1 Noise Management Measures

In the quantification of noise emissions and simulation of noise levels as a result of the proposed project, it was calculated that ambient noise evaluation criteria for human receptors will be exceeded at potential NSRs at Vaal Oewer when mining commences near this residential area. 'Strong' reaction can be expected from members of the community within this impact area.

From a noise perspective, the project may proceed. It is recommended, however, that mitigation measures be implemented to ensure minimal impacts on the surrounding environment.

The mitigation measures should be implemented in a tiered approach where noise is first controlled at the source (Section 5.1). If measured noise levels at the closest NSR is not within acceptable levels, noise levels should be mitigated further by means of controlling the spread of noise (Section 5.2). If noise measurements after these two approached still do not meet acceptable levels, noise can be controlled at the NSR (Section 5.3).

However, even with the best mitigation, it is possible that people may hear the mining operations. Reverse alarms and other impulsive sounds do have a nuisance effect and people may complain. It should be noted that reverse alarms are exempt from an acoustical assessment due to Government Notice R154 of 1992 (Noise Control Regulations) – Clause 7 (1) – "the emission of sound is for the purposes of warning people of a dangerous situation".

1.1 Controlling Noise at the Source

1.1.1 Engineering and Operational Practices

For general activities, the following good engineering practice **should** be applied to **all project phases**:

- All diesel-powered equipment and plant vehicles should be kept at a high level of maintenance. This should particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.
- Equipment with lower sound power levels must be selected. Vendors should be required to guarantee optimised equipment design noise levels.
- In managing noise specifically related to truck and vehicle traffic, efforts **should** be directed at:
    - Minimising individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.
    - Maintain road surface regularly to avoid corrugations, potholes etc.
    - Avoid unnecessary idling times.
    - Minimising the need for trucks/equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur. Alternatives to the traditional reverse 'beeper' alarm such as a 'self-adjusting' or 'smart' alarm could be considered. These alarms include a mechanism to detect the local noise level and automatically adjust the output of the alarm is so that it is 5 to 10 dB above the noise level near the moving equipment. The promotional

material for some smart alarms does state that the ability to adjust the level of the alarm is of advantage to those sites 'with low ambient noise level' (Burgess & McCarty, 2009). Another alternative to the traditional reverse 'beeper' is the use of white-noise generators. The white-noise generators use a wide range of white-noise frequencies. This enables the listener to instantly locate where and what direction the sound is coming from. The broadband sound also gives workers wearing hearing protection devices (HPDs) and people with hearing difficulties a better chance of hearing the alarm. White-noise reverse alarms create a "ssh-ssh" sound which is gentle on the ear and dissipates quickly, meaning the alarm can only be heard in the danger zone.

    - Limiting traffic to hours to between 06:00 and 18:00. The mining operations for this project is proposing that the operations would be restricted to these hours. This should include other non-routine noisy activities such as construction, decommissioning, start-up and maintenance.
- A **noise complaints register must be kept**.

Additional points that should be considered:

- Good public relations are essential at all stages of the project. Surrounding receptors should be informed about the sound generated by proposed project operations. The information presented to stakeholders should be factual and should not set unrealistic expectations. Potential annoyance levels have been linked to visibility and audibility. Audibility is distinct from the sound level, because it depends on both the ambient sound level and character (spectral, tones and impulsivity) of noises generated at the mine. Psychoacoustics is even more complex, but it has been found that a negative attitude towards a development does influence the possibility of noise complaints.
- Community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. Mining projects offer an economic benefit to the greater population. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the project.
- The developer must implement a line of communication (i.e. a help line where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or problems developing. Problems of this nature can be corrected quickly, and it is in the mine's interest to do so.

1.1.2 Specifications and Equipment Design

As the site or activity is in close proximity to NSRs, equipment and methods to be employed should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.

1.1.3 Enclosures

As far as is practically possible, source of significant noise should be enclosed. The extent of enclosure will depend on the nature of the machine and their ventilation requirements. Generators, pumps and blowers are examples of such equipment.

It should be noted that the effectiveness of partial enclosures and screens can be reduced if used incorrectly, e.g. noise should be directed into a partial enclosure and not out of it, there should not be any reflecting surfaces such as parked vehicles opposite the open end of a noise enclosure.

1.1.4 Use and Siting of Equipment

Plant and equipment should be sited as far away from NSRs as possible. Also:

a) Machines used intermittently should be shut down between work periods or throttled down to a minimum and not left running unnecessarily. This will reduce noise and conserve energy.
b) Plants or equipment from which noise generated is known to be particularly directional, should be orientated so that the noise is directed away from NSRs.
c) Acoustic covers of engines and compressors should be kept closed when in use or idling.
d) Doors to pump houses, and generators should be kept closed at all times.
e) Construction materials such as beams should be lowered and not dropped.

1.1.5 Maintenance

Regular and effective maintenance of equipment and plants are essential to noise control. Increases in equipment noise are often indicative of eminent mechanical failure. Also, sound reducing equipment/materials can lose effectiveness before failure and can be identified by visual inspection.

1.2 Controlling the Spread of Noise

Naturally, if noise activities can be minimised or avoided, the amount of noise reaching NSRs will be reduced. Alternatively, noise reduction screens, barriers, or berms can be installed to reduce noise at NSRs.

1.2.1 Distance

To increase the distance between source and receiver is often the most effective method of controlling noise since, for a typical point source at ground level, a 6-dB decrease can be achieved with every doubling in distance. It is however conceded that it might not always be possible.

1.2.2 Screening

If noise control at the source and the use of distance between source and receiver is not possible, screening methods must be considered. The effectiveness of a noise barrier is dependent on its length, effective height, and position relative to the source and receiver as well as material of construction. To optimize the effect of screening, screens should be located close to either the source of the noise, or the receiver.

The careful placement of barriers such as screens or berms can significantly reduce noise impacts but may result in additional visual impacts. Although vegetation such as shrubs or trees may improve the visual impact of construction sites, it will not significantly reduce noise impacts and should not be considered as a control measure.

Earth berms can be built to provide screening for large scale earth moving operations and can be landscaped to become permanent features once construction is completed. Care should be taken when constructing earth berms since it may become a significant source dust.

1.3 Controlling Noise at the Receiver

Receiver noise control is mostly achieved through building design. Good hearing conditions are very important in especially institutional, business and educational buildings and adequate airborne sound insulation may necessary in areas of the development likely to be exposed to road and air traffic noise. In any building, there are many possible transmission paths of sound and in most cases part of the sound produced in a room is transmitted indirectly via flanking elements, e.g. side walls, windows, ceiling and floors into adjacent rooms or to the outside.

Since the outside walls of buildings have a relatively low weight in comparison with that of the floor and the ceiling, outside walls can be considered as the main flanking path. Windows are the most important item of flanking paths of outside walls owing to the high sound transmission coefficient of glass panes (Elmallawany, 1983).

Suitable engineering methods for sound insulation of buildings typically include the consideration of single or double glazed of windows for classrooms and acoustically absorbent building materials. The introduction of sealed multiple glazed windows and doorways will necessitate the installation of air conditioning units properly designed, placed and maintained so as to minimize noise associate with such sources.

1.4 Summary of Mitigation Techniques

Table 9 provides a summary of the general effectiveness of various mitigation techniques.

Table 1: A summary of general effectiveness of various mitigation techniques

Mitigation Technique	General Effectiveness	Monetary Costs	Conditions where feasible
Vehicle components	Fair	N/A	N/A
Operational factors	Fair	Low	Local roads/site
Engineering considerations	Good/excellent	Medium	New construction
Barriers	Excellent (5-15 dBA reduction)	Medium	Almost always
Earth Berms	Excellent (5-15 dBA reduction)	Low	Wide corridors
Buildings and other man-made structures	Good (up to 10 dBA reduction)	N/A	Requires local/site planning
Vegetative screening	Fair/average	Medium	Almost always
Sound Insulation	Average	Medium	Case by case

1.5 Monitoring

An environmental noise monitoring campaign should be conducted annually during the operational phase, at five potential locations (Figure 17). The locations are selected to coincide with the closest sensitive receptors as well as potential noise impact zones.

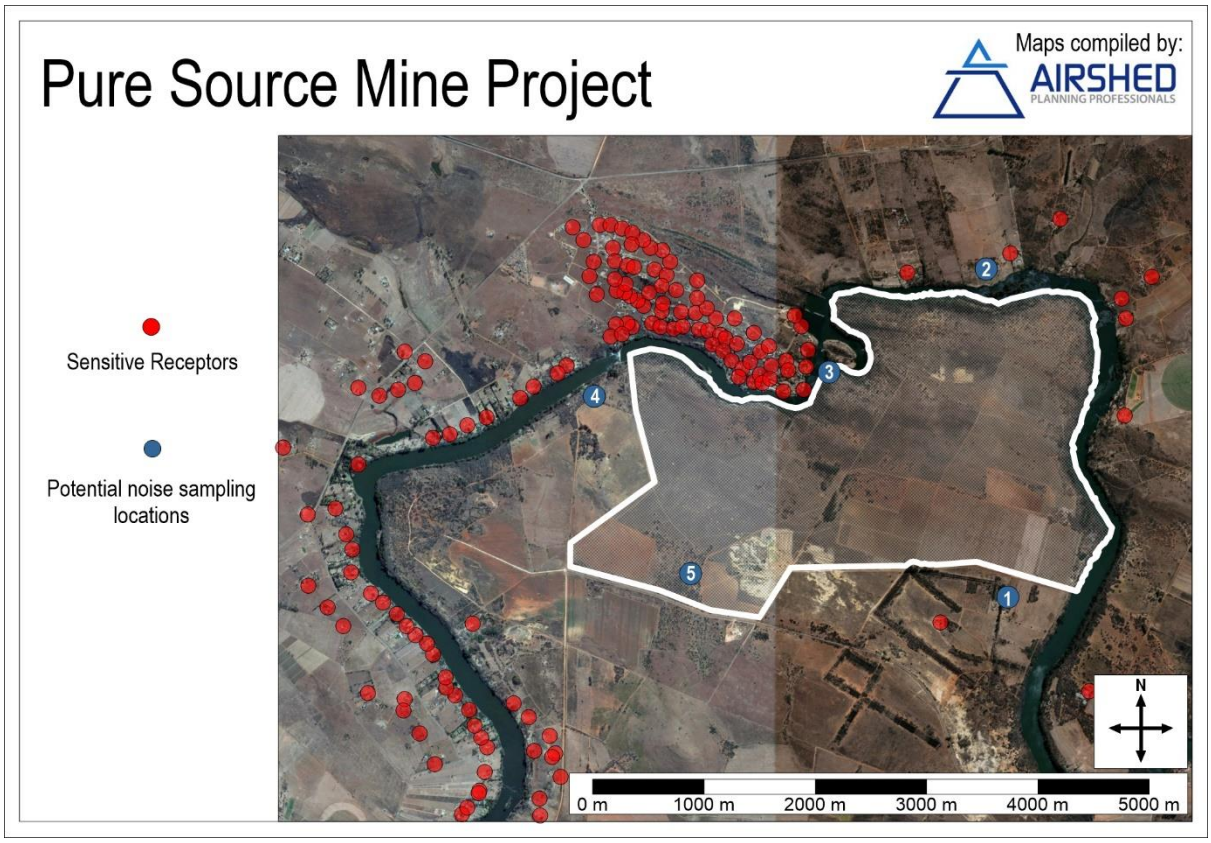

Figure 1: Proposed noise sampling locations

Also, In the event that noise related complaints are received short term (24-hour) ambient noise measurements should be conducted as part of investigating the complaints. The results of the measurements should be used to inform any follow up interventions.

The following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a trained specialist.
- Sampling should be carried out using a Type 1 SLM that meets all appropriate IEC standards and is subject to annual calibration by an accredited laboratory.
- The acoustic sensitivity of the SLM should be tested with a portable acoustic calibrator before and after each sampling session.
- Samples of at least 24 hours in duration and sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic environment should be taken.

- The following acoustic indices should be recoded and reported: L_{Aeq} (T), L_{Aleq} (T), statistical noise level L_{A90}, L_{AFmin} and L_{AFmax}, octave band or 3rd octave band frequency spectra.
- The SLM should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.
- Efforts should be made to ensure that measurements are not affected by the residual noise and extraneous influences, e.g. wind, electrical interference and any other non-acoustic interference, and that the instrument is operated under the conditions specified by the manufacturer. It is good practice to avoid conducting measurements when the wind speed is more than 5 m/s, while it is raining or when the ground is wet.
- A detailed log and record should be kept. Records should include site details, weather conditions during sampling and observations made regarding the acoustic environment of each site.

The investigation of complaints should include an investigation into equipment or machinery that likely results or resulted in noise levels annoying to the community. This could be achieved with source noise measurements.

1.6 Summary of Noise Management Plan

The targets for the noise management plan are provided in Table 10 with actions provided in Table 11.

Table 2: Noise Management Plan for the proposed project operations

No.	Mitigation Measures	Phase	Timeframe	Responsible party for implementation	Monitoring Party (frequency)	Target	Performance Indicators (Monitoring Tool)
A	Various management measures may be implemented including: controlling noise at source, controlling spread of noise, controlling noise at receiver. *It is recommend-ed that as a minimum, equipment be selected with lowest noise specifica-tions and where possible to enclose*	Operational Phase	Duration of operations	Applicant Environmental Manager	Environ-mental Manager (annually or when complaints are received)	IFC residential guidelines (55 dBA for day-time conditions	Sampled noise levels are with IFC residential guidelines at the closest noise sensitive receptors.

No.	Mitigation Measures	Phase	Timeframe	Responsible party for implementation	Monitoring Party (frequency)	Target	Performance Indicators (Monitoring Tool)
	noisy equipment. Mining operations should be restricted to day-time hours only.						
Noise Sampling							
B	Noise sampling be conducted at 5 sites annually.	Construction, operation and closure phases	10 to30-minute sample during the day. Sampling should be conducted annually during construction, operations and closure	Applicant Environmental Manager	Environ-mental Manager	Ensure compliance with IFC residential guidelines (55 dBA for day-time conditions	Type 1 SLM
C	Noise sampling be conducted at NSR in the event of a complaint.	Planning phase and proposed operational phase.	24-hour sample	Applicant Environmental Manager	Environ-mental Manager	Ensure compliance with IFC residential guidelines (55 dBA for day-time conditions	Type 1 SLM

Table 3: Action Plan

Phase	Management Action	Timeframe for Implementation	Responsible Party for Implementation	Responsible Party for Monitoring/Audit/Review
Construction Phase	Undertake day-time noise samples at 5 sampling locations or undertake noise sampling at NSRs in the event of a complaint	Annual sampling at 5 locations or when a complaint is received	Consultant	Consultant Environmental Manager (internal review)
Operational Phase	Undertake day-time noise samples at 5 sampling locations or undertake noise sampling at NSRs in the event of a complaint	Annual sampling at 5 locations or when a complaint is received	Consultant	Consultant Environmental Manager (internal review)
	Maintenance on equipment	Throughout operation	Environmental Manager	Environmental Manager (onsite monitoring)
Closure Phase	Undertake day-time noise samples at 5 sampling locations or undertake noise	Annual sampling at 5 locations or when a complaint is received	Consultant	Consultant Environmental Manager (internal review)

Phase	Management Action	Timeframe for Implementation	Responsible Party for Implementation	Responsible Party for Monitoring/Audit/Review
	sampling at NSRs in the event of a complaint			