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Transnet SOC

NOISE STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Proposed Postmasburg Housing Development, Northern Cape

Study done for:

Savannah ENVIRONMENTAL (PTY) LTD

Prepared by:

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EXECUTIVE SUMMARY

Enviro-Acoustic Research (EARES) was contracted by Savannah Environmental (Pty) Ltd to determine the existing noise environment in which the proposed Transnet Housing development is planned. The development is proposed by Transnet SOC Limited (Transnet).

The project is the result of a significant demand for housing in Postmasburg due to industrial and mining development. Transnet proposes to rezone and develop land belonging to Transnet into residential units. Most of this land is currently undeveloped.

A noise assessment was done as required by the National Noise Control Regulations which states that (Clause 3a):
"No person shall establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences";

This assessment therefore investigates the existing and future acoustical environment in the vicinity of the proposed Transnet Housing Development in Postmasburg. The main existing noise sources are the R325 and R385 roads as well as the railway facility.

Acoustical measurements and a site investigation indicated a rating level (acceptable zone sound level or rating level) conforming to an Urban District as defined in SANS 10103:2008 (55 and 45 dBA day/night-time Rating).

Calculations were done in accordance with the sound propagation model described by British CRTN (Road Traffic Noise) and CRN (Railway Noise). Road traffic calculations were checked using the SANS 10210:2004 model. This assessment considered an observed scenario, the existing peak hour (worst case) scenario, the projected future peak hour (worst case) as well as a future likely scenario (with some mitigation measures implemented).

This assessment indicates a sound environment at the proposed housing development where rating levels would exceed the daytime zone sound levels during peak traffic periods as well as the night-time zone sound level for all the scenarios evaluated.

Title:

Noise Study for Environmental Impact Assessment: Proposed Postmasburg Housing Development, Northern Cape

Client:

Savannah Environmental (Pty) Ltd on behalf of
Transnet SOC

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GLOSSARY OF ABBREVIATIONS

AZSL	Acceptable Zone Sound Level (Rating Level)
DEADP	Department of Environmental Affairs and Development Planning
DEDEA	Department of Economic Development and Environmental Affairs
DEA	Department of Environmental Affairs
EARES	Enviro-Acoustic Research cc
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act (Act 78 of 1989)
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
FEL	Front End Loader
IAPs	Interested and Affected Parties
i.e.	that is
IEM	Integrated Environmental Management
km	kilometres
LHD	Load haul dumper
m	Meters (measurement of distance)
m^2	Square meter
m^3	Cubic meter
mamsl	Meters above mean sea level
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
NGO	Non-government Organisation
PPE	Personal Protective Equipment
PPP	Public Participation Process
SABS	South African Bureau of Standards
SANS	South African National Standards
SHEQ	Safety Health Environment and Quality
TLB	Tip Load Bucket
UTM	Universal Transverse Mercator
WHO	World Health Organisation

1 INTRODUCTION

1.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research (EARES) was contracted by Savannah Environmental (Pty) Ltd (the main consultant) to conduct a Noise Impact Assessment (NIA) for Transnet's proposed Housing development project in Postmasburg. The site is located within the town of Postmasburg in the Northern Cape.

1.2 BRIEF PROJECT DESCRIPTION

There currently exists a significant demand for housing in Postmasburg due to industrial and mining development pressure in the region. Transnet proposes to rezone and develop land belonging to Transnet into residential units/ houses. Most of this land is currently undeveloped.

The noise impact assessment is conducted as Regulation 3(a) of Government Notice R154 of 1992 prohibits the establishment of a new township unless the layout plan considered the existing and future sources of noise (refer **section 2.2.1**). It is not done to assess the potential noise impact from the housing development on the surrounding receptors, as the potential noise impact would be of a low significance during both the construction and operational phases of this development. Because there are no new noise sources that will be introduced, no Environmental (noise) Management Plan will be required. Mitigation discussed in this report is optional for the developer.

1.3 STUDY AREA

The development is proposed on undeveloped land just south of the Transnet Freight Rail (TFR) Postmasburg Station in the Northern Cape. A site locality map is presented in **Figure 1-1** with the boundary of the proposed development illustrated as a **red** line. The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

1.3.1 Topography

The study area is recognised by relatively flat plains. There are little local topographical features that limit the propagation of noise.

1.3.2 Surrounding Land Use

The surrounding land use is residential (east and north-east) and industrial (south-west and north to north-west). The industrial areas to the south-west is mainly light industrial (servicing of equipment, plant and equipment hire) with the Transnet Postmasburg railway line and station forming the northern border.

1.3.3 Roads

The R325 and R385 carry most of the traffic in the area with the other roads carry insignificant numbers (in terms of noise). Excluding the single events from the railway line, ambient sound levels are significantly affected from traffic on the R385 and R325. The roads are indicated as **magenta** lines in **Figure 1-2**.

While noise levels will increase during single events (when cars use these smaller roads) the site assessment indicated that this traffic is significantly less than the traffic on the R325 and R385 roads and not of acoustic significance. They will not be considered in the noise impact assessment. A Traffic Impact Statement was conducted by Aurecon South Africa and this report will consider the peak traffic counts as received from the traffic engineer.

1.3.4 Residential areas

The development is bordered by residential dwellings located in the town of Postmasburg.

1.3.5 Other industrial activities

There are two distinctive industrial areas within the study area, namely the Transnet railway facility north to north-west as well as a light industrial/commercial area south-east from the proposed development. The site assessment indicated that the light industrial area does not contribute significant noise to the study area with most of the activities relating to services and equipment/plant hire. Ambient sound levels at the Transnet railway facility is generally low but is significantly influenced during periods when trains pass through the facility as well as during shunting operations. The railway lines are indicated as **magenta** lines in **Figure 1-2**.

A Front-End-Loader (FEL) was active during the site visit loading aggregate onto the rail wagons. A resident indicated that the FEL is mainly active during the day but it may operate in the evening at times. This FEL will not be considered in this report because, while audible was not considered a significant noise in the surrounding soundscape.

1.3.6 Ground conditions and vegetation

The surrounding area falls within the Savannah biome but is significantly altered due to urban development. Ground conditions will not be considered in this assessment.

Figure 1-1: Site map indicating the location of the proposed housing development

Figure 1-2: Study area indicating significant noise sources as identified

1.4 TERMS OF REFERENCE

SANS 10328:2008 (Edition 3) specifies the methods to be used in order to assess the noise impacts on the environment as result of a proposed *or* existing activity. The standard also stipulates the minimum requirements to be assessed for an EIA. These minimum requirements are:

1. the purpose of the investigation;
2. a brief description of the planned *or* existing development or the changes that are being considered;
3. a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements
4. the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics;
5. the identified noise sources that were not taken into account and the reasons as to why they were not assessed;
6. the identified noise-sensitive developments and the noise impact on them;
7. where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics;
8. an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations;
9. an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question;
10. the location of measuring or calculating points in a sketch or on a map;
11. quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made;
12. alternatives that were considered and the results of those that were assessed;
13. a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation;
14. a detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them;
15. conclusions that were reached;
16. proposed recommendations;

17. if remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority; and
18. any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future.

2 LEGAL CONTEXT, POLICIES AND GUIDELINES

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

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate in the particular circumstances. The subjectivity of this approach can be problematic which has led to the development of noise standards (see **Section 2.5**).

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

2.2 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. See also **section 2.2.1**.

2.2.1 National Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the national Noise Control Regulations (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Gauteng and Western Cape provinces. The Northern Cape currently have no provincial noise control regulations and the National Regulations will be in effect.

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

"**controlled area**" as:

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

c) industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or
ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA;

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

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

In addition:
In terms of Regulation 2 -
"A local authority may –
(c): if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;
(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or (c), reports or certificates in relation to the noise impact to the satisfaction of that local authority are submitted by the owner, developer, tenant or occupant to the local authority on written demand";

In terms of Regulation 3 (a):

"No person shall –

establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences";

In terms of Regulation 4 of the Noise Control Regulations:

"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

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

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures which may be regarded as reasonable. They include the following measures:

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

2.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT ("AQA" – ACT 39 OF 2004)

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of 2004) makes provision for:

(1) the Minister to prescribe essential national noise standards -

(a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or

(b) for determining –

(i) a definition of noise

(ii) the maximum levels of noise

(2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

This section of the Act is in force, but no such standards have yet been promulgated. Draft regulations have however, been promulgated for adoption by Local Authorities.

An atmospheric emission licence issued in terms of section 22 may contain conditions in respect of noise. This however is unlikely to be relevant to the project, as no atmospheric emissions licence is required.

2.4.1 Model Air Quality Management By-law for adoption and adaptation by Municipalities (GN 579 of 2010)

Model Air Quality Management By-Laws for adoption and adaptation by municipalities was published by the Department of Water and Environmental Affairs in the Government Gazette of 2 July 2010 as Government Notice 579 of 2010.

The main aim of the model air quality management by-law is to assist municipalities in the development of their air quality management by-law within their jurisdictions. It is also the aim of the model by-law to ensure uniformity across the country when dealing with air quality management challenges. Therefore, the model by-law is developed to be generic in order to deal with most of the air quality management challenges. With Noise Control being covered under the Air Quality Act (Act 39 of 2004), noise is also managed in a separate section under this Government Notice.

- **IT IS NOT** the aim of the model by-law to have legal force and effect on municipalities when published in the Gazette; and
- **IT IS NOT** the aim of the model by-law to impose the by-law on municipalities.

Therefore, a municipality will have to follow the legal process set out in the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000) when adopting and adapting the model by-law to its local jurisdictions.

2.5 NOISE STANDARDS

Four South African Bureau of Standards (SABS) scientific standards are considered relevant to noise from the roads. They are:

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.

- SANS 10210:2004. 'Calculating and predicting road traffic noise'.
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.

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

2.6 INTERNATIONAL GUIDELINES

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

2.6.1 Guidelines for Community Noise (WHO, 1999)

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

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

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

It further discusses how noise can impact (and propose guideline noise levels) on specific environments such as:

- residential dwellings
- schools and preschools
- hospitals
- ceremonies, festivals and entertainment events
- sounds through headphones
- impulsive sounds from toys, fireworks and firearms; and
- parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it propose that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB LAeq. At night, equivalent sound levels at the outside façades of the living spaces should not exceed 45 dBA and 60 dBA LAmax so that people may sleep with bedroom windows open.

It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

2.6.2 Night Noise Guidelines for Europe (WHO, 2009)

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

The 184-page report offers a comprehensive overview of research into the various effects of noise on sleep quality and health (including the health effects of non-waking sleep

arousal), and is recommended reading for anyone working with noise issues. The use of an outdoor noise standard is in part designed to acknowledge that people do like to leave windows open when sleeping, though the year-long average may be difficult to obtain (it would require longer-term sound monitoring than is usually budgeted for by either industry or neighbourhood groups).

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

2.6.3 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. The banks chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). 67 financial institutions (October 2009) have adopted the Equator Principles, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

2.6.4 IFC: General EHS Guidelines – Environmental Noise Management

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principle.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source.

It goes as far as to proposed methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;

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

It sets noise level guidelines (see **Table 2-1**) as well as highlighting the certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. Because this criterion will effectively sterilize large areas of any development it is the considered opinion that this criterion was likely introduced in order to address cases where the existing ambient noise level is already at, or in excess of the recommended limits.

Table 2-1: IFC Table .7.1-Noise Level Guidelines

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

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

2.7 INTERNATIONAL GUIDELINES – STANDARDS FOR NOISE FROM RAILWAYS

Noise reception limits exist on a national level in various forms for new and upgraded railway lines. Limits for existing railway lines are only in force in Switzerland, Denmark, Italy and will be in Sweden from 2015 on. Mandatory reception limits or insulation standards for new buildings along existing railway lines are, for example, in force in Finland, France and Switzerland.

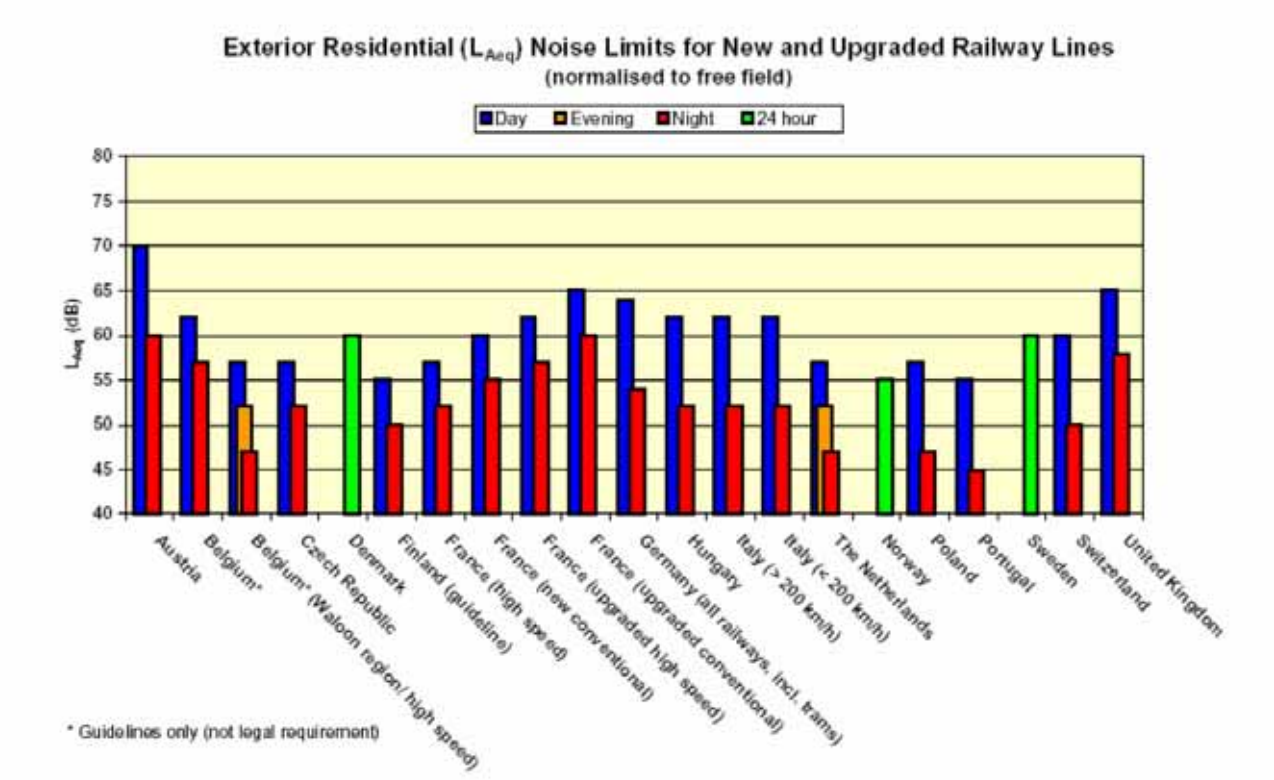

Figure 2-1: Residential Noise Limits for New and Upgraded Railway Lines[1]

These limits are however not completely comparable, as they differ in terms of:

- Indicators;
- Reference times;
- Receiver locations (free-field (reflection at the building not considered) or at the façade);
- The difference in levels amounts to 3 dB(A));
- Emission assumptions (levels, location);
- Transmission factors (e.g. weather conditions etc);
- Definition of substantial upgrading;
- Sometimes the limits are increased depending on existing exposure levels (Austria, France). In Italy limits depend on the distance from the track.

[1] European Commission, 2003

3 CURRENT ENVIRONMENTAL SOUND CHARACTER

3.1 MEASUREMENT PROCEDURE

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

3.2 LIMITATIONS: ACOUSTICAL MEASUREMENTS AND ASSESSMENTS

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement;
- Defining ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined (at that location). The more complex the sound environment, the longer the required measurement (especially when at a community or house);
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc);
- Measurements over wind speeds of 3 m/s will provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement point;

- Considering one sound descriptor is not sufficient for and acoustical assessment. Parameters such as **L_{AMin}, L_{AIeq}, L_{Aeq}, L_{Ceq}, L_{AMax}, L_{A10}, L_{A90}** and spectral analysis forms part of the many variables to be considered;
- It is technically difficult to correctly measure the spectral distribution of a large equipment in an industrial setting due to the other noise sources active in the area;
- Exact location of a sound level meter in an area in relation to structures, vegetation and external noise sources will impact on the measurements; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

3.3 EXISTING MEASURED SOUNDSCAPE

The location of the day/night ambient sound measurement locations are presented in **Table 3-1** below and is also illustrated in **Figure 3-1** as **blue** squares. These measurements were collected from approximately 22:30 – 23:30 on the evening of 22 July 2013. Sound level meter settings conform to specifications listed in SANS 10103 (South African Guidelines).

Table 3-1: Results of ambient (night) sound level monitoring (Datum type: WGS84, Decimal Degrees)

Point name	Latitude, Longitude	Wind speed Ave. (m/s)	L_{Aeq} (dBA)	L_{A90} (dBA)	$L_{A, max}$ (dBA)	$L_{A, min}$ (dBA)	Temp (°C)	Hum (%)
PBN01	-28.315448° 23.062217°	Continuous measurement, see following section.						
PBN02 (N)	-28.313684° 23.065144°	0.0	47.8	37.4	73.0	32.0	6.1	55
PBN03 (N)	-28.313466° 23.062709°	0.0	38.8	33.0	65.6	30.6	5.1	58
PBN04 (N)	-28.311090° 23.059744°	0.0	37.3	32.2	64.0	30.1	4.7	59
PBN05 (N)	-28.312460° 23.058752°	0.0	34.8	30.1	72.6	27.7	4.7	60

Ambient sounds observed consisted of traffic on the R325 and R385 roads, animals, insects and people (voices). Traffic noises dominated the ambient sound levels. Activities at the Transnet housing development site were not audible at any of the measurement locations.

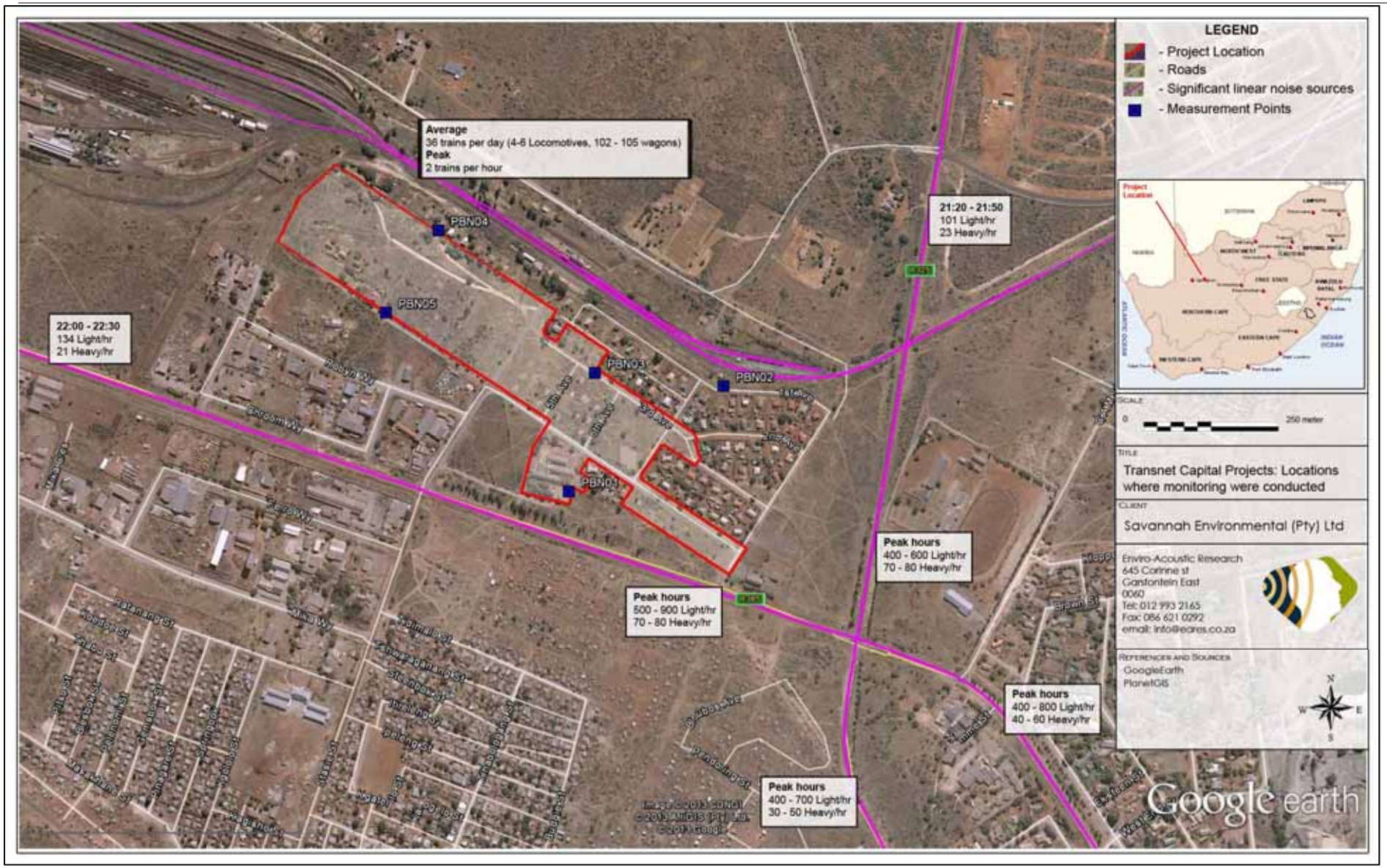

Figure 3-1: Localities of ambient sound measurement and traffic counts

3.3.1 Measurement point: (PBN01): Open field at nearby Transnet Offices

A number of 10 minute measurements were taken over a day/night period from the morning of the 22nd July till the morning of the 23rd July 2013. The sound level meter was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA. The equipment defined in **Table 3-2** was used for gathering data.

Table 3-2: Equipment used to gather data

Equipment	Model	Serial no	Calibration
SLM	Svan 955	27637	15 May 2013
Microphone	ACO 7052E	52437	15 May 2013
Calibrator	Rion NC-74	34494286	23 January 2013
Weather Station	WH3081PC	-	-

Microphone fitted with the appropriate windshield.

The measurement point was chosen as it was a safe and secure location for the equipment to be left overnight. It was placed in a relatively open field near the eastern fence of the property (see **Figure 3-1**). The sound level had a direct line of sight to the R385 road. Ambient sound levels were mainly dominated by the R385 traffic noises. **Figure 3-2** also indicates how the noise levels changed as peak traffic increases between 16:40 and 18:40.

Measured 10 minute L_{AIeq} day/night-time data: During the daytime (between 06:00 - 22:00) **L_{AIeq}** values ranged between 42.6 to 84.5 dBA. The night-time (between 22:00 - 05:00) **L_{AIeq}** values ranged between 39.8 to 49.9 dBA. The average value of the 79 ten-minute equivalent daytime measurements was calculated at 53.3 dBA with the 39 night-time 10-minute measurements being 43.0 dBA. The **$L_{AIeq,d}$** for the first daytime period was 66.7 dBA and the **$L_{AIeq,n}$** for the night-time period 43.6 dBA.

Measured 10 minute L_{A90} day/night-time data: L_{A90} daytime values (between 06:00 - 22:00) ranged from 38.4 to 59.8 dBA. The night-time (between 22:00 - 06:00) **L_{A90}** values ranged from 36.9 to 42.3 dBA. The average value of the 79 ten-minute equivalent daytime measurements was calculated at 45.1 dBA, while the 39 night-time measurements were 39.5 dBA.

L_{AIeq} - L_{A90} average difference, day/night-time: The average daytime difference between the **L_{AIeq}** and **L_{A90}** variables was 8.3 dBA while the difference at night was 3.6 dBA. This indicated much more impulsive noises during the day then during the night. It also indicated that there are consistent noises/sounds in the study area during all hours.

SANS 10103 Rating Level: Measured data indicated a day and night-time rating level of *"Urban (SANS 10103:2008)"* when evaluating the data (55/45 dBA day/night rating).

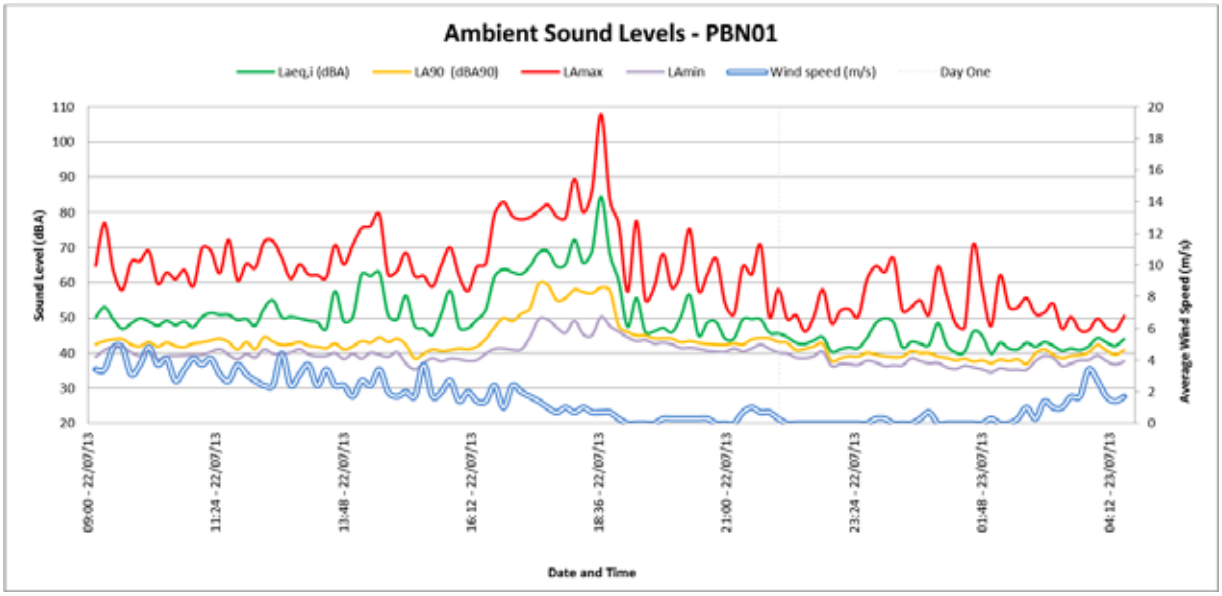

Figure 3-2: Ambient sound levels measured at PBN01

4 INVESTIGATED NOISE SOURCES

4.1 NOISE SOURCES: ROAD TRAFFIC NOISES

Noise propagation due to road traffic depends on various acoustical factors. The most important are briefly discussed below.

4.1.1 Road tyre interaction and other vehicle noise sources

The most significant noise contributor above 60 km p/h is the tyre interaction with the road surface. Tyre road impacts and shocks as well as tyre to road pumping (during standard rolling conditions, pumping is the compression of air under tyre tread) can contribute mainly below and above 1000 Hz respectively (up to 2000 Hz for pumping). The horn effect created by the geometry of the tyre and road surface can amplify at frequencies up to 10 000 Hz[2].

4.1.2 Road vehicle type

Vehicles noise emissions at speed vary from vehicle to vehicle. For acoustical purposes the classification of vehicles are considered as light or heavy. Heavy vehicles could be considered as a bus, articulated, tanker or other industrial haul trucks.

4.1.3 Road surface porosity and surface conditions

Road surface design, construction and maintenance can play an important part on the acoustical emissions of road traffic noise levels. Unpaved roads cause much more vibration in/on vehicle tyres than paved roads, with the results been higher noise levels. Similarly the porosity value of the paved roads makes a difference in the way the air pressure and acoustics interacts with road tyres at speed. The higher the porosity value of the tar road the less air will be "pumped" under the tyre tread. A smoothed tar road will also affect the vibration of the tyres less as bumps in the road will cause to the tyres to vibrate in a similar fashion to a drum on impact.

4.1.4 Road traffic volume

Road traffic with the volume and type of traffic generated may vary from day to day. Only noise levels due to traffic volumes from the existing roads will be estimated using the Calculation of Road Traffic Noise (CRTN; Department of Transport, 1988) prediction method.

4.1.5 Other road noise contributors

Other noise sources associated with motor vehicles include the exhaust outlet, engine motor and associated engine components (mostly audible below 60 km p/h) as well as the

[2] *FEHRL Report 2006/02, Guidance manual for the implementation of low-noise road surfaces*

general maintenance condition of the vehicles. Many motor engine revs per minute (rpm) convert to a low range of frequency below the 100 Hz range. Wind shear can contribute to this range but at much faster speeds.

4.2 NOISE SOURCES: RAILWAY NOISES

Disturbance from trains can be divided into two impacts, namely:

- Airborne noise from the operation of a surface rail line that is heard at, and within, noise-sensitive developments;
- Ground-borne noise and vibration generated inside a building by ground-borne vibration generated from the pass-by of a vehicle on rail.

This report as well as the ENIA however will only investigate the airborne noise disturbance for the following reasons:

- Noise radiated from train operations and track structures generally constitute the major noise sources from railway lines;
- Ground-borne noise mainly applies at receiver locations above rail operations in tunnels where ground-borne noise levels from rail transport are likely to be greater than airborne noise levels. Air-borne noise generally is far more annoying to a receptor than ground-borne vibrations;
- Only limited research into the impacts of ground-borne noise is available, and information and modelling on practices applied overseas is scarce;
- There is currently no accepted model available to allow the extend of vibration and ground-born noise from railway vehicles;
- Maintenance condition of the running stock wheels and railway track (including the condition of the ballast) is a major factor in the generation of vibration and ground-borne noise; and
- There are many factors involved in the estimation of vibration and ground-borne noise, including the surrounding geological strata, condition of the track, alignment, speed, weight, etc.

Noises associated with the operation can also be divided into three main sources, namely:

- Train movement (acceleration, deceleration, constant speed movement)
- Shunting and switching of trains on the stations; and
- Maintenance of locomotives, running stock, railway lines and refuelling at rail loops.

These noise sources should be treated differently, as the noise characteristics and propagation process associated with each of these sources are different.

4.2.1 Train movement

Rail traffic is considered as a line source of noise with a continuous area of impact both sides of and parallel to the railway line. Railway related noise is general acoustically characterised by high noise levels of relatively short duration. The wayside noise radiated into a community is the function of a number of different factors, namely:

- interaction of wheels and rails;
- the vehicle or locomotive propulsion system;
- type of locomotive and wagons;
- braking technology employed on the wagons and locomotives;
- railway alignment, in particular the design radius of curves and turns;
- auxiliary equipment;
- noise radiated from vibrating structures;
- train speed;
- train length;
- aerodynamics (for high speed operations);
- locomotive warning devise or horn noise.

Train speed is a major influence parameter for noise emission. The noise due to traction and auxiliary systems (diesel units, electrically driven powertrains, cooling equipment, compressors), if present, tends to be predominant at low speeds, up to around 60 km/h. The relationship with speed is illustrated in **Figure 4-1**.

Wheel-rail rolling noise is dominant up to speeds around 200-300 km/h, after which aerodynamic noise takes over as dominant factor. The transition speeds from traction noise to rolling noise and from rolling noise to aerodynamics noise depend entirely on the relative strength of these sources. The rolling noise, for example, depends strongly on the surface condition (roughness) of wheels and rails, whereas aerodynamic noise depends on the streamlining of the vehicle.

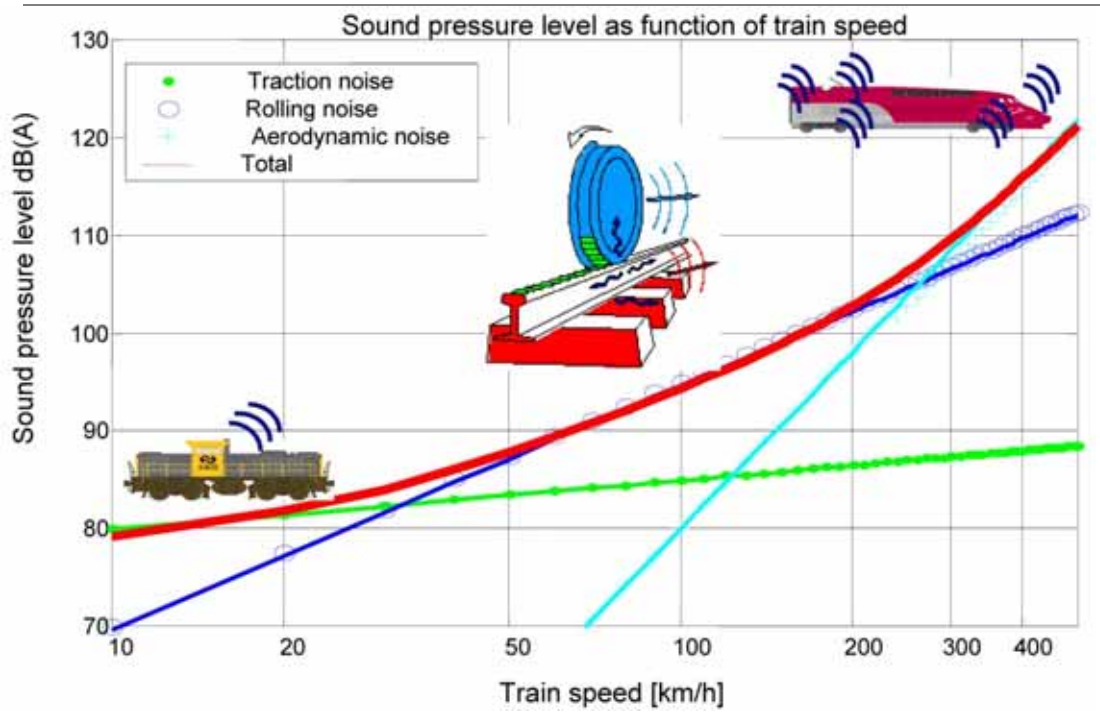

Figure 4-1: Railway exterior sound sources and typical dependence on train speed

Unfortunately there is no standard or guideline in South Africa stipulating the requirements to calculate or model the potential noise impacts from a railway operation. For this purpose it was selected to make use of the United Kingdom Department of Transport document, "Calculation of Railway Noise, 1995" (CRN).

4.2.2 Switching Yard operations

There are two main types of noises in a shunting yard, namely a a highly impulsive sound as the wagons slam into each other during coupling as well as the movement of the shunting locomotives as they power up to move the wagons around.

Other significant sources of noise include:

- noise generated during the start-up of the diesel engines (propulsion system, auxiliary[3] equipment);
- as movement of the diesel locomotives (without load);
- the sound from the shunting locomotives as it powers up to move the wagons around or onto the hump (high load);
- sound from the trains as it enters and leaves the yard at low speed (brake squeal from train, auxiliary equipment, propulsion system);

[3] Auxiliary equipment: compressors, motor generators, brakes, ventilation systems and any other locomotive-mounted equipment.

Noise levels due to brake squeal as trains approach the rail loop could range between the 90 to more than 105 dBA (peak). It can be audible for more than 2,000 meters. The character of this noise can be considered tonal and could also increase annoyance levels with receptors.

Although not significantly and generally far less than sources of noise mentioned above, other sources noises include:

- ancillary equipment in the yard (substations, compressors, refuelling, etc);
- railway maintenance operations;
- workshops and other equipment maintenance;
- induced noises due to the vibration of the railway line components during a train pass by.

5 METHODS: NOISE IMPACT ASSESSMENT

5.1 WHY NOISE CONCERNS COMMUNITIES[4]

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

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

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

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

Noise does not need to be loud to be considered "disturbing". One can refer to a dripping tap in the quiet of the night, or the irritating "thump-thump" of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

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

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

5.1.1 Annoyance associated with Industrial Activities[5]

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

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 5-1**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in Environmental Health Impact Assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise climate.

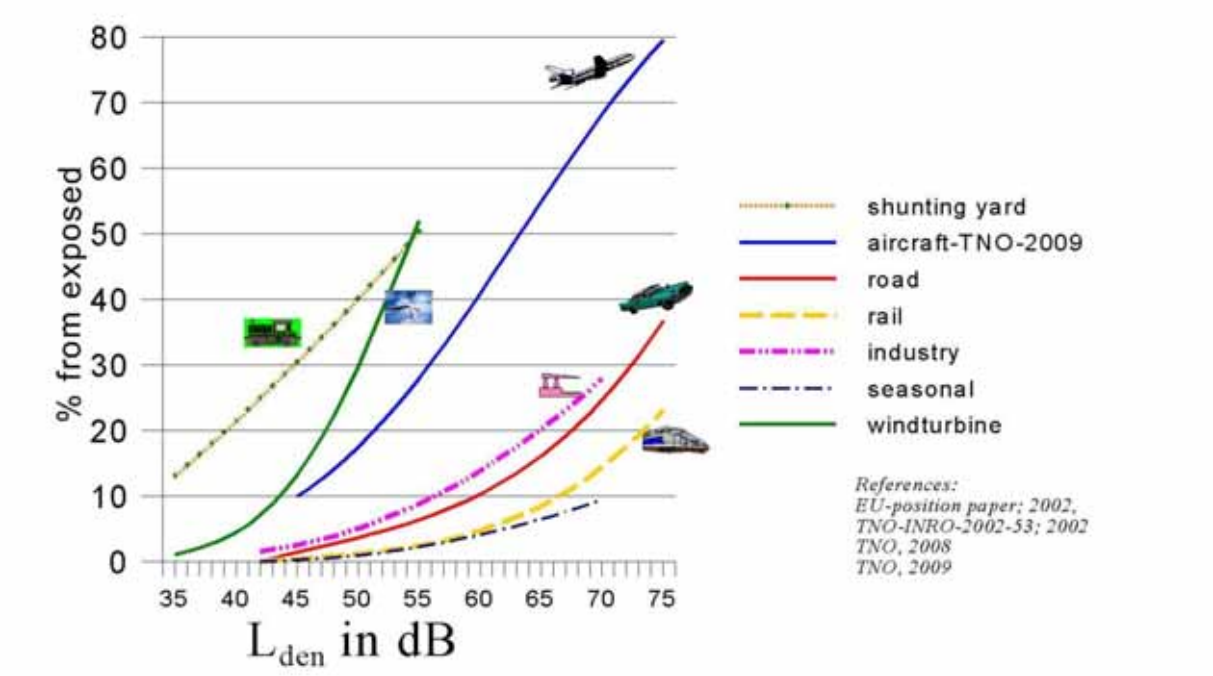

Figure 5-1: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling

[5] Van den Berg, 2011; Milieu, 2010.

As shown in **Figure 5-1**, there is significant potential of annoyance associated with noise from shunting operations, mainly due to the highly impulsive character of the noises created.

5.2 IMPACT ASSESSMENT CRITERIA

5.2.1 Overview: The common characteristics

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

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

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

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

5.2.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the Department of Environmental Affairs (June 2006) in terms of the NEMA, SANS 10103:2008 as well as guidelines from the World Health Organization.

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

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 5-2**.

- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 5-1**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

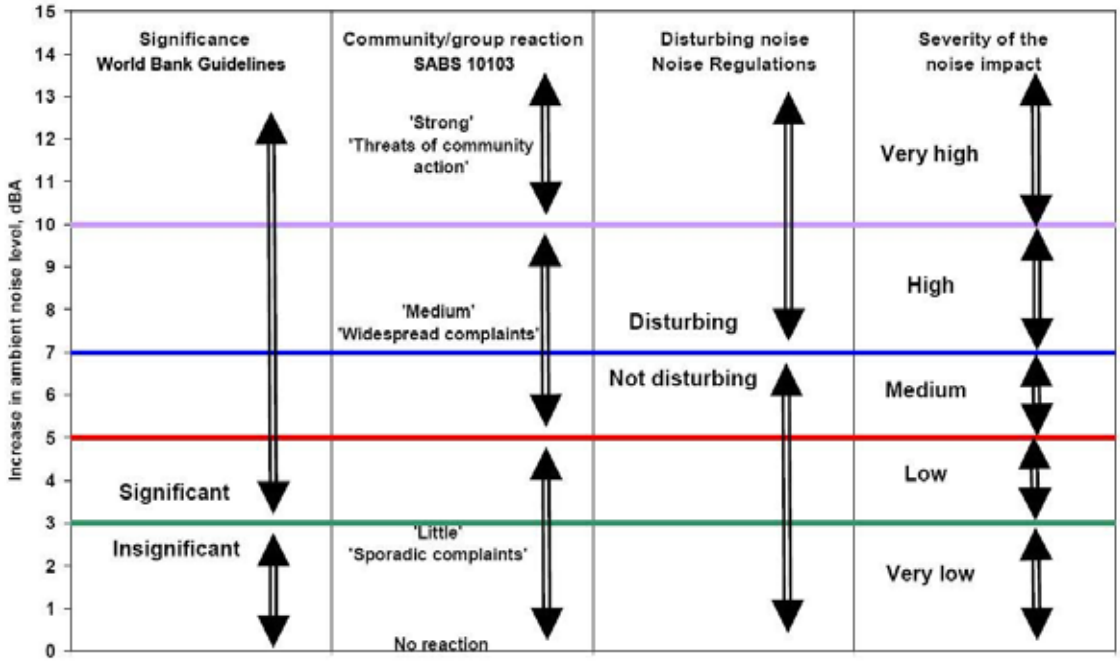

Figure 5-2: Criteria to assess the significance of impacts stemming from noise

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 5-1**). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,D}$ and $L_{Req,N}$, during the day and night respectively to which different types of developments may be exposed. The following rating levels are recommended:

- "Urban Districts" (55 and 45 dBA day/night-time Rating)

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

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

- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National and Provincial Noise Control Regulations).

Table 5-1: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

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

5.2.3 Other noise sources of significance

In addition, other noise sources that may be present should also be considered. During the day, people are generally bombarded with the sounds from numerous sources considered "normal", such as animal sounds, conversation, amenities and appliances (TV/Radio/CD playing in background, computer(s), freezers/fridges, etc). This excludes activities that may generate additional noise associated with normal work.

At night, sounds that are present are natural sounds from animals, wind as well as other sounds we consider "normal", such as the hum from a variety of appliances (magnetostriction) drawing standby power, freezers and fridges.

Figure 5-3 illustrates the sound levels associated with some equipment or in certain rooms. This is however more for illustrative purposes, as there are many manufacturers with different equipment, each with a different noise emission character.

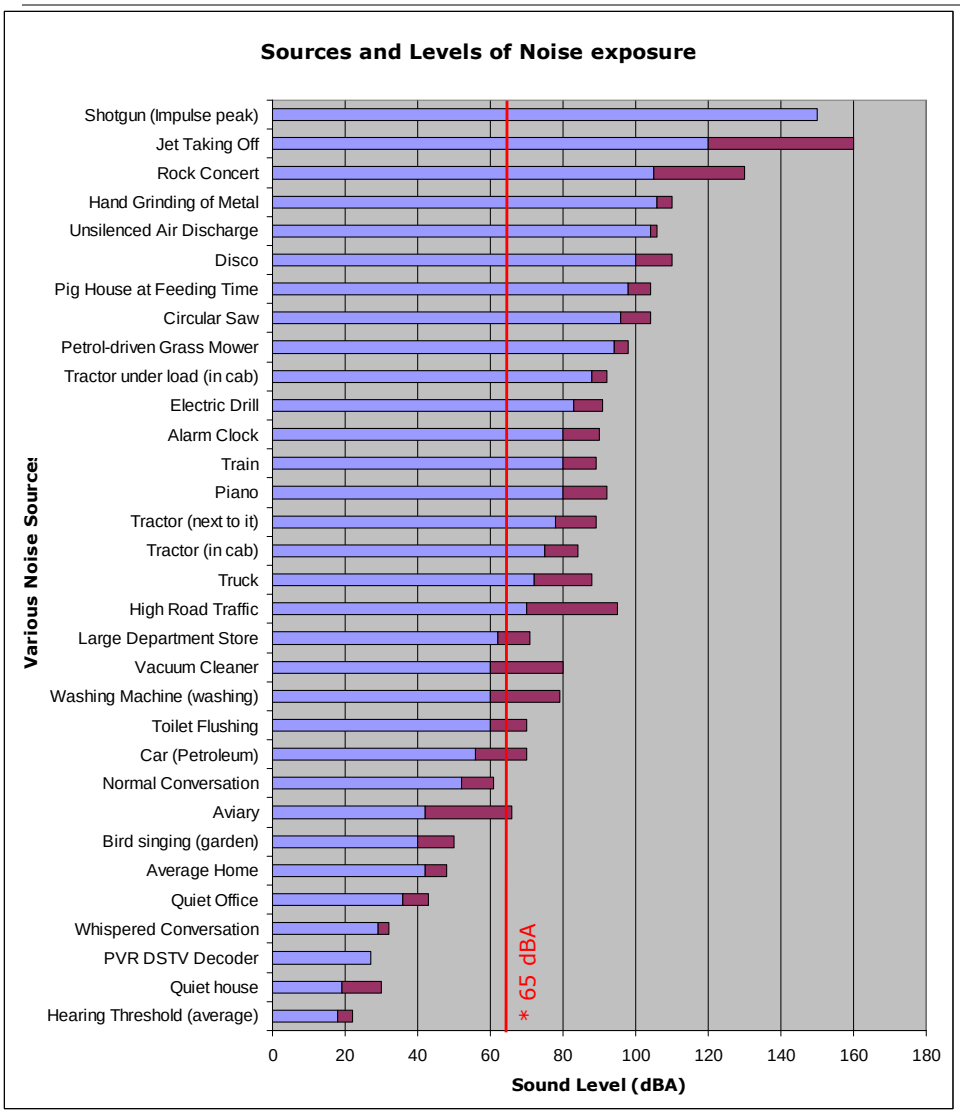

Figure 5-3: Typical Noise Sources and associated Sound Pressure Level

5.2.4 Determining the Significance of the Noise Impact

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

The impact consequence is determined by the summing the scores of Magnitude **Table 5-2**), Duration (**Table 5-3**) and Spatial Extent (**Table 5-4**). The impact significance (see **Sections 5.2.5** and **Section 5.2.6**) is determined by multiplying the Consequence result with the Probability score (**Table 5-5**).

An explanation of the impact assessment criteria is defined in the following tables.

Table 5-2: Impact Assessment Criteria - Magnitude

This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.		
Rating	**Description**	**Score**
Low	Total projected noise level is less than the Zone Sound Level in wind-still conditions.	2
Low Medium	Sound levels between 3 and 5 above the acceptable zone sound level (wind-less conditions).	4
Medium	Sound levels between 5 and 7 above the acceptable zone sound level (wind less conditions). Sporadic complaints expected.	6
High	Increase in sound pressure levels between 7 and 10 dBA above the acceptable zone sound level (wind-less conditions). Medium to widespread complaints expected.	8
Very High	Increases in sound pressure levels higher than 10 dB above the acceptable zone sound level (wind less-conditions). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	10

Table 5-3: Impact Assessment Criteria - Duration

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

Table 5-4: Impact Assessment Criteria – Spatial extent

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

Table 5-5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**

Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).	1
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25 %.	2
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50 %.	3
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined between 50 % to 75 %.	4
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100 %.	5

In order to assess each of these factors for each impact, the following ranking scales as contained in **Table 5-6** will be used.

Table 5-6: Assessment Criteria: Ranking Scales

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

5.2.5 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures).

Significance without mitigation is rated on the following scale:

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

		Resulting impact could influence the decision depending on the possible mitigation. Animpact which could influence the decision about whether or not to proceed with the project.

5.2.6 Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

SR<30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30<**SR** <60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR>60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

6 METHODS: CALCULATION OF NOISE CLIMATE

6.1 NOISE CLIMATE AROUND THE SURROUNDING ENVIRONMENT

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

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

Unfortunately there is no standard or guideline in South Africa stipulating the requirements to calculate or model the potential noise impacts from a railway operation. For this purpose it was selected to make use of the United Kingdom Department of Transport document, "Calculation of Railway Noise, 1995". The methodology proposed in this document is illustrated in **Figure 6-1**.

6.2 SOUND PROPAGATION: CALCULATION AND IMPACT ASSESSMENT LIMITATIONS

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

- Many sound propagation models do not consider sound characteristics as calculations are based on an equivalent level. These include intrusive sounds or amplitude modulation;
- Many sound propagation models do not calculate the increase of the ambient soundscape due to wind shear (masking noise);
- Most sound propagation models do not consider refraction through the various temperature layers (specifically relevant during the night-times);
- Most sound propagation models do not consider the low frequency range (third octave 16 – 31.5 Hz). This would be relevant to facilities with a potentially low frequency issues;
- Many environmental models consider sound to propagate in hemi-spherical way. Certain noise sources (e.g. a speakers, exhausts, fans) emit sound power levels in a directional manner;
- The octave sound power levels selected for processes and equipment accurately represents the sound character and power levels of processes/equipment. The determination of these levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;

- Sound power emission levels from processes and equipment change depending on the load the process and equipment is subject too. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load. Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;
- As it is unknown which processes and equipment will be operational, modelling considers a scenario where all processes and equipment are under full load 100% of the time. The result is that projected noise levels would likely over-estimate sound levels;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Many environmental models are not highly suited for close proximity calculations; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Ground conditions will not be considered in this assessment.

Due to these assumptions modelling generally could be out with as much as +10 dBA although realistic values ranging from 3 $\leq$ 5 dBA is more common in practice.

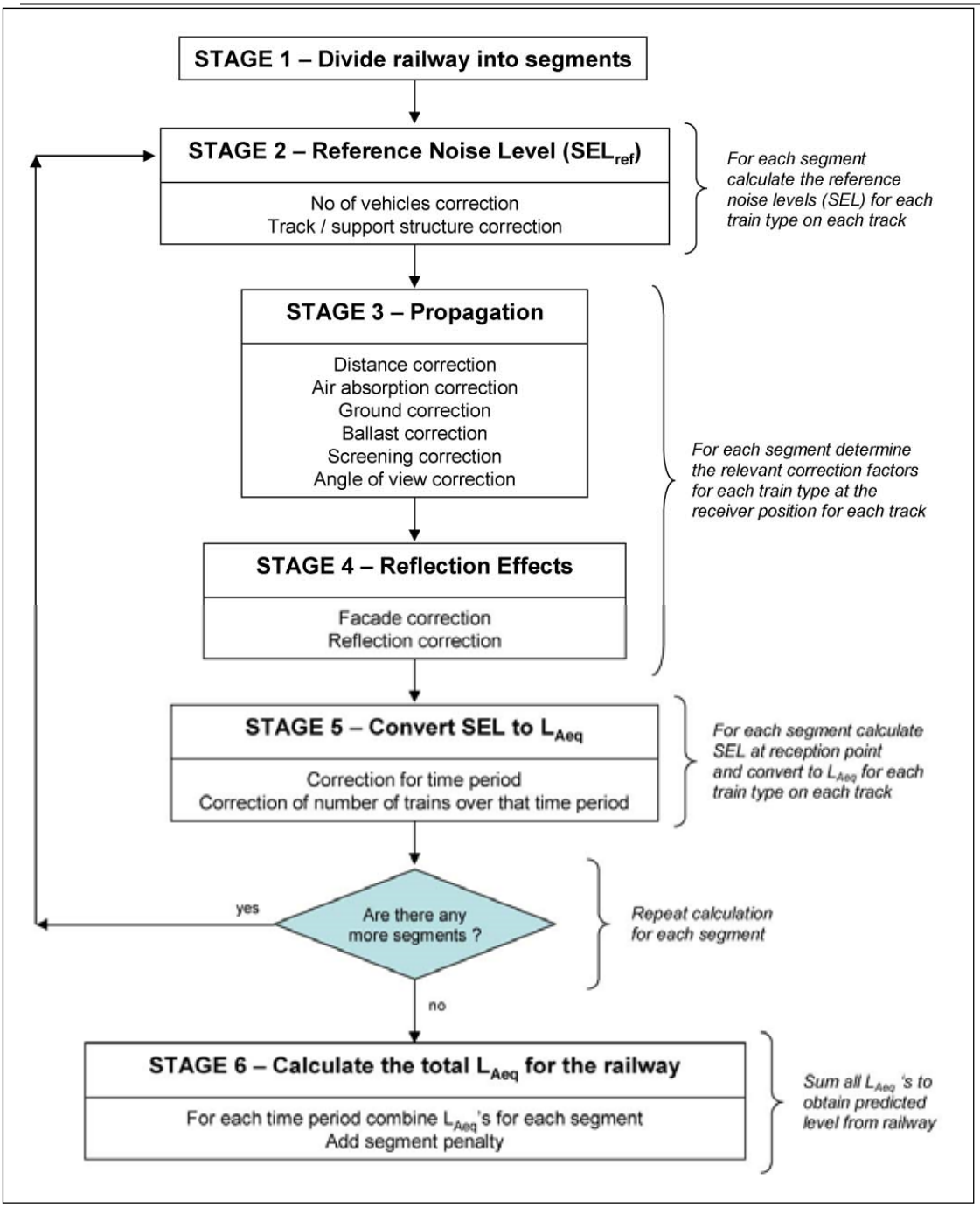

Figure 6-1: Flow diagram illustrating the methodology to calculate the noise from railways

6.3 INVESTIGATED SCENARIOS

Because night-time would be the more critical time when a quieter environment is desired this assessment will only consider the night scenario.

6.3.1 Observed Scenario

6.3.1.1 Road Traffic

The Author did a 30 minute traffic count at two locations (refer **Figure 3-1**) at 21:20 and again at 22:00. Based on the visual observations, traffic (and traffic noises) decreases significantly after 20:00 at night. The first scenario illustrates the traffic count as observed on the site.

6.3.1.2 Railway traffic

Based on the discussions with Mr. Willem Britz (Operations Manager: Transnet Freight Rail) it was revealed that there are currently an average of 36 trains passing through the station (18 loaded and 18 empty). Each train consists of either 4x 10E or 6x 18E electrical locomotives / 6x Class 34 diesel locomotives with 04 – 105 80-ton wagons. These trains can pass through the station at speeds up to 60 km/h on the mainline although speeds of 30 km/h are more common. When entering the yards speeds are 15 km/h. Based on the observations made during the site visit the following scenario was modelled, namely:

- The mainline (6x Class 73 electric locomotives and 104x 4-axle tread braked wagons per train with 15 trains passing through the station at 15 km/h during the night-time period
- No active shunting activities taking place.

6.3.2 Existing Scenario – Peak hours (Worst case)

6.3.2.1 Road Traffic Noise

A Traffic Impact Statement (TIS) was conducted by Aurecon during the evening of 29 and the morning of 30 July 2013. This was augmented by the author during the evening of 22 July 2013. While the TIA report was not available at the time this report was compiled, traffic counts were available and the available is data summarised in **Figure 3-1**.

Assumptions and road traffic numbers as modelled for the existing situation is presented in **Figure 6-2** using the UK CRTN model. This is likely to be the worst case scenario relating to peak traffic in the vicinity of the development at night.

6.3.2.2 Railway Noise

B Trains can pass through the station at speeds up to 60 km/h on the mainline although speeds of 30 km/h are more common. When entering the yards speeds are 15 km/h. Noise predictions will done using the UK CRN model.

Because of the different noise sources at the station two different models will be developed, namely:

- The mainline (6x Class 73 electric locomotives and 104x 4-axle tread braked wagons per train with 5 trains passing through the station at 60 km/h, 5 at 30 km/h and 5 at 15 km/hr); and
- The shunting line (1x Class 73 electric locomotive with 10x 4-axle tread braked wagons per train with 25 trains travelling at 15 km/h). A 12 dB correction was added to this noise level as per SANS 10103:2004 as the shunting operation is generating a highly impulsive noise.

These rail volumes as modelled for the existing situation are presented in **Figure 6-2**.

6.3.3 Future Scenario – Peak hours (Worst case)

6.3.3.1 Road Noise: Future (15 years)

Future traffic volumes were based on the assumption that traffic would be increasing at a compound rate of 3% per annum with the associated noise levels calculating using the UK CRTN model. Future road traffic numbers as modelled for the existing situation is presented in **Figure 6-3**.

6.3.3.2 Railway volumes: Future (15 years)

Based on the discussions with Mr. Willem Britz it is Transnet's planning to either start using the new Class 20E electrical locomotives or the Class 43 diesel locomotives. Being very powerful locomotives, it will be possible to increase the train lengths up to 208 wagons using 6 of these locomotives.

While longer trains will initially reduce the total number of trains passing through the station, based on the current mining development in the area it is assumed that the number of trains may increase to 36 trains per day within 15 years.

Similar to the existing scenario two different models will be developed, namely:

- The mainline (6x Class 43 diesel locomotives and 204x 4-axle tread braked wagons per train with 5 trains passing through the station at 60 km/h, 5 at 30 km/h and 5 at 15 km/hr); and
- The shunting line (1x Class 73 electric locomotive with 10x 4-axle tread braked wagons per train with 50 trains (at night) travelling at 15 km/h). A 12 dB correction was added to this noise level as per SANS 10103:2004 as the shunting operation is generating a highly impulsive noise.

Future railway traffic as modelled is presented in **Figure 6-3**.

6.3.4 Future Scenario – Likely Noise level during Peak hours

6.3.4.1 Road Noise: Future (15 years)

As per previous scenario.

6.3.4.2 Railway volumes: Future (15 years)

Similar to the existing scenario two different models will be developed, namely:

- The mainline (6x Class 43 diesel locomotives and 204x 4-axle tread braked wagons per train with a maximum speed limit in the vicinity of the residential areas of 30 km/h; and
- The shunting line (1x Class 73 electric locomotive with 10x 4-axle tread braked wagons per train with 50 trains (at night) travelling at 15 km/h). A 12 dB correction was added to this noise level as per SANS 10103:2004 as the shunting operation is generating a highly impulsive noise.

Future railway traffic as modelled is presented in **Figure 6-3**.

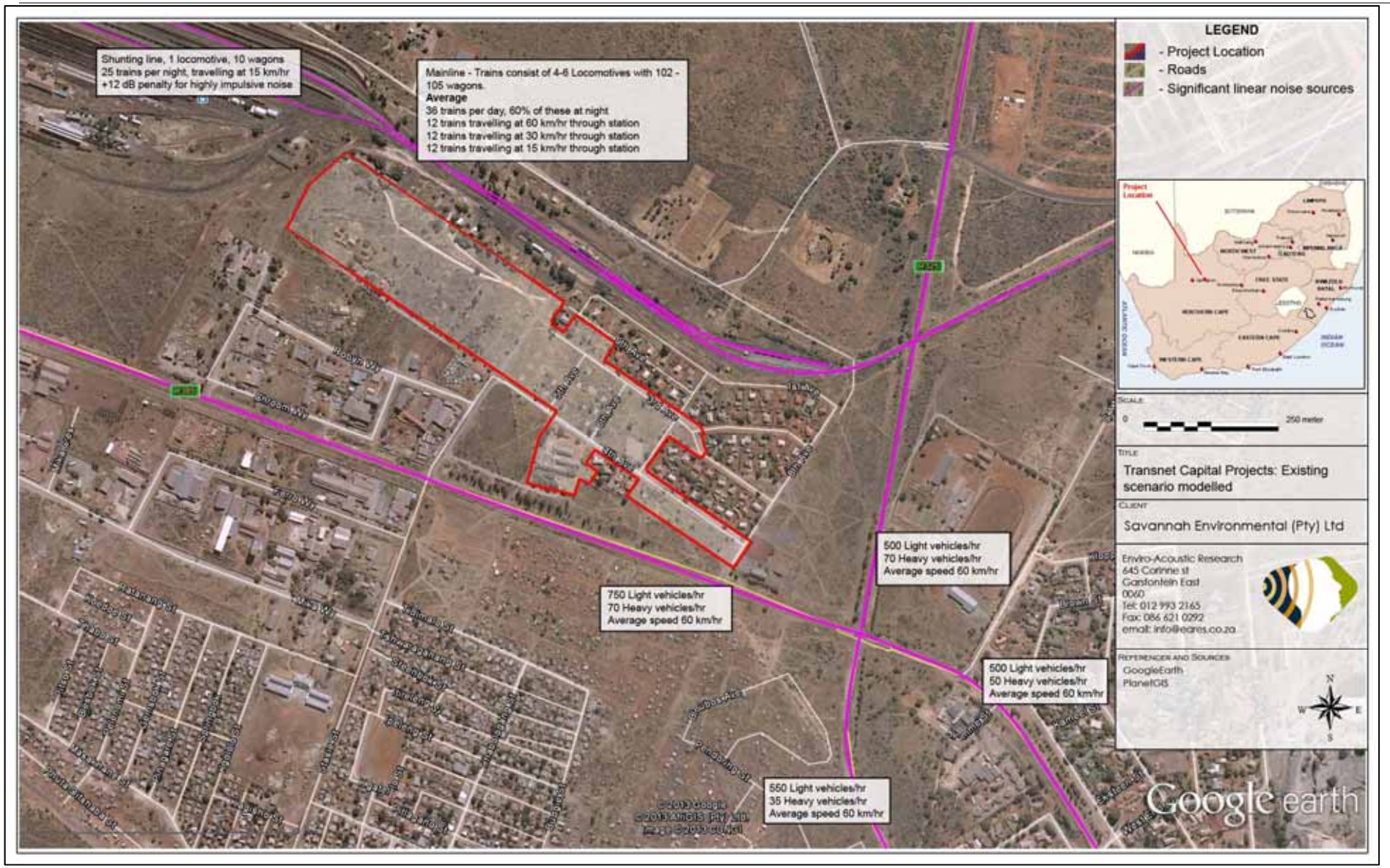

Figure 6-2: Existing scenario as modelled for the night-time period – Worse case

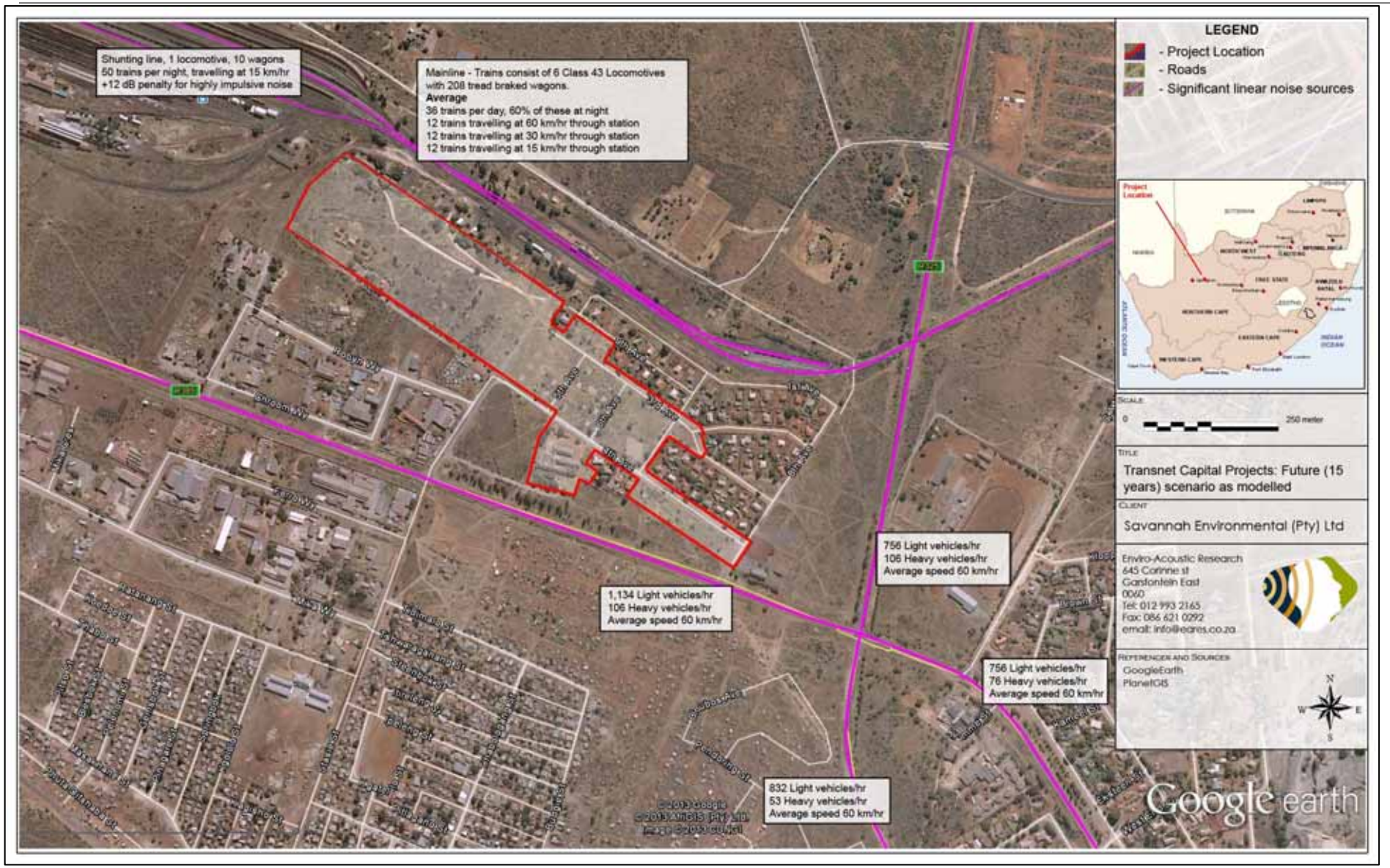

Figure 6-3: Future scenario as modelled for the night-time period – Worse case

7 MODELLING RESULTS AND IMPACT ASSESSMENT

7.1 OBSERVED SCENARIO: NOISE LEVELS AS MODELLED

The observed night-time soundscape surrounding the proposed housing development for the activities as defined in **section 6.3.1** is presented in **Figure 7-1**. This scenario presents the ambient noise levels associated with the road and railway traffic as observed during the site visit and defined with Mr. Britz. It excludes other noises detected during the site visit as these noise sources are considered insignificant compared to the noise from the road and railway system.

Because the modelled railway scenario is based on an assumption, the noise contour from the railway line should be considered to be a potential noise contribution (trains travelling at speeds up to 15 km/h). However, even at a speed of 15 km/h the railway line clearly could contribute a significant portion of the noise in the area, augmented from traffic noise from the two main roads in the area.

7.2 SCENARIO – WORST CASE: EXISTING NOISE LEVELS AS MODELLED – PEAK HOURS

The existing night-time soundscape surrounding the proposed housing development is presented in **Figure 7-2**. This scenario presents the ambient noise levels associated with the existing road and railway traffic during peak hours and includes the noise from the shunting operations, but exclude other noises detected during the site visit. This is because other noise sources are considered insignificant compared to the noise from the road and railway system.

Being a worst-case scenario it represents the maximum equivalent (average) noises ($L_{Req,1\ h}$) the area could be exposed to during peak traffic hours. Because the modelled railway scenario is based on an assumption, the noise contour from the railway line should be considered to be a potential noise contribution (trains at speeds up to 60 km/h). Trainway traffic again could contribute a significant portion of the noise in the area, augmented from traffic noise from the two main roads in the area.

It should be noted that this would be during a period when there is maximum traffic on the roads travelling at the maximum legal speed limit of 60 km/h as well as almost two trains travelling at 60 km/h through the station simultaneously. Whether such a scenario is probable is questionable, because:

- Road traffic average speeds decrease during peak hours due to congestion on the road. Long-term measurements conducted by the author next to a road during peak

traffic periods (including vehicle counts) indicated that average noise levels actually decrease during these periods.

- A train travelling at 60 km/h through the station is a rare occurrence.

7.3 SCENARIO – WORST CASE: FUTURE NOISE LEVELS AS MODELLED – PEAK HOURS

The projected future night-time soundscape surrounding the proposed development is presented in **Figure 7-3**. This scenario presents the ambient noise levels during peak hours associated with the projected road and railway traffic and includes the noise from the shunting operations. The limitations as highlighted in the previous section are applicable.

7.4 SCENARIO - LIKELY: FUTURE NOISE LEVELS AS MODELLED – PEAK HOURS

The projected future likely night-time soundscape surrounding the proposed housing development is presented in **Figure 7-4**. This scenario presents the ambient noise levels during peak hours associated with the projected road and railway traffic and includes the noise from the shunting operations. It however allows for certain management measures to minimise noise, including trains travelling at the more common 30 km/h for all trains entering and leaving the station (travelling within 200 meters from residential areas).

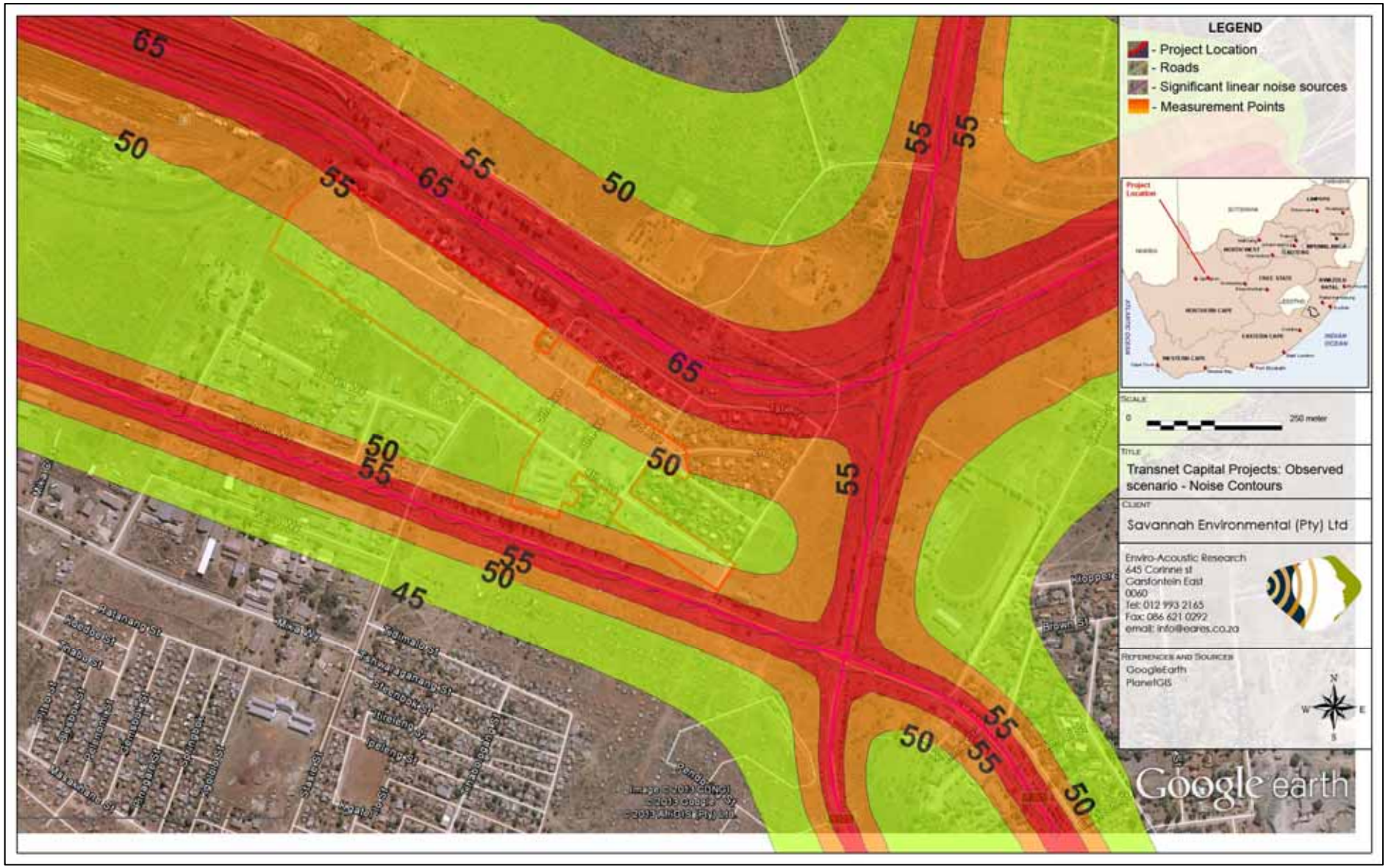

Figure 7-1: Observed scenario – night-time noise levels

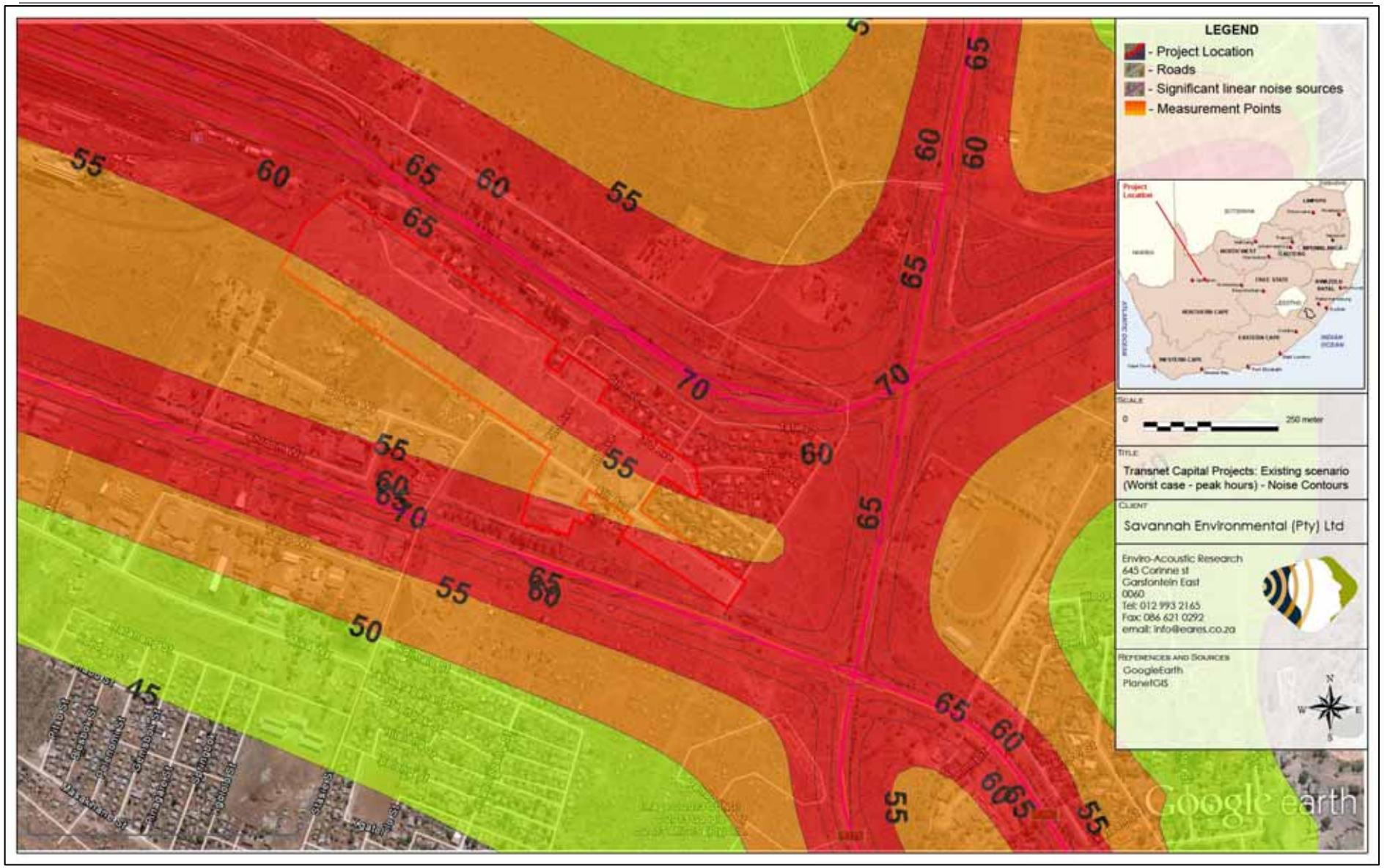

Figure 7-2: Projected existing scenario – Modelled worst-case night-time noise levels

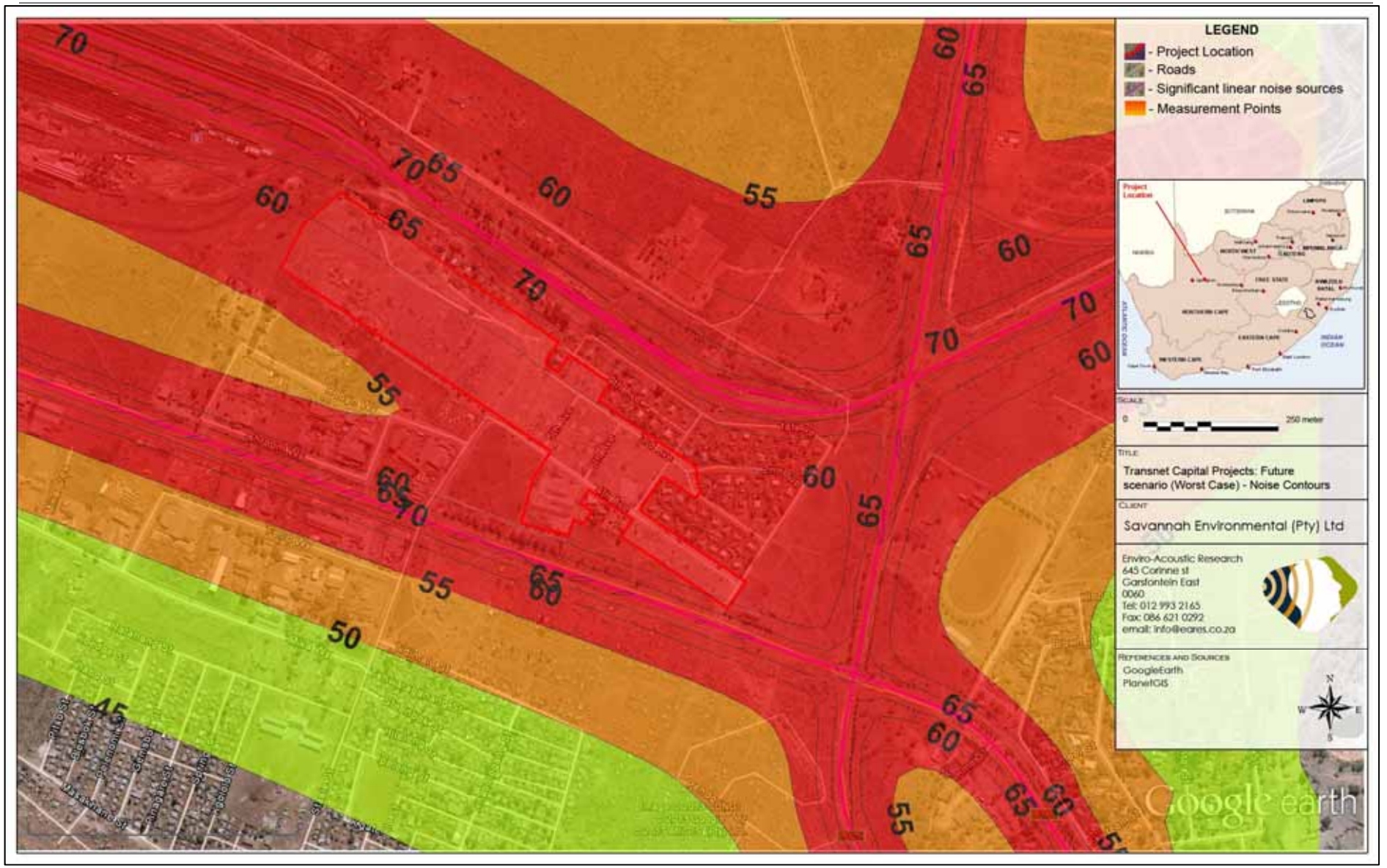

Figure 7-3: Projected future (15 years) scenario – Modelled worst-case night-time noise levels

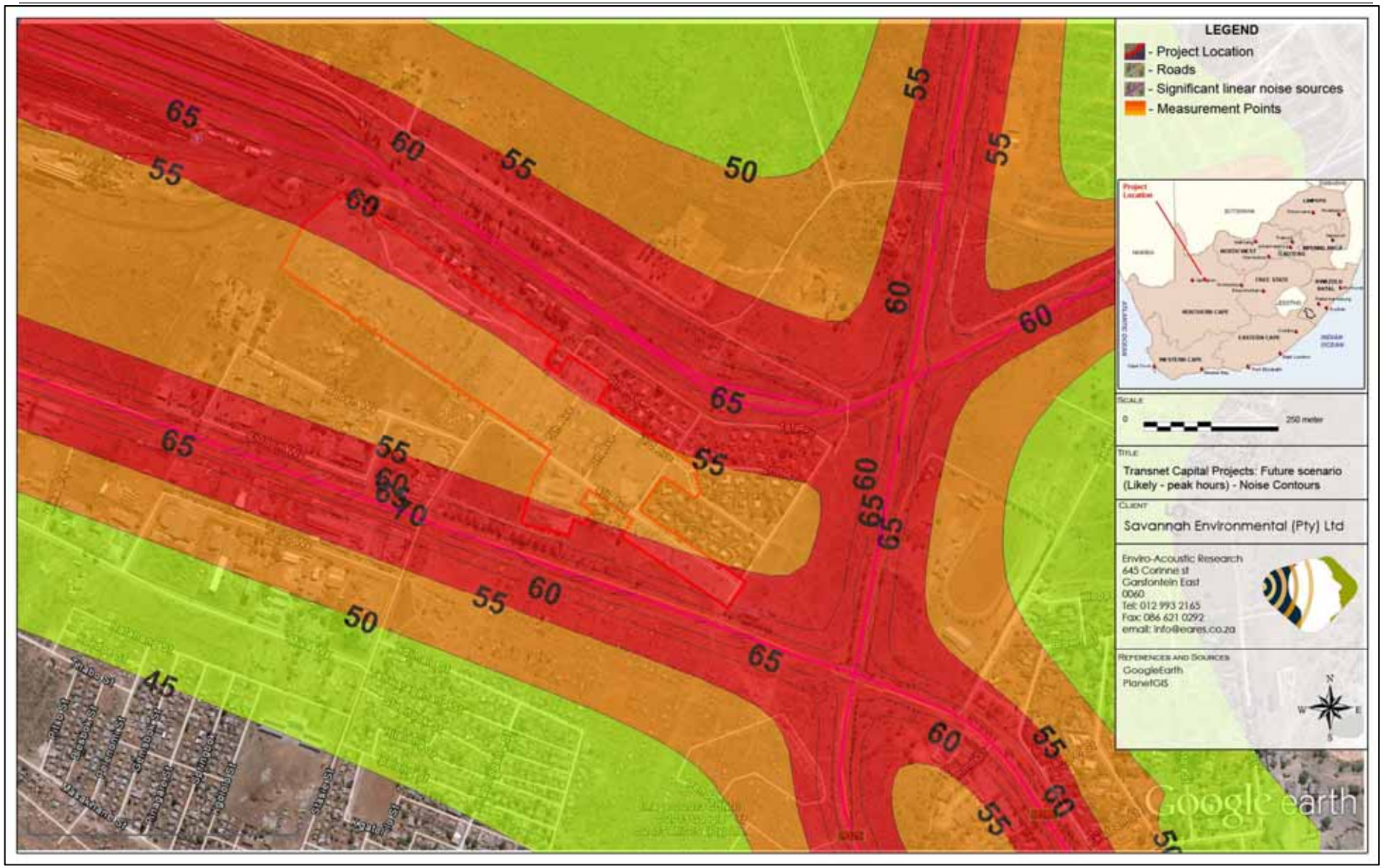

Figure 7-4: Projected future (15 years) scenario – Modelled likely night-time noise levels for peak hours

7.5 IMPACT ASSESSMENT – TRANSNET POSTMASBURG HOUSING DEVELOPMENT

The impact significance as assessment for residents in the housing development is presented in the following tables.

Table 7-1: Impact Assessment – Observed scenario

Nature:	Rating levels exceeding the recommended zone sound level during the evening (19:00 – 22:00) and night-time hours of (22:00 – 06:00)
Acceptable Rating Level	Urban district. Use of $L_{Req,D}$ of 55 dBA. Use of $L_{Req,N}$ of 45 dBA.
Extent	**Local (2)** – The impact could affect the local area (within 1,000 meters from the noise sources).
Duration	**Long term (4)** – Impacts that will continue for the life of the development
Magnitude ***($L_{Aeq,D}$ < 55 dBA)*** ***($L_{Aeq,N}$ < 45 dBA)***	Equivalent noise levels not expected to exceed the zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Equivalent noise levels will exceed the zone sound level during night-time hours (22:00 – 06:00). People closest to the railway operation and the R385 road can be exposed to equivalent noise rating levels between 5 – 10 dB higher than the zone sound level. The magnitude of the noise impact could be **high (8)**.
Probability	**Highly Likely (4)** • Ambient sound measurements already indicate an area that are impacted at times with increased noise levels • The first and second rows of houses adjacent to the R385 road and Railway line will act as a "sound barrier" assisting in the reduction noise propagation from these sources • Modelling the result of cumulative effect of activities at shunting line (+12 dB penalty), the railway line (2 trains per hour) and traffic on the R326 and R385. It presents a potential worst-case scenario. • Definite that railway and road activities will takes place simultaneously, cumulatively increasing the noise levels. • Shunting activities will increase annoyance levels. • Occupants likely economically dependent on Transnet that would result in a positive attitude towards the noises. • Provision of houses in an area with severe housing shortage will improve attitudes
Significance	**56 (Medium)**
Status	Negative.
Reversibility	High.
Comments	Mitigation recommended
Can impacts be mitigated?	Possible

Table 7-2: Impact Assessment: Existing scenario – Peak hours

Nature:	Rating levels exceeding the recommended zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Any additional traffic will increased the noise rating levels as determined for the "observed" scenario and impact negatively on night-time (22:00 – 06:00) quiet.
Acceptable Rating Level (Zone Sound Level)	Urban district. Use of $L_{Req,D}$ of 55 dBA. Use of $L_{Req,N}$ of 45 dBA.
Extent	**Local (2)** – The impact could affect the local area (within 1,000 meters from the noise sources).
Duration	**Long term (4)** – Impacts that will continue for the life of the development
Magnitude ***($L_{Aeq,D}$ < 55 dBA)*** ***($L_{Aeq,N}$ < 45 dBA)***	Equivalent noise levels would exceed the zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Equivalent noise levels will exceed the zone sound level during night-time

	hours (22:00 – 06:00). People closest to the railway operation and the R385 road can be exposed to noise rating levels up to 5 dB higher than the daytime Zone Sound Level and between 5 – 15 dB higher than the zone sound level. The magnitude of the noise impact could be **Very high (10)** at night.
Probability	**Highly Likely (4)** • Ambient sound measurements already indicate an area that are impacted at times with increased noise levels • The first and second rows of houses adjacent to the R385 road and Railway line will act as a "sound barrier" assisting in the reduction noise propagation from these sources • Definite that railway and road activities will takes place simultaneously, cumulatively increasing the noise levels. • Modelling the result of cumulative effect of activities at shunting line (+12 dB penalty), the railway line (2 trains per hour) and traffic on the R326 and R385. It presents a potential worst-case scenario. • Shunting activities will increase annoyance levels. • Occupants likely economically dependent on Transnet that would result in a positive attitude towards the noises. • Provision of houses in an area with severe housing shortage will improve attitudes
Significance	**60 (Medium)**
Status	Negative.
Reversibility	High.
Comments	Mitigation recommended
Can impacts be mitigated?	Possible

Table 7-3: Impact Assessment: Future scenario – Peak hours

Nature:	Rating levels exceeding the recommended zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Any additional traffic will increased the noise rating levels as determined for the "observed" scenario and impact negatively on night-time (22:00 – 06:00) quiet
Acceptable Rating Level (Zone Sound Level)	Urban district. Use of $L_{Req,D}$ of 55 dBA. Use of $L_{Req,N}$ of 45 dBA.
Extent	**Local (2)** – The impact could affect the local area (within 1,000 meters from the noise sources).
Duration	**Long term (4)** – Impacts that will continue for the life of the development
Magnitude ***($L_{Aeq,D}$ < 55 dBA)*** ***($L_{Aeq,N}$ < 45 dBA)***	Equivalent noise levels would exceed the zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Equivalent noise levels will exceed the zone sound level during night-time hours (22:00 – 06:00). People closest to the railway operation and the R385 road can be exposed to noise rating levels up to 10 dB higher than the daytime Zone Sound Level and potentially more than 10 dB higher than the zone sound level. The magnitude of the noise impact could be **Very high (10)** at night.
Probability	**Highly Likely (4)** • Ambient sound measurements already indicate an area that are impacted at times with increased noise levels • The first and second rows of houses adjacent to the R385 road and Railway line will act as a "sound barrier" assisting in the reduction noise propagation from these sources • Definite that railway and road activities will takes place simultaneously, cumulatively increasing the noise levels. • Modelling the result of cumulative effect of activities at shunting line (+12 dB penalty), the railway line (2 trains per hour) and traffic on the R326 and R385. It presents a potential worst-case scenario. • Shunting activities will increase annoyance levels. • Occupants likely economically dependent on Transnet that would result in a positive attitude towards the noises. • Provision of houses in an area with severe housing shortage will improve attitudes
Significance	**60 (Medium)**

Status	Negative.
Reversibility	High.
Comments	Mitigation recommended
Can impacts be mitigated?	Possible

Table 7-4: Impact Assessment: Future Likely scenario – Peak hours

Nature:	Rating levels exceeding the recommended zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Any additional traffic will increased the noise rating levels as determined for the "observed" scenario and impact negatively on night-time (22:00 – 06:00) quiet
Acceptable Rating Level (Zone Sound Level)	Urban district. Use of $L_{Req,D}$ of 55 dBA. Use of $L_{Req,N}$ of 45 dBA.
Extent	**Local (2)** – The impact could affect the local area (within 1,000 meters from the noise sources).
Duration	**Long term (4)** – Impacts that will continue for the life of the development
Magnitude ***($L_{Aeq,D}$ < 55 dBA)*** ***($L_{Aeq,N}$ < 45 dBA)***	Equivalent noise levels would exceed the zone sound level during peak hours (mornings 06:00 – 9:00) and late afternoon (17:00 – 19:00). Equivalent noise levels will exceed the zone sound level during night-time hours (22:00 – 06:00). People closest to the railway operation and the R385 road can be exposed to noise rating levels up to 5 dB higher than the daytime Zone Sound Level and between 5 – 15 dB higher than the zone sound level. The magnitude of the noise impact could be **Very high (10)** at night.
Probability	**Highly Likely (4)** • Ambient sound measurements already indicate an area that are impacted at times with increased noise levels • The first and second rows of houses adjacent to the R385 road and Railway line will act as a "sound barrier" assisting in the reduction noise propagation from these sources • Definite that railway and road activities will takes place simultaneously, cumulatively increasing the noise levels. • Modelling the result of cumulative effect of activities at shunting line (+12 dB penalty), the railway line (2 trains per hour) and traffic on the R326 and R385. It presents a potential worst-case scenario. • Shunting activities will increase annoyance levels. • Occupants likely economically dependent on Transnet that would result in a positive attitude towards the noises. • Provision of houses in an area with severe housing shortage will improve attitudes
Significance	**60 (Medium)**
Status	Negative.
Reversibility	High.
Comments	Mitigation recommended
Can impacts be mitigated?	Possible

8 MITIGATION OPTIONS

The mitigation of noise from existing roads and railway lines are unfortunately difficult and potentially expensive to implement. Of these mitigation measures the most effective would be the enforcing of certain speed limits by both the road (municipal function) and railway traffic (Transnet operational function). Mitigation discussed below is optional and not mandatory for the developer.

8.1 MITIGATION OPTIONS: MITIGATION OF NOISE SOURCE - RAILWAY

Because the commercial railway activities are excluded from the requirements of the *Government Notice R154 of 1992 (Noise Control Regulations) – Clause 2(c) (the need to implement mitigation measures) no mitigation measures are highlighted for railway traffic in this section.*

8.2 MITIGATION OPTIONS: MITIGATION OF NOISE SOURCE - ROADS

Noise from roads is a function of the local authority. The developer should consider and discuss with the municipality the active enforcement of the speed limit on the roads in the vicinity of the development.

8.3 PROPOSED MITIGATION OPTIONS: MITIGATION AT RECEPTORS

The following optional possibility can be considered by the developer:

1. Dwellings can be designed and constructed taking note of the higher noise levels in the area. This can include the lining of the ceiling with acoustic absorbent material and the use of double glazed windows. Any apertures from adjacent residents facing the roads and railway line (doors, windows etc.) with a direct line of sight can make use of double glazing.
2. That the developer obscures the line of sight from all receptors to the noise sources with the use of a barrier.

   Note:

   i. If this option is selected the barrier should be constructed as close as possible to the footprint of the roads or railway line (noise source) or residents for the housing development (receptors) as is feasibly possible. The barrier design needs to consider diffraction, and should have no aperture or gaps;

ii. The height of the berms/barriers should be at least 1 m higher than the line of sight to the highest noise source from the road/railway line to a receptors dwelling. Certain heavy vehicles and most locomotives have exhausts above the cabin of the vehicle (higher than two meters from ground level) and this must be considered when implementing the barrier. Barriers must also be sufficiently dense (at least 20 kilograms/square meter surface density) and sufficient in thickness. A brick wall provides a surface density of 244 kilograms/m^2 at thickness of 150 mm [6] and is considered as a typically good acoustical barrier.

iii. It should be noted that noise from the exhaust from trucks or locomotives are likely to exceed this barrier and would increase the single event noise levels at the adjacent dwellings.

[6] Environmental Protection Department; Government of the Hong Kong SAR Second Issue, January 2003

9 CONCLUSIONS

A noise assessment was done as required by the National Noise Control Regulations which states that (Clause 3a):
"No person shall establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences";

This assessment therefore investigates the existing and future acoustical environment in the vicinity of the proposed Transnet Housing Development in Postmasburg. The development of the housing development will not result in a noise impact of any significance (low) during either the construction or operational phase.

The main noise sources are the R325 and R385 roads as well as the railway facility. As these are existing operations it will impact on the potential receptors living in the housing development, an important fact the developer must consider.

Acoustical measurements and a site investigation indicated a rating level (acceptable zone sound level or rating level) conforming to an Urban District as defined in SANS 10103:2008 (55 day and 45 dBA night-time Rating).

Four scenarios were investigated, namely:

- An observed scenario as observed (road) and discussed (railway) onsite;
- The potential worst-case existing situation with maximum traffic (road and rail) during peak hours;
- The potential worst-case future scenario with maximum traffic (road and rail) during peak hours;
- The likely scenario with maximum traffic (road and rail) during peak hours but with the trains limited to a maximum speed of 30 km's when passing the proposed housing development.

Calculations were done in accordance with the sound propagation model described by British CRTN (Road Traffic Noise) and CRN (Railway Noise). Road traffic calculations were checked using the SANS 10210:2004 model. This assessment considered an observed scenario, the existing peak hour (worst case) scenario, the projected future peak hour (worst case) as well as a future likely scenario (some mitigation measures implemented).

This assessment however indicate a sound environment where rating levels would exceed the daytime zone sound levels during peak traffic periods as well as the night-time zone sound level for all the scenarios evaluated. The calculated rating levels are likely to exceed the recommended zone sound levels for an urban residential area in the future in the unmitigated situation.

Because the road and railway activities already exists it will be very difficult for the developer to implement measures to manage the generated noise levels at the source. The developer should however consider the noise levels as well as the viability of implementing measures at the receptor as suggested in **section 8.3**.

10 THE AUTHOR

The author of this report, M. de Jager (B. Ing (Chem), UP) graduated in 1998 from the University of Pretoria. He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker enclosure design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. As from 2007 he has been involved with the following projects:

- Full Noise Impact Studies for a number of Wind Energy Facilities, including: Cookhouse, Amakhala Emoyeni, Dassiesfontein/Klipheuwel, Rheboksfontein, AB, Dorper, Suurplaat, Gouda, Riverbank, Deep River, West Coast, Happy Valley, Canyon Springs, Tsitsikamma WEF, West Coast One, Karoo, Velddrift and Saldanha.
- Full Noise Impact Studies for a number of mining projects, including: Skychrome (Pty) Ltd (A Ferro-chrome mine),Mooinooi Chrome Mine (WCM), Buffelsfontein East and West (WCM),Elandsdrift (Sylvania),Jagdlust Chrome Mine (ECM),Apollo Brick (Pty) Ltd (Clay mine and brick manufacturer), Arthur Taylor Expansion project (X-Strata Coal SA), Klipfontein Colliery (Coal mine), Landau Expansion project (Coal mine), Modelling for Tweefontein Colliery Expansion.

The author is an independent consultant to the project, Savannah Environmental (Pty) Ltd and the client. He,

- does not and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations;
- have and will not have no vested interest in the proposed activity proceeding;
- have no and will not engage in conflicting interests in the undertaking of the activity;
- undertake to disclose all material information collected, calculated and/or findings, whether favourable to the development or not; and
- will ensure that all information containing all relevant facts be included in this report.

11 REFERENCES

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

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

	special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time	(1) Averaging detection time used in sound level meters as per South African

weighting	standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} *and* L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings;

	e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).

Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

Site Investigation – Photos of continuous monitoring locations

Photo 1: PBN01 measurement location

APPENDIX C

Project Layout

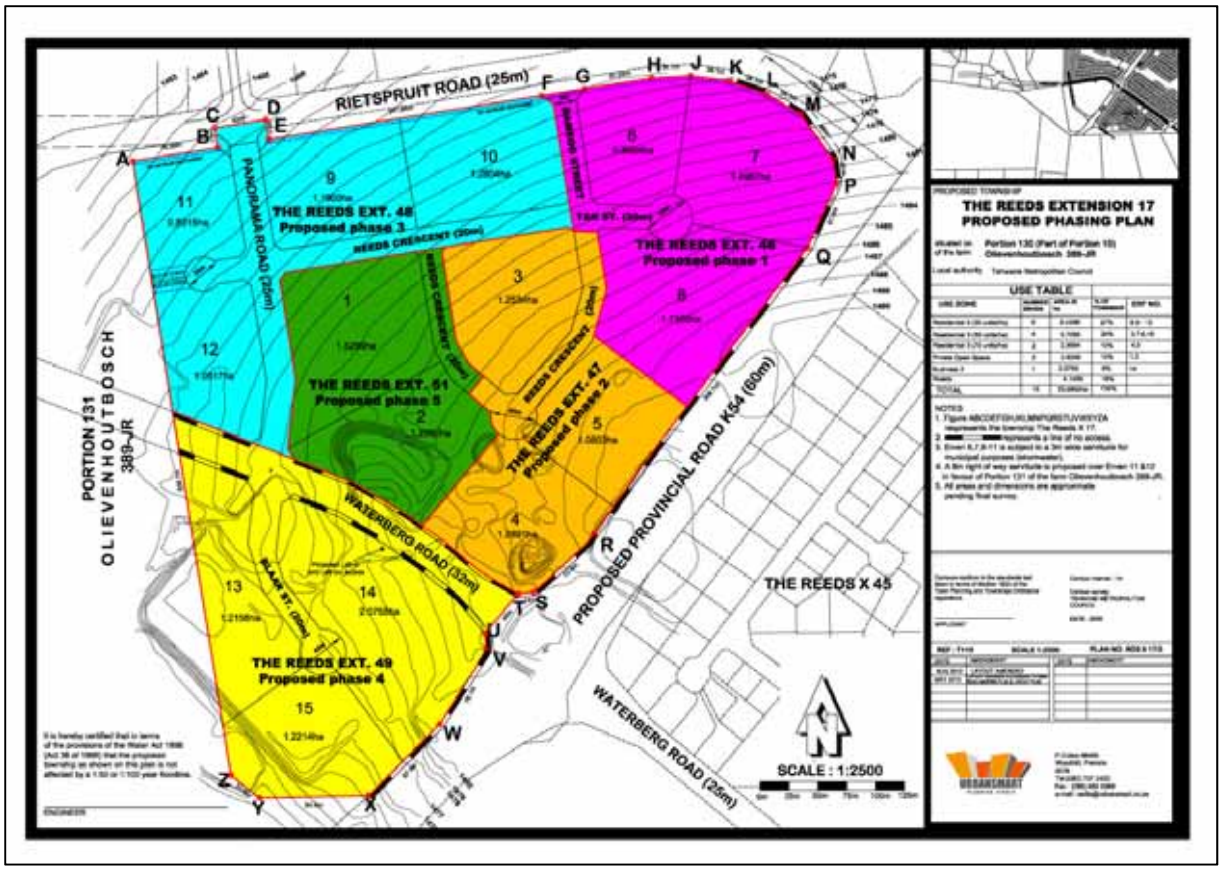

Figure 1: Project boundary layout