Rayten
ENGINEERING SOLUTIONS
Environmental and Engineering Consultants

ENVIRONMENTAL NOISE IMPACT REPORT (ENIR)

FOR THE PROPOSED MOKOLO CROCODILE RIVER AUGMENTATION PROJECT (MCWAP-2)

River Management System (RMS)

Rayten Project Number: **SCI-GBN-233252**
Rayten Reference Number: **GIBB-01-106-002-01**

Report compiled for:

GBN JOINT VENTURE

GIBB bigen Nyeleti

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REVISION AND APPROVAL PAGE

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Report Title	**MOKOLO CROCODILE RIVER AUGMENTATION PROJECT (MCWAP-2) River Management System (RMS): Environmental Noise Impact Assessment Report 2023**		
	Name	**Signature**	**Date**
Author	**Gift Bhebhe** (BA. *Env Man*) Air Quality and Noise Specialist		19 January 2024
Document Reviewer	**Chris Rankin** (*Pri Nat Sci*) Environmental Scientist		19 January 2024
Document Authorisation	**Clive Wray** *(Pr. Eng.)* Engineering Manager		19 January 2024

Report Submission Summary		
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EXECUTIVE SUMMARY

INTRODUCTION

Rayten Engineering Solutions (Pty) Ltd (hereafter referred to as "Rayten") was commissioned by Gibb (Pty) Ltd (representing Gibb-Bigen-Nyeleti Joint Venture, hereafter referred to as "GBN-JV") to conduct an environmental ambient noise assessment at three (3) gauging weirs, construction campsites and access roads.

The Scope of Services is to undertake a Noise Baseline and Impact Assessment in support of the Basic Assessment to be completed for the identified listed activities, in alignment with the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA").

The approximate coordinates of location of the site and the various components are the flow gauging weirs given below:

- Roodekopjes Dam/ Beestekraal Weir on the Crocodile River (West); S25.403640°, E27.574750°.
- Atlanta Weir on the Crocodile River (West); S25.206310°, E27.557940°.
- Approximately 50 – 100m downstream Paul Hugo Weir on the Crocodile River (West); S24.69508°, E27.40900°.

This report describes the potential noise impact that this project might have on the local community, highlighting the methods used, potential issues identified, findings and recommendations.

PROJECT DESCRIPTION

GIBB (Pty) Ltd, Bigen Africa Services (Pty) Ltd, and Nyeleti (Pty) Ltd Joint Venture (GBN-JV) was appointed by the Trans-Caledon Tunnel Authority (the TCTA) for the Consultancy Services for the River Management System Project: MCWAP-2A RMS.

The study area is the reach of the Crocodile River (West) downstream of the Hartbeespoort Dam up to the Vlieëpoort Abstraction Weir. Furthermore, the RMS will also be applicable to the reach of the Moretele River downstream of Klipvoor Dam up to its confluence with the Crocodile River (West), as well as to the reach of the Elands River downstream of Vaalkop Dam up to its confluence with the Crocodile River (West).

The Mokolo Crocodile River (West) Water Augmentation Project Phase 2 (MCWAP-2A) will convey 75 million m^3/a from the Crocodile River (West) via a large diameter pipeline to the Lephalale Area from Vlieëpoort south of Thabazimbi. The earlier Mokolo Crocodile River (West) Water Augmentation Project (MCWAP) Feasibility Study concluded that water supply for the MCWAP-2A would be provided primarily from surplus treated wastewater return flows available at Hartbeespoort Dam. The Crocodile River (West) provides the most cost-effective means of conveying this available surplus water from Hartbeespoort Dam to the Proposed Vlieëpoort Diversion Weir near the town of Thabazimbi.

OBJECTIVE OF THE NOISE STUDY

The focus of the study is to undertake a noise baseline and impact assessment in support of the Basic Assessment to be completed for the identified listed activities, in alignment with the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA") and to provide any potential noise mitigations that could be implemented within the gazetted corridor.

BASELINE: Daytime monitoring

Based on the daytime monitoring conducted from 06:00 AM to 10:00 PM, our observations and noise recordings indicate that all monitored points remained within acceptable sound level thresholds as specified for daytime hours in different districts (please refer to Table 6-4). The sound levels at these locations were influenced by several contributing factors, including the acoustic impact of water movement in the Crocodile River, the sounds of avian activity in the nearby trees, conversations of individuals in proximity to the monitoring equipment, vehicular traffic on adjacent gravel roads, and the continuous flow of vehicles on the R511 main road. Furthermore, during specific monitoring intervals, active water sprinkling for agricultural irrigation was observed.

BASELINE: Night-time monitoring

Throughout the night-time hours (from 10:00 PM to 6:00 AM), our observations reveal that only a limited number of monitoring points in various districts managed to maintain noise levels within the recommended thresholds. In contrast, several monitoring points exceeded the night-time noise criteria established for both rural and suburban districts, as determined through comprehensive early and late-night monitoring sessions (please refer to Table 6-5, Table 6-6, Table 6-7, and Table 6-8). Various activities were underway during the monitoring periods, including active irrigation water sprinkling on farms, a continuous stream of vehicles, including heavy trucks, on nearby roads, and the operation of agricultural tractors on farms. Furthermore, the sounds of songbirds, chirping insects, and the gentle flow of the river were distinctly audible at most locations.

While natural sounds, such as those produced by flowing rivers, chirping birds, insects, or rustling leaves, can at times register relatively high on the decibel scale, they tend to differ significantly from the disruptive nature of artificial noise sources like road traffic. Natural sounds, often perceived as harmonious elements of the environment, generally blend seamlessly with the surroundings, offering a soothing and non-intrusive auditory experience. In contrast, road noise, characterized by its constant and often jarring presence, can be considerably more disruptive, impacting overall tranquillity and quality of life. Thus, the distinction between these two types of sounds highlights the importance of addressing and mitigating artificial noise pollution, particularly in rural and suburban areas, while appreciating the natural symphony that surrounds us.

EXISTING POTENTIAL NOISE RESOURCES

Potential noise sources at the 3 gauging weirs can be defined as follows:

- Noise pollution from the R511 Regional route connecting Brits and Thabazimbi township and other gravel roads caused by the constant flow of vehicles on the road.
- Noise from agricultural activities i.e., irrigation and movement from agricultural vehicles.
- Noise from natural sources such as river water flow, winds, songbirds and insects chirping.

- People engaging in conversations.
- Water turbulence noise resulting from water movement through each weir.

FINDINGS

Construction works can have an impact on the surrounding environment. During the construction of the 3 gauging weirs, it is crucial to anticipate and address the potential noise generated throughout the various phases of the project. Construction activities often involve heavy machinery, drilling, blasting, and earthmoving, all of which can contribute to elevated noise levels. The operation of excavation equipment, such as bulldozers, excavators, crushers, and dump trucks, can produce continuous low-frequency noise, while drilling and blasting activities produce impulsive and high-intensity noise. Additionally, the transportation of materials and the construction of infrastructure within the gauging weirs site may involve the use of vehicles, generators, and construction tools, further contributing to the overall noise emissions. Given the magnitude and intensity of these activities, it is essential to implement effective noise control measures where possible, such as the use of well-maintained construction equipment and engaging with nearby residence and farmers to inform them when drilling and blasting may occur.

The proposed construction activities at each weir location will have the potential to raise the noise levels. These elevated noise levels may, at times, disturb the nearby communities, but the noise levels can be reduced with mitigation measures.

The noise impacts (after mitigation) are expected to have a **LOW** significance at all three weir sites.

RECOMMENDATIONS & MITIGATION OF NOISE IMPACT

Mitigation measures were identified and proposed that may reduce the significance of the noise impact. As there are potential noise-sensitive receptors living close to the activities, there will always be a risk of a noise impact.

With the correct implementation of mitigation measures and ongoing communication with the community, **the development of the proposed gauging weirs is acceptable from a noise impact perspective.**

A monthly noise monitoring campaign will be conducted during the Construction Phase at each weir site.

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GLOSSARY OF ABBREVIATIONS

AZSL	Acceptable Zone Sound Level (Rating Level)
dB	Decibel
DMRE	Department of Mineral Resources and Energy
EMPr	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
EP	Equator Principle
f	Fast setting
GG	Government Gazette
GN	Government Notice
Hz	Hertz
i	Impulse setting
i.e.	that is
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
km/h	kilometres per hour
LoM	Life of Mine
m	Meters
mamsl	Meters above mean sea level
MPRDA	Mineral and Petroleum Resource Development Act
MP	Monitoring Point
NCR	Noise Control Regulations (under Section 25 of the ECA)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NSD	Noise-Sensitive Development
NSR	Noise-Sensitive Receptor
RoM	Run of Mine
RPM	Revolutions per Minute
SABS	South African Bureau of Standards
SANS	South African National Standard
SPL	Sound Power Levels
St	Street
t	Time
ToR	Terms of Reference
UTM	Universal Transverse Mercator
WHO	World Health Organisation

1. NOISE ASSESSMENT TEAM

A. Noise Specialist (Senior Noise Specialist and SoundPlan Model)

Morne de Jager 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 generating the sound propagation plots and related risk tables.

B. Noise Specialist (Pr. Engineer and Reviewer)

Clive Wray is a Professional Mechanical Engineer (Pr. Eng. 20090334) and an experienced environmental specialist (12 years engineering experience and 9 years environmental experience). Clive Wray started his career in the petrochemical industry, then moved to the mining industry and later moved to environmental studies.

Below is a brief history of his career and certifications:

QUALIFICATIONS

- Professional Engineer (Pr. Eng.) Reg. No: 20090334
  Engineering Council of South Africa (ECSA)
- BSc (Eng) Honours Mechanical Engineering (1998-2002)
  University of Natal, South Africa (Awarded a Sasol Bursary (2000))

ADDITIONAL QUALIFICATIONS

• Noise Modelling and Assessments	SoundPlan
• Project Management Prof. (PMP)	Davis and Dean
• Pressure Vessel Design and Analysis	PVElite
• Project Management	OD&L Learning Centre
• Time Management	OD&L Learning Centre
• Effective Problem Solving (EPS)	OD&L Learning Centre

PROFESSIONAL EXPERIENCE

- Director/ SHEQ – Air quality monitoring and Noise Assessments / Engineering services (Rayten Engineering Solutions)
- Manager Engineering - Mining Process Plants / Chemical Plants (Basil Read)
- Senior / Lead Mechanical Engineer – Petrochemical (ThyssenKrupp Uhde)
- Risk Analyst / Project Engineer – Consulting (Amec Ltd)
- Mechanical Engineer - Building Services (Linaker Ltd)
- Mechanical Engineer - Oil and Petrochemical (Sasol Ltd)

Contact details for the Reviewer:

Reviewer: Clive Wray
Company: Rayten Engineering Solutions (Pty) Ltd
Email: info@rayten.co.za
Office number: 011 792 0880

C. Noise Specialist (Site Monitoring and Report Author):

The Author, Gift Bhebhe, is an experienced environmental specialist with 6 years environmental experience. Gift started his environmental career as the site sampling technician while pursuing his environmental studies. Working with various clients, Gift Bhebhe is well-experienced in the field of environmental noise monitoring and assessments.

Below is a brief history of his career and certifications:

QUALIFICATIONS

- BA (Eng) degree Environmental Management (obtained 2022)

ADDITIONAL QUALIFICATIONS

- SAMTRAC NOSA
- Incident Investigation NOSA
- Management Assistant Technicon SA

PROFESSIONAL EXPERIENCE

- Air Quality and Noise Monitoring specialist – Air quality monitoring and Noise Assessments / Engineering services (Rayten Engineering Solutions)
- Safety Health and Environmental officer/Incident Investigator - (Rayten Engineering Solutions)
- Lead/Senior Technician- (Rayten Engineering Solutions)
- Client Service Consultant – Finbond (Supreme Finance)

Contact details for the Author:

Author: Gift Bhebhe
Company: Rayten Engineering Solutions (Pty) Ltd
Email: info@rayten.co.za
Office number: 011 792 0880

2. DECLARATION OF INDEPENDENCE

I, **Gift Bhebhe**, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to this study 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 noise impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2014, and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I 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.
- 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, and;
- 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, 2014.

Gift Bhebhe

Clive Wray

Signature of the environmental practitioners

Name of company:
Rayten Engineering Solutions (Pty) Ltd

Date:
28 November 2023

3. CHECKLIST: GG43110 MINIMUM REQUIREMENTS

The National Web based Environmental Screening Tool[1] was used to screen the proposed site for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site locations illustrated in **Figure 4-1**. The site report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization (EA) documentation.

In terms of GNR320 (20 March 2020), a Noise Study must contain, as a minimum, the following information:

Clause	Requirement	Comment / Reference
2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Section 1
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Section 2
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	Section 6
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	Section 6
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	Figure 4-1
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Section 6
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	Section 11
2.5.8	any conditions to which this statement is subjected	Section 8
2.5.9	the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered	Worst Case and Expected Case were modelled and compared.
2.5.10	A motivation must be provided if there were development footprints identified as per paragraph 2.5.9 above that were identified as having a "low" noise sensitivity and that were not considered appropriate	

[1] https://screening.environment.gov.za/screeningtool/#/pages/welcome

2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	Section 10
2.5.12	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 6.1.1 and Section 8

4. INTRODUCTION

4.1 INTRODUCTION AND PURPOSE

Rayten Engineering Solutions (Pty) Ltd (hereafter referred to as "Rayten") was commissioned by Gibb (Pty) Ltd (representing Gibb-Bigen-Nyeleti Joint Venture, hereafter referred to as "GBN-JV") to conduct an environmental ambient noise assessment at three (3) gauging weirs, construction campsites and access roads.

The Scope of Services is to undertake a Noise Baseline and Impact Assessment in support of the Basic Assessment to be completed for the identified listed activities, in alignment with the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA").

The approximate coordinates of location of the site and the various components are the flow gauging weirs given below:

- Roodekopjes Dam/ Beestekraal Weir on the Crocodile River (West); S25.403640°, E27.574750°.
- Atlanta Weir on the Crocodile River (West); S25.206310°, E27.557940°.
- Approximately 50 – 100m downstream Paul Hugo Weir on the Crocodile River (West); S24.69508°, E27.40900°.

4.2 BRIEF PROJECT DESCRIPTION

GIBB (Pty) Ltd, Bigen Africa Services (Pty) Ltd, and Nyeleti (Pty) Ltd Joint Venture (GBN-JV) was appointed by the Trans-Caledon Tunnel Authority (the TCTA) for the Consultancy Services for the River Management System Project: MCWAP-2A RMS.

The study area is the reach of the Crocodile River (West) down+stream of the Hartbeespoort Dam up to the Vlieëpoort Abstraction Weir. Furthermore, the RMS will also be applicable to the reach of the Moretele River downstream of Klipvoor Dam up to its confluence with the Crocodile River (West), as well as to the reach of the Elands River downstream of Vaalkop Dam up to its confluence with the Crocodile River (West).

The Mokolo Crocodile River (West) Water Augmentation Project Phase 2 (MCWAP-2A) will convey 75 million m3/a from the Crocodile River (West) via a large diameter pipeline to the Lephalale Area from Vlieëpoort south of Thabazimbi. The earlier Mokolo Crocodile River (West) Water Augmentation Project (MCWAP) Feasibility Study concluded that water supply for the MCWAP-2A would be provided primarily from surplus treated wastewater return flows available at Hartbeespoort Dam. The Crocodile River (West) provides the most cost-effective

means of conveying this available surplus water from Hartbeespoort Dam to the Proposed Vlieëpoort Diversion Weir near the town of Thabazimbi.

The Feasibility Study also identified the need for the implementation of a River Management System (RMS) in the Crocodile River (West) and some of its tributaries as part of the MCWAP-2A. The RMS is a key component of MCWAP-2A. It will support the efficient operation and functioning of the system, including the effective and efficient management of releases of water from the upstream dams in the Crocodile River (West) Catchment to ensure adequate river flow at Vlieëpoort for the MCWAP-2A, whilst maintaining the Existing Lawful Use (ELU) of water users in the Crocodile River (West) Catchment. Furthermore, the RMS will provide a framework to ensure that the Water Resource Class (further referred to as the Class), the Reserve and Resource Quality Objectives (RQOs) are adhered to as recently gazetted (Government Gazette No. 42775. Government Notice 562 of 2019).

The RMS will include the following three river reaches:

- Reach 1: Crocodile River (West), from Hartbeespoort Dam to the downstream Vlieëpoort diversion weir.
- Reach 2: Moretele River downstream of Klipvoor Dam to its confluence with the Crocodile River (West).
- Reach 3: Elands River downstream of Vaalkop Dam to its confluence with the Crocodile River (West).

The purpose of the RMS is therefore to ensure that the required flow is maintained at the proposed Vlieëpoort Weir while at the same time allowing the ELU.

4.3 STUDY AREA

The approximate coordinates of each site and the flow gauging weirs are given below:

- A2H019 (Roodekopjes Dam/ Beestekraal Weir) on the Crocodile River (West);

  S 25.403640°, E 27.574750°.
- A2H059 (Atlanta Weir) on the Crocodile River (West);

  S 25.206310°, E 27.557940°.
- Approximately 50 – 100m downstream of A2H116/A2H132 (Paul Hugo Weir) on the Crocodile River (West);

  S 24.69508°, E 27.40900°.

Note that the numbers, e.g., A2H083, are the DWS numbers for the various flow gauging stations/weirs.

Refer to **Figure 4-1** for site locality:

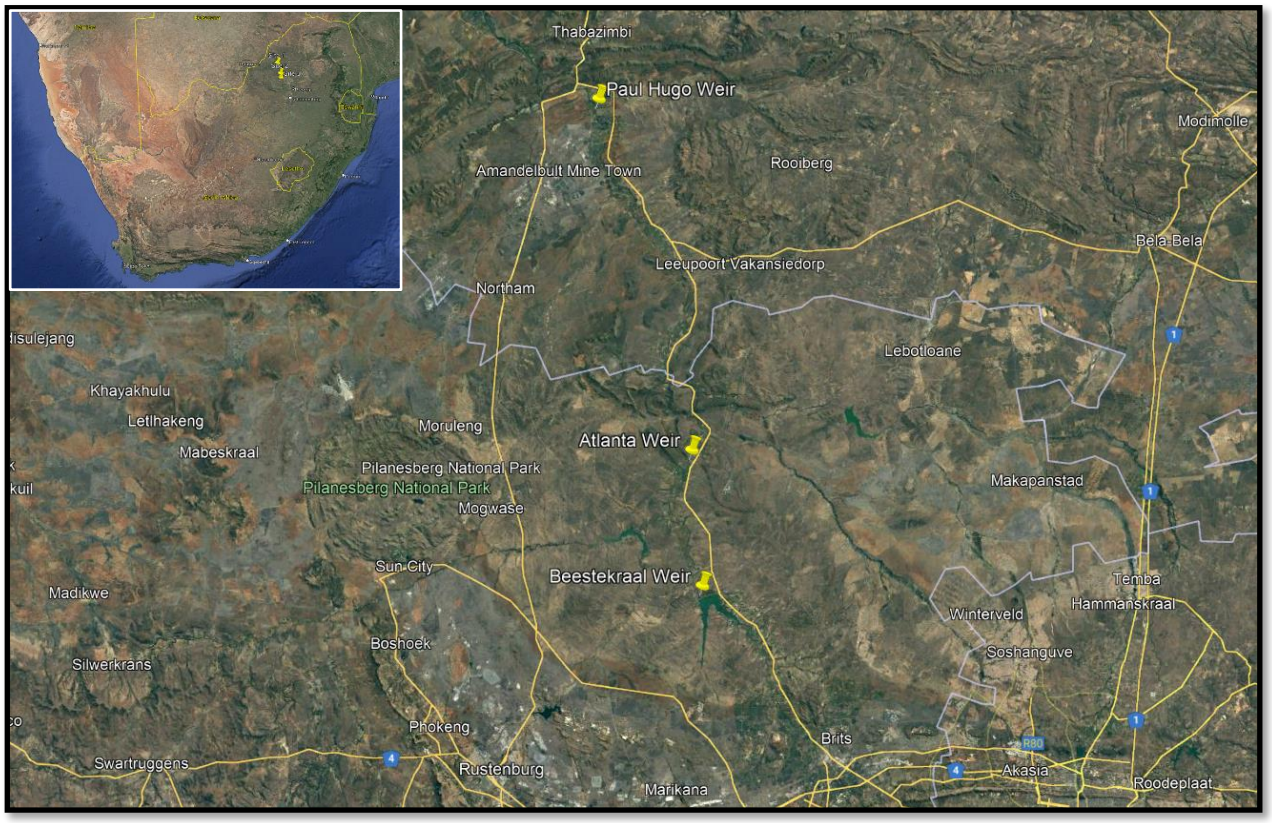


Figure 4-1: Site Locality of the 3 gauging weirs.

4.3.1 Topography

The area surrounding each project location acks significant variations in elevation or terrain features, making it relatively uniform and smooth.

Refer to **Figure 4-2** for the topography detail at each location:

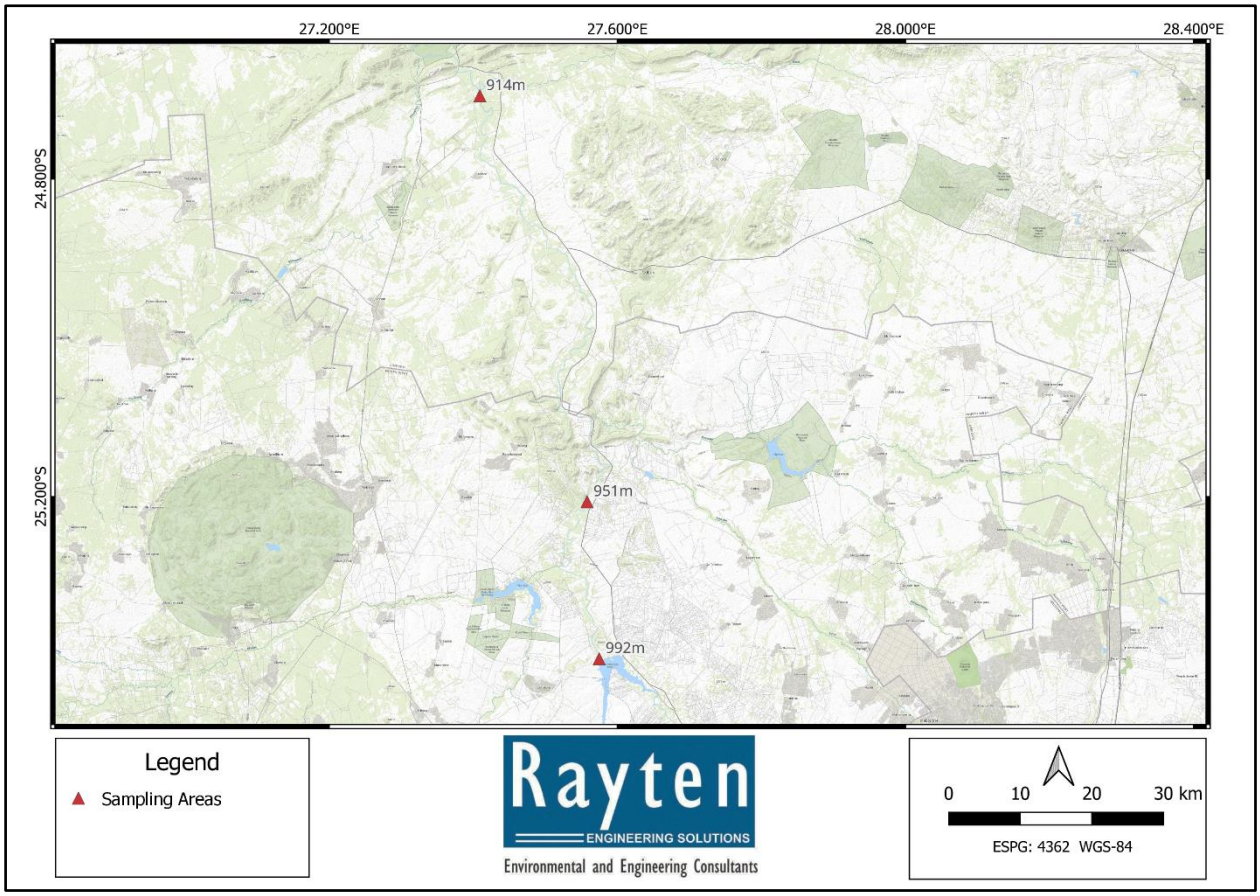


Figure 4-2: Surface topography elevation.

4.3.2 Surrounding Land Use

The land use surrounding the proposed gauging weirs consists predominantly of grassland, natural vegetation, cultivated land, farms, game lodges, main roads, farm roads, river, streams, and few areas consisting of residential areas.

4.3.3 Ground conditions and vegetation

It is the opinion of the author that the ground surface is generally medium-soft and 50% soft ground conditions will be used for modelling purposes. It should be noted that this factor is only relevant for sound waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

4.3.4 Sensitive Receptors

Farms, farm portions, public areas, residential areas, and potential noise-sensitive developments/receptors/communities are near the proposed 3 gauging weirs as detail below:

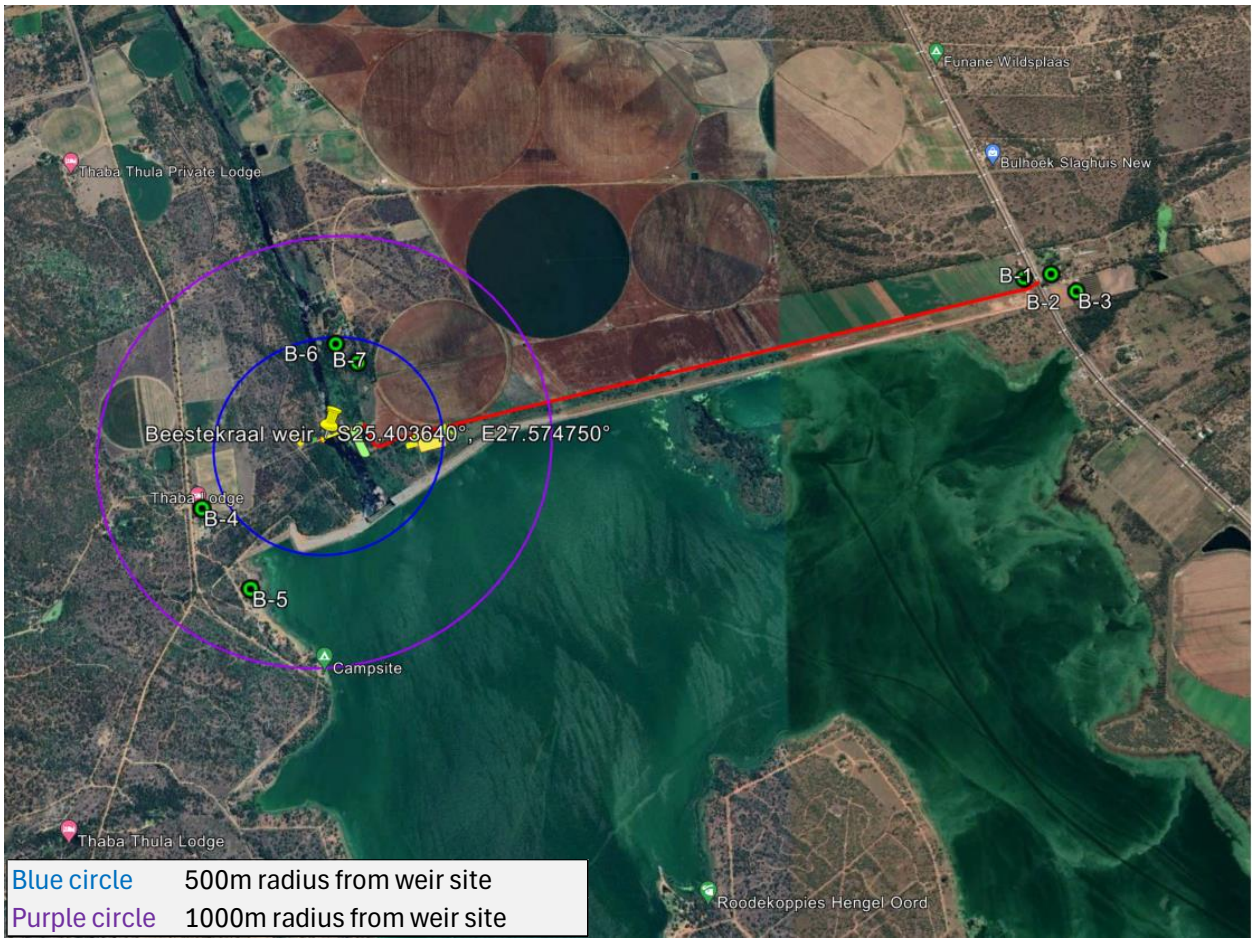


Figure 4-3: Sensitive Receptors Locations - Beestekraal weir.

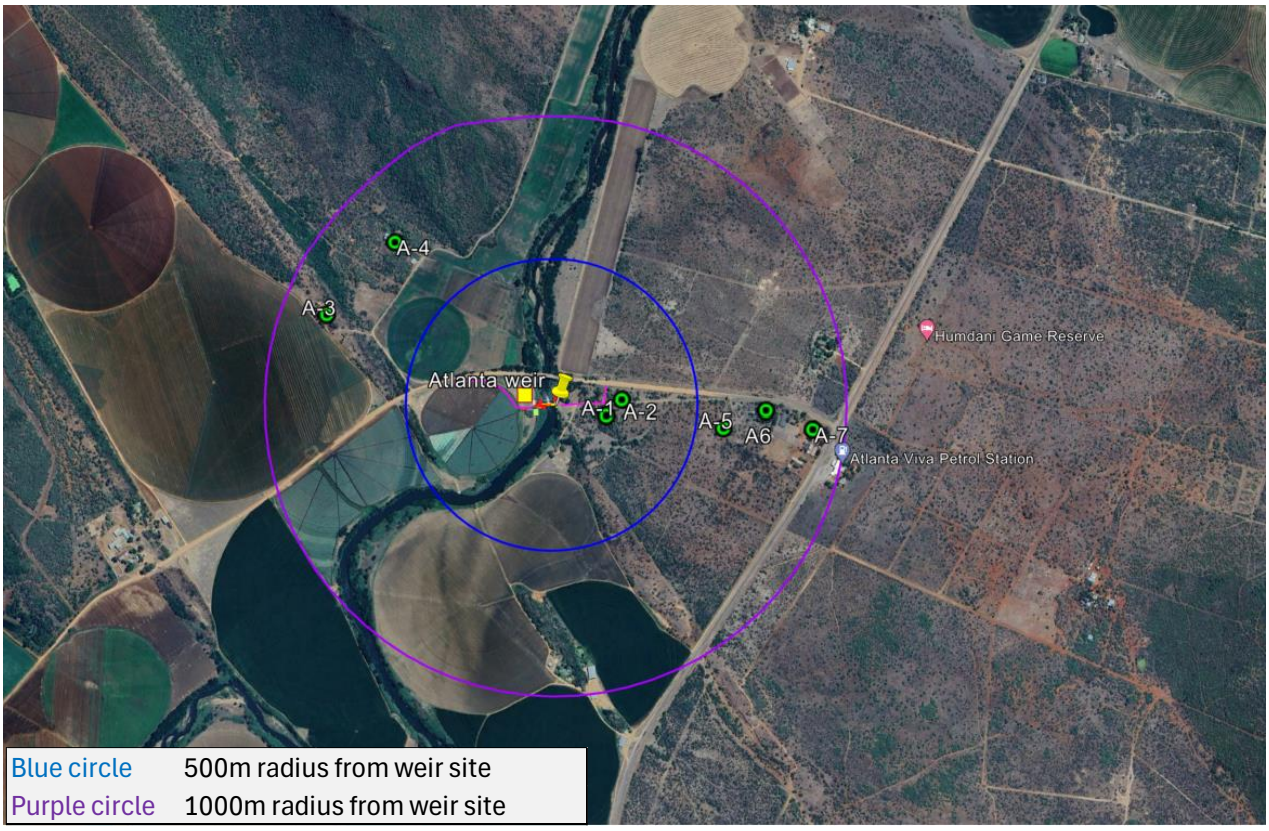


Figure 4-4: Sensitive Receptors Locations - Atlanta weir.

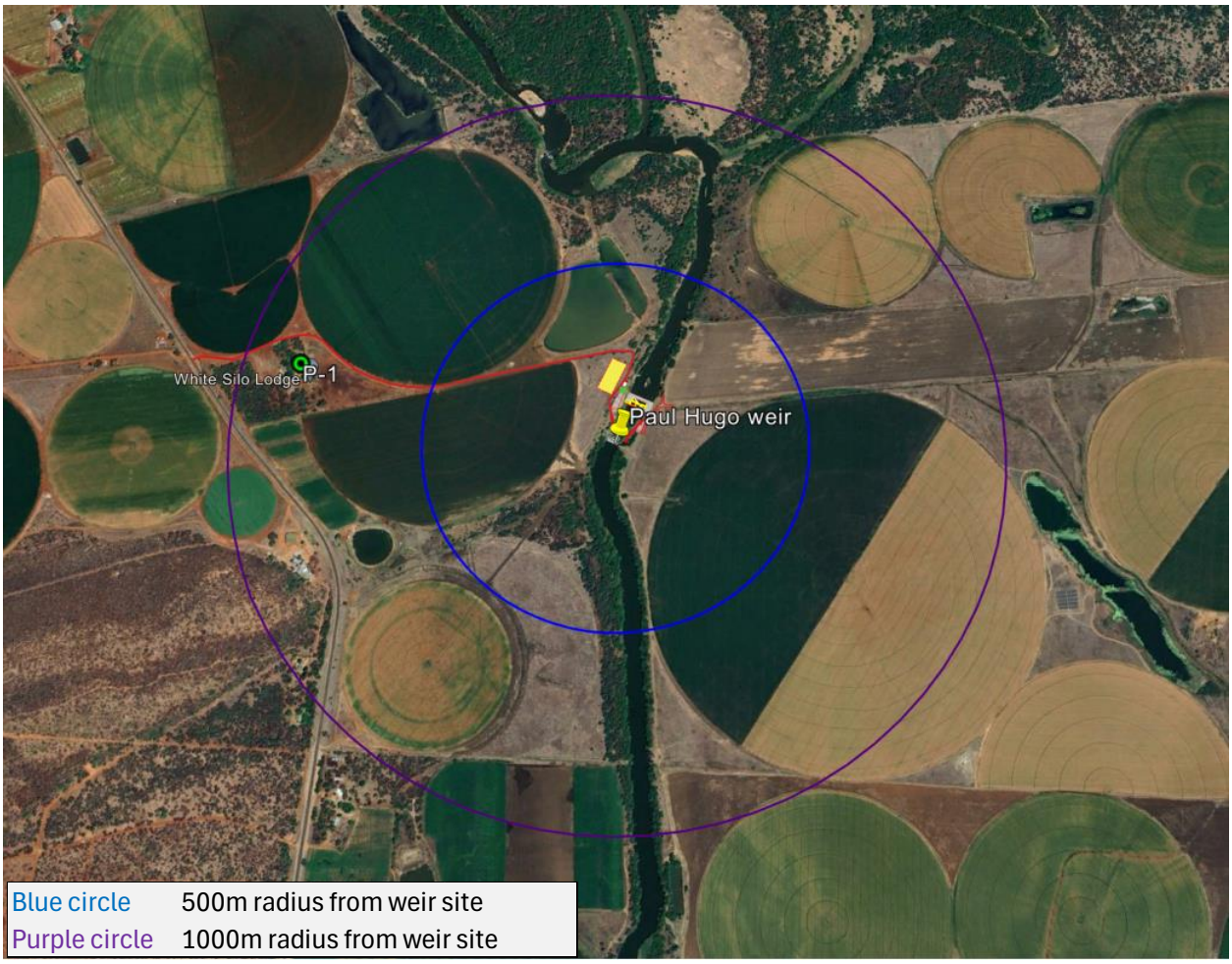


Figure 4-5: Sensitive Receptors Location – Paul Hugo weir

4.4 TERMS OF REFERENCE

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

- It was identified as an environmental theme needing further investigation i.t.o. the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A proposed change in land use as highlighted in SANS 10328:2008, section 5.3;
- if a proposed plant is to be developed on a site that is situated within 200 m of a noise-sensitive development (SANS 10328:2008 [5.4 (a)]) *or visa versa (SANS 10328:2008 [5.4 (b)])*;
- If a new road or railway line is to be established within 500 m (or, in the case of a busy throughway, 1 000 m) of a road or railway line (SANS 10328:2008 [5.4 (c)]) *or visa versa (SANS 10328:2008 [5.4 (c)])*;
- If a noise sensitive development is to be established within 1,000 m from an industry (SANS 10328:2008 [5.4 (g)]);

- If an industry (500 m for light industry as per SANS 10328:2008 [6.3.3 (g)]) is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);
- It is a controlled activity in terms of the NEMA regulations and an 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;
    - It is a potential environmental theme to be further assessed as identified using the national environmental screening tool as required by GG No. 43110 of 20 March 2020;
- 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) or GN R154 of 1992;

4.4.1 Requirements as per GG 43110

Regulation 320, dated 20 March 2020 and published in Government Gazette No. 43110, was promulgated by the Department of Environmental Affairs. This regulation outlines the procedures for conducting an environmental impact assessment and the minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation for a project. The regulation specifies the requirements for conducting a site sensitivity verification and specialist assessment, as well as the minimum content requirements for an environmental impact report when a specialist assessment is necessary, but no protocol has been prescribed.

As part of the assessment process, the current land use must be considered using the national web-based environmental screening tool found at https://screening.environment.gov.za to confirm the site sensitivity.

For this project, an applicant must submit a Noise Specialist Assessment if the site is identified as being of "very high" sensitivity for noise, or a Noise Compliance Statement if the site is identified as being of "low" sensitivity for noise. If the information gathered from the site sensitivity verification differs from the designation of "very high" sensitivity on the screening tool and it is found to be of "low" sensitivity, a Noise Compliance Statement must be submitted. Conversely, if the information gathered from the initial site sensitivity verification differs from the designation of "low" sensitivity on the screening tool and it is found to be of "very high" sensitivity, a Noise Specialist Assessment must be submitted.

If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint, excluding linear activities for which noise impacts are associated with construction activities only and the noise levels return to the current levels after the completion of construction activities.

In this case, a Noise Specialist Assessment applies. The minimum requirements for a Noise Specialist Assessment are covered in **Section 3**, in the form of a checklist.

4.4.2 Requirements as per South African National Standards

In South Africa the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It provides the maximum average ambient noise levels during the day and night to which different types of developments indoors may be exposed.

In addition, SANS 10328:2008 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 EIA purposes. These minimum requirements are:

a) the purpose of the investigation;
b) a brief description of the planned development or the changes that are being considered;
c) a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements;
d) the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics;
e) the identified noise sources that were not taken into account and the reasons as to why they were not investigated;
f) the identified noise-sensitive developments and the noise impact on them;
g) where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics;
h) an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations;
i) an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels,

as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question;

j) the location of measuring or calculating points in a sketch or on a map;

k) quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made;

l) alternatives that were considered and the results of those that were investigated;

m) a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation;

n) 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

o) conclusions that were reached;

p) proposed recommendations;

q) 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 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; and

r) any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future.

5. LEGAL CONTEXT, POLICIES AND GUIDELINES

The South African Constitution Act ("the Constitution") includes environmental rights in Section 24, which guarantee the right to an environment that is not harmful to one's well-being. In the context of noise, this means determining what level of noise is harmful to well-being. The common law approach defines acceptable noise levels as those which a reasonable person can be expected to tolerate in a particular situation. However, this subjective approach can be problematic, and therefore, noise standards have been developed (as discussed in **Section 5.1).**

Noise pollution falls under Part B of Schedule 5 of the Constitution, which designates it as a local authority responsibility. However, this is subject to the condition that the local authority has the capacity to carry out this function.

The National Environmental Management Act (Act 107 of 1998) defines "pollution" to include noise, and Section 28 of the Act requires reasonable measures to be taken to prevent noise pollution when establishing and operating any facility. NEMA outlines several measures that can be considered reasonable, including investigating and evaluating environmental impact, informing and educating employees about environmental risks, ceasing, modifying or controlling any activity causing pollution, containing or preventing the movement of pollution, eliminating the source of pollution, and remedying the effects of pollution.

Regulations have been issued in terms of NEMA, including Regulation 982 of December 2014 and Government Gazette 43110 of March 2020, which define minimum information requirements for specialist reports and provide protocols for the assessment and minimum report content requirements of environmental impacts for activities requiring environmental authorisation.

The Environment Conservation Act (ECA) (Act 73 of 1989) allows the Ministry of Water and Environmental Affairs to make regulations on noise, among other matters.

The National Noise Control Regulations (GN R154 of 1992) were promulgated under section 25 of the ECA and revised under Government Notice Number R. 55 of 14 January 1994 to make it mandatory for all authorities to apply the regulations. These regulations define controlled areas, disturbing noise, and zone sound levels, and set specific noise level limits for various situations:

"**controlled area**" as:

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

a) road transport noise in the vicinity of a road-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or

ii. the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, 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;

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 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 24hours, exceeds 61 dBA.

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

"**zone sound level**" as:
a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is the same as the Rating Level as defined in SANS 10103.

In addition:
In terms of Regulation 2 -
"A local authority may –
(a) establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences;
(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
(f) designate a controlled area in its area of jurisdiction or amend or cancel an existing controlled area by notice in the Official Gazette concerned.

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".

General prohibition
3. No person shall -
(c) make changes to existing facilities or existing uses of land or buildings or erect new buildings, if it shall in the opinion of a local authority house or cause activities which shall, after such change or erection, cause a disturbing noise, unless precautionary measures to prevent the disturbing noise have been taken to the satisfaction of the local authority;

Clause 7.(1) however exempts noise of the following activities, namely -
"The provisions of these regulations shall not apply, if -
(a) the emission of sound is for the purposes of warning people of a dangerous situation;
(b) the emission of sound takes place during an emergency."

5.1 NOISE STANDARDS

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

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.
- SANS 10210:2004. 'Calculating and predicting road traffic noise'.
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.

- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'.
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes.

5.2 INTERNATIONAL GUIDELINES

International guidelines exist for environmental noise management, including the Guidelines for Community Noise (World Health Organisation (WHO), 1999), Night Noise Guidelines for Europe (WHO, 2009), Equator Principles, and International Finance Corporation (IFC) General Environmental, Health and Safety Guidelines.

The WHO's Guidelines for Community Noise provides scientific knowledge on the health impacts of community noise and proposes guideline noise levels for different environments. For example, to protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB LAeq for a steady, continuous noise.

The WHO's Night Noise Guidelines for Europe refines previous guidelines and recommends a maximum year-round outside night-time noise average of 40 dB to avoid sleep disturbance and related health effects.

The Equator Principles and IFC General EHS Guidelines provide voluntary standards for assessing and managing social and environmental risks in project financing. The IFC guidelines propose methods for preventing and controlling noise emissions from project facilities.

6. BASELINE ASSESSMENT: NOISE MONITORING

Rayten was commissioned by GBN-JV to conduct an environmental ambient noise baseline study. The study consisted of a noise monitoring campaign at three (3) gauging weirs, construction campsites and access roads.

The noise monitoring campaign took place within the study areas listed in **Section 4.3.** The study areas are mainly classified as "rural districts", although some of the monitoring locations are referred to as "suburban districts" due to the main roads passing through.

Although every effort was made to measure ambient (background) noise levels accurately to establish an environmental noise baseline, the following factors need to be considered:

- Ambient sound character is dominated by natural sounds such as insects and birds, with wind through vegetation increasing in intensity as wind speed increases. The season, type of vegetation, density, and total surface area all determine the sound level and spectral characteristics. Sound levels are significantly impacted by the location of the sound measurement and the presence of constant sound sources, such as the river water flowing over the weirs.

- The impact of weather on sound propagation is determined by factors such as wind, temperature, and humidity. Wind is a significant factor in ambient sound levels in most rural locations. As wind speeds increase, the rustling of leaves can increase sound levels, depending on the type, density, and height of vegetation in the area. Wind also impacts sound propagation through the mechanism of refraction, bending sound waves and causing them to be heard more loudly by listeners standing downwind of the source.

- Temperature also affects sound propagation, with warm air near the ground causing sound waves to refract upward and away from the ground, resulting in lower noise levels. Conversely, cooler temperatures near the ground in the evening can cause sound to bend downward toward the ground, resulting in louder noise levels. Temperature gradients, like wind gradients, can significantly impact sound propagation over long distances.

6.1 SOUND MEASUREMENTS - PROCEDURE

The noise monitoring campaign was conducted 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", also considering the protocols defined in GG 43110.

Eleven (11) monitoring points were selected using a desktop study and Google Earth as per **Table 6-1, Figure 6-1, Figure 6-2, and Figure 6-3**. The monitoring points were selected in consideration of nearby* residents and businesses that may be directly affected by the proposed gauging weirs.

(* nearby – meaning within a 5km radius of the weir sites)

Table 6-1: Coordinates of Noise Monitoring Locations

Site Code	Description	GPS Coordinates	Classification
Site 1 Shongololo Campgrounds	A2H019 Roodekopjes Dam/ Beestekraal Weir	25°24'22.06"S 27°34'9.39"E	Rural districts
Site 2 Farm grounds	A2H019 Roodekopjes Dam/ Beestekraal Weir	25°23'45.37"S 27°36'19.66"E	Suburban districts with main road
Site 3 Eagle Landing Residence	A2H019 Roodekopjes Dam/ Beestekraal Weir	25°24'6.37"S 27°34'6.30"E	Rural districts
Site 4 Entrance to shop and residence	A2H059 Atlanta Weir	25°12'59.22"S 27°33'36.32"E	Suburban districts with main road
Site 5 Small House (Residence)	A2H059 Atlanta Weir	25°12'21.82"S 27°33'34.80"E	Rural districts
Site 6 House (Residence)	A2H059 Atlanta Weir	25°12'21.48"S 27°33'6.25"E	Rural districts
Site 7 Workshop Site for farmers	A2H059 Atlanta Weir	25°12'39.87"S 27°32'38.32"E	Rural districts
Site 8 Farm workers residence	Paul Hugo Weir	24°42'11.54"S 27°24'7.76"E	Suburban districts with main road

Site 9 White Silo Guest House	Paul Hugo Weir	24°41'52.15"S 27°24'4.34"E	Suburban districts with main road
Site 10 Farmhouse (Residence)	Paul Hugo Weir	24°41'6.17"S 27°23'31.54"E	Suburban districts with main road
Site 11 Coetzee Residence	Paul Hugo Weir	24°42'7.29"S 27°26'18.99"E	Suburban districts with main road

Figure 6-1: Beestekraal weir noise monitoring points

Figure 6-2: Atlanta weir noise monitoring points

Figure 6-3: Paul Hugo Weir noise monitoring points

Ambient sound and noise levels were measured on the 16th to 20th of October 2023. Monitoring was conducted during the day (06:00 AM - 22:00PM) and for two nights (22:00 PM - 06:00AM).

To ensure accurate and reliable measurements a BSWA Technology sound level meter (SLM) was used, which conforms to the performance and accuracy requirements of the International Electrotechnical Commission (IEC) Publication 651 and 804. The SLM was calibrated in February 2023 and was accompanied by an SLM calibrator, which conforms to the respective clauses of IEC 942. The accuracy of the measurements was further ensured by using the calibrator. The equipment used to gather data during the October 2023 noise assessment at the abovementioned water gauging weirs, is described and illustrated in **Table 6-2** below, and the calibration certificates for the SLM and calibrator are available in **Appendix B**.

Table 6-2: Equipment Used to Collect Data During Noise Assessment.

Equipment	Model	Serial Number	Calibration Date
SLM	BSWA 308	589011	February 2023
Calibrator	CA111	580965	February 2023
Microphone	MPA231T	540194	February 2023
Weather Station	HP2000	N/A	N/A

It should be noted that measurements at each location took place for at least 10 minutes at each monitoring point, with the SLM positioned at 1.2m above the ground in a horizontal position away from any obstacles that would interfere with the monitoring. Pre- and post-calibrations of the SLM took place to ensure the accuracy of the results obtained.

6.1.1 Limitations

Environmental acoustical measurements have certain limitations that should be considered. Firstly, ambient sound levels are the result of numerous sounds generated at varying distances over different time domains. Thus, if a high sound level is recorded on a particular day and time, it may not necessarily reflect the typical sound level at the site, and vice versa for a low measurement.

Additionally, seasonal changes, time of day, and meteorological conditions can all affect sound levels, making it difficult to determine a consistent and reliable measurement. It is important to consider all sources of noise, including those of environmental significance, when compiling an environmental acoustical report. Furthermore, measurements conducted during windy conditions (above wind speeds of 3 m/s) may provide data influenced by wind-induced noises.

Finally, the location of the sound level meter within residential or industrial areas may also pick up noise sources stemming from activities that are typical of those areas, such as the sound of nature or traffic coming from nearby roads.

6.1.2 Meteorological conditions during the survey

Meteorological data was recorded using a mobile weather station on site. The recorded meteorological parameters included:

Average Daytime Meteorological data 16 - 20 October 2023

Temperature:	26°C
Wind speed	9 km/h (2.5m/s)
Wind direction:	North
Humidity:	46 % Humidity

Night-time Meteorological data 16 – 20 October 2023

Temperature:	13°C
Wind speed:	7 km/h (1.9m/s)
Wind direction:	Northeast
Humidity	54 % Humidity

(Measurements carried out above wind speeds of 3 m/s could provide data influenced by wind-induced noises.)

6.2 AMBIENT SOUND LEVELS – FINDINGS & SUMMARY

Noise is defined as any unwanted sound that negatively affects the physical and/or emotional well-being of people or disturbs the convenience or peace of any person. The impact of noise on communities can vary and include annoyance, hindering speech communication, potential health risks, impeding thinking process, and interrupting concentration. Calculating the potential impact of noise involves considering the characteristics of sound, such as intensity, annoyance, loudness, and offensiveness.

Of these characteristics, only intensity is quantifiable. Various criteria are used to assess the impact of noise, including increase in noise levels, zone sound levels, and absolute or total noise levels. SANS 10103: 2008 provides guidelines for estimating the level of community response to an increase in ambient noise levels resulting from certain activities. An increase of more than 7 dB(A) is defined as a disturbing noise and is prohibited by the Noise Control Regulators. SANS 10103: 2008 describes the acceptable zone sound levels for noise in different districts:

Table 6-3: 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

NOTE 1 If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.

NOTE 2 If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in columns 5 to 7. (See also annex B.)

NOTE 3 In districts where outdoor $L_{R,dn}$ exceeds 55 dBA, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor $L_{Req,T}$ values in line with those given in table 1.

NOTE 4 For industrial districts, the $L_{R,dn}$ concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d} = L_{Req,n} = 70$ dBA can be considered as typical and normal.

NOTE 5 The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.

NOTE 6 The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as national parks, wilderness areas and bird sanctuaries, should not exceed a maximum A-weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.

a The values given in columns 2 and 5 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise and the time of day.

b The values given in columns 3, 4, 6 and 7 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness.

The following monitoring points are classified as **Rural Districts:**

Site 1, Site 3, Site 5, Site 6, Site 7
Daytime Limits 45 dB(A).
Night-time limits 35 dB(A).

The following monitoring points are classified as **Suburban Districts**:

Site 2, Site 4, Site 8, Site 9, Site 10, Site 11
Daytime Limits 50 dB(A).
Night-time limits 40 dB(A).

On-site Ambient Sound Levels Measured & Observations:

Daytime monitoring

Based on the daytime monitoring conducted from 06:00 AM to 22:00 PM, our observations and noise recordings indicate that all monitored points remained within acceptable sound level thresholds as specified for daytime hours in different districts (please refer to **Table 6-4**). The sound levels at these locations were influenced by several contributing factors, including the acoustic impact of water movement in the Crocodile River, the sounds of avian activity in the nearby trees, conversations of individuals in proximity to the monitoring equipment, vehicular traffic on adjacent gravel roads, and the continuous flow of vehicles on the R511 main road. Furthermore, during specific monitoring intervals, active water sprinkling for agricultural irrigation was observed.

Night-time monitoring

Throughout the night-time hours (from 22:00 PM to 6:00 AM), our observations reveal that only a limited number of monitoring points in various districts managed to maintain noise levels within the recommended thresholds. In contrast, several monitoring points exceeded the night-time noise criteria established for both rural and suburban districts, as determined through comprehensive early and late-night monitoring sessions (please refer to **Table 6-5, Table 6-6, Table 6-7, and Table 6-8**). Various activities were underway during the monitoring periods, including the use of water irrigation systems on surrounding farms, a continuous stream of vehicles, including heavy trucks on nearby roads, and the operation of agricultural tractors on farms. Furthermore, the sounds of songbirds, chirping insects, and the gentle flow of the river were distinctly audible at most locations.

While natural sounds, such as those produced by flowing rivers, chirping birds, insects, or rustling leaves, can at times register relatively high on the decibel scale, they tend to differ significantly from the disruptive nature of artificial noise sources like road traffic. Natural sounds, often perceived as harmonious elements of the environment, generally blend seamlessly with the surroundings, offering a soothing and non-intrusive auditory experience. In contrast, road noise, characterized by its constant and often jarring presence, can be considerably more disruptive, impacting overall tranquillity and quality of life.

Table 6-4: Noise Levels Measured at 3 gauging weirs - Day-time monitoring (06:00 – 22:00)

Site Code	Location Description	Minimum dB(A)	Maximum dB(A)	Average dB(A)	Daytime Threshold dB(A)	Compliance with limit	Comments on Maximum and Average Sound Pressure Levels found at Receptor & Activities Taking Place
Site 1	Beestekraal Weir	38.60	60.50	**43.61**	Rural districts 45	Compliant	Insects and birds chirping, vehicle noise from the nearby roads, people conversing near the monitoring point.
Site 2	Beestekraal Weir	33.20	61.40	**46.97**	Suburban districts 50	Compliant	Vehicles passing on R511 including trucks approximately 10-15 vehicles per minute and birds chirping.
Site 3	Beestekraal Weir	29.80	57.50	**38.81**	Rural districts 45	Compliant	Faint noise from vehicles on R511, birds chirping and one plane passing.
Site 4	A2H059 Atlanta Weir	34.90	55.20	**43.84**	Suburban districts 50	Compliant	Vehicles passing on R511 including trucks approximately 10-15 vehicles per minute and birds chirping.
Site 5	A2H059 Atlanta Weir	32.20	50.00	**38.64**	Rural districts 45	Compliant	Dogs barking, water noise from weir, birds chirping and one plane passing.
Site 6	A2H059 Atlanta Weir	30.50	51.50	**37.74**	Rural districts 45	Compliant	Birds chirping, noise from agricultural vehicles, noise from water pump.
Site 7	A2H059 Atlanta Weir	33.50	60.10	**42.15**	Rural districts 45	Compliant	Grinder active from Cornic farm, hammer noise, birds chirping.

Site 8	Paul Hugo Weir	33.10	81.90	**50.25**	Suburban districts 50	Non-Compliant with Mild concern	Vehicles including trucks passing approximately 10 vehicles per minute at Koedoeskop road, birds chirping and machinery noise.
Site 9	Paul Hugo Weir	33.40	62.20	**45.16**	Suburban districts 50	Compliant	Vehicles including trucks passing approximately 10 vehicles per minute at Koedoeskop road, birds chirping and noise from renovations at White silo.
Site 10	Paul Hugo Weir	35.50	82.90	**50.68**	Suburban districts 50	Non-Compliant with Mild concern	Irrigation systems from the farm, vehicles on road.
Site 11	Paul Hugo Weir	36.60	69.90	**48.80**	Suburban districts 50	Compliant	Vehicles passing on R511, one vehicle hooting for almost a minute.

Table 6-5: Noise Levels Measured at 3 gauging weirs night-time monitoring (22:00 PM - 06:00 AM)

Night 1 – 22:00 to 01:00AM (late evening monitoring):

Site Code	Location Description	Minimum dB(A)	Maximum dB(A)	Average dB(A)	Night-time Threshold dB(A)	Compliance with limit	Comments on Maximum and Average Sound Pressure Levels found at Receptor & Activities Taking Place
Site 1	Beestekraal Weir	39,50	50,40	**45,32**	Rural districts 35	Non-Compliant	Insects and birds chirping and water movement from the river. Vehicle noise from the nearby roads.
Site 2	Beestekraal Weir	35,50	66,50	**45,17**	Suburban districts 40	Non-Compliant	Vehicles passing on R511 including trucks and birds chirping.
Site 3	Beestekraal Weir	39,70	60,40	**45,09**	Rural districts 35	Non-Compliant	Faint noise from vehicles on R511, birds chirping and water movement from the river. 10-15 vehicles per min on R511 road.
Site 4	A2H059 Atlanta Weir	38,20	61,80	**45,85**	Suburban districts 40	Non-Compliant	Vehicles passing on R511 including trucks and birds chirping. 10-15 vehicles per min on R511 road.
Site 5	A2H059 Atlanta Weir	32,60	55,00	**36,85**	Rural districts 35	Non-Compliant with Mild concern	Vehicles passing on R511 including trucks and birds chirping.
Site 6	A2H059 Atlanta Weir	37,40	52,90	**39,96**	Rural districts 35	Non-Compliant	Irrigation systems from the farms, Birds chirping and vehicle noise from R511 and nearby gravel roads.
Site 7	A2H059 Atlanta Weir	33,80	52,00	**38,39**	Rural districts 35	Non-Compliant	Birds chirping and vehicle noise from R511 and nearby gravel roads.

Site 8	Paul Hugo Weir	29,00	74,10	**36,88**	Suburban districts 40	Compliant	Vehicles including trucks passing, birds chirping.
Site 9	Paul Hugo Weir	37,40	71,10	**45,58**	Suburban districts 40	Non-Compliant	Vehicles including trucks passing approximately 10 vehicles per minute, birds chirping and noise from renovations at White silo.
Site 10	Paul Hugo Weir	45,30	76,20	**50,40**	Suburban districts 40	Non-Compliant	Irrigation systems from the farm, vehicles on road.
Site 11	Paul Hugo Weir	35,60	67,10	**48,08**	Suburban districts 40	Non-Compliant	Vehicles passing on R511, birdsongs and insects.

Table 6-6: Noise Levels Measured at 3 gauging weirs night-time monitoring (22:00 PM - 06:00 AM)

Night 1: 01:00 – 06:00AM (early morning):

Site Code	Location Description	Minimum dB(A)	Maximum dB(A)	Average dB(A)	Night-time Threshold dB(A)	Compliance with limit	Comments on Maximum and Average Sound Pressure Levels found at Receptor & Activities Taking Place
Site 1	Beestekraal Weir	36,20	46,1	**39,7**	Rural districts 35	Non-Compliant with Mild concern	Insects and birds chirping and water movement from the river. No artificial sounds, mostly natural noise generators.
Site 2	Beestekraal Weir	33,30	60,20	**39,93**	Suburban districts 40	Compliant	Vehicles passing on R511 including trucks and birds chirping.
Site 3	Beestekraal Weir	36,3	59,8	**42,92**	Rural districts 35	Non-Complaint	Faint noise from vehicles on R511, birds chirping and water movement from the river.
Site 4	A2H059 Atlanta Weir	35,7	61,9	**42,85**	Suburban districts 40	Non-Compliant with Mild concern	Vehicles passing on R511 including trucks and birds chirping.
Site 5	A2H059 Atlanta Weir	32,1	51,0	**35,58**	Rural districts 35	Non-Compliant with Mild concern	Vehicles passing on R511 including trucks and birds chirping.
Site 6	A2H059 Atlanta Weir	38,1	50,1	**40,51**	Rural districts 35	Non-Compliant	Irrigation systems from the farms, Birds chirping and vehicle noise from R511 and nearby gravel roads.
Site 7	A2H059 Atlanta Weir	34,4	44,8	**39,14**	Rural districts 35	Non-Compliant	Birds chirping and vehicle noise from R511 and nearby gravel roads and water movement/circulation from the river.

Site 8	Paul Hugo Weir	26,2	51,7	**28,38**	Suburban districts 40	Compliant	Vehicles including trucks passing, birds chirping.
Site 9	Paul Hugo Weir	35	53,8	**39,83**	Suburban districts 40	Compliant	Vehicles on nearby roads, birds and insects, irrigation systems and water from weir.
Site 10	Paul Hugo Weir	42,8	57	**50,68**	Suburban districts 40	Non-Compliant	Irrigation systems from the farm, vehicles on road.
Site 11	Paul Hugo Weir	30,4	61,8	**40,46**	Suburban districts 40	Non-Compliant with Mild concern	Vehicles passing on R511, birdsongs and insects.

Table 6-7: Noise Levels Measured at 3 gauging weirs night-time monitoring (22:00 PM - 06:00 AM)

Night 2 – 22:00 to0 01:00AM (late evening monitoring):

Site Code	Location Description	Minimum dB(A)	Maximum dB(A)	Average dB(A)	Night-time Threshold dB(A)	Compliance with limit	Comments on Maximum and Average Sound Pressure Levels found at Receptor & Activities Taking Place
Site 1	Beestekraal Weir	36,60	56,40	**42,94**	Rural districts 35	Non-Compliant with Mild concern	Insects and birds chirping and water movement from the river. No artificial sounds, mostly natural noise generators.
Site 2	Beestekraal Weir	33,00	64,10	**45,82**	Suburban districts 40	Non-Complaint	Vehicles passing on R511 including trucks and birds chirping
Site 3	Beestekraal Weir	38,50	54,70	**42,18**	Rural districts 35	Non-Complaint	Faint noise from vehicles on R511, birds chirping and water movement from the river
Site 4	A2H059 Atlanta Weir	37,00	60,40	**42,61**	Suburban districts 40	Non-Compliant with Mild concern	Vehicles passing on R511 including trucks and birds chirping
Site 5	A2H059 Atlanta Weir	33,00	50,50	**39,43**	Rural districts 35	Non-Compliant	Vehicles passing on R511 including trucks and birds chirping
Site 6	A2H059 Atlanta Weir	39,40	50,00	**42,38**	Rural districts 35	Non-Compliant	Irrigation systems from the farms, Birds chirping and vehicle noise from R511 and nearby gravel roads
Site 7	A2H059 Atlanta Weir	42,20	47,50	**45,39**	Rural districts 35	Non-Compliant	Birds chirping and vehicle noise from R511 and nearby gravel roads

Site 8	Paul Hugo Weir	32,20	77,80	**39,57**	Suburban districts 40	Compliant	Vehicles including trucks passing, birds chirping
Site 9	Paul Hugo Weir	47,60	62,40	**51,70**	Suburban districts 40	Non-Compliant	Vehicles including trucks passing approximately 10 vehicles per minute, birds chirping and noise from renovations at white silo.
Site 10	Paul Hugo Weir	43,60	78,90	**55,07**	Suburban districts 40	Non-Compliant	Irrigation systems from the farm, vehicles on road.
Site 11	Paul Hugo Weir	38,80	47,40	**42,99**	Suburban districts 40	Non-Compliant with Mild concern	Vehicles passing on R511, birdsongs and insects

Table 6-8: Noise Levels Measured at 3 gauging weirs night-time monitoring (22:00 PM - 06:00 AM)

Night 2: 01:00 – 06:00AM (early morning):

Site Code	Location Description	Minimum dB(A)	Maximum dB(A)	Average dB(A)	Night-time Threshold dB(A)	Compliance with limit	Comments on Maximum and Average Sound Pressure Levels found at Receptor & Activities Taking Place
Site 1	Beestekraal Weir	44,20	48,10	**41,59**	Rural districts 35	Non-Compliant with Mild concern	Insects and birds chirping and water movement from the river. No artificial sounds, mostly natural noise generators.
Site 2	Beestekraal Weir	32,80	49,00	**35,42**	Suburban districts 40	Compliant	Vehicles passing on R511 including trucks and birds chirping and dogs barking from farm 100.
Site 3	Beestekraal Weir	30,60	51,60	**35,44**	Rural districts 35	Non-Compliant with Mild concern	Faint noise from vehicles on R511, birds chirping and water movement from the river.
Site 4	A2H059 Atlanta Weir	34,00	57,30	**41,42**	Suburban districts 40	Non-Compliant with Mild concern	Vehicles passing on R511 including trucks and birds chirping
Site 5	A2H059 Atlanta Weir	32,20	54,40	**34,52**	Rural districts 35	Compliant	Vehicles passing on R511 including trucks and birds chirping. While monitoring, one truck passed driving slowly near the monitoring device.
Site 6	A2H059 Atlanta Weir	32,00	49,00	**34,19**	Rural districts 35	Compliant	Irrigation systems from the farms, Birds chirping and vehicle noise from R511 and nearby gravel roads.
Site 7	A2H059 Atlanta Weir	34,50	47,40	**34,50**	Rural districts 35	Compliant	Birds chirping and vehicle noise from R511 and nearby gravel roads and water movement/circulation from the river.

Site 8	Paul Hugo Weir	29,60	69,10	**33,39**	Suburban districts 40	Compliant	Vehicles including trucks passing, birds chirping.
Site 9	Paul Hugo Weir	42,10	48,00	**45,07**	Suburban districts 40	Non-Compliant	Vehicles including, birds chirping and water pump station noise from the irrigation systems.
Site 10	Paul Hugo Weir	41,90	73,00	**38,44**	Suburban districts 40	Compliant	Irrigation systems from the farm, vehicles on road. Birds chirping.
Site 11	Paul Hugo Weir	42,80	57,00	**50,68**	Suburban districts 40	Non-Compliant	Vehicles passing on R511, birdsongs and insects.

The noise monitoring was done according to SANS 10328:2008 which states that noise assessments need to be conducted in the daytime (06:00AM – 22:00PM) and night-time (22:00PM – 06:00AM) to determine ambient noise levels for a specific site.

Based on the daytime monitoring, our observations and noise recordings indicate that all monitored points remained within acceptable sound level thresholds as specified for daytime hours in different districts.

Throughout the night-time hours, our observations reveal that only a limited number of monitoring points in various districts managed to maintain noise levels within the recommended thresholds. In contrast, several monitoring points exceeded the night-time noise criteria established for both rural and suburban districts, as determined through comprehensive early and late-night monitoring session. Majority of the exceedances occurred during the late-night monitoring session, i.e., between 22:00PM and 01:00AM.

The sound levels at these locations appeared to be influenced by several factors, including the noise generated by:

- Water flowing in the Crocodile River.
- Insects and Birds chirping.
- People conversing.
- Road noise (motor vehicles, trucks on the R511).
- Water pump and water sprinklers for the farmers.
- Workers in the distance (machinery and tools).

7. POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction and operation phases of the project. The potential noise impacts from the activities associated with these phases are discussed in the following sections.

It should be noted that there are numerous equipment and activities taking place at such a project, of which only a few pieces of equipment were identified and listed. This however is the main generators of noise, with the other activities or equipment having a minor impact on the noise levels. Based on noise measurements conducted at existing projects where modelling was conducted, the assumptions would be sufficient to ensure an accuracy within 5 dBA, leaning towards a more pre-cautious result (noise levels will be over-estimated).

Current noise sources at the gauging weirs can be defined as follows:

- Heavy traffic from 511 route connecting Brits and Thabazimbi township.
- Traffic from other gravel roads.
- Noise from songbirds and insects chirping (natural sounds).
- Agricultural activities such as irrigation and agricultural vehicles.
- People engaging in conversations.
- Water flowing within the Crocodile River.

7.1 PROJECT RELATED POTENTIAL NOISE SOURCES: CONSTRUCTION WORKS

The construction process will consist of the following principal activities:

- Site survey and preparation;
- Transport of components and equipment to site – certain components will be brought to site in sections by means of flatbed trucks. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, tar trucks, cranes, etc.).
- Establishment of site entrance, internal access roads, contractor's compound and security fencing;
- Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure. These activities will require the stripping of topsoil which will need to be stockpiled for rehabilitation purposes;
- Construction of required foundations of the road;
- The establishment of infrastructure such as workshops, and stormwater management trenches/channels.

- Excavation and Loading Equipment: Noise can arise from heavy machinery used for excavating and loading materials in the gauging weirs. Equipment such as excavators, loaders, and dump trucks generate engine and mechanical noises during their operations.
- Transportation of Materials: Trucks transporting excavated materials to and from the gauging weirs to construction sites or other destinations can contribute to noise pollution. Engine noise, tyre friction, and the sound of heavy vehicles passing by can be significant sources of noise.
- Processing and Crushing: If the materials extracted from the gauging weirs require processing or crushing on-site, the machinery used for these tasks can also contribute to noise emissions.
- Backup Alarms: Large construction vehicles and trucks often have backup alarms to warn others of their movement. These alarms can add to the overall noise levels in the vicinity.
- Construction Activities: If the borrowed materials are being used for construction projects near the freeway, the construction activities themselves, such as road construction, can generate noise during their execution.
- Dust Suppression: Measures employed to suppress dust, such as water spraying or dust control equipment, may also produce noise.

Mitigating the impact of these noise sources may involve engaging with nearby residence and farmers to inform them of the potential noise activities such as blasting, restricting construction activities during specific hours (restrict night-time construction activities and keep construction to day-time hours), and adhering to noise regulations and guidelines to ensure minimal disruption to nearby residents and the environment.

Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in **Table 7-1**.

Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 7-2**.

Table 7-1: Potential maximum noise levels generated by various equipment.

Equipment Description [2]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential maximum noise levels. (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Auger Drill Rig	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Concrete Saw	No	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Generator (<25KVA)	No	104.7	79.7	73.7	67.6	59.7	53.7	50.1	47.6	44.1	39.7	36.2	33.7	27.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Jackhammer	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Man Lift	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Paver	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Pickup Truck	No	89.7	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6

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

Pumps	No	111.7	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6
Rivit Buster/Chipping Gun	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Rock Drill	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sand Blasting (single nozzle)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Scraper	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sheers (on backhoe)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Soil Mix Drill Rig	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Tractor	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vacuum Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vacuum Street Sweeper	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Ventilation Fan	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibrating Hopper	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibratory Concrete Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

Table 7-2: 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
Air compressor	92.6	67.6	61.6	55.5	47.6	41.6	38.0	35.5	32.0	27.6	24.1	21.6	15.5
Bulldozer CAT D10	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
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
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
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
FEL (988) (FM)	115.6	90.7	84.6	78.6	70.7	64.6	61.1	58.6	55.1	50.7	47.1	44.6	38.6
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
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
Rock Breaker, CAT	120.7	95.7	89.7	83.7	75.7	69.7	66.2	63.7	60.2	55.7	52.2	49.7	43.7
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
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8

In conclusion, construction works can elevate noise levels within the surrounding environment. During the construction of the 3 gauging weirs, it is crucial to anticipate and address the potential noise generated throughout the various phases of the project. Construction activities often involve heavy machinery, drilling, blasting, and earthmoving, all of which can contribute to elevated noise levels. The operation of excavation equipment, such as bulldozers, excavators, crushers, and dump trucks, can produce continuous low-frequency noise, while drilling and blasting activities produce impulsive and high-intensity noise. Additionally, the transportation of materials and the construction of infrastructure within the gauging weirs site may involve the use of vehicles, generators, and construction tools, further contributing to the overall noise emissions. Given the magnitude and intensity of these activities, it is essential to implement effective noise control measures where possible, such as the use of well-maintained construction equipment and engaging with nearby residence and farmers to inform them when drilling and blasting may occur.

8. NOISE IMPACT ASSESSMENT (NOISE MODELLING)

8.1 NOISE MODEL USED

The noise emissions into the environment from the various sources as defined were calculated 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 time the activities and equipment are operational and generating noise levels;
- 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; and
- Acoustical characteristics of the ground.

The noise emission into the environment due to potential project traffic was calculated using the sound propagation model described in RLS-90 used in Germany. Corrections such as the following were considered:

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

This noise model generates the potential LA10 noise level, which is used in various countries (such as the United States of America, United Kingdom, Germany, Canada, Australia, New Zeeland, etc.) to define potential road traffic noise analysis (and abatement). This noise model is recommended for use to calculate potential traffic noises in Germany, Switzerland, Netherlands, United Kingdom, France, Denmark, Italy, Denmark and Austria.

8.2 UNCERTAINTIES, ASSUMPTIONS AND LIMITATIONS

Noise modelling provide a noise rating level, and the noise rating level should never be considered to be the expected noise level (or the sound pressure level as measured at a particular location). The purpose of noise modelling is to identify potential issues of concern, to allow the define measures to manage and mitigate the potential noise impact. The projected noise rating levels in addition are the output from a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty per cent (50%) soft ground conditions will be modelled as the area where the activities are proposed is well vegetated and sufficiently uneven to allow the consideration of medium ground conditions.
- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power 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 changes depending on the load the process and equipment are subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). 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 (when and for how long), modelling considers potential worst-case scenarios where processes and equipment are under full load 100% of the time. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise rating levels would likely be over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor. This was addressed by adding an impulsive penalty of 5 dBA for the worst-case scenario;
- Noise modelling assumes a constant noise emission rate from the traffic sources. However, the actual noise emission rates from vehicles can vary depending on factors such as actual vehicle speeds, engine types, types of vehicles, vehicle maintenance conditions, vehicle weight/load, etc.

- Noise modelling assumes average road conditions, considering a road that is well maintained with the road surface being uniform. Potholes, changes in the road surface due to wear and repairs or defects in the road surface are not considered;
- Noise modelling assumes an average height of road surface of 0.5 m above the surrounding ground surface;
- Noise modelling exclude the effect of buildings and significant vegetation and tree growth.

It must be noted that there is always subjectivity in noise assessments. Noise impact assessment involves subjective judgments about what constitutes an acceptable level of noise for surrounding receptors. Mining activities located close to receptors will result in a negative noise impact, but the significance of this impact could be difficult to define because:

- Different individuals or communities may have different thresholds for acceptable noise levels, and these subjective factors may not be fully captured by noise modelling or the impact assessment.
- The perception of noise impact may be influenced by other factors, such as their attitude towards the source of the noise or their overall quality of life. This can make it difficult to isolate the impact of noise on people's perception of their environment.
- The significance of a noise impact may also depend on factors such as the time of day, the character of the noise as well as the psychological and physiological factors (such as stress and anxiety) of the receptor. Receptors are generally far less annoyed by high noise levels during the day than when they are exposed to a far quieter noise at night.

8.3 INPUT DATA ASSUMED FOR THE NOISE MODEL

Increased noise levels are directly linked with the various activities associated with the proposed construction activities. Noise emitted during construction will be highly variable and depend on the type of activities taking place (possible drilling, pile driving, rock breaking, excavation, civil and form work, pouring of concrete, etc.), the number of equipment operating simultaneously and the extent of the area where equipment is moving around.

It should be noted that this noise impact assessment considers conceptual scenarios to estimate the potential impact of noise on the surrounding Noise-Sensitive Receptors (NSR) and should not be seen as a reflection of the construction activities, or specific noise levels at receptors at any specific times. Noise modelling select conceptual locations of construction activities to illustrate a potential worst-case scenario.

This report will focus on two potential scenarios for each weir project, namely:

- Worst-case construction activities, including:
  - A low-intensity area noise source of approximately 2,500 m^2 (to account for low intensity noise sources not specifically accounted – people shouting; material being handled; vehicles moving around; etc.).
  - A high-intensity area noise source of approximately 2,000 m^2 (to account for high intensity noise sources not specifically accounted – cement mixing, pouring and pumping; dust suppression equipment; material handling activities; etc.).
  - A general noise source (which could be a cement mixer, compressor, a small backhoe Loader, road truck, grader, etc.) generating noise under a full load 100% of the time.
  - A significant noise source (which could be a rock drill, excavator, pile driver, rock breaker). As the noise may contain an impulsive component, a penalty of 5 dBA was added to this noise source, with this activity generating noise under a full load 100% of the time.
  - 10 road trucks (average speed of 50 km/h) and 5 light delivery vehicles ("LDV") (average speed of 60 km/h) per hour travelling to the project area during the day using the existing and proposed access roads.

- Potential typical construction activities, including:
  - A low-intensity area noise source of approximately 2,500 m^2 (to account for low intensity noise sources not specifically accounted – people shouting; material being handled; vehicles moving around; etc.).
  - A high-intensity area noise source of approximately 1,000 m^2 (to account for high intensity noise sources not specifically accounted – cement mixing, pouring and pumping; dust suppression equipment; material handling activities; etc.).
  - A general noise source (which could be a cement mixer, compressor, a small backhoe Loader etc.) generating noise under a full load 100% of the time.
  - A significant noise source (which could be an excavator, large backhoe Loader, concrete truck and pump, etc.), with this activity generating noise under a full load 100% of the time. No penalty was added for impulsive noises.
  - 5 road trucks (average speed of 40 km/h) and 5 light delivery vehicles ("LDV") (average speed of 60 km/h) per hour travelling to the project area during the day using the existing and proposed access roads.

Sound power emission levels as defined in Error! Reference source not found. will be used in the noise modelling for both the construction and operational phase.

Table 8-1: Sound power emission levels used for modelling.

Equipment	Sound power level, dB re1 pW, in octave band, Hz							SPL
Process	63	125	250	500	1000	2000	4000	(dBA)
Point noise sources (dBA re 1 pW)								
Backhoe Loader	109.0	106.7	107.3	97.9	95.8	92.5	87.6	108.9
Excavator	113.8	114.2	110.3	108.3	106.3	103.9	103.7	113.0
General noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	108.8
Material handling	111.6	104.1	105.2	102.2	97.1	91.3	87.9	107.2
Material Tip	100.0	102.9	101.7	103.0	103.2	103.0	101.0	108.8
Road Transport truck (35t)	90.0	101.0	102.0	105.0	105.0	104.0	99.0	109.6
Area noise sources (dBA/m^2 re 1 pW)								
General Area Noise Source (High-intensity)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	65.0
General Area Noise Source (Low-intensity)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	55.0

8.4 IMPACT ASSESSMENT CRITERIA

The impact significance is determined by multiplying the sum of scores of Consequence (**Table 8-2**), Duration (**Table 8-4**) and the Spatial Extent (**Table 8-3**) with the Probability score (**Table 8-5**) to obtain the final Impact Significance as defined in the equation below. It should be noted that while intensity can be calculated to an extent, probability of an impact occurring, or a receptor being annoyed is difficult to determine using only this assessment.

$$Significance\ Rating = (Extent + Intensity + Duration)\ x\ Probability$$

Table 8-2: Impact Assessment Criteria – Magnitude / Intensity.

This defines the impact as experienced by any receptor. In this report, the NSR is defined as any resident in the area but excludes faunal species (because guideline levels are not available for animals).		
Rating	**Description**	**Score**
Minor	Increase in average sound pressure levels between 0 and 3 dB from the measured or calculated ambient noise levels.	2
Low	Increase in average sound pressure levels between 3 and 5 dB above the expected measured or calculated ambient noise levels.	4
Medium / Moderate	Increase in average sound pressure levels between 5 and 7 dB above the measured or calculated ambient noise levels.	6
High	Increase in average sound pressure levels between 7 and 10 above the measured or calculated ambient noise levels.	8
Very High	Increase in average ambient sound pressure levels higher than 10 dBA above the measured or calculated ambient noise levels.	10

Table 8-3: 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 whole, or a significant portion of the site.	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns (further than 1,000 m from site).	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 8-4: 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	The impact will either disappear with mitigation or will be mitigated through a natural process in a period significantly shorter than that of the construction phase (less than 6 months).	1
Short term	The impact will be relevant through to the end of a construction phase (less than 5 years).	2
Medium term	The impact will last up to the end of the development phases, where after it will be entirely negated. The impact could last between 5 and 20 years.	3
Long term	The impact will continue or last for the entire operational lifetime i.e., exceed 20 years of the development.	4
Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.	5

Table 8-5: Impact Assessment Criteria – Probability.

This describes the likelihood of a noise impact (receptors being annoyed) 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	Daytime noise levels are less than 45 dBA.	1
Possible	Daytime noise levels between 45 and 50 dBA.	2
Probable	Daytime noise levels between 50 and 55 dBA.	3
Highly Likely	Daytime noise levels between 55 and 60 dBA.	4
Definite	Daytime noise levels exceed 60 dBA.	5

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) as highlighted in **Table 8-6**.

Table 8-6: Impact Assessment Criteria – Significance without Mitigation.

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)	The 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.

8.5 PROJECTED NOISE LEVELS AND CONCEPTUAL IMPACT SIGNIFICANCE: *ATLANTA WEIR*

This assessment identified a number of potential noise-sensitive receptors ("NSR"), such as nearby residential housing and farmers, that may be influenced activities associated with construction of the Atlanta Weir. The potential significance of the noise impact for the two conceptual scenarios are defined in the following tables:

- Potential noise rating levels as well as the potential significance when considering potential worst-case construction activities, are defined per NSR in **Table 8.7**.

- Potential noise rating levels as well as the potential significance when considering potential typical construction activities, are defined per NSR in **Table 8.8** for the conceptual daytime period.

Table 8-7: Calculated Daytime Noise rating levels and potential significance – Worst-case scenario (Atlanta weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance	Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	A-1	45	40,5	56,6	16,2	Very High	Temporary	Local	Highly Likely	Medium	10	1	2	4	52
Day	A-2	45	40,5	54,2	13,9	Very High	Temporary	Local	Likely	Medium	10	1	2	3	39
Day	A-3	45	40,5	42,6	4,2	Low	Temporary	Local	Improbable	Low	4	1	2	1	7
Day	A-4	45	40,5	43,8	5,0	Low	Temporary	Local	Improbable	Low	4	1	2	1	7
Day	A-5	45	40,5	46,2	6,7	Moderate	Temporary	Local	Possible	Low	6	1	2	2	18
Day	A-6	45	40,5	48,5	8,6	High	Temporary	Local	Possible	Low	8	1	2	2	22
Day	A-7	45	40,5	46,7	7,1	High	Temporary	Local	Possible	Low	8	1	2	2	22

Table 8-8: Calculated Daytime Noise rating levels and potential significance – Typical construction scenario (Atlanta weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance	Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	A-1	45	40	53,2	13,4	Very High	Short-term	Local	Likely	Medium	10	2	2	3	42
Day	A-2	45	40	50,7	11,1	Very High	Short-term	Local	Likely	Medium	10	2	2	3	42
Day	A-3	45	40	40,6	3,3	Low	Short-term	Local	Improbable	Low	4	2	2	1	8
Day	A-4	45	40	41,6	3,9	Low	Short-term	Local	Improbable	Low	4	2	2	1	8
Day	A-5	45	40	42,9	4,7	Low	Short-term	Local	Improbable	Low	4	2	2	1	8
Day	A-6	45	40	45,5	6,6	Moderate	Short-term	Local	Possible	Low	6	2	2	2	20
Day	A-7	45	40	43,8	5,3	Moderate	Short-term	Local	Improbable	Low	6	2	2	1	10

8.6 PROJECTED NOISE LEVELS AND CONCEPTUAL IMPACT SIGNIFICANCE: *BEESTEKRAAL WEIR*

This assessment identified a number of potential noise-sensitive receptors ("NSR"), such as nearby residential housing and farmers, that may be influenced activities associated with construction of the Beestekraal Weir. The potential significance of the noise impact for the two conceptual scenarios are defined in the following tables:

- Potential noise rating levels as well as the potential significance when considering potential worst-case construction activities, are defined per NSR in **Table 8-9**.

- Potential noise rating levels as well as the potential significance when considering potential typical construction activities, are defined per NSR in **Table 8-10** for the conceptual daytime period.

Table 8-9: Calculated Daytime Noise rating levels and potential significance – Worst-case scenario (Beestekraal weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance	Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	B-1	45	47	50,2	4,9	Low	Temporary	Local	Likely	Low	4	1	2	3	21
Day	B-2	45	47	41,2	1,0	Minor	Temporary	Local	Improbable	Low	2	1	2	1	5
Day	B-3	45	47	35,6	0,3	Minor	Temporary	Local	Improbable	Low	2	1	2	1	5
Day	B-4	45	40,5	44,9	5,7	Moderate	Temporary	Local	Improbable	Low	6	1	2	1	9
Day	B-5	45	40,5	42,9	4,4	Low	Temporary	Local	Improbable	Low	4	1	2	1	7
Day	B-6	45	40,5	52,7	12,5	Very High	Temporary	Local	Likely	Medium	10	1	2	3	39
Day	B-7	45	40,5	54,2	13,9	Very High	Temporary	Local	Likely	Medium	10	1	2	3	39

Table 8-10: Calculated Daytime Noise rating levels and potential significance –Typical construction scenario (Beestekraal weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance	Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	B-1	45	47	47,4	3,2	Low	Short-term	Local	Possible	Low	4	2	2	2	16
Day	B-2	45	47	38,3	0,5	Minor	Short-term	Local	Improbable	Low	2	2	2	1	6
Day	B-3	45	47	32,8	0,2	Minor	Short-term	Local	Improbable	Low	2	2	2	1	6
Day	B-4	45	40	42,0	4,1	Low	Short-term	Local	Improbable	Low	4	2	2	1	8
Day	B-5	45	40	40,3	3,2	Low	Short-term	Local	Improbable	Low	4	2	2	1	8
Day	B-6	45	40	49,6	10,1	Very High	Short-term	Local	Possible	Low	10	2	2	2	28
Day	B-7	45	40	51,0	11,3	Very High	Short-term	Local	Likely	Medium	10	2	2	3	42

8.7 PROJECTED NOISE LEVELS AS WELL AS CONCEPTUAL IMPACT SIGNIFICANCE: *PAUL HUGO WEIR*

This assessment identified a number of potential noise-sensitive receptors ("NSR"), such as nearby residential housing and farmers, that may be influenced activities associated with construction of the Paul Hugo Weir. The potential significance of the noise impact for the two conceptual scenarios are defined in the following tables:

- Potential noise rating levels as well as the potential significance when considering potential worst-case construction activities, are defined per NSR in **This assessment** identified a number of potential noise-sensitive receptors ("NSR"), such as nearby residential housing and farmers, that may be influenced activities associated with construction of the Atlanta Weir. The potential significance of the noise impact for the two conceptual scenarios are defined in the following tables:

- Potential noise rating levels as well as the potential significance when considering potential worst-case construction activities, are defined per NSR in **Table 8.7**.

- Potential noise rating levels as well as the potential significance when considering potential typical construction activities, are defined per NSR in **Table 8.8** for the conceptual daytime period.

- Table 8-7;

- Potential noise rating levels as well as the potential significance when considering potential typical construction activities, are defined per NSR in Error! Reference source not found. for the conceptual daytime period.

Table 8-11: Calculated Daytime Noise rating levels and potential significance – Worst-case scenario (Paul Hugo weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance			Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	C-1	45	40,5	46,0	6,6	Moderate	Temporary	Local	Possible	Low			6	1	2	2	18

Table 8-12: Calculated Daytime Noise rating levels and potential significance –Typical construction scenario (Paul Hugo weir)

	Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level calculated from the Model	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance			Magnitude / Intensity	Duration	Extent	Probability of Impact Occuring	Significance
Day	C-1	45	40	42,5	4,4	Low	Short-term	Local	Improbable	Low			4	2	2	1	8

9. SOUND MODEL IMAGES

Figure 9-1: Noise levels (modelled) Worst-case construction activities – Atlanta Weir Site

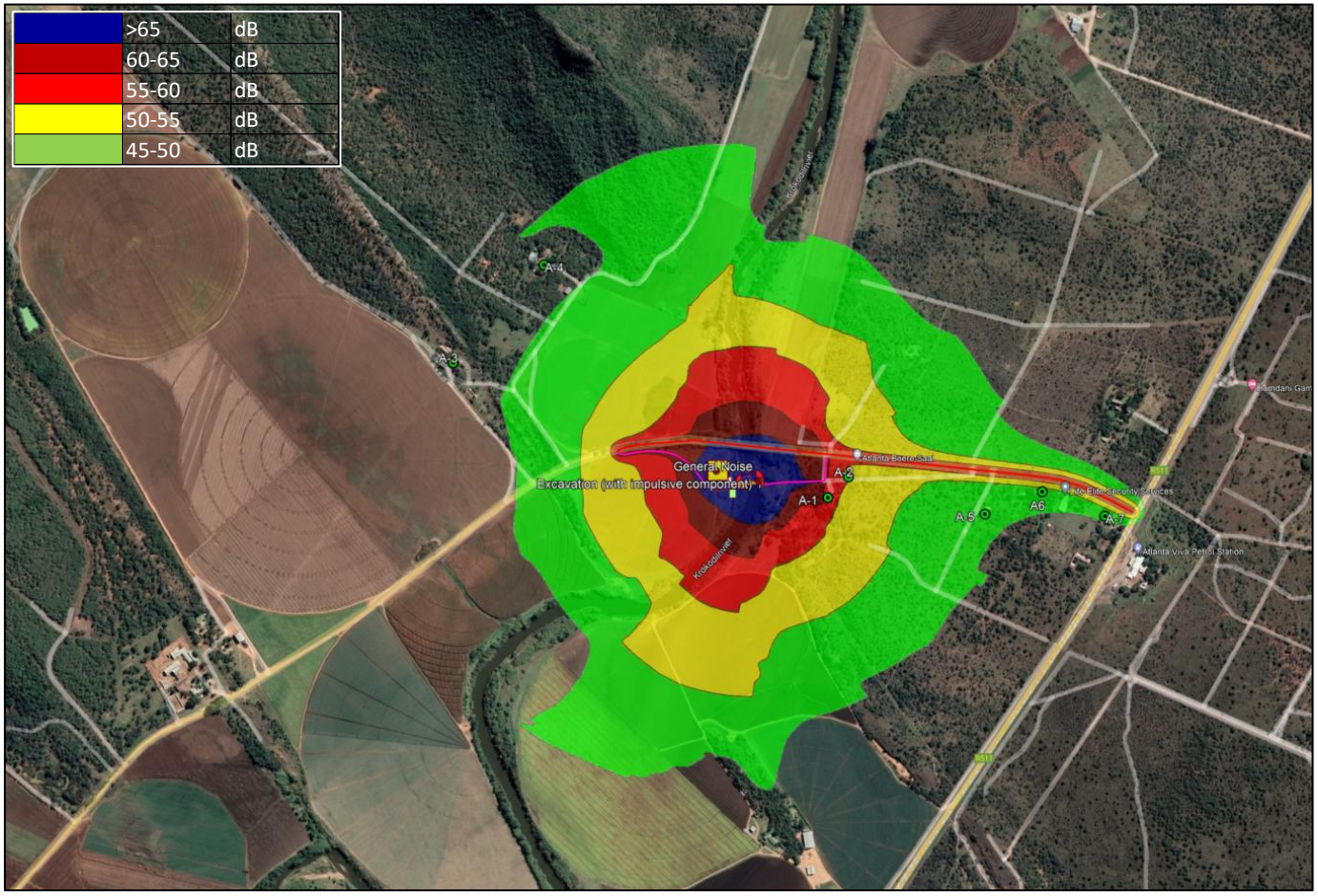


Figure 9-2: Noise levels (modelled) - Potential typical construction activities – Atlanta Weir Site

Figure 9-3: Noise levels (modelled) Worst-case construction activities – Beestekraal Weir Site

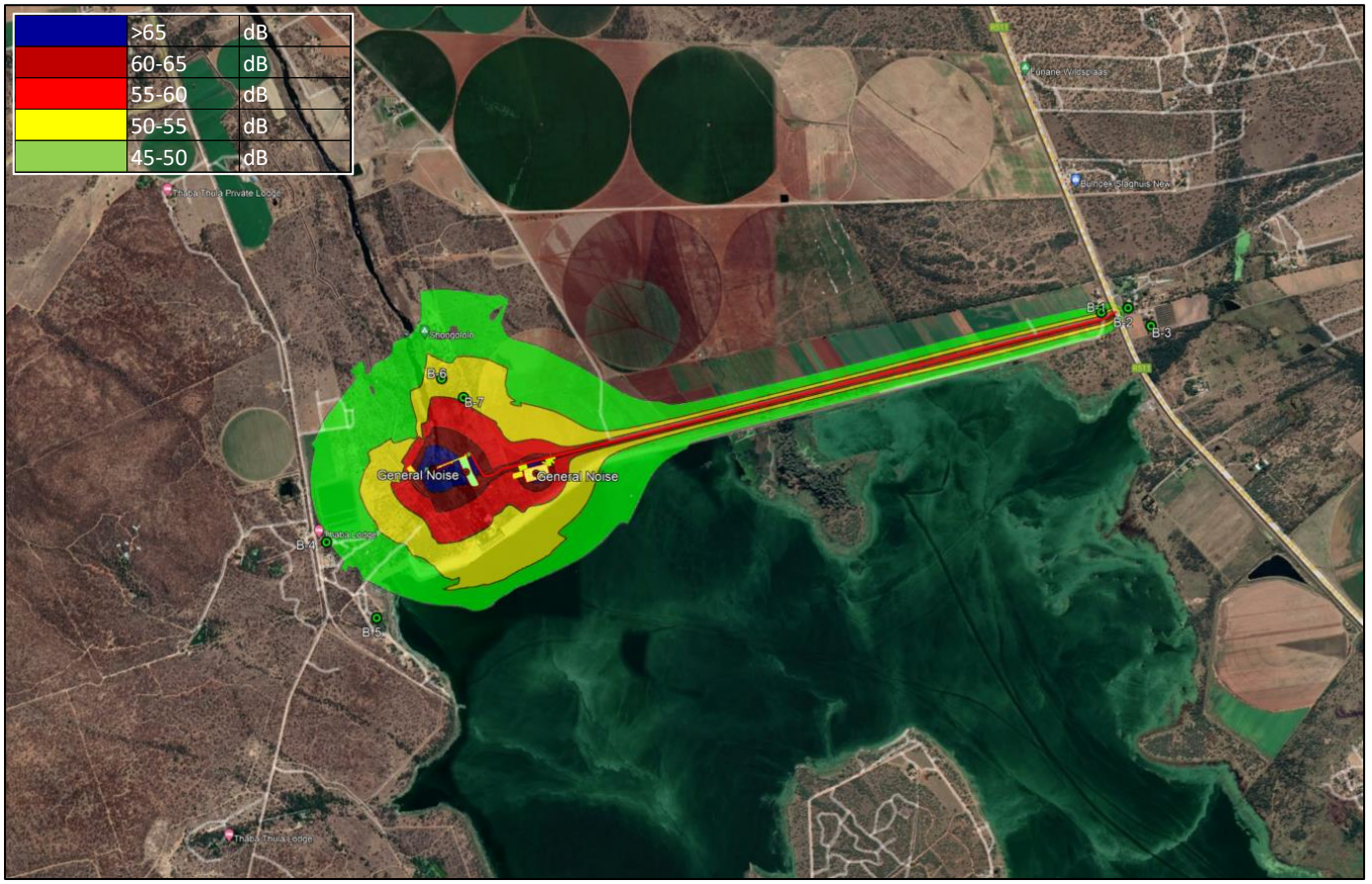


Figure 9-4: Noise levels (modelled) Potential typical construction activities – Beestekraal Weir Site

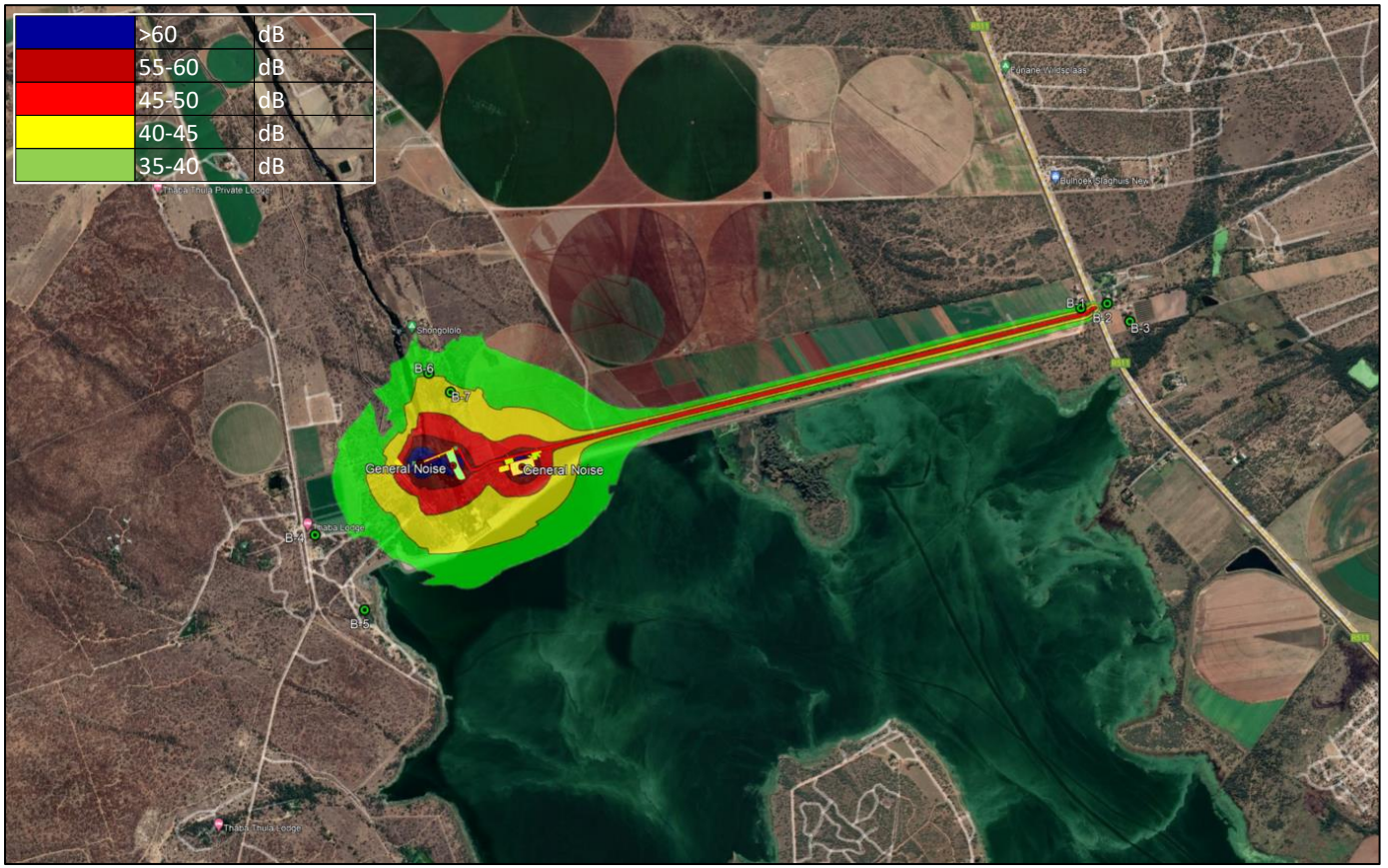


Figure 9-5: Noise levels (modelled) Worst-case construction activities - Paul Hugo Weir Site

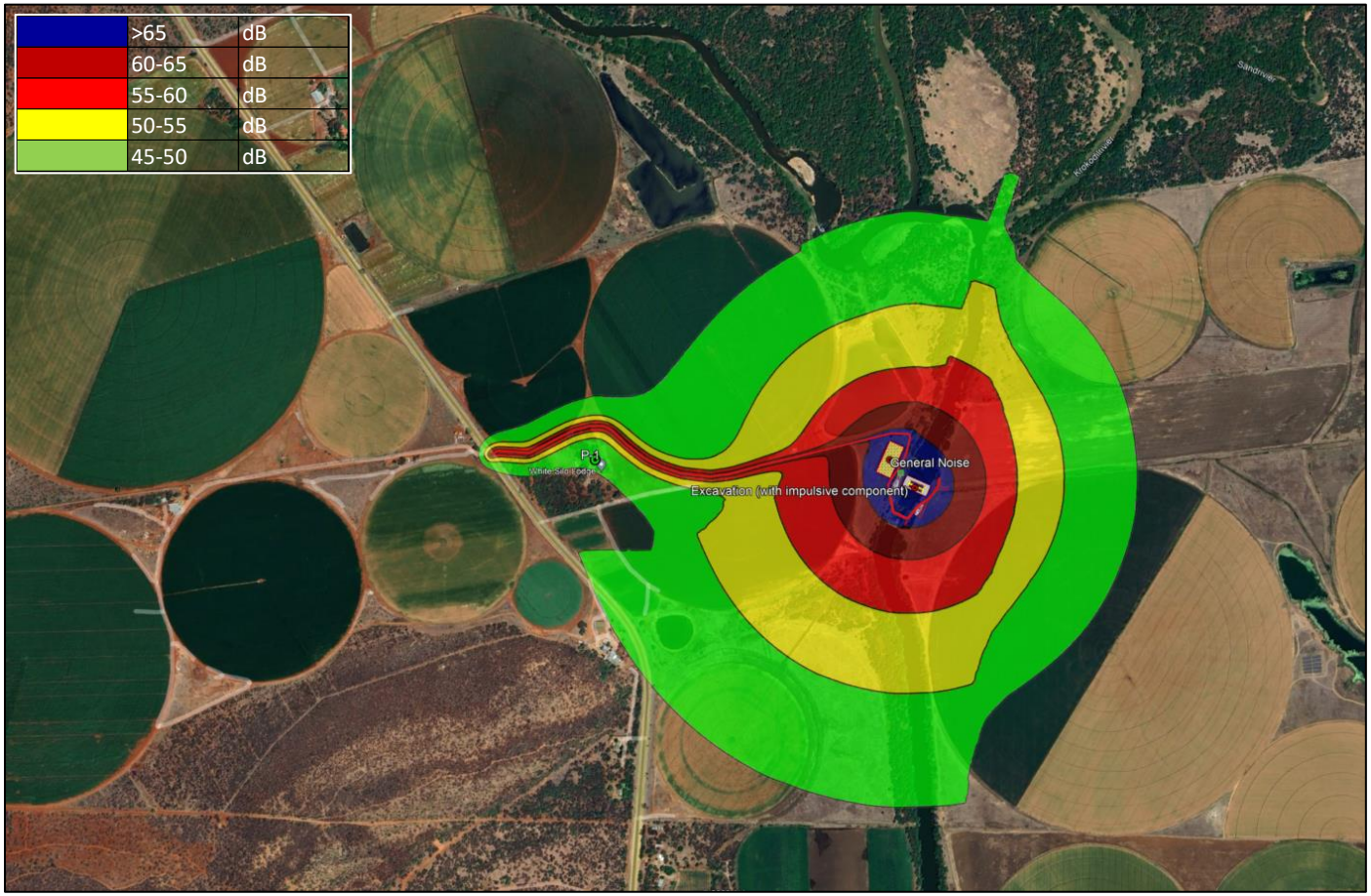
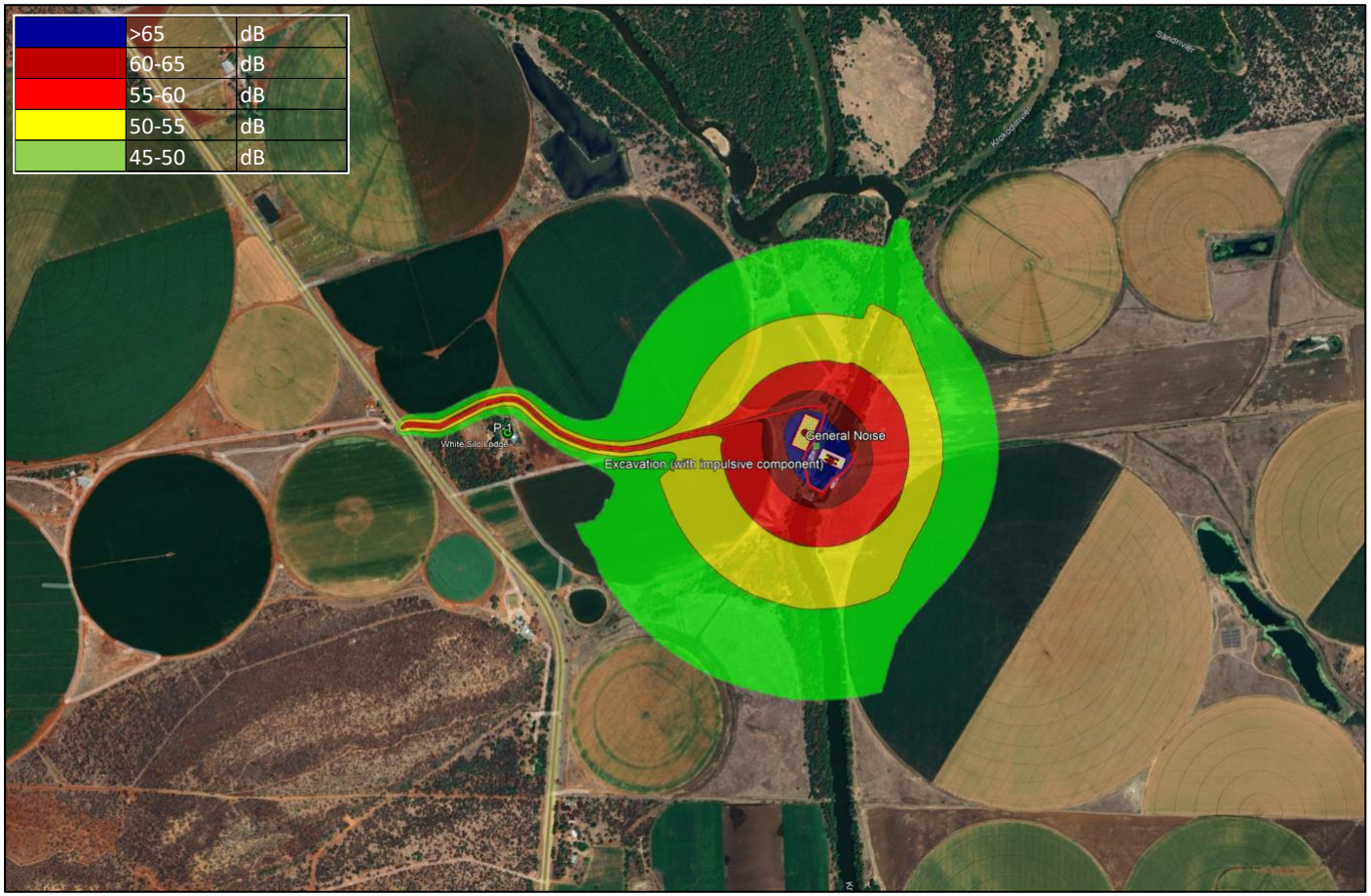


Figure 9-6: Noise levels (modelled) Potential typical construction activities - Paul Hugo Weir Site



10. MITIGATION OPTIONS

10.1 POTENTIAL NOISE MITIGATION MEASURES – *ATLANTA WEIR SITE*

While this assessment does determine a potential noise impact of a low to medium significance, it is well established that people's attitudes to noise can be influenced by their attitudes to the source or activity itself. Noise associated with a project will be accepted more readily by surrounding receptors if they consider that the project may benefit the, or that the developer or contractor is taking all possible measures to avoid unnecessary noise.

The attitude to the project, developer and contractor can also be improved through good community liaison and information distribution and the provision of a helpline to respond to queries or complaints.

As the noise modelling did consider a worst-case scenario, it is highly likely that the noise rating levels are over-estimated. It is therefore recommended that actual noise levels be measured during actual construction activities, together with discussing the actual noise levels with the closest NSR (NSR A-1 and A-2).

If NSR mention annoyance with noises from the project, it is critical to define the source of noise, which could be traffic noises, material handling noises or impulsive noises associated with rock breaking, drilling activities (if relevant). Mitigation must be designed and implemented depending on the source of noise, which could include:

- Reducing traffic speeds when passing NSR;
- Minimising traffic volumes early in the mornings and late in the afternoons, planning the delivery of material during the warmer periods of the day (lower air humidity and higher air temperature);
- Equipment should be maintained and fitted with the manufacturer recommended exhaust silencers and engine bay covers. Engine bays should be closed during operation;
- The applicant should consider the noise-sensitive environment and if possible, consider the sound power emission levels of the equipment and, if there are an option between similar equipment, select the one with the lowest sound power emission level;
- Making use of available material to develop temporary berms between the proposed weir and NSR A-1;
- The applicant should consider the use of white-noise reverse alarms on all mobile equipment; and,

10.2 POTENTIAL NOISE MITIGATION MEASURES – *BEESTEKRAAL WEIR SITE*

While this assessment does determine a potential noise impact of a low to medium significance, it is well established that people's attitudes to noise can be influenced by their attitudes to the source or activity itself. Noise associated with a project will be accepted more readily by surrounding receptors if they consider that the project may benefit the, or that the developer or contractor is taking all possible measures to avoid unnecessary noise.

The attitude to the project, developer and contractor can also be improved through good community liaison and information distribution and the provision of a helpline to respond to queries or complaints.

As the noise modelling did consider a worst-case scenario, it is highly likely that the noise rating levels are over-estimated. It is therefore recommended that actual noise levels be measured during actual construction activities, together with discussing the actual noise levels with the closest NSR (NSR B-6 and B-7).

If NSR mention annoyance with noises from the project, it is critical to define the source of noise, which could be traffic noises, material handling noises or impulsive noises associated with rock breaking, drilling activities (if relevant). Mitigation must be designed and implemented depending on the source of noise, which could include:

- Reducing traffic speeds when passing NSR;
- Minimising traffic volumes early in the mornings and late in the afternoons, planning the delivery of material during the warmer periods of the day (lower air humidity and higher air temperature);
- Equipment should be maintained and fitted with the manufacturer recommended exhaust silencers and engine bay covers. Engine bays should be closed during operation;
- The applicant should consider the noise-sensitive environment and if possible, consider the sound power emission levels of the equipment and, if there are an option between similar equipment, select the one with the lowest sound power emission level;
- Making use of available material to develop temporary berms between the proposed weir and NSR B-6/B-7;
- The applicant should consider the use of white-noise reverse alarms on all mobile equipment; and,

10.3 POTENTIAL NOISE MITIGATION MEASURES – *PAUL HUGO WEIR SITE*

While this assessment does determine a potential noise impact of medium significance, it might be due to the scenario investigated, as well as the strict EIA criteria used. It is well established that people's attitudes to noise can be influenced by their attitudes to the source or activity itself. Noise associated with a project will be accepted more readily by surrounding receptors if they consider that the project may benefit the, or that the developer or contractor is taking all possible measures to avoid unnecessary noise.

The potential significance of noise impacts during the construction phase however is low for construction activities at the Paul Hugo weir, and additional noise mitigation is not required.

11. CONCLUSIONS AND RECOMMENDATIONS

This Environmental Noise Impact Assessment (ENIA) covers the construction works related to the proposed Mokolo Crocodile River augmentation project.

The proposed activities have potential to raise the noise levels. These noises will be disturbing at times, but the noise levels can be reduced with mitigation. Even with mitigation measures in place, the projected noise levels may impact on the quality of living for the closest surrounding receptors.

The noise impacts (after mitigation) are expected to have a **LOW** significance at all three weir sites.

Mitigation measures were identified and proposed that may reduce the significance of the noise impact. As there are potential noise-sensitive receptors living within a close parameter from the activities, there will always be a risk of a noise impact.

With the correct implementation of mitigation measures and ongoing communication with the community, **the development of the proposed gauging weirs is acceptable from a noise impact perspective.**

Further investigations should include:

- A monthly noise monitoring campaign during the Construction Phase at each weir site.

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Anthropogenic	Human impact on the environment or anthropogenic impact on the environment includes impacts on biophysical environments, biodiversity and other resources
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.

Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g., sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Axle	Shaft connecting two wheels on either side of the vehicle. The wheels are forced to rotate at the same speed. Vehicles with independent wheels have 'stub axles' that do not connect the two wheels on either side of the vehicle.
Ballast	A layer of coarse stones supporting the sleepers.
Baseplate	A track component designed to hold the rail in place, usually with resilience to provide improved vibration isolation.
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 signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
dB(A)	Sound 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 thresholds of hearing. Decibels for sound levels in air are referenced to an atmospheric of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Echolocation	Echo locating animals emit calls out to the environment and listen to the echoes of those calls that return from various objects near them. They use these echoes to locate and identify the objects. Echolocation is used for navigation and for foraging (or hunting) in various environments.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.

Environmental 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 level measured continuously within a reference time interval *T*, which have the same mean-square sound as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast-reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there are 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 exist.
Grinding	A process for removing a thin layer of metal from the top of the rail head in order to remove roughness and/or to restore the correct profile. Special grinding trains are used for this.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound 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 (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.
Interburden	Material of any nature that lies between two or more bedded ore zones or mineral resource seams. Term is primarily used in surface mining
Joint rail	A connection between two lengths of rail, often held together by an arrangement of bolts and fishplates.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister

	of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
Locomotive	A powered vehicle used to draw or propel a train of carriages or wagons (as opposed to a multiple unit).
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.
Natural Sounds	Are sounds produced by natural sources in their normal soundscape.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.

Overburden	In mining and in archaeology, overburden (also called waste or spoil) is the material that lies above an area of economic or scientific interest. In mining, it is most commonly the rock, soil, and ecosystem that lies above a mineral resource seam or ore body
Pavement	Road surface or pavement is the durable surface material laid down on an area intended to sustain vehicular or foot traffic, such as a road or walkway.
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.
Rail head	The bulbous part at the top of the rail.
Rolling Stock	Rolling stock comprises all the vehicles that move on a railway. It usually includes both powered and unpowered vehicles, for example locomotives, railroad cars, coaches, and wagons.
ROM	The mineral resource delivered from the mine that reports to the processing or preparation plant is called run-of-mine, or ROM. This is the raw material for the plant and consists of mineral resource of interest, rocks, middling's, minerals and contamination
Shunting	Shunting, in railway operations, is the process of sorting items of rolling stock into complete train sets.
Railway Sidings	A siding, in rail terminology, is a low-speed track section distinct from a running line or through route such as a main line or branch line or spur. It may connect to through track or to other sidings at either end.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters.

	(2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound 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 Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound level to the reference sound level. International values for the reference sound 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).
Timbre	Timbre (also known as tone colour or tone quality) is the quality of the sound made by a particular voice or musical instrument.
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 (in the air brake) or atmospheric in the case of the vacuum brake.
Tone	Noise can be described as tonal if it contains a noticeable or discrete, continuous note. This includes noises such as hums, hisses, screeches, drones, etc. and any such subjective description is open to discussion and contradiction when reported.
Wagon	A freight-carrying vehicle.
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	Derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

CALIBRATION CERTIFICATES OF SLM & CALIBRATOR

sanas Calibration Laboratory
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1302

M AND N ACOUSTIC SERVICES (Pty) Ltd
Co. Reg. No: 2012/123238/07 VAT NO: 4300255876 BEE Status: Level 4
P.O. Box 61713, Pierre van Ryneveld, 0045
No. 15, Mustang Avenue
Pierre van Ryneveld, 0045
Tel: 012 689-2007 (076 920 3070) • Fax: 086 211 4690
E-mail: admin@mnacoustics.co.za
Website: www.mnacoustics.co.za

CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2023-AS-0252
ORGANISATION	RAYTEN ENGINEERING SOLUTION (PTY) LTD
ORGANISATION ADRESS	43 KAYBURNE AVENUE, RANDPARK RIDGE, RANDBURG, JOHANNESBURG, 2169
CALIBRATION OF	INTEGRATING SOUND LEVEL METER complete with built-in ⅓-OCTAVE/OCTAVE FILTER, ½" PRE-AMPLIFIER and ½" MICROPHONE
MANUFACTURERS	BSWA
MODEL NUMBERS	308, MA 231T and 231
SERIAL NUMBERS	589011, 580021 and 540958
DATE OF CALIBRATION	20 – 21 FEBRUARY 2023
RECOMMENDED DUE DATE	FEBRUARY 2024
PAGE NUMBER	PAGE 1 OF 6

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the number of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org

Calibrated by Calibration Technician:	K.L. MONTSHO	Clause 3.1, 3.2 & 3.4
Calibrated/Supervised by Calibration Technician:	W.S SIBANYONI	Clause 3.1 - 3.4
Authorized/Checked by SANAS Technical Signatory:	M. NAUDE	Date of Issue: 21 FEBRUARY 2023

Director: Marianka Naudé

CALIBRATION CERTIFICATE OF CALIBRATOR

sanas
Calibration Laboratory
148
1302

M AND N ACOUSTIC SERVICES (Pty) Ltd
Co. Reg. No: 2012/123338/07 VAT NO: 4300255878 BEE Status: Level 4
P.O. Box 61713, Pierre van Ryneveld, 0045
No. 15, Mustang Avenue
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Tel: 012 689-2007 / 076 320 2070 • Fax: 086 211 4690
E-mail: admin@mnacoustics.co.za
Website: www.mnacoustics.co.za

CERTIFICATE OF CONFORMANCE

CERTIFICATE NUMBER	2023-AS-0253
ORGANISATION	RAYTEN ENGINEERING SOLUTION (PTY) LTD
ORGANISATION ADDRESS	43 KAYBURNE AVENUE, RANDPARK RIDGE, RANDBURG, JOHANNESBURG, 2169
CALIBRATION OF	SOUND CALIBRATOR
MANUFACTURER	BSWA
MODEL NUMBER	CA 111
SERIAL NUMBER	580965
DATE OF CALIBRATION	21 FEBRUARY 2023
RECOMMENDED DUE DATE	FEBRUARY 2024
PAGE NUMBER	PAGE 1 OF 3

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Calibrated by:	Authorised/Checked by:	Date of Issue:
W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDE (SANAS TECHNICAL SIGNATORY)	21 FEBRUARY 2023

End Report