ENERTRAG South Africa (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the

proposed Hendrina Green Hydrogen and Ammonia Facility near Hendrina, Mpumalanga

Study done for:

Prepared by:

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EXECUTIVE SUMMARY

INTRODUCTION

Enviro-Acoustic Research cc was commissioned by ENERTRAG South Africa (Pty) Ltd (the applicant) to identify and assess the potential noise impact from the construction, operation and decommissioning of the proposed Hendrina Green Hydrogen and Ammonia Facility ("the Project") (and associated infrastructure) on the surrounding soundscape.

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

PROJECT DESCRIPTION

ENERTRAG SA proposes to develop the Hendrina Renewable Energy Complex, the complex comprises of five separate projects. The projects include two wind energy facilities, the associated grid infrastructure as well as a Green Hydrogen and Ammonia Facility. Each of these projects are being assessed separately, with this noise study specifically focusing on the green hydrogen and ammonia facility.

The production, storage and transport of hydrogen and ammonia is an industry undergoing in-depth research and developments. As a consequence, technological solutions are constantly being improved and changing, though conceptually the facility may comprise of the following main components:

- Water reservoir and treatment;
- Electrolyser;
- Air separation;
- Ammonia processing;
- Liquid air storage;
- Liquid ammonia storage;
- Hydrogen storage; and
- Other utilities, gantry loading area and associated infrastructure (access roads, electrical connections, security and access control, offices, etc.).

DESCRIPTION OF THE SURROUNDING LAND USE

Most dwellings featuring in the vicinity of the project focus area are scattered in a heterogeneous fashion, typical of a rural area. Croplands, animal husbandry and subsistence farming are predominant in the study area. There are a number of existing

and proposed coal mining activities in the vicinity of the Renewable Energy Complex (REC – referred to as the Project).

DESCRIPTION OF THE CLOSEST POTENTIAL NOISE SENSITIVE RECEPTORS

Potential noise-sensitive developments, receptors and communities ("NSR") were initially identified during the ENIA process for the Hendrina North and Hendrina South Wind Energy Facilities, with this report using the same numbering.

BASELINE SOUND LEVELS

Ambient (background) noise levels were measured during the week of 30 July to 6 August 2021 in accordance with the South African National Standard SANS 10103:2008, with the ambient sound levels measured at two different locations.

The two measurement locations had different soundscapes, with the one location being very quiet, being located away from typical human habitation, animals or vegetation, with the second location within 300 m of the R542 road. The R542 is used as a coal transport route and road traffic noises were significant at the second location.

Based on the measured ambient sound levels it is concluded that ambient sound levels are expected to be low and would be typical of a rural noise district, excluding locations up to an estimated distance of 1,000 m from the R542 road. The acceptable zone sound level (noise rating level) during low and no-wind conditions would be typical of a rural noise district, e.g.:

- **45 dBA for the daytime period;** and,
- **35 dBA for the night-time period**.

ACCEPTABLE NOISE LIMITS

The National Noise Control Regulations ("NCR") defines a "**disturbing noise**" as the 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. Accepting that the sound levels in the area may be typical of a rural noise district, the following noise limits are recommended:

- **52 dBA for the daytime period;** and,
- **42 dBA for the night-time period**.

FINDINGS

This study considers the potential noise impact on the surrounding environment due to the construction, operation and future decommissioning activities associated with the Project. It makes use of conceptual scenarios to develop noise propagation models to estimate

potential noise levels. Considering the ambient sound levels measured onsite, the proposed noise limits as well as the calculated noise levels, it was determined that the significance of the potential noise impacts, without mitigation, would be:

- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 1);
- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 2);
- of a **low significance** relating to potential road construction activity noises (leading to site alternative location 3);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 1);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 2);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 3);
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 at night;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 at night;
- of a **low significance** relating to potential infrastructure construction activity noises at site alternative location 3 at night;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 2 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 at night;
- of a **very low significance** relating to potential operational activity noises at site alternative location 2 at night; and

- of a **low significance** relating to potential operational activity noises at site alternative location 3 at night.

Potential cumulative noise impacts will be insignificant, resulting in a noise impact of a low significance for both the construction and operational phases.

MANAGEMENT & MITIGATION OF NOISE IMPACT

The significance of noise during the construction phase may have a noise impact of **very low** and of a **low** significance for all site location alternatives. The potential noise impact mainly relates to construction traffic passing close to NSR and daytime noise levels may exceed the recommended daytime noise limit of 52 dBA. Noises from passing traffic may annoy NSR. Potential measures that may reduce the probability of annoyance and potential complaints include:

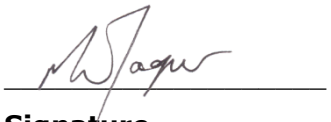
- Community participation, with the community notified of construction activities, the duration of the activities and potential impacts on them;
- Only permitting construction traffic during the daytime period; and
- Including noise as an environmental component in Health and Safety Induction training to employees, contractors and sub-contractors.

The significance of noise during the operation phase is **low** to **very low** for all alternative location options and additional mitigation measures are not required.

RECOMMENDATIONS

Considering the **low** to **very low** significance of the potential noise impacts (inclusive of cumulative impacts) for the proposed project and associated infrastructure, it is recommended that the project be authorized. In terms of acoustics, site alternative location 1 or 2 is preferred above location 3.

No further noise studies or noise measurements are required, subject that potential noise complaints be investigated (which may include additional noise level measurements).



Signature
Morné de Jager
2023 – 03 - 13

Report should be sited as:

De Jager, M (2023). "*Environmental Noise Impact Assessment for the Proposed Hendrina Green Hydrogen and Ammonia Facility near Hendrina, Mpumalanga*", Enviro-Acoustic Research cc, Pretoria

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ENERTRAG South Africa (Pty) Ltd

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WSP-EHGHAF/ENIA/202301-Rev 0

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GLOSSARY OF ABBREVIATIONS

ADT	Articulated Dump Trucks
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BESS	Battery Energy Storage System
DEM	Digital Elevation Model
DFFE	Department of Forestry, Fisheries and the Environment
EAP	Environmental Assessment Practitioner
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EHS	Environmental Health and Safety
EMPr	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
ENM	Environmental Noise Monitoring
ENPAT	Environmental Potential Atlas for South Africa
ETSU	Energy Technology Support Unit
EPs	Equator Principles
EPFIs	Equator Principles Financial Institutions
FEL	Front-end Loader
GHAF	Green Hydrogen and Ammonia Facility
GN	Government Notice

GNR	Government Notice Regulation
HNI	House Not Inhabited
I&APs	Interested and Affected Parties
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
LAN	Local Authority Notice
METI	Ministry of Economy, Trade, and Industry
NA	No Access
NASA	National Aeronautical and Space Administration
NEMA	National Environmental Management Act
NCR	Noise Control Regulations
NSR	Noise-sensitive Receptor
PPP	Public Participation Process
PV	Photo-Voltaic
REC	Renewable Energy Complex
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Level
SR	Significance Rating
TLB	Tractor-Loader-Backhoe (also referred to as a backhoe)
UTM	Universal Transverse Mercator
WHO	World Health Organization
WF/WEF	Wind Farm / Wind Energy Facility
WIN	Wind Induced Noises
WTG	Wind Turbine Generator
WTN	Wind Turbine Noise

GLOSSARY OF UNITS

^{o}C	Degrees Celsius (measurement of temperature)
dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)

km	Kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)
pW	pico Watt (10^{-12}) (measurement of power – sound power in air)
µPa	Micro pascal (measurement of pressure – in air in this document)

1 CHECKLIST: GG43110 MINIMUM REQUIREMENTS

The National Web based Environmental Screening Tool[1] was used to screen the proposed site (see **Figure 2-7** for the regional location) for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site location illustrated in **Figure 2-2**.

A screening report was developed for "*Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions => Emissions*", with the report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization (EA) documentation.

The potential noise sensitive areas layer is not included in the above-mentioned categories, but was obtained from the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the noise sensitive areas illustrated on **Figure 2-7**.

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

Clause	Requirement	Comment / Reference
2.3.1	Current ambient sound levels recorded at relevant locations over a minimum of two nights and that provide a representative measurement of the ambient noise climate, with each sample being a minimum of ten minutes and taken at two different times of the night on each night, in order to record typical ambient sound levels at these different times of night	Sections 4.1, 4.2 and 4.3
2.3.2	Records of the approximate wind speed at the time of the measurement	Section 4.3
2.3.3	Mapped distance of the receiver from the proposed development that is the noise source	Section 2.3.6 and 9
2.3.4	Discussion on temporal aspects of baseline ambient conditions	Section 4.1
2.4.1	Characterization and determination of noise emissions from the noise source, where characterization could include types of noise, frequency, content, vibration and temporal aspects	Table 5-2, Table 5-3 and Table 5-1

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

2.4.2	Projected total noise levels and changes in noise levels as a result of the construction, commissioning and operation of the proposed development for the nearest receptors using industry accepted models and forecasts	Section 9
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	Appendix A
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Appendix C
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	See section 4
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	See section 4.1
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	See Figure 2-2
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Site development limited to wind resource
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	See section 13
2.5.8	any conditions to which this statement is subjected	See section 8.6
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	Site development limited to the location of the wind resource
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	Site development limited to the location of the wind resource
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	See section 11 and 12
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	See section 8

2 INTRODUCTION

2.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was commissioned by ENERTRAG South Africa (Pty) Ltd (the applicant) to identify and assess the potential noise impact from the construction, operation and decommissioning of the proposed Hendrina Green Hydrogen and Ammonia Facility ("the Project") (and associated infrastructure) on the surrounding soundscape.

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

This study considered local regulations and both local and international guidelines, using the terms of reference ("ToR") as proposed by SANS 10328:2008 for a comprehensive Environmental Noise Impact Assessment ("ENIA") and as proposed by the requirements specified in the Assessment Protocol for Noise that were published on 20 March 2020, in Government Gazette 43110, GN 320. The study also considers the noise limits as proposed by the International Finance Corporation ("IFC") which is based on studies completed by the World Health Organization ("WHO").

2.2 BRIEF PROJECT DESCRIPTION

ENERTRAG SA proposes to develop the Hendrina Renewable Energy Complex, the complex comprises of five separate projects. The projects are:

- Hendrina North Wind Energy Facility (up to 200MW) over 3600ha;
- Hendrina South Wind Energy Facility (up to 200MW) over 2900ha;
- Hendrina North Grid Infrastructure (up to 275kV) – 15km;
- Hendrina South Grid Infrastructure (up to 275kV) – 16km;
- Green Hydrogen and Ammonia Facility (up to 25ha).

Each of these projects are being assessed separately, as part of the Complex development, and involve the undertaking of Listed Activities identified in the Environmental Impact Assessment ("EIA") Regulations, 2014 (as amended) and as such require an Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA") before being undertaken.

This noise study pertains specifically to the green hydrogen and ammonia facility, with the regional location presented in **Figure 2-2**.

The production, storage and transport of hydrogen and ammonia is an industry undergoing in-depth research and developments. As a consequence, technological solutions are constantly being improved and changing, though conceptually the facility may comprise of the following main components (see also **Figure 2-1**):

- Water reservoir and treatment;
- Electrolyser;
- Air separation;
- Ammonia processing;
- Liquid air storage;
- Liquid ammonia storage;
- Hydrogen storage; and
- Other utilities, gantry loading area and associated infrastructure (access roads, electrical connections, security and access control, offices, etc.).

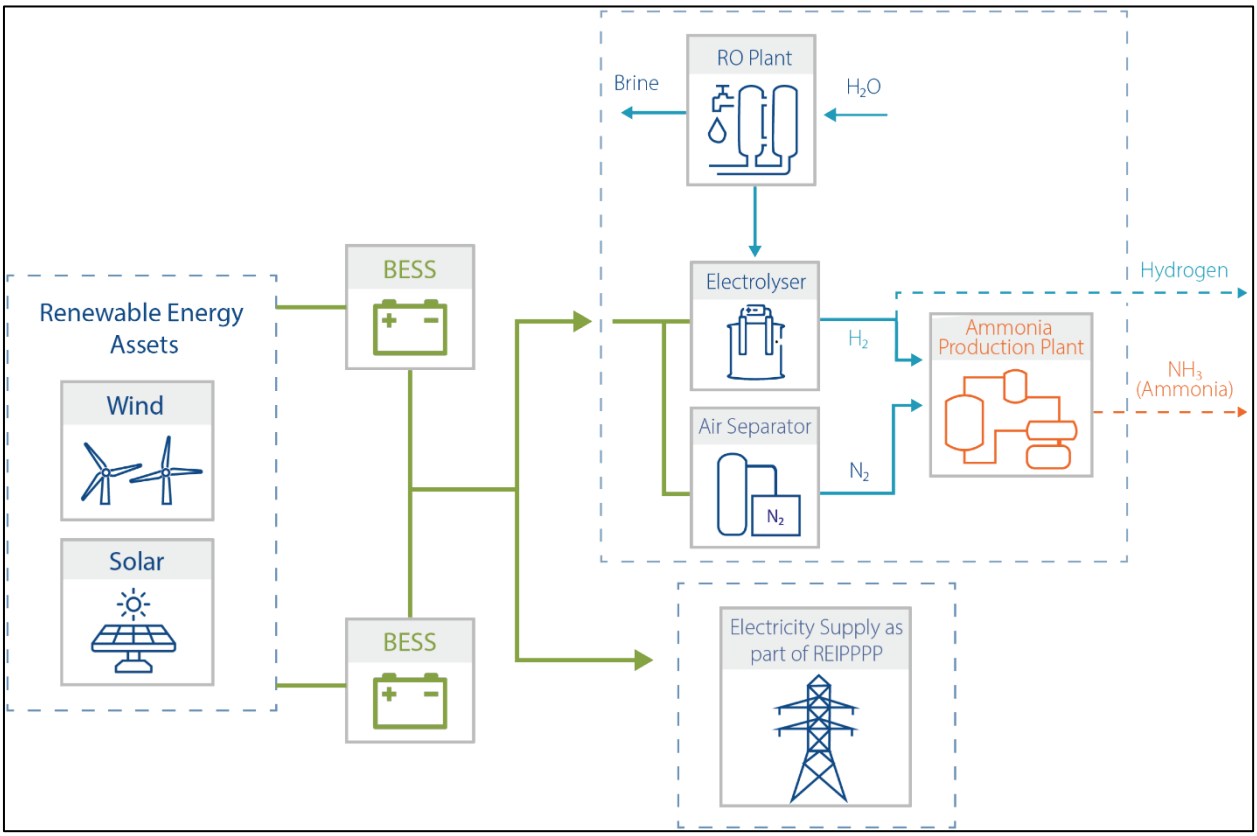

Figure 2-1: Conceptual green hydrogen and ammonia process flow

2.3 STUDY AREA

The study area falls within the Steve Tshwete Local Municipality (located in the Nkangala District Municipality), Mpumalanga province. The Steve Tshwete Local Municipality did publish

Noise By-Laws in August 2021 (see **section 3.1.1**). The study area is a conceptual area up to 2,000 m from all potential project infrastructure, defined as the project focus area ("PFA") in this report. The PFA is further described in terms of environmental components that may contribute to or change the sound character in the area.

2.3.1 Topography

The Environmental Potential Atlas of South Africa ("ENPAT") [**44**] describes the topography as *"slightly to moderately irregular undulating plains and hills"*. The project is situated at approximately 1,600 meters above sea level (mamsl). There are little natural features that could act as noise barriers considering practical distances at which sound propagates.

2.3.2 Surrounding Land Use

Most dwellings featuring in the vicinity of the project focus area are scattered in a heterogeneous fashion, typical of a rural area. Croplands, animal husbandry and subsistence farming are predominant in the study area. There are a number of existing and proposed coal mining activities to the west, south-west and south of the PFAs.

2.3.3 Transportation Networks

There are no roads of acoustic significance close to the proposed facilities.

2.3.4 Other industries and mines

There are a number of coal mines within 10 km from the project focus area, with the Hendrina North Wind Energy Facility ("WEF") and Hendrina South WEF located close to the proposed GHAF. These activities may increase cumulative noise levels in the area, though this study will only consider the potential effect of cumulative noises relating to the operations from the Hendrina South WEF, as noises from mining activities are not well defined in the vicinity of the project area.

2.3.5 Ground conditions and vegetation

The area falls within the Grassland biome, with the vegetation type reported as Eastern Highveld Grassland. The natural veldt has been impacted significantly due to anthropogenic activities. Most of the surface area is well vegetated with (seasonal) crops, grasses, shrubs, sedges and trees.

Taking into consideration available information it is the opinion of the author that the ground conditions (when considering acoustic propagation on a ground surface) can be classified as medium. A ground surface factor of 50% hard ground will be used.

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

2.3.6 Sensitive Receptors

Potential noise-sensitive developments, receptors and communities ("NSR") were initially identified during the ENIA process for the Hendrina North and Hendrina South WEFs (de Jager, 2022[a]; de Jager, 2022[b]), with this report using the same numbering. These receptors[2] are highlighted in **Figure 2-4** (site alternative option 1), **Figure 2-5** (site alternative option 2) and **Figure 2-6** (site alternative option 3). Also indicated on these figures are generalized 200, 500, 1 000 and 2 000 m buffer zones. Generally, noises from typical industrial projects:

- Could be significant within 200 m, with NSR[3] staying within 200m be subject to noises at a potentially sufficient level to be considered disturbing;
- Could be high up to a distance of 500 m from project infrastructure, with NSR potentially reporting the noise level to be annoying during quiet times;
- Could be audible at a distance of approximately 1,000m from project infrastructure, though the noise level is unlikely to be considered disturbing or annoying;
- Might be audible up to a distance of 2,000m at night during quiet periods. The noise level would be of a low concern at distanced greater than 2,000m (the PFA).

It should be noted that NSR 29 represents a caravan (**Figure 2-4**). There was no access to the site and the NSR is assumed noise-sensitive, even though the caravan may be moved in the future. Structures at other NSR are used for residential purposes.

2.4 ENVIRONMENTAL SENSITIVITY – NOISE THEME

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool[4].

Potential noise-sensitive areas with a "very high" sensitivity were obtained from the online screening tool using the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the potential noise-sensitive areas illustrated on **Figure 2-7** (site alternative option 1), **Figure 2-8** (site alternative option 2) and **Figure 2-9** (site alternative option 3).

[2] Confirmed as residential activities during the site visit
[3] Depending on the size of the project as well as the specific sound power emission levels of equipment and activities
[4] https://screening.environment.gov.za/screeningtool/#/pages/welcome

The screening report generated for the category "*Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions => Emissions"* does stipulate:

- that a Noise Specialist Study should be appended to the EIA, and
- that the GNR320 Assessment Protocol be followed when doing the noise impact assessment.

2.5 AVAILABLE INFORMATION

The author has completed a number of noise studies in the direct vicinity of the Project (see **Table 2-1** below), and the noise impact assessments as well as ambient sound level measurements collected are available.

Table 2-1: Available Reports/information

Date	Report/source
2018	De Jager, M. (2018): "*Environmental Noise Impact Assessment for the Proposed Ventilation Fan on the Farm Uitgedacht near Bethal, Mpumalanga*". Enviro-Acoustic Research CC, Pretoria
2019	De Jager, M. (2019): "*Environmental Noise Impact Assessment for the Proposed Dunbar Coal Project West of Hendrina, Mpumalanga*". Enviro-Acoustic Research CC, Pretoria
2019	De Jager, M. (2019): "*Blasting Impact Assessment for the Proposed Dunbar Coal Project West of Hendrina, Mpumalanga Province*". Enviro-Acoustic Research CC, Pretoria
2021	*De Jager, M* (2021). "*Noise Study for Environmental Impact Assessment for the Proposed Sudor Coal Project North of Bethal, Mpumalanga Province*", Enviro-Acoustic Research cc, Pretoria
2021	De Jager, M. 2021: *"Acoustical Measurement Report for Exxaro Coal Central Forzando South Operation, Mpumalanga".* Enviro-Acoustic Research cc, Pretoria
2022	De Jager, M. 2022: "*Environmental Noise Impact Assessment for the Proposed Hendrina North Wind Energy Facility and Associated Infrastructure near Hendrina, Mpumalanga".* Enviro-Acoustic Research cc, Pretoria
2022	De Jager, M. 2022: "*Environmental Noise Impact Assessment for the Proposed Hendrina South Wind Energy Facility and Associated Infrastructure near Hendrina, Mpumalanga".* Enviro-Acoustic Research cc, Pretoria

2.6 COMMENTS RECEIVED DURING THE EIA

The author is not aware of any comments raised by the authorities or interested and affected parties at the date this report was compiled. It should however be noted that the Noise

Assessment is part of a suite of studies commissioned by the Environmental Assessment Practitioner (EAP), who is undertaking the Public Participation Process (PPP) as part of the EIA. Comments regarding noise may only be available during the EIA and PPP process.

2.7 TERMS OF REFERENCE

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

- It was identified as an environmental theme needing further investigation in terms of (i.t.o.) the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- If an industry is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);
- If a wind farm (wind turbines - SANS 10328:2008 [5.4 (i)]) or a source of low-frequency noise (such as cooling or ventilation fans - SANS 10328:2008 [5.4 (l)]) is to be established within 2,000 m from a potential noise sensitive development *or vice versa*;
- 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 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;

2.7.1 Requirements as per Government Gazette 43110 of March 2020

The Department of Forestry, Fisheries and Environment (DFFE) also promulgated Regulation 320, dated 20 March 2020 as published in Government Gazette No. 43110. The Procedures for the Assessment and 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 would be applicable to this project.

This regulation defines the requirements for undertaking a site sensitivity verification, specialist assessment and the minimum report content requirements for environmental impact where a specialist assessment is required but no protocol has been prescribed. It requires that the current land use be considered using the national web based environmental screening tool to confirm the site sensitivity available at: https://screening.environment.gov.za.

If an applicant intending to undertake an activity identified in the scope of this protocol for which a specialist assessment has been identified on the screening tool on a site identified as being of:

- "very high" sensitivity for noise, must submit a Noise Specialist Assessment; or
- "low" sensitivity for noise, must submit a Noise Compliance Statement.

On a site where 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 a "low" sensitivity, a Noise Compliance Statement must be submitted.

On a site where 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 a "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 which case a compliance statement applies. In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

The minimum requirements for a Noise Specialist Study (i.t.o. GNR 320 of 2020) are also covered in **Section 1** in the form of a checklist.

This assessment will be comprehensive and a Noise Specialist Assessment will be submitted because there are a number of potential noise-sensitive receptors living within 2 000 m from the proposed Project.

2.7.2 Requirements as per South African National Standards (SANS)

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

In addition, SANS 10328:2008 (Edition 3) [**34**] 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 (see **section 2.1**);
b) a brief description of the planned development or the changes that are being considered (see **section 2.2**);
c) a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements (see **section 2.3 and 4**);
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 (see **section 5 and 7**);
e) the identified noise sources that were not taken into account and the reasons as to why they were not investigated (see **section 5, 7 and 8**);
f) the identified noise-sensitive developments and the noise impact on them (see **section 2.3.6, 9 and 10**);
g) where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics (see **section 8**);
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 (see **section 7 and 8**);
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 (see **section 4, 7 and 9**);
j) the location of measuring or calculating points in a sketch or on a map (see **sections 2.3** and **9**);
k) quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made (see **section 9**);
l) alternatives that were considered and the results of those that were investigated (see **section 10.4**);
m) a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation (see **section 2.6**);

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 (see **section 2.6**);
o) conclusions that were reached (see **section 13**);
p) proposed recommendations (see **section 13**);
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 (see **section 11 and 13**); 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 (see **section 13**).

Figure 2-2: Regional Location of the proposed Hendrina project

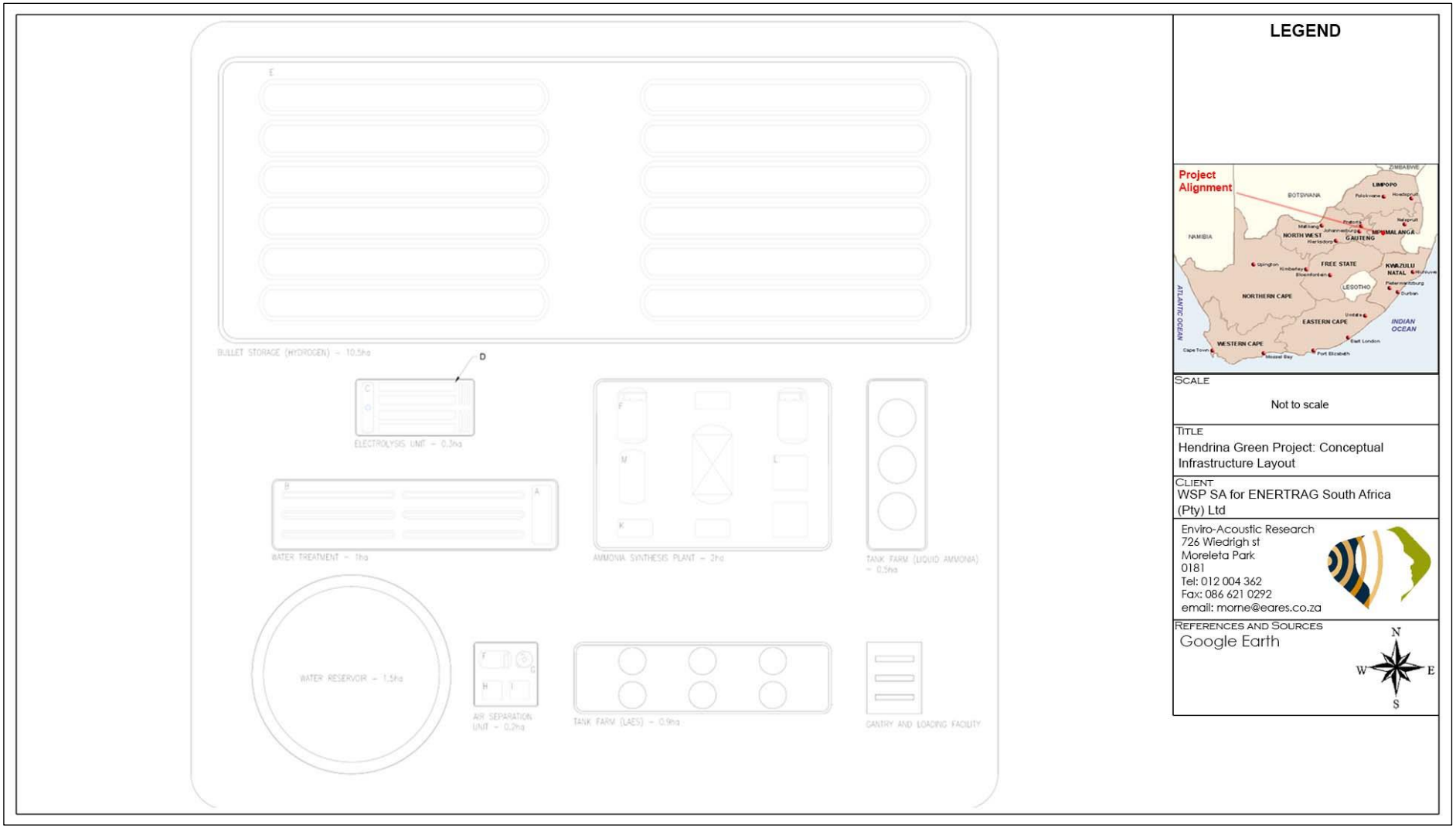

Figure 2-3: Conceptual Project Infrastructure Layout

Figure 2-4: Study area and potential noise-sensitive receptors close to the project, alternative site option 1

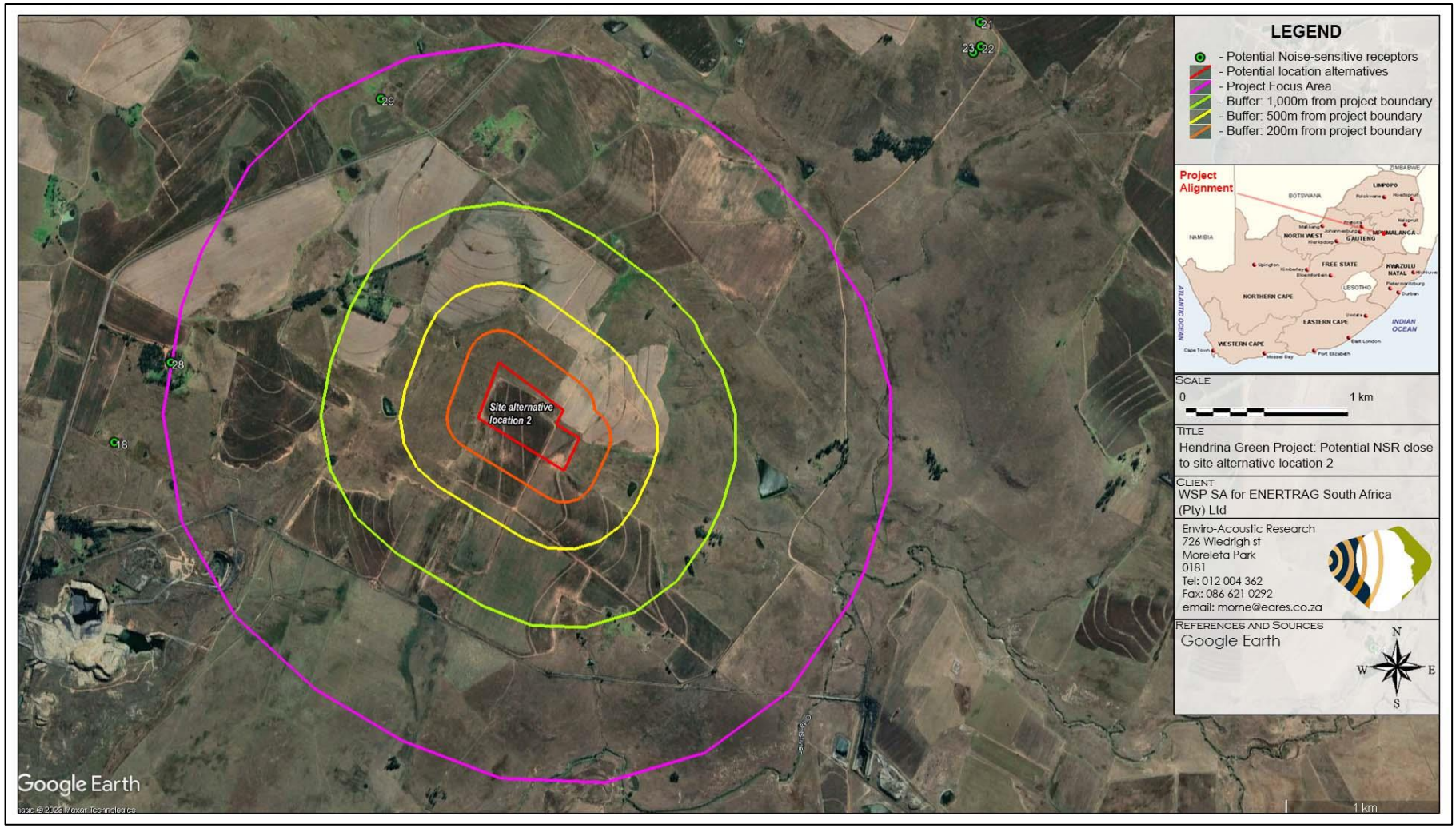

Figure 2-5: Study area and potential noise-sensitive receptors close to the project, alternative site option 2

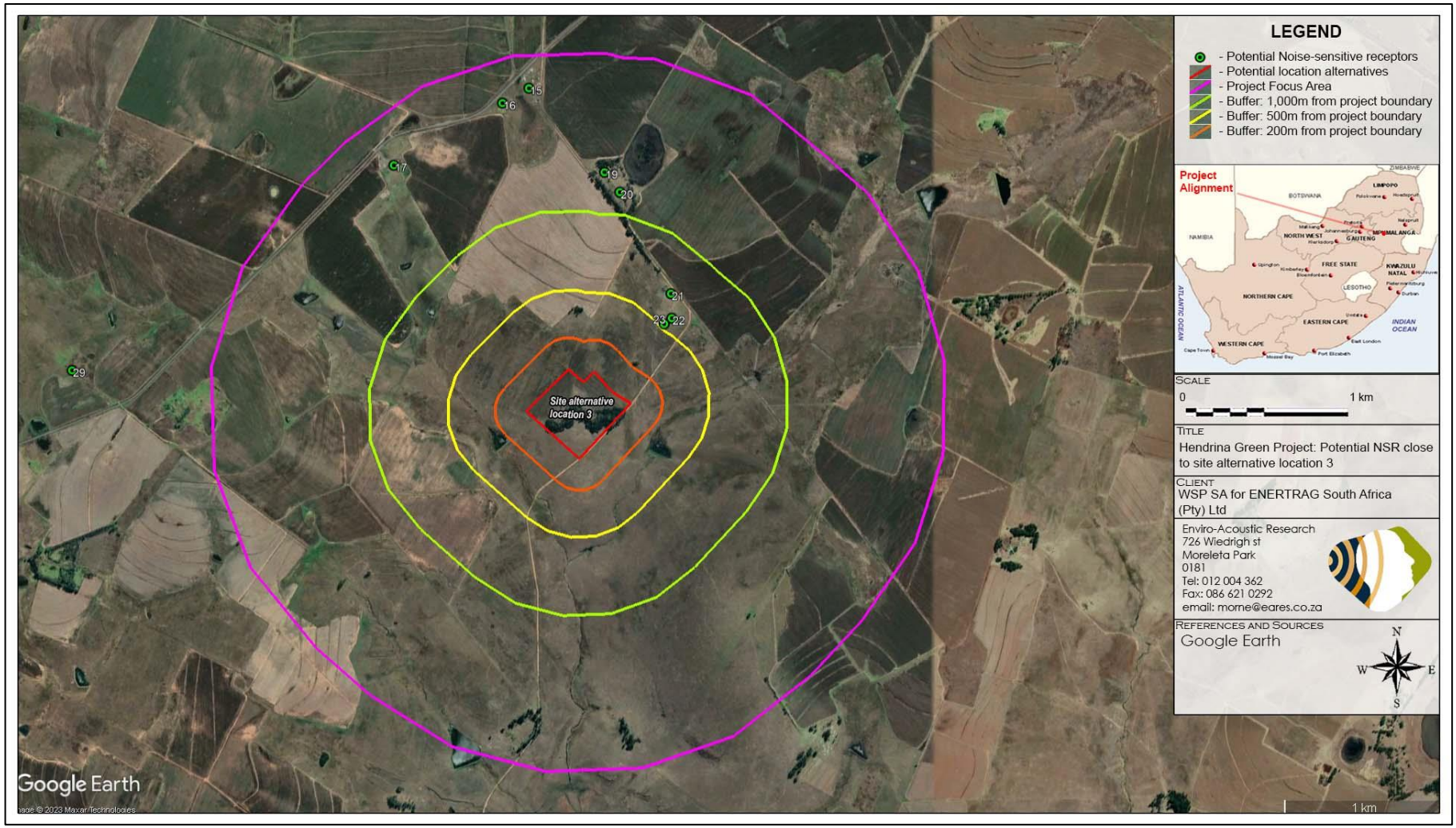

Figure 2-6: Study area and potential noise-sensitive receptors close to the project, alternative site option 3

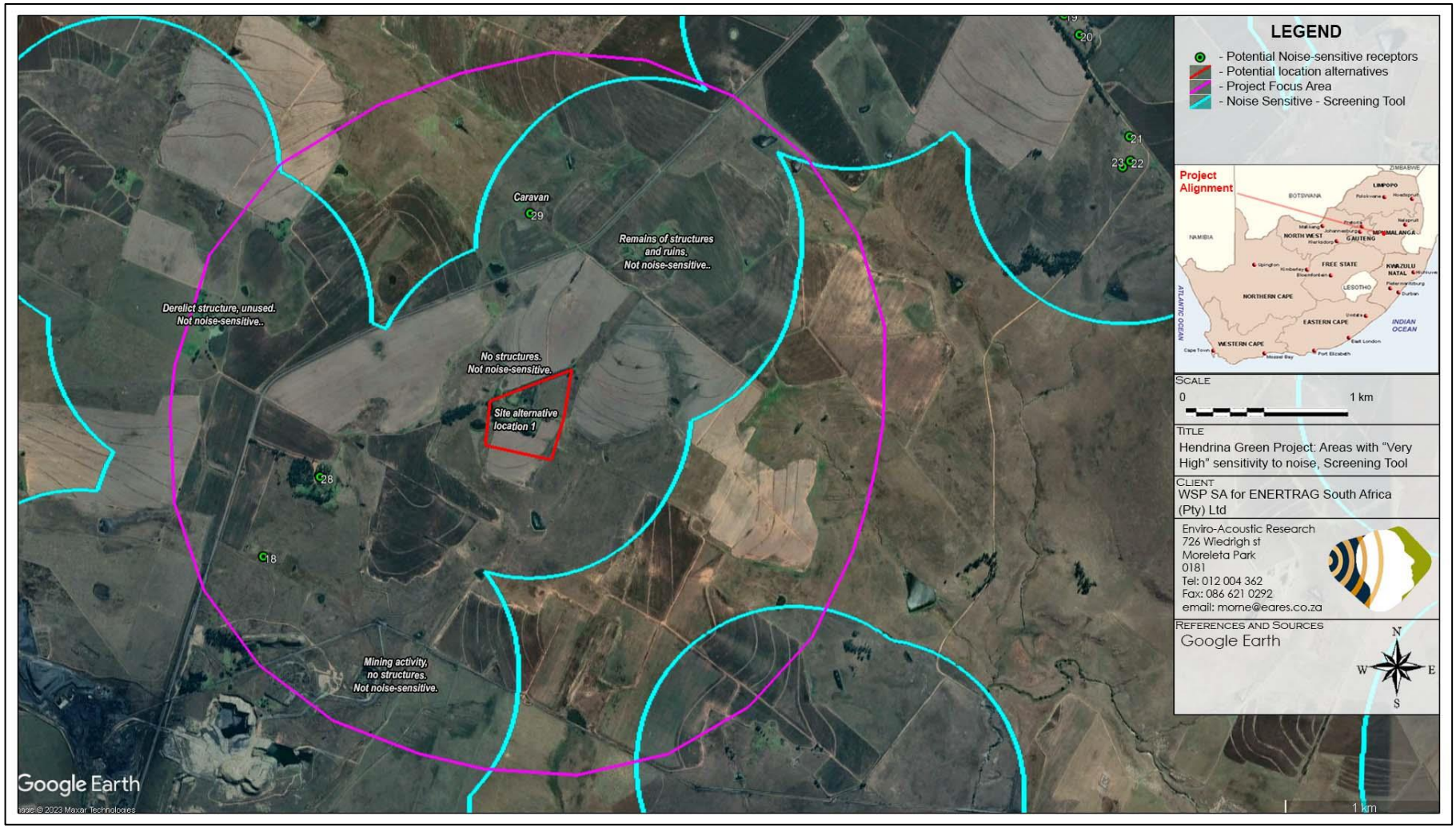

Figure 2-7: Study area and potential noise-sensitive areas identified by the online screening tool, site option 1

Figure 2-8: Study area and potential noise-sensitive areas identified by the online screening tool, site option 2

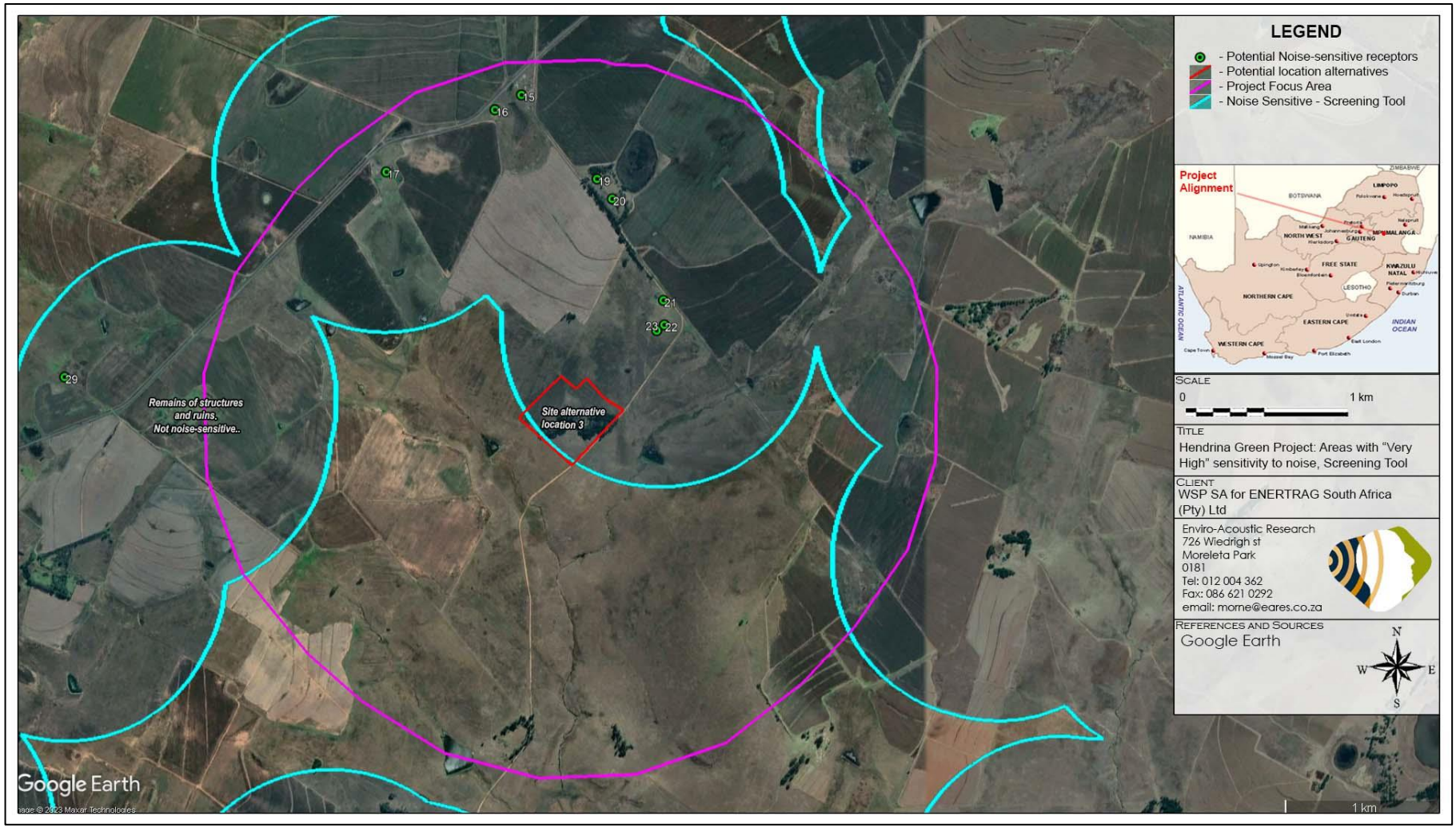

Figure 2-9: Study area and potential noise-sensitive areas identified by the online screening tool, site option 3

3 LEGAL CONTEXT, POLICIES AND GUIDELINES

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

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate in the particular circumstances. The subjectivity of this approach can be problematic, which has led to the development of noise standards (see **Section 3.4**).

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

3.1.1 Steve Tshwete Local Municipal Noise By-Laws, 2021

The Steve Tshwete Local Municipality promulgated Noise By-Laws as Local Authority Notice (LAN) 93 of 2021 in the Provincial Gazette No. 3287 (13 August 2021), as provided in Section 156 and 162 of the Constitution (the By-law) .

This by-law defines:
"**ambient sound level"** to mean:
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 meter was put into operation.

"**Disturbing Noise"** to mean:
A noise level that causes the ambient noise level to rise above the maximum designated sound levels.

The by-law defines "**Maximum designated sound levels"** in Part 1 of the Schedule to the by-law, highlighted in **Table 3-1**.

With the By-law only recently published, it is uncertain how the different facilities will be identified (Column 1 of **Table 3-1**) and how Residential buildings located within agricultural areas will be classified. The by-laws in addition does not address how proposed developments, that may influence the designated sound levels, will be authorized. It is

assumed that the Developer will have to apply for exemption in terms of regulation 10 of the By-Law from the Steve Tshwete Local Municipality.

Table 3-1: Maximum Permissible Designated Sound Levels for General Environment

COLUMN 1	COLUMN 2	
FACILITY	NOISE LIMITS dB(A) (L_{eq})	
	DAY	NIGHT
A. Any building used as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites.	45	35
B. Residential buildings.	50	35
C. Mixed residential (with some commercial and entertainment)	55	45
D. Residential + industry or small-scale production + commerce.	60	50
E. Industrial.	70	60

3.2 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environment, Forestry and Fisheries to make regulations regarding noise, among other concerns. See also **section 3.2.1**.

3.2.1 National Noise Control Regulations (GN R154 of 1992)

The Noise Control Regulations (NCR) were promulgated in terms of section 25 of the ECA. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial noise control regulations exist in the Free State, Gauteng and Western Cape provinces, but not in the Mpumalanga Province. The National Noise Control Regulations will be in effect in Mpumalanga, though it should be noted that By-Laws was published for the Steve Tshwete Local Municipality (see **section 3.1.1**).

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

"**controlled area**" as:

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

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, 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[5] 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;

[5] When comparing the results of a measurement (minimum duration of 10 minutes) without the noise under investigation with a similar measurement with the noise present.

(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."

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

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent

noise pollution occurring. NEMA sets out measures, which may be regarded as reasonable. They include the following measures:

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

In addition, a number of regulations have been promulgated as Regulation 982 of December 2014 (Government Notice 38282) in terms of this Act. It defines minimum information requirements for specialist reports, with Government Gazette (GG) 43110 (20 March 2020) updating the minimum requirements for reporting.

GG 43110 prescribe general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation. These protocols were promulgated in terms of sections 24(5)(a), (h) and 44 of the NEMA.

When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the NEMA are replaced by these requirements.

3.4 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' [**32**].
- SANS 10210:2004. 'Calculating and predicting road traffic noise' [**33**].
- SANS 10328:2008. 'Methods for environmental noise impact assessments' [**34**].
- 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' [**35**].

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

3.5 INTERNATIONAL GUIDELINES

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

3.5.1 Guidelines for Community Noise (WHO, 1999) [45]

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO expert task force meeting held in London, United Kingdom, in April 1999 [**45**]. It is based on the document entitled "Community Noise" that was prepared for the WHO and published in 1995 by the Stockholm University and Karolinska Institute.

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

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

It further discusses how noise can affect (and propose guideline noise levels) specific environments such as residential dwellings, schools, preschools, hospitals, ceremonies, festivals and entertainment events, sounds through headphones, impulsive sounds from toys, fireworks and firearms, and parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the day, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. At night, equivalent

sound levels at the outside façades of the living spaces should not exceed 45 dBA and 60 dBA L_{Amax} so that people may sleep with bedroom windows open. It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

3.5.2 Night Noise Guidelines for Europe (WHO, 2009) [46]

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the WHO has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe [**46**]. Rather than a maximum of 30 dB inside at night (which equals 45-50 dB max outside), the WHO now recommends a maximum year-round outside night-time noise average of 40 db to avoid sleep disturbance and its related health effects. The report notes that only below 30 dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40 dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

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

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

3.5.3 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not

or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. Revision III of the EPs has been in place since June 2013. The participating banks chose to model the Equator Principles on the environmental standards of the World Bank (1999) and the social policies of the International Finance Corporation (IFC). As of beginning 2022:

- More than 90 banks and financial institutions have voluntarily adopted the Equator Principles, which are based on IFC's Performance Standards[6].
- 32 export credit agencies of the Organization of Economic Co-operation and Development countries benchmark private sector projects against IFC's Performance Standards.
- The Multilateral Investment Guarantee Agency applies IFC's Performance Standards in its operations.
- The World Bank applies IFC's Performance Standards (known as World Bank Performance Standards) to projects supported by IBRD/IDA (International Bank for Reconstruction and Development/International Development Association) that are owned, constructed and/or operated by the private sector.

3.5.4 IFC: General EHS Guidelines – Environmental Noise Management [21]

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principles. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the IFC Environmental, Health and Safety (EHS) Guidelines.

Document 1.7[7] of the IFC: General EHS Guidelines states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from project facilities/operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source. It goes as far as to proposed methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;

6 https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/performance-standards

7 https://www.ifc.org/wps/wcm/connect/4a4db1c5-ee97-43ba-99dd-8b120b22ea32/1-7%2BNoise.pdf?MOD=AJPERES&CVID=nPtgwZY

- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment casing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas;
- Re-locating noise sources to less-sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

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

Table 3-2: IFC Table 7.1-Noise Level Guidelines

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

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

3.5.5 European Parliament Directive 2000/14/EC [17]

Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors was adopted by the European Parliament and the Council and first published

in May 2000 and applied from 3 January 2002. The directive placed sound power limits on equipment to be used outdoors in a suburban or urban setting. Failure to comply with these regulations may result in products being prohibited from being placed on the EU market. Equipment list is vast and includes machinery such as compaction machineries, dozers, dumpers, excavators, etc. Manufacturers as a result started to consider noise emission levels from their products to ensure that their equipment will continue to have a market in most countries.

4 CURRENT ENVIRONMENTAL SOUND CHARACTER

4.1 INFLUENCE OF SEASON ON AMBIENT SOUND LEVELS

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

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

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

- Faunal communication is more significant during the warmer spring and summer months as various species communicate in an effort to find mates. Faunal communication is normally less during the colder months.
- Seasonal changes in weather patterns, mainly due to increased wind speeds (also see **Sub Section 4.1.1** below) and potential gustiness of the wind.

For environmental noise, weather plays an important role, the greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible. Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the sub-sections below.

Ambient sound levels are generally less during the colder months (due to less faunal communication) and higher during the warmer months.

4.1.1 Effect of Wind

Wind alters sound propagation by the mechanism of refraction, that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with

the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high. Over short distances wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e., less than 5 m/s.

Wind speed frequently plays a role in increasing sound levels in natural locations. With no wind, there is little vegetation movement that could generate noises and faunal noises (normally birds and insects) dominate, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speed on sound levels depends on the vegetation type (deciduous versus conifers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes unanticipated consequences, as suitable vegetation may create suitable habitats and food sources attracting birds and insects (and the subsequent increase in faunal communication).

4.1.2 Effect of Humidity and Temperature

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

Generally, sound propagate better at lower temperatures (down to 10^{o}C), and with everything being equal, a decrease in temperature from 32^{o}C to 10^{o}C could increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

The effect of humidity on sound propagation is quite complex, but effectively relates to how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity. With everything being equal,

an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz at 20°C).

Together, the impact of temperature and humidity (together with air pressure - to a minor extent) are complex and highly dependent on the frequency composition of the noise. This is illustrated in **Figure 4-1**.

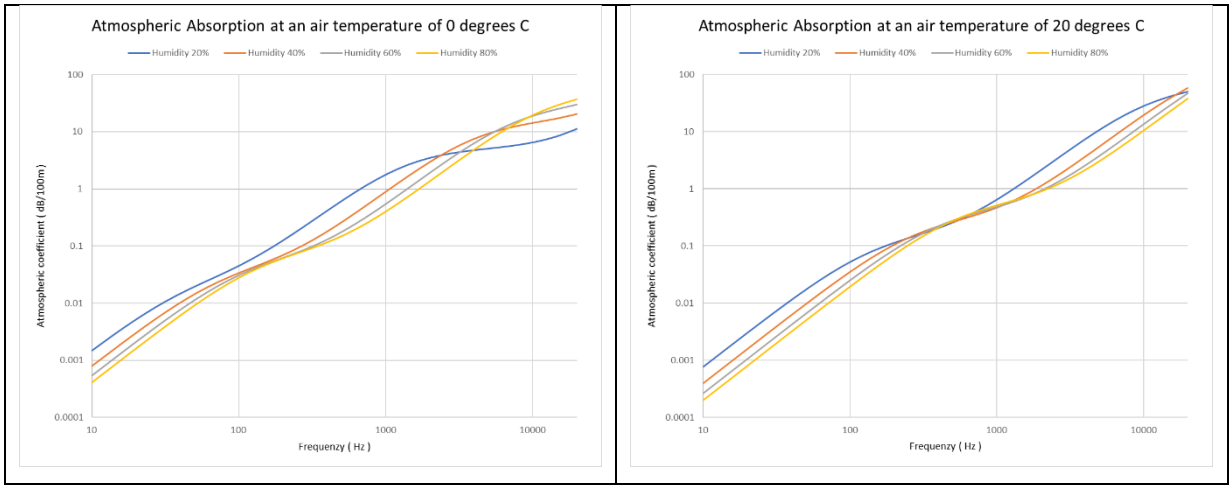

Figure 4-1: Effect of Temperature and Humidity on propagation of Sound

4.2 TEMPERATURE AND HUMIDITY MEASUREMENTS

Temperature and humidity were measured during the August 2021 site visit, with the average, maximum and minimum readings defined in **Table 4-1** with the various readings illustrated in **Figure 4-2**. For the purpose of modelling, average humidity of 50 % and temperatures of 10 °C at an air pressure of 850 kPA will be used.

Table 4-1: Temperature and Humidity measured onsite

	Humidity	Temperature
Day average	36.2	14.0
Night average	42.9	1.6
Day minimum	20.0	2.4
Day maximum	99.0	23.2
Night minimum	20.0	-3.5
Night maximum	99.0	7.1

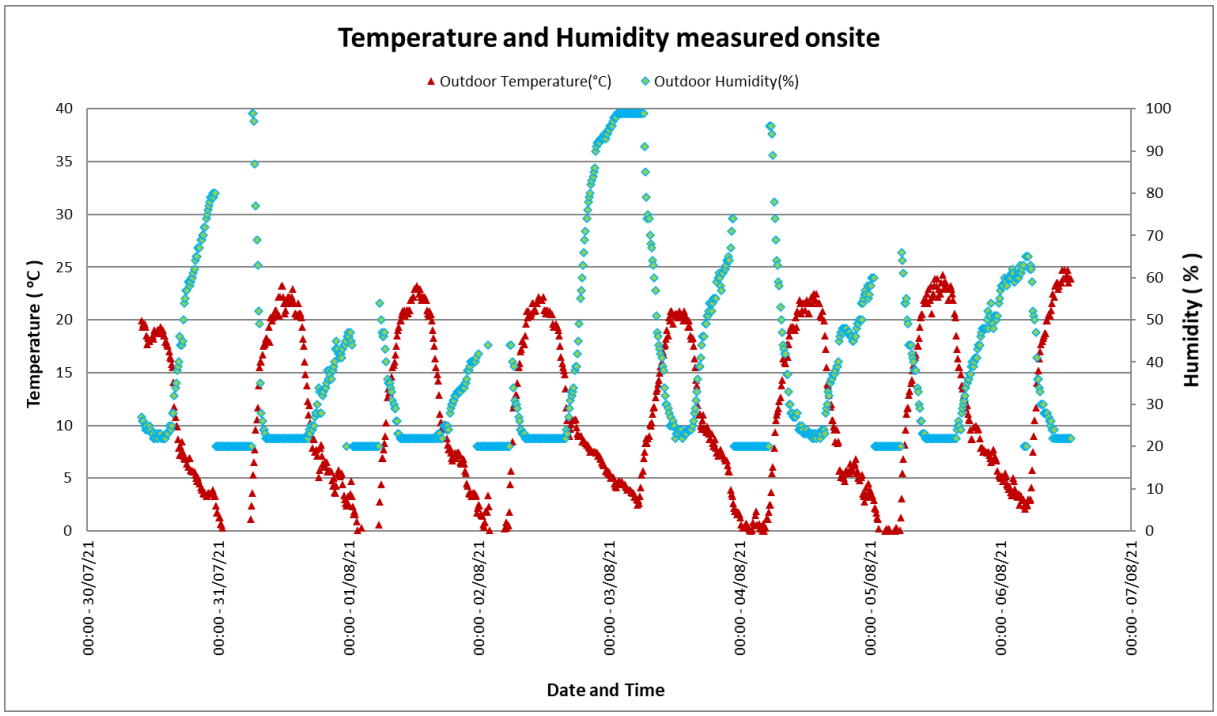

Figure 4-2: Temperature and Humidity readings measured onsite

4.3 SOUND MEASUREMENTS - PROCEDURE

Ambient (background) sound levels were measured over a period of a week from 30 July to 6 August 2021 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***" considering the protocols defined in GG 43110. The protocol defined the SANS guidelines to be used and time periods (in which measurements must be collected), with the guidelines specifying the acceptable techniques for sound measurements including, the type of equipment (Class 1), minimum duration of measurement, microphone positions and height above ground level, calibration procedures and instrument checks and supplementary weather measurements and observations.

Ambient sound levels were measured at two locations in the vicinity of the Project. The sound levels were measured using a class-1 Sound Level Meters (SLMs) with the measurement localities presented in **Figure 4-3**. The SLMs would measure "average" sound levels over 10-minute periods, save the data and start with a new 10-minute measurement until the instruments were stopped. Ambient sound measurements were also measured for other projects in the area, but the data collected during the period 30 July – 6 August 2021 is considered of high quality and providing sufficient information about the typical sound levels in the area.

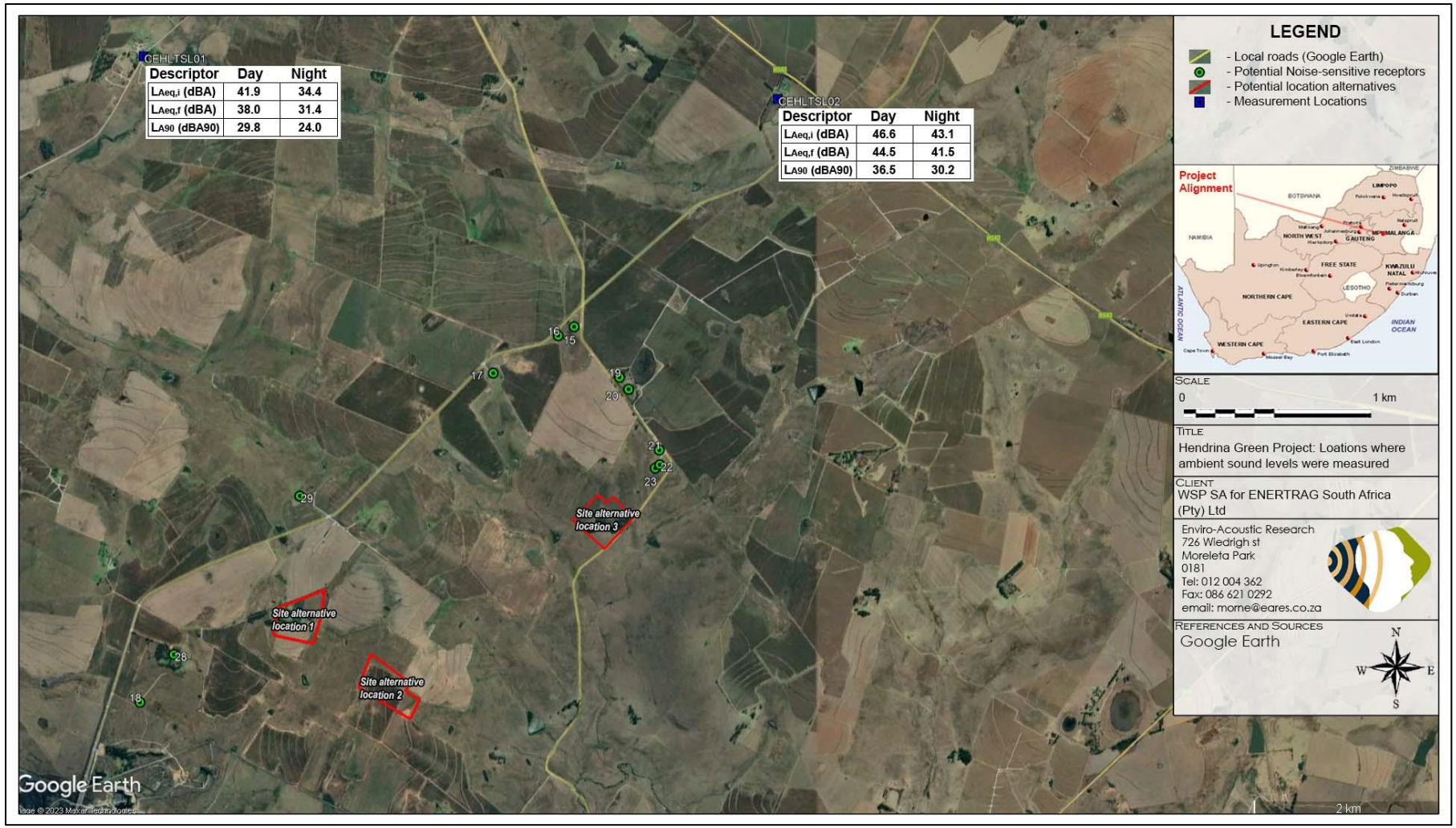

Figure 4-3: Localities where ambient sound levels were measured

4.3.1 Long-term Measurement Location CEHLTSL01

The equipment defined in **Table 4-2** was used for gathering data.

Table 4-2: Equipment used to gather data (SVAN 955) at GCAVLTSL01

Equipment	Model	Serial no	Calibration
SLM	Svan 955	27637	October 2020
Pre-amplifier	SV 12L	30336	October 2020
Microphone	ACO 7052E	52437	October 2020
Calibrator	Quest CA-22	J 2080094	July 2021
Anemometer	WH3081PC	-	-

The measurement location was selected to be indicative of potential ambient sound levels at a typical quiet farm dwelling in the area. While other locations were investigated, this location was ideal to illustrate typical sound levels at a quiet residential dwelling for the following reasons:

- The grass was relatively short which would reduce potential wind-induced noises (WIN) from this source;
- While there were some trees close to the microphone, they were bare (deciduous trees), limiting WIN from these sources;
- The dwelling was unused at the time of the measurement, limiting potential noises from the residents, typical of occupied residential dwellings (animals, TV/Radio, voices, etc.);
- The closest trees were further than 40m, and the direct effect of WIN was minimised;
- The closest eucalyptus trees (generally a significant source of WIN) were more than 100m away. On this project this was generally a problem as most of the other dwellings had a number of large trees close to potential measurement locations.

Photos of the measurement location are presented in **Appendix E**. Refer to **Table 4-3** highlighting sounds heard during equipment deployment and collection.

Table 4-3: Noises/sounds heard during site visits at CEHLTSL01

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Birds clearly audible and dominant. WIN dominant during wind gusts, though WIN was generally audible and a constant noise source.
	Sounds associated with the household	-
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Birds clearly audible and dominant. WIN dominant during wind gusts, though WIN was generally audible and a constant noise source.

	Sounds associated with the household	-
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-4** and summarized in **Table 4-4** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-5**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is slightly elevated, higher than a quiet rural environment. It is suspected that higher wind speeds increased WIN, raising the L_{A90} level.

Maximum noise levels generally did not exceed 65 dBA more than 10 times at night, though at least 14 events were logged during night 4, when this noise level was exceeded (tree branches swaying in the high winds, hitting the dwelling was suspected). If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[8].

Table 4-4: Sound levels considering various sound level descriptors at CEHLTSL01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	41.9	38.0	29.8	-
Night arithmetic average	-	34.4	31.4	24.0	-
Day equivalent	-	47.0	42.1	-	-
Night equivalent	-	47.5	36.7	-	-
Day minimum	-	22.1	17.3	-	3.2
Day maximum	82.9	65.4	55.2	-	-
Night minimum	-	17.3	15.1	-	3.2
Night maximum	76.8	66.5	52.3	-	-
Day 1 equivalent	-	43.8	39.9	-	-
Night 1 Equivalent	-	36.3	33.2	-	-

(8) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

Day 2 equivalent	-	45.7	40.1	-	-
Night 2 Equivalent	-	37.2	33.8	-	-
Day 3 equivalent	-	43.2	39.4	-	-
Night 3 Equivalent	-	37.1	34.2	-	-
Day 4 equivalent	-	45.0	42.1	-	-
Night 4 Equivalent	-	54.1	40.3	-	-
Day 5 equivalent	-	50.0	43.7	-	-
Night 5 Equivalent	-	38.6	37.3	-	-
Day 6 equivalent	-	49.7	44.2	-	-
Night 6 Equivalent	-	39.7	37.6	-	-
Day 7 equivalent	-	45.1	40.8	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-6** (night) and **Figure 4-7** (day).

Spectral frequencies indicate that faunal noises were a significant noise during the day, with most measurements indicating a broadband character. There is a light increase in acoustic energy between 400 and 800 Hz, with the source undefined. The spectral character is illustrated in **Figure 4-8** to **Figure 4-11**.

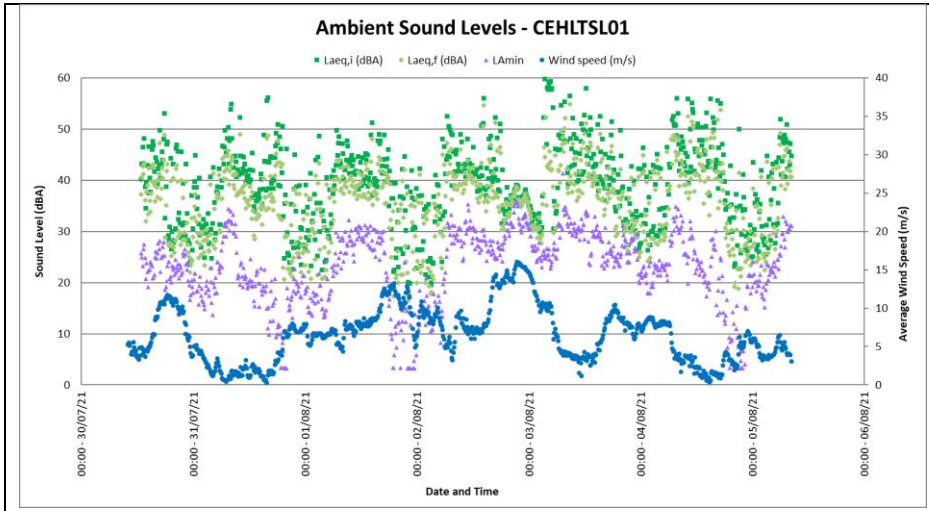

Figure 4-4: Ambient Sound Levels at CEHLTSL01

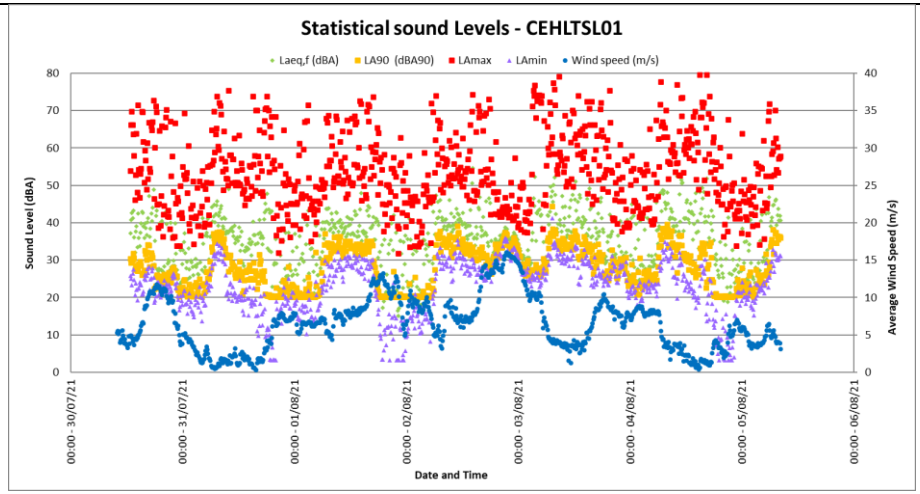

Figure 4-5: Maximum, minimum and Statistical sound levels at CEHLTSL01

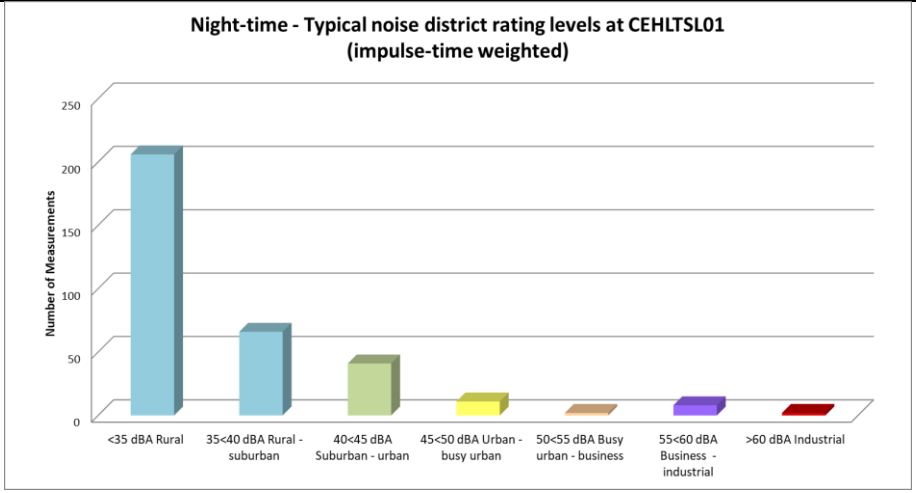

Figure 4-6: Classification of night-time measurements in typical noise districts at CEHLTSL01

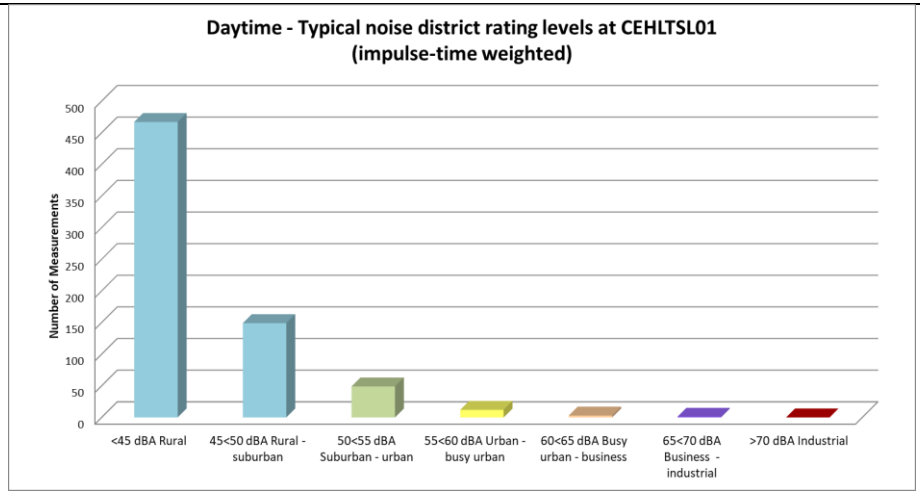

Figure 4-7: Classification of daytime measurements in typical noise districts at CEHLTSL01

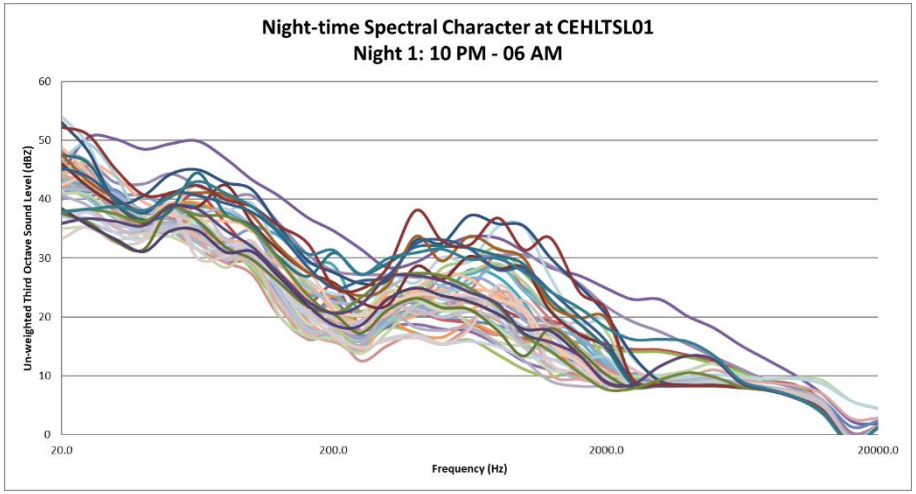

Figure 4-8: Spectral frequencies – CEHLTSL01, Night 1

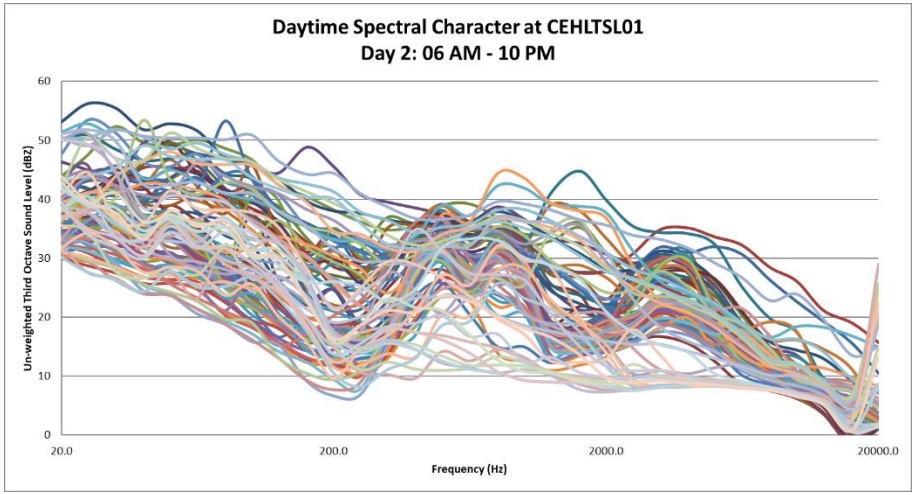

Figure 4-9: Spectral frequencies - CEHLTSL01, Day 2

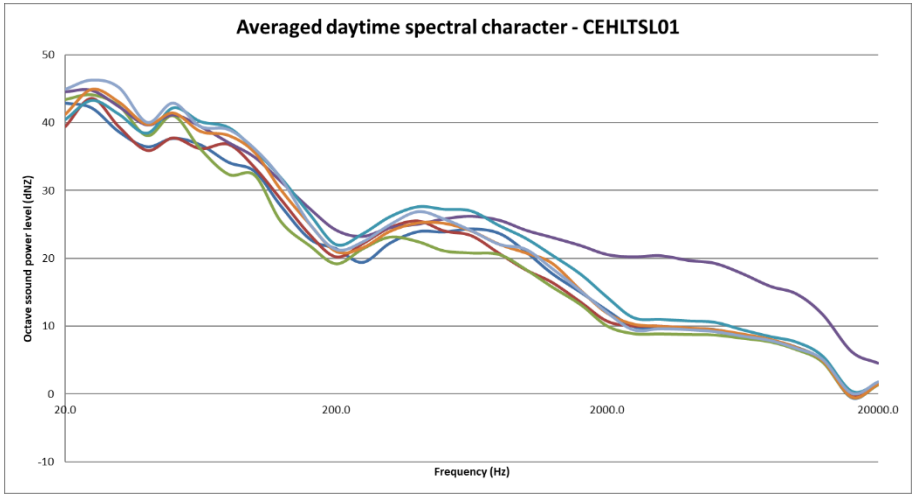

Figure 4-10: Average night-time frequencies - CEHLTSL01

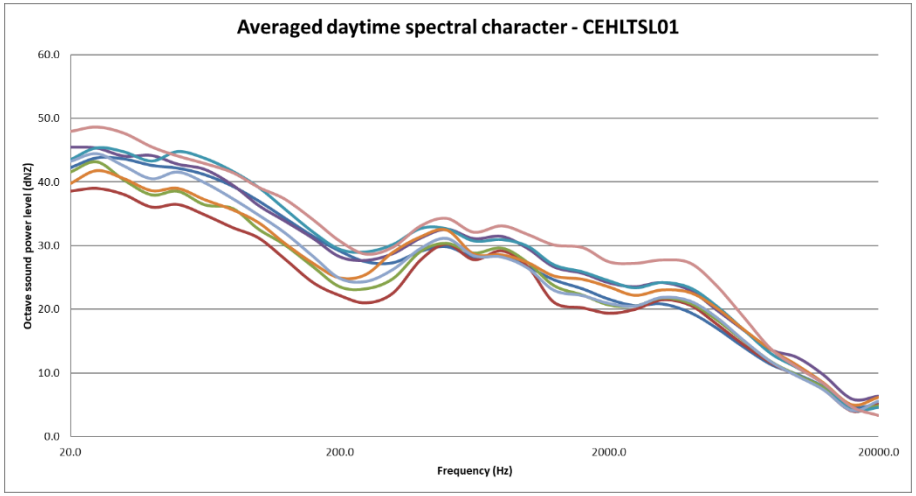

Figure 4-11: Average daytime frequencies - CEHLTSL01

4.3.2 Long-Term Measurement Location - CEHLTSL02

This measurement location was deployed at a residential dwelling close to the R542 road. This road is used as a coal haul route and noises from passing heavy vehicles were relatively constant. There were large coniferous trees within 20m with a constant susurrus often audible from these trees. The noise from the road traffic however was generally dominant. The equipment defined in **Table 4-5** was used for gathering data with **Table 4-6** highlighting sounds heard during equipment deployment and collection. **Appendix E** presents photos of the measurement location.

Table 4-5: Equipment used to gather data at CEHLTSL02

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34849	October 2020
Microphone	ACO 7052E & SV 12L	33077	October 2020
Calibrator	Quest CA-22	J 2080094	July 2021

Table 4-6: Noises/sounds heard during site visits at CEHLTSL02

Noises/sounds heard during onsite investigations		
Magnitude – Colour Code Used **Barely Audible** **Audible** **Dominating**	**During equipment deployment**	
	Faunal and Natural	Birds audible and generally dominant. WIN audible and significant at times.
	Residential	-
	Industrial & transportation	Road traffic noises constantly audible and significant to dominant.
	During equipment collection	
	Faunal and Natural	Birds audible and significant. WIN audible and significant.
	Residential	-
	Industrial & transportation	Road traffic noises constantly audible and significant to dominant.

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-12** and summarized in **Table 4-7** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-13**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient

noises) that impacts on average sound level. The L_{A90} level is elevated, indicating relative constant noises in the vicinity of the microphone. It is suspected that road traffic was this noise source.

The maximum noise levels did not exceed 65 dBA during the 7 nights. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[9].

Table 4-7: Sound level descriptors as measured at CEHLTSL02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	46.6	44.5	36.5	-
Night arithmetic average	-	43.1	41.5	30.2	-
Day Equivalent Levels	-	48.8	46.6	-	-
Night Equivalent Levels	-	45.4	43.5	-	-
Day minimum	-	37.3	35.8	-	18.5
Day maximum	75.8	56.8	55.2	-	-
Night minimum	-	25.7	23.7	-	19.1
Night maximum	77.0	58.5	50.3	-	-
Day 1 equivalent	-	49.2	47.5	-	-
Night 1 Equivalent	-	48.6	46.3	-	-
Day 2 equivalent	-	46.5	44.2	-	-
Night 2 Equivalent	-	41.4	40.2	-	-
Day 3 equivalent	-	49.1	46.1	-	-
Night 3 Equivalent	-	43.0	41.2	-	-
Day 4 equivalent	-	49.6	47.8	-	-
Night 4 Equivalent	-	45.8	44.4	-	-
Day 5 equivalent	-	48.0	45.7	-	-
Night 5 Equivalent	-	44.9	42.7	-	-
Day 6 equivalent	-	47.2	45.1	-	-
Night 6 Equivalent	-	44.1	42.4	-	-
Day 7 equivalent	-	46.7	44.6	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-14** (night) and **Figure 4-15** (day).

Spectral frequencies indicate that road traffic noises were generally dominant and the main noise source in the area. The spectral character is illustrated in **Figure 4-16** to **Figure 4-19**.

[9] World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

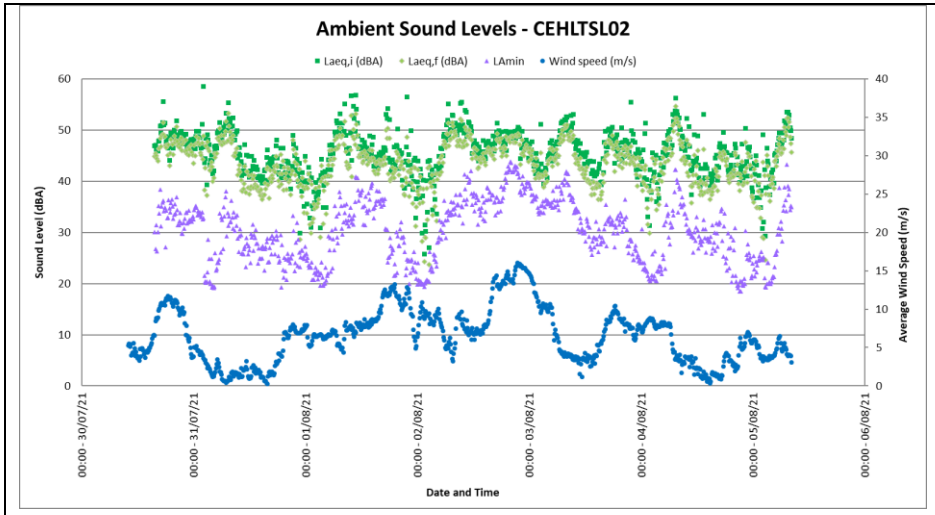

Figure 4-12: Ambient sound levels at CEHLTSL02

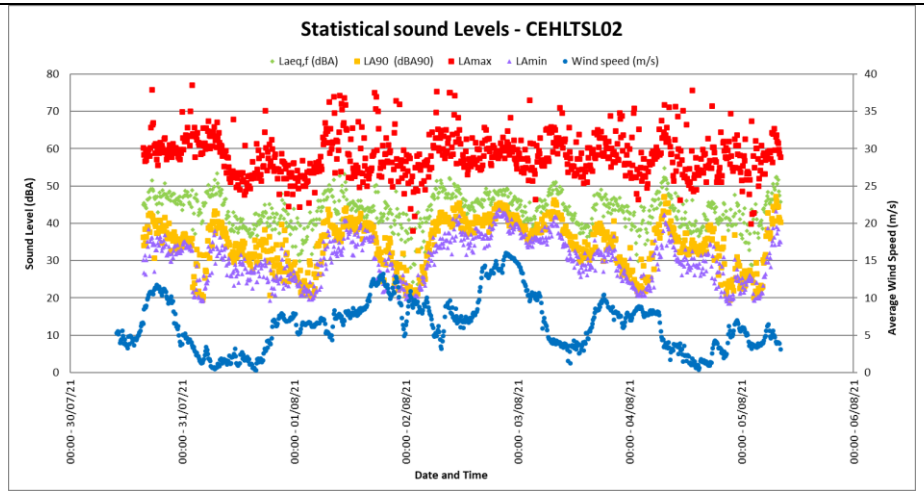

Figure 4-13: Maximum, minimum and statistical values at CEHLTSL02

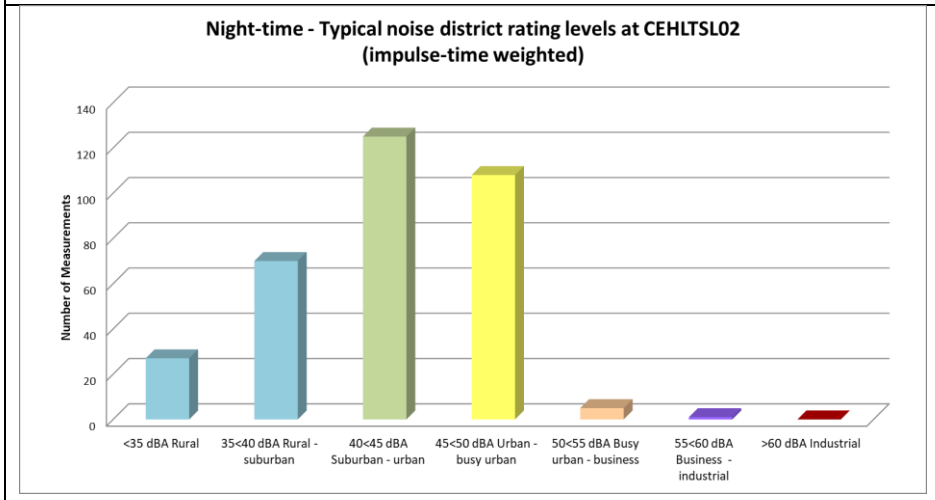

Figure 4-14: Classification of night-time measurements in typical noise districts at CEHLTSL02

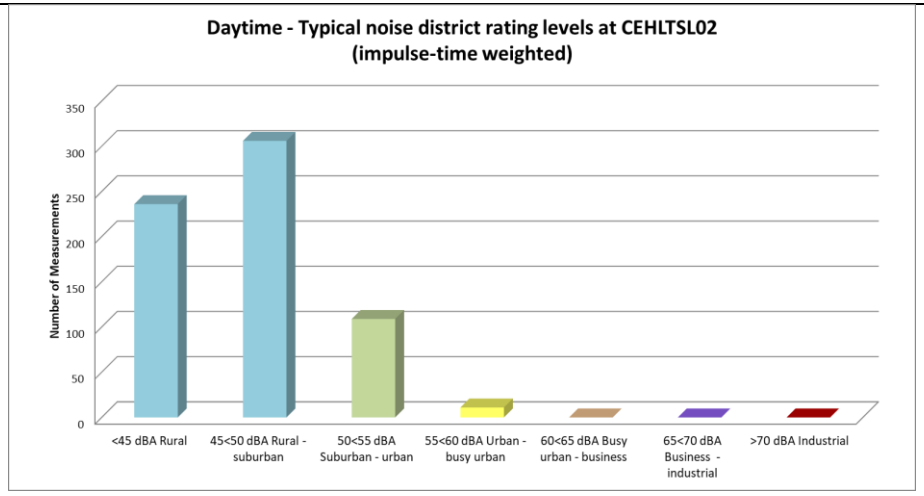

Figure 4-15: Classification of daytime measurements in typical noise districts at CEHLTSL02

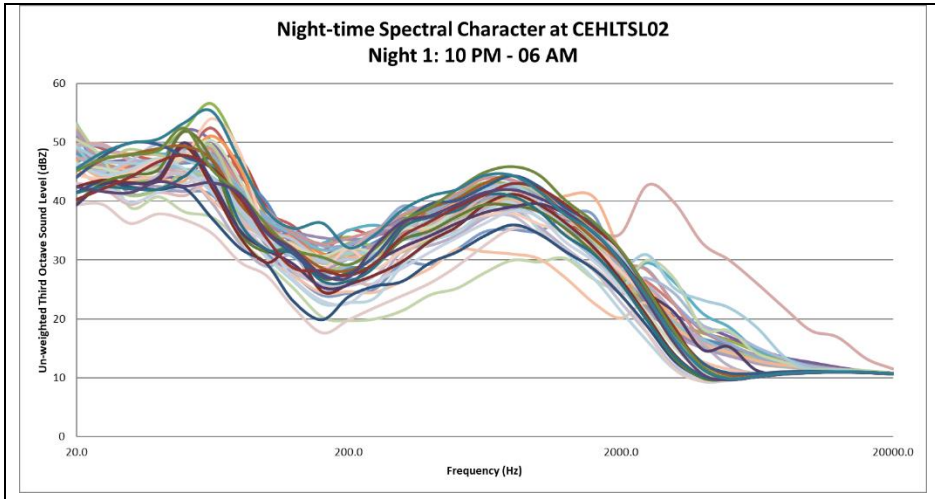

Figure 4-16: Night 1 spectral frequencies at CEHLTSL02

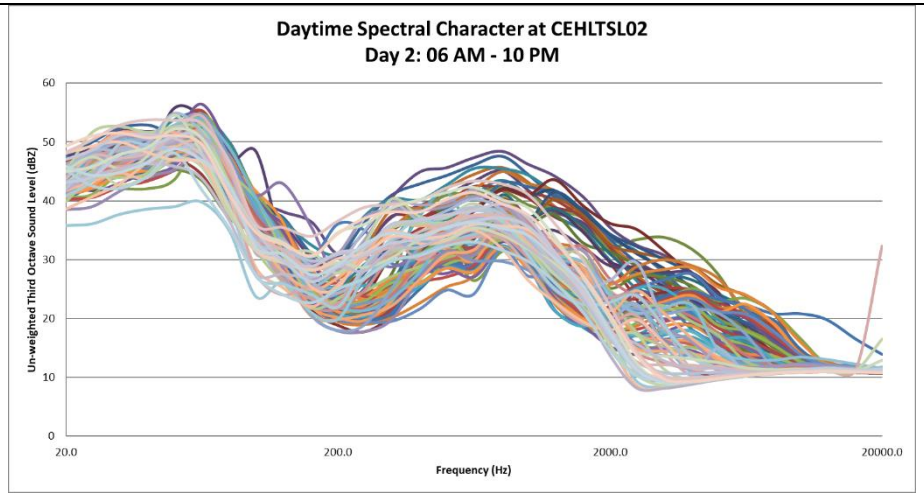

Figure 4-17: Day 2 spectral frequencies at CEHLTSL02

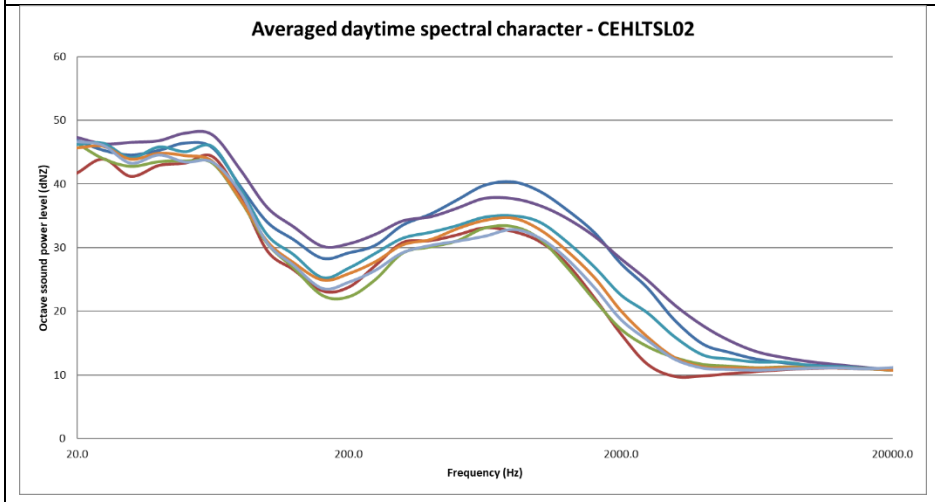

Figure 4-18: Average night-time frequencies at CEHLTSL02

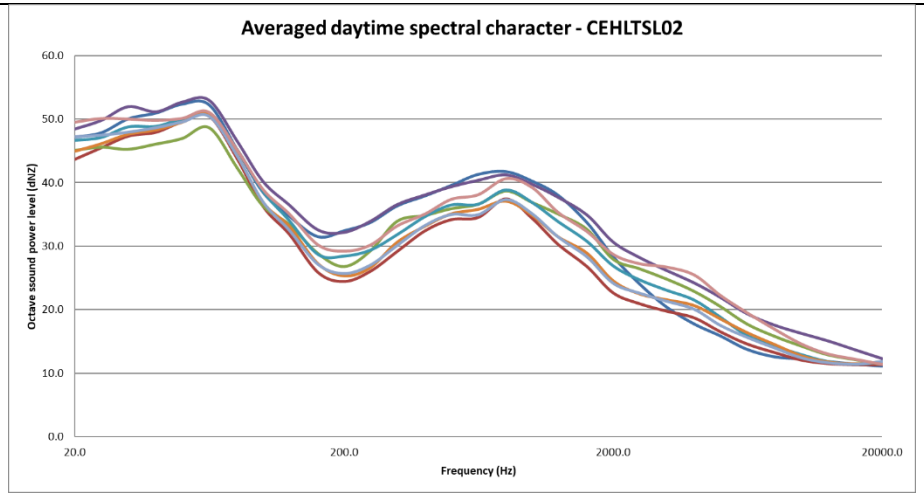

Figure 4-19: Average daytime frequencies at CEHLTSL02

4.4 SUMMARY OF AMBIENT SOUND LEVELS

Based on the sound measurements:

- **CEHLTSL01 – Quiet Farm Dwelling**
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the six full 16-hour daytime periods, the daytime $L_{Aeq,i}$ value is 47.0 dBA, with a rating level similar to a rural noise district. The arithmetic average of the various 10-minute $L_{Aeq,i}$ measurements are 41.9 dBA;
    - based on the seven 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 47.5 dBA, with a rating level similar to an urban, to busy urban (with main roads, business and workshops) noise district. The arithmetic average of the various 10-minute $L_{Aeq,i}$ night-time measurements are 34.4 dBA. The elevated night-time rating level is likely due to wind-induced noises influencing the impulse-weighted measurements;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the six full 16-hour daytime period, the $L_{Aeq,f}$ value is 42.1 dBA, with the arithmetic average being 38.0 dBA. This is typical of the noise rating levels expected of a quiet rural noise district and desired for residential use;
    - based on the seven full 8-hour night-time periods, the $L_{Aeq,f}$ value is 36.7 dBA, with the arithmetic average being 31.4 dBA. This is typical of the noise rating levels expected of a rural noise district and desired for residential use;
  - The statistical L_{A90} levels are slightly elevated for a rural noise district for the day- (29.8 dBA90) and low for the night-time (24.0 dBA90) periods.
  - The significant difference between the impulse- and fast-time weighted sound levels indicate noise sources with a significant impulsive character in the vicinity of the measurement location. There is insufficient information to postulate the source of the impulsive noises.
- **CEHLTSL02 – Dwelling close to the R542 road**
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the six full 16-hour daytime period, the daytime $L_{Aeq,i}$ value is 48.8 dBA, with a rating level slightly higher than a rural area, but less than a suburban noise district. The arithmetic average of the various 10-minute $L_{Aeq,i}$ measurements are 46.6 dBA. Based on the sounds heard onsite, roads in the area are a significant noise source;

- based on the seven 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 45.4 dBA, with a rating level similar to a typical urban noise district. The arithmetic average of the various 10-minute $L_{Aeq,i}$ measurements are 43.1 dBA. The ambient sound levels are significantly higher than expected for this area, considering the developmental character. Based on the sounds heard onsite, roads in the area are a significant noise source;

- The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
  - based on the six 16-hour daytime periods, the $L_{Aeq,f}$ value is 46.6 dBA, with the arithmetic average being 44.5 dBA. This is typical of the noise rating levels expected of an urban noise district;
  - based on the seven 8-hour night-time periods, the $L_{Aeq,f}$ value is 43.5 dBA, with the arithmetic average being 41.5 dBA. This is typical of the noise rating levels expected of an urban noise district. It is less than the IFC noise limit for residential use at night;
- The statistical L_{A90} levels are significantly elevated for both the day- (36.5 dBA90) and night-time (30.2 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined but likely relate to the traffic noises.

Excluding sound levels measured at CEHLTSL02, approximately 680 10-minute measurements were collected during the day, with the highest sound level measured being 55.2 dBA and the lowest sound level being 17.3 dBA. The daytime average of the 10-minute equivalent sound level measurements were 38.0 dBA.

Excluding sound levels measured at CEHLTSL02, approximately 330 10-minute measurements were collected at night, with the highest sound level measured being 52.3 dBA and the lowest sound level being 15.1 dBA. The night-time average of the 10-minute equivalent sound level measurements were 31.4 dBA.

Typical ambient sound levels are expected to be low and are typical of a rural noise district. The acceptable zone sound level (noise rating level) during low and no-wind conditions would be typical of a rural noise district, e.g.:

- **45 dBA for the daytime period;** and,
- **35 dBA for the night-time period**.

5 INVESTIGATION OF EXISTING AND FUTURE NOISE LEVELS

Increased noise levels are directly linked with the various activities associated with the construction of the proposed Project and related infrastructure, as well as the operational phase of the activity. The potential noise impacts from the activities associated with these phases are discussed in the following sections.

5.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

It is estimated that construction may take approximately 12 months subject to the final design of the Project, weather and ground conditions, including time for testing and commissioning. The construction process will consist of the following principal activities:

- Site survey and preparation;
- Establishment of site entrance, internal access roads, contractors' compound and passing places;
- Transport of components & equipment to site. 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, cement trucks, etc.). The transportation of ready-mix concrete to site or the materials for onsite concrete batching will result in a temporary increase in heavy traffic;
- Site preparation activities to clear vegetation at the footprint of the project site. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construction of foundations and associated civil work;
- Construct of buildings and establishment of ancillary infrastructure; and
- Site rehabilitation (if required) - once construction is completed and all construction equipment are removed; the site will be rehabilitated where practical and reasonable.

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dB, the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in **Table 5-2**.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 5-3**.

For the purpose of the construction noise impact, an area noise source will be considered over the larger project area, together with two general noise sources. The noise levels and the octave sound power emission levels used for modelling for the construction phase are highlighted in **Table 5-1**.

Table 5-1: Equipment list and Sound power emission levels used for modelling

Equipment	**Sound power level, dB re1 pW, in octave band, Hz**							**SPL**
Centre frequency	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**(dBA)**
Construction and WTG equipment and activities								
Air compressor	59.0	73.0	83.0	88.0	89.0	86.0	81.0	92.6
Air Filter House	107.9	97.6	102.1	92.2	86.9	84.6	85.6	96.7
Air Inlet Filter Housing	106.0	97.0	82.0	72.0	88.0	69.0	75.0	92.4
Air Inlet Filter Housing Duct	104.0	103.0	92.0	86.0	100.0	85.0	86.0	101.1
Ammonia Injection Skid	96.0	92.0	89.0	90.0	90.0	88.0	85.0	94.7
Cement truck (with cement)	104.0	107.0	106.0	108.0	107.0	105.0	102.0	111.7
Compressor (Liquid Gas Pipeline)	101.0	101.0	101.0	101.0	103.0	99.0	95.0	106.4
Compressor building	105.0	95.0	92.0	88.0	83.0	87.0	85.0	93.5
Compressor cooling fans	97.0	98.0	98.0	93.0	87.0	87.0	84.0	95.5
Condenser (Forced Water Cooling)	102.0	104.0	106.0	100.0	96.0	94.0	92.0	103.2
Condenser (Forced Air Cooled)	109.0	106.0	102.0	96.0	95.0	95.0	97.0	103.3
Crane	89.0	98.0	101.0	103.0	102.0	102.0	98.0	107.5
Dryer Gas Generator	108.0	107.0	105.0	102.0	99.0	96.0	93.0	104.6
Excavator - Cat 416D	103.1	103.7	106.4	99.7	98.3	95.3	92.3	103.9
Fan Array (Closed Cooling Water)	94.0	92.0	91.0	91.0	89.0	88.0	86.0	95.0
Front End Loader - Bell L1806C	109.0	106.7	107.3	97.9	95.8	92.5	87.6	102.7
General noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	108.8
Pump (Demineralized Water)	71.0	71.0	74.0	81.0	84.0	85.0	81.0	89.6
Pumps (Liquid gas)	90.0	92.0	93.0	93.0	93.0	98.0	88.0	101.0
Substation (one transformer)	86.6	83.0	88.6	82.1	80.6	69.4	73.2	85.2
Area noise sources (using the octave sound power characteristics of General Noise)								
General noise (dBA/m^2 re 1 pW)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	65.0

Table 5-2: Potential maximum noise levels generated by various mobile equipment and activities

Equipment Description[10]	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 modeling 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
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
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
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
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
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
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

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

Table 5-3: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent sound power emission levels (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	92.61	67.63	61.61	55.59	47.63	41.61	38.09	35.59	32.07	27.63	24.11	21.61	15.59
Air Filter House	96.67	71.70	65.68	59.66	51.70	45.68	42.16	39.66	36.14	31.70	28.18	25.68	19.66
Air Inlet Filter Housing	92.40	67.43	61.41	55.39	47.43	41.41	37.89	35.39	31.87	27.43	23.91	21.41	15.39
Air Inlet Filter Housing Duct	101.08	76.11	70.09	64.07	56.11	50.09	46.57	44.07	40.55	36.11	32.59	30.09	24.07
Ammonia Injection Skid	94.67	69.70	63.68	57.66	49.70	43.68	40.16	37.66	34.14	29.70	26.18	23.68	17.66
Cement truck (with cement)	111.71	86.74	80.72	74.69	66.74	60.72	57.19	54.69	51.17	46.74	43.21	40.72	34.69
Compressor (Liquid Gas Pipeline)	106.39	81.42	75.40	69.38	61.42	55.40	51.88	49.38	45.86	41.42	37.90	35.40	29.38
Compressor building	93.48	68.51	62.49	56.47	48.51	42.49	38.97	36.47	32.95	28.51	24.99	22.49	16.47
Compressor cooling fans	95.46	70.49	64.47	58.45	50.49	44.47	40.95	38.45	34.93	30.49	26.97	24.47	18.45
Condenser (Forced Water)	103.23	78.25	72.23	66.21	58.25	52.23	48.71	46.21	42.69	38.25	34.73	32.23	26.21
Condenser (forced-air cooled)	103.27	78.29	72.27	66.25	58.29	52.27	48.75	46.25	42.73	38.29	34.77	32.27	26.25
Crane	107.48	82.51	76.48	70.46	62.51	56.48	52.96	50.46	46.94	42.51	38.98	36.48	30.46
Dryer Gas Generator	104.60	79.63	73.61	67.59	59.63	53.61	50.09	47.59	44.06	39.63	36.11	33.61	27.59
Excavator - Cat 416D	103.86	78.89	72.87	66.85	58.89	52.87	49.35	46.85	43.33	38.89	35.37	32.87	26.85
Fan Array (Closed Cooling Water)	94.95	69.98	63.96	57.94	49.98	43.96	40.44	37.94	34.42	29.98	26.46	23.96	17.94
Front End Loader - Bell L1806C	102.68	77.71	71.69	65.67	57.71	51.69	48.17	45.67	42.15	37.71	34.19	31.69	25.67
General noise	108.76	83.79	77.77	71.75	63.79	57.77	54.25	51.75	48.23	43.79	40.27	37.77	31.75
General Noise - Construction (commercial)	96.54	71.57	65.55	59.53	51.57	45.55	42.03	39.53	36.01	31.57	28.05	25.55	19.53
Pump (Demineralized Water)	89.56	64.59	58.57	52.55	44.59	38.57	35.05	32.55	29.03	24.59	21.07	18.57	12.55
Pumps (Liquid gas)	100.95	75.98	69.96	63.94	55.98	49.96	46.44	43.94	40.42	35.98	32.46	29.96	23.94
Substation (one transformer)	85.22	60.25	54.23	48.21	40.25	34.23	30.71	28.21	24.69	20.25	16.73	14.23	8.21

5.2 POTENTIAL NOISE SOURCES: OPERATION PHASE

"Green" hydrogen and ammonia production differs from traditional hydrogen and ammonia production technologies in that the process relies exclusively on renewable energy resources. The input material is generally air and water.

The main noise generating sources are:

- Blowers and compressors, used to compress the air and the process at optimal pressure;
- Various motors and pumps to move liquid material around in the process;
- Potential steam safety release valves;
- Fans for potential forced cooling of ammonia and process gasses;
- Aerodynamic noises from the exhaust stacks.

The exact noise levels will depend on the layout, type and number of equipment, the load on the system, which equipment are located within buildings of structures as well as type of attenuators are used in the process. For the purpose of this assessment the study would assume the following noise sources:

- A demineralized water pump operating at the Electrolysis area;
- A gas compressor, a compressor cooling unit and forced-air condenser at the air separation unit;
- A compressor building, a compressor cooling unit, forced-air condenser as well as a liquid gas compressor at the ammonia synthesis plant; and
- Area noise sources at locations proposed for Electrolysis (0.3 ha), air separation (0.2 ha) and the ammonia synthesis (2 ha), emitting 65 dBA/m^2 (re 1 pW). This is to account for other noise sources not considered.

While this may not be the exact type of units that may be used at such a facility, it is typical equipment used at similar project and should represent characteristic noise generation equipment. The noise levels and the octave sound power emission levels used for the operational phase are highlighted in **Table 5-1**.

6 METHODS: NOISE IMPACT ASSESSMENT

6.1 NOISE IMPACT ON ANIMALS

A significant amount of research was undertaken during the 1960's and 70's on the effects of aircraft noise on animals [**1, 28**]. While aircraft noise has a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response with the strength and length of the startle response to be dependent on the following:

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

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

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

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

The only animal species studied in detail are humans, and studies are still continuing in this regard. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as humans age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar with all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals as indicated on **Figure 6-1**.

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research [**42**] that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in their environment

(excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

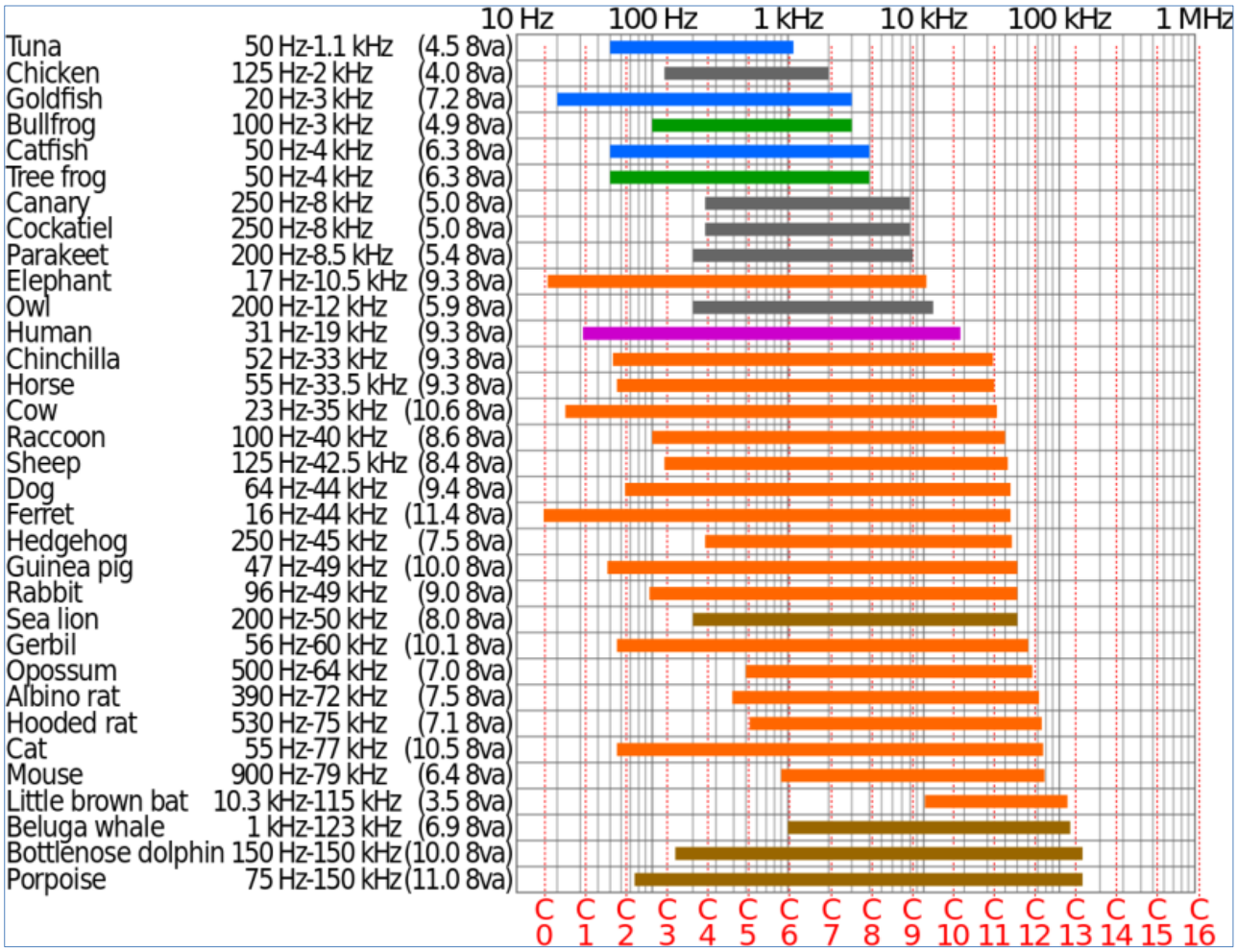

Figure 6-1: Logarithmic Chart of the Hearing Ranges of Some Animals[11]

6.1.1 Domesticated Animals

Excluding loud impulsive noises, considering the environmental noise levels (the noise levels were not defined, but levels of up to 100 dB were reported), it has been observed that most domesticated animals are generally not bothered by noise and generally can acclimatize relatively quickly to loud noises.

6.1.2 Wildlife

Studies indicated that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might

[11] https://en.wikipedia.org/wiki/Hearing_range

be impacted by noise would most likely relocate to a quieter area. Noise impacts are therefore very highly species-dependent [**5**, **10**, **11**, **28**, **42**].

6.1.3 Avifauna

As with other terrestrial faunal species, noise (character of sound or change in level) will impact on avifauna (birds of a particular region and/or habitat). Anthropogenic noises result in physical damage to ears, increased stress, flight or flushing, changes in foraging and other behavioural reactions. Ortega (2012) [**30**] summarized that additional responses (with ecological similar controls) include the avoidance of noisy areas, changes in reproductive success and changes in vocal communication. However, as with other faunal species, there are no guidelines to assess at which sound pressure level avifaunal will start to exhibit any response [**1**, **16**, **11**, **25**, **30**, **36**].

6.1.4 Concluding Remarks - Noise Impacts on Animals

From these and other studies the following can be concluded:

- To date there are no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals (Blickley *et al.* 2010) [**5**].
- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Dooling, 2007) [**16**].
- Terrestrial wildlife responses begin at noise levels of approximately 40 dBA, with 20% of papers documenting impacts below 50 dBA (Shannon *et al.* 2015) [**37**].
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2010) [**3**].
- Animals of most species exhibit adaptation with noise (Broucek, 2014) [**6**], including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Dooling, 2007) [**16**].
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals (startle response). This is due to the sudden and significant increase in noise levels due to these activities [**1**, **42**].

6.2 WHY NOISE CONCERNS COMMUNITIES [2, 11]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or

impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

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

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

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

Noise does not need to be loud to be considered "disturbing". One can refer to a dripping tap in the quiet of the night, or the irritating "thump-thump" of the music from a neighbouring house at night when one would prefer to sleep. Noise impacts are also complex to evaluate as numerous issues could cumulatively contribute to the severity of the impact, as discussed in the following subsections.

How a noise may impact (with this assessment using annoyance about the noise) on a receptor is also very complex to assess for the reasons highlighted in **section 6.2.1** below. Only considering the intensity of a sound (or noise) level, some people may become annoyed without hearing any noise (perceived impacts) where others may not even be reporting noise to be a concern, even when subjected to very high levels.

6.2.1 Noise Annoyance

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that the non-acoustic factors play a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity [**7**, **23**, **26**, **31**, **46**].

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 6-2**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in environmental health impact assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long-term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise levels.

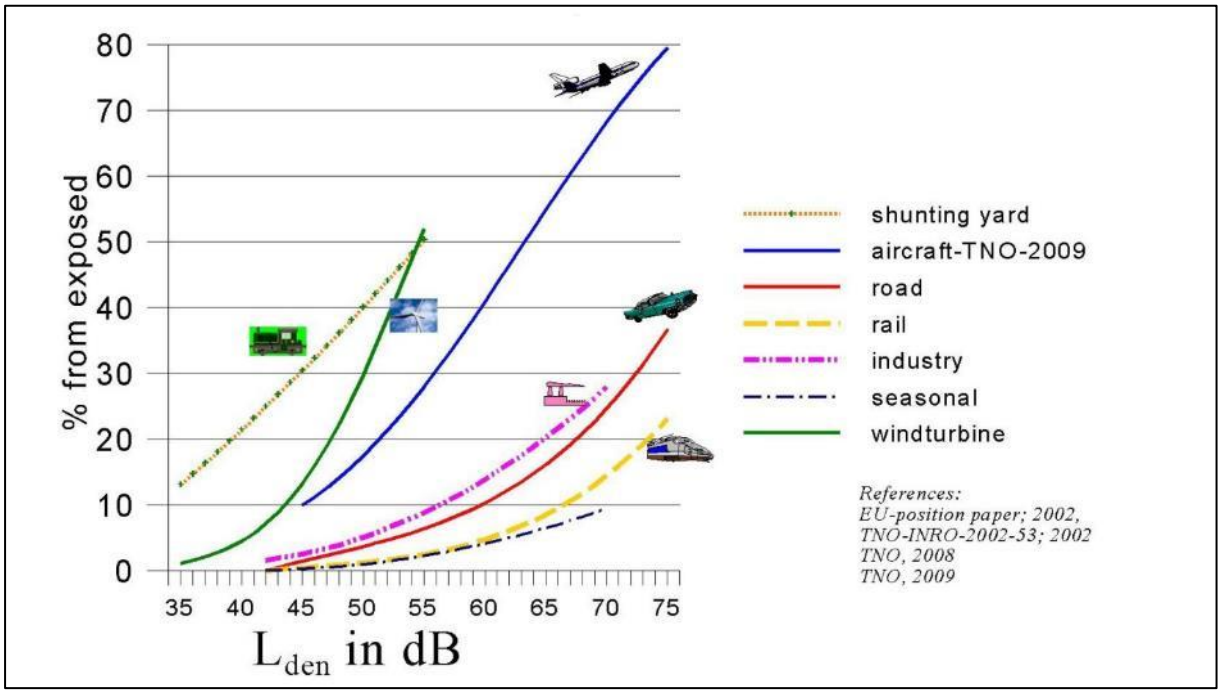

Figure 6-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling[12]

Severity of the annoyance depends on factors such as:

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

[12] Image from https://rigolett.home.xs4all.nl/ENGELS/topic.htm. Wind Turbine Annoyance curve from Pedersen (2007)

6.2.1.1 Disturbance to Sleep

Sleep is essential for mental and physical health, and noise is one of the most reported reasons why people may experience sleep interruptions at night. This may be sudden loud noises, with the WHO (2009) [**46**] reporting that, when maximum noises exceed 60 dBA, with average noise levels exceeding 40 dBA, it may increase the probability of being awakened.

6.2.1.2 Situational and Personal Factors

There are a few other aspects, collectively referred to as non-acoustical factors that may increase annoyance with a project [**26**]. These could include:

- Situational factors (visual issues, attractiveness of area) [**27**];
- Socio-economic factors (age, gender, income, level of education) [**26**, **27**]; and
- Personal factors (fear or worry in relation to noise source, sensitivity to noise, economic benefit from project, existing health condition) [**26**, **43**].

6.3 IMPACT ASSESSMENT CRITERIA

6.3.1 Overview: The Common Characteristics

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

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

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

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

6.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations of 2014 in terms of the NEMA, SANS 10103:2008, and guidelines from the WHO.

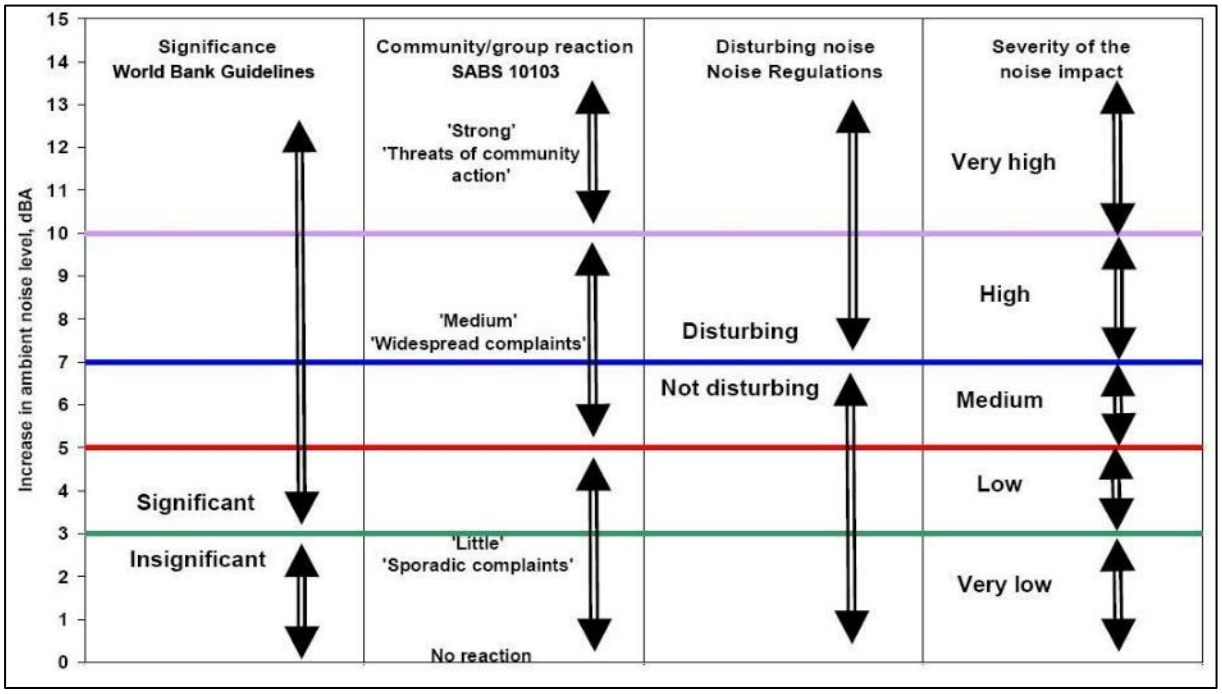

Figure 6-3: Criteria to assess the significance of impacts stemming from noise

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

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, caused by a new source of noise. With regards to the NCR, an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 6-3**.
- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, sets acceptable noise levels for various areas. See also **Table 6-1**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g., 65 dBA. Anything above this level will be considered unacceptable.

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 6-1**). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

Table 6-1: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

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

6.4 SETTING APPROPRIATE NOISE LIMITS

6.4.1.1 Using the National NCR to set noise limits

It should be noted that, while it is expected that the green facility will only operate when the associated WEFs are operational (and ambient sound levels may be higher due to wind-induced noises), it may be possible that the green plants are operational during period when the WEFs are not operational. This is because the WEFs would be storing energy in a cluster of battery energy storage systems for used during a period when there may be no winds. As such potential wind-induced noises will not be considered for this report.

Noise limits as set by the National NCRs (GN R154 of 1992 – **section 3.2.1**) defines a "**disturbing noise**" as the 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. Accepting that the sound levels in the area may be typical of a rural noise district, the following noise limits are recommended:

- **52 dBA for the daytime period;** and,
- **42 dBA for the night-time period**.

6.4.1.2 Using the Local By-Laws to set noise limits

All renewable energy projects require legal rights to use the land, necessitating various planning and land-use permissions. Land use and land development is a function of local

municipalities[13] and the requirements of the Steve Tshwete Noise By-laws (LAN 93 of 2021 – **section 3.1.1**) were taken into account:

- The proposed Project is located in an area with a complex developmental character, with agricultural as well as significant mining activities in the area. Residential dwellings in the area are generally associated with agricultural activities and there are no formal residential developments zoned for this purpose. When evaluating the current character in terms of **Table 3-1**, it is suspected that the current area will fall within General Environment:
    - C - Mixed residential (with some commercial and entertainment), stipulating a maximum sound level of 45 dBA at night, or
    - D - Residential + industry or small-scale production + commerce, stipulating a maximum sound level of 50 dBA at night.
- The Project will involve the changing of the land use from agricultural to a land-use zoning that permits the Project in terms of the relevant provincial and municipal legislation. This future rezone may designate the area to have a General Environment (in terms of maximum permissible sound levels) typical of class D (Residential + industry or small-scale production + commerce), stipulating a maximum sound level of 50 dBA at night.

However, these maximum sound levels are higher than the upper limit as recommended in **section 6.4.1.1**, and the noise limits recommended by the bylaw will not be used in this report.

6.5 DETERMINING THE SIGNIFICANCE OF THE NOISE IMPACT

The level of detail as depicted in the EIA Guidelines (CSIR, 2002) [**9**] was fine-tuned by assigning specific values to each impact, considering the impact rating methodology developed by the EAP. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria.

This scale takes into consideration the following variables:

- **Nature**: Whether the activity have a negative or positive impact on the environment.
- **Type**: A direct, indirect and/or cumulative effect of impact on the environment.
- **Magnitude:** The intensity of the impact on the surrounding receptors.

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- **Extent:** the spatial scale defines the physical extent of the impact.
- **Duration:** The temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- **Reversibility:** The degree to which an environment can be returned to its original/partially original state.
- **Consequence:** The consequence scale is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.
- **Probability:** The likelihood of impacts taking place as a result of project actions arising from the various alternatives.
- **Significance**: The criteria in **Table 6-7** was used to determine the overall significance of an activity. The impact effect (which includes duration; extent; consequence and probability) and the reversibility/mitigation of the impact are then read off the significance matrix in order to determine the overall significance of the issue. The overall significance is either negative or positive and will be classified as low, moderate or high.
- **Irreplaceable loss:** The degree of irreplaceable loss which an impact may cause, e.g., loss of non-regenerative vegetation or removal of rocky habitat or destruction of wetland.
- **Mitigation potential:** The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

The impact consequence is determined by summing the scores of Consequence (**Table 6-2**), the Spatial Extent (**Table 6-3**), the Reversibility (**Table 6-4**) as well as the Duration (**Table 6-5**) and multiplying with the Probability score (**Table 6-6**) to obtain the final Impact Significance.

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 with this assessment making use an empirical method as defined in **Table 6-6**.

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

Table 6-2: 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**
Very Low	No impact. Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Total projected noise level is less than the Zone Sound Level.	1
Low	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Total projected noise levels between 0 to 3 dBA above the Zone Sound Level.	2
Medium / Moderate	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 3 and 5 above the Zone Sound Level.	3
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Total projected noise levels between 5 and 7 dBA above the Zone Sound Level.	4
Very High	Increase in average ambient sound pressure levels higher than 10 dBA. Total projected noise levels higher than 7 dB above the Zone Sound Level. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	5

Table 6-3: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site only	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 outside the activity 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 6-4: Impact Assessment Criteria – Reversibility of Impact

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Reversible	The impact is fully reversible / recoverable without rehabilitation	1
Recoverable	The impact is reversible / recoverable with some rehabilitation	3
Irreversible	The impact is not reversible / recoverable despite rehabilitation	5

Table 6-5: 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**
Immediate	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 15 years.	3
Long term	The impact will continue or last for the entire operational lifetime i.e., exceed 20 - 25 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 6-6: 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	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).	1
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. In a rural environment, once noise levels exceed 35 dBA less than 10% of receptors may be annoyed by increased noises.	2
Probable	There is a possibility that the impact will occur to the extent that provisions must be made. At noise levels exceeding 45 dBA, up to 50% of people may become annoyed. Noise levels exceeding 42 dBA may be considered a disturbing noise and is prohibited in terms of the NCR.	3
Highly Likely	It is most likely that the impacts will occur at some stage of the development. At noise levels ranging between 45 and 52 dBA, between 50% and 75% of NSR may become annoyed.	4
Definite	The impact will take place regardless of any prevention plans and only mitigation actions or contingency plans to contain the effect can be relied on. Noise levels higher than 52 dBA is expected to annoy most NSR.	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 6-7**.

Table 6-7: Impact Assessment Criteria – Significance without Mitigation

TOTAL SCORE	4 TO 15	16 TO 30	31 TO 60	61 TO 80	81 TO 100
Environmental Significance Rating (Negative (-))	Very low	Low	Moderate	High	Very High
Environmental Significance Rating (Positive (+))	Very low	Low	Moderate	High	Very High

7 METHODS: CALCULATION OF NOISE LEVELS

7.1 POINT[14] AND AREA[15] NOISE SOURCES – CONSTRUCTION AND OPERATIONAL ACTIVITIES

The noise emissions from various sources were calculated in detail for the conceptual construction and operational activities by using the sound propagation algorithms described by the ISO 9613-2 model. The following were considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receivers 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;
- Screening corrections where applicable;
- Topographical layout; and
- Acoustical characteristics of the ground.

Potential operational cycles were not considered and a worst-case scenario was evaluated, assuming that all activities and equipment generate the maximum noise level 100% of the time.

The ISO 9613-2 noise propagation model is used, as it is the model most frequently recommended, with this noise propagation model preferred in Australia (EPA, 2009) [**19**], the European Union (Directive 2002/49/EC)[16] [**8**, **17**] and a number of other countries.

7.2 ROAD TRAFFIC NOISE LEVELS

The noise emission into the environment due to project road traffic (mainly construction traffic) will be estimated using a simplified noise propagation model described in SANS 10210:2004. It mainly considers the distance of receptor from the road as well as average speeds of travel. Factors that are not considered include topography and barrier effects (noise levels could be over-estimated), Road construction material (noise levels could be over-estimated), Types of vehicles used (noise levels could be under-estimated), Road gradient (noise levels could be over- or under-estimated); and Ground acoustical conditions (noise levels could be over-estimated).

[14] Typically a WTG, or a stationary noise generating activity or piece of equipment.
[15] Such as a large surface vibrating, up to a defined area where equipment is moving around. It can include an industrial project where the locations of noise generating activities or equipment cannot be defined. This is used as a worst-case, as the inclusion of a large area source(s) tend to over model noise levels.
[16] This directive does not recommend but actually stipulate the use of this noise model for industrial noise sources.

8 ASSUMPTIONS AND LIMITATIONS

8.1 LIMITATIONS - ACOUSTICAL MEASUREMENTS

Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of day, dependant on faunal characteristics (mating season, dawn chorus [17] early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind).

Selecting an ideal measurement location could be difficult, with various criteria assessed to identify the viability of a certain location as a point to define ambient sound levels. When selecting a measurement location, the most important criteria would be:

1. Security of the instrument (minimise risk to the technician; prevent theft; sabotage of the equipment);
2. Safety of the equipment (ensure that it does not prevent, interfere or limit typical agricultural or household activities; ensure that the instrument are not in a location where an animal could damage the instrument); and lastly,
3. The suitability of the measurement location to define ambient sound levels (the presence of certain trees or equipment, wetland or other water resources will influence ambient sound level significantly).

As such, after ensuring that the instrument is safe and secure, there are various environmental factors that could influence ambient sound levels measured. These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[(18)];
- Defining ambient sound levels using the result of one 10-minute measurement may be very inaccurate (very low confidence level in the results) relating to the reasons mentioned above, and measurements over a longer-term period is critical;

[(17)] Environ. We Int. Sci. Tech. *Ambient noise levels due to dawn chorus at different habitats in Delhi*. 2001. Pg. 134.
[(18)] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

- Some equipment that could influence measurements may be missed when deploying instruments, or, the equipment may not the audible. This could include equipment such as hidden water pumps and associated pipelines and outflows, ESKOM stepdown transformers, hidden compressors, inverters, condensers or other electrical equipment, etc. While not audible during deployment, such equipment may significantly influence ambient sound levels during quiet periods;
- Type, the number and sizes of trees in the vicinity of the instrument, as well as the distances between the microphone and these trees. Certain trees, especially fruiting trees could attract birds and other animals that will significantly impact on ambient sound levels;
- Type and number of animals in the vicinity of the microphone. Dogs, chickens, geese, etc. generate different noises randomly both night and day, and other livestock (sheep, goats, cattle, horses, etc.) kept in enclosures will also raise noise levels, especially if these animals are penned in large numbers;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. However, when determining the ambient sound levels associated with increased wind speeds, it is desired to measure ambient sound levels at higher wind speeds;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural environment, and in various cases sought after and pleasing. Ambient sound level data measured in such area however should not be used to develop an opinion in the potential prevailing ambient sound levels in the larger area;
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptors dwelling, or environmental ambient baseline contributors of significance (faunal, roads traffic, railway traffic movement etc.); and

  As a residential area develops the presence of people will result in increased dwelling related sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

8.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

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

- Many sound propagation models do not consider sound characteristics as calculations are based on an equivalent level (with the appropriate correction implemented e.g. tone or impulse). These other characteristics include intrusive sounds or amplitude modulation;
- Most sound propagation models do not consider refraction through the various temperature layers (specifically relevant during the night-times);
- Most sound propagation models do not consider the low frequency range (third octave 16 Hz – 31.5 Hz). This would be relevant to facilities with a potentially low frequency issue;
- Many environmental models consider sound to propagate in hemi-spherical way. Certain noise sources (e.g., a speaker, exhausts, fans) emit sound power levels in a directional manner;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Many environmental models are not highly suited for close proximity calculations; and
- Acoustical characteristics of the ground are over-simplified, with ground conditions accepted as uniform.

8.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

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

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

8.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

Any noise impact can be mitigated to have a low significance; however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of an NSR). These mitigation measures may be engineered, technological or due to management commitment.

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

It was assumed the mitigation measures proposed for the construction phase, if any is included and proposed in this report, will be considered during the planning phase, implemented during the construction phase and continued during the operational phase.

8.5 UNCERTAINTIES OF INFORMATION PROVIDED

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

- It is technically difficult and time-consuming to improve the measurement of spectral distribution of large equipment in an industrial setting. This is due to the many correction factors that need to be considered (e.g., other noise sources active in the area, adequacy of average time setting, surrounding field non-uniformity etc.[19] as per SANS 9614-3:2005);
- 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 a scenario where processes and equipment are under

[19] SANS 9614-3:2005. "Determination of sound power levels of noise sources using sound intensity – Part 3: Precision method for measurement by scanning".

full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely be over-estimated;

- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor, nor the potential effect of the modulation of amplitude of the noise;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (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; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform.

Due to the uncertainties highlighted in section **8.2** and **8.5**, modelling generally could be out with as much as +10 dBA (the potential noise level is over-modelled), although realistic values ranging from 3 dBA to less than 5 dBA are more common in practice.

8.6 CONDITIONS TO WHICH THIS STUDY IS SUBJECT

This study is not subject to any conditions.

9 PROJECTED NOISE RATING LEVELS

9.1 CONCEPTUAL SCENARIOS – NOISE DUE TO FUTURE CONSTRUCTION ACTIVITIES

9.1.1 Noises from Access Roads

Noises may be generated during the construction phase when access roads are constructed (or upgraded), as well as from construction traffic passing NSR. This assessment considers the potential impact on NSR located within the PFAs (for the three location alternatives), assuming an average of 40 vehicles per hour travelling past NSR at a speed of 60 km/h on the tar roads and 40 km/h on the gravel roads. Half of the vehicles are heavy vehicles.

The estimated noise levels are defined per site location alternative, considering the potential route that traffic may take in:

- **Appendix F, Table 1**, considering locations where construction activities may take place to access site alternative location 1;
- **Appendix F, Table 2**, considering locations where construction activities may take place to access site alternative location 2; and
- **Appendix F, Table 3**, considering locations where construction activities may take place to access site alternative location 3.

The estimated noise levels associated construction traffic passing NSR is defined in:

- **Appendix F, Table 4**, considering NSR that may be passed *en route* to site alternative location 1;
- **Appendix F, Table 5**, considering NSR that may be passed *en route* to site alternative location 2; and
- **Appendix F, Table 6**, considering NSR that may be passed *en route* to site alternative location 3.

9.1.2 Noises from construction activities

Noise models was developed considering the conceptual construction activities as discussed in **Section 5.1**, with the potential noise level contours illustrated in:

- **Figure 9-1**, with the potential construction noise levels defined per NSR in **Appendix F, Table 7** for activities at site alternative location 1;
- **Figure 9-2**, with the potential construction noise levels defined per NSR in **Appendix F, Table 8** for activities at site alternative location 2; and
- **Figure 9-3**, with the potential construction noise levels defined per NSR in **Appendix F, Table 9** for activities at site alternative location 3.

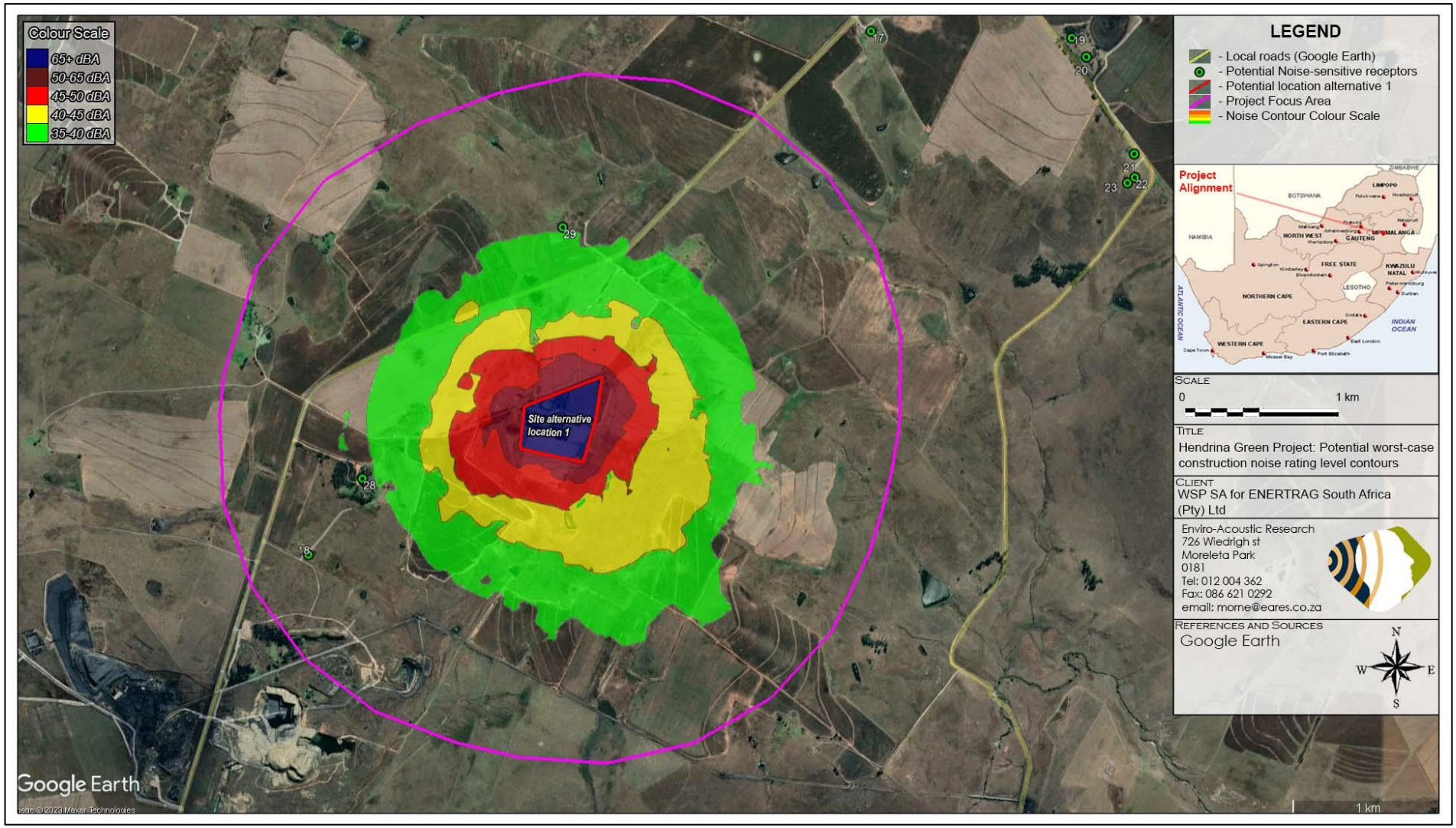

Figure 9-1: Potential noise rating level contours – Construction of facility at site location 1

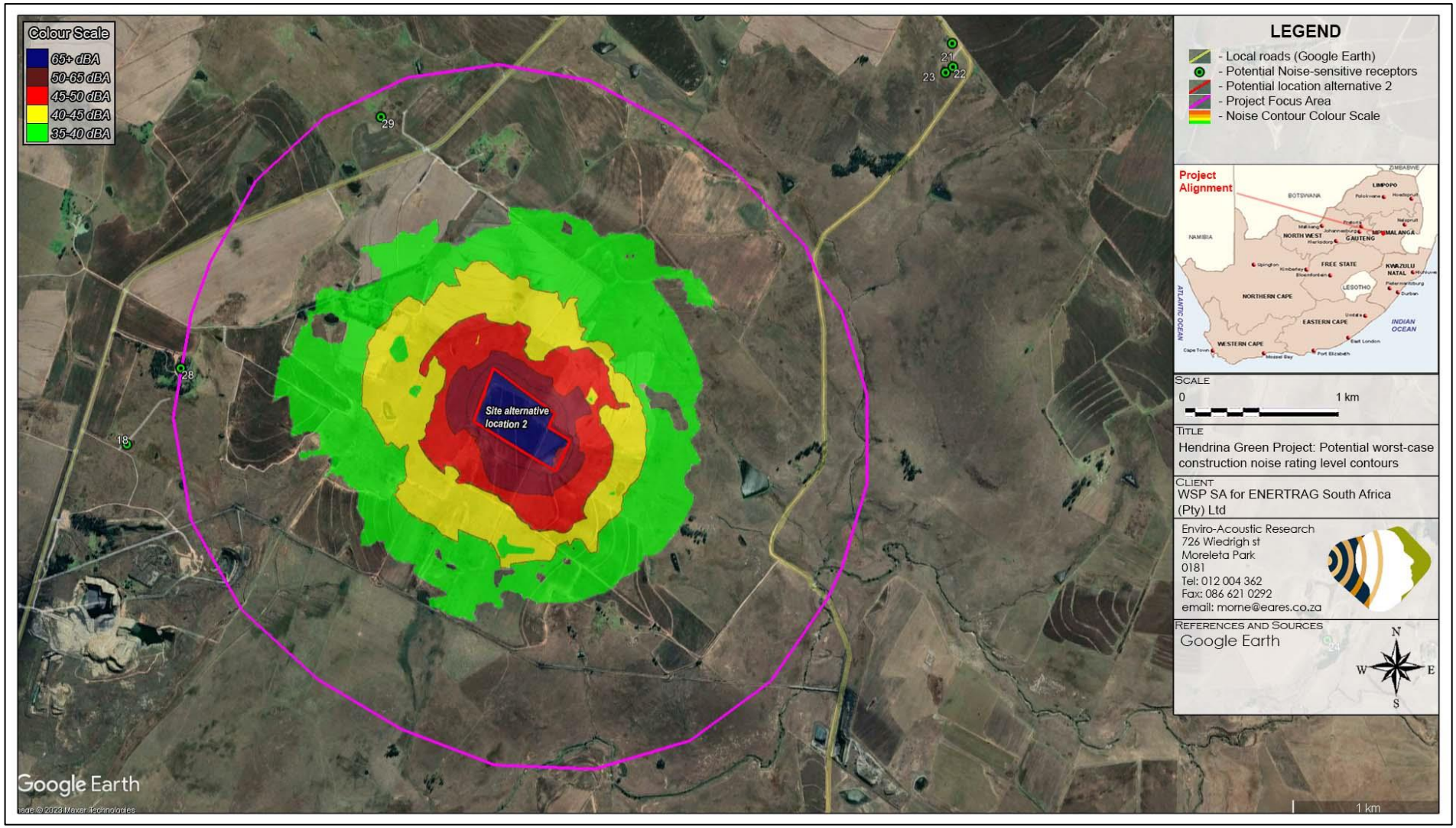

Figure 9-2: Potential noise rating level contours – Construction of facility at site location 2

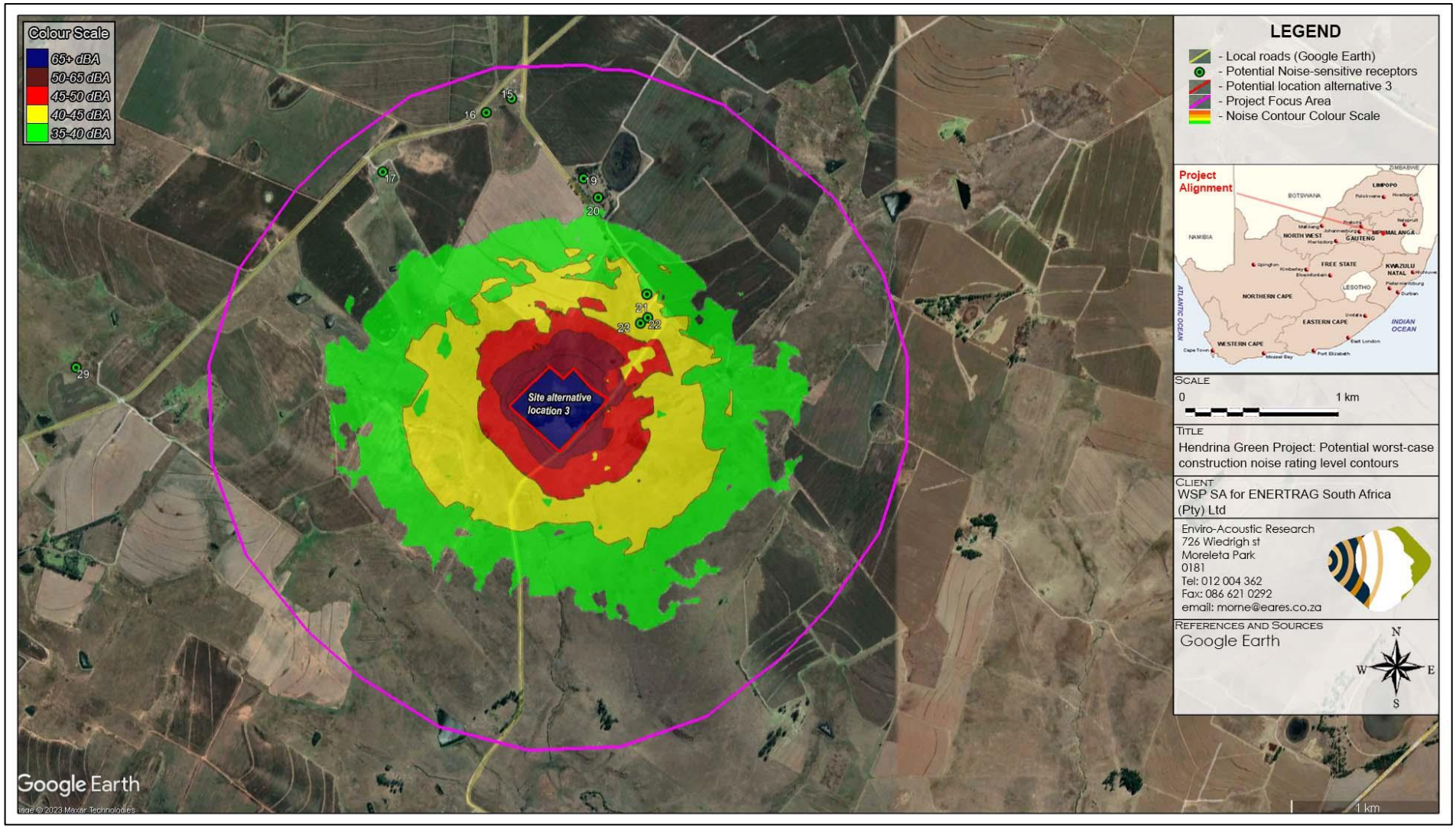

Figure 9-3: Potential noise rating level contours – Construction of facility at site location 3

9.2 CONCEPTUAL SCENARIOS – NOISE DUE TO FUTURE OPERATIONAL ACTIVITIES

Noise models were developed considering the conceptual operational activities as discussed in **Section 5.2**, with the potential noise rating level contours associated with the potential operational activities illustrated in:

- **Figure 9-4** and the calculated noise levels defined per NSR in **Appendix F, Table 13** for site alternative location 1;
- **Figure 9-5** and the calculated noise levels defined per NSR in **Appendix F, Table 14** for site alternative location 2; and
- **Figure 9-6** and the calculated noise levels defined per NSR in **Appendix F, Table 15** for site alternative location 3;

9.3 POTENTIAL CUMULATIVE NOISE IMPACTS

Cumulative noise impacts generally only occur when noise sources are closer than 2,000m from each other, with the cumulative impact also only affecting the area between the noise sources. As the distance between potential noise sources increase, the cumulative effect decreases, with noise sources further than 2,000m from an NSR having an insignificant influence on cumulative noises.

It is projected that typical ambient sound levels will be higher during typical operational periods, with the projected ambient sound level higher than the night-time rural rating levels (de Jager, 2022) due to wind-induced noises. As such, this will significantly diminish the potential effect of cumulative noises and the significance is expected to be very low.

9.4 POTENTIAL DECOMMISSIONING, CLOSURE AND POST-CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and/or operational phases. This is because:

- Decommissioning activities normally are limited to the daytime period, due to the lower urgency to complete this phase; and
- Decommissioning activities normally use smaller and less equipment, generating less noise than the typical construction or operational phases.

If required, the noise levels for decommissioning can be compared with the daytime construction phase noise level and the significance of the noise impact will be similar or less.

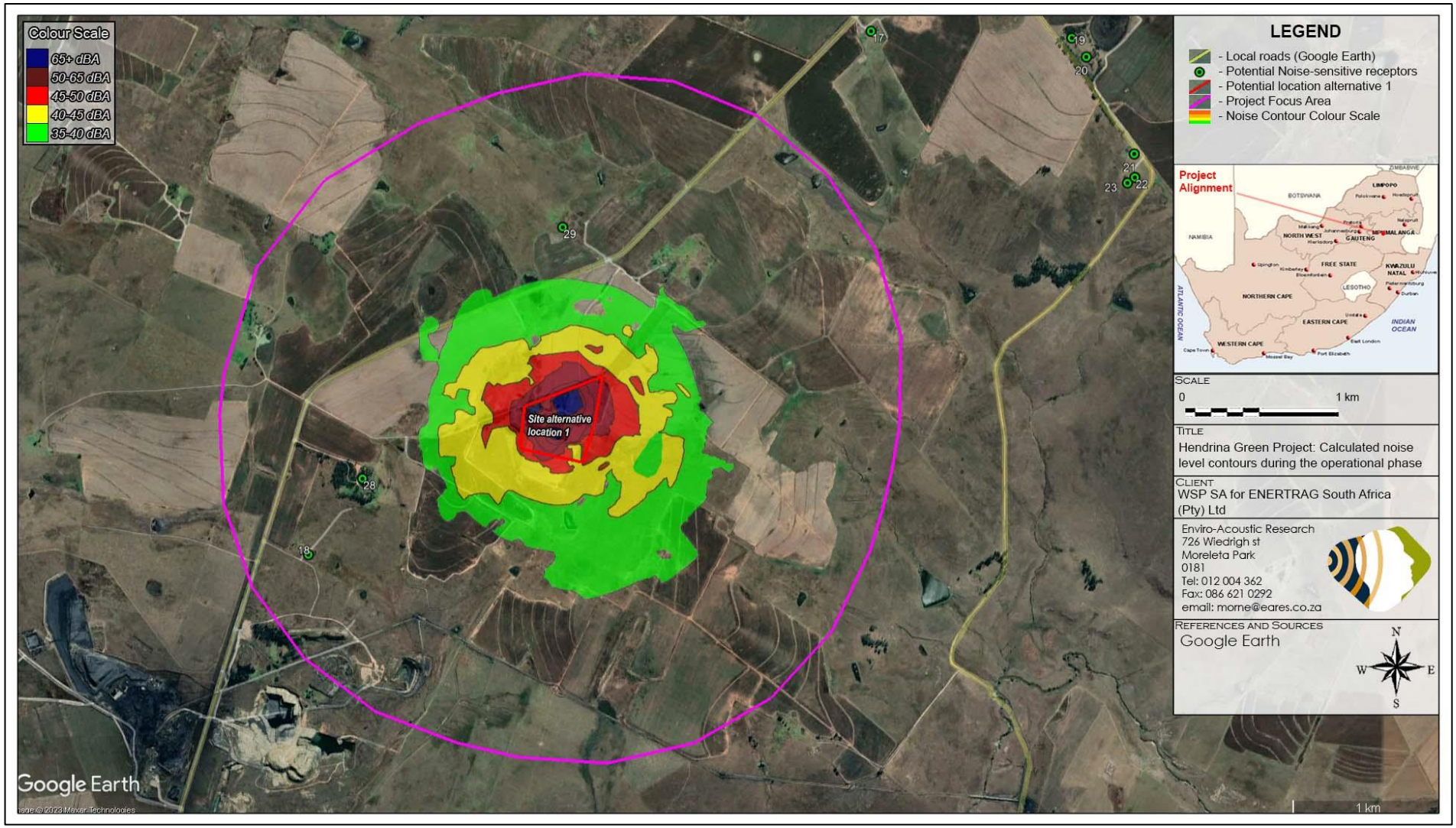

Figure 9-4: Potential noise rating level contours – Operational activities at site alternative location 1

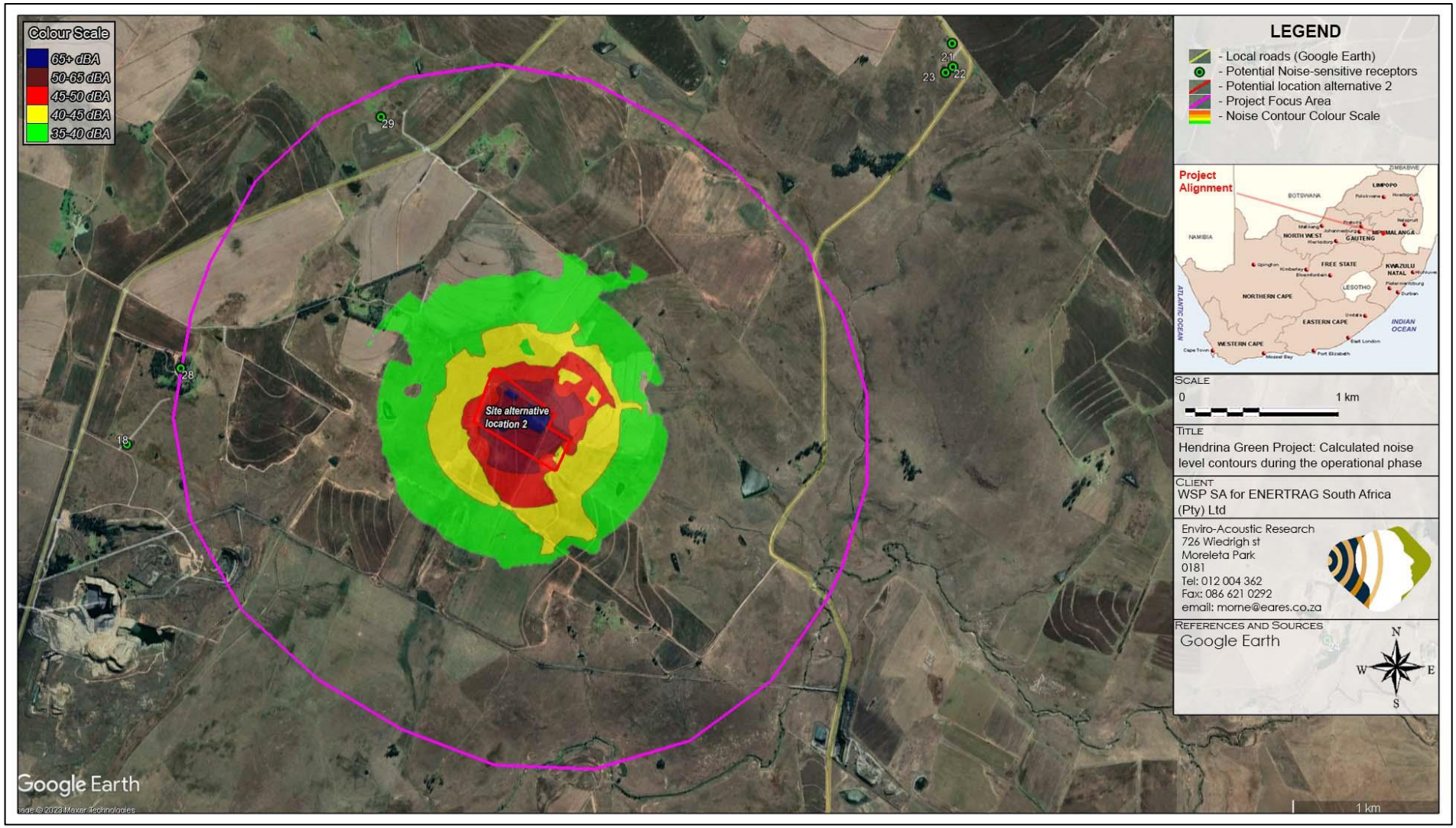

Figure 9-5: Potential noise rating level contours – Operational activities at site alternative location 2

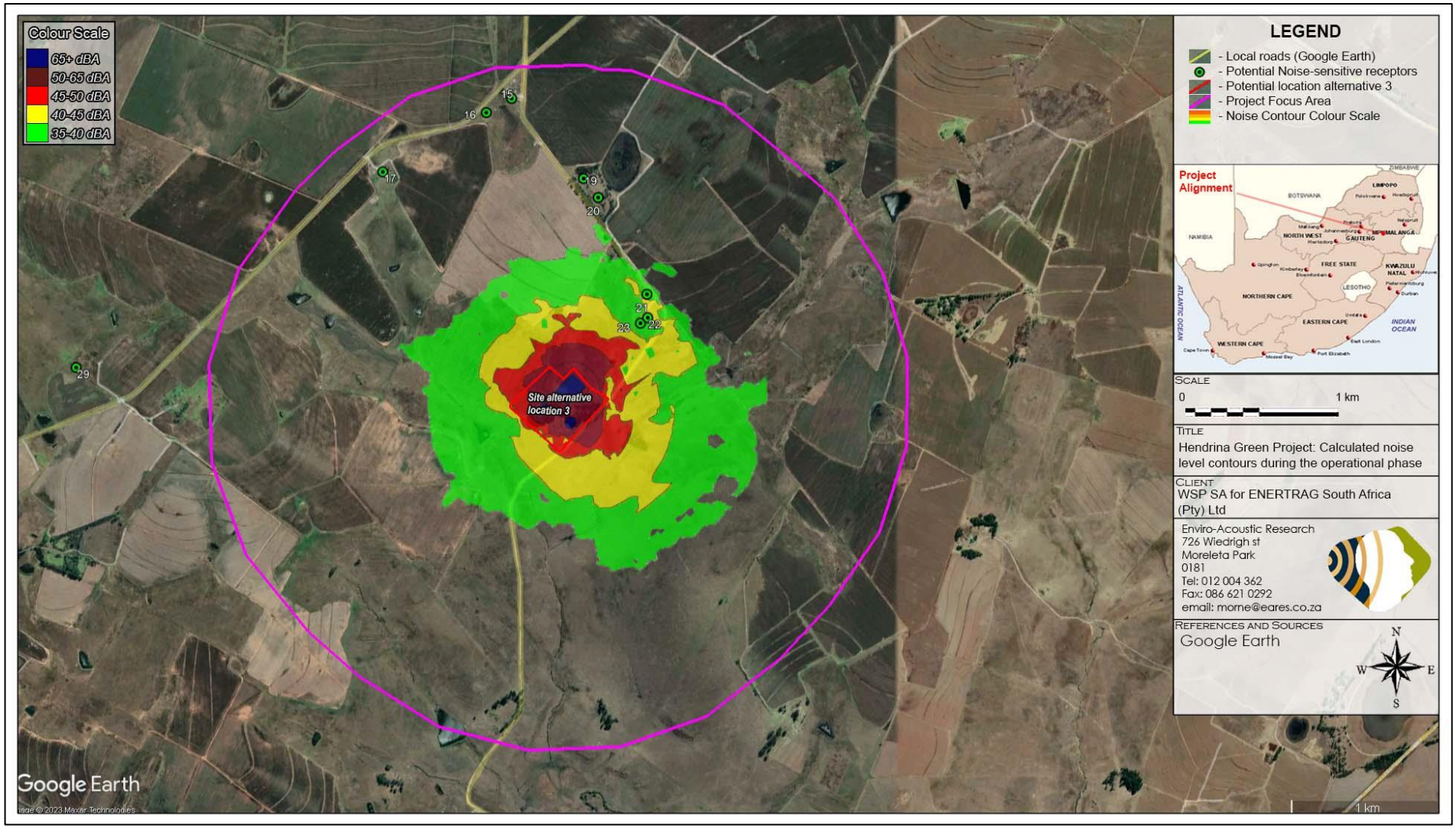

Figure 9-6: Potential noise rating level contours – Operational activities at site alternative location 3

10 SIGNIFICANCE OF THE NOISE IMPACT

10.1 NOISE IMPACT DUE TO FUTURE CONSTRUCTION ACTIVITIES

10.1.1 Construction activities relating to the Access Roads

Noises levels associated with the construction of the access road were estimated in **section 9.1.1**, with the estimated noise levels as well as the potential significance of the noise impact defined per NSR in:

- **Appendix F, Table 1**, considering locations where construction activities may take place to access site alternative location 1, with the significance of the impact summarized in **Table 10-1**;
- **Appendix F, Table 2**, considering locations where construction activities may take place to access site alternative location 2, with the significance of the impact summarized in **Table 10-2**; and
- **Appendix F, Table 3**, considering locations where construction activities may take place to access site alternative location 3, with the significance of the impact summarized in **Table 10-3**.

Table 10-1: Impact Assessment: Construction of access roads, location option 1

Nature: Noises generated with the construction of access roads *en route* to the site alternative location 1		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 1** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Moderate (3)	Moderate (3)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Temporary (1)	Temporary (1)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low** (7)	**Very Low** (7)
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime road construction activities and no additional mitigation is required.		
Cumulative impacts:		

The potential of cumulative noises for daytime construction activities are low.
Irreplaceable loss of resources?
Medium loss of resource (quiet environment away from busy roads).
Residual Risks:
There is no risk of any residual noises.

Table 10-2: Impact Assessment: Construction of access roads, location option 2

Nature: Noises generated with the construction of access roads *en route* to the site alternative location 2		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 2** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Moderate (3)	Moderate (3)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Temporary (1)	Temporary (1)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low** (7)	**Very Low** (7)
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime road construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-3: Impact Assessment: Construction of access roads, location option 3

Nature: Noises generated with the construction of access roads *en route* to the site alternative location 3		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the existing ambient sound levels with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 3** and summarized in this table.		
	Without Mitigation	***With Mitigation***

Magnitude (Table 6-2)	Very High (5)	Very High (5)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Temporary (1)	Temporary (1)
Probability (Table 6-6)	Possible (2)	Possible (2)
Significance of Impact (Table 6-7)	**Low (18)**	**Low (18)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low for daytime road construction activities and no additional mitigation is recommended.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

10.1.2Noises relating to Construction Traffic passing NSR

Noises levels associated with construction traffic passing NSR during the construction phase was estimated in **section 9.1.1**, with the estimated noise levels as well as the potential significance of the noise impact defined per NSR in

- **Appendix F, Table 4**, considering NSR that may be passed *en route* to site alternative location 1, with the significance of the impact summarized in;
- **Appendix F, Table 5**, considering NSR that may be passed *en route* to site alternative location 2, with the significance of the impact summarized in; and
- **Appendix F, Table 6**, considering NSR that may be passed *en route* to site alternative location 3, with the significance of the impact summarized in.

Table 10-4: Impact Assessment: Construction traffic passing NSR to location option 1

Nature: Noises relating to construction traffic passing NSR *en route* to the site alternative location 1		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 4** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Very High (5)	Very High (5)

Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Likely (3)	Likely (3)
Significance of Impact (Table 6-7)	**Low (30)**	**Low (30)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low relating to construction traffic passing NSR and additional mitigation is not required or recommended.		
Cumulative impacts: The potential of cumulative noises for daytime construction traffic are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-5: Impact Assessment: Construction traffic passing NSR to location option 2

Nature: Noises relating to construction traffic passing NSR *en route* to the site alternative location 2		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 5** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Very High (5)	Very High (5)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Likely (3)	Likely (3)
Significance of Impact (Table 6-7)	**Low (30)**	**Low (30)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low relating to construction traffic passing NSR and additional mitigation is not required or recommended.		
Cumulative impacts: The potential of cumulative noises for daytime construction traffic are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-6: Impact Assessment: Construction traffic passing NSR to location option 3

Nature: Noises relating to construction traffic passing NSR *en route* to the site alternative location 3		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 6** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Very High (5)	Very High (5)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Likely (3)	Likely (3)
Significance of Impact (Table 6-7)	**Low (30)**	**Low (30)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low relating to construction traffic passing NSR and additional mitigation is not required or recommended.		
Cumulative impacts: The potential of cumulative noises for daytime construction traffic are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

10.1.3 Construction of project infrastructure

The potential noise impact for the various construction activities at the Hendrina green project was calculated in **section 9.1.2**, with the potential significance of the noise impacts is defined per NSR in:

- **Appendix F, Table 7**, with the potential significance of the noise impact for daytime construction activities at site location alternative 1 summarized in **Table 10-7** (for daytime activities). While unlikely to take place, the potential impact for night-time construction activities defined in **Appendix F, Table 10**, with the significance summarized in **Table 10-8**;
- **Appendix F, Table 8**, with the potential significance of the noise impact for daytime construction activities at site location alternative 2 summarized in **Table**

10-9 (for daytime activities). While unlikely to take place, the potential impact for night-time construction activities defined in **Appendix F, Table 11**, with the significance summarized in **Table 10-10**; and

- **Appendix F, Table 9**, with the potential significance of the noise impact for daytime construction activities at site location alternative 3 summarized in **Table 10-11** (for daytime activities). While unlikely to take place, the potential impact for night-time construction activities defined in **Appendix F, Table 12**, with the significance summarized in **Table 10-12**.

Table 10-7: Impact Assessment: Daytime construction activities at site alternative location 1

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 1 during the day		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 7** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (6)**	**Very Low (6)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-8: Impact Assessment: Night-time construction activities at site alternative location 1

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 1 at night		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Night-time construction activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 10** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Low (2)	Low (2)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (8)**	**Very Low (8)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for night-time construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-9: Impact Assessment: Daytime construction activities at site alternative location 2

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 2 during the day		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 8** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)

Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (6)**	**Very Low (6)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-10: Impact Assessment: Night-time construction activities at site alternative location 2

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 2 at night		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Night-time construction activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 11** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (7)**	**Very Low (7)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for night-time construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		

Residual Risks: There is no risk of any residual noises.

Table 10-11: Impact Assessment: Daytime construction activities at site alternative location 3

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 3 during the day		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime construction activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 9** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Moderate (3)	Moderate (3)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low** (6)	**Very Low** (6)
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-12: Impact Assessment: Night-time construction activities at site alternative location 3

Nature: Noises generated during the construction of the green hydrogen and ammonia facility at site alternative location 3 at night
Acceptable Rating Level   Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location.   Night-time construction activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 12** and summarized in this table.

	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Very High (5)	Very High (5)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Short-term (2)	Short-term (2)
Probability (Table 6-6)	Possible (2)	Possible (2)
Significance of Impact (Table 6-7)	**Low (22)**	**Low (22)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low for night-time construction activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime construction activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

10.2 NOISE IMPACT DUE TO FUTURE OPERATIONAL ACTIVITIES

The operational noise levels were calculated for the various activities as conceptualised **section 9.2**, with the potential significance of the noise impacts defined per NSR in:

- **Appendix F, Table 13**, with the potential significance of the noise impact for daytime operational activities at site location alternative 1 summarized in **Table 10-13** (for daytime activities). The potential impact for night-time operational activities is defined in **Appendix F, Table 16**, with the significance summarized in **Table 10-14**;
- **Appendix F, Table 14**, with the potential significance of the noise impact for daytime operational activities at site location alternative 2 summarized in **Table 10-15** (for daytime activities). The potential impact for night-time operational activities is defined in **Appendix F, Table 17**, with the significance summarized in **Table 10-16**; and
- **Appendix F, Table 15**, with the potential significance of the noise impact for daytime operational activities at site location alternative 3 summarized in **Table 10-17** (for daytime activities). The potential impact for night-time operational activities is defined in **Appendix F, Table 18**, with the significance summarized in **Table 10-18**.

Table 10-13: Impact Assessment: Daytime operational activities at site alternative location 1

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 1 during the day		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime operational activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 13** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (8)**	**Very Low (8)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-14: Impact Assessment: Night-time operational activities at site alternative location 1

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 1 at night		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Night-time operational activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 16** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)

Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (9)**	**Very Low (9)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for night-time operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-15: Impact Assessment: Daytime operational activities at site alternative location 2

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 2 during the day		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Daytime operational activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 14** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (8)**	**Very Low (8)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		

Residual Risks: There is no risk of any residual noises.

Table 10-16: Impact Assessment: Night-time operational activities at site alternative location 2

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 2 at night		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Night-time operational activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 17** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Minor (1)	Minor (1)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (9)**	**Very Low (9)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for night-time operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-17: Impact Assessment: Daytime operational activities at site alternative location 3

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 3 during the day
Acceptable Rating Level   Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 41.9 (average impulse-weighted equivalent value) and 38.0 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location.   Daytime operational activities should not change the daytime rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 15** and summarized in this table.

	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Low (2)	Low (2)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Local (2)	Local (2)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (9)**	**Very Low (9)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is very low for daytime operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

Table 10-18: Impact Assessment: Night-time operational activities at site alternative location 3

Nature: Noises generated during the operation of the green hydrogen and ammonia facility at site alternative location 3 at night		
Acceptable Rating Level Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 34.4 (average impulse-weighted equivalent value) and 31.4 dBA (arithmetic fast-weighted average) (see **section 4.4**) at the quietest location. Night-time operational activities should not change the night-time rating level with more than 7 dB. The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix F, Table 18** and summarized in this table.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	High (4)	High (4)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Possible (2)	Possible (2)
Significance of Impact (Table 6-7)	**Low (24)**	**Low (24)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of the noise impact is low for night-time operational activities and no additional mitigation is required.		
Cumulative impacts: The potential of cumulative noises for daytime operational activities are low.		

Irreplaceable loss of resources?
Medium loss of resource (quiet environment away from busy roads).
Residual Risks:
There is no risk of any residual noises.

10.3 CUMULATIVE NOISE IMPACT

There is a very low risk of cumulative noises during the construction phase, as noises from other construction activities are highly unlikely to result in cumulative construction noise impacts (as it is unlikely to take place at the same time).

As discussed in **section 9.3**, there is an insignificant risk of a noise impact during periods when the wind turbines are operational. This is because ambient sound levels will be elevated due to wind-induced noises, and significantly higher than the rating levels assumed in this assessment. Considering the potential risks, the calculated noise levels as well as experience on similar projects, risks for cumulative impacts will be low as summarized in **Table 10-19** (relevant for all site alternative locations).

Table 10-19: Impact Assessment: Potential Cumulative Operational Noise Impacts

Nature: Cumulative noises generated due to the simultaneous operation of the wind turbines as well as noises from the green hydrogen and ammonia facility (at all site alternative locations)		
Acceptable Rating Level Wind turbines will only operate during period with increased winds, periods when ambient sound levels are expected to be higher than periods with no or low winds. When operating together with green project, there might be a slight cumulative effect.		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6-2)	Low (2)	Low (2)
Extent ($\Delta L_{Aeq,D}$>7dBA)(Table 6-3)	Regional (3)	Regional (3)
Reversibility (Table 6-4)	Reversible (1)	Reversible (1)
Duration (Table 6-5)	Long-term (4)	Long-term (4)
Probability (Table 6-6)	Improbable (1)	Improbable (1)
Significance of Impact (Table 6-7)	**Very Low (10)**	**Very Low (10)**
Status	Negative	Negative
Reversibility	High	High
Can impacts be mitigated	Yes	Yes
Mitigation: The significance of potential cumulative noise impacts is very low for the conceptual scenarios considered and no additional mitigation is required.		
Irreplaceable loss of resources? Medium loss of resource (quiet environment away from busy roads).		
Residual Risks: There is no risk of any residual noises.		

10.4 EVALUATION OF ALTERNATIVES

10.4.1 No-go option

The ambient sound levels will remain as is and the area would keep the rural noise character.

10.4.2 Proposed alternative site locations

The proposed green hydrogen and ammonia facility will slightly raise the noise levels at a number of the closest potential NSR. Three potential locations were investigated in detail, with the assessment indicating a low to very low significance for a noise impact to occur during the long-term operational phase. There might be a noise impact of a moderate significance during the construction phase, relating to construction traffic passing NSR.

In terms of acoustics, there is a slight preference for alternative site locations 1 and 2, with site location 3 least preferred. This is mainly due to the relative proximity of NSR to alternative location 3 compared to the other alternative locations.

11 MITIGATION OPTIONS

This study considers the potential noise impact on the surrounding environment due to the construction, operational and future decommissioning activities associated with the green project. It was determined that the potential noise impacts, without mitigation, would be:

- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 1);
- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 2);
- of a **low significance** relating to potential road construction activity noises (leading to site alternative location 3);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 1);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 2);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 3);
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 at night;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 at night;
- of a **low significance** relating to potential infrastructure construction activity noises at site alternative location 3 at night;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 2 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 at night;

- of a **very low significance** relating to potential operational activity noises at site alternative location 2 at night; and
- of a **low significance** relating to potential operational activity noises at site alternative location 3 at night.

Potential cumulative noise impacts will be insignificant, resulting in a noise impact of a low significance for both the construction and operational phases.

The project developer must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon, as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. At all stages, surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities will be inaudible due to existing high ambient sound levels. The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities, the spectral character and that of the surrounding soundscape (both level and spectral character).

The developer must implement a line of communication (i.e., a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers. The proposed project should maintain a commitment to the local community (people staying within 1,000 m from construction or operational activities) and respond to noise concerns in an expedient fashion. Sporadic and legitimate noise complaints could be raised. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or perforations or slits in the blades. Problems of this nature can be corrected quickly and it is in the developer's interest to do so.

Continuing management objectives would be to:

- aim to keep daytime noise levels below 52 dBA at all potential NSR (dwellings used for residential purposes);
- aim to keep night-time noise levels below 45 dBA at all potential NSR (dwellings used for residential purposes); and
- Prevent the generation of nuisance noises.

11.1 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING THE CONSTRUCTION PHASE

The significance of noise during the construction phase may have a noise impact of **very low** and of a **low** significance for all site location alternatives. The potential noise impact mainly relates to construction traffic passing close to NSR and daytime noise levels may exceed the recommended daytime noise limit of 52 dBA. Noises from passing traffic may annoy NSR. Potential measures that may reduce the probability of annoyance and potential complaints include:

- Community participation, with the community notified of construction activities, the duration of the activities and potential impacts on them;
- Only permitting construction traffic during the daytime period; and
- Including noise as an environmental component in Health and Safety Induction training to employees, contractors and sub-contractors.

11.2 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING OPERATION

The significance of noise during the operation phase is **low** to **very low** for all alternative location options. In terms of acoustics, site alternative location 1 or 2 is preferred above location 3.

11.3 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING DECOMMISSIONING

The potential significance of the noise impact would be similar as the construction phase (**low** significance) and no further mitigation is recommended or required for the decommissioning phase.

11.4 MITIGATION AND MANAGEMENT CONDITIONS TO BE INCLUDED IN THE EMPR AND ENVIRONMENTAL AUTHORIZATION

It is recommended that the project developer:

- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised;

- The Developer includes a component covering environmental noise in the Health and Safety Induction to sensitize all employees and contractors about the potential impact from noise, especially those employees and contractors that have to travel past receptors at night, or might be required to do work close (within 1,000m) to NSRs at night;
- The Developer investigates any reasonable and valid noise complaint if registered by a receptor staying within 1,000 m from the location where construction activities are taking place. A complaint register, keeping a full record of the complaint, must be kept by the Developer; and
- The use of vehicle horns should be minimized where possible.

12 ENVIRONMENTAL MONITORING PLAN

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

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

The significance of noise impacts was estimated to be low to very low, and additional noise monitoring is not recommended or required. However, should a reasonable and valid noise complaint be registered, the Developer should investigate the noise complaint as per the guidelines in **sub-section 12.1** and **12.2**. These guidelines should be used as a rough guideline as site-specific conditions may require that the monitoring locations, frequency or procedure be adapted.

12.1 MEASUREMENT LOCALITIES AND FREQUENCY

Should there be a noise complaint, once-off noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. These measurement locations can be reduced accordingly if the NSRs are relocated or the dwelling are no longer used for residential purposes.

12.2 MEASUREMENT PROCEDURES

Ambient sound measurements should be collected as defined in SANS 10103:2008. When a noise complaint is being investigated, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing or annoying noise event.

13 CONCLUSIONS AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the noise impacts due to the proposed development, operation and decommissioning of the Hendrina Green Hydrogen and Ammonia facility west of Hendrina in the Mpumalanga Province. It is based on a predictive model to estimate potential noise levels due to the various activities and to assist in the identification of potential issues of concern.

- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 1);
- of a **very low significance** relating to potential road construction activity noises (leading to site alternative location 2);
- of a **low significance** relating to potential road construction activity noises (leading to site alternative location 3);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 1);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 2);
- of a **low significance** relating to potential noises associated with construction traffic passing NSR (leading to site alternative location 3);
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 1 at night;
- of a **very low significance** relating to potential infrastructure construction activity noises at site alternative location 2 at night;
- of a **low significance** relating to potential infrastructure construction activity noises at site alternative location 3 at night;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 2 during the day;

- of a **very low significance** relating to potential operational activity noises at site alternative location 3 during the day;
- of a **very low significance** relating to potential operational activity noises at site alternative location 1 at night;
- of a **very low significance** relating to potential operational activity noises at site alternative location 2 at night; and
- of a **low significance** relating to potential operational activity noises at site alternative location 3 at night.

Potential cumulative noise impacts will be insignificant, resulting in a noise impact of a very low significance for both the construction and operational phases.

Considering the **low** to **very low** significance of the potential noise impacts (inclusive of cumulative impacts) for the proposed project and associated infrastructure, it is recommended that the project be authorized. In terms of acoustics, site alternative location 1 or 2 is preferred above location 3.

No further noise studies or noise measurements are required, subject that potential noise complaints be investigated (which may include additional noise level measurements).

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APPENDIX A

Curriculum Vitae

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

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Use License Applications and EIA's), auditing of license 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 20 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 as well as blasting impacts. Since 2007 he has completed more than 400 Environmental Noise Impact Assessments and Noise Monitoring Reports as well as various acoustic consulting services, including amongst others:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for - Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Isivunguvungu (Aurecon), De Aar (Aurecon), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Kokerboom 3 (Aurecon), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee (ARCUS), Kolkies (ARCUS), San Kraal (ARCUS), Phezukomoya (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Scarlet Ibis (CESNET), Albany (CESNET), Sutherland (CSIR), Kap Vley (CSIR), Kuruman (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Perdekraal (ERM), Teekloof (Mainstream), Eskom Aberdene (SE), Dorper (SE), Spreeukloof (SE), Loperberg (SE), Penhoek Pass (SE), Amakhala Emoyeni (SE), Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), Namas (SE), Zonnequa (SE), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Iziduli (SE), Msenge (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Boulders (SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST),*

	Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab), Wobben (IWP), Trakas (SiVest), Beaufort West (SiVest)
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo), Royal Sheba Project (Cabanga Environmental), Rietkol Silica (Jacana), Gruisfontein Colliery (Jacana), Lehlabile Colliery (Jaco-K Consulting), Bloemendal Colliery (Enviro-Insight), Rondevly Colliery (REC), Welgedacht Colliery (REC), Kalabasfontein Extension (EIMS), Waltloo Power Generation Project (EScience), Buffalo Colliery (Marang), Balgarthen Colliery (Rayten), Kusipongo Block C (Rayten), Zandheuvel (Exigo), NamPower Walvis Bay (GPT), Eloff Phase 3 (EIMS), Dunbar (Enviro-Insight), Smokey Hills (Prescali), Bierspruit (Aurecon)*
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental), Riverfarm Development (Terramanzi), Conakry to Kindia Toll Road (Rayten)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm (Globeleq), Sephaku Aganang (Exigo), Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Bank of Botswana measurements (Linnspace), Skukuza Noise Measurements (Concor), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm*

	Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream), Twisdraai Colliery (Lefatshe Minerals), SASOL Prospecting (Lefatshe Minerals), South32 Klipspruit (Rayten), Sibanye Stillwater Kroondal (Rayten), Rooiberg Asphalt (Rooiberg Asphalt), SASOL Shondoni (Lefatshe), SASOL Twisdraai (Lefatshe), Anglo Mototolo (Exigo), Heineken Inyaniga (AECOM), Glencore Izimbiwa (Cleanstream) Glencore Impunzi (Cleanstream), Black Chrome Mine (Prescali) Sibanye Stillwater Ezulwini (Aurecon), Sibanye Stillwater Beatrix (Aurecon), Bank of Botshwana (Linspace), Lakeside (Linspace), Skukuza (SiVest), Rietvlei Colliery (Jaco-K Consulting)
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering), Tiegerpoort Wedding Venue (Henwood Environmental), Monavoni Development (Marindzini), Rezoning of Portion 1 (Primo Properties), Tswaing Mega City (Makole), Mabopane Church (EP Architects), ERGO Soweto Cluster (Kongiwe), Fabio Chains (Marang), GIDZ JMP (Marang), Temple Complex (KWP Create), Germiston Metals (Dorean), Sebenza Metals (Dorean)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma Community Wind Farm Noise Simulation project (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (SE), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy), De Aar WEF (Holland), Quarterly Measurement Reports – Dangote Delmas (Exigo), Quarterly Measurement Reports – Dangote Lichtenburg (Exigo), Quarterly Measurement Reports – Mamba Cement (Exigo), Quarterly Measurement Reports – Dangote Delmas (Exigo) Quarterly Measurement Reports – Nokeng Fluorspar (Exigo), Proton Energy Limited Nigeria (ERM), Hartebeest WEF Update (Moorreesburg) (Savannah Environmental), Modderfontein WEF Opinion (Terramanzi), IPD Vredenburg WEF (IPD Power Vredenburg), Paul Puts WEF (ARCUS), Juno WEF (ARCUS), etc.*

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APPENDIX B

Glossary of Terms

GLOSSARY OF ACOUSTIC TERMS, DEFINITIONS AND GENERAL INFORMATION

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

	(ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.

F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} and L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.

Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e., A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.

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

APPENDIX C

Declaration of Independence

APPENDIX D

Site Sensitivity Verification

SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Part A of the Assessment Protocols published in GN 320 on 20 March 2020 (i.e., Site sensitivity verification is required where a specialist assessment is required but no specific assessment protocol has been prescribed) is applicable where the Department of Environment, Forestry and Fisheries Screening Tool has the relevant themes to verify.

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). The details of the site sensitivity verification are noted below:

Date of Site Visit	30 July to 6 August 2021
Specialist Name	Morné de Jager (Noise)
Professional Registration Number (if applicable)	Not applicable, there is no registration body in South Africa that could allow professional registration for acoustic consultants.
Specialist Affiliation / Company	Enviro-Acoustic Research CC

Output from National Environmental Screening Tool

The site was initially assessed using the National Environmental Screening tool, available at, https://screening.environment.gov.za. The output from the National Online Screening tool indicates a number of areas within, and up to 2,000 m from the project boundary is considered to be of a "very high" sensitivity to noise. These potentially "very high" sensitive areas (in terms of noise) are indicated on **Figures D.1, D.1 and D.3** together with the potential noise-sensitive receptors as identified.

Description on how the site sensitivity verification was undertaken

The site sensitivity was verified using:

a) *available aerial images (Google Earth®) (See **Figures D.1, D.1 and D.3** for identified potential noise-sensitive receptors);*
b) *the statuses of these structures were verified during the site visit during July 2021.*

Outcome of the Site Sensitivity Verification

There are a number of potential noise-sensitive areas in the vicinity of the proposed development. It should also be noted that there are a number of potential noise-sensitive areas that was not identified by the online screening tool, with other areas identified as noise sensitive, though the structures at these locations not used for residential activities.

Potential noise-sensitive activities were identified (verified during the July/August 2021 site visit) and marked as green dots on **Figures D.1, D.1 and D.3**. These areas are considered to be noise-sensitive and the potential impact from noise from the project is assessed in this Noise Specialist Study.

Signature
Morné de Jager
2023 – 02 - 01

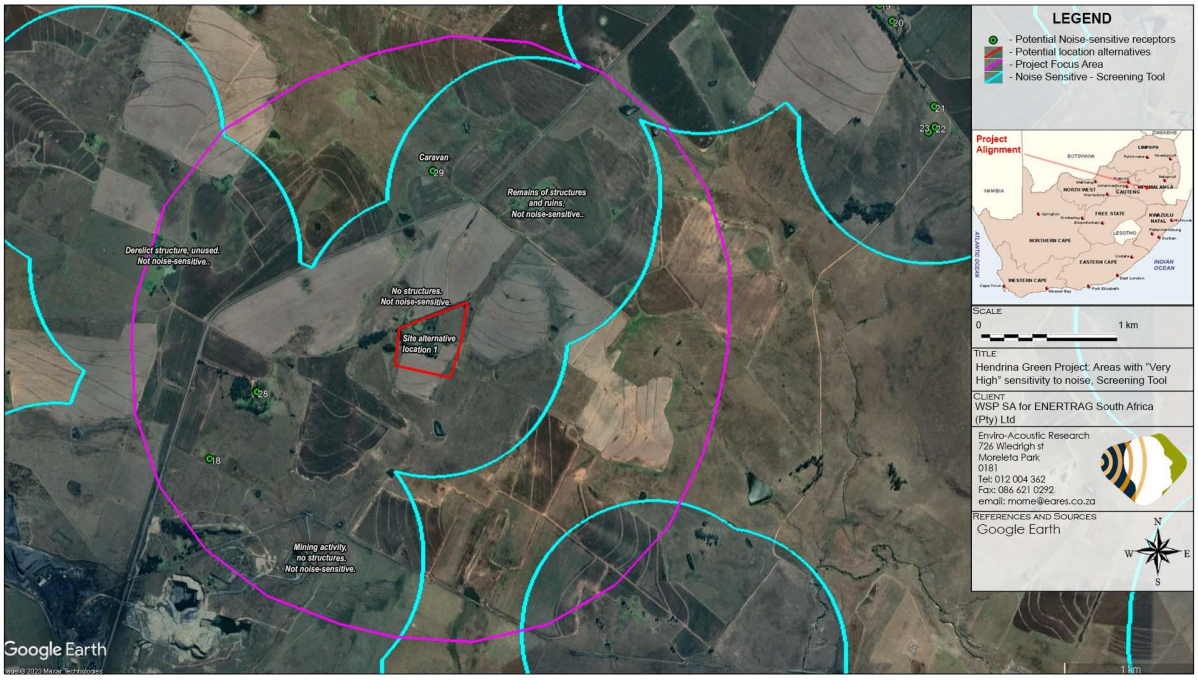

Figure D.1: Areas defined to be of "Very High" sensitivity in terms of noise by the online screening tool, Location alternative 1

Figure D.1: Areas defined to be of "Very High" sensitivity in terms of noise by the online screening tool, Location alternative 2

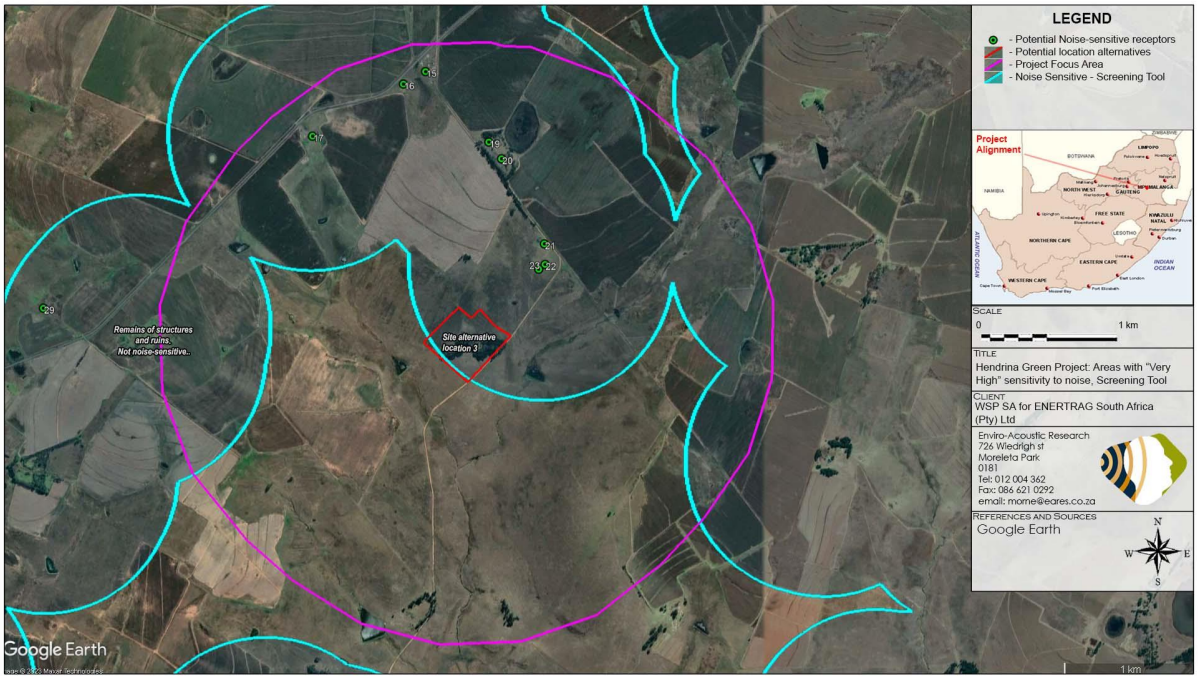

Figure D.1: Areas defined to be of "Very High" sensitivity in terms of noise by the online screening tool, Location alternative 3

APPENDIX E

Photos of Measurement Location

Photo B.1: Measurement location at CEHLTSL01 – Quiet farm dwelling

Photo B.2: Measurement location at CEHLTSL02 close to the R542 road

APPENDIX F

Calculated conceptual noise levels

Appendix F, Table 1: Projected construction (or upgrading) noise levels and daytime significance – route to site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
29	52	38.0	42.6	5.9	*Moderate (3)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

Appendix F, Table 2: Projected construction (or upgrading) noise levels and daytime significance – route to site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
29	52	38.0	42.6	5.9	*Moderate (3)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	*Very Low (7)*

Appendix F, Table 3: Projected construction (or upgrading) noise levels and daytime significance – route to site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	70.3	32.3	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
16	52	38.0	47.7	10.2	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
19	52	38.0	54.7	16.8	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
20	52	38.0	55.0	17.1	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
21	52	38.0	67.4	29.4	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*

22	52	38.0	52.5	14.7	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
23	52	38.0	51.0	13.2	*Very High (5)*	*Temporary (1)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*

Appendix F, Table 4: Projected construction traffic noise levels and daytime significance – route to site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	52.4	14.5	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	Low (30)
16	52	38.0	50.5	12.7	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	Low (30)
17	52	38.0	46.2	8.8	*High (4)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	Low (18)
29	52	38.0	42.0	5.5	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

Appendix F, Table 5: Projected construction traffic noise levels and daytime significance – route to site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	52.4	14.5	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	*Low (20)*
16	52	38.0	50.5	12.7	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	*Low (20)*
17	52	38.0	46.2	8.8	*High (4)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (20)*
29	52	38.0	42.0	5.5	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	*Very Low (8)*

Appendix F, Table 6: Projected construction traffic noise levels and daytime significance – route to site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	52.9	15.0	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	*Low (30)*
16	52	38.0	41.6	5.2	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	*Very Low (8)*
19	52	38.0	45.1	7.9	*High (4)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
20	52	38.0	45.2	8.0	*High (4)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Possible (2)*	*Low (18)*
21		38.0	51.4	13.6	*Very High (5)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Likely (3)*	*Low (30)*
22		38.0	44.0	7.0	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	*Very Low (8)*
23		38.0	43.2	6.4	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	*Very Low (8)*

Appendix F, Table 7: Projected noise levels and significance – Daytime construction activities at site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	17.4	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
16	52	38.0	17.6	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
17	52	38.0	21.2	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
18	52	38.0	29.7	0.6	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
19	52	38.0	17.4	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
20	52	38.0	16.2	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
21	52	38.0	17.4	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
22	52	38.0	17.7	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
23	52	38.0	17.9	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

28	52	38.0	34.4	1.6	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
29	52	38.0	34.7	1.7	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

Appendix F, Table 8: Projected noise levels and significance – Daytime construction activities at site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	16.6	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
16	52	38.0	15.9	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
17	52	38.0	20.1	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
18	52	38.0	27.5	0.4	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
19	52	38.0	17.5	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
20	52	38.0	15.1	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
21	52	38.0	19.2	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
22	52	38.0	19.2	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
23	52	38.0	19.5	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
28	52	38.0	30.5	0.7	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
29	52	38.0	27.8	0.4	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

Appendix F, Table 9: Projected noise levels and significance – Daytime construction activities at site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	27.2	0.3	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
16	52	38.0	27.7	0.4	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)

17	52	38.0	29.0	0.5	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
18	52	38.0	7.0	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
19	52	38.0	32.6	1.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
20	52	38.0	32.9	1.2	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
21	52	38.0	42.4	5.7	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
22	52	38.0	42.2	5.6	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
23	52	38.0	42.9	6.1	*Moderate (3)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
28	52	38.0	14.9	0.0	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)
29	52	38.0	21.5	0.1	*Minor (1)*	*Short-term (2)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (6)

Appendix F, Table 10: Projected noise levels and significance – Night-time construction activities at site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	17.4	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
16	42	31.4	17.6	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
17	42	31.4	21.2	0.4	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
18	42	31.4	29.7	2.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
19	42	31.4	17.4	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
20	42	31.4	16.2	0.1	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
21	42	31.4	17.4	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
22	42	31.4	17.7	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
23	42	31.4	17.9	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
28	42	31.4	34.4	4.8	*Low (2)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
29	42	31.4	34.7	5.0	*Low (2)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

Appendix F, Table 11: Projected noise levels and significance – Night-time construction activities at site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	16.6	0.1	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
16	42	31.4	15.9	0.1	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
17	42	31.4	20.1	0.3	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
18	42	31.4	27.5	1.5	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
19	42	31.4	17.5	0.2	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
20	42	31.4	15.1	0.1	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
21	42	31.4	19.2	0.3	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
22	42	31.4	19.2	0.3	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
23	42	31.4	19.5	0.3	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
28	42	31.4	30.5	2.6	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
29	42	31.4	27.8	1.6	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

Appendix F, Table 12: Projected noise levels and significance – Night-time construction activities at site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	27.2	1.4	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
16	42	31.4	27.7	1.5	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
17	42	31.4	29	2.0	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
18	42	31.4	7	0.0	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
19	42	31.4	32.6	3.7	*Low (2)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

20	42	31.4	32.9	3.8	*Low (2)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
21	42	31.4	42.4	11.3	*Very High (5)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Possible (2)*	*Low (22)*
22	42	31.4	42.2	11.1	*Very High (5)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Possible (2)*	*Low (22)*
23	42	31.4	42.9	11.8	*Very High (5)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Possible (2)*	*Low (22)*
28	42	31.4	14.9	0.1	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)
29	42	31.4	21.5	0.4	*Minor (1)*	*Short-term (2)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (7)

Appendix F, Table 13: Projected noise levels and significance – Daytime operational activities at site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	14.0	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
16	52	38.0	14.6	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
17	52	38.0	17.9	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
18	52	38.0	25.5	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
19	52	38.0	14.0	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
20	52	38.0	13.6	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
21	52	38.0	14.1	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
22	52	38.0	14.3	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
23	52	38.0	14.5	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
28	52	38.0	29.8	0.6	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
29	52	38.0	31.3	0.8	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

Appendix F, Table 14: Projected noise levels and significance – Daytime operational activities at site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	13.7	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
16	52	38.0	13.8	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
17	52	38.0	16.9	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
18	52	38.0	22.0	0.1	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
19	52	38.0	14.5	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
20	52	38.0	14.0	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
21	52	38.0	15.7	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
22	52	38.0	16.1	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
23	52	38.0	16.4	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
28	52	38.0	25.7	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
29	52	38.0	23.8	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

Appendix F, Table 15: Projected noise levels and significance – Daytime operational activities at site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	52	38.0	23.9	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
16	52	38.0	24.7	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
17	52	38.0	25.6	0.2	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
18	52	38.0	0.0	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
19	52	38.0	29.7	0.6	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

20	52	38.0	30.6	0.7	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
21	52	38.0	40.0	4.1	*Low (2)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
22	52	38.0	38.3	3.2	*Low (2)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
23	52	38.0	38.9	3.5	*Low (2)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
28	52	38.0	11.7	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)
29	52	38.0	17.9	0.0	*Minor (1)*	*Long-term (4)*	*Local (2)*	*Reversible (1)*	*Improbable (1)*	Very Low (8)

Appendix F, Table 16: Projected noise levels and significance – Night-time operational activities at site alternative location 1

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	14.0	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
16	42	31.4	14.6	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
17	42	31.4	17.9	0.2	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
18	42	31.4	25.5	1.0	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
19	42	31.4	14.0	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
20	42	31.4	13.6	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
21	42	31.4	14.1	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
22	42	31.4	14.3	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
23	42	31.4	14.5	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
28	42	31.4	29.8	2.3	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
29	42	31.4	31.3	3.0	*Low (2)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (10)

Appendix F, Table 17: Projected noise levels and significance – Night-time operational activities at site alternative location 2

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	13.7	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
16	42	31.4	13.8	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
17	42	31.4	16.9	0.2	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
18	42	31.4	22.0	0.5	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
19	42	31.4	14.5	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
20	42	31.4	14.0	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
21	42	31.4	15.7	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
22	42	31.4	16.1	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
23	42	31.4	16.4	0.1	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
28	42	31.4	25.7	1.0	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
29	42	31.4	23.8	0.7	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)

Appendix F, Table 18: Projected noise levels and significance – Night-time operational activities at site alternative location 3

Potential Noise-sensitive development / Receptor(s)	Recommended Night-time noise limit (NCR)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Reversibility	Probability of Impact Occurring	Significance
15	42	31.4	23.9	0.7	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
16	42	31.4	24.7	0.8	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
17	42	31.4	25.6	1.0	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
18	42	31.4	0.0	0.0	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
19	42	31.4	29.7	2.2	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)

20	42	31.4	30.6	2.6	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
21	42	31.4	40.0	9.2	*High (4)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Possible (2)*	Low (24)
22	42	31.4	38.3	7.7	*High (4)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (10)
23	42	31.4	38.9	8.2	*High (4)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Possible (2)*	Low (24)
28	42	31.4	11.7	0.0	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)
29	42	31.4	17.9	0.2	*Minor (1)*	*Long-term (4)*	*Regional (3)*	*Reversible (1)*	*Improbable (1)*	Very Low (9)

End of Report