • Placement of portable acoustical barriers or shields to mitigate noise from mobile or portable motorised equipment (e.g., graders, dozers, rock drills)[1] • Establishment and enforcement of standard operating procedures for vehicle/equipment maintenance and operation, including engine silencer maintenance/changeout • Scheduling/staggering major deliveries to occur during daylight hours • Enforcement of access road/mine road speed	As above

Potential Impact	Mitigation Measures[1]	Applicable Management Plans
As above	limits • Use of employee bus or rideshare programmes to minimise Project traffic • Management of vehicle fleets to ensure use of practical minimum number of operating vehicles or equipment items	As above
Hearing impacts to workforce from noise and vibration from routine operation of mobile and stationary heavy machinery, construction/ demolition activities, and other non-blasting sources	• Implementation of hearing protection programme standard operating procedures, use of personal protective equipment, and associated training programmes • Specification of motorised equipment purchases to conform to current EU standards for operator noise/vibration protection • Establishment and enforcement of standard operating procedures for vehicle maintenance and operation, including engine silencer maintenance/changeout	RMGC Occupational Health and Safety Plan • Applicable manufacturer's maintenance manuals
Construction phase (only)		
Hearing impacts to construction workforce from drilling/blasting operations (quarrying), handling and crushing of aggregate, and operation of the concrete batch plant	• Implementation of hearing protection programme standard operating procedures, use of personal protective equipment, and associated training programmes	RMGC Occupational Health and Safety Plan
Transient nuisance impacts to local residents in adjacent communities as well as habitations inside protected zone boundaries from drilling/blasting operations (quarrying), handling and crushing of aggregate, and operation of the concrete batch plant	• Consultation with local residents with regard to the scheduling of blasting activities • Implementation of controlled blasting procedures incorporating millisecond delay techniques and	Noise and Vibration Management Plan (**ESMS Plans, Plan E**) Environmental and Social Monitoring Plan (**ESMS Plans, Plan O**)

Potential Impact	Mitigation Measures[1]	Applicable Management Plans
	minimal use of high explosives in combination with ANFO blasting agents • Scheduling of quarry blasting to limit blasting operations to daylight hours only or in unusually unfavourable atmospheric conditions • Routine monitoring/measurement of ambient noise and vibration impacts for all blasting activities and initiation of blasting plan adjustments and other corrective/ preventive action where required • Management of vehicle fleets to ensure use of practical minimum number of operating vehicles or equipment items	Public Consultation and Disclosure Plan (**ESMS Plans, Plan K**) Annual Mining Plan (see Section 4.6.1, Roşia Montană Project Environmental and Social Management Plan (**ESMS Plans, Plan A**)
Potential vibration damage to sensitive structures from drilling/blasting operations (quarrying) and handling and crushing of aggregate	• Consultation with local residents with regard to the scheduling of blasting activities • Implementation of controlled blasting procedures incorporating millisecond delay techniques and minimal use of high explosives in combination with ANFO blasting agents • Scheduling of quarry blasting to limit blasting operations to daylight hours only or in unusually unfavourable atmospheric conditions • Routine monitoring of noise and vibration impacts to sensitive structures, and initiation of blasting programme refinements and other corrective/ preventive actions where required	Noise and Vibration Management Plan (**ESMS Plans, Plan E**) Environmental and Social Monitoring Plan (**ESMS Plans, Plan O**) Public Consultation and Disclosure Plan (**ESMS Plans, Plan K**)
Operations phase(only)		
Transient nuisance impacts to local residents in adjacent communities as well as habitations inside protected zone boundaries from drilling/blasting	• Consultation with local residents with regard to the scheduling of blasting activities	Noise and Vibration Management Plan (**ESMS Plans, Plan E**)

Potential Impact	Mitigation Measures[1]	Applicable Management Plans
operations in open pits	• Implementation of controlled blasting procedures incorporating millisecond delay techniques and minimal use of high explosives in combination with ANFO blasting agents • Scheduling of quarry blasting to limit blasting operations to daylight hours only or in unusually unfavourable atmospheric conditions • Routine monitoring of noise and vibration impacts to sensitive structures, and initiation of blasting programme refinements and other corrective/ preventive actions where required	Environmental and Social Monitoring Plan (**ESMS Plans, Plan O**) Public Consultation and Disclosure Plan (**ESMS Plans, Plan K**)
Potential vibration damage to sensitive structures from drilling/blasting operations in open pits	• Consultation with local residents with regard to the scheduling of blasting activities • Implementation of controlled blasting procedures incorporating millisecond delay techniques and minimal use of high explosives in combination with ANFO blasting agents • Scheduling of quarry blasting to limit blasting operations to daylight hours only or in unusually unfavourable atmospheric conditions • Routine monitoring of noise and vibration impacts to sensitive structures, and initiation of blasting programme refinements and other corrective/ preventive actions where required	Noise and Vibration Management Plan (**ESMS Plans, Plan E**) Environmental and Social Monitoring Plan (**ESMS Plans, Plan O**) Public Consultation and Disclosure Plan (**ESMS Plans, Plan K**)

2 Noise and Vibration Setting and Potential Receptors

The noise and vibration setting for the Roşia Montană Project involves complex mountainous topography; background noise from traffic on national highway DN 74A, tributary roads, and other local community sources; and a range of mining-related sources (e.g., drilling and blasting activities, the operation of mobile and stationary machinery, and the operation of vehicles and heavy equipment). Receptors include the workforce, visitors, local residents, and culturally significant/acoustically sensitive structures.

Human receptors can be divided into three groups, namely:

- the Project workforce, contractors, and other site visitors;
- the human populations of Roşia Montană, Abrud, and other communities or residents with dwellings located outside the boundary of the Project's industrial protection zone; and,
- pursuant to the conditions of the Urbanism Certificate, individuals who choose to retain dwellings within protected zones established within the overall boundary of the Project.

With regard to the latter individuals, voluntary resettlement and relocation options will remain available over all phases of the Project in accordance with the Project *Resettlement and Relocation Acton Plan* (see **ESMS Plans, Plan M**). Resettlement is an entirely voluntary option, however, so maintaining continuing communications with local residents via the Project *Public Consultation and Disclosure Plan* (**ESMS Plans, Plan K**) will remain an important element of the RMGC strategy for the ongoing management of ambient noise and vibration impacts. Please see Section 4.3.7 for additional discussion.

Project personnel working within the industrial protection zone will experience the greatest potential exposure to the highest levels of mining-related noise and vibration. Workplace noise and vibration issues will therefore be subject to specific regulations and BATS/BMPs aimed at preventing hearing loss and other deleterious health impacts for individual workers. As noted in Section 4.3.6, the mitigation strategy and management measures for workplace noise and vibration will be defined and implemented via the RMGC *Occupational Health and Safety Plan* and its supporting procedures, which will reflect a fundamental commitment to providing a safe and healthful working environment in accordance with Romanian regulations and relevant EU standards. Potential workforce impacts will be considered, for example, in the selection of personal protective equipment as well as in the selection of heavy equipment with appropriate acoustic protection provisions (see Section 4.3.6., **Table 4.3.6**, and **Table 4.3.7)**. As noted previously in **Table 4.3.1**, such impacts will also be carefully considered in the overall design of process plant buildings and ancillary structures, and reflected in appropriate use of centralised and automated machinery control systems, insulated solid-wall plant buildings, acoustically isolated control centres and work areas, and the acoustical isolation, shrouding, mounting, insulation, or silencing of various machinery sources.

The impacts of ambient mining-related noise and vibration to local residents will in general be far less significant than those encountered by the workforce, because of the much greater distances from specific mining sources, attenuation from natural and manmade acoustic barriers, the mitigating effects of topography, and other factors. It must be noted that the Roşia Valley and the surrounding region has a centuries-long history of exposure to mining operations and the noise and vibration issues typical of the mining industry. Exposure to significant levels of mining-related noise and vibration in this region dates back to introduction of the use of black powder blasting and steam power in the 18th century, followed by the introduction of the internal combustion engine and the use of dynamite and reliable detonation systems in the latter half of the 19th century. Mining and mineral processing activities have until recently, or are presently, being carried out in Roşia Montană and the nearby towns of Abrud and Roşia Poieni. These communities have a strong mining heritage that is an integral part of the regional and national cultural patrimony, and it may be observed that the noise from mining, mining-related transportation, and other related activities are generally recognised as inherent parts of community life. However, regional mining activities have been in decline for some years, and mining at the scale anticipated for the Project may be a new experience for some local residents. At "nuisance" levels (i.e., levels which impair people's use and enjoyment of their property and environment, but below levels which have implications for health and safety or other significant material loss or damage), such impacts tend to be highly subjective. For example, in a community with no mining heritage or no active cultural memory of a historical mining heritage, mining-related noise or traffic might be regarded as intrusive. On the other hand, for communities with existing mining activities or a recently active mining heritage, such impacts may be regarded as an acceptable and even welcome condition, associated with economic well being and other important social benefits.

Cultural issues and community history notwithstanding, much subjectivity and variability is to be expected in the perception of noise and vibration impacts. Although the concerns and interests of the current local population may be subjective, they nevertheless must be well understood and factored into the impact mitigation and management strategy. It is also understood that such concerns and interests may change over time; feedback processes have therefore been specifically developed as part of the Project *Public Consultation and Disclosure Plan* and *Noise and Vibration Management Plan* (**ESMS Plans, Plans K and E**) in order to accommodate potential changes, and are discussed in greater detail in Section 4.3.7.

3 Technical Considerations

The technical characteristics of noise and vibration in the region of the Roşia Montană Project were examined in a baseline noise and vibration study commissioned by RMGC in 2002 and 2003 and updated in 2005. The study was conducted for RMGC by S.C. Cepstra Grup A.R.L. (Cepstra), Bucharest, with additional support provided by Agraro Consult S.R.L. (Agraro). The results of the 2005 version of the study are provided for information in **Baseline Report 7**, *Noise and Vibration Baseline Report*.

Major technical issues that must be considered in the evaluation of impacts and the development of mitigation measures for noise and vibration are summarised in the following sections.

3.1 Noise Considerations

Acoustical scientists use special descriptors and various metrics in the assessment of sound levels and noise impacts. Noise is usually defined as unwanted sound that interferes with speech communication and hearing, or is otherwise disruptive to human behaviour. Under certain conditions, noise may cause hearing loss, interfere with human activities, and, in various ways, may affect human health and well being.

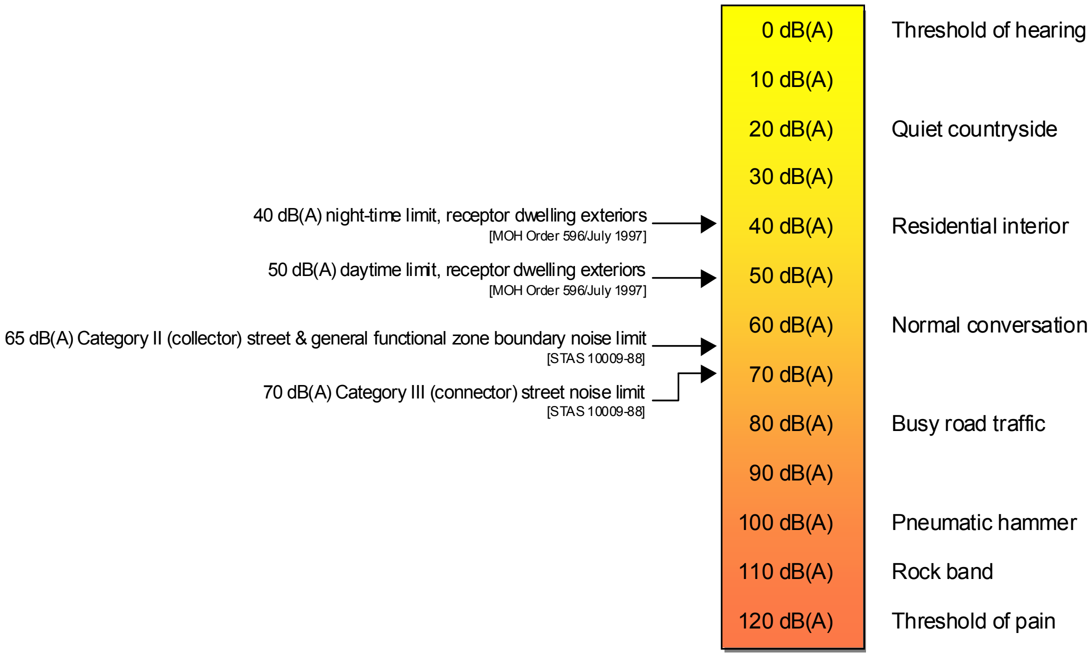
The decibel (dB) is the accepted standard unit for measuring sound levels because it accounts for large variations in sound pressure amplitude. All noise levels discussed in this Section are expressed relative to a standard reference value of 20 micropascals. When describing sound and its effect on a human population, "A-weighted" dB(A) sound levels are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the noise signal in a manner corresponding to the way the human ear perceives sound. The A-weighted noise level has been found to correlate well with human judgements of noisiness and has been used internationally for many years in the measurement and evaluation of industrial noise.

Although the A-weighted scale and the energy-equivalent metric are commonly used to quantify the range of human response to individual events or general community sound levels, the degree of annoyance or other response effects also depends on several other perceptibility factors, including:

- ambient (background) sound level;
- general nature of the existing conditions (e.g., quiet, rural vs. busy, urban settings);
- difference between the magnitude of the sound event level and ambient conditions;
- duration of the sound event;
- seasonality (e.g., likelihood of being indoors or outdoors and/or having windows open or closed);
- number of event occurrences and their repetitiveness; and
- the time of day that the event occurs.

A typical illustration of the decibel scale is presented in **Figure 4.3.1** that describes a number of typical sound pressure levels compared to regulatory limits established by Romanian regulations.

Figure 4.3.1: Typical Decibel Scale, with Romanian Regulatory Levels Noted[b]



When sound is measured for distinct time intervals, the statistical distribution of the overall sound level can be obtained during that period. The energy-equivalent sound level (L_{eq}) is the most common parameter associated with such measurements. The L_{eq} metric is a single-number noise descriptor that represents the average sound level over a given period of time, where the actual sound level varies with time. L_{max}, L_{min}, and L_{xx}, are also common noise descriptors. L_{max} and L_{min} are the maximum and minimum noise levels respectively, and L_{xx}, known as a statistical sound level, is the time-varying noise level that would be exceeded "xx" percent of the time.

Although the A-weighted scale is commonly used to quantify a range of human response to individual events or general community sound levels, the degree of annoyance or other physical response effects also depends on several other perceptibility factors, including:

- ambient (background) sound level;
- magnitude of the event sound level with respect to the background;
- duration of the sound event;
- overall number of event occurrences and how often they are repeated; and
- the time of day that the event occurs.

With regard to noise from blasting, it has long been observed that meteorological conditions have a substantial effect on the perceived intensity of a blast, although noise enhancement effects are extremely site specific and subject to significant variability[c]. Wind velocity and temperature (as a function of altitude) influence the propagation of sound waves. When compared to still air conditions, steady light to moderate winds tend to amplify noise levels downwind, and to decrease noise levels upwind from a given blasting source[d]. It has been noted that a steady, gentle breeze can increase noise levels without increasing background noise levels. On the other hand, winds of higher velocity tend to increase background levels due to turbulence or the movement of trees and shrubs, and may obscure other noise sources. Low wind velocities can enhance noise levels by several decibels relative to still conditions, assuming flat topography between sources and receiver. Conversely, upwind noise levels may be reduced by a similar amount. Temperature inversions are also known to increase blasting noise levels at some distance from the source, and most inversions occur during the night-time. Night-time blasting therefore increases the potential for noise to be considered a nuisance by human receptors, as sleep patterns may be disrupted. For this reason and other general blasting safety concerns, blasting after dark will be expressly prohibited.

3.2 Vibration

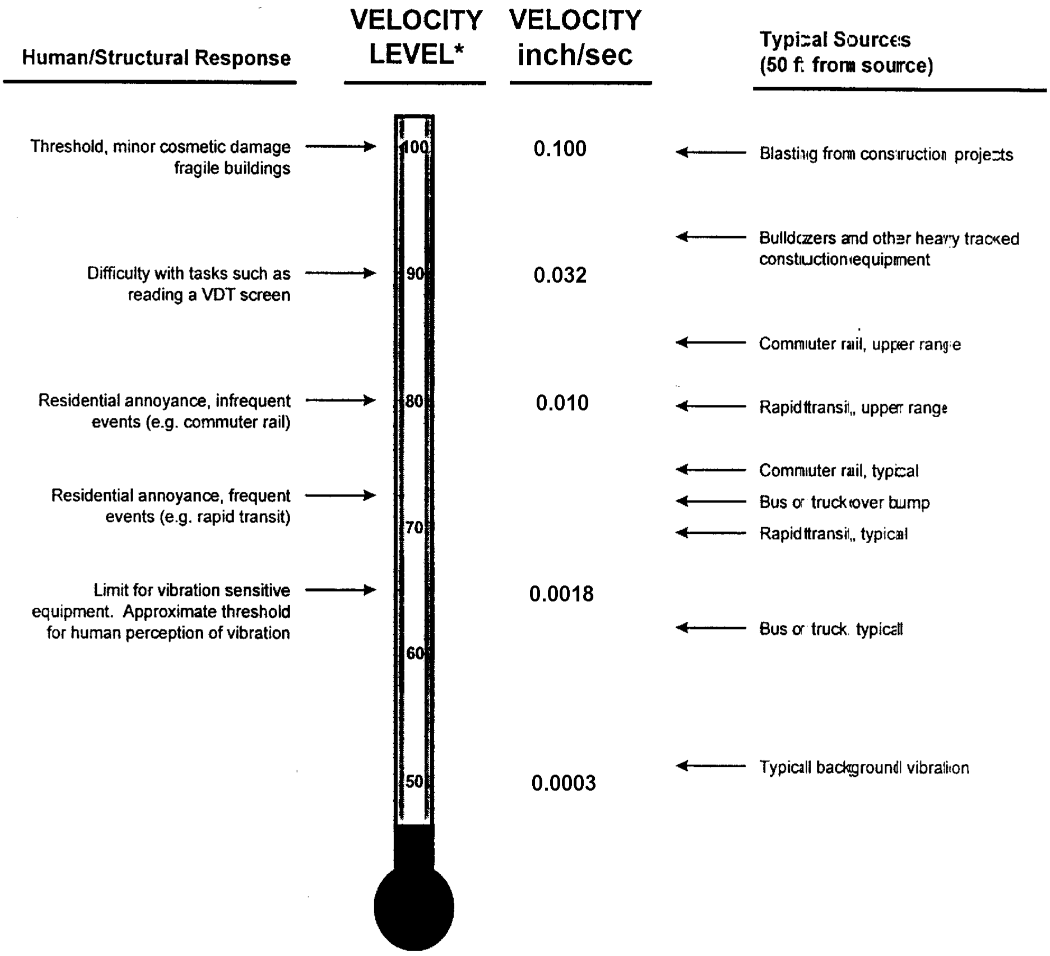
Vibration measurement is typically interpreted with regard to its potential harmfulness to structures and equipment. In an open pit mining operation, drilling and blasting operations are significant sources of vibration, along with the hauling of waste rock and ore and the operation of the mechanical crushing and separation equipment used in the ore beneficiation process. Blasting techniques have been much improved in recent years with regard to concentrating or directing blast energies to the specific area in which rock breakage is desired. However, it is expected that some vibrations will still radiate from individual blast areas. Blast vibration monitoring procedures will therefore be employed with each blast to measure frequency, velocity, and acceleration; this monitoring feedback will be used to continually refine and improve blasting plans with respect to minimising blasting effects on sensitive structures and nuisance impacts to local residents.

Vibration is an oscillatory motion which can be described in terms of displacement, velocity, or acceleration. For a vibrating floor, the displacement is simply the distance that a point on the floor moves away from its static position. The velocity represents the instantaneous speed of the floor movement, while acceleration is the rate of change of the speed. The response of humans, buildings, and equipment to vibration is normally described in terms of velocity or acceleration. Vibration amplitudes are usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal. The RMS of a signal is the average of the squared amplitude of the signal. For sources such as trucks or motor vehicles, peak vibration levels are typically much higher than RMS levels. Above certain limits, vibration associated with reciprocating or rotating motion may affect equipment performance or integrity, or the integrity of engineered structures; hence, process plant designs typically account for automated vibration monitoring and periodic bearing replacement in rotating equipment;
vibration dampening or isolation measures are also typically considered in motor mounts or other major equipment foundations or mounting arrangements.

Although PPV is appropriate for evaluating the potential of building damage, it is not suitable for evaluating human response, since it takes some time for the human body to respond to vibration signals. Therefore, RMS amplitude is more appropriate for evaluating human response to vibration. The RMS velocity is normally described in inches per second or millimetres per second.

Figure 4.3.2 presents typical vibration levels of a series of common sources, along with potential structural and human responses.

Figure 4.3.2: Common Vibration Sources and Human and Structural Responses



** RMS Vibration Velocity Level in dB relative to 10^{-6} inches/second*

Source: *Transit Noise and Vibration Assessment,*
U.S. DOT Federal Transit Administration, April 1995.

4 Noise and Vibration Regulations

Noise and vibration limits applicable to Project activities are described in the regulations noted in the following paragraphs, and will serve as the primary performance targets against which Project-related noise and vibration will be monitored (see Section 4.3.7).

4.1 Romanian Regulations

Permissible noise levels applicable to the communities outside of (and individuals living in protected zones within) the Project industrial protection zone boundary are noted on **Figure 4.3.2**, and are established by the following regulations:

- **Romanian Standard STAS 10009-88: Urban Acoustics: Permitted limits of noise levels**[e]; this standard refers to the admissible limits of noise in urban areas, differentiated by zones and areas of specific use, and technical categories of streets.
  - Exterior admissible noise values (L_{eq}) for streets, measured at the edge of the sidewalk and the roadway, are established as a function of the technical category of street and the associated traffic intensity. Category III (collector) streets have a maximum admissible equivalent level of noise of 65 dB(A). Category II (connector) streets have a maximum admissible noise equivalent of 70 dB(A).
  - The maximum admissible level of noise, L_{eq}, at the limit of industrial zones in urban areas is **65 dB(A).** Dwellings can be built on streets of different technical categories, or at the limit of zones or areas of a certain use, as long as the maximum noise value is 50 dB(A), measured 2 metres away from the building face
- **Order No. 536/July 1997 of the Ministry of Health** establishes the maximum limits for noise levels (L_{eq}) in dwellings. Daytime (0600 – 2200) limits are **50 dB(A),** measured 2 metres away from the building face; night-time (2200 – 0600) limits are set at **40 dB(A)** near dwellings, measured 2 metres away from the building face.

As can be seen from comparison with noise standards from other international locations in **Table 4.3.2**, Romanian standards are generally comparable to EU and other international standards.

Table 4.3.2: Comparison of Romanian and International Noise Standards

Country/Region	Acceptable Noise Level, dB(A)		
	Industrial Areas, Day/Night	Commercial Areas, Day/Night	Residential Areas, Day/Night
Romania	65	65	50/40
EU(UN WHO)	65	55	55/45
Australia	65/55	55/45	45/35
Japan	60/50	60/50	45/35
USA	70	60	45

Vibration standards have also been developed that address the effects of traffic and machinery-induced vibration on dwellings, cultural buildings, and occupants, and are described as follows:

Romanian Standard SR 12025/1-94: Vibration effects produced by road traffic on buildings or building parts (Measurement methods):[f] Standard SR 12025/1-94 establishes methods of measurement for the parameters related to traffic vibration propagated through streets and affecting buildings or building components.

Romanian Standard SR 12025/2-94: Building acoustics. Vibration effects on buildings or building parts (Permissible limits):[g] Standard SR 12025-2/94 establishes the admissible limits for dwellings and cultural buildings as well as occupants who may be affected by vibration, either from internal/external machinery or from propagated vibration from street traffic.

As shown **Tables 4.3.3 and 4.3.4** and **Figures 4.3.3 and 4.3.4**, admissible limits for both of these standards are expressed as the equivalent strength (S_{ech}) of vibrations for a range of frequencies. These tables are based on information provided in SR 12025/2-94, and will be used as the basis for assessing the acceleration and frequency data that will be routinely obtained in the noise and vibration monitoring programme described in Section 4.3.7 and the Project-specific *Noise and Vibration Management Plan* (**ESMS Plans, Plan E**).

No Romanian standards have been developed to date that apply specifically to vibrations induced by blasting operations. However, as previously noted, a rigorous blast vibration monitoring programme will be conducted as described in the *Noise and Vibration Management Plan*; frequency, velocity, and acceleration will be measured at sensitive structures adjacent to blasting areas for all blasting events. These data will be evaluated in view of any observed structural damage or degradation and factored into refinements or improvements of the applicable blasting plan, in conjunction with the evaluation and resolution of any complaints or observations communicated by local stakeholders.

4.2 European Union Regulations

The EU has reached agreement on several new directives addressing the management of noise and vibration in the working environment. These regulations will be considered in the development of preventive measures in the RMGC *Occupational Health and Safety Plan* (see Section 4.3.7) and the preventive maintenance plans that will be developed for major equipment; they are further described as follows.

- **Human Vibration Directive 2002/44/EC[h]:** Human Vibration Directive 2002/44/EC establishes workplace action values (whereby certain protective procedures must be set in place) and limit values (which must never be breached). The Directive sets single action values at 2.5 mm/s for hand-arm vibration and 0.5 mm/s for whole-body vibration, with a hand-arm limit value of 5 mm/s and a whole-body limit value of 1.15 mm/s.

Table 4.3.3: Admissible Vibration Emissions – Structures
(after Table 1, SR 12025/2-94)

No.	Type of Building	Admissible Strength Levels (see Figure 4.3.2)
1	Rigid structures (with bearing walls, masonry walls, and/or cast-in-place or pre-cast concrete core walls) and:	

No.	Type of Building	Admissible Strength Levels (see Figure 4.3.2)
	• Ground floor to 4-story, up to 15 m height	C_1
	Ground floor plus 4 to 10 story, 15- 35 m height	C_2
2	Multi-staged framed buildings, ground floor up to 10 stories and:	
	• Single openings	C_2
	• Multiple openings	C_3

Figure 4.3.3: Admissible Vibration Emissions – Acceptance Levels (Structures)
(after Figure 1, SR 12025/2-94)

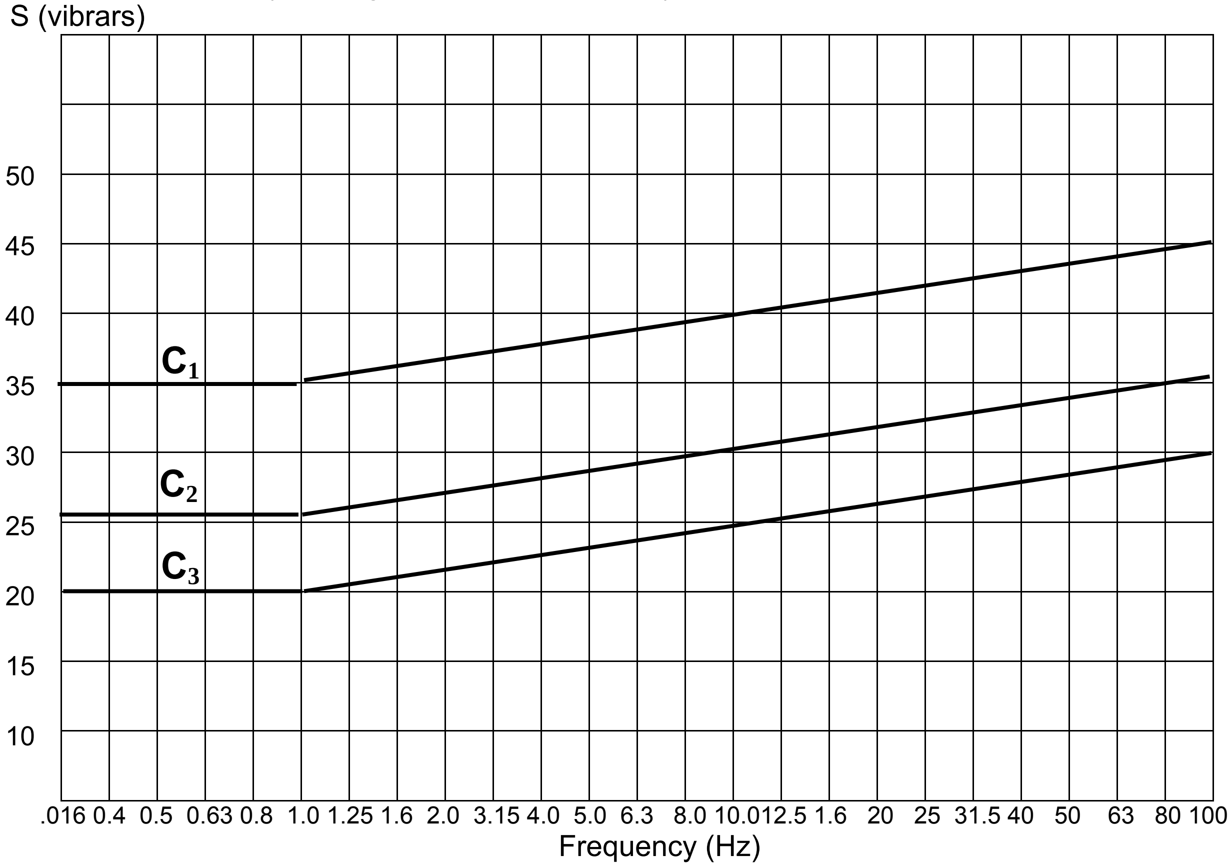
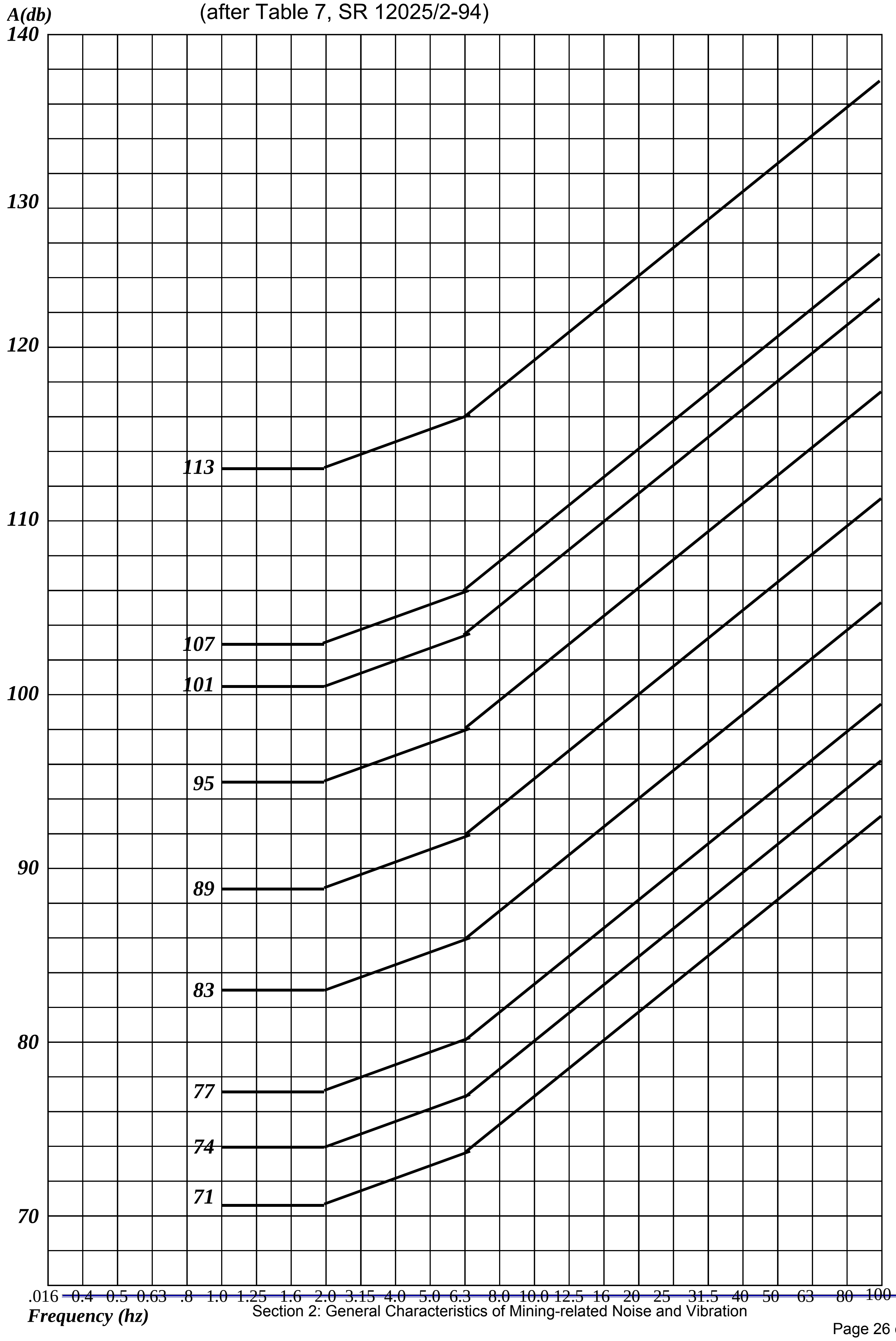


Table 4.3.4: Admissible Vibration Emissions – Occupants
(after Table 3, SR 12025/2-94)

No.	Building type	Admissible combined curve A_v^c (see Figure 4.3.3)
1	Dwellings (permanent habitations)	77
2	Dormitories, hotels, guest houses (temporary habitations)	77
3	Hospitals, clinics	71
4	Schools	77
5	Pre-schools	71
6	Technical/administrative buildings and their attachments (e.g., machine-shops, warehouses, storage areas)	83
7	Commercial buildings	89
Notes: See Section 2.5, SR 12025/2-94. A_v^c refers to a combined curve in the 1-2 Hz domain for		

transverse vibration curves, and in the 8-80 Hz for the longitudinal vibration curves. For the 2-8 Hz domain a linear interpolation between the two curves is estimated (see Figure 4.3.4). Numbers in the A_v^c column represent the acceleration level for a 2 Hz frequency, in decibels, reference value 10^{-6} m/s^2.

Figure 4.3.4: Admissible Vibration Emissions – Acceptance Levels (Occupants)
(after Table 7, SR 12025/2-94)



- **Noise at Work Directive 2003/10/EC; Official Journal of the EU no. L42, 15 February 2003, p38-44[i]:** This directive establishes minimum health and safety requirements for the exposure of workers to noise-related risks, including:

  - information and training must be provided to workers and sufficient and efficient hearing protection must be made available at 80 dB(A);
  - hearing protection must be worn at exposure to 85 dB(A);
  - at 85 dB(A), hearing protection zones must be provided where technically feasible and the risk of exposure so justifies;
  - all workers have the right to hearing tests; and
  - substitution and control options must take precedence over use of protective equipment.

Directive 2000/14/EC of the European Parliament and the Council, of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environmental by equipment for use outdoors[j]: This Directive recognises the desire of member states to control the emission of noise from machinery used outdoors and has been enacted to ensure that the requirements for reducing such noise are the same in every member state. It replaces previous legislation, which covered individual types of equipment, and provides for an approach which is consistent in each state of the EU as well as with the other community legislation which applies to machinery and equipment. The directive applies to a wide range of mobile equipment intended for outdoor use, and applies irrespective of the source of power. In practice, most equipment powered by diesel or petrol engines and much equipment which is electrically powered and which is used outdoors is addressed by the Directive. Examples include heavy diesel-powered construction and mining equipment and diesel generators.

No EU standards have been developed to date that apply specifically to vibrations induced by blasting operations as they may affect sensitive structures. However, as previously noted, a Project blast vibration monitoring programme will be established to measure frequency, velocity and acceleration at sensitive structures adjacent to blasting areas. Evaluation of these will be considered in refinements and improvements of the applicable blasting plan, in conjunction with the evaluation and resolution of any concerns communicated by local stakeholders.

5 Noise and Vibration Estimation, Modelling, and Assessment Methodologies

Preliminary cumulative estimates for stationary motorised equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate BMPs/BATs for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8 through 4.3.16** and **Exhibits 4.3.1** through **4.3.9**.

Project Years 0, 9, 10, 12, 14, and 19 were selected for modelling because they are considered to be representative of the most significant levels of noise-generating activity. They are also the same years used for air impact modelling purposes in Section 4.2, as air and noise impacts share many of the same sources or are otherwise closely correlated. In order to more accurately reflect potential receptor impacts, all of these exhibits integrate the background traffic estimates discussed in Section 4.3.6.1.

Tables 4.3.8 through 4.3.16 and **Exhibits 4.3.1 through 4.3.9** present the average maximum noise values likely to be experienced by the receptor community over all Project phases after incorporation of a variety of initial mitigation measures designed specifically to reduce the impacts associated with mobile and stationary machinery sources. The influence of non-mining related background (primarily traffic) noise is also included.

It should be emphasised that these exhibits do not directly reflect the transient nature of mobile sources; the modelling approach incorporates conservative assumptions, and actual noise values experienced by receptors may be higher or lower by several decibels. In addition, as discussed further in Section 4.3.6.3, the contribution of blasting effects to the cumulative impacts has not been included in these estimates, as such effects cannot be predicted with any certainty until completion and evaluation of operational blasting tests and the development of individual optimised blasting plans for each major rock body of interest (i.e. the sandstone and andesite quarries developed in the construction phase, and the ore bodies that will be excavated during the operations years). As a consequence, **Tables 4.3.8 through 4.3.16** and **Exhibits 4.3.1 through 4.3.9** should be considered conservative, average “worst-case” scenarios, after implementation of a number of initial mitigation measures, less the transient contribution of individual blast events from the optimised blasting programme.

The modelling methods and general assumptions that were used in the development of these estimates are discussed in the following paragraphs.

5.1 Noise Analysis and Evaluation Methods (Stationary Sources)

To evaluate the sound sources from the proposed mine processing facility and the semi-stationary material handling equipment (at the ore extraction, rock stockpiling, and topsoil holding areas), a proprietary computerised noise prediction program was used by AAC to simulate and model the future equipment noise emissions throughout the area. The modelling program uses industry-accepted propagation algorithms based on the following

American National Standards Institute (ANSI) and International Organisation for Standardisation (ISO) standards):

- ANSI S1.26-1995 (R2004), "Method for the Calculation of the Absorption of Sound by the Atmosphere"
- ISO 9613-1:1993, Acoustics -- Attenuation of sound during propagation outdoors -- Part 1: Calculation of the absorption of sound by the atmosphere
- ISO 9613-2:1996, Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation
- ISO 3891:1978, *Acoustics -- Procedure for describing aircraft noise heard on the groun*d

The calculations account for classical sound wave divergence (i.e., spherical spreading loss with adjustments for source directivity from point sources) plus attenuation factors due to air absorption, minimal ground effects, and barriers/shielding.

The general form of the main noise level processing algorithm is:

$$L_p = L_w + 10 \times \lg F(r) + DI + K - A_e - A_b - A_g - A_m$$

where

L_p = The sound *pressure* level at a given distance, r, from the sound source, as computed in the eight primary octave bands from 63 to 8,000 Hz. Sound pressure is what the human ear responds to and is an extrinsic acoustical characteristic; being dependent on the distance between the source and the receiver, as well as on other propagation factors. Sound pressure level is in decibels relative to the reference pressure of 20 microPascals.

L_w = The sound *power* level of a given source, as defined in the same octave bands above, and as given in decibels relative to the reference power of one picoWatt. Sound power is an intrinsic acoustical characteristic of the source and is independent of the location of a receiver or of any propagation factors associated with the pathway from the source to the receiver.

F(r) = The distance attenuation factor that accounts for wave divergence (also known as spherical spreading loss) from a point, line, or plane source to any given receptor. For a point source, $F(r) = 1/r^2$ so that the 10 x lg F(r) term becomes -20 x lg(r). In practical terms, this means that sound from a point source falls off with distance at the rate of 6 dB for every doubling of distance.

DI = Directivity Index
DI = 0 for spherical radiation (sound travelling in all directions)
DI = 3 for hemispherical radiation;
(such as a for source near the ground)
DI = 6 for ¼ spherical radiation;
(such as a for source near the ground and a wall)

DI = 9 for $^1/_8$ spherical radiation;
(such as a for source near the ground and at the intersection of two walls)

K = Conversion factor for distance units to account for 10 lg 4π; K = -11 for metric units and K = -0.68 for English units.

A_e = Attenuation due to atmospheric absorption.

A_b = Attenuation due to barriers.

A_g = Attenuation due to ground absorption.

A_m = Attenuation or augmentation due to meteorological effects from wind and/or temperature effects.

Calculations were performed using octave band sound power levels (abbreviated L_w) as inputs from each noise source. The computer outputs are in terms of octave band and overall A-weighted noise levels (sound pressure levels, abbreviated L_p) at discrete receptor positions or at grid map nodes (in preparation for computing a contour map). The output listing is ranked by relative noise contribution from each noise source.

This model has been validated by AAC over a number of years via noise measurements at several operating industrial sites that had been previously modelled during the engineering design phases. The comparison of modelled predictions versus actual measurements has consistently shown close agreement; typically in the range of 1 to 3 dB(A).

The Project site plan and process plant area and facility drawings were used to establish the position of the noise sources and other relevant physical characteristics of the site. Receptor locations were established using background reports and project engineering and environmental documentation provided by RMGC. With this information, the source locations and receptor locations were translated into input (x, y, and z) co-ordinates for the noise-modelling program.

5.2 Noise Analysis and Evlaution Methods (Mobile Sources)

Vehicle noise is a combination of the noises produced by the engine, exhaust, and tyres. The loudness of traffic noise can also be increased by defective mufflers or other faulty equipment. Any condition (such as a steep incline) that causes labouring of motor vehicle engines will also increase traffic noise levels. In addition, there are other, more complicated factors that affect the loudness of traffic noise. For example, as a person moves away from a highway, traffic noise levels are reduced by distance, terrain, vegetation, and natural and man-made obstacles. Traffic noise is not usually a serious problem for people who live more than 150 metres from heavily travelled highways or more than 30 to 60 metres from lightly travelled roads.

To evaluate the sound levels associated with haul trucks and other mobile sources traversing the site carrying excavated ore, waste rock, and topsoil, a noise analysis program based on the (U.S.) Federal Highway Administration's (FHWA) standard RD-77-108[k] model was used to calculate reference noise emissions values for heavy trucks along the project roadways. The FHWA model predicts hourly L_{eq} values for free-flowing traffic conditions and is generally considered to be accurate within 1.5 decibels (dB).

The model is based on the standardised noise emission factors for different types and weights of vehicles (e.g., automobiles, medium trucks, and heavy trucks), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The emission levels of all three vehicle types increase as a function of the logarithm of their speed. As an example, for heavy trucks, the relationship is:

Noise level at 15m (50 ft) = 24.6 lg(S) + 38.5, dB(A)

where S is the speed of the flow in km/hr

For simplicity and conservatism in the on-site material hauling activities, only heavy trucks were considered; all were assumed to be travelling at a constant 30 km/hr rate over a flat and hard surface, and no additional site or air absorption attenuation factors were used. Thus, the calculated truck noise levels at the standard 15m offset distance only varied by the number of truck "pass-bys" per hour for any given segment of project roadway. Further, with no additional attenuation factors, the reduction in sound levels versus distance would simplify to the standard term for spreading from a line source; that is, 3 dB reduction for every doubling of distance. This analytical approach tends to over-estimate the truck noise contribution for project-related hauling activities throughout the project site. The on-site roadway geometries, as were defined by and used in the air quality analysis, were used to establish the spatial relationships for calculating the truck noise emissions versus distance from each roadway.

Likewise, for off-site roadways serving the local population, the roadways were digitised to establish the geographical co-ordinates for each segment, while the traffic mix (automobiles, light trucks, heavy trucks, etc.) and flow volumes were taken from the project baseline conditions study. Calculations were made with the FHWA model to establish the reference hourly Leq sound level (at 15m) from each roadway and the noise levels propagating outward from all these off-site roads were modelled.

The results of these on-site and off-site roadway noise calculations (sound levels versus project co-ordinate system) were overlaid and logarithmically added to the contributions from pseudo-stationary noise activities (such as in the mining pits or at the rock quarries). These results are shown and discussed in Sections 4.3.6.4, 4.3.6.5, and 4.3.6.6.

5.3 Modelling Procedures, Inputs, and Assumptions (Process Plant and Mining Operations)

For the sake of conservatism, and as is standard practice in the description of environmental noise, the modelling of process plant and mining operations assumed stable atmospheric conditions suitable for reproducible measurements (under "standard-day" conditions of 59° F and 70% relative humidity), that are favourable for propagation. A minimal factor for ground attenuation was also used, although the site is vegetated and/or forested at levels which would actually yield considerable sound attenuation effects over substantial distances. These inherently conservative factors and assumptions resulted in an overall noise model that will tend be biased towards higher predicted values than would be expected in the actual environment in the area of the Project.

Earthmoving equipment (such as bulldozers, excavators, front loaders) typically relies on internal combustion for propulsion and for powering working mechanisms (such as buckets or blades). Engine noise typically dominates the overall noise emissions, with exhaust noise usually being most significant; followed by inlet and structural noise. Other secondary, sources of noise include mechanical and hydraulic transmission and actuation systems, and cooling fans. Typical operation cycles involve one or two minutes of full-power operation, followed by three or four minutes at lower power settings. This variation in power settings during typical operations will produce variable noise emissions, although not necessarily linearly related. To account for these variations in power and noise emissions, a power factor adjustment of – 4 dB(A) (based on industry-standard database) was applied to the full-power ratings of predominantly stationary equipment for use in noise analyses and modelling.

In addition, since a given item of equipment only operates part of the time that it is present at any given project site, a usage factor is typically assigned to each equipment item. This factor is usually calculated as the product of three parameters: (1) the fractional number of project areas at which the equipment is used, (2) the estimated fraction of each phase-duration during which the equipment is on-site, and (3) the duty cycle of operation – i.e., the fractional time that this equipment is operating while at that project area.[i] For this project, the first two parameters where simplified to 1; that is to say, a particular equipment item was assumed to be kept at a given project area throughout the duration of the different scenarios studied. Thus, the duty cycle was the only fractional term involved in the calculation. The noise analyses used the same duty cycle assumptions as were used for the air quality analyses (see Section 4.2); these factors ranged from 64 to 77%, which equates to sound level adjustments in the range of -2 to -1 dB(A), respectively.

All currently planned, continuously operating process plant equipment items that were deemed to be significant noise sources were included (e.g., the gyratory crusher, pebble crusher, and SAG and ball mills; conveyor systems; electric pump and agitator motors; end loaders). The processing plant was also assumed to operate 24 hours per day at its design capacity, which means its noise output was assumed to be constant, regardless of time of day.

Major topographical features, primarily focused on the ore excavation pits, were included as barriers to account for propagation losses due to shielding between a given noise source and a receptor location. However, for the sake of modelling conservatism, the potential shielding benefits of low-lying hills, buildings, and the rock/soil stockpiles were not considered. These initially assumed (nominal) sound emissions values were modelled to calculate the expected noise levels at the established receptor locations. A total of 25 receptor locations (nine along the project boundary and 16 at on-site or nearby, off-site residential locations) were used for the predictive analyses to assess the future noise conditions due to the proposed operations and equipment. Receptor locations are summarised in **Table 4.3.5.**

Table 4.3.5: Receptor Co-ordinate Assumptions

Land Use	Limits	Point	Project Co-ordinates
Dwellings	50 dB(A) STAS 10009 - 88	1	X_1 = 352743, Y_1 = 531166
		2	X_2 = 355513, Y_2 = 531892
		3	X_3 = 356626, Y_3 = 532895
		4	X_4 = 357333, Y_4 = 534551
		5	X_5 = 357856, Y_5 = 535664
		6	X_6 = 356307, Y_6= 535536
		7	X_7 = 356036, Y_7 = 535492
		8	X_8 = 355640, Y_8 = 535517
		9	X_9 = 356161, Y_9 = 536028
		10	X_{10}= 355124, Y_{10}= 536343

Land Use	Limits	Point	Project Co-ordinates
		11	X_{11}= 354260, Y_{11}= 536356
		12	X_{12}= 353094, Y_{12}= 536043
		13	X_{13}= 353657, Y_{13}= 534893
		14	X_{14}= 353792, Y_{14}= 533974
		15	X_{15}= 354900, Y_{15}= 535500
		16	X_{16}= 354450, Y_{16}= 535750
Buffer zone (PUZ boundary)	65 dB(A) STAS 10009 - 88	1	X_1 = 353249, Y_1 = 531954
		2	X_2 = 354212, Y_2 = 531390
		3	X_3 = 356829, Y_3 = 533846
		4	X_4 = 357606, Y_4 = 535087
		5	X_5 = 357045, Y_5 = 536126
		6	X_6 = 355922, Y_6= 536675
		7	X_7 = 353003, Y_7 = 535536
		8	X_8 = 353767, Y_8 = 534472
		9	X_9 = 353585, Y_9 = 532978

Note: AAC added residential receptor locations 15 and 16 to assess the residential areas north of the Carpeni protected zone.

5.3.1 Noise and Vibrations Estimation, Modelling and Assessment Methodologies Used by the Romanian Independent Consultant

In assessing the impact of stationary, semi-mobile and mobile sources, various approaches were used, as presented in the following sections.

5.3.2 Stationary or Semi-Mobile Sources (Considered Point Sources)

In assessing noise levels due to point sources (stationary or semi-mobile sources) the following standards were considered:

- ISO 9613 -1: 1993, Acoustics – Sound attenuation during propagation in free space – Part 1: Calculation of sound absorption into the atmosphere.
- ISO 9613 -2: 1996, Acoustics – Sound attenuation during propagation in free space – Part 2: General calculation methods.:

Under ISO9613-2, noise level attenuation during propagation is given by the following relation:

$$A_{ech} = A_{div} + A_{atm} + A_{sol} + A_{ecr} + A_{supl} \qquad (1)$$

where:
A_{ech} – total attenuation;
A_{div} – attenuation due to geometric divergence;
– attenuation due to absorption into the atmosphere;
A_s – attenuation due to te soil effect;
A_{ecr} – attenuation due to screens;

A_{supl} - attenuation due to other effects (propagation through forest screens, , propagation through industrial areas, propation through built-on areas). Such attenuation ($A_{supl)}$ was not considered in this case, in a more unfavourable approach.

Acoursic pressure levels are calculated for each octave based on relation:

$$L_p = L_w - A_{ech} \qquad (2)$$

where:
L_p – acoustic pressure level;
L_w – acoustic power level (together with spectral distribution and directivity it characterizes a source of noise).
A_{ech} – sum of positive values.

a) Geometric Divergence (A_{div})

Geometric divergence is considered for a spherical dispersion from a point source in free space (expressed in dB):

$$A_{div} = [20\lg(\tfrac{d}{d_0}) + 11] \qquad (3)$$

where:
d - the distance between the source and the receptor, expressed in metres;
d_0 - reference distance (= 1 m).

Note: The constant in equation (3) – value 11 – links to the level of acoustic power and the level of acoustic pressure at distance d_0, which is 1 m away from the omni-directional point source.

b) Atmospheric Absorption (A_{atm})

Attenuation due to atmospheric absorption (A_{atm}), expressed in dB, in the case of propagation along distance d, expressed in metres, is given by equation:

$$A_{atm} = \tfrac{\alpha d}{1000} \qquad (4)$$

where: α atmospheric attenuation coefficient, in dB / km.

The atmospheric attenuation coefficient very much depends on the sound frequency, ambient temperature and relative air humidity, and, to a lesser extent, on tha ambient atmospheric pressure.

Depending on sound frequency, different atmospheric attenuations will result for each octave, so that for a weighted noise level A, for the same propagation distance, different atmospheric attenuation values will result, depending on the spectral composition of the analysed noise.

For the calculation of environmental noise levels, the atmospheric attenuation coefficient must consider average vales determined for the relevant weather condition interval for the area of operation.

For the weather conditions of the investigated site and the characteristic noise range of most operational equipment, the calculated value was α = 4 dB(A)/km.

c) The Soil Effect (A_{sol})

Soil-induced attenuation, A_{sol}, is mainly the result of interference of noise reflected by the ground with noise directly propagated from the source to the receptor. For the care where:

- only the level of acoustic pressure, A, near the receptor, is of concern;
- noise propagation only occurs over porous or mixed (predominantly porous) terrain,
- the noise is not a pure tone, and
- for surface areas of any shape, soil effect may be calculated by means of equation (5)>

$$A_{sol} = 4.8 - (2\tfrac{h_m}{d})[17 + (\tfrac{300}{d})] \geq 0 \quad (5)$$

where: h_m – average height of the propagation pathway above ground, expressed in metres;

d - the distance between the source and the receptor, expressed in metres;

Average height h_m may be expressed by the method included in standard ISO 9613-2
Negative values of A_{sol} in equation (5) will be replaced by 0.

In the area, apart from the rocky terrain, characteristic to quarries and connecting roads, there is a large proportion of porous ground, often thickly vegetated, used for agriculture, forest, as hay meadows, or orchards.

Propagation beyond the pit and road areas, will be above generally porous land and therefore, in calculating the soil effect, we may apply equation (5) as recommended by ISO 9613-2.

d) Screening (A_{ecr})

An object will be considered an acoustic screen if it meets the following conditions:

- surface density at least 10 kg/m^2;
- its surface is free of fissures or holes;
- horizontal dissemination from the object perpendicular on the source-receptor direction is greater than the acoustic wavelength λ for a nominal average frequency for the considered octave band.

In calculating attenuation due to screening, one may use the Maekawa diagram or one of the relations that may convert it into an algebraic function, such as the Kurze – Anderson relation.

Road Traffic

For Urban Traffic

For this type of traffic we used the method recommended in Directive 2002/49/EC i.e. the French National Calculation Method "NMPB – Routes – 96 (SETRA – CERTU – LCPC – CSTB)" indicated in "Arrete du 5 mai 1995 relatif au bruit des infrastructures routieres, Journal Officiel du 10 mai 1995, Article 6" and French Standard XPS 31-133.

For emission-related input data, this document refers to "guide de bruit des transports terestres, fascicule prevision des niveaux sonores, CETUR 1980".
For Site Traffic

Considering the use of specific, high power vehicles of high levels of acoustic power, it was assessed that the use of acoustic emissions based on pe "Guide de bruit des transports terrestres, fascicule prevision des niveaux sonores, CETUR 1980", or (US) Federal Highway Administration's (FHWA), would obtain underestimated values foe the emissions.

Therefore, the input data for the model were inferred based on the acoustic power levels provided by the manufacturer.

Site traffic during the construction and closure phases on various roads, in the pits during the operational stage, and on surface roads connecting various facilities (pits, process plants, waste rock piles, topsoil piles, quarries, etc.) will include high capacity vehicles, of acoustic powers greater than normal vehicles involved in urban and inter-city traffic.

The characteristic acoustic powers for such vehicles are provided by the manufacturer. They are indicated in Tables 4 and 5.

For road traffic, XPS 31-133 uses L_{AW}/m *(as input data for acoustic power per metre of road).*

Frequency dependence of the acoustic power level, in dBA, of a point source ***i*** on a one octave band ***j*** is calculated from the sound emission levels for vehicles, using the following equation:

$$L_{Awi} = L_{Aw}/m + 10 * \lg(l_i) + R(j) \qquad (6)$$

where:

L_{Aw}/m is the acoustic power level per meter of length associated to the line source in the one octave band, in dB(A), given by:

$$L_{Aw}/m = L_W + 10 * \log\left(\frac{Q}{1000 * V}\right) \qquad (7)$$

where:
l_i – length of one sector of the line source, represented by point component ***i***
Thus, the line source representing the road is modeled by point sources that allow for the application of the relations included in ISO 9613-2.

R(j) – correction, in dB(A), for the one octave band j, given in Table 1;

L_w – acoustic power level of the vehicle;

Q / number of vehicles in the reference interval (1 hour);
V – vehicle speed.

Table 4.3.6: Correction in obtaining weighted value A corresponding to octave j for the noise generated by urban road traffic.

j	Octave band [Hz]	R(j) Values [dB(A)]
1	125	-14.5
2	250	-10.2
3	500	-7.2
4	1000	-3.9
5	2000	-6.4
6	4000	-11.4

The spectral distribution of vehicles (all equipped with diesel engines), will obtain a similar table.

Table 4.3.7: Correction in obtaining weighted value A corresponding to octave j for the noise generated by the diesel engine equipment involved in Project activities

j	One octave band [Hz]	R(j) Correction Values [dB(A)]
1	31.5	-50.3
2	63	-32.6
3	125	-17.5
4	250	-7
5	500	-6.6
6	1000	-5.4
7	2000	-7.2
8	4000	-13.4
9	8000	-21.5

Table 4.3.8: Correction in obtaining weighted value A corresponding to octave j for the noise generated by drilling installation-type equipment

j	Octave band [Hz]	R(j) Values [dB(A)]
1	31.5	-54.9
2	63	-37.2
3	125	-22.1
4	250	-17.6
5	500	-13.2
6	1000	-7
7	2000	-3.8
8	4000	-6
9	8000	-12.1

The following gives the input data for the software (developed by dr. ing. Mihai Zaplaic – S.C. CEPSTRA GR(O)UP S.R.L. for PhD thesis presented in 2003 tutored by prof. Dr.

Nicolae Enescu) based on the relationships recommended in ISO 1996-2 and NMPB/XP S 31-133).

Software Input Data

The input data for the noise forecast model are presented in the following.

Table 4.3.9: Acoustic powers of the equipment used in Project activities

No.	Equipment	Mechanical power (P) (kW)	Acousti c power dB(A)	Calculation relation for acoustic power (Directive 14/2000/EC)
1	Grader (Cat 16H)	205	111	
2	Tracked Dozer (Cat D9R)	302	114	
3	Hydraulic Shovel (O&K RH200)	1670	119,5	**84+11log(P)**
4	Wheel front loader (Cat 992G)	530	113	
5	Wheel front loader (Cat 998G)	321	110	
6	Drilling rig [IR ECM 470]	107	109	**86+11log(P)**
7	Excavator (Cat 325CL)	125	104	
8	Wheel dozer (Cat 834G)	392	111	**82+11log(P)**
9	Drilling rig	454	116	**86+11log(P)**
10	Truck Cat 769D	362	110	
11	Truck Cat 785C	1005	118	
12	Truck Cat 773E	485	116	
13	Road tanker	447	116	
14	Explosives truck	447	116	

If the stationary and semi-mobile equipment in the pit is used 100% (worst case), the resulting acoustic power level is:

L_{wrez} = 123,5 dB(A)

Table 4.3.10: Equipment used in the pits (at maximum capacity)

No.	Equipment	Mechanical power (P) (kW)	Acoustic power dB(A)	Calculation relation for acoustic power (Directive 14/2000/EC)
1	Grader (Cat 16H)	205	111	
2	Tracked Dozer (Cat D9R)	302	114	
3	Hydraulic Shovel (O&K RH200)	1670	119.5	**84+11*log(P)**
4	Wheel front loader (Cat 992G)	530	113	
5	Wheel front loader (Cat 998G)	321	110	
6	Drilling rig [IR ECM 470]	107	109	**86+11log(P)**
7	Excavator (Cat 325CL)	125	104	
8	Wheel dozer (Cat 834G)	392	111	**82+11log(P)**
9	Drilling rig	454	116	**86+11log(P)**
Resulting power 123.5 dB(A)				

Based on the acoustic powers of the heavy vehicles used in the Project, the input data for those vehicles will be as in the following Table.

Table 4.3.11: Input data for the heavy vehicles used in the Project, based on their acoustic power

Type of vehicle	Mechanical power	Acoustic power level PWL(A)	Acoustic power per linear metre at velocity 10 km/h	Acoustic power per linear metre at velocity 30 km/h
	(kW)	dB(A)	dB(A)/m	dB(A)/m
Truck Ca 769D	362	110	70	65.23
Truck Cat 773E	485	116	76	71.23
Road tanker Cat 777D	746	116	76	71.23
Truck Cat 773E	1005	118	78	73.23

If a source operates only some of the reference time, i.e. is characterized by time use indicator θ (values ranging from 0 to 1), the calculated power will be:

$$L_{w\theta} = L_w + 10 * \lg(\theta)$$

Table 4.3.12: Average hourly trips for each pit and year of the operational phase

No.	Pit	Year 9	Year 10	Year 12	Year 14
1	Cetate	5,09	9,94	28,22	18,91
2	Cârnic	12,91	-	-	-
3	Orlea	15,71	20,3	7,58	15,71
4	Jig	1,68	5,18	12,81	-

Note: The calculation will consider the number of passes (double of the number of trips)

Table 4.3.13: Pit depth per year in the operational phase

No.	Pit	Year 9	Year 10	Year 12	Year 14
1	Cetate	-110	-140	-145	-150
2	Cârnic	-170	-	-	-
3	Orlea	-50	-90	-120	-
4	Jig	-50	-100	-	-

Assuming slope p = 10 % for the pit roads, the pit road section will have length L=H/p.

Acoustic power levels in covering the pit road distance for a number of vehicles N is:

$L_{wcar} = L_{w / m} + 10*\log(L) + 10*\log(N)$

Sound emission calculation accounts for the fact that a trip involves two passes by a receptor – one running empty and one full.

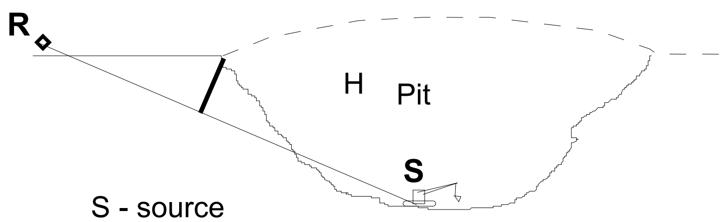
Table 4.3.14: Acoustic powers [dB(A)] characteristic to in-pit traffic

No.	Pit	Year 9	Year 10	Year 12	Year 14
1	Cetate	121.5	12 5.4	130.1	128.5
2	Cârnic	127.4	-	-	-
3	Orlea	123	126.6	123.6	-
4	Jig	118.1	125.1	-	-

This shows important values of equivalent pit traffic powers that need to be considered.

Cross/sections through the pits show that, starting from a distance of 20-30 m from the pit edge, an equivalent screen of height over 10 , is a common element (Figure 4.3.5).

Figure 4.3.5: Cross-section through a pit, source, receptor point and screen equivalent



S - source
R - receptor
He – height of equivalent screen

Therefore, the pit wall will act as an efficient sound screen for the pit equipment as well as for pit traffic.

Equivalent acoustic power levels corresponding to the pits in representative years (the logarithmic sum of the acoustic power of stationary and semi-mobile equipment and the power corresponding to pit traffic) are given in the following Table.

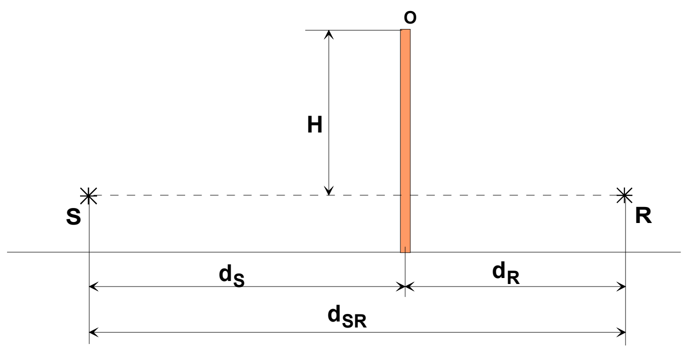
Table 4.3.15: Total acoustic powers associated to the pits in representative years

No.	Pit	Year 9	Year 10	Year 12	Year 14
1	Cetate	125,6	127,4	130,9	129,7
2	Cârnic	129,7			
3	Orlea	126,3	128,3	126,6	
4	Jig	124,6	127,4		

Screen Efficiency

The following figure is a schematic representation of the calculation elements underlying the assessment of a screen effect on the noise level conveyed from the source to the receptor.

Figure 4.3.6 Simplified screen schematic



S – Source
R – Receptor
H – effective screen height
d_S – Source - screen distance
d_{SR} – Source - receptor distance

The following shows the results of the assessment of the efficiency of some screen types on the noise at receptor level.

Case 1: Attenuation by a screen equivalent to distance d_{SR} = 300 m, H = 10 m
(considered to be a semi-infinite screen)

Case 1 corresponds to the situations where the noise sources are pit equipment starting from depth of some tens of metres and the pit walls are equivalent screens of heights over 10 m.

Table 4.3.16: Attenuation of noise levels provided by the screen, depending on the source-screen distance (Case 1)

d_S [m]	30	60	90	120	150	180	210	240	270
A [dB]	20.54	18.26	17.13	16.58	16.42	16.58	17.13	18.26	20.54

Case 2: Attenuation by a screen equivalent to d_{SR} = 300 m, H = 3 m
(considered to be a semi-infinite screen)

Case 2 corresponds to potential situations where protection is provided by screens of effective height at least 3 m, located near the operating sources.

Table 4.3.17: Attenuation of noise levels provided by the screen, depending on the source-screen distance (Case 2)

d_S [m]	**10**	**20**	**30**	**40**	**50**	**150**	**250**	**260**	**270**	**280**
A [dB]	15	12.49	11.23	10.51	10	8.54	10	10.51	11.23	12.49

Ana analysis of the attenuation values shows the greater effectiveness of a screen placed near the source or the receptors.

From an economic perspective, it appears that, where possible, screening near the sources is preferable, in this case the protected area being considerably larger.

6 Noise and Vibration – Project Sources and Impacts

6.1 Background Considerations

The Roşia Montană Project is located in a predominantly rural region that has been inhabited for many centuries, and land usage has been relatively uncontrolled. As a consequence, existing residential and agricultural land areas are currently interspersed with areas impacted by historical or active mining operations. Many existing residences and other village structures abut or are located with little or no setback from existing national and county roads. Because of such heavily intermingled land uses, even with the voluntary relocations of many residents to new homes and communities outside of the Project boundary, opportunities for mitigating the impacts associated with noise and vibration by increasing the distance between the source and potential receptors are very limited.

The current Project boundary is the result of negotiations between RMGC and the administrative districts of Oras Abrud and Roşia Montană, and is defined by Urbanism Certificate 68/20.08.2004. In the legal negotiations that established the Project boundary, potential Project setback considerations had to be weighed against the establishment of protected zones and other competing land use interests. Although noise and vibration and other potential impacts were subjectively considered along with many other factors in the negotiation of this boundary, it must be understood that the boundary was developed as a workable compromise, reflecting the land use, real estate, and other interests of the surrounding communities and the well-being of their inhabitants, as well as environmental considerations and the overall viability of Project economics. It should also be noted that several protected zones were also established within the Project boundary (see **Exhibit 2.2** and **Exhibits 4.3.1 through 4.3.9**) in order to protect buildings of architectural or cultural interest and other physical features meriting protection as part of the region's cultural patrimony. Habitation within these protected zones is also specifically permitted by the Urbanism Certificate, and it is expected that a number of residential dwellings will be maintained over the life of the project.

As previously noted, RMGC commissioned a baseline study in 2002 and 2003 that assessed background noise and vibration in the region of the Project. The study was updated in 2005 and is provided for information in **Baseline Report 5,** *Noise and Vibration Baseline Report.* The noise and vibration levels associated with the former Roşiamin mining operations are also discussed in this report, to a certain extent, since Roşiamin was still operating when the study was originally performed. While such information may be useful for comparative purposes, noise from the Roşiamin is specifically excluded from the evaluation of noise and vibration baseline conditions, because these operations will cease prior to the start-up of the Roşia Montană Project. Baseline conditions will therefore consist primarily of the noise associated with vehicular traffic sources. Apart from mining operations, the Roşia Montană Project area is generally rural in character, and as such (apart from major roads and trafficways) may be generally characterised by noise levels ≤ 35 dB(A). Existing non-mining noise sources include road traffic and operating agricultural equipment. Of these, road traffic noise predominates, and current traffic levels contribute to the baseline conditions for both noise and vibration. National Road DN 74A (connecting Abrud to Zlatna and Câmpeni) skirts the western side of the Project area and provides a link with the major Romanian road network via the regional centre of Alba Iulia. This road presently experiences moderate use by a mix of heavy and light vehicles, in keeping with its role as a link between major centres of population in Alba County. The county roads which links the DN 74A with Roşia Montană and Corna Valley are also subject to a mix of heavy and light vehicle traffic, with heavy truck traffic primarily being associated with copper mining activities at Roşia Poieni (currently accessed via the Corna Valley road).

Evaluation and interpretation of available baseline data as part of the AAC modelling effort suggests that background noise, especially from the DN 74A road through the town of Abrud, is already near or above Romanian residential standards [50 dB(A) daytime/40 dB(A) night-time] without the additional influence of mining-related activities. As a general observation, traffic on all national roads is likely to increase in concert with the overall long-term growth of the Romanian economy; this trend is likely to also be experienced on the DN 74A road, regardless of the influence of Project mining activities.

The Roşia Montană Project noise and vibration impacts mitigation strategy (see Section 4.3.7.1) is therefore strongly focused on:

- application of BATs and BMPs to minimise noise and vibration impacts associated with Project construction, operation, and decommissioning, at the source wherever possible;
- routine, continuing monitoring of the effectiveness of BAT/BMP mitigation measures with reference to applicable regulatory limits; and
- undertaking systematic refinements and improvements over the life of the project, with an emphasis on any areas in which monitoring may indicate potential exceedances of regulatory limits.

6.2 General Considerations - Mobile and Stationary Machinery Sources

RMGC has committed to purchase a new mining equipment fleet that, to the extent available, meets the requirements of EU Directive 2000/14/EC. As noted in **Tables 4.3.6 and 4.3.7**, most major equipment items are indeed manufactured for the EU market and are (or by the time they are purchased, will be) designed to meet the Directive. Acoustical shielding and other features mitigating ambient and operator-specific noise and vibration impacts are in most cases incorporated as part of the manufacturers' standard designs for equipment destined for the EU market.

With regard to stationary machinery items (virtually all of which will be located at the process plant), preliminary design data specify that all major crushing and grinding equipment be installed underground or in insulated, metal-sheathed buildings with concrete foundations and vibration-dampening mounting arrangements. Preliminary specifications for most major machinery items include specific noise performance requirements and, as appropriate, requirements for vibration monitoring as the means of detecting bearing wear on major rotating machinery. As previously noted, the modelling approach for the project plant takes the mitigating factors into account that are offered by the designs of individual buildings, the overall layout and arrangement of the process plant, and the noise performance requirements specified for major rotating/mechanical equipment.

6.3 General Considerations – Blasting Sources

The primary purpose of blasting is the efficient and low cost breakage of pit or quarry rock, to enable it to be loaded and hauled to processing or stockpile areas. The excavation of the four (Cetate, Cârnic, Orlea, and Jig) open pits and the two Project quarries will employ advanced millisecond delay blasting methods using low-energy ammonium nitrate-fuel oil

(ANFO) explosives. These methods are designed to maximise rock breakage without compromising the safety of the workforce, while minimising airblast, fly rock, and off-site ground motion (vibration) that could potentially affect the integrity of sensitive structures. Economics and safe blasting practice requires using the minimum amount of explosives necessary to achieve the desired rock breakage. Blasting will be initiated by millisecond-delay, non-electric (“Nonel”) methods, which may be considered a BMP for this type of mining operation. Although a blasting pattern may contain many blast holes, if the firing sequence is properly delayed only small amounts of explosives are detonated simultaneously. Multiple small blasts therefore work as single unit without generating any more off-site ground motion than an individual small blast.

Table 4.3.18: Manufacturer's Available Acoustic Performance Data – Major Equipment Items

Equipment Description						Octave Band Sound Power Levels, PWL, in dB re 1 picoWatt								Sound Power
Equipment Make/ Model	**Equipment Type**	**Engine Power Rating (kW)**	**Sound Level Data Source**	**Test Standard**	**31.5 Hz**	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1K Hz**	**2K Hz**	**4K Hz**	**8K Hz**	**Emissions, in dB(A) re 1 picoWatt**
CAT D6R Series III	Track dozer	130	Manufacturer information	EU Directive 2000/14/EC[1]	101	105	110	113	108	106	103	97	91	111 PWL(A)
CAT D8T	Track dozer	228	Manufacturer information	EU Directive 2000/14/EC[1]	103	107	112	115	110	108	105	99	93	113 PWL(A)
CAT D9T	Track dozer	302	Manufacturer information	EU Directive 2000/14/EC[1]	104	108	113	116	111	109	106	100	94	114 PWL(A)
CAT 16H	Motor grader	205	Manufacturer information	EU Directive 2000/14/EC[2]	101	105	110	113	108	106	103	97	91	111 PWL(A)
CAT 325L	Track Excavator	125	Manufacturer information	EU Directive 2000/14/EC	94	98	103	106	101	99	96	90	84	104 PWL(A)
CAT 769D	Haul truck	362	Manufacturer information	EU Directive 2000/14/EC	100	104	109	112	107	105	102	96	90	110 PWL(A)
CAT 773E	Haul truck	485	Manufacturer information	ISO 6393 (static)	106	110	115	118	113	111	108	102	96	116 PWL(A)
CAT 777D	Dump/ water truck	746	Manufacturer information	ISO 6393 (static)	106	110	115	118	113	111	108	102	96	116 PWL(A)
CAT 785C	Haul truck	1005	Manufacturer information	ISO 6393 (static)	108	112	117	120	115	113	110	104	98	118 PWL(A)
CAT 815F	Wheel compactor	164	Manufacturer information	ISO 6393 (dynamic)	101	105	110	113	108	106	103	97	91	111 PWL(A)
CAT 825H	Wheel compactor	235	Manufacturer information	EU Directive 2000/14/EC	99	103	108	111	106	104	101	96	89	109 PWL(A)
CAT 834H	Wheel dozer	413	Manufacturer information	EU Directive 2000/14/EC	100	104	109	112	107	105	102	96	90	110 PWL(A)
CAT 980H	Wheel loader	321	Manufacturer information	EU Directive 2000/14/EC	98	102	107	110	105	103	100	94	88	108 PWL(A)
CAT 988H	Wheel loader	321	Manufacturer information	EU Directive 2000/14/EC	100	104	109	112	107	105	102	96	90	110 PWL(A)
CAT 992G	Wheel	530	Manufacturer	ISO 6393	103	107	112	115	110	108	105	99	93	113

Equipment Description					Octave Band Sound Power Levels, PWL, in dB re 1 picoWatt									Sound Power
Equipment Make/ Model	**Equipment Type**	**Engine Power Rating (kW)**	**Sound Level Data Source**	**Test Standard**	**31.5 Hz**	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1K Hz**	**2K Hz**	**4K Hz**	**8K Hz**	**Emissions, in dB(A) re 1 picoWatt**
	loader		information	(static)										PWL(A)
Atlas-Copco ECM 470	Rock drill (tracked)	107	Mfgr. Test Data	ISO 3746 (static)	109	113	118	121	116	114	111	105	99	119 PWL(A)
O&K RH200	Hydraulic shovel	1680	Mfgr. Test Data	ISO 6385 (dynamic)	–	119	122	124	121	118	116	115	107	124 PWL(A)

Notes:
[1] As amended by 2005/88/EC for Stage I allowances.
[2] The 16H model is not currently noise certified for the European Union to 2000/14/EC Stage II levels. The manufacturer confirms that it or its replacement model will be certified, but a firm availability date has not been established as of this writing. The current 16H Stage I sound level is listed in the table above for reference.

Table 4.3.19: Major Equipment Sources/Estimated Noise Emission Values for Representative Project Years

Major Equipment Items [1]	Power [kW]	No. of Units[3] PY 0 [2] Road Construction		No. of Units PY 0 Plant/ ancillary structures construction		No. of Units PY 0 Sulei quarrying operations	No. of Units PY 0 Pig Valley quarrying operations	No. of Units PY 0 TMF embankment Constructions	No. of Units PY 9 Operations	No. of Units PY 10 Operations	No. of Units PY 12 Operations	No. of Units PY 14 Operations	No. of Units PY 19 Closure		Noise Emission [Acoustic Power (L_w) per equipment unit] ,[3] dB(A) re 1 picoWatt
		Top soil	Fill	Top soil	Fill								TMF	Processing Plant	
CAT D6 Dozer	130	-	-	-	-	-	-	-	-	-	-	-	-	-	111
CAT D8 Dozer	228	-	1	-	1	1	1	1	-	-	-		1	-	113
CAT D9 Dozer	302	1	-	1	-	-	-	-	3	3	3	3	-	-	114
CAT 815 Compactor	164	-	1	-	-	-	-	-	-	-	-	-	-	-	111
CAT 825 Compactor	235	-	-	-	1	-	-	-	-	-	-	1	-	1	109
CAT 980 Front End Loader	321	-	-	-	-	-	-	-	-	-	-	-	-	1	108
CAT 988 Front End Loader	321	1	-	1	-	1	1	1	1	1	1	1	-	-	110
CAT 992 Front End Loader	530	-	-	-	-	-	-	-	1	1	1	1	1	-	113
CAT 834H Wheel Dozer	413	-	-	-	-	-	-	-	1	1	1	1	-	-	110
CAT 769 Haul Truck	362	3	3	3		4	4	4	-	-	-	-	-	-	110

Major Equipment Items [1]	Power [kW]	No. of Units[3] PY 0 [2] Road Construction		No. of Units PY 0 Plant/ ancillary structures construction		No. of Units PY 0 Sulei quarrying operations	No. of Units PY 0 Pig Valley quarrying operations	No. of Units PY 0 TMF embankment Constructions	No. of Units PY 9 Operations	No. of Units PY 10 Operations	No. of Units PY 12 Operations	No. of Units PY 14 Operations	No. of Units PY 19 Closure		Noise Emission [Acoustic Power (L_w) per equipment unit] ,[3] dB(A) re 1 picoWatt
		Top soil	Fill	Top soil	Fill								TMF	Processing Plant	
CAT 785C Haul trucks	1005	-	-	-	-	-	-	-	23	20	17	15	-	-	118
CAT 773D Haul trucks	485	-	-	-	-	-	-	-	1	1	1	1	-	-	116
CAT 777D Haul trucks	746	-	-	-	3	-	-	-	-	-	-	-	-	-	116
CAT 777 Water Truck	746	-	-	-		-	-	-	2	2	2	2	-	-	116
Water truck	447	-	1		1	-	-	-	-	-	-	-	-	-	116
Dump Truck	447	-	-	-	-	-	-	-	-	-	-	-	-	2	116
AtlasCopco ECM 470 Rock Drill	107	-	-	-	-	1	1	1	1	1	1	-	-	-	119
Crane	298	-	-	-	-	-	-	-	-	-	-	-	-	1	109
CAT 325L Excavator	125	-	-	-	-	-	-	-	2	2	1	1	-	-	104
CAT 16H Motor Grader	205	-	-	-	-	-	-	-	2	2	2	2	-	-	111
O&K RH200 Hydraulic shovel	1680	-	-	-	-	-	-	-	3	3	3	3	-	-	124

Major Equipment Items [1]	Power [kW]	No. of Units[3] PY 0 [2] Road Construction		No. of Units PY 0 Plant/ ancillary structures construction		No. of Units PY 0 Sulei quarrying operations	No. of Units PY 0 Pig Valley quarrying operations	No. of Units PY 0 TMF embankment Constructions	No. of Units PY 9 Operations	No. of Units PY 10 Operations	No. of Units PY 12 Operations	No. of Units PY 14 Operations	No. of Units PY 19 Closure		Noise Emission [Acoustic Power (L_w) per equipment unit] ,[3] dB(A) re 1 picoWatt
		Top soil	Fill	Top soil	Fill								TMF	Processing Plant	
Generator, large	2100	-	-	-	1	-	-	-	-	-	-	-	-	-	98
Generator, small	550	-	-	-	-	-	1	-	-	-	-	-	-	-	98

Notes:

[1] Listed equipment items reflect a preliminary estimate of RMGC and construction/closure contractor fleet requirements and coincide with the assumptions made for air emissions modelling as discussed in Section 4.2. Final fleet configuration may vary depending on equipment availability, final mining plan requirements, economic conditions, and other factors.

[2] Maximum number of units operating in given Project Year (PY) and or given construction/demolition areas (PY 00 and 19 only). Project Years are considered representative in that they incorporate predicted maximum equipment utilisation or activity levels. Selected years are the same as those selected for air emissions modelling as discussed in Section 4.2 and correspond to the modelling results presented in Exhibits 4.3.1 through 4.3.9.

[3] Available manufacturers' emissions information or data are shown above, with more details provided in Table 4.3.6. Please note that generator emissions for the 2100 and 550 kW generators were estimated using the Prime Power electrical rating (Pel) method, per ISO 8528-1, *Reciprocating internal combustion engine driven alternating current generating sets – Part 1: Application, ratings, and performance* (International Organisation for Standardisation, 2005); see Section 4.3.5.1. Noise emissions values for other equipment were calculated using the methodologies described in Section 4.3.5.

Blasts will typically be initiated by Nonel detonating cord and blasting caps, placed inside small high explosive charges that are used to assure complete detonation of the ANFO explosive. Once the blasting agents and initiators are emplaced within each blast hole, the hole will be backfilled or "stemmed" with blast hole cuttings, which serves to direct the blast energy in the ground and thereby minimise the generation of fly rock and airborne dust. Precise delays, combined with proper stemming procedures and the matching of explosive type and velocity to the rock mass will result in efficient breakage of rock, no damage to surrounding structures, and minimal ejection of dust or fly rock. When a mine blast is properly executed, the observer will see the ground rise and settle in a gently propagating wave pattern. As the wave propagates, multiple small explosions keep the rock breakage “front” moving.

As previosuly noted, blasting operations will be subject to a continual process of optimisation in order to maximise localised rock breakage within the ore body of interest; to minimise the potential for accidents associated with the use of explosives; to keep blasting costs to a practical minimum and still supports an economically viable production rate; and, to the extent possible, to minimise the potential noise, vibration, and airborne dust impacts to the workforce and external receptors. Operational blasting tests must therefore be conducted and optimised blasting plans developed for each major rock body of interest. Blasting-specific impacts cannot be estimated with any precision until such tests have been completed.

Blasting plans will be developed for the sandstone and andesite quarries in the construction phase, as well as the various ore bodies that will be excavated in the open pits during the operational phase of the Project through Project Year 14. Blasting plans will be subject to continual improvement through implementation of the Project-specific blast vibration monitoring programme [see Section 4.3.7 and the *Noise and Vibration Management Plan* (**ESMS Plans, Plan E)**]. Frequency, velocity, and acceleration will be measured at sensitive structures adjacent to blasting areas. The effects of each blast will be evaluated with regard to any observed structural damage or degradation. Any such observations will be factored into refinements of the applicable blasting plan, in conjunction with the evaluation and resolution of any complaints or observations communicated by local stakeholders.

Blasting plans and their supporting procedures will also consider international BMPs for blasting design as well as the scheduling and management of blasting operations. With regard to noise from blasting, it has long been observed that meteorological conditions have a substantial effect on the perceived intensity of a blast, although noise enhancement effects are extremely site specific and subject to significant variability.[c] As an example, wind velocity and temperature (as a function of altitude) are known to influence the propagation of sound waves. When compared to still air conditions, steady light to moderate winds tend to amplify noise levels downwind, and to decrease noise levels upwind from a given source.[d] It has also been noted that a steady, gentle breeze can increase noise levels without increasing background noise levels. On the other hand, winds of higher velocity tend to increase background levels due to turbulence or the movement of trees and shrubs, and may obscure other noise sources. Low wind velocities can enhance noise levels by several decibels relative to still conditions, assuming a relatively flat topography between sources and receiver. Conversely, upwind noise levels upwind may be reduced by a similar amount. Temperature inversions are also known to increase noise levels at some distance from the source, and most inversions occur during the night-time. Night-time blasting therefore increases the potential for noise to be considered a nuisance by human receptors, as sleep patterns may be disrupted. For this reason and because of other general blasting safety concerns, night-time blasting will be prohibited on the Roşia Montană Project. Other blasting restrictions will be invoked on a case-by-case basis if unfavourable meteorological conditions are encountered.

Blasting operations will cease at Project Year 14, as the last three years of processing will be confined to stockpiled low-grade ore.

6.4 Construction Phase Sources and Impacts

AAC conducted a preliminary modelling study to assess the potential noise and vibration impacts associated with construction phase of the Project. The assumptions and results of this study are presented in the following paragraphs. The acoustical characteristics of major construction-phase equipment sources (provided by the manufacturer or calculated where unavailable) and predicted equipment usage figures for the representative Project Years shown in **Tables 4.3.5 and 4.3.6** were specifically considered.

Sources:

Noise sources in the construction phase will have both stationary and transient characteristics, and are expected to be generated from the following sources:

- non-mine related traffic on local highways and access roads (background);
- operation of heavy equipment use and other noise associated with the demolition of existing structures within the Project's industrial protection area;
- operation of trucks for haulage of construction materials, aggregate, equipment, and waste materials;
- construction/fabrication of the process plant, workshops and storage areas, and other ancillary facilities (e.g. explosives magazines, Temporary Hazardous Waste Storage Facility);
- operation of trucks and heavy equipment for temporary installation/decommissioning of the concrete batch plant;
- operation of trucks and heavy equipment for road construction and maintenance;
- operation of trucks and heavy equipment for surface water management system earthworks construction;
- operation of trucks and heavy equipment for construction of the Tailings Management Facility (TMF) starter dam, diversion channels, and other earthworks;
- operation of trucks and heavy equipment for preparation of the open pits and waste rock stockpile areas;
- site preparation, blasting tests, and drilling and blasting operations in the Sulei and La Piriul Porcului quarries;
- operation of mobile and stationary equipment involved with the handling, transport and crushing of quarried aggregate;
- operation of portable generators;
- blasting tests for the ore bodies to be excavated in the first years of operation;
- construction-related workforce traffic;
- operation of backup safety alarms on heavy vehicles; and
- blast warning and all-clear horns or sirens.

Impacts:

The potential noise and vibration-related impacts associated with construction-phase activities may include:

- hearing impacts and other potentially deleterious health-related impacts to the construction workforce;
- transient nuisance-level impacts to local residents dwelling outside the Project's industrial boundary and within specific protected areas within the Project boundary; and
- vibration damage to sensitive structures in specific protected areas within the Project boundary.

As previously noted, transient blasting-related impacts are not considered in the development of the noise model, since such impacts cannot be predicated with any certainty until blasting tests are completed for the rock bodies of interests. The sources of the modelled impacts may therefore be generally characterised as stationary machinery-based noise from construction areas, linear noise from vehicular traffic, and point source noise from specific static or stationary locations. These impacts will occur over an anticipated two-year construction period and a 7-day per week, 24-hour per day schedule.

Exhibits 4.3.1 through 4.3.4 present conservatively modelled, preliminary predictions of maximum (average worst-case) cumulative (background plus phase-specific) effects for stationary machinery-based noise, linear noise from vehicular traffic, and background noise during major construction phase activities. **Tables 4.3.7 through 4.3.10** present the relative contribution of background and project sources at the noted receptor locations. Additional interpretation for each of the four scenarios so represented is provided as follows:

Exhibit 4.3.1 – Construction of Process Plant Access Road (Major Road 1): The modelling results depicted in **Exhibit 4.3.1** indicate that cumulative noise impacts from the construction of the access road to the process plant may potentially range up to 65 dB(A), centred on the new road alignment. Although the sources will be transient, at certain points in time daytime and night-time noise limits could potentially be exceeded in a number of the residential locations most proximate to the east-west portion of the road along Roşia Stream. . It should be noted that the 60-65 dB(A) area to the immediate northeast of receptor B7 represents a maximum predicted impact from localised road-building activities; similar impacts may be expected a different points in time along the entire road alignment (e.g., from the Gura Rosiei intersection to the new process plant site).

Due to the contribution of background traffic on road DN74A, similar impacts could potentially occur at residential receptors in and near Abrud. Similar impacts may also be expressed at habitations near the eastern end of the protected area, from the operation of the Sulei quarry in support of road-building activities. The 60-65 dB(A) area at the Sulei quarry will remain generally localised to quarry operations; impacts to receptors in the protected area may be expected to be significantly reduced as the quarry excavation increases in depth.

The input assumptions represented in **Exhibit 4.3.1** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Report on Noise and Vibration Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr

Reference noise emission rating: based on noted mixture of vehicles, for each individual roadway listed as follows:

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq})
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq})
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: based on noted vehicles, for the roadways listed as follows:

Road ID: Major Road 1 (Access roadway)
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Processing Plant through-way
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Minor Road 13
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 1
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%;
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings
Area ID and Activity: Base build-up on Major Road 1; assumes equipment/vehicle(s) in use will be as follows:

Cat D8 (1)
Cat 815 (1)
Cat 16 (1)
Cat 777 (1)

Area ID and Activity: Quarrying base rock for roadway build-up at Sulei Quarry [assumed to be on the near-side of the Sulei peak as a worst case orientation]; assumes equipment/vehicle(s) in use will be as follows:
Cat D8 (1)
Cat 988 (1)
Cat 769 (4)

Rock drill (1)
Blasthole Drill (1)

Table 4.3.20 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.1.**

Table 4.3.20: Preliminary Cumulative Noise Estimates from Stationary (non-blasting)and Mobile Sources – Construction of Major Road 1

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	<35	55
R-2	50 day/40 night	36	~36
R-3	50 day/40 night	~37	~37
R-4	50 day/40 night	40	45
R-5	50 day/40 night	39	45
R-6	50 day/40 night	44	46
R-7	50 day/40 night	43	44
R-8	50 day/40 night	42	45
R-9	50 day/40 night	43	45
R-10	50 day/40 night	38	40-45
R-11	50 day/40 night	41	43
R-12	50 day/40 night	49	50
R-13	50 day/40 night	45	45
R-14	50 day/40 night	41	44
R-15	50 day/40 night	43	45
R-16	50 day/40 night	43	44
B-1	65	<35	43
B-2	65	<35	43
B-3	65	38	43
B-4	65	40	45
B-5	65	49	49
B-6	65	39	40-45
B-7	65	56	56
B-8	65	43	44
B-9	65	37	43

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown in Table 4.3.5

<u>Exhibit 4.3.2 – Construction of Major Road 2 (Southern Bypass):</u> The modelling results depicted in **Exhibit 4.3.2** suggest that cumulative noise impacts from the construction of the southern bypass road (connecting to the road to Roşia Poieni on the ridge above the southern slope of the Corna Valley) may potentially range up to 65 dB(A), centred on the new road alignment. Although the sources will be transient, at certain points in time daytime and night-time noise limits could potentially be exceeded in a number of isolated residential dwellings proximate to the road alignment. It should be noted that the 60-65 dB(A) area to the immediate west of receptor R-3 represents a maximum predicted impact from localised road-building activities; similar areal impacts may be expected a different points in time along the entire road alignment (e.g., from the connection point at receptor R-3 southwest to the entrance point on the Bucium Valley road).

Due to the contribution of background traffic on road DN74A, similar impacts could potentially occur at residential receptors in and near Abrud. Similar impacts may also be expressed at habitations near the eastern end of the protected area, from the operation of the Sulei quarry in support of road-building activities. The 60-65 dB(A) area at the Sulei quarry will remain generally localised to quarry operations; impacts to receptors in the protected area may be expected to be significantly reduced as the quarry excavation increases in depth.

Input assumptions represented in **Exhibit 4.3.2** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Report on Noise and Vibration Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Reference noise emission rating: based on noted mixture of vehicles, for each individual roadway listed as follows:

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: based on noted vehicles, for the roadway described as follows:

Road ID: Major Road 2A (Southern Bypass Road)
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Base build-up on Major Road 2A; assumes equipment/vehicle(s) in use will be as follows:
Cat D8 (1)
Cat 815 (1)
Cat 16 (1)
Cat 777 (1)

Area ID and Activity: Quarrying base rock for roadway build-up at Sulei Quarry (assumed to be on the near-side of the Sulei peak as a worst case orientation); assumes equipment/vehicle(s) in use will be as follows:
Cat D8 (1)
Cat 988 (1)
Cat 769 (4)
Rock drill (1)
Blasthole Drill (1)

Table 4.3.21 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.2.**

Table 4.3.21: Preliminary Cumulative Noise Estimates from Stationary (non-blasting) and Mobile Sources – Construction of Major Road 2 (Southern Bypass)

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	<35	50
R-2	50 day/40 night	43	49
R-3	50 day/40 night	59	59
R-4	50 day/40 night	36	36-38
R-5	50 day/40 night	<35	44
R-6	50 day/40 night	44	45
R-7	50 day/40 night	42	44
R-8	50 day/40 night	38	44
R-9	50 day/40 night	42	44
R-10	50 day/40 night	35	40-45
R-11	50 day/40 night	<35	40-45
R-12	50 day/40 night	<35	40-45
R-13	50 day/40 night	<35	40-45
R-14	50 day/40 night	<35	40-45
R-15	50 day/40 night	36	40-45
R-16	50 day/40 night	<35	40-45
B-1	65	<35	40-45
B-2	65	43	45
B-3	65	43	44
B-4	65	35	44
B-5	65	49	49
B-6	65	38	40-45
B-7	65	<35	40-45
B-8	65	<35	40-45
B-9	65	<35	40-45

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5

<u>Exhibit 4.3.3 - Operation of Sulei Quarry and Construction of Tailings Dam and Secondary Containment Dam:</u> The modelling results depicted in **Exhibit 4.3.3** suggest that cumulative noise impacts from the construction of the TMF tailings and secondary containment dams may potentially range up to 75 dB(A), centred primarily on the southwest face of the main dam alignment and secondary containment dam basin/sump areas. Although the sources will be transient, at certain points in time these Project activities could contribute to the exceedance of night-time noise limits at a number of residential dwellings in southeastern Abrud and its outskirts. Background traffic will contribute to the noise profile near the construction area as well as at residential receptors in and near Abrud along the DN74A corridor. Similar impacts may also be expressed at habitations near the eastern end of the protected area, from the operation of the Sulei quarry in support of dam construction. The 60-65 dB(A) area at the Sulei quarry will remain generally localised to quarry operations. Other 45-50 dB(A) impacts along the Project road from the Sulei quarry to the dam site are not likely to significantly affect habitated areas.

At this same point in time, construction activities will occur at the process plant site (filling/grading of the plant area, erection of structures, and installation of major equipment) and the centre of the plant site may experience 75 dB(A). Although the sources will be transient, at certain points in time daytime and night-time noise limits could potentially be exceeded in a number of isolated residential dwellings to the west of receptor point B8.

Input assumptions represented in **Exhibit 4.3.3** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Report on Noise and Vibration Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being utilised for local traffic flows
Reference noise emission rating: based on noted mixture of vehicles, for each individual roadway listed as follows:

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq})
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this stage
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: based on noted vehicles, for the roadways listed as follows:

Road ID: Minor Road 1
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Minor Road 8
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Minor Road 10

Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 14
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Filling and base build-up of TMF Dam; assumes equipment/vehicle(s) in use will be as follows:
Cat D8T (1)
Cat 988H (1)
Cat 769D (4)
A-C ECM 470 (1)
O&K RH200 (1)

Area ID and Activity: Filling and base build-up of Processing Plant pad (worst-case scenario); assumes equipment/vehicle(s) in use will be as follows:
Cat D8T (1)
Cat 825H (1)
Cat 777D (3)
Cat 773D (1)
2100 kW Electrical Generator (1)
Batch Plant (concrete)

Area ID and Activity: Quarrying base rock for roadway build-up at Sulei Quarry [assumed to be on the near-side of the Sulei peak as a worst case orientation]; assumes equipment/vehicle(s) in use will be as follows:
Cat D8 (1)
Cat 988 (1)
Cat 769 (4)
Rock drill (1)
Blasthole Drill (1)

Table 4.3.22 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.3.**

Table 4.3.22: Preliminary Cumulative Noise Estimates from Stationary (Non-Blasting)and Mobile Sources - Operation of Sulei Quarry and Construction of Tailings Dam and Secondary Containment Dam

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	44	50
R-2	50 day/40 night	43	45
R-3	50 day/40 night	38	44
R-4	50 day/40 night	40	45
R-5	50 day/40 night	37	45
R-6	50 day/40 night	45	46
R-7	50 day/40 night	43	44
R-8	50 day/40 night	42	45
R-9	50 day/40 night	43	45
R-10	50 day/40 night	38	40-45
R-11	50 day/40 night	39	40-45
R-12	50 day/40 night	38	43-44
R-13	50 day/40 night	47	48
R-14	50 day/40 night	43	53
R-15	50 day/40 night	43	45
R-16	50 day/40 night	43	45
B-1	65	53	53
B-2	65	54	54
B-3	65	38	49
B-4	65	40	44-45
B-5	65	49	50
B-6	65	39	40-45
B-7	65	36	43-44
B-8	65	56	56
B-9	65	48	49

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5

Exhibit 4.3.4 – Construction of Cetate Water Catchment Dam and La Piriul Porcului quarry: The modelling results depicted in **Exhibit 4.3.4** suggest that the cumulative noise impacts from the operation of the La Piriul Porcului (Pig Valley) sandstone quarry and the construction of the Cetate Water Catchment Dam containment dams may potentially range up to 75 dB(A), centred primarily within the quarry excavation. Although the sources will be transient, at certain points in time these Project activities could potentially contribute to the exceedance of daytime and night-time noise limits at a number of residential dwellings in several small hamlets in the Roşia Valley. Background traffic will contribute to the noise profile at residential receptors in and near Abrud along the DN74A corridor.

At the same general point in time, construction activities will also be occurring at the process plant site (e.g., filling/grading of the plant area, erection of structures, and installation of major equipment); the centre of the plant site may experience 75 dB(A). Although the sources will be transient, at certain points in time daytime and night-time noise limits could potentially be exceeded in a number of isolated residential dwellings to the west of receptor point B8.

Input assumptions represented in Exhibit 4.3.4 are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Report on Noise and Vibration Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being utilised for local traffic flows
Reference noise emission rating: based on noted mixture of vehicles, for each individual roadway listed as follows:

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this stage
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: based on noted vehicles, for the roadways listed as follows:

Road ID: Minor Road 2
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 5
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 8
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 13
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Filling and base build-up of Cetate Dam; assumes equipment/vehicle(s) in use will be as follows:

Cat D8T (1)
Cat 988H (1)
Cat 769D (4)

Area ID and Activity: Filling and base build-up of Processing Plant pad (worst-case scenario); assumes equipment/vehicle(s) in use will be as follows:
Cat D8T (1)
Cat 825H (1)
Cat 777D (3)
Cat 773D (1)
2100 kW Electrical Generator (1)
Batch Plant (concrete)

Area ID and Activity: Quarrying base rock for dam build-up at Pig Valley Quarry; assumes equipment/vehicle(s) in use will be as follows:
Cat D8 (1)
Cat 988 (1)
Cat 769 (4)
Rock drill (1)
Blasthole Drill (1)
550 kW Electrical Generator (1)

Table 4.3.23 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.4.**

Table 4.3.23: Preliminary Cumulative Noise Estimates from Stationary (non-blasting)and Mobile Sources – Construction of Cetate Water Catchment Dam and Pig Valley Quarry

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	<35	50
R-2	50 day/40 night	<35	40-45
R-3	50 day/40 night	34	40-45
R-4	50 day/40 night	34	40-45
R-5	50 day/40 night	<35	40-45
R-6	50 day/40 night	39	44
R-7	50 day/40 night	41	44
R-8	50 day/40 night	44	46
R-9	50 day/40 night	40	43
R-10	50 day/40 night	46	47
R-11	50 day/40 night	55	55
R-12	50 day/40 night	53	53
R-13	50 day/40 night	50	50
R-14	50 day/40 night	53	53
R-15	50 day/40 night	49	50
R-16	50 day/40 night	55	55
B-1	65	<35	40-45
B-2	65	<35	40-45
B-3	65	37	40-45
B-4	65	<35	40-45
B-5	65	37	40-45

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
B-6	65	40	40-45
B-7	65	53	53
B-8	65	56	56
B-9	65	<35	40-45
Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5			

Noise management and mitigation strategies and specific measures that may (depending on the results of monitoring) be applied during the construction phase are discussed further in Sections 4.3.7.1 through 4.3.7.3.

Sources and Impact in the Pre-Production Phase

Construction of the access road to the process plant (Main Road No. 1)

Background noise is generated by existing traffic on the surrounding roads, assessed based on the traffic data in the following Table:

Table 4.3.24: Calculated traffic on urban roads

No.	Alignment	Light vehicles*/hour	Heavy vehicles**/hour	Lw/m
1	Abrud – Zlatna	102	20	82,5
2	Abrud – belt road	61	15	81,0
3	Abrud – through the town	42	5	77,2
4	Abrud – Câmpeni	102	20	82,5
5	To Roşia Montană	19	3	74,7
6	Neglected on Corna Valley			

*- mass < 3500 kg
** - mass >= 3500 kg

Construction involves a succession of activities of various durations, which will be simultaneous for the most part. It was considered that the time required for road development is similar to the longest operation involved. In this case, the duration was considered equal to the digging period, i.e. 46 days.

Table 4.3.25: Fixed sources and associated acoustic powers

Equipment	Acoustic power dB(A)
Tracked Dozer Cat D8	113
Front loader Cat 988	110
Bulldozer Cat D9	114
Compacter Cat 815	111
Grader Cat 16	111
Truck Cat 769	110

The time for the execution of 1 m of road (expressed in hours) is the total time of road development divided by the road length, expressed in metres

Te/m = Te/L = (46 * 24)/4961.07 = 0.222 hr/m

The total acoustic power of the equipment used is calculated by logarithmic addition, which gives a value of 117.5 dB(A).

Considering that the equipment group will spend 0.222 hr per metre of road, it results that the level of power released per metre of length, per one hour intervals, is $L_{w,1h}$ = 117.5 + 10*lg(0.222) = 110.82.

Relating it to the total duration of road development, of 1104 hours, the level of acoustic power per metre will be $L_{w / m}$ = 80,4 dB(A).

Thus allowed for the association of a power density to each metre of road, to be inputted into the software for Main Road 1.

For haul vehicles, the acoustic power per metre of length (sound power level per meter length along the lane) is calculated based on the vehicle acoustic power $L_{w.}$

Table 4.3.26: Model input data for the heavy vehicles based on their acoustic power

Type of vehicle	Mechanical power	Acoustic power level PWL(A)	Acoustic power per linear metre at velocity 10 km/h	Acoustic power per linear metre at velocity 30 km/h
	(kW)	dB(A)	dB(A)/m	dB(A)/m
CAT 769D	362	110	70	65.23
CAT 773E	485	116	76	71.23
CAT 777D	746	116	76	71.23
CAT 785	1005	118	78	73.23

Thus, for a total number of trips 8515 in 46 days, i.e. 17030 passes, it follows that N = 17,030/(46*24) = 15.42 passes/hr.

For a truck type CAT 769D, , the level of acoustic power per metre will be 70 dB(A) for a speed of 10 km/hr.

For trips/hr, the level of acoustic power per linear metre is:
70 + 10*log(15,42) = 81,9 dB(A)

By calculating the logarithmic sum of the acoustic power level per mtetre from traffic and that of semi-mobile transit traffic, the total calculated value is $L_{w/m}$ = 84,2 dB(A), for Main Road 1.

For secondary road 13: Lw/m = 68,0 dB(A)

For secondary road 1: Lw/m = 79,3 dB(A), la 1157 * 2 = 2314 passes for road tanker with Lw = 116 dB(A)

Table 4.3.27: Model input data for the noise level from construction activities on Main Road 1

<table>
<tr><th>Activity</th><th>Duration (days)</th><th>Acoustic power levels of relevant equipment dB(A)</th><th>Average acoustic power level for 46 days dB(A)</th><th>Acoustic power level per metre of road for the 46 days dB(A)</th></tr>
<tr><td>Topsoil stripping</td><td>6</td><td>114,76</td><td rowspan="4">117,5</td><td rowspan="4">80,4</td></tr>
<tr><td>Digging</td><td>46</td><td>115,46</td></tr>
<tr><td>Filling</td><td>19</td><td>115,12</td></tr>
<tr><td>Base laying</td><td>4</td><td>116,54</td></tr>
<tr><td>Transport of materials</td><td></td><td>8168 + 347 trips</td><td></td><td>81,9</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Total: 84,2</td></tr>
</table>

Construction of Southern Bypass (Major Road 2)

Background noise is generated by existing traffic on the surrounding roads, assessed based on the traffic data in the following Table.

Table 4.3.28: Calculated traffic on urban roads

No.	Alignment	Light vehicles/hour	Heavy vehicles/hour	Lw/m
1	Abrud – Zlatna	102	20	82,5
2	Abrud – belt road	61	15	81,0
3	Abrud – through the town	42	5	77,2
4	Abrud – Câmpeni	102	20	82,5
5	To Roşia Montană	19	3	74,7
6	Corna Valley	neglected		

Construction involves a succession of activities of various durations, which will be simultaneous for the most part. It was considered that the time required for road development is similar to the longest operation involved. In this case, the duration was considered equal to the digging period, i.e. 42 days.

Table 4.3.29: Fixed sources and associated acoustic powers

Equipment	Acoustic power dB(A)
Bulldozer Cat D8	113
Front loader Cat 988	110
Bulldozer Cat D9	114
Compacter Cat 815	111
Grader Cat 16	111
Truck Cat 769	110

The time for the execution of 1 m of road (expressed in hours) is the total time of road development divided by the road length, expressed in metres

Te/m = Te/L = (42 * 24)/1465.74 = 0.69 hr/m

The total acoustic power of the equipment used is calculated by logarithmic addition, which gives 117.7 dB(A).

Considering that the equipment group will spend 0.69 hr per metre of road, it results that the level of power released per metre of length, per one hour intervals, is $L_{w,1h}$ = 117.7 + 10*lg(0.69) = 116.6.

By relating it to the total duration of road development, of 1104 hours, the level of acoustic power per metre will be $L_{w / m}$ = 85.7 dB(A).

Thus allowed for the association of a power density to each metre of road, to be inputted into the software for Main Road 2.

For haul vehicles, the acoustic power per metre of length (sound power level per meter length along the lane) is calculated based on the vehicle acoustic power $L_{w.}$

Table 4.3.30: Model input data for the heavy vehicles based on their acoustic power

Type	Mechanical power	Acoustic power level PWL(A)	Acoustic power per linear metre at velocity 10 km/h	Acoustic power per linear metre at velocity 30 km/h
	(kW)	dB(A)	dB(A)/m	dB(A)/m
CAT 769D	362	110	70	65,23
CAT 773E	485	116	76	71,23
CAT 777D	746	116	76	71,23
CAT 785	1005	118	78	73,23

Thus, for a total number of trips totalling 18900 passes, it follows that N = 18900/(42*24) = 18.75 passes/hr.

For a truck type CAT 769, , the level of acoustic power per metre will be 70 dB(A) for a speed of 10 km/hr.

For 18.75 trips/hr, the level of acoustic power per linear metre is:
70 + 10*log(18.75) = 82.73 dB(A)

By calculating the logarithmic sum of the acoustic power level per mtetre from traffic and that of semi-mobile transit traffic, the total calculated value is $L_{w/m}$ = 84,2 dB(A), for Main Road 1.

For secondary road 13 Lw/m = 68.0 dB(A)

For secondary road 1 Lw/m = 79.3 dB(A), at la 1157 * 2 = 2314 passes for one road tanker with Lw = 116 dB(A).

Table 4.3.31: Model input data for the noise level from construction activities on Main Road 2

Activity	Duration (days)	Acoustic power levels of relevant equipment	Average acoustic level for 46 days dB(A)	Acoustic power level per metre of road for the 46 days dB(A)
Topsoil stripping	9	114,76	117,7	85,7
Digging	42	115,46		

Activity	Duration (days)	Acoustic power levels of relevant equipment	Average acoustic level for 46 days dB(A)	Acoustic power level per metre of road for the 46 days dB(A)
Filling	17	115,12		
Base laying	4	116,54		
Transport of materials		9100 + 350 trips		82,7
				Total: 87,5

Estimated Noise Levels generated in the operation of Sulei Quarry and the Building of the TMF and SRS Dams

Background noise is generated by existing traffic off site, assessed based on the traffic data in the following Table.

Table 4.3.32: Calculated traffic on urban roads

No.	Alignment	Light vehicles*/hour	Heavy vehicles/hour	Lw/m
1	Abrud – Zlatna	102	20	82,5
2	Abrud – belt road	61	15	81,0
3	Abrud – through the town	42	5	77,2
4	Abrud – Câmpeni	102	20	82,5
5	To Roşia Montană	19	3	74,7
6	Neglected on Corna Valley			

In the case of the dams and the process plant, construction involves a range of activities of various durations, which will be simultaneous for the most part.
The modeling included activities at Sulei Quarry, the construction of the process plant pad, the building of the TMF dam.

Sources involved in the operation of Sulei Quarry:

- Bulldozer Cat D8 – 1 pc.
- Front loader Cat 988 – 1 pc.
- Truck Cat 769 – 4 pcs.
- Drilling rig – 1 pc.
- Drilling rig for blasting holes – 1 pc.

The resulting acoustic level is $L_{W\ rez}$ = 123 dB(A)

Sources involved in the construction of the Process Plant pad:

- Bulldozer Cat D8 – 1 pcs.
- Compacter Cat 825H – 1 pcs.
- Road tanker Cat 777D – 1 pc.
- Truck Cat 773D – 1 pc.
- Electric generator – 1 pc.
- Concrete mixing plant

The resulting acoustic level is $L_{W\ rez}$ = 117 dB(A)

Sources involved in the construction TMF dam:

- Bulldozer Cat D8 – 1 pcs.
- Front loader Cat 988H – 1 pcs.
- Truck Cat 769D – 4 pcs.
- Drilling rig ECM470 – 1 pc.

The resulting acoustic level is $L_{W\ rez}$ = 122 dB(A)

The stationary sources included were as follows: the process plant area, topsoil stockpile near the process plant, topsoil pile near the TMF, topsoil pile near Sulei Quarry, waste rocks stockpile, each with an acoustic power level of 113 dB(A).

For haul vehicles, the acoustic power per metre of length (sound power level per meter length along the lane) is calculated based on the vehicle acoustic power $L_{w.}$

Table 4.3.33: Model input data for the heavy vehicles based on their acoustic power

Type	Mechanical power	Acoustic power level PWL(A)	Acoustic power per linear metre at velocity 10 km/h	Acoustic power per linear metre at velocity 30 km/h
	(kW)	dB(A)	dB(A)/m	dB(A)/m
CAT 769D	362	110	70	65.23
CAT 773E	485	116	76	71.23
CAT 777D	746	116	76	71.23
CAT 785	1005	118	78	73.23

Table 4.3.34: Levels of acoustic power per linear metre of roads

No.	Alignment	Trips per hour	Vehicle acoustic power dB(A)	Acoustic power per m of road dB(A)
1	Secondary road 10:	6	113	80.78
2	Secondary road 14:	12	113	83.79
3	Secondary road 8:	12	113	83.79
4	Plant site access doad	35.8	116	91.53
5	Secondary road 1:	6	113	80.78
6	Secondary road 13:	6	113	83.78

Estimated Noise Levels generated in the operation of La Paraul Porcului Quarry and the Building of the Cetate Water Catchment Dam

Background noise is generated by existing traffic off site, assessed based on the traffic data in the following Table.

Table 4.3.35: Calculated traffic on urban roads

No.	Alignment	Light vehicles*/hour	Heavy vehicles/hour	Lw/m
1	Abrud – Zlatna	102	20	82.5
2	Abrud – belt road	61	15	81.0
3	Abrud – through the town	42	5	77.2
4	Abrud – Câmpeni	102	20	82.5
5	To Roşia Montană	19	3	74.7
6	Neglected on Corna Valley			

La Paraul Porcului Quarry is used for the extraction of building material for Cetate Dam.

Sources involved in the operation of La Paraul Porcului Quarry:

- Bulldozer Cat D8 – 1 pcs.
- Front loader Cat 988 – 1 pcs.
- Truck Cat 769 – 4 pcs.
- Drilling rig – 1 pc.
- Drilling rig – 1 pc.
- Electric generator – 1 pc.

The resulting acoustic level is $L_{W\ rez}$ = 123 dB(A)

Sources involved in the building of Cetate Dam:

- Bulldozer Cat D8T – 1 pcs.
- Front loader Cat 988H – 1 pcs.
- Truck Cat 769D – 4 pcs.

The resulting acoustic level is $L_{W\ rez}$ = 119 dB(A)

For haul vehicles, the sound power level per meter length along the lane is calculated based on the vehicle acoustic power $L_{w.}$

Table 4.3.36: Model input data for the heavy vehicles based on their acoustic power levels

Type	Mechanical power	Acoustic power level PWL(A)	Acoustic power per linear metre at velocity 10 km/h	Acoustic power per linear metre at velocity 30 km/h
	(kW)	dB(A)	dB(A)/m	dB(A)/m
CAT 769D	362	110	70	65.23
CAT 773E	485	116	76	71.23
CAT 777D	746	116	76	71.23
CAT 785	1005	118	78	73.23

Note that materials are hauled on a short distance, the stationary and mobile sources working on a relatively limited area.

Figure 4.3.4 shows the assessment for this situation.
Receptors D11 and D12 are the most exposed.

6.5 Operations Phase Sources and Impacts

<u>**Sources:**</u>

The potential sources of noise and vibration during the operational phase of the Project will be associated with the following activities, and will exhibit both transient and stationary characteristics:

- non-mine related traffic on local highways and access roads (background);
- open pit area blasting tests and operational drilling and blasting activities;

- operation of drilling, excavation, and loading equipment in the open pits;
- hauling and tipping of ore, waste rock, and low-grade ore at various stockpile locations;
- hauling and tipping of aggregate and topsoil for ongoing construction, repair, and (after Project Year 10) ongoing reclamation activities;
- operation of trucks for hauling equipment, spare parts, reagents, fuel, general, supplies, wastes, and other materials, to and from the Project site;
- operation of the process plant (e.g., crushers, conveyors, SAG and ball mills, pumps, compressors, and other motorised equipment);
- operation of heavy equipment in the construction of the final raise of the TMF dam and ancillary facilities;
- testing and operation of portable and/or emergency generators;
- general employee /visitor vehicle traffic; and
- blast warning, all-clear, and other safety or emergency horns or sirens.

<u>Impacts:</u>

The potential noise and vibration impacts associated with operations phase activities include:

- hearing impacts and other potentially deleterious health-related impacts to mineworkers and the onsite contractor workforce;
- transient, primarily nuisance-level impacts to local residents dwelling outside the Project's industrial protection area; and
- potential vibration effects on sensitive structures in protected areas and outside the Project boundary.

The sources of these impacts may be generally characterised as stationary machinery-based noise from construction areas, linear noise from vehicular traffic, and point source noise from daytime blasting operations through Project Year 14 (after which processing will be conducted using stockpiled low-grade ore). Round-the clock operation is anticipated for the full 16 years of operation.

Exhibits 4.3.5 through 4.3.8 present conservatively modelled predictions of maximum cumulative effects for stationary machinery-based noise, linear noise from vehicular traffic, and background noise during representative years of major operations phase activities. As noted previously, transient impacts from routine blasting of the ore bodies in the open pits are not considered, since blasting impacts cannot be predicted with certainty until initial blasting tests are completed.

Additional interpretation of each of these scenarios is provided as follows:

<u>Exhibit 4.3.5 - Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 9:</u> The modelling results depicted in Exhibit 4.3.5 suggest that in Project Year 9, cumulative noise impacts from mining activities in the Orlea and Cârnic pits may range up to 75 and 65 dB(A), respectively, centred primarily within the pit excavations. Although these sources will be transient and mitigated to a substantial degree by the gradual deepening of the pit excavations, at certain points in time these Project activities could potentially contribute to the exceedance of daytime and night-time noise limits at a number of residential dwellings in the Roşia Montană protected area and other isolated locations in Roşia Valley. Waste rock and ore hauling and stockpiling activities will also contribute to the noise profile, and process plant operations may contribute to exceedances at night-time limit in isolated locations to the west of the process plant. Background traffic will continue to contribute to a similar noise profile at residential receptors in and near Abrud along the DN74A corridor.

It should be noted that in the air quality impact analyses (see Section 4.2) for the operational phases of the Project, some of the minor roads were subdivided into links to aid in developing the emissions and assessing the impacts. Minor Road 1 was divided into air quality Links 2 through 4. Minor Road 2 was divided into Links 7 through 9. Minor Road 4 was labelled Link 6. Air quality Links 1, 10, and 14 represented the in-pit haul roads for Cârnic pt, Orlea pit, and Jig pit, respectively. Link 5 represented the in-pit haul road for Cetate pit for model years 8 and 10, while Link 5A represented the Cetate pit in-pit haul roads for model years 12 and 14. Fin Links 11 through 13 represented previously undesignated roads, with Link 11 used as a road connecting to the north end of Minor Road 2, transversing easterly. Link 12 represented a road from Link 11 to the haul road to the north Cetate pit; Link 13 connects Link 11 with the Jig pit. The same vehicular and traffic-pattern assumptions have been used in the assessment of noise and vibration impacts.

The input assumptions represented in **Exhibit 4.3.5** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road : fully functional and being used for local traffic flows
Reference noise emission rating: as noted for each roadway

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this time
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: as noted for each roadway

Road ID: Major Road 1 (Plant Access Road)
Flow rate: 3 truck pass-bys per hour on any given roadway segment (transportation of daily supplies and chemicals)
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Air Quality Link 1-Cârnic Loop
Flow rate: 6.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 55.0 dB(A) at 15m

Road ID: Air Quality Link 2-Cârnic East Waste Rock Haul Road
Flow rate: 3.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 51.7 dB(A) at 15m

Road ID: Air Quality Link 3-Cârnic South Waste Rock Haul Road
Flow rate: 6.3 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 54.8 dB(A) at 15m

Road ID: Air Quality Link 4-Cetate Joint Road
Flow rate: 6.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 55.0 dB(A) at 15m

Road ID: Air Quality Link 6a-TMF Waste Rock Haul Road
Flow rate: 0.3 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 40.8 dB(A) at 15m

Road ID: Air Quality Link 7-Main Joint Haul Road
Flow rate: 5.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.9 dB(A) at 15m

Road ID: Air Quality Link 8-Orlea Haul Road
Flow rate: 5.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.9 dB(A) at 15m

Road ID: Air Quality Link 10-Orlea Loop
Flow rate: 5.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.9 dB(A) at 15m

Road ID: Air Quality Link 15-stockpile Road
Flow rate: 5.3 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 54.0 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Processing Plant in full operation; most noisy equipment is inside of buildings

Area ID and Activity: Mining at the Cârnic pit (assumed pit depth is elevation of 700m); assumes equipment/vehicle(s) in use will be as follows:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)
Cat 834G (1)
Cat 988G (1)
Cat 992G (1)
RH200 (1)
ECM 470 (2)

Area ID and Activity: Mining at the Orlea pit (assumed pit depth is elevation of 800m); assumes equipment/vehicle(s) in use will be as follows:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)

Cat 834G (1)
Cat 988G (1)
Cat 992G (1)
RH200 (1)
ECM 470 (2)

Area ID and Activity: Handling/placement of Cârnic pit waste rock at the Cârnic waste stockpile; assumes equipment/vehicle(s) in use will be one Cat D8T

Area ID and Activity: Handling/placement of Orlea and Cârnic waste rock at the TMF; assumes equipment/vehicle(s) in use will be one Cat 834H

Table 4.3.37 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.5.**

Table 4.3.37: Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 9

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	42	50
R-2	50 day/40 night	40-45	44
R-3	50 day/40 night	~43	45
R-4	50 day/40 night	47	48
R-5	50 day/40 night	~43	45
R-6	50 day/40 night	50	51
R-7	50 day/40 night	60	60
R-8	50 day/40 night	57	57
R-9	50 day/40 night	50	50
R-10	50 day/40 night	48	49
R-11	50 day/40 night	47	49
R-12	50 day/40 night	45	48
R-13	50 day/40 night	49	50
R-14	50 day/40 night	49	50
R-15	50 day/40 night	59	59
R-16	50 day/40 night	54	54
B-1	65	44	48
B-2	65	44	46
B-3	65	47	49
B-4	65	44	46
B-5	65	45	46
B-6	65	43	44
B-7	65	50	50
B-8	65	53	54
B-9	65	43	47

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5

<u>Exhibits 4.3.6 - Preliminary Cumulative Noise Estimates from Stationary (non-blasting) and Mobile Sources – Operations Phase, Year 10:</u> **Exhibit 4.3.6** suggests that in Project

Year 10, cumulative noise impacts from mining activities in the Jig and Orlea pits may range up to 80 and 70 dB(A), respectively, centred primarily within the pit excavations. Although these sources will be transient and will be substantially mitigated by the deepening of the associated pit excavations, at certain points in time these Project activities could potentially contribute to the exceedance of daytime and night-time noise limits at a number of residential dwellings in the Roşia Montană protected area and other isolated locations in Roşia Valley. Backfililng activities at the Cârnic pit and other waste rock and ore haulage, stockpiling, and backfilling activities will contribute to the noise profile. Continuing process pant operations may contribute to night-time exceedances in isolated receptor locations to the west of the process plant. Background traffic will continue to contribute to a similar noise profile at residential receptors in and near Abrud along the DN74A corridor.

Input assumptions represented in **Exhibit 4.3.6** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being utilised for local traffic flows
Reference noise emission rating: as noted for each roadway

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [(57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană (45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this time
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: as noted for each roadway

Road ID: Major Road 1 (Plant Access Road)
Flow rate: 3 truck pass-bys per hour on any given roadway segment (transportation of supplies/materials/consumables)
Reference noise emission rating**:** 51.5 dB(A) at 15m

Road ID: Air Quality Link 1-Cârnic Loop
Flow rate: 1.6 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 48.8 dB(A) at 15m

Road ID: Air Quality Link 6a-TMF Waste Rock Haul Road
Flow rate: 0.5 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 43.6 dB(A) at 15m

Road ID: Air Quality Link 7-Main Joint Haul Road
Flow rate: 3.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.4 dB(A) at 15m

Road ID: Air Quality Link 8-Orlea Haul Road

Flow rate: 3.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.4 dB(A) at 15m

Road ID: Air Quality Link 10-Orlea Loop
Flow rate: 4.3 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.0 dB(A) at 15m

Road ID: Air Quality Link 11-Orlea Joint Road
Flow rate: 2.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 50.2 dB(A) at 15m

Road ID: Air Quality Link 12-Orlea Waste Rock Haul Road
Flow rate: 1.6 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 48.8 dB(A) at 15m

Road ID: Air Quality Link 13-Jig Haul Road
Flow rate: 1.0 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 46.8 dB(A) at 15m

Road ID: Air Quality Link 14-Jig Loop
Flow rate: 1.0 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 46.8 dB(A) at 15m

Road ID: Air Quality Link 15-stockpile Road
Flow rate: 3.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 51.6 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localized area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Processing Plant in full operation; most noisy equipment is inside of buildings

Area ID and Activity: Mining at the Jig pit (assumed pit depth is elevation of 891m); assumes equipment/vehicle(s) in use will be:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)
Cat 834G (1)
Cat 988G (1)
Cat 992G (1)
RH200 (1)
ECM 470 (2)

Area ID and Activity: Mining at the Orlea pit (assumed pit depth is elevation of 720m); assumes equipment/vehicle(s) in use will be:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)
Cat 834G (1)

Cat 988G (1)
Cat 992G (1)
RH200 (1)
ECM 470 (2)

Area ID and Activity: Depositing and Jig pit waste rock to the Cârnic stockpile; assumes equipment/vehicle(s) in use will be one Cat D8T

Area ID and Activity: Placing/handling Jig pit waste rock at the TMF; assumes equipment/vehicle(s) in use will be one Cat 834H

Table 4.3.38 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.6.**

Table 4.3.38: Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 10

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	~37	50
R-2	50 day/40 night	~38	44
R-3	50 day/40 night	40	45
R-4	50 day/40 night	42	45
R-5	50 day/40 night	~38	45
R-6	50 day/40 night	44	45
R-7	50 day/40 night	45	47
R-8	50 day/40 night	49	49
R-9	50 day/40 night	47	49
R-10	50 day/40 night	51	52
R-11	50 day/40 night	47	49
R-12	50 day/40 night	43	45
R-13	50 day/40 night	47	49
R-14	50 day/40 night	48	49
R-15	50 day/40 night	57	57
R-16	50 day/40 night	54	54
B-1	65	41	44
B-2	65	42	44
B-3	65	45	47
B-4	65	38	45
B-5	65	41	40-45
B-6	65	44	44
B-7	65	49	49
B-8	65	52	53
B-9	65	41	~43

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5

Exhibit 4.3.7 - Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 12: Exhibit 4.3.5 suggests that cumulative noise impacts from backfilling activities in the Jig and Orlea pits may range up to 75 and 70 dB(A), respectively, centred primarily within the deepest areas of the pit excavations.

Although these sources will be transient and will be substantially mitigated by the depth of the associated pit excavations, as backfilling progresses these Project activities could potentially contribute to the exceedance of night-time noise limits at a number of residential dwellings in the Roşia Montană protected area and other isolated locations in Roşia Valley. Waste rock and ore haulage, stockpiling, and backfilling activities will contribute to the noise profile, as will process plant operations. Raising of the Cârnic waste rock stockpile to its final elevation will increase the noise levels in the are of the TMF, and may have a limited night-time impact on receptors at isolated locations the east of receptor location B-3. Background traffic will continue to contribute to potential exceedances of the daytime and night-time standard at residential receptors in and near Abrud along the DN74A corridor.

Input assumptions represented in **Exhibit 4.3.7** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being used for local traffic flows
Reference noise emission rating: as noted for each roadway

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană (45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this time
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: as noted for each roadway

Road ID: Major Road 1 (Plant Access Road)
Flow rate: 3 truck pass-bys per hour on any given roadway segment (transportation of supplies/materials/consumables)
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Air Quality Link 1-Cârnic Loop
Flow rate: 0.5 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 43.3 dB(A) at 15m

Road ID: Air Quality Link 5b-Cetate Loop (Years 12 & 14)
Flow rate: 10.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 57.0 dB(A) at 15m

Road ID: Air Quality Link 6a-TMF Waste Rock Haul Road
Flow rate: 2.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 49.9 dB(A) at 15m

Road ID: Air Quality Link 7-Main Joint Haul Road
Flow rate: 2.4 truck pass-bys per hour on any given roadway segment

Reference noise emission rating: 50.6 dB(A) at 15m

Road ID: Air Quality Link 8-Orlea Haul Road
Flow rate: 7.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 55.6 dB(A) at 15m

Road ID: Air Quality Link 9-Cetate North Road
Flow rate: 5.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.8 dB(A) at 15m

Road ID: Air Quality Link 10-Orlea Loop
Flow rate: 3.0 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Air Quality Link 11-Orlea Joint Road
Flow rate: 5.7 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 54.3 dB(A) at 15m

Road ID: Air Quality Link 12-Orlea Waste Rock Haul Road
Flow rate: 0.5 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 43.3 dB(A) at 15m

Road ID: Air Quality Link 13-Jig Haul Road
Flow rate: 5.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.8 dB(A) at 15m

Road ID: Air Quality Link 14-Jig Loop
Flow rate: 5.1 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 53.8 dB(A) at 15m

Road ID: Air Quality Link 15-stockpile Road
Flow rate: 5.9 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 54.5 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localized area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Processing Plant in full operation; most noisy equipment is inside of buildings

Area ID and Activity: Mining at the Cetate pit (assumed pit depth is elevation of 730m); assumes equipment/vehicle(s) in use will be:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)
Cat 834G (1)
Cat 988G (1)
Cat 992G (1)
RH200 (2)

ECM 470 (3)

Area ID and Activity: Mining at the Orlea pit (assumed pit depth is elevation of 660m); assumes equipment/vehicle(s) in use will be:
Cat D9T (1)
Cat 16H (1)
Cat 325L (1)
Cat 834G (1)
Cat 988G (1)
Cat 992G (1)
RH200 (1)
ECM 470 (3)

Area ID and Activity: Handling/placing Orlea pit waste rock to the Cârnic stockpile; assumes equipment/vehicle(s) in use will be one Cat D8T

Area ID and Activity: Handling/placing Cetate pit waste rock at the TMF; assumes equipment/vehicle(s) in use will be one Cat 834H

Area ID and Activity: Handling/placing Cetate pit waste rock in the Jig pit (re-filling); assumes equipment/vehicle(s) in use will be one Cat D8T

Table 4.3.39 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.7.**

Table 4.3.39: Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 12

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	40-45	50
R-2	50 day/40 night	40-45	44
R-3	50 day/40 night	40-45	45
R-4	50 day/40 night	44	47
R-5	50 day/40 night	40-45	45
R-6	50 day/40 night	47	48
R-7	50 day/40 night	48	49
R-8	50 day/40 night	51	51
R-9	50 day/40 night	51	51
R-10	50 day/40 night	48	48
R-11	50 day/40 night	49	49
R-12	50 day/40 night	45	~48
R-13	50 day/40 night	49	49
R-14	50 day/40 night	49	49
R-15	50 day/40 night	60	60
R-16	50 day/40 night	54	55
B-1	65	~44	~47
B-2	65	44	46
B-3	65	47	48
B-4	65	40-45	46
B-5	65	~43	46
B-6	65	47	48
B-7	65	49	50

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
B-8	65	53	54
B-9	65	44	~48
Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5			

Exhibit 4.3.8 - Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 14: **Exhibit 4.3.8** suggests that cumulative noise impacts from backfilling activities in the Cetate pit may range up to 70 dB(A), centred in the pit excavation. Although these sources will be transient, as backfilling progresses these Project activities could potentially contribute to the exceedance of daytime and night-time noise limits at few residential dwellings in the Roşia Montană protected area and other isolated locations in Roşia Valley and to the west of the process plant, although impacts will decrease along the eastern edge of the protected zone and southerly in the direction of the reclaimed Cârnic stockpile and the TMF. Other reclamation activities will contribute to the overall noise profile, and background traffic will continue to contribute to potential exceedances of the daytime and night-time standard at residential receptors in and near Abrud along the DN74A corridor.

Input assumptions represented in **Exhibit 4.3.8** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being used for local traffic flows
Reference noise emission rating: as noted for each roadway

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road (57 dB(A) at 15m for hourly L_{eq})
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [(45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS**

All on-site roads have been built by this time
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: as noted for each roadway

Road ID: Major Road 1 (Plant Access Road)
Flow rate: 3 truck pass-bys per hour on any given roadway segment (transportation of supplies/materials/consumables)
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Air Quality Link 5b-Cetate Loop (Years 12 & 14)
Flow rate: 14.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 58.2 dB(A) at 15m

Road ID: Air Quality Link 6a-TMF Waste Rock Haul Road
Flow rate: 3.9 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.6 dB(A) at 15m

Road ID: Air Quality Link 8-Orlea Haul Road
Flow rate: 4.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.9 dB(A) at 15m

Road ID: Air Quality Link 9-Cetate North Road
Flow rate: 4.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.9 dB(A) at 15m

Road ID: Air Quality Link 10-Orlea Loop
Flow rate: 4.2 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 52.9 dB(A) at 15m

Road ID: Air Quality Link 15-Stockpile Road
Flow rate: 5.9 truck pass-bys per hour on any given roadway segment
Reference noise emission rating: 54.5 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localized area (pseudo-stationary source)
Usage Factors (see Section 4.3.5.3 for description): typically -2 dB for <70% and -1 dB for >70%
Power Factor (see Section 4.3.5.3 for description): -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Processing Plant in full operation; most noisy equipment is inside of buildings

Area ID and Activity: Mining at the Cetate pit (assumed pit depth is elevation of 650m); assumes equipment/vehicle(s) in use will be as follows:
Cat D9T (2)
Cat 16H (2)
Cat 325L (1)
Cat 834G (2)
Cat 988G (1)
Cat 992G (1)
RH200 (3)
ECM 470 (4)

Area ID and Activity: Handling/placing Cetate pit waste rock to the TMF; assumes equipment/vehicle(s) in use will be one Cat 834H

Area ID and Activity: Handling/placing pit waste rock to the Orlea pit (re-filling with new base at elevation 700m); assumes equipment/vehicle(s) in use will be one Cat D8T

Table 4.3.40 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.8.**

Table 4.3.40: Preliminary Cumulative Noise Estimates from Stationary (Non-blasting) and Mobile Sources – Operations Phase, Year 14

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	39	50
R-2	50 day/40 night	42	44
R-3	50 day/40 night	43	45
R-4	50 day/40 night	42	45
R-5	50 day/40 night	41	45
R-6	50 day/40 night	43	45
R-7	50 day/40 night	44	47
R-8	50 day/40 night	47	48
R-9	50 day/40 night	43	45
R-10	50 day/40 night	44	47
R-11	50 day/40 night	44	46
R-12	50 day/40 night	43	46
R-13	50 day/40 night	47	49
R-14	50 day/40 night	48	49
R-15	50 day/40 night	54	54
R-16	50 day/40 night	49	50
B-1	65	43	~48
B-2	65	43	46
B-3	65	43	44
B-4	65	42	45
B-5	65	43	~47
B-6	65	~43	~48
B-7	65	48	50
B-8	65	53	53
B-9	65	44	47

Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5

Noise management and mitigation strategies and specific measures that may (depending on the results of monitoring) be applied during the operations phase are discussed further in Sections 4.3.7.1, 4.3.7.2, and 4.3.7.4.

Sources and Impact in the Operating Phase - Romanian Consultant

Site Traffic Flows on Surface Roads

Note: The values below are for two-way trips. For the estimation of noise levels when the number of vehicle is accounted for, the values should be multiplied by 2, as they assume 2 passes by a receptor located on the roadside, one running empty, and the other one full.

Traffic Flows for Year 9

The first column shows the operational pit, and the second column the destinations of the material excavated from it. The number of hourly trips are given in parantheses.

CÂRNIC (12.91)	**Process Plant (5.2)**
	TMF (1)
	Carnic Waste Rock Disposal Site (5.31)

ORLEA (15.71)	**Process Plant (**6.26)
	TMF (1)
	Carnic Waste Rock Disposal Site (8.45)

JIG (1.68)	**Process Plant (**0.18)
	TMF (1.5)
	Carnic Waste Rock Disposal Site (**very little**)

CETATE (5.09)	**Process Plant (**0.59)
	TMF (1)
	Carnic Waste Rock Disposal Site (3.5)

Traffic Flows for Year 10

ORLEA (20.3)	**Process Plant (**13.3)
	Carnic Pit – filling (7)

JIG (5.18)	**Process Plant (**1.5)
	TMF (2.5)
	Carnic Pit – filling (1.18)

CETATE (9.94)	**Process Plant** (2)
	Carnic Pit – filling (7.94)

Traffic Flows for Year 12

ORLEA (7.58)	**Process Plant** (6)
	Carnic Pit – filling (1.58)

CETATE (28.22)	**Process Plant** (10)
	TMF (6)
	Jig Pit – filling (11)
	Orlea Pit – filling (1.22)

Traffic Flows for Year 14

CETATE (18.91)	**Process Plant** (9)
	TMF (5)
	Orlea Pit – filling (4.91)

The values of acoustic power per metre of road length L_w/m corresponding to various sections for the situations encountered during the investigated operations years

These values are used as input data in calculating the noise levels.

Figure 4.3.7: Separate site road sections for which road traffic levels and acoustic emissions in the form of acoustic power were calculated per m of length.

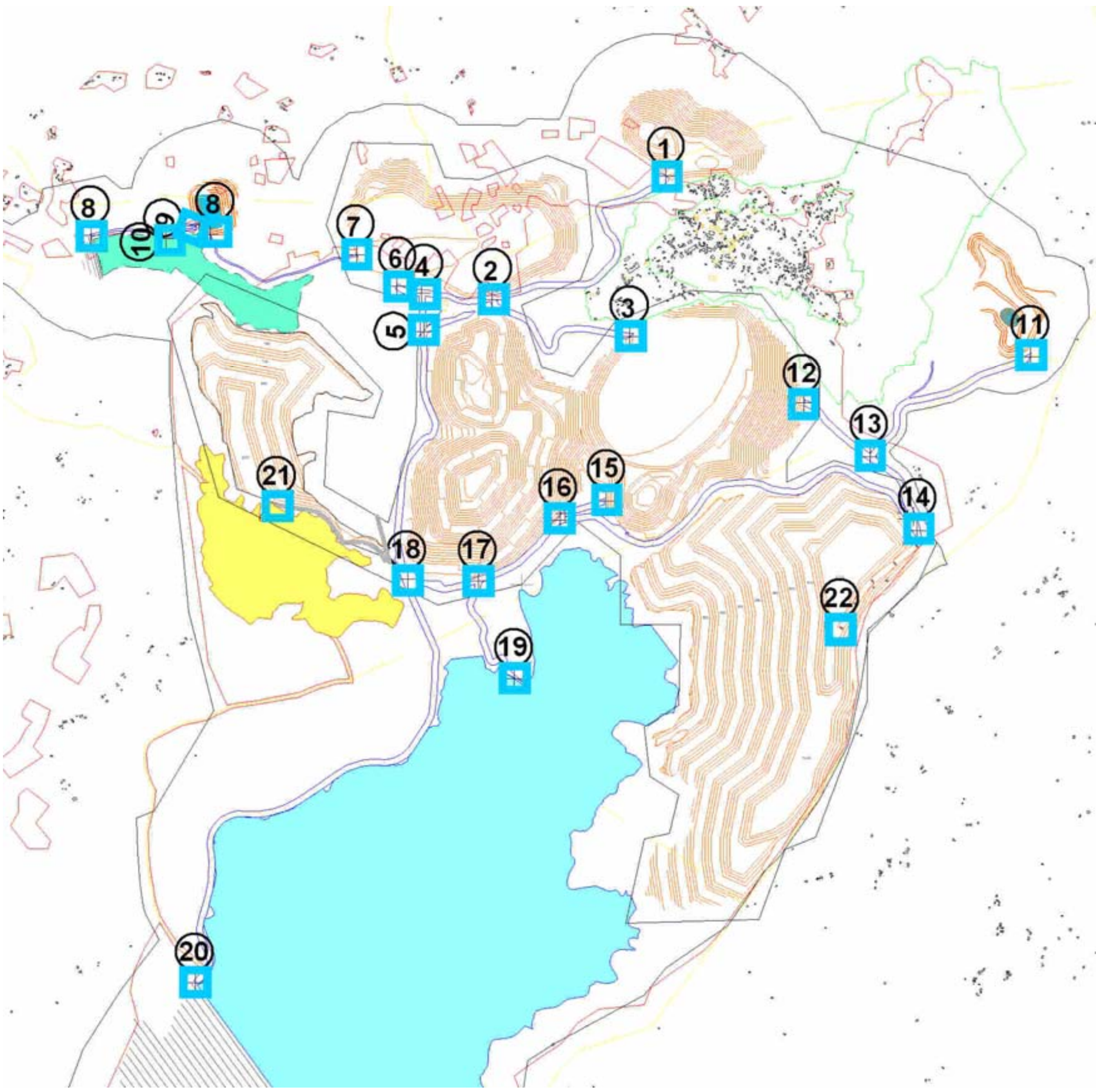


Table 4.3.41: Sound emissions on ore and waste rock haul roads (acoustic power per metre of road length in dB(A)/m)

Alignment	A		B		C		D		E		F		G		H		I	
	1-2		2-3		2-4		4-6		4-18		18-22		18-20		18-21		12-22	
Relevant Pit	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m	Passes	dB(A)/m
Pit CÂRNIC 9			13.4	89.27	13.4	89.27			13.4	89.27			2	81	11.4	88.56	10.62	88.26
Pit ORLEA 9							31.4	92.96	31.4	92.96	16.9	90.27	2	81	12.52	88.97		
Pit JIG 9	3.76	83.75			2.76	82.4			2.76	82.4	0.22	71.42	3	82.77	0.36	73.56		
Pit CETATE 9			7	86.45	3.18	83			3.18	83			2	81	1.18	78.71		
Pit ORLEA 10			14	89.46	14	89.46	40.6	94.1	26.6	92.25					26.6	92.25		
Pit JIG 10	10.36	88.15	2.36	81.73	8	87.03			8	87.03			5	85	3	82.77		
Pit CETATE 10			15.88	90	4	84.02			4	84.02					4	84.02		
Pit ORLEA 12			3.16	83	3.16	83	15.6	90	12	88.8					12	88.8		
Pit CETATE 12	22	91.42			36.22	93.59	2.44	81.87	32	93.05			6	85.78	20	91		
Pit CETATE 14					37.82	93.77	9.82	87.92	28	92.47			10	88	18	90.55		

Assessed noise levels, relevant sources for each assessment, sensitive receptors for exceedance of limit values

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 9. CETATE Pit

Sources:

- extraction activity in Cetate Pit
- haulage on Cetate Pit roads
- backfilled waste rock grading at Carnic Pit
- Plant Site activity
- TMF activity

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D6 – 52 dB(A)

D7 – 60 dB(A)

D8 – 60 dB(A)

D13 – 50 dB(A)

D14 – 50 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 9. CÂRNIC Pit

Sources:

- extraction activity in Carnic Pit
- haulage on Carnic Pit roads
- backfilled waste rock grading at Carnic Pit
- Plant Site activity
- TMF activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D4 – 54 dB(A)

D6 – 60 dB(A)

D7 – 62 dB(A)

D8 – 63 dB(A)

D13 – 51 dB(A)

D14 – 52 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 9. Jig Pit

Sources:

- extraction activity in Jig Pit
- haulage on Jig Pit roads
- Plant Site activity
- TMF activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D8 – 55 dB(A)

D13 – 50 dB(A)

D14 – 51 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 9. Orlea Pit

Sources:

- extraction activity in Orlea Pit
- haulage on Orlea Pit roads
- waste rock grading at Carnic stockpile
- Plant Site activity
- TMF activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D4 – 57 dB(A)

D6 – 50dB(A)

D7 – 51 dB(A)

D8 – 53 dB(A)

D13 – 52 dB(A),

D14 – 53 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 9. Operations in ORLEA and CARNIC Pits – assumed as worst case

Sources:

- extraction activity in Orlea Pit

- haulage on Orlea Pit roads
- extraction activity in Carnic Pit
- haulage on Carnic Pit roads
- Plant Site activity
- TMF activity
- waste rock grading at Carnic stockpile

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D4 – 58 dB(A),

D6 – 57dB(A),

D7 – 66 dB(A),

D8 – 64 dB(A),

D13 – 55 dB(A),

D14 – 54 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 10. Cetate Pit

Sources:

- extraction activity in Cetate Pit
- haulage on Cetate Pit roads
- backfilled waste rock grading at Carnic Pit
- haulage on Carnic Pit roads
- Plant Site activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D6 – 60dB(A)

D7 – 63 dB(A)

D8 – 63 dB(A)

D13 – 50dB(A)

D14 – 50 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 10. Jig Pit

Sources:

- extraction activity in Jig Pit
- haulage on Jig Pit roads

- backfilled waste rock grading at Carnic Pit
- haulage on Carnic Pit roads
- Plant Site activity
- TMF activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D6 – 57dB(A)

D7 – 62 dB(A)

D8 – 65 dB(A)

D13 – 51 dB(A)

D14 – 52 dB(A)

Exhibit 4.3.5 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 10. Orlea Pit

Sources:

- extraction activity in Orlea Pit
- haulage on Orlea Pit roads
- backfilled waste rock grading at Carnic Pit
- haulage on Carnic Pit roads
- Plant Site activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D6 – 58dB(A)

D7 – 61 dB(A)

D8 – 62 dB(A)

D13 – 54 dB(A)

D14 – 52 dB(A)

Exhibit 4.3.7 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 12. Cetate Pit

Sources:

- extraction activity in Cetate Pit
- haulage on Cetate Pit roads
- backfilled waste rock grading at Jig Pit
- haulage on Jig Pit roads

- Plant Site activity
- on-site surface haulage
- backfilled waste rock grading at Orlea Pit
- haulage on Orlea Pit roads

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D6 – 53 dB(A)

D7 – 56 dB(A)

D8 – 62 dB(A)

D13 – 52 dB(A)

D14 – 53 dB(A)

Exhibit 4.3.7 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 12. Orlea Pit

Sources:

- extraction activity in Orlea Pit
- haulage on Orlea Pit roads
- backfilled waste rock grading at Carnic Pit
- haulage on Carnic Pit roads
- Plant Site activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D4 – 57 dB(A)

D6 – 55dB(A)

D7 – 60 dB(A)

D8 – 58 dB(A)

D13 – 51 dB(A)

D14 – 51 dB(A)

Exhibit 4.3.8 Cumulated noise emissions from stationary and mobile sources during the operational phase, Year 14. Cetate Pit

Sources:

- extraction activity in Cetate Pit
- haulage on Cetate Pit roads
- backfilled waste rock grading at Orlea Pit
- haulage on Orlea Pit roads

- Plant Site activity
- on-site surface haulage
- TMF activity
- on-site surface haulage

Sensitive receptors to exceeded limit values (Leq ≥ 50 dBA):

D8 – 53 dB(A)

D13 – 52 dB(A)

D14 – 53 dB(A)

6.6 Decommissioning/Closure Phase Sources and Impacts

Sources:

As noted in **Exhibit 4.3.9,** the potential sources of noise and vibration during the decommissioning/closure phase of the Project will be associated with the following activities, and will exhibit both transient and stationary characteristics:

- Non-mine related traffic on local highways and access roads (background);
- operation of cranes and other heavy equipment for the dismantling and disassembly of the process plant and other ancillary facilities within the industrial protection area;
- operation of trucks and heavy equipment for haulage of waste materials, as well as materials destined for recycling;
- operation of trucks and other heavy equipment for reclamation, rehabilitation, and revegetation of the two quarry areas; the TMF; the Secondary Containment Dam; waste rock stockpiles; water collection dams and earthworks; various topsoil stockpile areas; specific sections of access roads in the industrial area; and the Cetate Water Catchment Dam and pond; and
- workforce transportation and other decommissioning/closure phase - related traffic.

Impacts:

The potential impacts associated with these activities primarily include hearing impacts on the decommissioning/closure phase workforce and nuisance impacts to local residents dwelling outside the Project's industrial boundary or in protected areas. No blasting operations are anticipated for this phase of the Project. Because of the substantially reduced levels of industrial activity by Project Year 16 and the absence of blasting operations after year 14, noise/vibration impacts to residents dwelling outside the Project boundary or in protected areas are estimated to be substantially less than the impacts experienced in the construction or operation phases of the Project. **Exhibit 4.3.9** depicts estimated areas of noise impacts at year 19 that are related to the restoration and rehabilitation of the process plant area, the pits, the TMF, and the Temporary HazardousWaste Storage Facility and other ancillary facilities. Although these results may be interpreted as a return of the site to pre-Project or background noise and vibration conditions that are still dominated by local traffic sources, the model is intrinsically conservative and does suggest some residual potential for day- and night-time exceedances at isolated locations to the west of the process plant and to the southeast of the TMF that in part could be the result of site decommissioning and closure activities. Similarly, some residual potential for night-time exceedances may remain in the Roşia valley and Roşia Montană protected area. Again, it is likely that background traffic will continue to contribute to potential exceedances of the daytime and night-time standard at residential receptors in and near Abrud along the DN74A corridor.

Input assumptions represented in **Exhibit 4.3.9** are summarised as follows:

- **EXISTING ROADWAYS (off-site)**

Vehicle(s): mixture of cars, vans, trucks, and other vehicles
Flow rate: adjusted from Tables 2 – 9 of Report on Noise and Vibration Baseline Conditions Report (Jan 2005)
Speed: assumed 30 km/hr
Southern Bypass Road: fully functional and being utilised for local traffic flows
Reference noise emission rating: based on noted mixture of vehicles, for each individual roadway listed as follows:

Road ID: Abrud to Campeni/Carpinis [61 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud to Zlatna [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Abrud by-pass; parallel to Abrud to Zlatna road [57 dB(A) at 15m for hourly L_{eq}]
Road ID: Gura Rosiei to Roşia Montană [45 dB(A) at 15m for hourly L_{eq})
Road ID: Southern By-pass from Bucium Sat to Corna 'Y' [45 dB(A) at 15m for hourly L_{eq}]
Road ID: Southern By-pass from Corna 'Y' northward to Lupsa [45 dB(A) at 15m for hourly L_{eq}]

- **PROJECT ROADWAYS (on-site)**

All on-site roads have been built by this stage of the Project
Vehicle(s): heavy-haul trucks (such as CAT 769- or 777-class trucks)
Speed: assumed 30 km/hr
Flow rate and reference noise emission rating: based on noted vehicles, for the roadways listed as follows:

Road ID: Major Road 1 (Plant Access Road)
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 1
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Minor Road 9 and 3a
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

Road ID: Minor Road 14
Flow rate: 1 truck per hour on any given roadway segment
Reference noise emission rating: 46.7 dB(A) at 15m

Road ID: Tailings Impoundment Traverse-way
Flow rate: 3 trucks per hour on any given roadway segment
Reference noise emission rating: 51.5 dB(A) at 15m

- **PROJECT OPERATIONS (on-site)**

Vehicle(s): as noted for each area
Speed: assumed 10 km/hr, but only in a localised area (pseudo-stationary source)
Usage Factors: typically -2 dB for <70% and -1 dB for >70%

Power Factor: -4 dB to account for difference between full, rated, and idle power settings

Area ID and Activity: Reclamation and reshaping of Cârnic Waste Rock Stockpile; assumes equipment in use will be one Cat D9T

Area ID and Activity: Demolition of Processing Plant; assumes equipment/vehicle(s) in use will be as follows:
Cat 825H (1)
Cat 980D (1)
Cat 773D (3)
Crane (1)

Area ID and Activity: Reclamation and soil over-laying of Tailings Impoundment Area; assumes equipment/vehicle(s) in use will be as follows:
Cat D8T (1)
Cat D9T (1)
Cat 992D (1)
Cat 825H (1)
Cat 769 (1)

Table 4.3.42 presents the estimated noise profile contributions from mining-related activities to this scenario, as well as the cumulative (background plus mining-related) estimates at each receptor location that collectively form the basis for the model output depicted in **Exhibit 4.3.9.**

Table 4.3.42: Preliminary Cumulative Noise Estimates from Stationary (non-blasting) and Mobile Sources – Operations Phase, Year 19

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
R-1	50 day/40 night	37	50
R-2	50 day/40 night	47	49
R-3	50 day/40 night	39	44
R-4	50 day/40 night	41	45
R-5	50 day/40 night	<35	45
R-6	50 day/40 night	38	40-45
R-7	50 day/40 night	38	40-45
R-8	50 day/40 night	39	45
R-9	50 day/40 night	37	40-45
R-10	50 day/40 night	37	40-45
R-11	50 day/40 night	38	40-45
R-12	50 day/40 night	38	40-45
R-13	50 day/40 night	40-45	45
R-14	50 day/40 night	50	50
R-15	50 day/40 night	41	45
R-16	50 day/40 night	40	44
B-1	65	41	44
B-2	65	44	47
B-3	65	45	47
B-4	65	35	40-45
B-5	65	34	40-45
B-6	65	36	40-45
B-7	65	40-45	45
B-8	65	54	54
B-9	65	43	45

Receptor	Noise Level Limit, A-wtd hourly Leq, Lp(A)	Project Noise Contributions (only), A-wtd hourly Leq, Lp(A)	Project contributions plus predicted existing conditions, A-wtd hourly Leq, Lp(A)
Note: R = Residential receptors (dwellings); B = Receptors at industrial (buffer) zone boundary; all receptor co-ordinates are as shown on Table 4.3.5			

It is anticipated that some closure phase activities will actually start during the operation phase in year 10 of the Project, and some level of closure activity will continue until year 21. Such activities include the reshaping of waste rock stockpile slopes and the Cârnic open pit, placement of topsoil, and revegetation. Noise management and mitigation strategies and specific measures to be applied during the closure phase are described in Sections 4.3.7.1, 4.3.7.2, and 4.3.7.5.

Sources and Impact in the Decommissioning/Closure Phase - Romanian Consultant

Closure is a phase which, from a noise perspective, shares a lot elements with the construction phase, mainly related to the transitory character of the activities, but also the types of sources involved. Year 19 was selected as representative for the noise levels characteristic to the decommissioning/closure phase.

a) ASSESSMENT

Background noise is generated by existing traffic off site, assessed based on the traffic data in the following Table.

Table 4.3.43: Calculated traffic on urban roads

No.	Alignment	Light vehicles*/hour	Heavy vehicles/hour	Lw/m
1	Abrud – Zlatna	102	20	82.5
2	Abrud – belt road	61	15	81.0
3	Abrud – through the town	42	5	77.2
4	Abrud – Câmpeni	102	20	82.5
5	To Roşia Montană	19	3	74.7
6	Neglected on Corna Valley			

The situation of noise sources in Year 19 will be different from that of the operations phase, as it will depend on a number of predictable and unpredictable factors. Thus, in Year 19, many of the facilities will be closed, whth closure activities starting in Year 5 of the Project.

The following is an analysis of the acoustic implications of closure activities in two of the most important facilities: the TMF and the Process Plant.

TMF - activities

- TMF covering with the first soil layer (material spreading and compacting - duration: 157 days);
- TMF covering with vegetation (unloading, spreading and compacting, regrading - duration: 94 days);

- Dam covering with the first soil layer (unloading from vehicles, spreading and compacting, regrading - duration: 61 days);
- Dam covering with vegetation (unloading from vehicles, spreading and compacting, regrading - duration: 18 days);
- Excavation of water drainage channel in the TMF pond (excavation, loading onto vehicles - duration: 75 days);

The sources involved by these activities are distributed by sub-unit hour shares. In determining noise levels, a maximum acoustic power was assumed to result from the simultaneous use of the equipment, in unit hour shares, i.e. continuous use of equipment (anyway, it is assumed that the equipment will be used almost continuously, allocated to various activities under way).

Mobile sources (haulage vehicles) will move on a limited area, therefore may be considered quasi-stationary).

Table 4.3.44: Noise sources for the closure phase

No.	Equipment	Mechanical power (kW)	Acoustic power dB(A)
1	Grader (Cat 16H)	205	111
2	Tracked Dozer (Cat D6R)	205	111
3	Tracked Dozer (Cat D8R)	265	113
4	Tracked Dozer (Cat D9R)	302	114
5	Wheel front loader (Cat 992G)	530	113
6	Wheel dozer (Cat 9884G)	321	110
7	Truck 769D	362	110

The resulting acoustic level is $L_{W\ rez}$ = 121 dB(A)

Processing plant – activities:

- Buildings demolition (bulldozer, vehicle loading) – duration 453 days;
- Foundation demolition (bulldozer, vehicle loading) – duration 197 days;
- Land reclamation (regarding – duration 23 days, topsoil unloading – duration 10 days, soil spreading and compacting- duration: 10 days);

Table 4.3.45: Noise sources for the closure phase

No.	Equipment	Mechanical power (kW)	Acoustic power dB(A)
1	Wheel front loader (Cat 998G)	321	110
2	Excavator (Cat 325CL)	125	104
3	Road tanker/ Truck	447	116
4	Crane	298	114

The resulting acoustic level is $L_{W\ rez}$ = 119 dB(A)

Figure 4.3.18 shows the assessed levels of noise for the closure and rehabilitation activities at the two main facilities.

7 Mitigative Measures for Noise and Vibration

7.1 Mitigation Strategy

Because of 1) the nature and location of the negotiated Project industrial zone boundary; 2) the establishment of protected areas within the industrial zone within which habitation will be permitted; 3) the proximity of noise and vibration receptors within adjacent communities and, at dwellings with the protected areas; 3) the significant level of background traffic noise in the DN 74A corridor, and 4) the uncertain influence of atmospheric conditions and other fundamental characteristics of noise and vibration, it is recognised that some potential for regulatory exceedance of residential and industrial standards, especially where centres of Project activity (e.g., process plant operation, TMF construction, open pit excavation) are close to the Project boundary or protected areas. This general observation is borne out by the preliminary modelling efforts described in Section 4.3.6. Some of the factors leading to this conclusion (such as background traffic volumes on the national highway, atmospheric effects, and Project boundary and protected area locations) are beyond RMGC's ability to control or materially influence. Nevertheless, RMGC will adopt and implement a noise and vibration management strategy that is designed to minimise the noise and vibration footprint of the Project to the extent possible through the implementation of internationally recognised BATs/BMPs. The Roşia Montană Project will:

- employ currently applicable regulatory limits for noise and vibration as specific monitoring goals or performance targets;
- select and monitor representative sensitive receptor locations in the zones suggested by the preliminary, intrinsically conservative modelling results documented in **Exhibits 4.3.1 through 4.3.9 (**and/or as established by physical surveys of sensitive structures);
- at the selected monitoring locations, measure ambient noise levels as well as vibration frequency, velocity, and acceleration to determine actual noise and vibration impacts; these data will provide the basis for an ongoing noise and vibration monitoring programme [see Section 6.2 of the Project *Noise and Vibration Management Plan* (**ESMS Plans, Plan E**)] that will be continually adjusted to account for changing Project characteristics, stakeholder interests, and regulatory requirements, as they may occur over the life of the Project;
- undertake proactive communications with local residents through public meetings and regular individual contacts as the means of communicating blasting schedules, deliveries of SHLO equipment, or other significant noise- or vibration-generating activities and obtain resident feedback on the effectiveness of mitigation measures;
- evaluate monitoring programme data and apply additional BATs (see **Table 4.3.16** for a list of proven BAT options that may be selected from to address specific monitored conditions) to minimise noise and vibration impacts to the extent possible, as appropriate for the various job functions of the workforce and the location of the Project boundaries and receptors in relation to specific sources or sets of sources;
- evaluate the relative effectiveness of the BATs so applied, through continued monitoring actions; and
- continue to refine or update source controls, apply alternate BATs or BMPs, and/or undertake additional corrective or preventive action in order to continually minimise or mitigate noise and vibration impacts to the workforce and local residents for the life of the mining operation.

Table 4.3.46: Potential BAT Options or Mitigation /Minimisation of Noise and Vibration

BAT	Minimisation Potential	BAT Sources
1. Adjust frequency of deliveries by heavy vehicles to prevent concentrated impacts to adjacent communities	• Variable	4
2. Adjust construction schedules to minimise night-time activities requiring the use of high acoustical-energy equipment (e.g., dozers, excavators)	• Variable	4
3. Create noise control barriers via earthen berms or bunds, which can be as long as required and from 10 to 20m high depending on the topography and geometry of the source(s) and receptor(s)	5 to 20 dB(A)	7, 4, 5, 6
4. Acoustic treatment of dwellings in special situations, as necessary to improve habitable spaces	10 to 20 dB(A)	7, 10, 7
5. Fit heavy haul trucks with additional noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, other options may include: • engine combustion management systems • enclosing engine bays • aerodynamic radiator fan design • noise-control louvers or baffles on radiator grille • noise-control louvers or baffles on hydraulic system cooling fans • high-performance silencers • variable backup warning systems, adjusted for ambient conditions • chain mesh mudflaps • low-noise tyre tread design	• 2 to 5 dB(A) • 5 to 10 dB(A) • 2 to 3 dB(A) • 2 to 3 dB(A) • 2 to 3 dB(A) • 5 to 10 dB(A) • variable benefits • <3 dB(A) • 1 to 3 dB(A)	7, 10, 11, 8, 9, 10, 11, 12
6. Fit excavators with noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, options may include: • engine combustion management systems • sound-absorbing panels within engine bays, under the deck area, and inside the counterweight • sound absorbing panels around the powerpacks and hydraulic cooler house	• 2 to 5 dB(A) • 3 to 5 dB(A) • 5 to 10 dB(A) • 2 to 4 dB(A)	7, 10, 11, 13, 15

[4] *Mine Planning for Environment Protection*, Commonwealth of Australia, Environmental Protection Agency, Best Practice Environmental Management in Mining, June, 1995
[5] *Noise Management at Martha Mine, Newmont Mining; www.marthamine.co.nz/sound.html*
[6] *Noise, Vibration, and Airblast Control*, Environment Australia, 1998; www.ea.gov.au/industry/sustainable/mining/booklets/noise/noise3.html#3
[7] Australian Government, Department of the Environment and Heritage, *Checklists for Sustainable Minerals*, Checklist for Noise, Vibration, and Airblast Control, 2003
[8] *Pollution Prevention and Abatement Guidelines for the Mining Industry*, World Bank/UNIDO/UNEP draft guidelines, July 1993
[9] Caterpillar web site; www.cat.com
[10] *Essentials – Noise Management in the Construction Industry: A Practical Approach*, Government of Western Australia, 3/99
[11] *Noise Control Resource Guide – Surface Mining*, U. S. Department of Labor, Mine Safety and Health Administration (MSHA)
[12] *Environment and Community – Opportunities and Challenges for Mine Planning and Operations, Mt. Arthur Coal (BHP Billiton), May 2005*

BAT	Minimisation Potential	BAT Sources
• use multiple hydrostatically-controlled units for engine cooling (vs. single belt-driven fan) • variable backup warning systems, adjusted for ambient conditions • primary/secondary silencers, tuned to engine exhaust characteristics	• 1 to 3 dB(A) • variable benefits • 5 to 10 dB(A)	
7. Fit dozers with additional noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, options may include: • engine combustion management systems • high-performance silencers • engine shrouding • variable backup warning systems, adjusted for ambient conditions • optional tread control devices to reduce "track slap" characteristics	• 2 to 5 dB(A) • 5 to 10 dB(A) • 5 to 10 dB(A) • variable benefits • variable benefits	7, 10, 11, 12, 13, 14, 15, 16, 13

The monitoring and management of noise and vibration impacts to receptors in adjacent communities or habitations within the protected areas of the Project will be managed in accordance with the *Noise and Vibration Management Plan* (**ESMS Plans, Plan E**), which describes the specific management processes that will be implemented to minimise noise and vibration in accordance with appropriate BMPs and BATs. As summarised in **Figure 4.3.6,** this includes the active incorporation of noise and vibration feedback into establishing or refining:

- the Noise and Vibration Management Plan itself;
- individual blasting plans for the two quarries and four open pits; and
- the *Cultural Heritage Management Plan* (which lists cultural important structures that must be considered with regard to their potential sensitivity to vibration impacts; as discussed in ESMS Plans, Plan N).

The noise and vibration monitoring requirements specified in the *Noise and Vibration Management Plan* will be integrated into the overall environmental monitoring scheme for the Project and implemented as discussed in **ESMS Plans, Plan O**, *Environmental and Social Monitoring Plan.*

The RMGC Occupational Health and Safety Plan, and the Project Noise and Vibration Management Plan, Cultural Heritage Management Plan, Public Consultation and Disclosure Plan, and Environmental and Social Monitoring Plan are all key components of the Roşia Montană Project Environmental and Social Management Plan (**ESMS Plans, Plan A**). As such, all of these documents will be kept current and relevant over the life of the mining operation in accordance with the change control procedures referenced in the Roşia Montană Project Environmental and Social Management Plan.

[13] *Bulldozer Noise Control, U. S. Department of Labor, Mine Safety and Health Administration* (MSHA).

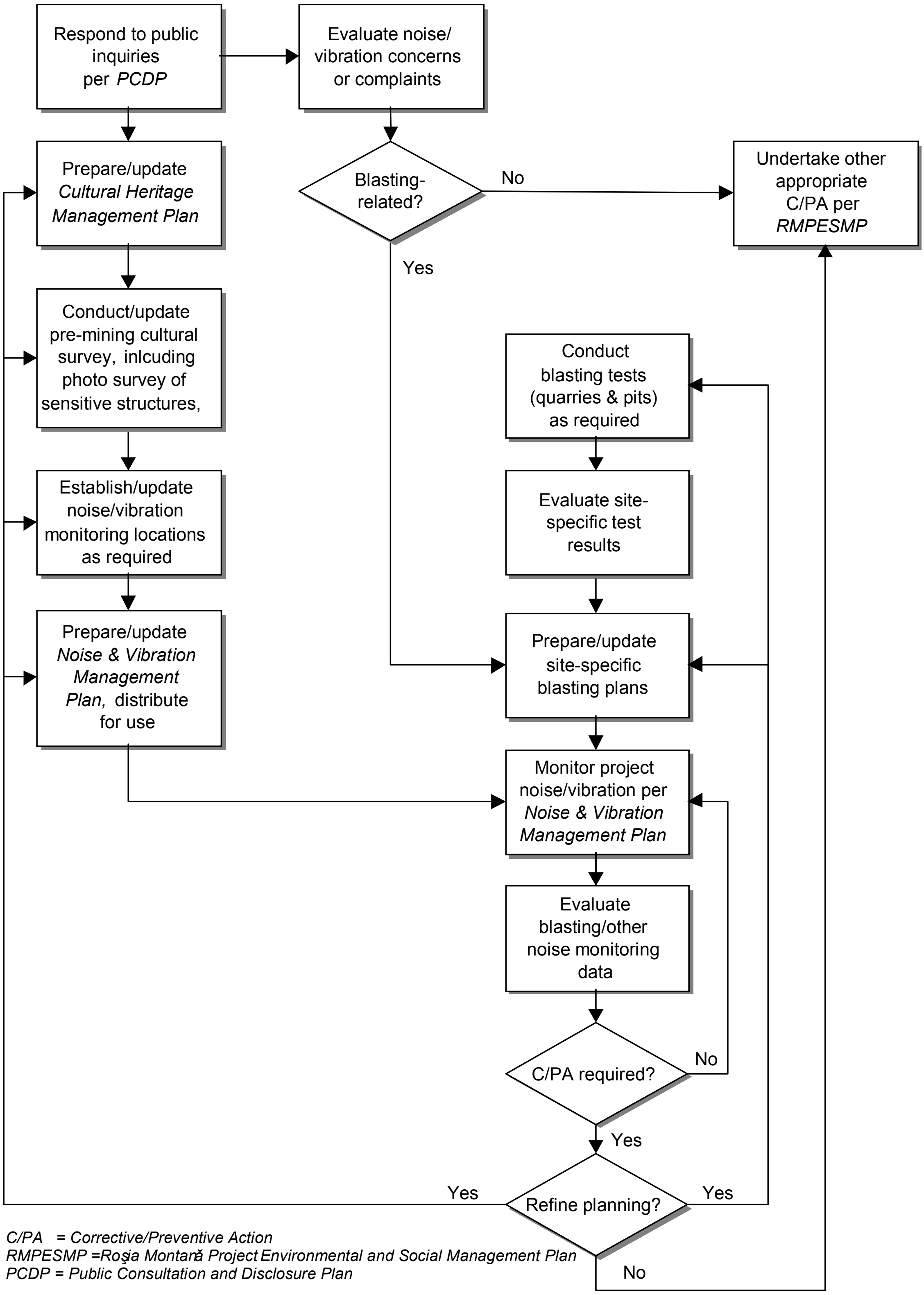
7.2 Mitigation Measures – General

As noted in **Table 4.3.1**, workplace noise and vibration considerations associated with the identified sources will be reflected in 1) the basic design of the mine, mine access and haul roads, the process plant and ancillary facilities; 2) the operation and maintenance of mining vehicles and equipment; 3) the development of the hearing protection programme requirements and other standard workplace health and safety procedures contained in the RMGC *Occupational Health and Safety Plan*; and 4) the development of millisecond-delay blasting plans tailored to individual rock types or ore body characteristics, as noted in the Project *Noise and Vibration Management Plan* (the first iteration of which is provided in **ESMS Plans, Plan E).**

The measures proposed for the mitigation of noise and vibration impacts associated with the Project consist of a combination of:

- ***engineered measures*** such as: implementation of millisecond delay blasting techniques; adjustment of stemming lengths; reducing the size of the blast/number of blastholes; adjustment of charge weights and delays; or minimising the proportion of high explosives used in relation to lower-energy ANFO blasting agents, in order to minimise airburst/flyrock impacts; acoustical insulation/isolation considerations in the process plant design; and installation of acoustical berms in critical locations and acoustical shielding devices for major equipment;

Figure 4.3.8: Noise and Vibration Management Process



C/PA = Corrective/Preventive Action
RMPESMP =Roşia Montană Project Environmental and Social Management Plan
PCDP = Public Consultation and Disclosure Plan

- implementation of ***institutional controls*** such as establishment of hearing protection zones, installation of signage, establishment and enforcement of vehicle speed limits, or use of appropriate personal protective equipment as noted in the hearing protection programme defined by the RMGC *Occupational Health and Safety Plan*;
- implementation of appropriate ***technical or procedural controls***, such as preventive maintenance programmes for major equipment, in order to keep acoustic emissions within normal operational limits;
- ***administrative controls***, including linkage of quarry- and pit-specific blasting plans with the noise and vibration monitoring feedback systems established under the *Noise and Vibration Management Plan* (**ESMS Plans, Plan E**); active engagement of the public and other external stakeholders in the identification and resolution of noise and vibration management issues, via the communications mechanisms established by the *Public Consultation and Disclosure Plan* (**ESMS Plans, Plan K**); and formal corrective and preventive action processes as described in the *Roşia Montană Project Environmental and Social Management Plan* (**ESMS Plans, Plan A**); and
- ***long-term monitoring of noise and vibration impacts*** to the workforce, to sensitive structures, and to human receptors outside the boundary of the industrial protection area/industrial area. This latter programme will include:
  - ***workplace noise and vibration monitoring*** in accordance with RMGC *Occupational Health and Safety Plan* requirements, in order to ensure that the hearing protection zones, signage, personal protective gear, and other institutional controls established in the process plant, pit operations areas, and other areas of the Project remain appropriate in consideration of actual measured values and the requirements of governing regulations; monitoring locations will be selected that are representative of the individuals most exposed to specific sources;
  - performance of photography- and physical mapping-based **pre-mining vibration damage/condition surveys of sensitive structures** identified in the Cultural Heritage Management Plan (**ESMS Plans, Plan N**), as described in the Noise Management Plan; and
  - ***monitoring of human receptors and vibration-sensitive structure external to the boundary of the industrial protection area;*** a series of noise and vibration monitoring locations will be established at or near the boundary of the industrial protection area and at structures or habitations within individual protected areas in order to determine the potential impact on residents of Roşia Montană, Abrud, and other nearby receptor communities. As previously noted, monitoring data will, at a minimum, be fed back into the refinement or adjustment of individual blasting plans. In addition, any complaints or questions related to noise and vibration will be evaluated and resolved via the communications procedures and corrective and preventive action processes define, respectively, in the *Public Consultation and Disclosure Plan* and *Roşia Montană Project Environmental and Social Management Plan.*

The overall selection of mitigative measures for this phase will be based on the results of the monitoring programme and the specific characteristics of the source and receptor(s). However, preliminary modelling suggests that significant noise and vibration profile improvements will be achievable with the institution of relatively simple mitigative measures. As an example, **Exhibit 4.3.10** illustrates the sort of improvements (drawn from the BAT options summary presented in **Table 4.3.17**) that may be achievable during the construction of the TMF and process plant, with the Sulei quarry in full operation. For illustration purposes, **Exhibit 4.3.10** compares Scenario A (the baseline condition represented in

Exhibit 4.3.3) to Scenario B, which represents the benefits of adding several straightforward mitigation measures to the baseline condition. These measures are listed as follows:

- **MITIGATION MEASURES (Scenario B, Exhibit 4.3.10)**

Area ID and Activity: Filling and raising of TMF Dam; assumes equipment/vehicles in use will be mitigated as follows:

- Temporary localised acoustical shielding applied around the ECM 470 work area (10 dB noise reduction assumed)
- O&K RH200 treated with engine enclosure, hydraulic pump enclosure, and improved exhaust silencer (10 dB noise reduction assumed)

Area ID and Activity: Filling and base build-up of processing plant pad (worst case); assumes that a 12m high earthen berm will be constructed along the western edge of the process plant site, between the plant site and the Project boundary

Area ID and Activity: Quarrying base rock for roadway build-up at Sulei Quarry [note: assumed to be on the near-side of the Sulei peak as a worst case orientation]; assumes that temporary and localised shielding will be applied around drill rig work areas (10 dB noise reduction assumed)

As may be seen in the in the example depicted in **Exhibit 4.3.10, Scenario B**, incorporation of these additional mitigative measures for selected acoustically energetic sources could potentially result in reduction in noise impacts to nearby receptors by approximately 5-10 dB(A).

7.2.1 Impact Mitigation Measures - Construction Phase - Romanian Consultant

It is clear that in the construction area of the two main roads 1 and 2, there will be higher short-term (up to a few hours) values, of 65-70 dB(A) near some residences, but the short time involved will not justify the adoption of complex mitigation measures **(Exhibits 4.3.1 and 4.3.2**).

“Source” actions, such as equipping the machinery with adequate noise absorption shields will lead to important reductions of 8-10 dB(A). Also, installation of 4-5 m high portable screens in the work area (height need to exceed the level of the acoustic action centres of the equipment sources) between the semi-mobile groups and the receptors, would reduce noise by 5 – 8 dB(A).

Activities conducted at the TMF and Sulei Quarry (**Exhibit 4.3.3.(** may generate noise levels above 50 dB(A) on a small area in Abrud and around the residences of Rosia Montana.

Strong action is required on the powerful noise sources, first involving “source actions” – drilling equipment screening with acoustic shields and noise absorbents to reduce the power levels by the expected attenuation (10 dBA) both at Sulei Quarry, and at the TMF.

The need was also revealed for the building of a berm at least 5 m high between Sulei Quarry and the central part of Rosia Montana, this being able to reduce the noise levels for the sensitive receptors of Rosia Montana by 5 – 8 dB(A). It is important that the noise screen should be as close to the source as possible, both for reduction efficiency and for economic reasons, as the protected area is larger the nearer the screen is to the source. In the area between Sulei Quarry and Rosia Montana, a natural obstacle (hill) was identified, which should act as an efficient noise screen.

Although the process plant equipment in the operational phase will be placed indoors, which will normally reduce outside noise levels by at least 30 dB(A), monitoring will allow decision on whether to build a screen or a perm between the plant and the neighbouring residences, as a useful measure in the construction phase.

Also, wherever possible, it will help to install screens in the receptor area, especially when the sources stretch over a larger area.

Exhibit **4.3.4** shows the estimated noise levels generated in the operation of La Paraul Porcului Quarry and the Building of the Cetate Water Catchment Dam. In regard to the activities at La Paraul Porcului Quarry, they will start at ground level, so that in the first stage the equipment will bi in the line of sight to the sensitive receptors nearby. “Source” action will be very helpful at this stage. Drilling equipment shielding is a must, as attenuation of at least 10 dB(A) will be required. Protection against quarry-related noise will be provided by the building of a berm by adequate stockpiling of materials as close to the quarry as possible, on the side of receptors D11 and D12.

7.3 Mitigation Measures – Construction Phase

As noted in **Table 4.3.1,** the mitigation measures that will be employed in the construction phase include a combination of engineered measures (such as those described in Section 4.3.7.2 and **Figure 4.3.10**), health and safety programme controls, technical/procedural controls; and continual monitoring and corrective/preventive action.

Construction and quarry blasting noise impacts to the workforce will be mitigated through the implementation of hearing protection programme procedures, use of personal protective equipment, and associated training programmes, in accordance with the RMGC *Occupational Health and Safety Plan*.

In addition to the acoustical shielding and noise-limitation measures described previously, impacts to both the workforce and local residents that are related to vehicle (and mobile equipment) engine and road noise will be mitigated by establishment and enforcement of speed limits and standard operating procedures for vehicle/equipment maintenance and operation, as well as encouragement of employee ridesharing and bus programmes. Standard operating procedures will also contain minimum requirements for engine silencer changeout and other noise-related maintenance items.

Transient nuisance impacts to receptors from quarry blasting and blasting test operations will also be mitigated through the implementation of modern, controlled, millisecond delay blasting methods. Such methods will be defined by quarry-specific blasting plans incorporating millisecond delay techniques to ensure maximum localised rock breakage, with minimal airburst and flyrock effects, and pre-planned energy levels that reflect the intrinsic strength of the quarried materials and the vibration tolerance of any nearby sensitive structures. With the millisecond delay method, blast initiation is accomplished by using lightweight non-electric (Nonel) detonating cord to carry the detonation from hole to hole. This light initiating cord is so small in diameter that it does not contribute significantly to noise. Two types of Nonel delays are typically used:

- surface delays are used to momentarily delay the detonation front along the surface initiating cord at millisecond intervals; and,
- downhole delays, located in the hole as part of the blast initiator, that momentarily delay the detonation of the booster (again by millisecond intervals).

Typically, large open pit hard rock mines may initiate blast sequences that contain 50 to 80 blast holes. However, during that sequence only a small number of holes are fired simultaneously. Ground motion away from the blast is a function of the separation distance and amount of explosives detonated simultaneously. When the firing sequence is properly delayed, only small amounts of explosives are detonated simultaneously. These multiple small blasts act as single unit without generating any more off-site ground motion than would be expected in an individual small blast.

When a millisecond delay blast is properly executed, an observer will see the ground rise and settle in a gentle wave pattern. As the wave propagates, multiple small explosions keep the rock breakage wave moving. Precise delays combined with a proper match of down hole explosive type and velocity to the rock mass will result in efficient breakage of the rock and greatly minimised potential for causing damage to surrounding structures. Determining the proper match of explosive to rock type, stemming lengths, charge weights and delays is critical, however, hence the need for conducting small-scale blasting tests and preparation of rock type- or ore body-specific blasting plans. The use of high explosives will be minimised, to the extent possible, by their use in appropriate combination with lower-energy ANFO blasting agents.

Quarry blasting will be limited to no more than one blast per quarry per workday. Blasting at night will be prohibited. Blasting will be discouraged and postponed where possible during unfavourable atmospheric conditions (e.g., still air, fog or haze, temperature inversions, steady downgradient winds towards receptor locations).

A comprehensive noise and vibration-monitoring programme will be implemented in accordance with the Project's *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan*. Monitoring will be conducted and corrective/preventive action will be initiated where necessary per *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan* requirements.

7.4 Mitigative Measures – Operations Phase

The mitigative measures that will be employed in the operations phase are also summarised in **Table 4.3.1** and likewise include a combination of engineered measures (such as those described in Section 4.3.7.2 and **Figure 4.3.10**), health and safety programme controls, technical/procedural controls; and a continual monitoring of potential impacts to local residents and sensitive structures. RMGC will employ an ANFO-based millisecond delay blast design that minimises airblast and flyrock, and maximises rock breakage with minimal ground motion. The blasting schedule will specifically prohibit overlapping/simultaneous blasts in multiple pits and quarries, more than one blast per pit or quarry per workday, or blasting at night, all of which will have the effect of reducing nuisance impacts to the external communities. To the extent possible, blasting will be conducted within a specific time window that is communicated to local communities via the mechanisms described in the *Public Consultation and Disclosure Plan*. Blasting plan effectiveness will be continually evaluated based on noise/vibration monitoring feedback, and blasting plans refined or re-optimised wherever required.

With regard to the process plant, standard operating procedures and schedules will be established requiring periodic routine maintenance of crushing, milling, and other major mechanical equipment items, in order to prevent vibration damage. Vibration dampening equipment mounting schemes, acoustically insulated workspaces, shrouding, baffles, insulation, and other noise/vibration control features will be appropriately integrated into the overall plant design. Use of centralised automated control systems will also minimise the need for workforce activity in high noise areas.

The comprehensive noise and vibration monitoring programme begun in the construction phase will continue be implemented in accordance with the *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan*. Local residents will be engaged in periodic noise/vibration surveys and continuing dialog maintained in accordance with the RMGC *Public Consultation and Disclosure Plan.* Monitoring will be conducted and corrective/ preventive action will be initiated where necessary per *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan* requirements.

7.5 Impact Mitigation Measures - Operations Phase - Romanian Consultant

Assessment of the active sources in the operational phase indicates as a main source **road traffic** between various locations on the industrial site, involving heavy vehicles of mechanical power more than 1005 kW and acoustic power level 118 dB(A), followed by **Process Plant activities,** the **TMF** and **Cârnic waste Rock Stockpile**, where the sources are ground level and "line of sight," while the third source category includes **stationary and semi-mobile pit equipment** and the **pit road traffic.**

Sensitive receptors to exceeded noise levels are revealed in the assessments for various situations in the years of the operational phase.

In reducing noise levels, the mitigation measures will be taken:

a) Source Actions:

- Purchase of new equipment, meeting the requirements of Directive 2000/14/EC.
- - Providing measures to reduce the acoustic power level ever since the equipment is commissioned. These measures include fitting the sources with noise absorbents and noise shields, in general for the engine and exhaust parts (where applicable) Consideration will be given to air circulation for equipment cooling and normal operation. Good practice may account for noise level reductions of about 10 dBA.

Source action will be in descending order of the noise levels they generate. Source classification in the order of mitigation measure implementation is as follows:

- Trucks of the Cat 785-type of acoustic power 118 dB(A), as they are widely used on the Project site and have high levels of acoustic power;
- Drilling machinery of high acoustic power and whistling-type noises, involving high degree of nuisance;
- Excavator type O&K RH200 of high acoustic power;
- Other sources, in the descending order of acoustic powers.

b) **Receptor Actions**

- For isolated receptors, it may be easier and more economic to protect them by screens, and noise insulation on the building.

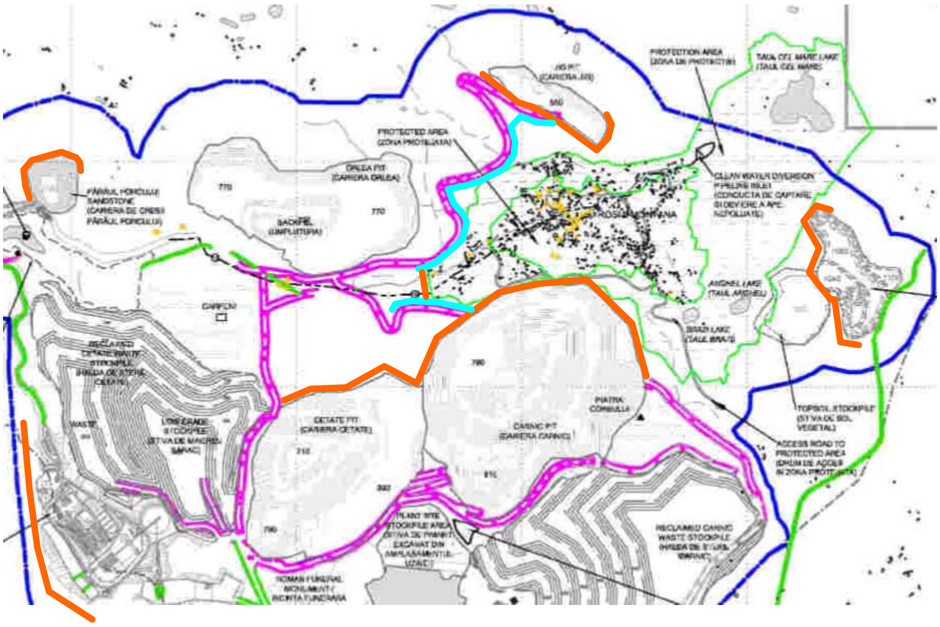
c) Actions along the source-receptor distance:

- - Building screens between the source and the receptors. Attenuation provided by a screen is proportionate to the closeness to the source or to the receptor;
- - Building of berms, especially near the high enough sources , so as to prevent the line of sight effect on the receptors;
- - Adopting a work strategy in the pits so as to have a screening wall at all times between the pit and the sensitive receptors;
- Building as many roads as possible in cuttings. This way the road is in a better position, and if roadside screens are installed, their efficiency is important.

The figure below shows the Project site and places where mitigation measures will be placed between the sources and the receptors, involving screens and berms (or screening walls resulting from the work technology).

Figure 4.3.9: Actions along the source-receptor distance:

- berms;
- screening walls resulting from pit operation practices;
- roadside screens



Berma, perete ecran (Inaltimea: minimum 5 m)

Ecran amplasat la bordura soselei (Inaltimea minima: 4 m)

Note that noise level mitigation measures at source will be implemented by the purchase of vehicles and machinery compliant to Directive 14/2000 and, where relevant, fitting them with insulating shields prior to commissioning. Noise mitigation screening will primarily involve existing natural objects as often as possible. Other noise mitigation measures (berm building, screen installation, receptor protection measures) will be implemented wherever necessary. Identification of such cases will be based on the results of the monitoring programme.

7.6 Mitigative Measures – Decommissioning/Closure Phase

As also noted in **Table 4.3.1**, the mitigative measures that will be employed in the decommissioning/closure phase are essentially identical to those presented for the construction phase in Section 4.3.7.3, except that no blasting operations are anticipated, and the overall scale of activity will be sharply reduced as closure activities are concluded. These mitigative measures include a combination of engineered measures, health and safety programme controls, technical/procedural controls; and continued monitoring of impacts to local residents and sensitive structures. The comprehensive noise and vibration monitoring programme begun in the construction phase will continue be implemented in accordance with the *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan*. Local residents will be engaged in periodic noise/vibration surveys and continuing dialog maintained in accordance with the *Public Consultation and Disclosure Plan.* Monitoring will be conducted and corrective/preventive action initiated where necessary per *Noise and Vibration Management Plan* and *Environmental and Social Monitoring Plan* requirements, up to the point that decommissioning/closure is deemed to be complete.

7.7 Impact Mitigation Measures – Decommissioning/Closure Phase - Romanian Consultant

The measures applied in the preceding phases (“source” measures or measures applied along the source-receptor distance) will largely determine a ready made situation in mitigating the noise from closure activities. It is clear that demolition and reclamation activities will involve semi-mobile and mobile sources, and a number of measures, other than those already in place, will be required, based on noise and vibrations monitoring at this stage. In most cases, the sources will have been already fitted for noise reduction, the screens will already have been built where required.

8 References

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[c] Source: Environment Australia, 1998: *Noise, Vibration and Airblast Control: Best Practice Environmental Management In Mining*, ISBN 0 642 54510 3

[d] Romanian Standard 12025/1-94: *Vibration effects produced by road traffic on buildings or building parts (Measurement methods)*

[e] Government of Romania, 1997: *Order 536/97 of the Ministry of Health for endorsement of the Norms and Hygiene and of the Recommendations on the Life Conditions of the Population* and *Government of Romania, 1988:* STAS 10009-88, Maximum Allowable Values of Noise Emissions for Road Traffic

[f] Romanian Standard 12025/2-94: *Building acoustics. Vibration effects on buildings or building parts (Permissible limits)*

[g] European Community, 2002: *Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)*

[h] European Community, 2003: *Noise at Work Directive 2003/10/EC; Official Journal of the EU no. L42, 15 February 2003, p38-44*

[i] European Community, 2000: *Directive 2000/14/EC of the European Parliament and the Council, of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environmental by equipment for use outdoors*

[j] European Community, 2005: Directive 2005/88/EC of the European Parliament and of the Council of 14 December 2005 Amending Directive 2000/14/EC on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors

[k] FHWA, 1978; FHWA Highway Traffic Noise Prediction Model; see *Federal Highway Administration Report Number FHWA-RD-77-108.* US Federal Highway Administration, Washington, D.C.

[l] U.S. Environmental Protection Agency (USEPA), 1971; "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances"; Washington, D.C