Phakwe Richards Bay Gas Power 3 (Pty) Ltd

NOISE STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

for the

Proposed Development of a 2,000MW Gas to Power Facility at Richards Bay, KwaZulu Natal

Study done for:

savannah environmental

Prepared by:

EARES
Enviro Acoustic Research
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EXECUTIVE SUMMARY

INTRODUCTION

Enviro Acoustic Research cc (EARES) was commissioned by Savannah Environmental (Pty) Ltd to determine the potential noise impact on the surrounding environment due to the proposed Phakwe 2,000Mw gas to power facility located within the Richards Bay IDZ. This study focus on environmental noise, evaluating the potential noise impact on the closest residential areas to the development.

PROJECT DESCRIPTION

The Phakwe Richards Bay Gas Power 3 CCPP (PRBGP3) and associated infrastructure is proposed to be constructed within the Richards Bay Industrial Development Zone (IDZ), zone 1F.

The power plant will operate at mid-merit to baseload duty and will include the following main infrastructure:

- Up to 4 gas turbines for the generation of electricity through the use of natural gas (liquid or gas forms), or a mixture of Natural gas and Hydrogen (in a proportion scaling up from 20% H2) as fuel source, operating all turbines at mid-merit or baseload (estimated 16 to 24 hours daily operation).
- Exhaust stacks associated with each gas turbine.
- Up to 4 Recovery Steam Generator (HRSG to generate steam by capturing the heat from the turbine exhaust.
- Up to 4 steam turbines to generate additional electricity by means of the steam generated by the HRSG.
- Steam turbine water system will be a closed cycle with air cooled condensers.
- Air cooled condensers to condensate used steam from the steam turbine.
- Compressed air station to supply service and process air.
- Closed Fin-fan coolers to cool lubrication oil for the gas turbines
- Gas generator Lubrication Oil System.
- Gas pipeline supply conditioning process facility. Please note, gas supply will be via dedicated pipeline from the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed) or, alternatively directly from the Regasification facilities at RB Harbour. The gas pipeline will be separately authorized.
- Diesel emergency generator for start-up operation.

SURROUNDING LAND USES

The project is proposed within the existing and appropriately zoned Richards Bay Industrial Development Zone 1F with mainly industrial uses taking place in the area.

POTENTIAL NOISE-SENSITIVE RECEPTORS

An assessment of the site was done using available aerial images (Google Earth®) to identify potential dwellings that could be considered to be noise-sensitive developments (NSD). The site was visited in July 2020 to confirm the status of a number of dwellings, with the site visit confirming the noise-sensitive suburb of "Wild en Weide".

BASELINE

Ambient (background) noise levels were measured over a 2-night periods from 28 to 30 July 2020 in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***", also considering the protocols defined in GG 43110.

Semi-continuous measurements were collected at three locations in the "Wild en Weide" residential suburb (approximately 44 hours at each location). 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.

The average fast-weighted sound levels indicate an area where:

- Daytime ambient sound levels are typical of a sub-urban noise district; and,
- Night-time ambient sound levels are typical of an urban noise district.

It should be noted that ambient sound levels closer to the R619 road would be higher, mainly due to road traffic noises. However, for the purpose of this assessment, ambient rating levels typical of a residential area in an urban environment will be used for the 'Wild en Weide' suburb. The acceptable noise rating levels (the zone sound level) for residential use in an urban area is the same as the noise limits recommended by the IFC and WHO, set at:

- 55 dBA for the daytime period, and
- 45 dBA for the night-time period.

Proposed activities at the project should not exceed the recommended noise rating levels, nor should it change the existing ambient sound levels with more than 3 dB (IFC recommended increase above ambient if existing ambient sound levels already exceed the WHO guidelines).

FINDINGS

Potential scenarios were conceptualized for the future proposed construction and operational phases, with the output of the modelling exercise indicating a potential noise impact of low significance for the both the day- and night-time periods. No mitigation or management measures are required or recommended to reduce environmental noise levels. The power generation facility still has to comply with the relevant Health and Safety Regulations and Guidelines that my stipulate periodic noise monitoring (Noise-Induced Hearing Loss Regulations [GNR 307 of 2020] as well as the Occupational Health and Safety Act, 1993 [Act 85 of 1993]).

RECOMMENDATIONS

No additional acoustic studies are recommended for this development, and it will not be required to develop or implement an environmental noise monitoring programme considering:

- the developmental character of the area;
- the results from the night-time ambient sound level measurements;
- the projected low significance of the noise impacts

It is therefore recommended that the proposed 2,000MW Phakwe Gas to Power Project be authorized from an acoustic perspective.

Report should be sited as:

De Jager, M (2022). "*Noise Study for Environmental Impact Assessment for the Proposed Development of a 2,000 Gas to Power Facility at Richards Bay, KwaZulu Natal*", Enviro-Acoustic Research cc, Pretoria

Client:

Savannah Environmental (Pty) Ltd
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GLOSSARY OF ABBREVIATIONS

AZSL	Acceptable Zone Sound Level (Rating Level)
dB	Decibel
EARES	Enviro-Acoustic Research cc
EMP	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
EP	Equator Principle
f	Fast setting
GG	Government Gazette
GN	Government Notice
Hz	Hertz
i	Impulse setting
i.e.	that is
IDZ	Industrial Development Zone
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
km/h	kilometres per hour
LPG	Liquid Petroleum Gas
m	Meters

mamsl	Meters above mean sea level
NCR	Noise Control Regulations (under Section 25 of the ECA)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NSD	Noise-Sensitive Development
RMPP	Risk Mitigation Power Plant
RPM	Revolutions per Minute
SABS	South African Bureau of Standards
SANS	South African National Standard
SPL	Sound Power Levels
ToR	Terms of Reference
UTM	Universal Transverse Mercator
WHO	World Health Organisation

1 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining-related courses (Mining [stoping and development], 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, the last two during which he studied Mining Engineering. He used to be a holder of a temporary blasting certificate during the period he mined at JCI: Cook 2 shaft. He changed course from Mining Engineering to Chemical Engineering after the second year of his studies at the University of Pretoria.

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

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period, he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing a number of these projects. 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 300 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), Pienaarspoort 1 and 2 (SE), Kokerboom 3 (Zutari), Mphepo Zambia (SLR)
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), ECM Lannex (Prescali). ECM Tweefontein (Prescali), Smokey Hills (Prescali), Dalyshope (Digby Wells), Eland Platinum Mine (JEMS), Tweefontein (Prescali), Lannex (Prescali), Salene Manganese (Prescali), Baberton Gas to Power (Rayten)*
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)*
Noise Compliance Statements	*Dwarsrug BESS (SiVEST), Hyperion BESS (SE), Loeriesfontein BESS (SiVEST), Platsjambok East and West BESS (SiVEST), Waaihoek BESS (CESNET)*
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), Rheboksfontein WEF (ERM), Umzinde WEF (Zutari), Kokerboom 4 (Zutari), etc.

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2 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent specialist in this application
- I will perform the work relating to this study in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental noise impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2014, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- all the particulars furnished by me in this form are true and correct;
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act, and;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.

_____

Signature of the environmental practitioner:

Name of company:

Enviro-Acoustic Research cc

Date:

2022 – 04 – 19

3 CHECKLIST: GG43110 MINIMUM REQUIREMENTS

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

- *Utilities Infrastructure => Electricity => Generation => Non Renewable => Hydrocarbon => Petroleum*, and
- *Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions => Emissions*.

Potential noise sensitive areas are not included in these categories, but was obtained from the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the online tool indicating that most of the larger area is considered to be of a "Very High" Noise sensitivity. This is likely due to the online screening tool being based on an incorrect or old database. However, the site visit did identify an area that could be considered as noise sensitive, and as a result this assessment will take the form of a Noise Specialist Study.

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

Clause	Requirement	Comment / Reference
2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Section 1
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Section 2
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	Section 6
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	Section 6.1

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

2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	Figure 4-1. The Screening tool considers the larger area to be of "very high" noise sensitivity
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Site limited to the availability of land for development as well as the proximity of power distribution infrastructure.
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	Section 15
2.5.8	any conditions to which this statement is subjected	Section 10.6
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 limited to the availability of land for development as well as the proximity of power distribution infrastructure.
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	
2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	Section 13 and 14
2.5.12	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 10

4 INTRODUCTION

4.1 INTRODUCTION AND PURPOSE

Enviro Acoustic Research cc (EARES) was commissioned by Savannah Environmental (Pty) Ltd to determine the potential noise impact on the surrounding environment due to proposed 2,000 MW Gas to Power Plant (GTPP) located within the Richards Bay IDZ.

This report describes the potential noise impact that the operation might have on potential noise-sensitive areas, highlighting the methods used, potential issues identified, findings and recommendations. The Terms of Reference (ToR) for this study is in the guidelines provided by SANS 10103:2008, SANS 10328:2008, the procedures defined in Government Gazette 43110 of 20 March 2020 (GNR 320) and the National Noise Control Regulations GN R154 of 1992. The study also considers the noise limits as proposed by the International Finance Corporation (IFC) for a residential area which is based on studies completed by the World Health Organization (WHO).

4.2 BRIEF PROJECT DESCRIPTION

4.2.1 Project Background

The Phakwe Richards Bay Gas Power 3 CCPP (PRBGP3) and associated infrastructure is proposed to be constructed on erven 16820, 16819,1/16674 and a subdivision of erf 17442 within the Richards Bay IDZ Zone 1F, and will occupy approximately 11.8ha.

The power plant will operate at mid-merit to baseload duty and will include the following main infrastructure:

- Up to 4 gas turbines for the generation of electricity through the use of natural gas (liquid or gas forms), or a mixture of Natural gas and Hydrogen (in a proportion scaling up from 20% H2) as fuel source, operating all turbines at mid-merit or baseload (estimated 16 to 24 hours daily operation).
- Exhaust stacks associated with each gas turbine.
- Up to 4 Recovery Steam Generator (HRSG to generate steam by capturing the heat from the turbine exhaust.
- Up to 4 steam turbines to generate additional electricity by means of the steam generated by the HRSG.
- The water treatment plant will demineralise incoming water from municipal or similar supply, to the gas turbine and steam cycle requirements. The water treatment plant

will produce two parts demineralised water and reject one-part brine, which will be discharged to the RB IDZ stormwater system.

- Steam turbine water system will be a closed cycle with air cooled condensers. Make-up water will be required to replace blow down.
- Air cooled condensers to condensate used steam from the steam turbine.
- Compressed air station to supply service and process air.
- Water pipelines and water tanks for storage and distributing of process water. (Potential sourcing of alternative water outside RB IDZ supply (Municipality))
- Water retention pond
- Closed Fin-fan coolers to cool lubrication oil for the gas turbines
- Gas generator Lubrication Oil System.
- Gas pipeline supply conditioning process facility. Please note, gas supply will be via dedicated pipeline from the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed) or, alternatively directly from the Regasification facilities at RB Harbour. The gas pipeline will be separately authorized.
- Site water facilities including potable water, storm water, waste water
- Fire water (FW) storage and FW system
- Diesel emergency generator for start-up operation.
- Onsite fuel conditioning including heating system.
- All underground services: This includes stormwater and wastewater.
- Ancillary infrastructure including:
  - Roads (access and internal);
  - Warehousing and buildings;
  - Workshop building;
  - Fire water pump building;
  - Administration and Control Building;
  - Ablution facilities;
  - Storage facilities;
  - Guard House;
  - Fencing;
  - Maintenance and cleaning area;
  - Operational and maintenance control centre;
- Electrical facilities including:
  - Power evacuation including GCBs, GSU transformers, MV busbar, HV cabling and 1x275kV or 400kV GIS Power Plant substation.
  - Generators and auxiliaries;

» Service infrastructure including:
  - Stormwater channels;
  - Water pipelines
  - Temporary work areas during the construction phase (laydown areas)

A dedicated pipeline to connect into an on-site gas receiving and conditioning station will provide the natural gas or the mixture of natural gas and Hydrogen. The pipeline will be connected to the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed), or it will extend directly to the Regasification facilities in the R Harbour. A separate EIA process will be undertaken for the dedicated fuel-supply pipeline.

Component	**Description/ Dimensions**
Landowner	Richards Bay Industrial Development Zone (IDZ), Phase 1F
Electricity Generating capacity	2000MW (installed)
Proposed technology	Combined Cycle Gas Turbine Technology with associated Balance of Plant
Stack dimensions (Site elevation: 43 - 47 m above mean sea)	» Exhaust and bypass stack height will be a minimum of 45m up to 90m (1 stack per Heat Recovery Steam Generator (HRSG) and one additional bypass for each gas turbine. » Diameter of each stack is expected to be approximately 9m
Fuel Sources	» Natural gas (LNG or similar) - 2,218,407,840 (i.e. 2,218 million) normal m^3. » Mixture of Natural gas and Hydrogen
Site access	The site will be accessed via existing roads within the IDZ Phase 1F (already approved through an EIA undertaken for the Phase 1F infrastructure) and internal access roads (width of up to 6m) which will be constructed.
Grid connection	» Onsite substation (275kV or 400kV) » The Phakwe Richards Bay Gas Power 3 CCPP will be connected to the national grid via a 275kV or 400kV Eskom Switching Station and underground transmission cables that will connect to the selected

	Eskom grid connection point A EIA process will be undertaken for the switching station and transmission line.
Associated infrastructure	» Temporary laydown areas; » Warehousing and buildings; » Workshop building; » Fire water pump building; » Administration and Control Building; » Ablution facilities; » Storage facilities; » Guard House; » Fencing; » Maintenance and cleaning area; » Operational and maintenance control centre

4.3 STUDY AREA

The facility is proposed in the vicinity of Richards Bay, located within the boundaries of the City of uMhlathuze Local Municipality and the King Cetshwayo District Municipality. A site locality map is presented in **Figure 4-1** illustrating the location of the site. The site is further described in terms of environmental components that may contribute or change the sound character in the area.

4.3.1 Existing Ambient Sound and Noise Levels

Sound levels were measured during July 2020 with the results summarized in **section 6.3**. Due to industrial and road traffic noises dominating and ambient sound levels in this area, the season when the measurements are collected has no influence on the measurement results.

4.3.2 Topography

ENPAT[2] (1998) describes the topography as *"Plains"* , while Musina L. & Rutherford (The vegetation of South Africa, Lesotho and Swaziland)[3] delineates the area as *"flat coastal plain".* There are little natural features that could act as noise barriers considering practical distances at which sound propagates.

[2] Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "*Environmental Potential Atlas for South Africa"*, Pretoria, 1998.
[3] Musina L. & Rutherford." The vegetation of South Africa, Lesotho and Swaziland". Strelitzia 19, South African National Biodiversity Institute, Pretoria. 2006.

4.3.3 Surrounding Land Use

The project is proposed within the Richards Bay IDZ, Phase 1F (located within the Richards Bay Municipal area), with only industrial uses taking place in the area.

4.3.4 Roads

There are a number of roads within the IDZ, though noise from road traffic on these routes will unlikely to influence the ambient sound levels in the closest residential areas. The only road that may influence the ambient sound levels in the Wild en Weide suburb is the R619, which carries traffic night and day.

4.3.5 Other Industrial Activities

The site is proposed in an existing industrial area with noises from various other activities in the vicinity of the project area. However, the only noteworthy noise is the existing Tata Steel (Richards Bay Alloys) facility located directly west of the Phakwe site. The Richards Bay Gas to Power facility, located directly adjacent to the Phakwe site, was also authorized.

4.3.6 Ground conditions and vegetation

The site falls within the Savanna biome, with the natural vegetation type being Coastal Forest and Thornveld. Considering information gained during the site visit and GoogleEarth ® imagery it appears that the natural vegetation has been significantly disturbed by anthropogenic activities, though the ground surface is generally covered with dense vegetation.

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 soft, which implies that the ground surface could absorb some of the acoustic energy hitting the ground surface.

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

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

An assessment of the site was done using available aerial images (GoogleEarth®) to identify potential dwellings that could be considered to be noise-sensitive developments (NSD). The

site was visited in July 2020 to confirm the status of these NSD, with the identified NSD[4] indicated on **Figure 4-2**.

Also indicated on this figure are generalized 500, 1000 and 2 000m buffer zones. Generally, normally, noises from such industrial activities:

- are limited to a distance of less than 500m from active access roads, though this would normally be less than 200m with low traffic volumes and speeds associated with such roads (night-time impacts). This can be increased to a distance of 1,000m, normally associated with very busy roads (such as a busy national road where average speeds exceed 100km/h);
- are significant and clearly audible within 500m, with receptors staying within 500m from activities being able to detect the change in ambient sound levels with potential complaints about the noise levels;
- are generally clearly audible, but the noise impact is limited to a distance of approximately 1,000m from the active industrial activities. Ambient sound levels are increased due to noises from the industrial activities, with the potential noise impact measurable and audible. Noise levels from such industrial activities are generally less than 45 dBA further than 1,000m from these activities;
- are generally audible up to a distance of 2,000m at night and may be audible up to 4,000m during very quiet periods at night with certain meteorological conditions; and
- are normally of a low concern at distanced greater than 2,000m from activities at night (though it may be audible up to 4,000m during very quiet periods).

These buffer distances may not be valid with very large mining or industrial operations, or in areas with very low or high ambient sound levels.

[4] Around 60 small structures rented to workers/contractors in the area, with the closest structures used for residential purposes approximately 720 m from the boundary of the project area.

Figure 4-1: Locality map indicating the proposed project focus area

Figure 4-2: Aerial image indicating potentially noise-sensitive receptors close to the proposed project focus area

4.5 COMMENTS RECEIVED DURING THE EIA PROCESS

The author is not aware of any comments raised (relating to acoustics) by the authorities or interested and affected parties at the date this report was compiled.

4.6 TERMS OF REFERENCE

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

- It was identified as an environmental theme needing further investigation i.t.o. the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020 (GNR320 of 2020);
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- if a proposed plant is to be developed on a site that is situated within 200 m of a noise-sensitive development (SANS 10328:2008 [5.4 (a)]) *or visa versa (SANS 10328:2008 [5.4 (b)])*;
- If a new road or railway line is to be established within 500 m (or, in the case of a busy throughway, 1 000 m) of a road or railway line (SANS 10328:2008 [5.4 (c)]) *or visa versa (SANS 10328:2008 [5.4 (c)])*;
- If a noise sensitive development is to be established within 1,000 m from an industry (SANS 10328:2008 [5.4 (g)]);
- If an industry (500 m for light industry as per SANS 10328:2008 [6.3.3 (g)]) is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);
- 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 visa 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;

4.6.1 Requirements as per GNR 320 of 2020

The Department of Environmental Affairs also promulgated Government Notice Regulation (GNR) 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.

With a number of potential noise-sensitive receptors living within 1,000m from the proposed power generation activities, this assessment will be comprehensive and submit a Noise Specialist Assessment.

The minimum requirements for a Noise Specialist Study are also covered in **Section 3** in the form of a checklist.

4.6.2 Requirements as per South African National Standards

In South Africa the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It 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) 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 4.1**);
b) a brief description of the planned development or the changes that are being considered (see **section 4.2**);
c) a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements (see **section 6**);
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 7**);
e) the identified noise sources that were not taken into account and the reasons as to why they were not investigated (see **section 7**, **9** and **10**);
f) the identified noise-sensitive developments and the noise impact on them (see **section 4.4, 11 and 12**);
g) where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics (see **section 10**);
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 9 and 10**);
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 6, 9** and **11**);

j) the location of measuring or calculating points in a sketch or on a map (see **Figure 6-1** and **section 11**);
k) quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made (see **section 11**);
l) alternatives that were considered and the results of those that were investigated (see **section 12.4**);
m) a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation (see **section 4.5**);
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 4.5**);
o) conclusions that were reached (see **section 15**);
p) proposed recommendations (see **section 15**);
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 13** and **15**); 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 15**).

5 LEGAL CONTEXT, POLICIES AND GUIDELINES

5.1 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 5.4**).

"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.

5.2 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 National Environmental Management Act, 1998.

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 National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements.

5.3 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. See also **section 5.3.1**.

5.3.1 National Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R 154 of 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial noise control regulations exist in the Free State, Gauteng and Western Cape provinces but not in KwaZulu Natal.

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 e, exceeds 61 dBA.

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

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

In addition:
In terms of Regulation 2 -
"A local authority may –
(a) establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences;
(c):" if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply

in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;
(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or (f) designate a controlled area in its area of jurisdiction or amend or cancel an existing controlled area by notice in the Official Gazette concerned.

In terms of Regulation 4 of the Noise Control Regulations:
"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

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

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

5.4 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'.
- SANS 10210:2004. 'Calculating and predicting road traffic noise'.
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'.
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

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

It must be noted that SANS 10103:2008 does stipulate *"for industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d} = L_{Req,n}$ =70 dBA can be considered as typical and normal".*

5.5 INTERNATIONAL GUIDELINES

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

5.5.1 Guidelines for Community Noise (WHO, 1999)

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

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

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

It further discusses how noise can 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.

5.5.2 Night Noise Guidelines for Europe (WHO, 2009)

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

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

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

5.5.3 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). Eighty-three financial institutions (2016) have adopted the Equator Principles, which have become the de facto standard for banks and investors on how to assess major development projects around the world.

5.5.4 IFC: General EHS Guidelines – Environmental Noise Management

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

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

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

- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 5-1**) and highlights the certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. This criterion will effectively sterilize large areas of any development. Therefore, it is EARES'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 5-1: IFC Table .7.1-Noise Level Guidelines

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

The document uses the $L_{Aeq,1hr}$ 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.

5.5.5 European Parliament Directive 200/14/EC

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

6 CURRENT ENVIRONMENTAL SOUND CHARACTER

6.1 EFFECT OF SEASON ON 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. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation generated noise. In addition, 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 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 could have a significant 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 during the warmer spring and summer months as various species communicate in an effort to find mates; and
- Seasonal changes in weather patterns, mainly wind (also see **section 6.1.1**).

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 following sections.

6.1.1 Environmental factors that influence the propagation of sound

Sound is a sequence of waves of pressure that propagate through a compressible medium such as air. In air, there are three main properties that can affect the behaviour of sound propagation, namely:

1. The motion of the medium itself, e.g. wind in air. In the case of wind, if the air movement is in the direction of the sound wave, the sound can be transported further;

2. The relationship between density and pressure. This relationship, affected by temperature, determines the speed of sound within the medium;
3. The viscosity of the medium. This determines the rate at which sound is attenuated.

During this propagation, the sound waves can be reflected, refracted or attenuated by this medium. Atmospheric absorption depends on frequency, relative humidity, temperature and atmospheric pressure.

6.1.2 Effect of wind on ambient sound levels

Wind speed can be a significant factor for ambient sound levels at most rural locations. With no wind, there is little vegetation movement that could generate noises, 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 speeds 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 the effect of faunal communication as vegetation may create suitable habitats and food sources for fauna, attracting more animals in number and species diversity as may be found in the natural veldt.

6.1.3 Effect of wind on sound propagation

Excluding wind-induced noises relating to increased wind speeds, 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.

6.1.4 Effect of temperature and humidity on sound propagation

On a typical sunny afternoon, air is warmest near the ground 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 as a temperature inversion will cause sound to

bend downward toward the ground and results in louder noise levels at the listener's position. Like wind gradients, temperature gradients can influence sound propagation over long distances and further complicate measurements.

Generally, sound propagate better at lower temperatures (down to 10°C), and with everything being equal, a decrease in temperature from 32°C to 10°C would increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz). Air temperature as measured onsite is defined in **Table 6-1**. It should be noted that humidity was very high, due to very overcast conditions with significant rain the days prior to the measurement period. There was some slight drizzle during the measurement period though it is considered unlikely to have influence the measurements.

The effect of humidity on sound propagation is quite complex but effectively relates 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% could increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz). Humidity as measured onsite is defined in **Table 6-1**.

Table 6-1: Average Humidity and Temperature measured onsite

	Humidity	Temperature
Day average	72.5	20.2
Night average	96.8	14.0
Day minimum	32.0	10.9
Day maximum	99.0	26.7
Night minimum	89.0	11.2
Night maximum	99.0	16.1

6.2 FACTORS THAT INFLUENCE AMBIENT SOUND LEVELS AT A DWELLING

There are a number of factors that determine how ambient sound levels close to a dwelling might differ from the ambient sound levels further away (or even at another dwelling in the area), including:

- Type of activities taking place in the vicinity of the dwelling;
- Equipment being used near the dwelling, especially equipment such as water pumps, compressors and air conditioners;
- Whether there are any windmills ("*windpompe*") close to the dwelling as well as their general maintenance condition;
- Types of trees around dwelling (conifers vs. broad-leaved trees, habitat that it provides to birds, food that it may provide to birds);

- The number, type and distance between the dwelling (the measuring point) and trees. This is especially relevant when the trees are directly against the house (where the branches can touch the roof);
- Distance to large infrastructural developments, including roads, railroads and even large diameter pipelines – if roads, traffic loading characteristics;
- Distances to other noise sources, whether anthropogenic or natural (such as the ocean or running water);
- The material used in the construction of the dwelling and maintenance status;
- The design of the building, including layout and number of openings (relating to the detection and second generation of low-frequency noises); and
- The type and how many farm or domestic animals are in the vicinity of the dwelling.

6.3 SOUND MEASUREMENTS DONE IN THE VICINITY OF THE PROJECT AREA

Ambient (background) noise levels were measured over a 2-night periods from 28 to 30 July 2020 in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***", also considering the protocols defined GG 43110 of 20 March 2020 (GNR 320 of 2020).

The guidelines and protocol define the procedures, minimum equipment accuracy and time periods (in which measurements must be collected) such as:

- type of equipment (Class 1) to be used;
- minimum duration of measurement as well as time periods when measurements must take place;
- microphone positions and height above ground level;
- calibration procedures and instrument checks; and
- supplementary weather measurements and observations.

Semi-continuous measurements were collected over a period of two (2) nights at three locations in the "Wild en Weide" residential suburb (approximately 44 hours at each location). The measurement locations are presented in **Figure 6-1**, with the measurement results summarized on this figure. 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.

Figure 6-1: Localities where ambient sound levels were measured

6.3.1 Ambient Sound Measurements at RBGPLTSL01

The microphone was deployed in a residential stand in the Wild and Weide suburb, with the SLM located approximately 180m from the R619 road. There was no vegetation close to the microphone. Sounds heard onsite are described in the following table, with photos of the measurement location presented in **Appendix B**.

Table 6-2: Noises/sounds heard during site visits at receptor RBGPLTSL01

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: Barely Audible Audible Dominating	**Faunal and Natural**
	Deployment: Birds audible. Slight wind-induced noises at times. Collection: Birds audible at times
	Residential and other Anthropogenic
	Deployment: Dogs audible in the area. Voices of children playing in area. Grinding noises audible in distance. Collection: Household noises audible at times (music playing).
	Industries, Commercial and Road Traffic
	Deployment: Road noises in the area dominant and significant Collection: Road noises in the area dominant and significant

Table 6-3: Equipment used to gather data at RBGPLTSL01

Equipment	Model	Serial no	Calibration
SLM	Svan 977	34160	March 2019
Microphone	ACO 7052E & SV 12L	54645	March 2019
Calibrator	Quest CA-22	J 2080094	July 2019
Weather Station	WH3081PC	-	-

- Microphone fitted with the appropriate windshield.

6.3.1.1 Summary of Ambient Sound levels measured

Impulse equivalent sound levels (South African legislation): Figure 6-2 illustrates how the impulse-weighted 10-minute equivalent values change over time with **Table 6-4** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels. The various sound measurements are classified into different noise districts as illustrated in **Figure 6-4** and **Figure 6-5** respectively.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown in **Figure 6-2** with **Table 6-4** defining the average values for the time period. 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.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used 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 the average sound level. **L_{A90}** is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time in **Figure 6-3** and **Table 6-4**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Figure 6-3** and **Table 6-4**.

Table 6-4: Sound levels considering various sound level descriptors at RBGPLTSL01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	50.0	47.5	43.0	-	-
Night arithmetic average	-	42.8	41.1	37.4	-	-
Day equivalent average	-	52.1	49.2	-	-	-
Night equivalent average	-	44.6	42.6	-	-	-
Day minimum	-	42.2	40.4	-	32.2	-
Day maximum	80.6	58.3	55.2	-	-	-
Night minimum	-	37.1	35.6	-	29.8	-
Night maximum	70.4	53.4	50.5	-	-	-
Day 1 equivalent		49.4	46.6			Afternoon and evening only
Night 1 Equivalent		42.8	40.6			8-hour night equivalent average
Day 2 equivalent		52.1	49.2			16-hour day equivalent average
Night 2 Equivalent		45.9	44.0			8-hour night equivalent average
Day 3 equivalent		46.1	43.6			Morning only

The statistical data (**$L_{A90,f}$**) indicate a location where ambient sound levels are significantly elevated both day and night. **L_{Amax}** levels exceeded 65 dBA a few times during the night-time measurements for both night-time periods (at least twice and five times the first and second nights respectively). When more than 10 sound events occur at night (where the noise level exceeds 65 dBA) maximum events may disturb the sleep of people.

6.3.1.2 Spectral Frequencies

Spectral character: Third octaves were measured and are displayed for the first night and second day (**Figure 6-6** and **Figure 6-7**) with the averaged spectral character illustrated for the night and daytime periods in **Figure 6-8** and **Figure 6-9**.

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relatively smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies. People generally do not hear these frequencies unless very quiet due to the low response of the ear to these low frequencies. Sounds from wind-induced noises generally have significant acoustic energy in this frequency range (normally identified by a smooth curve). Most measurements show significant acoustic energy in the 20 – 200 Hz range, with a clearly detectable peak at 50 Hz. This likely relates to road traffic engine noises from the roads in the area.

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally peaking in 630 – 1,600 Hz range (depending on vehicular speed and road characteristics). This frequency band displays a broadband character with significant acoustic energy in the 630 – 1,600 Hz range, with a slight peak at 1,000 Hz. This likely relates from road-tyre interaction from traffic in the area.

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt, etc. There are generally little acoustic energy in this frequency band.

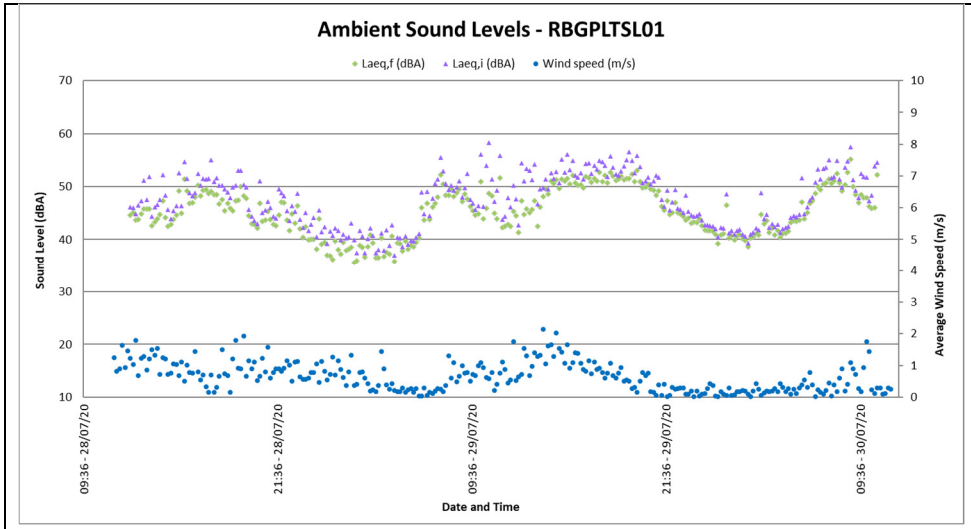

Figure 6-2: Ambient Sound Levels at RBGPLTSL01

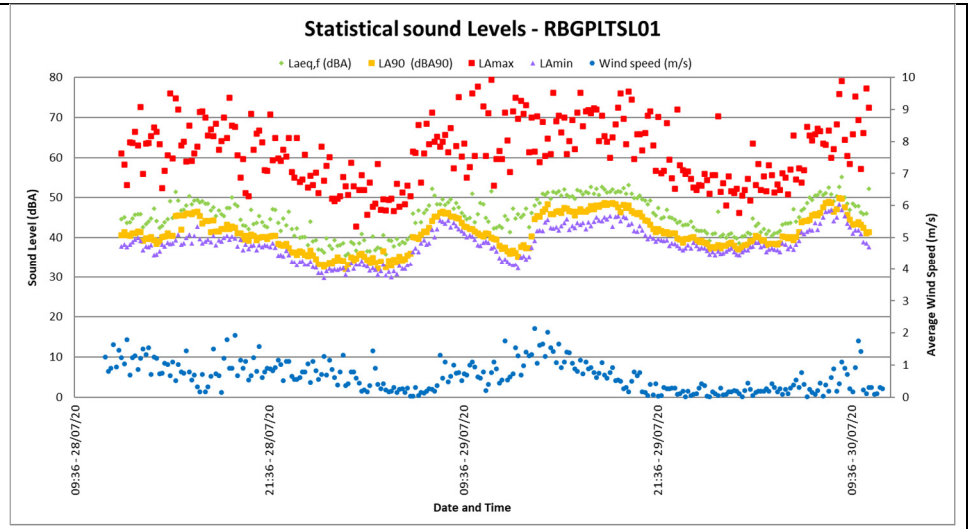

Figure 6-3: Maximum, minimum and statistical values at RBGPLTSL01

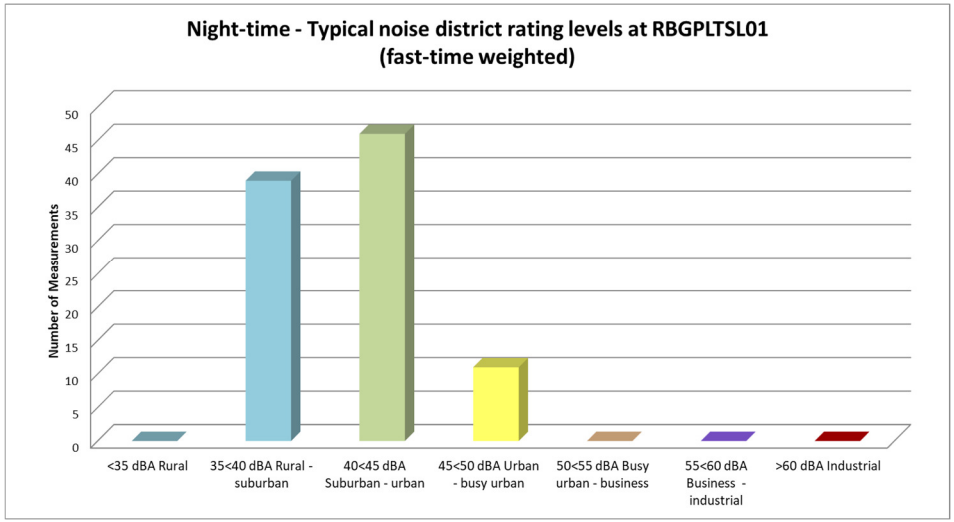

Figure 6-4: Classification of night-time noise levels – RBGPLTSL01

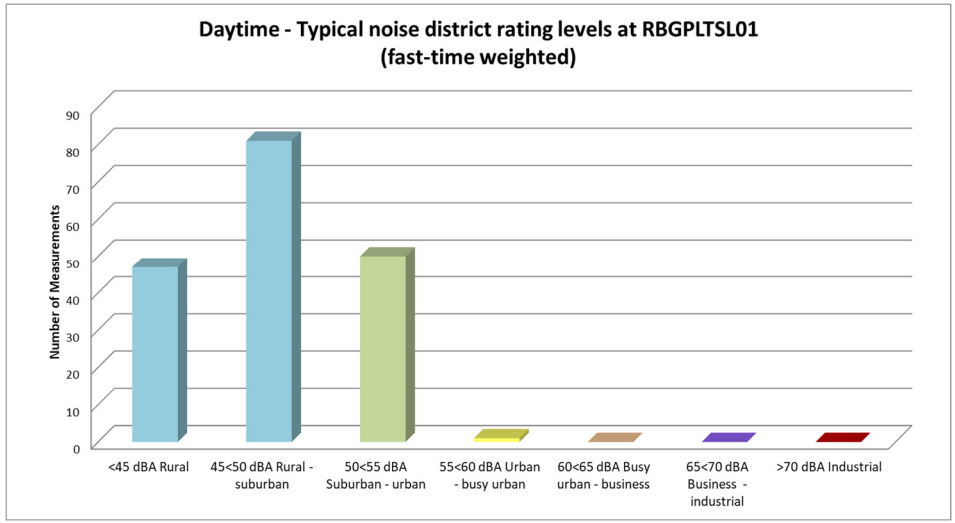

Figure 6-5: Classification of daytime noise levels - RBGPLTSL01

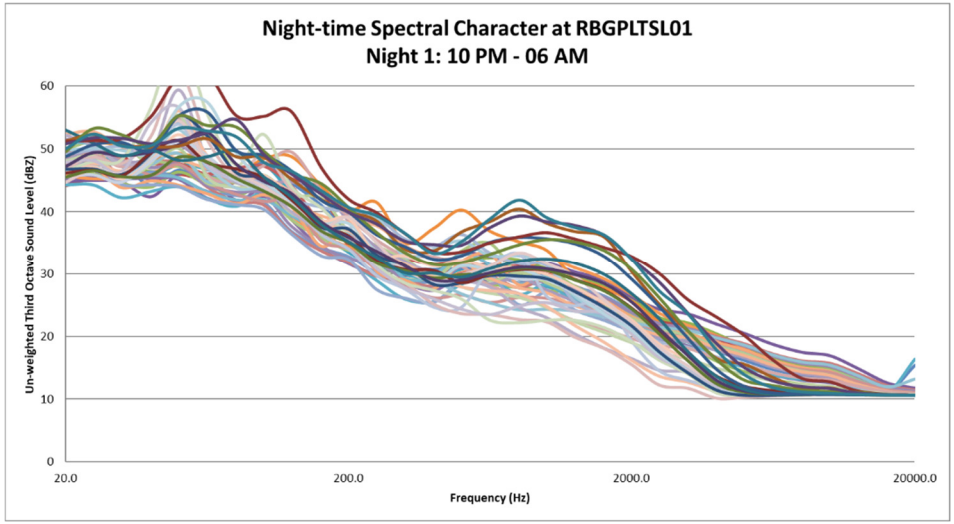

Figure 6-6: Spectral frequencies – RBGPLTSL01, Night 1

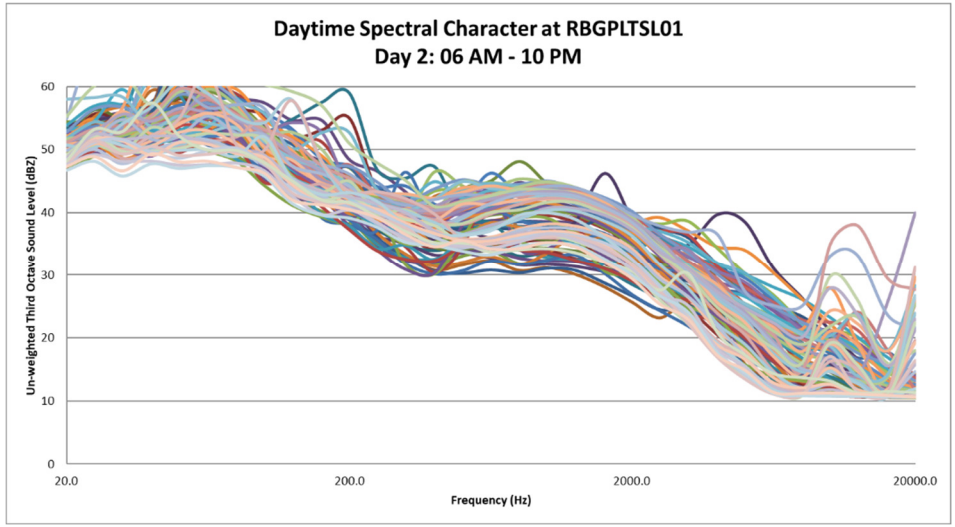

Figure 6-7: Spectral frequencies - RBGPLTSL01, Day 2

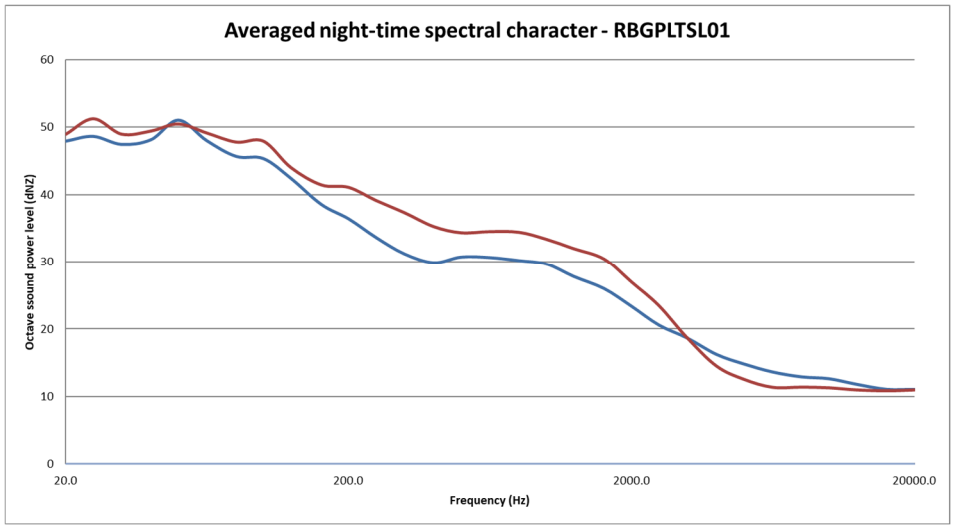

Figure 6-8: Averaged night-time spectral frequencies

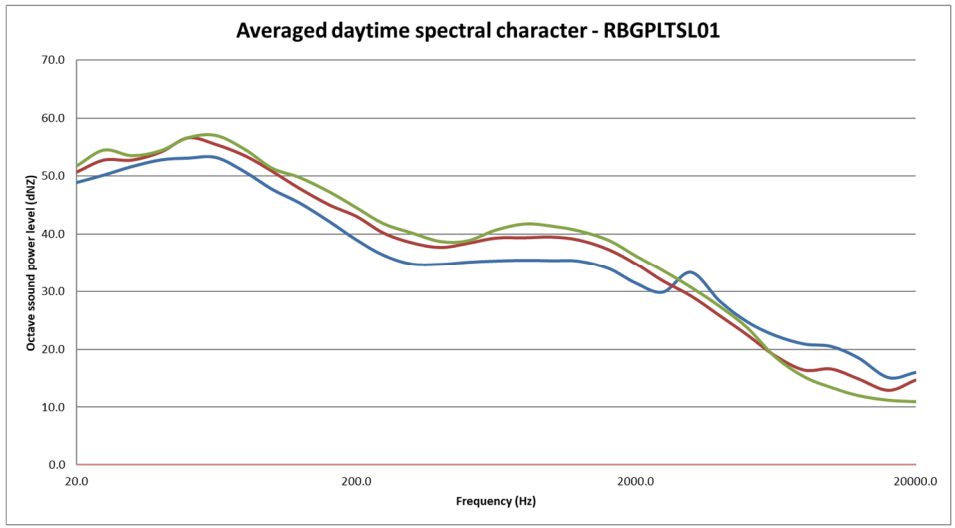

Figure 6-9: Averaged night-time spectral frequencies

6.3.2 Ambient Sound Measurements at RBGPLTSL02

The microphone was deployed in a residential stand in the Wild and Weide suburb, with the SLM located approximately 230m from the R619 road and around 50m from Antelope Alley. There was no vegetation close to the microphone. Sounds heard onsite are described in the following table, with photos of the measurement location presented in **Appendix B**.

The equipment defined in **Table 6-5** was used for gathering data, with **Table 6-6** highlighting sounds heard during equipment deployment and collection.

Table 6-5: Equipment used to gather data at RBGPLTSL02

Equipment	Model	Serial no	Calibration
SLM	Svan 955	27637	October 2019
Microphone	ACO 7052E & SV 12L	52437	October 2019
Calibrator	Quest CA-22	J 2080094	July 2020

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-6: Noises/sounds heard during site visits at RBGPLTSL02

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: **Barely Audible** **Audible** **Dominating**	**Faunal and Natural**
	Deployment: Wind-induced noises at times. Collection: Birds audible at times
	Residential and other Anthropogenic
	Deployment: Grinding noises audible in area. People laughing at times. Collection: Hammering from erf across the street. Children playing in house, voices audible at times.
	Industries, Commercial and Road Traffic
	Deployment: Road noises in the area clearly audible and significant at times Collection: Road noises in the area audible

6.3.2.1 Summary of Ambient Sound levels measured

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-10** and summarized in **Table 6-7** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-11**. 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 the presence of constant noises in the area that raises the noise levels. Considering

measurements collected in urban areas, this is likely the cumulative effect from traffic noises, potentially air conditioners operating and domestic animal noises. The maximum noise level exceeded 65 dBA only once the first night. 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.

Table 6-7: Sound levels considering various sound level descriptors at RBGPLTSL02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	52.2	49.2	43.7	-	-
Night arithmetic average	-	43.0	41.6	37.4	-	-
Day equivalent average	-	57.2	52.8	-	-	-
Night equivalent average	-	44.6	43.4	-	-	-
Day minimum	-	39.9	38.2	-	32.2	-
Day maximum	90.1	69.5	62.3	-	-	-
Night minimum	-	37.4	34.8	-	29.0	-
Night maximum	66.0	52.4	51.6	-	-	-
Day 1 equivalent		53.9	49.5			Afternoon and evening only
Night 1 Equivalent		42.7	41.1			8-hour night equivalent average
Day 2 equivalent		56.1	51.5			16-hour day equivalent average
Night 2 Equivalent		45.9	44.8			8-hour night equivalent average
Day 3 equivalent		50.9	46.9			Morning only

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 6-12** (night) and **Figure 6-13** (day).

6.3.2.2 Spectral Frequencies

As with measurement location RBGPLTSL01, traffic noises appear to be a significant and general dominant noise source in the area. There are some acoustic energy around 3,150 – 5,000Hz during the day, suspected to be from faunal sources (birds, frogs or insects). The spectral frequencies are illustrated in **Figure 6-14** to **Figure 6-17**.

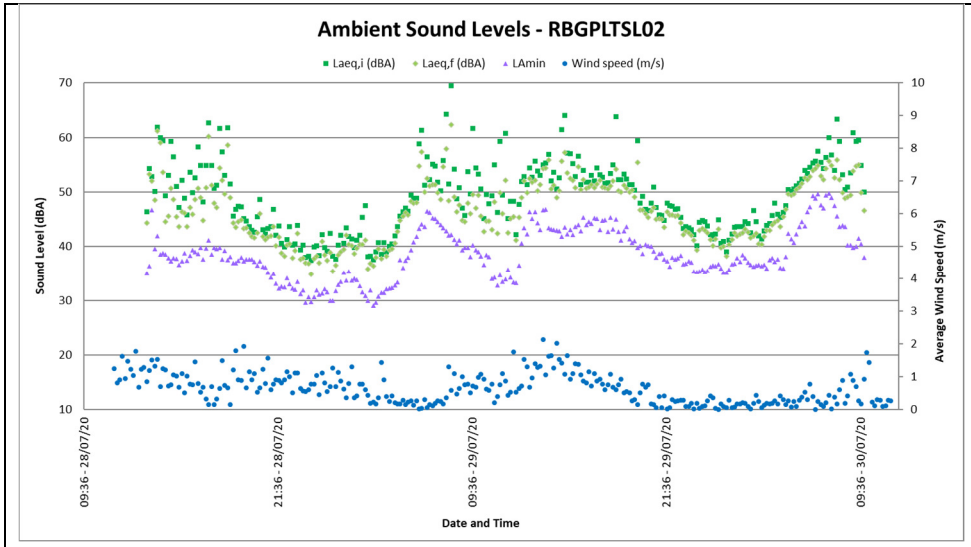

Figure 6-10: Ambient Sound Levels at RBGPLTSL02

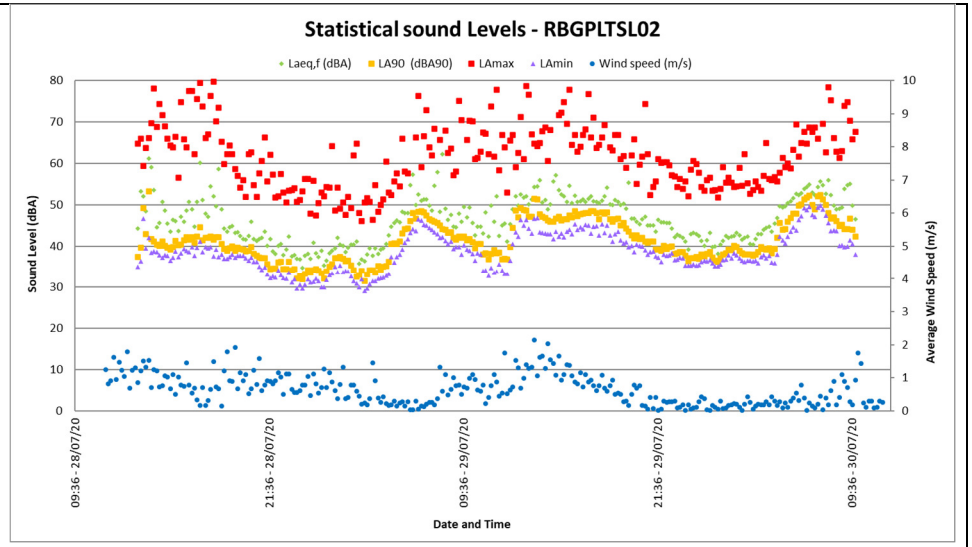

Figure 6-11: Maximum, minimum and Statistical sound levels at RBGPLTSL02

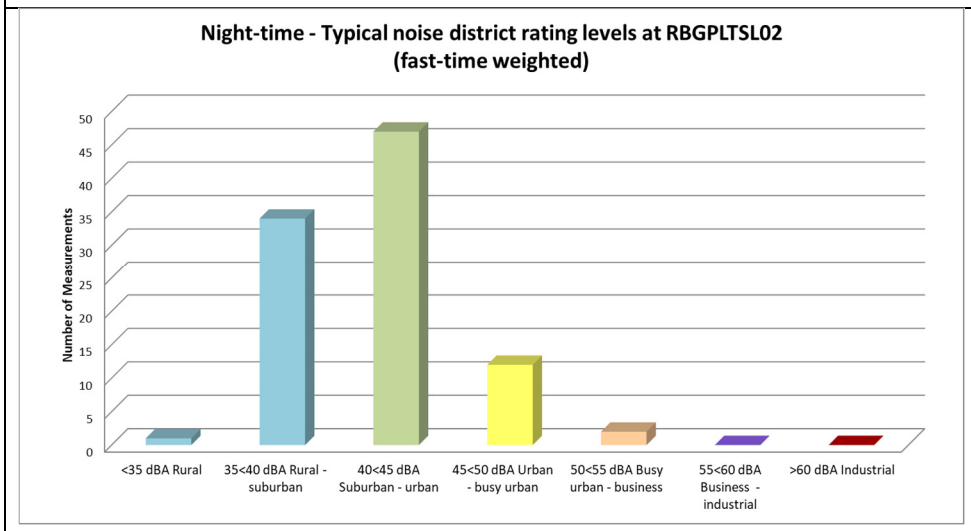

Figure 6-12: Classification of night-time measurements in typical noise districts at RBGPLTSL02

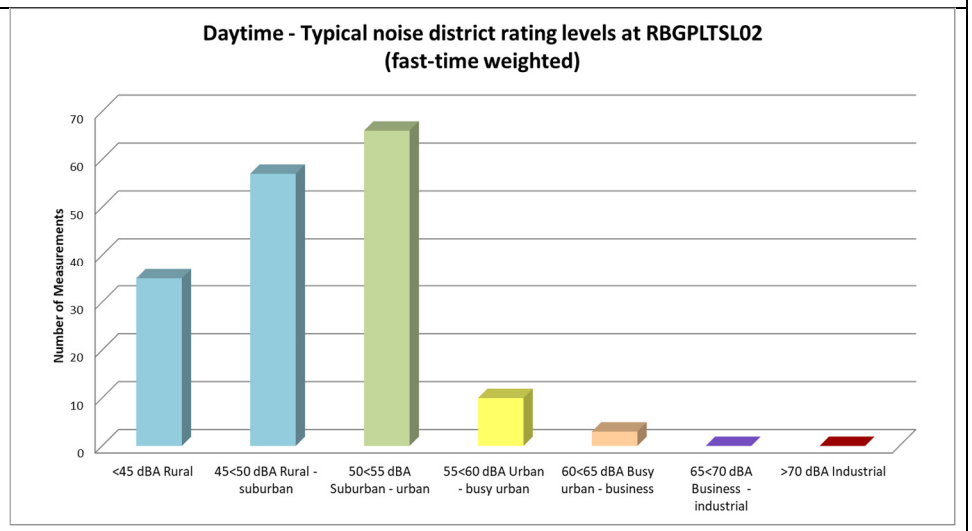

Figure 6-13: Classification of daytime measurements in typical noise districts at RBGPLTSL02

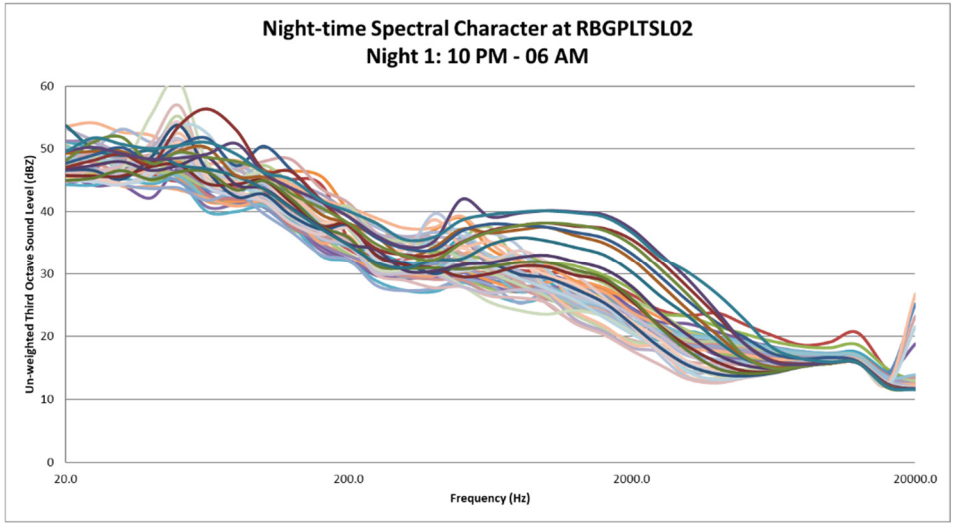

Figure 6-14: Spectral frequencies – RBGPLTSL02, Night 1

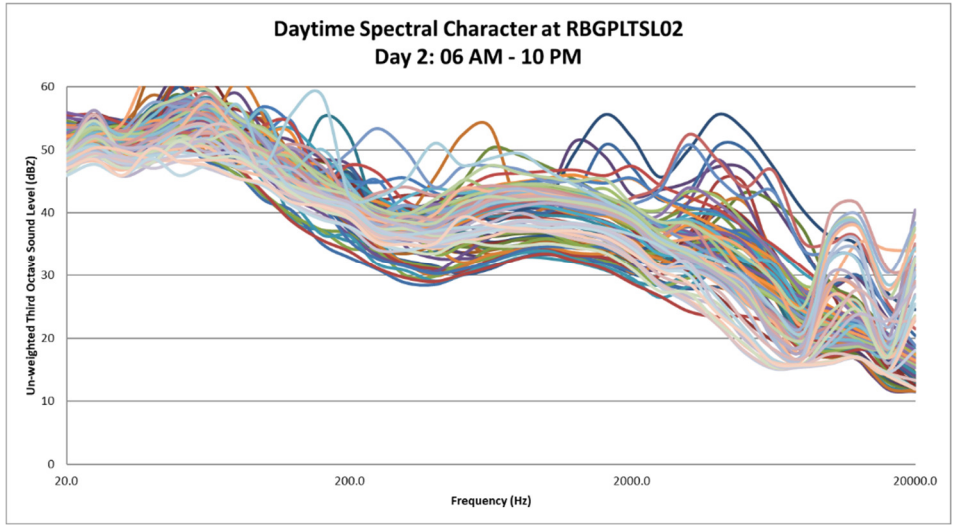

Figure 6-15: Spectral frequencies - RBGPLTSL02, Day 2

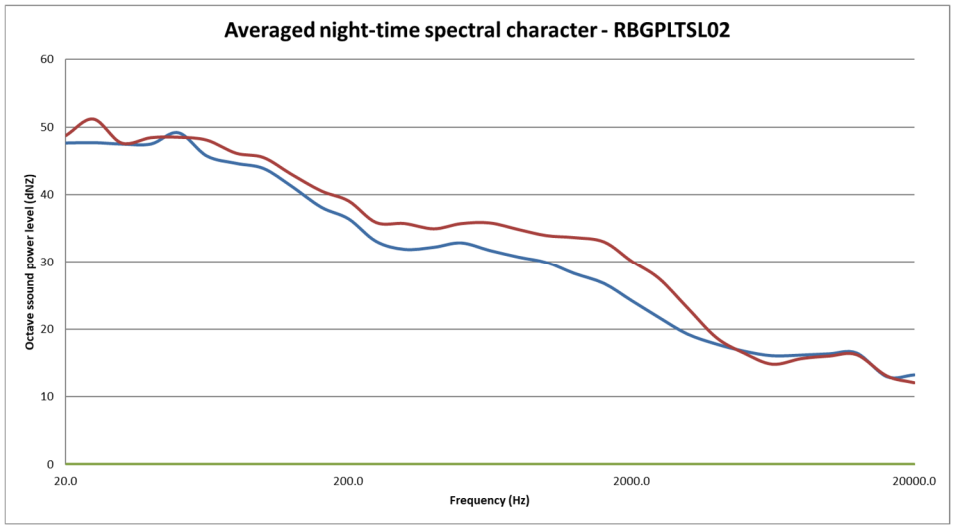

Figure 6-16: Average night-time frequencies - RBGPLTSL02

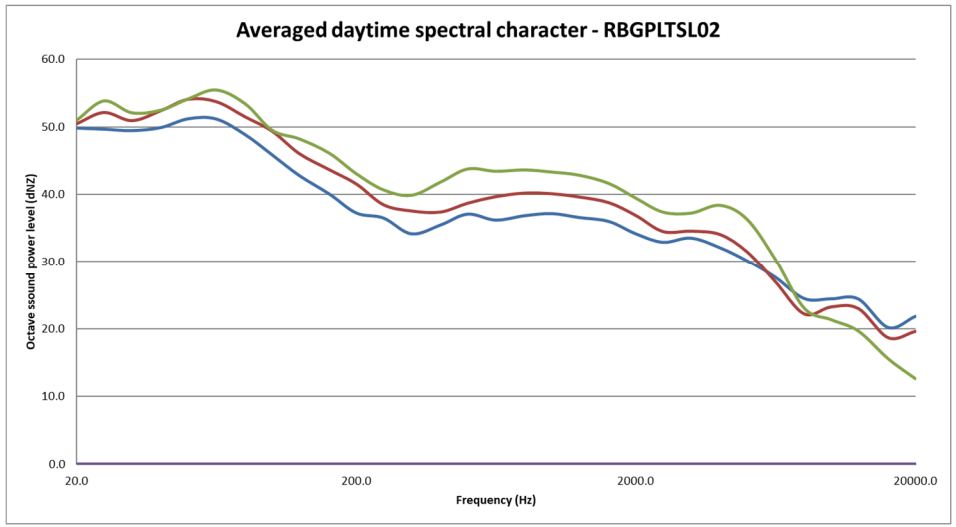

Figure 6-17: Average daytime frequencies - RBGPLTSL02

6.3.3 Ambient Sound Measurements at RBGPLTSL03

The microphone was deployed in a residential stand in the Wild and Weide suburb, with the SLM located approximately 310m from the R619 road. There was some vegetation close to the microphone and wind-induced noises is suspected to influence some of the measurements. Sounds heard onsite are described in the following table, with photos of the measurement location presented in **Appendix B**.

The equipment defined in **Table 6-8** was used for gathering data with **Table 6-9** highlighting sounds heard during equipment deployment and collection.

Table 6-8: Equipment used to gather data at RBGPLTSL03

Equipment	Model	Serial no	Calibration Date
SLM	SVAN 977	36176	January 2020
Microphone and Pre-amplifier	ACO 7052E & SV 12L	49596	January 2020
Calibrator	Quest CA-22	J 2080094	Jun 2020

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-9: Noises/sounds heard during site visits at RBGPLTSL03

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: **Barely Audible** **Audible** **Dominating**	**Faunal and Natural**
	Deployment: Birds (weavers in surrounding trees) were generally dominant. Wind-induced noises. Collection: Birds (weavers in surrounding trees) were generally dominant.
	Residential and other Anthropogenic
	Deployment: Dogs barking in area. Lawnmower (or leave blower) in area. Voices from residents at times. Collection: Radio or TV audible.
	Industries, Commercial and Road Traffic
	Deployment: - Collection: Road noises audible in distance

6.3.3.1 Summary of Ambient Sound levels measured

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-18** and summarized in **Table 6-10** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-19**. 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 significantly elevated, indicating the presence of constant noises in the area that raises the noise levels.

The maximum noise level exceeded 65 dBA only three times the first night. 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.

Table 6-10: Sound levels considering various sound level descriptors at RBGPLTSL03

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	49.8	45.6	39.6	-	-
Night arithmetic average	-	40.2	38.1	34.3	-	-
Day equivalent average	-	57.1	54.7	-	-	-
Night equivalent average	-	41.2	39.1	-	-	-
Day minimum	-	38.2	36.6	-	29.2	-
Day maximum	86.3	69.3	68.6	-	-	-
Night minimum	-	34.1	33.0	-	27.9	-
Night maximum	68.6	47.7	46.5	-	-	-
Day 1 equivalent		50.0	44.4			Afternoon and evening only
Night 1 Equivalent		40.3	37.6			8-hour night equivalent average
Day 2 equivalent		56.7	54.4			16-hour day equivalent average
Night 2 Equivalent		41.9	40.3			8-hour night equivalent average
Day 3 equivalent		46.8	42.6			Morning only

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 6-20** (night) and **Figure 6-21** (day).

6.3.3.2 Spectral Frequencies

Both day and night indicated acoustic energy at 25, 50 and 100Hz, with the source undefined (at 40 to 48 dB typical environmental noises may have masked these frequencies). This is normally associated with transformer noises. Numerous measurements indicated a relative smooth curve, indicating that wind-induced noises did influence the ambient sound level measurements. A peak in acoustic energy between 3,150 and 5,000Hz indicate the presence of faunal noises during the daytime period (birds, frogs and possibly insects). The spectral character is illustrated in **Figure 6-22** to **Figure 6-25**.

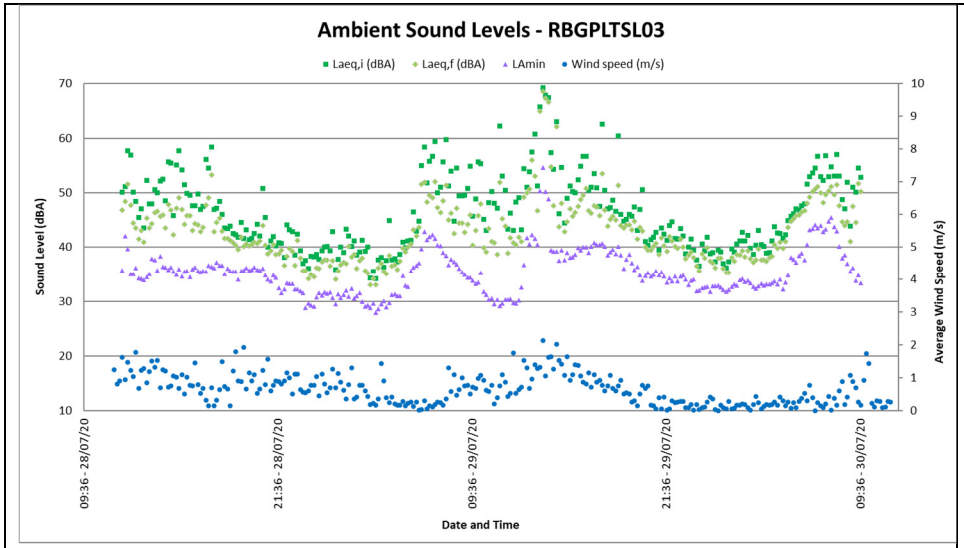

Figure 6-18: Ambient Sound Levels at RBGPLTSL03

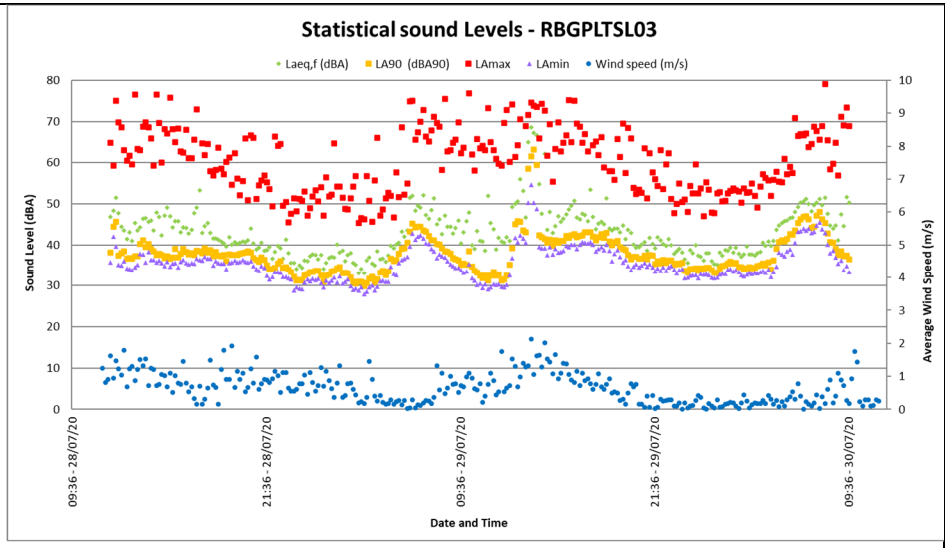

Figure 6-19: Maximum, minimum and Statistical sound levels at RBGPLTSL03

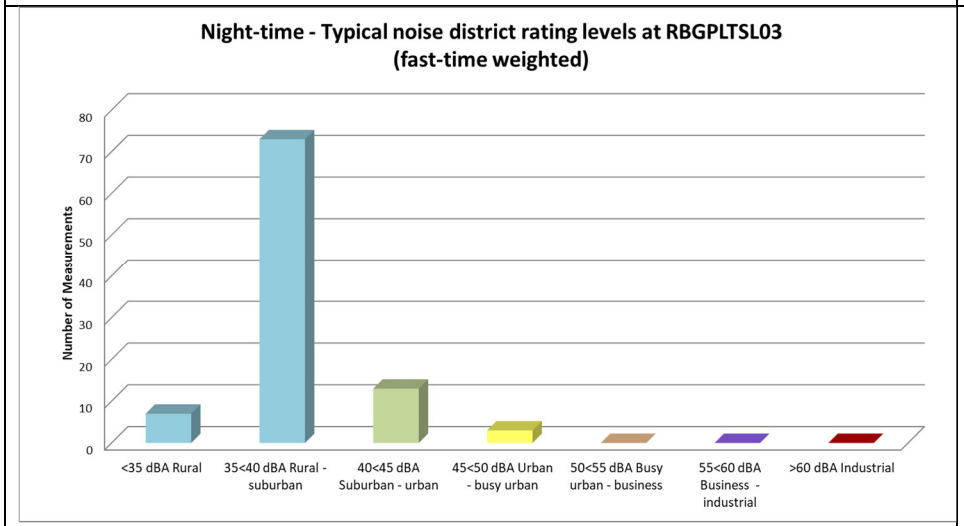

Figure 6-20: Classification of night-time measurements in typical noise districts at RBGPLTSL03

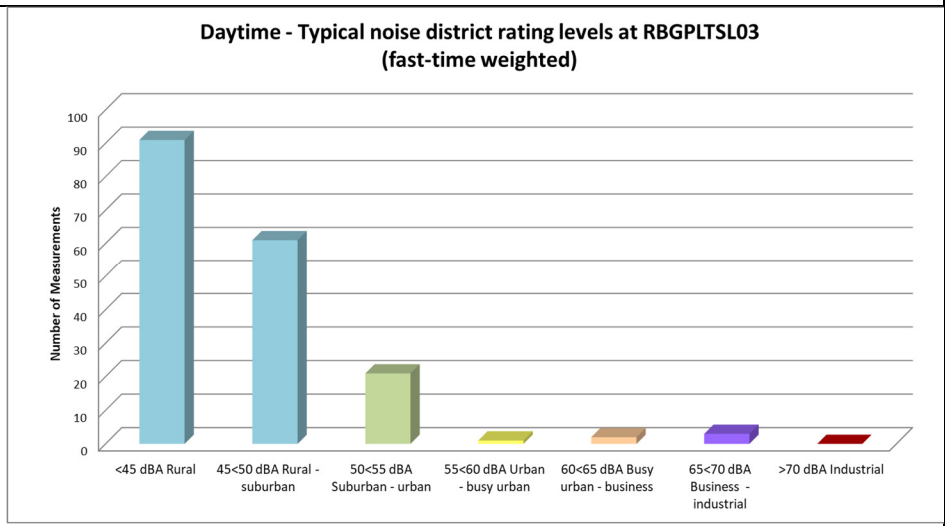

Figure 6-21: Classification of daytime measurements in typical noise districts at RBGPLTSL03

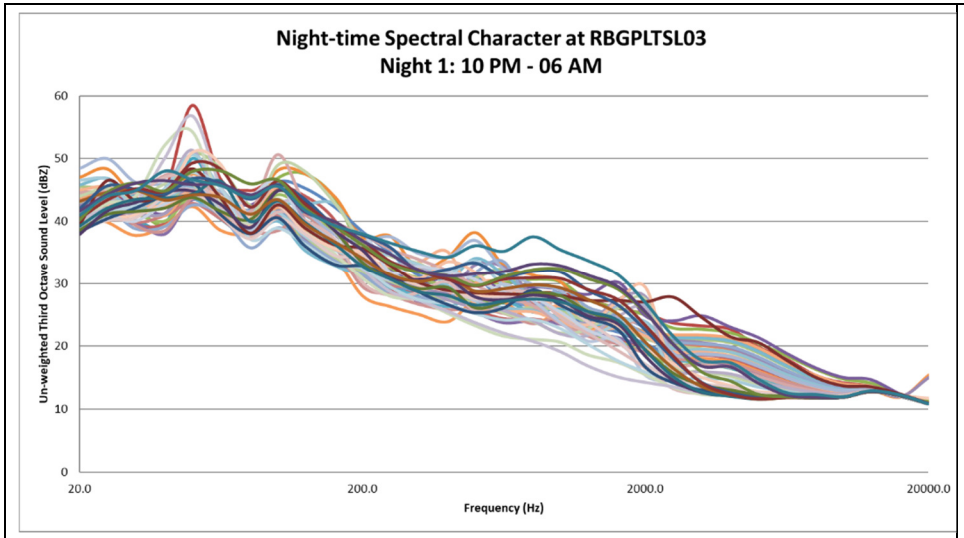

Figure 6-22: Spectral frequencies – RBGPLTSL03, Night 1

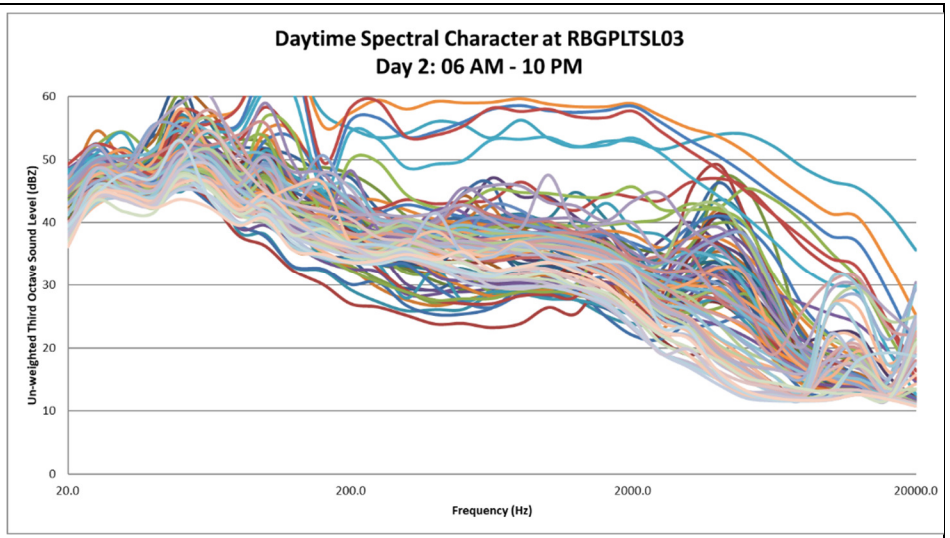

Figure 6-23: Spectral frequencies - RBGPLTSL03, Day 2

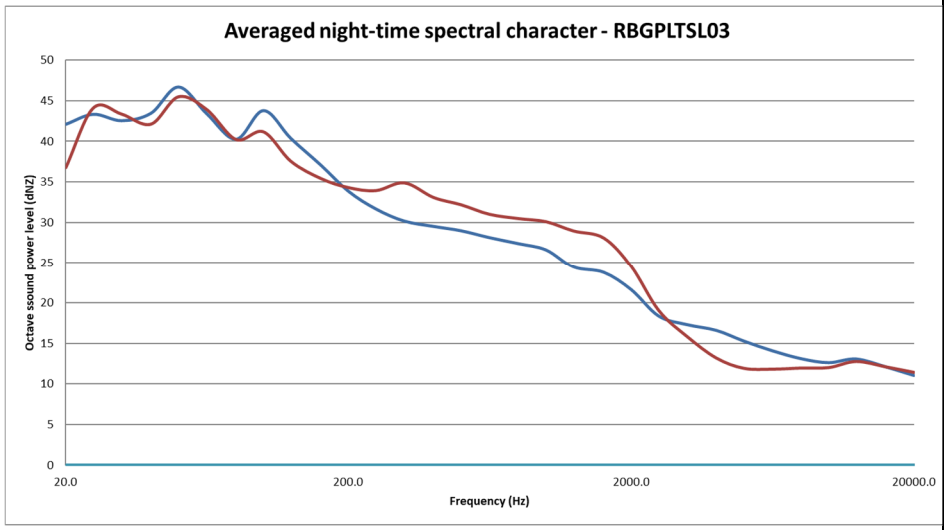

Figure 6-24: Average night-time frequencies - RBGPLTSL03

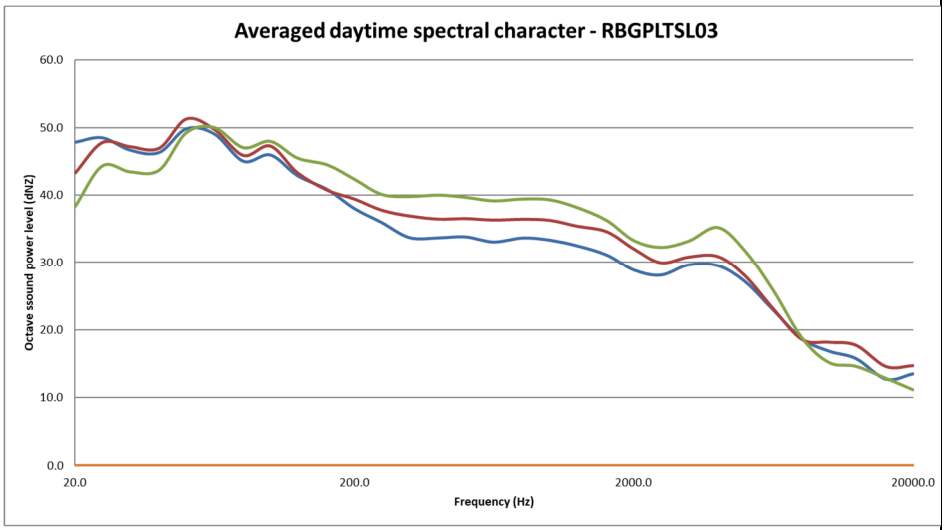

Figure 6-25: Average daytime frequencies - RBGPLTSL03

6.4 SUMMARY OF AMBIENT SOUND LEVELS

The onsite ambient sound levels are defined in the previous section, and, considering the developmental nature of the area as well as the onsite sound levels, the following can be summarized:

- **RBGPLTSL01:**
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating levels. Thus:
    - based on the full 16-hour daytime period, the daytime $L_{Aeq,i}$ value was 52.1 dBA, with the arithmetic average being 50.0 dBA. The rating level is similar of a suburban noise district, and lower than expected for this area. Based on the sounds heard onsite, roads in the area are the dominant noise source during the day;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value was 44.6 dBA, with the arithmetic average being 42.8 dBA. The rating level is similar of an urban noise district, with the ambient sound levels typical of an area with this developmental character. Based on the sounds heard onsite, roads in the area are the dominant noise source.
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels with the author generally recommending the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. Thus:
    - based on the full 16-hour daytime period, the equivalent $L_{Aeq,f}$ value was 49.2 dBA, with the arithmetic average being 47.5 dBA. This is typical of the noise rating levels expected of a urban environment and acceptable for daytime residential use;
    - based on the two 8-hour night-time periods, the equivalent $L_{Aeq,f}$ value was 42.6 dBA, with the arithmetic average being 41.1 dBA. This is typical of the noise levels expected of a urban environment and acceptable for residential use at night.
- **RBGPLTSL02:**
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating levels. Thus:
    - based on the full 16-hour daytime period, the daytime $L_{Aeq,i}$ value was 57.2 dBA, with the arithmetic average being 52.2 dBA. The rating level is similar of an urban noise district and typical for this area considering the developmental character. Based on the sounds heard onsite, roads in the area are the dominant noise source during the day;

- based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value was 44.6 dBA, with the arithmetic average being 43.0 dBA. The rating level is similar of an urban noise district, with the ambient sound levels typical of an area with this developmental character. Based on the sounds heard onsite, roads in the area are the dominant noise source.

- The fast-weighted sound level is generally used internationally to define the ambient sound levels with the author generally recommending the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. Thus:
  - based on the full 16-hour daytime period, the equivalent $L_{Aeq,f}$ value was 52.8 dBA, with the arithmetic average being 49.2 dBA. This is typical of the noise rating levels expected of an urban environment and acceptable for daytime residential use;
  - based on the two 8-hour night-time periods, the equivalent $L_{Aeq,f}$ value was 43.4 dBA, with the arithmetic average being 41.6 dBA. This is typical of the noise levels expected of an urban environment and acceptable for residential use at night.

- **RBGPLTSL03:**
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating levels. Thus:
    - based on the full 16-hour daytime period, the daytime $L_{Aeq,i}$ value was 57.1 dBA, with the arithmetic average being 49.8 dBA. The rating level is similar of an urban to suburban noise district and typical for this area considering the developmental character. Based on the sounds heard onsite, bird, wind-induced noises and roads in the area are the source of noises during the day;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value was 41.2 dBA, with the arithmetic average being 40.2 dBA. The rating level is similar of an urban noise district, with the ambient sound levels typical of an area with this developmental character. Based on the sounds heard onsite, roads in the area are the dominant noise source.
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels with the author generally recommending the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. Thus:
    - based on the full 16-hour daytime period, the equivalent $L_{Aeq,f}$ value was 54.7 dBA, with the arithmetic average being 45.6 dBA. This is typical of the noise rating levels expected of an urban environment and acceptable for daytime residential use;
    - based on the two 8-hour night-time periods, the equivalent $L_{Aeq,f}$ value was 39.1 dBA, with the arithmetic average being 38.1 dBA. This is typical of the noise

levels expected of a quiet urban environment and ideal for residential use at night.

It should be noted that ambient sound levels closer to the R619 road would be higher, mainly due to road traffic noises. However, for the purpose of this assessment, ambient rating levels typical of a residential area in an urban environment will be used for the 'Wild en Weide' suburb. The acceptable noise rating levels (the zone sound level) for residential use in an urban area is the same as the noise limits recommended by the IFC and WHO, set at:

- 55 dBA for the daytime period, and
- 45 dBA for the night-time period.

7 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction of the power generation plant and related infrastructure, the operational activities and the future closure and decommissioning phases of the project. The potential noise impacts from the activities associated with these phases are discussed in the following sections.

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

7.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

7.1.1 Construction equipment

It is estimated that construction will take approximately 36 - 48 months, with mobile equipment and activities generating the maximum noises only 50% of the time. The construction process will consist of the following principal activities:

- Site survey and preparation;
- Transport of components and equipment to site – all components will be brought to site in sections by means of flatbed trucks. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g., excavators, trucks, graders, compaction equipment, 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;
- Establishment of site entrance, internal access roads, contractor's compound and security fencing;
- Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construction of required foundations at the plant and other infrastructure;

- The establishment of infrastructure such as workshops, gas storage infrastructure, power generation buildings infrastructure and stormwater management trenches/channels.

Construction activities will take place at various locations, at different times, with equipment operating under different loads (generating different noise levels). It should be noted that noise levels generated by such industrial projects is generally significantly less than the operational phase.

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 7-1**.

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 7-2**. A list of construction equipment that may be used at this project for construction (for which the sound power emission levels will be used) are defined in **Table 7-3**. A worst-case scenario will be evaluated, considering a general noise source, emitting 113.6 dBA (re 1 pW) at eight locations on the project site.

To account for undefined construction noises sources, area noise sources (emitting 65 dBA/m^2 re 1 pW) are included at the locations proposed for the power generation activities.

7.1.2 Traffic

The potential significant source of noise during both the construction and operational phases are additional traffic to and from the site, as well as traffic on the site. Being an industrial area close to busy main roads with significant traffic, these potential noise sources will not be investigated. Due to a relative short impact associated with shift changes, the potential impact from increased traffic will not be considered.

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

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

[5] Equipment list and Sound Power Level sources: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm and British Standard BS5228:20124 - "Noise and Vibration Control on Construction and Open Sites"

Table 7-2: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Air compressor	92.6	67.6	61.6	55.5	47.6	41.6	38.0	35.5	32.0	27.6	24.1	21.6	15.5
Bulldozer CAT D10	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
Cement truck (with cement)	111.7	86.7	80.7	74.7	66.7	60.7	57.2	54.7	51.2	46.7	43.2	40.7	34.7
Crane	107.5	82.5	76.5	70.5	62.5	56.5	53.0	50.5	46.9	42.5	39.0	36.5	30.5
Diesel Generator (Large - mobile)	106.1	81.2	75.1	69.1	61.2	55.1	51.6	49.1	45.6	41.2	37.6	35.1	29.1
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
FEL (988) (FM)	115.6	90.7	84.6	78.6	70.7	64.6	61.1	58.6	55.1	50.7	47.1	44.6	38.6
Gas Compressor	108.0	82.4	76.4	70.3	62.4	56.4	52.8	50.3	46.8	42.4	38.9	36.4	30.3
Gas Compressor Cooling Fan	96.0	70.4	64.4	58.4	50.4	44.4	40.9	38.4	34.8	30.4	26.9	24.4	18.4
Gas Turbine (unmitigated)	108.4	83.3	77.3	71.3	63.3	57.3	53.8	51.3	47.8	43.3	39.8	37.3	31.3
Gas Turbine (with acoustic treatment)	98.1	73.1	67.1	61.1	53.1	47.1	43.6	41.1	37.5	33.1	29.6	27.1	21.1
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Road Truck average	109.6	84.7	78.7	72.6	64.7	58.7	55.1	52.6	49.1	44.7	41.1	38.7	32.6
Rock Breaker, CAT	120.7	95.7	89.7	83.7	75.7	69.7	66.2	63.7	60.2	55.7	52.2	49.7	43.7
Selective Catalytic Reduction Tempering Fans	104.0	79.0	73.0	67.0	59.0	53.0	49.5	47.0	43.5	39.0	35.5	33.0	27.0
Step-up transformer	97.3	72.4	66.3	60.3	52.4	46.3	42.8	40.3	36.8	32.4	28.8	26.3	20.3
Vibrating roller	106.3	81.3	75.3	69.3	61.3	55.3	51.8	49.3	45.8	41.3	37.8	35.3	29.3
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8

7.2 POTENTIAL NOISE SOURCES: OPERATIONAL PHASE

7.2.1 Noise Sources associated with Gas Turbine Power Projects

The major noise sources for a typical most combine-cycle gas turbine (CCGT) power plants are the air-cooled condenser (ACC), the steam turbine generator (STG), the inlet filter house (IFH), the exhaust stack as well as the heat recovery steam generator (HRSG) (Significant temporary noises are also created during start-up due to high-pressure steam flowing through the piping, though this will not be the subject of this assessment).

The combustion turbine and generator (CTG) are typically housed in weather enclosures (typical also incorporating acoustical treatment) which significantly decrease noise emissions. This is not to suggest that other balance-of-plant (BOP) equipment does not generate noise, as the cumulative effect of fuel gas compressors, air compressor skids, boiler feedwater pumps, lube oil coolers, and other equipment can also have a profound effect on far-field noise levels. Significant noise source that generally contribute more than 80% of the noise include:

- The ACC (or Cooling Tower) - a major noise source, primarily due to the cumulative effect of a bank of fans located between 4 to 10 meters above ground level. For mitigation, options include fan selection (larger, slower-turning fans), fan deck acoustic barrier walls and air inlet acoustic baffles;
- The Exhaust Stack and HRSG – often the primary noise source, with noise generated by turbulent exhaust gases exiting the stack, the vibrating casing and various BOP equipment associated with the HRSG. Vertical silencers in the stack, horizontal silencers within the HRSG are typically used to mitigate noise caused by the exhaust stream itself with acoustical lagging and thicker casing material used to reduce this noise source;
- The STG – consisting of the steam turbine, the steam generator, condenser and condensate pumps. This equipment is normally protected from the elements inside an enclosure, typically treated acoustically to reduce noise levels.

It should be noted that even in industrial areas, noises from equipment and activities must also consider the potential noise impact on people working in the vicinity of the equipment. Manufacturers of such power generation equipment would consider the Occupational Health and Safety Regulations requirements, providing acoustical treatment to ensure that employees are not subject to unreasonable noise levels. As such manufacturers would aim to limit noise emission levels to be less than 85 dBA (measured at 10 m) from various equipment.

7.2.2 Conceptual Noise Sources Evaluated

For the purpose of the noise model the following noise sources will be considered:

- Area noise sources, emitting 65 dBA/m^2 (re 1 pW) over the project area to address potential unaccounted noise sources in this area;
- An area noise source, emitting 55 dBA/m^2 (re 1 pW), at the switchyard, representing transformer noises;
- Each Gas Turbine Generator Systems will be represented as a number of single point sources as defined in **Table 7-3** considering the layout as provided by the applicant.

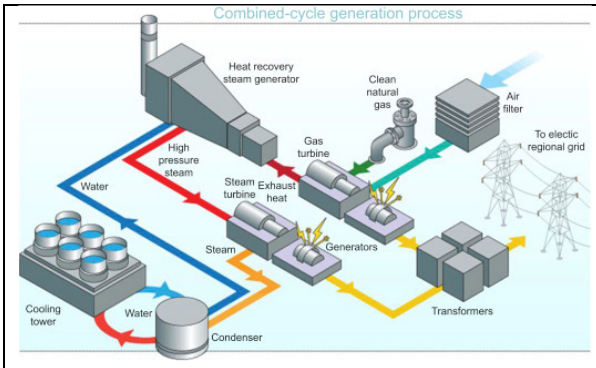

Figure 7-1: CCGT schematic[6]

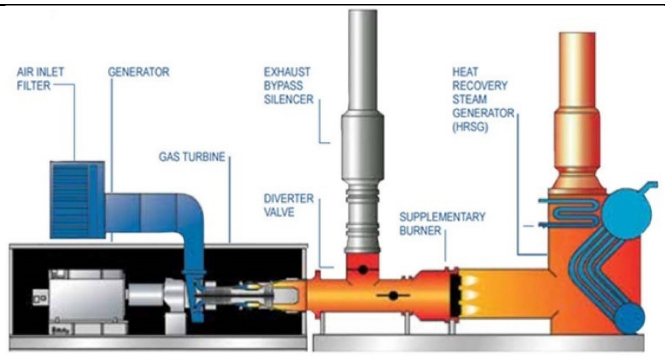

Figure 7-2: Gas Turbine Package with HRSG schematic[7]

Table 7-3: Equipment list and Sound power emission levels used for modelling

Construction activities and Power Generation equipment								
Equipment	**Sound power level, dB re 1 pW[8], in octave band, Hz**							**SPL**
Centre frequency	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**(dBA)**
Point Sources (dBA re 1 pW)								
Air Cooled Condenser	109	106	102	96	95	95	97	103
General Noise – Construction	95.0	100.0	103.0	105.0	105.0	100.0	100.0	113.6
HRSG	136.0	125.0	119.0	114.0	108.0	105.0	102.0	117.2
SGT5-2000 - Gas Turbine Package	134.0	123.0	118.0	115.0	110.0	108.0	107.0	117.7
SGT5-2000 – Inlet Filter house	110.0	104.0	94.0	82.0	83.0	89.0	82.0	94.4
SGT5-2000 - Diffuser Extension Duct	112.0	109.0	106.0	105.0	98.0	98.0	93.0	106.0
SGT5-2000 - Exhaust Stack	131.0	114.0	102.0	100.0	95.0	95.0	95.0	107.6
SGT5-2000 - Lube Oil Coolers	98.0	100.0	101.0	96.0	92.0	90.0	88.0	98.8
SGT5-2000 - Transformers	89.0	103.0	103.0	99.0	94.0	87.0	83.0	100.2
SGT5-2000 – Balance of Plant (BoP)	121.0	116.0	112.0	103.0	97.0	91.0	85.0	107.1
Area Sources (dBA/m^2 re 1 pW)								
General noise	51.2	56.2	59.2	61.2	61.2	56.2	56.2	65.0

[6] Alsaffar, Iman & Ezzat, Akram. (2020). Qualitative Risk Assessment of Combined Cycle Power Plant Using Hazards Identification Technique. Journal of Mechanical Engineering Research and Developments. 43. 284-293.
[7] U.S Department of Energy: Combined Heat and Power Technology Fact Sheet Series.
[8] Sound power levels are referenced to 10^{-12} Watt (1 pW)

7.3 POTENTIAL NOISE SOURCES: FUTURE NOISE SCENARIO – DECOMMISSIONING

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

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

8 METHODS: NOISE IMPACT ASSESSMENT

8.1 WHY NOISE CONCERNS COMMUNITIES[9]

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

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

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

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

Severity of the annoyance depends on factors such as:

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

[9] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

8.1.1 Annoyance associated with Industrial Processes

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 plays a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity.

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 8-1**, are recommended in a European Union position paper published in 2002,[10] 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.

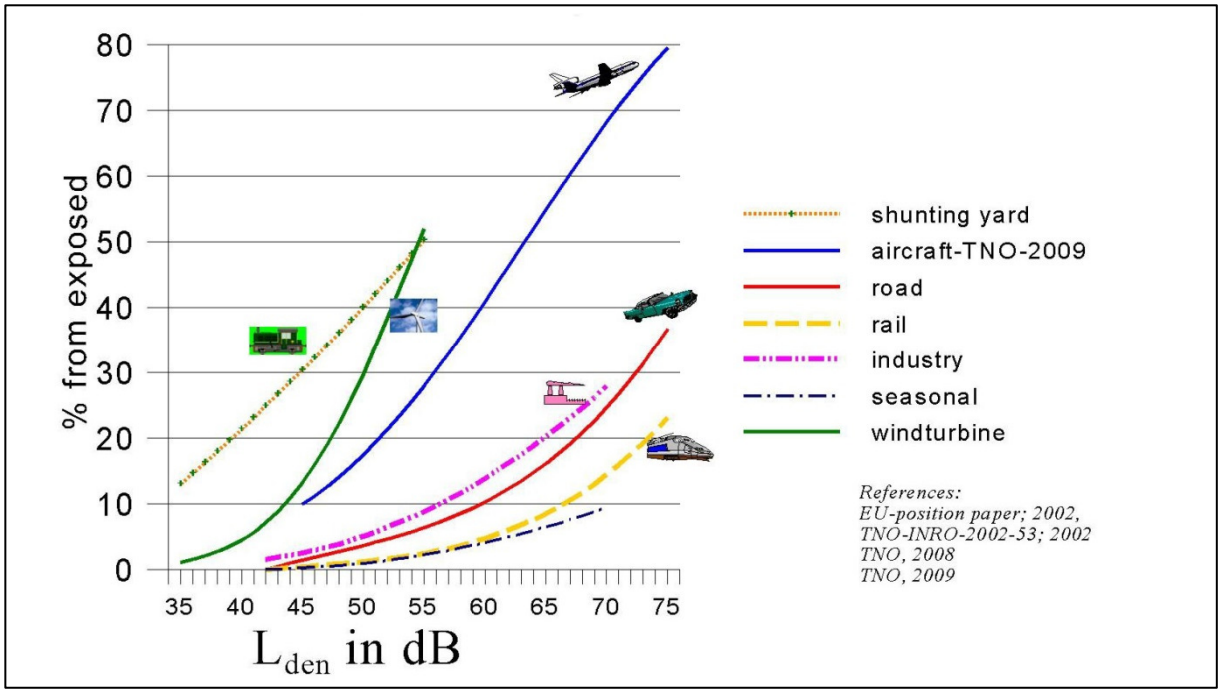

Figure 8-1: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling

(10) Image from presentation, Almgren (2011). Sources Miliue, 2010, European Comm., 2010, Jansen, 2009.

As shown in **Figure 8-1**, there is significant potential of annoyance associated with noise from shunting operations, mainly due to the highly impulsive character of the noises created.

8.2 IMPACT ASSESSMENT CRITERIA

8.2.1 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.

8.2.2 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.

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 Noise Control Regulations, an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 8-2**.
- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 8-1**.

- *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 8-1**). 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.

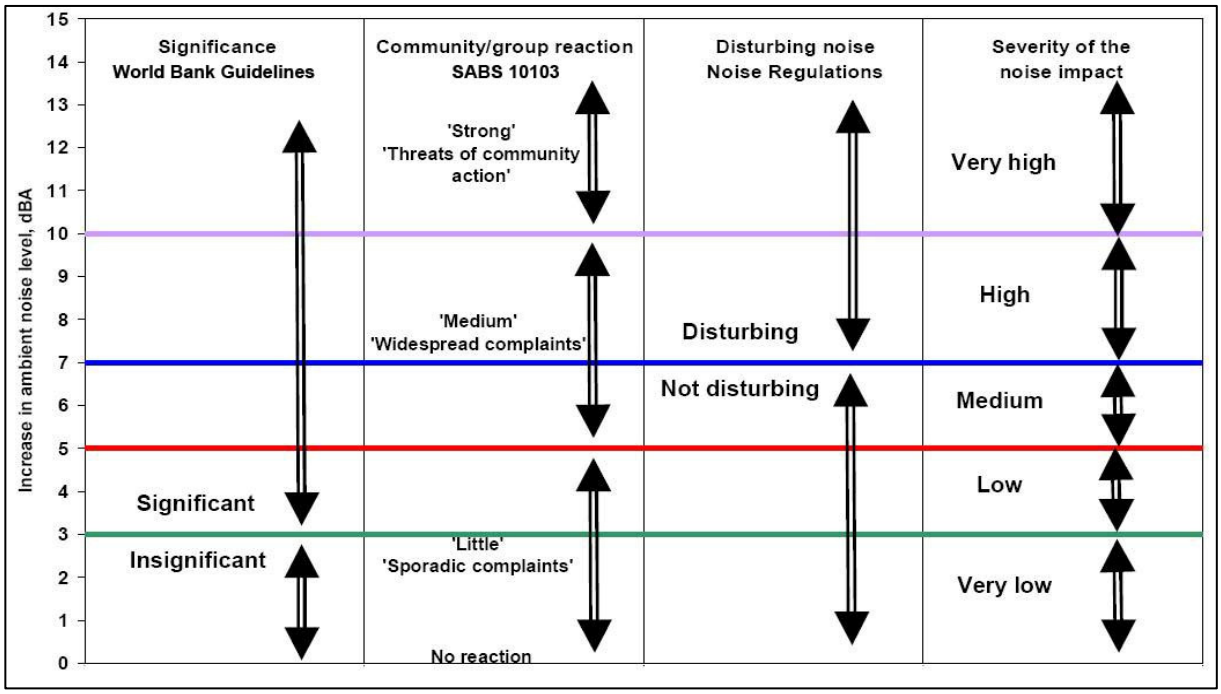

Figure 8-2: Criteria to assess the significance of impacts stemming from noise

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

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

more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited by national and provincial noise control regulations.

Table 8-1: 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						**EARES rating colour code**
	Outdoors			Indoors, with open windows			
	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time $L_{Req,n}$	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time $L_{Req,n}$	
Residential areas							
a) Rural districts	45	45	35	35	35	25	Rural
b) Suburban districts with little road traffic	50	50	40	40	40	30	Suburban
c) Urban districts	55	55	45	45	45	35	Urban
Non-residential areas							
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40	Busy urban
e) Central business districts	65	65	55	55	55	45	Business
f) Industrial districts	70	70	60	60	60	50	Industrial

8.3 SETTING APPROPRIATE NOISE LIMITS

Onsite ambient sound measurements (**Section 6.3**) indicated a site with elevated ambient sound levels more typical of an urban noise district (with main roads, business and workshops).

Considering the results of the measurements, ambient sound levels in the vicinity of the project site are elevated, with industrial noises from various activities being a potential significant contributor to noise in the area. Based on the ambient sound levels, as well as the local (urban noise rating level acceptable for residential use) and international guidelines (noise limits acceptable for residential use), the recommended zone sound level will be;

- **55 dBA for daytime noise levels;** and,
- **45 dBA for night-time noise levels**.

However, because the existing ambient sound levels already exceed the night-time noise limit, the proposed development should not change the existing ambient sound levels with more than 3 dB (as per IFC, 2007 – see **section 5.5.4**).

8.4 DETERMINING THE SIGNIFICANCE OF THE NOISE IMPACT

The level of detail as depicted in the 2014 EIA regulations, as amended on 07 April 2017, was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value as defined in the third column in the tables below.

The impact consequence is determined by summing the scores of Magnitude (**Table 8-2**), Duration (**Table 8-3**) and Spatial Extent (**Table 8-4**). The impact significance (see **Table 8-7**) is determined by multiplying the Consequence result with the Probability score (**Table 8-5**). An explanation of the impact assessment criteria is defined in the following tables.

Table 8-2: Impact Assessment Criteria – Magnitude

This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.		
Rating	**Description**	**Score**
Minor	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Ambient sound levels are defined by the lower of the measured $L_{AIeq,8hr}$ or $L_{AIeq,16hr}$ during measurement dates. Total projected noise level is less than the Zone Sound Level and/or Equator Principle in wind-still conditions.	2
Low	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Total projected noise levels between 3 and 5 above the Zone Sound Level and/or Equator Principle (wind-less conditions).	4
Moderate	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 5 and 7 above the Zone Sound Level and/or Equator Principle (wind less conditions). Sporadic complaints expected.	6
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Total projected noise levels between 7 and 10 dBA above the Zone Sound Level and/or Equator Principle (wind-less condition). Medium to widespread complaints expected.	8
Very High	Increase in average ambient sound pressure levels higher than 10 dBA. Total projected noise levels higher than 10 dB above the Zone Sound Level and/or Equator Principle (wind less-conditions). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	10

Table 8-3: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operation and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of very short duration (portion of construction period) and intermittent/occasional (0 – 1 year).	1
Short term	Impacts that are short, predicted to last only for the duration of the construction period (2 - 5 years).	2
Medium term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating (5 - 15 years).	3
Long term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating (>15 years).	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	5

Table 8-4: Impact Assessment Criteria – Spatial extent

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

Table 8-5: Impact Assessment Criteria - Probability

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

In order to assess each of these factors for each impact, the following ranking scales as contained in **Table 8-6** will be used.

Table 8-6: Assessment Criteria: Ranking Scales

PROBABILITY		MAGNITUDE	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
Definite/don't know	5	Very high/don't know	10
Highly likely	4	High	8
Likely	3	Moderate	6
Possible	2	Low	4
Improbable	1	Minor	2
DURATION		**SPATIAL SCALE**	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
Permanent	5	International	5
Long Term	4	National	4
Medium Term	3	Regional	3
Short term	2	Local	2
Temporary	1	Footprint	1

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 defined in **Table 8-7**.

Table 8-7: Calculating the Significance Rating for the Noise Impact

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

8.5 REPRESENTATION OF NOISE LEVELS

Noise rating levels will be calculated in detail in this report using the appropriate sound propagation models as defined. It is therefore important to understand the difference

between sound or noise level as well as the noise rating level (also see Glossary of Terms, **Appendix A**).

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

9 METHODS: CALCULATION OF NOISE LEVELS

9.1 NOISE FROM POINT, LINEAR AND AREA SOURCES

The noise emissions from various sources were calculated in detail for the conceptual existing 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.

9.2 NOISE FROM ROAD TRAFFIC

The noise emission into the environment due to project road traffic will be calculated using the sound propagation model described in RLS-90. Calculated corrections such as the following will be considered:

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

While the output of the RLS-90 model provides a L_{A10} level, this report will use this level as the calculated L_{Aeq} level, together with the output of the ISO 9613-2 model and represent this as the noise level. The L_{A10} level is normally higher than the L_{Aeq} and this level will represent the worst-case scenario.

10 ASSUMPTIONS AND LIMITATIONS

10.1 LIMITATIONS - ACOUSTICAL MEASUREMENTS

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced a measurement using the reading result at the end of the measurement. Therefore, trying to define ambient sound levels using the result of one 10-minute measurement can be inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement. When singular measurements are used, a precautious stance must be adopted (this report only report long-term measurements collected over a 2-night period).
- Ambient sound levels are dependent not only on time of day and meteorological conditions but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[11].
- It is assumed that the measurement locations represent other residential dwellings in the area (similar environment), yet, in practice, this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
    - the distance to closest trees, number and type of trees as well as the height of trees;
    - distance to roads, construction material of the road, the traffic volumes on that road as well as the average speeds on this road;

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

  - available habitat and food for birds and other animals;
  - distance to residential dwelling, type of equipment used at dwelling (compressors, air-con);
  - general maintenance condition of house (especially during windy conditions); and
  - number and type of animals kept in the vicinity of the measurement locations (typical land use taking place around the dwelling).
- Measurements over wind speeds of 3 -5 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity, which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during the dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural baseline, and in various cases sought after and pleasing. Using this data to define the ambient sound level will result in a higher rating level, and data collected close to such measurement locations will not be considered;
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as L_{AMin}, L_{Aeq}, L_{AMax}, L_{A10}, L_{A90} and spectral analysis forms part of the many variables that can be considered. However, South African legislation requires consideration of the impulse-weighted L_{Aeq} setting that will be considered when measuring ambient sound levels;
- 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 measuring 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 noises, voices, animals and equipment (including TVs and radios). The result is that ambient sound levels will increase as an area matures.

10.2 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;

- Sound propagation models do not consider refraction through the various temperature layers (specifically relevant during the night-times);
- Most sound propagation models do not consider the low frequency range (third octave 16 Hz – 31.5 Hz). This would be relevant to facilities with a potentially low frequency issues;
- Many environmental models consider sound to propagate in hemi-spherical way. Certain noise sources (e.g. a speakers, exhausts, fans) emit sound power levels in a directional manner;
- The 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. Ground conditions will not be considered in this assessment.

Due to these assumptions, modelling generally could be out with as much as +10 dBA, although realistic values ranging from 3 dBA to less than 5 dBA are more common in practice.

10.3 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.

10.4 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 NSD). 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 is 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 will be implemented and continued during the operational phase.

10.5 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:

- 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 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;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty per cent (50%) soft ground conditions will be modelled as the area where the construction activities are proposed is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions.

10.6 CONDITIONS TO WHICH THIS STUDY IS SUBJECT

This study is not subject to any conditions.

11 PROJECTED NOISE RATING LEVELS

11.1 CONCEPTUAL SCENARIO – POTENTIAL FUTURE CONSTRUCTION ACTIVITIES

A conceptual construction scenario will be investigated, considering the noise-generating activities as discussed in **section 7.1** and depicted in **Figure 11-1**. The potential noise contours for the conceptual scenario are illustrated in:

- **Figure 11-2** from 55 dBA upwards for the conceptual daytime construction scenario. The noise levels (as well as the potential significance of the noise impact) at the identified NSD are defined in **Appendix C, Table 1**; and,
- **Figure 11-3** from 45 dBA upwards for the conceptual daytime construction scenario. The noise levels (as well as the potential significance of the noise impact) at the identified NSD are defined in **Appendix C, Table 2**.

11.2 CONCEPTUAL SCENARIO – POTENTIAL FUTURE OPERATIONAL ACTIVITIES

The scenario considered the conceptual noise-generating activities discussed in **section 7.2** and depicted in **Figure 11-4**. The potential noise contours for the conceptual scenario are illustrated in:

- **Figure 11-5** from 55 dBA upwards for the conceptual daytime power generation activities. The noise levels (as well as the potential significance of the noise impact) at the identified NSD are defined in **Appendix C, Table 3**; and,
- **Figure 11-6** from 55 dBA upwards for the conceptual daytime power generation activities. The noise levels (as well as the potential significance of the noise impact) at the identified NSD are defined in **Appendix C, Table 4**.

11.3 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 operational phases and noise from these phases will not be investigated further.

Figure 11-1: Conceptual construction noise sources

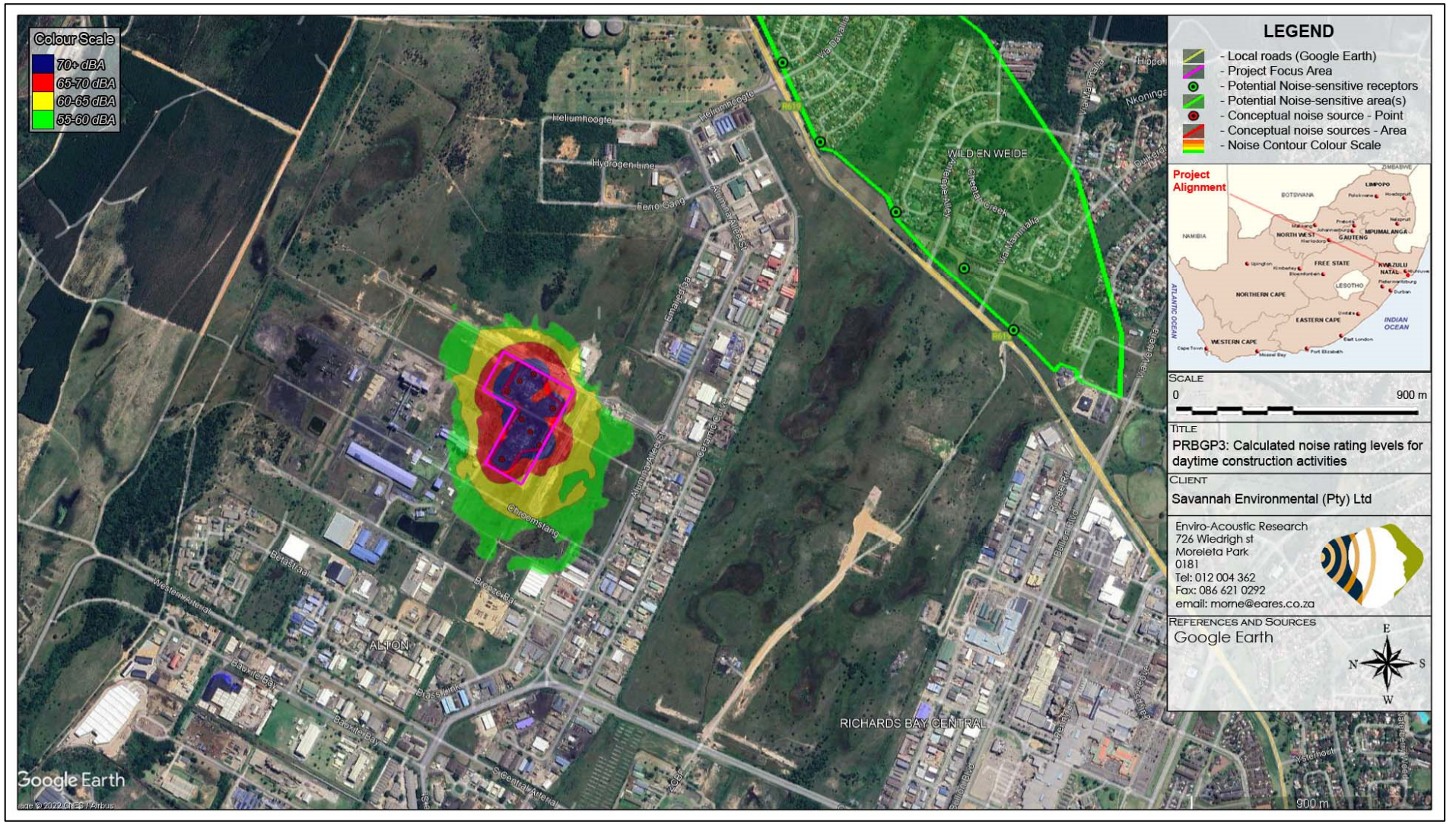

Figure 11-2: Projected conceptual daytime construction noise level contours

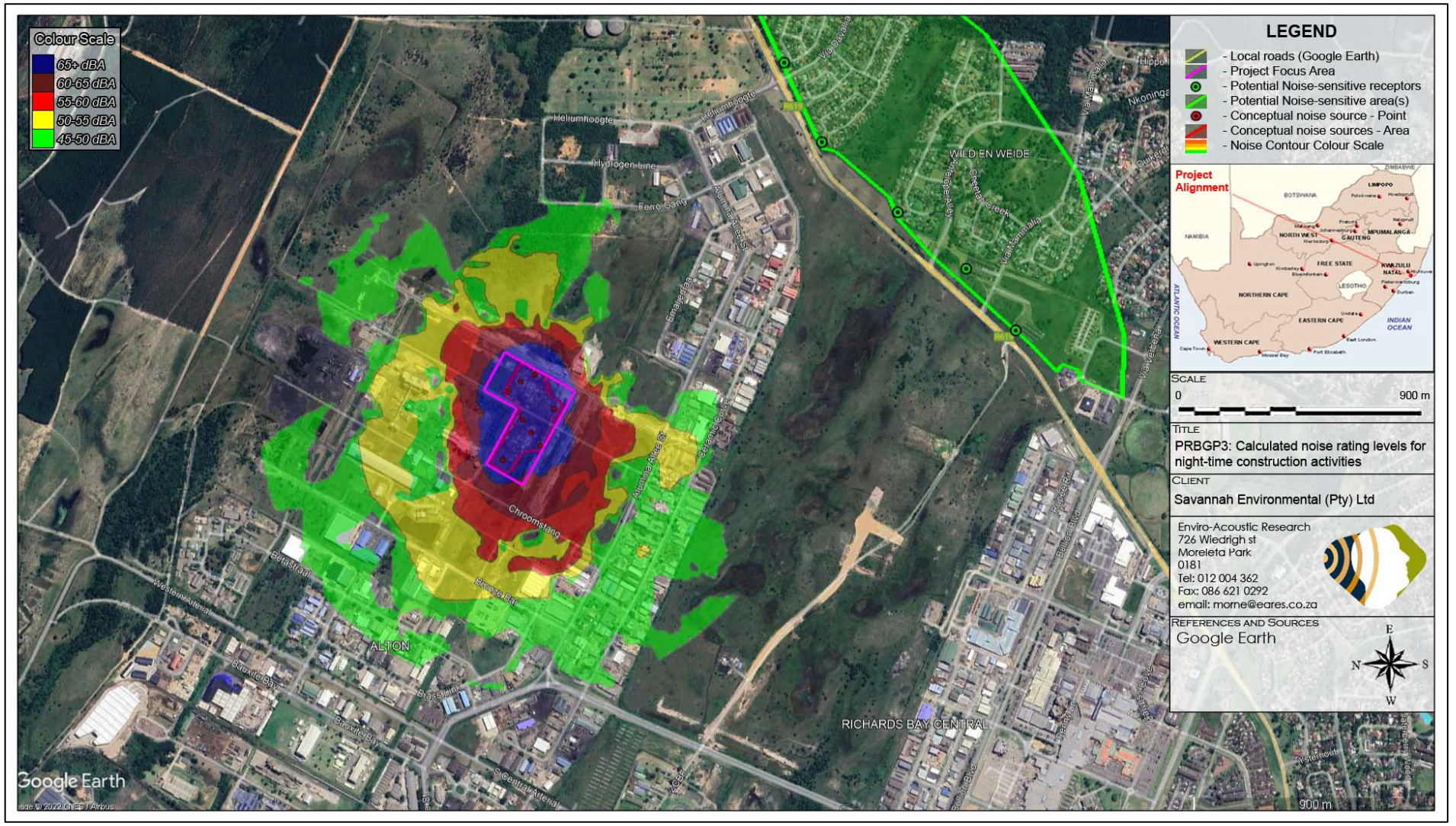

Figure 11-3: Projected conceptual night-time construction noise level contours

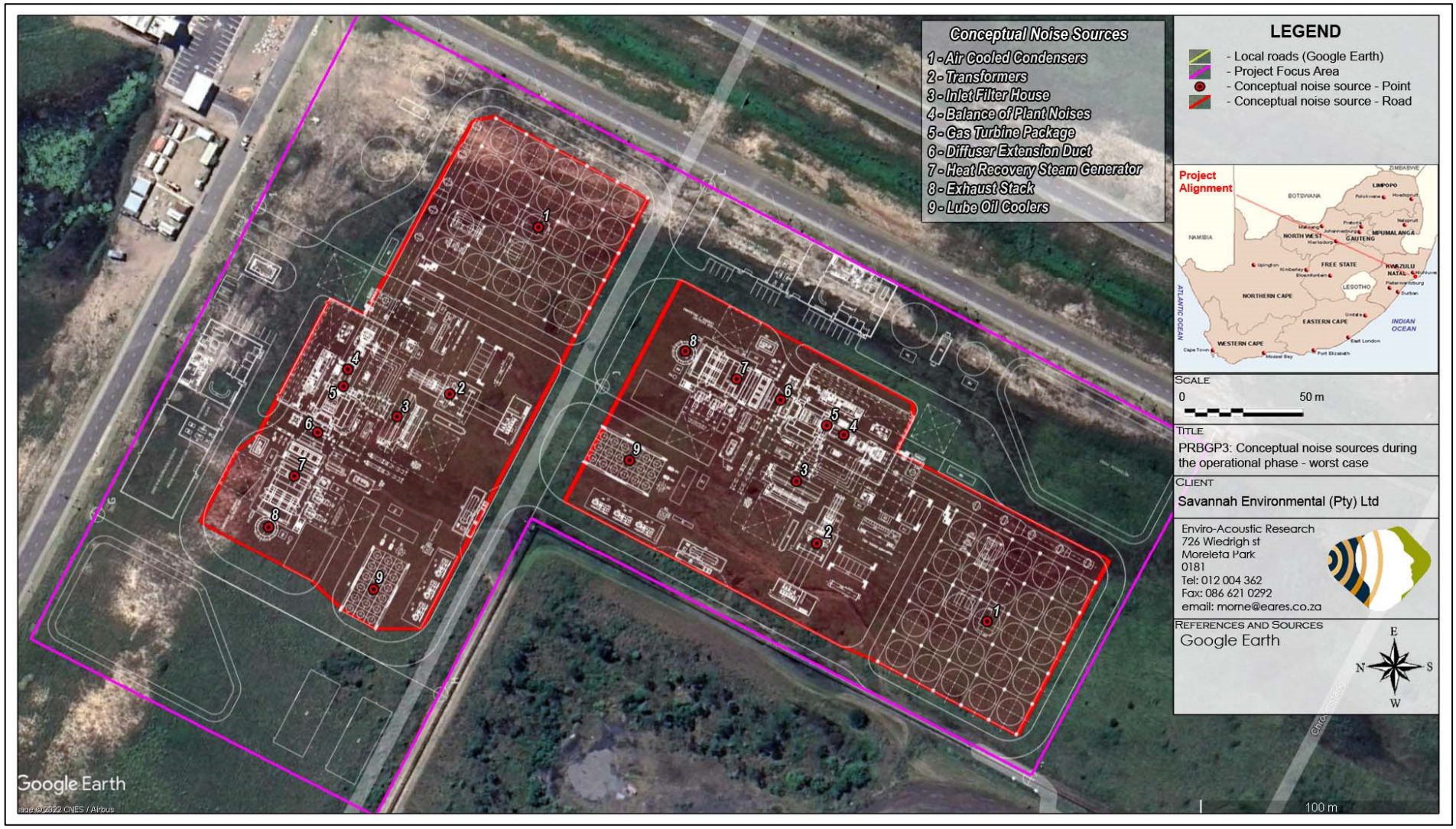

Figure 11-4: Conceptual operational noise sources

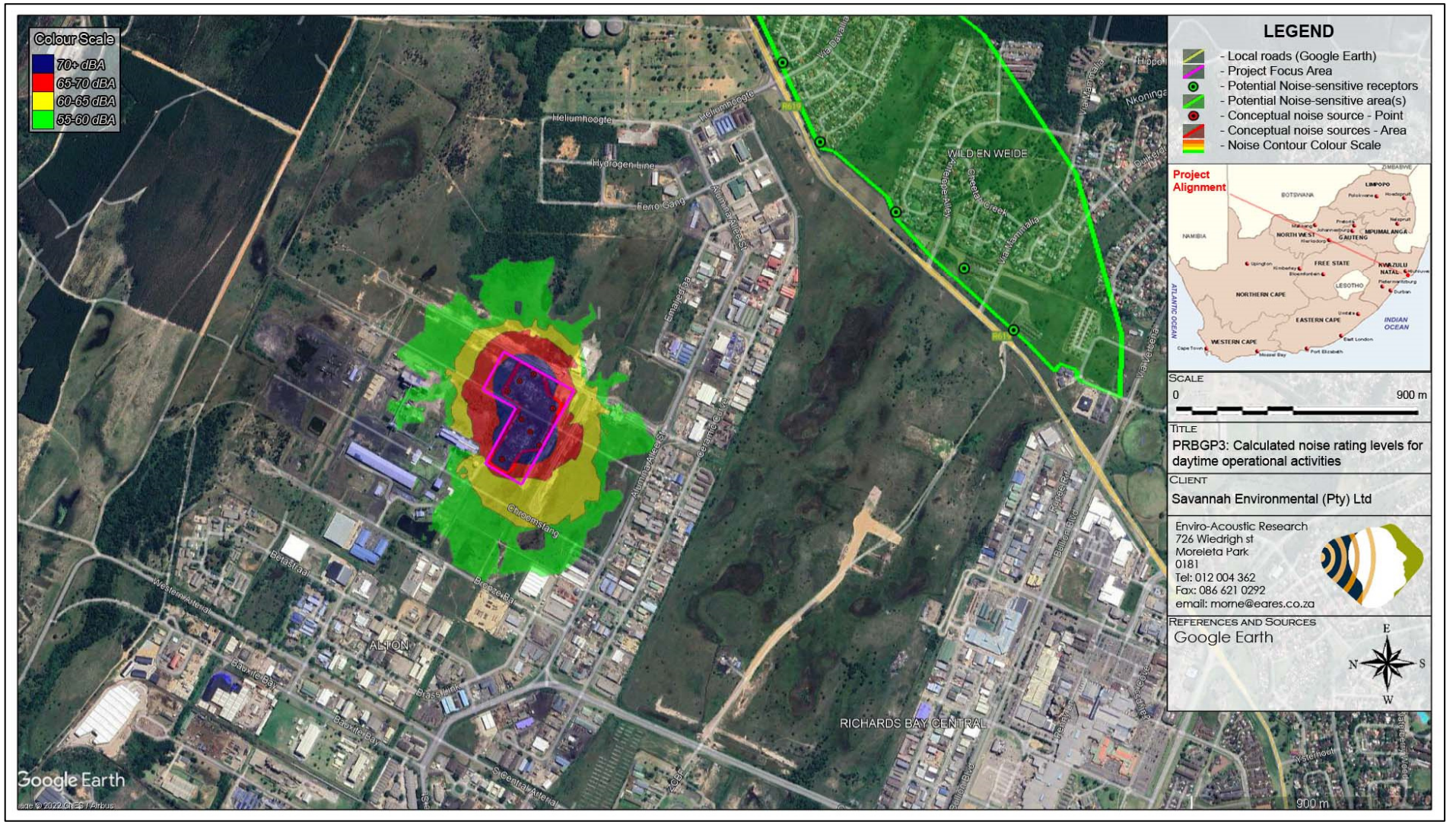

Figure 11-5: Projected conceptual daytime operational noise level contours

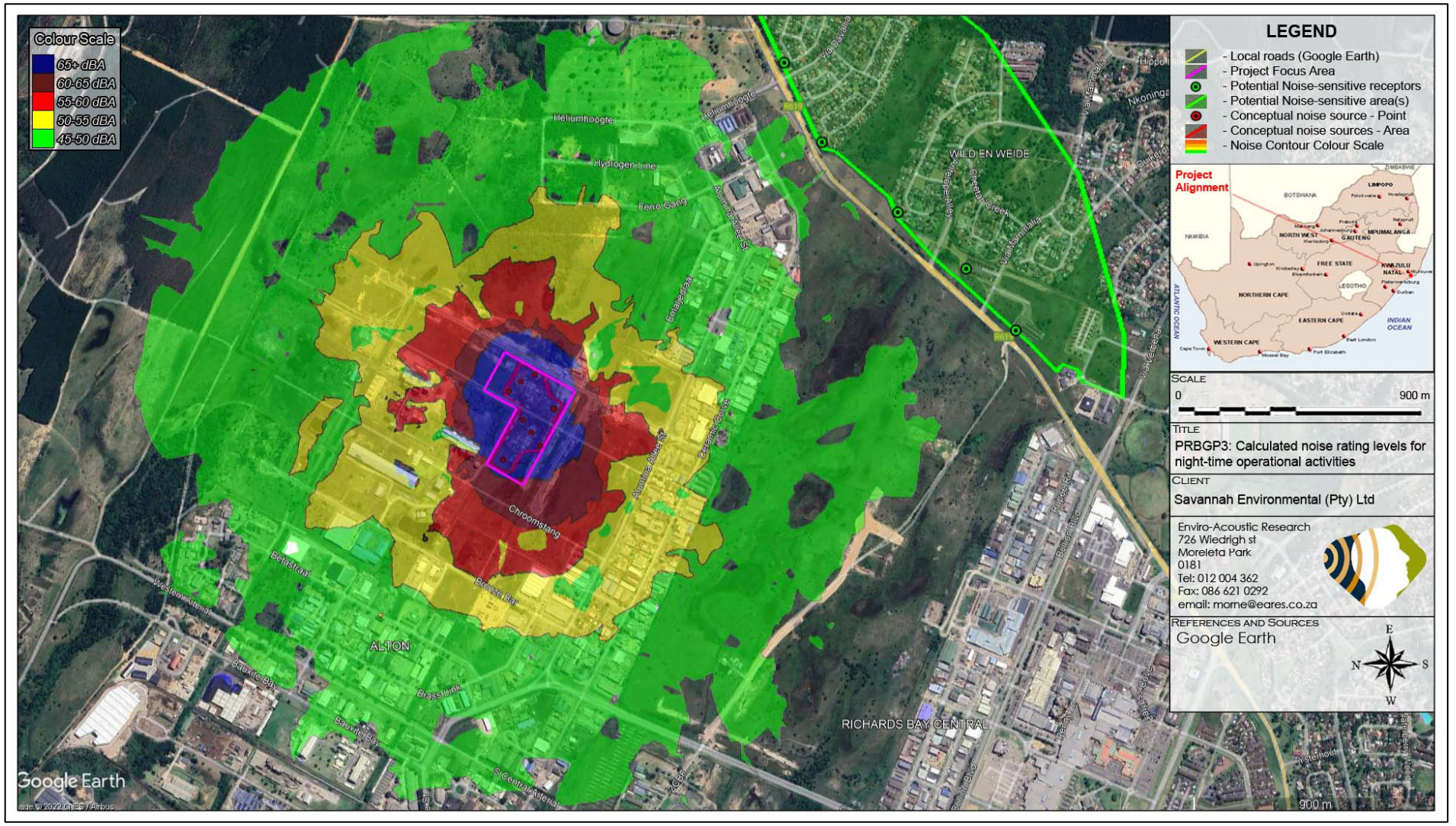

Figure 11-6: Projected conceptual night-time operational noise rating level contours

12 SIGNIFICANCE OF THE NOISE IMPACT

12.1 POTENTIAL CONSTRUCTION NOISE LEVELS - NOISE IMPACT

The noise levels for the various conceptualized construction activities were calculated in **section 11.1**. The potential significance of the noise impacts is summarized in **Table 12-1** for noise impacts relating to potential daytime construction activities and summarized in **Table 12-2** for a potential night-time scenario.

Table 12-1: Noise Impact Assessment: Potential day-time construction activities

Nature of Impact: Precautious approach, with daytime ambient sound level measurements (see **section 6.3**) indicating noise levels typical of a suburban noise district refer to **Table 8-1**), though it should be noted that measurements were collected further from the R619 road. Ambient sound levels closer to the R619 will be higher. Considering the developmental character, a rating level typical of an urban noise district will be assumed (55 dBA). The projected noise levels, the potential change in ambient sound level as well as the potential significance are defined in **Appendix C, Table 1** for the daytime period for the NSD identified.			
Impact description: Increase in ambient sound levels in the noise-sensitive residential areas north-east of the project site.			
Prior to Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Construction noises will not change the ambient sound levels during the day.	**Low (6)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to construction phase will last 1 – 5 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Mitigation / Management Measures			
Mitigation: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			
Post Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Construction noises will not change the ambient sound levels during the day.	**Low (6)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to construction phase will last 1 – 5 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Cumulative impacts: Potential of cumulative noise impact is low, with the construction noise model considering the cumulative scenario (worst-case noise impact).			
Residual Risks: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			

Table 12-2: Noise Impact Assessment: Potential night-time construction activities

Nature of Impact: Precautious approach, with night-time ambient sound level measurements (see **section 6.3**) indicating noise levels typical of an urban noise district refer to **Table 8-1**), though it should be noted that measurements were collected further from the R619 road. Ambient sound levels closer to the R619 will be higher. Considering the developmental character, a rating level typical of an urban noise district will be assumed (45 dBA). The projected noise levels, the potential change in ambient sound level as well as the potential significance are defined in **Appendix C, Table 2** for the night-time period for the NSD identified.			
Impact description: Increase in ambient sound levels in the noise-sensitive residential areas north-east of the project site.			
Prior to Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Construction noises will not change night-time ambient sound levels.	**Low (6)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to construction phase will last 1 – 5 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Mitigation / Management Measures			
Mitigation: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			
Post Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Construction noises will not change night-time ambient sound levels.	**Low (6)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to construction phase will last 1 – 5 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Cumulative impacts: Potential of cumulative noise impact is low, with the construction noise model considering the cumulative scenario (worst-case noise impact).			
Residual Risks: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			

12.2 POTENTIAL OPERATIONAL NOISE LEVELS - NOISE IMPACT

The impact assessment for the various proposed operational activities (as conceptualised in **section 7.2**) was calculated in **section 11.2**. The potential significance of the noise impacts is summarized in:

- **Table 12-3** for noise impacts relating to daytime operational activities; and,
- **Table 12-4** for noise impacts relating to night-time operational activities.

Table 12-3: Noise Impact Assessment: Potential daytime operational activities

Nature of Impact: Precautious approach, with daytime ambient sound level measurements (see **section 6.3**) indicating noise levels typical of a suburban noise district refer to **Table 8-1**), though it should be noted that measurements were collected further from the R619 road. Ambient sound levels closer to the R619 will be higher. Considering the developmental character, a rating level typical of an urban noise district will be assumed (55 dBA). The projected noise levels, the potential change in ambient sound level as well as the potential significance are defined in **Appendix C, Table 3** for the daytime period for the NSD identified.			
Impact description: Increase in ambient sound levels in the noise-sensitive residential areas north-east of the project site.			
Prior to Mitigation			
	Rating	Motivation	Significance
Magnitude ***(****Table 8-2****)***	Minor (2)	Operational noises (power generation activities) will not change the ambient sound levels during the day.	**Low (8)**
Duration ***(****Table 8-3****)***	Long-term (4)	The noise impact relating to the operational phase can last up to 25 years.	
Extent ***(*$\Delta L_{Aeq,D}$***>7dBA)*** ***(****Table 8-4****)***	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability ***(****Table 8-5****)***	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Mitigation / Management Measures			
Mitigation: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			
Post Mitigation			
	Rating	Motivation	Significance
Magnitude ***(****Table 8-2****)***	Minor (2)	Operational noises (power generation activities) will not change the ambient sound levels during the day.	**Low (8)**
Duration ***(****Table 8-3****)***	Long-term (4)	The noise impact relating to the operational phase can last up to 25 years.	
Extent ***(*$\Delta L_{Aeq,D}$***>7dBA)*** ***(****Table 8-4****)***	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability ***(****Table 8-5****)***	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Cumulative impacts: Potential of cumulative noise impact is low.			
Residual Risks: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			

Table 12-4: Noise Impact Assessment: Potential night-time operational activities

Nature of Impact: Precautious approach, with night-time ambient sound level measurements (see **section 6.3**) indicating noise levels typical of an urban noise district refer to **Table 8-1**), though it should be noted that measurements were collected further from the R619 road. Ambient sound levels closer to the R619 will be higher. Considering the developmental character, a rating level typical of an urban noise district will be assumed (45 dBA). The projected noise levels, the potential change in ambient sound level as well as the potential significance are defined in **Appendix C, Table 4** for the night-time period for the NSD identified.			
Impact description: Increase in ambient sound levels in the noise-sensitive residential areas north-east of the project site.			
Prior to Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Operational noises (power generation activities) will not change night-time ambient sound levels.	**Low (8)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to the operational phase can last up to 25 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Mitigation / Management Measures			
Mitigation: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			
Post Mitigation			
	Rating	Motivation	Significance
Magnitude *(Table 8-2)*	Minor (2)	Operational noises (power generation activities) will not change night-time ambient sound levels.	**Low (8)**
Duration *(Table 8-3)*	Short-term (2)	The noise impact relating to the operational phase can last up to 25 years.	
Extent ***($\Delta L_{Aeq,D}$>7dBA)*** *(Table 8-4)*	Local (2)	The noise impact would extent from the site, potentially as far as 1,000m.	
Probability *(Table 8-5)*	Improbable (1)	It is improbable that the higher noise level and change in ambient sound levels will impact on the closest NSD.	
Cumulative impacts: Potential of cumulative noise impact is low.			
Residual Risks: Significance of the construction noise impact is **low** for the scenario as conceptualized and additional mitigation measures are not required.			

12.3 CUMULATIVE NOISE IMPACT

There is a very low risk of cumulative noises during the construction phase, as noises from other construction activities (such as the authorized Richards Bay Gas to Power project, or the authorized Chlor-Alkali Plant are highly unlikely to result in cumulative construction noise impacts.

Noises from the existing Tata Steel (Richards Bay Alloys) and authorized Richards Bay Gas to Power project will result in a cumulative noise impact, potentially raising the total noise

levels with a maximum of 3 dBA. Other industrial projects are too far from this project to pose any potential risk for cumulative effects and their contribution can be excluded. The potential significance of the cumulative noise impacts summarised in **Table 12-5**.

Table 12-5: Impact Assessment: Potential Cumulative Operational Noise Impacts

Aspect / Impact pathway: *Cumulative* effects of numerous industrial projects operating simultaneously in the vicinity of the proposed Phakwe Gas to Power project. The projected cumulative noise level, the change in ambient sound levels as well as the potential noise impact is defined per NSD in **Appendix C, Table 5** and summarized in this table.		
Nature of potential impact: Increase in ambient sound levels.		
Receiver no	**Projected Noise Levels**	
All NSDs	Noise levels less than 45 dBA	Noise levels less than 45 dBA
	Overall impact of the proposed Phakwe Gas to Power project considered in isolation (**Appendix C, Table 4**)	**Cumulative impact of the project and other projects in the area** (**Appendix C, Table 5**)
Status (positive/negative)	Negative	Negative
Magnitude *(Table 8-2)*	Minor	Low
Duration *(Table 8-3)*	Long-term	Long-term
Extent ($\Delta L_{Aeq,D}$>7dBA) *(Table 8-4)*	Local	Local
Probability *(Table 8-5)*	Improbable	Possible
Magnitude *(Table 8-2)*	**Low Risk (6)**	**Low Risk (20)**
Reversibility	High	High
Loss of resources	Low	Low
Can impacts be mitigated?	Yes, but not required.	Yes, but not required.
Confidence in findings: High. Worst-case scenario evaluated.		
Mitigation: Significance of noise impact is low for the scenario as conceptualized.		

12.4 EVALUATION OF ALTERNATIVES

12.4.1 Alternative 1: No-go option

The ambient sound levels will remain as is. The noise levels experienced by the surrounding receptors (from the activity) will remain as it is currently. Ambient sound levels are already elevated due to noises from industrial activities and road traffic in the area.

12.4.2 Alternative 2: Proposed development of Power Station

The proposed development of the Power Generation Project (worst-case evaluated) may raise the noise levels at the closest potential noise-sensitive developments as identified.

However, considering the existing ambient sound levels and projected noise level (low levels at the closest NSD), it is likely that the proposed construction and operational activities will be inaudible to just audible at the locations of the identified NSDs.

The project will however greatly assist in the economic growth and development challenges South Africa is facing by allowing the power generation activities to continue. This will assist in providing employment and other business opportunities. Considering only noise[12], people may have a neutral to positive perception of the project and could see the need and desirability of the project.

[12] Considering only noise as other environmental factors may affect other people.

13 MITIGATION OPTIONS

This assessment considers the potential noise impact on the surrounding environment due to future power generation activities. It considers typical noise levels from power generation equipment and activities, while also accepting that manufacturers of such equipment will not subject employees at such a project to unreasonable noise levels.

It was determined that the potential noise impact would be of a low significance for future activities, both day and night. While noise levels will be high onsite, no additional mitigation measures are recommended or are required to manage the potential impact of environmental noise on the surrounding NSD.

It is recommended that the applicant design the power generation plant to limit the noise emission levels from equipment and related activities to be less than 90 dBA (measured at 10m).

13.1 MITIGATION OPTIONS THAT SHOULD BE INCLUDED IN THE EMP AND EA

It is not required to include any potential mitigation or management measures regarding noise in the EMP or EA.

14 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.

However, future environmental noise monitoring is not required, considering:

- the developmental character of the area;
- the results from the ambient sound level measurements collected in the area;
- the projected low significance of the noise impacts.

The power generation facility still has to comply with the relevant Health and Safety Regulations and Guidelines that my stipulate periodic noise monitoring (Noise-Induced Hearing Loss Regulations [GNR 307 of 2020] as well as the Occupational Health and Safety Act, 1993 [Act 85 of 1993]).

15 CONCLUSIONS AND RECOMMENDATIONS

This ENIA covers the proposed activities at the proposed development of a power generation project within the Richards Bay IDZ (zone 1F), KwaZulu Natal Province.

Potential scenarios were conceptualized for the future proposed construction and operational phases, with the output of the modelling exercise indicating a potential noise impact of low significance for both the day- and night-time periods for all the project phases. No mitigation or management measures are required or recommended to reduce noise levels (when considering Environmental Noise). The power generation facility still has to comply with the relevant Health and Safety Regulations and Guidelines that my stipulate periodic noise monitoring (Noise-Induced Hearing Loss Regulations [GNR 307 of 2020] as well as the Occupational Health and Safety Act, 1993 [Act 85 of 1993]).

Similarly, no additional acoustic studies are recommended for this development, and it will not be required to develop or implement an environmental noise monitoring programme considering:

- the developmental character of the area;
- the results from the night-time ambient sound level measurements;
- the projected low significance of the noise impacts

It is therefore recommended that the proposed 2,000MW Phakwe Gas to Power Project be authorized from an acoustic perspective.

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Anthropogenic	Human impact on the environment or anthropogenic impact on the environment includes impacts on biophysical environments, biodiversity and other resources
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Axle	Shaft connecting two wheels on either side of the vehicle. The wheels are forced to rotate at the same speed. Vehicles with independent wheels have 'stub axles' that do not connect the two wheels on either side of the vehicle.
Ballast	A layer of coarse stones supporting the sleepers.
Baseplate	A track component designed to hold the rail in place, usually with resilience to provide improved vibration isolation.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Echolocation	Echo locating animals emit calls out to the environment and listen to the echoes of those calls that return from various objects near them. They use these echoes to locate and

	identify the objects. Echolocation is used for navigation and for foraging (or hunting) in various environments.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental 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 exist.
Grinding	A process for removing a thin layer of metal from the top of the rail head in order to remove roughness and/or to restore the correct profile. Special grinding trains are used for this.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound 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.
Interburden	Material of any nature that lies between two or more bedded ore zones or mineral resource seams. Term is primarily used in surface mining
Joint rail	A connection between two lengths of rail, often held together by an arrangement of bolts and fishplates.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
Locomotive	A powered vehicle used to draw or propel a train of carriages or wagons (as opposed to a multiple unit).
L_{AMin} and L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Natural Sounds	Are sounds produced by natural sources in their normal soundscape.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Overburden	In mining and in archaeology, overburden (also called waste or spoil) is the material that lies above an area of economic or scientific interest. In mining, it is most commonly the rock, soil, and ecosystem that lies above a mineral resource seam or ore body
Pavement	Road surface or pavement is the durable surface material laid down on an area intended to sustain vehicular or foot traffic, such as a road or walkway.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.

Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Rail head	The bulbous part at the top of the rail.
Rolling Stock	Rolling stock comprises all the vehicles that move on a railway. It usually includes both powered and unpowered vehicles, for example locomotives, railroad cars, coaches, and wagons.
ROM	The mineral resource delivered from the mine that reports to the processing or preparation plant is called run-of-mine, or ROM. This is the raw material for the plant and consists of mineral resource of interest, rocks, middlings, minerals and contamination
Shunting	Shunting, in railway operations, is the process of sorting items of rolling stock into complete train sets.
Railway Sidings	A siding, in rail terminology, is a low-speed track section distinct from a running line or through route such as a main line or branch line or spur. It may connect to through track or to other sidings at either end.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Timbre	Timbre (also known as tone colour or tone quality) is the quality of the sound made by a particular voice or musical instrument.
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Tone	Noise can be described as tonal if it contains a noticeable or discrete, continuous note. This includes noises such as hums, hisses, screeches, drones, etc. and any such subjective description is open to discussion and contradiction when reported.
Wagon	A freight-carrying vehicle.

Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

Site Investigation – Photos of measurement locations

Photo B.1: Measurement location RBNSTSL01

Photo B.2: Measurement location RBNSTSL02

Photo B.3: Measurement location RBNSTSL03

APPENDIX C

Calculated conceptual noise levels

Appendix C, Table 1: Projected daytime noise levels due to future construction activities

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Urban)	Potential Existing Ambient Sound Levels (long-term, night-time fast-weighted average)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	55	48.8	33.1	0.1	Minor	Short-term	Local	Improbable	Low
2	55	48.8	33.5	0.1	Minor	Short-term	Local	Improbable	Low
3	55	48.8	36.0	0.2	Minor	Short-term	Local	Improbable	Low
4	55	48.8	26.8	0.0	Minor	Short-term	Local	Improbable	Low
5	55	48.8	23.9	0.0	Minor	Short-term	Local	Improbable	Low
6	55	48.8	27.7	0.0	Minor	Short-term	Local	Improbable	Low
7	55	48.8	29.4	0.0	Minor	Short-term	Local	Improbable	Low
8	55	48.8	22.9	0.0	Minor	Short-term	Local	Improbable	Low
9	55	48.8	25.5	0.0	Minor	Short-term	Local	Improbable	Low

Appendix C, Table 2: Projected night-time noise levels due to future construction activities

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, Urban)	Potential Existing Ambient Sound Levels (long-term, night-time fast-weighted average)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	45	44.2	33.1	0.3	Minor	Short-term	Local	Improbable	Low
2	45	44.2	33.5	0.4	Minor	Short-term	Local	Improbable	Low
3	45	44.2	36.0	0.6	Minor	Short-term	Local	Improbable	Low
4	45	44.2	26.8	0.1	Minor	Short-term	Local	Improbable	Low
5	45	44.2	23.9	0.0	Minor	Short-term	Local	Improbable	Low
6	45	44.2	27.7	0.1	Minor	Short-term	Local	Improbable	Low
7	45	44.2	29.4	0.1	Minor	Short-term	Local	Improbable	Low
8	45	44.2	22.9	0.0	Minor	Short-term	Local	Improbable	Low
9	45	44.2	25.5	0.1	Minor	Short-term	Local	Improbable	Low

Appendix C, Table 3: Projected daytime noise levels due to future operation activities

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Urban)	Potential Existing Ambient Sound Levels (long-term, night-time fast-weighted average)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	55	48.8	40.9	0.7	Minor	Long-term	Local	Improbable	Low
2	55	48.8	42.4	0.9	Minor	Long-term	Local	Improbable	Low
3	55	48.8	43.2	1.1	Minor	Long-term	Local	Improbable	Low
4	55	48.8	38.7	0.4	Minor	Long-term	Local	Improbable	Low
5	55	48.8	37.5	0.3	Minor	Long-term	Local	Improbable	Low
6	55	48.8	40.1	0.5	Minor	Long-term	Local	Improbable	Low
7	55	48.8	40.4	0.6	Minor	Long-term	Local	Improbable	Low
8	55	48.8	36.7	0.3	Minor	Long-term	Local	Improbable	Low
9	55	48.8	37.7	0.3	Minor	Long-term	Local	Improbable	Low

Appendix C, Table 4: Projected night-time noise levels due to future operation activities

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, Urban)	Potential Existing Ambient Sound Levels (long-term, night-time fast-weighted average)	Projected Noise Level, Worst-case construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	45	44.2	40.9	1.7	Minor	Long-term	Local	Improbable	Low
2	45	44.2	42.4	2.2	Minor	Long-term	Local	Improbable	Low
3	45	44.2	43.2	2.6	Minor	Long-term	Local	Improbable	Low
4	45	44.2	38.7	1.1	Minor	Long-term	Local	Improbable	Low
5	45	44.2	37.5	0.8	Minor	Long-term	Local	Improbable	Low
6	45	44.2	40.1	1.4	Minor	Long-term	Local	Improbable	Low
7	45	44.2	40.4	1.5	Minor	Long-term	Local	Improbable	Low
8	45	44.2	36.7	0.7	Minor	Long-term	Local	Improbable	Low
9	45	44.2	37.7	0.9	Minor	Long-term	Local	Improbable	Low

Appendix C, Table 5: Projected night-time noise levels due to future worst-case cumulative effects

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, IFC/WHO)	Potential Existing Ambient Sound Levels (long-term, night-time fast-weighted average)	Projected Noise Level	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	45	44.2	43.9	2.9	Minor	Long-term	Local	Improbable	Low
2	45	44.2	45.4	3.7	Low	Long-term	Local	Possible	Low
3	45	44.2	46.2	4.2	Low	Long-term	Local	Possible	Low
4	45	44.2	41.7	2.0	Minor	Long-term	Local	Improbable	Low
5	45	44.2	40.5	1.6	Minor	Long-term	Local	Improbable	Low
6	45	44.2	43.1	2.5	Minor	Long-term	Local	Improbable	Low
7	45	44.2	43.4	2.6	Minor	Long-term	Local	Improbable	Low
8	45	44.2	39.7	1.3	Minor	Long-term	Local	Improbable	Low
9	45	44.2	40.7	1.6	Minor	Long-term	Local	Improbable	Low

APPENDIX D

Site Verification Report

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	28, 29 and 30 July 2020
Specialist Name	Francois de Vries (Noise)
Professional Registration Number (if applicable)	Not applicable, there is no registration body in South Africa that could allow professional registration for acoustic consultants. Mr. de Vries has been doing Noise Measurements for the past 5 years, working directly under Mr. Morné de Jager (author of this report).
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 that most of the surrounding area (including the existing industrial area) is considered to be of a "very high" sensitivity to noise.

Description on how the site sensitivity verification was undertaken

The site sensitivity was verified using:

a) available aerial images (Google Earth® - dated 13/07/2020 and 13/08/2020);
b) a site visit by Mr. Francois de Vries that confirmed receptors indicated in Photos **D.1** and **D.2** (identified as NSDs 1 and 2).

Figure D.1: Closest Noise-Sensitive Areas to the project focus area

<u>Outcome of the Site Sensitivity Verification</u>

1. There is a confirmed residential area to the north-east of the proposed development. This area is considered to have a "very high" sensitivity to noise (verified during the July 2020 site visit). The potential impact from noise from the proposed Gas to Power project is assessed in this Noise Specialist Study;
2. Other potential noise-sensitive areas identified by the Online Screening Tool are not noise-sensitive, with any previous evidence of residential structures removed with the development of the various industries in the area. This is in contrast with the findings of the Online Screening Tool output.

Signature
Morné de Jager
Author of Report
2022 – 04 – 19

Signature
Francois de Vries
Technician (site visit)
2022 – 04 – 19

End of Report