Cennergi (Pty) Limited

# ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the

## Proposed Tshivhaso Coal-Fired Power Plant near Lephalale, Limpopo Province

*Study done for:*

Savannah Environmental (Pty) Ltd

*Prepared by:*

EAR Enviro Acoustic Research

**P.O. Box 2047, Garsfontein East, 0060**
**Tel: 012 – 004 0362, Fax: 086 – 621 0292, E-mail: info@eares.co.za**

# EXECUTIVE SUMMARY

## INTRODUCTION AND PURPOSE

Enviro-Acoustic Research CC was contracted by Savannah Environmental (the EAP) to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the development of the Tshivhaso Coal-fired Power Station west of Lephalale, Limpopo Province.

## PROJECT DESCRIPTION

Cennergi (Pty) Ltd (the developer) is proposing the construction of a coal-fired power station on a site near Lephalale in the Limpopo Province. The power station would have a capacity of up to 1,200MW (to be developed in two phases of 600MW each). The project is to be known as the Tshivhaso Coal-fired Power Plant.

The development include the power station buildings (boilers/furnaces, turbines, generator, cooling tower, control room, etc.) as well as the required ancillary infrastructure.

## BASELINE ASSESSMENT

Ambient sound levels were measured previously in the vicinity of the proposed development. This included long-term measurements over a period of at least one night at three locations, as well as two short-term measurements. The area has a rural character in terms of appearance and development, with a high potential to be quiet away from the Grootegeluk Colliery and Matimba Power Station within the study area.

Considering the results of the ambient sound measurements, the main source of sound was of faunal origin, with other sounds from various sources raising the sound levels. Sound levels for most of the area would be typical of a Rural Noise District (as per SANS 10103:2008). While sound levels may increase at times, this was mainly due to natural sounds (wind, birds, insects, etc.) and the area can be considered naturally quiet.

## NOISE IMPACT DETERMINATION AND FINDINGS

The projected noise rating levels were calculated using an acoustic propagation model. As the location for the power station or residue deposit was not defined, locations were conceptualized in the middle of the preferred options. At these locations, the potential noise rating levels were less than 35 dBA at the Noise-Sensitive Developments (NSD).

## NEED AND DESIRABILITY OF PROJECT

Due to economic advantages, power generation does provide valuable employment, business opportunities and green energy. It must be noted when such projects are close to potential noise-sensitive receptors, consideration must be given to ensuring a compatible co-existence. This does not suggest that the sound from the facility should not be audible under all circumstances as this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source, but rather that the sound due to the power generation activities should be at a reasonable level in relation to the ambient sound levels.

## MANAGEMENT AND MITIGATION OF NOISE IMPACT

Mitigation is not required, although generic measures are recommended for the developer to note. Mitigation mainly relates to planning to ensure that the power station be developed sufficiently away from any receptors to ensure a low significance noise impact. Measurement locations, frequencies and procedures are provided as a guideline for the developer to consider should there be a noise complaint.

## RECOMMENDATIONS

While this project will have a noise impact of a number of the closest NSD's, these impacts are of low significance and can be considered insignificant. It is however important that the potential noise impact be evaluated should the location of the power station or any associated systems be closer 2,000m from a confirmed NSD.

It is therefore the opinion of the Author that the increases in noise levels are of minor significance. It is therefore the recommendation that the project should be authorised (from a noise impact perspective).

# CONTENTS OF THE SPECIALIST REPORT – CHECKLISTS

| **Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6** | **Cross-reference in this report** |
|---|---|
| (a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae; | **Section 13** |
| (b) a declaration that the specialist is independent in a form as may be specified by the competent authority; | **Section 14** *(also separate document to this report)* |
| (c) an indication of the scope of, and the purpose for which, the report was prepared; | **Section 1.1** |
| (d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment; | **Section 3.1** |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process; | **Section 1.6** |
| (f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure; | **Sections 3.1** and **Section 3.3** |
| (g) an identification of any areas to be avoided, including buffers; | Not relevant and required. |
| (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; | Buffers not required. |
| (i) a description of any assumptions made and any uncertainties or gaps in knowledge; | **Section 6** |
| (j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment; | **Sections 7** and **Sections 8** |
| (k) any mitigation measures for inclusion in the EMPr; | **Section 9.5.1** |
| (l) any conditions for inclusion in the environmental authorisation; | **Sections 9.5.2** |
| (m) any monitoring requirements for inclusion in the EMPr or environmental authorisation; | **Section 11.1** |
| (n) a reasoned opinion—<br>i. as to whether the proposed activity or portions thereof should be authorised; and<br>ii. if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan; | i. **Section 12**<br>ii. **Sections 9.5.1** and **9.5.2** |
| (o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | No comments received (**Section 1.5**) |
| (p) any other information requested by the competent authority | Nothing requested |

| **Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 3 - Environmental Impact Assessment Process** | **Cross-reference in this report** |
|---|---|
| Describe any policies or legislation relevant to your field that the applicant will need to comply with. | **Sections 2.2.1** |
| Comment on need/desirability of the proposal in terms your field and in terms of the proposal's location. | **Section 8.5** |
| Determine the--<br>(i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and<br>(ii) degree to which these impacts-<br>(aa) can be reversed;<br>(bb) may cause irreplaceable loss of resources, and<br>(cc) can be avoided, managed or mitigated; | **Sections 7**, **8** and **9** |
| Determine what the most ideal location within the site for the activity is in terms of your field. | **Section 8.5** |
| Identify suitable measures to avoid, manage or mitigate identified impacts. | (i) **planning, design and pre-construction**;<br>Section 8.1<br>(iii) **construction**;<br>Section 8.2<br>(iv) **operation;**<br>Section 8.3<br>(v) **decommissioning, closure & rehabilitation**.<br>Section 8.4 |
| Identify residual risks that need to be managed and monitored. | There will be no residual risks after closure. |
| Include a concluding statement indicating a preferred alternative in terms of your field. | In terms of acoustics the preferred sites are the best locations for the proposed developments. The Matimba-Medupi Loop-in similarly is preferred to the Medupi-Witkop Loop-in. |

**This report should be sited as:**

De Jager, M. (2015): "*Environmental Noise Impact Assessment for the proposed Tshivhaso Coal-Fired Power Plant near Lephalale, Limpopo Province*". Enviro-Acoustic Research CC, Pretoria

**Client:**

Savannah Environmental (Pty) Ltd
for Cennergi (Pty) Ltd

Unit 10, Building 2
5 Woodlands Drive Office Park
Woodmead
2191

**Report no:**

SE-CTPS/ENIA/201608-Rev 1

**Author:**

*M. de Jager* *(B. Ing (Chem))*

**Review:**

*Shaun Weinberg* *(B.Sc. Applied Mathematics in Physics Stream – in process)*

**Date:**

August 2016

# TABLE OF CONTENTS

page

# LIST OF TABLES

# LIST OF FIGURES

page

# GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| AZSL | Acceptable Zone Sound Level (Rating Level) |
| CFB | Circulating Fluid Bed |
| DoE | Department of Energy |
| EARES | Enviro Acoustic Research cc |
| ECA | Environment Conservation Act (Act 78 of 1989) |
| EMPr | Environmental Management Programme |
| ESP | Electrostatic Precipitator |
| FEL | Front End Loader |
| i.e. | for example |
| IFC | International Finance Corporation |
| km | kilometres (measurement of distance) |
| $km^2$ | square kilometres |
| LHD | Load haul dumper |
| m | meters (measurement of distance) |
| $m^2$ | Square meter |
| $m^3$ | Cubic meter |
| mamsl | Meters above mean sea level |
| m/s | meters per second |
| NEMA | National Environmental Management Act, 1998 (Act 107 of 1998) |
| NCR | Noise Control Regulations (under Section 25 of the ECA) |
| NSDs | Noise Sensitive Developments |
| NSRs | Noise Sensitive Receptors |
| SABS | South African Bureau of Standards |
| SANS | South African National Standards |
| SLM | Sound Level Meter |
| TLB | Tip Load Bucket |
| ToR | Terms of Reference |
| UTM | Universal Transverse Mercator |
| WHO | World Health Organisation |

# 1 INTRODUCTION

## 1.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research (EARES) was contracted by Savannah Environmental (Pty) Ltd (the consultant or EAP) to determine the potential noise impact on the surrounding environment due to the proposed development of the Tshivhaso Coal-Fired Power Station. This facility will be located some 20km west of Lephalale in the Limpopo Province (see regional map in **Figure 1-1**).

This report describes ambient sound levels in the area, potential worst-case noise rating levels and the potential noise impact that the plant may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

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

## 1.2 BRIEF PROJECT DESCRIPTION

Cennergi (Pty) Ltd (the developer) is proposing the construction of a coal-fired power station on a site near Lephalale in the Limpopo Province. The power station would have a capacity of up to 1,200MW (to be developed in two phases of 600MW each). The project is to be known as the Tshivhaso Coal-fired Power Plant.

Various options regarding siting of the power station and associated infrastructure are being investigated (see also **Figure 1-2**). The alternatives were identified during the scoping phase and after considering the input of other stakeholders were reduced to include:

- Power Station – Site option 1 (Graafwater);
- Ash residue deposit – Site option 2 and Graafwater (same site as power station);
- Power line – Matimba – Medupi Loopin).

Apart from the power station buildings (boilers/furnaces, turbines, generator, cooling tower, control room, etc.) themselves, the ancillary infrastructure could include the following:

- Access roads;

- Coal and sorbent stock yard;
- Material handling (offloading) areas;
- Coal, ash, sorbent and gypsum conveyors;
- Coal mill (for grinding the coal into fine material);
- A High Voltage (HV) yard within the power station precinct;
- Water and wastewater treatment facilities;
- Ash and spent sorbent disposal systems;
- Ash dump site;
- Gypsum storage facility;
- Raw water pipeline and reservoirs;
- Dams for storage of "clean" and "dirty" water;
- Railway lines and sidings;
- Overhead transmission line to connect to Eskom grid;
- Power supply for the construction phase (substation, transmission and distribution lines);
- Maintenance, medical, administration, services, control buildings; and
- Construction camp.

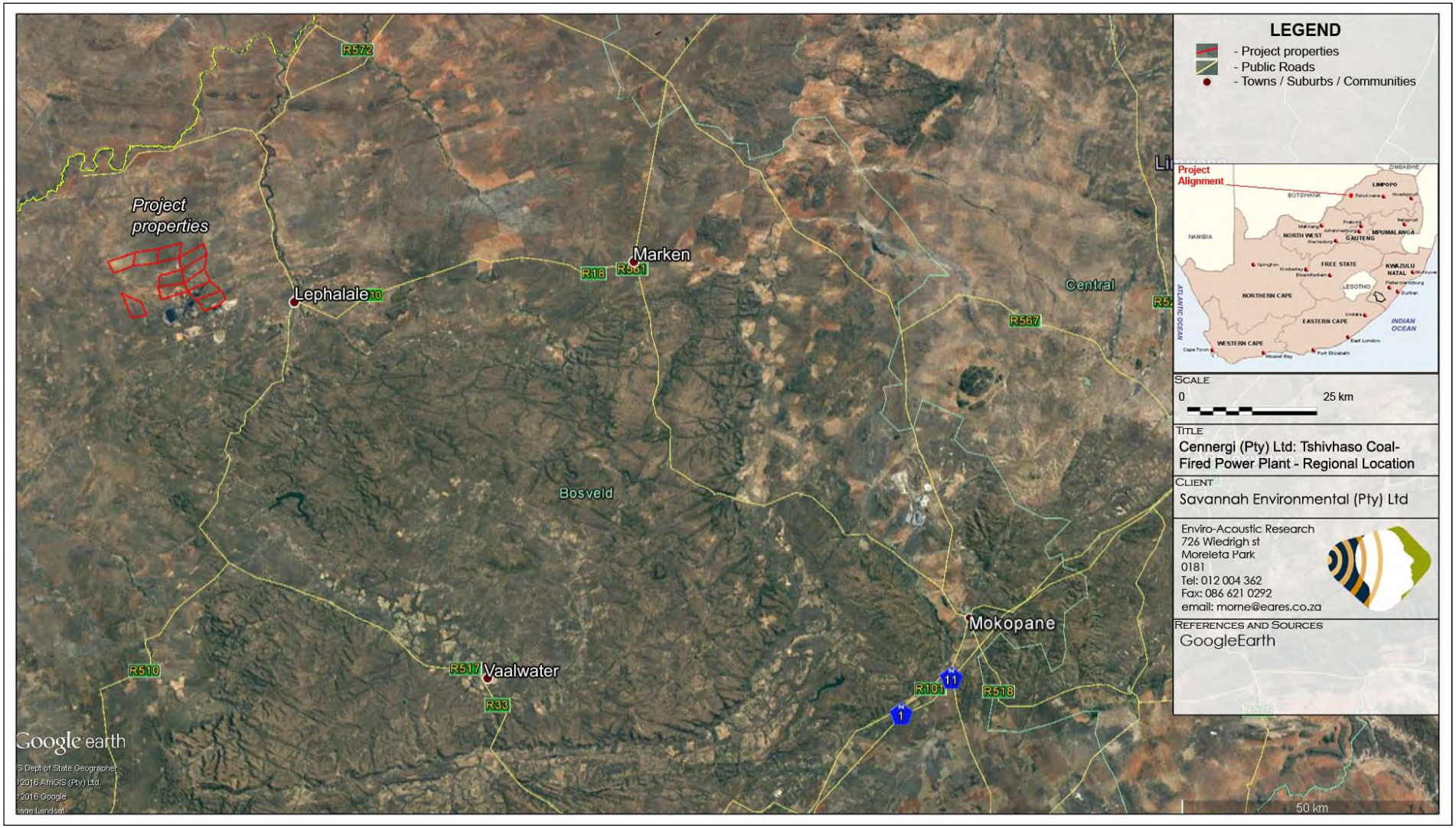


**Figure 1-1: Locality map indicating potential farm properties involved in the Tshivhaso Project**


**Figure 1-2: Proposed Tshivhaso Coal-fired Power Station site alternatives**

## 1.3 STUDY AREA

The proposed project is located approximately 20km west of Lephalale, adjacent to the existing Grootegeluk Coal Colliery (just north). The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

The study area in terms of acoustics concerns a number of farms with a number of dwellings or potential receptors in the vicinity of the proposed development. The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

### 1.3.1 Topography

ENPAT[1] (1998) describes the topography as *"plains"*. The project will be approximately 900 m above sea level (mamsl). There are no natural features that could act as noise barriers for the sound from the project.

### 1.3.2 Surrounding Land Use

The area in the vicinity of the proposed development is currently classified as *"Vacant"* or *"Unspecified"*. A previous site visit revealed that the area is mainly wilderness with game ranches forming a large part of the agricultural activities (cattle farming).

### 1.3.3 Roads and rail roads

There is one gravel district road that traverses the area. There are no other roads or railway lines within 2,000m from the proposed development. Based on observations made during previous site visits, the existing road does not carry any traffic of acoustic significance.

### 1.3.4 Residential areas

Excluding potentially NSD's identified in **Section 1.5**, there are no formal residential areas, communities or towns within 5,000m from the facility.

### 1.3.5 Other industrial and commercial processes

The Grootegeluk Colliery is located south of the proposed Tshivhaso project. Noises from the colliery may cumulatively add to noises from the power station.

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

### 1.3.6 Ground conditions and vegetation

The area falls within the Savannah biome, with the vegetation type being bushveld. The ground is covered with grasses, shrubs and trees and would be considered as 50% acoustically absorbent. This influences the propagation of the sound from the power station, as the fraction of sound that is reflected from the ground would be influenced as certain frequencies would be absorbed by the ground surface.

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

### 1.3.7 Existing Ambient Sound Levels

Ambient sound levels were measured during the Environmental Noise Impact Assessment (ENIA) process for the:

- Sekoko Railway Siding (September 2011);
- Sekoko Waterberg Colliery (November 2012); and
- Thabametsi Power Station (May 2014).

The area has a rural developmental character, with night-time sounds typical of a rural area. Sound levels can be elevated at times due to wind-induced noises as well as faunal sounds and the site may be thought of as "naturally" quiet. Onsite measurements and the existing soundscape are discussed in more detail in **Section 3**.

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

Potentially sensitive receptors, also known as Noise-Sensitive Developments (NSD's), located close to the proposed development site (and alternative sites) were identified using Google Earth® during the Scoping Phase, confirmed during previous site visits (see **Figure 1-3**).

## 1.5 COMMENTS REGARDS TO NOISE RECEIVED DURING THIS PROJECT

No comments with regards to noise have been registered, or have been made known to the author at the time this report was compiled.

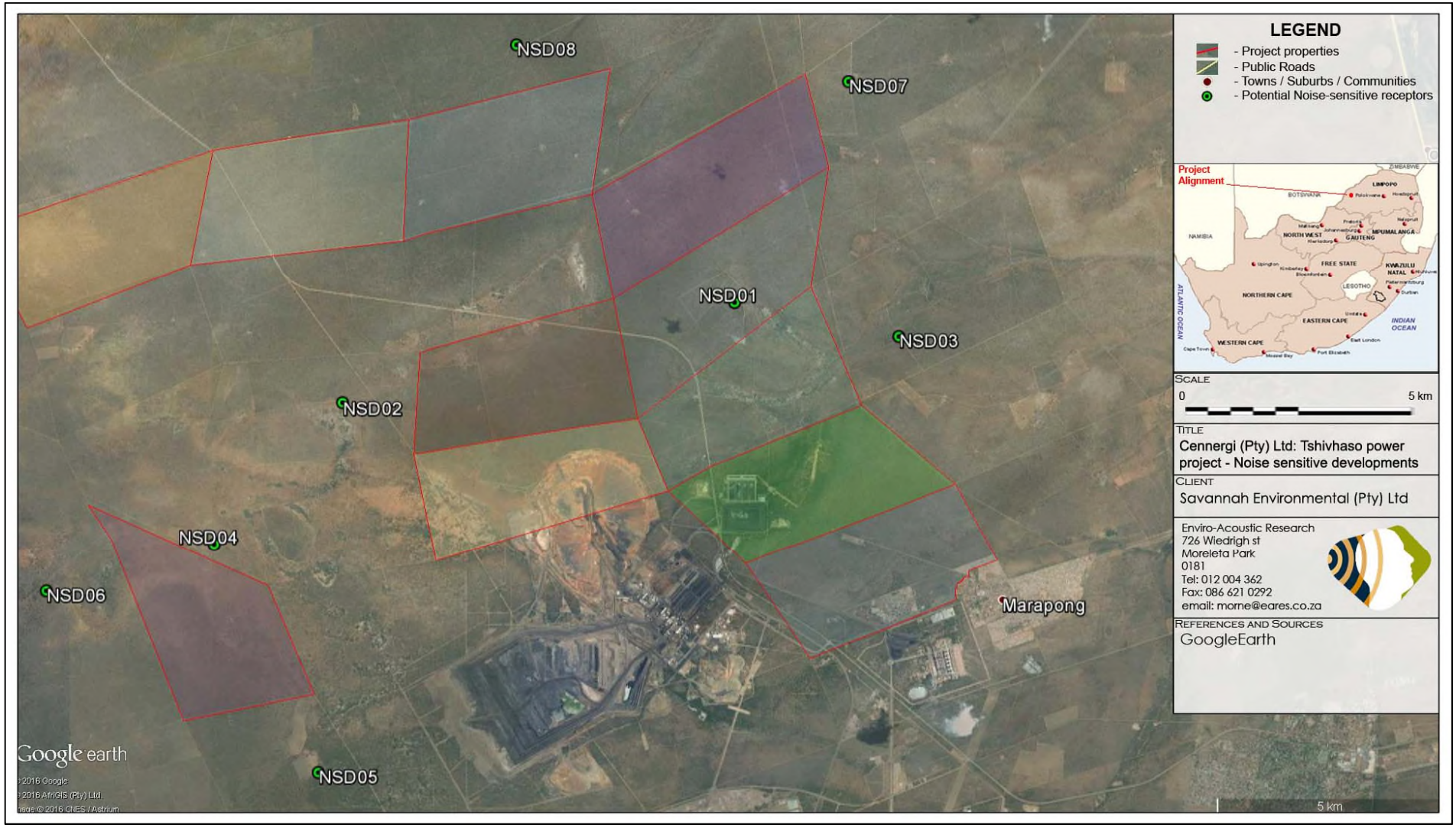


**Figure 1-3: Aerial image indicating potentially noise-sensitive receptors identified**

## 1.6 TERMS OF REFERENCE (TOR)

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

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

In addition, Appendix 6 of GN 982 of December 2014 (Gov. Gaz. 38282), issued in terms of the National Environmental Management Act, No. 107 of 1998 also defines minimum information requirements for specialist reports.

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

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

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

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

# 2 LEGAL CONTEXT, POLICIES AND GUIDELINES

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

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

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

## 2.2 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

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

### 2.2.1 Noise Control Regulations (GN R154 of 1992)

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

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. The National Regulations will be in effect in the Northern Cape Province.

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 10103:2008.*

***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".*

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

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

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

In addition, Appendix 6 of GN 982 of December 2014 (Gov. Gaz. 38282), issued in terms of this Act, have general requirements for EAPs and specialists. It also defines minimum information requirements for specialist reports.

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

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

(1) the Minister to prescribe essential national noise standards -

(a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or

(b) for determining –

(i) a definition of noise

(ii) the maximum levels of noise

(2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

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

An atmospheric emission licence issued in terms of Section 22 may contain conditions in terms of noise. This, however, is not relevant to the project as no atmospheric emissions will take place.

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

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

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

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

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

## 2.5 NOISE STANDARDS

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

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004. 'Calculating and predicting road traffic noise';

- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method';
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

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

## 2.6 INTERNATIONAL GUIDELINES

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

### 2.6.1 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.

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

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

### 2.6.2 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 not sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB, "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

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

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

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

### 2.6.4 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 Principle.

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

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

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

- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

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

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

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

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

### 2.6.5 National and International Guidelines - Appropriate limits for game parks and wilderness

The United States National Park Services identifies that "intrusive" un-natural sounds are of concern for the National Park Services (United States[2]) as many visitors go to parks to enjoy the soundscape (interpreted as natural soundscape). Naturally quiet places will not mean (as per interpretation of the author and available information) that the noise levels in the area will be low but rather that the soundscape contributors are of a natural origin (faunal communication, wind, water etc.).

These natural events could include the dawn chorus when songbirds start to sing at the start of a new day or frogs croaking after a rainfall event. Although game park visitors, receptors in "natural" areas and hospitality industries may not seek intrusive un-natural sounds, the operation of the game park/hospitality industry or receptors dwelling itself is source of anthropogenic noise (vehicles, game park electrical and mechanical

[2] National Park Services, "Soundscape Preservation and Noise Management", 2000, p. 1.

infrastructure etc.). National Parks do though implement their own guidelines/rules regarding noise created by park visitors.

Natural sounds can contribute a meaningful magnitude [3] to the ambient soundscape depending on season, time, faunal species, habitat and habitat fragmentation etc. Although the magnitude may be loud, natural sounds may contain harmonics[4] and other pleasant sounds that visitors seek when going to parks or wilderness areas.

Certain International states have tried implementing laws regarding external environmental "un-natural" noise sources into areas with natural sounds. In USA there exist numerous state and local laws to encourage industries near parks to keep within limits set out by the local authorities[5]. The United States National Park Service's efforts include attempts to reduce the flights over the Grand Canyon due to the introduction of non-natural impulsive noise events at the park.

### 2.6.6 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.

#### *2.6.6.1 ISO 14000*

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

- minimize how their operations (processes etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land);
- comply with applicable laws, regulations, and other environmentally oriented requirements, and
- 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, analysing data, and implementing corrective and preventive actions.

[3] Environ. We Int. Sci. Tech, "Ambient noise levels due to dawn chorus at different habitats in Delhi", 2001, p. 134.
[4] Panatcha Anusasananan, Suksan Suwanarat, Nipon Thangprasert, "Acoustic Characteristics of Zebra Dove in Thailand", p. 4.
[5] E.g. State of Oregon's Environmental Standards for Wilderness Areas

### 2.6.7 European Parliament Directive 200/14/EC

Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors was adopted by the European Parliament and the Council and first published in May 2000. The Directive was applied from January 3rd, 2002. The Directive placed sound power limits on equipment to be used outdoors in a suburban or urban setting. Failure to comply with these regulations may result in products being prohibited from being placed on the EU market. The equipment list is vast and includes machinery such as compaction machineries, dozers, dumpers excavators etc. Manufacturers as a result started to consider noise emission levels from their products to ensure that their equipment will continue to have a market in most countries.

# 3 CURRENT ENVIRONMENTAL SOUND CHARACTER

## 3.1 AMBIENT SOUND MEASUREMENTS

Ambient (background) noise levels were measured during previous studies in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***".

Ambient sound levels were measured previously for a number of other projects in the area, described in the following reports:

- De Jager, M. 2012: *"Acoustical Baseline study on various farms near the town of Lephalale, Limpopo Province"*, M2 Environmental Connections cc, Pretoria.
- De Jager, M. 2012: *"Noise Report for Scoping purposes: Establishment of the Peerboom Colliery near Lephalale, Limpopo"*, M2 Environmental Connections cc, Pretoria.
- De Jager, M. 2013: *"Noise Study for Environmental Impact Assessment: Establishment of the Thabametsi 1.200 MW Coal-fired Power Station near Lephalale, Limpopo"*. Enviro-Acoustic Research cc, Pretoria.
- De Jager, M. 2013: *"Noise Study for Environmental Impact Assessment: Establishment of the Sekoko Waterberg Colliery near Lephalale, Limpopo"*. Enviro-Acoustic Research cc, Pretoria.

## 3.2 EXISTING SOUNDSCAPE

The location of the day/night ambient sound measurement locations are presented in **Table 3-1** below and is also illustrated in **Figure 3-1** as blue squares. Sound level measuring equipment settings conform to specifications listed in SANS 10103:2008 (South African Guidelines). The sound level measuring equipment was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA.

**Table 3-1: Day/night-time measurement locations (Datum type: WGS 84)**

| Point name | Latitude | Longitude |
|---|---|---|
| **DW01** | -23.616559° | 27.481321° |
| **IASM01** | -23.644842° | 27.453804° |
| **IASM02** | -23.697691° | 27.474693° |
| **IASM03** | -23.595833° | 27.483097° |
| **IASM04** | -23.591280° | 27.468497° |

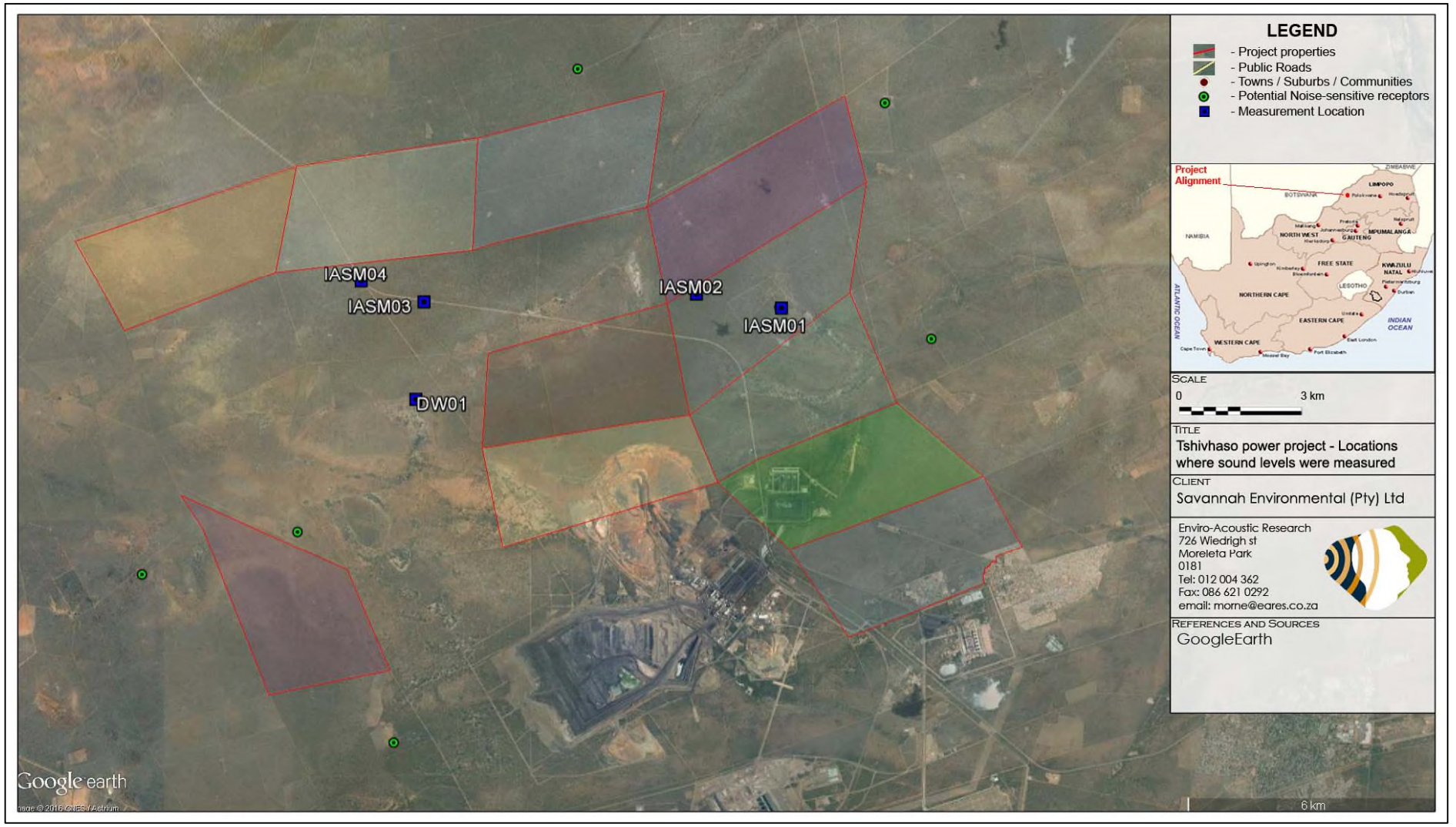


**Figure 3-1: Localities where ambient sound levels were measurement**

### 3.2.1 Measurement point DW01: (NSD02): Mr. van Wyk – van der Waltspan

An instrument was deployed at this location from the afternoon of 1st November till the morning of 2nd November 2012. The equipment defined in **Table 3-2** was used for gathering data.

**Table 3-2: Equipment used to gather data at DW01**

| Equipment | Model | Serial no |
|---|---|---|
| SLM | Rion NL-32 | 01182945 |
| Microphone | Rion UC-53A | 315479 |
| Calibrator | Rion NH-21 | 28879 |
| Weather Station | WH3081PC | - |

Microphone fitted with the appropriate windshield.

The measurement location was selected to be reflective of the typical ambient sound levels that this NSD may experience in the area. As a result a Sound Level Meter (SLM) was erected in an area close to the dwelling where the resident may spend time. Daytime ambient sounds were mainly natural comprising of wind induced noises and bird song, with little sounds of anthropogenic origin impacting on the area.

Unfortunately, most of the data at this point is not usable as the extension cable connecting sound level meter with the microphone was damaged soon after the measurement equipment was erected. It is assumed monkeys bit into the cable destroying it, as a troupe of them were seen at this premises during the site investigational date. Only 6 daytime measurements were collected, with $\mathbf{L_{AIeq}}$ levels ranging between 45 and 59 dBA. $\mathbf{L_{AMax}}$ and $\mathbf{L_{AMin}}$ levels for this hour period were 81.6 and 32.2 dBA respectively. $\mathbf{L_{A90}}$ values ranged between 34.5 and 38.1 dBA90.

The owner could not be contacted during the latest site visit to arrange access to repeat the measurements.

### 3.2.2 Measurement point – IASM01 (NSD01)

A number of 10 minute measurements were taken over a day/night period from the morning of 23rd till the morning of 24th May 2013. The equipment defined in **Table 3-3** was used for gathering data. Measured data is presented in **Figure 3-2**.

**Table 3-3: Equipment used to gather data at IASM01**

| Equipment | Model | Serial no |
|---|---|---|
| SLM | Rion NL-32 | 01182945 |
| Microphone | Rion UC-53A | 315479 |
| Calibrator | Rion NH-21 | 28879 |
| Weather Station | WH3081PC | - |

Microphone fitted with the appropriate windshield.

The measurement location was selected to be reflective of the typical ambient sound levels that this NSD may experience in the area. As a result a SLM was erected in an open field close to the fence, directly in front of the house. The ambient sound levels as measured are shown on **Figure 3-2** illustrated a rural area in terms of sound levels.

The daytime average $\mathbf{L_{AIeq}}$ value was 33.3 dBA (ranging between 22.6 and 69.2 dBA) with $\mathbf{L_{A90}}$ being 21.2 dBA90 (ranging between 15.8 and 32.6 dBA90). The average difference between $\mathbf{L_{AIeq}}$ and $\mathbf{L_{A90}}$ was 12.1 dB indicating impulsive noise dominating. Based on the sounds heard during the site visit, most of the sounds were of faunal origin. Note that a far-off noise with a broadband character was audible during quiet times.

Night-time $\mathbf{L_{AIeq}}$ values ranged from 24.4 to 35.4 dBA averaging at 29.0 dBA. $\mathbf{L_{A90}}$ values ranged from 16.6 to 28.0 dBA, averaging at 22.6 dBA. The average difference between $\mathbf{L_{AIeq}}$ and $\mathbf{L_{A90}}$ was 6.5 dBA. Impulsive sounds were less dominant, with the ambient sound scape likely dominated with typical night-time sounds from frogs and insects. Based on the sounds heard during the day, it is possible that the broadband noise would be more audible at night.

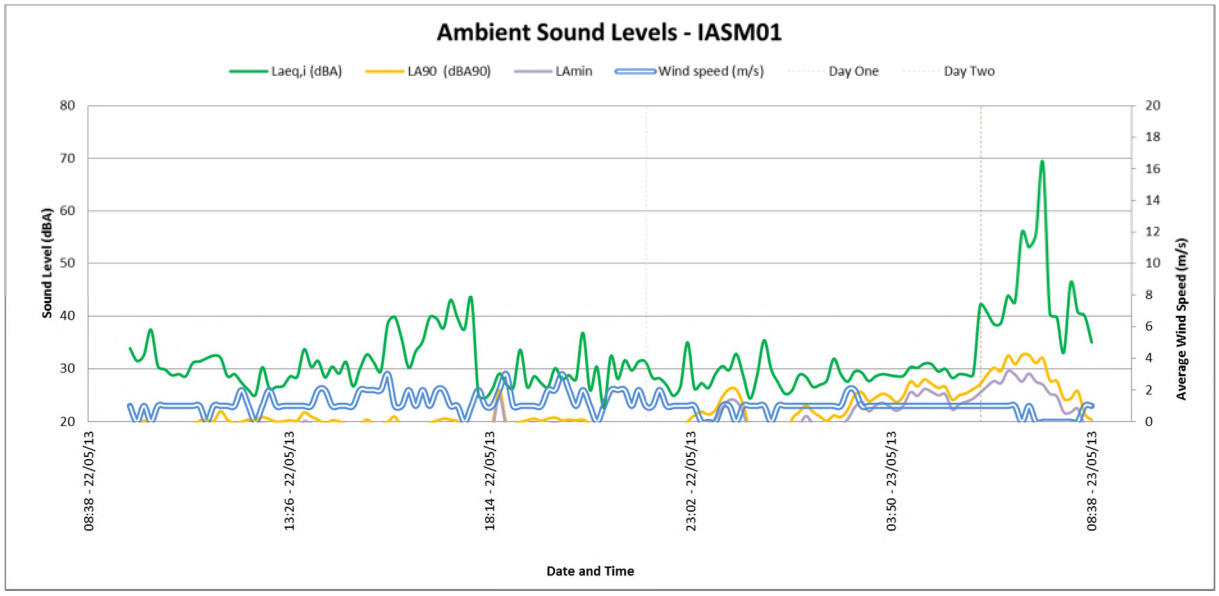


**Figure 3-2: Ambient Sound Levels at IASM01**

The site is rural in terms of development and character, with both day and night-time ambient sound levels confirming the rural nature.

### 3.2.3 Measurement point - IASM02

A number of 10 minute measurements were taken over 21 hours from the morning 23rd till morning 24th May 2013. The equipment defined in **Table 3-4** was used for gathering data. The instrument was installed at an unused tent camp inside the reserve. It was confirmed that there would be no people working in the vicinity during the measurement period, and at most, there might be a few cars driving past this location during the day. It can therefore assume that faunal sounds dominated the measurements as there was no wind during the measurement period.

**Table 3-4: Equipment used to gather data at IASM02**

| Equipment | Model | Serial no |
|---|---|---|
| SLM | Rion NA-28 | 00901489 |
| Microphone | Rion UC-59 | 02087 |
| Calibrator | Rion NC-74 | 34494286 |
| Weather Station | WH3081PC | - |

Microphone fitted with the appropriate windshield.

The ambient sound levels as measured are shown in **Figure 3-3** and illustrate an area with sound levels typical of a natural environment in winter.

The daytime average $\mathbf{L_{AIeq}}$ value was 30.2 dBA (ranging between 15.7 and 51.5 dBA) with $\mathbf{L_{A90}}$ being 21.4 dBA90 (ranging between 15.1 and 48.2 dBA90). The average difference between $\mathbf{L_{AIeq}}$ and $\mathbf{L_{A90}}$ was 8.9 dB indicating some impulsive noise. Based on the sounds heard during the site visit, all of the sounds were of faunal origin.

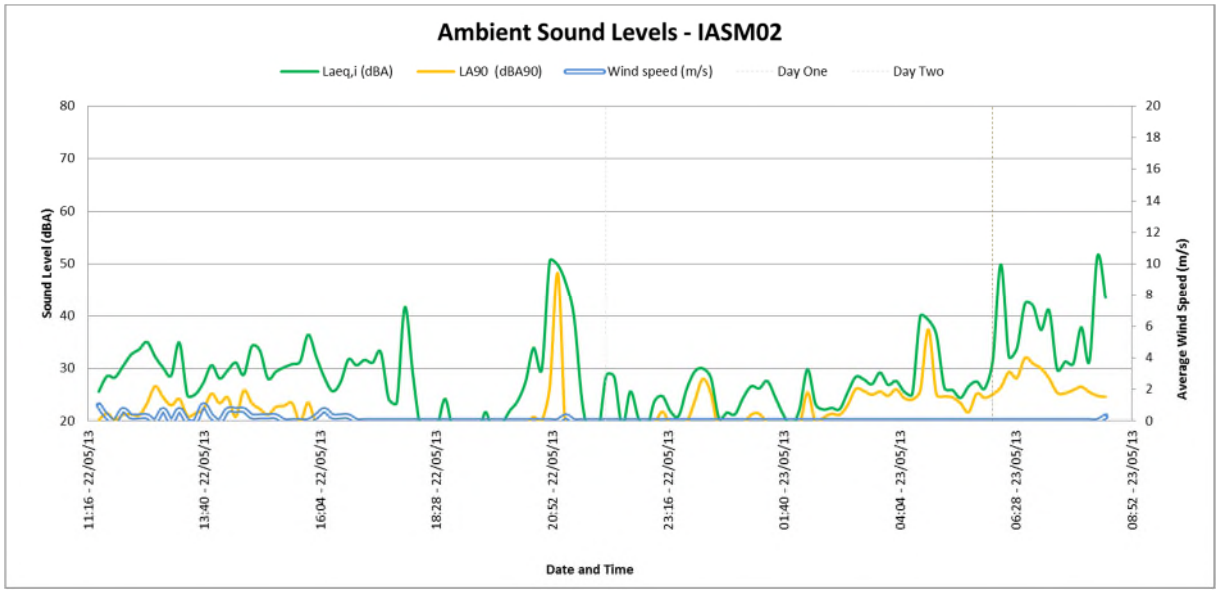


**Figure 3-3: Ambient Sound Levels at IASM02**

Night-time **$L_{AIeq}$** values ranged from 19.2 to 39.9 dBA averaging at 25.8 dBA. **$L_{A90}$** values ranged from 16.9 to 37.4 dBA, averaging at 21.7 dBA. The average difference between **$L_{AIeq}$** and **$L_{A90}$** was 4.1 dBA. Impulsive sounds were few with the ambient soundscape likely dominated by typical night-time sounds from frogs and insects.

Being beginning winter, the measurements reflect a very quiet area un-impacted by sound from anthropogenic origin. Measurements during spring and summer could report sound levels that are 10 – 20 dB higher, mainly due to increased faunal activity at night (especially insects).

**Figure 3-4** and **Figure 3-5** illustrates the spectral measurements collected at this receptor, similarly indicating a quiet area with very little sounds with any low frequency content (typical of various anthropogenic sounds) or tonality. Daytime measurements show most acoustic energy in the 500 – 8,000 Hz range, indicating numerous different sound sources. Night-time measurements show most acoustic energy in the 2,500 – 8,000 Hz range as well as an unidentified peak (non-significant) in the 160 Hz frequency. The 2,500 – 5,000 Hz frequency range is frequently associated with sounds from insects such as crickets as well as various frogs.

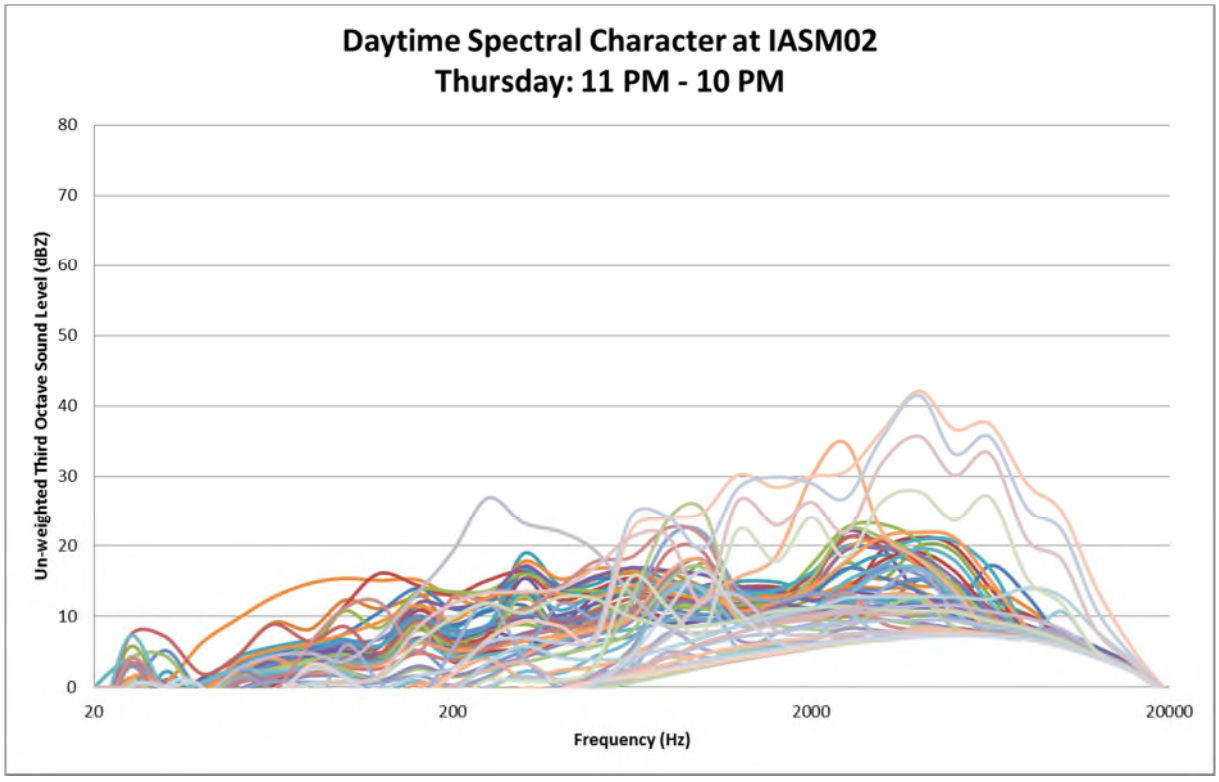


**Figure 3-4: Spectral Frequency Distribution as measured onsite at IASM02**

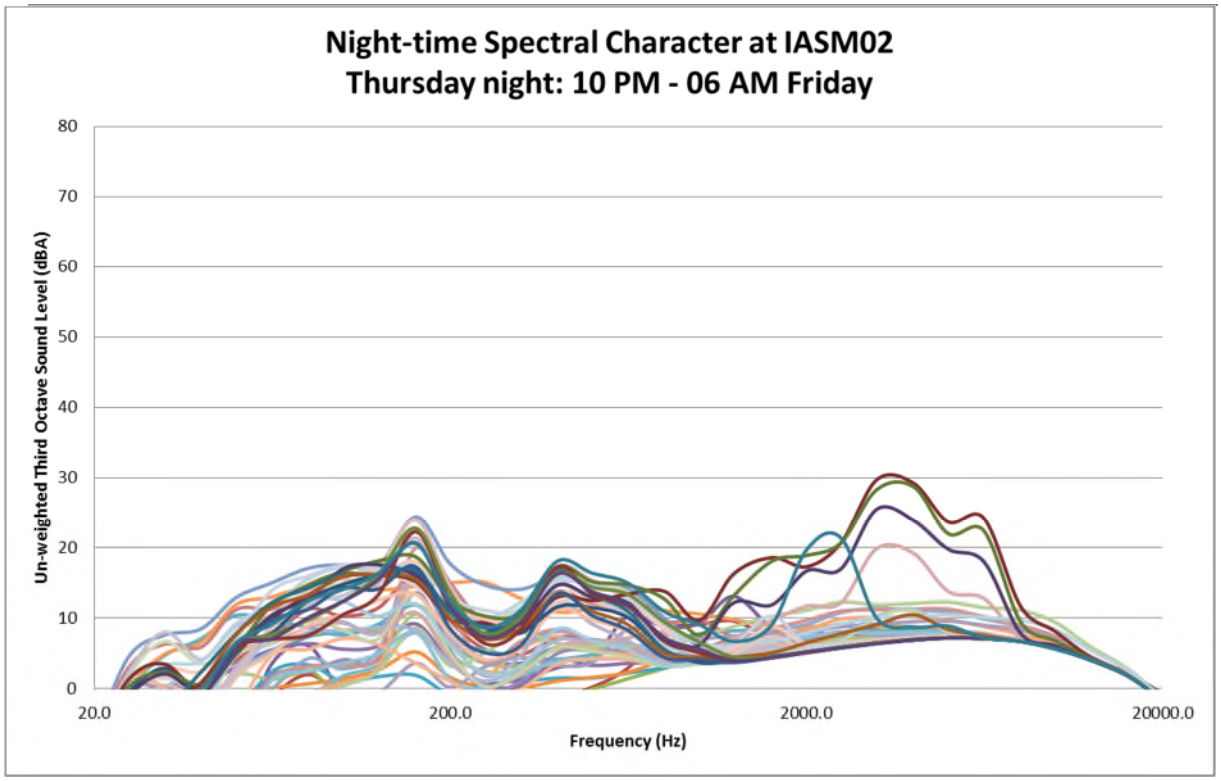


**Figure 3-5: Spectral Frequency Distribution as measured onsite at IASM02**

### 3.2.4 Single 10-minute measurements

A number of single measurements were taken during the morning of the 22nd to measure the sound levels as well as to count possible traffic on the gravel road that traverse the property. As with the other measurement locations, the data collected also confirm the rural character of the area. The equipment defined in **Table 3-5** was used for gathering data. The results are presented in **Table 3-6** below.

**Table 3-5: Equipment used to do 10-minute measures**

| Equipment | Model | Serial no | Calibration |
|---|---|---|---|
| SLM | Rion NA-28 | 00901489 | 1 June 2012 |
| Microphone | Rion UC-59 | 02087 | 1 June 2012 |
| Calibrator | Rion NC-74 | 34494286 | 24 February 2012 |
| Weather Station | WH3081PC | - | - |

Microphone fitted with the appropriate windshield.

**Table 3-6: Results of ambient sound level measurements**

| Point name | Wind speed Ave. (m/s) | $L_{AIeq,10min}$ (dBA) | $L_{A90}$ (dBA) | $L_{AMax}$ (dBA) | $L_{AMin}$ (dBA) |
|---|---|---|---|---|---|
| IASM03 | No wind | 34.3 | 25.6 | 52.4 | 19.7 |
| IASM04 | No wind | 46.4 | 25.9 | 65.6 | 63.7 |

No vehicles passed during the period when the measurements were collected. Ambient sounds mainly consisted of bird calls and insects with turtledoves, guinea fowls, partridges and pheasants clearly audible at times. Monkeys were also audible at the second location.

## 3.3 AMBIENT SOUND LEVELS – SUMMARY

Considering the results of the ambient sound measurements, the main source of sound was of faunal origin, with other sounds from various sources raising the sound levels.

While sound levels are higher closer to the activities of Grootegeluk Colliery and the Power Stations, areas away from these facilities were generally quiet. Sound levels for most of the area would be typical of a Rural Noise District (as per SANS 10103), and while sound levels may increase at times, this was mainly due to natural sounds (wind, birds, insects, etc.) and the area can be considered naturally quiet.

# 4 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked to various activities associated with the construction of the facility and related infrastructure as well as the operational phase of the activity.

## 4.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

### 4.1.1 Construction equipment

Construction activities include:

- Development of access roads;
- Site establishment (contractors camp, equipment and material storage, security and access control, security fence);
- Vegetation and topsoil removal;
- Establishment of the waste disposal facilities;
- Establishment of storage (coal stockpile footprints) and material handling facilities; and
- Construction of infrastructure (foundations to completed structure).

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dBA the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by construction equipment as well as the potential extent are presented in **Table 4-1**. The potential extent depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral character of the noise and the ambient soundscape in the surroundings.

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

### 4.1.2 Commissioning of Power Station

Significant but temporary noises will be generated during the start-up and commissioning phase of the power plant:

- High energy noises are generated during hot commissioning and clean-out of the heat exchanger and in particular the super-heater piping, using high pressure high temperature steam in order to clean the pipe internals off all welding debris and mill scale. The high pressure steam would be vented to atmosphere, generating high energy noise for a few hours per day over a number of days; and
- Testing of high pressure steam safety valves during commissioning could generate very high noise levels. This however is a very temporary event only lasting for a few minutes at a time.

### 4.1.3 Traffic

An additional source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include heavy and light vehicles transporting equipment, building materials as well as contractors to and from the site. More difficult to define are noises generated due to the development of other commercial activities that provide formal and informal services to the project, employees and contractors.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Considering traffic volumes observed at the construction site of the Medupi and Kusile Power Stations, this study will assume 40 heavy and 300 light vehicles moving to the construction area (travelling at an average of 60 km/h).

### 4.1.4 Blasting

Blasting may be required as part of the civil works to clear obstacles. However, blasting will not be considered during the EIA phase for the following reasons:

- Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure includes:
    - The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
    - Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).

  - Reducing the total size of the blast.
  - Damping materials used to cover the explosives.

- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity mining/quarrying.
- Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relatively fast resulting in a higher acceptance of the noise.

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

| Equipment Description[6] | 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| Roller | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Ventilation Fan | No | 119.7 | 94.7 | 88.7 | 82.6 | 74.7 | 68.7 | 65.1 | 62.6 | 59.1 | 54.7 | 51.2 | 48.7 | 42.6 |
| Vibratory 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 |

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

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

| Equipment Description | Equivalent (average) Sound Levels (dBA) | Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 m | 10 m | 20 m | 50 m | 100 m | 150 m | 200 m | 300 m | 500 m | 750 m | 1000 m | 2000 m |
| Bulldozer CAT D11 | 113.3 | 88.4 | 82.3 | 76.3 | 68.4 | 62.3 | 58.8 | 56.3 | 52.8 | 48.4 | 44.8 | 42.3 | 36.3 |
| Cement truck (with cement) | 111.7 | 86.7 | 80.7 | 74.7 | 66.7 | 60.7 | 57.2 | 54.7 | 51.2 | 46.7 | 43.2 | 40.7 | 34.7 |
| Crane | 107.5 | 82.5 | 76.5 | 70.5 | 62.5 | 56.5 | 53.0 | 50.5 | 46.9 | 42.5 | 39.0 | 36.5 | 30.5 |
| Cooling fans | 111.8 | 86.8 | 80.8 | 74.8 | 66.8 | 60.8 | 57.3 | 54.8 | 51.3 | 46.8 | 43.3 | 40.8 | 34.8 |
| Diesel LDV Idling | 70.6 | 45.7 | 39.6 | 33.6 | 25.7 | 19.6 | 16.1 | 13.6 | 10.1 | 5.7 | 2.1 | -0.4 | -6.4 |
| Diesel Generator (Large - mobile) | 106.1 | 81.2 | 75.1 | 69.1 | 61.2 | 55.1 | 51.6 | 49.1 | 45.6 | 41.2 | 37.6 | 35.1 | 29.1 |
| Electrical Turbine Generator | 116.7 | 91.8 | 85.7 | 79.7 | 71.8 | 65.7 | 62.2 | 59.7 | 56.2 | 51.8 | 48.2 | 45.7 | 39.7 |
| 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 |
| Exhaust Fans | 90.6 | 65.6 | 59.6 | 53.5 | 45.6 | 39.6 | 36.0 | 33.5 | 30.0 | 25.6 | 22.1 | 19.6 | 13.5 |
| 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 |
| General Noise - Construction (commercial) | 96.5 | 71.6 | 65.6 | 59.5 | 51.6 | 45.6 | 42.0 | 39.5 | 36.0 | 31.6 | 28.1 | 25.6 | 19.5 |
| Generator building | 96.0 | 71.0 | 65.0 | 59.0 | 51.0 | 45.0 | 41.5 | 39.0 | 35.5 | 31.0 | 27.5 | 25.0 | 19.0 |
| 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 |
| Road Transport Reversing/Idling | 108.2 | 83.3 | 77.2 | 71.2 | 63.3 | 57.2 | 53.7 | 51.2 | 47.7 | 43.3 | 39.7 | 37.2 | 31.2 |
| Road Truck average | 109.6 | 84.7 | 78.7 | 72.6 | 64.7 | 58.7 | 55.1 | 52.6 | 49.1 | 44.7 | 41.1 | 38.7 | 32.6 |
| Steam Turbine Condenser | 105.4 | 80.4 | 74.4 | 68.4 | 60.4 | 54.4 | 50.9 | 48.4 | 44.9 | 40.4 | 36.9 | 34.4 | 28.4 |
| Steam venting | 101.7 | 76.7 | 70.7 | 64.7 | 56.7 | 50.7 | 47.2 | 44.7 | 41.2 | 36.7 | 33.2 | 30.7 | 24.7 |
| Tip-load-bucket | 108.8 | 83.8 | 77.8 | 71.8 | 63.8 | 57.8 | 54.3 | 51.8 | 48.3 | 43.8 | 40.3 | 37.8 | 31.8 |
| Turbine Generator | 116.7 | 91.8 | 85.7 | 79.7 | 71.8 | 65.7 | 62.2 | 59.7 | 56.2 | 51.8 | 48.2 | 45.7 | 39.7 |
| Vibrating roller | 106.3 | 81.3 | 75.3 | 69.3 | 61.3 | 55.3 | 51.8 | 49.3 | 45.8 | 41.3 | 37.8 | 35.3 | 29.3 |
| Portable Diesel Generator | 99.9 | 75.0 | 68.9 | 62.9 | 55.0 | 48.9 | 45.4 | 42.9 | 39.4 | 35.0 | 31.4 | 28.9 | 22.9 |
| Water Cooling Fans 2 | 113.0 | 88.0 | 82.0 | 76.0 | 68.0 | 62.0 | 58.5 | 56.0 | 52.4 | 48.0 | 44.5 | 42.0 | 36.0 |

## 4.2 OPERATIONAL NOISES – GENERAL

South Africa's energy resource base is dominated by coal. Coal provides about 80% of SA's primary energy needs and this is unlikely to change significantly in the next 20 years.

A power station converts energy into a form which can be used by people i.e. electricity. **Figure 4-1** below illustrates[7] how electricity is typically produced at a coal-fired power station. While being more complex and costly, Circulating Fluid Bed (CFB) technology is more efficient and has a lower environmental impact and will likely be the technology that will be used at the power plant.

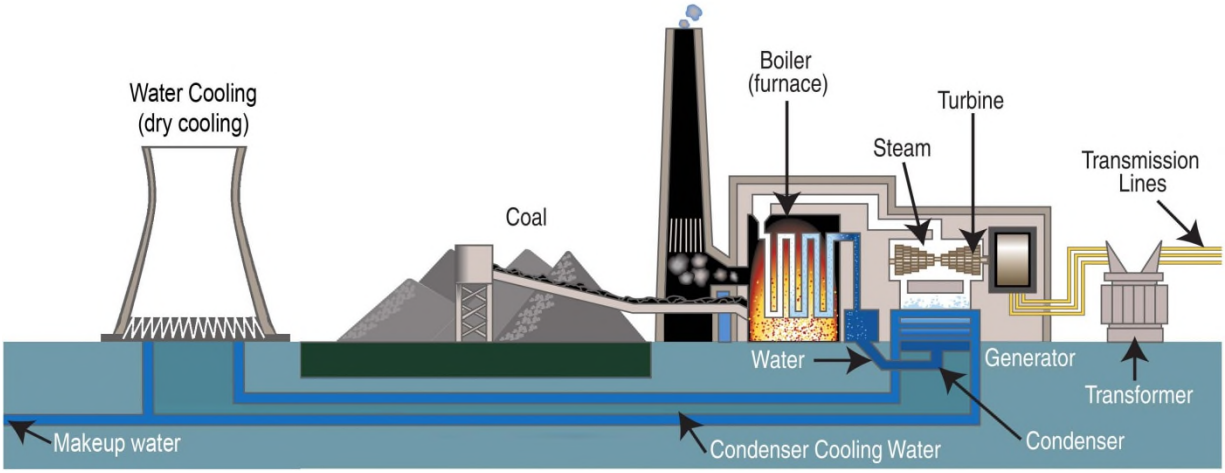


**Figure 4-1: Illustration of typical coal-fired power generation**

### 4.2.1 Noise-generating equipment during operation

The following is a basic description of the process flow (equipment or processes that generates noise indicated in ***bold italics***) for the generation of electricity:

1. Fuel: When required by the boiler, a ***stacker-reclaimer*** serves coal onto a ***conveyor system*** which transports the coal to the ***day silos (material handling)*** next to the ***boiler***. The coal is ***pulverized*** and drawn directly into the ***furnace*** for combustion;
2. CFB Boiler ***(air intake fans (induced and forced draft fans), blowers, steam venting, etc.)***: Fluidised beds consist of a bed of sand which is heated up and fluidised by passing streams of air through the sand. Solid fuel (such as coal / biomass) is introduced to the hot suspended sand on upward-blowing jets of air

[7] Highly simplified, not showing most ancillary processes such as material handling, coal pulverisers, pumps, blowers, heat exchangers, fans, filters (baghouse, cyclones or electrostatic), waste disposal systems, air compressors, black start equipment, typical backup systems, etc.

and the solid fuels start to combust. The result is a turbulent mixing of gas and solids. The tumbling action provides effective chemical reactions and heat transfer. The CFB has a ***filter system (cyclones typically)*** to separate the sand and coarse particles from the hot flue gases which leave the exhaust of the furnace. Due to the design of the CFB, limestone can be injected directly into the bed where it neutralises most of the sulphur which is released from the fuel during combustion leading to very low Sulphur Dioxide emissions. Intake fans generate significant noises;

3. Smoke stacks ***(Electrostatic Precipitator (ESP) or baghouses)***: Gases that are released from combustion in the furnaces, are filtered and then released into the atmosphere through smoke stacks;
4. ***Ash disposal***: Ash is removed from the exhaust gasses and will be disposed on ash-dams near the power station or alternatively removed from the site where it can be used (e.g. brick making or road building). Disposal will likely be a ***conveyor belt system*** where spreaders will distribute the ash over the residue deposit;
5. Cooling ***(large cooling fans)***: The proposed power plant will be designed with dry cooling technology in order to significantly reduce water consumption. This is generally the most significant identifiable noise source at a power station;
6. Flue Gas Desulphurisation: $SO^2$ emissions from the Power plant will be controlled by means of limestone injection in the combustion zone of the CFB boilers. Limestone is ***dried***, ***crushed*** and ***injected*** into the boiler using compressed air or blowers;
7. Turbine and generator ***(steam turbine generators)***: The high pressure steam is piped to turbines where it passes through the turbine blades, causing the blades to turn. The movement of the steam through the turbines causes the thermal (heat) energy to be converted to mechanical energy as the turbine is linked to the rotor of the generator. The rotor is an electromagnet which spins inside large coils of copper to generate electricity (alternating current (AC), which is essentially what is produced by a power station;
8. Ancillary services: There are numerous equipment and activities that generate noise. These include the various ***motors*** that drive pumps, ***air compressors***, aerodynamic noises from the various ***fans*** and ***blowers***, noises from ***piping and ducts***. This equipment is associated with the larger systems such as ***cyclones***, ***electrostatic precipitators***, ***condenser***, ***heat-exchangers*** etc. and the cumulative effect of these pieces of equipment can have a profound effect on far-field noise levels.

The main sources of noise are associated with the intake and cooling fans as well as material handling activities at the coal stockpile. Boilers, steam turbines and generators are generally constructed within fixed structures that will attenuate the noise from this equipment. Noise from ancillary services and activities such as pumps (boiler feed, water, chemical, condensate and vacuum), air compressors and onsite traffic generally is far less than the noise from the main sources, but, due to cumulative effect can have an impact in the far-field. The addition of the *"general noise"* noise source represents these noises. Considering the potential noise sources that can be identified, a list was compiled in **Table 4-3**.

The equipment defined in **Table 4-3** will be used for the purpose of the noise impact assessment. Sound power levels of equipment likely to be located within buildings will be reduced using the typical sound transmission loss values of 1.6 mm galvanised steel sheeting. It should be noted that the boiler and turbine generators are normally enclosed in a generator building with the cooling fans (not indicated on figures) placed high on the cooling towers (near the generator building).

**Table 4-3: Third Octave Sound Power Emission Levels used for modelling during operational phase**

| **Equipment** | **Sound power level, dB re1 pW, in octave band, Hz** | | | | | | | **SPL** |
|---|---|---|---|---|---|---|---|---|
| **process** | ***63*** | ***125*** | ***250*** | ***500*** | ***1000*** | ***2000*** | ***4000*** | **(dBA)** |
| **Coal pulverisers** | 99.0 | 99.0 | 95.0 | 93.0 | 90.0 | 89.0 | 84.0 | 96.0 |
| **Coal Yard Equipment** | 110.0 | 107.0 | 104.0 | 105.0 | 101.0 | 99.0 | 96.0 | 106.8 |
| **Conveyor Transfer points** | 98.3 | 97.3 | 97.5 | 96.7 | 95.1 | 90.9 | 87.6 | 99.4 |
| **Electrical Turbine Generator** | 115.0 | 123.0 | 109.0 | 110.0 | 110.0 | 111.0 | 109.0 | 116.7 |
| **Boiler Intake Fans** | 107.4 | 106.3 | 115.9 | 112.1 | 106.9 | 99.4 | 91.7 | 112.9 |
| **General noise** | 95.0 | 100.0 | 103.0 | 105.0 | 105.0 | 100.0 | 100.0 | 108.8 |
| **Generator building** | 79.9 | 84.3 | 82.8 | 89.0 | 95.4 | 79.1 | 66.9 | 96.0 |
| **Material Handling** | 111.6 | 104.1 | 105.2 | 102.2 | 97.1 | 91.3 | 87.9 | 103.2 |
| **Steam turbine condenser** | 108.0 | 108.0 | 107.0 | 102.0 | 100.0 | 97.0 | 92.0 | 105.4 |
| **Water Cooling Fans** | 118.5 | 115.5 | 116.0 | 111.2 | 104.3 | 103.9 | 100.0 | 113.0 |
| | **Typical sound transmission loss values** | | | | | | | |
| | ***63*** | ***125*** | ***250*** | ***500*** | ***1000*** | ***2000*** | ***4000*** | |
| **1.6 mm galvanised steel sheet** | 4 | 14 | 21 | 27 | 32 | 37 | 43 | |

As the layout plans are not available at this early stage of the project, these noise sources are located in isolation in the model, with no buildings that will attenuate noises and frequently attenuating, blocking and absorbing noises from the activity. This report therefore presents that worst-case scenario.

### 4.2.2 Traffic

Considering typical traffic moving to and from an operational power station it is not foreseen that traffic will contribute to significant noise from and to the site. In additional

there will be minimal traffic noise on the site. It will therefore not be considered during the operational phase.

## 4.3 POTENTIAL NOISE SOURCES: DECOMMISSIONING

Decommissioning starts when power generation at the facility stops, signalling the beginning of the dismantling of the equipment. Activities that can take place include:

- Dismantling of the remaining equipment and infrastructure. This includes the following:
    - Dismantling of all equipment,
    - Removal of all remaining redundant infrastructure (buildings, dams, workshop, access roads, possibly the offices and other buildings, etc.).
    - Removal of any contaminated soil.
    - The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage.
    - Seeding of disturbed areas (if necessary to re-establish vegetation).
    - Monitoring and maintenance of the rehabilitated areas.

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

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

# 5 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

## 5.1 NOISE IMPACT ON ANIMALS[8]

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on animals. While aircraft noise have a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources.

Overall, the research suggests that species differ in their response to:

- Various types of noise;
- Durations of noise; and
- Sources of noise.

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

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

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

From these and other studies the following can be concluded:

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

Various guidelines exist that briefly mention how noise can impact on wildlife from industrial and commercial industries, although none define any acoustical criteria[9]. Faunal

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

guidelines mainly exist regarding the protection of an animal's surrounding environment, with "physical" impacts such as water, vegetation etc. far more critical than that of acoustics.

### 5.1.1 Domestic 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)[10&11]. The high noise levels in a kennel facility may see negative influences on animals cardiovascular systems and behaviour, and may be damaging to the hearing of dogs[12]. However, noise levels from Wind Turbines will never reach such high levels where it may impact on the hearing of domestic animals.

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 due to any slight unfamiliar sounds or noises. 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. A change in the heart rate, renal blood flow and blood pressure of study subjects were noted in the above studies.

### 5.1.2 Wildlife

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 averaging6 m/s, noise levels during early morning dawn chorus or loud cicada noises during late evening or early morning.

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 impacted by noise would most likely relocate to a quieter area.

[9] E.g. International council of Mining & Metals. "Good Practice Guidance for Mining and Biodiversity". P.g. 63.
[10] Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[11] David Key, Essential Kennel Designs.
[12] Wei, B. L. (1969). Physiological effects of audible sound. AAAS Symposium Science, 166(3904), 533-535.

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 may mask the sounds of a predator approaching; similarly predators depending on hearing would not be able to locate their prey.

### 5.1.3 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (rats, mice) the laboratory test subjects differ in many aspects (genetics, behaviour etc.). Also noise levels of studies are conducted at generally very high levels at over 100 dB, much more than what would be experienced in environmental settings around industrial, commercial or transportation activities.[13] Other dissimilarities between 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 exists dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels did indicate physiological, behavioural changes, hearing loss and other such effects[14].

## 5.2 WHY NOISE CONCERNS COMMUNITIES[15]

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

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

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

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance,

[13] USEPA, 1971: *"Effects of Noise on Wildlife and other animals".*
[14] Ann Linda Baldwin. *"Effect of Noise on Rodent Physiology"*. 2007.
[15] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

in some cases, annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

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

Severity of the annoyance depends on factors such as:

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

## 5.3 IMPACT ASSESSMENT CRITERIA

### 5.3.1 Overview: The common characteristics

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

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified.

Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the

environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

### 5.3.2 Noise criteria of concern

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

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

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

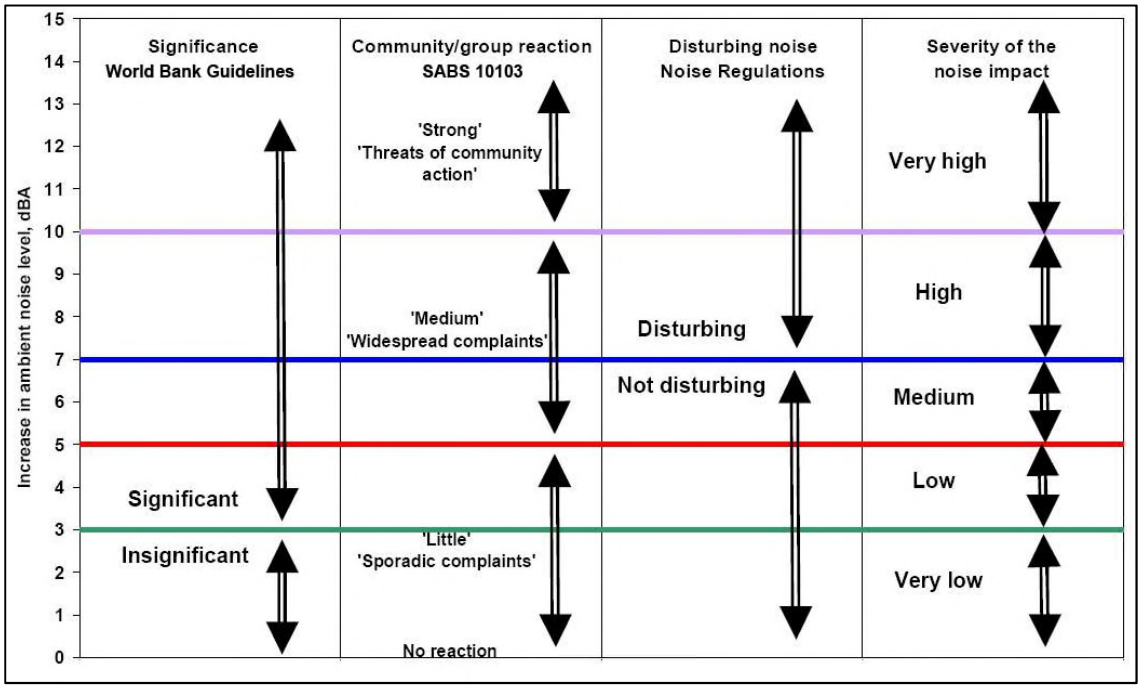


**Figure 5-1: Criteria to assess the significance of impacts stemming from noise**

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 5-1**). It provides the equivalent ambient noise

levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

Acoustical measurements in the vicinity of the project site indicated a quiet area where natural sounds generally dominate. The potential noise impact will be evaluated in terms of (i.t.o.) the rural acceptable rating level as well as the IFC noise-limits as defined below:

- "Rural Noise Districts" (45 and 35 dBA day/night-time Rating i.t.o. SANS 10103:2008).
- "Equator principles" (55 and 45 dBA day/night-time limits i.t.o. IFC Noise Limits) as well as a change in ambient sound levels (to be less than 3 dB).

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

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

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

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

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

*5.3.2.1 Annoyance associated with noise from Industrial Activities*[16]

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

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 5-2**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance.

[16]Van den Berg, 2011; Milieu, 2010.

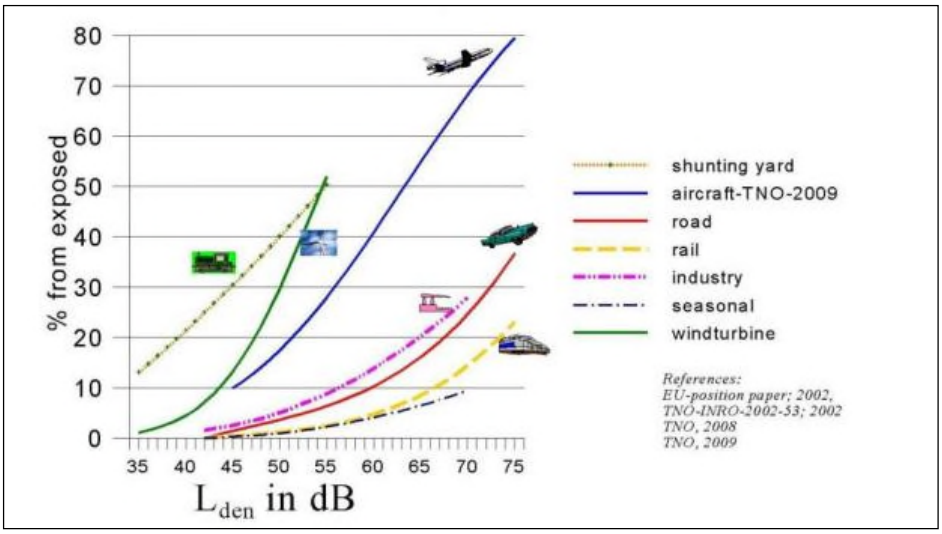


**Figure 5-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling**

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

### 5.3.3 Other noise sources of significance

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

At night, sounds that are present are natural sounds from animals, wind as well as other sounds we consider "normal", such as the hum from a variety of appliances (magnetostriction) drawing standby power, freezers and fridges.

### 5.3.4 Determining the Significance of the Noise Impact

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value as defined in the third column in the tables below.

The impact consequence is determined by the summing the scores of Magnitude (**Table 5-2**), Duration (**Table 5-3**) and Spatial Extent (**Table 5-4**). The impact significance (see **sections 5.3.5** and **5.3.6**) is determined by multiplying the Consequence result with the Probability score (**Table 5-5**). An explanation of the impact assessment criteria is defined in the following tables.

**Table 5-2: Impact Assessment Criteria - Magnitude**

| **This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.** | | |
|---|---|---|
| **Rating** | **Description** | **Score** |
| *Low* | Increase in average sound pressure levels between 0 and 3 dB from the expected wind induced ambient sound level.<br>No change in ambient sound levels discernible.<br>Total projected noise level is less than the Zone Sound Level in wind-still conditions. | 2 |
| *Low Medium* | Increase in average sound pressure levels between 3 and 5 dB from the (expected) wind induced ambient sound level.<br>The change is barely discernible, but the noise source might become audible. | 4 |
| *Medium* | Increase in average sound pressure levels between 5 and 7 dB from the (expected) wind induced ambient sound level.<br>Sporadic complaints expected.<br>Any point where the zone sound levels are exceeded during wind still conditions. | 6 |
| *High* | Increase in average sound pressure levels between 7 and 10 dB from the (expected) wind induced ambient sound level.<br>Medium to widespread complaints expected. | 8 |
| *Very High* | Increase in average sound pressure levels higher than 10 dBA from the (expected) wind induced ambient sound level. Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action.<br>Any point where noise levels exceed 65 dBA at any receptor. | 10 |

**Table 5-3: Impact Assessment Criteria - Duration**

| **The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.** | | |
|---|---|---|
| **Rating** | **Description** | **Score** |
| *Temporary* | Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional. | 1 |
| *Short term* | Impacts that are predicted to last only for the duration of the construction period. | 2 |
| *Long term* | Impacts that will continue for the life of the Project, but ceases when the Project stops operating. | 4 |
| *Permanent* | Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime. | 5 |

**Table 5-4: Impact Assessment Criteria – Spatial extent**

| Classification of the physical and spatial scale of the impact | | |
|---|---|---|
| **Rating** | **Description** | **Score** |
| *Site* | The impacted area extends only as far as the activity, such as footprint occurring within the total site area. | 1 |
| *Local* | The impact could affect the local area (within 1,000 m from site). | 2 |
| *Regional* | The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns. | 3 |
| *National* | The impact could have an effect that expands throughout the country (South Africa). | 4 |
| *International* | Where the impact has international ramifications that extend beyond the boundaries of South Africa. | 5 |

**Table 5-5: Impact Assessment Criteria - Probability**

| This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows: | | |
|---|---|---|
| **Rating** | **Description** | **Score** |
| *Improbable* | The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %). | 1 |
| *Possible* | The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25 %. | 2 |
| *Likely* | There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50 %. | 3 |
| *Highly Likely* | It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined to be between 50 % to 75 %. | 4 |
| *Definite* | The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100 %. | 5 |

### 5.3.5 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures).

Significance without mitigation is rated on the following scale:

| | | |
|---|---|---|
| **SR**<30 | Low (L) | Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required. |
| 30<**SR** <60 | Medium (M) | Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged. |
| **SR**>60 | High (H) | Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project. |

### 5.3.6 Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

| | | |
|---|---|---|
| **SR**<30 | Low (L) | The impact is mitigated to the point where it is of limited importance. |
| 30<**SR** <60 | Medium (M) | Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw. |
| **SR**>60 | High (H) | The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable. |

## 5.4 REPRESENTATION OF NOISE LEVELS

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

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

# 6 ASSUMPTIONS AND LIMITATIONS

## 6.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement. It is assumed that the measurement locations represents other residential dwellings in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including;
    - the distance to closest trees, number and type of trees as well as the height of trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwelling, type of equipment used at dwelling (compressors, air-cons);
    - general maintenance condition of house (especially during windy conditions); and
    - a number and type of animals kept in the vicinity of the measurement locations.
- Measurement locations for this project were selected to be in a relatively quiet area, away from the residential dwelling to minimize the potential of extraneous noises impacting on the ambient sound levels,
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation and external noise sources will influence measurements. It may determine whether one is measuring anthropogenic sounds from a receptors dwelling, or environmental ambient soundscape contributors of significance (faunal, roads traffic, railway line movement etc.). At times there are extraneous noises that cannot be heard during deployment, or not operational, that can significantly

impact on readings (such as water pumps, transformers, faunal communication, etc.);

- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.) – when close to any busy or significant roads. Traffic however is highly dependent on the time of day as well as general agricultural activities taking place during the site investigation. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. This study found that traffic in the area was very low, yet it cannot be assumed that it is always low.
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limit the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels. The site visit apparently coincided with a relatively windy period;
- Ambient sound levels are depended not only time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder 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[17];
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and in various cases sought after and pleasing;
- Considering more than one sound descriptor or equivalent can improve an acoustical assessment. Parameters such as $L_{AMin}$, $L_{AIeq}$, $L_{AFeq}$, $L_{Ceq}$, $L_{AMax}$, $L_{A10}$, $L_{A90}$ and spectral analysis forms part of the many variables that can be considered; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

[17] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

## 6.2 CALCULATING NOISE EMISSIONS ADEQUACY OF PREDICTIVE METHODS

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

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout,
- Acoustical characteristics of the ground. Hard ground propagates sound more efficiently than soft ground.

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

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

As stated previously, it is important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms).

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

## 6.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

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

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

## 6.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

Any noise impact can be mitigated to have a low significance, however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of a NSD), or the mitigation may result in the project not being economically viable. These mitigation measures may be engineered, technological or due to management commitment.

For the purpose of the EIA (determination of the significance of the noise impact) mitigation measures will be selected that are feasible, mainly focussing on management of noise impacts using rules, policy and require a management commitment. This however does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management).

It will be assumed the mitigation measures proposed for the construction phase were implemented and continued during the operational phase.

## 6.5 UNCERTAINTIES OF INFORMATION PROVIDED

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

- The octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of this processes/equipment. The determination of these levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment change depending on the load the process and equipment is subject too. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load. Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worst-case scenario;
- As it is unknown which processes and equipment will be operational (and when operational and for how long), modelling considers a scenario where all processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely over-estimate noise levels;
- Ambient sound levels vary over time of day, season and largely depend on the complexity and development character of the surrounding environment. To allow the calculation of change in ambient sound levels, a potential ambient sound level of 35 dBA is assumed. This level represents a quiet environment;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- 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; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. 75% hard ground conditions will be modelled even though the area where the facility will be located is relatively well vegetated and uneven - this will hence yield a conservative outcome.

In addition, as an exact location is not provided, the power station is located in the centre of the two alternative locations for modelling. The noise impact of the ash residue deposit is only evaluated conceptually.

With no layout available, the potential benefit of sounds being absorbed, attenuated and scattered from buildings cannot be considered that the modelled scenario represents a worse-case scenario.

# 7 PROJECTED NOISE RATING LEVELS

## 7.1 CONSTRUCTION PHASE NOISE IMPACT (CONCEPTUAL)

This section investigates the conceptual construction activities as discussed in **section 4.1**. Construction activities are highly dependent on the final operational layout

### 7.1.1 Description of Construction Activities Modelled

As no exact locations or layouts were provided, noises from construction activities will be conceptualised as presented in **Figure 7.1** (considering the preferred alternative). The ash residue deposit will be developed on the farm Vooruit (see **Figure 1-2** – closest location representing a worse-case scenario). The output will be used to consider the potential noise impact if the power station and residue deposit are developed at a different locations, including the farm Appelvlakte.

As can be seen from this layout, a number of different activities will take place, each with a specific impact on the closest potentially noise-sensitive developments. The one-hour equivalent noise rating will be calculated with the potential noise impact illustrated for the night-time period (the most sensitive time period).

The following activities are assumed:

1. Surface development at the location of the Power Station site. Activities include the stripping of vegetation (***bulldozer***). Topsoil will be excavated (***excavator***) and loaded onto a ***haul truck*** and stockpiled just east of the Power Station site;
2. Surface development at the location of the Ash Dump area. Activities include the stripping of vegetation (***bulldozer***). Topsoil will be excavated (***excavator***) and loaded onto a ***haul truck*** and stockpiled just west of the gravel road;
3. Access road development using a ***Grader***;
4. General noise generated at a laydown area located next to the gravel road;
5. Construction activities (***General noise***) at four different locations as illustrated **Figure 7.1**. This noise will be impulsive and a penalty of 5 dB will be added to the calculated noise level;
6. Digging of foundation of the foundations for the power line pylons;
7. An estimated 300 light passenger vehicles and 40 heavy vehicles per hour travelling on the access road to and from the construction site (road from Lephalale). Traffic travels at 60 km/h on a tarred road;
8. Night-time temperature averages 15$^{o}$ C with humidity at 80% (very good conditions for sound propagation);

9. Relative soft ground absorption conditions, with 50% of sound waves hitting the ground being absorb by vegetation and soils; and
10. Because the noise-generating activities of Grootegeluk and Matimba are further than 2,000m from the main development of power station the potential cumulative noise impact is not considered.

### 7.1.2 Results of modelling – conceptual construction activities

The output of the model for the conceptual construction scenario is illustrated in **Figure 7.2** (day time) and **Figure 7.3** (night-time period).

While there are numerous uncertainties, **Table 7-1** illustrate likely distances (potential buffers) between certain activities and potential noise-sensitive developments where noise levels may be exceeded.

**Table 7-1: Distances from construction activities for set noise rating levels**

| Noise Rating level | Distance from numerous simultaneous construction activities (m) | Distance from single construction activity (m) | Distance from conceptualized construction traffic route (m) |
|---|---|---|---|
| 35 dBA | 1,500m | 1,000m | 600m |
| 40 dBA | 1,000m | 640m | 350m |
| 45 dBA | 600m | 380m | 200m |


**Figure 7.1: Conceptualised Construction Activities**

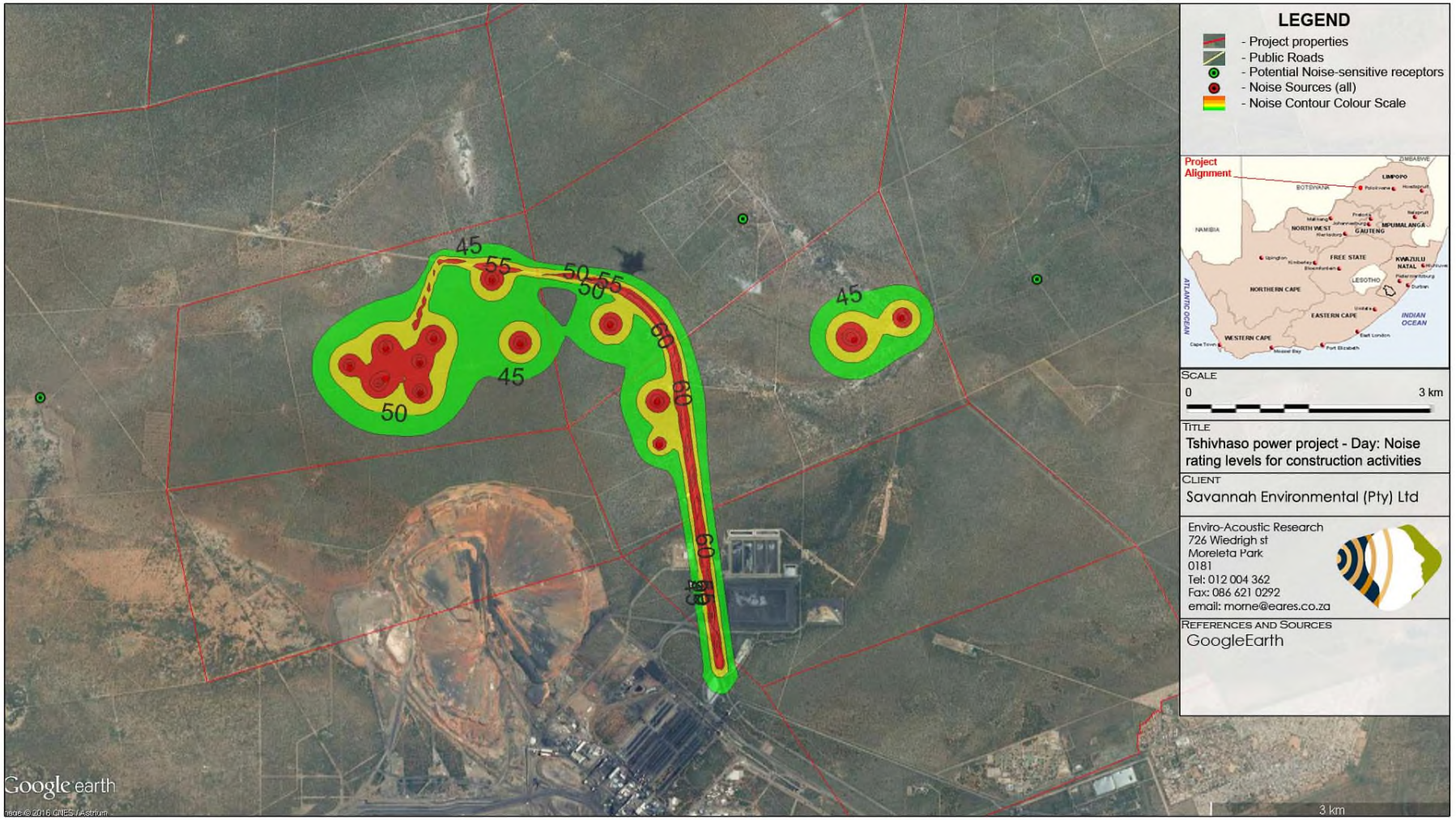


**Figure 7.2: Daytime construction noise: Contours of constant noise rating levels**

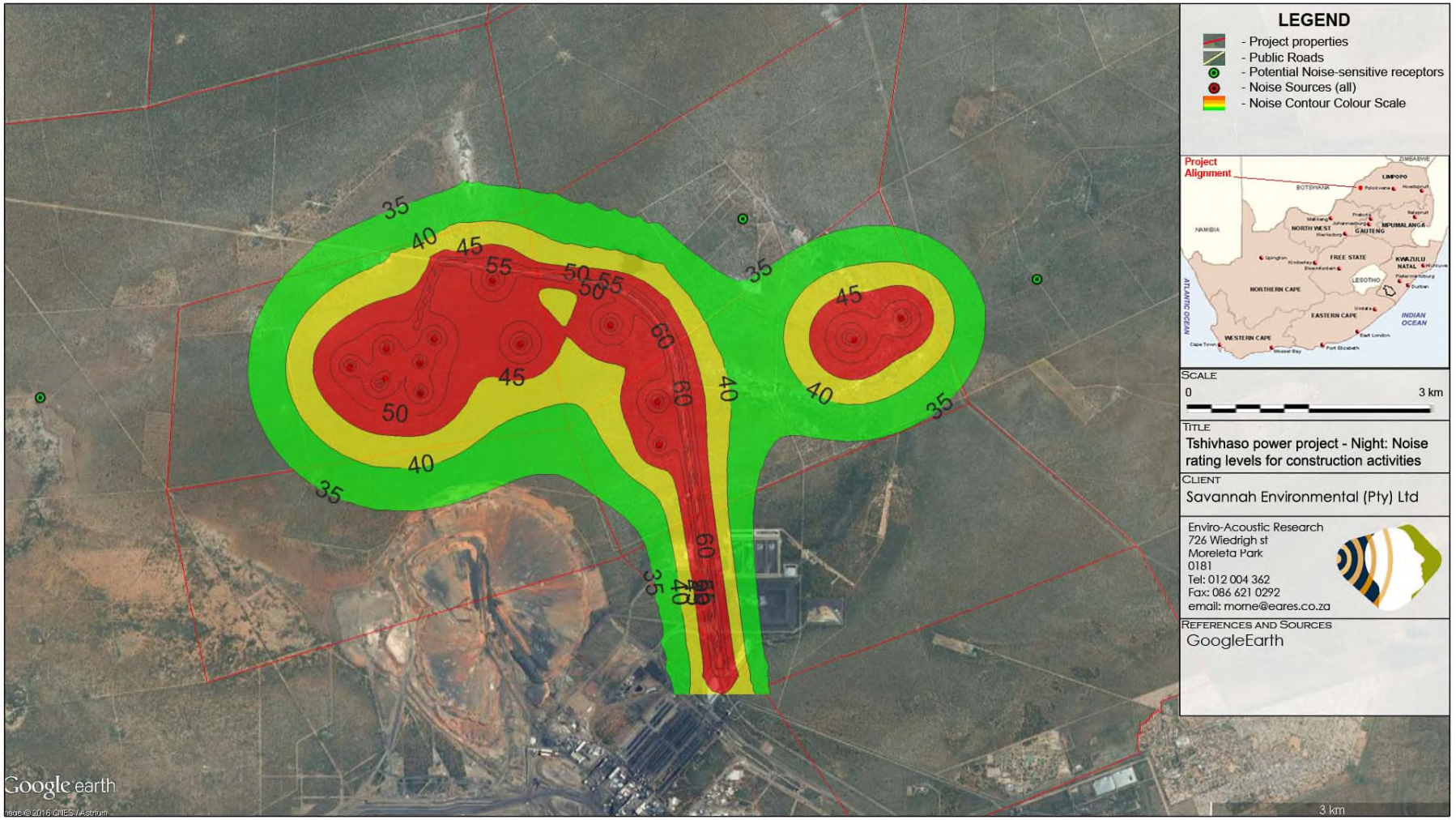


**Figure 7.3: Night-time construction noise: Contours of constant noise rating levels**

## 7.2 OPERATIONAL PHASE NOISE IMPACT

### 7.2.1 Investigated Scenario: Operational Phase

Daytime (06:00 – 22:00) and night-time (22:00 – 06:00) future operations will be assessed in this section. Most critical investigational times would be the night-time hours when a quiet environment is desired (at night for sleeping, weekends etc.).

Potential noise-generating operational activities are discussed in **section 4.2** and conceptualised as illustrated in **Figure 7-4**. The third octave sound power levels selected for the conceptualised scenario are defined in **Table 4-3**. Third octave sound is data obtained from a library of previous reports as well as a host internet / other resources.

The following assumptions are considered in the model:

- The power station is developed in the middle of alternative site 1, considering the layout of the Matimba power station (power station). The coal stockpile were conceptualised south of the power station. The noise-generating activities as conceptualised are illustrated in **Figure 7-4**;
- There are no structures that will attenuate, scatter or absorb acoustic energy. A worst-case scenario was assessed whereby the noise generating activities are operating under load simultaneously;
- No penalties have been added for potential noise sources with an impulsive or tonal character as this is unlikely to occur at the power station;
- Existing noise contributors were not considered as they are further than 2,000m of the potential noise-sensitive development or the proposed Tshivhaso development;
- A basic correction for equipment (steam turbine and generator) that is assumed to be in buildings (or surrounded by cladding). Cladding considered to be 1.6mm galvanized steel sheets;
- Road traffic was not considered as it will be a low source of noise (based on observations at existing power stations);
- Coal delivery to the power station was not considered. This will likely be a conveyor belt system, but, considering the location of potential receptors, the conveyor belt will likely pass further than 2,000m from any NSD and a noise impact from this source are unlikely;
- The delivery of limestone material was not considered. It will likely be delivered using existing routes (road and rail);
- Intervening ground conditions of a medium-hard ground nature, i.e. no dense flora etc. (acoustically 50% absorbent); and

- Activities functioning during wind-still conditions, in good sound propagation conditions (20° C temperature and 60% humidity for the day, 15° C temperature and 80% humidity for the night).

### 7.2.2 Results of modelling – conceptual construction activities

The output of the model for the conceptual operational scenario is illustrated in **Figure 7-5** (day time) and **Figure 7-6** (night-time period).

While there are numerous uncertainties, **Table 7-2** illustrate likely distances (potential buffers) between certain activities and potential noise-sensitive developments where noise levels may be exceeded.

**Table 7-2: Distances from conceptual operation for set noise rating levels**

| Noise Rating level | Distance from power station (m) | Distance from conveyor belt (m) | Distance from ash dump spreader (m) |
|---|---|---|---|
| 35 dBA | 2,400m | 800m | 600m |
| 40 dBA | 1,500m | 350m | 360m |
| 45 dBA | 1,020m | 130m | 200m |

## 7.3 DECOMMISSIONING AND CLOSURE PHASE NOISE IMPACT

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and operational phases and noise from the decommissioning and closure phases will therefore not be investigated further.


**Figure 7-4: Conceptual operational noise-generating activities at alternative site 1**

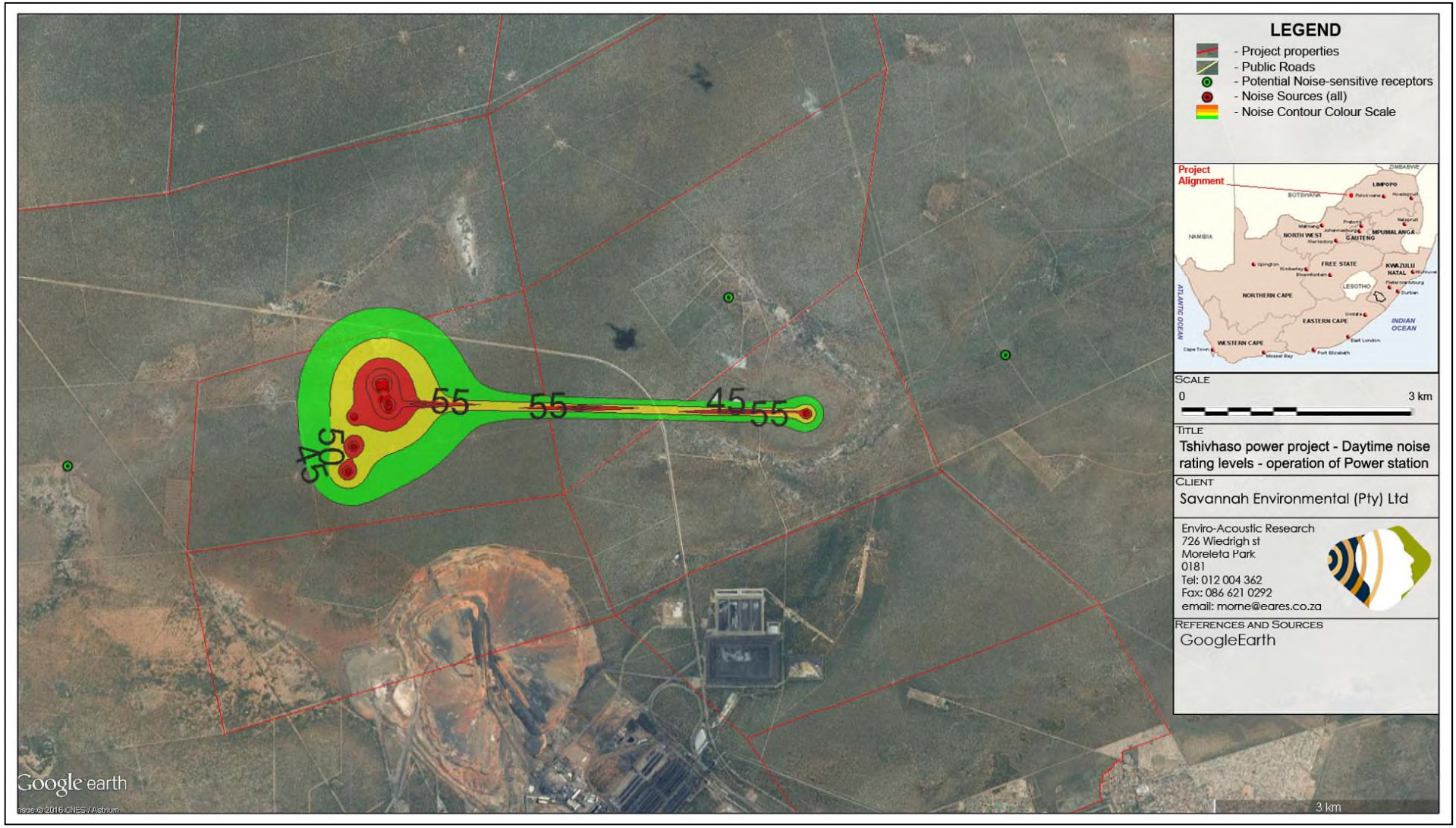


**Figure 7-5: Daytime operational noise: Contours of constant noise rating levels**

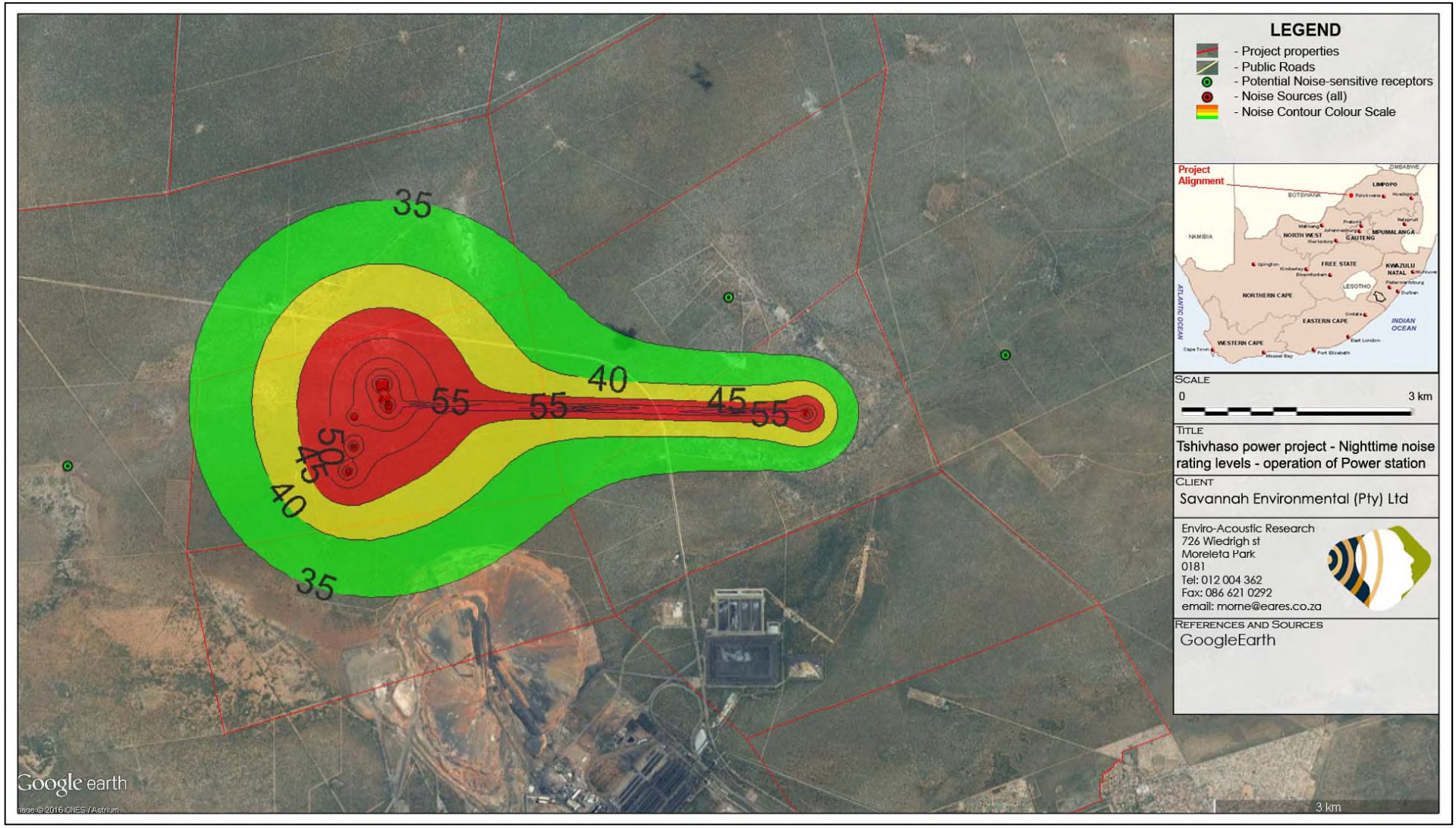


**Figure 7-6: Night-time operational noise: Contours of constant noise rating levels**

# 8 SIGNIFICANCE OF THE NOISE IMPACT

## 8.1 PLANNING PHASE NOISE IMPACT

No noise is associated with the planning phase and this will not be investigated in further.

## 8.2 CONSTRUCTION PHASE NOISE IMPACT

The impact assessment for the various conceptual construction activities are described in **Section 4.1**, defined and assessed in **section 7.1**. The distances at which potential construction activities may result in a noise impact is defined in **Table 7-1**. Considering the projected noise rating levels as well as the expected daytime ambient sound level, there is a low risk for a noise impact during the construction phase for the scenario as evaluated (Power Station built at alternative site 1 and ash residue deposit at option 3). The potential noise impacts are summarized in **Table 8-1**.

**Table 8-1: Impact Assessment: Construction Activities (Alternative site 1)**

| | | |
|---|---|---|
| ***Nature:***<br>Various construction activities taking place simultaneously. | | |
| **Receiver no** | | |
| All NSD | Noise levels below 35 dBA | Noise levels below 35 dBA |
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Regional (3) | Regional (3) |
| ***Duration*** | Short (2) | Short (2) |
| ***Magnitude*** | Low (2) | Low (2) |
| ***Probability*** | Improbable (1) | Improbable (1) |
| ***Significance*** | **Low (7)** | **Low (7)** |
| ***Status (positive/negative)*** | Negative | Negative |
| ***Reversibility*** | Very High | Very High |
| ***Loss of resources?*** | No | No |
| ***Can impacts be mitigated?*** | Yes, discussed to ensure a low impact | Yes, discussed to ensure a low impact |
| ***Confidence in findings:***<br>Medium. As the location of the power station is not defined it assumes that the power station will be constructed far from the NSD identified. | | |
| ***Mitigation:***<br>Significance of noise impact is low for the scenario as conceptualized. Mitigation are however highlighted for the developer to consider during the future planning stages to ensure that the significance of the noise impact remain low. | | |
| ***Cumulative impacts:***<br>Potential of cumulative noise impact is low. | | |
| ***Residual Risks:***<br>No residual noise risk exists. | | |

## 8.3 OPERATIONAL PHASE NOISE IMPACT

The impact assessment for the various activities defined in **sections 4.2** and **7.2**, with the projected noise levels calculated in **section 7.2**. The distances at which potential construction activities may result in a noise impact is defined in **Table 7-2**.

The significance of the noise impact is considered to be low on all receptors for the scenario as evaluated. The noise impact is assessed and summarized in **Table 8-2**.

**Table 8-2: Impact Assessment: Operational Activities**

| ***Nature:*** Various equipment and systems operating simultaneously | | |
|---|---|---|
| **Receiver no** | | |
| All NSD | Less than 35 dBA | Less than 35 dBA |
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Regional (3) | Regional (3) |
| ***Duration*** | Long (4) | Long (4) |
| ***Magnitude*** | Low (2) | Low (2) |
| ***Probability*** | Improbable (1) | Improbable (1) |
| ***Significance*** | **Low (9)** | **Low (9)** |
| ***Status (positive/negative)*** | Negative | Negative |
| ***Reversibility*** | Very High | Very High |
| ***Loss of resources?*** | No | No |
| ***Can impacts be mitigated?*** | Yes, discussed to ensure a low impact | Yes, discussed to ensure a low impact |
| ***Confidence in findings:*** Medium. As the location of the power station is not defined it assumes that the power station will be constructed far from the NSD identified. | | |
| ***Mitigation:*** Significance of noise impact is low for the scenario as conceptualized. Mitigation are however highlighted for the developer to consider during the future planning stages to ensure that the significance of the noise impact remain low. | | |
| ***Cumulative impacts:*** Potential of cumulative noise impact is low. | | |
| ***Residual Risks:*** No residual noise risk exists. | | |

## 8.4 DECOMMISSIONING PHASE NOISE IMPACT

Final decommissioning activities will have a noise impact lower than either the construction or operational phases. This is because decommissioning and closure activities normally take place during the day using minimal equipment (due to the decreased urgency of the project). While there may be various activities, there is a very small risk for a noise impact.

## 8.5 EVALUATION OF ALTERNATIVES

The project will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa. The project will generate short and long-term employment and other business opportunities. People in the area that are not directly affected by increased noises will likely have a positive perception of the project and will see the need and desirability of the project.

### 8.5.1 No-go option

The ambient sound levels will remain as is (relatively low).

### 8.5.2 Power Station on Graafwater (preferred option)

The proposed power generation activities (worse-case evaluated) may raise the noise levels in the direct vicinity of the power station, but there are no receptors close this location. Even if this power station is developed on the western side of Graafwater 456 LQ, NSD02 is still further than 1,500 m from the power station. For the evaluated scenario, this relate to a noise rating level of approximately 40 dBA (at approximately 1,500m).

When developed further than 2,500 m from this receptor, the significance of the potential noise impact will be low.

### 8.5.3 Power Station Alternative site 2 (eliminated after scoping)

If the power station is developed in the middle of the Eendrachtpan 451 LQ property there is a low potential of a noise impact from the power station. However, increased noises due to transport of material (coal and limestone), if the routes are not well planned may pose a noise impact on NSD01.

In terms of acoustics, the location on the farm Graafwater 456 LQ (Alternative site 1) is preferred to the alternative site 2 (Eendrachtpan 451 LQ).

### 8.5.4 Ash residue deposit option on Farm Vooruit (eliminated after scoping)

Night-time construction noises will be audible at NSD01 if the ash residue deposit is developed on the farm Vooruit 449 LQ, but the impact will be low during the operational phase. If the ash residue deposit is developed further than 1,000 m from NSD01 the noise impact would be low during all phased of the development.

### 8.5.5 Ash residue deposit option on Farm Appelvlakte (preferred option)

With no potential noise-sensitive receptors in the vicinity of farm Appelvlakte 448 LQ, the risk of a noise impact will be low.

In terms of acoustics, there is little preference whether the Ash Residue Deposit is developed on the Farm Appelvlakte or Graafwater.

# 9 MITIGATION OPTIONS

The developer must note that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. At all stages surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations.

It is counterproductive to suggest that the activities (or facility) will be inaudible due to existing high ambient sound levels. The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities, the spectral character and that of the surrounding soundscape (both level and spectral character).

## 9.1 PLANNING PHASE MITIGATION MEASURES

The biggest potential mitigation measure would be locating the power station and ash residue deposit as far as possible from potential noise-sensitive receptors. If the project systems are planned further than 2,500m from any NSD the potential of a noise impact would be low.

## 9.2 CONSTRUCTION PHASE MITIGATION MEASURES

The study considers the potential noise impact on the surrounding environment due to construction activities during the day- and night-time periods. It was determined that the potential noise impact would be of low significance if the power station are developed further than 2,500m from any NSD.

It is recommended that the developer implement a line of communication (i.e. a help line) where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The project should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated.

### 9.2.1 Mitigation options available to reduce Construction Noise Impact

No mitigation options are proposed due to the low risk of a noise impact to occur during the construction phase.

## 9.3 OPERATIONAL PHASE MITIGATION MEASURES

### 9.3.1 Mitigation options available to reduce Operational Noise Impact

The significance of noise during the operational phase is low and additional mitigation measures are not required.

## 9.4 DECOMISSIONING PHASE MITIGATION MEASURES

### 9.4.1 Mitigation options available to reduce Decomissioning Noise Impact

The significance of noise during the decommissioning phase is low and additional mitigation measures are not required.

## 9.5 SPECIAL CONDITIONS

### 9.5.1 Special conditions that should be included in the Environmental Management Programme report

The developer must implement a line of communication (i.e. a help line) where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers.

### 9.5.2 Special conditions that should be included in the Environmental Authorization

1. The potential noise impact must be reviewed should the power station or any of the project components are developed closer than 2,000 m from any potential noise-sensitive receptors.
2. The developer must investigate any reasonable and valid noise complaint if registered by a potential noise-sensitive receptors staying within 2,000 m from the power station or any associated activities.

# 10 ENVIRONMENTAL MANAGEMENT OBJECTIVES

Environmental Management Objectives are difficult to be defined for noise because ambient sound levels would in any event slowly increase as developmental pressures increase in the area. This is due to increased traffic associated with increased development, human habitation, agriculture and even eco-tourism. While these increases in ambient sound levels may be low (and insignificant) it has the effect of cumulatively increasing the ambient sound levels.

The moment the power generation facility stops operation, ambient sound levels will drop to levels similar to the pre-development levels, or to new levels (typical of other areas with a similar developmental character) if other development has occurred in the interim.

# 11 ENVIRONMENTAL MONITORING PLAN

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

- Passive measuring – the registering of any complaints (reasonable and valid) regarding noise; and
- Active measuring – the measurement of noise levels at identified locations.

No active environmental noise monitoring is recommended due to the low significance for a noise impact to develop. However, should a reasonable and valid complaint about noise be registered, it is the responsibility of the developer to investigate this complaint as per the following sections. It is recommended that the noise investigation be done by an independent acoustic consultant.

While this section recommends a noise monitoring programme, it should be used as a guideline as site specific conditions may require that the monitoring locations, frequency or procedure be adapted.

## 11.1 MEASUREMENT LOCALITIES AND PROCEDURES

### 11.1.1 Measurement Localities

No routine noise measurements or locations are recommended. Noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. A second instrument must be deployed at a control point away from the potential noise source during the measurement period.

### 11.1.2 Measurement Frequencies

Once-off measurements if and when a reasonable and valid noise complaint is registered. Results and feedback must be provided to the complainant. If required and recommended by an acoustic consultant, there may be follow-up measurements or a noise monitoring programme can be implemented.

### 11.1.3 Measurement Procedures

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

## 11.2 RELEVANT STANDARD FOR NOISE MEASUREMENTS

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. It should be noted that the SANS standard also refers to a number of other standards.

## 11.3 DATA CAPTURE PROTOCOLS

### 11.3.1 Measurement Technique

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

### 11.3.2 Variables to be analysed

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

### 11.3.3 Database Entry and Backup

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

### 11.3.4 Feedback to Receptor

A measurement report must be compiled considering the requirements of the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. The facility must

provide feedback to the potential noise-sensitive receptors using the channels and forums established in the area to allow interaction with stakeholders, alternatively in a written report.

## 11.4 STANDARD OPERATING PROCEDURES FOR REGISTERING A COMPLAINT

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

- Full details (names, contact numbers, location) of the complainant;
- Date and approximate time when this non-compliance occurred;
- Description of the noise or event;
- Description of the conditions prevalent during the event (if possible).

# 12 CONCLUSIONS AND RECOMMENDATIONS

Enviro-Acoustic Research CC was contracted by Savannah Environmental (the EAP) to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the development of the Tshivhaso Coal-fired Power Station west of Lephalale, Limpopo Province.

Ambient sound levels were measured previously in the vicinity of the proposed development. This included long-term measurements over a period of at least one night at three locations, as well as two short-term measurements. The area has a rural character in terms of appearance and development, with a high potential to be quiet away from the Grootegeluk Colliery and Matimba Power Station within the study area.

Considering the results of the ambient sound measurements, the main source of sound was of faunal origin, with other sounds from various sources raising the sound levels. Sound levels for most of the area would be typical of a Rural Noise District (as per SANS 10103), and while sound levels may increase at times, this was mainly due to natural sounds (wind, birds, insects, etc.) and the area can be considered naturally quiet.

The projected noise rating levels were calculated using a acoustical propagation model. As the location for the power station or residue deposit was not defined, locations were conceptualized in the middle of the preferred options. At these locations, the potential noise rating levels were less than 35 dBA at the potential noise-sensitive receptors.

Mitigation is not required, although generic measures are recommended for the developer to note. Mitigation measures mainly relates to the planning phase, with the recommendation that the power station be located sufficiently away from potential noise-sensitive receptors. Measurement locations, frequencies and procedures are provided as a guideline for the developer to consider should there be a noise complaint.

Due to economic advantages, power generation does provide valuable employment, business opportunities and green energy. It must be noted when such projects are close to potential noise-sensitive receptors, consideration must be given to ensuring a compatible co-existence. This does not suggest that the sound from the facility should not be audible under all circumstances as this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source, but rather that the sound due to the power generation activities should be at a reasonable level in relation to the ambient sound levels.

While this project will have a noise impact of a number of the closest noise-sensitive receptors, these impacts are of low significance and can be considered insignificant. It is however important that the potential noise impact be evaluated should the location of the power station or any associated systems be closer 2,000m from a confirmed NSD.

It is therefore the opinion of the Author that the increases in noise levels are of minor significance. It is therefore the recommendation that the project should be authorised (from a noise impact perspective).

# 13 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Licence Applications and EIA's), auditing of licence conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 8 years, and was involved with the following projects in the last few years:

| | |
|---|---|
| **Wind Energy Facilities** | *Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), iNCa Gouda (Aurecon SA), Kangnas (Aurecon), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Happy Valley (SE), Deep River (SE), Saldanha WEF (Terramanzi), Loeriesfontein (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Plateau East and West (Aurecon), Saldanha (Aurecon), Veldrift (Aurecon), Tsitsikamma (SE), AB (SE), West Coast One (SE), Namakwa Sands (SE), Dorper (SE), VentuSA Gouda (SE), Amakhala Gunstfontein (SE), Klipheuwel (SE), Cookhouse (SE), Cookhouse II (SE), Canyon Springs (Canyon Springs), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Outeniqwa (Aurecon), Koningaas (SE), Eskom Aberdene (SE), Spitskop (SE), Rhenosterberg (SiVEST), Bannf (Vidigenix), Wolf WEF (Aurecon)* |
| **Mining and** | *BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon* |

| | |
|---|---|
| **Industry** | *Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Delft Sand (AGES), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream), Stuart Coal – Weltevreden (CleanStream), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream), EastPlats (CleanStream), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali)* |
| **Road and Railway** | *K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane)* |
| **Airport** | *Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping* |
| **Noise monitoring** | *Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional, Sephaku Delmas (AGES), Amakhala Gunstfontein WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon)* |
| **Small Noise Impact Assessments** | *TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), Natref (NEMAI), RareCo (SE), Struisbaai WEF (SE)* |
| **Project reviews and amendment reports** | *Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma (Cennergi), Amakhala Gunstfontein (Windlab), Spreeukloof (Savannah), Spinning Head (Savannah), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy)* |

# 14 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

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

**Disclosure of Vested Interest**

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

_____
Signature of the environmental practitioner:

**Enviro-Acoustic Research cc**
Name of company:

_____
Date:

# 15 REFERENCES

In this report reference was made to the following documentation:

1. Autumn, Lyn Radle, 2007: '*The effect of noise on Wildlife: A literature review'.*
2. Chapman *et al*. 2013: '*Spatio-temporal differences in the history of health and noise complaints about Australian wind farms: evidence for the psychogenic, "communicated disease" hypothesis'*. Sydney School of Public Health, University of Sydney
3. Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm
4. Hartley, J.C., Stephen, R.O. 1992. '*A Paradoxical Problem. Can bush crickets discriminate frequency?'.* J. exp. Biol. 163, 359-365.
5. Kroesen and Schreckenberg, 2011. '*A measurement model for general noise reaction in response to aircraft noise'.* J. Acoust. Soc. Am. 129 (1), January 2011, 200-210.
6. Noise quest. 2010. '*Aviation Noise Information & Resources*': http://www.noisequest.psu.edu/pmwiki.php?n=Main.HomePage
7. Norton, M.P. and Karczub, D.G. 2003. '*Fundamentals of Noise and Vibration Analysis for Engineers*, Second Edition'.
8. SANS 10103:2008. '*The measurement and rating of environmental noise with respect to annoyance and to speech communication*'.
9. SANS 10210:2004. '*Calculating and predicting road traffic noise*'.
10. SANS 10328:2008. '*Methods for environmental noise impact assessments*'.
11. SANS 10357:2004. '*The calculation of sound propagation by the Concave method*'.
12. USEPA, 1971: *Effects of Noise on Wildlife and other animals*
13. World Health Organization, 2009, '*Night Noise Guidelines for Europe'.*
14. World Health Organization, 1999, '*Protection of the Human Environment; Guidelines for Community Noise*'.
15. World Health Organization, 1999; '*Noise quest, 2010*'; Journal of Acoustical Society of America, 2009'.

# APPENDIX A

## Glossary of Acoustic Terms, Definitions and General Information

| | |
|---|---|
| *1/3-Octave Band* | A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band. |
| *A – Weighting* | An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound. |
| *Air Absorption* | The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules. |
| *Alternatives* | A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances. |
| *Ambient* | The conditions surrounding an organism or area. |
| *Ambient Noise* | The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation. |
| *Ambient Sound* | The all-encompassing sound at a point being composite of sounds from near and far. |
| *Ambient Sound Level* | Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used. |
| *Amplitude Modulated Sound* | A sound that noticeably fluctuates in loudness over time. |
| *Applicant* | Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation. |
| *Assessment* | The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision. |
| *Attenuation* | Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels. |
| *Audible frequency Range* | Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound. |
| *Ambient Sound Level* | The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations. |
| *Broadband Noise* | Spectrum consisting of a large number of frequency components, none of which is individually dominant. |
| *C-Weighting* | This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz. |
| *Controlled area (as per National Noise Control Regulations)* | a piece of land designated by a local authority where, in the case of-<br>(a) road transport noise in the vicinity of a road-<br>(i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or<br>(ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under |

| | |
|---|---|
| | Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA;<br><br>(b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or<br><br>(c) industrial noise in the vicinity of an industry-<br>(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<br>(ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA; |
| *dB(A)* | Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear. |
| *Decibel (db)* | A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa. |
| *Diffraction* | The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction. |
| *Direction of Propagation* | The direction of flow of energy associated with a wave. |
| *Disturbing noise* | Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more. |
| *Environment* | The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects. |
| *Environmental Control Officer* | Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise. |
| *Environmental impact* | A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them. |
| *Environmental Impact 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. |
| *Environmental issue* | A concern felt by one or more parties about some existing, potential or perceived environmental impact. |
| *Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)* | The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time. |
| *Equivalent continuous A-weighted rating level ($L_{Req,T}$)* | The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value. |
| *F (fast) time weighting* | (1) Averaging detection time used in sound level meters.<br>(2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too |

| | |
|---|---|
| | rapidly fluctuating sound. |
| *Footprint area* | Area to be used for the construction of the proposed development, which does not include the total study area. |
| *Free Field Condition* | An environment where there is no reflective surfaces. |
| *Frequency* | The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. |
| *Green field* | A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists. |
| *G-Weighting* | An International Standard filter used to represent the infrasonic components of a sound spectrum. |
| *Harmonics* | Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone. |
| *I (impulse) time weighting* | (1) Averaging detection time used in sound level meters as per South African standards and Regulations.<br>(2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing. |
| *Impulsive sound* | A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level. |
| *Infrasound* | Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind. |
| *Integrated Development Plan* | A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000). |
| *Integrated Environmental Management* | IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach. |
| *Interested and affected parties* | Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public. |
| *Key issue* | An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved. |
| $L_{A90}$ | the sound level exceeded for the 90% of the time under consideration |
| *Listed activities* | Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act. |
| $L_{AMin}$ *and* $L_{AMax}$ | Is the RMS (root mean squared) minimum or maximum level of a noise source. |
| *Loudness* | The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility. |
| *Magnitude of impact* | Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring. |
| *Masking* | The raising of a listener's threshold of hearing for a given sound due to the presence of another sound. |

| | |
|---|---|
| *Mitigation* | To cause to become less harsh or hostile. |
| *Negative impact* | A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance). |
| *Noise* | a. Sound that a listener does not wish to hear (unwanted sounds).<br>b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record.<br>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:<br>a) districts (see table 2 of SANS 10103:2008)<br>1. rural districts,<br>2. suburban districts with little road traffic,<br>3. urban districts,<br>4. urban districts with some workshops, with business premises, and with main roads,<br>5. central business districts, and<br>6. industrial districts;<br>b) educational, residential, office and health care buildings and their surroundings;<br>c) churches and their surroundings;<br>d) auditoriums and concert halls and their surroundings;<br>e) recreational areas; and<br>f) nature reserves.<br>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.<br>(2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations. |
| *Sound Level* | The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level. |
| *Sound Power* | Of a source, the total sound energy radiated per unit time. |

| | |
|---|---|
| *Sound Pressure Level (SPL)* | Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as $L_p$ in dB (not weighted) or in various other weightings. |
| *Soundscape* | Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution. |
| *Study area* | Refers to the entire study area encompassing all the alternative routes as indicated on the study area map. |
| *Sustainable Development* | Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987). |
| *Tread braked* | The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake. |
| *Zone of Potential Influence* | The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant. |
| *Zone Sound Level* | Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008. |

End of Report