Table 5:

Equations for the variation of σ_y and σ_z

Pasquill stability class	σ_y	σ_z
A	$0.22x(1+0.0001x)^{-0.5}$	$0.20x$
B	$0.16x(1+0.0001x)^{-0.5}$	$0.12x$
C	$0.11x(1+0.0001x)^{-0.5}$	$0.08x(1+0.0002x)^{-0.5}$
D	$0.08x(1+0.0001x)^{-0.5}$	$0.06x(1+0.0015x)^{-0.5}$
E	$0.06x(1+0.0001x)^{-0.5}$	$0.03x(1+0.0003x)^{-1}$
F	$0.04x(1+0.0001x)^{-0.5}$	$0.016x(1+0.0001x)^{-1}$

The simplest Gaussian solution assumes that the plume is free to expand in all directions without constraint. In the usual situation of an elevated source at some height above the ground, downwind dispersion is always limited by the presence of the ground, while upward dispersion may be limited by an elevated inversion. Assuming that no pollutant is absorbed by the ground, any pollutant that reaches the ground is available for upward dispersion and the following equation takes into account reflection at the ground:

$$C_{x,y} = \frac{Q}{2\pi u \sigma_z \sigma_y} \exp \frac{-y^2}{2\sigma_y^2} \left[\exp - \frac{1}{2} \left(\frac{z-H}{\sigma_z^2} \right)^2 \right] + \exp \left[-\frac{1}{2} \left(\frac{z+H}{\sigma_z^2} \right)^2 \right]$$

Results

This section contains the results of the predicted maximum and average ground level concentrations generated through the ISC-AERMOD VIEW model.

Concentration and deposition isopleths illustrated in **Figure 8** to **10** reflect interpolated values for each receptor grid point for various averaging periods. It has generally been found that the accuracy of dispersion models improve with increased averaging periods. The prediction of instantaneous peaks are the most difficult and are normally performed with more complicated dispersion models specifically fine-tuned and validated for the process and location. For this reason concentrations

resulting from routine releases are given for at least two averaging periods, viz. highest daily and annual averages. No significant upset (intermittent release) sources are expected for the process.

The results presented in **Figure 8** to **10** reflect the spectrum from maximum ground level concentrations, occurring during very unstable conditions with low wind speeds, to low wind speeds during very stable conditions resulting in maximum impact area.

Dispersion results are presented under the following subsections:

- Daily average dust deposition rates during construction and normal operations (**Figure 8**);
- Daily average PM_{10} concentration during normal operations (**Figure 9**); and
- Annual average PM_{10} concentration during normal operation (**Figure 10**).

The following additional inputs were included in the simulation of emissions from the Brown Shaft II Project:

- Source emission rates contained in **Table 4**.
- Emission control factors contained in **Table 4**.
- *Emission Inventory for the Goedehoop Coal Mine Operations In Mpumalanga,* a project done on behalf of Anglo Coal by Airshed Planning Professionals.
- A uniform Cartesian grid with a resolution of 250m by 250m.
- Local meteorological data for the period 1 June 2007 to 31 May 2012.
- Average annual background dust deposition rate of 192mg/m^2/day for cumulative assessment.
- Average annual background PM_{10} concentration of 43.29µg/m^3 for cumulative assessment.

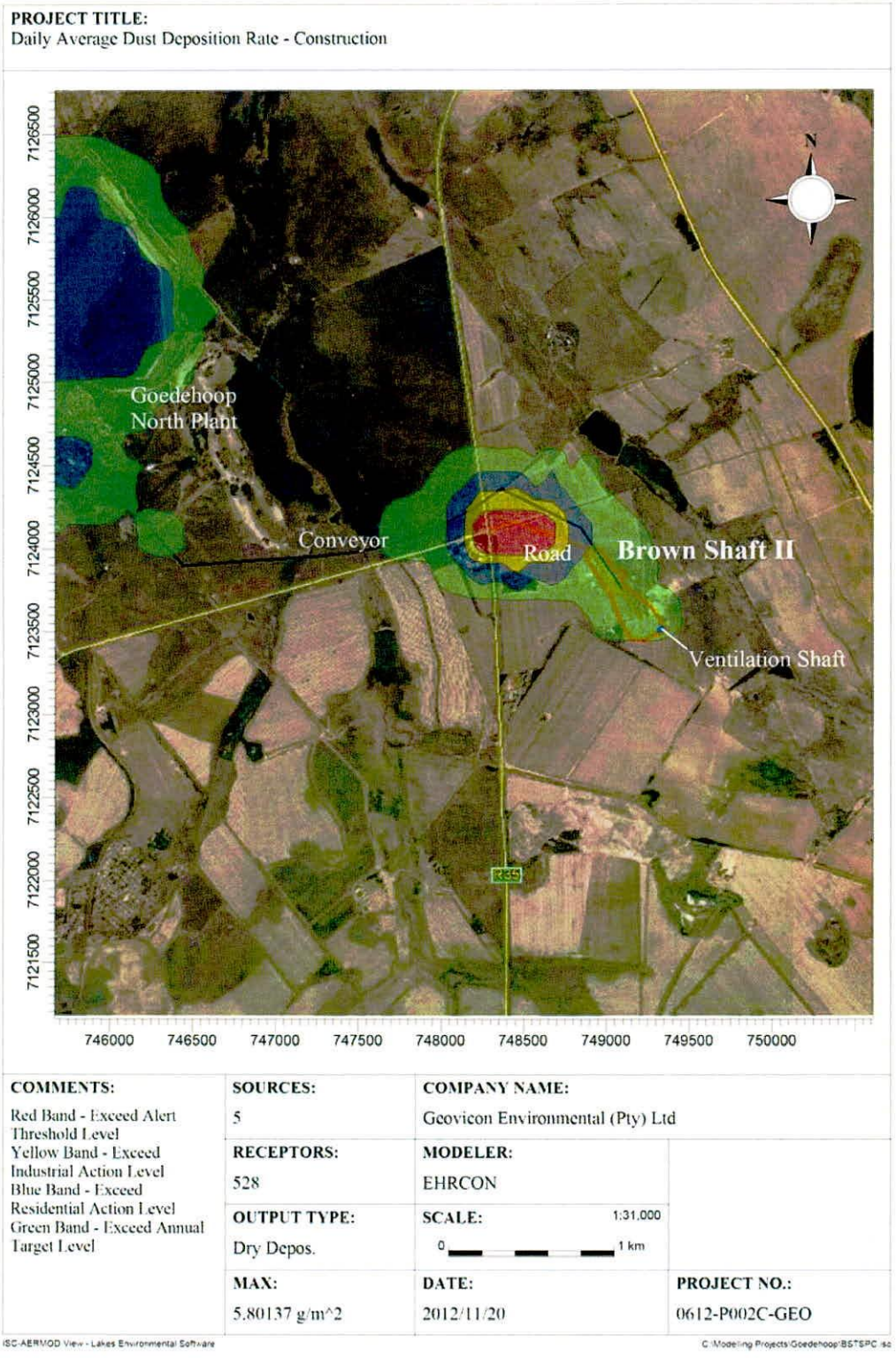

Figure 8a: Daily average Dust Deposition Rate – Construction/Decommissioning Phase (SANS Alert Threshold Level – 2 400mg/m^2/day, Industrial Action Level – 1 200mg/m^2/day, Residential Action Level – 600mg/m^2/day, Annual Target Level – 300mg/m^2/day)

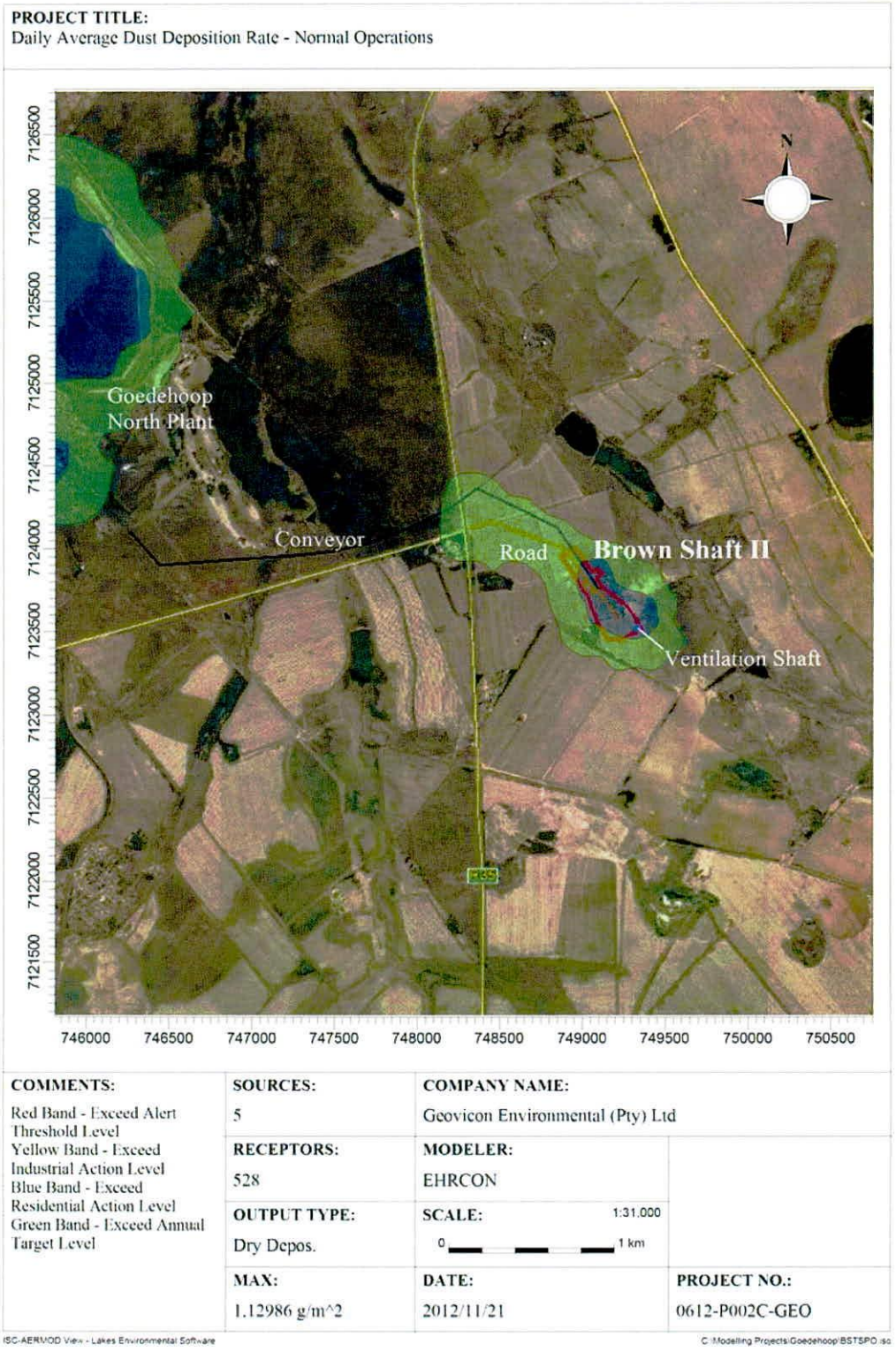

Figure 8b: Daily average Dust Deposition Rate – Operational Phase

(SANS Alert Threshold Level – 2 400mg/m^2/day, Industrial Action Level – 1 200mg/m^2/day, Residential Action Level – 600mg/m^2/day, Annual Target Level – 300mg/m^2/day)

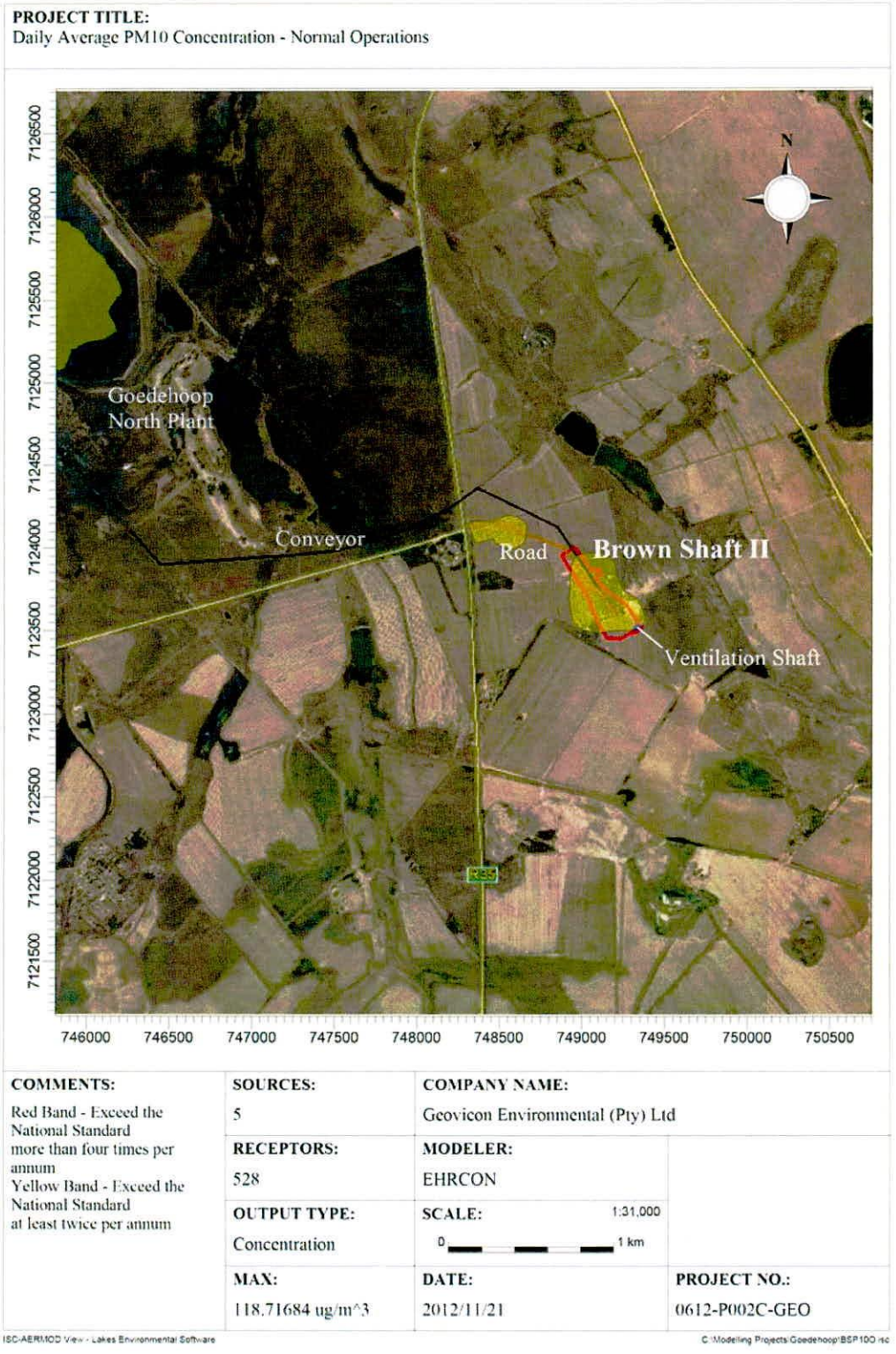

Figure 9: Daily Average PM_{10} Concentration – Operational Phase (South African National Standard - 120µg/m^3)

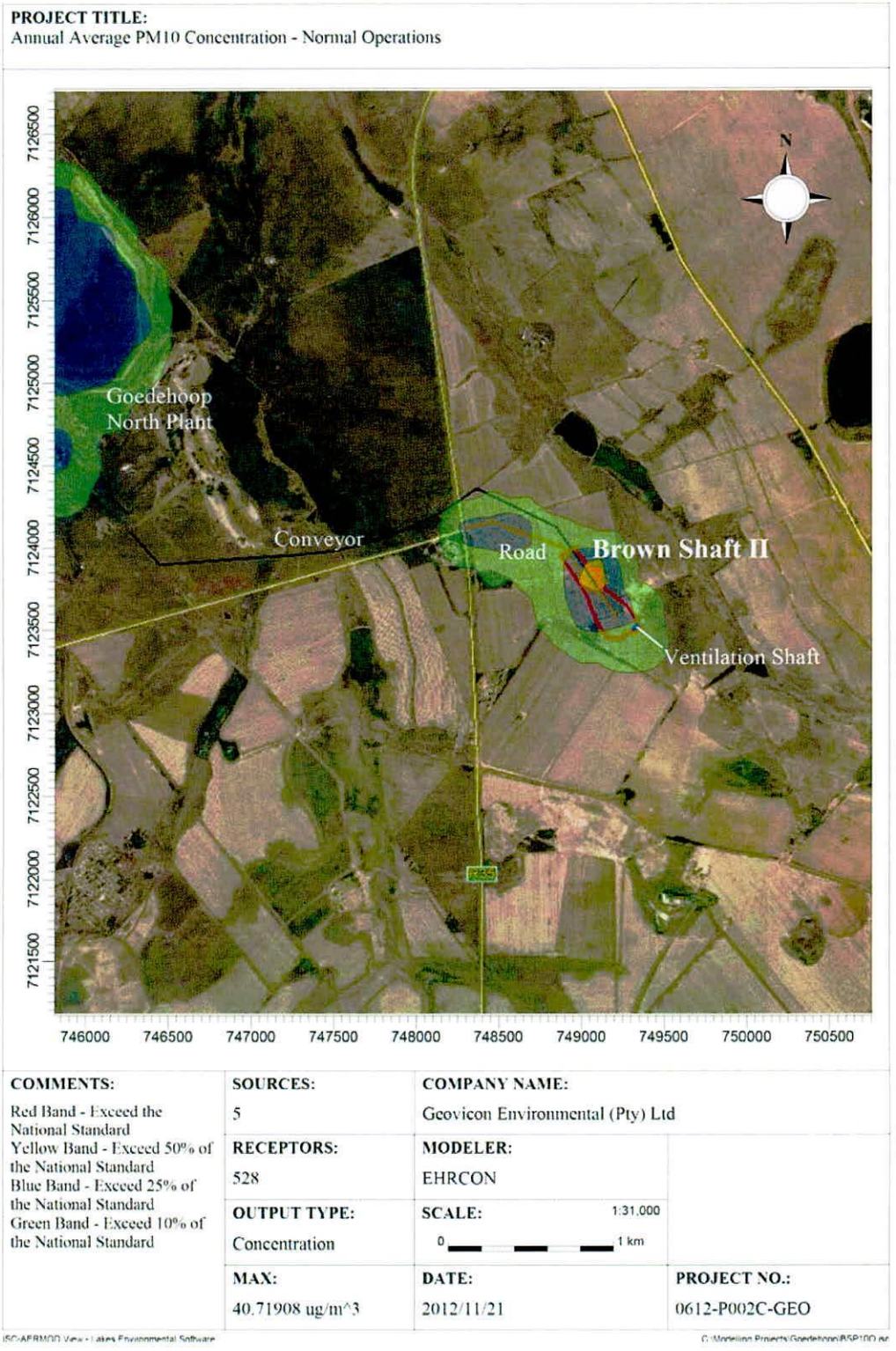

Figure 10: Annual Daily Average PM_{10} Concentration – Operational Phase (South African National Standard - 50µg/m^3)

4.3. DISCUSSION

Prior to an analysis of the simulation results it is recommendable to briefly review areas of uncertainty which needs to be taken into account in the interpretation of the results. The range of uncertainty of the Gaussian plume model is given by the US-EPA as being in the range of -50% to +200% when used under the recommended conditions. Uncertainties are, however, not only associated with the mathematical model itself, but also with the generation of the meteorological and source data used as input data. It is well known that wind data errors are the major cause of poor agreement, especially for short-term predictions and long down-wind distances. The selection of a suitable meteorological data set for use in the simulation analysis is fundamental to the accuracy of the results. Errors in source strengths translate directly into errors of similar magnitudes in the model prediction.

There will always be some error in any geophysical model, but it is desirable to structure the model in such a way to minimise the total error. A model really represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components; the uncertainty due to errors in the model physics, the uncertainty due to data errors and the uncertainty due to stochastic processes (turbulence) in the atmosphere.

The impact evaluation consists of a comparison of modelled results to ambient air quality guidelines and a significance rating of the predicted impacts. Simulations were undertaken to determine dust deposition and PM_{10}. Averaging periods were selected to facilitate comparisons between predicted concentrations and ambient air quality guidelines.

Dust deposition

Nuisance dust from construction operations will probably exceed the residential action level up to a distance of 400m downwind of operations. The receivers of concern are the commercial/residential dwellings at the R35/Bank intersection.

It is unlikely that dust deposition will be a concern during underground mining operations. Vehicle entering and leaving the main access road will always be the most visible sources of pollution. Dust

deposition rates as high as 1 100mg/m^2/day are predicted on-site, during extreme pollution episodes associated with dry and windy spells.

The modeling predictions of this study are based on standard emission control tactics, such as the wetting of roads. The current impact on dust deposition rates in the area can be further reduced through the implementation of a combination of other control options in a focused approach.

PM_{10}

PM_{10} concentrations are likely to remain below the 24-hour and annual AQA limits during the operational phase of the project.

Maximum daily concentrations as high as 118µg/m^3 could occur within the shaft area boundary.

Annual PM_{10} concentrations, as a result of this project, will remain below the current background levels at the nearest sensitive receivers.

The recent publication of the Air Quality Baseline Assessment for the Highveld Priority Area (DEAT) confirmed the significant contribution of opencast mining and mobile equipment operation to ambient PM_{10} concentrations concluded from the emission inventory conducted for this project. Other important sources of PM_{10} in this project relate to material handling and fugitive emissions from exposed areas.

This impact study considered the cumulative effects on air quality caused by the aggregate of past and present actions in the area. Baseline PM_{10} concentrations are supported from recent monitoring data collected in Hendrina.

Linear relationships between fine particulate concentrations and human health risks are published by organisations such as the WHO. Relatively low PM_{10} concentrations have been associated with various health effects including; increased respiratory hospital admissions, respiratory system exacerbation, cough and in some cases mortality.

Predicted PM_{10} concentrations associated with the Brown Shaft II Project are well above the lowest level at which statistically significant health effects have been noted to occur (i.e. 20 to 25µg/m^3). However, ambient PM_{10} limits are not based on any safe level but rather constitute an acceptance of risk (i.e. acceptance of additional hospital admissions for respiratory ailment per million persons exposed).

The assessment of potential impact was based on the professional judgment, fieldwork and desktop analysis, as appropriate. Potential impacts were assessed according to the criteria and rating scales as set out in **Table 6**.

Table 6a:

Air Quality Impact Assessment Criteria and Rating Scales

Magnitude	
The magnitude of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as follows:	
(I)nsignificant – Score 2	The impact alters the affected environment in such a way that the natural processes or functions are not affected
(M)oderate – Score 4 or 6	The affected environment is altered, but functions and processes continue, albeit in a modified way.
(H)igh – Score 8 or 10	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Duration	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
(T)emporary – Score 1	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term – Score 2	The impact will be relevant through to the end of a construction phase.
(M)edium term – Score 3	The impact will last up to the end of the development phase, where after it will be entirely negated.
(L)ong term – Score 4	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent – Score 5	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial scale	
Classification of the physical and spatial scale of the impact.	
(F)ootprint – Score 1	The impacted are extends only as far as the activity, such as footprint occurring within the total site area.
(S)ite – Score 2	The impact could affect the whole, or a significant portion of the site.
(R)egional – Score 3	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
(N)ational – Score 4	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational – Score 5	Where the impact has international ramifications that extend beyond the boundaries of South Africa.

Table 6b:

Air Quality Impact Assessment Criteria and Rating Scales

Probability	
This describes the likelihood of the impacts actually occurring. 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:	
Improbable – Score 1	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%).
(P)ossible – Score 2	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 as 25%.
(L)ikely – Score 3	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 as 50%.
(H)ighly likely – Score 4	It is most likely that the impact 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 as 75%.
(D)efinite – Score 5	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 as 100%.

Impacts were quantified on acceptability to human health basis. The significance of the impact takes into account the nature of the impact, extent, duration, intensity, probability of occurrence and confidence in the predicted modeling results according to the following calculation:

(Duration + Scale + Magnitude) x Probability = Significance

Where

<20 : No significance

<40 : Low

<60 : Medium

>60 : High

Table 7:

Air Quality Impact Significance Ratings

Significance ratings - Unmitigated	
No significance	The impact is not substantial and does not require any mitigation action.
(L)ow	The impact is of little importance, but may require limited mitigation.
(M)edium	The impact is of importance and is therefore considered to have a negative impact. Mitigation is require to reduce the negative impacts to acceptable levels.
(H)igh	The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.
Significance ratings - Mitigated	
No significance	The impact will be mitigated to the point where it is regarded as insubstantial.
Low (L)	The impact will be mitigated to the point where it is of limited importance.
Low to medium (LM)	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.
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.
Medium to high (MH)	The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.
High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as 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.

Table 8 below contains a summary of the air quality impact on human health posed by the Brown Shaft II Project.

Table 9a:

Air Quality Impact Assessment for the Brown Shaft II Project

Nature of Impact		
Dust deposition during construction, decommissioning and closure		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Moderate (4)
Probability	Highly likely (4)	Likely (3)
Significance	Medium (44)	Low (27)
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

Please refer to Section 4.4 of the report.

Cumulative impacts:

Low background dust deposition rate. Impact from process limited to 0.4 kilometres.

Residual impacts:

Contravention of the action level expected at receptors near the R35/Bank Road intersection.

Table 9b:

Air Quality Impact Assessment for the Brown Shaft II Project

Nature of Impact		
Dust deposition emissions during the operational phase		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (4)	Moderate (4)
Probability	Highly likely (4)	Likely (3)
Significance	Medium (40)	Low (30)
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

Please refer to Section 4.4 of the report.

Cumulative impacts:

Low background dust deposition rate. Impact from process limited to 0.2 kilometres.

Residual impacts:

No contraventions expected at the nearest sensitive receiver.

Table 9c:

Air Quality Impact Assessment for the Brown Shaft II Project

Nature of Impact		
PM_{10} emissions during the operational phase		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (6)	Moderate (4)
Probability	Highly likely (4)	Likely (3)
Significance	Medium (48)	Low (30)
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

Please refer to Section 4.4 of the report.

Cumulative impacts:

High background PM_{10} concentration increases the spatial scale and magnitude of the impact.

Residual impacts:

Contravention of the 24-hour average AQA standard beyond the mining boundary unlikely. Annual average PM_{10} concentration below the lower assessment threshold at the nearest sensitive receivers.

4.4. RECOMMENDATIONS

Ambient air quality assessment

According to SANS 1929:2005 the concentrations of specific pollutants within an area shall be evaluated against the following thresholds to determine applicable assessment methods:

a) upper assessment threshold, i.e. the 99th percentile pollutant levels represent a pollutant value exceeding 70% of a limit value (taking into account limit values for all periods which have been used to derive averages).
b) lower assessment threshold, i.e. the 99th percentile pollutant levels represent a pollutant value below 50% of all limit values (taking into account limit values for all periods which have been used to derive averages).

Provision should be made for three air pollutant concentration assessment methods, based on the classification pollutant concentrations relative to the upper and lower assessment thresholds. These methods are:

a) mandatory monitoring, which may be supplemented by modelling techniques to provide an adequate level of information on ambient air quality. This method should be implemented where the upper assessment threshold for a specific pollutant is exceeded;
b) a combination of measurement and modelling techniques should be implemented in areas and for pollutants for which concentrations are between the upper and lower assessment thresholds; and
c) the sole use of modelling or objective estimation techniques is permissible for pollutant concentrations below the lower assessment threshold.

The classification to determine applicable assessment methods should be based on air pollutant concentrations recorded during the previous five years where data is available. Results from measurement campaigns of short duration during the period of a year and at locations likely to be typical of the highest pollution levels may be combined with information from emission inventories and modelling to provide the concentration data required. Classification should be reviewed earlier

than every five years in the event of significant changes in activities relevant to ambient air pollutant concentrations.

In view of the predicted ambient pollutant concentrations resulting from emissions from the Brown Shaft II Project the following is recommended:

a) A priority must be given to continuous monitoring of ambient dust deposition rates for the full duration of the project. Source monitoring stations should be positioned near the shaft and access roads. A receptor monitoring station should be commissioned at the commercial/residential receivers near the R35/Bank Road intersection. Dust deposition monitoring is essential to determine spatial and temporal trends, and to track progress made by control measures implemented.
b) An emissions inventory and annual modelling regime must be maintained throughout the life of the project.

The ultimate purpose of monitoring is not merely to collect data, but to provide information necessary to make informed decisions on managing and improving the environment. Monitoring fulfils a central role in this process, providing the necessary sound scientific basis for policy and strategy development, objective setting, compliance measurement against targets and enforcement action.

However, the limitations of monitoring should be recognised. In many circumstances, measurements alone may be insufficient, or impractical for the purpose of fully defining population exposure. No monitoring programme, however well funded and designed, can hope to comprehensively quantify patterns of air pollution in both space and time. At best monitoring provides an incomplete, but useful, picture of current environmental air quality. Monitoring often needs to be used in conjunction with other objective assessment techniques, including modelling, emission measurement and inventories, interpolation and mapping.

Air quality management objectives

The relationship between data collected and the information to be derived from it is essential in compiling an effective air quality management programme. The air quality management programme for Anglo Coal should ideally focus on the following key objectives:

- Determining population exposure and health impact assessment.
- Informing the public about air quality and raising awareness.
- Identifying threats to natural ecosystems.
- Determining compliance with national and international standards.
- Providing objective inputs to management.
- Source apportionment and identification.
- Policy development and prioritisation of management actions.
- Development/validation of management tools such as models and inventories.
- Assessing point or area source impacts.
- Trend qualification, to identify future problems or progress against management actions.

The setting of clear objectives enables the definition of objectives for data quality. These requirements must be met to ensure that the overall objectives are achieved. This may include the following:

- Measurement accuracy and precision.
- Traceability to metrology standards.
- Temporal completeness (data capturing).
- Spatial representation and coverage.
- Consistency from site to site and over time.
- International comparability/harmonisation.

Monitoring, modelling and emission measurements should be regarded as complementary components in any integrated approach to air quality management.

Dust control measures – Processes and Plant

Careful consideration must be given to the relationship of activities on-site to sensitive areas beyond the property boundary. Some of the factors that should be taken into account in the process layout to reduce dust impacts are:

- placing dust generating activities where maximum protection can be obtained from natural features;
- locating dust generating activities where prevailing winds will blow dust away from the receiving community; and
- minimising the need to transport and handle materials by placing adequate storage facilities close to processing areas.

The location of dust generating activities will change during the different phases of the project and therefore, the relationship with receivers around the site. It is important that the minimisation of dust through site design is addressed at each phase of the operation.

Dust control at processes and plant could be affected through installation of mechanical ventilation systems, wet suppression systems and vacuum sweeping to name but a few.

Control measures essential to ensure the health of employees will have a dual effect in that it will also mitigate the environmental impact.

Table 10:

Brown Shaft II Project fugitive dust control measures

Activity	Control measure
Vehicle entrained dust	Where possible, pave all major haul routes. Paving is effective, but expensive and unsuitable for surfaces used by very heavy vehicles or subject to spillage of material in transport. In addition, dust control measures will usually still be required on the paved surfaces. The use of gravel or slag can be moderately effective, but repeated additions are normally required.
	Set speed limits of 35km/hr or less for site traffic on paved roads and 10km/hr on unpaved surfaces. Speed control has a linear effect on dust emissions. Thus by reducing speed from 30 to 15km/hr, emissions can be reduced by 50%.
	Wet suppression of unpaved areas should be applied during dry windy periods, using a water car and/or sprinklers at a rate of more than 2.0l/m^2/hour.
	Chemical suppression can also be used in conjunction with wet suppression. This involves the use of chemical additives in the water, which aids the formation of a binding crust. Repeated treatment is normally required.
	Inspect road integrity and repair frequently.
	Provide firm marshalling areas.
	Reduce track-on through the use of a wheel wash-bay.
	Reduce unnecessary traffic.
	Cover loads with tarpaulins.
	Limit load size.
	Minimise travelling distance through good layout and process design.
Mining	Limit the area of operation what is absolutely necessary.
	Rehabilitation should be performed on an ongoing basis.
Stockpiles	Limit the height and slope of stockpiles to reduce wind entrainment. The ideal stockpile is not higher than 3m, has a gentle slope (>45°) and has an irregular apex.
	Ideally stockpiles should be fully enclosed.
	Minimise drop heights onto stockpiles.
	Wind barriers can be effectively used to control pollution from stockpiles.

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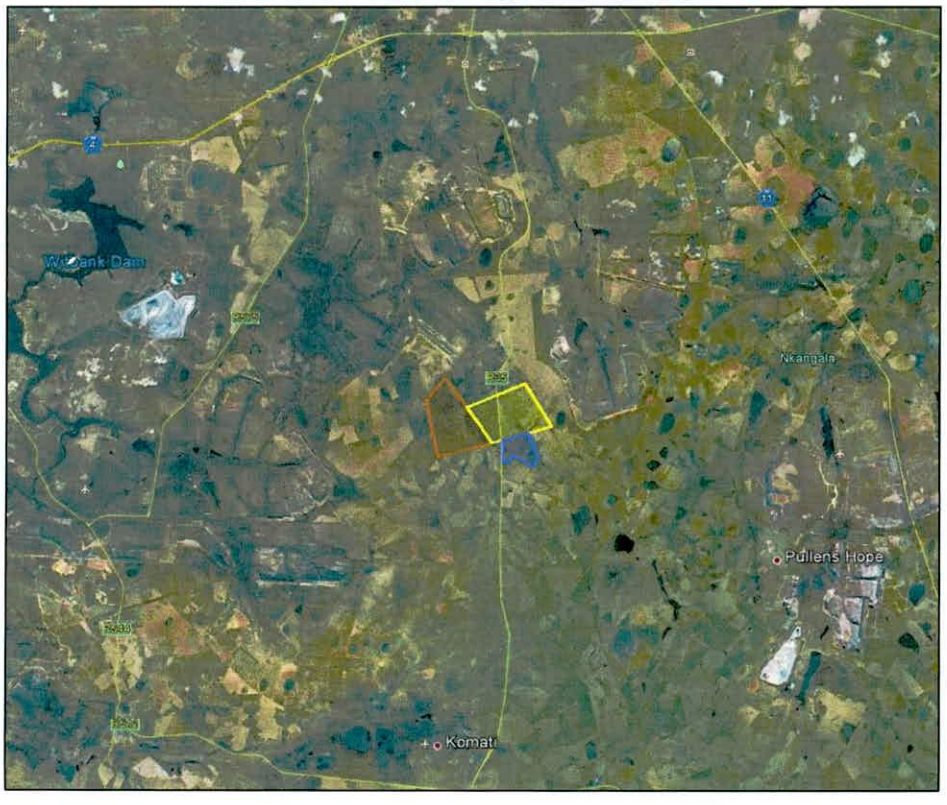
Appendix 7

Noise Impact Assessment Report for the proposed Access Brown Shaft II Project Area

Geovicon Environmental (Pty) Ltd

NOISE IMPACT STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Proposed establishment of the Goedehoop North Brown Shaft Two/Conveyor Belt, on the farms Wolvenfontein 471 JS and Bankfontein 340 JS, near Emalahleni, Mpumalanga



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EXECUTIVE SUMMARY

M2 Environmental Connections was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding sound environment due to the establishment of the Goedehoop North Brown Shaft Two (including a conveyor belt establishing a transportation link to an existing facility). The proposed development is to mine coal, and to be situated on various farms close to the town of Emalahleni in the Mpumalanga.

This report makes use of a predictive model to identify noise issues of concern. With worst case scenarios investigated, this assessment indicated that the proposed Goedehoop North Brown Shaft/conveyor belt will have a noise impact of a ***Low significance*** on receptors in the area during the construction phase and operational phase during the daytime hours. However investigations indicated that there was a ***Medium significance*** during the night-time operational hours.

Mitigation options were investigated and proposed for the night-time operational hours. With mitigated options implemented the outcome of the investigation indicated that the Goedehoop North Brown Shaft Two/conveyor belt will have a noise impact of a ***Low significance*** on all identified receptors in the study area during the all important night-time operational phase.

With a ***Low significance*** of a noise impact in the study area, construction mitigation options were included to ensure that the acceptable rating was adhered to, namely:

- Co-ordinated the pray times at the Mosque (**NSD03**) with the blasting times at the proposed development. It has been indicated by the owner of the Mosque that pray times occur five or more times a day, and pray times are dependant on the season; and
- Construction activities of loud noise significance must be restricted to the hours of 06:00 – 22:00.

The night-time investigations concluded that mitigation is required, however with mitigation measures implemented a ***Low significance*** would be applicable. Most important mitigation options highlighted during the operational phase included:

- Direct line of sight from receptors **NSD03-NSD06** to obscured by a berm (and as close as possible to the mine shaft). The berm/barrier needs to be one meter higher than the highest noise source on the mine shaft. Berm/barrier materials

sourced from top or other soils obtained during construction excavations (not a brick or concrete wall). Berm/ barrier is not necessary for conveyor belt or conveyor belt components (implemented);

- If a feeder bin and conveyor belt gearbox (or drive train) will be used on the conveyor belt, it is recommended that these components be placed at a minimum of 360 meters from **NSD03-NSD05** (the closets receptors along the route of the conveyor belt to the existing facility); and
- The conveyor belt itself (without gearbox/drive train or feeder bin), should be placed at a minimum distance of 150 meters from **NSD03-NSD05** (the closets receptors along the route of the conveyor belt).

Should the layout of the proposed development change significantly with the introduction of a loud noise source such as crushing, screening or washing plants, it is recommended that the new layout be remodelled/reviewed in terms of the potential noise impact by an independent acoustics specialist.

Title:

Noise Impact Study for Environmental Impact Assessment: Proposed Establishment of the Goedehoop North Brown Shaft Two/Conveyor Belt, on the farms Wolvenfontein 471 JS and Bankfontein 340 JS, near Emalahleni, Mpumalanga.

Client:

Geovicon Environmental (Pty) Ltd on behalf of AngloAmerican — Middleburg Mpumalanga

Report no:

RES-G/NIS/201202-Rev 0

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Date:

June 2012

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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
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
MENCO	M² Environmental Connections cc
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

GLOSSARY OF TERMS

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 note 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.
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.
Background 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.
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	Modification of the progressive wave distribution due to the presence of obstacles in the field. 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).
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
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.
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	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development

Management	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.
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
Reverberant Sound	The sound in an enclosure excluding that is received directly from the source.

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.
Sound Level	The level of the frequency weighted and time weighted sound pressure as determined by a sound level meter.
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).
Zoneof 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 SANS10103.

1 INTRODUCTION

1.1 INTRODUCTION AND PURPOSE

M2 Environmental Connections was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding sound environment due to the establishment of the Goedehoop North Brown Shaft Two (including a conveyor belt establishing a transportation link to an existing facility). The proposed development is to mine coal, and to be situated on various farms close to the town of Emalahleni in the Mpumalanga.

This report describes the potential noise impact that such a facility may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations. Blasting was only briefly considered for this report.

1.2 BRIEF PROJECT DESCRIPTION

Anglo American proposes the establishment of a mine shaft (Brown Shaft Two), conveyor belt and associated infrastructure on the farm Bankfontein 340 JS and the farm Wolvenfontein 741 JS. The proposed development is situated approximately 20 km south-east of the town of Emalahleni.

The proposed development consists of a mine shaft, of which the materials will be transported by means of a conveyor belt to an existing facility within close proximity to the Goedehoop North Brown Shaft Two (**Figure 1-2**). No washing, screening or crushing activities has been indicated by the Anglo American engineering department dealing with the proposed development. The mine shaft locality and related infrastructure has been confirmed by the engineers, however the conveyor belt and drive train locality is undefined. The development is also proposed to work past the night-time hours of 22:00.

1.3 TERMS OF REFERENCE

SANS 10328:2008 (Edition 3) specifies the methods to assess the noise impacts on the environment due to a proposed activity that might impact on the environment. The standard also stipulates the minimum requirements to be investigated for an EIA. These minimum requirements are:

1. the purpose of the investigation
2. a brief description of the planned 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 investigated
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 investigated
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.

1.4 STUDY AREA

The study area is described in terms of environmental components that may contribute or change the sound character in the area. A regional site locality map is presented in **Figure 1-1**.

1.4.1 Topography

The development is proposed in a relatively flat topography. There are man-made berms and structures that will serve as noise barriers.

1.4.2 Roads and rail roads

The R35 carries high traffic volumes (relative to sound emissions) and traverses the study site from north to southseparating the proposed facility (including the start of the proposed conveyor belt) from the existing facility (end of the proposed conveyor belt). The locality of this road is also along the boundary of a few noise-sensitive developments (also known as NSD or receptor) in the study area.

An unnamed/unidentified paved road with less traffic volumes than the R35 road was viewed to traverse the area from east to west and is one of the main vehicle routes from the R35 road to the existing facility in the study area. Other smaller paved and un-paved roads traverse the area but it carries insignificant traffic. The locality of R35 road is illustrated in **Figure 1-1.**

1.4.3 Surrounding Land use

The surrounding land use is mainly mining considering the existing development in the study area. Areas further away from the existing development were seen to be rural in terms of acoustics.

1.4.4 Residential areas

Residential dwellings (also known as noise-sensitive developments, receptors or NSD's) are defined in more detail in **Section 1.6**. A place of worship (Mosque) was identified in the study area.

Identified NSD's in the study area are presented in **Figure 1-2**

1.4.5 Ground conditions and vegetation

The area is not well covered with vegetation with low growing grass defining the area along with a few scattered areas of trees. Ground conditions were seen to be of hard ground conditions, which would not be very acoustically absorbent in nature.

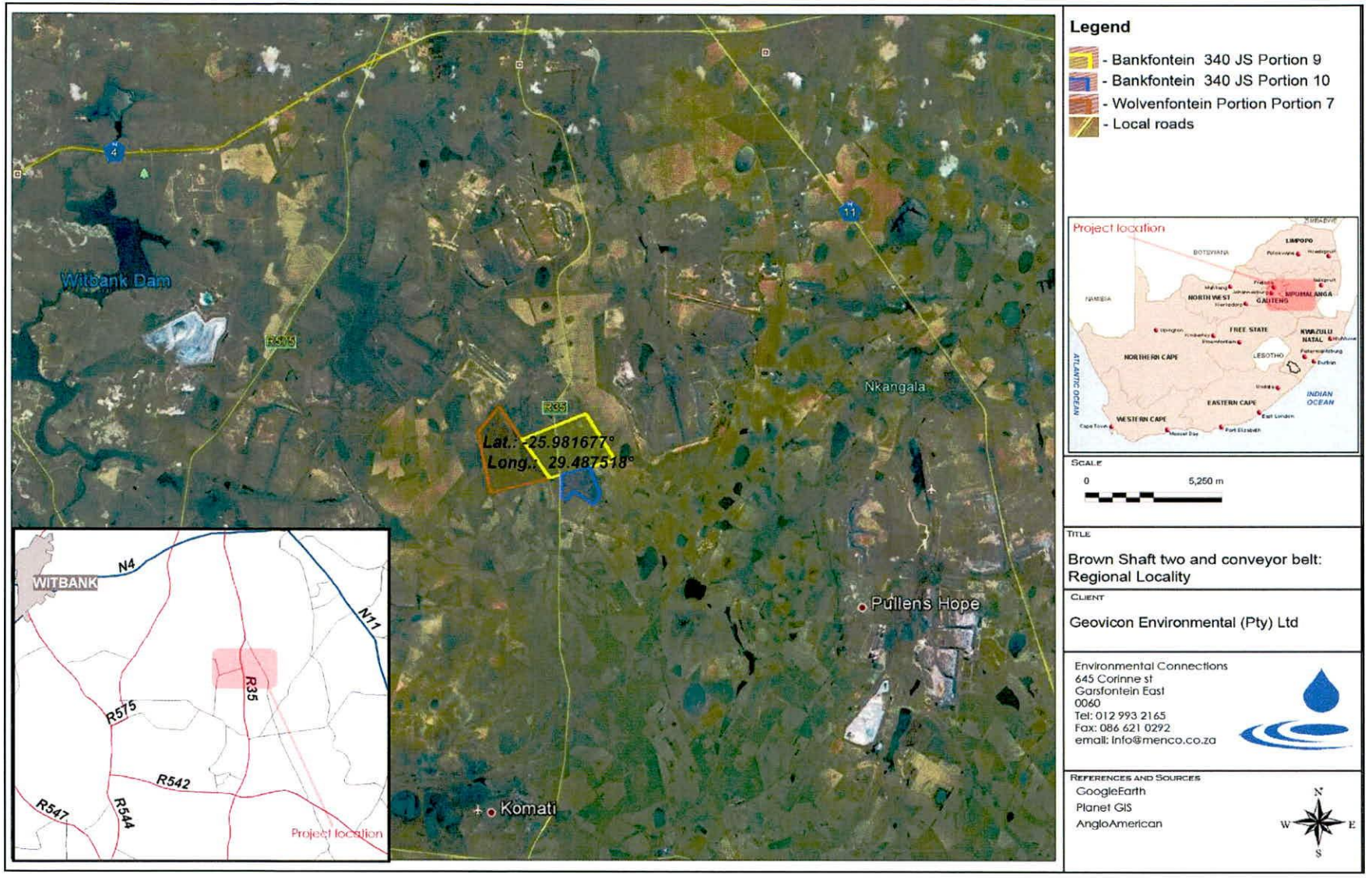

Figure 1-1: Site map indicating the regional locality of the proposed development

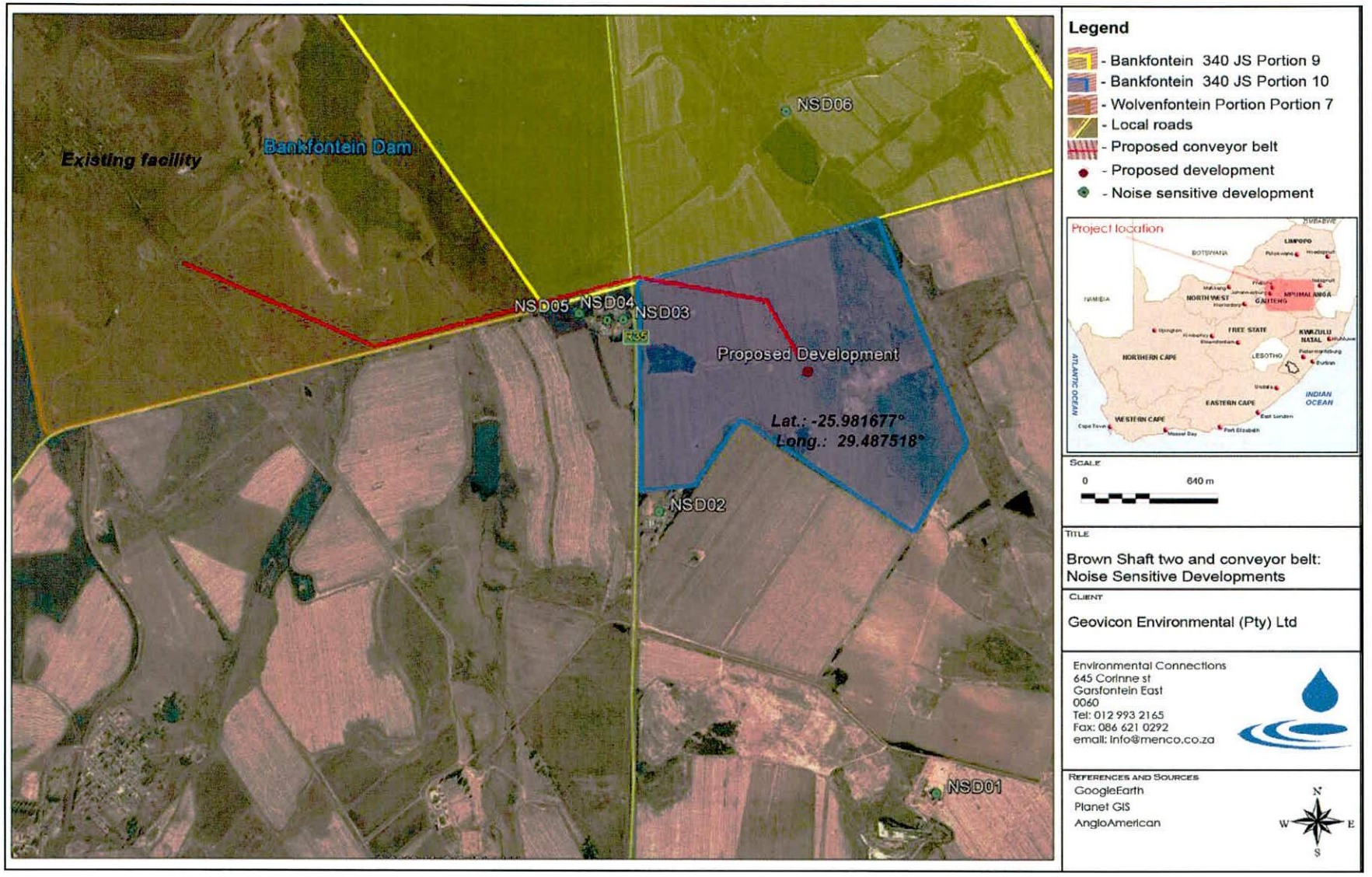

Figure 1-2: Aerial image indicating potentially noise-sensitive receptors near proposed development

1.4.6 Existing Background Ambient Sound Levels

The study area has a rural character in terms of the background sound levels. Onsite measurements and the existing soundscape are discussed in more detail in **Section 3.3**.

1.5 Available Information

The following Noise Studies in the area were conducted by the author; namely:

- *"Desktop Ambient Noise Study for the Development of a Long-Term Environmental Monitoring Programme";*
- *"NIA Establishment of the Schoongezicht Expansion near Emalahleni, Mpumalanga"*; and
- "NIA: *Establishment of Landau Colliery"* (work done for Cleanstream Environmental Services).

1.6 Potential sensitive receptors (Noise Sensitive Developments)

Potentially sensitive receptors, also known as noise-sensitive developments (NSDs) were initially identified using Google Earth®, supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph. The status of the building (commercial, industrial or residential) needs to be indentified as well.

Potential receptors in and around the proposed development were identified and are presented in **Figure 1-2**, with their localities defined in **Table 1-1**.

Table 1-1: Locations of the identified noise-sensitive developments (Datum type: WGS84 – Hartbeeshoek)

Noise-sensitive development	Status	Location (Latitude)	Location (Longitude)	Est. distance to development (m)
NSD01	Residential	-26.000516°	29.494486°	1,900
NSD02	Residential/business	-25.989823°	29.481740°	950
NSD03	Religious	-25.982195°	29.479753°	740
NSD04	Residential/commercial	-25.982257°	29.479035°	810
NSD05	Residential	-25.982034°	29.477758°	980
NSD06	Residential	-25.973490°	29.486566°	990

The following should be noted:

- **NSD03** is a place of worship (a Mosque), discussions with the owner confirmed they operate more than five times a day (at various hours and seasonal dependant). Their current pray schedule starts at 06:00, with the last pray scheduled at 19:30. SANS10103 maximum rating levels for places of worship designed for *indoor* purposes is set at a maximum of 35 dBA;
- **NSD03** – **NSD05** is a business premises with shops, two workshops (maintenance for vehicles) and other business premises facilities. **NSD05** is a formal settlement located next to these business premises;
- **NSD02** was at first identified to be a business premises during the site visit, however during discussions with the owner of the premises he mentioned that it was a residential dwelling as well.

Other buildings in the area were visited but were identified as derelict mine buildings and infrastructure.

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 2.7**).

"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

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 2.6**.

2.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

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")

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of2004) 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 will however, not be relevant to the facility, as no atmospheric emissions will take place.

2.5 MODEL AIR QUALITY MANAGEMENT BY-LAW FOR ADOPTION AND ADAPTATION BY MUNICIPALITIES

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.

- **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.

2.6 NOISE CONTROL REGULATIONS

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, however not for the Mpumalanga Province.

It should be noted that the National Noise Control Regulations defines:

"controlled area"

means 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"

means 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"

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 the same as the Rating Level as defined in SANS 10103.*

In addition:

In terms of Regulation 2 (d):

"A local authority may –

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 (c):

"No person shall –

make changes to existing facilities or existing uses of land or buildings or erect new buildings, if it shall in the opinion of a local authority house or cause activities which shall, after such change or erection, cause a disturbing noise, unless precautionary measures to prevent the disturbing noise have been taken to the satisfaction of the local authority";

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".

2.7 NOISE STANDARDS

Four South African Bureau of Standards (SABS) scientific standards are considered relevant to noise from the development. 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.*

2.8 INTERNATIONAL GUIDELINES

2.8.1 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.

Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.

The document uses the L_{Aeq} and $L_{A,max}$ noise descriptors to define noise levels. It should be noted that a follow-up document focusing on Night-time Noise Guidelines for Europe (WHO, 2009).

2.8.2 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 30dB inside at night (which equals 45-50dB max inside), the WHO now recommends a maximum year-round outside night-time noise average of 40db to avoid sleep disturbance and its related health effects. The report notes that only below 30dB (outside annual average) are *"no significant biological effects observed,"* and that between 30 and 40dB, 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 40dB, *"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."

2.8.3 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.

2.8.4 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.

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 for Europe.

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.

The equipment defined in **Table 3-1** was used for gathering data. It should be noted that the microphones used in conjunction with the various sound level meters are regularly laboratory checked between calibration intervals. These would include instances where the diaphragm of the microphone would be cleaned of any contaminates.

Table 3-1: Equipment used to gather data

Equipment	Model	Serial no	Calibration
SLM	Rion NL-32	01182945	23 January 2012
Microphone*	Rion UC-53A	315479	23 January 2012
Preamplifier	Rion NH-21	28879	23 January 2012
Calibrator	Rion NC-74	34494286	24 January 2012
Anemometer	Kestrel 4000	587391	Calibrated[1]
SLM	Svan 955	27324	31 January 2012
Microphone*	ACO 7052E	49596	31 January 2012
Preamplifier	Svantek SV12L	25685	31 January 2012

***Microphone fitted with appropriate wind shield**

3.2 ON-SITE MEASUREMENTS

Measurements were taken during the day and night of the 12th and 13th of June 2012. The sound measuring equipment was calibrated directly before, and directly after the measurements was collected. In all cases drift was less than 0.2 dBA. The locations used to measure ambient (background) sound levels are presented in **Figure 3-1**.

[1] Certificate of Conformity issued by Nielsen-Kellerman Co.

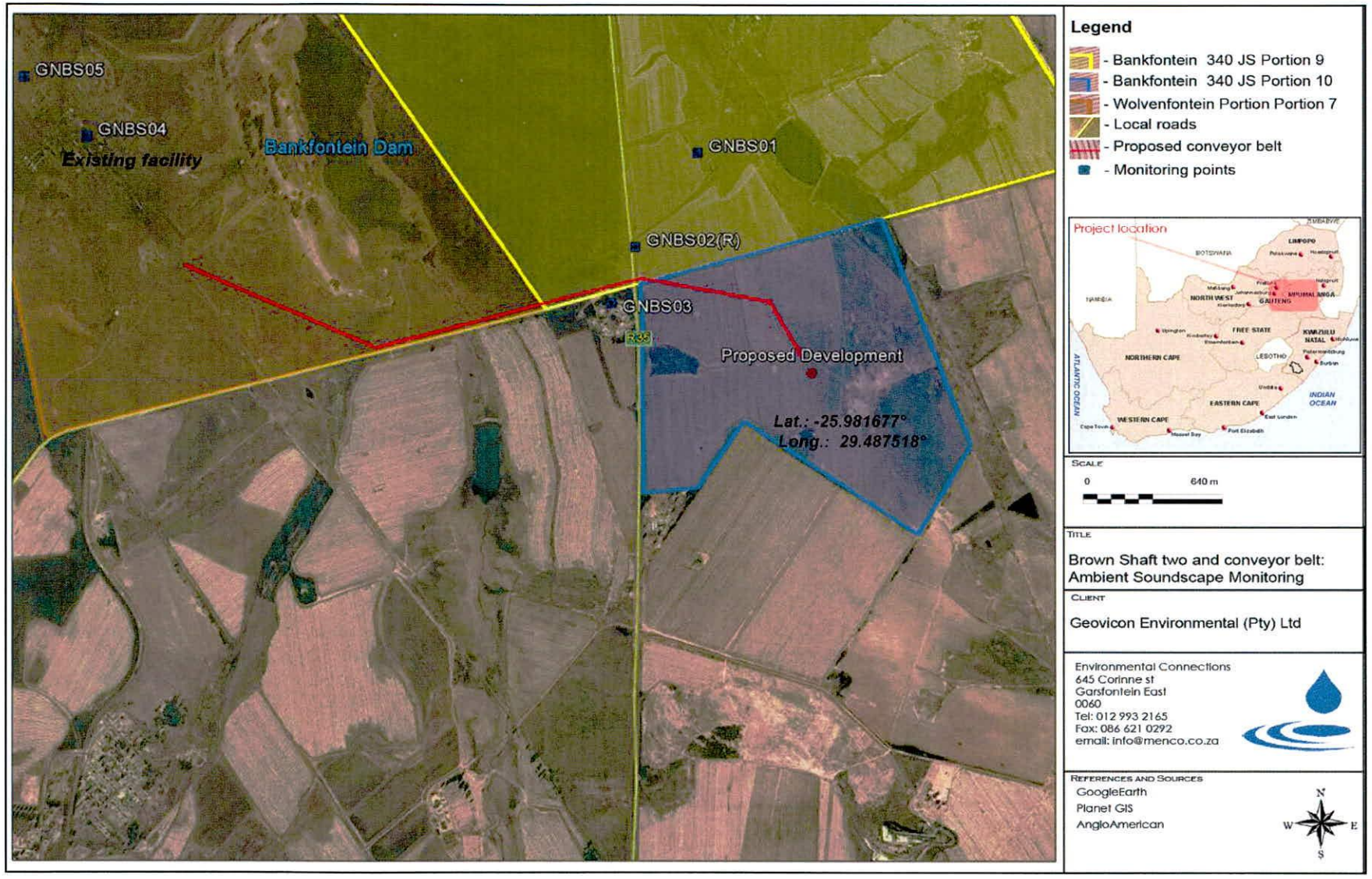

Figure 3-1: Ambient measurement points selected near the proposed facility

These points are considered sufficient to determine the ambient (background) sound levels in the area. The results of the singular ten minute bin samples are presented in **Table 3-2** with the average of numerous 10 minute bins taken over a 20 hour day/night-time period presented in **Table 3-3**.

Table 3-2: Results of singular ten minute bin sound level samples (Datum type: WGS84, Decimal Degrees)

Point name	Latitude, Longitude	$L_{AIeq,T}$ (dBA)	L_{A90} (dBA)	$L_{A,max}$ (dBA)	$L_{A,min}$ (dBA)	Ave Wind Speed (m/s)	Comments and sounds during monitoring
GNBS02(R)	-25.979235° 29.480011°	73.0	35.0	89.0	30.3	1.7	Road traffic noise.
GNBS03(A)	-25.981520° 29.479083°	59.2	49.6	69.7	46.3	5	Wind friction, road traffic noise (R35 and access road to NSD03 – NSD05), compressor and light industrial activities at NSD03 – NSD05 and people talking.

Note: SLM fitted at all times with appropriate windshield; and
(R)(A)(Ref) = Denotes Road, Ambient or Reference sample.

Table 3-3: Results of 20 hour ten minute bin ambient sound level samples (Datum type:WGS84, Decimal Degrees)

Point name	Latitude, Longitude	Ave. $L_{AIeq,T}$ (dBA)	Ave L_{A90} (dBA)	Minimum L_{A90} (dBA)	Maximum L_{A90} (dBA)	Highest wind gust (m/s)	Comments and sounds during monitoring
GNBS01(A)	-25.975345° 29.482577°	53.81	36.54	25.8	54.8	3.1	Ambient day/night-time monitoring point.
GNBS05(Ref)	-25.973657° 29.452435°	58.87	52.28	40.50	59.2	8.2	Existing mine day/night-time monitoring point.

Note: SLM fitted at all times with appropriate windshield; and
(R)(A)(Ref) = Denotes Road, Ambient or Reference sample.

The following should be noted:

- **GNBS01 (A)** was selected to determine the ambient soundscape away from the R35 road and existing mining activities. The average results of all ten minute bin monitoring data is presented in **Table 3-3**, with the data for this point represented below in **Figure 3-2.** Data obtained indicated that the R35 road was still audible at this monitoring point, with traffic traversing the road during day and night-time hours. It is assumed that since there was no other noise source of significance near the monitoring station besides the road (and security guard), that the equivalent

measurement spikes seen ever so often was road traffic related. The location of this monitoring point was selected to be near a security area for equipment safety reasons;

- **GNBS05 (Ref)** was selected to determine the ambient noise levels emanating from the existing facility in the area. The average results of all ten minute bin data is presented in **Table 3-3**, with all data for this point represented below in **Figure 3-3.** Data indicated that even during night-time hours with no wind present that the existing facility defined the ambient noise levels at this point. The locality of this point was selected to be near a security area for equipment safety reasons;
- **GNBS02(R)** locality was selected to indicate road traffic noise and road conditions of the R35 road (refer to **Table 3-2**); and
- **GNBS03 (A)** was selected monitoring point to indicate the likely noise levels experienced at **NSD03 – NSD05** during the daytime hours. Wind conditions during this sample were relatively gusty. Data indicated that **NSD03** (a place of worship) experienced high noise levels at the boundary of this property due to road traffic and other anthropogenic noise source (SANS10103 recommendation for place of worship at 35 dBA *indoor*).

Although weekly or even monthly long term monitoring is the best methodology in obtaining data for an assessment, the samples obtained during the site visitation is seen as sufficient enough to provide an estimation of the existing ambient soundscape in the study area.

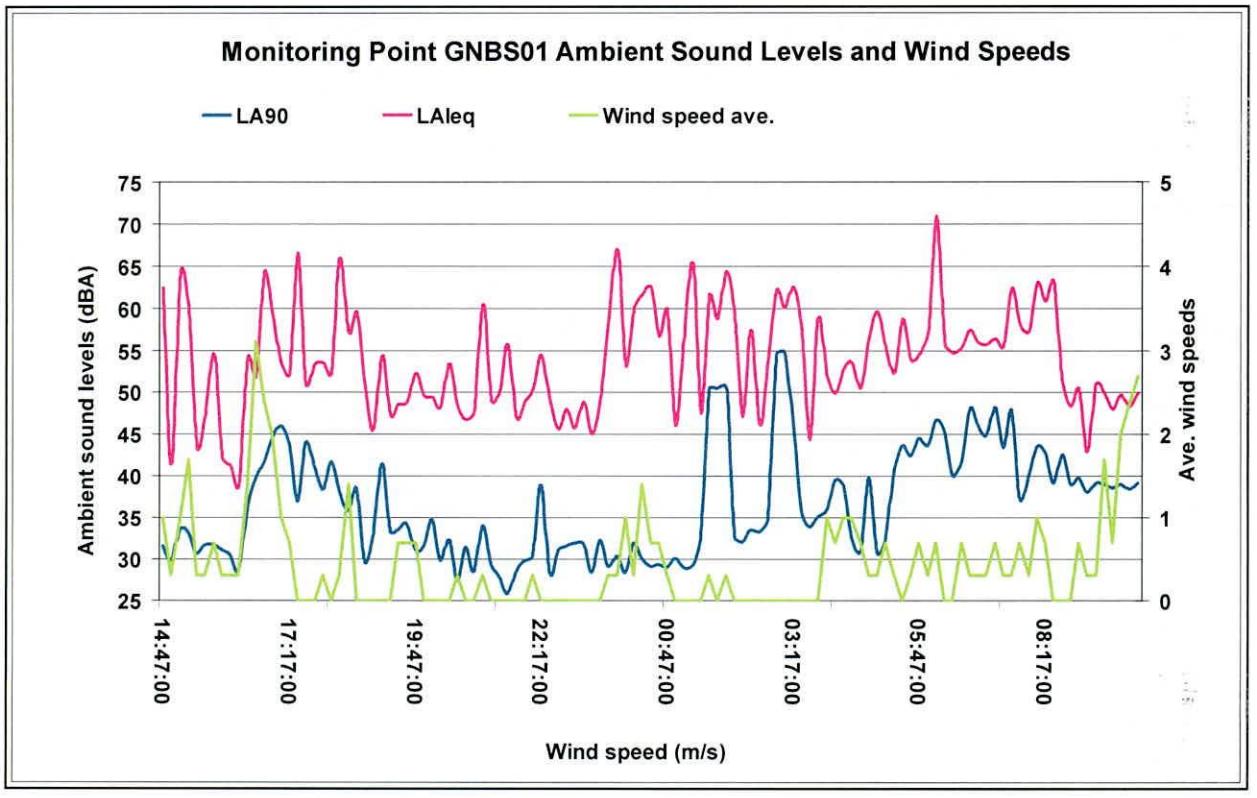

Figure 3-2: Ambient Sound Levels GNBS01

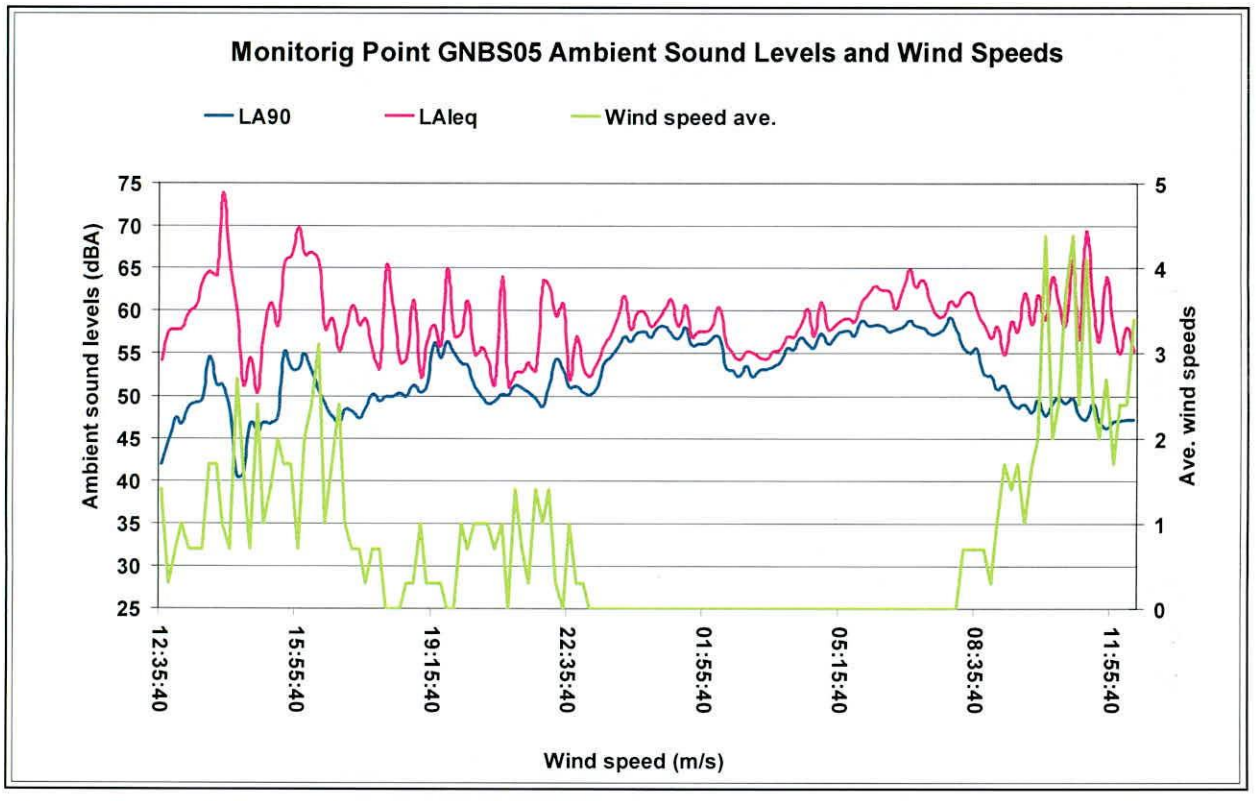

Figure 3-3 Ambient Sound Levels GNBS05

3.3 ESTIMATED MINIMUM AMBIENT SOUNDSCAPE

The main anthropogenic noises of significance in the vicinity of the proposed development during the day/night-time hours were the road traffic noise emanating from the R35 road and the existing facility (mining facility).

3.3.1 Daytime Ambient Soundscape

As mentioned the paved R35 road was one of the main contributors to the daytime ambient soundscape. Traffic as observed on this road on the 12th and 13th June 2012 is presented below:

- *186 vehicles/hour (16% trucks) on the single lane paved R35 road (in two directions) travelling at approximately 60 km/h (the vehicles traverse this road at much higher speeds).*

Contours of noise levels defining the daytime ambient soundscape are presented in **Figure 3-4**. Contours of noise are defined from 45 dBA upwards. The daytime ambient soundscape has been estimated while excluding external noise sources.

It included:

- Mining activities of the developer;
- Traffic on the R35.

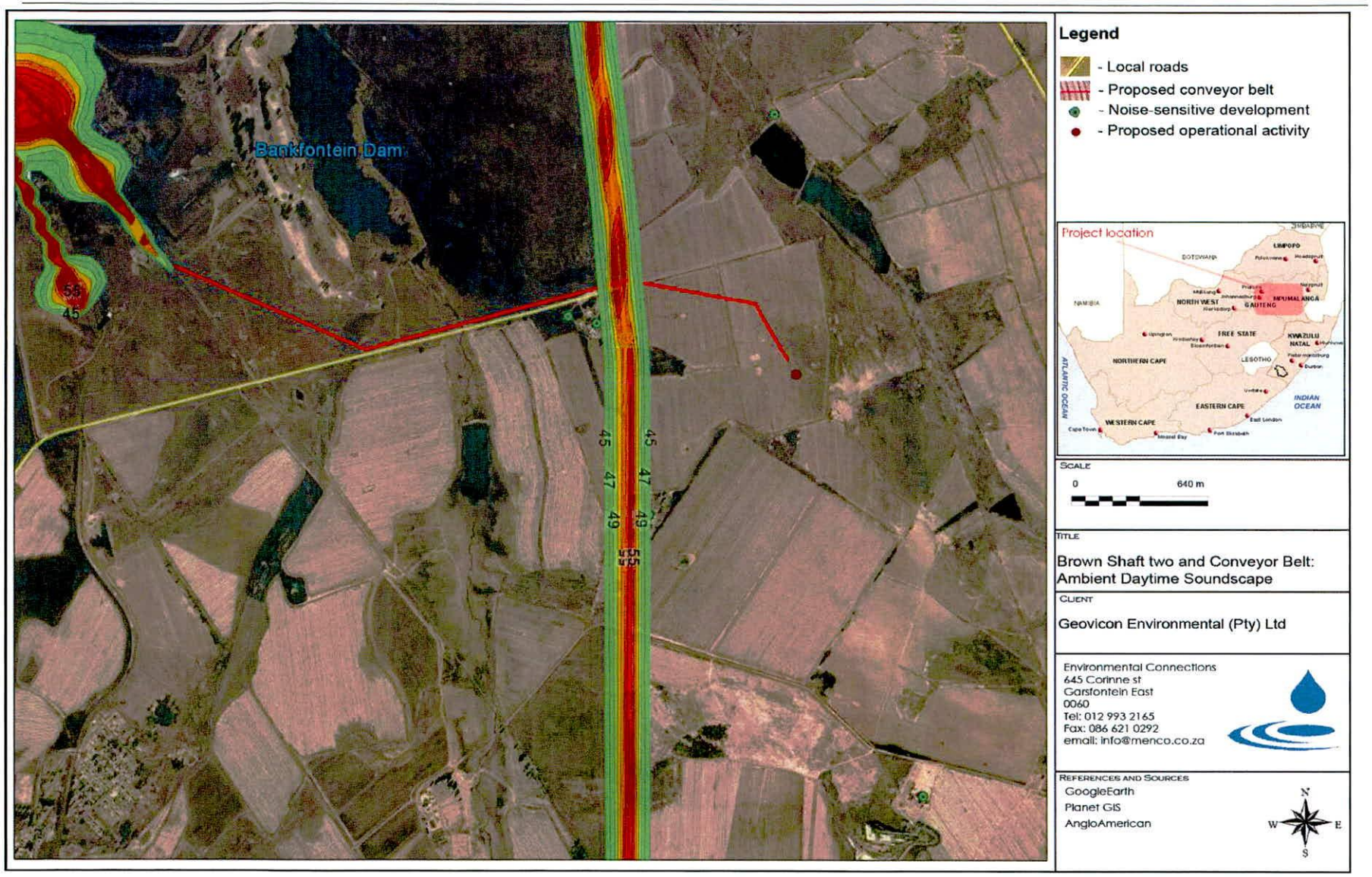

Figure 3-4: Daytime Ambient Soundscape: Contours of constant sound levels

Description of modelled ambient conditions for ambient soundscape featured:

- Basic noise levels of the single lane paved R35 road (in two directions), taking into consideration the traffic flow and heavy vehicle percentage; road gradient of 0% considered;
- A direct line of sight from roads to defined NSD's; road gradient of 0% considered;Receptors are considered at a 1,5m height to road noise;
- Road surface is of "average" nature (non-porous paved road);
- Distance from receiver to noise source considered;
- Intervening ground conditions of a hard ground nature (not very acoustically absorbent in nature); and
- The roads functioning during wind-still conditions, in good sound propagation conditions (20°C and 80% humidity).

3.3.2 Night-time Ambient Soundscape

The R35 road and existing facility are the main contributors to the night-time ambient soundscape. Traffic volumes were obtained by referring to **Figure 3-2** and **Table 3-3** whereby the ten minute window where the least amount of vehicles traversing the road was calculated. Traffic volumes are presented below:

- *10 vehicles/hour (50% trucks) on the single lane paved R35 road (in two directions) travelling at approximately 110 km/h.*

Contours of noise levels defining the night-time ambient soundscape are presented in **Figure 3-5**. Contours of noise are defined from 35 dBA upwards. The night-time ambient soundscape has been estimated while excluding external noise sources.

It included:

- Mining activities of the developer;
- Traffic on the R35.

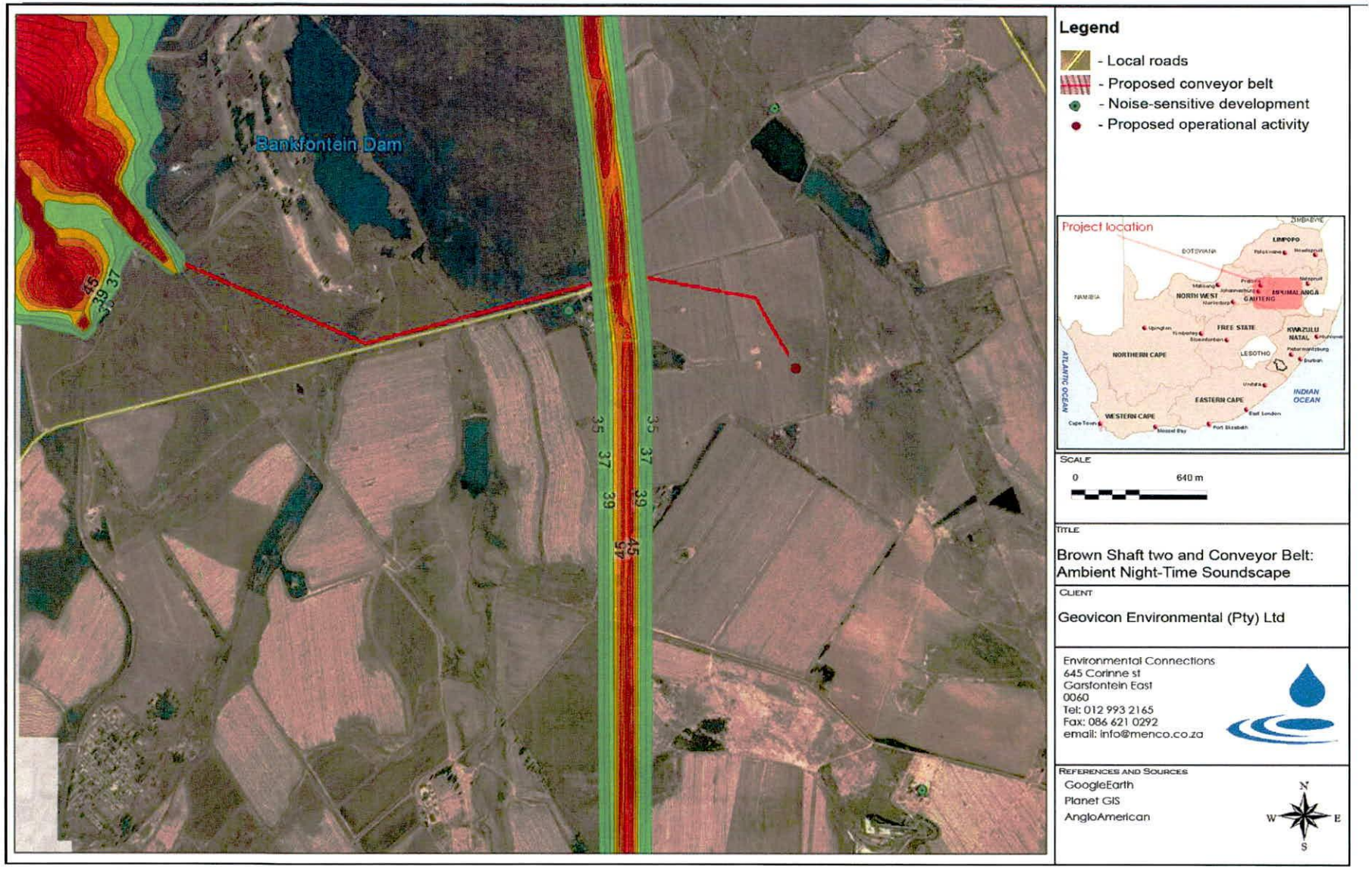

Figure 3-5: Night-time Ambient Soundscape: Contours of constant sound levels

Description of modelled ambient conditions for ambient soundscape featured:

- Basic noise levels of the two lane paved R35 road, taking into consideration the traffic flow and heavy vehicle percentage; road gradient of 0% considered;
- A direct line of sight from roads to defined NSD's; road gradient of 0% considered,Receptors are considered at a 1,5m height to road noise;
- Road surface is of "average" nature (non-porous paved road);
- Distance from receiver to noise source considered;
- Intervening ground conditions of a hard ground nature (not very acoustically absorbent in nature); and
- The roads functioning during wind-still conditions, in good sound propagation conditions (20°C and 80% humidity).

4 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction of the facility and related infrastructure, as well as the operational phase of the activity. Operational activities defined in this section are based on discussions and schematics supplied by the engineers from AngloAmerican dealing with the proposed development.

4.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

4.1.1 Construction equipment

Construction activities include:

- **Establish access roads** – It is expected that access to the proposed development will make use of the existing dirt road on the site (i.e. purple line in **Figure 7-1**);
- **Drilling** – It is highly likely that blasting by means of explosives would be used to excavate the mine shaft. As is the practice with blasting, core holes are drilled into rock, blasted, and aggregate removed by means of plant equipment;
- **Site preparation activities** - Includes clearance of vegetation at the footprint of all infrastructures. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site. Site preparation for the mine shaft is expected to consist of rock rubble removal from blasted rock;
- **Construct foundations** – The volume of concrete for bases/foundations and strip footings is unknown for this report. Due to the small size of the project in terms of construction, it is unlikely that an on-site batching plant would be used to source concrete aggregate;
- **Transport of components & equipment to site** –All components will be brought to site by means of heavy or other vehicles. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc); and
- **Erect infrastructure** – Various mechanical, electrical and other non concrete related plant equipment would require installation. This would include the conveyor belt and its associated components (conveyor drive train, conveyor gearbox etc).

The equipment likely to be required to complete the above tasks will typically include:

- excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, pile drivers, concrete truck(s), , fork lift(s) and various 4WD and service vehicles.

Octave sound power levels typical for this equipment are presented in **Appendix A**.

4.1.2 Material supply: Concrete batching plants and use of Borrow Pits

There exist three options for the supply of the concrete to the development site. These options are:

1. The transport of "ready-mix" concrete from the closest centre to the development.
2. The transport of aggregate and cement from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities. This would most likely be a movable plant.
3. The establishment of a small quarrying activity, where aggregate will be mined, crushed and screened and used onsite. Cement will still be transported to the site, where there will be a small movable concrete batching plant.

For the purpose of the EIA, Option 2 was assumed as being the preferred option. Aggregate will be sourced from existing commercial borrow pits in the area.

4.1.3 Blasting

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relative fast results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control.

4.1.4 Traffic

A significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to construct the development.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

It is expected that an existing dirt road on the site will be used by the construction crew.

4.2 Potential Noise Sources: Operational Phase

Noise emitted by proposed development can be associated with various types of noises and noise sources. These include mechanical sources due to operation of plant equipment, material impact noises (such as found at a feeder bin where material is dropped at a height to ground level) and electrical noise (reverse hooters from trucks). These sources generally have different characteristics and can be considered separately.

The following potential noisy infrastructure has been identified for the proposed development:

- **Feeder bin** - (impact, friction noise). At conveyor belt junctions (where conveyors change direction) on route to the existing facility, it is expected that feeder bins would be required to link the previous stretch of the conveyor belt to the following stretch;
- **General work at the workshop area** - (mechanical, impact and friction noises). This would be activities such as equipment maintenance, off-loading and material handling;
- **Front end loader (small – medium size)** - (Mechanical, friction noise). Any stockpiles (small or large) considered on the mine shaft will need to be managed by means of a front end loader (FEL); and
- **Grader (small – medium size)** - (mechanical, friction noise). Management of surface areas may make us of a grader.

5 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

5.1 Noise Impact on Animals[2]

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on animals. While aircraft noise have a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources.

Overall, the research suggests that species differ in their response to:

- Various types of noise
- Durations of noise
- Sources of noise

A general animal behavioural reaction to aircraft noise is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed
- whether there is one animal or a group
- whether there have been some previous exposures

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

From these and other studies the following can be concluded:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate.
- Animals of most species exhibit adaptation with noise, including aircraft noise and sonic booms .
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate.
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals.

[2]Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

5.1.1 Domestic Animals

It has been observed that most domestic animals are generally not bothered by noise, excluding most impulsive noises.

5.1.2 Wildlife

Noise impacts are therefore very highly species dependent. Studies showed that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area.

5.2 WHY NOISE CONCERNS COMMUNITIES[3]

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)
- 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,

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

- 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,
- The attitude of the receptor about the emitter (noise source).

5.3 IMPACT ASSESSMENT CRITERIA

5.3.1 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
- 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.

5.3.2 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 5-1**.

- *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.

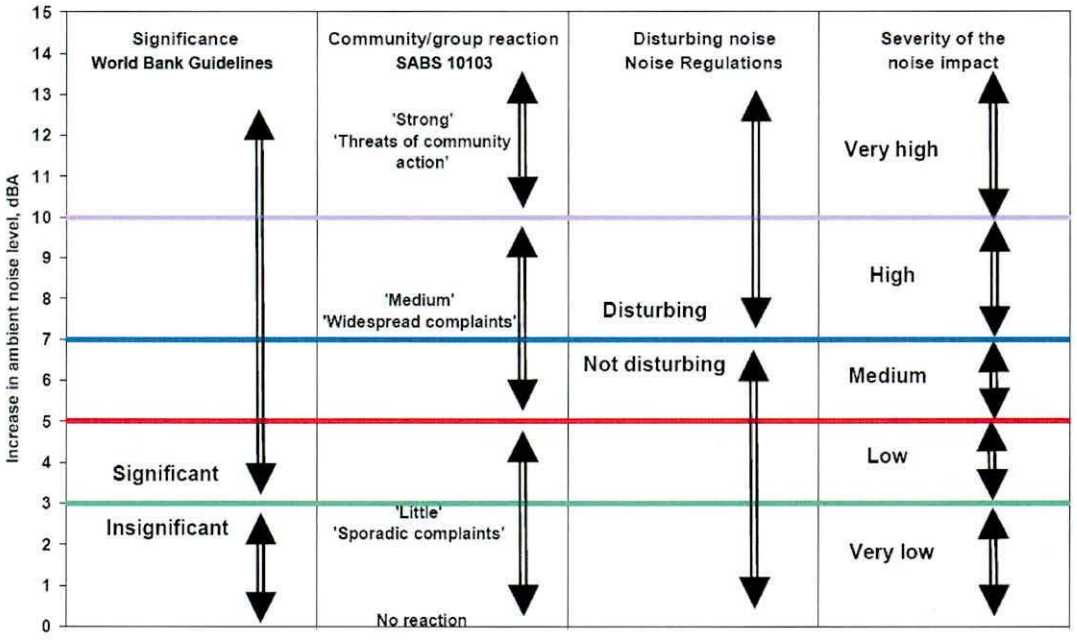

Figure 5-1: Criteria to assess the significance of impacts stemming from noise

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. For rural areas the Zone Sound Levels are:

- Day (06:00 to 22:00) - $L_{Req,d}$ = 45 dBA; and
- Night (22:00 to 06:00) - $L_{Req,n}$ = 35 dBA.

For the purpose of this Environmental Noise Impact Assessment the Zone Sound Levels as proposed in SANS 10103:2008 would be adopted to be acceptable to the noise sensitive developments in the area during periods when the wind speeds are less than 4 m/s.

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

5.3.3 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 5-2 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.

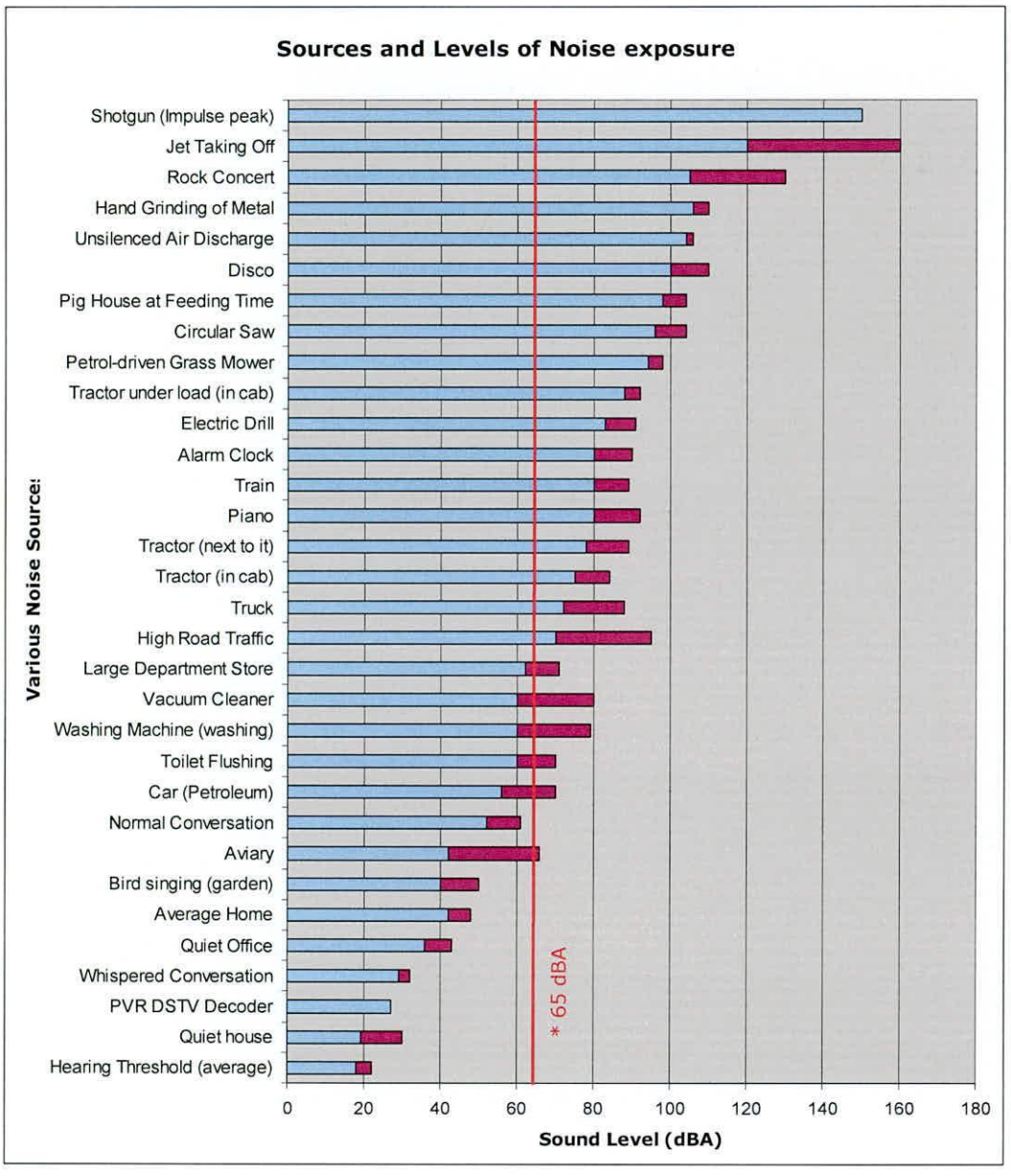

Figure 5-2: Typical Noise Sources and associated Sound Pressure Level

5.3.4 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, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. An explanation of the impact assessment criteria is defined in **Table 5-2**.

Table 5-2: 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.	
Temporary	Impacts are predicted to be of short duration and intermittent/occasional.
Short term	Impacts that are predicted to last only for the duration of the construction period.
Long term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating.
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.
Spatial scale	
Classification of the physical and spatial scale of the impact	
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Local	The impact could affect the local area (within 1,000m from site).
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National	The impact could have an effect that expands throughout the country (South Africa).
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
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:	
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 %).
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 %.
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 %.
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 to be between 50 % to 75 %.
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 %.
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.	
Low	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Total projected noise level is less than the Zone Sound Level in wind-still conditions.
Low Medium	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Increase in sound pressure levels between 3 and 5 above the acceptable zone sound level (wind-less conditions).
Medium	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 5 and 7 above the acceptable zone sound level (wind less conditions). Sporadic complaints expected.
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Increase in sound pressure levels between 7 and 10 dBA above the acceptable zone sound level. Medium to widespread complaints expected.

Very High	Increase in average sound pressure levels higher than 10 dBA. 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 noise levels exceed 65 dBA at any receptor.

In order to assess each of these factors for each impact, the following ranking scales as contained in **Table 5-3** will be used.

Table 5-3: 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

5.3.5 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).