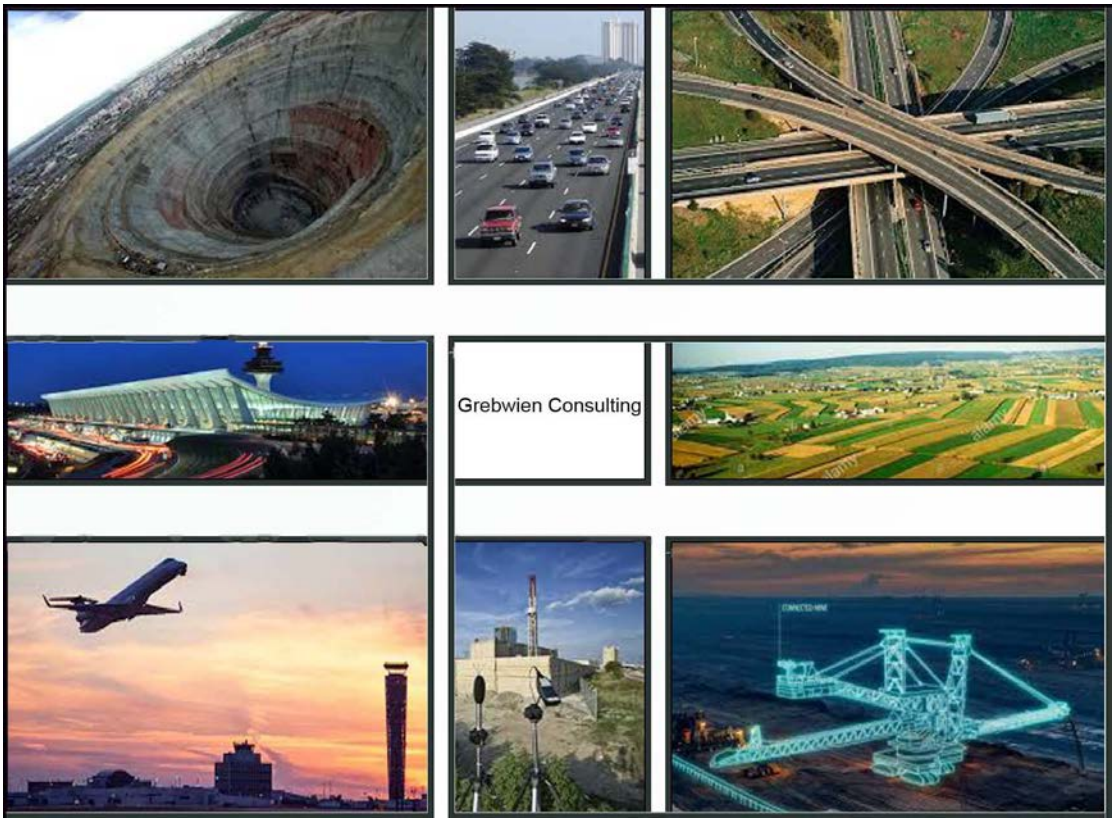
Bauba A Hlabirwa Mining Investments (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT REPORT

The extension of the Bauba Moeijelijk Mining Project, Limpopo Province



Study done for:

Prepared by:
Grebwien Consulting

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EXECUTIVE SUMMARY

INTRODUCTION

Grebwien Consulting was commissioned by Red Kite Environmental Solutions (Pty) Ltd (the main consultant) to conduct an Environmental Noise Impact Assessment (ENIA) report for the Moeijelijk Chrome Mine's project extensions. Bauba A Hlabirwa Mining Investments (Pty) Ltd (Bauba) proposes extensions to their existing chrome mine situated within the Limpopo province. The Terms of reference for this study has been based on the methodology described in the National/International guidelines and regulations: SANS 10103:2008, GN R154 (Noise Control Regulations) and IFC: General EHS Guidelines (Equator Principal).

BASELINE

Twelve (12) potential noise receptors were identified, including the local Tsibeng community. Measurements taken within the study area and indicated that receptors were generally subjected to a rating level of:

- "Suburban Noise Districts" (50 and 40 dBA day/night-time Rating Level - SANS 10103:2008).

FINDINGS

The report considers worst-case scenarios, evaluating the potential noise impact during peak hours. The results of the full ENIA evaluation and the resultant significance rating of the noise impacts would be:

- Low during Planning phase;
- Medium during Construction activities;
- Medium-high significance during the Operational phase;
- Medium during Closure and Decommissioning phase; and
- Low during the Post-Closure Phase.

Mitigation options in the planning and operational phases would be required. With the implementation of mitigation measures a low operational significance could be achieved. It should be noted that this does not suggest that the sound from the project should be inaudible, however it should be in line with legislative requirements.

RECOMMENDATIONS

The most important mitigation options recommended include the screening (i.e. masking of the noise by berm/barrier etc.) of the plant area and open cast areas and in relation to the closest receptors (receptors bordering the project). The plant areas should be enclosed with any external ventilation facing away from receptors. A berm needs to be implemented between the open cast pits and the Tsibeng community. It must also be noted that if blasting is required to take place near a receptor's dwelling (within 500 m), the developer must consult with a Vibration & Blasting Specialist. An annual Acoustical Measurement & Audit Programme is recommended to be implemented prior to construction phase. If the project layout or report assumptions changes, then these findings should be re-evaluated. The project will not present a fatal flaw in terms of noise. It is thus recommended that the project be approved, however mitigation options must be adhered to.

Title:

Weinberg, SJ. 2017. "*Environmental Noise Impact Assessment Report: The development of the Bauba Platinum Farms Mining Project, Limpopo Province"*. Grebwien Consulting

Client:

Red Kite Environmental Solutions (Pty) Ltd
on behalf of
Bauba A Hlabirwa Mining Investments (Pty) Ltd

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Totiusdal
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Report no. & Date

MCM – 2017 rev. 0
November 2017

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GLOSSARY OF ABBREVIATIONS

ADT	Articulated Dump Trucks
app.	Approximately
AQA	National Environmental Management: Air Quality Act,
dB	Decibel
dBA	Decibel A weighted
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act (Act No. 78 of 1989)
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ENIA	Environmental Noise Impact Assessment
ENPAT	Environmental Potential Atlas of South Africa
EP	Equator Principles
EPFI	Equator Principles Financial Institution
f	fast setting, see Appendix A
FEL	Front End Loader
GN	Government Notice
h	Hour(s)
Hz	Hertz
i	Impulse setting, see Appendix A
I&APs	Interested and Affected Parties
IEC	International Electrotechnical Commission
IEM	Integrated Environmental Management
IFC	International Finance Corporation
i.e.	that is
kg/m^2	Kilogram per Square Meter
km	kilometres
km/h	Kilometres per hour
LHD	Load haul dumpers
m	Meters (measurement of distance)
m^2	Square meter
m^3	Cubic meter
m/s	Meters per Second
mm	Millimetre
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
p/h	Per Hour

ROM	Runoff Mine
RPM	Revs per minute
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Levels
t	Time
UTM	Universal Transverse Mercator
VCI	Visual Condition Index
WHO	World Health Organisation

1 DECLARATION & SPECIALIST CHECKLIST

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Specialist:	Environmental Noise		
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Professional affiliation(s) (if any)			

Project Consultant:			
Contact person:			
Postal address:			
Postal code:		Cell:	
Telephone:		Fax:	
E-mail:			

The specialist appointed in terms of the Regulations

I, **Shaun Weinberg**, declare that (General declaration):

- I act as the independent specialist 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 the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- 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;
- all the particulars furnished by me in this form are true and correct; 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.

Signature of the specialist:

Grebwien Consulting
Name of company:

Date:

Checklist in terms of Regulation GNR 982 of 2014, Appendix 6

(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 1**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Section 1**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 2**
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Section 8**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	**Section 4 Section 5** and **Section 7**
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	**Section 1** and **Section 4**
(g) an identification of any areas to be avoided, including buffers;	**Section** It should be noted that buffers and constraints map is only used to identify areas of concern and not a no-go indicator.
(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;	**Section 10**
(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;	**Section 10**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None received
(p) any other information requested by the competent authority	Nothing requested

2 INTRODUCTION

2.1 INTRODUCTION AND PURPOSE

Grebwien Consulting was commissioned by Red Kite Environmental Solutions (Pty) Ltd (the main consultant) to conduct an Environmental Noise Impact Assessment (ENIA) report for the Moeijelijk Chrome Mine's project extensions. Bauba A Hlabirwa Mining Investments (Pty) Ltd (Bauba) proposes extensions to their existing chrome mine situated within the Limpopo province.

The Terms of Reference (ToR) for this study has been based on the methodology described in the National/International guidelines and regulations: SANS 10103:2008, GN R154 (Noise Control Regulations) and IFC: General EHS Guidelines (Equator Principal).

2.2 BRIEF PROJECT DESCRIPTION

The Moeijelijk Chrome Mine's operations are a basic open cast truck and excavator operation. A basic overview of current operations includes:

- Open cast pits mined in a typical grid by grid truck and excavator method. Stripping of overburden/topsoil stockpiled onsite and ROM mined; and
- ROM hauled to markets via side tipping interlinks.

The following project extensions are proposed:

- New open cast pits mined in the same methodology as their current open cast operations;
- Haul route to link open cast pits to the proposed plant area; and
- A new plant entailing crushing, washing and screening.

The project boundary in its regional setting is presented in **Figure 2-1**.

2.3 STUDY AREA

The study area consists of components that may affect the sound environment.

2.3.1 Topography

ENPAT[1] describes the surrounding land use as *"Low mountains".* This project and study area is located on a relatively flat geographical section from a visual perspective. The mine has implemented significant berms around the existing open cast areas and in relation to the receptors within the study area.

[1] Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "*Environmental Potential Atlas for South Africa"*, Pretoria, 1998.

2.3.2 Surrounding Land Use

The zoning of the land use was not defined, but considering the onsite investigations, the area may be a residential (community) area. Some business and educational facilities exist within the residential area(s). Certain mining activities (including Bauba chrome mine) feature in the surrounding areas.

2.3.3 Transportation Networks

The most important roads (in terms of calculable acoustics near a receptors dwelling) is the R37 route. This road is presumably a high class district distributor[2]. It is expected that vehicle speeds on these roads would range from 60 - 80[3] km/h. The route is a single lane (alternative directions) paved road, with no stop junctions in the study area. From a visual inspection the road surfaces may be classified as poor – fair in terms of the Visual Condition Index (VCI) (this is relevant due to the paving-tyre interaction as vehicle speeds exceed 60 km/h. s). Smaller (less significant) single carriage paved roads exist in the study area, linking residential areas to higher class networks.

The mine itself has internal haul roads that link open cast and underground mining areas to local transportation areas.

2.3.4 Potential Sensitive Receptors (Noise-Sensitive Developments)

Residential areas and potential noise-sensitive developments/receptors were identified using tools such as Google Earth® within a distance of up to 1,000 m (recommendation SANS 10328:2003) from closest development infrastructures. Receptors were further defined by site visits (during various measurement dates) as well as information obtained from discussions with the developer and surrounding receptors.and the potential noise sensitive receptors are presented in **Figure 2-2**. One receptor/community is within the study area, namely the Tsibeng community (see **Appendix C** for UTM locality).

2.4 AVAILABLE INFORMATION

Bauba A Hlabirwa Mining Investments has an annual measurement report in place for their existing operations. Various available resources based on online and existing information is presented below.

Table 2-1: Available information

Information description
S. Weinberg. *"Moeijelijk Chrome Mine on the 29 September – 2 October 2017, Limpopo Province"*. Grebwein Consulting. 2017
S. Weinberg. *"The development of the Bauba Platinum Farms Mining Project, Limpopo Province"*. Grebwein Consulting. 2017

[2] Committee of Transport Officials. "*TRH 26, South African Road Classification and Access Management Manual*". Version 1.0.2012.
[3] NO. 93 OF 1996: NATIONAL ROAD TRAFFIC ACT, 1996.

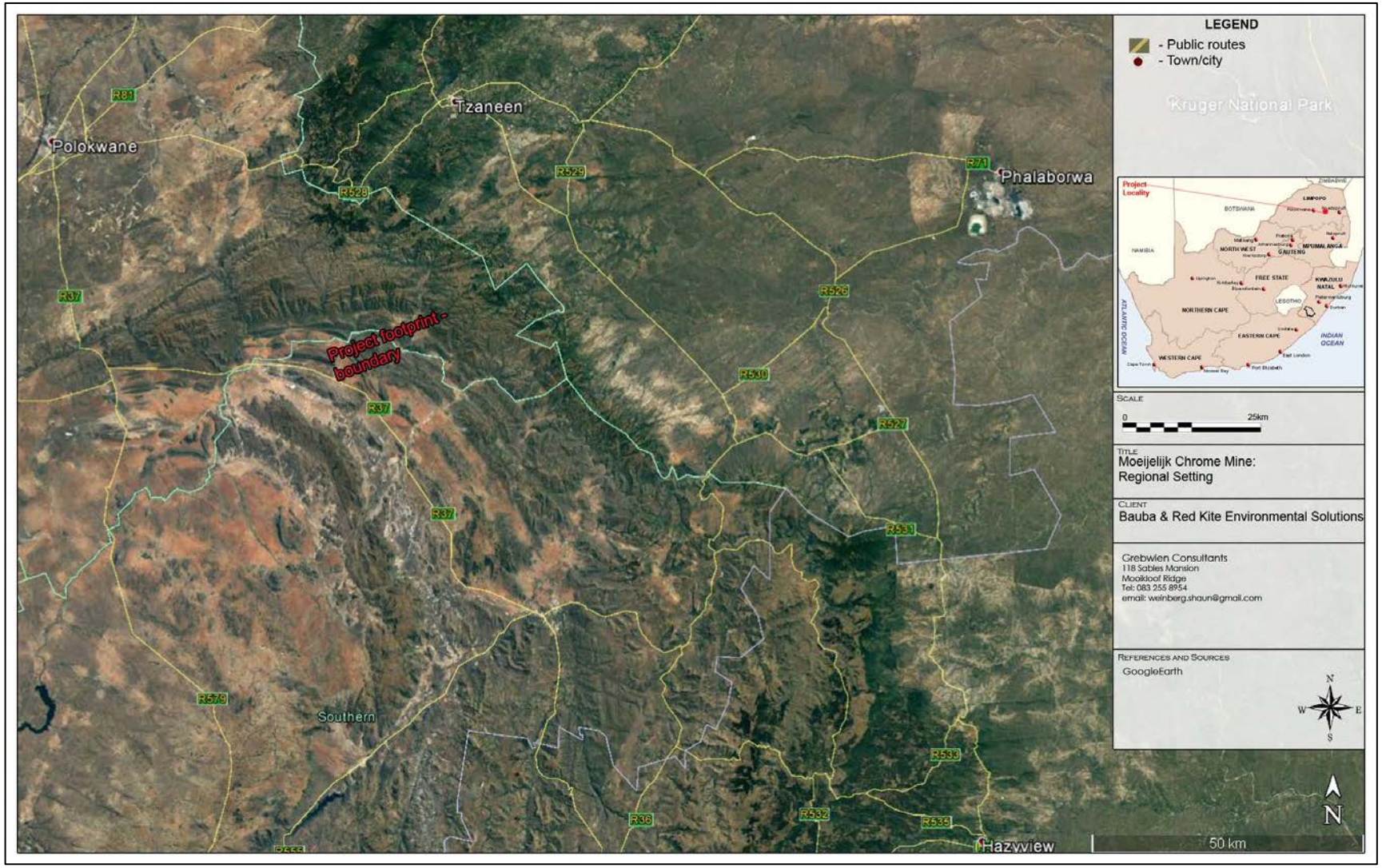


Figure 2-1: Site map indicating the regional locality of the project

Figure 2-2: Study area of Noise-Sensitive Developments for assessment purpose

3 LEGAL CONTEXT, POLICIES AND GUIDELINES

3.1 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 in the particular circumstances. The subjectivity of this approach can be problematic which has led to the development of noise standards (see **Section 3.5**).

"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.

3.2 THE ENVIRONMENT CONSERVATION ACT (ACT NO 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 3.2.1**.

3.2.1 National Noise Control Regulations (GN R154 of 1992)

The national Noise Control Regulations (NCRs) (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated in terms of section 25 of the ECA. These 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 for provincial and local authorities. Provincial Noise Control Regulations exists in the Free State, Gauteng and Western Cape provinces.

The National Noise Control Regulations (GN R154 1992) defines:

"**controlled area**" as:

a piece of land designated by a local authority where, in the case of--

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 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA.

"**disturbing noise**" as:

noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

"**zone sound level**" as:

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 the same as the Rating Level as defined in SANS 10103.

In addition:

In terms of Regulation 2 -

"A local authority may –

(c):"if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;

(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or (c), reports or certificates in relation to the noise impact to the satisfaction of that local authority are submitted by the owner, developer, tenant or occupant to the local authority on written demand".

In terms of Regulation 4 of the Noise Control Regulations:

"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

Clause 7.(1) however exempts noise of the following activities, namely -

"The provisions of these regulations shall not apply, if -

(a) the emission of sound is for the purposes of warning people of a dangerous situation;

(b) the emission of sound takes place during an emergency."

3.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO 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 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.

In addition, Appendix 6 of National Environmental Management Act, 1998 (Act No. 107 of 1998), GN 326 of 07 April 2017, issued in terms of this Act, have general requirements for Environmental Assessment Practitioners (EAPs) and specialists. It also defines minimum information requirements for specialist reports.

3.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT ("AQA" – ACT NO 39 OF 2004)

Section 34 of the National Environmental Management: Air Quality Act (Act No. 39 of 2004) 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 is in force, but no such standards have yet been promulgated. 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 respect of noise.

3.4.1 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 to deal with most of the air quality management challenges. With

Noise Control being covered under the Air Quality Act (Act No. 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 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.

3.5 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from developments, 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'.
- 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.*

It must be noted that SANS10103:2008 does stipulate *"for industries legitimately operating in an industrial district during the entire 24 h day/night cycle,* $L_{Req,d} = L_{Req,n} = 70$ *dBA can be considered as typical and normal".*

3.6 INTERNATIONAL GUIDELINES

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

3.6.1 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. It discusses the specific effects of noise on communities including:

- Interference with communication, noise-induced hearing impairment, sleep disturbance effects, cardiovascular and psychophysiological effects, mental health effects, effects on performance, annoyance responses and effects on social behavior.

It further discusses how noise can impact (and propose guideline noise levels) on specific environments such as:

- Residential dwellings, schools and preschools, hospitals, ceremonies, festivals and entertainment events, sounds through headphones, impulsive sounds from toys, fireworks and firearms, parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. At night, equivalent sound levels at the outside facades of the living spaces should not exceed 45 dBA and 60 dBA L_{Amax} so that people may sleep with bedroom windows open.

It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

3.6.2 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."

3.6.3 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. Revision III of the EPs has been in place since June 2013. The participating banks chose to model the Equator Principles on the environmental standards of the World Bank (1999) and the social policies of the International Finance Corporation (IFC). Eighty-three financial institutions (2016) 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.

3.6.4 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 Principles. 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.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from project facilities/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 propose 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 below) 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 3-1: 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 in Europe.

In South Africa, Swaziland and Mozambique (study areas for Grebwien Consulting) a trend for community encroachment closer to industrial zoned areas has been seen. This makes it difficult for certain industries with residential areas adjacent to an industrial zone to meet the criteria of the 45 dBA set out by the International Finance Corporation.

3.6.5 Environmental Management Systems

Many organisations implement their own Environmental Management Systems tools for planning, implementing and maintaining policy for environmental protection. The more popular International system is highlighted below.

3.6.5.1 ISO 14000

ISO 14000 is a family of standards related to environmental management that exists to help organizations:

a. minimize how their operations (processes etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land);
b. comply with applicable laws, regulations, and other environmentally oriented requirements, and
c. continually improve in the above.

The term “continual improvement” refers to an on-going process of performance enhancement. In the context of this environmental standard, it means that you need to enhance your organization’s overall environmental performance by enhancing its environmental management system and by improving its ability to manage the environmental aspects of its activities, products, and services. Continual improvements can be achieved by carrying out internal audits, performing management reviews, analyzing data and implementing corrective and preventive actions.

4 EIA LEVEL INVESTIGATION OF EXISTING AND FUTURE NOISE LEVELS

The operations of certain industrial operations may occur over a 24 hour cycle (day and night). The most important time for investigations will be during the night-time hours (defined by SANS10103:2008 as 22:00 – 06:00). Five (5) scenarios will be investigated. These would include the planning, construction, operation, closure and decommissioning and post-closure phases. This will allow a comprehensive ENIA during any phase of the project. The most relevant of phases is the operational phase, as the noise capacity that can be generated during this phase can be long-term.

This document briefly discusses blasting and vibration and noise impacts on fauna. However, its methodology and purpose is environmental noise on humans as per 10328:2008. Thus, the most relevant noise to consider is surface infrastructure as underground works will not generate noise at receptors. It should be noted that certain important underground works does extend to the surface, with the most important been the mine portal.

The Sound Power Levels (SPL) used for the modelled scenario(s) are presented in **Table 4-1** (maximum noises) and **Table 4-2** (average or equivalent noises). It should be noted that such Sound Power Levels (SPL) are what a piece of equipment can generate at maximum capacity, and which was used for the worst-case evaluated scenario(s).

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

Equipment Description[4]	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
Backhoe	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
Chain Saw	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
Concrete Saw	No	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
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
Jackhammer	Yes	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
Man Lift	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
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6

[4] Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Paver	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
Pickup Truck	No	89.7	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6
Pumps	No	111.7	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6
Rivit Buster/Chipping Gun	Yes	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
Rock Drill	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
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
Sand Blasting (single nozzle)	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
Scraper	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
Sheers (on backhoe)	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
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	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
Soil Mix Drill Rig	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
Tractor	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
Vacuum Excavator (Vac-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
Vacuum Street Sweeper	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
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
Vibrating Hopper	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 Concrete 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
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
Warning Horn	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
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

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

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative and mitigation 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 D10	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 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 CAT D5	107.4	82.4	76.4	70.4	62.4	56.4	52.9	50.4	46.9	42.4	38.9	36.4	30.4
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
Dumper/Haul truck - CAT 700	115.9	91.0	85.0	78.9	71.0	65.0	61.4	58.9	55.4	51.0	47.5	45.0	38.9
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
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
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 - CAT 950G	102.1	77.2	71.2	65.1	57.2	51.2	47.6	45.1	41.6	37.2	33.7	31.2	25.1
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
Grader	110.9	85.9	79.9	73.9	65.9	59.9	56.4	53.9	50.3	45.9	42.4	39.9	33.9
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

4.1 PHASES INVESTIGATED

4.1.1 Potential Noise Sources – Design Phase

There will be no noise generating activities in this phase. However, during this phase certain mitigation options (if required) can be implemented within the design and planning of the project. This includes certain design elements or management decisions which will eliminate or reduce noise generation activities. During the mitigation options section (if mitigation options are required) this phase will be referred to again (planning phase mitigation).

4.1.2 Potential Noise Sources – Construction Phase

Construction related scenarios entail the implementation of infrastructure (subsoil, concrete and steel works etc.), haul route corridor, and open cast topsoil excavations. It should be noted that only a daytime scenario was considered.

A Front End Loader (FEL) Sound Power Level (SPL) of + 90dB was used in assessments. No berms or barriers were considered (equipment could operate in a free field condition i.e. topsoil removal and the absence of topsoil/overburden stockpiles for rehabilitation purpose). The representation is a generic linear representation of noisy construction activities that could occur during the infrastrucuture, haul route corridor or open-cast pit construction.

Most construction work would likely be conducted during daytimes. At times infrastructure construction may be conducted during the night due to:

- Concrete work that would be required during one pour (e.g. a concrete slab);
- Working overtime due to schedule constraints that was not met due to bad weather etc.

However, infrastructure construction works (if applicable) during these hours would likely be kept to a minimum or not have a potential for an impact due to:

- It will be short-term (one or two nights etc.) playing a role in making it "*Temporary*" on the impact assessment duration criteria. Although the rating level is lower during the night, the night-work (if applicable) may still be a low impact; and
- Working during the night is expensive for contractors (overtime for workers, lighting required etc.) and thus night-work would likely be kept to a minimum.

Open cast excavations/topsoil removal (i.e. construction of open cast pits) may occur during all hours including night-times.

4.1.2.1 Open cast construction/site preparation/stripping activities & stockpile construction

The following are possibly the main construction related sources of open cast pits:

- Vegetation removal and the stripping of topsoil at open cast pits by means of articulated dump trucks (ADT), Front End Loaders (FEL), dozers etc. Typical practice is to stockpile stripped topsoil on opposite parallel mining grids creating a berm, and to be used for backfilling or to be hauled to stockpiles/dumps;
- Drilling of hard overburden (surface level to illustrate a potential worst-case scenario);
- Development of the topsoil, hards, softs and overburden dumps/stockpiles (around mining pits); and
- Development of the internal and access roads.

4.1.2.2 Plant

The mine proposes a crushing, washing and screening plant. The most relevant noisy construction activities are briefly discussed below:

- Sub-soil works (compaction of soils, trenching etc.);
- Concrete pouring and vibration (no onsite batching plant was considered); and
- Cranage required moving large components and material.

4.1.2.3 Delivery/Access Routes/Corridors

Construction or upgrading or existing roads may include the following noise generating activities:

- Deliveries of different road paving aggregate and stockpiling them onsite (see **Appendix A** for definition of paving);
- Soil excavations, the removal of soils for foundations by usage of a grader (if required);
- Compaction of soils with a vibrator roller; and
- A road paver and asphalt truck working in conjunction to pave the road if bituminous tar will be used. Roads may likely be unpaved.

4.1.2.4 Blasting

Rock blasting may be required to break down rock to level the ground inside the footprint. However, blasting will not be considered during the Scoping or EIA phase for the following reasons:

- 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; 1
- 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 and the blast will be over relatively fast, resulting in a higher acceptance of the noise.

If blasting is required to take place closer than 500 m from a receptor's dwelling, it is recommended that the mine consult with a blasting specialist regarding the matter.

4.1.2.5 Discard/Mineral Residue Deposits Management/Stockpiles or Waste Rock Dumps

Stockpile development usually entails ADT's trucking the aggregate/chrome to the stockpile area and loading by means of a chute (if a ROM stockpile) or dumped by the ADT. Dust suppression trucks are in use in these areas to ensure minimal dust fallout. Hards, softs, overburden, interburden etc. may likely make use of roller compactors (steel or rubber) to ensure soil and subsoil compaction. The basic functions of an acoustical nature are briefly discussed below:

- Development and management of the stockpiles (making use of a Front End Loader - FEL);
- Compaction and management of discard residue top layers (compactor, roller grader, dust suppression by water tanker); and
- Delivery of residue via ADT's (ADT).

4.1.2.6 Baseline – Cumulative Impact

There exists other noise generating sources within the study area e.g. transportation networks. These sources will not be investigated in the designed modelled scenario as:

- Designed scenarios will be a worst-case investigation. The scenarios investigated/designed is applicable at a time at maximum capacity and should mask any other baseline noise contributors within close proximity to the project; and
- It should be noted that measured and selected Rating Level will represent the baseline noise contributors.

4.1.3 Potential Noise Sources – Operational Phase

4.1.3.1 Haul Road Design, Specifications & Information

Two separate scenarios were investigated namely 10 and 30 heavy vehicles per hour. Road paving for the haul routes will consider unpaved (dirt) roads. From a noise perspective, unpaved roads can create louder noise levels than paved routes (especially if the unpaved route is badly maintained or if the paved route considers factors to reduce noise levels). However, noise levels relating to the road paving generally depends on traffic exceeding speeds of app. +60 km/h. Mine roads usually are managed at 60 km/h (health and safety related) and thus the paving option will not play a major role in the noise levels.

4.1.3.2 Discard/Mineral Residue Deposits Management

For a designed scenario the ADT will operate as close to the receptors as feasible, while remaining on the project footprint. It should also be noted that berms would likely be implemented on the footprint of the project (e.g. a 2 m high berm on project footprint), however noise sources can extend over these berms (e.g. exhaust port above cabin of heavy equipment). A correction for berms and stockpile slopes was considered.

4.1.3.3 Plant

The following was assumed to take place at the crushing, washing and screening plant:

- Material handling/sorting/primary crushing (rotary crusher/grizzly) into manageable lumps;
- Washing and screening of ROM; and
- Weigh-bridge for trucks entering/exiting the development.

Acoustical screening was assumed around equipment (i.e. brick or building cladding around equipment). A point source of SPL 119 dB was considered at the plant area used to represent a loud noise source. A small screening correction was considered for the correction of equipment in an internal structure, certain equipment may be based outside (e.g. a crusher).

4.1.3.4 Truck and Shovel Open Cast Mining

The following noise generation activities will be modelled for the open cast operational representation scenario at the mine:

- Excavation and loading-hauling/dumping of overburden/interburden using articulated dump trucks (ADT's), Load haul dumpers (LHD's), excavators and other mining equipment. Development of boxcuts;
- Further compaction of subsoil for access routes to the pits;
- Ore excavation from open cast pits and load-haul-dumping (at the material tips);
- Dust suppression on haul routes and open cast pits by means of water dozers; and
- Pit backfill with aggregate such as topsoil (rehabilitation) etc.

During this phase surrounding berms, highwalls and stockpiles will have been developed. Berms and highwalls can provide an acoustical buffer to noise from noise source to receivers within the study area, if located correctly. As a precautious approach, the modelled scenario considered the tip of the open cast with no berm (noise source on a high point above berms and developed highwalls). The SPL mentioned in the construction section was used for assessment.

4.1.3.5 Baseline – Cumulative Impact

See section **4.1.2.6**.

4.1.4 Potential Noise Sources – Closure and Decommissioning Phase

In general, removal and rehabilitation activities have a significantly lower noise impact than both the construction and operational phases. The closure phase will be consolidated and considered the same as the construction phase for the following reasons:

- Removal and rehabilitation activities are generally less intense than construction and operational activities;
- Noise levels are lower and will be limited to daylight hours. This reduces the significance of the noise impact; and
- The impact would be similar or less than the construction phase impact.

4.1.5 Potential Noise Sources – Post-Closure Phase

No potential noise impact is envisaged during this stage.

5 METHODS: NOISE IMPACT ASSESSMENT

5.1 POTENTIAL NOISE IMPACTS ON ANIMALS[5] [6]

To date there is no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals. With the available information in mind, this document's intent remains a determination of the potential increase of the rating level at a receptor's dwelling as per legislation/guidelines, and due to a proposed noise source of significance.

Sections below briefly discuss certain studies conducted on faunal and noise.

5.1.1 Effects of Noise on Wildlife

Potential noise impacts on wildlife are very highly species-dependent. Studies showed that most animals adapt to noises and would even return to a site after an initial disturbance, even if the noise continues. The more sensitive animals that might be affected by noise would most likely relocate to a quieter area.

There are a few specific studies discussing the potential impacts of noise on wildlife associated with construction, transportation and industrial facilities. Available information indicates that noises from transportation and industrial activities may mask the sounds of a predator approaching; similarly, predators depending on hearing would not be able to locate their prey.

Many natural-based acoustics themselves may be loud or impulsive. Examples include thunder, wind induced noises that could easily exceed 35 dBA ($L_{A90,fast}$) above wind speeds averaging 6 m/s (wind conditions of a moderate breeze on the Beaufort Scale[7]), noise levels during early morning dawn chorus or loud cicada noises during late evening or early morning.

5.1.2 Effects of Noise on Domesticated Animals

It may be that domesticated animals are more accustomed to noise sources of an industrial, commercial or other anthropogenic nature, although exposure to high noise levels may affect domestic animals' well-being. Sound levels in animal shelters can exceed 100 dB, much more than what can be expected at a domestic dwelling from an industrial, commercial or transportation noise source (10 minute equivalent)[8] [9]. The high noise levels may see negative influences on animals' cardiovascular systems and behaviour, and may be damaging to the hearing of dogs in the kennel facility[(10)].

[5] USEPA, 1971: *"Effects of Noise on Wildlife and other animals".*
[6] Autumn, Lyn Radle. The effect of noise on Wildlife: A literature review. 2007.
[7] Met Office, "National Meteorological Library and Archive Fact sheet 6 – The Beaufort Scale", Version 1, Crown copyright 2010, p.4.
[8] Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[9] David Key, Essential Kennel Designs.
[10] Wei, B. L. (1969). Physiological effects of audible sound. AAAS Symposium Science, 166(3904), 533-535.

Domesticated animals may also respond differently to noises than animals in the wild. Domesticated dogs are pack animals and may respond excitedly or vocally to other noises, smells, visual and other stimulants, in contrast to wild animals that may flee at the slight sound of a noise or visual disturbances. Animals that are transported at least once in their life (such as pigs to an abattoir) would endure high noise levels for the duration of the delivery period[11]. A change in the heart rate, renal blood flow and blood pressure of study subjects were noted in the above studies.

5.1.3 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (e.g. rats, mice), the laboratory test subjects differ in many aspects (genetics, behaviour, etc.). Also, noise levels of studies are generally very high (at levels over 100 dB), much more than what would be experienced in environmental settings around industrial, commercial or transportation activities.[12] Other dissimilarities to laboratory tests and a natural environment include the time exposure (duration of noise), the spectral and noise character (impulsive noise vs. constant noise), etc. Although there exist dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels exhibited physiological and behavioural changes, hearing loss and other effects[13].

5.2 IMPACT ASSESSMENT CRITERIA

5.2.1 South African Guideline/Legislation

The South African SANS 10103:2008 guidelines were used to determine the Rating Level or change thereof (See also **Table 5-1**) It provides the equivalent ambient noise levels (referred to as Rating Levels) $L_{Req,D}$ and $L_{Req,N}$ to which various areas are defined in terms of noises. The various rating levels in the mentioned table have been colour coded by the Author for ease of use for the reader.

It must be noted that SANS 10103:2008 does stipulate *"for industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d} = L_{Req,n} = 70$ dBA can be considered as typical and normal".* Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National Noise Control Regulations).

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						**Rating colour code**
	Outdoors			Indoors, with open windows			
	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time	

[11] D B Stephens and R d Rader. J R Soc Med. 1983.
[12] USEPA, 1971: *"Effects of Noise on Wildlife and other animals".*
[13] Ann Linda Baldwin. *"Effect of Noise on Rodent Physiology"*. 2007.

			$L_{Req,n}$			$L_{Req,n}$	
a) Rural districts	45	45	35	35	35	25	Rural
b) Suburban districts with little road traffic	50	50	40	40	40	30	Suburban
c) Urban districts	55	55	45	45	45	35	Urban
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40	Busy urban
e) Central business districts	65	65	55	55	55	45	Business
f) Industrial districts	70	70	60	60	60	50	Industrial

The rating selected for the receptors in the study based on measurements (**section 8**) is as follows:

- "Suburban Noise Districts" (50 and 40 dBA day/night-time Rating Level in terms of (i.t.o). SANS 10103:2008);
- Certain areas (closer to road transportation networks) will have a higher rating than suburban.

5.2.1.1 International Finance Corporation

International guidelines should also be considered. The IFC residential, institutional and educational referenced areas include ratings of:

- Use of L_{day} of 55 dBA during the daytimes; and
- Use of L_{night} of 45 dBA during the night-time.

The Rating levels are also illustrated in **Figure 5-1** below. It should be noted that these criteria use the fast setting (also refer to **Section 3.6**). In the measured section if the fast setting is exceeded by the above criteria it will be highlighted in **bold red** for better referencing.

Figure 5-1: Rating Level

5.2.2 Assessment Criteria of the Potential Noise Impact

The impact matrix template was designed by the main consultant and was defined by the author to better suite acoustics. The matrix is presented in **Table 5-2** with the further definition of the author (in terms of acoustics) provided in **bold** lettering.

Risk assessment involves the calculation of the magnitude of potential consequences (levels of impacts) and the likelihood (levels of probability) of these consequences to occur. Risk = Consequence + Likelihood; where: (i) likelihood is the probability of occurrence of an impact that affects the environment; and, (ii) consequence is the environmental impact if an event occurs.

Table 5-2: Assessment Criteria: Ranking scales assessment criteria

Assessment	Definition	Quantification				
		1	2	3	4	5
Environment Type. **It was selected to make use of a 2 for all assessments. The change of the rating level regardless of its nature determines the impact (see Nature below).**	Type of environment anticipated to be impacted	Degraded sites/ heavy industrial areas/ high density townships	High density residential/ retail and office complexes/ central business districts/ medium industrial/ largescale agriculture	Medium density residential/ light industrial/ office parks/ sports facilities/ medium scale agriculture	Low density residential/ small scale agriculture/ small holdings	Greenfield sites/ nature reserves/ protected areas/ natural recreational facilities
Nature	The potential of the impact to cause harm	Negligible Impact. **In terms of acoustics an increase of the $L_{R,d/n}$ of 0 < 3 dB.**	Minor Impact. **In terms of acoustics an increase of the $L_{R,d/n}$ of 3 < 5 dB.**	Moderate Impact. **In terms of acoustics an increase of the $L_{R,d/n}$ of 5 < 7 dB. Note, non-compliance in terms of NCR.**	High Impact. **In terms of acoustics an increase of the $L_{R,d/n}$ of 7 < 10 dB.**	Severe/ Irreversible Impact. **In terms of acoustics an increase of the $L_{R,d/n}$ of +10 dB.**
Extent	The spatial extent or population extent of an impact	Within project area (<500m from project	Surrounding area (500m – 1km radius)	Outside project area (1 – 5km radius)	Regional and provincial (5 – 50km radius)	National or international (>50km radius)
Duration. **The noise levels during operational phase may be constantly audible, however the Nature (increase above Rating Level) determines compliance.**	The period the impact will interact with the receiving environment	Immediate (days)	Short term (weeks	Medium term (months)	Long term (years)	Beyond life of project
Frequency	How often the impact will occur	Less than once a year	Annually	Monthly	Weekly	Daily
Probability	The likelihood of the impact occurring	Rare	Unlikely	Possible	Likely	Almost certain

Consequence can be calculated as the sum of the risk levels comprising environment type, nature, extent and duration of the potential impact. Likelihood can be calculated as the sum of the risks of frequency and probability of the impact occurring. The likelihood and consequence can input into a matrix in order to identify the significance of the risk occurring. The C + L matrix method therefore combines the scores from the qualitative or semi-quantitative ratings of consequence (levels of impact) and the likelihood (levels of probability) that a specific consequence will occur (not just any consequence) to generate a risk score and risk rating.

Table 5-3: Consquence of the potential impact

Likelihood	Consequence				
	2 – 6	5 – 8	9 – 11	12 – 15	14 – 17
	5 – 8	9 – 11	12 – 15	14 – 17	18 – 21
	9 – 11	12 – 15	14 – 17	18 – 21	20 – 23
	12 – 15	14 – 17	18 – 21	20 – 23	24 – 27
	14 – 17	18 – 21	20 – 23	24 – 27	26 – 30

The significance rating can be derived from the rating matrix in **Table 5-4**.

Table 5-4: Significance Rating

Environmental Significance			Description of Rating
	2 – 8	Low Significance	No specific management action required
	9 – 11	Medium-low Significance	Administrative management actions required
	12 – 17	Medium Significance	Management and monitoring action plans required
	18 – 23	Medium-high Significance	Specific management and monitoring plans required
	24 – 30	High Significance	Detailed management and monitoring plans required, potential red flag impact

6 ASSUMPTIONS AND LIMITATIONS

6.1 LIMITATIONS OF ENVIRONMENTAL ACOUSTICAL MEASUREMENTS

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. 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 day, dependant on faunal characteristics (mating season, dawn chorus[14] early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind). This excludes the potential effect of sounds from anthropogenic origin;
- As mentioned above seasonal changes in the surrounding environment can change the measured baseline. Many faunal species are more active during warmer periods than colder periods. As an example, cicada are usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[15];
- Defining ambient sound levels using the result of one 10-minute measurement may be very inaccurate (very low confidence level in the results) relating to the reasons mentioned above;
- Determination of noise sources of environmental significance are an important factor to consider when compiling an environmental acoustical report;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural baseline, and in various cases sought after and pleasing;
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as L_{AMin}, L_{Aeq}, L_{AMax}, L_{A10}, L_{A90} and spectral analysis forms part of the many variables that can be considered. The South African Legislation however is the $L_{Aeq,I}$ setting, and must at all times be considered;
- It is technically difficult and time consuming to improve the measurement of spectral distribution of large equipment in an industrial setting. This is due to the many correction factors that need to be considered (e.g. other noise sources active in the area, adequacy of average time setting, surrounding field non-uniformity etc.[16] as per SANS 9614-3:2005);
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptor's dwelling, or environmental ambient baseline contributors of significance (faunal, roads traffic, railway traffic movement etc.); and

[14] Environ. We Int. Sci. Tech. *Ambient noise levels due to dawn chorus at different habitats in Delhi*. 2001. Pg. 134.
[15] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.
[16] SANS 9614-3:2005. "Determination of sound power levels of noise sources using sound intensity – Part 3: Precision method for measurement by scanning".

- As a residential area develops, the presence of people will result in increased dwelling related 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 LIMITATIONS AND ADEQUACY OF THE PREDICTIVE MODELLED SCENARIO(S)

Limitations due to the calculations of the noise emissions into the environment include the following:

- Many sound propagation models do not consider sound characteristics as calculations are based on an equivalent level (with the appropriate correction implemented e.g. tone or impulse). These other characteristics include intrusive sounds or amplitude modulation;
- Many sound propagation models do not accurately (or at all) calculate the increase of the ambient baseline due to wind shear (masking noise);
- Most sound propagation models do not consider refraction through the various temperature layers (specifically relevant during the night-times);
- Most sound propagation models do not consider the low frequency range (third octave 16 Hz – 31.5 Hz). This would be relevant to facilities with a potentially low frequency issues;
- Many environmental models consider sound to propagate in hemi-spherical way. Certain noise sources (e.g. a speakers, exhausts, fans) emit sound power levels in a directional manner;
- The octave sound power levels selected for processes and equipment accurately represents the sound character and power levels of 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 may change depending on the load the process and equipment are subject to. 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 worst-case scenario;
- As it is unknown which exact processes and equipment will be operational, modelling considers a scenario where all processes and equipment are under full load 100% of the time. The result is that projected noise levels would likely over-estimate or over-engineered sound levels;
- 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;
- Many environmental models are not highly suited for close proximity calculations;
- Acoustical characteristics of the ground are over-simplified, with ground conditions accepted as uniform. Ground conditions will not be considered in this assessment; and
- Due to the assumptions the calculated noise levels would likely be an over-engineered scenario with noise contours assisting in the estimation of a worst-case scenario assessment.

7 METHODS: CALCULATION OF NOISE LEVELS

7.1 NOISE LEVELS ON THE SURROUNDING ENVIRONMENT

7.1.1 Point Sources (Future industrial noise sources)

The modelled noise scenario(s) were evaluated in terms of SANS 10357:2004 and ISO 9613-2 models. The following were considered:

- The octave band SPL emission levels of processes and equipment;
- The distance of the receivers from the noise sources;
- The impact of atmospheric absorption;
- The meteorological conditions in terms of Pascal stability;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Screening corrections where applicable;
- Topographical layout; and
- Acoustical characteristics of the ground.

7.1.2 Linear Sources – Road conditions (ambient soundscape and access routes)

The noise emission into the environment due to road traffic will be calculated using the sound propagation model described in SANS 10210:2004 and Calculation of Road Traffic Noise United Kingdom (CoRTN 1996). Calculated 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;
- Road gradient; and
- Ground acoustical conditions.

Although the SANS 10210:2004 model is the South African guideline on road noise propagation, there exists International various models (each model in itself has its own advantages and issues), and include:

- VBUS – Germany model;
- NMPB - Roads 2008 =- French model;
- Calculation of Road Traffic Noise (CoRTN) – British model; and
- FHWA 1998 TNM – United States model.

8 BASELINE ENVIRONMENTAL SOUND CHARACTER

8.1 AMBIENT SOUND LEVEL MEASUREMENTS

For ambient sound/noise level measurements within the study area were conducted on 11 May 2018. The equipment used is defined in **Appendix B** (along with site measurement photos).

Due to safety concerns only daytime measurements were conducted (between hours of 06:00 – 22:00). Measurements were conducted in the afternoon at approximately 3 pm. Weather conditions were fine with no wind. During measurements the existing chrome mine operations was lightly audible. Community related sounds and transportation networks was audible, at times faunal communication was heard (bird song, insects etc.). The resulting measurements is presented in **Table 8-1** below. Third octave spectral frequencies as well as a photo and summary of the Rating Level (in terms of L_{AIeq} measurements) are also presented in **Table 8-1**. A summary is:

- L_{AIeq},1/10 minutes: During the daytime the area would be like a rural or suburban setting in terms of the Rating Level;
- LA90: background noise levels were low-moderate with some constant background noise levels;
- L_{AMax}/L_{Amin}: Impulsive noise events (L_{Amax} descriptor) indicated moderate impulsive events in the study area. Impulsive events were from community, faunal and transportation related noises/sounds;
- Third octave frequencies: Lower frequencies were moderate in peaks. Peaks would be contributed to mechanical related sounds in the study area including mining noises. Mid frequencies peaks were from communication or other community related sounds (dogs barking, music etc.). Higher frequencies were from bird song or insects sounds.

The rating selected (refer to **section 5.2.1** discussing the rating level in more detail) is therefore:

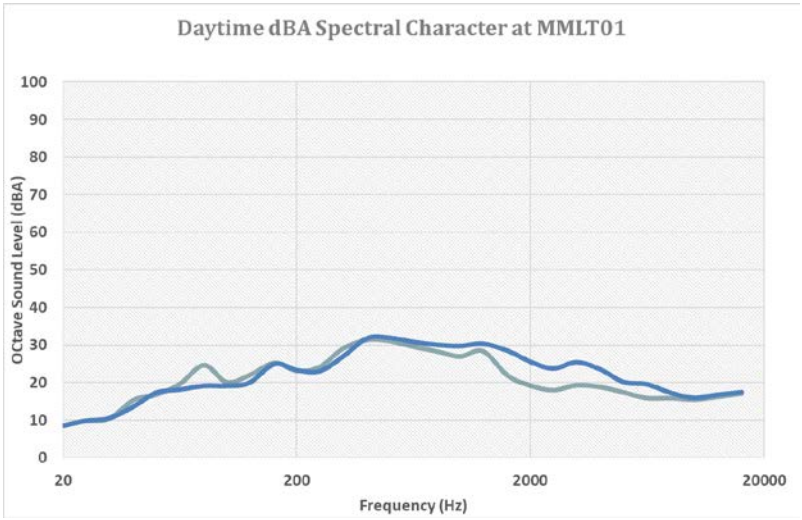
- "Suburban Noise Districts" (50 and 40 dBA day/night-time Rating Level - SANS 10103:2008). The Rating level selected considered that during the night-times measurements would reflect a suburban setting. Based on the mining activities as well as the development of the community and local transportation networks a suburban setting in terms of the Rating Level would be more suitable; and
- Certain areas (closer to busy road transportation networks) will have a higher rating than suburban.

Table 8-1: LAIeq, LAFeq , Stastitistcal Values & LAMin/LAMax

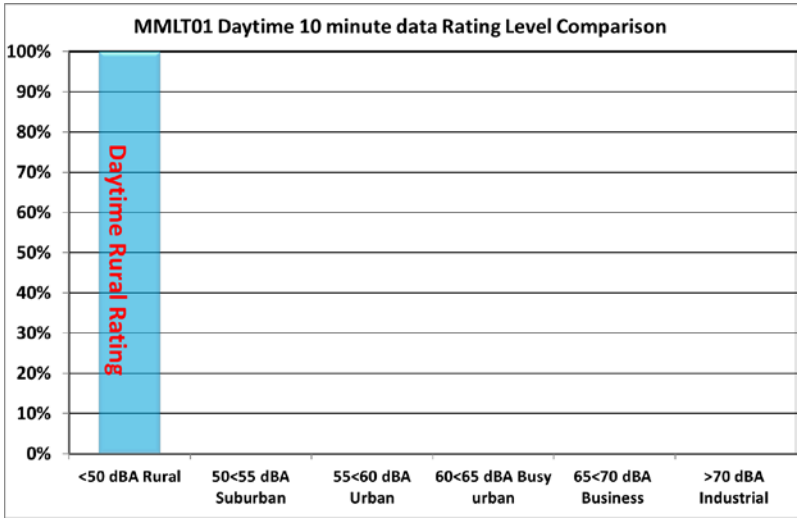
L_{AIeq},1/10minute	L_{AFeq},1/10minute	LA90	L_{AMin}	L_{AMAx}
42.8	35	32.6	30.7	41.3
35.6	34	31.7	29.7	38.7
40.4	36.8	33.0	30.8	50.7
50.8	41.4	34.6	33.0	59.4
40.7	38.1	34.4	32.2	48.1
40.0	34.3	31.7	30.0	48.2
36.7	33.8	31.6	29.9	40.8
41.4	35.4	33.7	33.3	40
42.9	37.2	31.3	27.7	57.2

Figure 8-1: Measurement Locality

Table 8-2: Rating Level base on LAIeq values, spectral data, photo of measured localiy



Spectral frequencies



Rating Level base on LAIeq values

Photo

9 SCENARIO: FUTURE NOISE LEVELS

9.1 INVESTIGATED SCENARIOS

The worst-case phases are discussed in more detail in **section 4**. Calculated noise levels are based on the outside dwelling façade (environmental acoustics). Modelled impact scenarios are a representation of the precautionary principle (considering the noise source operating at full load or at maximum noise emission level). The following can be highlighted regarding the presented noise contours:

- All noise levels were considered in a hemispherical fashion (e.g. facing all directions). The ventilation shaft will be directional and noise contours can be greatly reduced if implemented facing away from receptors; and
- Calculations will not be relevant at all times but rather used to illustrate peak operational hours for assessment purposes.

The only applicable phases for further investigations are the construction/closure and operational phases (discussed further below). The design and post-closure phases are not discussed below as they do not have any noise generating infrastructure.

9.1.1 Investigated Construction/Closure & Operational Worst-Case Maximum Capacity Noise Levels

The primary and secondary corrections considered for the worst-case future scenario is presented in **Table 9-1**. Construction scenarios were considered from the closest noise source (red dot, **Figure 9-1**) in relation to receptors. Only the closest noise sources in relation to receptors were considered. Noise sources too far or with no potential to increase receptors rating was not considered.

The haul roads were assessed separately in a linear fashion, considering two conceptual scenarios of 10 and 30 heavy vehicles per hour.

Table 9-1: $L_{R,d/n}$ Worst-Case scenario investigated

Intervening environmental factors	
Receiver(s)	See layout below. Where communities are situated, the outer most residential units in relation to the noise source under investigation were considered.
Intervening ground correction	Medium-hard (75% hard).
Metrological	Activities assessed functioned during wind-still times and during good sound propagation conditions (20^{o}C and 80% humidity).
Ground elevation contours & acoustical barriers/ facade correction.	Elevation contours were not considered. Building infrastructure on the project footprint would act as a buffer of noise. Infrastructure that was for certain to be a single (or higher) story unit was considered for corrections (orange line in figures below). Stockpile areas/open cast footprints were considered to for a screening correction (operational phase only). Open cast pits further to the south of the project (see below figure) would be based on a mountainous section.
Investigated Construction/Closure Scenario	
Point sources	Receptors were assessed in relation to the closest noise sources (red dot) in figure below. Only daytime assessed as no important night-time noise is envisaged. However, during times there may be required to do some night-time work (short-term).
Investigated Operational Scenario	
Point sources	Noise sources are defined in **section 10.1.3** with footprints/noise sources presented in figure below. Open cast pits further to the south of the project (see below figure) would be based on a mountainous section. This section may increase the line-of-sight of noise sources over berms/open cast benches etc. However the open cast footprint is well over 1km from the closest receptor(s) with no potential for such a scenario to influence the rating level of receptors.
Linear noise source – Operational Phase only (relevant only for receptors inside facility)	
Traffic vehicles p/h	10 < 30 ADDT p/h or day/night.
% heavy vehicles	100% for all traffic volumes above
Average speed (km/h)[17]	An estimated 60 km/h.
Road Surface	Unpaved (gravel route).
Stop junction	No.
Lanes	Single alternative direction lanes.
Operational time	Night-time assessed.

[17] As per most mines health and safety standards

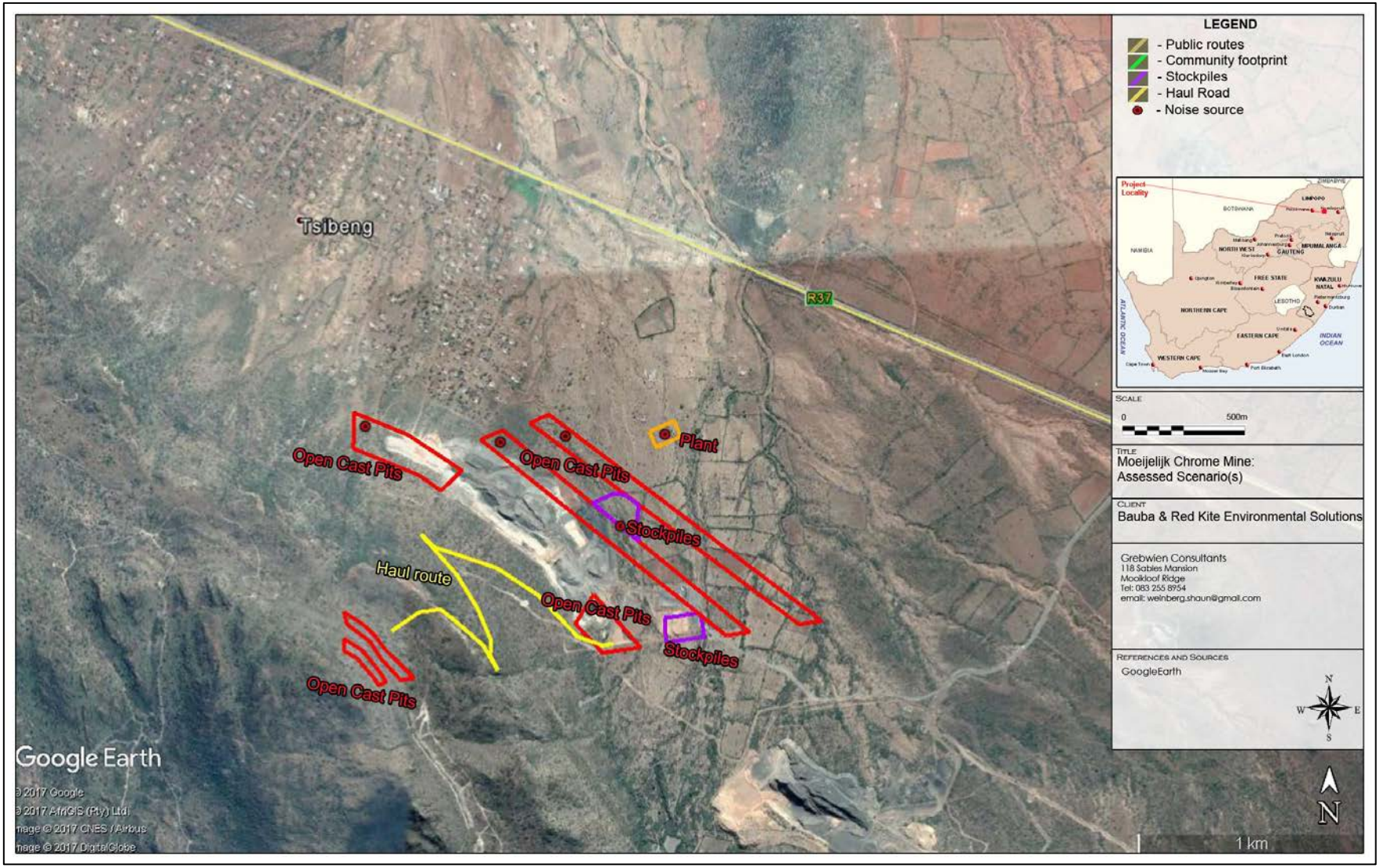


Figure 9-1: Assessed scenarios

10 MODELLING RESULTS AND IMPACT ASSESSMENT

10.1 MODELLED SCENARIOS AND IMPACT ASSESSMENT

Contours were illustrated from 40 dBA onwards in increments of 5 dB (L_{Rn} of Suburban 40 dBA). The contours of the roads were assessed separately in a linear fashion, and could be applied to any of the main phases (**Figure 10-1**). The modelled scenario indicated that haul route would not change the rating level of receptors.

10.1.1 Design Phases

No impact assessment conducted for this phase as no noise will be generated.

10.1.2 Construction

The impact assessment is presented in **Table 10-1** with the linear scenario presented in **Figure 10-1**. Certain small scale-temporarily construction (boundary fence, footprint not illustrated in this document) will take place close to receptors. However, if any change of rating level is to occur it will be *"Immediate"* (i.e. a few days) with noise levels likely far less than illustrated in project linear scenario (**Figure 10-1**). Larger noisier construction activities at open cast pits/stockpiles/plant area etc. (see **Figure 10-1** for linear representation) has the potential to influence and/or change the Rating Level at the closest receptors NSD1 – NSD3 and NSD12. However with mitigation measure in place the noise can be kept to acceptable levels in terms of the Rating Level. Based on these factors noise projections for the construction phase will comply with the National (GN R154) Noise Control Regulations, SANS 10103:2008 guideline and International Finance Corporation if mitigation options are adhered to.

10.1.3 Operational

The worst-case night-time scenario for the project is presented in **Figure 10-2** illustrating the scenario on a map format and in 3D isopleths. The daytime project would be the same, however the contours of +50 dBA would be relevant for an L_{Rd} change. The impact assessment is presented in **Table 10-2** and **Table 10-3** (day and night assessments respectively). The resulting worst-case noise projections indicated that the operations will comply with the National and Provincial Noise Control Regulations, SANS 10103:2008 guideline and International Finance Corporation ***only*** if mitigation options are adhered to. Mitigation around the open cast pits and plant area will be required.

10.1.4 Closure Phases

The impact assessment will be similar to the construction and operational phase (see section **10.1.2** above).

10.1.5 Post-Closure Phases

No impact assessment conducted for this phase as no noise will be generated.

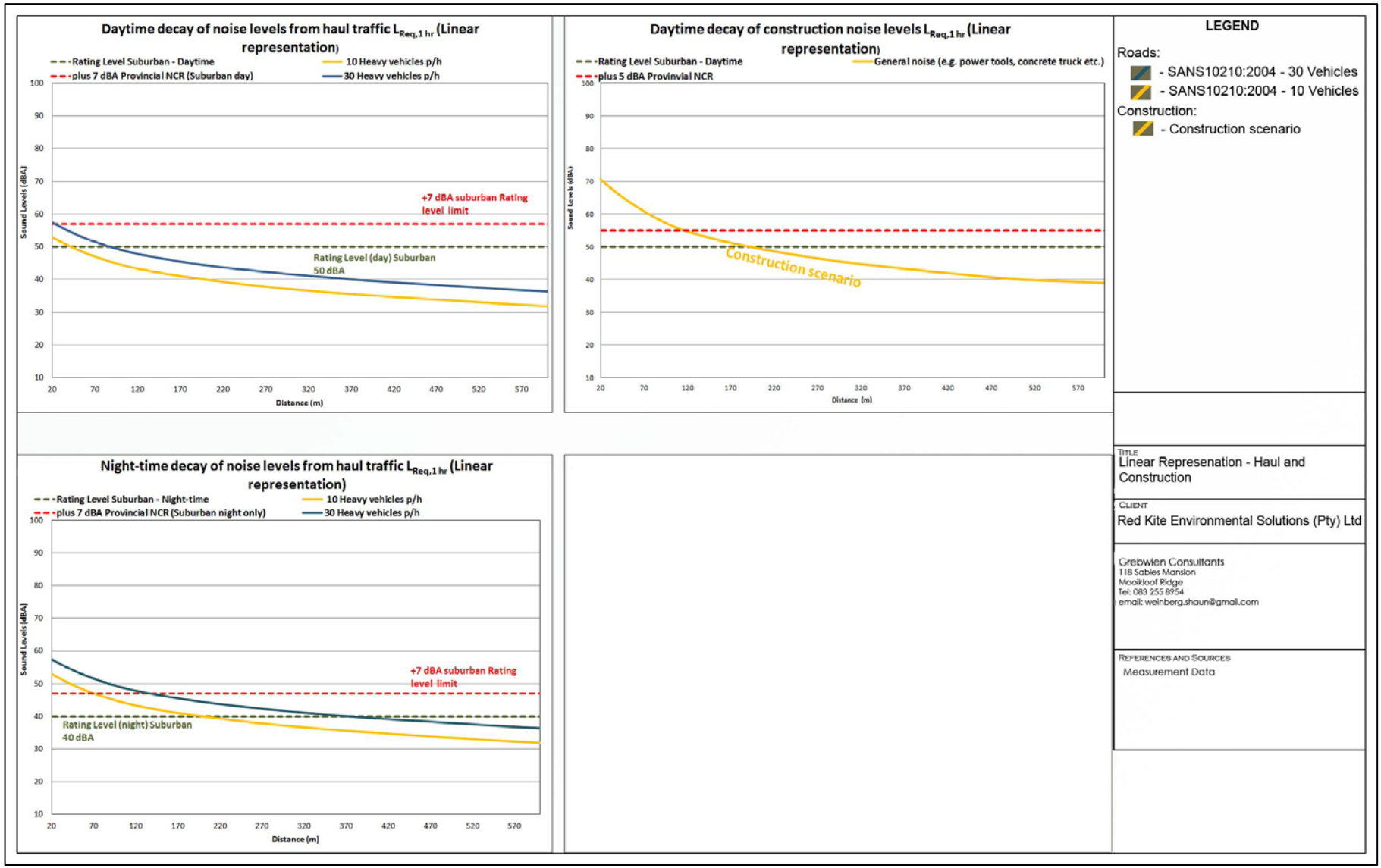


Figure 10-1: Roads & Construction assessment– linear representation

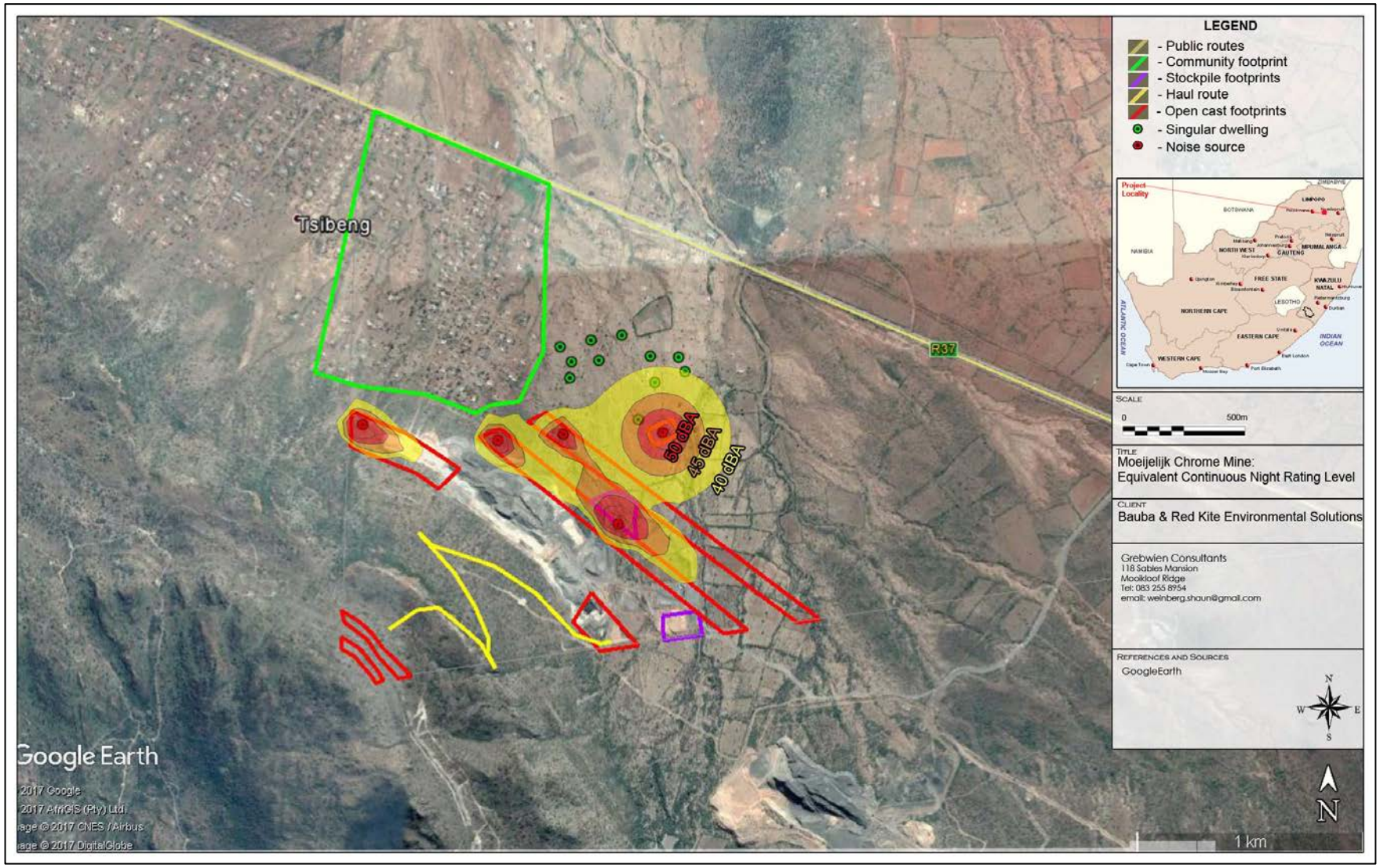


Figure 10-2: Operational phase –Night-time Continous Rating Level

Table 10-1: Impact Assessment – Construction/Closure phases (daytime)

Receiver no.	Projected noise level - $L_{Aeq,1hr}$ (dBA)	Rating Level ($L_{Req,d}$) (dBA)	Environment Type	Nature	Extent	Duration	Frequency	Probability	Environmental Significance
Daytime									
1	+55	**50**	2	3	1	2	5	2	15
2	+50		2	2	1	2	5	1	13
3	+50		2	2	1	2	5	1	13
4	<50		2	1	1	2	5	1	12
5	<50		2	1	1	2	5	1	12
6	<50		2	1	1	2	5	1	12
7	<50		2	1	1	2	5	1	12
8	<50		2	1	1	2	5	1	12
9	<50		2	1	1	2	5	1	12
10	<50		2	1	1	2	5	1	12
11	<50		2	1	1	2	5	1	12
12	+55		2	3	1	2	5	2	15

Table 10-2: Impact Assessment – Operational phase (daytime)

Receiver no.	Projected noise level - $L_{Aeq,1hr}$ (dBA)	Rating Level ($L_{Req,d}$) (dBA)	Environment Type	Nature	Extent	Duration	Frequency	Probability	Environmental Significance
Daytime									
1	+50	**50**	2	1	1	4	5	2	15
2	<50		2	1	1	4	5	1	14
3	<50		2	1	1	4	5	1	14
4	<50		2	1	1	4	5	1	14
5	<50		2	1	1	4	5	1	14
6	<50		2	1	1	4	5	1	14
7	<50		2	1	1	4	5	1	14
8	<50		2	1	1	4	5	1	14
9	<50		2	1	1	4	5	1	14
10	<50		2	1	1	4	5	1	14
11	<50		2	1	1	4	5	1	14
12	<50		2	1	1	4	5	1	14

Table 10-3: Impact Assessment – Operational phase (night-time)

Receiver no.	Projected noise level - $L_{Aeq,1hr}$ (dBA)	Rating Level ($L_{Req,d}$) (dBA)	Environment Type	Nature	Extent	Duration	Frequency	Probability	Environmental Significance
Night-time									
1	+50	**40**	2	4	1	4	5	4	20
2	+40		2	2	1	4	5	2	15
3	+40		2	2	1	4	5	2	15
4	<40		2	1	1	4	5	1	14
5	<40		2	1	1	4	5	1	14
6	<40		2	1	1	4	5	1	14
7	<40		2	1	1	4	5	1	14
8	<40		2	1	1	4	5	1	14
9	<40		2	1	1	4	5	1	14
10	<40		2	1	1	4	5	1	14
11	<40		2	1	1	4	5	1	14
12	<40		2	1	1	4	5	1	14

10.2 EVALUATION OF IMPACTS IN TERMS OF NOISE IMPACTS

When using a noise limit ($L_{Req,n}$) of 40 dBA as proposed by SANS 10103:2008, it is clear that there is a potential noise impact of a Medium-high Significance at the following areas:

- Operations of the plant near the closest receptors (NSD01 in **Figure 2-2**).

Mitigation options are recommended and discussed in **section 11** of this report. The most important time for mitigation options would be during the operational phase as it will be the longest duration. Construction and closure mitigation options will also be required.

No alternatives were evaluated and the layout as presented was considered as the only layout. In terms of acoustic the project will not present a fatal flaw.

11 MITIGATION OPTIONS & ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The most important phase for further acoustical investigations is the operational phase, with the night-time operations been the most likely time for a noise impact. The mitigation options are separated into:

- **Special condition in the Environmental Authorisation** – The project team, relevant authority and mine need to note these mitigation options would likely ensure compliance in terms of noise (GN R154);
- **Recommended** – Mitigation options should be considered by project team and mine in order minimise the risk of noise impact or reduce the noise annoyance.

11.1 PRE-PLANNING STAGE

The pre-planning phase is the most important of the phases. It has no noise generating capacity, however during this stage design options can be considered (and specifically relating to the operational phase). The below mitigation options should be implemented during relevant phases (construction, operational or closure etc.):

- **Special condition in the Environmental Authorisation -** A berm/acoustical barrier need to be implemented in front of the plant area facing receptors NSD1 – NSD3. A berm needs to be implemented between the open cast pits near NSD12 the Tsibeng community. Equipment operating at open cast pits must ensure operations behind berms and highwalls in relation to receptors. Berm localities are presented in **Figure 11-1**. The following must be considered to ensure the wall acts as an affective acoustical screen:
    - Walls/berms/barriers to be built as close as feasibly possible to the noise source;
    - The height of the barrier is at least 2 - 3 m higher than the line of sight to the top of the highest noise source at the noisy area in relation to a receptor, although the higher the berm/barrier the better acoustical screen tool it will be[18]. Barriers must also be sufficiently dense (at least 10 kg/m^2) [19] and sufficient in thickness. A brick wall provides a surface density of 244 kg/m^2 at thickness of 150 mm[20] and is considered as a typically good acoustical barrier;
    - The wall/berm should be sufficiently long to block the line of sight from receptors to the sides of the stack; and
    - No apertures (gaps, entrances) should be implemented in walls/berms.
- **Special condition in the Environmental Authorisation -** An Annual Acoustical Measurement & Audit Programme is recommended to be implemented and conducted prior to construction phase (to improve the characterisation of the baseline) and then during all other phases (up till end of closure). Refer to **Section 11.6** which outlines the proposed acoustical measurement;

[18] Norton, M.P. and Karczub, D.G, *"Fundamentals of Noise and Vibration Analysis for Engineers",* Second Edition, 2003, p.600.
[19] International Finance Corporation. General EHS Guidelines – Environmental Noise Management.
[20] Everest and Pohlmann, "Master Handbook of Acoustics", Fifth Edition, 2009, p. 121.

- **Special condition in the Environmental Authorisation –** The plant would require been in an enclosure (building, housing unit) where technically feasible (consultation with project Engineers would be required). The housing unit should not have any openings (windows or doorways) facing receptors if feasible. Any ventilation exhaust fans etc. on the outside façade of this building should face away from receptors NSD1- NSD3;
- **Not compulsory, recommended –** The design of stockpile areas should be considered. The slope of the stockpiles (if it is to be sloped) should be implemented sloping away from receptors. Berms on the edge of the stockpiles should be implemented (ensuring the height is higher than the highest noise source on the stockpile).
- **Not compulsory, recommended** – The developer could minimise the night-time operations of the plant area to between 06:00 – 22:00 (**note not compulsory option**);
- **Not compulsory, recommended** - Acoustical mufflers (or silencers) should be considered on equipment exhausts. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material ensuring that the seam gap between the hood and vehicle body is minimised;
- **Not compulsory, recommended** - Alarm signals localities that warn of equipment malfunctioning should be considered (equipment at the plant area). Equipment alarms should be considered indoors and not on outside façades. If this option is not feasible then the developer design team should consider placing the alarms facing away from the closest receptors. Alarms should be considered to be a lower volume capacity. It must be noted that alarms are exempt from mitigation options in this ENIA (see section **3.2.1** or proceeding point below);
- **Not compulsory, recommended** - The developer should investigate the use of white-noise generators instead of tonal reverse alarms on heavy vehicles operating on roads and industrial areas. 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".
- **Special condition in the Environmental Authorisation** (this option needs to be discussed with the engineering team as other factors besides acoustics needs to be considered) – If any ventilation is proposed at the plant area (or from an underground works) it is recommended that the shaft is not facing upwards (skywards). Certain metrological conditions (particularly during night-times) can see refraction of noise over the wall due to the various temperature inversion layers. This means that noise levels from the source may propagate back down to the ground at a receptor's dwelling due to the curvature of sound in the warmer upper night-time atmosphere. Placing the ventilation shaft upwards may allow for this propagation[21]. A stack silencer should be implemented (e.g. a stack silencer liner inside the stack). The ventilation stacks should if possible be planned facing away from receptors and planned not to overlook any berms or barriers into receptor areas (if feasibly possible).

[21] Norton, M.P. and Karczub, D.G, *"Fundamentals of Noise and Vibration Analysis for Engineers",* Second Edition, 2003, p.600.

No mitigation options on the road paving options are necessary for internal haul roads. However, if feasible:

- Roads should be planned so as to reduce heavy vehicles reversing when collecting or dumping at stockpiles/tips etc. This will minimise the use of reverse alarms on vehicles; and
- Roads capable of more than 60 km/h should be well maintained and smooth (if unpaved dirt road).

11.2 CONSTRUCTION PHASE

During the shorter-term construction phase the mitigation options will include:

- Pre-planning phase mitigation options are adhered to (**section 11.1**). Mitigation options highlighted for **Special condition for Environmental Authorisation** needs to be specifically noted;
- Communication between the receptors and the developer need to be implemented and maintained, highlighting the outcome of this study. The developer/contractor(s) should consider conducting work at a time when the surrounding community members are at work/school (e.g. between the hours of 08:00 and 16:00 etc.);
- Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them.

It must be also noted that if blasting is required to take place near a receptor's dwelling (within 500 m), the developer must consult with a Vibration & Blasting Specialist.

11.3 OPERATIONAL PHASE

The operational phase should consider:

- Pre-planning phase mitigation options are adhered to (**section 11.1**). These mitigation options are specifically relevant for night-time operations and receptors bordering the project footprint. Mitigation options highlighted for **Special condition for Environmental Authorisation** needs to be specifically noted;
- Communication between the receptors and the developer needs to be implemented and maintained (see point above in construction phase); and
- If the layout or assumptions changes, the findings of this report be reviewed.

11.4 CLOSURE PHASE

See mitigation options for the construction phase above (**section 11.2**).

11.5 POST-CLOSURE PHASE

No mitigation options required.

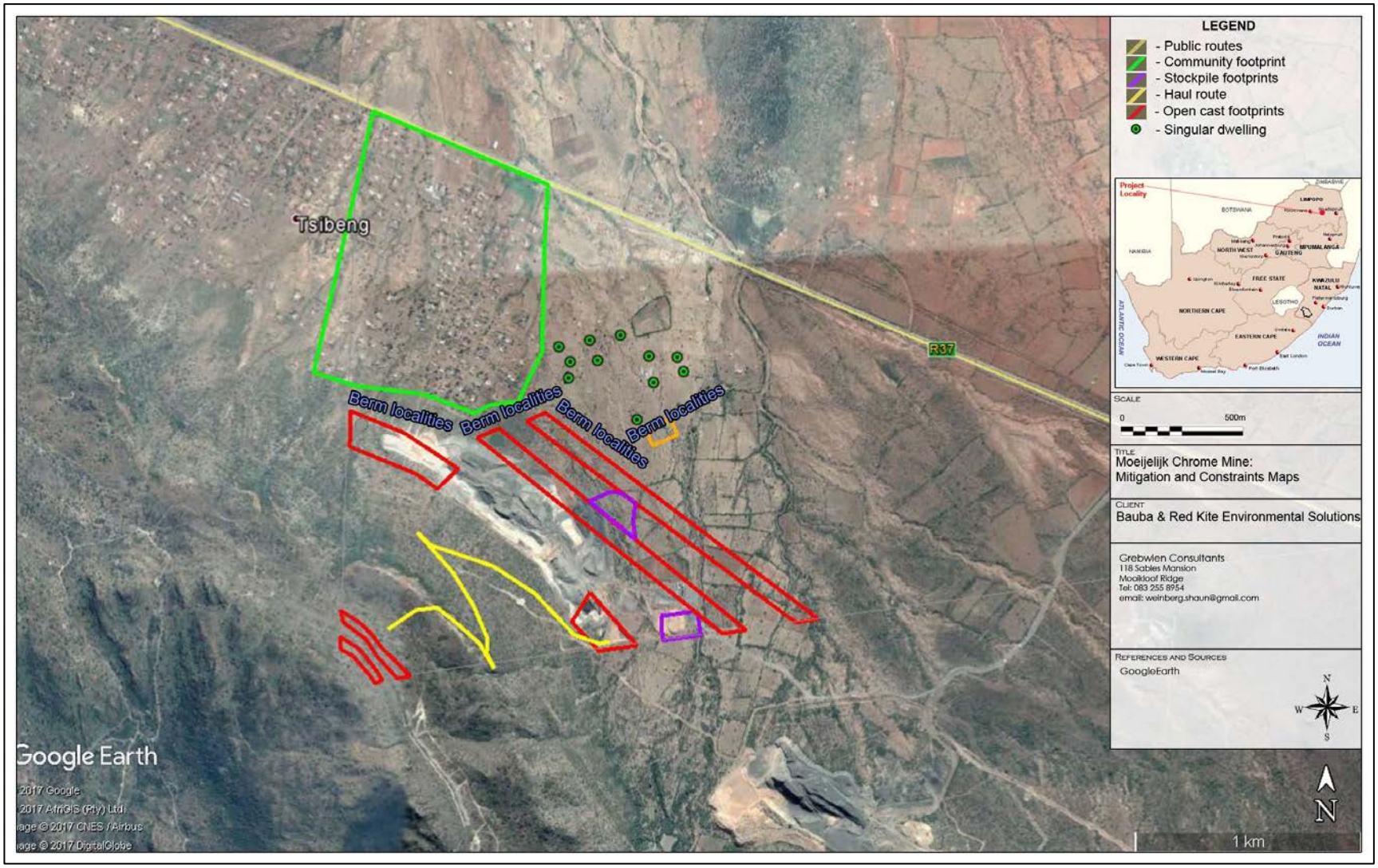


Figure 11-1: All phase important mitigation areas, constraints maps

11.6 ENVIRONMENTAL MONITORING PLAN

An annual Acoustical Measurement & Audit Programme report is recommended. The measurement report frequency should be reviewed after the first two or three reports have been conducted. The frequency of the reports can be adjusted according to the level of mitigation options implemented by the developer onsite and based on the recommendations of the acoustical consultant.

It is recommended that the measurements are conducted during all phases with prior baseline measurements conducted a few times (during all season) before the construction phase. This will enable the improvement of the baseline characterisation.

Ambient sound measurements should be collected as defined in SANS 10103:2008. Due to the variability that naturally occurs in sound levels at most locations, it is recommended that semi-continuous measurements are conducted over a period of at least 24 hours, covering at least a full day- (SANS10103:2008 timeframe of 06:00 – 22:00) and night-time (22:00 – 06:00) period. Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{AIeq,10min}$ (National Noise Control Regulation requirement), L_{AF90} (background noise level as used internationally) and $L_{AFeq,10min}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise. When a noise complaint is being investigated, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event. Other variables and measurement recommended settings to be analysed include L_{AMin}, L_{AMax}, L_{Amin} and L_{A10}.

Noise measurements must be continued as long as there are potential receptors living within 1,000 m of the boundaries of the project, or as long as a valid noise complaint is registered.

12 CONCLUSIONS AND RECOMMENDATIONS

Assessments done in this document are as recommended by the National/International guidelines and regulations SANS 10103:2008, SANS 0328:2008 and GN R154. The report considers a worst-case scenario, evaluating the potential noise impact during peak hours.

The results of the full ENIA evaluation the significance rating of the noise impacts could be:

- Low during Planning phase;
- Medium during Construction activities;
- Medium-high significance during the Operational phase;
- Medium during Closure and Decommissioning phase; and
- Low during the Post-Closure Phase.

Mitigation options in the planning and operational phases would be required. With mitigation a low operational significance could be achieved. It should be noted that this does not suggest that the sound from the project should be inaudible however it should be in line with legislation requirements.

The most important mitigation options recommended include the screening (i.e. masking of the noise by berm/barrier etc.) of the plant area in relation to the closest receptors (receptors bordering the project). The plant areas should be enclosed with any external ventilation facing away from receptors. A berm needs to be implemented between the open cast pits near NSD12 the Tsibeng community. It must also be noted that if blasting is required to take place near a receptor's dwelling (within 500 m) the developer must consult with a Vibration & Blasting Specialist.

An annual Acoustical Measurement & Audit Programme is recommended to be implemented prior to construction phase (to improve the characterisation of the baseline) and during all following phases (up till end of closure). Measurements protocol is defined in this document. Noise measurements must be continued as long as there are potential receptors living within 1,000 m of the boundaries of the operation, or as long as a valid noise complaint is registered. Feedback regarding noise measurements should be presented to all stakeholders and other Interested and Affected (I&AP's) parties in the area. The feedback platform and interval periods should be defined by the developer, with an annual feedback period recommended.

If the project layout or report assumptions changes, then these findings should be re-evaluated. The project will also not present a fatal flaw in terms of noise. In terms of acoustics it is recommended that the project be approved, however mitigation options must be adhered to.

13 THE AUTHOR

The author of this report, Shaun Weinberg, has from May 2009 worked as an Environmental Consultant at the firm M^2 Environmental Connections (MENCO), and then at Enviro-Acoustics Research from 2012. His extensive experience in Noise related studies and research has subsequently motivated him to establish Grebwien Consulting in 2017, of which he is currently the founder/managing director. His environmental background includes being involved in acoustical measurements (including ETSU-R97 methodology), Baseline, Environmental Noise Impact Assessments, Recommended Longer Term Measurement Plans, Measurement and Auditing Reports.

A list of some project he has been involved with (since 2008) is presented below:

Mining and Industry	BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream), Goedehoop Colliery (Geovicon), Delft Sand (AGES), Brandbach Sand (AGES), Schoongesicht (CleanStream)
Road and Railway	K220 Road Extension (Urbansmart), Boskop Road (MTO), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Swaziland Rail Link – Assessment of 4 Schools in Swaziland (Aurecon), Extension of Atterbury Road, City of Tshwane (Bokomoso)
Noise monitoring	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), Transnet Noise Analysis (Aurecon), Unica Iron and Steels's Babelgi Plant Operations (Unica), Dangote Cement Aganang Quarterly Monitoring Report (Exigo), Sephaku Cement Delmas Quarterly Monitoring Report (Exigo)
Small Noise Impact Assessments	TCTA AMD Project Baseline (AECOM), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), uMzimkhulu Landfill Site (Nzingwe Consultancy), Proposed Linksfield Residential Development (Bokomoso)

14 DECLARATION OF INDEPENDENCE

I, Shaun Weinberg 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 2017, 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 proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2017.

_____

Signature of the environmental practitioner:

Name of company: **Grebwien Consulting**

_____

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 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.
Anthropogenic	Human impact on the environment or anthropogenic impact on the environment includes impacts on biophysical environments, biodiversity and other resources
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.
Best Practices	A best practice is a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark. In addition, a "best" practice can evolve to become better as improvements are discovered.
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.
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.
Echolocation	Echo locating animals emit calls out to the environment and listen to the echoes of those calls that return from various objects near them. They use these echoes to locate and identify the objects. Echolocation is used for navigation and for foraging (or hunting) in various environments.
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 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 Assessment	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 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.
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.
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.
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.
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.
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.
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.
Natural Sounds	Are sounds produced by natural sources in their normal baseline.
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.
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).
Tone	Noise can be described as tonal if it contains a noticeable or discrete, continuous note. This

	includes noises such as hums, hisses, screeches, drones, etc. and any such subjective description is open to discussion and contradiction when reported.
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 measurement locations/Sound Level Meter Specifications

Figure B.1: Measurement Point MMLT01: Tsibeng community

Table B.1: Rion NLS32 Specifications

L_{Aeq},1/10minute	
Model	Rion NL32
Serial number	00661742
Microphone	UC-53A No. 310007
Preamp	NH-21 No. 19745
Calibration Date	16 May 2016

End of Report