dBAcoustics

Tel.	**+27 11 679-1451**	**PO Box 1219**
Fax	**+27 11 679-1451**	**Allensnek**
Cell	**+27 82 922 0298**	**1737**
e-Mail	**barendv@xsinet.co.za**	

Environmental Noise Impact Assessment

Proposed Township Establishment
Portions 146 and 147 and the Remainder of Portions 145, 160 and 164 of the Farm Witfontein 301 JR

Klerksoord Ext 25 & 26
Klerksoord

Project No: 144/2008
Compiled by: B v/d Merwe
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Contents:

1. Purpose of the Study

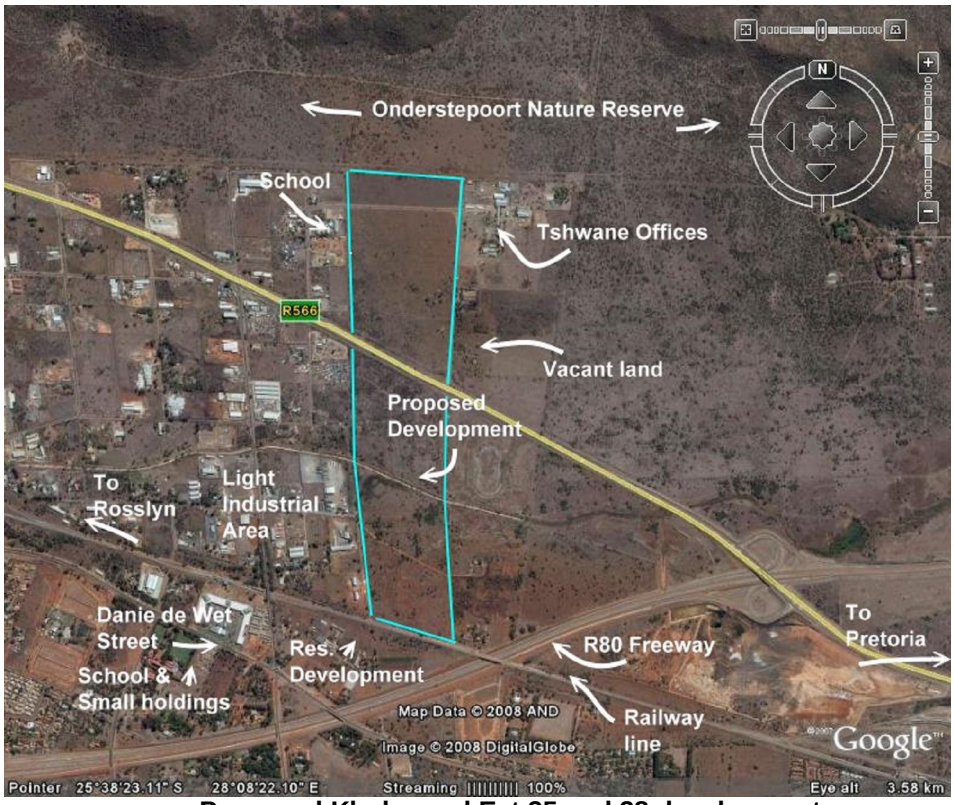
- The noise survey was carried out in order to determine the prevailing ambient noise levels in the vicinity of the proposed development.

- Quantify the alleged impact of noise on the prevailing ambient levels and the outdoor environment.

2. Introduction

The proposed development will consist out of a residential component in the southern section between the railway line and the R 566 Provincial road of the property and a light industrial component in the northern section between the R566 road and the Onderstepoort Nature Reserve.

There is an existing light industrial development on the western side and vacant land on the eastern side with the Onderstepoort Nature Reserve on the northern side of the proposed development. The R 566 Provincial Road divides the property into a northern and a southern side and the R80 Freeway is towards the Southeastern side of the property. The main railway line between Rosslyn and Pretoria is on the Southern side of the development.



Proposed Klerksoord Ext 25 and 28 development

The purpose of this study is to identify noise sources in and around the proposed development, which may have an impact on the development and to recommend mitigatory measures for compliance to the Noise Control Regulations and the South African National Standards SANS 10103 of 2008 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.

The aspect, which will be addressed in this report, is noise and to quantify and assess the intrusion of traffic and train noise from the abutting road and/or railway line. These two sources are the main contributor to the prevailing ambient noise level for this area. The light industrial area to the west creates noise to a certain extent and there was some noise

audible on the boundary between the industrial park and the proposed development. The stretch along the railway line will only be exposed to noise when there is a train after which the prevailing ambient noise level will be maintained.

3. Background to noise

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

Noise from a point source attenuates at a rate of 6 dB per doubling of distance from a point source and from a line source at a rate of 3 dB per doubling of distance – Inverse Square
Law. In free field conditions a point source (diesel generator) which is measured at 87,0 dBA and at 10m from the source 84,5 dBA will be at 20m 78,5 dBA and at 40m the SPL will be 72,5 dBA etc. At a line source, which is road with cars, the reduction will only be 3 dB per doubling of distance.

The decibel scale is logarithmic therefore decibel levels cannot be added together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 dB.

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

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

- long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95 dBA. This will seldom happen in far-field conditions.

- Interference with speech where important information by the receiver cannot be analyzed due to loud noises.

- Excessive loudness – loud music or impulse sound created by explosions

- Annoyance – Barking dogs

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

The effect of noise on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is very difficult to predict and is influenced by the emotional state of the complainant, his attitude towards the noise source, the time of day or night and the day of the week.

Types of noise exposure:

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

Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens.

Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

The human condition is affected by the intensity of the sound; the length of time of exposure and how often over time the human is exposed to it. Urban dwellers are besieged by noise, not only in the city streets but also in the busy workplaces and by household noises.

The World Health Organisation has published a series of recommended maximum sound pressure levels applicable to various situations:

Descriptor	Limit	Situation or effect
LAeq, 24	70 dBA	Negligible risk of hearing impairment
LAeq, 8	75 dBA	Negligible
LAeq	30 dBA	Excellent speech intelligibility
LAeq	55 dBA	Fairly good speech intelligibility
LAeq	30 dBA	No sleep disturbance in a bedroom
LAmax	45 dBA	No sleep disturbance – peak inside bedroom
LAeq	55 dBA	Residential areas, outdoors, daytime
LAeq	45 dBA	Residential areas, outdoors, night time

4. Method of evaluation

The noise survey was conducted in terms of the provisions of the Noise Control Regulations and the South African National Standards.

The following integrated noise level meters were used in the noise survey:

Instrument 1

Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072
Larsen Davis Pre-amplifier – Serial no. PRM831 0206
Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184
Larsen Davis Calibrator 200 – Serial no.3073

Instrument 2

Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 824A3282
Larsen Davis Pre-Amplifier – Serial No. PRM 902/3493
Larsen Davis ½" free field microphone – Serial No. 2541/7937
Larsen Davis Calibrator 200 – Serial no.3073

The instrument was calibrated before and after the measurements were done and coincided within 0,5 dBA.

Batteries were fully charged and the windshield was in place at all times.

Copies of the Calibration Certificates are attached for easy reference.

5. Comments

The noise survey was carried out at the boundary of the proposed development.

In terms of Table 5 of SANS 10103 of 2008 the following response by people can be expected should the ambient noise level be exceeded:

Categories of community/group response

1	2	3
Excess $)L_{Req,T}$ [1)] dB	**Estimated community/group response**	
	Category	**Description**
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

1) Calculate $)L_{Req,T}$ from the appropriate of the following:

a) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).

b) $)L_{Req,T}$ = $L_{req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.

c) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2.

The difference between the actual noise and the ambient noise level will determine how people will respond to sound.

The following is of relevance to the ambient noise measurements:

- The L_{Aeq} was measured over a sampling period in excess of 10 minutes at each measuring points and was done during the daytime and nighttime period.

6. Methodology of the study

6.1 Site visit
6.2 Ambient noise measurements
6.3 Noise emissions during daytime and nighttime at the proposed residential development
6.4 Noise impacts
6.5 Assessment of the noise impact

6.1 Site visit

A site visit was carried out prior to doing the noise survey in order to:

- Identify the major contributors to the prevailing ambient noise level in and around the proposed development.
- Identify the major feeder roads in the vicinity of the proposed development.
- Any other sources of noise.

- The site visit was furthermore done to identify potential measuring positions in an around the proposed development.

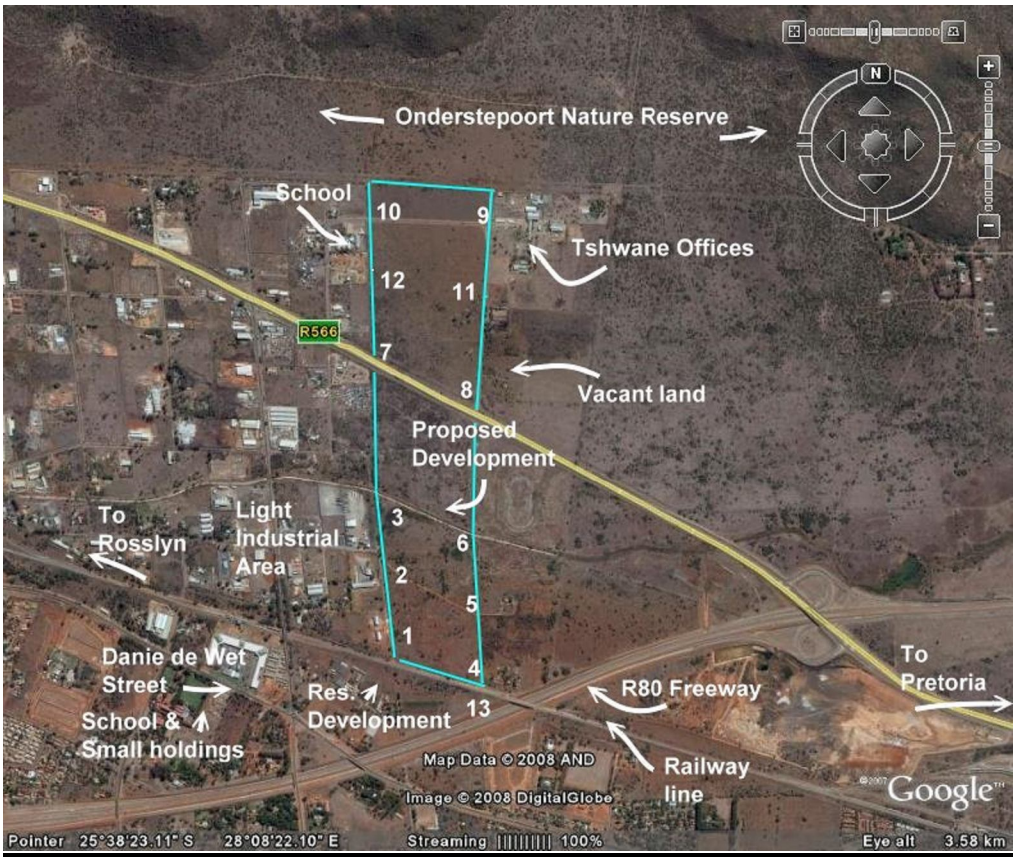
6.2 Ambient noise measurements

Ambient noise readings were taken at the following measuring points:

Position	Co-ordinates
1	25^{0}38.856 S; 028^{0}08.111 E
2	25^{0}38.692 S; 028^{0}08.073 E
3	25^{0}38.539 S; 028^{0}08.043 E
4	25^{0}38.959 S; 028^{0}08.307 E
5	25^{0}38.801 S; 028^{0}08.304 E
6	25^{0}38.673 S; 028^{0}08.297 E
7	25^{0}38.238 S; 028^{0}08.056 E
8	25^{0}38.340 S; 028^{0}08.282 E
9	25^{0}37.942 S; 028^{0}08.301 E
10	25^{0}37.935 S; 028^{0}08.059 E
11	25^{0}38.184 S; 028^{0}08.307 E
12	25^{0}38.095 S; 028^{0}08.039 E

Other measuring position:

- Next to R80 on embankment – Position 13



Measuring points and other information

6.3 Noise emissions during daytime and nighttime at the proposed development

The ambient noise level in the middle of the proposed development is made up out of traffic noise for the stretch along the R566 and industrial noise for the stretch abutting the industrial area. The ambient noise level is made up out of traffic noise, industrial type noise and train noise. There is also aircraft noise at times. There is a

constant flow of traffic during daytime and the noise level along the section abutting the industrial area reduce during nighttime because there are very little industrial activities during the nighttime period. During nighttime there is an increase in insect noise, which subsequently increase the ambient noise level accordingly. There is a decline in traffic and trains during the nighttime period.

6.4 Noise impacts

The difference between the actual noise and the ambient noise level will determine how people will respond to sound and what the noise impact on an individual will be. In order to evaluate such there must be uniform guidelines to evaluate each scenario. The World Health Organization has laid down sound pressure levels for specific districts and SANS 10103 of 2008 has provided the following recommended equivalent continuous noise levels per district:

Typical rating levels for ambient noise in districts

1	2	3	4	5	6	7
	***Equivalent continuous* rating level $L_{Req.T}$ [1)] for ambient noise** dBA					
	Outdoors			**Indoors, with open windows**		
Type of district	***Day-night*** L_{Rdn} [2)]	**Day-time** L_{Rd} [1)]	**Night-time** L_{Rn} [1)]	***Day-night*** L_{Rdn} [2)]	**Day-time** L_{Rn} [1)]	**Night-time** L_{Rn} [1)]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

In districts where the $L_{R.dn}$ exceeds 55.0 dBA, residential buildings e.g. dormitories, hotel accommodation and residences, these areas should preferably be treated acoustically to obtain indoor $L_{Reg.T}$ values in line with Table 1 of SANS 10103 of 2008.

The reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and are for daytime between 6h00 to 22h00 and for nighttime between 22h00 and 6h00.

The recommended ambient noise level for an urban residential district is 55 dBA for the daytime period and 45 dBA during the nighttime period. The nighttime ambient noise level next to busy roads and freeways seldom drop below 55 dBA and there are various examples of residential developments along busy roads.

The response to noise can be classified as follows:

- An increase of 0dBA or less will cause no response from the affected community. For a person with normal hearing an increase of less than 3 dBA will not be noticeable
- An increase between 0dBA – 10 dBA will elicit little to sporadic response. When the difference is more than 5 dBA above the ambient noise level a person with normal hearing will start to hear the difference.
- An increase between 5dBA and 15 dBA will elicit medium response from the affected community.
- An increase between 10dBA and 20 dBA will elicit strong community reaction.

The overlapping categories are because there is no clear-cut transition from one community response to another and there are variables, which should be taken into account when evaluating a potential noise problem.

6.6 Assessment of noise impacts

Two aspects are important when considering potential noise impacts on a specific area, and it is:

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

In terms of noise increases, persons exposed to an increase of 2 dBA or less would not notice the difference. Some people exposed to increases of 3-4 dBA will notice the increase in noise level, although the increase would not be considered serious. Noise increases of 5dBA and above are very noticeable, and, if these are frequent incidents, or continuous in nature, could represent a significant disturbance.

Although the recommended sound pressure level for a residential area according to the IFC of the World Bank is 55.0dBA during daytime and 45.0dBA during nighttime the SANS 10103 of 2008 have the following recommended continuous rating levels for a district next to a busy road:

Urban district next to a busy road

- Day-night 60 dBA
- Daytime 60 dBA
- Nighttime 50 dBA

The section of the proposed development along the R566 feeder road will be exposed to higher sound pressure levels whereas the areas some distance from the road and the railway line will have lower noise levels. This is due to the distance from the road and the topography of the property.

The train noise is not a continuous noise as for road traffic at busy roads and the increase in the noise level is for a short period of time only after which the prevailing ambient noise level is normal again.

7. Results of the Noise Surveys

7.1 Description of the environment

- Klerksoord Ext 25 & 26

7.2 Measured Ambient noise levels

- Klerksoord Ext 25 & 26

7.3 Noise impact during daytime and night time

7.4 Results i.t.o. SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

7.1 Description of the environment

- Klerksoord Ext 25 & 26

The proposed housing development will be situated on flat ground with trees and a railway line on the southern side and the R 566 road on the northern side. The proposed light industrial development will be situated on flat ground conditions with the R566 road on the southern side and the Onderstepoort Nature Reserve on the northern side. There is an existing industrial area on the western boundary.

The following meteorological conditions were recorded:

30 October 2008

- Wind speed – Daytime - less than1.8 m/s, Nighttime – less than 2.1 m/s
- Temperature – 15.0^{o}C to 29.5^{o}C – No strong temperature gradient occurred near the ground
- Cloud cover – There was a threat of rain during the day and night
- Wind direction – There was northeasterly wind during the day and nighttime period.
- Humidity – High humidity during daytime with some rain forecast for the nighttime period.

7.2 Measured Ambient noise levels

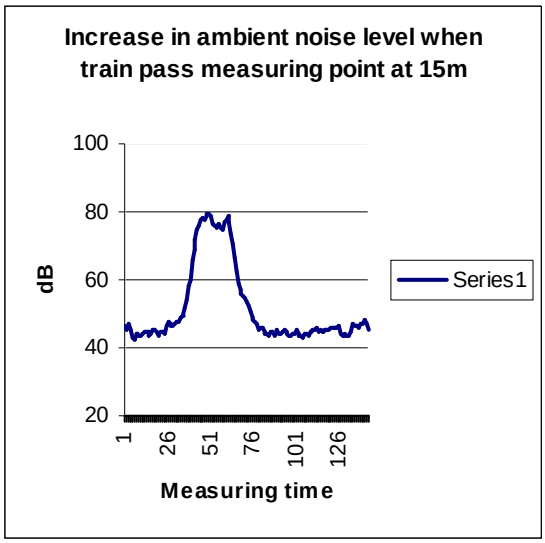
Position	Ambient Daytime (dBA)	L_{Max} - dBA	L_{Min} - dBA	Ambient Nighttime (dBA)	L_{Max} - dBA	L_{Min} - dBA
1	50.1	68.6	39.4	45.6	54.6	42.3
2	50.3	72.5	40.7	45.6	54.6	42.3
3	50.3	63.2	42.6	46.3	60.6	42.5
4	50.3	72.5	40.7	46.1	61.8	43.3
5	51.0	73.1	39.7	46.0	59.6	41.4
6	48.2	68.0	40.7	46.7	63.2	42.6
7	64.9	78.9	41.5			
8	63.2	76.6	40.8	61.4	80.5	43.7
9	45.0	64.3	32.4	43.1	48.3	39.7
10	43.8	64.6	33.5	43.5	54.6	38.6
11	49.8	71.8	39.5	49.4	56.0	40.9
12	49.5	66.6	41.7			
13	68.8	89.6	46.7			

Next to R80 on embankment – Position 13

Leq – dBA 68.8dBA
L_{Max} – dBA 89.6dBA
L_{Min} – dBA 46.7dBA

When a train passed the measuring site at measuring position 4 the noise level was measured at:

Leq – dBA	66.1dBA
L_{Max} – dBA	86.8dBA
L_{Min} – dBA	39.4dBA



This is however a situation when the ambient noise level is raised for the period the train is in the vicinity of the receptor, after which the prevailing ambient noise level is maintained.

7.3 Noise impact during daytime and nighttime.

Daytime

The prevailing noise level along the R 566 boundary is 64.0dBA and at the Northern boundary abutting the Onderstepoort Nature Reserve, the prevailing sound pressure level is 44.4dBA.

Along the railway line at the Southern boundary the sound pressure level when a train passes the measuring site the sound pressure level is 66.1 dBA and during no train activities the sound pressure level is 50.1dBA. There are other noises i.e. bird and insect noise which is there all the time due to the nature of the environment. The distant traffic noise is at times audible throughout the property depending on the intensity of the traffic and the wind direction.

Nighttime

During nighttime the prevailing ambient noise level is made up of insect noise and traffic noise. There is very little sound from the industrial area as most of the industries close at 18h00. The prevailing noise level along the R 566 boundary is 61.4dBA and at the Northern boundary abutting the Onderstepoort Nature Reserve, the sound pressure level is 43.1dBA.

Along the railway line at the Southern boundary the sound pressure level when a train passes the measuring site the sound pressure level is 66.1 dBA and during no train activities the sound pressure level is 45.6dBA. The distant traffic noise becomes more audible at night as the cars travel at higher speeds with the resultant increase in the sound pressure level.

The increase in the prevailing noise level is only for the duration the trains are in the vicinity of the receptor.

The prevailing noise levels are for the external environment and not the internal environment of a building and/or house.

7.4 Results i.t.o. SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication and SANS 10210 of 2004, the national standard for the calculating and predicting of road traffic noise

SANS 10103 of 2008

There is a constant flow of traffic along the R 566 provincial road, which runs through the middle from the eastern to the western side of the proposed development. This create a situation that the prevailing ambient noise levels are higher at this portion of the proposed development and at times higher along the southern boundary when there is a train. The prevailing ambient noise level along the western boundary is typical of the noise levels expected along a light industrial area.

The sound pressure level will decrease along the R 566 road by 3.0dB and along the boundary next to the light industrial area by 6.0dB per doubling of the distance from the source. (Inverse Square Law principle where the sound will decrease by either 3.0dB or 6.0dB with the doubling of distance from the source)

SANS 10210 of 2004

The increase of the prevailing ambient noise level with the influx of vehicles to and from the proposed development is calculated as follows:

Basic Model

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

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

The mean traffic flow was based on 80 motor- vehicles per hour and 80 heavy-duty vehicles per hour for the study area (this will not be the norm throughout the day)

Primary corrections to the basic model:

- Corrections for speed of traffic and percentage of heavy vehicles, $L_{P,v}$
- Correction for gradient, L_{gr}
- Correction for road surface texture, L_{t}
- Correction for ground conditions and distance of the receiver, $L_{d,hr}$

L_{Aeq} (1h) = $L_{Basic} + L_{P,v} + L_{gr} + L_{t} + L_{d,hr}$

- At a gradient of 0 % and a speed of 60 km/h the projected sound pressure level at 20m from the road is **62.8 dBA**

The above sound pressure values are calculated on direct line of sight and should the vegetation, distance from the source and topography factors be taken into consideration, the values will be lower than the above calculated values.

There will be no impact on the prevailing ambient noise levels should the traffic volume increases by 160 vehicles per hour in the vicinity of the proposed development along the R 566 road.

The internal traffic and industrial activities will not have an impact on the residential areas to the South of the proposed development due to the distance between the light industrial area and the residential area and the higher sound pressure levels along the railway line.

8. Recommendations

- A 1.5 m earthberm with a 1.8m wall to be erected along the boundary of the property abutting the railway line to create a noise barrier along the Southern boundary. The distance between the railway line boundary and the houses to be 30m.
- The distance between the houses and the R 566 road will have to be 20m and a 2.0m wall to be erected on the entire boundary abutting the road.
- The entertainment area and sleeping areas of the houses abutting the road and the railway line will have to face away from the road and/or the railway line.
- A 2.0m wall to be erected along the entire length of the residential area abutting the light industrial area.

9. Conclusion and summary

The proposed development will be in line with SANS 10103 of 2008 - The measurement and rating of environmental noise with respect to annoyance and to speech communication and the Gauteng Noise Control Regulations, provided that the acoustic screening measures are in place before occupation of the units may take place.

Barend van der Merwe
Acoustic Consultant

Definitions/Noise:

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

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

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

where

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

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

NOTE The internationally accepted symbol for sound level is dBA.

distant source

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

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

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

where

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

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

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

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

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

intelligible speech
speech that can be understood without undue effort

low frequency noise
sound, which predominantly contains frequencies below 100 Hz

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

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

specific noise
a component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source

NOTE Complaints about noise usually arise as a result of one or more specific noises.

ambient sound level
means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

disturbing noise
means a noise that cause the ambient noise level to rise 7 dBA above the designated zone level, or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in table 2 of SANS 10103.

Abbreviations: SPL = Sound Pressure Levels, dB = Decibel, dBA = Decibel A weighted