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Environmental Noise and Vibration survey – Expansion of railway loops at Thabazimbi, Ferrogate and Northam Limpopo Province

Project No : 016/2017
Compiled by: B v/d Merwe
Date : 13 April 2017

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 **Nsovo Environmental Consulting** 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 **Basic assessment of sections of the railway lines at Thabazimbi, Ferrogate and Northam, .** 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:  ________________

Full Name: Barend Jacobus Barnardt van der Merwe

Date: 13 April 2017

Title / Position: Environmental noise and vibration specialist

Qualification(s):\ MSc Environmental Management

Experience (years/ months):14 years

Registration(s): SAAI, NACA and SAIOH

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 14 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, 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);

- South African Institute of Occupational Hygiene (SAIOH).

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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Executive summary

Introduction

The Thabazimbi railway line is an existing railway line and trains are using this line on a daily basis between mines to the north and the south. The noise and vibration survey is divided into three sections such as the Thabazimbi corridor, Ferrogate corridor and the Northam corridor. There will be no loading at any of these proposed railway loops as all the commodities moved by the trains is loaded at the mines at Ferrogate, Northam and Thabazimbi. No hauling of commodities will therefore take place along the existing road infra-structure. There are two private railway loops located at Ferrogate which can be used as loading sites but the mine will manage this if it is required. The private railway loops are not in use at this stage.
It is planned to increase the train movement along the Thabazimbi and Ferrogate sections from 27 trains per week to 58 trains per week and at the Northam section from 37 trains per week to 68 trains per week.

The study area covered the boundaries of the three study areas and the noise receptors. The residents of the farm houses in the vicinity of the proposed railway loops are already exposed to train activities and traffic noise because of the R510 road and the existing railway line between the north and the south. Domestic noise and natural noises such as insects, wind and animal noises is part of the prevailing environmental ambient noise level.

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

- There was a constant to intermittent flow of traffic along the R510 during the day and night time periods respectively;
- The train activities between Thabazimbi and Northam create an increased noise level on a finite basis when there are train movements;
- The wind and weather conditions play an important role in noise propagation;
- Distant traffic contributes to a large portion of the prevailing ambient noise levels in the vicinity of some of the noise receptors.

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

- Seasonal farm activity noise;
- Heavy duty vehicle noise;
- Distant traffic noise from the abutting gravel and feeder roads;

- Train noise;
- Domestic and central business associated noise in Northam;
- Distant mine activity noise in some areas;
- Insects;
- Birds;
- Wind noise.

Noise and Vibration 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, vibration or sound is part of our daily exposure to different sources which is part of daily living. Some of these physical attributes may at times be intrusive but people may get used to it without noticing the higher levels.

The noise intrusion levels during the Construction phase of the proposed project will be insignificant and will be restricted to the place of activity during the day time. The noise intrusion during the operational phase will be low and the proposed activities will not be more than 7.0dBA above the prevailing ambient noise level for it to be classified as a noise disturbance.

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

- The increase in the noise and vibration levels, and;
- The overall noise and vibration levels produced.

The proposed changes during the construction, operational and closure phases will require approved management measures and ongoing noise and ground vibration surveys will have to be carried out to ensure compliance to the relevant noise and vibration regulations and/or standards.

Conclusion and Recommendations

There will not be an increase in the prevailing ambient noise levels in the vicinity of the proposed railway loops for the additional activities to be classified as a noise disturbance in terms of the Noise Control Regulations (NCR,1994). The activities at the proposed railway loops will increase by less than 2.0dBA. The traffic noise from traffic along the R510 road already contributes to the higher noise level at some of the residential areas. The noise increase from the train activities take place on a finite type basis as the prevailing ambient noise level is maintained once the train moves away from the residential areas. The frequency will increase due to the bigger demand to move commodities along this corridor but this will not be on a continuous basis but on an intermittent basis.

The possible noise intrusion from train activities can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Noise Control Regulations, and the International Finance Corporation's Environmental Health and Safety Guidelines. The proposed noise and vibration management plan must be in place during the construction and operational phases so as to identify any noise increase on a pro-active basis and to address the alleged noise and vibration complaints accordingly.

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), other than fair remuneration for work performed in terms of the 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	Page 3
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Pages 3,4 and 5
b)	A declaration that the specialist is independent	Page 2
c)	An indication of the scope of, and the purpose for which, the report was prepared	Pages 15
d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Page 26
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	Page 21
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Page 28
g)	An identification of any areas to be avoided, including buffers	Not applicable
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	Page 14, 28
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Page 22
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	Page 45, 47
k)	Any mitigation measures for inclusion in the EMPr	Page 47
l)	Any conditions for inclusion in the environmental authorisation	Page 45
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Page 61
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	Page 63-65
(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	Page 48,49
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	Did not do as Transnet was in consultation with the parties
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Did not do as Transnet was in consultation with the parties
q)	Any other information requested by the competent authority	Not aware of any

1. Introduction

The Thabazimbi railway line is an existing railway line and trains are using this line on a daily basis between mines to the north and the south. The noise and vibration survey is divided into three sections such as the Thabazimbi corridor, Ferrogate corridor and the Northam corridor. There will be no loading at any of these proposed railway loops as all the commodities moved by the trains is loaded at the mines at Ferrogate, Northam and Thabazimbi. No hauling of commodities will therefore take place along the existing road infra-structure. There are two private railway loops located at Ferrogate which can be used as loading sites but the mine will manage this if it is required. The private railway loops are not in use at this stage. The current and future status of trains using this corridor is given in Table 1.1.

Table 1-1: Current and proposed use of the corridor

Physical Attributes	Current status	Proposed use of the corridor
Train length	100 wagons – 1 623.3m	200 wagons – 2 623.3m
Number of locomotives and wagons per coal train	100 wagons with 3 to 4 diesel locomotives per train	200 wagons with 3 to 4 diesel locomotives or 3 to 4 electric locomotives per train
Number of locomotives and wagons for other commodities	37 to 80 wagons with 3 to 4 diesel locomotives or 3 to 4 electric locomotives per train	37 to 80 wagons with 3 to 4 diesel locomotives or 3 to 4 electric locomotives per train
Total trains per week at Thabazimbi	27 trains per week	58 trains per week
Total trains per week at Ferrogate	27 trains per week	58 trains per week
Total trains per week at Northam	37 trains per week	68 trains per week
Train time table	Every 90 minutes in each direction	Every 60 minutes in each direction

The existing train corridor runs along the R510 road from Point B to C and from Point A to B through the Exxarro mine area

The noise and vibration study was carried out on 27 and 28 March 2017 at the three study areas respectively.

The location of the different mine areas and haul routes and the feeder road is illustrated in Figure 1-1.

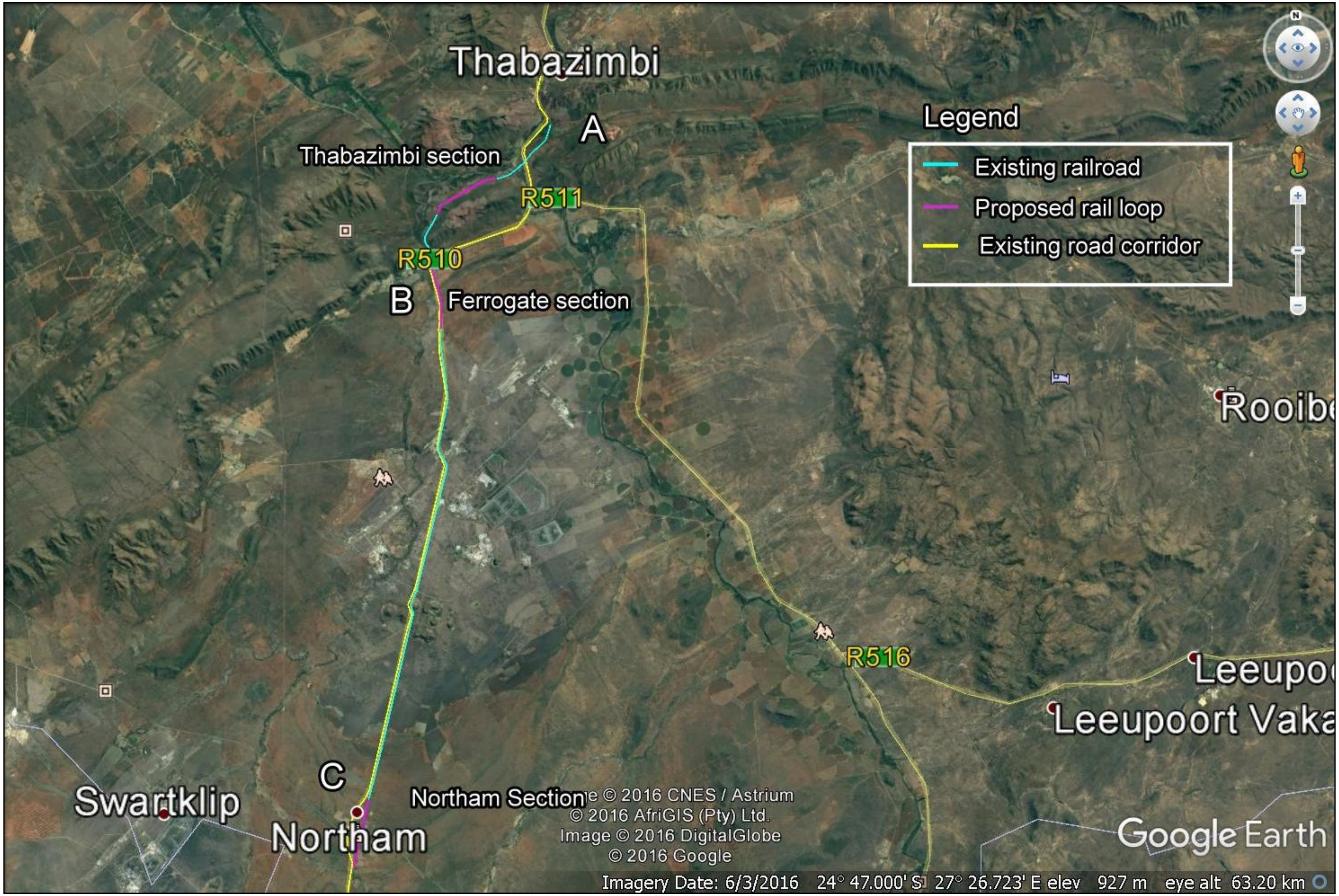


Figure 1-1: Location of project area

The proposed development entails the expansion of railway loops at the different sites to accommodate 200 wagon trains at a time. The expansion will consist out of the following:

- The development of two (2) railway loops of approximately 3.4km, crewing facilities, seven (7) culverts and associated infrastructure adjacent to the existing railway line at Thabazimbi;
- The expansion of the existing railway network of approximately three kilometre (3.75km) and five (5) culverts at Ferrogate; and
- The extension of the existing loop by approximately four kilometre (4km) and two (2) culverts at Northam.

The purpose of the noise and vibration study was:

- To determine the environmental baseline noise levels along the boundaries of the different rail road sections and in the vicinity of the noise receptors which is situated along the train corridor.

The baseline information will be used to calculate the possible intrusion levels at the noise receptor areas.

2. Background to environmental noise and vibration

2.1 Environmental noise and vibration

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 6.0dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3.0dB 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 95.0dBA. 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 mine 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, $L_{Req.d} = L_{Req.n} = 70$dBA 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 dBA 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: Estimated community/group response when the ambient noise level is exceeded

Excess	Estimated community/group response	
dB	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

Vibration may it be ground or air-borne vibration is the term used to describe oscillation, reciprocation or other periodic motion of a body forced from equilibrium. A low level of vibration is a normal feature of the environment and is not always perceptible to most people. It may become perceptible when there is a sound connected to the air-borne vibration or ground movement during ground vibration.

A vibration complaint in residential situations may often arise when the vibration magnitude are slightly greater than the perceptible levels. This may be caused by train and/or vehicular movement and may be perceived in close proximity of the rail and/or road. Because people are able to 'feel' very low levels of vibration, they often overestimate the risk of damage associated with vibration in buildings. This is especially true when the source of the vibration is outside the building, and not within their control. Conversely, people will often readily accept much higher levels of vibration from familiar sources such as wind, domestic appliances and people walking on floors and slamming doors. People are exposed to the following vibration levels on a daily basis.

Table 2-3: Vibration levels generated by normal day-to-day human activities (Source: Newmont, 2004)

Human Activity	**Vibration level – Peak Particle Velocity as mm/s**
Jumping	≤ 250
Heel drop	≤ 150
Nail hammering	≤ 100
Walking	≤ 40
Shutting door	≤ 30
Sliding door	≤ 10

The following ground vibration levels may elicit some response to people exposed to vibration activities.

Table 2-4: Human response to ground vibration and air blast levels (Source: Jones & Stocks, 2004)

Average Human Response	**Ground vibration –**	**Air blast - dB**
Barely to distinctly perceptible	0.05 – 2.54	50 - 70
Distinctly perceptible to strongly perceptible	2.54 – 12.7	70 - 90
Strongly perceptible to mildly pleasant	12.7 – 25.0	90 - 120
Mildly unpleasant to distinctly unpleasant	25.0 – 50.0	120 - 140
Distinctly unpleasant to intolerable	50.0 – 200.0	140 - 170

2.2 Vibration

There was no ground vibration levels measured during the time of the survey. Human reaction to vibration will be in response to the resulting effects of both ground and airborne vibration and in particular the combined effects of such vibration. Heavy-duty vehicles, trains and/or machinery can furthermore create ground vibration depending on the distance and ground type between the activity and the receptor.

Wavelength differences associated with this frequency range mean that any effects of topography are likely to be pronounced for the audible component of air over pressure levels rather than the concussive component. A topographic barrier i.e. an earthberm or rock face will play an important role in reducing the audible effect (over-air pressure levels) rather than the concussive effect. The shock waves have a relatively high dominant frequency and the energy contained in the shock wave will reduce rapidly as the resultant energy will be subjected to geometric and natural attenuation.

Meteorological conditions such as wind speed, direction, temperature, cloud cover and humidity will affect the intensity of the air over pressure levels perceived at a distance from the blasting area. The air over pressure levels at the source should be minimized in order for the energy to be within acceptable criteria at a distance. This could be achieved by proper blast design. In general, individual blasts should not exceed 25mm/s in the vicinity of properly constructed buildings and the average level should not exceed 10mm/s in the vicinity of poorly constructed buildings.

3. Study methodology

3.1 Instrumentation

The noise survey was conducted in terms of the provisions of SANS 10103 of 2008 (The measurement and rating of environmental noise with respect to annoyance and to speech communication). 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.

The instrument was calibrated before and after the noise readings were done and coincided within 1.0 dBA. Batteries were fully charged and a windshield was in use at all times. The calibration certificates are attached as Appendix A. The measured ambient noise level 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.

The following equation was used to calculate the noise level at the noise sensitive areas during the construction phase:

$$L_p = L_w - 20\log R - 7dB$$

Where, Lp is the sound level at a distance from the source in dBA;

Lw is the sound level at the source in dBA;

R is the distance from the source.

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

- Earthworks - 85.5dBA;
- Delivery of material - 80.5dBA;
- Civil construction – 85.0dBA;
- Earth drilling – 95.0dBA;
- TLB Activities - 80.0dBA;
- Foundations and pouring of concrete - 80.5dBA;

This above equation and the Interactive noise calculator (ISO 9613) will be used to determine the noise levels during the operational phase of the project. The noise levels at the noise receptors will be added in a logarithmic manner to determine the overall sound exposure at the receptor. The categorization of the intrusion levels during the construction and operational phases are as follows.

Table 3-1: Noise intrusion levels and how it is perceived

Different noise level increases	**How the noise increase is perceived**	**Colour code**
Sound level change of 1.0dB	Barely be detected by humans	
Change of 2.0dB to 3.0dBA	Barely noticeable	
Change of 5.0dB	Readily noticeable	
Change of 10.0dB	Perceived as a doubling in loudness	
Change of 20.0dB	Represents a dramatic change	

3.2 Uncertainties or gaps of the information

There were no environmental noise data available and a new plan of study was designed to obtain the relevant environmental noise levels at the boundaries of the study areas, feeder roads and at the abutting residential areas.

3.3 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 traffic noise, agricultural activities but exclude traffic noise which was intermittent in the vicinity of the measuring point. The measuring points are illustrated in Figure 3.1 (Thabazimbi section), Figure 3.2 (Ferrogate section) and Figure 3.3 (Northam section).

Figure 3.1 – Measuring points at Thabazimbi section

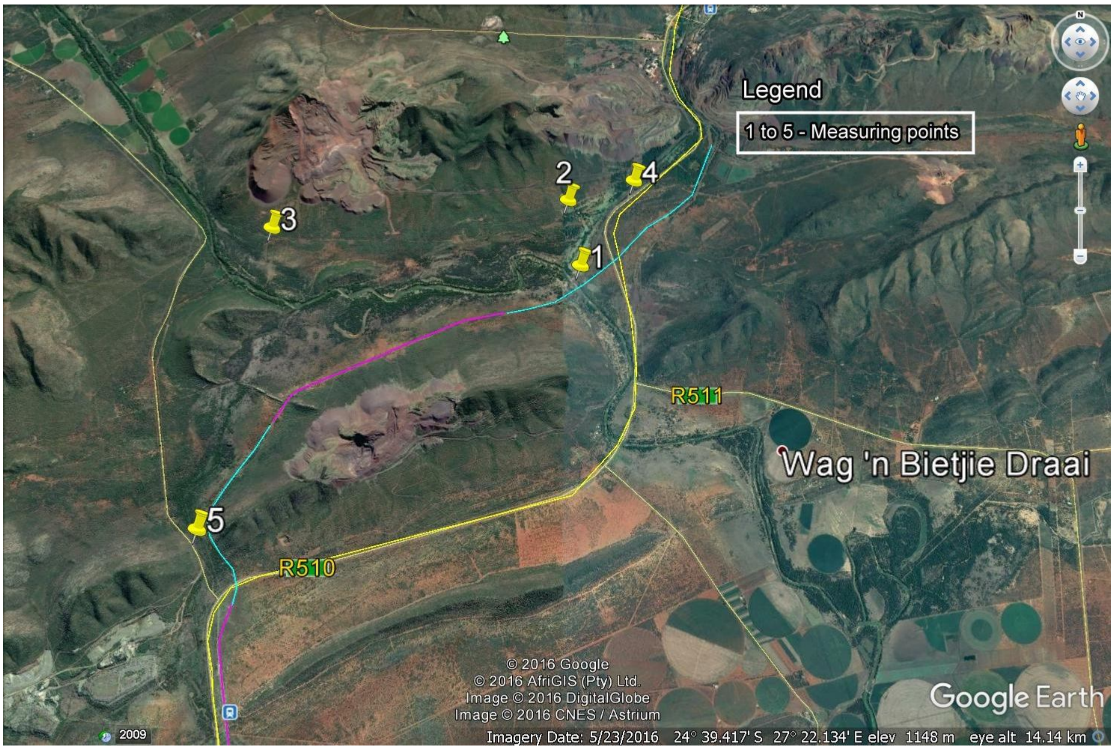


Figure 3.2 – Measuring points at Ferrogate section

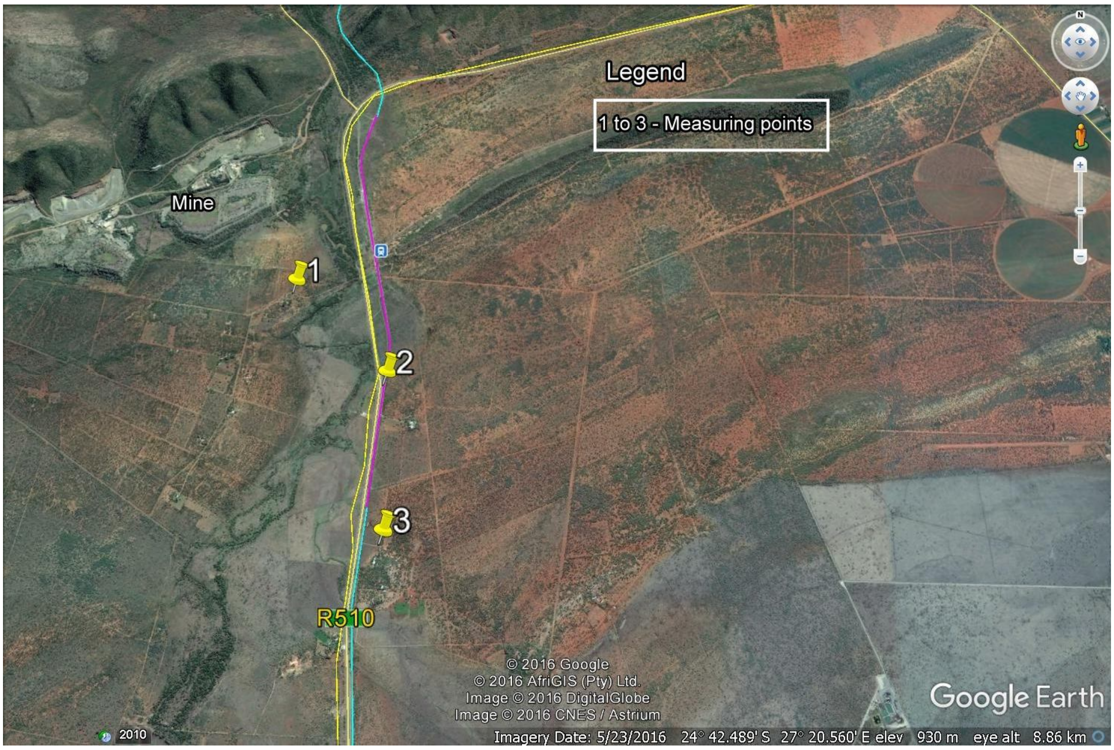
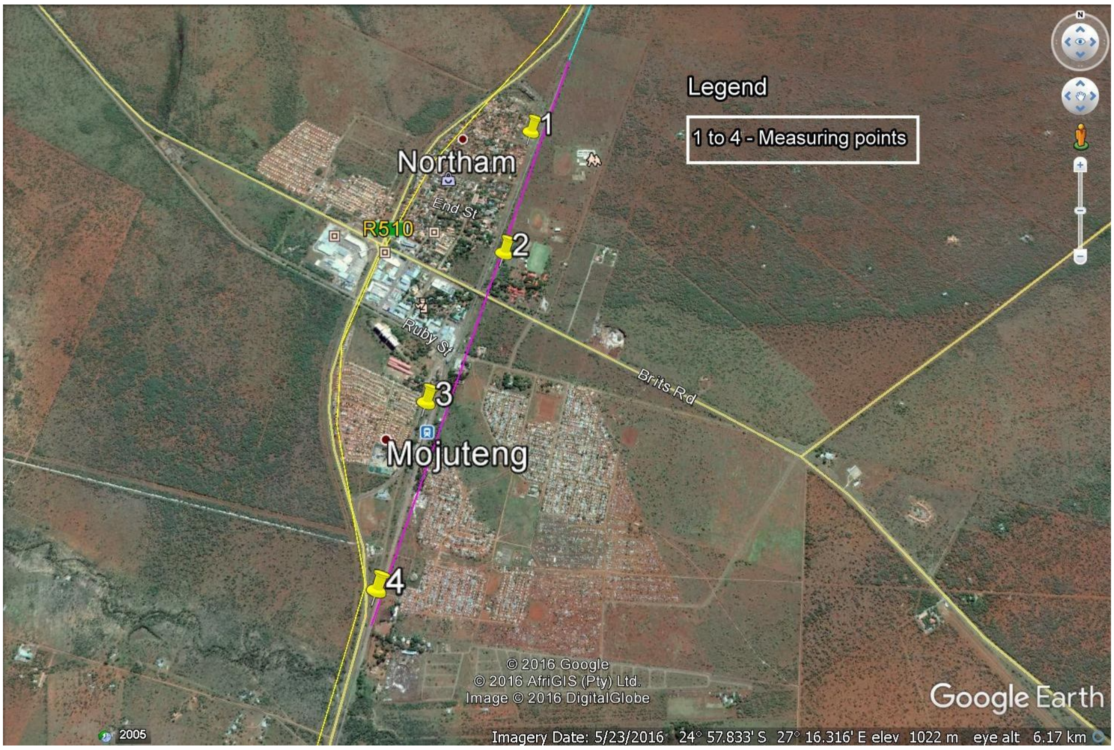


Figure 3-3: Measuring points at the opencast mine



The measuring points along the boundaries of the study area and the physical attributes of each measuring point are illustrated in Table 3.2. The co-ordinates are illustrated in degrees, decimal minutes.

Table 3-2: Measuring points and co-ordinates for the study area

Thabazimbi section			
Position	**Latitude**	**Longitude**	**Remarks**
1	24^0 38,584S	027^0 22,291E	MP 135m west of the railway line and 610m west from the R510. Distant traffic noise.
2	24^0 37,945S	027^0 22,153E	Guest house 1050m n/w from the railway line & 640m west of the R510. Distant traffic noise.
3	24^0 38,262S	027^0 19,553E	Railway line 2 346m from the railway line. Natural noises such as birds & insects.
4	24^0 37,834S	027^0 22,776E	60m from the R510 road. Traffic noise.
5	24^0 38,689S	027^0 19,180E	Railway line 230m from the gravel road. Distant traffic noise from mine and R510.
Ferrogate section			
Position	**Latitude**	**Longitude**	**Remarks**
1	24^0 42,082S	027^0 19,164E	Entrance to Piet Strydom, Rooidam. 630m to the R510 & 773m to the rail way line. Distant traffic noise.
2	24^0 42,540S	027^0 19,665E	20m from the road and 15m from the railway line. Traffic noise.
3	24^0 43,275S	027^0 19,689E	Farm of Hannes Nortje. 153m from the railway line and 188m from the R510.
Northam section			
Position	**Latitude**	**Longitude**	**Remarks**
1	24^0 57,012S	027^0 16,197E	Residential properties 31m from access road and 50m from the railway line. Traffic noise.
2	24^0 57,467S	027^0 16,108E	Road in school. 65m from the railway line and 85m from the access road. Traffic noise.
3	24^0 57,971S	027^0 15,861E	15m from road and 50m from the railway line. Distant traffic noise.
T **4**	24^0 58,530S	027^0 15,736E	Close to the R510 and railway line. Traffic noise.

The following is of relevance to the ambient noise measurements:

- The L_{Aeq} was measured over a representative sampling period in excess of 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.

3.4 Site Characteristics

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

- There was a constant to intermittent flow of traffic along the R510 Road;
- There was one train during the day and one train during the night time period.
- The wind and weather conditions play an important role in noise propagation;
- Distant traffic and agricultural noises contribute to a large portion of the prevailing ambient noise levels;
- Mine activities were audible in the vicinity of MP5 whereas traffic noise was audible at the majority of measuring points throughout the study area;
- There was no mine activities at the Thabazimbi Iron Ore mine and subsequently no noisy activities at the mine during the time of the noise survey except for the odd vehicle which entered the mine area;
- The traffic noise was perceived to be louder during the night time period due to the slight wind which was blowing.

3.5 Current noise sources

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

- Traffic noise from Hauling vehicles and motor-vehicles;
- Intermittent train activity noise;
- Central Business District noise;
- Domestic type noise;
- Seasonal agricultural type noise.

3.6 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:

27 March 2017

Daytime

- Wind speed – less than 1.8m/s;
- Temperature – 34.5°C – No strong temperature gradient occurred near the ground;
- Cloud cover – No clouds;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 20%.

Night time

- Wind speed – less than 1.5m/s;
- Temperature – 23.5°C ;
- Cloud cover – No cloud cover;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 20%.

28 March 2017

Daytime

- Wind speed – less than 1.7m/s;
- Temperature – 33.5°C – No strong temperature gradient occurred near the ground;
- Cloud cover – High cloud cover;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 20%.

The wind speed and wind direction will determine the propagation of the mine activity noises and how the residents will perceive the mine activity noises.

4. Regulatory and Legislative Requirements

There are specific regulatory and legislative requirements which regulate the proposed development in terms of environmental noise and vibration. 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 the noise control regulations is that a noise disturbance is created when the ambient noise level is exceeded by 7.0dBA.

4.2 South African National Standard – 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 Standard – SANS 10210 of 2004

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

4.4 South African National Standard – SANS 10328 of 2008

This national standard provides the methods for environmental noise impact assessments.

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.

4.5 United States Bureau of Mines – USBM (1980). Structure response and damage produced by ground vibration from surface mine blasting.

The recommended ground vibration levels should not exceed 10,0m/s for clay huts and 25.0mm/s for properly constructed buildings.

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.

It is widely recognized that many aspects of a change in the prevailing activities 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 (Garvin *et al*., 2009).

5. Description of the receiving environment

The prevailing ambient noise level was made up out of traffic, intermittent agricultural activities, insects, birds and mine activity noises. The residential properties in the vicinity of the different study areas are illustrated in Figure 5.1.

Figure 5-1: Residential properties

The distances between the different mine areas and the residential properties are given in Table 5.1. This is for direct line of sight and vertical structures such as trees, topography between the source and receptors were not taken into consideration.

Table 5-1 Distances between the train activities and the residential areas.

Residential areas	The distance between the identified residential properties and the R510 road and the proposed railway line/ loop is given in meters	
	R510 Road	Railway line/loop
A	460	926
B	355	2 089
C	446	2 248
D	110	1 170
E	690	810
F	1 307	1 335
G	305	275
H	175	132
I	285	260
J	30	50
K	243	210
L	131	50
M	30	125

6 Results of the noise survey

The noise survey was done during the day and the night time periods at the different measuring points throughout the study area.

6.1 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 agricultural, traffic noise, distant mine noise and natural noise sources. 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 study area.

Thabazimbi section								
Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**38.7**	63.5	28.3	Distant traffic noise.	**45.2**	61.3	38.0	Distant traffic noise & insects.
2	**37.7**	57.2	27.9	Distant traffic noise.	**40.8**	62.2	37.6	Distant traffic noise & insects.
3	**29.6**	52.7	21.7	Natural noises only.	**40.5**	64.7	34.5	Natural & insect noises.
4	**57.3**	73.3	30.6	Traffic noise.	**50.7**	61.5	36.8	Traffic & insect noises.
5	**36.1**	50.1	27.2	Distant mine activity noise.	**44.3**	58.2	42.3	Distant mine & insect noise.
Ferrogate section								
Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**35.6**	52.3	26.3	Distant traffic noise.	**38.5**	54.0	28.4	Distant traffic & insect noise.
2	**64.6**	76.9	41.6	Traffic noise.	**52.3**	74.6	26.2	Intermittent traffic & insect noise.
3	**45.6**	56.8	28.2	Distant traffic noise.	**47.6**	66.0	26.3	Distant traffic & insect noise.
Northam section								
Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**52.1**	67.1	44.1	Traffic noise.	**47.8**	57.5	44.3	Traffic & insect noises.
2	**42.9**	64.0	37.5	Distant traffic noise.	**44.2**	57.6	37.4	Distant traffic noise & insects.
3	**55.9**	76.5	41.4	Traffic noise.	**45.0**	63.9	36.9	Traffic & insect noises.
4	**58.4**	73.2	51.3	Traffic noise.	**55.7**	73.1	53.4	Traffic & insect noises.

The increase in the prevailing ambient noise level with the noise from the locomotives (first peak) and the wagon noise (second increased level from the wagons) is illustrated in Figure 6-1. This is a finite type noise as there is an increase from the locomotive and wagons after which the prevailing ambient noise level is maintained. This will occur each time a train passed a specific point within the study area. There will be no loading activities at the proposed loops and the increase of the prevailing ambient noise level will be from the train activities only. There will be a reduction of 3.0dB per doubling of distance from the train (Inverse square law). The average noise level over a period of 8 minutes was 76.0dBA with a maximum noise level of 98.0dBA. The noise reduction of the maximum noise level of 98.0dBA from the locomotives will be 35.0dBA over a distance of 200m.

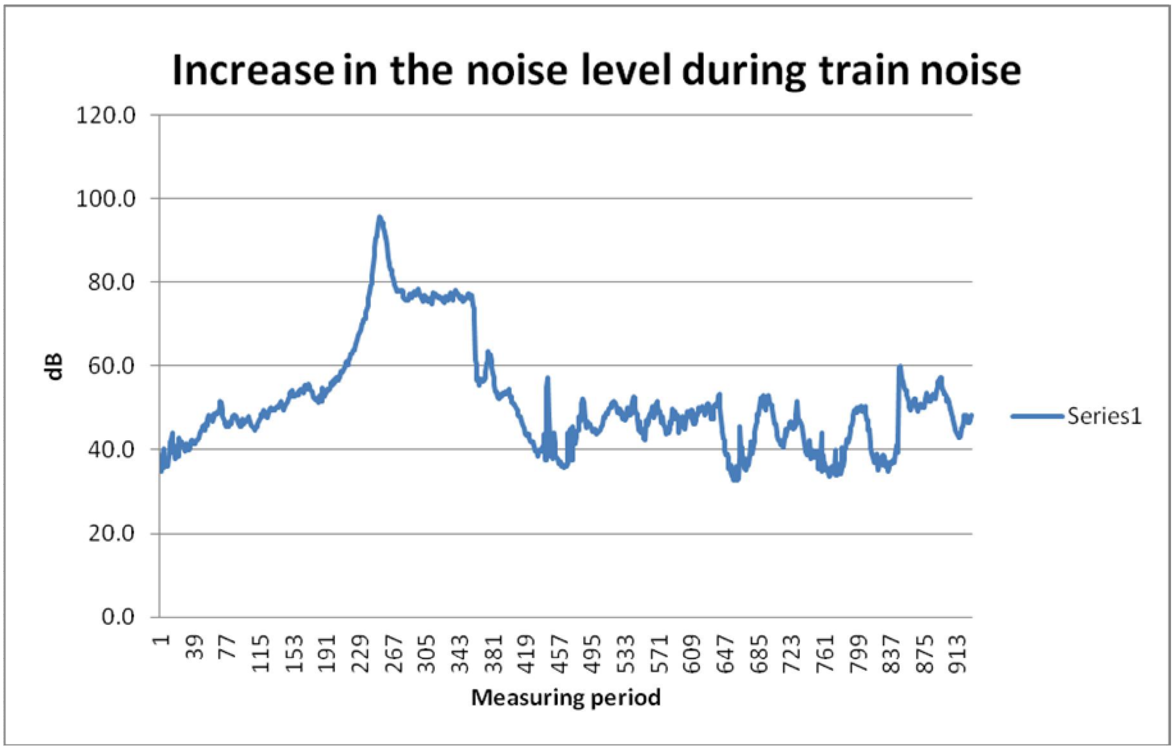


Figure 6-1: Increase in the prevailing ambient noise level

The following noise levels are from construction machinery which is used during the civil construction activities which will have to be done during the construction phase of the project.

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
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
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**

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 sensitive areas. 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 will seldom happen and the cumulative noise level will therefore be lower.

6.2 Noise impact at the different residential areas

The prevailing ambient noise levels throughout the study area differed and existing noise sources such as traffic noise contribute to the prevailing ambient noise level for a specific area. The distance from the road, which is the main contributor to the prevailing ambient noise level play a role on how the traffic noise will be perceived by the noise receptors. The distances between the two linear noise sources (R510 and the rail road) are given in Table 5.1.

6.3 Construction phase

The noise levels during the construction phase at the different residential areas are illustrated in Table 6.3. Construction activities will take place during daytime periods only and although that the night time noise intrusion levels are illustrated. The colour coding is done in terms of Table 3.1 on Page 18.

Table 6.3: Noise intrusion levels during the construction phase

Residential	Earthworks	Delivery of building material	Civil construction	Earth drilling	TLB activities - dBA	Foundations and pouring of concrete	Cumulative noise level - dBA	Prevailing ambient noise level during the day - dBA	Cumulative daytime noise level - dBA	Daytime noise intrusion - dBA	Prevailing ambient noise level during the night - dBA	Cumulative night time noise level - dBA	Night time noise intrusion - dBA
A	21.2	21.2	20.7	30.7	15.7	14.2	31.7	37.7	38.7	1.0	40.4	40.9	0.5
B	14.1	14.1	13.6	23.6	8.6	7.1	24.6	38.7	38.9	0.2	45.2	45.2	0.0
C	13.5	13.5	13.0	23.0	8.0	6.5	24.0	36.1	36.4	0.3	44.3	44.3	0.0
D	19.1	19.1	18.6	28.6	13.6	12.1	29.7	36.1	37.0	0.9	44.3	44.4	0.1
E	22.3	22.3	21.8	31.8	16.8	15.3	32.9	35.6	37.5	1.9	38.5	39.5	1.0
F	18.0	18.0	17.5	27.5	12.5	11.0	28.5	35.6	36.4	0.8	38.5	38.9	0.4
G	31.7	31.7	31.2	41.2	26.2	24.7	42.2	45.6	47.2	1.6	47.6	48.7	1.1
H	38.1	38.1	37.6	47.6	32.6	31.1	48.6	45.6	50.4	4.8	47.6	51.1	3.5
I	32.2	32.2	31.7	41.7	26.7	25.2	42.7	42.9	45.8	2.9	44.2	46.5	2.3
J	46.5	46.5	46.0	56.0	41.0	39.5	57.0	52.1	58.3	6.2	47.8	57.5	9.7
K	34.1	34.1	33.6	43.6	28.6	27.1	44.6	42.9	46.8	3.9	44.2	47.4	3.2
L	46.5	46.5	46.0	56.0	41.0	39.5	57.0	55.9	59.5	3.6	45.0	57.3	12.3
M	38.6	38.6	38.1	48.1	33.1	31.6	49.1	55.9	56.7	0.8	45.0	50.5	5.5

6.4 Operational phase

The noise levels, which will be generated by the different train activities during the by-pass and stationary at the proposed loops, will be determined by using the ISO 9613 – Interactive noise calculator method. SANS 10210 of 2004 will be used to calculate the increase in the traffic noise during the construction phase.

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

- Train noise during by-pass – 76.0dBA;
- Train stop over at loops – 90.0dBA;
- Maintenance – 85.0dBA.

The noise intrusion levels are categorized according to how the increase in sound is perceived by people in Table 6.10 as given as follows:

Table 6-10: Categorization of how sound is perceived

Different noise level increases	**How the noise increase is perceived**	**Colour code**
Sound level change of 1.0dB	Barely be detected by humans	
Change of 2.0dB to 3.0dBA	Barely noticeable	
Change of 5.0dB	Readily noticeable	
Change of 10.0dB	Perceived as a doubling in loudness	
Change of 20.0dB	Represents a dramatic change	

The noise intrusion at each of the noise receptors during the operational phase before the proposed changes were made and after the proposed changes will be completed are based on the noise levels of the different activities is given in Table 6.11 (existing) and after the proposed changes in Table 6.12.

Table 6-11: Noise intrusion at the noise receptors during train activities before the proposed project

Residential property	Train in motion	Maintenance	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	49.3	15.7	**49.3**	37.7	40.4	**11.6**	**8.9**
B	45.8	8.6	**45.8**	38.7	45.2	**7.1**	**0.6**
C	45.5	8.0	**45.5**	36.1	44.3	**9.4**	**1.2**
D	48.3	13.6	**48.3**	36.1	44.3	**12.2**	**4.0**
E	49.9	16.8	**49.9**	35.6	38.5	**14.3**	**11.4**
F	47.8	12.5	**47.8**	35.6	38.5	**12.2**	**9.3**
G	54.6	26.2	**54.6**	45.6	47.6	**9.0**	**7.0**
H	57.8	32.6	**57.8**	45.6	47.6	**12.2**	**10.2**
I	54.9	26.7	**54.9**	42.9	44.2	**12.0**	**10.7**
J	62.0	41.0	**62.1**	52.1	47.8	**10.0**	**14.3**
K	55.8	28.6	**55.8**	42.9	44.2	**12.9**	**11.6**
L	62.0	41.0	**62.1**	55.9	45.0	**6.2**	**17.1**
M	58.0	33.1	**58.1**	55.9	45.0	**2.2**	**13.1**

Table 6-12: Noise intrusion at the noise receptors during train activities after completion of the project

Residential property	Train in motion	Train in stop over	Maintenance	Cumulative Levels	Noise level - Daytime	Noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	49.3	21.2	15.7	**49.4**	37.7	40.4	**11.7**	**9.0**
B	45.8	14.1	8.6	**45.8**	38.7	45.2	**7.1**	**0.6**
C	45.5	13.5	8.0	**45.5**	36.1	44.3	**9.4**	**1.2**
D	48.3	19.1	13.6	**48.3**	36.1	44.3	**12.2**	**4.0**
E	49.9	22.3	16.8	**49.9**	35.6	38.5	**14.3**	**11.4**
F	47.8	18.0	12.5	**47.8**	35.6	38.5	**12.2**	**9.3**
G	54.6	31.7	26.2	**54.6**	45.6	47.6	**9.0**	**7.0**
H	57.8	38.1	32.6	**57.9**	45.6	47.6	**12.3**	**10.3**
I	54.9	32.2	26.7	**54.9**	42.9	44.2	**12.0**	**10.7**
J	62.0	46.5	41.0	**62.2**	52.1	47.8	**10.1**	**14.4**
K	55.8	34.1	28.6	**55.8**	42.9	44.2	**12.9**	**11.6**
L	62.0	46.5	41.0	**62.2**	55.9	45.0	**6.3**	**17.2**
M	58.0	38.6	33.1	**58.1**	55.9	45.0	**2.2**	**13.1**

The calculations to determine the noise level from the additional traffic during the construction phase of the proposed project 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 4 will be heavy-duty vehicles and 4 will be motor-vehicles.

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.

Primary corrections to the basic model:

- 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.

Propagation:

- 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 **46.5dBA** during the construction phase

6.5 Wind direction

There was no information available on the wind direction and the wind speed.

7. 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 for a period of 10-minutes or more. Noise however becomes audible when the prevailing ambient noise level is exceeded by 5.0dBA. It will therefore be more environmentally sustainable for the proposed project that the latter benchmark be used. The increased noise levels are for the duration of the train activities within the vicinity of the noise receptors.

There will be a difference between the summer and winter periods as the insect activities such as crickets raise the prevailing ambient noise level during the summer whereas the prevailing ambient noise level during the winter will be lower. This was only a summer period noise survey and the winter period cannot be accounted for. The wind direction, other noises (e.g. traffic noise) distances and topography between the different railway loops will play a role in the noise propagation and how the residents will perceive the train activity sound. The topography between the residential areas and the different proposed railway loops differ.

8. Impact Identification and Assessment

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 8.1. These are the average noise levels in the workplace and at home that will mask noise from a source introduced into an area:

Table 8-1: 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

Two aspects are important when considering potential noise impacts of a project and it is:

- The increase in the noise level, and;
- The overall noise level produced.

Pre-construction and construction phase

There will be no pre-construction phase as this is an existing railway line with trains which use the railway line daily.

The machinery that will be used during the construction phase of the project will be excavators, dozers, graders, earth-moving equipment, cranes, dump trucks, generators and Tractor, Loader, Backhoe (TLB) etc., which will work at specific areas at times and the noise levels are illustrated in Table 6.2. The following activities will generate noise during the construction phase of the project:

- Earthworks;
- Delivery of building material;
- Civil construction activities;
- Earth drilling;

- TLB activities;
- Foundations and pouring of concrete.

Operational phase

The noise sources within the project area that may create increased noise levels on a temporary and/or permanent basis during the operational phase of the project:

- Trains in motion;
- Trains stationary at the stop overs;
- Maintenance activities at the different sites.

Closure phase

- Back fill of railway corridor, removal of rails and stones;
- Planting of grass and vegetation at the rehabilitated area;
- Removal of infra-structure.

8.1 Environmental impact assessment

The different components of the proposed changes to the railway lines will be assessed by using the following impact assessment methodology as illustrated in Table 8.1 (risk rating) and Table 9.3 (scoring of the risks).

Table 8-2: Risk Rating

Evaluation Component	Rating Scale and Description/criteria
MAGNITUDE of negative impact (at the indicated spatial scale)	**10 - Very high**: Bio-physical and/or social functions and/or processes might be *severely* altered. **8 - High**: Bio-physical and/or social functions and/or processes might be *considerably* altered. **6 - Medium**: Bio-physical and/or social functions and/or processes might be *notably* altered. **4 - Low** : Bio-physical and/or social functions and/or processes might be *slightly* altered. **2 - Very Low**: Bio-physical and/or social functions and/or processes might be *negligibly* altered. **0 - Zero**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
MAGNITUDE of POSITIVE IMPACT (at the indicated spatial scale)	**10 - Very high (positive)**: Bio-physical and/or social functions and/or processes might be *substantially* enhanced. **8 - High (positive)**: Bio-physical and/or social functions and/or processes might be *considerably* enhanced. **6 - Medium (positive)**: Bio-physical and/or social functions and/or processes might be *notably* enhanced. **4 - Low (positive)**: Bio-physical and/or social functions and/or processes might be *slightly* enhanced. **2 - Very Low (positive)**: Bio-physical and/or social functions and/or processes might be *negligibly* enhanced. **0 - Zero (positive)**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
DURATION	**5 - Permanent** **4 - Long term**: Impact ceases after operational phase/life of the activity > 60 years. **3 - Medium term**: Impact might occur during the operational phase/life of the activity – 60 years. **2 - Short term**: Impact might occur during the construction phase - < 3 years. **1 - Immediate**
EXTENT (or spatial scale/influence of impact)	**5 - International**: Beyond National boundaries. **4 - National**: Beyond Provincial boundaries and within National boundaries. **3 - Regional**: Beyond 5 km of the proposed development and within Provincial boundaries. **2 - Local**: Within 5 km of the proposed development. **1 - Site-specific**: On site or within 100 m of the site boundary. **0** - None
IRREPLACEABLE loss of resources	**5 – Definite** loss of irreplaceable resources. **4 – High** potential for loss of irreplaceable resources. **3 – Moderate** potential for loss of irreplaceable resources. **2 – Low** potential for loss of irreplaceable resources. **1 – Very low** potential for loss of irreplaceable resources. **0 - None**
REVERSIBILITY of impact	**5 –** Impact **cannot** be reversed. **4 – Low** potential that impact might be reversed. **3 – Moderate** potential that impact might be reversed. **2 – High** potential that impact might be reversed. **1 –** Impact **will be** reversible. **0 –** No impact.
PROBABILITY (of occurrence)	**5 - Definite:** >95% chance of the potential impact occurring. **4 - High probability:** 75% - 95% chance of the potential impact occurring. **3 - Medium probability:** 25% - 75% chance of the potential impact occurring **2 - Low probability:** 5% - 25% chance of the potential impact occurring. **1 - Improbable:** <5% chance of the potential impact occurring.
Evaluation Component	**Rating Scale and Description/criteria**
CUMULATIVE impacts	**High**: The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. ***Medium:*** The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. ***Low:*** The activity is localised and might have a negligible cumulative impact. ***None:*** No cumulative impact on the environment.

The Significance Score of each potential environmental impact is calculated by using the following formula:

- SS (Significance Score) = (magnitude + duration + extent + irreplaceable + reversibility) x probability. The maximum Significance Score value is 150.

The Significance Score is then used to rate the Environmental Significance of each potential environmental impact as per Table 8.3 below. The Environmental Significance rating process is completed for all identified potential environmental impacts both before and after implementation of the recommended mitigation measures.

Table 8-3: Significance score categorization

Significance Score	Environmental Significance	Description/criteria
125 – 150	Very high (VH)	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options.
100 – 124	High (H)	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options.
75 – 99	Medium-high (MH)	If left unmanaged, an impact of medium-high significance could influence a decision about whether or not to proceed with a proposed project. Mitigation options should be relooked.
40 – 74	Medium (M)	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project.
<40	Low (L)	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.
+	Positive impact (+)	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project.

8.2 Impact assessment for the construction phase

The following activities are associated with the construction phase of the project:

- Earthworks;
- Delivery of building material;
- Civil construction activities;
- Earth drilling;
- TLB activities;
- Foundations and pouring of concrete.

Table 8-4: Earthworks

Activity	***Earthworks***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	2	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							

After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	2	2	2	2	2	+	Low

Table 8-5: Delivery of building material

Activity	***Delivery of building material***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	2	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	2	2	2	2	2	+	Low

Table 8-6: Civil construction activities

Activity	***Civil construction activities***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	2	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	2	2	2	2	2	+	Low

Table 8-7: Earth drilling

Activity	***Earth drilling***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	2	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	2	2	2	2	2	+	Low

Table 8-8: TLB activities

Activity	TLB activities							
Project phase	Construction phase							
Impact Summary	Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.							
Potential Impact Rating	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	+/-	Scoring
	6	2	2	3	3	3	+	Medium
Management Measures	Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							
After Management Impact Rating	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	+/-	Scoring
	4	2	2	2	2	2	+	Low

Table 8-9: Foundations and pouring of concrete

Activity	Foundations and pouring of concrete							
Project phase	Construction phase							
Impact Summary	Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.							
Potential Impact Rating	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	+/-	Scoring
	6	2	2	3	3	3	+	Medium
Management Measures	Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.							
	Environmental noise survey to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam footprint areas where construction will take place. Residential properties B, C, D and F excluded.							
After Management Impact Rating	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	+/-	Scoring
	4	2	2	2	2	2	+	Low

8.1.2 Impact assessment for the operational phase

The following activities are associated with the operational phase of the project:

- Trains in motion;
- Trains stationary at the stop overs;
- Maintenance activities at the different sites.

The impact rating during the different stages of the operational phase of the project is as follows:

Table 8-10: Trains in motion

Activity	Trains in motion							
Project phase	Operational phase							
Impact Summary	Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.							
Potential Impact Rating	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	+/-	Scoring
	6	3	2	3	3	3	+	Medium
Management Measures	Earthberm to be constructed at along the railway corridor at the railway loops in the vicinity of residential areas J & L. Annual environmental noise survey to be carried out at the residential areas excluding residential areas B, C, D and F and at the foot print boundary of the railway loops.							

After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	2	2	+	Low

Table 8-11: Trains stationary at the stop overs

Activity	***Trains stationary at the stop overs***							
Project phase	*Operational phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	3	3	+	Medium
Management Measures	*Earthberm to be constructed at along the railway corridor at the railway loops in the vicinity of residential areas J & L.* *Annual environmental noise survey to be carried out at the residential areas excluding residential areas B, C, D and F and at the foot print boundary of the railway loops.*							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	2	2	+	Low

Table 8-12: Maintenance activities at the different sites

Activity	***Maintenance activities at the different sites***							
Project phase	*Operational phase*							
Impact Summary	*Noise increase at the boundary of the abutting residential areas excluding residential areas B, C, D and F.*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	3	3	+	Medium
Management Measures	*Noise control measures must be in place to ensure that the prevailing ambient noise level is not exceeded by more than 7.0dBA during the maintenance activities.*							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	2	2	+	Low

8.1.3 Impact assessment for the closure phase

The following activities are associated with the closure phase:

- Back fill of the railway corridor, removal of rail road and stones;
- Planting of grass and vegetation at the rehabilitated areas;
- Removal of infra-structure.

The impact rating during the different stages of the closure phase of the project is as follows:

Table 8-13: Back fill of the railway corridor, removal of rail road and stones

Activity	***Back fill of the railway corridor, removal of rail road and stones***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the railway loops footprint and at the abutting residential areas*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	3	2	2	2	2	+	Low

Table 8-14: Planting of grass and vegetation at rehabilitated areas

Activity	***Planting of grass and vegetation at rehabilitated areas***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the railway loops footprint and at the abutting residential areas*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	3	2	2	2	2	+	Low

Table 8-15: Removal of infra-structure

Activity	***Removal of infra-structure***							
Project phase	*Construction phase*							
Impact Summary	*Noise increase at the railway loops footprint and at the abutting residential areas*							
Potential Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	6	3	2	3	3	3	+	Medium
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*							
After Management Impact Rating	***Magnitude***	***Duration***	***Extent***	***Irreplaceable***	***Reversibility***	***Probability***	***+/-***	***Scoring***
	4	3	2	2	2	2	+	Low

9. 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.

9.1 Acoustic screening recommendations

The acoustic screening measures for the project are given in Table 9.1. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 9-1: Recommended acoustic screening measures

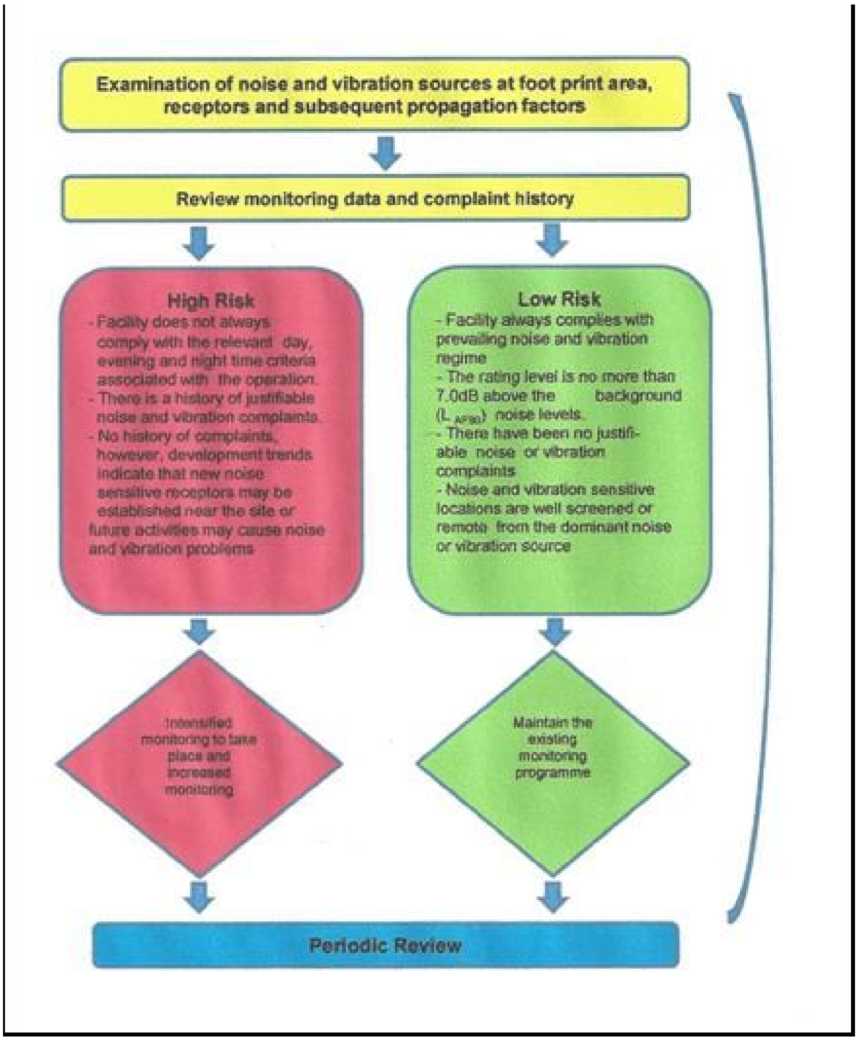
Activity	Recommendations
Construction phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Construction activities to take place during daytime period only. • Environmental noise surveys to be done on a quarterly basis at the Thabazimbi, Ferrogate and Northam construction foot print areas. Residential areas B, C, D and F will be excluded.
Operational phase	• Emergency generators to be placed in such a manner that it is away from any residential areas. • Noise monitoring to be done along the railway loops footprint and at the residential area in the vicinity of the railway loops at Thabazimbi, Ferrogate and Northam on an annual basis. • Earthberms between the residential areas (J & L) and the railway loops to ensure that the train activities are screened adequately so that there is not an increase of more than 7.0dBA at the abutting residential area. • Actively manage the process and the noise management plan must be used to ensure compliance to the noise regulations and/or standards. The 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 90.0dBA to be done during daytime only. • Noise monitoring on a quarterly basis.

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:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment causing radiating noise;
- Installing vibration isolation for mechanical equipment;
- Re-locate noise sources to areas which are less noise sensitive, to take advantage of distance and natural shielding;
- Taking advantage during the design stage of natural topography as a noise buffer;
- Develop a mechanism to record and respond to complaints.

The following noise management plan as illustrated in Figure 10.1 must be used to identify any new noise sources which may have an impact on the abutting noise sensitive areas.

Figure 9-1: Noise management plan



10. Conclusion

There will not be an increase in the prevailing ambient noise levels in the vicinity of the proposed railway loops for the additional activities to be classified as a noise disturbance in terms of the Noise Control Regulations. This is illustrated in Tables 6.12 and 6.13 where the activities at the proposed railway loops will increase by less than 2.0dBA. The traffic noise from traffic along the R510 road already contributes to the higher noise level at some of the residential areas. The noise increase from the train activities take place on a finite type basis as the prevailing ambient noise level is maintained once the train moves away from the residential areas. The frequency will increase due to the bigger demand to move commodities along this corridor but this will not be on a continuous basis but on an intermittent basis. The train movement along this line was 4 to 5 trains per day and it is envisaged to increase it to 8 to 9 trains per day.

The noise impact during the construction phase, which will take place during daytime periods only, will be insignificant. The noise regime will change during the operational phase in the vicinity of the railway loops and abutting residential areas but not more than 5.0dBA where the difference will be observed by the residents in the vicinity of the rail railway loops/railway line as there is already train activities along this train corridor.

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

The basic elements of the Environmental Management System will be to:

- List the potential environmental impacts;
- Set of operational procedures for monitoring, controlling and reducing impacts;
- Recording the results and respond to complaints timeously;
- Procedure for internal environmental noise and/or vibration audits.

The Environmental Management Plan (EMP) for the proposed railway loops will consist of the following as illustrated in Table 10.1. Regular environmental monitoring (ground vibration and airborne noise propagation) will provide the data for reviewing, checking and revising the Environmental Management plan (EMP).

Table 10-1: Noise and vibration environmental management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated noise levels will be adhered to at all times.	Annual	The engineer during the construction phase and the responsible person (Transnet/ Environmental Department) during the operational phase of the project
Monitoring objective	Measure the environmental noise levels during the construction phase of the project to ensure compliance to the recommended noise.	Quarterly basis after which the frequency of monitoring may change to an annual basis	Transnet/ Environmental Department.
Monitoring technology	The environmental noise monitoring must take place with a calibrated Class 1 noise monitoring equipment.	Quarterly basis during the construction phase and a quarterly basis during the operational phase for the first year thereafter on an annual basis or as required.	Transnet/ Environmental Department.
Specify how the collected information will be used	The data must be collated and discussed on a quarterly basis during the construction phase and on a quarterly basis to annual basis during the operational phase for the first year thereafter on an annual basis.	Quarterly basis during the construction phase and a quarterly basis during the operational phase for the first year thereafter on an annual basis or as required.	Transnet/ Environmental Department.
Spatial boundaries	At the boundaries of the residential areas in the vicinity of the railway loops at Thabazimbi, Ferrogate and Northam respectively.	Quarterly basis during the construction phase and a quarterly basis during the operational phase for the first year 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 and vibration levels.	Quarterly basis during the construction phase and a quarterly basis during the operational phase for the first year 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 SANS 10103 of 2008 with calibrated equipment.	Calibrated equipment which complies with the recommendations of SANS 10103 of 2008 must be used at all times.	Environmental noise and vibration specialist

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

11. List of Definitions and Abbreviations

11.1 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

11.2 Abbreviations

dBA – A-weighted sound pressure level;

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	2016-1602
ORGANISATION	dB ACOUSTICS
ORGANISATION ADDRESS	P.O. BOX 1219, ALLENSNEK, 1737
CALIBRATION OF	INTEGRATING SOUND LEVEL METER, ½" MICROPHONE and built-in ⅓-OCTAVE/OCTAVE FILTER
MANUFACTURERS	LARSON.DAVIS and PCB
MODEL NUMBERS	831 and 377 B02
SERIAL NUMBERS	0001072 and 102184
DATE OF CALIBRATION	18 AUGUST 2016
RECOMMENDED DUE DATE	AUGUST 2017
PAGE NUMBER	PAGE 1 OF 4

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

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

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Calibrated by:	Authorized/Checked by:	Date of Issue:
C. DE CLERCQ (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	22 AUGUST 2016

Director: Marianka Naudé