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Proposed development of the Lephalale Railway Yard west of the Town Lephalale, Lephalale Local Municipality, Limpopo Province

Project No: 068/2019
Compiled by: B v/d Merwe
Date: 21 January 2019

DECLARATION OF INDEPENDENCE

I, **Barend J B van der Merwe,** as duly authorised representative of **dBAcoustics**, hereby confirm my independence and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which **Naledzi Environmental Consultants CC** was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act) for the **compilation of an EIA for the construction and operation of the proposed Lephalale railway Yard which is situated in the Lephalale Local Municipality, Limpopo Province – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 and any other specific and relevant legislation (national and provincial), policies, guidelines and best practice.

Signature:  ________________

Barend Jacobus Barnardt van der Merwe

Date	:	21 January 2019
Title / Position	:	Environmental noise and vibration specialist
Qualification(s	:	MSc Environmental Management
Experience	:	18 years
Registration(s)	:	SAAI, NACA, IAIASA and SAIG

Details of specialist and expertise

I, Barend JB van der Merwe of 43 6th Street, Linden Johannesburg have been an environmental noise and ground vibration specialist for the last 15 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise sensitive areas. I am also involved with the noise and ground vibration impact assessments and the environmental management plans compilation of large projects such as wind farms, mining, roads, trains (primarily the Gautrain) and various point noise sources. As a post-graduate student in Environmental Management at the University of Johannesburg, I obtained an MSc degree with the research project concentrating on the impact of noise and ground vibration on a village close to a new underground mine. I have played a major role in the identification, evaluation and control of physical factors such as noise and ground vibration in the following projects – wind farms, various platinum and coal mines and the quarterly noise evaluation of the Gautrain, the decommissioning of the N11 near Mokopane, construction of the P166 near Mbombela, design of the Musina by-pass, noise mitigatory measures at the N17 road near Trichardt, establishment of the weigh bridge along the N3 near Pietermaritzburg, George Western by-pass. The following large environmental companies are amongst my clients: Gibb, Royal Haskoning DHV, Coffey Environmental, Golder Associates Africa (Pty) Ltd, GCS Environmental (Pty) Ltd, Globesight Environmental Consulting, Knight Piesold Environmental (Pty) Ltd, MattMcdonold Engineering (Pty) Ltd and SRK Engineering (Pty) Ltd.

Qualifications

1. MSc Environmental Management – University of Johannesburg;
2. BSc Honours in Geography and Environmental Management – University of Johannesburg;
3. National Higher Diploma in Environmental Health - Witwatersrand Technikon;
4. National Diploma in Public Health - Cape Town Technikon;
5. National Certificate in Noise Pollution - Technikon SA;
6. National Certificate in Air Pollution - Technikon SA;
7. National Certificate in Water Pollution - Technikon SA;
8. Management Development Diploma - Damelin Management School; and
9. Advanced Business Management Diploma - Rand Afrikaans University.

Membership

- South African Institute of Acoustics (SAAI);
- International Association of Impact Assessment (IAIA);
- National Association of Clean Air (NACA);

- South African Association of Geographers (SAAG).

Experience

- Noise impact assessment of different mine establishments;
- Noise Control Officer i.t.o. Noise Control Regulations;
- Compilation of noise management plans;
- Annual and quarterly baseline noise surveys;
- Moderator Wits Technikon – Environmental Pollution III.
- Various road projects for SANRAL.
- Compilation of the Integrated Pollution strategy for Ekurhuleni Town Council.
- Represent clients at Town Planning Tribunals.
- Represent clients at Housing Board tribunals.
- Determine residual noise levels in certain areas as required by clients.
- Noise attenuation at places of entertainment.
- Design and implementation of sound attenuators.
- Noise projections and contouring.
- Advisory capacity regarding noise related cases to local authorities: - Sandton, Roodepoort, Randburg, Krugersdorp, Alberton, Centurion, Vereeniging. Due to my previous experience in Local Government I provide a service to these Local government departments on the implementation of the Noise Control Regulations and SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to land use, health annoyance and to speech communication.
- Identification, Evaluation and Control of noise sources in industry.

I was involved in the following noise impact assessments during the Environmental Impact Assessment process (Noise and/or Vibration):

- Airlink BID for landing in Kruger National Park;
- Coal gasification plant in Theunissen;
- Langhoogte and Wolseley wind farms;
- Widening of N3 at Howick, KZN;
- Tulu Kapi Mine, Ethiopia;
- Boabab Iron Ore Mine, Mozambique;
- N11 Decommissioning Mokopane;
- Baseline noise survey for NuCoal Mines, Woestalleen, Vuna and Mooiplaats Collieries;
- Baseline noise monitoring Mooinooi mine;

- Leeuwpan coal mine;
- N17 Road at Trichardt for KV3 Engineers;
- N17 Road in Soweto;
- Proposed new by-pass road at Musina;
- George Western By-pass road between George Airport and Outeniqua Pass;
- Gautrain baseline monitoring;
- Upgrade of Delmas Road extensions in Moreletta Park, Pretoria;
- Proposed weigh bridge, N3, Pietermaritzburg:
- Tonkolili Manganese mine, Sierra Leone;
- Proposed wind turbines in the Western Cape – Caledon;
- Extension of works at the PPC factory in Piketberg;
- Exxaro Arnot Colliery – Mooifontein;
- Hydro power plant – 2 Sites in Durban;
- Coal export terminal in Beira, Mozambique;
- Site selection for new Power Station – Kangra Mine, Piet Retief;
- Gas exploration at Ellisras;
- Noise survey and assessment of future mine shafts at various mines;
- Mining exploration at Potgietersrus – Lonmin Akani;
- New coal mines in Witbank – Dorstfontein Expansion Project;
- New coal mines in Middelburg and Ermelo;
- New Vanadium Manganese mine in Potgietersrus;
- Xolobeni mining project in Transkei;
- Glynn mines in Sabie;
- Rezoning of properties for housing at Burgersfort, Shosanguve, Hammanskraal;
- Various noise impact assessment for clients in and around Centurion;
- Relocation of night races from Newmarket racecourse to Turfontein racecourse;
- Rezoning applications for private clients.

Indemnity and Conditions Relating to this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on scientific and recommended survey and assessment techniques. This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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Should the Client wish to utilise any part of, or the entire report, for a project other than the subject project, permission must be obtained from dBAcoustics CC. This will ensure validation of the suitability and relevance of this report on an alternative project.

Executive summary

Introduction

dBAcoustics was appointed by Naledzi Environmental Consultants CC to determine and assess the potential environmental noise and vibration impact of the proposed Lephalale rail yard activities on the abutting farmhouses which are situated in the vicinity of the proposed rail yard. The proposed railway yard activities will be located partially on the Farms Geelhoutkloof 359LQ, Enkeldraai 314LQ and Kringgatspruit 318LQ (now Pontes Estates 712LQ). The proposed borrow pits (two) will be situated on Kringgatspruit 318LQ and Buffelsjagt 317LQ and the potential environmental noise and ground vibration impact will also be evaluated at the abutting farms Vergulde Heim 316LQ, Enkeldraai 314LQ, Zandnek 358LQ and Nooitgedacht 514LQ respectively.

The noise survey was carried out during the winter period on 23 and 24 July 2018 and an additional noise survey was carried out at Thabazimbi rail yard on 15 November 2018.

The number of trains passing the proposed facility per day is 8 trains in both directions and it will increase to 18 trips during the construction and operational phase of the project. This will be required to transport coal from the Waterberg reserves. The proposed works at the Lephalale yard will form part of the endeavour to increase the capacity of coal. The main function of the yard will be to switch crew, service and maintain the diesel locomotives. The proposed infra-structure at the yard will consist out of the following:

- The construction of new railway lines of 4.8km (Phase 1= 4.8km and Phase 2 = 3.7km);
- Construction and extension of culverts;
- Infra Crew Building;
- Guard Houses;
- Staff amenities;
- Provisional facilities;
- Fire suppression systems which require a foam storage tank, water storage tank and foam pipelines;
- Roads and carports;
- Sanding Facilities (for sandbox container on locomotives-traction improvement);
- Effluent management (water/oil separator);

- Two (2) 300 000 litres diesel tanks and decanting slabs – There shall be four (4) rail decanting points and one road decanting point provided all at one location. The fuel storage volume is 600 000 litres;
- 12 x 12 500 litre conservancy tanks will be used at various facilities;
- 1 x 500 litre diesel tanker in the fire pump room;
- 6720 litres of oil storage (32 drums of oil); and
- Water Reservoir.

The following observations were made in and around the study area:

- There was a constant flow of traffic along the feeder roads during the day and intermittent during the night;
- Grootegeluk mine and the two power stations (Matimba & Medupi power stations) were operational during the time of the noise survey;
- Mining, traffic and power station activity noise was audible at the farms in the vicinity of the rail yard;
- The wind and weather conditions play an important role in noise propagation.

The following noise sources were identified in the vicinity of and the boundaries of the study area:

- Grootegeluk mine;
- Matimba and Medupi Power stations;
- Heavy duty vehicles and motor vehicles;
- Seasonal and permanent agricultural activities;
- Existing trains along the railway line;
- Insects and birds;
- Wind noise.

Noise Impact Assessment

In terms of the Noise Regulations a noise disturbance is created when the prevailing ambient noise level is exceeded by 7.0dBA or more. Noise is part of our daily exposure to different sources which is part of daily living and some of these physical attributes which may at times be part of the ambient levels that people get used to without noticing the higher levels.

Two aspects are important when considering potential impacts of a project:

- The increase in the noise levels, and;

- The overall noise levels which will be created by the rail yard activities.

The proposed development of the rail yard during the construction, operational and decommissioning phases will require approved management measures and ongoing noise surveys and mitigatory measures will have to be carried out to ensure compliance to the relevant noise regulations and/or standards.

Conclusion and Recommendations

There will be an upwards shift in the immediate environmental noise levels during the construction phase on a temporary basis and a more permanent basis during the operational phase in the vicinity of the rail yard. The proposed Lephalale rail yard project will be situated in an area where there are distant mining activities, feeder roads and residential areas. The proposed Lephalale rail yard project will be situated in an area where there are distant mining activities, feeder roads and residential areas. The noise impact assessment revealed that the noise increase will not be audible to low during the construction phase and not audible to very high during the operational phase and not audible during the decommissioning phase. The threshold value of 7.0dBA will be exceeded at noise receptors K, L and M for the duration the hooter will be activated inside the yard area and at intersections.

Animals depend on acoustic signals for essential functions. Some species have become threatened or endangered because of loss of habitat and further relocation as a result of noise disturbance is not possible. There is still an absence of understanding how observed behavioral and physiological effects translate into ecological consequences for wildlife. There are examples where a loud noise did not impact on the breeding and well-fare of wild life (IEMR, 2000).

The potential noise increase from the proposed Lephalale rail yard establishment can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles, compliance to the Local Noise Regulations and the International Finance Corporation's Environmental Health and Safety Guidelines. The proposed noise management plan must be in place during the construction and operational phases so as to identify any noise increase on a pro-active basis. The proposed Lephalale rail yard establishment will comply with the relevant Noise Control Regulations and SANS 10103 of 2008 provided that the noise mitigatory measures are in place.

Barend van der Merwe – MSc UJ
Environmental noise and vibration specialist

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This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 – Regulation 982 and the following aspects are dealt with in the report:

No.	Requirement	Section in report
1a)	Details of -	
(i)	The specialist who prepared the report	P3
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	P3-P5
b)	A declaration that the specialist is independent	P3-P5
c)	An indication of the scope of, and the purpose for which, the report was prepared	P13 and P16
d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	P7
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	P23
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	P26
g)	An identification of any areas to be avoided, including buffers	P26
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	P14 & P15
i)	A description of any assumption made and any uncertainties or gaps in knowledge	P51
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment	P51
k)	Any mitigation measures for inclusion in the EMPr	P53
l)	Any conditions for inclusion in the environmental authorisation	P53
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	P56
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	P56
(ii)	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	P7 & P56
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

1 Introduction

dBAcoustics was appointed by Naledzi Environmental Consultants CC to determine and assess the potential environmental noise and ground vibration impact of the proposed railway yard activities which will be located partially on the Farms Geelhoutkloof 359LQ, Enkeldraai 314LQ and Kringgatspruit 318LQ (now Pontes Estates 712LQ). The proposed borrow pits (two) will be situated on Kringgatspruit 318LQ and Buffelsjagt 317LQ and the potential environmental noise and ground vibration impact will also be evaluated at the abutting farms Vergulde Heim 316LQ, Enkeldraai 314LQ, Zandnek 358LQ and Nooitgedacht 514LQ respectively.

The number of trains passing the proposed facility per day is 8 trains in both directions and it will increase to 18 trips during the construction and operational phase of the project. This will be required to transport coal from the Waterberg reserves. The proposed works at the Lephalale yard will form part of the endeavour to increase the capacity of coal. The main function of the yard will be to switch crew, service and maintain the diesel locomotives. The proposed infra-structure at the yard will consist out of the following:

- The construction of new railway lines of 4.8km (Phase 1= 4.8km and Phase 2 = 3.7km);
- Construction and extension of culverts;
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- Two (2) 300 000 litres diesel tanks and decanting slabs – There shall be four (4) rail decanting points and one road decanting point provided all at one location. The fuel storage volume is 600 000 litres;
- 12 x 12 500 litre conservancy tanks will be used at various facilities;
- 1 x 500 litre diesel tanker in the fire pump room;
- 6720 litres of oil storage (32 drums of oil); and
- Water Reservoir.

The railway yard coordinates for the by-pass line and the arrival line is given in Table 1.

Table 1-1: Railway yard coordinates

Phase	Start	End
1 – By-pass line	23° 46.570'S 27° 25.931'E	23° 45.016'S 27° 28.193'E
2 – Arrival line	23° 46.195'S 27° 26.276'E	23° 45.076'S 27° 28.096'E

The construction of the yard will require extensive cutting of the topography of the proposed yard area and the cutting soil will be used for screening of the yard area. The railway yard will be developed on the single railway line between Lephalale (Grootegeluk Coal mine) and Thabazimbi which is currently in use by trains to and from Lephalale. The railway line from the Boikarabelo Coal Mine to the west will join in with this railway line and a photo of the yard area and the two additional lines are illustrated in Figure 1.1.

Figure 1-1: Proposed Railway yard area

An aerial imagery of the proposed Lephalale railway yard, railway line, feeder roads and farm portions are illustrated in Figure 1.2.

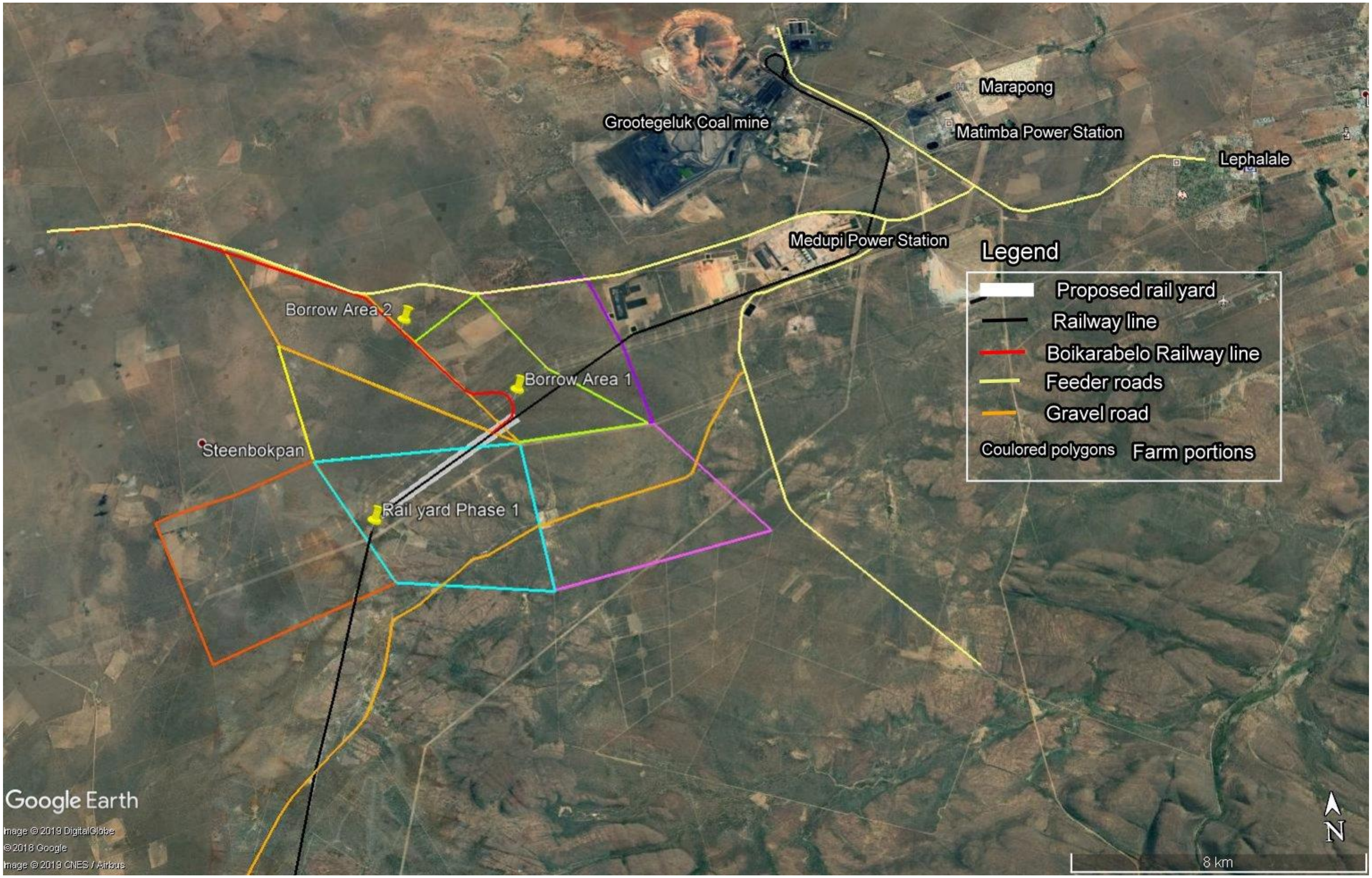


Figure 1-2: Locality map of the proposed rail yard and other information

The purpose of the environmental noise study and impact assessment was:

- To determine the environmental baseline noise levels along the boundaries of the rail yard area and residential areas in the vicinity of the Lephalale rail yard study area.

The environmental noise baseline information will be used to calculate the potential noise intrusion levels at the abutting noise receptors.

2 Background to environmental noise and vibration

2.1 Environmental noise

Sound is a wave motion, which occurs when a sound source sets the nearest particles of air in motion. The movement gradually spreads to air particles further away from the source. Sound propagates in air with a speed of approximately 340 m/s.

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – inverse square law. Expressed logarithmically as decibels, this means the sound level decreases 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance. The decibel scale is logarithmic, therefore decibel levels cannot be added in the normal arithmetic way, for example, two sound sources of 50.0dB each do not produce 100.0dB but 53.0dB, nor does 50.0dB and 30.0dB equal 80.0dB, but remains 50.0dB. Air absorption is important over large distances at high frequencies and it depends on the humidity but is typically about 40.0dB/km @ 4000 Hz. Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

When measuring the intensity of a sound, an instrument, which duplicates the ear variable sensitivity to sound of different frequency, is usually used. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter because it conforms to the internationally standardized A-weighting curves. Measurements of sound level made with this filter are called A-weighted sound level measurements, and the unit is dB.

Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. The sound may be propagated during upwind conditions upwards to create a sound shadow. A downwind refracts the sound towards the ground producing a slight increase in sound level over calm isothermal conditions. The velocity of sound is inversely proportional to the temperature therefore a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

For a source and receiver close to the ground quite large attenuation can be obtained at certain frequencies over absorbing surfaces, noticeably grassland. This attenuation is caused by a change in phase when the reflected wave strikes the absorbing ground and the destructive interference of that wave with the direct wave. The reduction in sound tends to be concentrated between 250 Hz and 600 Hz.

Noise screening can be effective when there is a barrier between the receiver and the source i.e. walls, earth mounds, cuttings and buildings. The performance of barriers is frequency dependent. To avoid sound transmission through a barrier the superficial mass should be greater than 10 Kg/m^2.

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3.0-5.0dBA.

There are certain effects produced by sound which, if it is not controlled by approved acoustic mitigatory measures, seem to be construed as undesirable by most people and they are:

- Long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95.0 dBA. This will seldom happen in far-field conditions;
- Interference with speech where important information by the receiver cannot be analyzed due to loud noises;
- Excessive loudness;
- Annoyance.

A number of factors, for example clarity of speech, age of listener and the presence of noise induced threshold displacement, will influence the comprehensibility of speech communication.

The effect of noise (with the exception of long duration, high level noise) on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is very difficult to predict and is influenced by the emotional state of the complainant, his attitude towards the noisemaker, the time of day or night and the day of the week.

Types of noise exposure:

- Continuous exposure to noise – The level is constant and does not vary with time e.g. traffic on freeway and an extractor fan;

- Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens;
- Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

Noise affects humans differently and the new noise which will be coming from the rail yard establishment and the associated activities will depend upon the intensity of the sound, the length of time of exposure and how often over time the ear is exposed to it. Urban dwellers are besieged by noise, not only in the city streets but also in the busy workplaces and household noises.

The time-varying characteristics of environmental noise are described using statistical noise descriptors:

- Leq: The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same period of time.

- L_{Max}: The instantaneous maximum noise level for a specified period of time.

- L_{Min}: The instantaneous minimum noise level for a specified period of time.

The following relationships occur for increases in A-weighted noise levels:

- The trained healthy human ear is able to discern changes in sound levels of 1.0dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3.0dBA;
- A change in sound level of 5.0dBA is a readily perceptible increase in noise level;
- A 10.0dBA change in the sound level is perceived as twice as loud as the original source.

The World Bank in the Environmental Health and Safety Regulations has laid down the following noise level guidelines:

- Residential area – 55.0dBA for the daytime and 45.0dBA for the nighttime period;
- Industrial area – 70.0dBA for the day- and nighttime periods.

The difference between the actual noise and the ambient noise level and the time of the day and the duration of the activity, will determine how people will respond to sound and what the noise impact will be. In order to evaluate such, there must be uniform guidelines to evaluate each scenario. SANS 10103 of 2008 has laid down sound pressure levels for specific districts and has provided the following continuous noise levels per district as given in Table 2.1.

Table 2-1: Recommended noise levels for different districts.

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for ambient noise - dBA					
	Outdoors			Indoors, with open windows		
	Day-night L_{Rdn}	Daytime L_{Reqd}	Night-time L_{Reqn}	Day-night $L_{R.dn}$	Daytime $L_{Req.d}$	Night-time $L_{Req.n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

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

The response to noise can be classified as follows:

- An increase of 1.0dBA to 3.0dBA above ambient noise level will cause no response from the affected community. For a person with normal hearing an increase of 0dBA to 3.0dBA will not be noticeable
- An increase between 1.0dBA – 10.0dBA will elicit little to sporadic response. When the difference is more than 5.0dBA above the ambient noise level a person with normal hearing will start to hear the difference.
- An increase between 5.0dBA and 15.0dBA will elicit medium response from the affected community.
- An increase between 10.0dBA and 20.0dBA will elicit strong community reaction.

Because there is no clear-cut transition from one community response to another as well as several variables, categories of responses can overlap. This should be taken into consideration during the evaluation of a potential noise problem. There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, industrial and feeder roads in close proximity of each other. The ambient noise level will therefore differ throughout the study area, depending on the region and the measuring position in relation to areas with existing mining activities. People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in Table 2.2.

Table 2-2: Response when ambient noise levels is exceeded

Excess dB	Estimated community/group response	
	Category	Description
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

2.2 Vibration

Blast induced ground vibrations, both surface waves (those travelling just under the earth's surface, analogous to water waves) and body waves (those travelling through the ground), naturally attenuate with increased distance from the blast site due to material damping and geometric spreading. Body waves attenuate more rapidly than the surface waves, resulting in the surface waves being more dominant at greater distances. The vibration intensity perceived or measured at the closest receptors around the Project Site would therefore be dominated by surface waves. The rate at which ground vibrations attenuate from the blast source depends on a variety of conditions, including the type and condition of the bedrock being blasted, depth and composition of the earth covering deposits (soil), and the general topography.

The effect of vibrations on structures is related to both the amplitude and the dominant frequency of the vibration, as well as the type and configuration of the structure. The peak particle velocity (PPV) is the most commonly-used measure of the intensity of the ground vibration due to blasts. Two of the most important variables that affect the PPV from a blast are the distance from the source and the maximum explosive charge weight per delay period.

Table 2.3 provides a listing of effects related to increasing levels of ground vibration intensities that are used to assess the impacts of vibration.

Table 2-3: Effects from varying intensities of ground vibration

Ground Vibration Intensity, mm/s	Ground Vibration Effect
0.3 – 0.5	Becomes perceptible to humans
2.0	Ghana national regulatory limit to prevent damage to weakest of building materials in residential structures in study area
12.5	DRC limit for ground-borne vibration at sensitive receptors, USBM recommended limit to prevent damage to weakest of building materials in well-built wood-frame structures (e.g., plaster-on-lath).
19.1	Recommended limit to prevent damage to drywall/sheetrock construction.
50.0	Recommended limit for construction blasting and quarry blasting at high frequencies.
75 - 125	Hairline cracks may start developing in plaster.
300 - 600	Micro-cracks may start developing in rock.

Peak ground vibration limits generally established for blasting sites to prevent damage to adjacent facilities or structures generally range from 12.5 mm/s to 25.0 mm/s, depending on the dominant frequency of the ground vibration and the type of construction method of the houses. This assessment assumes that most of the houses in the vicinity of the proposed rail yard are of modern type construction and a ground vibration limit of 25.0mm/s is recommended. Any traditional type construction methods (clay) may have suffered from previous degrees of deterioration. They are therefore more sensitive to blast vibrations than structures using modern materials and technology (e.g. block-built) and a recommended maximum ground vibration limit of 12.5mm/s is recommended.

At the time of this assessment, limited information was available regarding the proposed surface blasting parameters, including the proposed weight of charge per interval.

Air-pressure levels

Blast induced air vibration effects are primarily influenced by the prevailing weather conditions at the time of the blast and less so by the factors influencing ground vibrations. Air-pressure levels are only expected to occur within and off the project area when blasting takes place at the surface. Underground mine blasting operations typically do not generate surface air vibration effects.

Air-pressure levels in excess of 140.0 dBL are necessary to cause glass or window damage, such as the cracking of a poorly set plate glass window. Windows are typically the first material to show signs of distress from excessive air vibrations as they are the least able to withstand high external air pressures. Air-pressure limits commonly used for surface mining operations where blasting can be expected to occur over many years typically fall in the range of 120.0 to 134.0 dBL measured at the nearest sensitive receptor.

A list of effects from increasing levels of air vibration intensities is provided in Table 2.4.

Table 2-4: Effects from varying intensities of air pressure levels

Air Vibration Intensity, dBL	Effect
95	Equivalent to a wind gust at 5 km/hr.
110	Equivalent to a wind gust at 11 km/hr.
120	DRC limit and USBM cautionary limit set for quarries and open
133	Recommended limit for large scale surface mine blasting. Equivalent to a wind gust of 43 km/hr.
140	May result in window breakage.
171	General window breakage.

Adoption of Evaluation Criteria - Vibration

The adopted evaluation criteria for the assessment of ground vibrations and air overpressure and the rationale for their selection are provided in Table 2.5.

Table 2-5: Adopted Vibration Evaluation Criteria

Vibration Intensity	Rationale
Ground Vibration, mm/s	
≤ 0.5 mm/s	Ground vibrations are below or just at perceptible levels to humans
>0.5 and ≤ 2.0 mm/s	Ground vibrations are perceptible to humans and may be annoying, but are below levels that would cause damage to the weakest of materials at all frequency ranges
> 2.0 and ≤12 mm/s	Ground vibrations are perceptible and almost certainly annoying to humans and may cause damage to homesteads, depending on the dominant frequency of the blast vibration and existing condition of the structure
>12 mm/s	Damage may occur to well-built wooden framed structures
Air overpressure, dBL	
< 90 dBL	Air vibrations are below levels that would be easily perceptible to humans
> 90 dBL and ≤ 117 dBL	Air pressure changes are easily perceptible to humans but do not result in damage to structures
> 117 dBL and ≤ 140 dBL	Air pressure changes may result in damage to traditional structures
> 140 dBL	Air pressure changes may shatter windows

3 Study methodology

3.1 Instrumentation

The noise survey was conducted in terms of the provisions of the Noise Control Regulations, 1994 and the SANS 10103 of 2008 (The measurement and rating of environmental noise with respect to annoyance and to speech communication) using a digital Larson Davis 831 – Class 1 meter with Logging, Environmental 1/1, 1/3 Octave Band and percentiles Sound Level Meter (Class 1). On taking measurements the device-meter scale was set to the "A" weighed measurement scale which enables the device to respond in the same manner as the human ear. The device was held approximately 1.5 m above the surface and at least 3.0m away from hard reflecting surfaces. A suitable wind shield was used on the microphone for all measurements in order to minimise wind interference. The Instrument was checked and calibrated prior to use and maintained in accordance with equipment and coincided below 1.0dBA.The following instruments were used in the noise survey:

- Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072;
- Larsen Davis Pre-amplifier – Serial no.PRM831 0206;
- Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184;
- Larsen Davis Calibrator 200 – Serial no.9855;
- Certificate Number: 2018-AS-0912;
- Date of Calibration: 15 August 2018; and,
- Date of next calibration August 2019.

The instrument was calibrated before and after the measurements was done and coincided within 1.0dBA. Batteries were fully charged and the windshield was in place at all times.

The noise survey was carried out in terms of the Noise Control Regulations being:

"16 (1) Any person taking readings shall ensure that -

(a) sound measuring instruments comply with the requirements for type I instrument in accordance with SABS-IEC 60651, SABS-IEC 60804 and SABS-I EC 60942 as the case may be;

(b) the acoustic sensitivity of sound level meters is checked before and after every series of measurements by using a sound calibrator, and shall reject the results if the before and after calibration values differ by more than 1 dBA;

(c) the microphones of sound measuring instruments are at all times provided with a windshield;

(d) the sound measuring instruments are operated strictly in accordance with the manufacturer's instructions; and

(e) sound measuring instruments are verified annually by a calibration laboratory for compliance with the specifications for accuracy of national codes of practice for acoustics, to comply with the Measuring Units and National Measuring Standards Act 1973 (Act No. 76 of 1973).

(2) The measuring of dBA values in respect of controlled areas, ambient sound levels or noise levels in terms of these regulations shall be done as follows:

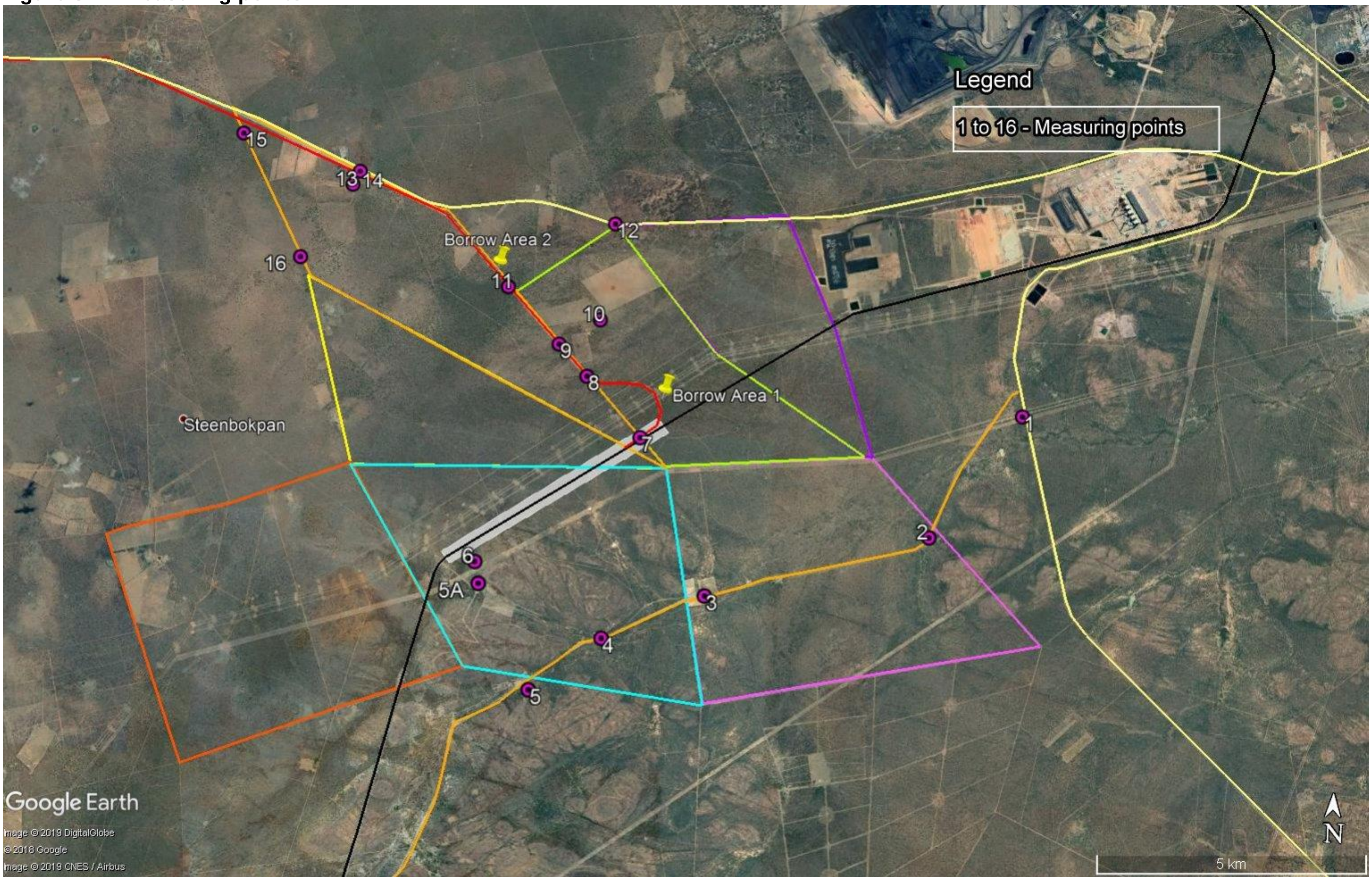
(a) outdoor measurements on a piece of land: By placing the microphone of an integrating impulse sound level meter at least 1,2 metres, but not more than 1,4 metres, above the ground and at least 3,5 metres away from walls, buildings or other sound reflecting surfaces".

The calibration certificates are attached as Appendix A. The measured ambient noise levels (without the train movement noise) during the daytime and night time periods will be the baseline ambient noise criteria for the study area and will be evaluated in terms of SANS 10103 of 2008.

3.2 Measuring points

The measuring points for the study area were selected to be representative of the prevailing ambient noise levels for the study area and include all the noise sources such as distant mining activities, power station noise, traffic and domestic noise. The measuring points are illustrated in Figure 3.1.

Figure 3-1: Measuring points



The location of the measuring points throughout the study area and the physical attributes of each measuring point are illustrated in Table 3.1.

Table 3-1: Measuring points and co-ordinates for the study area

Position	Latitude	Longitude	Remarks
1	23^0 44.596'S	27^0 33.563'E	Gravel road at the intersection with the feeder road.
2	23^0 45.900'S	27^0 31.518'E	Gravel road at the entrance to Kumanati Lodge.
3	23^0 46.593'S	27^0 29.017'E	Along gravel road in the vicinity of Lephalale game trackers.
4	23^0 46.934'S	27^0 28.146'E	Gravel road and distant Medupi power station.
5	23^0 47.610'S	27^0 27.111'E	Gravel road behind the hill.
5A	23^0 43.055'S	27^0 32.409'E	Along a dirt road in the vicinity of Geelhoutkloof foreman's residence.
6	23^0 46.344'S	27^0 26.428'E	In the vicinity of the proposed rail yard.
7	23^0 44.990'S	27^0 28.213'E	In the vicinity of the proposed rail yard.
8	23^0 44.366'S	27^0 27.572'E	In the veldt.
9	23^0 44.037'S	27^0 27.233'E	In the veldt.
10	23^0 43.757'S	27^0 27.490'E	In the veldt in the vicinity of a farmhouse.
11	23^0 43.443'S	27^0 26.610'E	In the veldt.
12	23^0 42.708'S	27^0 27.806'E	In the vicinity of the Steenbokpan road.
13	23^0 42.389'S	27^0 24.717'E	In the vicinity of the Steenbokpan road at farm house.
14	23^0 42.239'S	27^0 24.787'E	In the vicinity of the Steenbokpan road.
15	23^0 41.867'S	27^0 23.384'E	In the vicinity of the Steenbokpan road.
16	23^0 43.209'S	27^0 24.179'E	Along gravel road in the vicinity of a farmhouse.

The following is of relevance to the ambient noise measurements:

- The L_{Aeq} was measured over a representative sampling period exceeding 10 minutes at each measuring point;
- The noise survey was carried out during the day and nighttime period being 6h00 to 22h00 for the day time and 22h00 to 6h00 for the night time period.

3.3 Site Characteristics

The following observations were made in and around the study area:

- There was a continuous to intermittent flow of traffic along the tarred feeder roads to the north of the study area (along Steenbokpan Road);
- The tarred feeder road to the east of the study area was used by traffic and heavy-duty trucks;
- The gravel road along the southern side of the study area was used on an intermittent basis by light vehicles and trucks;
- Domestic type noise, train noise, traffic and Medupi power station noise contribute to the prevailing ambient noise level; and,
- The wind and weather conditions play an important role in noise propagation.

3.4 Current noise sources

The following are noise sources in the vicinity of and the boundaries of the study area:

- Domestic/farm activity noises;
- Intermittent traffic along the feeder roads and gravel roads;
- Intermittent train and train hooting noise;
- Distant traffic noise from the abutting feeder roads;
- Noise from Medupi power station;
- Insects and birds; and,
- Wind noise.

3.5 Atmospheric conditions during the noise survey

The noise readings were carried out at the different measuring points and the prevailing atmospheric conditions i.e. wind speed, wind direction and temperature were taken into consideration. The following meteorological conditions were recorded:

23 and 24 July 2018

Daytime

- Wind speed – less than 2.2m/s;
- Temperature – 24.5^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – Scattered clouds;
- Wind direction – The wind was blowing from a north-easterly direction;
- Humidity – less than 5% humidity.

Night time

- Wind speed – No wind to 0.5m/s;
- Temperature – 10.5^{o}C ;
- Cloud cover – No clouds;
- Wind direction – The wind was blowing from a north-easterly direction;
- Humidity – less than 5% humidity.

The wind speed and wind direction will determine the propagation of the railway and/or power station activity noises and how the residents will perceive such noises.

4. Regulatory and Legislative Requirements

There are specific regulatory and legislative requirements which regulate the proposed development in terms of environmental noise. The legislative documents are as follows:

4.1 Department of Environment Affairs: Noise Control Regulations promulgated under the Environment Conservation Act**,** (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.

These noise control regulations are applicable in the study area and the main aspect of these noise control regulations is that you may exceed the prevailing ambient noise levels by 7.0dBA before a noise disturbance is created.

4.2 South African National Standards – SANS 10103 of 2008

The South African National Standards provide the guidelines for the different recommended prevailing ambient noise levels and how to evaluate when a specific operation or activity is creating a noise disturbance and what reaction can be expected if a noise disturbance is created.

4.3 South African National Standards – SANS 10210 of 2004

This national standard is used when calculating or predicting increased road traffic noise during new developments.

4.4 Environmental, Health and Safety Guidelines of the IFC of the World Bank

The recommended noise level for a noise sensitive area is 55.0dBA during the day and 45.0dBA during the night.

The Constitution of the Republic of South Africa Act, (Act No 108 of 1996) makes provision for the health and well-being of the citizens and to prevent pollution and to promote conservation.

According to Article 24 of the Act, everyone has the right to:

(a) an environment that is not harmful to their health and well-being; and

(b) have the environment protected for the present and future generations through reasonable legislative and other measures that-

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecological sustainable development and use of natural resources, while promoting justifiable economic and social development.

4.5 Railway type noise

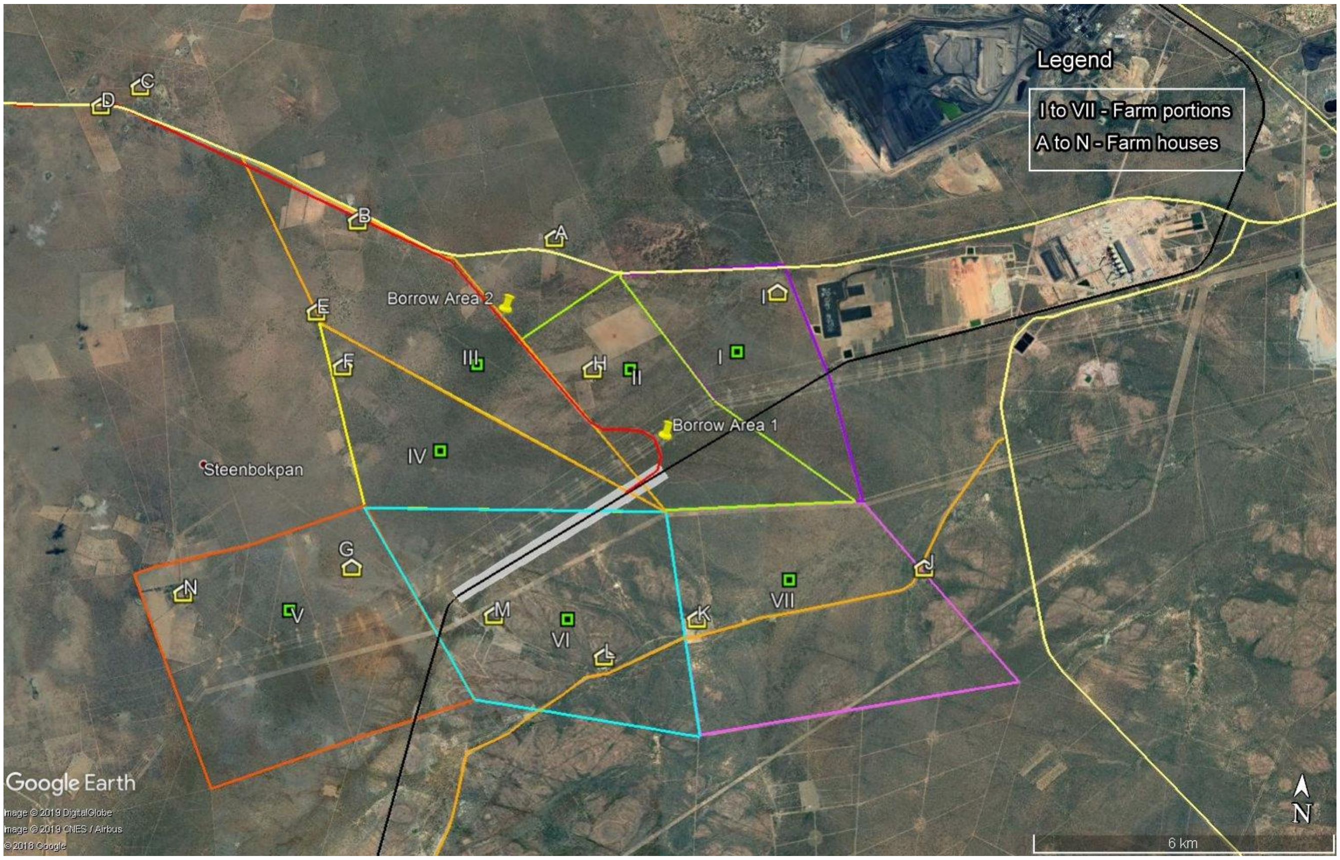
The Noise Control Regulations, 1994 excludes railway type noise as an aspect for consideration in the control of noise. For purposes of this noise assessment it was decided to be guided by the recommended noise levels applicable in United Kingdom (UK) – 63.0dBA to 68.0dBA, United States of America (USA) – 67.0dBA, Australia – 60.0dBA, Japan – 55.0dBA to 60.0dBA. The following maximum noise levels of 60.0dBA during the day and 50.0dBA during the night is proposed to be used for the defined noise sensitive areas along the boundaries of the rail yard. The primary indicator of an acceptable noise impact level will therefore be used as well as the threshold level of 7.0dBA, referred to in the Noise Control Regulations, 1994 that a noise disturbance is created when the ambient noise level is exceeded by a threshold level of 7.0dBA before such noise can be classified as a noise disturbance. Due to the nature of the train movement anticipated for the rail yard the noise can be classified as an intermittent noise and not a continuous noise as applicable along busy railway lines.

It is widely recognized that many aspects of mechanised operations may lead to an increase in the environmental ambient noise levels. The impact of such an increase in the prevailing noise levels can be both physical and physiological. Many aspects of mechanised operations lead to an increase in noise levels over the prevailing ambient levels (Garvin *et al*., 2009).

5 Description of the receiving environment

The prevailing ambient noise levels in build-up areas were created by domestic activities, distant traffic, barking dogs and wind in the trees whereas the prevailing ambient noise level in the study area was created by intermittent traffic and rail noise, farm activity noises, wind in trees, insects and bird noises. The farm houses are spread out throughout the study area and the location of the farm houses are illustrated in Figure 5.1. The veldt is covered with trees, shrubs and natural grass (typical of a bushveld area) and the area can be classified as undulated topography. There are a few outcrops throughout the study area. The farm portions and the farmhouses are illustrated in Figure 5-1.

Figure 5-1: Location of the farm houses within the study area.



The identification of the farm portions is as follow:

I – Vergulde Heim 316LQ;

II – Buffelsjagt 317LQ;

III – Kringgatspruit 318LQ;

IV – Enkeldraai 314LQ;

V – Zandnek 358LQ;

VI – Geelhoutkloof 359LQ;

VII – Nooitgedacht 514LQ.

The proposed rail yard activity which will take place on the farm portions and the farmhouses are given in Table 5.1. Farmhouses A, C, D and E are situated on the perimeter of the farm portion study area and the potential impact of the proposed rail yard development will also be evaluated on these farm houses.

Table 5-1: Proposed activities and farm houses on the different farm portions

Farm portion	Farm	Proposed rail yard	Remarks

	house	activity	
Vergulde Heim 316LQ	I	Distant existing railway line	In excess of 2 000m from the proposed rail yard development and borrow pits.
Buffelsjagt 317LQ	H	Borrow pit 1	In excess of 2 000m from the proposed rail yard development and borrow pits.
Kringgatspruit 318LQ	B	Portion of the rail yard and Borrow pit 2	In excess of 2 000m from the proposed rail yard development and borrow pits.
Enkeldraai 314LQ	F	Portion of the rail yard and Borrow pit 2	In excess of 2 000m from the proposed rail yard development and borrow pits.
Zandnek 358LQ	G, N	Distant existing railway line	In excess of 2 000m from the proposed rail yard development and borrow pits.
Geelhoutkloof 359LQ	L, M	Rail yard and existing railway line	Noise receptor L In excess of 2 000m from the proposed rail yard and borrow pits and noise receptor M will be 837m from the proposed rail yard development.
Nooitgedacht 514LQ	J, K	Distant existing railway line	In excess of 2 000m from the proposed rail yard development and borrow pits.

The height above mean sea level (AMSL) of the farm houses (A to N) in relation to the railyard which is 940m (AMSL) and the distance between the railyard (eastern, middle, and western) and the farm houses are given in Table 5.2.

Table 5-2: Height above mean sea level of the farmhouses and the distances between proposed trail yard and borrow pits in meters

Farmhouse	AMSL	Remarks	Eastern side	Middle of rail yard	Western side	Borrow pit 1	Borrow pit 2
A	937	Lower than rail yard	4985	5820	7113	4653	2010
B	924	Lower than rail yard	7675	7136	7566	7636	3539
C	909	Lower than rail yard	13003	12398	12113	12909	8880
D	910	Lower than rail yard	13312	12692	12277	13356	9320
E	937	Lower than rail yard	7305	6451	6168	7571	3795
F	935	Lower than rail yard	6428	5241	4980	6688	3351
G	958	Higher than rail yard	6134	4074	2196	6773	5847
H	936	Lower than rail yard	2288	3397	5005	2020	2053
I	919	Lower than rail yard	4531	6769	8665	3861	5708
J	905	Lower than rail yard	5956	7609	9281	5856	9858
K	921	Lower than rail yard	3146	3545	4807	3599	7274
L	939	Lower than rail yard	3726	2608	3147	4363	7032
M	953	Higher than rail yard	4154	2057	837	4823	5912
N	962	Higher than rail yard	9512	7856	5647	10047	8371

6 Results of the noise survey

The prevailing ambient noise levels at the different measuring points are given in Table 6.1. These noise levels include all the noise sources currently in the area such as distant traffic noise, distant mine noise and natural noise sources. A noise survey was carried out at MP5A during the time a train passed the measuring point at 837m. The Leq is the average noise level for the specific measuring point over a period of time, the Lmax is the maximum noise level and the Lmin is the minimum noise level registered during the noise survey for the specific area in dBA.

Table 6-1: Noise levels for the day and night in the vicinity of the Lephalale rail yard study area.

Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**33.2**	54.4	24.8	Distant plant and traffic noise.	**36.4**	51.5	31.3	Distant Medupi plant audible.
2	**29.7**	49.4	22.1	Far distant Medupi power station noise.	**34.0**	63.5	18.6	Far distant Medupi power station noise.
3	**30.1**	50.5	21.3	Far distant Medupi power station noise.	**30.4**	47.7	18.0	Far distant Medupi power station noise.
4	**27.4**	66.0	21.1	Far distant Medupi power station noise.	**29.1**	49.0	16.8	Natural noises such as insects and wind.
5	**31.0**	50.4	23.3	Natural noises such as birds and wind.	**29.0**	44.6	18.3	Natural noises such as insects and wind.
5A	**27.1**	59.5	15.7	Natural noises such as birds and wind.	**22.2**	45.5	15.7	Natural noises such as insects and wind.
6	**33.6**	63.5	20.8	Distant Medupi plant noise.	**30.6**	63.6	20.8	Natural noises such as insects and wind.
7	**37.5**	54.2	27.4	Natural noises such as birds and wind.	**30.6**	63.6	20.8	Natural noises such as insects and wind. Distant Medupi power station audible.
8	**33.9**	51.3	26.7	Natural noises such as birds and wind. Distant traffic noise.	**30.5**	56.1	21.7	Distant Medupi power station audible.
9	**37.3**	55.0	26.7	Natural noises such as birds and wind. Distant traffic noise.	**31.9**	57.5	21.8	Distant Medupi power station audible.
10	**30.0**	48.4	20.9	Natural noises such as birds and wind. Distant traffic noise.	**31.9**	57.5	21.8	Distant Medupi power station audible.
11	**38.8**	66.4	21.8	Natural noises such as birds and wind. Distant traffic noise.	**27.7**	46.1	22.9	Distant Medupi power station audible.
12	**36.6**	60.4	23.6	Natural noises such as birds and wind. Traffic noise excluded 2 x trucks and 4 x motor vehicles.	**29.9**	51.9	22.4	Distant Medupi power station audible.
13	**38.6**	54.5	27.0	Distant traffic noise.	**25.9**	46.6	18.9	Distant Medupi power station audible.
14	**40.5**	60.9	27.4	Natural noises such as birds and wind.	**25.9**	46.6	18.9	Corona noise from overhead power lines.
15	**47.9**	73.8	21.4	Natural noises such as birds and wind. Traffic excluded (1 x truck and 3 x motor-vehicles)	**29.7**	46.7	17.0	Natural noises such as insects and wind.
16	**39.0**	59.4	25.3	Natural noises such as birds and wind.	**32.4**	48.4	22.2	Natural noises such as insects and wind.

The arithmetic ambient noise level throughout the study area is as follows:

- Along the gravel road to the south MPs 1, 2, 3, 4 and 5

    - Daytime – 30.3dBA;
    - Night time – 27.8dBA.
- Proposed rail yard MPs 5A, 6 and 7
    - Daytime – 32.7dBA;
    - Night time – 27.8dBA.
- Farm portions to the north of proposed rail yard MPs 8, 9, 10, 11 and 16
    - Daytime – 35.8dBA;
    - Night time – 30.9dBA.
- Along Steenbokpan Road MPs 12, 13, 14 and 15
    - Daytime – 40.9dBA;
    - Night time – 27.9dBA.

The ground vibration levels throughout the study area (23 July 2018) were insignificant as the ground vibration levels were between 0.381mm/s to 0.835mm/s.

A noise survey was carried out at the Thabazimbi Rail yard on 8 November 2018 and the following noise levels were recorded:

- Locomotive idling at 50m from the measuring point – 51.3dBA;
- Three (3) locomotives passing the measuring point at 50m – 57.3dBA;
- Shunting at 100m from the measuring point – 46.4dBA;
- Work on line and air pressure release at 30m – 59.3dBA;
- Locomotive start up and using air brakes at 40m – 63.1dBA;
- Filling up locomotive at 3m from measuring point – 71.3dBA to 80.1dBA;
- Passing train and hooting at 15m from measuring point – 82.8dBA with a maximum noise level of 107.1dBA when train hoot; and,
- Motor vehicle traffic inside the yard – 46.4dBA.

The ground vibration levels were recorded at the Thabazimbi rail yard and the ground vibration levels at a distance from the train activities were between 1.73mm/s to 2.55mm/s.

The following noise levels are from construction machinery which is used during the construction and earth works. The machinery will not work all at once and the rock drill operation will work individually when it will be required. This will be a point source like many of the machinery whereas dump trucks/hauling vehicles will create a linear noise source.

The noise reduction calculated in Table 6.2 is for direct line of sight and medium ground conditions. Engineering control measures and topography can have an influence on how the noise level is perceived by the occupants of nearby noise receptors. The cumulative noise level of the machinery and equipment will be 64.9dBA at 60m and 40.8dBA at 960m from the construction area if all the machinery operates in a radius of 30m at one time (this is for direct line of sight with no earth berm in place).

Table 6-2: Sound pressure levels of construction machinery

Equipment	**Reduction in the noise level some distance from the source - dBA**								
Cumulative distance from source in meters	2m from the source	15m	30m	60m	120m	240m	480m	960m	1920m
Dump truck	91.0	62.5	56.5	50.4	44.4	38.4	32.4	26.4	20.3
Backhoe	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Drilling Equipment	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Flatbed truck	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pickup truck	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Tractor trailer	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Crane	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pumps	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Welding Machine	72.0	43.5	37.5	31.4	25.4	19.4	13.4	7.4	1.3
Generator	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Compressor	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pile driver	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Jackhammer	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Rock drills	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Pneumatic tools	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Cumulative noise levels from the construction activities when all of such work within a radius of 30m	**105.5**	**76.9**	**70.9**	**64.9**	**58.9**	**52.9**	**46.8**	**40.8**	**34.8**

Earthworks and possible blasting will be required at the borrow pits to remove the topsoil and to dislodge rock which may be used at the construction of the railway line.

Ground vibration will be created by blasting activities during the operational phase of the project and the following formulas were used to calculate the over-air pressure levels/air vibration levels and ground vibration levels based on typical mass of charge per delay of 300kg, 500kg, 750kg and 1 000kg of site-mixed slurry explosives respectively. The ICI Handbook of Blasting Tables (ICI, 1971) provides the following formula for calculating ground-borne vibration:

$$V = k.\left(\frac{R}{\sqrt{W}}\right)^b$$

Where V is the peak particle velocity (mm/s)

R is the distance from the blast to the monitoring point (m)

W is the explosive charge weight per delay (kg)

The Australian Standard 2187.2-2006 (Standards Australia, 2006) was used in the absence of site specific constants for *k* and *b* in the above formula.

k: 1140

b: -1.6

Air Overpressure Levels/Air vibration

The level of air overpressure during blasting at a distance from the blasting area was calculated using the following equation from the ICI Blasting Handbook:

$$P[dBZ]5\% = 165.3 - 24\log 10\left(\frac{D}{\sqrt[3]{W}}\right)$$

Where P is the 95th percentile peak pressure (dBZ);

D is the distance from the blast (m); and

W is the charge per mass delay (kg).

The following criteria, based on international standards, in Table 2 are designed to ensure adequate protection of sensitive land uses whilst permitting the operations to be conducted in a practical manner. The criteria are presented as 95 percentile limits for human comfort in occupied buildings and avoiding risk of cosmetic and structural damage to buildings from long term effects of vibration. Lower limits are set for the night time period. No distinction is made between minor and moderate significance because of the nature of impacts resulting from blasting and the response of receptors. Critical impacts from air blast are identified where air blast noise from blasting exceeds 140.0 dBL, generally accepted as the safe threshold for hearing. No blasting will take place during the night time periods and only the daytime levels will be used.

Table 6-3: Criteria for the evaluation of air blast vibration and ground vibration

Period	Air blast dB(L)				Vibration PPV mm/s			
	Not significant	Minor/Moderate	Major	Critical	Not significant	Minor/Moderate	Major	Critical
Daytime	<115	>115-125	>125-140	>140	<2	>2-5	>5-10	>10
Night time	<105	>105-115	>115-140	>140	<1	>1-2	>2-5	>5

7 Noise impact levels at the different residential areas

7.1 Environmental noise level calculations

The assessment of environmental noise impacts will vary because of the different prevailing ambient noise levels in different districts according to Table 2 of SANS 10103 of 2008. There is recommended noise levels for ambient noise levels in different districts. (See Table 2-1). The increase in the in the prevailing ambient noise level is quantified as follow:

The increase in the prevailing ambient noise level is calculated in the following manner:

$\Delta L\text{Req,T} = L\text{Req,T (post)} - L\text{Req,T (pre)}$

where,

*L*Req,T (post) – noise level after completion of the project – projected or calculated noise levels;

*L*Req,T (pre) – noise level before the proposed project – ambient noise level.

The criteria for assessing the magnitude of a noise impact are illustrated in Table 7.1.

Table 7-1: Noise intrusion level criteria

Increase Δ-dBA	Assessment of impact magnitude	Color code
0 <Δ≤ 1	Not audible	
1 <Δ≤ 3	Very Low	
3 <Δ≤ 5	Low	
5 <Δ≤ 10	Medium	
10 <Δ≤ 15	High	
15 <Δ	Very High	

The noise levels at the noise sensitive areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor. The following formula was used to calculate the noise level at the noise sensitive areas during the construction, operational and decommissioning phases of the project:

$Lp = Lw - 20\log R - \alpha$

Where, Lp is the sound level at a distance from the source in dBA;
Lw is the sound level at the source in dBA;
α is the noise reduction due to the distance from the source (5.0dBA);
R is the distance from the source.

The above equation and the Interactive noise calculator (ISO 9613) will be used to determine the noise levels during the construction, operational and decommissioning phases of the project. The noise levels at the noise sensitive areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor.

The following sound levels were used in determining the noise level at the residential areas during the construction phase:

- Site clearing and grubbing of footprint – 90.5dBA
- Civil Construction at the railway yard footprint - 85.5dBA;
- Assembly of water and diesel tanks – 87.5dBA;
- Activities at the borrow-pits – 85.0dBA;
- Construction of the roads – 87.5dBA; and
- Construction of the railway line – 90.0dBA.

The noise intrusion level during the operational phase will be based on the following noise levels at the railway yard:

- Locomotive start-up and idling – 90.5dBA;
- Shunting operations – 93.5dBA;
- Release of air brakes – 95.0dBA;
- Maintenance work within the workshop – 85.0dBA;
- Outdoor maintenance work – 85.0dBA;
- Re-fuelling of locomotive – 83,0dBA;
- Passing train – 87.0dBA;
- Train hooter – 110dBA; and
- General noise level inside yard area without train activities – 50.0dBA.

The noise intrusion level during the decommissioning phase will be based on the following noise levels at the source:

- Removal of infra-structure – 85.0dBA; and
- Rehabilitation of disturbed footprint – 85.0dBA.

8 Noise Impact Assessment Analysis

8.1 Construction phase at the rail yard

The noise intrusion levels at the residential areas A to N, (in dBA) will be insignificant, during the construction phase of the rail yard and activities at the burrow pits and is illustrated in the following tables.

Table 8-1: Noise intrusion levels in dBA during construction at eastern side and burrow pit 1

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	11.5	6.5	8.5	6.6	8.5	11.5	17.2	35.8	0.1
B	7.8	2.8	4.8	2.3	4.8	7.8	13.4	35.7	0.0
C	3.2	-1.8	0.2	-2.2	0.2	3.2	8.8	35.7	0.0
D	3.0	-2.0	0.0	-2.5	0.0	3.0	8.6	30.0	0.0
E	8.2	3.2	5.2	2.4	5.2	8.2	13.8	30.1	0.1
F	9.3	4.3	6.3	3.5	6.3	9.3	14.9	30.1	0.1
G	9.7	4.7	6.7	3.4	6.7	9.7	15.2	30.1	0.1
H	18.3	13.3	15.3	13.9	15.3	18.3	24.0	31.0	1.0
I	12.4	7.4	9.4	8.3	9.4	12.4	18.1	35.8	0.1
J	10.0	5.0	7.0	4.6	7.0	10.0	15.6	29.9	0.2
K	15.5	10.5	12.5	8.9	12.5	15.5	21.0	30.8	0.5
L	14.1	9.1	11.1	7.2	11.1	14.1	19.5	30.7	0.4
M	13.1	8.1	10.1	6.3	10.1	13.1	18.6	30.6	0.3
N	5.9	0.9	2.9	0.0	2.9	5.9	11.5	30.4	0.1

Table 8-2: Noise intrusion levels in dBA during construction at middle and burrow pit 1

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	10.2	5.2	7.2	6.6	7.2	10.2	16.0	35.7	0.0
B	8.4	3.4	5.4	2.3	5.4	8.4	14.0	35.7	0.0
C	3.6	-1.4	0.6	-2.2	0.6	3.6	9.2	35.7	0.0
D	3.4	-1.6	0.4	-2.5	0.4	3.4	9.0	30.0	0.0
E	9.3	4.3	6.3	2.4	6.3	9.3	14.8	30.1	0.1
F	11.1	6.1	8.1	3.5	8.1	11.1	16.5	30.2	0.2
G	13.3	8.3	10.3	3.4	10.3	13.3	18.6	30.3	0.3
H	14.9	9.9	11.9	13.9	11.9	14.9	21.0	30.5	0.5
I	8.9	3.9	5.9	8.3	5.9	8.9	15.1	35.7	0.0
J	7.9	2.9	4.9	4.6	4.9	7.9	13.7	29.8	0.1
K	14.5	9.5	11.5	8.9	11.5	14.5	20.1	30.7	0.4
L	17.2	12.2	14.2	7.2	14.2	17.2	22.5	31.0	0.7
M	19.2	14.2	16.2	6.3	16.2	19.2	24.5	31.3	1.0
N	7.6	2.6	4.6	0.0	4.6	7.6	13.0	30.4	0.1

The environmental noise impact of the construction phase of the proposed rail yard activities at the residential areas is illustrated in Table 8.1. The noise impact will be insignificant at the different noise receptors A to N during the construction phase.

Table 8-3: Noise intrusion levels in dBA during construction at western side and burrow pit 1

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	8.5	3.5	5.5	6.6	5.5	8.5	14.5	35.7	0.0
B	7.9	2.9	4.9	2.3	4.9	7.9	13.5	35.7	0.0
C	3.8	-1.2	0.8	-2.2	0.8	3.8	9.4	35.7	0.0
D	3.7	-1.3	0.7	-2.5	0.7	3.7	9.2	30.0	0.0
E	9.7	4.7	6.7	2.4	6.7	9.7	15.1	30.1	0.1
F	11.6	6.6	8.6	3.5	8.6	11.6	17.0	30.2	0.2
G	18.7	13.7	15.7	3.4	15.7	18.7	23.9	31.0	1.0
H	11.5	6.5	8.5	13.9	8.5	11.5	18.5	30.3	0.3
I	6.7	1.7	3.7	8.3	3.7	6.7	13.5	35.7	0.0
J	6.1	1.1	3.1	4.6	3.1	6.1	12.2	29.8	0.1
K	11.9	6.9	8.9	8.9	8.9	11.9	17.7	30.5	0.2
L	15.5	10.5	12.5	7.2	12.5	15.5	20.9	30.8	0.5
M	27.0	22.0	24.0	6.3	24.0	27.0	32.3	34.4	4.1
N	10.5	5.5	7.5	0.0	7.5	10.5	15.8	30.5	0.2

Table 8-4: Noise intrusion levels in dBA during construction at eastern side and burrow pit 2

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	11.5	6.5	8.5	13.9	8.5	11.5	18.6	35.8	0.1
B	7.8	2.8	4.8	9.0	4.8	7.8	14.5	35.7	0.0
C	3.2	-1.8	0.2	1.0	0.2	3.2	9.2	35.7	0.0
D	3.0	-2.0	0.0	0.6	0.0	3.0	8.9	30.0	0.0
E	8.2	3.2	5.2	8.4	5.2	8.2	14.6	30.1	0.1
F	9.3	4.3	6.3	9.5	6.3	9.3	15.7	30.2	0.2
G	9.7	4.7	6.7	4.7	6.7	9.7	15.3	30.1	0.1
H	18.3	13.3	15.3	13.8	15.3	18.3	24.0	31.0	1.0
I	12.4	7.4	9.4	4.9	9.4	12.4	17.8	35.8	0.1
J	10.0	5.0	7.0	0.1	7.0	10.0	15.3	29.9	0.2
K	15.5	10.5	12.5	2.8	12.5	15.5	20.8	30.8	0.5
L	14.1	9.1	11.1	3.1	11.1	14.1	19.4	30.6	0.3
M	13.1	8.1	10.1	4.6	10.1	13.1	18.5	30.6	0.3
N	5.9	0.9	2.9	1.5	2.9	5.9	11.6	30.4	0.1

Table 8-5: Noise intrusion levels in dBA during construction at middle and burrow pit 2

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	10.2	5.2	7.2	13.9	7.2	10.2	17.7	35.8	0.1
B	8.4	3.4	5.4	9.0	5.4	8.4	14.9	35.7	0.0
C	3.6	-1.4	0.6	1.0	0.6	3.6	9.5	35.7	0.0
D	3.4	-1.6	0.4	0.6	0.4	3.4	9.3	30.0	0.0
E	9.3	4.3	6.3	8.4	6.3	9.3	15.5	30.2	0.2
F	11.1	6.1	8.1	9.5	8.1	11.1	17.1	30.2	0.2
G	13.3	8.3	10.3	4.7	10.3	13.3	18.7	30.3	0.3
H	14.9	9.9	11.9	13.8	11.9	14.9	21.0	30.5	0.5
I	8.9	3.9	5.9	4.9	5.9	8.9	14.6	35.7	0.0
J	7.9	2.9	4.9	0.1	4.9	7.9	13.3	29.8	0.1
K	14.5	9.5	11.5	2.8	11.5	14.5	19.8	30.7	0.4
L	17.2	12.2	14.2	3.1	14.2	17.2	22.4	31.0	0.7
M	19.2	14.2	16.2	4.6	16.2	19.2	24.5	31.3	1.0
N	7.6	2.6	4.6	1.5	4.6	7.6	13.1	30.4	0.1

The environmental noise impact of the construction phase of the other mining activities at the residential areas is illustrated in Table 8.1. The noise impact will be insignificant at the different noise receptors A to N during the construction phase.

Table 8-6: Noise intrusion levels in dBA during construction at western side and burrow pit 2

Residential property	Site clearing and grubbing of footprint - dBA	Civil construction activities at the railway yard footprint	Assembly of water and diesel tanks	Activities at the borrow pits	Construction of the roads	Construction of the railway lines	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - Daytime
A	8.5	3.5	5.5	13.9	5.5	8.5	16.8	35.8	0.1
B	7.9	2.9	4.9	9.0	4.9	7.9	14.6	35.7	0.0
C	3.8	-1.2	0.8	1.0	0.8	3.8	9.7	35.7	0.0
D	3.7	-1.3	0.7	0.6	0.7	3.7	9.5	30.0	0.0
E	9.7	4.7	6.7	8.4	6.7	9.7	15.8	30.2	0.2
F	11.6	6.6	8.6	9.5	8.6	11.6	17.5	30.2	0.2
G	18.7	13.7	15.7	4.7	15.7	18.7	23.9	31.0	1.0
H	11.5	6.5	8.5	13.8	8.5	11.5	18.5	30.3	0.3
I	6.7	1.7	3.7	4.9	3.7	6.7	12.7	35.7	0.0
J	6.1	1.1	3.1	0.1	3.1	6.1	11.7	29.8	0.1
K	11.9	6.9	8.9	2.8	8.9	11.9	17.2	30.5	0.2
L	15.5	10.5	12.5	3.1	12.5	15.5	20.8	30.8	0.5
M	27.0	22.0	24.0	4.6	24.0	27.0	32.3	34.4	4.1
N	10.5	5.5	7.5	1.5	7.5	10.5	15.8	30.5	0.2

The impact assessment for the construction phase is illustrated in Tables 8.7 to 8.12.

Table 8-7: Site clearing and grubbing of footprint

Areas	***Site clearing and grubbing of footprint***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-8: Civil construction activities at the railway yard footprint

Areas	***Civil construction activities at the railway yard footprint***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-9: Assembly of water and diesel tanks

Areas	***Assembly of water and diesel tanks***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-10: Activities at the borrow pits

Areas	***Activities at the borrow pits***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-11: Construction of the roads

Areas	***Construction of the roads***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-12: Construction of the railway lines

Areas	***Construction of the railway lines***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

8.2 Operational Phase

The environmental noise impact during the operational phase at the noise receptors is illustrated in Table 8.13. The noise impact will be insignificant at the different noise receptors A to N.

Table 8-13: Noise intrusion levels in dBA during the operational phase

Residential property	Locomotive start -up and idling	Release of air brakes	Shunting operations	Maintenance work in the workshop	Outdoor maintenance work	Fill up locomotive	Passing train	General noise level in rail yard	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	15.2	15.2	13.2	5.2	5.2	2.7	19.7	-14.8	22.8	35.9	31.3	0.2	0.7
B	13.4	13.4	11.4	3.4	3.4	0.9	17.9	-16.6	21.0	38.8	27.1	0.1	1.2
C	8.6	8.6	6.6	-1.4	-1.4	-3.9	13.1	-21.4	16.2	38.7	26.3	0.0	0.4
D	8.4	8.4	6.4	-1.6	-1.6	-4.1	12.9	-21.6	16.0	38.7	26.3	0.0	0.4
E	14.3	14.3	12.3	4.3	4.3	1.8	18.8	-15.7	21.9	34.7	32.8	0.2	0.4
F	16.1	16.1	14.1	6.1	6.1	3.6	20.6	-13.9	23.7	34.8	32.9	0.3	0.5
G	18.3	18.3	16.3	8.3	8.3	5.8	22.8	-11.7	25.9	35.1	33.3	0.6	0.9
H	19.9	19.9	17.9	9.9	9.9	7.4	24.4	-10.1	27.4	35.3	33.6	0.8	1.2
I	13.9	13.9	11.9	3.9	3.9	1.4	18.4	-16.1	21.5	33.5	36.5	0.3	0.1
J	12.9	12.9	10.9	2.9	2.9	0.4	17.4	-17.1	20.4	30.2	34.2	0.5	0.2
K	19.5	19.5	17.5	9.5	9.5	7.0	24.0	-10.5	27.1	32.0	30.5	1.1	1.8
L	22.2	22.2	20.2	12.2	12.2	9.7	26.7	-7.8	29.7	31.7	32.4	3.1	2.3
M	32.6	32.6	30.6	22.6	22.6	20.1	37.1	2.6	40.2	40.4	40.2	11.2	15.9
N	12.6	12.6	10.6	2.6	2.6	0.1	17.1	-17.4	20.2	30.7	28.5	0.2	0.4

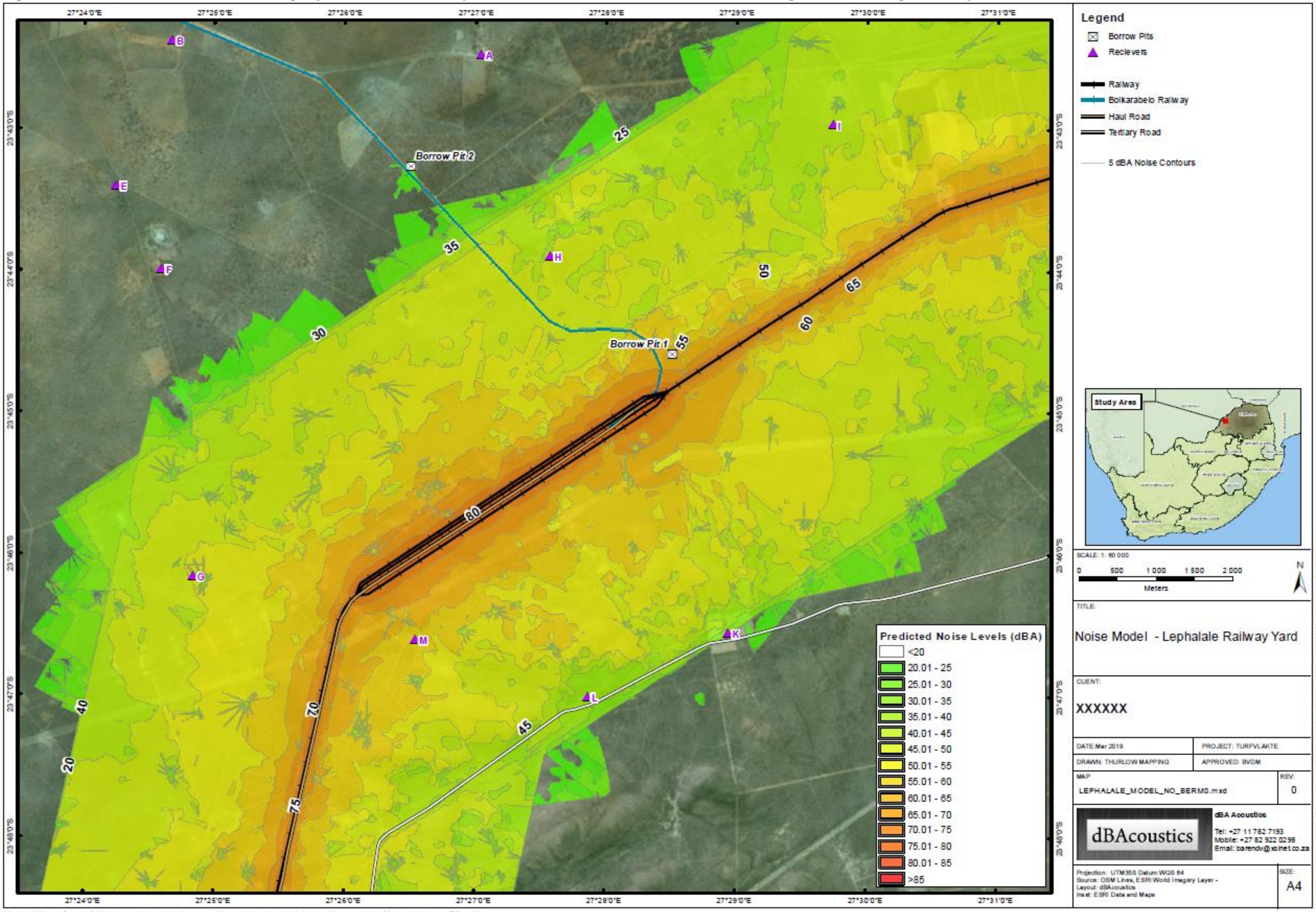
The noise intrusion levels of the train horn in use at the middle of the train yard at the different noise receptors are illustrated in Table 8.14.

Table 8-14: Noise intrusion levels during the use of the train horn

Residential area	Train hooter	Cumulative noise level	Cumulative noise level	Intrusion level daytime	Intrusion level night time
A	30.2	36.8	33.4	1.1	2.8
B	28.4	36.4	32.7	0.7	2.1
C	23.6	36.0	31.4	0.3	0.8
D	23.4	30.9	32.5	0.9	0.6
E	29.3	32.7	33.8	2.7	1.9
F	31.1	33.6	34.5	3.6	2.6
G	33.3	35.0	35.7	5.0	3.8
H	34.9	36.1	36.6	6.1	4.7
I	28.9	36.5	32.8	0.8	2.2
J	27.9	31.9	34.9	2.2	0.9
K	34.5	35.9	35.3	5.6	7.5
L	37.2	38.0	37.6	7.7	9.8
M	39.2	39.8	39.5	9.5	11.7
N	27.6	32.2	30.7	1.9	2.9

The noise contours during the operational phase of the activities at the proposed rail yard with a 2m high earthberm on both sides of the entire rail yard is illustrated in Figure 8.1 and 3m earthberm in Figure 8.2.

Figure 8-1: Noise contours during operations at rail yard and the movement of train along the existing railway line.



The impact assessment for the operational phase is illustrated in Tables 8.15 to 8.22.

Table 8-15: Locomotive start -up and idling

Areas	***Locomotive start -up and idling***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-16: Release of air brakes

Areas	***Release of air brakes***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-17: Shunting operations

Areas	***Shunting operations***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-18: Maintenance work in the workshop

Areas	***Maintenance work in the workshop***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-19: Outdoor maintenance work

Areas	***Outdoor maintenance work***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-20: Re-fuelling locomotive

Areas	***Re-fuelling locomotive***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-21: Passing train

Areas	***Passing train***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-22: General noise level in rail yard

Areas	***General noise level in rail yard***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**0.8**	**9.6**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

Table 8-23: Noise intrusion at NSA M

Areas	***General noise level in rail yard***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**4**	**0.8**	**11.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**0.8**	**8.8**	**-**	**M**

8.3 Decommissioning phase

The noise intrusion levels during the decommissioning phase will be insignificant and is illustrated in Table 8.24.

Table 8-24: Noise intrusion levels in dBA during the decommissioning phase

Residential	Demolition of all surface infrastructure	Rehabilitation of all disturbed areas	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	5.2	7.2	9.3	35.7	30.6	0.0	0.0
B	3.4	5.4	7.6	35.7	30.6	0.0	0.0
C	-1.4	0.6	2.8	35.7	30.6	0.0	0.0
D	-1.6	0.4	2.6	30.0	31.9	0.0	0.0
E	4.3	6.3	8.4	30.0	31.9	0.0	0.0
F	6.1	8.1	10.2	30.0	31.9	0.0	0.0
G	8.3	10.3	12.4	30.1	31.9	0.1	0.0
H	9.9	11.9	14.0	30.1	32.0	0.1	0.1
I	3.9	5.9	8.0	35.7	30.6	0.0	0.0
J	2.9	4.9	7.0	29.7	34.0	0.0	0.0
K	9.5	11.5	13.6	30.4	28.0	0.1	0.2
L	12.2	14.2	16.3	30.5	28.1	0.2	0.3
M	14.2	16.2	18.4	30.6	28.3	0.3	0.5
N	2.6	4.6	6.7	30.3	27.8	0.0	0.0

The environmental noise impact of the activities during the decommissioning phase at the residential areas is illustrated in Table 8.25 and Table 8.26. The noise impact will be insignificant at the different noise receptors A to N.

Table 8-25: Demolition of all infra-structure

Areas	***Demolition of all infra-structure***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-26: Planting of grass on rehabilitated areas

Areas	***Planting of grass on rehabilitated areas***								
Impact Summary	*Noise increase at the boundary of the railway yard footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

8.4 Blasting and over pressure calculations

The blasting and over-air pressures levels for activities at borrow pit 1 and borrow pit 2 are illustrated in Table 8.27 and 8.28 respectively. The values are colour coded according to Table 6.3: Criteria for the evaluation of air blast vibration and ground vibration. The impact at the residential areas during blasting at the borrow pits will be insignificant.

Table 8-27: Ground vibration and air pressure levels at the residential properties from activities at borrow pit 1

Noise receptor	Distance in meters	Calculated vibration levels at the receptor with 300kg site mixed slurry explosives	Calculated dBL value (dB) at the receptor with 300kg site mixed slurry explosives	Calculated vibration level at the receptors with 500kg site mixed slurry explosives	Calculated dBL value (dB) at the receptor with 500kg site mixed slurry explosives
A	4653	0.57	97.1	0.85	98.9
B	7636	0.23	91.9	0.35	93.7
C	12909	0.05	86.5	0.08	88.2
D	13356	0.05	86.1	0.07	87.9
E	7571	0.21	92.0	0.31	93.8
F	6688	0.25	93.3	0.38	95.1
G	6773	0.10	93.2	0.15	95.0
H	2020	0.55	105.8	0.82	107.6
I	3861	0.11	99.0	0.16	100.8
J	5856	0.04	94.7	0.07	96.5
K	3599	0.07	99.8	0.11	101.5
L	4363	0.08	97.8	0.12	99.5
M	4823	0.10	96.7	0.15	98.5
N	10047	0.06	89.1	0.09	90.8

Table 8-28: Ground vibration and air pressure levels at the residential properties from activities at borrow pit 2

Noise receptor	Distance in meters	Calculated vibration levels at the receptor with 300kg site mixed slurry explosives	Calculated dBL value (dB) at the receptor with 300kg site mixed slurry explosives	Calculated vibration level at the receptors with 500kg site mixed slurry explosives	Calculated dBL value (dB) at the receptor with 500kg site mixed slurry explosives
A	2010	0.57	105.8	0.85	107.6
B	3539	0.23	99.9	0.35	101.7
C	8880	0.05	90.4	0.08	92.1
D	9320	0.05	89.9	0.07	91.6
E	3795	0.21	99.2	0.31	101.0
F	3351	0.25	100.5	0.38	102.3
G	5847	0.10	94.7	0.15	96.5
H	2053	0.55	105.6	0.82	107.4
I	5708	0.11	95.0	0.16	96.7
J	9858	0.04	89.3	0.07	91.0
K	7274	0.07	92.4	0.11	94.2
L	7032	0.08	92.8	0.12	94.6
M	5912	0.10	94.6	0.15	96.4
N	8371	0.06	91.0	0.09	92.7

9 Calculation of road traffic noise

The proposed routes will be along the rail servitude and the existing feeder roads. The traffic along the feeder roads exists out of heavy–duty trucks and motor-vehicles. The prevailing ambient noise level along the feeder road was as follows:

- 66.8dBA during the day and 62.2dBA during the night.

The calculations to determine the noise level from the additional traffic are based on the following equation:

SANS 10210 of 2004, the national standard for the calculating and predicting of road traffic noise was used to calculate the noise level to be generated by the traffic along the proposed road. The traffic will create a finite type noise as this road is already used by other vehicles on an ad hoc basis.

The calculation of the noise levels during the construction phase are based on a total of 8 vehicles per hour of which 6 will be heavy-duty vehicles and 2 will be motor-vehicles. The traffic volume per hour during the operational phase will be 10 vehicles of which 8 will be heavy-duty and 2 motor-vehicle per hour.

Basic Model

$L_{Basic} = 38.3 + 10 \text{ Log } (Q_r)$ dBA,

where; L_{Basic} = basic noise level in dBA and Q_r is the mean traffic flow per hour.

<u>Primary corrections to the basic model:</u>

- Traffic flow Q – vehicles/hour;
- Corrections for speed of traffic and percentage of heavy vehicles, $L_{P,v}$;
- Correction for gradient, L_{gr};
- Correction for road surface texture, L_t.

<u>Propagation:</u>

- Correction for ground conditions and distance of the receiver, $L_{d,hr}$;
- Height relative to source h,m;
- Average height of propagation h_{av}, m.

The calculated traffic noise level at 25m from the road will be <u>along the feeder roads</u> during the <u>*construction phase*</u> will be 47.5dBA and during the <u>*operational phase*</u> 50.7dBA. There will therefore be no noise impact from traffic activities (during the construction and/or operational phases) onto the residential properties.

10 Assumptions and Limitations

The following limitations forms part of the environmental noise impact assessment:

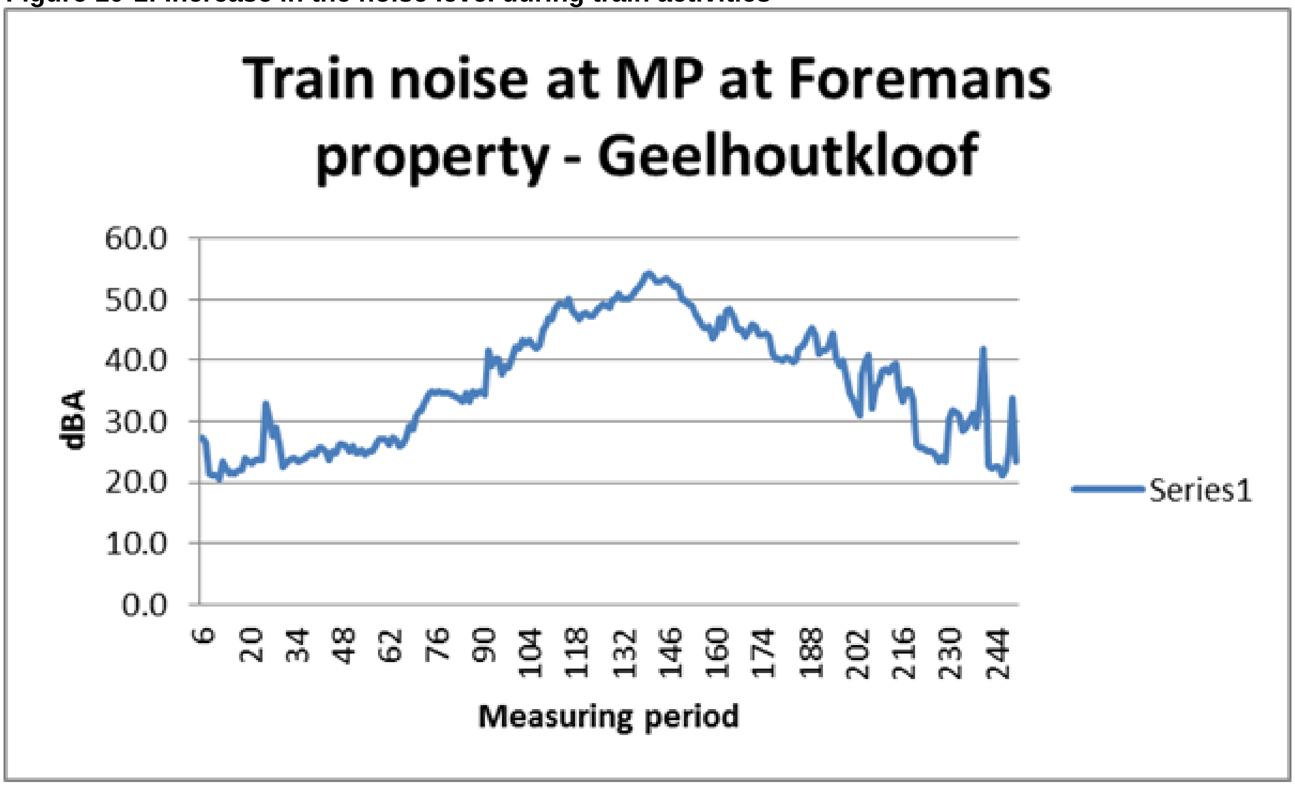
- This an existing railway line with existing train activities during the day and night time period;
- The prevailing ambient noise levels for the study area was created by far and near noise sources associated with traffic and distant mining activities with the result that the prevailing ambient noise level may change at times;
- Noise measurements in the presence of winds in excess of 3.0m/s may impact the outcome of the environmental noise results;
- Insect activities during the summer periods increase the prevailing ambient noise level during the day and night time periods accordingly;
- The influx of traffic into an area will have an influence on the prevailing ambient noise levels and should be considered during the noise impact assessment process.

11 Discussions

The proposed rail yard will take place along an existing rail line with trains which will travel along the existing railway line on a daily basis during the day and the night.

The following graph illustrates the noise levels during train activities as recorded at noise sensitive area M at Geelhoutkloof. The graph illustrates that there is an increase in the noise level when the train approached the MP which was some 837m from the rail line and the noise level decreases to the level of the prevailing ambient noise level once the train passed the measuring point. An intermittent noise increase is created and this will occur once there are trains. The cumulative impact of the train activities and the rail yard activities will create a noise intrusion on an intermittent basis.

Figure 10-1: Increase in the noise level during train activities



A noise survey which was carried out at the Thabazimbi rail yard revealed that the prevailing ambient noise levels when there were no train activities was 46.4dBA which was created by distant traffic (Thabazimbi rail yard is situated next to a busy feeder road and in the vicinity of the Town) and limited activities within the rail yard. The ground vibration levels were recorded at the Thabazimbi rail yard and the ground vibration levels at a distance from the train activities were between 1.73mm/s to 2.55mm/s. The ground vibration levels throughout the study area (23 July 2018) were insignificant as the ground vibration levels were between 0.381mm/s to 0.835mm/s. There were no ground vibration levels at the residential properties.

There will be a difference between the summer and winter periods as the insect activities such as crickets raise the prevailing ambient noise levels dramatically during the summer period whereas the prevailing ambient noise levels will not be influenced by insects during the winter period. The distances and topography between the proposed rail yard activities and the residential areas will play a role in the noise propagation and how the sound from the proposed rail yard activities will be perceived.

Noise or sound is part of our daily exposure to different sources which is part of daily living and some of the sounds which are intrusive such as traffic noise forms part of the ambient noise that people get accustomed to without noticing the higher sound levels. Any person in the workplace and at home is exposed to the following noise levels as given in Table 10-1. These are the average noise levels in the workplace and at home that will mask noise from a source introduced into an area:

Table 11-1 Different noise levels in and around the house and workplace

	Activity	**dBA**
Communication	Whisper	30.0
Communication	Normal Conversation	55.0-65.0
Communication	Shouted Conversation	90.0
Communication	Baby Crying	80.0
Communication	Computer	37.0-45.0
Home/Office	Refrigerator	40.0-43.0
Home/Office	Radio Playing in Background	45.0-50.0
Home/Office	Background Music	50.0
Home/Office	Washing Machine	50.0-75.0
Home/Office	Microwave	55.0-59.0
Home/Office	Clothes Dryer	56.0-58.0
Home/Office	Alarm Clock	60.0-80.0
Home/Office	Vacuum Cleaner	70.0
Home/Office	TV Audio	70.0
Home/Office	Flush Toilet	75.0-85.0
Industry	Industrial activities	85.0-95.0
Home/Office	Ringing Telephone	80.0
Home/Office	Hairdryer	80.0-95.0
Home/Office	Maximum Output of Stereo	100.0-110.0

12 Recommendations

The following three primary variables should be considered when designing acoustic screening measures for the control of sound and/or noise:

- The source – Reduction of noise at the source;

- The transmission path – Reduction of noise between the source and the receiver;
- The receiver – Reduction of the noise at the receiver.

The last option is not applicable as it was decided to control the noise levels at the source.

12.1 Acoustic screening recommendations

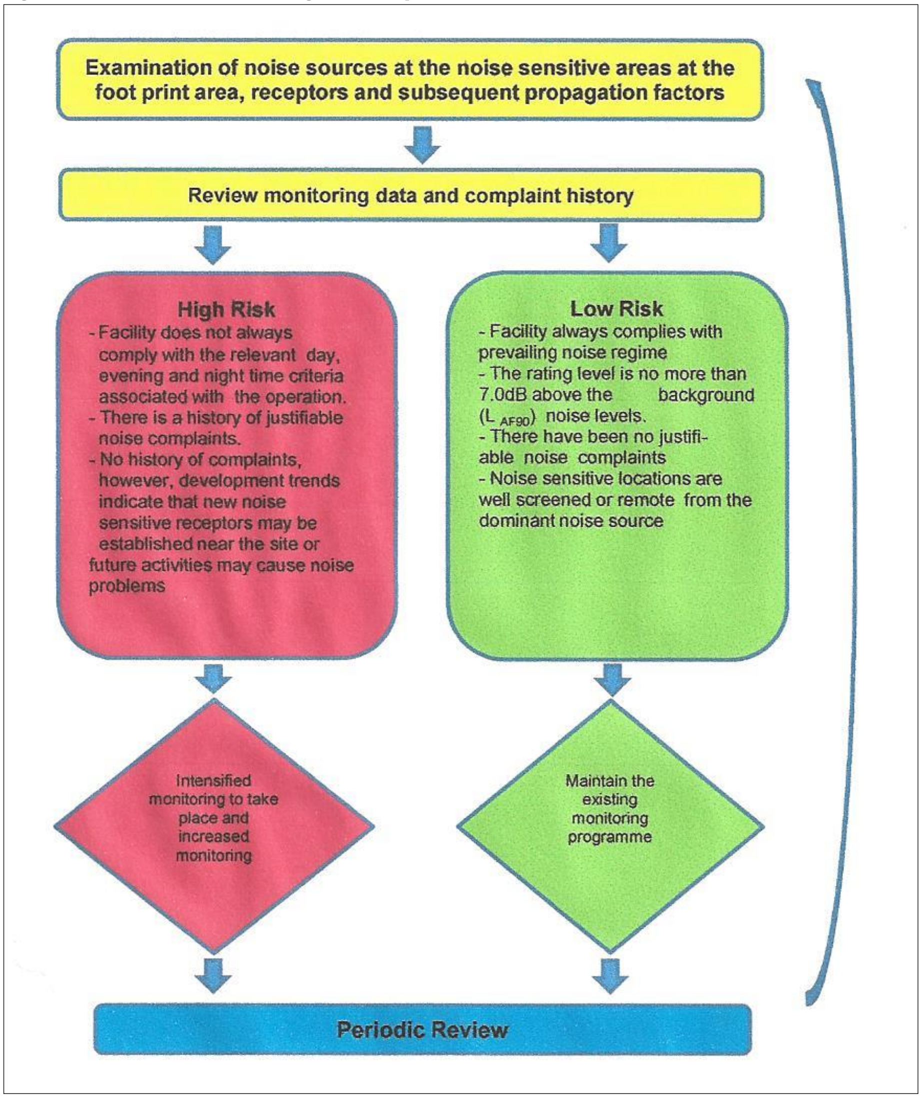
The acoustic screening measures for the project are given in Table 12.1. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 12-1: Recommended acoustic screening measures

Activity	Recommendations
Construction phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Construction activities to take place during daytime period only. • Noise monitoring on a quarterly basis.
Operational phase	• Noise monitoring to be done at the rail yard footprint, noise sources within rail yard footprint and at the abutting residential areas on a monthly basis after which the frequency can change to a quarterly/annual basis should there be no noise intrusion levels at the abutting residential properties especially NSA M.. • Actively manage the proposed rail yard activity and the noise management plan must be used to ensure compliance to the noise regulations and/or standards. • The noise levels to be evaluated in terms of the baseline noise levels.
Decommissioning phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Activities to take place during daytime period only. • Vehicles to comply with manufacturers' specifications and any activity which will exceed 85.0dBA to be done during daytime only.
Cumulative impact of the entire process	• Actively manage the process and noise impact assessment to determine compliance to the noise regulations. The levels to be evaluated in terms of the baseline noise levels.

The following are the Environmental, Health and Safety Guidelines of the IFC of the World Bank, which should be taken into consideration during the construction, operational and decommissioning phases of the project. The following noise management plan as illustrated in Figure 12.1 must be used to identify any new noise sources which may have an impact on the abutting noise sensitive areas.

Figure 12-1: Noise management plan



Noise monitoring will have to be carried out to determine the potential shift in the prevailing ambient noise levels on a monthly basis after which the frequency of monitoring may change to a quarterly/annual basis. Noise readings to be carried out at the measuring points as illustrated in Figure 3.1.

13 Conclusion

The proposed Lephalale rail yard project will be situated in an area where there are distant mining activities, feeder roads and residential areas. The noise impact assessment revealed that the noise increase will not be audible to low during the construction phase (Tables 8-1, 8-2, 8-3, 8-4, 8-5 and 8-6) and not audible to very high during the operational phase (Table 8-13) and not audible during the decommissioning phase (Table 8-24). The threshold value of 7.0dBA will be exceeded at noise receptors K, L and M for the duration the hooter will be activated inside the yard area and at intersections.

Animals depend on acoustic signals for essential functions. Some species have become threatened or endangered because of loss of habitat and further relocation as a result of noise disturbance is not possible. There is still an absence of understanding how observed behavioral and physiological effects translate into ecological consequences for wildlife. There are examples where a loud noise did not impact on the breeding and well-fare of wild life (IEMR, 2000).

Integrated Environmental Management (IEM) is a continuous process that ensures that the environmental impacts which can be introduced by mechanised activities during the construction, operational and decommissioning phases are avoided or mitigated throughout the project life cycle from design to the operational phase of the project (DEAT, 2004).

The Environmental management Plan (EMP) for the proposed rail yard establishment will consist of the following as illustrated in Table 13.1. Regular environmental monitoring will provide the data for reviewing, checking and revising the EMP.

Table 13-1: Environmental noise management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated noise levels will be adhered to at all times.	Monthly and quarterly	The engineer during the construction phase and the responsible person (Transnet Environmental Department) during the construction phase of the project, and a quarterly audit to be done by an approved environmental noise specialist.
Monitoring objective	Measure the environmental noise levels during the construction, operational and decommissioning phases of the project to ensure compliance to the recommended and threshold noise levels.	Monthly basis after which the frequency of monitoring may change to a quarterly basis	Transnet Environmental Department.
Monitoring technology	The environmental noise monitoring must be done with a calibrated Class 1 noise monitoring equipment.	Monthly to Quarterly basis	Transnet Environmental Department
Specify how the collected information will be used	The data must be collated and discussed on a monthly basis during the construction phase and on a monthly to quarterly basis during the operational phase for the first two	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first	Transnet Environmental Department

	years thereafter on an annual basis with the site engineer (construction phase) and the responsible department (Transnet Environmental Department).	two years thereafter on an annual basis or as required.	
Spatial boundaries	At the boundaries of the identified residential areas as well as at the rail yard boundaries.	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis or as required.	Transnet Environmental Department.
Define how the data will be analysed and interpreted and how it should be presented in monitoring reports	Reports must be compiled for each monitoring cycle and the results must be compared to the previous set of results to determine if there was a shift in the prevailing ambient noise levels.	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis or as required.	Transnet Environmental Department
Accuracy and precision of the data	The noise survey will have to be conducted in terms of the recommendations of the Noise Control regulations, 1994 and SANS 10103 of 2008.	Calibrated equipment which complies with the recommendations of SANS 10103 of 2008 must be used at all times.	Environmental noise specialist

The proposed rail yard project will comply with the relevant Noise Control Regulations, 1994 and SANS 10103 of 2008 provided that the noise mitigatory measures are in place and that the noise management plan be adhered to at all times.

Barend van der Merwe – MSc UJ
Environmental noise and vibration specialist

14. List of Definitions and Abbreviations

14.1 Definitions

Ambient noise
The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources, both near and far

A-weighted sound pressure level (sound level) (L_{pA}), in decibels
The A-weighted sound pressure level is given by the equation:

$L_{pA} = 10 \log (p_A/p_o)^2$

Where

p_A is the root-mean-square sound pressure, using the frequency weighting network A in pascals; and

p_o is the reference sound pressure (p_o = 20 μPa).

NOTE The internationally accepted symbol for sound level is dBA.

Distant source
A sound source that is situated more than 500 m from the point of observation

Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$), in decibels
The value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T, has the same mean-square sound pressure as a sound under consideration whose level varies with time. It is given by the equation

$$L_{Aeq,T} = 10 \log \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p_A^2(t)}{p_o^2} \, dt \right]$$

Where
$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, in decibels, determined over a time interval T that starts at t_1 and ends at t_2;

p_o is the reference sound pressure (p_o = 20 μPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal, in pascals.

Impulsive sound
Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise

Initial noise
The component of the ambient noise present in an initial situation before any change to the existing situation occurs

Intelligible speech
Speech that can be understood without undue effort

Low frequency noise
Sound, which predominantly contains frequencies below 100 Hz

Nearby source
A sound source that is situated at a distance of 500 m or less from the point of observation

Residual noise
The ambient noise that remains at a given position in a given situation when one or more specific noises are suppressed

Specific noise
A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source
NOTE Complaints about noise usually arise as a result of one or more specific noises.

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 meter was put into operation.

Disturbing noise
Means a noise that causes the ambient noise level to rise above the designated zone level by 7.0dBA or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in table 2 of SANS 10103.

Noise nuisance
Means any sound which disturbs or impairs the convenience or peace of any person

14.2 Abbreviations

dBA – A-weighted sound pressure level;

EMP – Environmental Management Plan;

IBR – Angular trapezoidal fluted profile sheet;

IFC – International Finance Corporation;

Km/h - Kilometers per hour;

Kg/m^3 – Kilogram per cubic meter;

m/s – meters per second;

NSA – Noise sensitive areas;

L_{Basic} – Basic noise level in dBA;

SANS – South African National Standards;

TLB – Tractor-loader-backhoe

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Appendix A

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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	*2018-AS-0912*
ORGANISATION	*dB ACOUSTICS*
ORGANISATION ADRESS	*P.O. BOX 1219, ALLENS NEK, 1737*
CALIBRATION OF	*INTEGRATING SOUND LEVEL METER complete with built-in ⅓ OCTAVE/OCTAVE FILTER and ½" MICROPHONE*
MANUFACTURERS	*LARSON DAVIS and PCB*
MODEL NUMBERS	*831, PRM 831 and 377B02*
SERIAL NUMBERS	*0001072, 0206 and 102184*
DATE OF CALIBRATION	*15 AUGUST 2018*
RECOMMENDED DUE DATE	*AUGUST 2019*
PAGE NUMBER	*PAGE 1 OF 6*

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Director: Marianka Naudé

Appendix B
Nature or Status of the Impact

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how will it be affected. The nature of the impact can be described as negative or positive and can be derived from the significance ratings of the impacts.

RATING	DESCRIPTION	QUANTITATIVE RATING
Positive	A benefit to the holistic environment	1
Negative	A detriment to the holistic environment	-1

Probability of the Impact

The certainty or probability of the impact describes the likelihood of the impact actually occurring.

RATING	DESCRIPTION	QUANTITATIVE RATING
Improbable	In all likelihood the impact will not occur	1
Low Probability	Possibility of the impacts to materialise is very low	2
Probable	A distinct possibility that the impact will occur	3
Highly Probable	Most likely that the impact will occur	4
Definite	The impact will occur regardless of any prevention measures	5

Duration of the Impact

The duration of the impact refers to the temporal scale of the impact or benefit, in terms of the period of time that the surrounding environment will be affected or altered by the proposed project. This is determined by the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Short term	0-5 years Less than the project lifespan	1
Medium term	5 – 10 years	2
Long term	Life of project 15 - 40 years	3
Permanent	Where the impact will be irreversible and will remain	4

Spatial Extent of the Impact

The extent of the impact refers to the spatial scale of the impact or benefit of the proposed project and the area over which it extends. A description is provided of whether effects are limited in extent or affects a wide area or group of people. The extent is rated according to the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Site Specific	Effects occur within the site / servitude boundary	1
Local	Effects extend beyond the site boundary Affects immediate surrounding areas	2
Regional	Widespread effect Extends far beyond the site boundary Effects felt within a 50 km radius of the surface lease area	3
National	Effects felt beyond the 50km radius	4

Intensity of the Impact

The severity or intensity of an impact is an attempt to quantify the magnitude of the impacts and benefits associated with the proposed project. The severity scale accounts for extent and magnitude, but is subject to the value judgement of the report writer. The following scale is useful in measuring severity and benefit.

RATING	DESCRIPTION	QUANTITATIVE RATING
Very severe	Substantial deterioration / improvement Irreversible or permanent Cannot be mitigated	4
Very Beneficial	Permanent improvement and benefit	4
Severe	Marked deterioration Long term duration Serious and severe impacts Mitigation is very expensive, difficult or time consuming	3
Beneficial	Large improvement Long term duration	3
Moderately Severe	Moderate deterioration Medium term to long term duration Fairly easily mitigated	2
Moderately Beneficial	Moderate improvement Medium to long term duration	2
Slight	Minor deterioration Short to medium term duration	1

RATING	DESCRIPTION	QUANTITATIVE RATING
	Mitigation is easy, cheap or quick	
Beneficial	Minor improvement Short to medium term duration	1

Frequency of the Impact

The frequency of the impact refers to the temporal scale of the impact or benefit, in terms of the period of time that the surrounding environment will be affected or altered by the proposed project. This is determined by the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Continuous	Daily	1
Frequent	Less than daily (hours)	0.8
Infrequent	Moderate frequency (weekly)	0.5
Occasional	Less than weekly (Once or twice per month)	0.2

Significance of the impact

After assessment of an impact in accordance to the preceding six criteria, the significance of an impact can be determined through a synthesis of the aspects produced in terms of their status, probability, duration, frequency, extent and severity. The significance of an impact is an expression of the cost or value of an impact to society. The focus of EIAs must be a judgement as to whether or not impacts are significant, based upon the value system of society, or groups of people (Thompson, 1988, 1990).
The significance of the impact is determined by the following formula:

(Status * Certainty/Probability + Duration + Extent + Intensity)* Frequency = Significance

The following totals were used to calculate the threshold "classes" to determine the significance of the impact.

RATING	DESCRIPTION	THRESHOLD OF SIGNIFICANCE (Negative)
High	Negative long term / permanent change to the social environment	13 – 18
Medium	Medium or long term effects to the social environment These effects are real and mitigation is possible, difficult and often costly	7 – 12.9
Low	Short term effects on the social environment Effects are not substantial and are often viewed as unimportant Mitigation is cheap, easy, quick or seldom required	0 – 6.9

Some of the impacts will prove to be positive and a benefit to the social environment. Should the nature of the activity, as assessed, be positive the significance threshold will be reversed and the impact will be a benefit to the holistic environment.

RATING	DESCRIPTION	THRESHOLD OF SIGNIFICANCE (Positive)
High	To the greater benefit of the social environment No mitigation or monitoring needed	13 – 18
Medium	A benefit to the holistic environment Monitoring is needed Some mitigation is needed	7 – 12.9
Low	No real benefits to the holistic environment Mitigation and monitoring is needed	0 – 6.9