Ntshovelo Mining Resources (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for

Vlakvarkfontein Extensions, East of Delmas, Mpumalanga

Study done for:

20 YEARS 1993 - 2013 Leaders in Environmental Management

ENVIRONMENTAL IMPACT EIMS MANAGEMENT SERVICES

Prepared by:

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE OF STUDY

Enviro-Acoustic Research CC was contracted by Environmental Impact Management Services to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the proposed development of the Vlakvarkfontein Extension, east of Delmas.

This report describes ambient sound levels in the area, potential worst-case noise rating levels and the potential noise impacts that the facility may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations. This report did not investigate vibrations and only briefly discusses blasting.

This study considered local regulations and both local and international guidelines, using the terms of reference (ToR) as proposed by SANS 10328:2008 to allow for a comprehensive Environmental Noise Impact Assessment report.

PROJECT DESCRIPTION

Ntshovelo Mining Resources (Pty) Ltd wish to extend their mining operations at their Vlakvarkfontein Colliery. Coal mining will be undertaken by the conventional opencast truck and shovel rollover method and will be opencast only. The coal will be hauled from the pit to the Run-of-Mine (ROM) stockpile area located on site.

BASELINE ASSESSMENT

The existing soundscape was assessed by means of sound measurements during a site visit in November 2017. A number of 10 minute measurements were taken over a five night-time period at two different locations.

Both measurement locations showed high elevated ambient sound levels, with natural noises (wind induced and faunal) playing a significant role in these high ambient sound levels. It is unknown how ambient sound levels will change during other seasons and the mine will benefit to define ambient sound levels during different seasons.

NOISE IMPACT FINDINGS AND MITIGATION MEASURES

This impact assessment used the noise emission characteristics of mining equipment as identified during a site visit, taking a precautionary approach to considering the worst-case scenarios.

Conceptual noise propagation models were developed for various scenarios as described in this report. The output of the modelling highlighted a potential for a noise impact of medium significance due to construction and operational activities.

While there is a risk of a noise impact, this impact can be mitigated and reduced, with the magnitude of the reduction depending on the options selected as well as how the operation is managed. The proposed project will not introduce potential fatal flaws in terms of acoustics. With the selection of the required mitigation options, projected noise levels can be managed and this project can be authorized.

NEED AND DESIRABILITY OF PROJECT – INCLUDING PROJECT ALTERNATIVES

The additional activities (worst-case evaluated) will raise the noise levels from the project during all phases of the project. The changes in ambient sound levels could be significant at night and the closest receptors may find the noises disturbing and unacceptable. Management and mitigation are

available to reduce the significance of the noise impact, but the mining activity will be audible and the closest receptors may still find it disturbing.

In terms of the waste disposal alternatives, the noise impact assessment considers the potential worst-case noise impact, with conceptual noise generating activities taking place close to the community living just north of the mining area. As can be seen from the noise contours, the development of waste disposal facilities close to the community could have a significant impact on the noise levels, especially if the activities take place at night. However, if a waste disposal deposit can be developed between the mining site and the community during the construction phase (during the day), this will assist in reducing operational noise levels as these structures will act as a noise barrier to a certain extent. All three waste disposal alternatives could pose a noise risk of similar significance (if located at the same distance from the community), although all three alternatives can be mitigated when considering the mitigation measures proposed.

The development of the mining project will however create employment as well as secondary business opportunities. It will generate a financial benefit on a regional to national scale by extracting a valuable mineral resource.

RECOMMENDATIONS AND CONCLUSIONS

While there is a risk of a noise impact, this impact can be mitigated and reduced, with the magnitude of the reduction depending on the options selected as well as how the operation is managed. The proposed project will not introduce potential fatal flaws in terms of acoustics. With the selection of the required mitigation options, projected noise levels can be managed and this project can be authorized.

CONTENTS OF THE SPECIALIST REPORT – CHECKLISTS

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	**Cross-reference in this report**
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	**Section 12**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Section 13**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 1.1**
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Sections 3.1 & 3.4**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	**Section 1.5**
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	**Section 3.4**
(g) an identification of any areas to be avoided, including buffers;	Not relevant and required. Noise contours modelled and illustrated in **Sections 7.1 & 7.3.**
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 6**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	**Sections 7** & **8**
(k) any mitigation measures for inclusion in the EMPr;	**Sections 9.3.2**
(l) any conditions for inclusion in the environmental authorisation;	**Sections 9.3.1**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Section 10**
(n) a reasoned opinion— i. as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	i. **Section 11** ii. **Sections 9.1 & 9.2**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto;	No comments received

and	
(p) any other information requested by the competent authority	Nothing requested

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 3 - Environmental Impact Assessment Process	**Cross-reference in this report**
Describe any policies or legislation relevant to your field that the applicant will need to comply with.	**Section 2**, specifically **section 2.2.1**
Comment on need/desirability of the proposal in terms your field and in terms of the proposal's location.	**Section 8.4.2**
Determine the-- (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and (ii) degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources, and (cc) can be avoided, managed or mitigated;	**Sections 8.1, 8.2 & 8.3**
Determine what the most ideal location within the site for the activity is in terms of your field.	**Not relevant, the location is determined by the location of the mineral resource**
Identify suitable measures to avoid, manage or mitigate identified impacts.	(i) **planning, design and pre-construction**; Section **8.1** (iii) **construction**; Section **8.1** (iv) **operation;** Section **8.2** (v) **decommissioning, closure & rehabilitation**. Section **8.3**
Identify residual risks that need to be managed and monitored.	There will be no residual risks after closure.
Include a concluding statement indicating a preferred alternative in terms of your field.	No alternative available.

This report should be sited as:
De Jager, M. (2017): "*Environmental Noise Impact Assessment for Vlakvarkfontein Extensions East of Delmas*". Enviro-Acoustic Research CC, Pretoria

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Report no:
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GLOSSARY OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AZSL	Acceptable Zone Sound Level (Rating Level)
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act (Act 78 of 1989)
EMP	Environmental Management Plan
FEL	Front End Loader
i.e.	that is
IFC	International Finance Corporation
km	kilometres
LHD	Load haul dumper
m	Meters (measurement of distance)
m^2	Square meter
m^3	Cubic meter
mamsl	Meters above mean sea level
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
SABS	South African Bureau of Standards
SANS	South African National Standards
TLB	Tip Load Bucket
UTM	Universal Transverse Mercator
WHO	World Health Organisation

1 INTRODUCTION

1.1 Introduction and Purpose

Enviro-Acoustic Research (EARES) was contracted by Environmental Impact Management Services (Pty) Ltd (the consultant) to determine the potential noise impact on the surrounding environment due to proposed extensions at Vlakvarkfontein Colliery east Delmas, Mpumalanga Province (see **Figure 1-1**).

This report describes ambient sound measurements collected in the area, calculated noise rating levels and the potential noise impact that the operation may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations. This report did not investigate vibrations and only briefly considers blasting.

This study considered local regulations and both local and international guidelines, using the terms of reference as proposed by SANS 10328:2008 to allow for a comprehensive Environmental Noise Impact Assessment.

1.2 Brief Project Description

Ntshovelo Mining Resources (Pty) Ltd wish to extend their mining operations at their Vlakvarkfontein Colliery. Coal mining will be undertaken by the conventional opencast truck and shovel rollover method and will be opencast only. The coal will be hauled from the pit to the Run-of-Mine (ROM) stockpile area located on site.

Key, noise generating infrastructure planned includes:

- Opencast mining pit;
- Various dumps (overburden and discard) and stockpiles (topsoil);
- A new coal processing facility;
- Haul roads from pit to plant;
- Haul roads inside mining area to mine access point;
- ROM Stockpile Area; and
- Other surface infrastructure (office, storage facilities, weigh bridges, new PCD dam, water management).

The Environmental Noise Impact Assessment also assesses a number of process alternatives, including:

- The stockpiling of filter cake (fines) for use as non-select product (Alternative P2a) versus the disposal (Alternative P2b) of this filter cake.
- The disposal of carboniferous wastes (wash plant waste rock and possibly filter cake) to pit (Alternative P3d) versus the disposal to a surface waste disposal facility located on old rehabilitated mine area (Alternative P3a) versus the disposal to a surface waste disposal facility located on un-mined area (Alternative P3b).
- The Pump-treat-discharge (Alternative P4a) of mine water versus the Pump-store -treat-discharge (Alternative P4b) of this water.

1.3 Study Area

The mine is located approximately 20 km east of Delmas (see **Figure 1-1**), Mpumalanga. The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

Figure 1-1: Site map indicating the regional locality of the proposed eMakhazeni Project

1.3.1 Topography

ENPAT[1] (1998) describes the topography as *"plains and pans"* , while Musina L. & Rutherford (The vegetation of South Africa, Lesotho and Swaziland)[2] delineates the area as "moderately undulating plains, including some low hills and pan depressions". The project is situated at approximately 1,550 meters above sea level (mamsl).

The local area is relatively flat and there are little natural features that could act as noise barriers considering practical distances at which sound propagates.

1.3.2 Surrounding Land Use

The area in the vicinity of the proposed development is agriculture and mining, currently classified as *cultivated: temporary – commercial dryland and mines and quarries"* with mining operations and crop cultivations featuring the bulk of the land use. There is an informal settlement just north of the project area with a few scattered farm dwellings/communities in the vicinity.

1.3.3 Roads

The most important road (in terms of calculable acoustics near a receptors dwelling) is the class 1 N12 and R555 roads. The N12 is too far from the project site to influence the soundscape at the site. The R555 pass the project site around 700m to the north and impacts on the ambient sound levels up to 500m from this road (at night, less during the day), with traffic being audible up to 1000m at night (see NSDs 11 – 15, **Figure 1-2**).

Excluding the roads used by the various mines in the areas, smaller unpaved roads exist but they roads generally do not carry sufficient traffic to warrant considering their contribution to the ambient soundscape (even though these roads to contribute to single events).

1.3.4 Residential areas

Excluding farm dwellings (and associated worker communities), there are no formal residential areas within 2,000 m from the proposed mining activities. There are a number of farm dwellings in the area (also see **Figure 1-2**) with an informal residential settlement just north of the project area.

1.3.5 Other industrial Activities – Railway line

There is a railway line running parallel with the R555 (just south of the R555), carrying a number of trains per day. While passing trains will result in increased noise levels during passing, total volumes over a 24 hour period is low and the noise contribution from this source will not be considered.

1.3.6 Ground conditions and vegetation

The area falls within the Grassland biome, with the vegetation type being Turf Highveld[3] (Themeda Veld according to ENPATS). The mean annual evaporation ranges between 2000 - 2200 mm per annum, while mean annual precipitation is approximately 600 - 700 mm per annum[4]. The natural environment has been significantly altered by agricultural activities (as well as mining).

Taking into consideration available information it is the opinion of the author that the ground surface is sufficiently covered to assume 50% hard ground conditions for modelling purposes. It should be

[1] Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "*Environmental Potential Atlas for South Africa"*, Pretoria, 1998.
[2] Musina L. & Rutherford." The vegetation of South Africa, Lesotho and Swaziland". Strelitzia 19, South African National Biodiversity Institute, Pretoria. 2006.
[3] Musina L. & Rutherford." The vegetation of South Africa, Lesotho and Swaziland". Strelitzia 19, South African National Biodiversity Institute, Pretoria. 2006.
[4] South African Water Research Commission, "*Water Resources of South Africa 2005 (WR2005).* WRC Report No.: K5/1491", South Africa: WRC Publications, 2009.

noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

1.3.7 Existing Ambient Sound Levels

Onsite measurements and the existing soundscape are discussed in more detail in **Section 3**.

1.4 POTENTIAL NOISE-SENSITIVE RECEPTORS (DEVELOPMENTS) AND NO-GO AREAS

Potentially sensitive receptors, also known as noise-sensitive developments (NSDs) were identified using Google Earth®. This was supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from the measurement of ambient sound levels was to confirm the presence of derelict or abandoned dwellings that could possibly be seen as sensitive receptors, small dwellings that could not be identified on the aerial image and dwellings that might have been constructed after the date of the aerial photograph. The status of the buildings needed to be established as well.

Potential receptors, within approximately 1,000 m in and around the proposed project were identified (presented in **Figure 1-2**). It should be noted that, if the project proceeds, some of the receptors must be relocated as they reside within the direct footprint of the mining areas.

1.5 TERMS OF REFERENCE

A noise impact assessment must be completed for the following reasons:

- If there are potential noise-sensitive receptors staying within 2,000m from any wind turbine (SANS 10328:2008)
- It is a controlled activity in terms of the NEMA regulations and a ENIA is required, because:
    - It may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice 579 of 2010; and
- It is generally required by the local or district authority as part of the environmental authorization or planning approval in terms of Regulation 2(d) of GN R154 of 1992.

In addition, Appendix 6 of GN 326 of December 2014 (Gov. Gaz. 38282), issued in terms of the National Environmental Management Act, No. 107 of 1998 also defines minimum information requirements for specialist reports.

The document that addresses the issues concerning environmental noise in South Africa is SANS 10103:2008, which was revised and brought in line with the guidelines of the World Health Organisation (WHO) during 2006 - 2008. It provides the maximum average ambient noise levels during the day and night to which different types of developments indoors may be exposed.

In addition, the South African National Standard (SANS) 10328:2008 (Edition 2) specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for Scoping purposes. These minimum requirements are:

1. The purpose of the investigation;
2. A brief description of the planned development or the changes that are being considered;
3. A brief description of the existing environment;
4. The identification of the noise sources that may affect the particular development, together with their respective estimated sound pressure levels or sound power levels (or both);

5. The identified noise sources that were not taken into account and the reasons why they were not investigated;
6. The identified noise-sensitive developments and the estimated impact on them;
7. Any assumptions made with regard to the estimated values used;
8. An explanation, either by a brief description or by reference, of the methods that were used to estimate the existing and predicted rating levels;
9. The location of the measurement or calculation points, i.e. a description, sketch or map;
10. Estimation of the environmental noise impact;
11. Alternatives that were considered and the results of those that were investigated;
12. A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation;
13. A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them;
14. Conclusions that were reached;
15. Recommendations, i.e. if there could be a significant impact, or if more information is needed, a recommendation that an environmental noise impact assessment be conducted; and
16. If remedial measures will provide an acceptable solution, which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after a certain time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority.

Figure 1-2: Aerial image indicating potentially noise-sensitive receptors

2 LEGAL CONTEXT, POLICIES AND GUIDELINES

2.1 THE REPUBLIC OF SOUTH AFRICA CONSTITUTION ACT ("THE CONSTITUTION")

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate under the particular circumstances. The subjectivity of this approach can be problematic, which has led to the development of noise standards (see **Section 2.5**).

"Noise pollution" is specifically included in Part B of Schedule 5 of the Constitution, which means that noise pollution control is a local authority competence, provided that the local authority concerned has the capacity to carry out this function.

2.2 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. See also **section 2.2.1**.

2.2.1 Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the national Noise Control Regulations (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Gauteng and Western Cape provinces but not in Mpumalanga.

2.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998)

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures which may be regarded as reasonable. They include the following measures:

1. to investigate, assess and evaluate the impact on the environment;
2. to inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;
3. to cease, modify or control any act, activity or process causing the pollution or degradation;
4. to contain or prevent the movement of the pollution or degradation;
5. to eliminate any source of the pollution or degradation; and
6. to remedy the effects of the pollution or degradation.

2.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT (ACT 39 OF 2004)

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of2004) makes provision for:

(1) the Minister to prescribe essential national noise standards -
  (a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or
  (b) for determining –
    (i) a definition of noise
    (ii) the maximum levels of noise
(2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

This section of the Act has been promulgated, but no such standards have yet been issued. Draft regulations have however, been promulgated for adoption by Local Authorities.

An atmospheric emission licence issued in terms of Section 22 may contain conditions in terms of noise. This, however, is unlikely to be relevant to the mine as no atmospheric emissions are expected to take place.

2.4.1 Model Air Quality Management By-law for adoption and adaptation by Municipalities (GN 579 of 2010)

Model Air Quality Management By-Laws for adoption and adaptation by municipalities was published by the Department of Water and Environmental Affairs in the Government Gazette of 2 July 2010 as Government Notice 579 of 2010.

The main aim of the model air quality management by-law is to assist municipalities in the development of their air quality management by-law within their jurisdictions. It is also the aim of the model by-law to ensure uniformity across the country when dealing with air quality management challenges. Therefore, the model by-law is developed to be generic in order to deal with most of the air quality management challenges. With Noise Control being covered under the Air Quality Act (Act 39 of 2004), noise is also managed in a separate section under this Government Notice.

- **IT IS NOT** the aim of the model by-law to have legal force and effect on municipalities when published in the Gazette; and
- **IT IS NOT** the aim of the model by-law to impose the by-law on municipalities.

Therefore, a municipality will have to follow the legal process as set out in the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000) when adopting and adapting the model by-law to its local jurisdictions.

2.5 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from mines, industry and roads. They are:

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004. 'Calculating and predicting road traffic noise';
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method';
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful *per se.*

2.6 NATIONAL TRANSPORT POLICY (SEPTEMBER 1996)

The White Paper sets the vision for transport in South Africa that provides for *safe, reliable, effective, efficient and fully integrated transport operations and infrastructure which….. are environmentally and economically sustainable*. The White Paper further states that "*the provision of transportation infrastructure and the operation of the transportation system have the potential for causing damage to the physical and social environment, inter alia, through atmospheric and noise pollution, ecological damage and severance. … The Department of Transport is committed to an integrated environmental management approach in the provision of transport*". It is also stated that "*As part of the overall long-term vision for the South African transport system, transport infrastructure will, inter alia, be structured to ensure environmental sustainability and internationally accepted standards*". One of the strategic objectives for transport infrastructure to achieve this vision is to promote environmental protection and resource conservation.

2.7 INTERNATIONAL GUIDELINES

While a number of international guidelines and standards exist, those selected below are used by numerous countries for environmental noise management.

2.7.1 Guidelines for Community Noise (WHO, 1999)

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO- expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled "Community Noise" that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments.

Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.

The document uses the L_{Aeq} and $L_{A,max}$ noise descriptors to define noise levels. It should be noted that a follow-up document focusing on Night-time Noise Guidelines for Europe (WHO, 2009).

2.7.2 Night Noise Guidelines for Europe (WHO, 2009)

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the World Health Organization has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe. Rather than a maximum of 30 dB inside at night (which equals 45-50 dB max outside), the WHO now recommends a maximum year-round outside night-time noise average of 40 db to avoid sleep disturbance and its related health effects. The report notes that only below 30 dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40 dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the* *effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB, "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

The 184-page report offers a comprehensive overview of research into the various effects of noise on sleep quality and health (including the health effects of non-waking sleep arousal), and is recommended reading for anyone working with noise issues. The use of an outdoor noise standard is in part designed to acknowledge that people do prefer to leave windows open when sleeping, though the year-long average may be difficult to obtain (it would require longer-term sound monitoring than is usually budgeted for by either industry or neighbourhood groups).

While recommending the use of the average level, the report notes that some instantaneous effects occur in relation to specific maximum noise levels, but that the health effects of these "cannot be easily established."

2.7.3 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. The banks chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). 67 financial institutions (October 2009) have adopted the Equator Principles, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

2.7.4 IFC: General EHS Guidelines – Environmental Noise Management

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principle.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source.

It goes as far as to proposed methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment casing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas ;

- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 2-1**) as well as highlighting the certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. This criterion will effectively sterilize large areas of any development. It is, therefore, the considered opinion that this criterion was introduced to address cases where the existing ambient noise level is already at, or in excess of the recommended limits.

Table 2-1: IFC Table .7.1-Noise Level Guidelines

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The document uses the $L_{Aeq,1\ hr}$ noise descriptors to define noise levels. It does not determine the detection period, but refers to the IEC standards, which requires the fast detector setting on the Sound Level Meter during measurements for Europe.

3 CURRENT ENVIRONMENTAL SOUND CHARACTER

3.1 EFFECT OF SEASON ON SOUND LEVELS

Natural sounds are a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises such as wind flowing through vegetation increasing as wind speed increase. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation generated noise. In addition, factors such as the season (e.g. dry or no leaves versus green leaves), the type of vegetation (e.g. grass, conifers, deciduous), the vegetation density and the total vegetation surface all determine both the sound level as well as spectral characteristics.

Ambient sound levels are significantly affected by the area where the sound measurement location is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and even increased wind speeds have an insignificant to massive impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings) however are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication during the warmer spring and summer months as various species communicate in an effort to find mates; and
- Seasonal changes in weather patterns, mainly wind (also see **section 3.2**).

For environmental noise, weather plays an important role; the greater the separation distance, the greater the influence of the weather conditions; so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible.

Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the following sections.

3.1.1 Effect of wind on sound propagation

Wind alters sound propagation by the mechanism of refraction; that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high.

Over short distances, wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e. less than 3 – 5 m/s.

3.1.2 Effect of temperature on sound propagation

On a typical sunny afternoon, air is warmest near the ground and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, resulting in cooler temperatures near the ground. This condition, often referred to is a temperature inversion will cause sound to bend downward toward the ground and results in louder noise levels at the listener position. Like wind gradients, temperature gradients can influence sound propagation over long distances and further complicate measurements.

Generally sound propagate better at lower temperatures (down to 10°C), and with everything being equal, a decrease in temperature from 32°C to 10°C would decrease the sound level at a listener 600 m away by 3 dB (at 1,000 Hz).

3.1.3 Effect of humidity on sound propagation

The effect of humidity on sound propagation is quite complex, but effectively relates how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by 3 dB (at 1,000 Hz).

3.2 EFFECT OF WIND SPEEDS ON VEGETATION AND SOUND LEVELS

Wind speed is a determining factor for sound levels at most rural locations. With no wind, there is little vegetation movement that could generate noises, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speeds on sound levels depends on the vegetation type (deciduous versus connivers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes the effect of faunal communication as vegetation may create suitable habitats and food sources.

3.3 INFLUENCE OF WIND ON NOISE LIMITS

Current local regulations and standards do not consider changing ambient (background) sound levels due to natural events such as can be found near the coast or areas where wind-induced noises are prevalent. This is unfeasible with wind energy facilities as these facilities will only operate when the wind is blowing. It is therefore important that the contribution of wind-induced noises be considered when determining the potential noise impact from such as a facility. Care should be taken when taking this approach due to other factors that complicate noise propagation from wind turbines.

While the total ambient sound levels are of importance, the spectral characteristics also determine the likelihood that someone will hear external noises that may or may not be similar in spectral characteristics to that of the vegetation that created the noise. Bolin (2006) did investigate spectral characteristics and determined that annoyance might occur at levels where noise generated by wind turbine noise exceeds natural ambient sounds with 3 dB or more.

Low frequency noises can also be associated with some wind turbines. Separating the potential low frequency noise from wind turbines from that generated by natural sources as well as other anthropogenic sources can and will be a challenge.

There are a number of factors that determine how ambient sound levels close to a dwelling (or the low-frequency noise levels inside the house) might differ from the ambient sound levels further away (or even at another dwelling in the area), including:

- Type of activities taking place in the vicinity of the dwelling;
- Equipment being used near the dwelling, especially equipment such as water pumps, compressors and air conditioners;
- Whether there are any windmills (*"windpompe"*) close to the dwelling as well as their general maintenance condition;
- Type of trees around dwelling (conifers vs. broad-leaved trees, habitat that it provides to birds, food that it may provide to birds);

- The number, type and distance between the dwelling (measuring point) and trees. This is especially relevant when the trees are directly against the house (where the branches can touch the roof);
- Distance to large infrastructural developments, including roads, railroads and even large diameter pipelines;
- Distances to other noise sources, whether anthropogenic or natural (such as the ocean or running water);
- The material used in the construction of the dwelling;
- The design of the building, including layout and number of openings;
- How well the dwelling is maintained; and
- The type and how many farm animals are in the vicinity of the dwelling.

3.4 AMBIENT SOUND LEVEL AND CHARACTER MEASUREMENTS

Ambient (background) noise levels were measured at over a four night-time period from 13 – 17 November 2017 at two locations in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

Additional, short-term measurements were collected on and around the project site to augment the measurement data. The sound measurement locations are illustrated in **Figure 3-1** as blue squares. These measurements were used to define the sound power levels of the mining equipment as well as to assist in checking the accuracy of the noise propagation model.

Sound level measuring equipment settings conform to specifications listed in SANS 10103 (South African Guidelines). The sound level measuring equipment was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA.

Figure 3-1: Localities where ambient sound levels were measured (as well as exisint noise levels)

3.4.1 Ambient Sound Measurements at VVFASLLT01

The microphone was deployed close to the office with a direct line of sight to the R555. There were some trees within 10m of the microphone that increased wind-induced noises during windy periods. Photos of the measurement location are presented in **Appendix B**. Sounds heard onsite are described in the following table.

Table 3-1: Noises/sounds heard during site visits at receptor VVFASLLT01

Magnitude Scale Code: Barely Audible / Audible / Dominating	Ambient Sound Character – Sounds of significance heard onsite
	Faunal and Natural
	Birds audible and dominant at times. Wind induced noises at times.
	Residential and other Anthropogenic
	Air conditioners operating in the area. The site manager confirmed that they are switched off at night.
	Industries, Commercial and Road Traffic
	Passing traffic clearly audible during event. Spraying of a trailing in the workshop area (only during deployment of microphone). Impulsive noises from workshop area at times. Noises from the mine not audible.

Excluding blasting and passing road trucks, mining noises were not raised as a concern.

Table 3-2: Equipment used to gather data at VVFASLLT01

Equipment	Model	Serial no	Calibration
SLM	SVAN 977	34160	February 2017
Microphone	ACO Pacific 7052E	54645	February 2017
Calibrator	Quest CA-22	J 2080094	July 2017
Weather Station	WH3081PC	-	-

- Microphone fitted with the appropriate windshield.

Impulse equivalent sound levels (South African legislation): illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-3** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on with **Table 3-3** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-3** and defined in **Table 3-3**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-3** and illustrated in **Figure 3-3**.

Table 3-3: Sound levels considering various sound level descriptors at VVFASLLT01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	59	56	44	-	-
Night arithmetic average	-	56	53	42	-	-
Day minimum	-	48	46	-	31	-
Day maximum	116	90	77	-	-	-
Night minimum	-	37	36	-	30	-
Night maximum	115	89	78	-	-	-
Day 1 equivalent	-	69	63	-	-	Afternoon and evening only
Night 1 Equivalent	-	64	57	-	-	8 hour night equivalent average
Day 2 equivalent	-	61	59	-	-	16 hour day equivalent average
Night 2 Equivalent	-	73	62	-	-	8 hour night equivalent average
Day 3 equivalent	-	62	58	-	-	16 hour day equivalent average
Night 3 Equivalent	-	54	52	-	-	8 hour night equivalent average
Day 4 equivalent	-	64	62	-	-	16 hour day equivalent average
Night 4 Equivalent	-	55	53	-	-	8 hour night equivalent average
Day 5 equivalent	-	70	59	-	-	Morning only

The statistical data ($L_{A90,f}$) indicate a location with significantly elevated noise levels both day and night, even though L_{Amin} data indicate a location with potential to become quiet. L_{Amax} levels exceeded 65 dBA during most of the night-time measurements. When sound events occur at night where the noise level exceeds 65 dBA, this may disturb the sleep of people. Based on sounds heard onsite this likely relates to noises from traffic on the R555 passing the measurement area. Considering the character of the area, sounds heard as well as the average $L_{Aeq,i}$ and $L_{Aeq,f}$ values, the area can be considered noisy with sound levels typical of a **urban (with workshops, main roads and business premises) to industrial** noise districts (SANS 10103:2008 – see **Table 5-1** - zone sound level or the equivalent continuous rating level. Ambient sound levels are summarised and grouped as can be expected for a typical noise district (**Figure 3-4** and **Figure 3-5**).

Third octaves were measured and are displayed in the following figures. While not evident considering the sound level data, spectral data indicated that wind-induced noises had a significant impact on a few of the measurements.

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relative smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies. People generally do not hear these frequencies unless very quiet due to the low response of the ear to these low frequencies. Sounds from wind-induced noises generally have significant acoustic energy in this frequency range (normally identified by a smooth curve).

Both day- and night-time data indicated various noises in this frequency band with no specific character (various noise sources). There are different noise sources with significant acoustic energy in this frequency band.

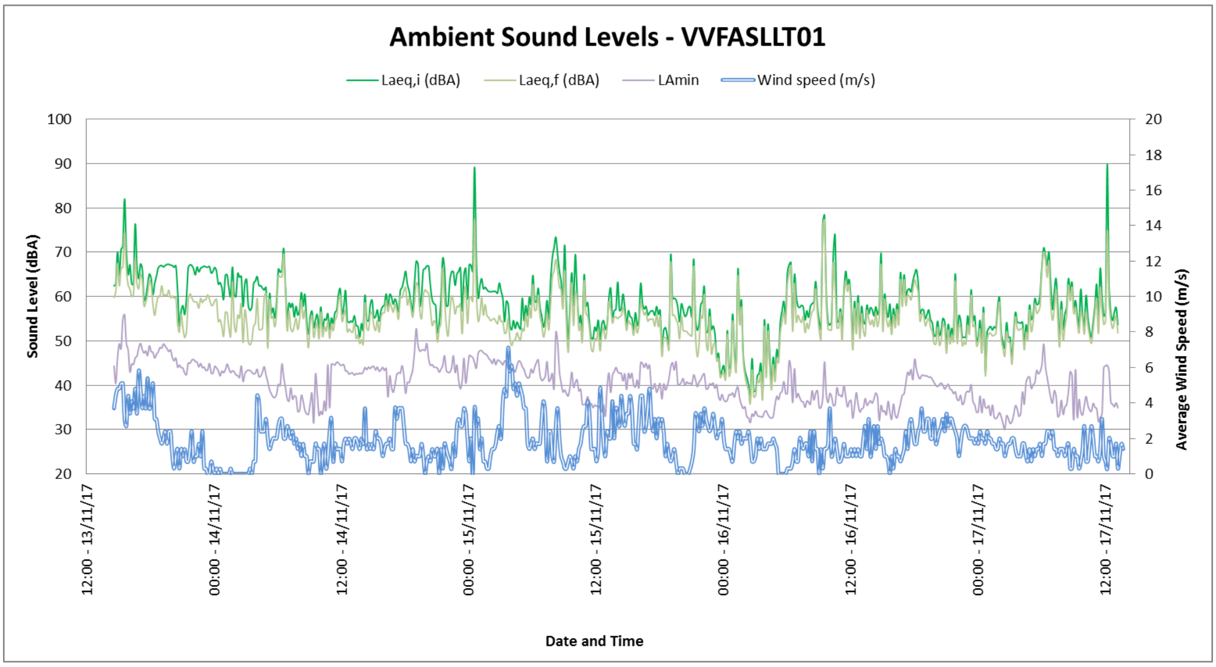

Figure 3-2: Ambient Sound Levels at VVFASLLT01

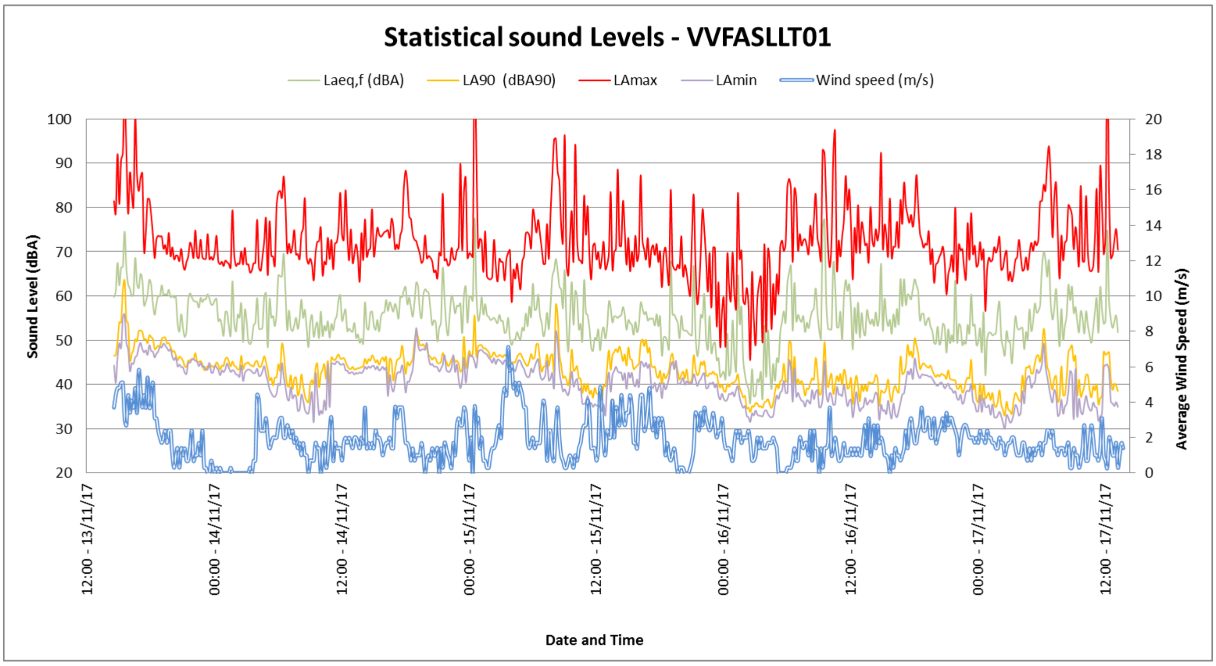

Figure 3-3: Maximum, minimum and statistical values at VVFASLLT01

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally peaking in 630 – 1,600 Hz range (depending on vehicular speed and road characteristics).

Daytime measurements showed numerous different and significant sounds, likely related to traffic on the R555, due to the significant acoustic energy in the 500 – 2,000 Hz frequency range. Wind-induced noise may have assisted in smoothing out the frequency curves, hiding other sounds that may have been visible (i.t.o. spectral signatures). Night-time measurements also indicate a noise source with a peak at 1,600Hz, although, at an acoustic energy level of 30 – 35 dB, this sound would have been masked most of the time.

<u>Higher frequency (2,000 Hz upwards)</u> – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc.

Early morning, evening and night-time measurements show acoustic energy in the 3,150 - 4,000 Hz, most likely relating to bird communication.

Compliance with international and local guidelines: While measured ambient sound levels were higher, considering the developmental character of the area, the acceptable zone rating level would be typical of a **sub-urban area** (40 dBA at night and 50 dBA during the day) as defined in SANS 10103:2008. Mining activities (calculated noise levels should not change these proposed noise levels with more than 7 dBA).

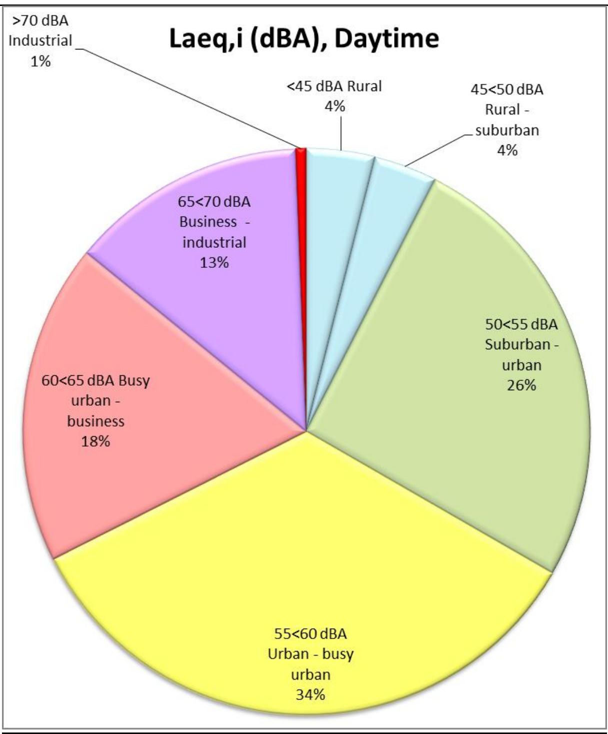

Figure 3-4: Daytime ambient sound levels grouped into typical noise districts

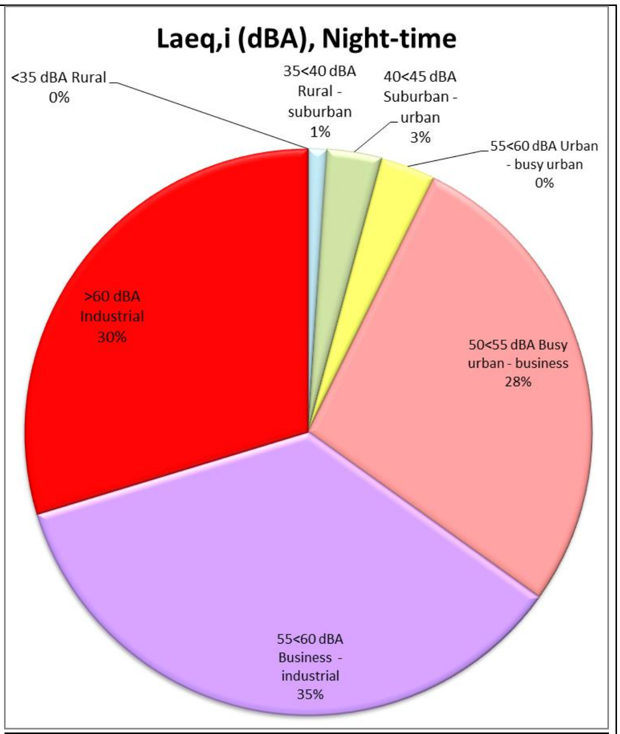

Figure 3-5: Night-time ambient sound levels grouped into typical noise districts

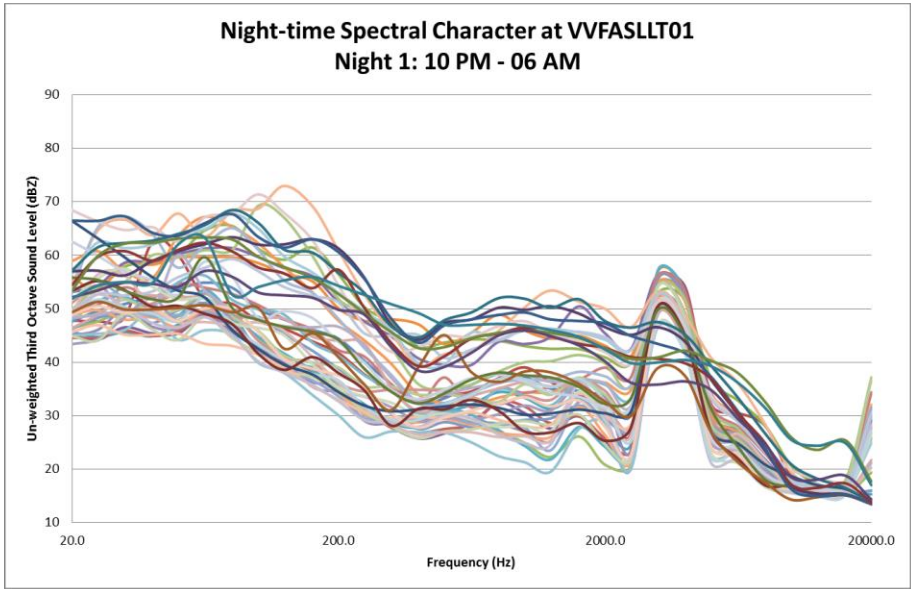

Figure 3-6: Spectral frequencies – VVFASLLT01, Night 1

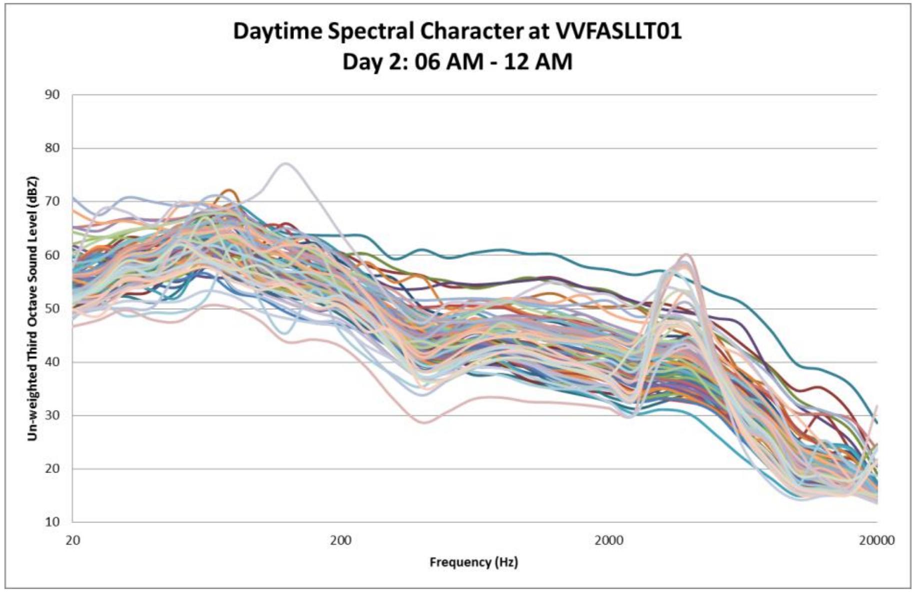

Figure 3-7: Spectral frequencies - VVFASLLT01, Day 2

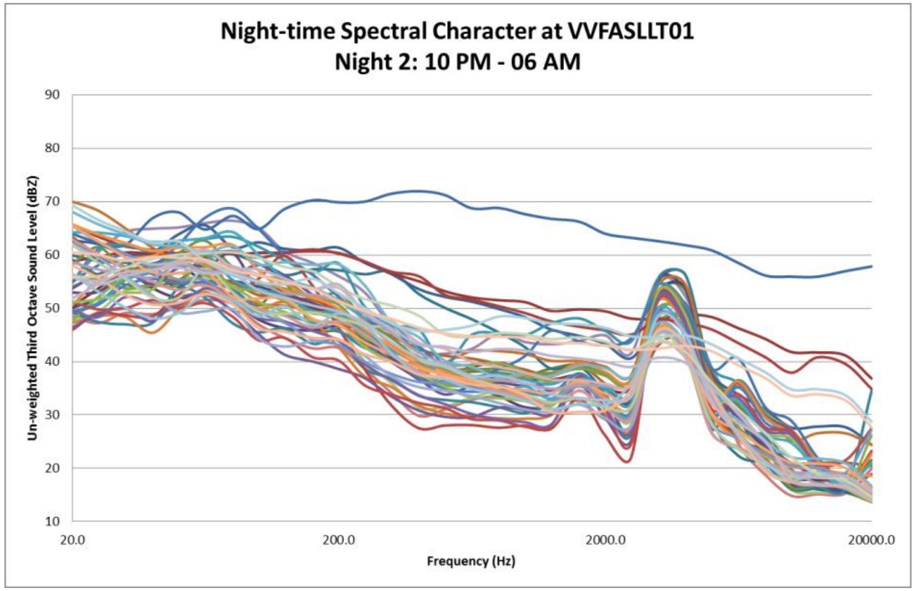

Figure 3-8: Spectral frequencies - VVFASLLT01, Night 2

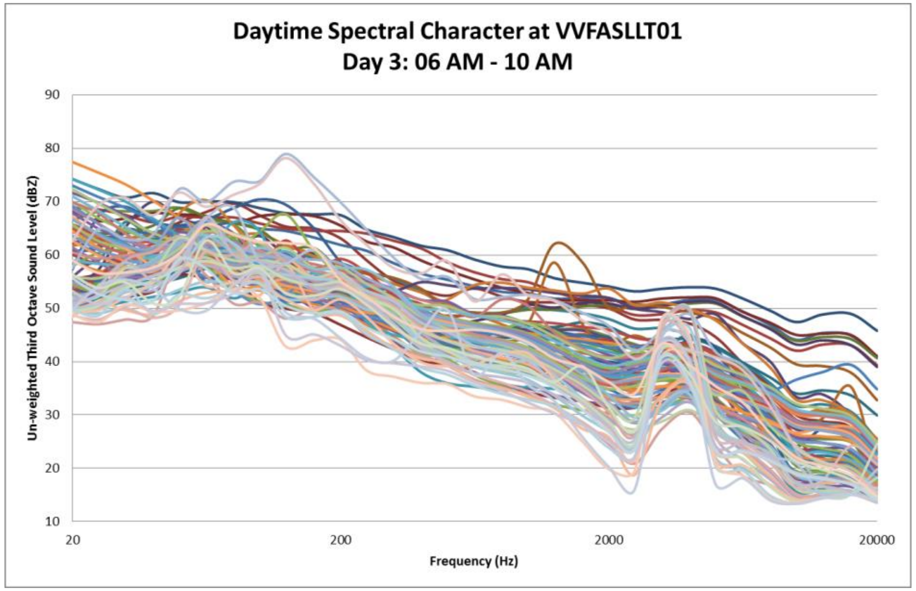

Figure 3-9: Spectral frequencies - VVFASLLT01, Day 3

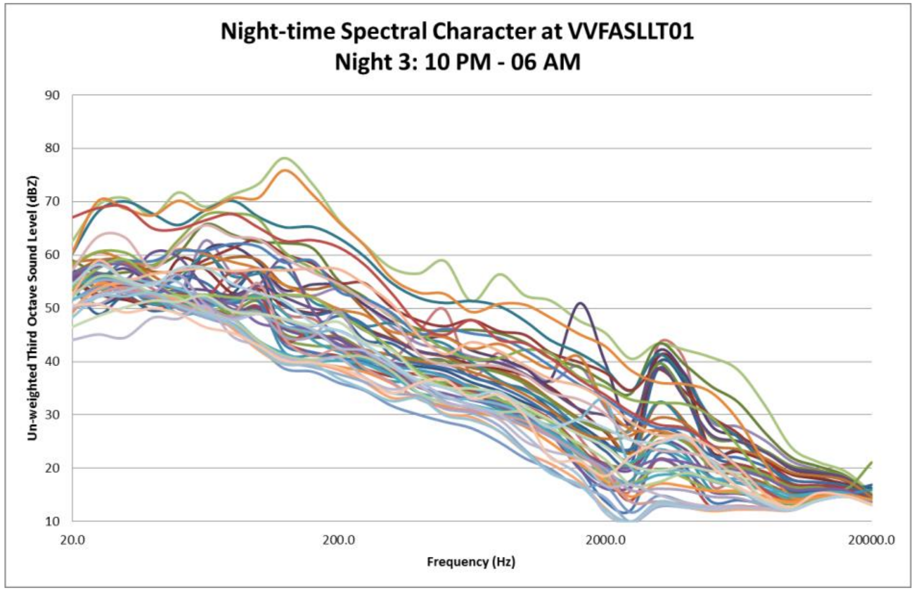

Figure 3-10: Spectral frequencies – VVFASLLT01, Night 3

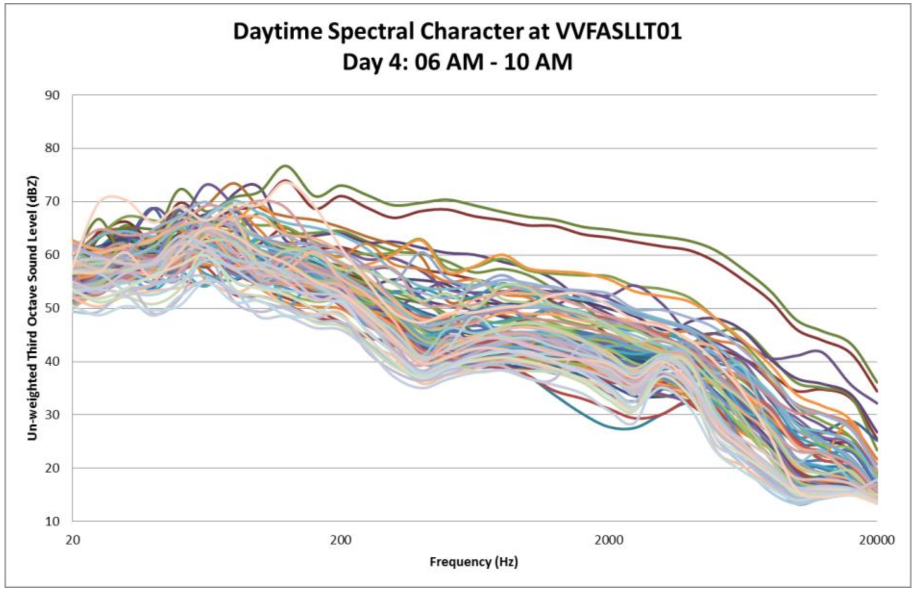

Figure 3-11: Spectral frequencies - VVFASLLT01, Day 4

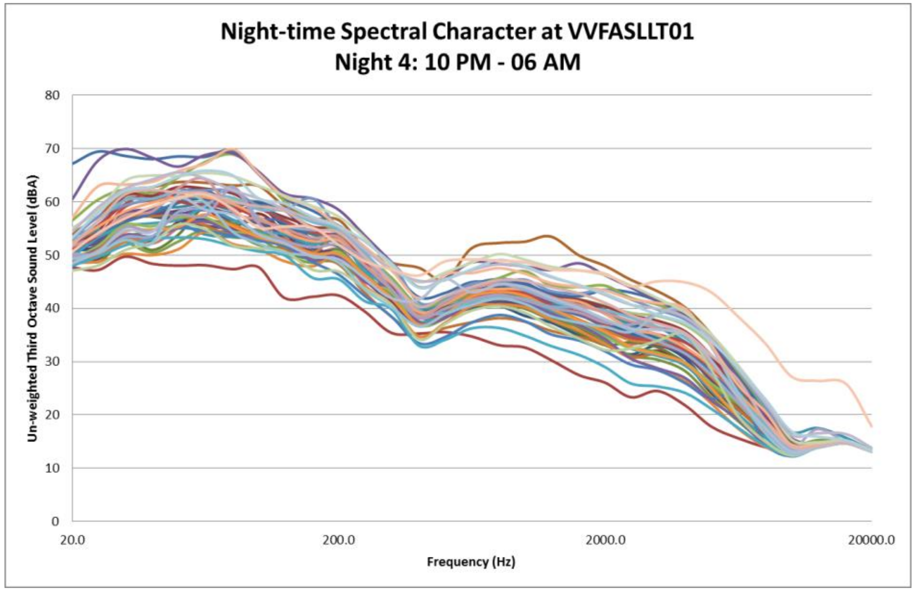

Figure 3-12: Spectral frequencies - VVFASLLT01, Night 4

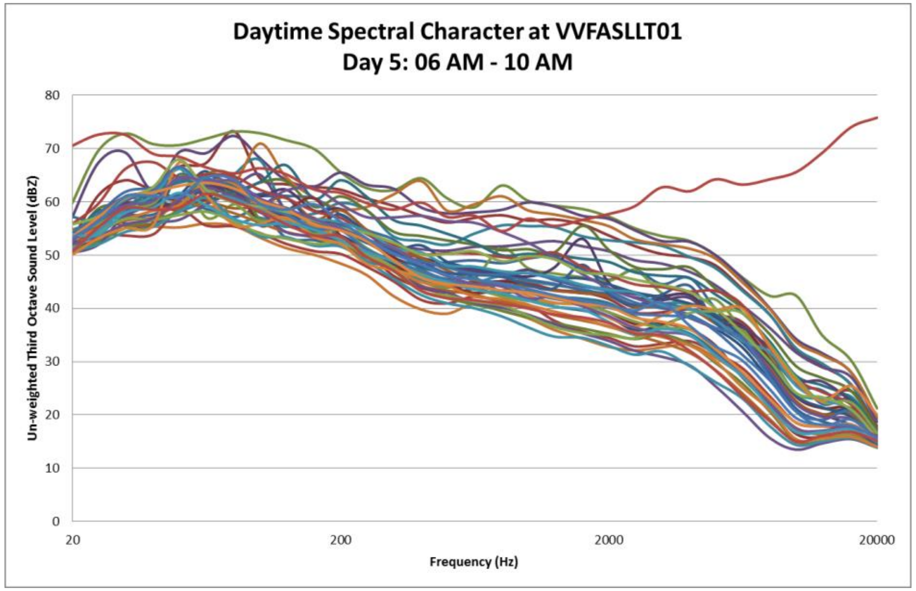

Figure 3-13: Spectral frequencies - VVFASLLT01, Day 5

3.4.2 Ambient Sound Measurements at VVFASLLT02

The instrument was deployed in the garden area of a house further than 1,000m from the closest mining activities. Mining activities were not audible during the site visit at this location, but it is possible that it may be audible during quiet periods. Due to large trees in the vicinity of the house, wind-induced noises would be significant during windy-periods. These trees also provided adequate habitat for birds. Refer to Appendix B for photos of this measurement location. The equipment defined in **Table 3-5** was used for gathering data. Measured sound levels are presented in **Figure 3-14** and **Figure 3-15** and defined in **Table 3-6**.

Table 3-4: Noises/sounds heard during site visits at receptor VVFASLLT02

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: Barely Audible / Audible / Dominating	**Faunal and Natural**
	Birds audible and dominant. Wind induced noises, especially during wind gusts.
	Residential and other Anthropogenic
	-
	Industries, Commercial and Road Traffic
	There was no industrial type sounds audible during deployment. Farming equipment was audible at times during deployment.

Table 3-5: Equipment used to measure sound levels at VVFASLLT02

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34849	October 2016
Microphone	ACO Pacific 7052E	55974	October 2016
Calibrator	Quest CA-22	J 2080094	July 2017

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Impulse equivalent sound levels (South African legislation): Figure 3-14 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-6** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 3-14** with **Table 3-6** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. **L_{A90}** is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-15** and defined in **Table 3-6**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-6** and illustrated in **Figure 3-15**.

Table 3-6: Sound levels considering various sound level descriptors at VVFASLLT02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	59	53	43	-	-
Night arithmetic average	-	63	57	47	-	-
Day minimum	-	48	42	-	28	-
Day maximum	101	78	75	-	-	-
Night minimum	-	38	34	-	28	-
Night maximum	103	77	67	-	-	-
Day 1 equivalent	-	65	60	-	-	Afternoon and evening only
Night 1 Equivalent	-	66	61	-	-	8 hour night equivalent average
Day 2 equivalent	-	56	48	-	-	16 hour day equivalent average
Night 2 Equivalent	-	68	62	-	-	8 hour night equivalent average
Day 3 equivalent	-	66	60	-	-	16 hour day equivalent average
Night 3 Equivalent	-	68	60	-	-	8 hour night equivalent average
Day 4 equivalent	-	63	59	-	-	16 hour day equivalent average
Night 4 Equivalent	-	61	53	-	-	8 hour night equivalent average
Day 5 equivalent	-	54	45	-	-	Morning only

The statistical data (**$L_{A90,f}$**) indicate a location with significantly elevated noise levels both day and night due to a constant background sound. Ambient sound levels are actually slightly higher at this location than at VVFASLLT01. **L_{Amin}** data indicate a location with a potential to become quiet. Considering the development character, sounds heard as well as the average **$L_{Aeq,i}$** and **$L_{Aeq,f}$** values, the noise rating level would be typical of a **urban (with workshops, main roads and business premises) to industrial** noise districts (SANS 10103:2008 – see **Table 5-1** - zone sound level or the equivalent continuous rating level. Ambient sound levels are summarised and grouped as can be expected for a typical noise district (**Figure 3-16** and **Figure 3-17**).

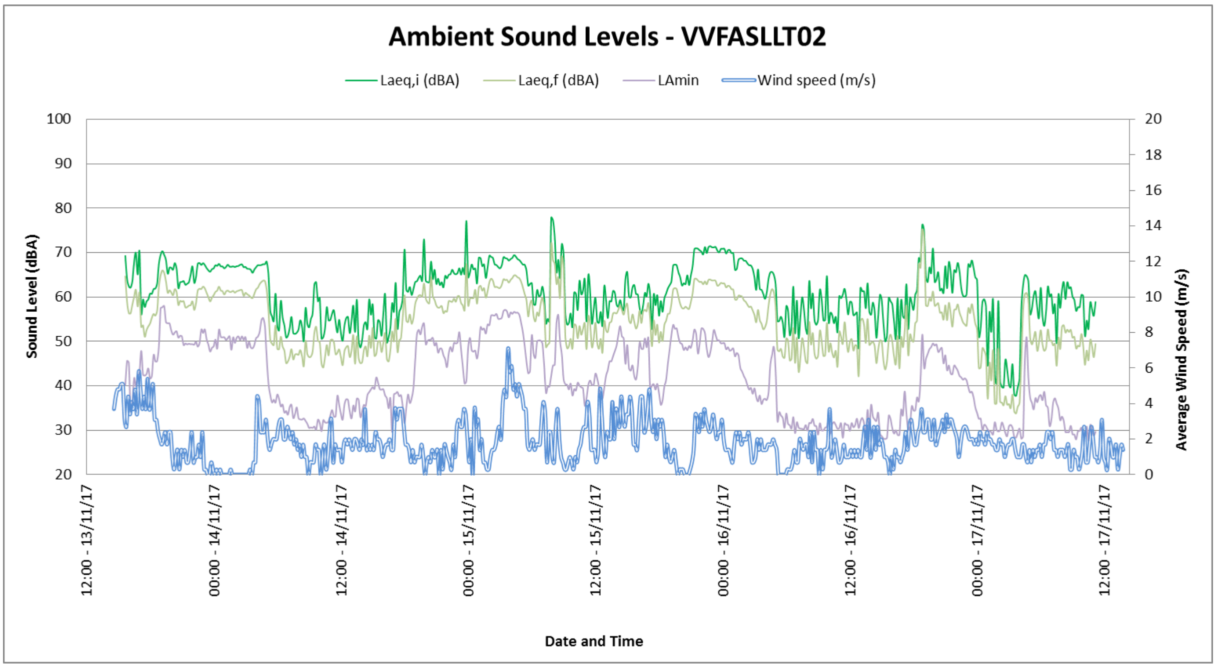

Figure 3-14: Ambient Sound Levels at VVFASLLT02

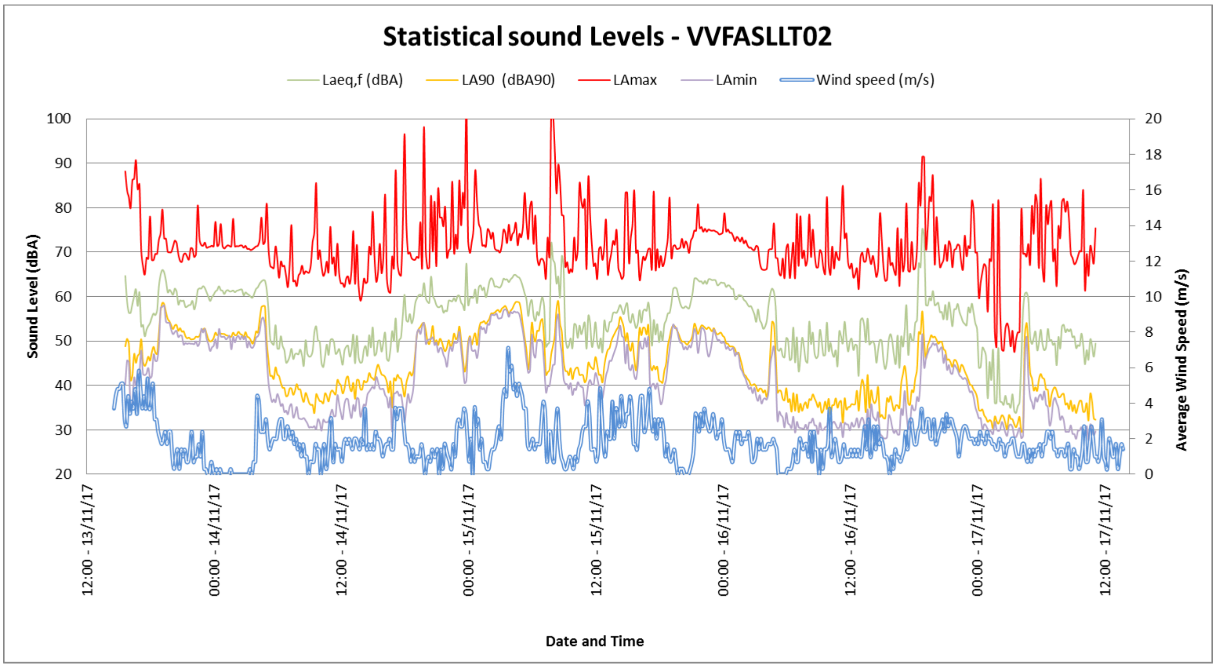

Figure 3-15: Maximum, minimum and statistical values at VVFASLLT02

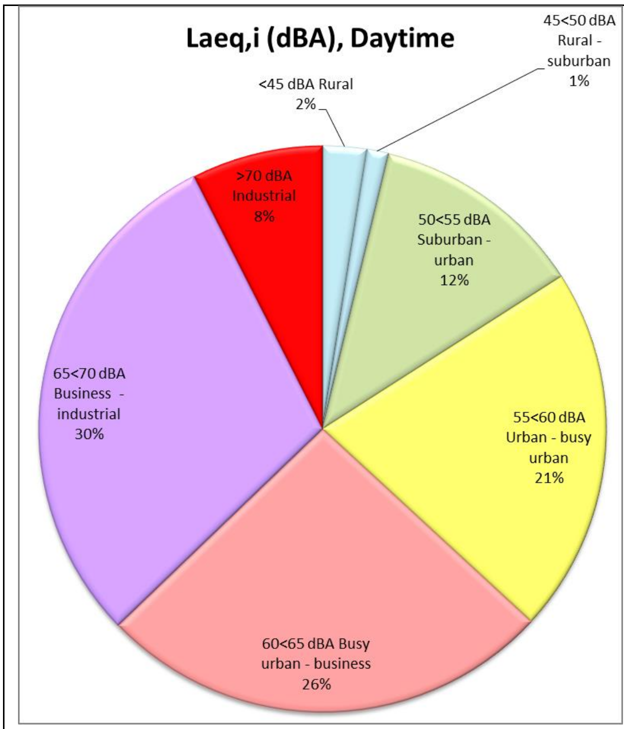

Figure 3-16: Daytime ambient sound levels grouped into typical noise districts

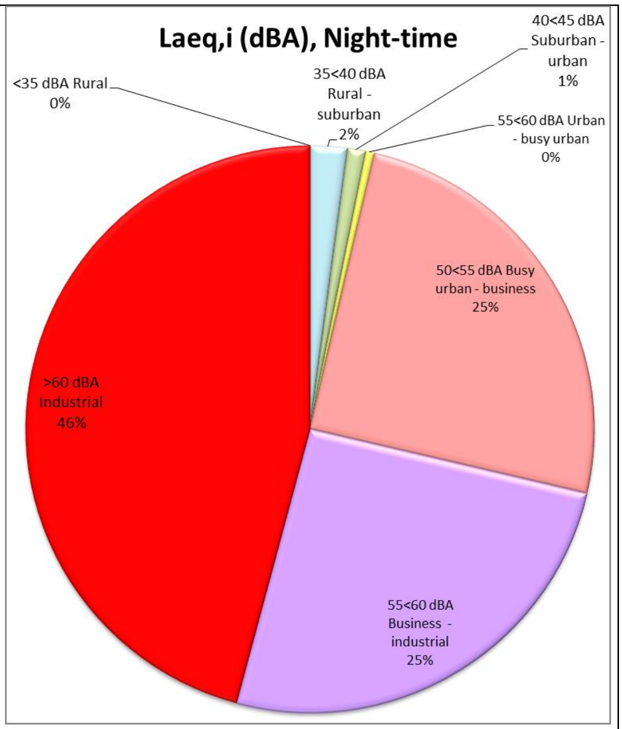

Figure 3-17: Night-time ambient sound levels grouped into typical noise districts

Third octaves were measured and are displayed in the following Figures. There is some significant acoustic energy in the 3.150 – 4,000Hz frequency range due to bird communication. There are numerous other different noise sources in the area, likely due to dogs and typical household activities.

Compliance with international guidelines: While measured ambient sound levels were higher, considering the developmental character of the area, the acceptable zone rating level would be typical of a **rural area** (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008. Mining activities (calculated noise levels should not change these proposed noise limits with more than 7 dBA).

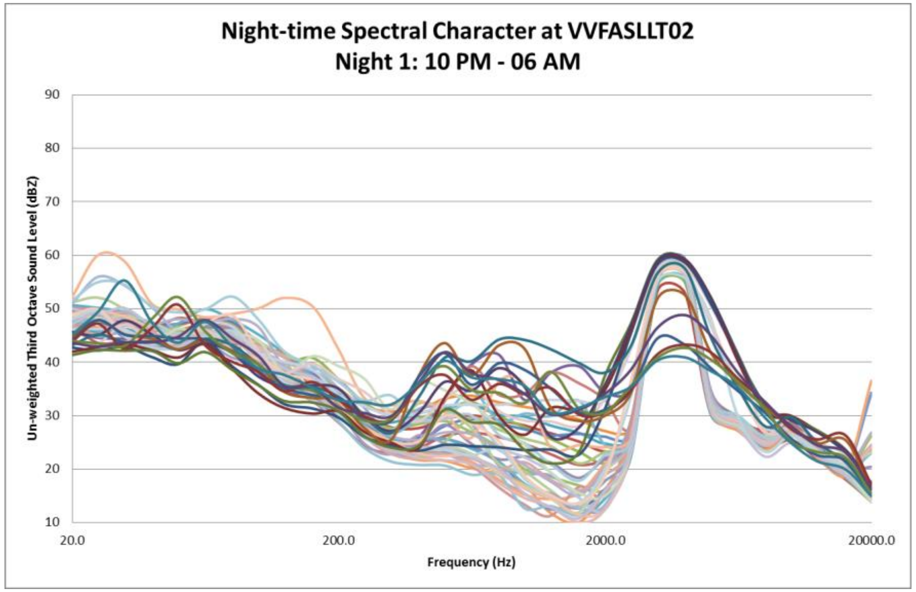

Figure 3-18: Spectral frequencies – VVFASLLT02, Night 1

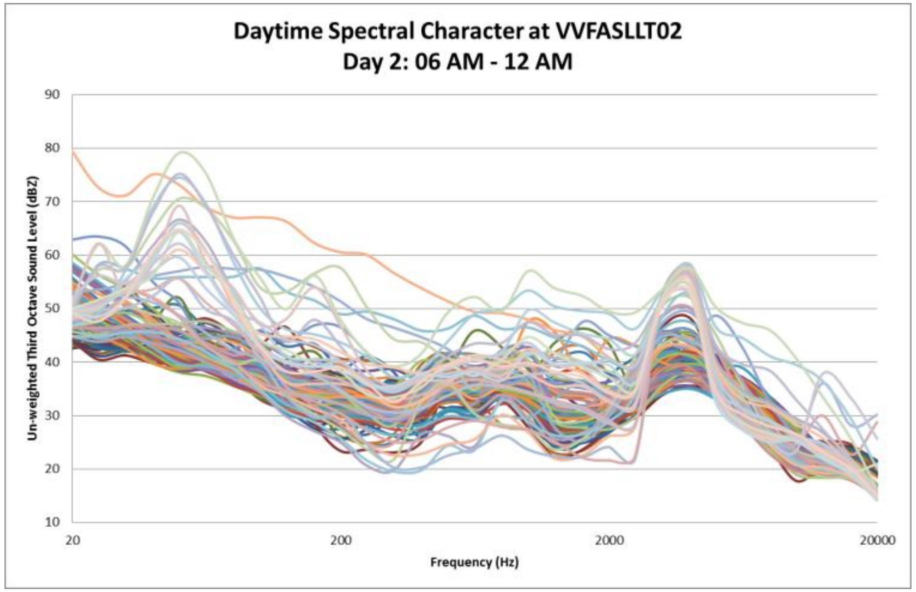

Figure 3-19: Spectral frequencies - VVFASLLT02, Day 2

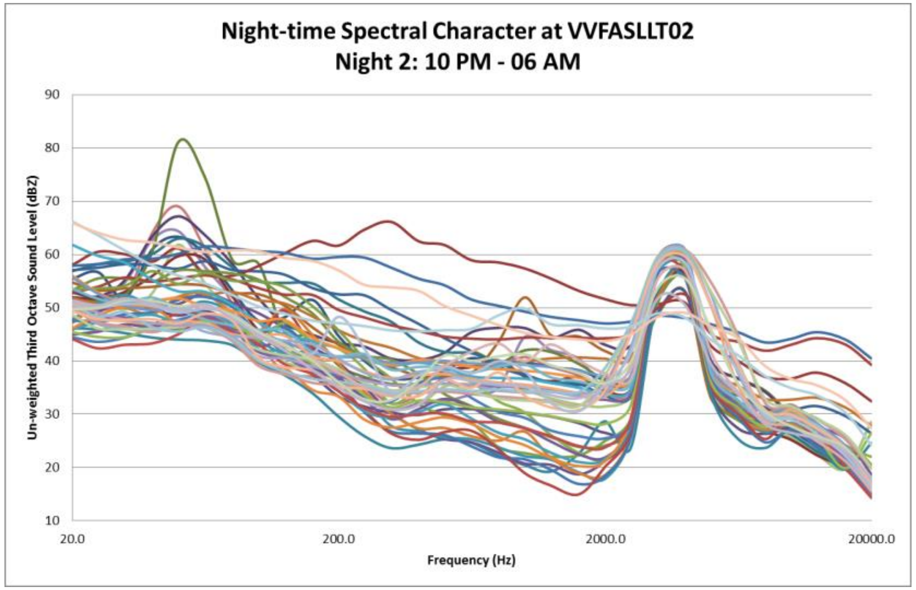

Figure 3-20: Spectral frequencies - VVFASLLT02, Night 2

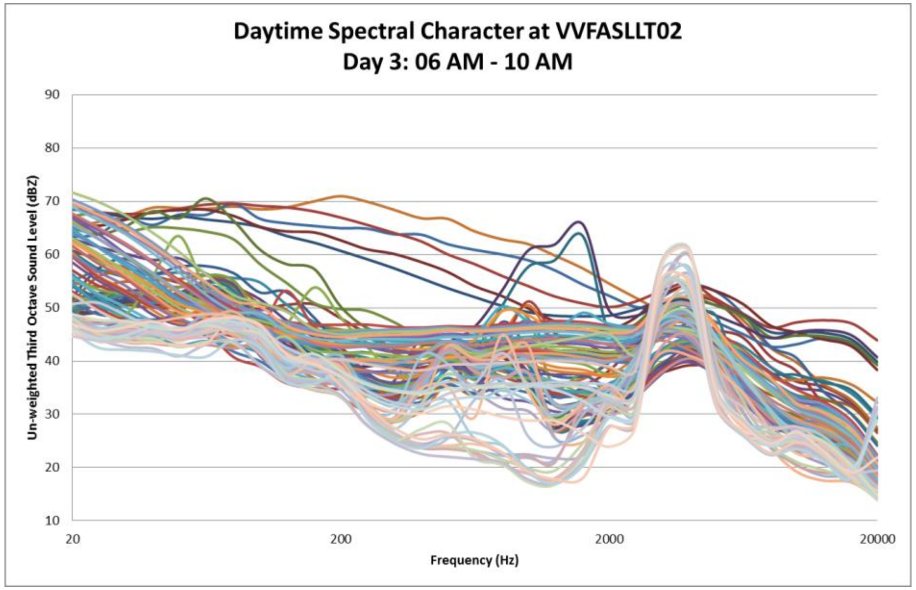

Figure 3-21: Spectral frequencies - VVFASLLT02, Day 3

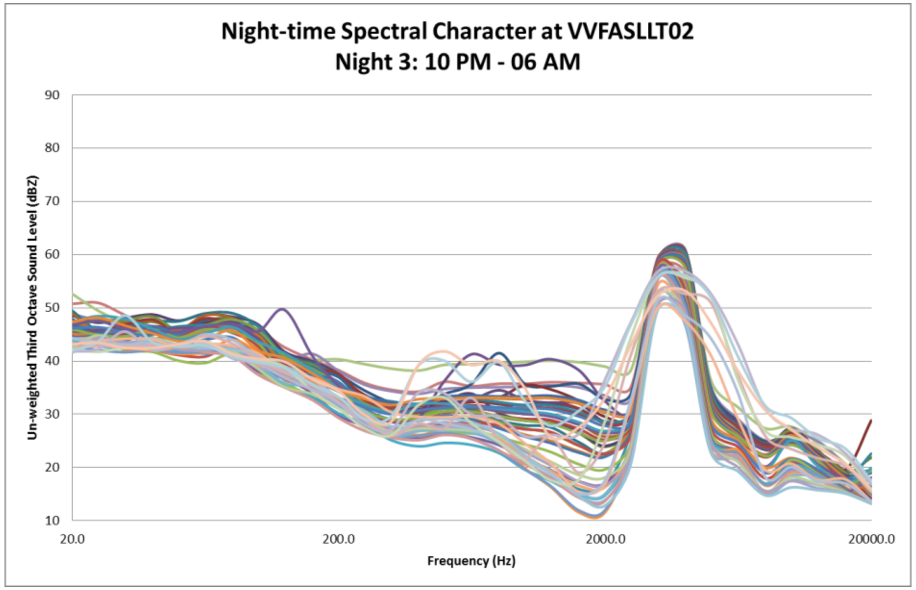

Figure 3-22: Spectral frequencies – VVFASLLT02, Night 3

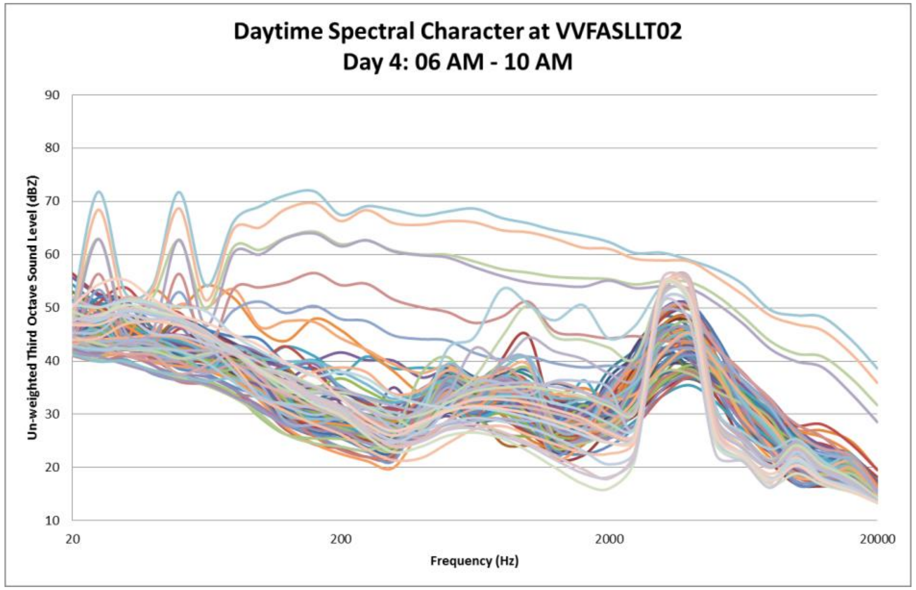

Figure 3-23: Spectral frequencies - VVFASLLT02, Day 4

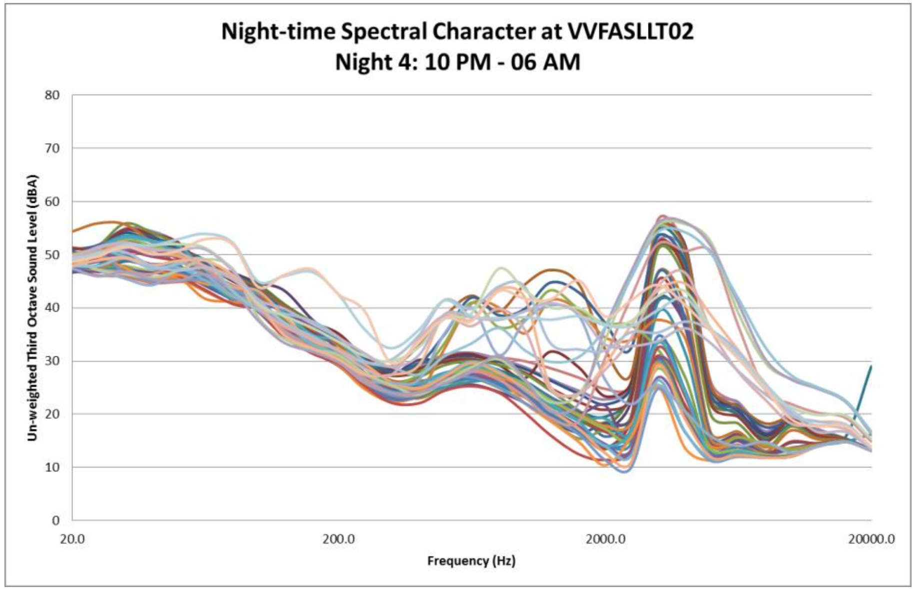

Figure 3-24: Spectral frequencies - VVFASLLT02, Night 4

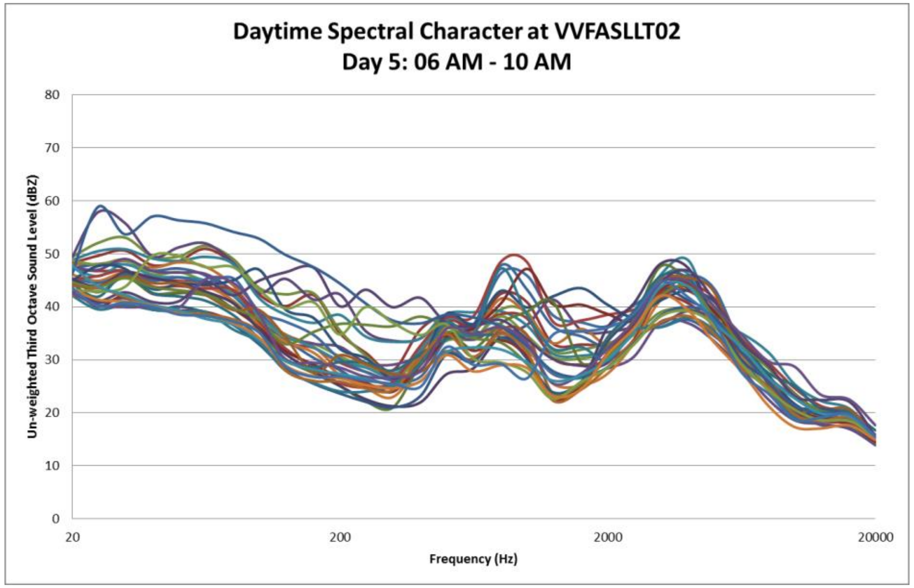

Figure 3-25: Spectral frequencies - VVFASLLT02, Day 5

3.4.3 Single Measurements – On and in vicinity of mining area

A number of single measurements were collected to gauge the noise levels from the plant and mining activities as well as to define the ambient sound character (levels and spectral). Equipment used at these locations is defined in the following table. Refer to **Appendix B** for a photo of this measurement location.

Table 3-7: Equipment used to do singular measurements around Hernic

Equipment	Model	Serial no	Calibration
SLM	RION NA-28	00901489	February 2017
Microphone	UC-59	02087	February 2017
Calibrator	Quest QC-20	QOC 020005	June 2017

Note: SLM fitted at all times with appropriate windshield

Note:

$L_{Aeq,i}$ - Equivalent A-weighted noise level, similar to an average noise level – Impulse-detector

$L_{Aeq,f}$ - Equivalent A-weighted noise level, similar to an average noise level – Fast-detector

L_{A90} - Noise level that is exceeded 90% or more of the time – Fast-detector

The data collected and information about the measurement locations are presented in the following tables.

3.4.4 Summary of Ambient Sound Measurements

All the measurements indicated a site with a very complex sound character. Areas away from busy roads and mining activities are very quiet, with measurement locations closer to houses, busy roads and mining activities indicating higher sound levels. Vegetation growth closer to dwellings creates habitat, attracting birds and insects, which in turn make sounds that increases the ambient sound levels. The vegetation also increased wind-induced noises. The larger area, away from roads, dwellings and mining activities can be rated as Rural as per the SANS 10103:2008 criteria.

Table 3-8: Summary of singular noise measurements

Measurement location	$L_{Aeq,i}$ level (dBA)	$L_{Aeq,f}$ level (dBA)	L_{A90} Level (dBA90)	Spectral character	Comments
Security Access Gate	74 74 66	70 71 65	38 39 42	**Figure 3-26**	Main entrance with road trucks entering and leaving. Road trucks the dominant noise with trucks operating in distance audible during quiet periods. Birds audible. People working on trucks in area (impulsive noises at times). Chickens audible in distance. - 3 trucks in, 5 trucks out. Water bowser out. Light delivery vehicle (LDV) with alarm out. - 2 trucks in, 6 trucks out. Water bowser and LDV with siren in. - 1 truck in, 3 trucks out. Truck idling in the area.
VVFASLS01	68 82	65 77	36 34	**Figure 3-27**	Quiet area with voices generally audible. Rooster in distance. Mining activities audible in distance, mainly reverse alarms. At around 35 dBA area quiet with no trucks passing. Sheep bleating in distance. Wind increases noise levels to around 38 - 39. - 4 trucks and 5 cars first measurement with passing train loudly hooting in distance. - 6 trucks and water bowser. Max noise due to truck blowing hooter as he passed microphone.
VVFASLS11	51 43	48 39	34 37	**Figure 3-28**	Birds dominant source of noise. Water bowser operating in far distance and just audible. Farming equipment working in distance and audible at times. Reverse alarms audible and quite constant. Mining equipment just audible at times. Impulsive noises from mining area audible at times. Trucks of Westcoal passing in distance at times and audible though minimal impact on sound measurement.
VVFASLS12	50 48	47 45	37 37	**Figure 3-29**	Music from town constant background sound at around 41 dBA (with no other sounds in area). Birds clearly audible and likely dominant sound. Truck passing dominant sound during event. Farm tractor in distance clearly audible. Mining activities not audible. Passing trucks can raise noise level from ambient with about 10 dBA at measurement location. Mine LDV passing next to microphone source of maximum noise. Third truck very noisy (rattling) and raising ambient noise level with about 15 dB. - 4 trucks in distance, LDV (2 x) passing direct on road next to microphone. - 3 trucks passing in short succession increasing ambient with 17 dB. 4 trucks total.
VVFASLS13	44 49	40 41	33 32	**Figure 3-30**	Mining activities audible and constant with impulsive sounds at times. Reverse alarms frequent and audible but barely register or change sound level. Voices in far distance from people collecting wood just audible at times. Birds clearly audible and dominant. Mac noises birds. Insects audible. Sound level variable due to birds. Trucks traveling audible at times. Sound levels 32 - 36 when no bird calls.
VVFASLS14	69	61	27	**Figure 3-31**	Blast at 12:16, 2 minutes in measurement. Birds dominant noise source. Mining activities just audible with reverse alarms. Alarm or siren audible for few minutes before blast.
VVFASLS15	40 49 34	35 48 33	29 31 30	**Figure 3-32**	Approximately 30 minutes after blast. Measurement at VVFASLS16 collected before this measurement. Birds audible and dominant. Mining activities clearly audible but low impact. Reverse alarms, sound similar to a rock breaker, material falling, trucks moving around. Loud noises due to birds in area. Sound levels around 35 dBA with birds quiet. Mining in full swing second measurement. Drilling activities clearly audible with sound level 38 dBA. Plane over flight at 2 minutes.

Measurement location	$L_{Aeq,i}$ level (dBA)	$L_{Aeq,f}$ level (dBA)	L_{A90} Level (dBA90)	Spectral character	Comments
VVFASLS16	52	48	30	**Figure 3-33**	Measured after VVFASLS13, before VVFASLS15. Mining did not start after blast. Trucks on R566 barely audible in distance during passing. Reverse alarms from mining area just audible. Cars or LDV passing in mining area audible. Broadband hum started during second measurement. Mining activities started during the second measurement with trucks passing in vicinity.
	45	42	32		
VVFASLS17	50	47	34	**Figure 3-34**	Mining activities audible, likely bulldozer or FEL. Reverse alarm clearly audible. Birds dominant. Passing road trucks clearly audible. Car passing first measurement. Plane over flight second measurement.
	45	43	31		

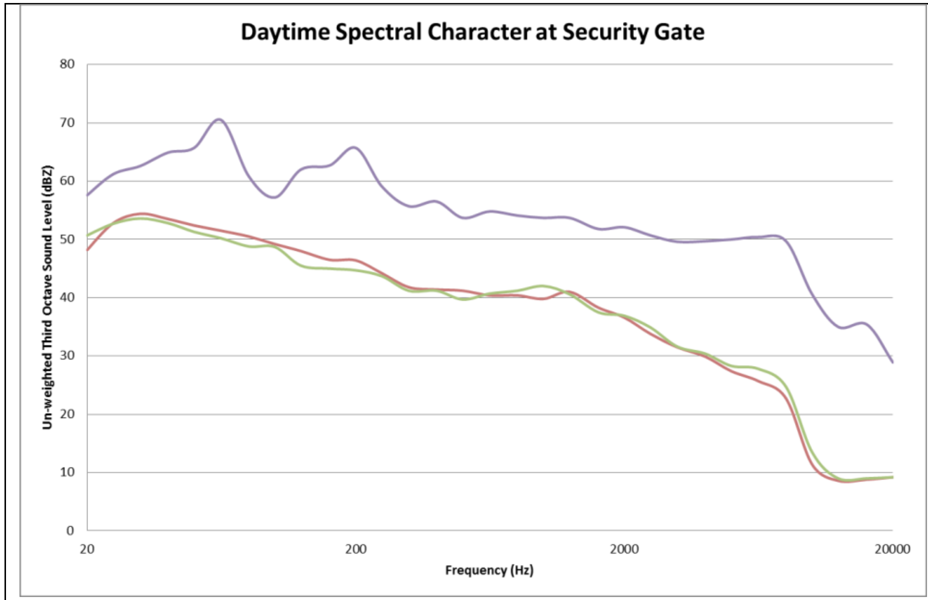

Figure 3-26: Spectral frequencies recorded at Security Access Gate

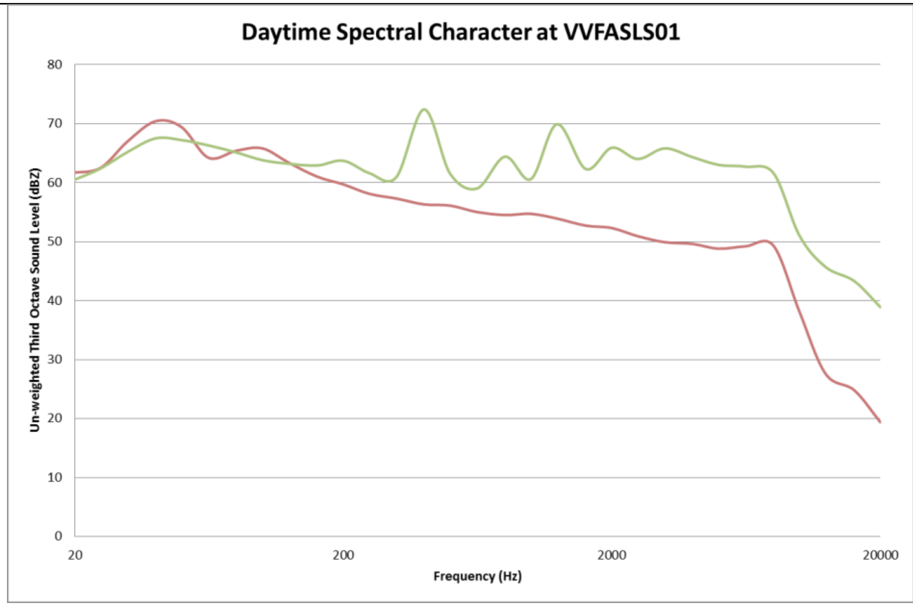

Figure 3-27: Spectral frequencies recorded at VVFASLS01

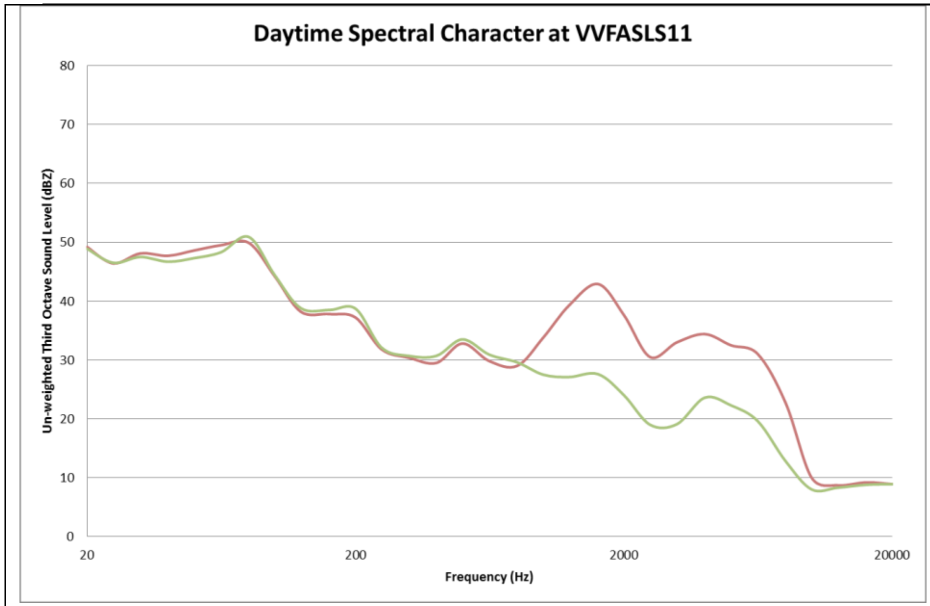

Figure 3-28: Spectral frequencies recorded at VVFASLS11

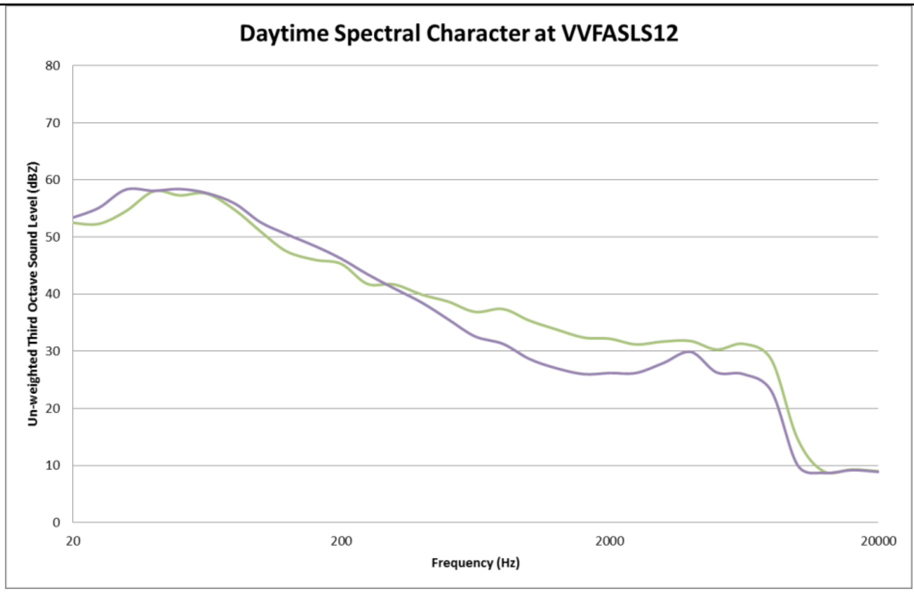

Figure 3-29: Spectral frequencies recorded at VVFASLS12

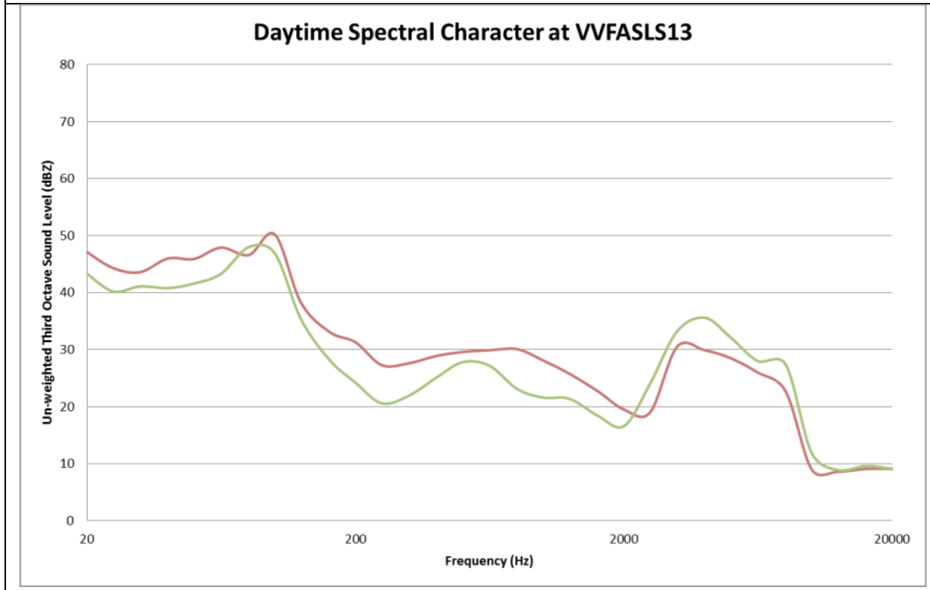

Figure 3-30: Spectral frequencies recorded at VVFASLS13

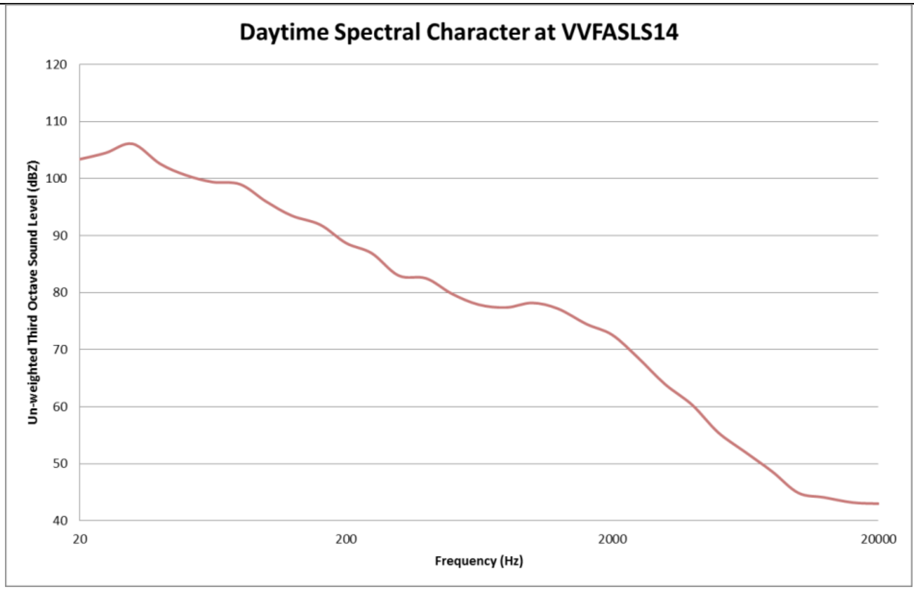

Figure 3-31: Spectral frequencies recorded at VVFASLS14

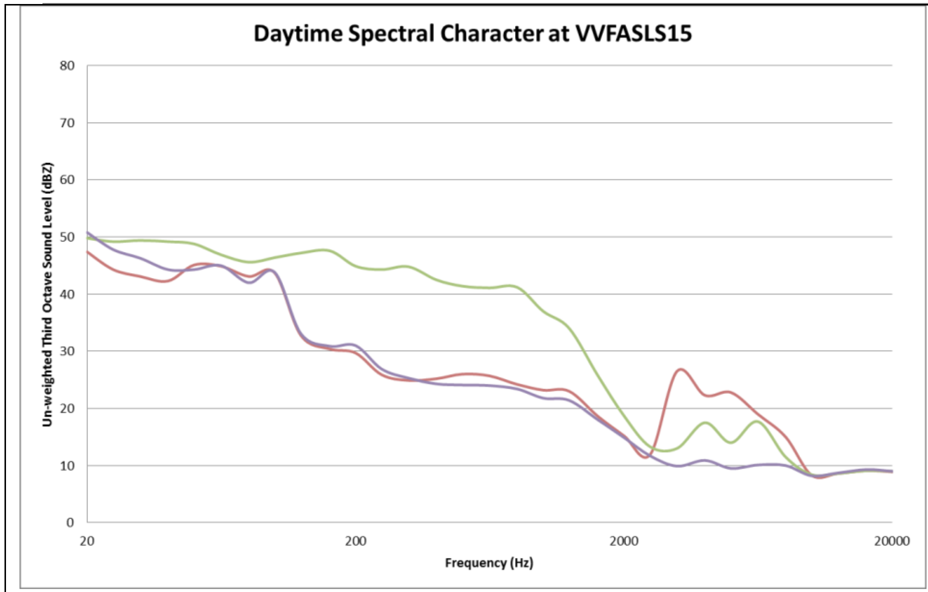

Figure 3-32: Spectral frequencies recorded at VVFASLS15

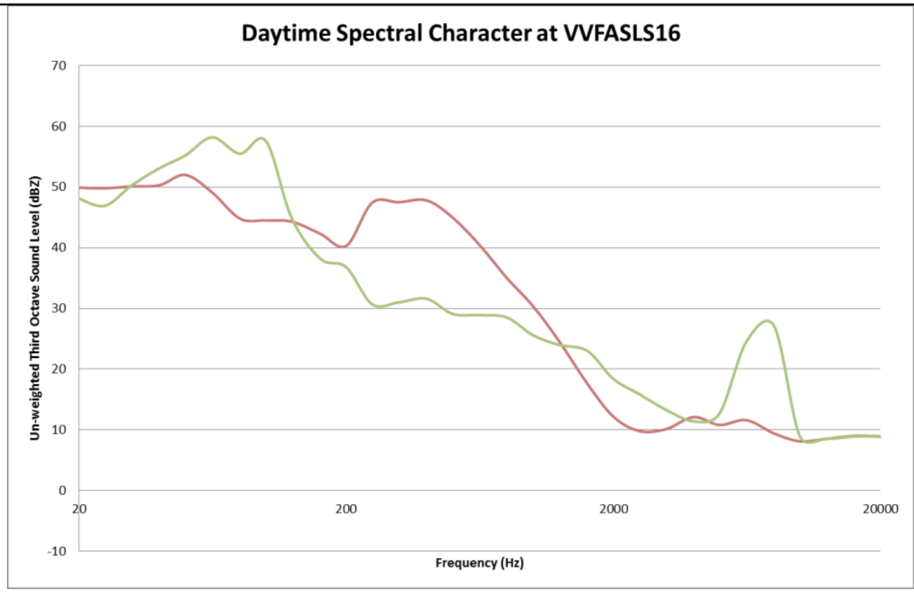

Figure 3-33: Spectral frequencies recorded at VVFASLS16

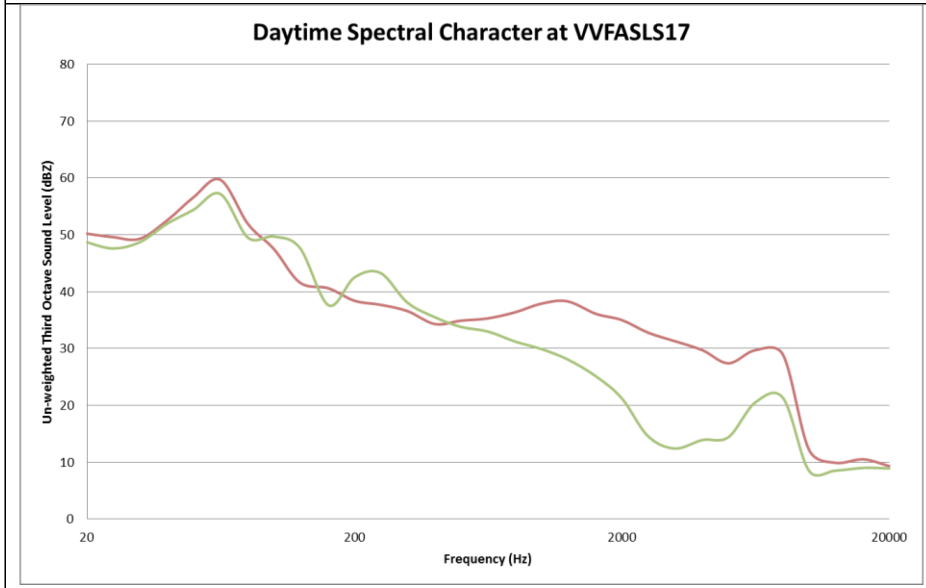

Figure 3-34: Spectral frequencies recorded at VVFASLS17

4 POTENTIAL NOISE SOURCES

4.1 POTENTIAL NOISE: PLANNING AND DESIGN

Being an existing operational mine, planning will not change the existing noise levels at the mine.

4.2 EXISTING SOUNDSCAPE AND CONSTRUCTION NOISES

This is an existing operational mine and the area have been influenced by the operational activities, with the construction activities adding to the noise levels on the site.

The level and character of the construction noise will be highly variable as different activities with different equipment take place at different times, for different periods of time (operating cycles), in different combinations/sequences and on different parts of the construction site.

The potential extent and impact of construction noises depends on numerous factors, including, amongst others, the prevailing ambient sound levels during the instance the maximum noise event occurred as well as the character of the noise.

Maximum noises generated can be audible over a large distance; however, it is generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dBA, the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in **Table 4-1**.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a mining construction site is presented in **Table 4-2**.

4.2.1 Existing Noise Levels

This is an existing operation, with the following noise generating activities taking place:

- Removal of vegetation and the loading of topsoil using bulldozers, excavators and articulated dump trucks (ATDs);
- Drilling of the over- and/or midburden to prepare for blasting;
- Loading of over- and midburden using excavators and ATDs with the material disposed at various soft, hard and carbonaceous residue deposits / stockpiles;
- Loading of coal ROM to be hauled to the ROM stockpile at the crushing/screening plant (excavators and ADTs);
- Material handling at the ROM area, crushing and screening of the ROM and material handling at the product stockpiles;
- Loading of the coal product on road trucks (front end loaders and road trucks);
- Loading and management of discard at the plant;
- Ancillary activities such as water spraying (dust control), vehicle maintenance at the workshops.

These activities however are not static and vary as the load and location is changing during a typical work day. As an example, while the crusher may be operational, it generates high noise levels after ROM is loaded and the crusher is actively crushing the ROM. Similarly, screens will only generate full-load noise levels during the screening of crushed ROM. Existing noise contours are presented considering the noise levels measured onsite during the site visit, although it should be noted that these activities can vary significantly during a typical day.

4.2.2 Development of mining extensions

The following are likely the main construction related sources that could add to the existing noises (existing operational activities) in the area:

- Vegetation removal and the stripping of topsoil at the open cast pit, dump and stockpile areas using bulldozers, excavators, front end loaders (FEL), articulated dump trucks (ADT), water dozers, etc. This will be stockpiled close to the project area as illustrated in **Figure 7-1**, to be used for backfilling or to be hauled to specific stockpiles/dumps;
- Development of the topsoil, hards, softs and overburden dumps/stockpiles (as illustrated in **Figure 7-1**) - bulldozers, articulated dump trucks (ADT), etc.; and,
- Development of the initial boxcut - excavators, articulated dump trucks (ADT), drill rigs, etc. This is before the first overburden is blasted and most of the activities are taking place at ground surface level.

It should be noted that the construction phase may last from a few months up to 5 years, but once the first product is delivered the construction phase is considered finished. Future construction would be taking place as part of the operational phase.

4.2.3 Blasting

Rock blasting may be required to break down rock. However, blasting will not be considered as part of the noise impact assessment for the following reasons:

- A blasting specialist would be appointed to compile a Blasting Assessment;
- Blasting is highly regulated and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner;
- Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure includes:
  - The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
  - Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).
  - Reducing the total size of the blast.
  - Damping materials used to cover the explosives.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity mining/quarrying.
- Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relative fast result in a higher acceptance of the noise.

4.2.4 Vibrations

South African Standards for vibration are limited to the SABS ISO 4866:1990 and SABS ISO 2631-1 1991. These documents are based on human and building infrastructure that is exposed to vibrations. It is a trend in African countries to refer to International Standards and guidelines in terms of vibration criteria.

Infrastructure vibrations predominately occur below 300 Hz, with many International guidelines highlighting the need to consider the measurement frequency weighting when assessing vibrations (relating more to railway bound vehicles).

A ground-borne vibration is a system interlinking the noise source, vibration medium and receiver with one another. Several different mechanisms constitute this system including the distances, infrastructure specifications and noise source under investigation's *modus operandi*. There are many factors involved in the sophisticated estimation of vibration and ground-borne vibration, including[5]:

1. The medium - The surrounding geological strata, bedrock depth, soil type, bedrock contours, soil layering, depth of the water table etc.;
2. The source – The noise sources under investigation etc.; and
3. The receiver – Receptor's foundation design, building construction, interior acoustical absorption and location of building etc.

However blasting and vibration are interlinked and this will be investigated by the Blasting Specialist.

4.2.5 Delivery/Access roads, design, specifications & information

The main source of traffic noise during the construction phase relates to traffic around the project due to material delivery as well construction crew vehicle movement. The access routes acoustical contribution to the surrounding sound environment depends on a host of factors ranging from road traffic volumes, vehicle specifications (tyre design, light or heavy etc.), road tyre interaction specifications (including road paving design such as surface porosity, surface texture etc.), road traffic speeds and a host of other considerations. Noise levels associated with traffic inside the plant boundary would have a minor impact considering other industrial sounds in the area, and will not be discussed or considered further. Construction vehicles to and from the project and on public routes were not considered as it does not fail within the scope of work.

4.3 OPERATIONAL NOISES – GENERAL

4.3.1 Mining Activities

The Operational Phase commenced when the first load of coal was removed from the opencast pit[6] and will end when the last load of coal is removed from the opencast pit. The following mining and related activities (actions and processes) are expected to occur during the remainder of the Operational Phase:

- *Mining activities:* Progressive development of opencast void which amongst other includes the clearing of land, removal-, stockpiling and placement of topsoil, loading over overburden as mining progresses (this may include the drilling and blasting of hard overburden/interburden to expose the coal), the extraction and removal of coal, the progressive use of overburden as backfill once coal was extracted as part of rehabilitation of opencast voids (including sequential backfilling and levelling as well as distribution and shaping of soils and landscaping of backfilled areas), maintenance of in-pit roads, etc.;
- *Underground activities:* Ventilation fans, compressors, vehicular movement on the ramps, etc.;
- *Plant activities:* Crushing and Screening, material movement, etc.;

[5] David A. Towers, P.E. Rail Transit Noise and Vibration; Sinan Al Suhairy. Prediction of Ground Vibration from Railways.2000
[6] To be developed first, underground sections to be developed initially from the open cast pits.

- *Rehabilitation activities:* Material loading, material transport and management, sloping of rehabilitated areas, re-vegetation and maintenance – note this is generally activities that are mostly limited to the daylight hours;
- *Related activities*: Utilisation and management of surface infrastructure, does not generate significant noises.

The level and character of the noise during this phase will be highly variable as different activities with different equipment take place at different times, for different periods of time (operating cycles), in different combinations, in different sequences and on different parts of the site. Potential maximum noise levels generated by various mining equipment as well as the potential extent of these sounds are presented **Table 4-1** with **Table 4-2** presenting the typical sound power levels associated with various activities (or equipment).

The Environmental Noise Impact Assessment also assesses a number of process alternatives, briefly discussed below:

The stockpiling of filter cake (fines) for use as non-select product (Alternative P2a) versus the disposal (Alternative P2b) of this filter cake.

This will not change the noise levels as the activity; in relation with the other mining activities taking place onsite will have a minor, potentially un-measurable noise impact.

The disposal of carboniferous wastes (wash plant waste rock and possibly filter cake) to pit (Alternative P3d) versus the disposal to a surface waste disposal facility located on old rehabilitated mine area (Alternative P3a) versus the disposal to a surface waste disposal facility located on un-mined area (Alternative P3b).

This noise impact assessment considers the potential worst-case noise impact, with noise generating activities taking place close to the community living just north of the mining area. The potential effect of increased noise levels therefore depends on the distance between the potential noise-sensitive receptors and the noise-generating activities, and not the various carboniferous waste disposal alternatives. Mitigation measures also recommend locating noise-generating activities further from potential noise-sensitive receptors where possible.

The Pump-treat-discharge (Alternative P4a) of mine water versus the Pump-store -treat-discharge (Alternative P4b) of this water.

This activity has a very low potential for generating noises that could disturbing. It will not be investigated further.

Table 4-1: Potential maximum noise levels generated by construction equipment

Equipment Description[7]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential **maximum** noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Auger Drill Rig	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Generator (<25KVA, VMS Signs)	No	104.7	79.7	73.7	67.6	59.7	53.7	50.1	47.6	44.1	39.7	36.2	33.7	27.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Ventilation Fan	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6

7

Table 4-2: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Bulldozer CAT D11	113.3	88.4	82.3	76.3	68.4	62.3	58.8	56.3	52.8	48.4	44.8	42.3	36.3
Bulldozer CAT D9	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
Bulldozer CAT D6	108.2	83.3	77.3	71.2	63.3	57.3	53.7	51.2	47.7	43.3	39.8	37.3	31.2
Bulldozer Komatsu 375	114.0	89.0	83.0	77.0	69.0	63.0	59.5	57.0	53.4	49.0	45.5	43.0	37.0
Crusher/Screen (MTC Mobile)	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.0	44.6	41.1	38.6	32.6
Coal crushing plant (50 k tons)	114.5	89.5	83.5	77.5	69.5	63.5	60.0	57.5	54.0	49.5	46.0	43.5	37.5
Coal silo (Material Transfer)	103.2	78.3	72.2	66.2	58.3	52.2	48.7	46.2	42.7	38.3	34.7	32.2	26.2
Coal Screen	105.1	80.1	74.1	68.1	60.1	54.1	50.6	48.1	44.6	40.1	36.6	34.1	28.1
Diesel Generator (Large - mobile)	106.1	81.2	75.1	69.1	61.2	55.1	51.6	49.1	45.6	41.2	37.6	35.1	29.1
Drilling Machine	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.1	44.6	41.1	38.6	32.6
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Dumper/Haul truck - Bell 25 ton (B25D)	108.4	83.5	77.5	71.4	63.5	57.5	53.9	51.4	47.9	43.5	40.0	37.5	31.4
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
Excavator - Hitachi 870 (80 t)	108.1	83.1	77.1	71.1	63.1	57.1	53.6	51.1	47.5	43.1	39.6	37.1	31.1
Excavator - Hitachi 270 (30 t)	104.5	79.6	73.5	67.5	59.6	53.5	50.0	47.5	44.0	39.6	36.0	33.5	27.5
FEL - Bell L1806C	102.7	77.7	71.7	65.7	57.7	51.7	48.2	45.7	42.1	37.7	34.2	31.7	25.7
FEL - Komatsu WA380	100.7	75.7	69.7	63.7	55.7	49.7	46.2	43.7	40.1	35.7	32.2	29.7	23.7
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
JBL TLB	108.8	83.8	77.8	71.8	63.8	57.8	54.3	51.8	48.3	43.8	40.3	37.8	31.8
Road Truck average	109.6	84.7	78.7	72.6	64.7	58.7	55.1	52.6	49.1	44.7	41.1	38.7	32.6
Vibrating roller	106.3	81.3	75.3	69.3	61.3	55.3	51.8	49.3	45.8	41.3	37.8	35.3	29.3
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8

4.3.2 Traffic

A source of noise during the operational phase will be traffic to and from the project site, traffic around the colliery, ROM and product transport and activities associated with waste management. This will be a continuation of the existing and construction traffic.

4.3.3 Blasting

Blasting will not be considered during the EIA phase for the reasons defined in **section 4.2.2**.

4.4 POTENTIAL NOISE SOURCES: DECOMMISSIONING PHASE

The Decommissioning Phase is considered the phase which begins after the last load of coal is removed from the opencast mining area and ends when the Mine receives a Closure certificate from the DMR. It should also be noted that many Decommissioning Phase activities (e.g. concurrent rehabilitation of mined out areas) will take place during the Operational Phase of the mine to minimise the resultant and long-term environmental impacts.

The Decommissioning Phase will include:

- Decommissioning and rehabilitation of the mining area:
  - Backfilling of the final opencast void area with remaining stockpiled overburden.
  - Removal of other infrastructure no longer required (temporary buildings).
  - The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage.
  - Placement of topsoil on rehabilitated surface areas followed by seeding (if necessary to re-establish vegetation).
  - Monitoring and maintenance of the rehabilitated areas.
  - Removal of all remaining redundant infrastructure (which includes the haul roads, pollution control dams, waste residue sites earmarked for removal, berms and other water management infrastructures).
  - Removal of contaminated soil.
  - Monitoring and maintenance of the rehabilitated areas.
  - Application for a Closure Certificate for the site.

While there are numerous activities that may be taking place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase is normally less than both the construction and operational phases for the following reasons:

- Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors;
- There is a lower urgency of completing this phase and less equipment remains onsite (and are used simultaneously) to effect the final decommissioning.

5 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

5.1 Noise Impact on Animals[8]

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on animals. While aircraft noise have a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed;
- whether there is one animal or a group; and
- whether there have been some previous exposures.

Overall, the research suggests that species differ in their response to noise depending on the duration of the noise, magnitude of the noise, characteristic of the noise, the source of noise and how accustomed they are to the noise (previous exposure).

Extraneous noises impacts on animals as it can increase stress levels and even impact on their hearing. Masking sounds may affect their ability to react to threats, compete and seek mates and reproduce, hunt and forage, communicate and generally to survive.

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

The only animal species studied in detail are humans, and studies are still continuing today. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as humans age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar with all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals (see **Figure 5-1**).

Only a few faunal species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject with a few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in the environment (excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

[8] Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

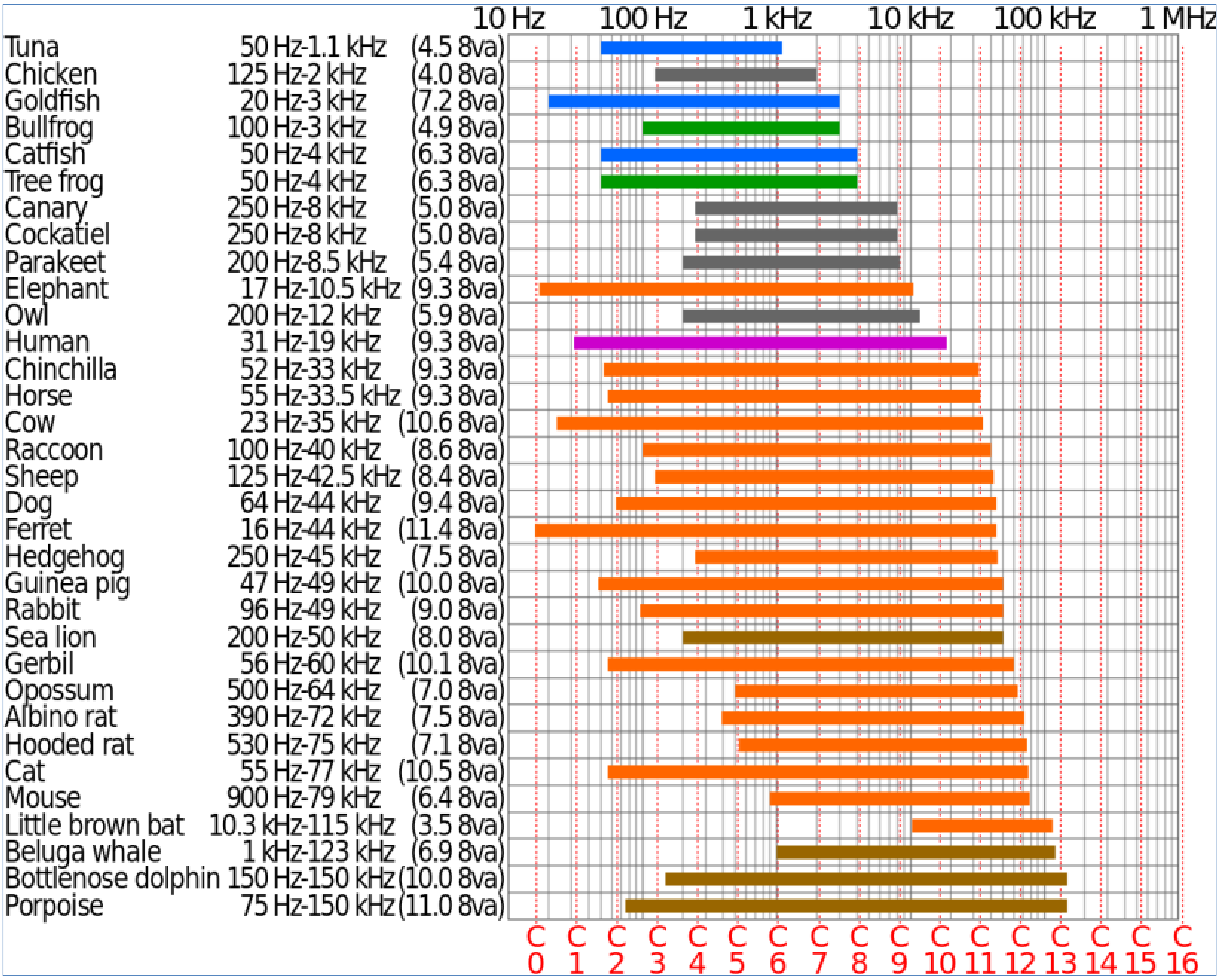

Figure 5-1: Logarithmic chart of the hearing ranges of some animals

A general animal behavioural reaction to impulsive noises is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed;
- whether there is one animal or a group; and
- whether there have been some previous exposures.

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

From these and other studies the following can be concluded:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate.
- Animals of most species exhibit adaptation with noise, including impulsive noises by changing their behaviour.
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate.
- Noises associated with helicopters, motor- and quad bikes does significantly impact on animals.

To date there are however no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals.

5.1.1 Domestic Animals

It has been observed that most domestic animals are generally not bothered by noise, excluding most impulsive noises.

5.1.2 Wildlife

Studies showed that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Noise impacts are therefore very highly species dependent.

5.2 WHY NOISE CONCERNS COMMUNITIES[9]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

5.3 IMPACT ASSESSMENT CRITERIA

5.3.1 Overview: The common characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;

[9] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

5.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts considering the latest EIA Regulations, SANS 10103:2008 as well as guidelines from the World Health Organization.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 5-2**.
- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 5-1**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

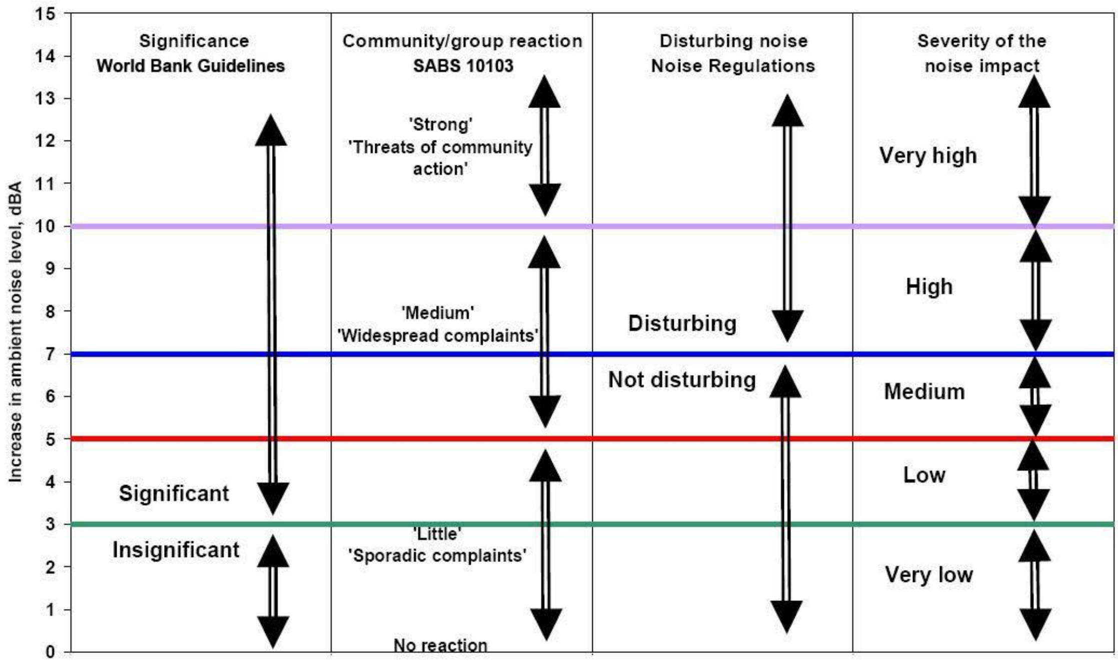

Figure 5-2: Criteria to assess the significance of impacts stemming from noise

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 5-1**). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National and Provincial Noise Control Regulations).

Acoustical measurements and the site investigations (based on character of area) indicated that the noise rating of the area would be typical of a **rural noise district** (45 and 35 dBA day/night-time Rating). The activities of the colliery should not exceed the noise limits (set by the International Finance Corporation) in the vicinity of the proposed development.

5.3.3 Other noise sources of significance

In addition, other noise sources that may be present should also be considered. During the day, people are generally bombarded with the sounds from numerous sources considered "normal", such as animal sounds, conversation, amenities and appliances (TV/Radio/CD playing in background, computer(s), freezers/fridges, etc.). This excludes activities that may generate additional noise associated with normal work.

At night, sounds that are present are natural sounds from animals, wind as well as other sounds we consider "normal", such as the hum from a variety of appliances (magnetostriction) drawing standby power, freezers and fridges. However: As the mine mainly operates during daylight hours this study will not investigate the night-time scenario.

Table 5-1: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req.T}$) for noise** dBA					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]	**Day/night** $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

5.3.4 Annoyance associated with mining activities

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that non-acoustic factors plays a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity.

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 5-3**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance.

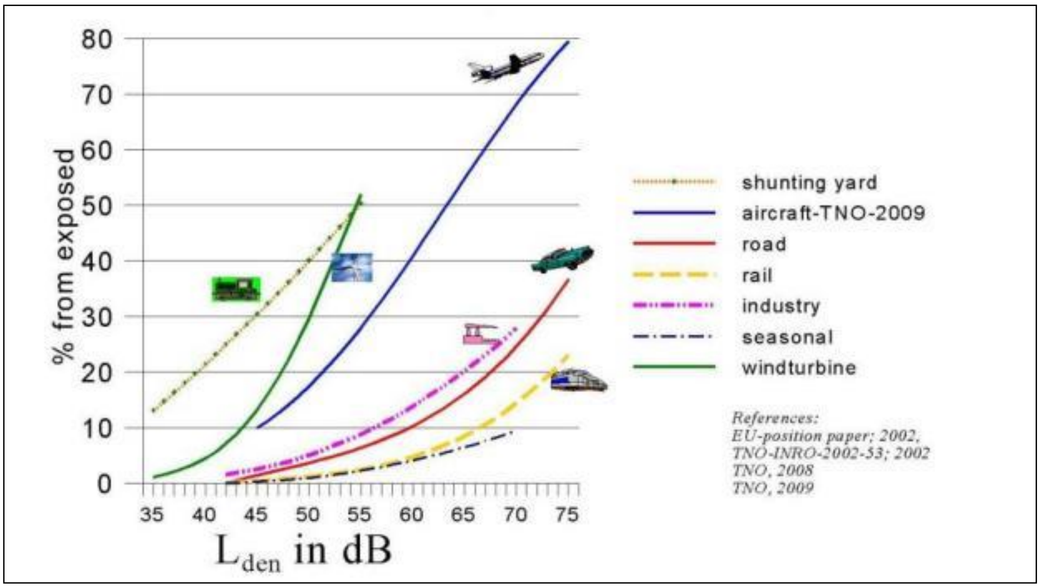

Figure 5-3: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling

This can be used in Environmental Health Impact Assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long term. It is not applicable to local complaint type situations or to an assessment of the short-term effects of a change in noise climate.

5.3.5 Determining the Significance of the Noise Impact

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2014). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). Please note that the impact assessment must apply to the identified Sub Station alternatives as well as the identified Transmission line routes.

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E+D+M+R)}{4} \times N$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 5-2**.

Table 5-2: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected) – change less than 3 dB.

Aspect	Score	Definition
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected) – change between 3 and 5 dB.
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way) – change between 5 and 7 dB.
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease) – change between 7 and 10 dB.
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease) – change higher than 10 dB.
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P (refer to following table). Probability is rated/scored as per **Table 5-3**.

Table 5-3: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 5-4: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 5-5**.

Table 5-5: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

<u>Impact Prioritisation:</u>
In accordance with the requirements of Appendix 2 and Appendix 3 of the 2014 EIA Regulations (GNR 982), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 5-6: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be

		replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 11. The impact priority is therefore determined as follows:

Priority = PR + CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to **Table 5-7**).

Table 5-7: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 5-8: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area)
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area)

5.4 REPRESENTATION OF NOISE LEVELS

Noise rating levels will be calculated in the ENIA report using the appropriate sound propagation models as defined. It is therefore important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms, Appendix A).

Sound or noise levels generally refers to a level as measured using an instrument, whereas the noise rating level refers to a calculated sound exposure level to which various corrections and adjustments was added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In the ENIA it will be used to illustrate the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time.

6 ASSUMPTIONS AND LIMITATIONS

6.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement (especially when at a community or house). This study did collect measurements at one location for approximately 22 hours in 10-minute bins. It is assumed that the measurement location represents other residential dwellings in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including;
    - the distance to closest trees, number and type of trees as well as the height of trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwelling, type of equipment used at dwelling (compressors, air-cons);
    - general maintenance condition of house (especially during windy conditions);
    - number and type of animals kept in the vicinity of the measurement locations.
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.). Traffic however is highly dependent on the time of day as well as general agricultural activities taking place at the time of traffic counts. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. This study found that traffic in the area was very low, yet it cannot be assumed that is is always low.
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels. The site visit unfortunately coincided with a relatively windy period;
- Ambient sound levels are depended not only time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

6.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

The noise emissions into the environment from the various sources as defined will be calculated for the operational phase in detail, using the sound propagation model described in ISO 9613-2.

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout,
- Acoustical characteristics of the ground. 50% soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of relatively soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

The noise emission into the environment due to additional traffic will be calculated using the sound propagation model described in SANS 10210. Corrections such as the following will be considered:

- Distance of receptor from the road;
- Road construction material;
- Average speeds of travel;
- Types of vehicles used;
- Ground acoustical conditions

It is important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms).

Sound or noise levels generally refers to a sound pressure level as measured using an instrument, whereas the noise rating level refers to a calculated sound exposure level to which various corrections and adjustments was added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In this project it illustrate the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time. It is used to define potential issues of concern and not to predict a noise level at a potential noise-sensitive receptor. For this the selected model is internationally recognised and considered adequate.

6.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds are also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor, but to calculate a noise rating level that is used to identify potential issues of concern.

6.4 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. Assumptions include:

- The octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of this processes/equipment. The determination of these levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;

- Sound power emission levels from processes and equipment change depending on the load the process and equipment is subject too. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load. Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;
- As it is unknown which processes and equipment will be operational (and when operational and for how long), modelling considers a scenario where all processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely over-estimate noise levels;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- XYZ topographical information is derived from the ASTER Global DEM data, a product of METI and NASA. There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. 50% soft ground conditions will be modelled as the area where the operation is taking place is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions.

7 PROJECTED NOISE RATING LEVELS

7.1 CURRENT AMBIENT SOUND LEVELS

Ambient sound levels were measured in the area and discussed on **Section 3.4**. A model was developed for the existing activities of the mine, considering noise sources identified during the site visit as well as the results of the noise measurements. The output of this initial model was again checked by adding additional measurement locations (see **Figure 3-1**). Rail road and road traffic (on the R555) was not considered.

Considering the equipment observed and identified onsite, the following operational activities were assessed:

- Overburden drilling using 2x Case CX210B fitted with diamond drill booms, each with a Doosan mobile diesel compressors (21/215 and XHP900). The equipment is operating 2 m below the ground surface, with a 3 m berm around the opencast area.
- Material bulldozing using a CAT D6 bulldozer (in the vicinity of the drillers).
- Active overburden loading using (equipment is operating 10 m below the ground surface, with a 3 m berm around the opencast area.):
    - Two Hitachi EX870 excavators (loading overburden onto the haul trucks),
    - One CAT D10 bulldozer operating in the vicinity of the excavators,
    - Four Hitachi EH1100 haul trucks (generally two being loaded while other two are moving overburden a distance away),
    - One CAT D8 bulldozer sloping the overburden dumped by the haul trucks close to the mining area.
- Crushing of ROM as well as the loading of the product.
- Transport of coal product to the coal stockpiles.
- Loading of the coal product using a FEL onto road trucks.
- Transport of the coal product to the market at a rate of 20 trucks per hour.

Conceptual noise contours are illustrated in **Figure 7-1** for the scenario for the situation as observed. It should be noted that it was reported that no coal ROM was loaded during the site visit. The third octave sound power levels selected for the modelled scenarios are presented in **Table 7-1**.

Table 7-1: Third Octave Sound Power Emission Levels used for modelling

Equipment	Sound power level, dB re1 pW, in octave band, Hz							SPL
Frequency	63	125	250	500	1000	2000	4000	(dBA)
Articulated Dump Truck (ADT) - Bell B40D	102.5	108.6	106.5	105.4	104.5	99.2	97.2	109.4
Bulldozer – Komatsu 375	120.2	117.1	114.8	112.0	108.8	104.2	98.3	114.0
Case driller and Compressor	121.6	123.3	118.3	115.3	114.2	113.9	111.3	120.8
Crusher and screening plant	110.6	111.2	110.9	111.2	110.8	107.0	100.6	114.5
Drill machine – Generic	107.2	109.4	109.2	106.1	104.7	101.2	99.8	109.6
Excavator – Hitachi 870	108.4	108.2	110.0	104.8	102.7	97.7	97.9	108.1
General Noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	108.8
Road truck – 30 ton	90.0	101.0	102.0	105.0	105.0	104.0	99.0	109.6

7.2 PROJECTED CONSTRUCTION NOISE LEVELS

The conceptual scenario envisioned and discussed in **section 4.2** is illustrated in **Figure 7-2**. Projected daytime noise rating contours are presented in **Figure 7-3** for the conceptual scenario, with **Figure 7-4** presenting the projected night-time noise rating contours. **Figure 7-5** illustrates potential noise levels at potential noise-sensitive receptors for the larger construction area, considering a worse-case scenario (multiple construction activities taking place close to the receptors).

The following were considered:

- Equipment operates at a 100% load for 100% of the time. This is generally unrealistic and presents the worst case scenario.
- ROM crushing and loading activities, as well as product loading will take place during the start of the construction phase.
- Mining activities observed will not take place, with the equipment moved to the area where mining will start.
    - Activities will include the dumping of topsoil in area close to the informal settlement;
    - Stripping and loading of topsoil;
    - Drilling activities (for boxcut development).
- At the start of the mining operation the equipment are on ground level, with no new berms or walls that can act as an acoustical screen that can attenuate construction noises.
- General noise due to site preparation and civil works in the area where the new plant will be developed;
- Receptors are regarded at 1.5 m height in relation to the surrounding environment and noise sources considered at 2.0 m above ground level elevation;
- Intervening ground conditions of a medium soft nature (acoustically absorbent – 75% of the acoustic energy hitting the ground surface is absorbed);
- Activities functioning during wind-still conditions, in good sound propagation conditions (10^{o}C and 70% humidity).

While there are numerous other activities that can take place at the mine, the activities conceptualised normally are responsible for 90% of the noise being generated on the operation. Octave sound power levels as used in this assessment is presented in the following **table**. This data is obtained from a library of previous reports, field measurements as well as an internet host / other resources.

7.3 PROJECTED OPERATIONAL PHASE NOISE LEVELS

Noise contours were developed for the conceptual operational noise as discussed in **section 4.3** and conceptualized and illustrated in **Figure 7-6**. Daytime operational noise levels are illustrated in **Figure 7-7** with **Figure 7-8** illustrating the potential night-time operational noise levels. The following assumptions are valid for this conceptual scenario:

- Mining starts at the boxcut developed during the construction phase with overburden loaded 10m below the surface. The drilling of the overburden takes place 2m below the ground surface. The walls of the opencast area will act as an acoustic screen.
- Drilling of blast holes just south of the active mining area.
- The stripping of topsoil, loading and hauling takes place on the ground surface.
- A 3m berm is implemented around the opencast with a 6m barrier north of the mining site.
- Crushing and screening of ROM at the new plant area. Loading of product close to the plant area.
- A total of 20 road haul trucks (per hour) travelling to the market from the new plant area.

This noise impact assessment considers the potential worst-case noise impact, with conceptual noise generating activities taking place close to the community living just north of the mining area.

7.4 REHABILITATION, DECOMMISSIONING, CLOSURE AND POST CLOSURE PHASE NOISE IMPACT

Significant rehabilitation activities take place during the operational phase, with some final rehabilitation during the closure phase. Decommissioning, closure and post closure activities are generally far less than the other phases due to the low urgency as well as the fact that these activities are generally limited to daytime hours. Post closure activities are limited to care and maintenance that have a very low noise impact. It will not be investigated further.

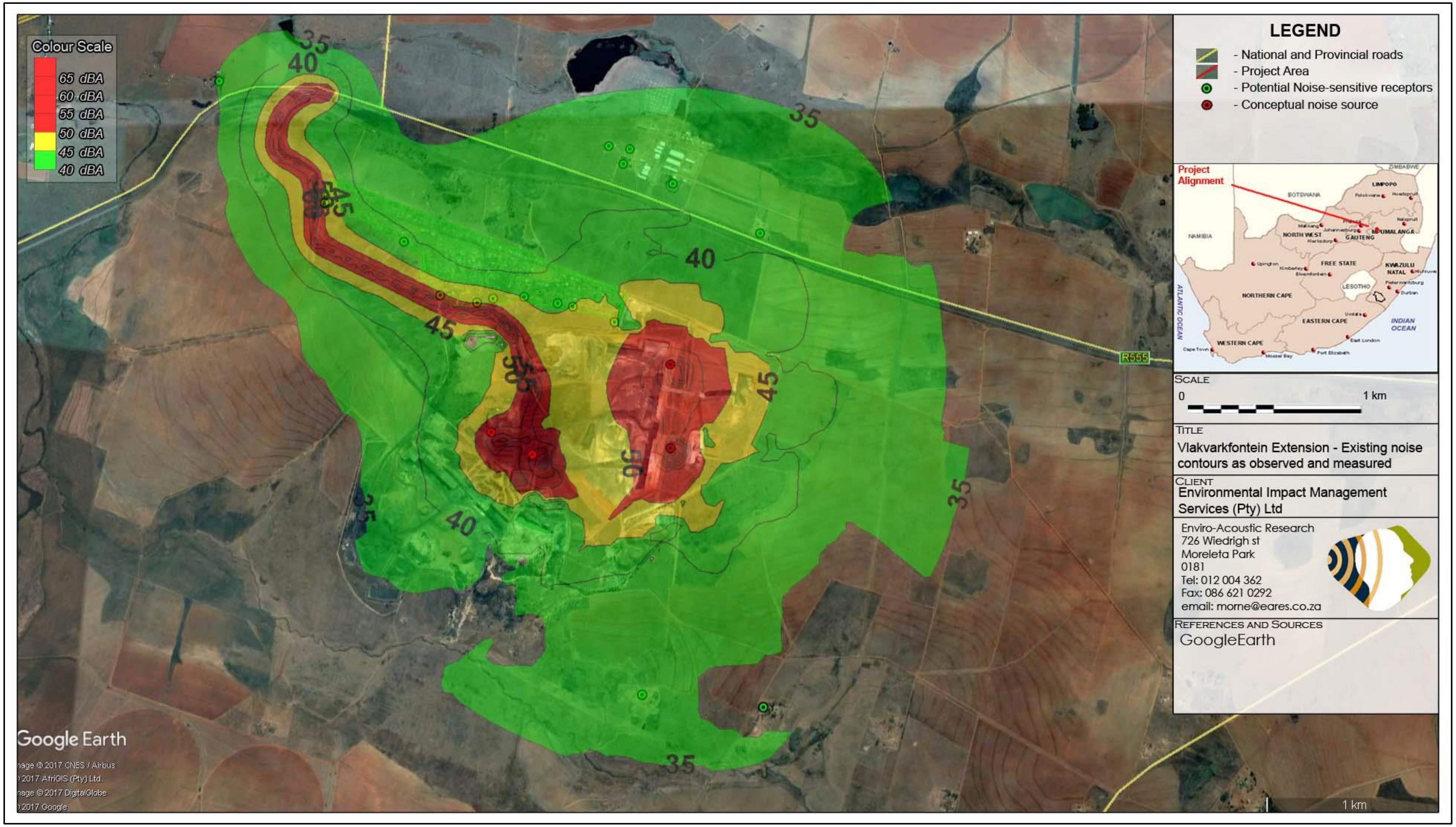

Figure 7-1: Conceptual noise levels due to mining activities as observed (colour scale showing night-time limits of 45 dBA)

Figure 7-2: Conceptual construction noise activities at the mine

Figure 7-3: Projected conceptual construction noise levels - contours of noise levels (daytime)

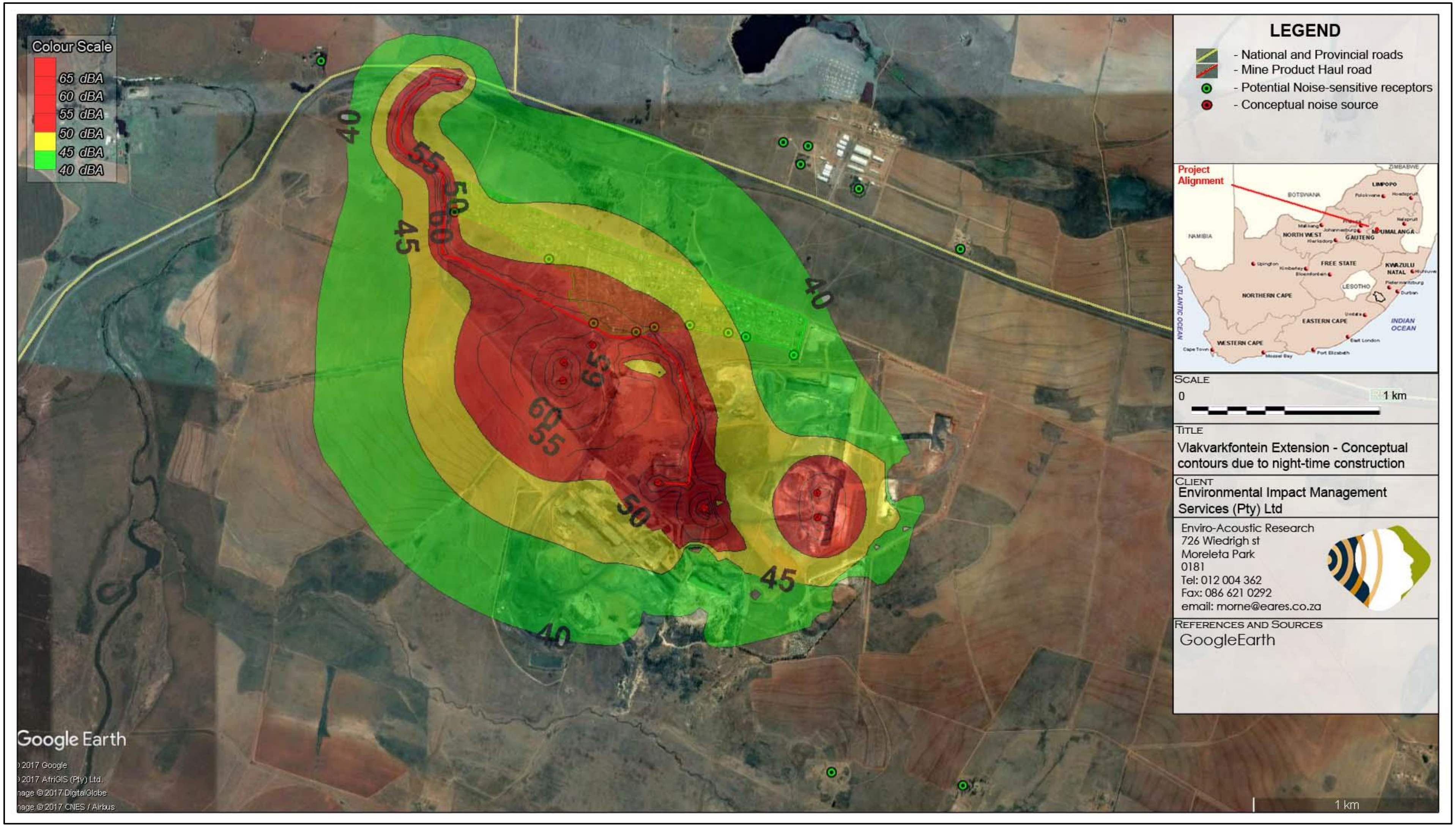

Figure 7-4: Projected conceptual construction noise levels - contours of noise levels (night-time)

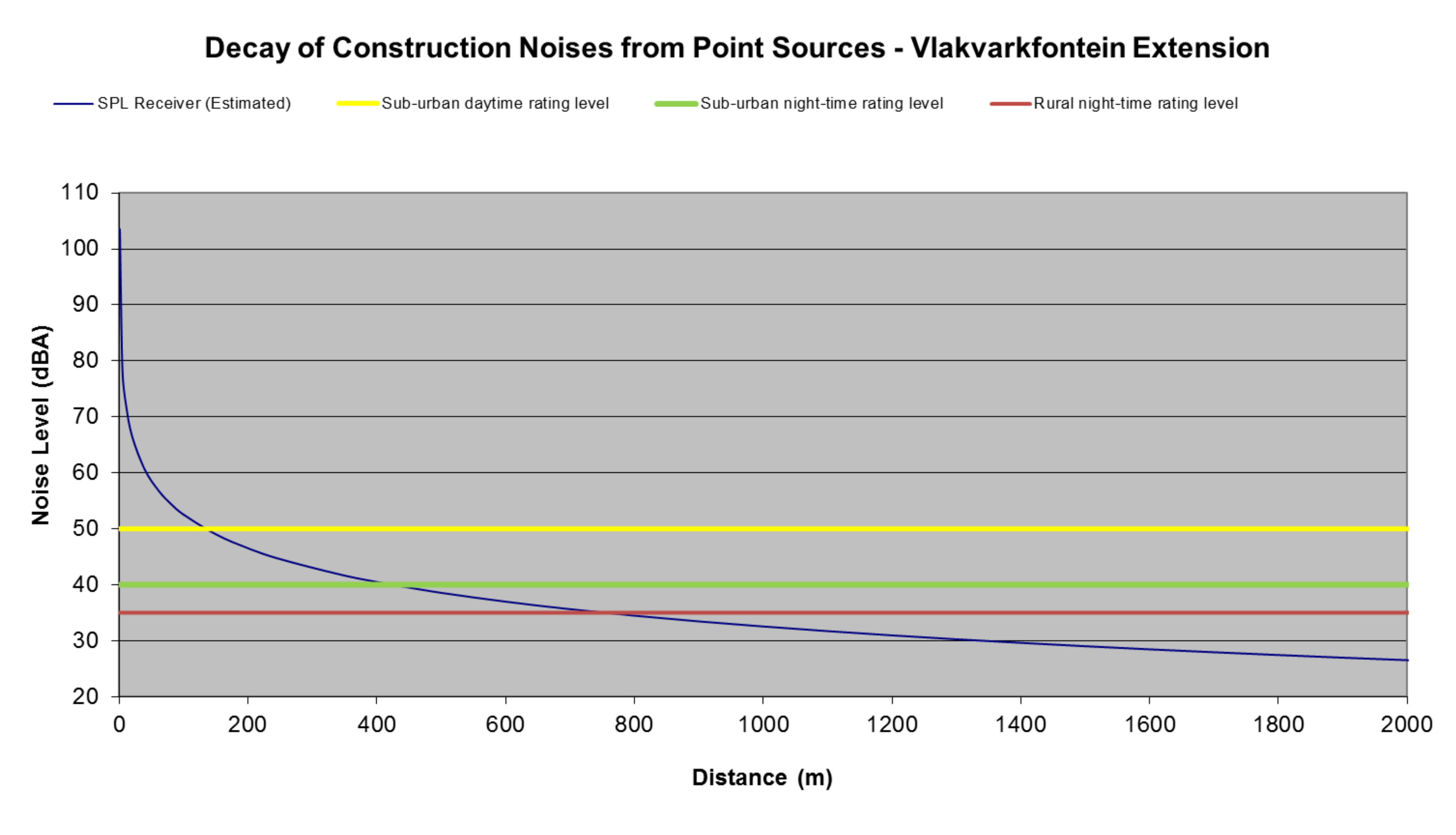

Figure 7-5: Conceptual construction noise levels over distance from point sources

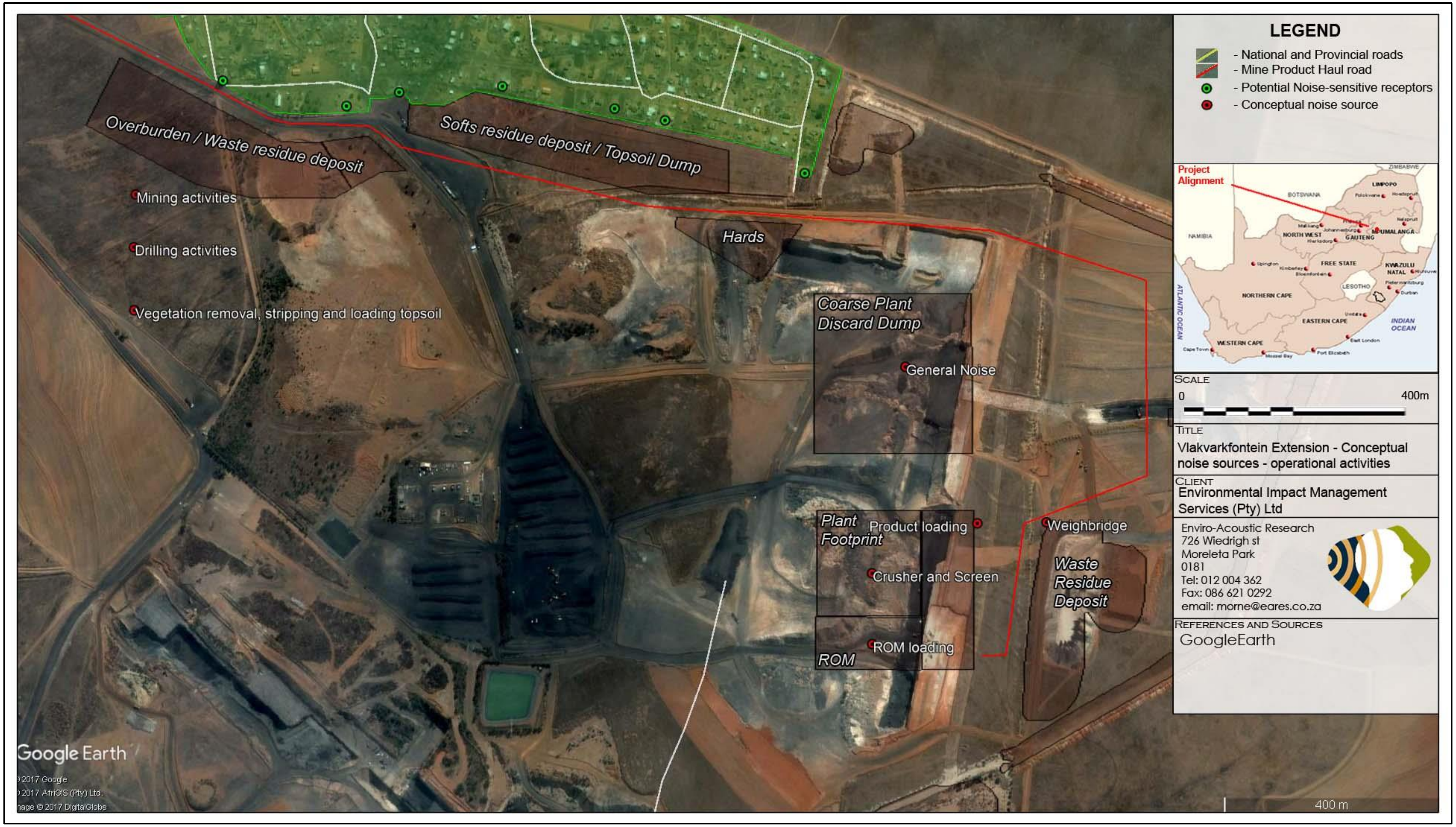

Figure 7-6: Conceptual operational noise activities

Figure 7-7: Projected conceptual operational noise levels - contours of noise levels (daytime)

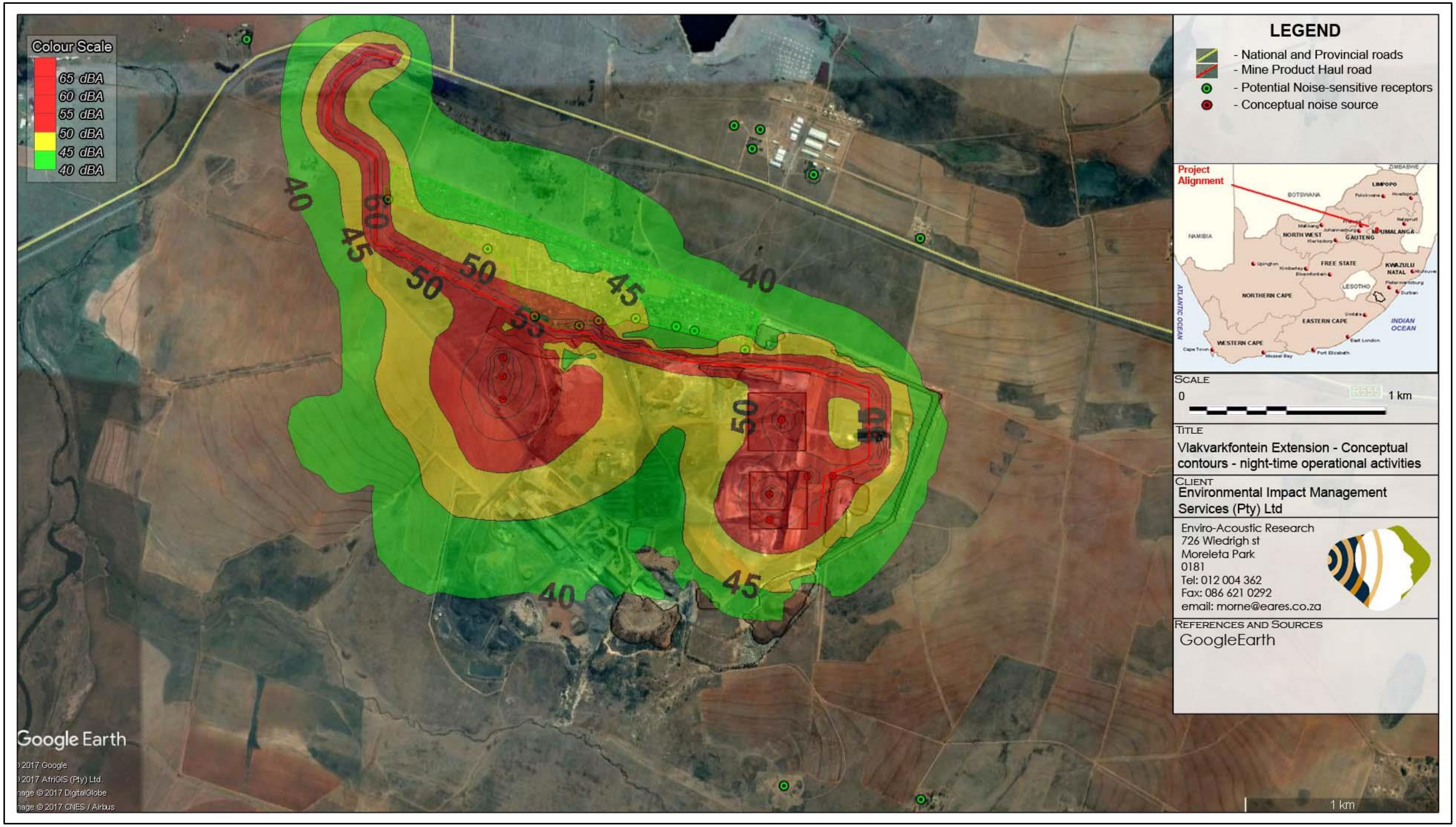

Figure 7-8: Projected conceptual operational noise levels - contours of noise levels (night-time)

8 SIGNIFICANCE OF THE NOISE IMPACT

8.1 Construction Phase Noise Impact

The potential noise-generating construction activities as discussed in **section 4.2**, conceptualized as per **Figure 7-1** was modelled, with the potential noise rating levels illustrated in **Figure 7-3** and **Figure 7-4**. The significance of the potential noise impacts are defined in **Table 8-1** for the daytime scenario, using the criteria as described in **Table 5-2** to **Table 5-8**. **Table 8-2** define the significance of the potential noise impact for the night-time scenario.

The noise impact assessment considers the potential worst-case noise impact, with conceptual noise generating activities taking place close to the community living just north of the mining area. As can be seen from the noise contours, the development of waste disposal facilities close to the community could have a significant impact on the noise levels, especially if the activities take place at night.

The placement of stockpiles and waste disposal facilities between the community and the mine would assist in noise management as these structures will act as a noise barrier to a certain extent. The development of such structures close to the community should ideally be limited to day-time activities.

This is also importance considering the location alternatives for waste disposal, as the potential effect of increased noise levels depends on the distance between the potential noise-sensitive receptors and the noise-generating activities.

Table 8-1: Impact Assessment: Construction Activities – daytime scenario

Impact Name	**Increase in noise levels at surrounding receptors due to construction activities in the day**				
Alternative	**Alternative 1**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	2	2	Reversibility of Impact	1	1
Duration of Impact	2	2	Probability	4	3
Environmental Risk (Pre-mitigation)					-10.00
Mitigation Measures					
See section 9.1.1					
Environmental Risk (Post-mitigation)					-6.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1

The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-7.00

Table 8-2: Impact Assessment: Construction Activities – night-time scenario

Impact Name	**Increase in noise levels at surrounding receptors due to construction activities at night**				
Alternative	**Alternative 1**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	3	3	Reversibility of Impact	1	1
Duration of Impact	2	2	Probability	5	3
Environmental Risk (Pre-mitigation)					-13.75
Mitigation Measures					
See section 9.1.1					
Environmental Risk (Post-mitigation)					-7.50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-8.75

Table 8-3: Impact Assessment: Daytime coal haulage during construction phase

Impact Name	**Increase in noise levels at surrounding receptors due to coal hauling during the day**				
Alternative	**Alternative 1**				
Phase	**Construction and Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	2
Extent of Impact	2	2	Reversibility of Impact	1	1
Duration of Impact	4	4	Probability	3	2
Environmental Risk (Pre-mitigation)					-9.00
Mitigation Measures					
See section 9.1.2					
Environmental Risk (Post-mitigation)					-4.50
Degree of confidence in impact prediction:					High
Impact Prioritisation					

Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-5.25

Table 8-4: Impact Assessment: Night-time coal haulage during construction phase

Impact Name	**Increase in noise levels at surrounding receptors due to coal hauling activities at night**				
Alternative	**Alternative 1**				
Phase	**Construction and Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	2
Extent of Impact	3	3	Reversibility of Impact	1	1
Duration of Impact	4	4	Probability	4	3
Environmental Risk (Pre-mitigation)					-13.00
Mitigation Measures					
See section 9.1.2					
Environmental Risk (Post-mitigation)					-7.50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-8.75

8.2 OPERATIONAL PHASE NOISE IMPACT

The potential noise-generating operational activities as discussed in **section 4.3**, conceptualized as per **Figure 7-6** was modelled, with the potential noise rating levels illustrated in **Figure 7-7** and **Figure 7-8**. The significance of the potential noise impacts are defined in **Table 8-5** for the daytime scenario, using the criteria as described in in **Table 5-2** to **Table 5-8**. **Table 8-6** define the significance of the potential noise impact for the night-time scenario using the same criteria.

The noise impact assessment considers the potential worst-case noise impact, with conceptual noise generating activities taking place close to the community living just north of the mining area. As can be seen from the noise contours, the development of waste disposal facilities close to the community could have a significant impact on the noise levels, especially if the activities take place at night. If a waste disposal deposit can be developed between the mining site and the community during the construction phase (during the day), this will assist in reducing operational noise levels as these structures will act as a noise barrier to a certain extent.

This is relevant for the waste disposal alternatives, as the potential effect of increased noise levels depends on the distance between the potential noise-sensitive receptors and the noise-generating activities. In terms of noise impacts there is no preference for any of the waste disposal alternatives. All three alternatives could pose a noise risk of similar significance (if located at the same distance from the community), although all three alternatives can be mitigated when considering the mitigation measures proposed.

Table 8-5: Impact Assessment: Operational Activities – daytime mining activities

Impact Name	**Increase in noise levels at surrounding receptors due to operational mining activities in the day**				
Alternative	**Alternative 1**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	2	Reversibility of Impact	1	1
Duration of Impact	4	4	Probability	3	2
Environmental Risk (Pre-mitigation)					-8.25
Mitigation Measures					
See section 9.2					
Environmental Risk (Post-mitigation)					-5.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-5.83

Table 8-6: Impact Assessment: Operational Activities – night-time scenario

Impact Name	**Increase in noise levels at surrounding receptors due to operational mining activities at night**				
Alternative	**Alternative 1**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	3	3	Reversibility of	1	1

			Impact		
Duration of Impact	4	4	Probability	5	3
Environmental Risk (Pre-mitigation)					-16.25
Mitigation Measures					
See section 9.2					
Environmental Risk (Post-mitigation)					-9.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-10.50

8.3 DECOMMISSIONING AND CLOSURE PHASE NOISE IMPACT

Final decommissioning activities will have a noise impact lower than either the construction, operational or first stage decommissioning phases. This is because decommissioning activities normally take place during the day using minimal equipment (due to the decreased urgency of the project). The previously mined opencast areas would have been rehabilitated during the operational and stage one decommissioning phases minimising activities to the plant area (demolishing and some rehabilitation activities). While there may be various activities, there is a very small risk for a noise impact.

8.4 EVALUATION OF ALTERNATIVES

8.4.1 Alternative: No-go option

The ambient sound levels will remain as is. The noise levels experienced by the surrounding receptors (from the activity) are relatively low.

8.4.2 Alternative 1: Development of the Vlakvarkfontein Extension

The additional activities (worse-case evaluated) will raise the noise levels from the project during the construction phase (from existing noise levels). Noise levels during the operational phase would be similar to the existing noise levels. The changes in ambient sound levels, maximum noises and total noise levels could be significant at night and the closest receptors may find the noises disturbing and unacceptable. Management and mitigation are available to reduce the significance of the noise impact, but the mining activity will be audible and the closest receptors may still find it disturbing.

In terms of the waste disposal alternatives, the noise impact assessment considers the potential worst-case noise impact, with conceptual noise generating activities taking place close to the community living just north of the mining area. As can be seen from the noise contours, the development of waste disposal facilities close to the community could have a significant impact on the noise levels, especially if the activities take place at night. However, if a waste disposal deposit can be developed between the mining site and the community during the construction phase (during the day), this will assist in reducing operational noise levels as these structures will act as a noise barrier to a certain extent. All three waste disposal alternatives could pose a noise risk of similar significance (if located at the same distance from the community), although all three alternatives can be mitigated when considering the mitigation measures proposed.

The development of the mining project will however create employment as well as secondary business opportunities. It will generate a financial benefit on a regional to national scale by extracting a valuable mineral resource.

9 MITIGATION OPTIONS

Mitigation can be divided into technical and management options. Technical options may include the use of quieter equipment or the use of berms (acoustical screens) between the noise sources and the receptors. Management options include operating at different times, operating equipment at different locations as well as limiting the simultaneous use of equipment. Monitoring may be required to measure the success of the mitigation measures. However, even with the best mitigation, it is possible that people may hear the mining operation at night. Reverse alarms and other impulsive sounds do have a nuisance effect and people may complain.

As such the following general comments are for the mine developer to note:

1. Good public relations are essential. At all stages surrounding receptors should be informed about the sound generated by proposed project. The information presented to stakeholders should be factual and should not set unrealistic expectations. It is counterproductive to suggest that the operation will be inaudible, or to use vague terms like "quiet". While noise levels from the mine would be similar and even less than the typical sound levels at receptors, there will be periods when noises will be audible from the mine. The magnitude of the sound will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Similarly, 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 as well as the level and character (spectral, tones and impulsive) of noises generated at the mine. Psychoacoustics is even more complex, but it has been found that a negative attitude towards a development do influence the possibility of noise complaints.
2. 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 a economic benefit to the greater population. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the wind farm, to ensure they do not feel that advantage have been taken of them.
3. 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.

9.1 CONSTRUCTION PHASE

Due to the high significance for a noise impact to occur, specific mitigation options are required during the construction of the mining infrastructure. It is highly recommended that the mine include an Environmental Awareness component in their Safety and Health induction which should include a sound and noise facet (to allow employees and contractors to realize the potential noise risks that activities - especially night-time activities - pose to the surrounding environment). All employees and contractors should receive this training.

9.1.1 Mitigation of construction activities

Generalized mitigation measures are further highlighted for the mine developer to note as this may assist in reducing events where increased noises may affect surrounding receptors:

- The development and implementation of an Environmental Awareness section in the Safety and Health Induction training programme.
- Planning to use stockpiles and residue deposits to assist as acoustical screens.
- The use the smaller/quieter equipment when operating near receptors;
- The developer should investigate the use of white-noise generators instead of tonal reverse alarms on heavy vehicles operating on roads, in mine pits and at stockpile areas[10]. This option is highly recommended although it must be noted that reverse alarms is 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";*
- Where possible, only operate during the day. If night-time construction activities are required, do not operate closer than 200m from any receptors (prevent a noise level exceeding 47 dBA at receptors); Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures.
- Use available material to develop a berm between construction activities and surrounding noise-sensitive receptors to break the line of sight as soon as possible. This berm should ideally be constructed during the daytime using minimal equipment. With correct implementation such a berm can significantly reduce noise levels at the surrounding receptors.
- The development and implementation of a quarterly noise monitoring programme.

9.1.2 Mitigation of coal haulage during construction and operational phases

The hauling of coal could have a significant impact on the closest receptors in the informal community living just north of the mining site, especially for night-time coal hauling activities. This can be managed by considering and implementing mitigation measures feasible for this specific operation:

- Relocating the haul route such as an agreement to use the same haul road as Westcoal.
- Minimize night-time (especially between 23:00 and 04:00) activities to minimize impact on sleeping patterns in the closest community members.
- Optimal use of berms and barriers between the haul road and the community, especially a berm that can completely block the line of sight.
- Vehicles can travel slower past the community at night.
- Ensuring that the truck drivers participate in an environmental induction programme, highlighting the need to consider the local community (topics such as slower driving, minimal use of hooters, minimal use of air-brakes, maintenance of haul trucks).

9.2 OPERATIONAL PHASE

There is a risk of a noise impact during the operational phase of medium significance. Mitigation options proposed to minimise the generation of disturbing noise levels and noise complaints.

The potential mitigation measures include:

- The continued implementation of an Environmental Awareness section in the Safety and Health Induction training programme.
- Placement of stockpiles and residue deposits to assist as acoustical screens.
- Minimise night-time operational activities within 200m from identified receptors (if not taking place behind a berm).

[10] White Noise Reverse Alarms: http://www.brigade-electronics.com/products.

- If taking place behind a berm (at least 5 m high), minimise night-time operational activities within 100m from identified receptors.
- Selecting the most appropriate coal haulage option (see section 9.1.2).

9.3 SPECIAL CONDITIONS

9.3.1 Conditions for inclusion in the Environmental Authorisation

Conditions that should be included in the Environmental Authorization include:

- An Acoustical Measurement & Audit Programme must be developed and implemented before the construction of the new opencast pit (the Vlakvarkfontein Extension). Noise measurements should continue as long as mining activities take place within 500 m from the closest potential noise-sensitive receptors;
- Planning to use available stockpiles and residue deposits as berms to assist with acoustical screening;
- The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 1,000 m from any mining activities; and
- If blasting is required to take place near a receptors dwelling (within 500 m), the developer must consult with a Vibration & Blasting Specialist.
- The mine should be able to indicate that they considered the various mitigation measures proposed in this report, and reasons why it could not be implemented or why it is not feasible.

9.3.2 Conditions for inclusion in the Environmental Management Programme

The aspects that could be included in the EMP to ensure compliance with the Noise Control Regulations include the following:

- An Acoustical Measurement & Audit Programme must be developed and implemented before the construction of the new opencast pit. Noise measurements should continue as long as mining activities take place within 500 m from the closest potential noise-sensitive receptors;
- The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 1,000 m from any mining activities; and,
- If blasting is required to take place near a receptors dwelling (within 500 m), the developer must consult with a Vibration & Blasting Specialist.
- The mine should be able to indicate that they considered the various mitigation measures proposed in this report, and reasons why it could not be implemented or why it is not feasible.

10 ENVIRONMENTAL MONITORING PLAN

Environmental Noise Monitoring can be divided into two distinct categories, namely:

- Passive monitoring – the registering of any complaints regarding noise; and
- Active monitoring – the measurement of noise levels at identified locations.

As there are a potential for a noise impact, active environmental noise monitoring is recommended. Additional monitoring should be undertaken should a valid complaint be registered. The mine must investigate any such complaint as per the following sections. It is recommended that the noise investigation be done by an independent acoustic consultant.

10.1 MONITORING LOCALITIES AND PROCEDURES

10.1.1 Monitoring Localities

Day and night-time measurements are recommended at the community north of the mining area. Additional noise measurements should be collected at the location of the person that registered a noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. A second instrument must be deployed at the mine during the measurement.

10.1.2 Monitoring Procedures

Ambient sound measurements should be collected as defined in SANS 10103:2008. If a safe and secure measurement location can be identified, it is recommended that semi-continuous measurements are conducted over a period of at least 16 hours, covering the full daytime period of 06:00 – 22:00. Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise. The equipment could also be set to record the 1-second sound level. If measurements are collected due to a noise complaints, sound level measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event.

If no safe and secure measurement location can be identified for longer term measurements, shorter measurements can be collected, together with notes about the sounds as can be heard by the specialist.

10.2 RELEVANT STANDARD FOR NOISE MONITORING

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008.

10.3 MONITORING FREQUENCIES

Quarterly noise monitoring is recommended. An additional noise measurement location can be added to investigate a noise complaint during the quarterly monitoring.

10.4 DATA CAPTURE PROTOCOLS

10.4.1 Monitoring Technique

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008.

10.4.2 Variables to be Analysed

Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise.

10.4.3 Database Entry and Backup

Data must be store unmodified in the electronic file saved from the instrument. This file can be opened to extract the data to a spread sheet system to allow the processing of the data and to illustrate the data graphically. Data and information should be safeguarded from accidental deletion or corruption.

10.4.4 Feedback to Receptor

A monitoring report must be compiled considering the requirements of the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. The mine must provide feedback to the potential noise-sensitive receptors using the channels and forums established in the area to allow interaction with stakeholders, alternatively in a written report.

10.5 STANDARD OPERATING PROCEDURES FOR REGISTERING A COMPLAINT

When a noise complaint is registered, the following information must be obtained:

- Full details of the complainant;
- Date and approximate time when this non-compliance occurred;
- Description of the noise or event.

11 CONCLUSIONS AND RECOMMENDATIONS

Enviro-Acoustic Research CC was contracted by EIMS (the EAP) to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the proposed development of the Vlakvarkfontein Extension east of Delmas, Mpumalanga.

The existing soundscape was assessed by means of sound measurements during a site visit in November 2017. A number of 10 minute measurements were taken over a five night-time period at two different locations.

Both measurement locations showed significantly elevated ambient sound levels, with natural noises (wind induced and faunal) playing a significant role in these high ambient sound levels. It is unknown how ambient sound levels will change during other seasons and the mine will benefit to define ambient sound levels during different seasons.

Conceptual noise propagation models were developed for various scenarios as described in this report. The output of the modelling highlighted a potential for a noise impact of medium significance due to construction and operational activities.

While there is a risk of a noise impact, this impact can be mitigated and reduced, with the magnitude of the reduction depending on the options selected as well as how the operation is managed. The proposed project will not introduce potential fatal flaws in terms of acoustics. With the selection of the required mitigation options, projected noise levels can be managed and this project can be authorized.

12 THE AUTHOR

The author of this report, M. de Jager (B. Ing (Chem), UP) graduated in 1998 from the University of Pretoria. He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker enclosure design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. As from 2007 he has been involved with the following projects:

Wind Energy Facilities	*Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), iNCa Gouda (Aurecon SA), Kangnas (Aurecon), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Happy Valley (SE), Deep River (SE), Saldanha WEF (Terramanzi), Loeriesfontein (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Plateau East and West (Aurecon), Saldanha (Aurecon), Veldrift (Aurecon), Tsitsikamma (SE), AB (SE), West Coast One (SE), Namakwa Sands (SE), Dorper (SE), VentuSA Gouda (SE), Amakhala Emoyeni (SE), Klipheuwel (SE), Cookhouse (SE), Cookhouse II (SE), Canyon Springs (Canyon Springs), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Outeniqwa (Aurecon), Koningaas (SE), Eskom Aberdene (SE), Spitskop (SE), Rhenosterberg (SiVEST), Bannf (Vidigenix), Wolf WEF (Aurecon)*
Mining and Industry	*BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Delft Sand (AGES), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream), EastPlats (CleanStream), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali)*
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping*
Noise monitoring	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional, Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind),*

	Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon)
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), Natref (NEMAI), RareCo (SE), Struisbaai WEF (SE)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (Savannah), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy)*

13 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2010, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the propose d activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010.

____
Signature of the environmental practitioner:

Enviro-Acoustic Research cc
Name of company:

27 November 2017
Date:

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no go” alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.

Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 µ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that

Assessment	requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$) to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound

	are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} *and* L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings;

	e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.

Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

Site Investigation – Photos of monitoring locations

Photo B.1: Measurement location VVFASLLT01

(Vlakvarkfontein Colliery in far distance, R555 around 80 from microphone)

Photo B.2: Measurement location VVFASLLT02

(Vlakvarkfontein Colliery in far distance)

Photo B.3: Measurement location VVFASLLT03

End of Report