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Proposed Newcastle Landfill Site
On a Portion of the Farm Greenwich 8784
Newcastle
Kwa Zulu Natal

Project No: 042/2018
Compiled by: B v/d Merwe
Date: 22 March 2018

DECLARATION OF INDEPENDENCE

I, **Barend J B van der Merwe,** as duly authorised representative of **dBAcoustics**, hereby confirm my independence and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which **GCS Water and Environmental Consultants** was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act) for the **compilation of an EIA and EMP for the construction of the proposed Greenwich Landfill Site which is situated on a Portion of the Farm Greenwich 8789, Newcastle, Kwa Zulu Natal – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 and any other specific and relevant legislation (national and provincial), policies, guidelines and best practice.

Signature: 

Full Name: Barend Jacobus Barnardt van der Merwe

Date	:	22 March 2018
Title / Position	:	Environmental noise and vibration specialist
Qualification(s)	:	MSc Environmental Management
Experience	:	15 years
Registration(s)	:	SAAI, NACA, IAIASA and SAIOH

Details of specialist and expertise

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

Qualifications

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

Membership

- South African Institute of Acoustics (SAAI);
- International Association of Impact Assessment (IAIA);

- National Association of Clean Air (NACA);
- South African Association of Geographers (SAAG);
- South African Institute of Occupational Hygiene (SAIOH).

Experience

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

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

- Airlink BID for landing in Kruger National Park;
- Coal gasification plant in Theunissen;
- Langhoogte and Wolseley wind farms;
- Widening of N3 at Howick, KZN;
- Tulu Kapi Mine, Ethiopia;
- Boabab Iron Ore Mine, Mozambique;
- N11 Decommissioning Mokopane;

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

Indemnity and Conditions Relating to this Report

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

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Executive summary

Introduction

dBAcoustics was appointed to determine and assess the environmental noise impact of the proposed Greenwich landfill site some 5.0km south of Newcastle. The potential noise impact on the abutting residential areas will be assessed and recommendations will be made for the proposed development to comply with the relevant noise standards and regulations. The noise study was carried out on 12 March 2018.

The following Landfill establishment is proposed for the project:

- Landfill site;
- Infra-structure such as workshops, offices, weigh bridge, roads, wash bays etc. associated with landfill operations at the proposed site;
- Access road to the proposed landfill site

The study area covered the roads and residential areas in the vicinity of the proposed landfill operations. The residents in the vicinity of the proposed landfill site are exposed to traffic noise, distant traffic noise, and agricultural activity noises, domestic and natural noises such as insects, wind and animal noises. These existing noise sources forms part of the prevailing environmental ambient noise level for the study area.

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

- There was a constant flow of traffic along the N11 feeder roads during the day and intermittent during the night;
- Intermittent flow of traffic along the feeder road to the west and the south of the proposed landfill site;
- There were mining activities at the time of the study at the mines in the vicinity of the study area;
- The wind and weather conditions play an important role in noise propagation.

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

- Agricultural activity noise;
- Heavy duty vehicle noise;
- Distant traffic noise from the abutting feeder road;

- Insects;
- Birds;
- Wind noise.

Noise Impact Assessment

In terms of the Noise Regulations a noise disturbance is created when the prevailing ambient noise level is exceeded by 7.0dBA or more. Noise however becomes audible when the prevailing ambient noise level is exceeded by 5.0dBA. Noise is part of our daily exposure to different sources which is part of daily living and some of these physical attributes which may at times be intrusive forms part of the ambient levels that people get used to without noticing the higher levels.

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

- The increase in the noise levels, and;
- The overall noise levels which will be created by the activities along the access road to the proposed landfill site and activities at the proposed landfill site.

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

Conclusion and Recommendations

The proposed landfill establishment will be situated in a district where there are feeder roads, agricultural activities and residential areas. The noise impact assessment revealed that the noise increase will be insignificant and that the noise increase will not exceed the threshold value of 7.0dBA granted by the Noise Control Regulations. The recommended noise mitigatory measures will ensure that the proposed Greenwich landfill operations will be environmentally sustainable.

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

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

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

Contents

Figures

Tables

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

No.	Requirement	Section in report
1a)	Details of -	
(i)	The specialist who prepared the report	P3-P5
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	P3-P5
b)	A declaration that the specialist is independent	P2
c)	An indication of the scope of, and the purpose for which, the report was prepared	P14
d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	P13
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	P18
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	P22
g)	An identification of any areas to be avoided, including buffers	P22
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	P13
i)	A description of any assumption made and any uncertainties or gaps in knowledge	P38
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment	P39
k)	Any mitigation measures for inclusion in the EMPr	P39
l)	Any conditions for inclusion in the environmental authorisation	P40
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	P41
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	P41
(ii)	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	P41
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

1. Introduction

dBAcoustics was appointed to determine and assess the potential environmental noise impact of the proposed Greenwich Landfill site 12km south of the Town Newcastle. The landfill establishment will take place in an area where there are agricultural activities, distant residential areas and feeder roads. The noise impact assessment will consider and evaluate the additional sound levels which will be introduced into the vicinity of the study area. There will be two types of noise sources of which the point source will be at the proposed landfill site and the linear noise source which will be along the route/s to the landfill site. The impact assessment will be done according to the standardised risk matrix which was supplied by GCS.

The noise survey was carried out on 19 March 2018 during the day and night time periods. The location of the proposed Greenwich landfill site is illustrated in Figure 1-1.

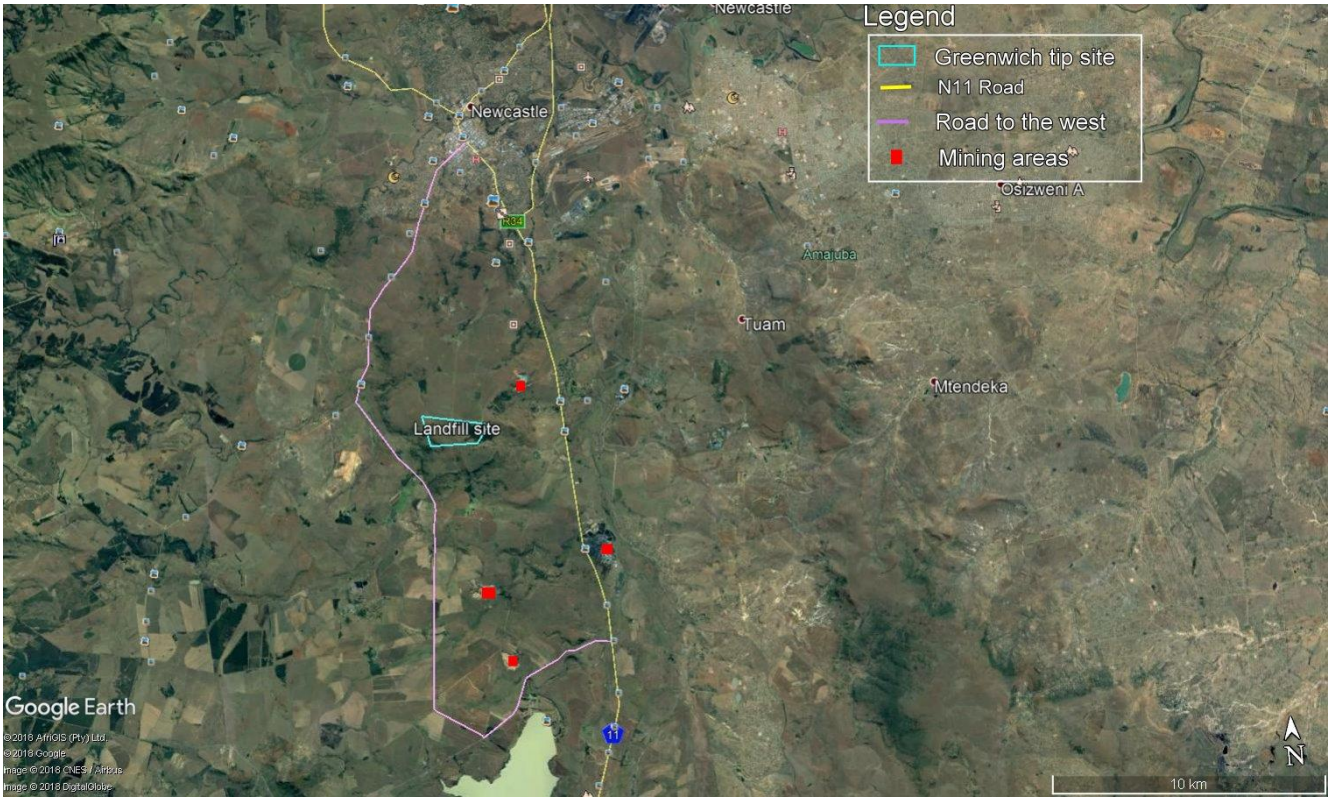


Figure 1-1: Greenwich Landfill location

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

- To determine the environmental baseline noise levels in the vicinity of the proposed Greenwich tip site and along the abutting feeder roads.

The environmental noise baseline information will be used to calculate the potential noise intrusion levels at the noise receptor areas at the two study areas.

2. Background to environmental noise

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

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – inverse square law. Expressed logarithmically as decibels, this means the sound level decreases 6.0dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance. The decibel scale is logarithmic, therefore decibel levels cannot be added in the normal arithmetic way, for example, two sound sources of 50.0dB each do not produce 100.0dB but 53.0dB, nor does 50.0dB and 30.0dB equal 80.0dB, but remains 50.0dB. Air absorption is important over large distances at high frequencies and it depends on the humidity but is typically about 40.0dB/km @ 4000 Hz. Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

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

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

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

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

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

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

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

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

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

Types of noise exposure:

- Continuous exposure to noise – The level is constant and does not vary with time e.g. traffic on freeway and an extractor fan;
- Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens;
- Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

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

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

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

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

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

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

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

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

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

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

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

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

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

The response to noise can be classified as follows:

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

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

Table 2-2: Estimated community/group response when the ambient noise level is exceeded

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

3. Study methodology

3.1 Instrumentation

The noise survey was conducted in terms of the provisions of the Noise Control Regulations, 1994 and SANS 10103 of 2008 (The measurement and rating of environmental noise with respect to annoyance and to speech communication). The following instruments were used in the noise survey:

- Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072;
- Larsen Davis Pre-amplifier – Serial no. PRM831 0206;
- Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184;
- Larsen Davis Calibrator 200 – Serial no.9855.

The instrument was calibrated before and after the noise readings were done and coincided within 1.0 dBA. Batteries were fully charged and a windshield was in use at all times. The calibration certificates are attached as Appendix A. The measured ambient noise level during the daytime and night time periods will be the baseline ambient noise criteria for the study area and will be evaluated in terms of SANS 10103 of 2008.

3.2 Measuring points

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

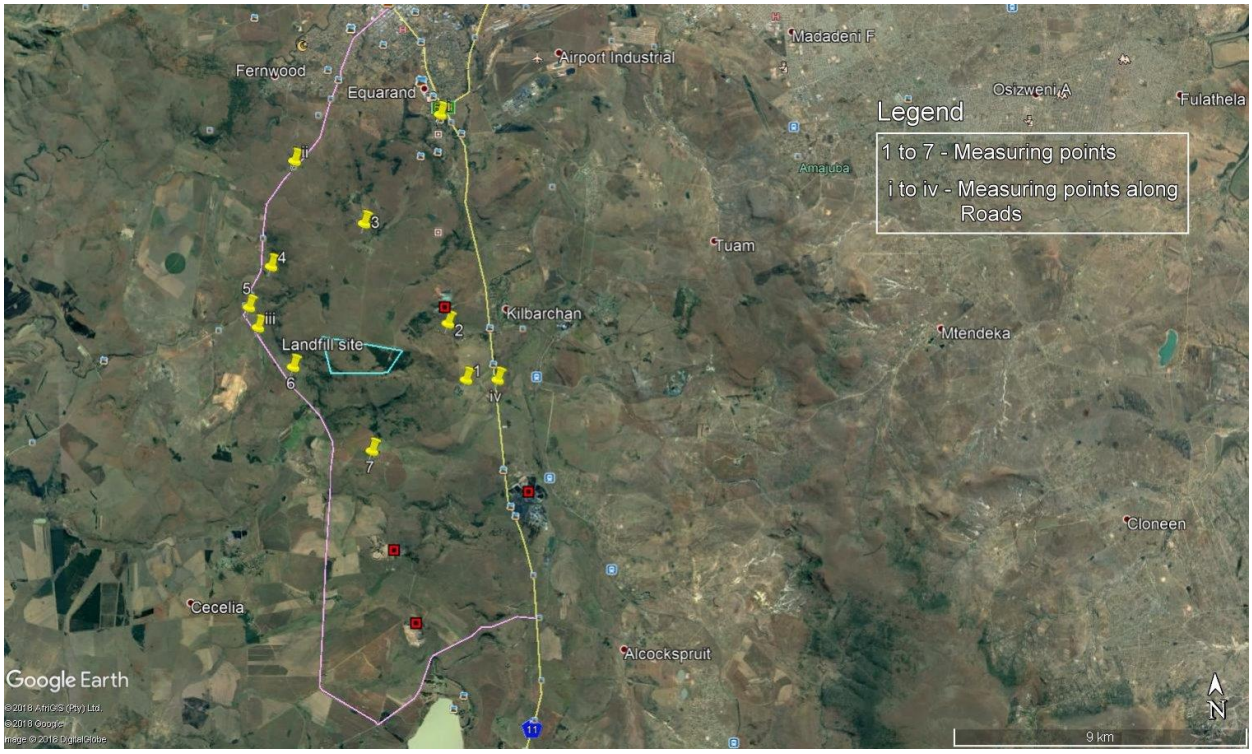


Figure 3-1: Measuring points

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

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

Position	Latitude	Longitude	Remarks
1	27° 51.675'	29° 57.157'	Entrance to the residential area some distance from the N11 road. Distant traffic noise.
2	27° 50.744'	29° 56.858'	Along a gravel road in the vicinity of a processing plant and some distance from the N11. Distant mine and traffic noise.
3	27° 49.069'	29° 55.375'	On the plateau in the vicinity of agricultural holdings/residential properties. Distant traffic noise.
4	27° 49.718'	29° 53.613'	At Norseland farm. Distant traffic noise.
5	27° 50.373'	29° 53.168'	At the boundary of the property. Distant traffic noise.
6	27° 51.376'	29° 53.962'	At the boundary of the property. Distant traffic noise.
7	27° 52.789'	29° 55.380'	In the vicinity of the farm house some distance from the feeder road. Far distant traffic noise.
i	27° 47.317'	29° 56.838'	Along the access road to MP3. Traffic noise.
ii	27° 47.999'	29° 54.104'	Along the feeder road. Traffic noise.
iii	27° 50.710'	29° 53.326'	Along the feeder road. Traffic noise.
iv	27° 51.692'	29° 57.741'	Along the feeder road. Traffic noise.

The following is of relevance to the ambient noise measurements:

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

3.3 Site Characteristics

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

- There was an intermittent flow of traffic along the tarred feeder road to the south and west of the study area during the day and little to no traffic during the night;
- There was a constant flow of traffic during the day and the night along the N11 Road. It became intermittent from 1h00 until 4h00;
- There was limited agricultural activities at the farm houses and such will change during the season when harvesting takes place;
- The wind and weather conditions play an important role in noise propagation;
- Distant traffic noise and agricultural type noises contribute to a large portion of the prevailing ambient noise level in the vicinity of the study area.

3.4 Current noise sources

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

- Domestic noises;
- Intermittent traffic along the feeder roads and haul road;
- Distant traffic noise from the abutting feeder roads;
- Insects;
- Birds;
- Wind noise.

3.5 Atmospheric conditions during the noise survey

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

12 March 2018

Daytime

- Wind speed – less than 1.7m/s;

- Temperature – 25.5^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 20% humidity.

Night time

- Wind speed – No wind to 1.3m/s;
- Temperature – 15.5^{o}C ;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a south-westerly direction;
- Humidity – 10% humidity.

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

4. Regulatory and Legislative Requirements

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

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

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

4.2 South African National Standards – SANS 10103 of 2008

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

4.3 South African National Standards – SANS 10210 of 2004

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

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

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

The Constitution of the Republic of South Africa Act, (Act No 108 of 1996) makes provision for the health and well-being of the citizens and to prevent pollution and to promote conservation. According to Article 24 of the Act, everyone has the right to:

(a) an environment that is not harmful to their health and well-being; and
(b) have the environment protected for the present and future generations through reasonable legislative and other measures that-
    (i) prevent pollution and ecological degradation;
    (ii) promote conservation; and
    (iii) secure ecological sustainable development and use of natural resources, while promoting justifiable economic and social development.

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

5. Description of the receiving environment

The prevailing ambient noise levels in the study area were created by domestic activities, distant traffic, wind and natural conditions. Some of the residential areas are located close to or in the vicinity of the feeder roads with the result that the prevailing ambient noise levels will be higher due to the traffic during the day and the night respectively. The proposed tip site will be higher than the residential areas with vertical barriers (hills) between the residential area and the proposed tip site. The distance (m) and difference in meters above the sea-level between the middle of the proposed tip site and the abutting residential is illustrated in Table 5.1.

Table 5-1: Distance (m) between the noise receptors and the middle of the landfill site

Residential areas	MAMSL - m	Distance - m
A	1299	6070
B	1293	6708
C	1284	7086

D	1345	4772
E	1335	3681
F	1288	4886
G	1261	4100
H	1229	3664
I	1266	2006
J	1322	2051
K	1297	2906
L	1234	3068
M	1354	948
N	1237	4601

The noise receptors (A to N) in the vicinity of the proposed Greenwich landfill site are illustrated in Figure 3.2.

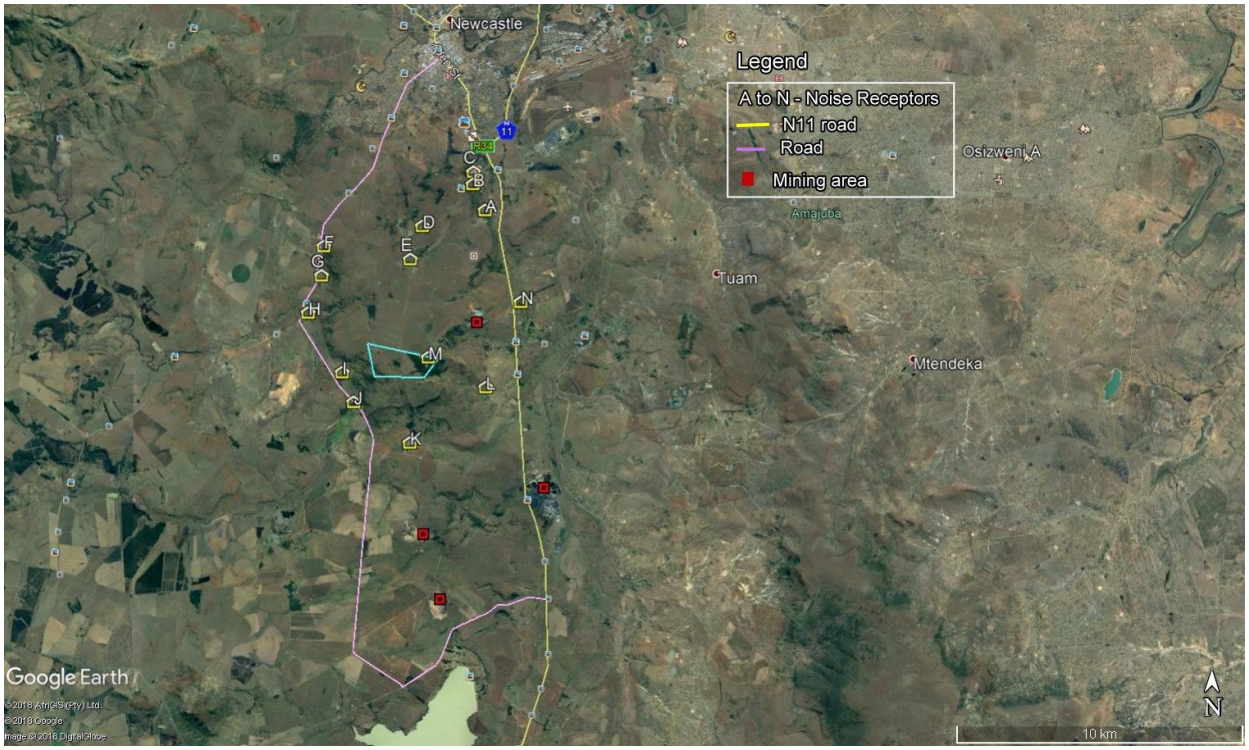


Figure 3-2: Noise receptors

6. Results of the noise survey

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

Table 6-1: Noise levels for the day and night at the study area.

Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**42.9**	65.3	33.7	Distant traffic noise.	**44.2**	59.2	36.2	Distant traffic and insect noises.
2	**39.0**	64.6	30.8	Distant traffic noise.	**44.2**	59.2	36.2	Distant traffic and insect noises.
3	**32.6**	64.8	22.0	Natural noises.	**33.9**	59.7	28.2	Distant traffic and insect noises.
4	**36.6**	57.5	23.7	Distant traffic noise.	**41.7**	56.5	34.9	Distant insect noises.
5	**39.2**	65.0	23.8	Distant traffic noise.	**44.6**	52.5	39.3	Distant insect noises.
6	**35.8**	55.9	22.2	Distant traffic noise.	**36.0**	64.0	29.0	Distant insect noises.
7	**44.2**	64.4	26.2	Distant traffic noise.	**37.5**	65.4	30.3	Distant insect noises.
i	**44.7**	64.2	38.7	Distant traffic noise.	**42.3**	64.3	31.9	Distant insect noises.
ii	**52.7**	73.9	27.5	Intermittent traffic noise.	**41.7**	56.5	34.9	Distant insect noises.
iii	**42.3**	64.0	23.0	Intermittent traffic noise.	**34.3**	57.3	22.0	Distant insect noises.
iv	**61.3**	75.2	39.3	Traffic noise.	**58.1**	73.5	48.6	Distant insect noises.

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

Table 6-3: Sound pressure levels of construction machinery

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

The noise reduction calculated in Table 6.2 is for direct line of sight and medium ground conditions. Engineering control measures and topography can have an influence on how the noise level is perceived by the occupants of nearby noise sensitive areas. The cumulative

noise level of the machinery and equipment will be 64.9dBA at 60m and 40.8dBA at 960m from the construction area if all the machinery operates in a radius of 30m at one time. This will seldom happen and the cumulative noise level will therefore be lower.

7. Noise impact levels at the different residential areas

7.1 Environmental noise level calculations

The assessment of environmental noise impacts will vary because of the different prevailing ambient noise levels in different districts according to Table 2 of SANS 10103 of 2008 whereby recommendations of prevailing ambient noise levels are referred to (Table 2-1). In order to simplify the assessment of the magnitude of noise impacts in terms of increases, it is recommended that the increase in the in the prevailing ambient noise level is quantified as follows: The following equation was used to calculate the noise level at the noise sensitive areas during the construction phase:

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

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

Lw is the sound level at the source in dBA;

α is the noise reduction due to the distance from the source (5.0dBA);

R is the distance from the source.

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

The following sound levels (construction activities) were used in determining the noise level at the residential areas:

Construction phase

- Site clearing and grubbing of the footprint areas – 90.5dBA
- Construction of landfill liner - 90.5dBA;
- Civil Construction and construction activities of pipeline, service road, wash bays, workshop and a powerline - 85.5dBA;
- Building material and equipment deliveries at the site – 85.5dBA.

Operational phase

- Traffic to the landfill site – 80.0dBA;
- Off-loading of waste – 90.5dBA;
- Compaction activities – 95.0dBA;
- Maintenance activities – 85.0dBA;
- Emergency signal on landfill machinery – 90.0dBA;
- Emergency generator – 90.0dBA.

Decommissioning and closure phase

- Demolition of surface infrastructure – 90.5dBA;
- Rehabilitation of landfill site – 85.0dBA.

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

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

where,

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

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

Table 7-1: Noise intrusion level criteria

Increase Δ-dBA	**Assessment of impact magnitude**	**Colour code**
$0 < \Delta \leq 1$	Not audible	
$1 < \Delta \leq 3$	Very Low	
$3 < \Delta \leq 5$	Low	
$5 < \Delta \leq 10$	Medium	
$10 < \Delta \leq 15$	High	
$15 < \Delta$	Very High	

The noise levels at the noise sensitive areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor.

8. Noise Impact Assessment Analysis

The following methodology was used to rank these impacts. Clearly defined rating and rankings scales (In order to assess each of these factors for each impact, the ranking scales in Table 8.1 – Table 8.7 were used. to **Error! Reference source not found.**) were used to assess the impacts associated with the proposed activities. The impacts identified by each specialist study and through public participation were combined into a single impact rating table for ease of assessment.

Each impact identified was rated according the expected magnitude, duration, scale and probability of the impact (**Error! Reference source not found.**).

To ensure uniformity, the assessment of potential impacts will be addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale will be provided to the specialist to assess the impacts associated with their investigation.

Each impact identified will be assessed in terms of scale (spatial scale), magnitude (severity) and duration (temporal scale). Consequence is then determined as follows:

Consequence = Severity + Spatial Scale + Duration

The Risk of the activity is then calculated based on frequency of the activity and impact, how easily it can be detected and whether the activity is governed by legislation. Thus:

Likelihood = Frequency of activity + frequency of impact + legal issues + detection

The risk is then based on the consequence and likelihood.

Risk = Consequence x likelihood

In order to assess each of these factors for each impact, the ranking scales in Table 8.1 – Table 8.7 were used.

Table 8.1: Severity.

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful / within a regulated sensitive area	5

Table 8.2: Spatial Scale - How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Local (within 5km)	3
Regional / neighboring areas (5km to 50km)	4
National	5

Table 8.3: Duration.

One day to one month (immediate)	1
One month to one year (Short term)	2
One year to 10 years (medium term)	3
Life of the activity (long term)	4
Beyond life of the activity (permanent)	5

Table 8.4: Frequency of the activity - How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table 8.5: Frequency of the incident/impact - How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 8.6: Legal Issues - How is the activity governed by legislation?

No legislation	1
Fully covered by legislation	5

Table 8.7: Detection - How quickly/easily can the impacts/risks of the activity be detected on the environment, people and property?

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Environmental effects will be rated as either of high, moderate or low significance on the basis provided in
Table 8.8.

Table 8.8: Impact Ratings.

RATING	CLASS
1 – 55	(L) Low Risk
56 – 169	M) Moderate Risk
170 – 600	(H) High Risk

8.1.1 Construction phase

The environmental noise impact assessment in terms of the magnitude of a noise impact during the construction phase of the landfill site at the residential areas is illustrated in Table 8.9.

Table 8-9: Calculated noise levels during the Construction phase

Residential property	Site clearing and grubbing of footprint	Construction of landfill liner	Civil Construction activities wash bays and workshop	Civil Construction (Service road) - dBA	Civil Construction (Power line) - dBA	Building material and equipment deliveries at the site	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	**Intrusion noise level - daytime**	**Intrusion noise level - night time**
A	9.8	4.8	6.8	6.8	6.8	-0.2	14.5	39.0	41.7	**0.0**	**0.0**
B	8.9	3.9	5.9	5.9	5.9	8.9	14.7	39.0	41.7	**0.0**	**0.0**
C	8.5	3.5	5.5	5.5	5.5	8.5	14.3	39.0	41.7	**0.0**	**0.0**
D	11.9	6.9	8.9	8.9	8.9	11.9	17.7	32.7	34.0	**0.1**	**0.1**
E	14.2	14.2	14.2	14.2	14.2	14.2	22.0	33.0	34.2	**0.4**	**0.3**
F	11.7	11.7	11.7	11.7	11.7	11.7	19.5	36.7	41.7	**0.1**	**0.0**
G	13.2	13.2	13.2	13.2	13.2	13.2	21.0	36.7	41.7	**0.1**	**0.0**
H	14.2	14.2	14.2	14.2	14.2	14.2	22.0	36.0	36.2	**0.2**	**0.2**
I	19.5	19.5	19.5	19.5	19.5	19.5	27.2	36.4	36.5	**0.6**	**0.5**
J	19.3	19.3	19.3	19.3	19.3	19.3	27.0	36.3	36.5	**0.5**	**0.5**
K	16.2	16.2	16.2	16.2	16.2	16.2	24.0	44.2	37.7	**0.0**	**0.2**
L	15.8	15.8	15.8	15.8	15.8	15.8	23.5	43.0	41.8	**0.1**	**0.1**
M	26.0	26.0	26.0	26.0	26.0	26.0	33.7	40.1	36.8	**1.1**	**2.9**
N	12.2	12.2	12.2	12.2	12.2	12.2	20.0	61.3	58.1	**0.0**	**0.0**

The impact assessment for the construction phase is illustrated in Tables 8-10 to 8-15.

Table 8-10: Clearing of footprint area, stripping and stockpiling of topsoil

Activity	***Clearing of footprint area, stripping and stockpiling of topsoil***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***

Rating	3	2	2	5	4	5	1	105	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-11: Construction of landfill liner

Activity	***Construction of landfill liner***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

Table 8-12: Civil construction activities for wash bays and workshop

Activity	***Civil construction activities for wash bays and workshop***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

Table 8-13: Civil construction – service road

Activity	***Civil construction - service road***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

Table 8-14: Civil construction – power line

Activity	***Civil Construction - power line***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

Table 8-15: Building material and equipment deliveries at the site

Activity	***Building material and equipment deliveries at the site***								
Project phase	*Pre-construction and Construction phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No construction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

8.1.2 Operational Phase

The environmental noise impact during the operational phase at the residential areas is illustrated in Table 8-16. The noise impact will be not audible to very low (insignificant) at the different noise receptors.

Table 8-16: Noise intrusion levels (dBA) during the operational phase

Residential property	Traffic to and from the landfill site	Off-loading of waste	Compaction activities	Maintenance activities	Emergency signal on landfill machinery	Emergency generator	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	6.8	9.8	14.8	6.8	9.8	9.8	18.4	39.0	41.7	**0.0**	**0.0**
B	5.9	8.9	13.9	5.9	8.9	8.9	17.4	39.0	41.7	**0.0**	**0.0**
C	5.5	8.5	13.5	5.5	8.5	8.5	17.0	39.0	41.7	**0.0**	**0.0**
D	8.9	11.9	16.9	8.9	11.9	11.9	20.5	32.9	34.1	**0.3**	**0.2**
E	11.2	14.2	19.2	11.2	14.2	14.2	22.7	33.0	34.2	**0.4**	**0.3**
F	8.7	11.7	16.7	8.7	11.7	11.7	20.3	36.7	41.7	**0.1**	**0.0**
G	10.2	13.2	18.2	10.2	13.2	13.2	21.8	36.7	41.7	**0.1**	**0.0**
H	11.2	14.2	19.2	11.2	14.2	14.2	22.8	36.0	36.2	**0.2**	**0.2**
I	16.5	19.5	24.5	16.5	19.5	19.5	28.0	36.5	36.6	**0.7**	**0.6**
J	16.3	19.3	24.3	16.3	19.3	19.3	27.8	36.4	36.6	**0.6**	**0.6**
K	13.2	16.2	21.2	13.2	16.2	16.2	24.8	44.2	37.7	**0.0**	**0.2**

L	12.8	15.8	20.8	12.8	15.8	15.8	24.3	43.0	41.8	**0.1**	**0.1**
M	23.0	26.0	31.0	23.0	26.0	26.0	34.5	40.3	37.2	**1.3**	**3.3**
N	9.2	12.2	17.2	9.2	12.2	12.2	20.8	61.3	58.1	**0.0**	**0.0**

The impact assessment for the operational phase is illustrated in Tables 8-17 to 8-22.

Table 8-17: Traffic to and from the landfill site

Activity	***Traffic to and from the landfill site***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*The preferred access road along the eastern side of the site off the N11 to be used (Figure 9-1). The existing gravel road to be upgraded to a tar surfaced road.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-18: Off-loading activities

Activity	***Off-loading of waste***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No off-load activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-19: Compaction activities

Activity	***Compaction activities***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*The compactors must comply with the manufacturer's specifications on noise reduction and no source at the compactor must exceed 85.0dBA. Should there be a noise source exceeding 85.0dBA such must be acoustically screened off. No compaction activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-20: Maintenance activities

Activity	***Maintenance activities***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*Maintenance on the machinery must be done in the workshop and in emergency conditions such must be done not to exceed 85.0dBA.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-21: Emergency signal – reverse signal on landfill machinery

Activity	***Emergency signal – reverse signal on landfill machinery***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*The warning reverse signal on all landfill machinery to be replaced with the vibration signal (If it is approved by the Department of Labour – Occupational Health and Safety) No landfill activities to be allowed during night time..*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

Table 8-22: Emergency generator

Activity	***Emergency generator***								
Project phase	*Operational phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	3	2	2	5	4	5	1	105	Moderate
Management Measures	*The siting of the emergency generator to be done in conjunction with the accredited environmental noise specialist. Noise test to be done for the generator not to create a noise intrusion.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	2	5	1	78	Moderate

8.1.3 Decommissioning and closure phase

The environmental noise impact during the decommissioning and closure phase at the residential areas is illustrated in Table 8-23. The noise impact will be not audible to very low (insignificant) at the different noise receptors B to D and very low at noise receptor A during the night and low during the day.

Table 8-23: Noise intrusion levels during the decommissioning phase

Residential	Demolition of all surface infrastructure	Rehabilitation of all disturbed areas	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	**Intrusion noise level - daytime**	**Intrusion noise level - night time**
A	9.8	6.8	11.6	39.0	41.7	**0.0**	**0.0**
B	8.9	5.9	10.6	39.0	41.7	**0.0**	**0.0**
C	8.5	5.5	10.3	39.0	41.7	**0.0**	**0.0**
D	11.9	8.9	13.7	32.7	33.9	**0.1**	**0.0**
E	14.2	11.2	15.9	32.7	34.0	**0.1**	**0.1**
F	11.7	8.7	13.5	36.6	41.7	**0.0**	**0.0**
G	13.2	10.2	15.0	36.6	41.7	**0.0**	**0.0**
H	14.2	11.2	16.0	35.8	36.0	**0.0**	**0.0**
I	19.5	16.5	21.2	35.9	36.1	**0.1**	**0.1**
J	19.3	16.3	21.0	35.9	36.1	**0.1**	**0.1**
K	16.2	13.2	18.0	44.2	37.5	**0.0**	**0.0**
L	15.8	12.8	17.5	42.9	41.7	**0.0**	**0.0**
M	26.0	23.0	27.7	39.3	34.8	**0.3**	**0.9**
N	12.2	9.2	14.0	61.3	58.1	**0.0**	**0.0**

The impact assessment for the decommissioning phase is illustrated in Tables 8-24 to 8-25.

Table 8-24: Demolition of all surface infra structure

Activity	***Demolition of all infra-structure***								
Project phase	*Decommissioning phase*								
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*								
	Consequence			***Likelihood***				***Impact rating***	
Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

Table 8-25: Rehabilitation of all disturbed areas

Activity	***Rehabilitation of all disturbed areas***		
Project phase	*Decommissioning phase*		
Impact Summary	*Noise increase at the boundary of the landfill site footprint and at the abutting residential areas*		
	Consequence	***Likelihood***	***Impact rating***

Potential Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	2	2	2	5	3	5	1	84	Moderate
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and any noise sources above 85.0dBA to be acoustically screened off. No activities to be done during night time.*								
	Consequence			***Likelihood***				***Impact Rating***	
After Management Impact Rating	Severity	Spatial Scale	Duration	Frequency of activity	Frequency of impact	Legal issues	Detection	***Rating***	***Class***
	1	2	2	3	1	5	1	50	Low

9. Calculation of road traffic noise

The proposed route to and from the Landfill site is illustrated in Figure 9.1.

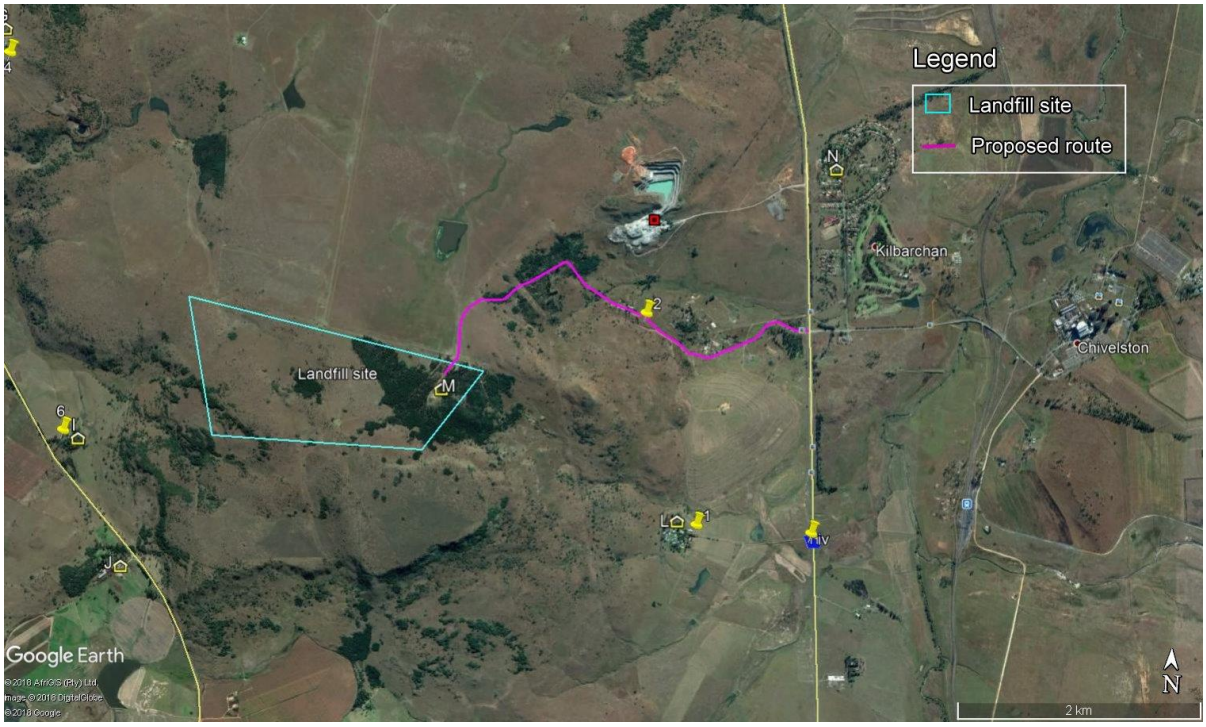


Figure 9-1: Access road to proposed landfill site

The traffic along the feeder consists out of heavy–duty trucks and motor-vehicles. The prevailing ambient noise level along the feeder roads and at the nearest noise receptors were as follows:

- Along the N11 – 61.3dBA during the day and 58.1dBAdBA during the night;
- Gravel road to the site – 39.0dBA during the day and 44.2dBA during the night;
- At noise receptor E – 32.6dBA during the day and 33.9dBA during the night;
- At noise receptor L – 42.9dBA during the day and 44.2dBA during the night;
- At noise receptor M – 39.0dBA during the day and 44.2dBA during the night.

The calculations to determine the noise levels from the additional traffic were based on the following equation:

SANS 10210 of 2004, the national standard for the calculating and predicting of road traffic noise was used to calculate the noise level to be generated by the traffic along the proposed road. The traffic will create a finite type noise as the N11 road is already used by other vehicles and the calculations during the construction phase was based on 10 vehicles of which 8 will be heavy duty vehicles and 2 motor vehicles per hour. The calculations during the operational phase were based on 40 vehicles per hour of which 20 will be heavy duty vehicles and 20 motor-vehicles.

Basic Model

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

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

Primary corrections to the basic model:

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

Propagation:

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

The calculated noise levels during the construction phase will be as follows:

- Along the N11 – 49.2dBA;
- Along the upgraded access road – 49.2dBA;
- In the vicinity of noise receptor E – 12.8dBA;
- In the vicinity of noise receptor L – 21.3dBA;
- In the vicinity of noise receptor M – 36.3dBA.

The calculated noise levels during the operational phase will be as follows:

- Along the N11 – 52.6BA;
- Along the upgraded access road – 52.6dBA;

- In the vicinity of noise receptor E – 16.2dBA;
- In the vicinity of noise receptor L – 24.7dBA;
- In the vicinity of noise receptor M – 40.3dBA.

10. Assumptions and Limitations

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

- The prevailing ambient noise levels for the study area was created by far and near noise sources associated with traffic and seasonal agricultural activities with the result that the prevailing ambient noise level may change at times;
- Noise measurements in the presence of winds in excess of 3.0m/s may impact the outcome of the environmental noise results;
- The identification of noise measuring points may create a problem in terms of the prevailing noise levels should it not be done with outmost care and in a scientific manner;
- The influx of traffic into an area will have an influence on the prevailing ambient noise levels and should be considered during the noise impact assessment process.

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

Noise or sound is part of our daily exposure to different sources which is part of daily living and some of the sounds which are intrusive such as traffic noise forms part of the ambient noise that people get accustomed to without noticing the higher sound levels. Any person in the workplace and at home is exposed to the following noise levels as given in Table 11-1. These are the average noise levels in the workplace and at home that will mask noise from a source introduced into an area:

Table 10-1 Different noise levels in and around the house and workplace

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

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

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

11. Recommendations

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

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

11.1 Acoustic screening recommendations

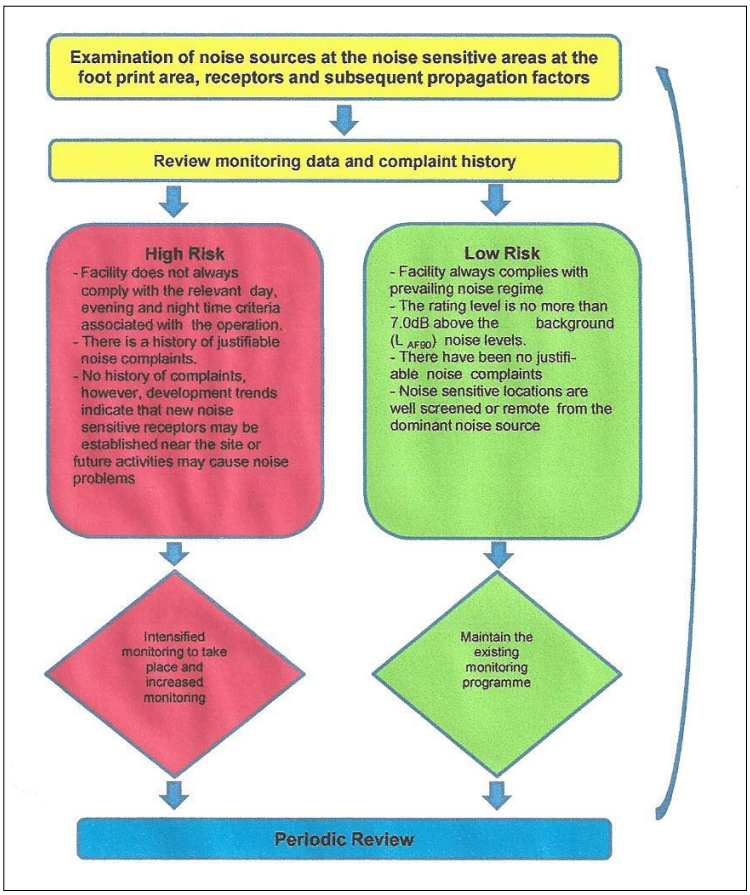
The acoustic screening measures for the project are given in Table 11-1. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 11-1: Recommended acoustic screening measures

Activity	**Recommendations**
Construction phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Construction activities to take place during daytime period only. • Noise monitoring on a quarterly basis. • Excessive noise levels above 85.0dBA to be screened off. • The existing gravel access road to be upgraded to a tarred surface.
Operational phase	• Emergency generators to be placed in such a manner that it is away from any residential area. • Noise monitoring to be done at the proposed landfill site and at the abutting residential areas on a monthly basis after which the frequency can change to a quarterly basis. • The reverse signal on vehicles working at the landfill site to be replaced with a vibrating type siren if it is approved by the Department of Labor. • Actively manage the process and the noise management plan must be used to ensure compliance to the noise regulations and/or standards. The noise levels to be evaluated in terms of the baseline noise levels.
Decommissioning phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Activities to take place during daytime period only. • Vehicles to comply with manufacturers' specifications and any activity which will exceed 85.0dBA to be done during daytime only.

The following noise management plan as illustrated in Figure 11.1 must be used to identify any new noise sources which may have an impact on the abutting noise sensitive areas.

Figure 11-1: Noise management plan



12. Conclusion

The proposed landfill establishment will be situated in a district where there are feeder roads, agricultural activities and residential areas. The noise impact assessment revealed that the noise increase will be insignificant and that the noise increase will not exceed the threshold value of 7.0dBA granted by the Noise Control Regulations. The recommended noise mitigatory measures will ensure that the proposed Greenwich landfill operations will be environmentally sustainable.

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

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

- List the potential environmental impacts;
- Set of operational procedures for monitoring, controlling and reducing impacts;
- Recording the results and respond to complaints timeously;

- Procedure for internal environmental noise audits.

The Environmental management Plan (EMP) for the proposed mine establishment will consist of the following as illustrated in Table 12.1. Regular environmental monitoring will provide the data for reviewing, checking and revising the EMP.

Table 12-1: Environmental noise management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated noise levels will be adhered to at all times.	Monthly basis after which the frequency of monitoring may change to a quarterly basis	The project engineer and the responsible person (Greenwich landfill site) during the construction and operational phases of the project
Monitoring objective	Measure the environmental noise levels during the construction, operational and decommissioning phases of the project to ensure compliance to the recommended and threshold noise levels.	Monthly basis after which the frequency of monitoring may change to a quarterly basis	The project engineer and the responsible person (Greenwich landfill site) during the construction and operational phases of the project
Monitoring technology	The environmental noise monitoring must be done with a calibrated Class 1 noise monitoring equipment.	Monthly to Quarterly basis	The site engineer and independent qualified environmental noise specialist.
Specify how the collected information will be used	The data must be collated and discussed on a monthly basis during the construction phase and on a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis with the site engineer.	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis or as required.	The site engineer and the responsible person (Greenwich landfill site) during the construction and operational phases of the project
Spatial boundaries	At the boundaries of the identified residential areas as well as at the landfill footprint boundaries.	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis or as required.	The site engineer and the responsible person (Greenwich landfill site) during the construction and operational phases of the project
Define how the data will be analysed and interpreted and how it should be presented in monitoring reports	Reports must be compiled for each monitoring cycle and the results must be compared to the previous set of results to determine if there was a shift in the prevailing ambient noise levels.	Monthly basis during the construction phase and a monthly to quarterly basis during the operational phase for the first two years thereafter on an annual basis or as required.	The site engineer and the responsible person (Greenwich landfill site) during the construction and operational phases of the project
Accuracy and precision of the data	The noise survey will have to be conducted in terms of the recommendations of SANS 10103 of 2008 and the applicable noise regulations.	Calibrated equipment which complies with the recommendations of SANS 10103 of 2008 must be used at all times.	Environmental noise specialist

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

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Environmental noise and vibration specialist

13. List of Definitions and Abbreviations

13.1 Definitions

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

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

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

Where

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

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

NOTE The internationally accepted symbol for sound level is dBA.

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

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

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

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

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

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

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

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

Intelligible speech
Speech that can be understood without undue effort

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

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

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

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

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

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

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

13.2 Abbreviations

dBA – A-weighted sound pressure level;

EMP – Environmental Management Plan;

IBR – Angular trapezoidal fluted profile sheet;

IFC – International Finance Corporation;

Km/h - Kilometers per hour;

Kg/m^3 – Kilogram per cubic meter;

m/s – meters per second;

NSA – Noise sensitive areas;

L_{Basic} – Basic noise level in dBA;

SANS – South African National Standards;

TLB – Tractor-loader-backhoe

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MANUFACTURERS	LARSON.DAVIS and PCB
MODEL NUMBERS	831, PRM 831 and 377 B02
SERIAL NUMBERS	0001072, 0206 and 102184
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