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Environmental Noise Basic Assessment for the Proposed Harmony West Wits Reclamation and Deposition Project

Project done on behalf of **Environmental Impact Management Services**

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Revision Record

Revision Number	**Date**	**Reason for Revision**
Rev 0	August 2026	For internal review
Rev 1	August 2026	For client review

LIST OF ACRONYMS AND SYMBOLS

Airshed	Airshed Planning Professionals (Pty) Ltd
dB	Descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure.
dBA	Descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure that has been A-weighted to simulate human hearing.
EAP	Environmental Assessment Practitioner
EC	European Commission
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EMPr	Environmental Management Programme
GG	Government gazette
GN	Government notice
Hz	Frequency in Hertz
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
kHz	Kilohertz
km	Kilometre
kW	Kilowatt
L_{Aeq} (T)	The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured) (in dBA)
L_{AIeq} (T)	The impulse corrected A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured) (in dBA)
L_{A90}	The A-weighted 90% statistical noise level, i.e., the noise level that is exceeded during 90% of the measurement period. It is a very useful descriptor which provides an indication of what the L_{Aeq} could have been in the absence of noisy single events and is considered representative of background noise levels (L_{A90}) (in dBA)
L_{AFmax}	The A-weighted maximum sound pressure level recorded during the measurement period
L_{AFmin}	The A-weighted minimum sound pressure level recorded during the measurement period

LOM	Life of Mine
L_P	Sound pressure level (in dB)
L_W	Sound Power Level (in dB)
m	Metres
m/s	Speed in metres per second
NACA	National Association for Clean Air
NEMAQA	National Environmental Management: Air Quality Act
NSRs	Noise sensitive receptors
PAR	Pan African Resources PLC
Pa	Pressure in Pascal
µPa	Pressure in Micro-Pascal
p_{ref}	Reference pressure, 20 µPa
RWD	Return Water Dam
SABS	South African Bureau of Standards
SACNASP	South African Council for Natural Scientific Professions
SANS	South African National Standards
SLM	Sound level meter
tpm	Tonnes per month
TSF	Tailings Storage Facility
WG-AEN	Working Group for the Assessment of Exposure to Noise
WHO	World Health Organisation
WRF	Weather Research and Forecasting Model
%	Percent
°C	Degrees Celsius

EXECUTIVE SUMMARY

Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake a Basic Environmental Noise Compliance Statement as part of the proposed new Deelkraal II Tailings Storage Facility (TSF) project (hereafter referred to as the project).

The main objective of the noise specialist study was to determine the potential impact on the acoustic environment and noise sensitive receptors (NSRs) as a result of the project activities and to recommend suitable management and mitigation measures.

To meet the above objective, the following tasks were included in the Scope of Work:

- A study of legal requirements for noise pertaining to the project (including local legislation).
- Identification of sensitive receptors in the vicinity of the project.
- Identify and quantify noise emission sources from the project activities.
- Undertake initial calculations to determine the potential noise impacts from the source.
- Recommendation of mitigation and management measures.
- Provide summary report of findings.

The findings from the noise assessment found that noise criteria may be exceeded at the NSR of Elandsrand ~160 m to the northeast of the upgraded gold plant as follows:

- Day-time construction activities:
    - The draft Environmental Noise Standards for urban districts;
    - The Gauteng Noise Control Regulations (60 dBA);
    - The National Noise Control Regulations (increase of 7 dBA in noise levels resulting in “disturbing noise”).
- Day-time operations at the upgraded gold plant:
    - The draft Environmental Noise Standards for urban districts.
- Night-time operations at the upgraded gold plant:
    - The draft Environmental Noise Standards for urban districts;
    - The National Noise Control Regulations (increase of 7 dBA in noise levels).

The significance of the project was found to be as follows:

- Construction Phase:
    - Without mitigation: medium to low negative significance rating.
    - With mitigation: medium to low negative significance rating.
    - Overall significance rating: medium to low negative significance rating.
- Operation Phase:
    - Without mitigation: medium to high negative significance rating.
    - With mitigation: medium to low negative significance rating.
    - Overall significance rating: medium to low negative significance rating.
- Decommissioning Phase:

- Without mitigation: medium to low negative significance rating.
- With mitigation: medium to low negative significance rating.
- Overall significance rating: medium to low negative significance rating.

Based on the findings of the environmental noise assessment, it is the specialist's opinion that the project can be authorised, provided that the following recommendations are taken into account:

- All construction, decommissioning, start-up and maintenance activities are limited to day-time hours (i.e. 06:00 to 18:00).
- Noisy stationery equipment (>85 dBA) is enclosed at the upgraded gold plant as far as is reasonably practicable.
- Scheduling of construction and decommissioning activities are communicated and co-ordinated with nearby residents (i.e. Elandsrand and residential areas within 400 m of the construction pipeline and power lines).
- A noise complaints register is kept. If complaints are received, they must be promptly investigated, recorded and addressed. Channels for logging of complaints should be communicated to all residents within 850 m of project activities.

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Environmental Noise Basic Assessment for the Proposed Harmony West Wits Reclamation and Deposition Project

1 INTRODUCTION

1.1 Project Description

Randfontein Estates Limited (a subsidiary of Harmony Gold Mining Company) (hereafter referred to as the applicant) has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the required authorisation processes and to compile and submit the required documentation in support of application for the proposed new Deelkraal II Tailings Storage Facility (TSF) project and associated infrastructure on a site located approximately 13 km southwest of Carletonville in the Merafong City Local Municipality, West Rand District Municipality, Gauteng Province (i.e. the Proposed Harmony West Wits Reclamation and Deposition Project).

The Applicant requires additional deposition capacity for West Wits region's operations. The applicant plans on constructing the Deelkraal II TSF to cater for the additional future capacity. This TSF will receive residue from Kusasalethu, and Savuka plants and will also assist in returning process water for reclaiming the existing Deelkraal 1 TSF and Kusasalethu TSF for processing at Kusasalethu plant. Additional planned infrastructure includes slurry, potable, sewage and return water pipelines, access roads, pump stations, a return water dam and a power line. Proposed upgrades to the existing Kusasalethu plant are also proposed as part of the project.

The Savuka Plant treats tailings from the Savuka Dormant TSFs (Old North TSFs) at a rate of 330 000 tpm and deposits the subsequent tailings on Savuka 5 & 7 TSFs. Harmony plans on remining Deelkraal 1 Dormant TSF and Kusasalethu TSF amongst other potential future sources. These TSFs will be processed through the Kusasalethu Plant at 500 000 tpm. The planned Life of Mine (LOM) for the West Wits region exceed the available deposition capacity of the existing TSFs. Therefore, additional deposition capacity is required.

The Kusasalethu Plant will accommodate future reclamation operations and will therefore need site/s to deposit the tailings. Harmony owns ground, located adjacent to the Deelkraal 1 Dormant TSF, that can be used i.e. for the proposed Deelkraal II TSF. The Deelkraal 1 Dromant TSF and adjacent virgin ground footprint combined geometry will accommodate the future reclamation operations deposition rate and capacity. The proposed TSF will cover an area of approximately 430 ha.

In addition to the Deelkraal II TSF, additional infrastructure is also proposed, as follows:

- A new Return Water Dam in the vicinity of the Deelkraal II TSF;
- Upgrades to the existing Kusasalethu plant including new/upgrade of gold and new uranium sections;
- Slurry pipelines:
    - Reclaimed Slurry from Deelkraal 1 to Kusasalethu (~10.6 km);
    - Kusasalethu Barren Tailings to Deelkraal II and booster pump station (~10.2 km);
    - Reclaimed Slurry from Kusasalethu TSF to Kusasalethu Plant (~2 km);
    - Slurry pipeline from Kusasalethu Plant to Savuka TSF (~4.97 km); and

    - Slurry pipeline from Savuka plant to DF5 TSF (~2.9 km).
- Process Water Pipelines:
    - Process Water Feed from Kusasalethu Plant to Deelkraal Reclamation (~9.54 km) –
    - Return Water Feed to Kusasalethu Process Water Tank (~9.58 km); -
    - Driefontein DP2 Pump Station to North Boundary Dam (~4.78 km); -
    - DP2 feed to Tau Tona Reverse Osmosis Plant (~0.1 km); -
    - Nursery Pumpstation #3 to Kusasalethu Process Water Tank (~9 km); and
    - Process Water pipelines from Kusasalethu Plant to Savuka White Tanks (~8 km).
- Powerlines (all powerlines will be 22 kV or lower):
    - Powerline from Kusasalethu Plant to the existing Deelkraal TSF (~9.2 km);
    - Powerline from Kusasalethu Plant to the Kusasalethu TSF (~1.8 km);
    - Powerline from Savuka shaft to Kusasalethu Plant (~8.1 km).
- Potable Water pipeline from Rand Water supply point to the Deelkraal TSF (~8.52 km).
- Deelkraal 1 TSF Reclamation Pump Station.
- Kusasalethu TSF Reclamation Pump Station.
- New Access Roads (2 x 3.5 m double road) adjacent to pipeline routes/OH lines and around Deelkraal II TSF (where no access road is already in place).
- Topsoil Stockpiles and overburden stockpiles.
- Ancillary construction infrastructure including workshops and laydown areas.

1.2 Study Objective

Airshed Planning Professionals (Pty) Ltd was appointed by EIMS to undertake a Basic Environmental Noise Compliance Statement as part of the proposed Harmony West Wits Reclamation and Deposition project (hereafter referred to as the project).

1.3 Scope of Work

To meet the above objective, the following tasks were included in the Scope of Work:

- A study of legal requirements for noise pertaining to the project (including local legislation).
- Identification of sensitive receptors in the vicinity of the project.
- Identify and quantify noise emission sources from the project activities.
- Undertake initial calculations to determine the potential noise impacts from the source.
- Recommendation of mitigation and management measures.
- Provide summary report of findings.

1.4 Specialist Details

1.4.1 Specialist Details

Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.

1.4.2 Competency Profile of Specialist

Reneé von Gruenewaldt is a Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP) and a member of the National Association for Clean Air (NACA).

Following the completion of her bachelor's degree in atmospheric sciences in 2000 and honours degree (with distinction) with specialisation in Environmental Analysis and Management in 2001 at the University of Pretoria, her experience in air pollution started when she joined Environmental Management Services (now Airshed Planning Professionals) in 2002. Reneé von Gruenewaldt later completed her master's degree (with distinction) in Meteorology at the University of Pretoria in 2009.

Reneé von Gruenewaldt became a partner of Airshed Planning Professionals in September 2006. Airshed Planning Professionals is a technical and scientific consultancy providing scientific, engineering, strategic impact assessments, management services and policy support to assist clients in addressing a wide variety of air pollution and environmental noise related projects.

She has experience on the various components of environmental noise assessments from 2015 to present. Her project experience range over various countries in Africa, providing her with an inclusive knowledge base of international legislation and requirements pertaining to noise impacts.

A comprehensive curriculum vitae of Reneé von Gruenewaldt is provided in Appendix A. A declaration of independence is provided in Appendix B.

1.5 Background to Environmental Noise and the Assessment Thereof

Before more details regarding the approach and methodology adopted in the assessment is given, the reader is provided with some background, definitions and conventions used in the measurement, calculation and assessment of environmental noise.

Noise is generally defined as unwanted sound transmitted through a compressible medium such as air. Sound in turn, is defined as any pressure variation that the ear can detect. Human response to noise is complex and highly variable as it is subjective rather than objective.

A direct application of linear scales (in pascal (Pa)) to the measurement and calculation of sound pressure leads to large and unwieldy numbers. As the ear responds logarithmically rather than linearly to stimuli, it is more practical

to express acoustic parameters as a logarithmic ratio of the measured value to a reference value. This logarithmic ratio is called a decibel or dB. The advantage of using dB can be clearly seen in Figure 1-1. Here, the linear scale with its large numbers is converted into a manageable scale from 0 dB at the threshold of hearing (20 micro-pascals (µPa)) to 130 dB at the threshold of pain (~100 Pa) (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

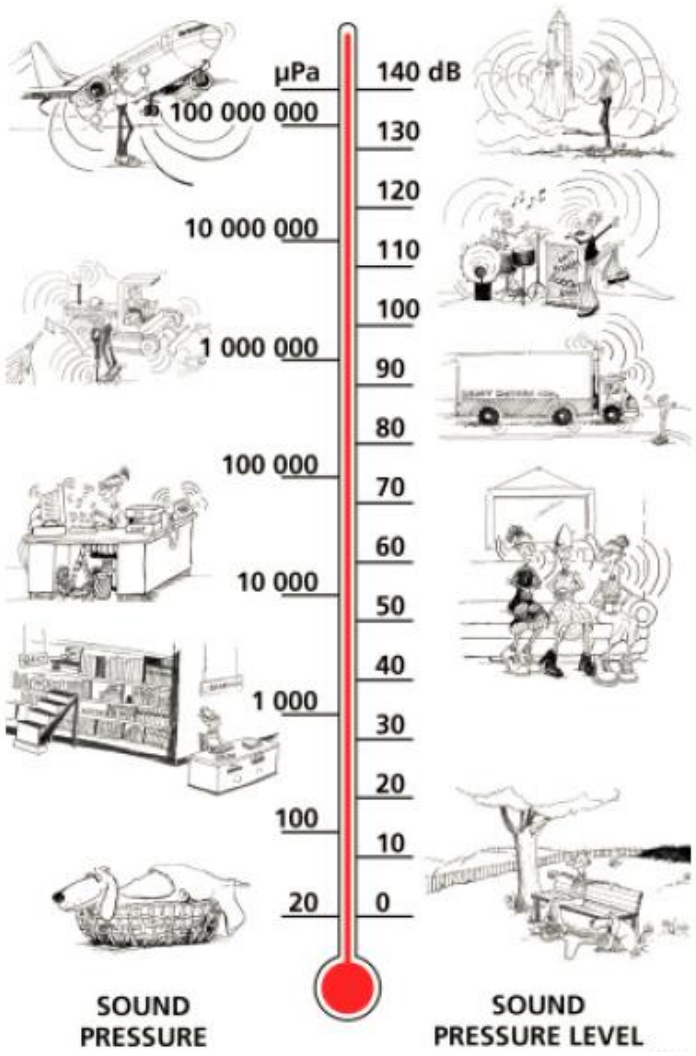


Figure 1-1: The decibel scale and typical noise levels (Brüel & Kjær Sound & Vibration Measurement A/S, 2000)

As explained, noise is reported in dB. "dB" is the descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure. The relationship between sound pressure and sound pressure level is illustrated in this equation.

$$L_p = 20 \cdot \log_{10}\left(\frac{p}{p_{ref}}\right)$$

Where:

Lp *is the sound pressure level in dB;*

p *is the actual sound pressure in Pa; and*

$\boldsymbol{p_{ref}}$ *is the reference sound pressure (p_{ref} in air is 20 μPa).*

1.5.1 Perception of Sound

Sound has already been defined as any pressure variation that can be detected by the human ear. The number of pressure variations per second is referred to as the frequency of sound and is measured in hertz (Hz). The hearing frequency of a young, healthy person ranges between 20 Hz and 20 000 Hz.

Even though an increase in sound pressure level of 6 dB represents a doubling in sound pressure, an increase of 8 to 10 dB is required before the sound subjectively appears to be significantly louder. Similarly, the smallest perceptible change is about 1 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.5.2 Frequency Weighting

Since human hearing is not equally sensitive to all frequencies, a 'filter' has been developed to simulate human hearing. The 'A-weighting' filter simulates the human hearing characteristic, which is less sensitive to sounds at low frequencies than at high frequencies (Figure 1-2). "dBA" is the descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units (in this case sound pressure) and have been A-weighted.

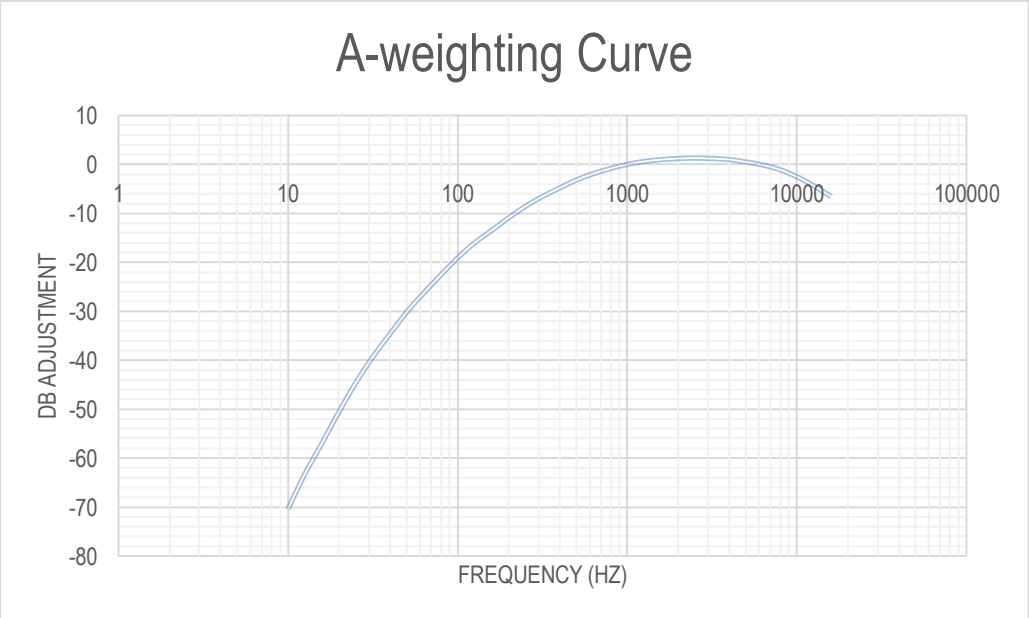


Figure 1-2: A-weighting curve

1.5.3 Adding Sound Pressure Levels

Since sound pressure levels are logarithmic values, the sound pressure levels as a result of two or more sources cannot simply be added together. To obtain the combined sound pressure level of a combination of sources such as those at a mine or industrial plant, individual sound pressure levels must be converted to their linear values and added using:

$$L_{p_combined} = 10 \cdot \log\left(10^{\frac{L_{p1}}{10}} + 10^{\frac{L_{p2}}{10}} + 10^{\frac{L_{p3}}{10}} + \cdots 10^{\frac{L_{pi}}{10}}\right)$$

This implies that if the difference between the sound pressure levels of two sources is nil the combined sound pressure level is 3 dB more than the sound pressure level of one source alone. Similarly, if the difference between the sound pressure levels of two sources is more than 10 dB, the contribution of the quietest source can be disregarded (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.5.4 Environmental Noise Propagation

Many factors affect the propagation of noise from source to receiver. The most important of these are:

- The type of source and its sound power (L_W);
- The distance between the source and the receiver;
- Atmospheric conditions (wind speed and direction, temperature and temperature gradient, humidity etc.);
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption; and
- Reflections.

To arrive at a representative result from either measurement or calculation, all these factors must be taken into account (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.6 Study Approach and Methodology

The assessment included a study of the legal requirements pertaining to environmental noise impacts, a study of the physical environment of the area surrounding the development and the analyses of existing noise levels in the area. The impact assessment focused on the estimation of sound power levels (L_W's) (noise 'emissions') and sound pressure levels (L_P's) (noise impacts) associated with the construction and operational phase of the development. The findings of the assessment components informed recommendations of management measures, including mitigation and monitoring. Individual aspects of the noise impact assessment methodology are discussed in more detail below.

1.6.1 Information Review

An information requirements list was sent to EIMS at the onset of the project. In response to the request, the following information was supplied:

- Site location map;
- Process description; and,
- List of equipment for construction and operation phases of the project.

1.6.2 Review of Assessment Criteria

In South Africa, provision is made for the regulation of noise under the National Environmental Management Air Quality Act (NEMAQA) (Act. 39 of 2004). Draft Environmental Noise Standards, referencing the SANS 10103 of 2008 'The measurement and rating of environmental noise with respect to annoyance and to speech communication', was made available in June 2024. These standards are currently out for comment.

Use was made of the draft Environmental Noise Standards, National Noise Control Regulations and Gauteng Noise Control Regulations.

1.6.3 Study of the Receiving Environment

NSRs generally include private residences, community buildings such as schools, hospitals and any publicly accessible areas outside an industrial facility's property. Potential NSRs were identified from satellite imagery (Google Earth – accessed September 2025 and August 2026).

The ability of the environment to attenuate noise as it travels through the air was studied by considering land use and terrain. Land-use was determined from satellite imagery (Google Earth) and site observations.

1.6.4 Baseline Environmental Noise Survey

Since a baseline noise survey did not form part of the scope of work of this assessment, reference is made to typical rating levels as published under SANS 10103 (2008). The rating levels for urban districts (Table 3-1) were used to estimate background day- and night-time noise levels in the study area. These levels were used to estimate cumulative impacts and the predicted increase in noise levels due to project activities.

1.6.5 Source Inventory

To determine the change in noise impacts associated with the project, a source inventory had to be developed. A list of equipment for construction and operation was provided and used to compile the source inventory for these phases. L_W's for mobile equipment and pumps were calculated using predictive equations for industrial machinery as per the Handbook of Acoustics, Chapter 69, by Bruce and Moritz (1998). Use was also made of sound power levels for similar equipment and factors and default values recommended for use by the European Commission's (EC) Working Group for the Assessment of Exposure to Noise (WG-AEN) in their Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure (EC WG-AEN, 2003).

1.6.6 Noise Propagation Simulations

The propagation of noise from the proposed development was simulated with the DataKustic CadnaA software. Use was made of the International Organisation for Standardization's (ISO) 9613 module for outdoor noise propagation from industrial noise sources.

1.6.6.1 ISO 9613

ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable to propagation from sources of known sound emission. These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The method also predicts an average A-weighted sound pressure level. The average A-weighted sound pressure level encompasses levels for a wide variety of meteorological conditions. The method specified in ISO 9613 consists specifically of octave-band algorithms (with nominal mid-band frequencies from 63 Hz to 8 kHz) for calculating the attenuation of sound which originates from a point sound source, or an assembly of point sources. The source (or sources) may be moving or stationary. Specific terms are provided in the algorithms for the following physical effects: geometrical divergence, atmospheric absorption, ground surface effects, reflection and obstacles. A basic representation of the model is given in the equation below:

$$L_P = L_W - \sum [K_1, K_2, K_3, K_4, K_5, K_6]$$

Where;

L_P *is the sound pressure level at the receiver;*
L_W *is the sound power level of the source;*
K_1 *is the correction for geometrical divergence;*
K_2 *is the correction for atmospheric absorption;*
K_3 *is the correction for the effect of ground surface;*
K_4 *is the correction for reflection from surfaces; and*
K_5 *is the correction for screening by obstacles.*

This method is applicable in practice to a great variety of noise sources and environments. It is applicable, directly or indirectly, to most situations concerning road or rail traffic, industrial noise sources, construction activities, and many other ground-based noise sources.

To apply the method of ISO 9613, several parameters need to be known with respect to the geometry of the source and of the environment, the ground surface characteristics, and the source strength in terms of octave-band sound power levels for directions relevant to the propagation.

1.6.6.2 Simulation Domain

If the dimensions of a noise source are small compared with the distance to the listener, it is called a point source. All sources were quantified as point sources or areas/lines represented by point sources. The sound energy from a point source spreads out spherically, so that the sound pressure level is the same for all points at the same distance from the source and decreases by 6 dB per doubling of distance. This holds true until ground and air attenuation noticeably affect the level. The impact of an intruding industrial noise on the environment will therefore rarely extend over more than 5 km from the source and is therefore always considered "local" in extent.

The propagation of noise was calculated for discrete points from 20 m to 850 m from the project activities. The model was set to calculate L_P's at a height of 1.5 m above ground level.

1.6.7 Presentation of Results

Results are presented in tabular form.

1.6.8 Recommendations of Management and Mitigation

The findings of the noise specialist study informed the recommendation of suitable noise management and mitigation measures.

1.7 Management of Uncertainties

The following limitations and assumptions should be noted:

- The quantification of sources of noise was limited to the construction and operation phases of the proposed project only. Closure phase activities are expected to be similar or less significant and its impacts only assessed qualitatively. Noise impacts will cease post-closure.
- The mitigating effect of buildings and topography acting as acoustic barriers were not taken into account providing a conservative assessment of the noise impacts off-site.
- The attenuation modelling was conservatively undertaken assuming equal distribution of wind in all directions to assess the maximum potential noise impact.
- All project construction activities were assumed from 06:00 to 18:00.
- All project operation activities were assumed for a 24-hour period.
- No measured baseline noise levels were available for the assessment. It was assumed that the baseline noise levels would be similar to urban districts as defined in the draft Environmental Noise Standards.
- The environmental noise assessment focussed on the evaluation of impacts for humans.

2 REGULATORY REQUIREMENTS AND ASSESSMENT CRITERIA

2.1 National Noise Control Regulations

The 1992 Noise Control Regulations (The Republic of South Africa, 1992) published in terms of Section 25 of the Environment Conservation Act (Act no. 73 of 1989) defines a “disturbing noise” as a 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.

The Noise Control Regulations were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

In 1994, with the shift of regulatory power from governmental to provincial level, the authority to promulgate noise regulations was ceded to provinces. Each province could therefore decide whether to develop their own regulations, or to adopt and adapt existing regulations. To date, three provinces (Gauteng, Free State and Western Cape) have promulgated such regulations.

2.2 Gauteng Noise Control Regulations

In Gauteng, the 1992 Noise Control Regulations were replaced by the Gauteng Noise Control Regulations in 1999 (The Gauteng Provincial Government, 1999). Of importance to the current study are the Gauteng Noise Control Regulations definitions for the following:

a) A “controlled area” is a piece of land designated by a local authority where, in case of industrial noise near 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 was in operation, exceeds 60 dBA; or
    ii. the calculated outdoor equivalent continuous "A"-weighted” sound pressure level at a height of at least 1.2 metres, but not more than 1.4 metres, above the ground for a period of 24 hours, exceeds 60 dBA.
b) A “disturbing noise" means a noise level that causes the ambient noise level to rise above the designated zone level, or if no zone level has been designated, the typical rating levels for ambient noise in districts, as per SANS 10103 (2008) (Table 2-1).

2.3 South African National Standards

In South Africa, provision is made for the regulation of noise under the National Environmental Management Air Quality Act (NEMAQA) (Act. 39 of 2004). Draft Environmental Noise Standards were published in June 2024 which are, at the time of this assessment, out for public comment. These recommended Environmental Noise Standards reference the South African Bureau of Standards (SABS) standard SANS 10103 (2008) ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’ (Table 2-1). This standard has been widely applied in South Africa and is frequently used by local authorities when investigating noise

complaints. The standard is also fully aligned with the World Health Organisation (WHO) guidelines for Community Noise (WHO, 1999).

Table 2-1: Draft South African National Standards for Environmental Noise

Type of district	Land use purpose	10-Minute L_{Aeq} dB(A) - Outdoor Noise	
		Day-time (06:00 – 22:00)	Night-time (22:00 – 06:00)
Agricultural districts	Agricultural purposes	45	35
Suburban districts	Residential purposes	50	40
Urban districts	Business purposes	55	45
Urban districts with one or more of the following: business premises; and main roads.	Business purposes	60	50
Central business districts	Business purposes	65	55
Industrial districts	Business purposes	70	60

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

- $\Delta \leq 0$ dB: There will be no community reaction;
- 0 dB < $\Delta \leq 10$ dB: There will be 'little' reaction with 'sporadic complaints';
- 5 dB < $\Delta \leq 15$ dB: There will be a 'medium' reaction with 'widespread complaints'. $\Delta = 10$ dB is subjectively perceived as a doubling in the loudness of the noise;
- 10 dB < $\Delta \leq 20$ dB: There will be a 'strong' reaction with 'threats of community action'; and
- $\Delta > 15$ dB: There will be a 'very strong' reaction with 'vigorous community action'.

The categories of community response overlap because the response of a community does not occur as a stepwise function, but rather as a gradual change.

2.4 Regulations Regarding Report Writing

This report complies with the requirements of the National Environmental Management Act, 1998 (NEMA, No. 107 of 1998) and the EIA regulations (Government Notice [GN] R982 as amended by GN 326 of 7 April 2017; GN 706 of 13 July 2018 and GN 320 of 20 March 2020). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 2-2: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (Government Notice [GN] R982 as amended by GN 326 of 7 April 2017; GN 706 of 13 July 2018 and GN 320 of 20 March 2020)

A specialist report prepared in terms of the Environmental Impact Regulations must contain:	Relevant section in report
Details of the specialist who prepared the report	Section 1.4
The expertise of that person to compile a specialist report including a curriculum vitae	Section 1.4.1 Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Appendix B
An indication of the scope of, and the purpose for which, the report was prepared	Section 1.3
An indication of the quality and age of base data used for the specialist report;	Section 3
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.6
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 3.1
An identification of any areas to be avoided, including buffers	Section 3.1 Section 4
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;	Figure 3-1
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.7
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Section 4
Any mitigation measures for inclusion in the EMPr	Section 5
Any conditions for inclusion in the environmental authorisation	Section 5
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
Regarding the acceptability of the proposed activity or activities; and	Section 4
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, and where applicable, the closure plan	Section 4 Section 5 Section 6
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable
A summary and copies if any comments that were received during any consultation process	None received
Any other information requested by the competent authority.	None received

2.5 Procedures for the Assessment

This report complies with protocols for the assessment and minimum report content in terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998 (NEMA, No. 107 of 1998) (Government Gazette [GG] No. 43110) published on 20 March 2020. The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 2-3: Noise compliance statement in terms of Government Gazette No. 43110 (2020)

Assessment and Reporting on Noise Impacts	Section in Report
Details and relevant qualifications and experience of the noise specialist preparing the assessment including a curriculum vitae	Section 1.4 and Appendix A
Signed statement of independence by the specialist	Appendix B
A map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the sensitivity map generated by the national web based environmental screening tool.	Figure 3-1
Confirmation from the specialist that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Recommendations made on siting of noise sources in Section 5.
A substantiated statement from the noise specialist/environmental assessment practitioner on the acceptability of the development and a recommendation on the approval or not of the development	Section 6
Any conditions to which the statement is subjected.	Section 6
Where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr.	Section 5
A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 1.7
A signed copy of the Noise Compliance Statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	Appendix B

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Potential Sensitive Receptors

Potential NSRs within the project area, include individual dwellings and residential areas (i.e. Deelkraal, Elandsrand, Elandsridge, Wedela, Western Deep Levels, Southdene, Northdene, The Village and Doornfontein). Identified sensitive receptors for the assessment are included in Figure 3-1.

3.2 Environmental Noise Propagation and Attenuation Potential

3.2.1 Atmospheric Absorption and Meteorology

The main meteorological parameters affecting the propagation of noise include wind speed, wind direction and temperature. These along with other parameters such as relative humidity, air pressure, solar radiation and cloud cover affect the stability of the atmosphere and the ability of the atmosphere to absorb sound energy.

Wind speed increases with altitude. This results in the 'bending' of the path of sound to 'focus' it on the downwind side and creating a 'shadow' on the upwind side of the source. Depending on the wind speed, the downwind level may increase by a few dB but the upwind level can drop by more than 20 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). It should be noted that at wind speeds of more than 5 m/s, ambient noise levels are mostly dominated by wind generated noise.

Meteorological data from the Weather Research and Forecasting (WRF)[1] Model, for the period 2022 to 2024, was selected for the assessment (Figure 3-2). The modelled data set indicates wind flow primarily from the northern sector for day- and night-time (Figure 3-2). On average, noise impacts are expected to be slightly more notable to the south.

Temperature gradients in the atmosphere create effects that are uniform in all directions from a source. On a sunny day with no wind, temperature decreases with altitude and creates a 'shadowing' effect for sounds. On a clear night, temperatures may increase with altitude thereby 'focusing' sound on the ground surface. Noise impacts are therefore generally more notable during the night (Figure 3-3).

[1] The Weather Research and Forecasting (WRF) Model is a state of the art mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications.

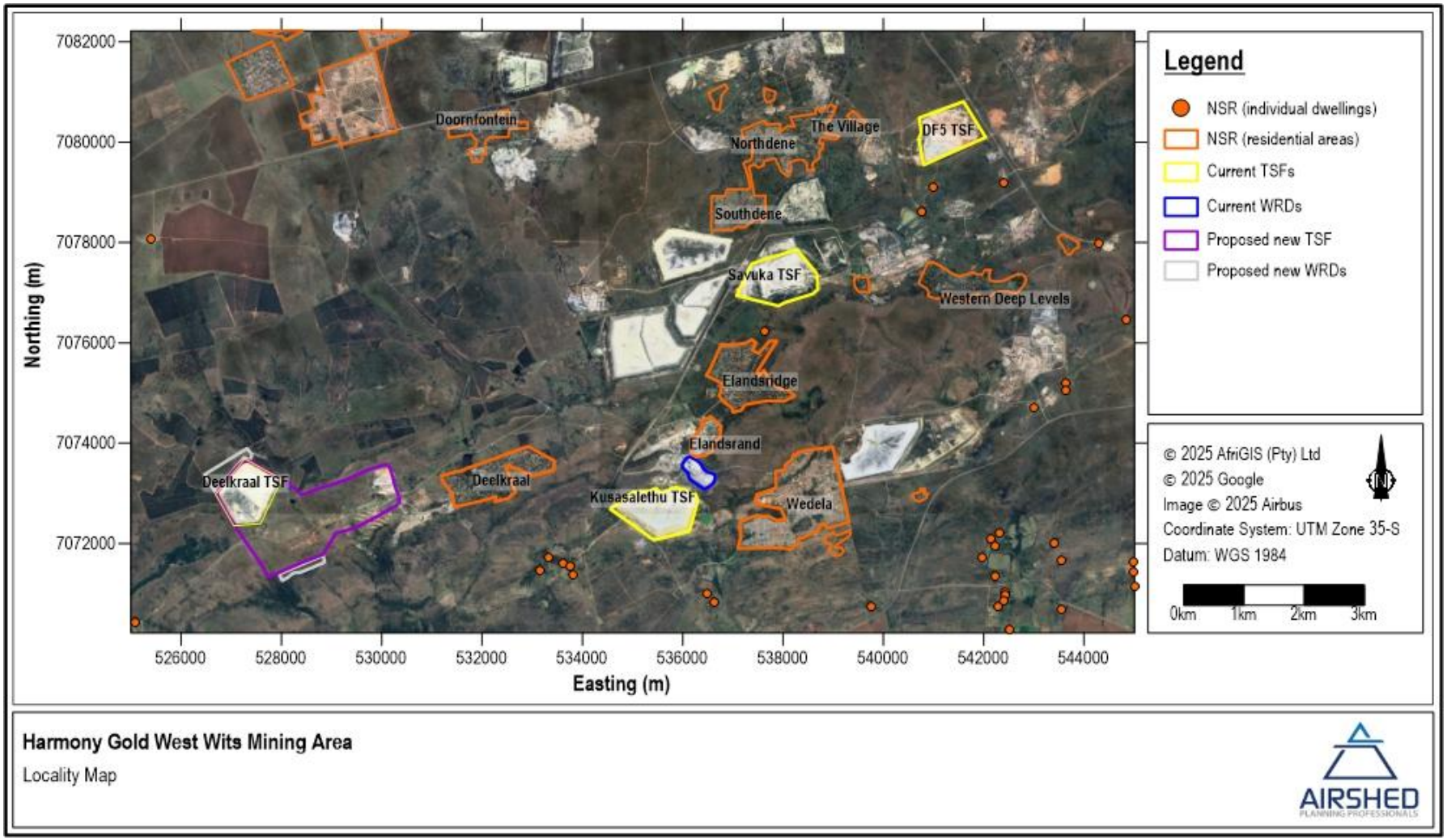
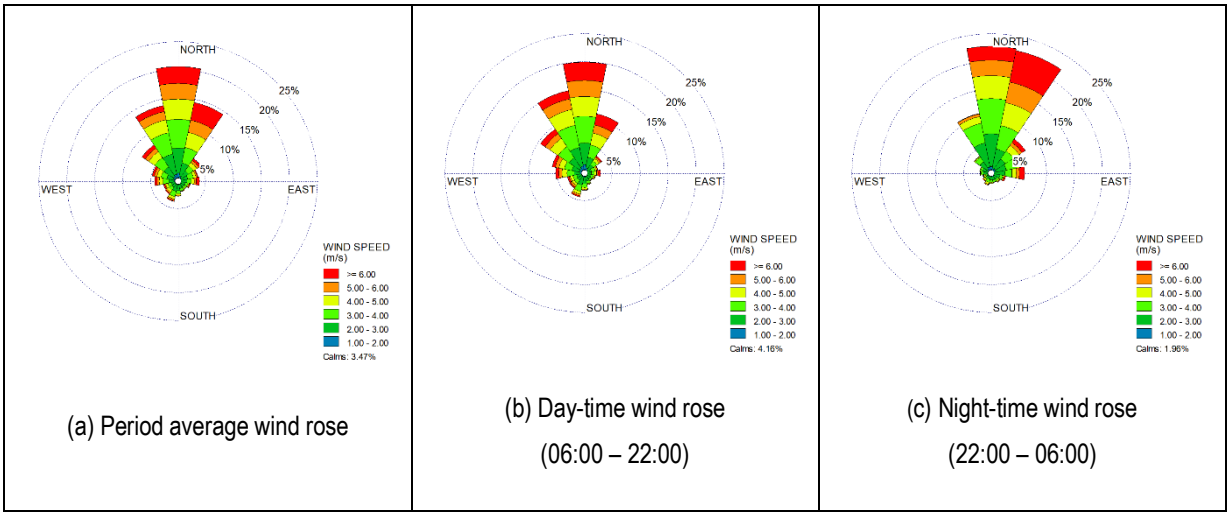


Figure 3-1: Identified sensitive receptors for the assessment



(a) Period average wind rose

(b) Day-time wind rose (06:00 – 22:00)

(c) Night-time wind rose (22:00 – 06:00)

Figure 3-2: Wind rose for WRF data for the period 2022 to 2024

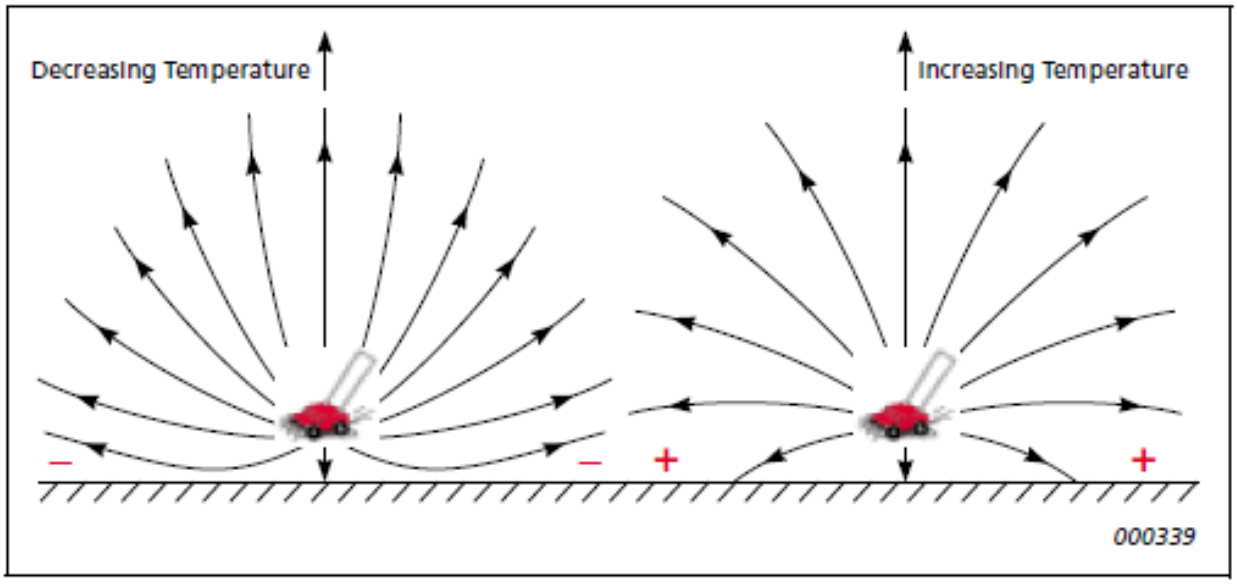


Figure 3-3: Bending the path of sound during typical day time conditions (image provided on the left) and night-time conditions (image provided on the right)

3.2.2 Terrain, Ground Absorption and Reflection

Noise reduction caused by a barrier (i.e., natural terrain, installed acoustic barrier, building) depends on two factors namely the path difference of a sound wave as it travels over the barrier compared with direct transmission to the

receiver and the frequency content of the noise (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). The topography[2] for the study area is provided in Figure 3-4.

Sound reflected by the ground interferes with the directly propagated sound. The effect of the ground is different for acoustically hard (e.g., concrete or water), soft (e.g., grass, trees or vegetation) and mixed surfaces. Ground attenuation is often calculated in frequency bands to take into account the frequency content of the noise source and the type of ground between the source and the receiver (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). Based on observations, ground cover was found to be acoustically soft.

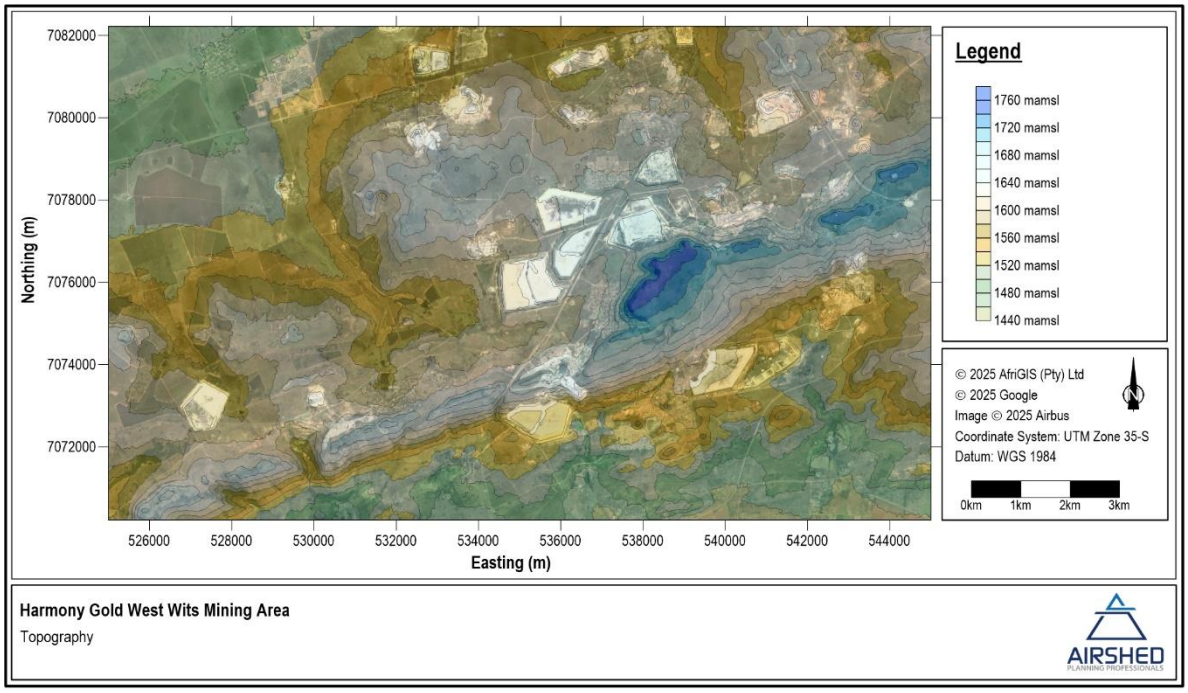


Figure 3-4: Topography for the study area

3.3 Background Noise Levels

Since a baseline noise survey did not form part of the scope of work of this assessment, reference is made to typical rating levels as published under the draft SANS Environmental Noise Standards. The rating levels for urban districts (Table 3-1) were used to estimate background day- and night-time noise levels in the study area. These levels were used to estimate cumulative impacts and the predicted increase in noise levels due to the project operations.

[2] SRTM1 from the United States Geological Survey at https://earthexplorer.usgs.gov

Table 3-1: Draft South African National Standards for Environmental Noise for urban districts

Type of district	Land use purpose	10-Minute L_{Aeq} dB(A) - Outdoor Noise	
		Day-time (06:00 – 22:00)	Night-time (22:00 – 06:00)
Urban districts	Business purposes	55	45

4 IMPACT ASSESSMENT FOR THE PROJECT

4.1 Noise Sources and Sound Power Levels

The reader is reminded of the non-linearity in the addition of L_W's. If the difference between the sound power levels of two sources is nil the combined sound power level is 3 dB more than the sound pressure level of one source alone. Similarly, if the difference between the sound power levels of two sources is more than 10 dB, the contribution of the quietest source can be disregarded (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

Construction activities were assumed to be from 06:00 to 18:00. The list of mobile equipment for construction activities provided for the proposed TSF site, the new reclamation pumpstations, new pipelines and powerlines is summarised in Table 4-1 with the octave band frequency spectra L_W's for each source provided.

Operation activities were assumed for 24 hours per day. Noise sources generated by the proposed TSF operations is summarised in Table 4-2 with noise sources for the upgraded gold plant provided in Table 4-3. The mobile and stationary noise sources for the upgraded gold plant during operations is provided in Table 4-4 and Table 4-5 respectively. The noise levels from the pump and reclamation plants were estimated with the European Commission Working Group Assessment of Exposure to Noise (EC WG-AEN) general sound power levels for heavy industries. This sound power level was applied site wide at the proposed pump and reclamation plants as a conservative approach (Table 4-6).

Table 4-1: Octave band frequency spectra L_W's for the construction equipment

Equipment	Qty	Hours/day	Power rating (kw)	Type	L_W octave band frequency spectra (dB)								L_W (dB)	L_{WA} (dBA)	Source
					63	125	250	500	1000	2000	4000	8000			
45t Articulated Dump Truck	10	10	390	L_W	113.9	118.9	121.9	116.9	114.9	111.9	105.9	99.9	125.5	120.2	L_W Predictions (Bruce & Moritz, 1998)
70t Ridged Dump Truck	6	10	526	L_W	115.2	120.2	123.2	118.2	116.2	113.2	107.2	101.2	126.8	121.5	L_W Predictions (Bruce & Moritz, 1998)
50t Hydraulic Excavators	4	10	330	L_W	113.2	118.2	121.2	116.2	114.2	111.2	105.2	99.2	124.8	119.4	L_W Predictions (Bruce & Moritz, 1998)
D8/D9 Bulldozers	3	10	363	L_W	113.6	118.6	121.6	116.6	114.6	111.6	105.6	99.6	125.2	119.9	L_W Predictions (Bruce & Moritz, 1998)
16M Motor Graders	2	8	217	L_W	111.4	116.4	119.4	114.4	112.4	109.4	103.4	97.4	123.0	117.6	L_W Predictions (Bruce & Moritz, 1998)
Wheel Loaders	3	8	450	L_W	114.5	119.5	122.5	117.5	115.5	112.5	106.5	100.5	126.2	120.8	L_W Predictions (Bruce & Moritz, 1998)
Compactors/ Rollers	4	8	160	L_W	110.0	115.0	118.0	113.0	111.0	108.0	102.0	96.0	121.7	116.3	L_W Predictions (Bruce & Moritz, 1998)
Water Bowser	4	8	335	L_W	113.3	118.3	121.3	116.3	114.3	111.3	105.3	99.3	124.9	119.5	L_W Predictions (Bruce & Moritz, 1998)
Service Trucks	2	8	298	L_W	112.7	117.7	120.7	115.7	113.7	110.7	104.7	98.7	124.4	119.0	L_W Predictions (Bruce & Moritz, 1998)
Mobile Crane	1	6	270	L_W	112.3	117.3	120.3	115.3	113.3	110.3	104.3	98.3	123.9	118.6	L_W Predictions (Bruce & Moritz, 1998)
Telehandlers	2	6	73	L_W	106.6	111.6	114.6	109.6	107.6	104.6	98.6	92.6	118.3	112.9	L_W Predictions (Bruce & Moritz, 1998)
Light Delivery Vehicles	10	4	140	L_W	109.5	114.5	117.5	112.5	110.5	107.5	101.5	95.5	121.1	115.7	L_W Predictions (Bruce & Moritz, 1998)
Double Cab Vehicles	25	3	150	L_W	109.8	114.8	117.8	112.8	110.8	107.8	101.8	95.8	121.4	116.0	L_W Predictions (Bruce & Moritz, 1998)

Table 4-2: Octave band frequency spectra L_W's for the TSF operation equipment

Equipment	Qty	Power rating (kw)	Type	L_W octave band frequency spectra (dB)								L_W (dB)	L_{WA} (dBA)	Source
				63	125	250	500	1000	2000	4000	8000			
125 m³/h RWD2 pump, motor and skid	2	18.5	L_W	79.7	80.7	82.7	82.7	85.7	82.7	78.7	72.7	90.9	89.3	LW Predictions (Bruce & Moritz, 1998)
80 m³/h RWD3 pump, motor and skid	2	11	L_W	77.4	78.4	80.4	80.4	83.4	80.4	76.4	70.4	88.7	87.0	LW Predictions (Bruce & Moritz, 1998)

Table 4-3: Octave band frequency spectra L_W's for the mobile equipment at the upgraded gold plant during operations

Equipment	Qty	Power rating (kw)	Type	L_W octave band frequency spectra (dB)								L_W (dB)	L_{WA} (dBA)	Source
				63	125	250	500	1000	2000	4000	8000			
LDVs	5	140	L_W	120.5	109.5	114.5	117.5	112.5	110.5	107.5	101.5	123.8	118.5	L_W Predictions (Bruce & Moritz, 1998)
Minibus vehicles	1	130	L_W	120.1	109.1	114.1	117.1	112.1	110.1	107.1	101.1	123.5	118.2	L_W Predictions (Bruce & Moritz, 1998)
Forklifts	2	50	L_W	116.0	105.0	110.0	113.0	108.0	106.0	103.0	97.0	119.3	114.1	L_W Predictions (Bruce & Moritz, 1998)
Telehandler	1	73	L_W	117.6	106.6	111.6	114.6	109.6	107.6	104.6	98.6	121.0	115.7	L_W Predictions (Bruce & Moritz, 1998)
Skid steer/ small loader	1	78.5	L_W	117.9	106.9	111.9	114.9	109.9	107.9	104.9	98.9	121.3	116.0	L_W Predictions (Bruce & Moritz, 1998)
Petrol pool vehicles	2	150	L_W	120.8	109.8	114.8	117.8	112.8	110.8	107.8	101.8	124.1	118.8	L_W Predictions (Bruce & Moritz, 1998)

Table 4-4: Octave band frequency spectra L_W's for the stationary equipment at the upgraded gold plant during operations

Equipment	Qty	Type	L_W octave band frequency spectra (dB)									L_W (dB)	L_{WA} (dBA)
			31.5	63	125	250	500	1000	2000	4000	8000		
Diesel fired elution heater	1	L_W		24.1	44.3	59.3	70.1	76.5	78.9	78.5	74.3	83.6	84.2
Diesel-fired carbon regeneration kiln	1	L_W	69.6	82.8	92.9	100.4	105.8	109	110.2	110	107.9	116.0	116.1
Emergency generator	1	L_W	84	97.2	107.3	114.8	120.2	123.4	124.6	124.4	122.3	130.4	130.5
Firewater pump	1	L_W	35.1	61.5	81.7	96.7	107.5	113.9	116.3	115.9	111.7	121.0	121.6

Table 4-5: General sound power levels for industries (EC WG-AEN, 2003)

Type of Industry	A-weighted Sound Power Level, L_{WA} (dBA/m²)	
	Day-time	Night-time
Heavy Industries	65.0	65.0
Light Industries	60.0	60.0
Commercial Use	60.0	60.0

4.2 Noise Propagation and Simulated Noise Levels

The propagation of noise generated during the construction and operational phases for the project was estimated using the CadnaA model in accordance with ISO 9613. The attenuation of noise was conservatively assumed by not taking any terrain features into account.

Results are presented in tabular form (Table 4-6) (at various distances from the project noise sources) assuming typical urban background levels, as described in Section 3.3.

If the baseline acoustic climate is typical of urban areas, as described in Section 3.3, project activities could be exceeded applicable noise criteria as follows:

- Day-time construction activities:
  - The draft Environmental Noise Standards for urban districts up to 400 m from activities.
  - The Gauteng Noise Control Regulations (60 dBA) up 250 m from activities.
  - The National Noise Control Regulations (increase of 7 dBA in noise levels resulting in “disturbing noise”) up to 200 m from activities.
- Day-time operations at the upgraded gold plant:
  - The draft Environmental Noise Standards for urban districts up to 250 m from activities.
  - The Gauteng Noise Control Regulations (60 dBA) up 150 m from activities.
  - The National Noise Control Regulations (increase of 7 dBA in noise levels) up to 100 m from activities.
- Night-time operations at the upgraded gold plant:
  - The draft Environmental Noise Standards for urban districts up to 800 m from activities.
  - The Gauteng Noise Control Regulations (60 dBA) up 150 m from activities.
  - The National Noise Control Regulations (increase of 7 dBA in noise levels) up to 400 m from activities.

Table 4-6: Summary of day- and night-time simulated noise levels (provided as dBA) due to the project construction and operational activities as a distance from the project source

Project Noise Source and Distance from the Source		Baseline (Assumed Typical Rural Levels) (dBA)		Simulated Sound Pressure Levels due to Project Operations (dBA)[a][b]		Increase from Baseline (dBA)[c]	
		Day	Night	Day	Night	Day	Night
Distance from construction site (i.e. proposed TSF, upgraded gold plant, the reclamation pumpstations, pipelines and powerlines)	20 m	55	45	**78**		23.4	0.0
	50 m	55	45	**73**		18.2	0.0
	100 m	55	45	**68**		13.3	0.0
	150 m	55	45	**65**		10.4	0.0
	200 m	55	45	**63**		8.5	0.0
	250 m	55	45	**61**		6.9	0.0
	300 m	55	45	**59**		5.7	0.0
	400 m	55	45	**57**		4.1	0.0
	500 m	55	45	55		3.0	0.0
Distance from new TSF during operation	20 m	55	45	34	34	0.0	0.3
	50 m	55	45	28	28	0.0	0.1
	100 m	55	45	23	23	0.0	0.0
	150 m	55	45	20	20	0.0	0.0
	200 m	55	45	18	18	0.0	0.0
	250 m	55	45	16	16	0.0	0.0
	300 m	55	45	15	15	0.0	0.0
	400 m	55	45	12	12	0.0	0.0
	500 m	55	45	10	10	0.0	0.0
Distance from upgraded gold plant	20 m	55	45	**74**	**74**	19.1	29.0
	50 m	55	45	**69**	**69**	13.8	23.6
	100 m	55	45	**64**	**64**	9.2	18.7
	150 m	55	45	**61**	**61**	6.6	15.6
	200 m	55	45	**58**	**58**	5.0	13.5
	250 m	55	45	**57**	**57**	3.8	11.8
	300 m	55	45	55	**55**	3.0	10.4
	400 m	55	45	53	**53**	1.9	8.2
	500 m	55	45	51	**51**	1.3	6.6
	600 m	55	45	49	**49**	0.9	5.3
	700 m	55	45	47	**47**	0.7	4.3
	800 m	55	45	46	**46**	0.5	3.5
	850 m	55	45	45	45	0.4	3.2
Distance from the reclamation pumpstations	20 m	55	45	41	41	0.2	1.3
	50 m	55	45	35	35	0.0	0.4
	100 m	55	45	30	30	0.0	0.1
	150 m	55	45	27	27	0.0	0.1
	200 m	55	45	25	25	0.0	0.0
	250 m	55	45	23	23	0.0	0.0
	300 m	55	45	22	22	0.0	0.0

Project Noise Source and Distance from the Source		Baseline (Assumed Typical Rural Levels) (dBA)		Simulated Sound Pressure Levels due to Project Operations (dBA)[a][b]		Increase from Baseline (dBA)[c]	
		Day	Night	Day	Night	Day	Night
	400 m	55	45	19	19	0.0	0.0
	500 m	55	45	17	17	0.0	0.0

Notes:

(a) Exceedance of the draft Environmental Noise Standards for urban areas is provided in bold

(b) The attenuation modelling was conservatively undertaken assuming equal distribution of wind in all directions to assess the maximum potential noise impact. The noise impacts for day- and night-time were thus estimated to be the same.

(c) Likely community response in accordance with the SANS 10103:

< 3 dBA	< 5 dBA	< 10 dBA	< 15 dBA	< 20 dBA
Change imperceptible	*No reaction*	*'Little' reaction with sporadic complaints*	*'Medium' reaction with widespread complaints*	*'Strong' to 'very strong' reaction with threats of community action or vigorous community action.*

For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. According to SANS 10103 (2008); the predicted increase in noise levels from the current baseline (assuming baseline levels to be typical of urban areas) is expected to result in the following community reaction due to project activities:

- Day-time construction activities:
  - 'Strong' reaction with threats of community action up to 50 m from activities.
  - 'Medium' reaction with widespread complaints up to 150 m from the activities.
  - 'Little' reaction with sporadic complaints up to 300 m from activities.
- Day-time operations at the upgraded gold plant:
  - 'Strong' reaction with threats of community action up to 20 m from activities.
  - 'Medium' reaction with widespread complaints up to 50 m from the activities.
  - 'Little' reaction with sporadic complaints up to 150 m from activities.
- Night-time operations at the upgraded gold plant:
  - 'Strong' reaction with threats of community action up to 150 m from activities.
  - 'Medium' reaction with widespread complaints up to 300 m from the activities.
  - 'Little' reaction with sporadic complaints up to 600 m from activities.

Given the distances of potential exceedances of noise criteria, the only sensitive receptor that may be impacted is Elandsrand ~160 m to the northeast of the upgraded gold plant (see Figure 3-1). Exceedances of noise criteria at this receptor may be as follows:

- Day-time construction activities:
  - The draft Environmental Noise Standards for urban districts;

    - The Gauteng Noise Control Regulations (60 dBA);
    - The National Noise Control Regulations (increase of 7 dBA in noise levels resulting in “disturbing noise”).
- Day-time operations at the upgraded gold plant:
    - The draft Environmental Noise Standards for urban districts;
- Night-time operations at the upgraded gold plant:
    - The draft Environmental Noise Standards for urban districts;
    - The National Noise Control Regulations (increase of 7 dBA in noise levels).

In according to SANS 10103 (2008); the community reaction from Elandsrand due to project activities is expected to be as follows:

- Day-time construction activities:
    - ‘Medium’ reaction with widespread complaints.
- Night-time operations at the upgraded gold plant:
    - ‘Medium’ reaction with widespread complaints.

4.3 Significance Rating

The 2014 EIA Regulations require that impacts be assessed in terms of the nature, significance, consequence, extent, duration and probability of the impacts; including the degree to which these impacts can be reversed, may cause irreplaceable loss of resources, and can be avoided, managed or mitigated. The significance ranking methodology used in this assessment is provided in Appendix C.

The project is expected to have the following significance rating (Table 5 1):

- Construction Phase:
    - Without mitigation: medium to low negative significance rating.
    - With mitigation: medium to low negative significance rating.
    - Overall significance rating: medium to low negative significance rating.
- Operation Phase:
    - Without mitigation: medium to high negative significance rating.
    - With mitigation: medium to low negative significance rating.
    - Overall significance rating: medium to low negative significance rating.
- Decommissioning Phase:
    - Without mitigation: medium to low negative significance rating.
    - With mitigation: medium to low negative significance rating.
    - Overall significance rating: medium to low negative significance rating.

Table 4-7: Significance rating for potential noise impacts due to the project activities

Impact Description		Pre-Mitigation							Post Mitigation									Priority Factor Criteria			
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Pre-mitigation significance	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Post-mitigation significance	Confidence		Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
Incremental increase in noise levels exceeding noise criteria at potential sensitive receptors (i.e. residential areas and individual dwellings)	Construction [(a)]	-1	2	2	3	1	4	-8 (medium to low)	-1	2	2	3	1	3	-6 (medium to low)	Medium		2	1	1.13	-6.75 (medium to low)
	Operation [(b)]	-1	2	4	3	1	4	-10 (medium to high)	-1	2	4	3	1	3	-7.5 (medium to low)	Medium		2	1	1.13	-8.44 (medium to low)
	Decommission-ing [(a)]	-1	2	2	3	1	4	-8 (medium to low)	-1	2	2	3	1	3	-6 (medium to low)	Medium		2	1	1.13	-6.75 (medium to low)

(a) To reduce the nuisance effects of the proposed construction and decommissioning on the community, the following mitigation actions are recommended:

- Construction staff need to be trained on noise control plan during health & safety briefings;
- 'Low noise' equipment, or methods of work is to be selected;
- Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events;
- Regular inspection and maintenance of all equipment is to be established;
- Avoid unnecessary equipment idling;
- Limit activities to day-time working hours (06:00 – 18:00);
- Establish community engagement and ensure all affected persons have been consulted with prior to the commencement of and during activities.

(b) To reduce the nuisance effects of the proposed gold plant operation on the community, the following mitigation actions are to be applied:

- Routine monitoring of ambient noise at Elandsrand;
- Train operational staff on noise control plan during health & safety briefings;
- Regular inspection and maintenance of all equipment.
- Enclosure of noisy equipment (>85 dBA)
- A noise complaints register must be kept.
- If complaints are received, noise sampling should be undertaken at the NSRs and source of noise should be investigated.

5 MANAGEMENT MEASURES

In the quantification of noise emissions and simulation of noise levels as a result of the project, it was found that draft Environmental Noise Standards may be exceeded at the closest NSR to the upgraded gold plant (i.e. Elandsrand). It should be noted that discussion below provides optional mitigations, not all of which will need to be implemented, but consideration can be given should the need for mitigation arise.

5.1 Construction and Closure

Good engineering and operational practices will reduce levels of annoyance. For general activities, the following good engineering practice should be applied:

- All diesel-powered equipment and plant vehicles should be kept at a high level of maintenance. This should particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.
- In managing noise specifically related to vehicle traffic, efforts should be directed at:
    - Minimising individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.
    - Maintain road surfaces regularly to repair potholes etc.
    - Keep all roads well maintained and avoid steep inclines or declines to reduce acceleration/brake noise.
    - Avoid unnecessary idling at all times.
- Construction materials such as beams should be lowered and not dropped.
- Construction and decommissioning activities should be limited to day-time hours (06:00 – 18:00).
- A noise complaints register must be kept.

5.2 Operation

5.2.1 General Good Engineering Practices

Good engineering and operational practices will reduce levels of annoyance. For general activities, the following good engineering practice should be applied:

- Where possible, other non-routine noisy activities such as start-up and maintenance, should be limited to day-time hours.
- A noise complaints register must be kept.

5.2.2 Specifications and Equipment Design

Equipment can be reviewed to ensure the quietest available technology is used. Where equipment with lower sound power levels is selected, vendors/contractors should be required to guarantee optimised equipment design noise levels.

5.2.3 Enclosures

As far as is practically possible, stationery sources of significant noise (>85 dBA) should be enclosed. The extent of enclosure will depend on the nature of the machine and their ventilation requirements. Pumps, generators and motors are examples of such equipment.

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

5.2.4 Use and Siting of Equipment and Noise Sources

Recommendations on use and siting of equipment is as follows:

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

5.3 Monitoring

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

The following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a trained specialist.
- Sampling should be carried out using a Type 1 Sound Level Meter (SLM) that meets all appropriate International Electrotechnical Commission (IEC) standards and is subject to annual calibration by an accredited laboratory.
- The acoustic sensitivity of the SLM should be tested with a portable acoustic calibrator before and after each sampling session.

- Samples sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic environment should be taken.
- The following acoustic indices should be recoded and reported: L_{Aeq} (T), statistical noise level L_{A90}, L_{AFmin} and L_{AFmax}, octave band or 3rd octave band frequency spectra.
- The SLM should be located approximately 1.5 m above the ground and no closer than 3.5 m to any reflecting surface.
- Efforts should be made to ensure that measurements are not affected by the residual noise and extraneous influences, e.g., wind, electrical interference and any other non-acoustic interference, and that the instrument is operated under the conditions specified by the manufacturer. It is good practice to avoid conducting measurements when the wind speed is more than 5 m/s, while it is raining or when the ground is wet.

A detailed log and record should be kept. Records should include site details, weather conditions during sampling and observations made regarding the acoustic environment of each site.

6 CONCLUSION

Based on the findings of the environmental noise assessment, it is the specialist's opinion that the project can be authorised, provided that the following recommendations are taken into account:

- All construction, decommissioning, start-up and maintenance activities are limited to day-time hours (i.e. 06:00 to 18:00).
- Noisy stationery equipment (>85 dBA) is enclosed at the upgraded gold plant as far as is reasonably practicable.
- Scheduling of construction and decommissioning activities are communicated and co-ordinated with nearby residents (i.e. Elandsrand and residential areas within 400 m of the construction pipeline and power lines).
- A noise complaints register is kept. If complaints are received, they must be promptly investigated, recorded and addressed. Channels for logging of complaints should be communicated to all residents within 850 m of project activities.

7 REFERENCES

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APPENDIX A – CURRICULUM VITAE

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	Reneé von Gruenewaldt (*nee* Thomas)
Profession	Air Quality and Environmental Noise Scientist
Position	Principal consultant
Date of Birth	13 May 1978
Years with Firm	Since January 2002
Nationalities	South African

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP)
- Member of the National Association for Clean Air (NACA)

KEY QUALIFICATIONS

Reneé von Gruenewaldt (Air Quality Scientist): Reneé joined Airshed Planning Professionals (Pty) Ltd (previously known as Environmental Management Services cc) in 2002. She has, as a Specialist, attained over twenty (20) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and nine (9) years of experience in the field of environmental noise assessments. As an environmental practitioner, she has provided solutions to both large-scale and smaller projects within the mining, minerals, and process industries.

She has developed technical and specialist skills in various air quality modelling packages including the AMS/EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff-based model (CALPUFF and CALMET), puff-based HAWK model and line-based models, Lagrangian GRAL model. Her experience with air emission models includes Tanks 4.0 (for the quantification of tank emissions), WATER9 (for the quantification of wastewater treatment works) and GasSim (for the quantification of landfill emissions). Noise propagation modelling proficiency includes CONCAWE, South African National Standards (SANS 10210) for calculating and predicting road traffic noise and CadnaA for propagation of industrial, road and rail noise sources.

Having worked on projects throughout Africa (i.e., South Africa, Mozambique, Malawi, Kenya, Angola, Democratic Republic of Congo, Namibia, Madagascar and Egypt for Air Quality Impact Assessments and Mozambique, Namibia, Botswana, Kenya, Ghana, Suriname and Afghanistan for Environmental Noise Impact Assessments) Reneé has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

RELEVANT EXPERIENCE (AIR QUALITY)

Mining and Ore Handling

Reneé has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite, manganese and mineral sands mines. These include: compilation of emissions databases for Landau and New Vaal coal collieries (SA), impact assessments and management plans for numerous mines over Mpumalanga (viz. Schoonoord, Belfast, Goedgevonden, Mbila, Evander South, Driefontein, Hartogshoop, Belfast, New Largo, Geluk, etc.), Mmamabula Coal Colliery (Botswana), Moatize Coal Colliery (Mozambique), Revuboe Coal Colliery (Mozambique), Toliera Sands Heavy Minerals Mine and Processing (Madagascar), Corridor Sands Heavy Minerals Mine monitoring assessment, El Burullus Heavy Minerals Mine and processing (Egypt), Namakwa Sands Heavy Minerals Mine (SA), Tenke Copper Mine and Processing Plant (DRC), Rössing Uranium (Namibia), Lonmin platinum mines including operations at Marikana, Baobab, Dwaalkop and Doornvlei (SA), Impala Platinum (SA), Pilannesburg Platinum (SA), Aquarius Platinum, Hoogland Platinum Mine (SA), Tamboti PGM Mine (SA), Sari Gunay Gold Mine (Iran), chrome mines in the Steelpoort Valley (SA), Mecklenburg Chrome Mine (SA), Naboom Chrome Mine (SA), Kinsenda Copper Mine (DRC), Kassinga Mine (Angola) and Nokeng Flourspar Mine (SA), etc.

Mining monitoring reviews have also been undertaken for Optimum Colliery's operations near Hendrina Power Station and Impunzi Coal Colliery with a detailed management plan undertaken for Morupule (Botswana) and Glencor (previously known as Xstrata Coal South Africa).

Air quality assessments have also been undertaken for mechanical appliances including the Durban Coal Terminal and Nacala Port (Mozambique) as well as rail transport assessments including BHP-Billiton Bauxite transport (Suriname), Nacala Rail Corridor (Mozambique and Malawi), Kusile Rail (SA) and WCL Rail (Liberia).

Metal Recovery

Air quality impact assessments have been carried out for Highveld Steel, Scaw Metals, Lonmin's Marikana Smelter operations, Saldanha Steel, Tata Steel, Afro Asia Steel and Exxaro's Manganese Pilot Plant Smelter (Pretoria).

Chemical Industry

Comprehensive air quality impact assessments have been completed for NCP (including Chloorkop Expansion Project, Contaminated soils recovery, C3 Project and the 200T Receiver Project), Revertex Chemicals (Durban), Stoppani Chromium Chemicals, Foskor (Richards Bay), Straits Chemicals (Coega), Tenke Acid Plant (DRC), and Omnia (Sasolburg).

Petrochemical Industry

Numerous air quality impact assessments have been completed for Sasol (including the postponement/exemption application for Synfuels, Infrachem, Natref, MIBK2 Project, Wax Project, GTL Project, re-commissioning of boilers at Sasol Sasolburg and Ekandustria), Engen Emission Inventory Functional Specification (Durban), Sapref refinery (Durban), Sasol (at Elrode) and Island View (in Durban) tanks quantification, Petro SA and Chevron (including the postponement/exemption application).

Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the ash expansion projects at Kusile, Kendal, Hendrina, Kriel and Arnot; Fabric Filter Plants at Komati, Grootvlei, Tutuka, Lethabo and Kriel Power Stations; the proposed Kusile, Medupi (including the impact assessment for the Flue Gas Desulphurization) and Vaal South Power Stations. Reneé was also involved and the cumulative assessment of the existing and return to service Eskom power stations assessment and the optimization of Eskom's ambient air quality monitoring network over the Highveld.

In addition to Eskom's coal fired power stations, various Eskom nuclear power supply projects have been completed including the air quality assessment of Pebble Bed Modular Reactor and nuclear plants at Duynefontein, Bantamsklip and Thyspunt.

Apart from Eskom projects, power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Paratus Power Plant).

Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the Waste Water Treatment Works in Magaliesburg, proposed Waterval Landfill (near Rustenburg), Tutuka Landfill, Mogale General Waste Landfill (adjacent to the Leipardsvlei Landfill), Cape Winelands District Municipality Landfill, the Tsoeneng Landfill (Lesotho) and the FG Landfill (near the Midstream Estate). Air quality impact assessments have also been completed for the BCL incinerator (Cape Town), the Ergo Rubber Incinerator and the Ecorevert Pyrolysis Plant.

Cement Manufacturing

Impact assessments for ambient air quality have been completed for the Holcim Alternative Fuels Project (which included the assessment of the cement manufacturing plants at Ulco and Dudfield as well as a proposed blending platform in Roodepoort).

Management Plans

Reneé undertook the quantification of the baseline air quality for the first declared Vaal Triangle Airshed Priority Area. This included the establishment of a comprehensive air pollution emissions inventory, atmospheric dispersion modelling, focusing on impact area "hotspots" and quantifying emission reduction strategies. The management plan was published in 2009 (Government Gazette 32263).

Reneé has also been involved in the Provincial Air Quality Management Plan for the Limpopo Province.

RELEVANT EXPERIENCE (GREENHOUSE GAS EMISSION FOOT-PRINTING AND CLIMATE CHANGE IMPACT STATEMENTS)

Mining and Tailings Storage Facilities

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for numerous mines over the highveld of South Africa and the Democratic Republic of Congo. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

Gas to Power Plants

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for gas to power plants proposed for South Africa. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

RELEVANT EXPERIENCE (NOISE)

Mining

Reneé has undertaken numerous environmental noise assessments for mining operations. These include environmental noise impact assessments including baseline noise surveys for numerous coal, platinum, manganese, tin and zinc mines. Projects include, but are not limited to, Balama (Mozambique), Masama Coal (Botswana), Lodestone (Namibia), Osino (Namibia), Kurmuk (Ethiopia), Gamsberg (SA), Prieska (SA), Kolomela (SA), Heuningkranz (SA), Syferfontein (SA), South 32 (SA), Mamatwan (SA), Alexander (SA) and Marula Platinum Mine (SA), etc.

Power Generation

Environmental noise assessments have been completed for numerous Eskom coal fired power station studies in SA including the Kriel Fabric Filter Plant, Kendal ash facility, Medupi ash facility. Apart from Eskom projects, power plant assessments have also been completed in Botswana (Morupule), Kenya (geothermal power plants), Suriname (EBS power plant) and SA (combined cycle power plants and thermal power plants).

Process Operations

Environmental noise assessments have been undertaken for various process operations including waste disposal facilities (Bon Accord in Gauteng), bottling and drink facilities (Imali and Isanti Project in Gauteng) and Smelter (Gamsberg in Northern Cape).

Transport

An environmental noise assessment was completed for the Obetsebi road expansion and flyover project in Ghana, the Scorpion Zinc Mine transport route in Namibia and the Sisian-Kajaran (North-South Corridor) Road Project in Armenia.

Gas Pipelines

An environmental noise assessment was completed for the Sheberghan gas pipeline in Afghanistan.

Baseline Noise Surveys

Baseline noise surveys have been undertaken for numerous mining and process operation activities (including Raumix quarries, Kolomela and Sibanye Stillwater Platinum Mines (SA)) in support of onsite Environmental Management Programmes.

OTHER EXPERIENCE (2001)

Research for B.Sc. Honours degree was part of the "Highveld Boundary Layer Wind" research group and was based on the identification of faulty data from the Majuba Sodar. The project was THRIP funded and was a joint venture with the University of Pretoria, Eskom and Sasol (2001).

EDUCATION

M.Sc. Earth Sciences	University of Pretoria, RSA, Cum Laude (2009) Title: *An Air Quality Baseline Assessment for the Vaal Airshed in South Africa*
B.Sc. Hons. Earth Sciences	University of Pretoria, RSA, Cum Laude (2001) Environmental Management and Impact Assessments
B.Sc. Earth Sciences	University of Pretoria, RSA, (2000) Atmospheric Sciences: Meteorology

ADDITIONAL COURSES

CALMET/CALPUFF	Presented by the University of Johannesburg, RSA (March 2008)
Air Quality Management	Presented by the University of Johannesburg, RSA (March 2006)

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Ghana, Suriname, Afghanistan, Malawi, Liberia, Kenya, Angola, Democratic Republic of Congo, Ethiopia, Afghanistan, Lesotho, Namibia, Madagascar, Egypt, Suriname and Iran.

EMPLOYMENT RECORD

January 2002 - Present

Airshed Planning Professionals (Pty) Ltd, (previously known as Environmental Management Services cc until March 2003), Principal Air Quality and Environmental Noise Scientist, Midrand, South Africa.

2001

University of Pretoria, Demi for the Geography and Geoinformatics department and a research assistant for the Atmospheric Science department, Pretoria, South Africa.

Department of Environmental Affairs and Tourism, assisted in the editing of the Agenda 21 document for the world summit (July 2001), Pretoria, South Africa.

1999 - 2000

The South African Weather Services, vacation work in the research department, Pretoria, South Africa.

CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Understanding the Synoptic Systems that lead to Strong Easterly Wind Conditions and High Particulate Matter Concentrations on The West Coast of Namibia, H Liebenberg-Enslin, R von Gruenewaldt, H Rauntenbach and L Burger. National Association for Clean Air (NACA) conference, October 2017.
- Topographical Effects on Predicted Ground Level Concentrations using AERMOD, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2011.
- Emission Factor Performance Assessment for Blasting Operations, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2009.
- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007.
- A High-Resolution Diagnostic Wind Field Model for Mesoscale Air Pollution Forecasting, R.G. Thomas, L.W. Burger, and H Rautenbach. National Association for Clean Air (NACA) conference, September 2005.
- Emissions Based Management Tool for Mining Operations, R.G. Thomas and L.W. Burger. National Association for Clean Air (NACA) conference, October 2004.
- An Investigation into the Accuracy of the Majuba Sodar Mixing Layer Heights, R.G. Thomas. Highveld Boundary Layer Wind Conference, November 2002.

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.



11/02/2026

Signature of staff member

Date (Day / Month / Year)

Full name of staff member: Reneé Georgeinna von Gruenewaldt

APPENDIX B – DECLARATION OF INDEPENDENCE

DECLARATION OF INDEPENDENCE - PRACTITIONER

Name of Practitioner: Reneé von Gruenewaldt
Name of Registration Body: South African Council for Natural Scientific Professions
Professional Registration No.: 400304/07

Declaration of independence and accuracy of information provided:
Environmental Noise Basic Assessment for the Proposed Harmony West Wits Reclamation and Deposition Project

I, René von Gruenewaldt, declare that I am independent of the applicant. I have the necessary expertise to conduct the assessments required for the report and will perform the work relating the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer 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 air quality officer. The additional information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of this Act.

Signed at Pretoria on this 18th of August 2026

SIGNATURE
Principal Noise Scientist
CAPACITY OF SIGNATORY

APPENDIX C – SIGNIFICANCE RATING METHODOLOGY

The impact significance rating methodology, as presented herein and utilised for all EIMS Impact Assessment Projects, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. The ER is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives.

Determination of Environmental Risk:

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

For the purpose of this methodology the consequence of the impact is represented by:

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

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table C-1** below.

Table C-1: Criteria for determining impact consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site)
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years)
	3	Medium term (6-15 years)

Aspect	Score	Definition
	4	Long term (15 – 65 years, the impact will cease after the operational life span of the project)
	5	Permanent (> 65 years, no mitigation measure of natural process will reduce the impact after construction/operation/decommissioning)
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way)
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease)
Reversibility	1	Impact is reversible without any time and cost
	2	Impact is reversible without incurring significant time and cost
	3	Impact is reversible only by incurring significant time and cost
	4	Impact is reversible only by incurring prohibitively high time and cost
	5	Irreversible Impact

Once the C has been determined the significance is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table C-2**.

Table C-2: Probability scoring

Probability	1	Improbable (Rare, the event may occur only in exceptional circumstances, the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <5% chance)
	2	Low probability (Unlikely, impact could occur but not realistically expected; >5% and <20% chance)
	3	Medium probability (Possible, the impact may occur; >20% and <50% chance)
	4	High probability (Likely, it is most probable that the impact will occur- > 50 and <90% chance)
	5	Definite (Almost certain, the impact is expected to, or will, occur, >90% chance)

The result is a qualitative representation of relative significance (S) associated with the impact. S is therefore calculated as follows:

$$S = C \times P$$

Table C-3: Determination of significance

Consequence	5 – very high	5	10	15	20	25
	4 - high	4	8	12	16	20
	3 - medium	3	6	9	12	15
	2 - low	2	4	6	8	10
	1 – very low	1	2	3	4	5
		1 - improbable	2 - low	3 - possible	4 - probable	5 - definite
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These S scores are then grouped into respective classes as described in **Table C-4**.

Table C-4: Significance scores

Significance Scores	
Value	Description
≤4.25	Low (i.e. where this impact is unlikely to be a significant environmental risk/ reward)
>4,25, ≤8.5	Low-Medium (i.e. where the impact could have a significant environmental risk/ reward)
>8.5, ≤13.75	High-Medium (i.e. where the impact could have a significant environmental risk/ reward)
>13.75	High (i.e. where the impact will have a significant environmental risk/ reward)

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

Impact Prioritisation:

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

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

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

Table C-5: Criteria for determining prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table C-5. The impact priority is therefore determined as follows:

$$Priority = Cl + LR$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (refer to **Table C-6**).

Table C-6: Determination of prioritisation factor

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance (FS), the PF is multiplied by the significance of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table C-7: Final environmental significance rating

Significance Rating	Description
< -25	Very High (Impacts in this class are extremely significant and pose a very high environmental risk. In certain instances, these may represent a fatal flaw. They are likely to have a major influence on the decision and may be difficult or impossible to mitigate. Offset's may be necessary.
-13.75 to -25	High negative (These impacts are significant and must be carefully considered in the decision-making process. They have a high environmental risk or impact and require extensive mitigation measures).
-8.5 to -13.75	Medium-High negative (i.e. Impacts in this class are more substantial and could have a significant environmental risk. They may influence the decision to develop in the area and require more robust mitigation measures).
-4.25 to -8.5	Medium- Low negative (i.e. These impacts are slightly more significant than low impacts but still do not pose a major environmental risk. They might require some mitigation measures but are generally manageable).
-1 to -4.25	Low negative (i.e. Impacts in this class are minor and unlikely to have a significant environmental risk. They do not influence the decision to develop in the area and are typically easily mitigated.
0	No impact
1 to 4.25	Low positive
4.25 to 8.5	Medium-Low positive
8.5 to 13.75	Medium-High positive
>13.75	High positive

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.