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Environmental Noise Impact Assessment

3.2MW Photovoltaic Power Generation Plant at Unilever, Commissioner Street, Boksburg East, City of Ekurhuleni, Gauteng

Project No: 047/2022
Compiled by: B v/d Merwe
Date: 25 February 2022

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 **Ecoleges Environmental Consultants cc, Machadodorp** was appointed as Environmental Assessment Practitioner **compilation of an EIA and EMP for a 3.2MW Photovoltaic Solar Plant at Unilever, Boksburg.** 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: 25 February 2022
Title / Position: Environmental noise & vibration specialist
Qualification(s): MSc Environmental Management
Experience (years/ months): 20 years
Registration(s): IAIAsa, SAAI, NACA, SSAG

Details of specialist and expertise

I, Barend JB van der Merwe of 43 6th Street, Linden Johannesburg have been an environmental noise and ground vibration specialist for the last 14 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise sensitive areas. I am also involved with the noise and ground vibration impact assessments and the environmental management plans compilation of large projects such as wind farms, mining, roads, trains (primarily the Gautrain) and various point noise sources. As a post-graduate student in Environmental Management at the University of Johannesburg, I obtained an MSc degree with the research project concentrating on the impact of noise and ground vibration on a village close to a new underground mine. I have played a major role in the identification, evaluation and control of physical factors such as noise and ground vibration in the following projects – wind farms, various platinum and coal mines and the quarterly noise evaluation of the Gautrain, 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 and the Booysensdal North mine expansion. The following large environmental companies are amongst my clients: Amec Foster Wheeler, Gibb, Royal Haskoning DHV, Coffey Environmental, Dhamana Consulting, Ecoleges Environmental Consultants cc, Golder Associates Africa (Pty) Ltd, GCS Environmental (Pty) Ltd, Knight Piesold Environmental (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):

- Booysensdal North expansion project;
- 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 provided by Unilever and/or Ecoleges cc. 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 refer 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 by Ecoleges Environmental Consultants to conduct a noise impact assessment of the proposed 3.6MW Solar Photovoltaic (PV) Power Generation Development Project plant and infra-structure for Unilever Factory, Boksburg. The proposed PV site is situated west of the Unilever Factory, Boksburg, south of a railway corridor, east of Kruger Road and north of St Dominics Road. The proposed Photovoltaic (PV) power generation plant project will include the construction and operational phases and the assessment in terms of the noise increase anticipated in the prevailing ambient noise levels of the study area.

The following processes will be undertaken on the site:

- Preparation of the area where the photovoltaic panels will be placed;
- Installation of the photovoltaic power panels;
- Operation and Maintenance activities;
- Laydown areas;
- Inverter Station; and,
- Entrance road to the proposed PV plant area.

The entrance road to the site will be off an existing feeder road. The noise impact assessment for this project will be done to determine the potential noise impact on the residential area to the west and at the SPCA north of the proposed PV Plant site.

Noise Impact Assessment

The noise impact assessment was done to determine what acoustic screening measures will be required to comply with the Noise Control legislation and or Standards.

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

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

The proposed 3.2MW Photovoltaic power generation plant and changes during the construction, operational and decommissioning phases may require approved environmental management measures,

ongoing environmental noise survey and mitigatory measures to ensure compliance to the relevant noise regulations and/or standards.

Conclusion and Recommendations

The following recommendations will be applicable for the activities during the different phases to comply with the noise standards:

- Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.
- Construction activities to take place during daytime periods only.
- All equipment with noise levels exceeding 85.0dBA to be acoustically screened off by means of engineering control measures.
- The Inverter will have to be acoustically screened off (acoustic screen on the side facing the residential areas) when the sound from the Inverter is audible at the abutting residential areas.

There will be no noise intrusion into the abutting residential area to the west during the construction and/or operational phases and the preferred alternative will be no 1.

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

Contents

List of Figures

List of Tables

This report was prepared in terms of the Environmental Management Act, 1998 (Act No. 107 of 1998) as amended, the Environmental Impact Assessment Regulations, 2014 as amended – no. 43110 of 20 March 2020 and the following aspects are dealt with in the report:

No.	Requirement	Section in report
1a)	Details of -	
(i)	The specialist who prepared the report	Page 3
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Page 3
b)	A declaration that the specialist is independent	Page 2
c)	An indication of the scope of, and the purpose for which, the report was prepared	Page 15
cA)	An indication of the quality and age of the base data used for the specialist report	Page 15
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Page 25
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Page 17
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	Pages 17
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Pages 25
g)	An identification of any areas to be avoided, including buffers	n/a
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Page 13 and Page 28
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Page 15
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment	Page 42
k)	Any mitigation measures for inclusion in the EMPr	Page 45
l)	Any conditions for inclusion in the environmental authorisation	Page 45
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Page 45
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	Page 47
iA)	Regarding the acceptability of the proposed activity or activities: and	Page 47
(ii)	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Page 47
o)	A description of any consultation process that was undertaken during preparing the specialist report	n/a

1. Introduction

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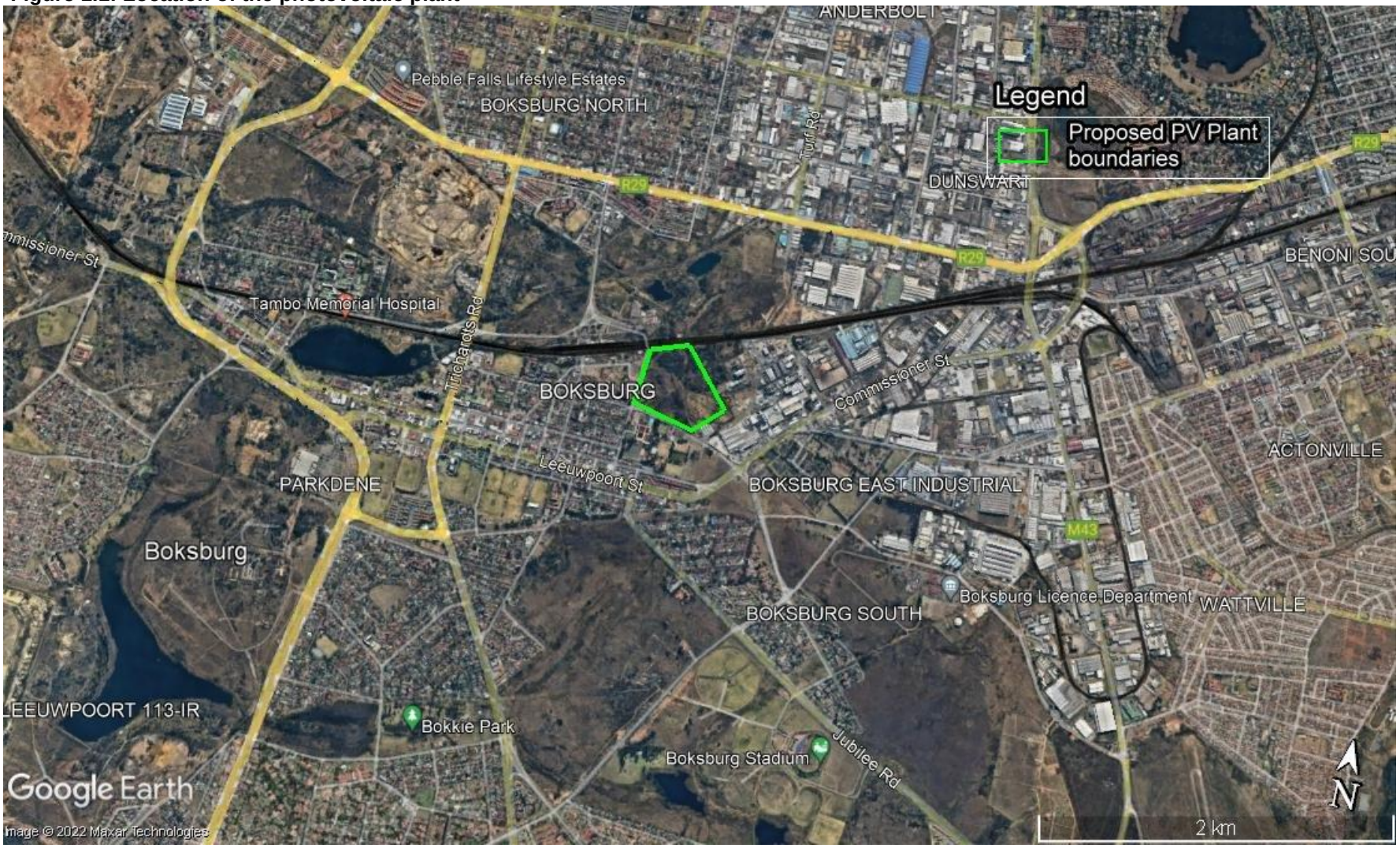
The power plant uses crystalline silicon photovoltaic (PV) technology to convert sunlight into DC electricity. 400 individual PV panels of nominal 327-Watt peak output will be deployed. PV panels are mounted in frames that rotate to track the sun from East to West during the day to maximize the sun facing area of the panels. Inverters (12 x 2MW Converters) convert DC to AC electricity, and combiners, switchgear, and step-up transformers are used to inject the power output to the Unilever power reticulation network.

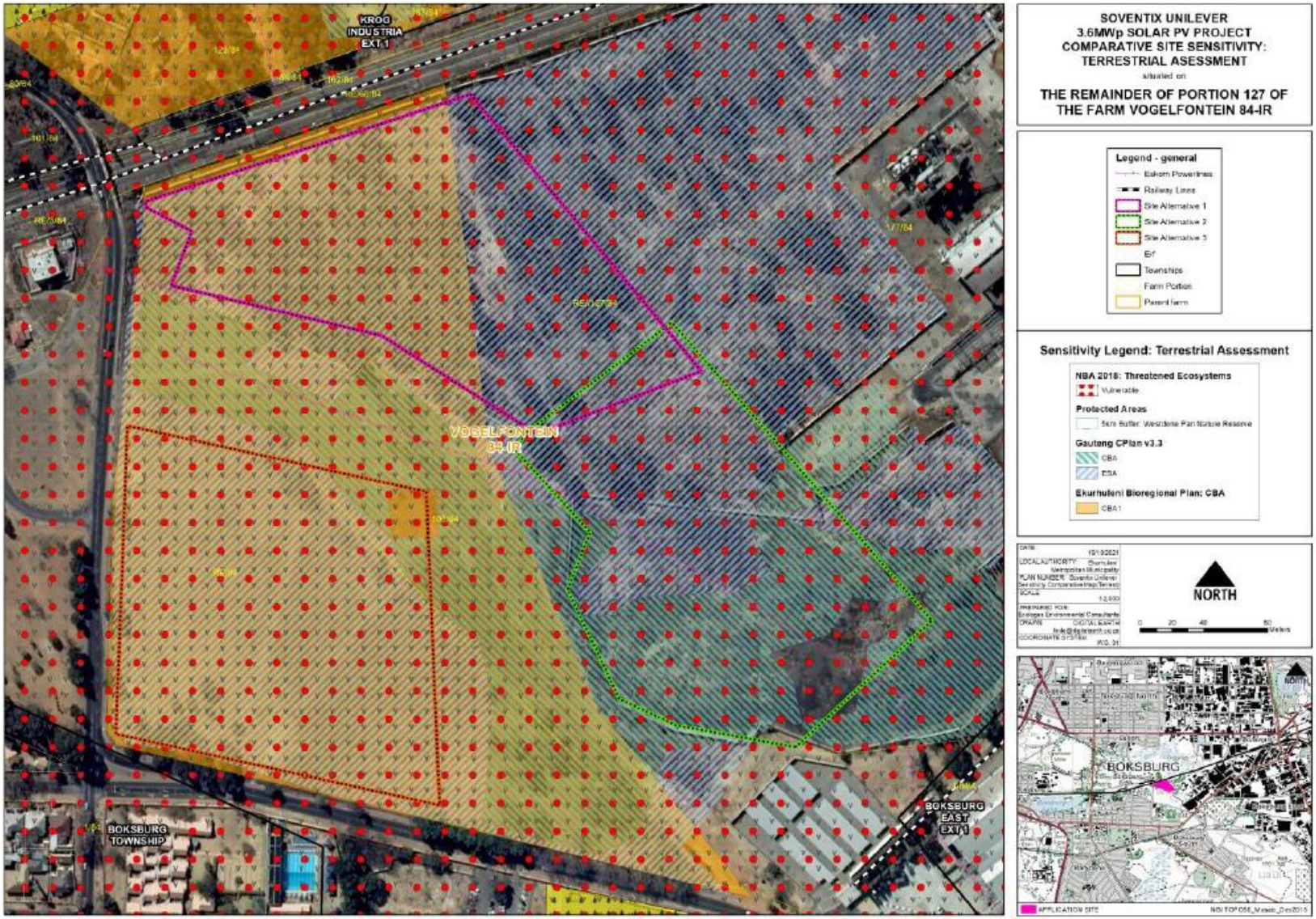
Total area to be fenced is approximately 16.44Ha and the proposed PV plant footprint (3 alternatives areas) is illustrated in Figure 1.1.

Figure 1.1: Location of the photovoltaic plant



The location of the three proposed PV plant locations is illustrated in Figure 1.2.

Figure 1.2: Alternative development footprints for the Soventix Unilever solar PV Project plant.



The purpose of the noise study was to determine the environmental baseline noise levels at the residential areas in the vicinity of the proposed PV plant.

The prediction and modelling section of the report was required to investigate and predict the potential impact the PV plant (during the construction and operational phases) may have on the living environment in the vicinity of the proposed PV plant. The purpose of this phase of the assessment will be to calculate and predict the noise levels in the vicinity of the PV plant in terms of the Noise Control Regulations, 1999.

1.1 Scope of Work

The general objectives of the specialist study were to:

- Gain a detailed understanding of the baseline noise environment at the proposed PV plant and infra-structure areas and at the residential areas;
- Identify areas that should be avoided due to irreplaceable environmental sensitivity or irreversible environmental impact, or identification of mitigation measures to replace/rehabilitate impacted sensitivities;
- Determine and assess the impacts (including cumulative impacts) to receptors and resources in the vicinity of the proposed PV plant;
- Identify if there are any fatal flaws in terms of noise associated with the proposed development;
- Develop environmental management measures so that negative impacts may be mitigated, and positive benefits enhanced;
- Provide guidance with regard to any further legal requirements/licenses or permits that may be needed.

1.2 Noise impact assessment method

The noise impact assessment will be done accordance with to the Noise Control Regulations. 1999 and South African National Standards 10103 of 2008 which will be dealt with later on in the report.

1.3 Assumptions and Limitations

The following limitations forms part of the environmental noise measurements:

- The prevailing ambient noise levels for the study area was created by far and near noise sources associated with distant traffic, distant industrial activities, and domestic activities with the result that the prevailing ambient noise level may change at times;

- Noise measurements in the presence of winds more than 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 to and from the proposed PV plant may have an influence on the prevailing ambient noise levels and will be investigated as there are already traffic movement along the access roads; and
- Insect noise may inflate the prevailing ambient noise level during summertime whereas the prevailing ambient noise during wintertime may be lower.

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 dB 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 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB but remains 50 dB. Air absorption is important over large distances at high frequencies, and it depends on the humidity but is typically about 40 dB/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 3-5 dBA.

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.

Several 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 (except for 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.

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

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

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

- The trained healthy human ear can discern changes in sound levels of 1 dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3 dBA;
- A change in sound level of 5 dBA is a readily perceptible increase in noise level;
- A 10-dBA 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 dBA for the daytime and 45 dBA for the nighttime period;
- Industrial area – 70 dBA 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. 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.

The response to noise can be classified as follows:

- An increase of 1.0dBA to 3.0dBA above ambient noise level will cause no response from the affected community. For a person with normal hearing an increase of 0dBA to 3 dBA will not be noticeable;
- An increase between 1.0dBA – 10.0dBA will elicit little to sporadic response. When the difference is more than 5.0dBA above the ambient noise level a person with normal hearing will start to hear the difference;
- An increase between 5.0dBA and 15.0dBA will elicit medium response from the affected community;
- An increase between 10.0dBA and 20.0dBA will elicit strong community reaction.

Because there is no clear-cut transition from one community response to another as well as several variables, categories of responses can overlap. This should be taken into consideration during the evaluation of a potential noise problem. There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, industrial and feeder roads in proximity of each other. The ambient noise level will therefore differ throughout the study area, depending on the region and the measuring position in relation to areas with existing mining activities. People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in Table 2.1.

Table 2-1: 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

Noise levels were measured in accordance with ISO 1996:2003, BS 4142 using a digital Larson Davis 831 – Class 1 meter with Logging, Environmental 1/1, 1/3 Octave Band and percentiles Sound Level Meter (Class 1). On taking measurements the device-meter scale was set to the “A” weighed

measurement scale which enables the device to respond in the same manner as the human ear. The device was held approximately 1.5 m above the surface and at least 3.0m away from hard reflecting surfaces. A suitable wind shield was used on the microphone for all measurements in order to minimise wind interference. The Instrument was checked and calibrated prior to use and maintained in accordance with equipment and coincided below 1.0dBA.

The noise measurement standards for above procedures include:

- ISO 1996-1:2003 “Acoustics – Description, assessment and measurement of environmental noise – Part 1: Basic quantities and assessment procedures”;
- ISO 1996-2:2007 “Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels”; and
- ISO 1996-3:2003 – “Acoustics – Description and measurement of environmental noise -- Part 3: Application to noise limits.”

The noise survey was performed in accordance with the recommended method for evaluating the environmental noise impact on surrounding communities, with respect to annoyance: “The measurement and rating of environmental noise with respect to land use, health, annoyance and speech communication”.

Each measurement was taken over a representative period of time to ensure that all possible variations in noise generation in the area, i.e., all possible noise sources are included in the measurement value – IFC, 2007.
The following procedure was followed during the noise survey:

The noise survey was conducted in terms of the provisions of the Noise Control Regulations, 1999 and the South African National Standards, SANS 10103 of 2008.

The following integrated noise level meter was used in the noise survey:

<u>Larson Davis 831</u>

- 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. 377B02-316581;
- Larsen Davis Calibrator 200 – Serial no.9855;
- Certificate Number: 2019-AS-0892A;
- Date of Calibration: 17 February 2021.

<u>Larson Davis LXT Sound Expert</u>

- Larsen Davis Integrated Sound Level Meter Type 1 – Serial no. S/N 0006037;

- Larsen Davis Pre-amplifier – Serial no. PRM LXT1 and 377B 02;
- Larsen Davis Calibrator 200 – Serial no.9855;
- Certificate Number: 2019-AS-0892A;
- Date of Calibration: 28 July 2020.

The instrument was calibrated before and after the measurements was done and coincided within 1.0dBA. Batteries were fully charged, and the windshield was in place at all times.

The noise survey was carried out in terms of the Noise Control Regulations Section 16 of the Noise Control Regulations,1999 applicable in South Africa being:

"16 (1) Any person taking readings shall ensure that -

(a) sound measuring instruments comply with the requirements for type I instrument in accordance with SABS-IEC 60651, SABS-IEC 60804 and SABS-I EC 60942 as the case may be;

(b) the acoustic sensitivity of sound level meters is checked before and after every series of measurements by using a sound calibrator, and shall reject the results if the before and after calibration values differ by more than 1 dBA;

(c) the microphones of sound measuring instruments are at all times provided with a windshield;

(d) the sound measuring instruments are operated strictly in accordance with the manufacturer's instructions; and

(e) sound measuring instruments are verified annually by a calibration laboratory for compliance with the specifications for accuracy of national codes of practice for acoustics, to comply with the Measuring Units and National Measuring Standards Act 1973 (Act No. 76 of 1973).

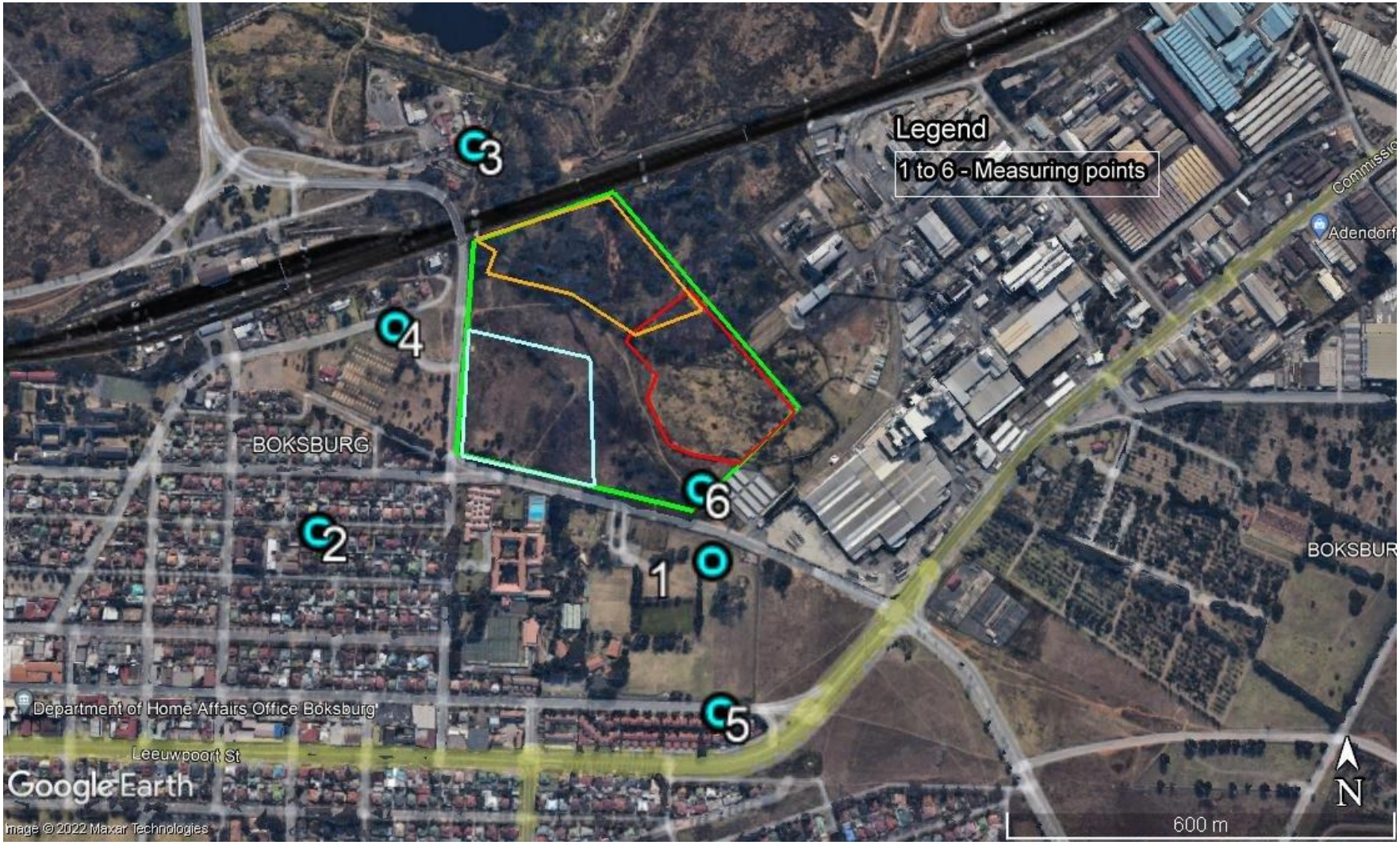
(2) The measuring of dBA values in respect of controlled areas, ambient sound levels or noise levels in terms of these regulations shall be done as follows:

(a) outdoor measurements on a piece of land: By placing the microphone of an integrating impulse sound level meter at least 1,2 metres, but not more than 1,4 metres, above the ground and at least 3,5 metres away from walls, buildings or other sound reflecting surfaces".

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 noise, domestic activities, and distant industrial activities (Boksburg East Industrial) but exclude traffic noise which was intermittent in the vicinity of the measuring point at the time of the noise survey. The measuring points are illustrated in Figure 3.1.

Figure 3-1: Measuring points for the study area



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 study area

Position	Latitude	Longitude	Remarks
1	26° 13.307'S	28° 16.058'E	North-eastern St Dominic's School Boundary
2	26° 13.278'S	28° 15.695'E	Along Claim St, residential are to the west of the plant
3	26° 12.957'S	28° 15.841'E	At Boksburg SPCA, north of plant
4	26° 13.109'S	28° 15.767'E	Along Du Plessis Road, abutting Jukskei Klub, west of the plant
5	26° 13.432'S	28° 16.064'E	Along St Dominics Road, south of the plant
6	26° 13.247'S	28° 16.049'E	Just west of the Unilever plant gate

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;
- A 24-hour noise survey was conducted at MP3 (SPCA property);
- The noise survey was carried out during the day and nighttime period being 6h00 to 22h00 for the daytime 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 a continuous flow of traffic along Kruger Road and St Dominics Road respectively, limited to no traffic along the gravel feeder roads;
- Industrial type noise was audible at all the measuring points;
- The wind and weather conditions play an important role in noise propagation.

3.4 Current noise sources

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

- Intermittent traffic noise;
- Domestic type noises;
- Industrial type noise;

- Insects;
- Birds;
- Wind noise.

3.5 Atmospheric conditions during the noise survey

The noise readings were carried out at the different measuring points during the dry/ wet season respectively and the prevailing atmospheric conditions i.e., wind speed, wind direction and temperature is illustrated in Table 3.2.

Table 3-2: Atmospheric conditions

Measuring points	Daytime			Night- time		
	Temperature - ºC	Wind direction	Wind speed – m/s	Temperature - ºC	Wind direction	Wind speed – m/s
1	26.4	North-easterly	2.1	19.8	No wind	No wind
2	28.8	North-easterly	1.9	19.7	No wind	No wind
3	28.0	North-easterly	1.7	19.4	No wind	No wind
4	28.0	North-easterly	0.7	18.9	No wind	No wind
5	28.3	No wind	No wind	19.2	No wind	No wind
6	27.5	No wind	No wind	19.5	No wind	No wind

4. Regulatory and Legislative Requirements

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

4.1 Department of Environment Affairs: Noise Control Regulations promulgated under the Environment Conservation Act, (Act No. 73 of 1989), Government Gazette No. 15423, 20 August 1999.

These noise control regulations are applicable in the study area and the main aspect of these noise control regulations is that you may not exceed the prevailing ambient noise levels at all 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 General 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.

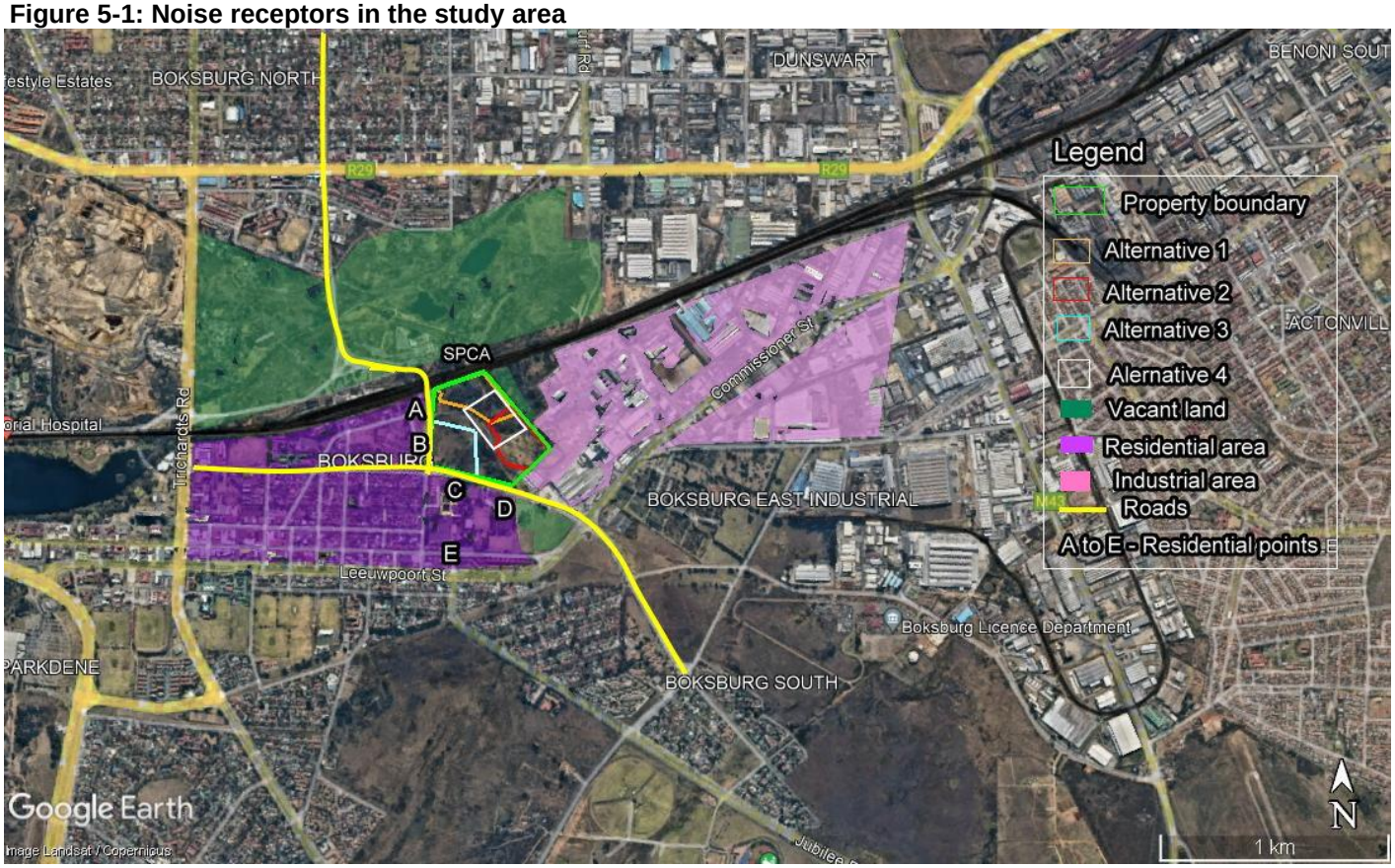
The Constitution of the Republic of South Africa Act, (Act No 108 of 1996) makes provision for the health and well-being of the citizens and to prevent pollution and to promote conservation.

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:
(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.

5. Description of the receiving environment

The prevailing ambient noise levels within the study area were created by distant industrial activities (Boksburg East industrial zone), traffic noise along the feeder roads, domestic type noises, and school activities on an intermittent basis. The residential areas consist out of single housing units, cluster houses and roads which runs through the study area. The noise receptors are illustrated in Figure 5.1.

Figure 5-1: Noise receptors in the study area



The distances between the nearest boundary of the abutting residential area to the potential noise source within the boundaries of the PV plant is illustrated in Table 5.1. The distances between the central inverter, sub-station, 33kV line and the maintenance activities (distance between the PV arrays and the nearest residential area) were calculated by means of the direct line of site.

Table 5-1: Distances between the noise receptors and the noise sources

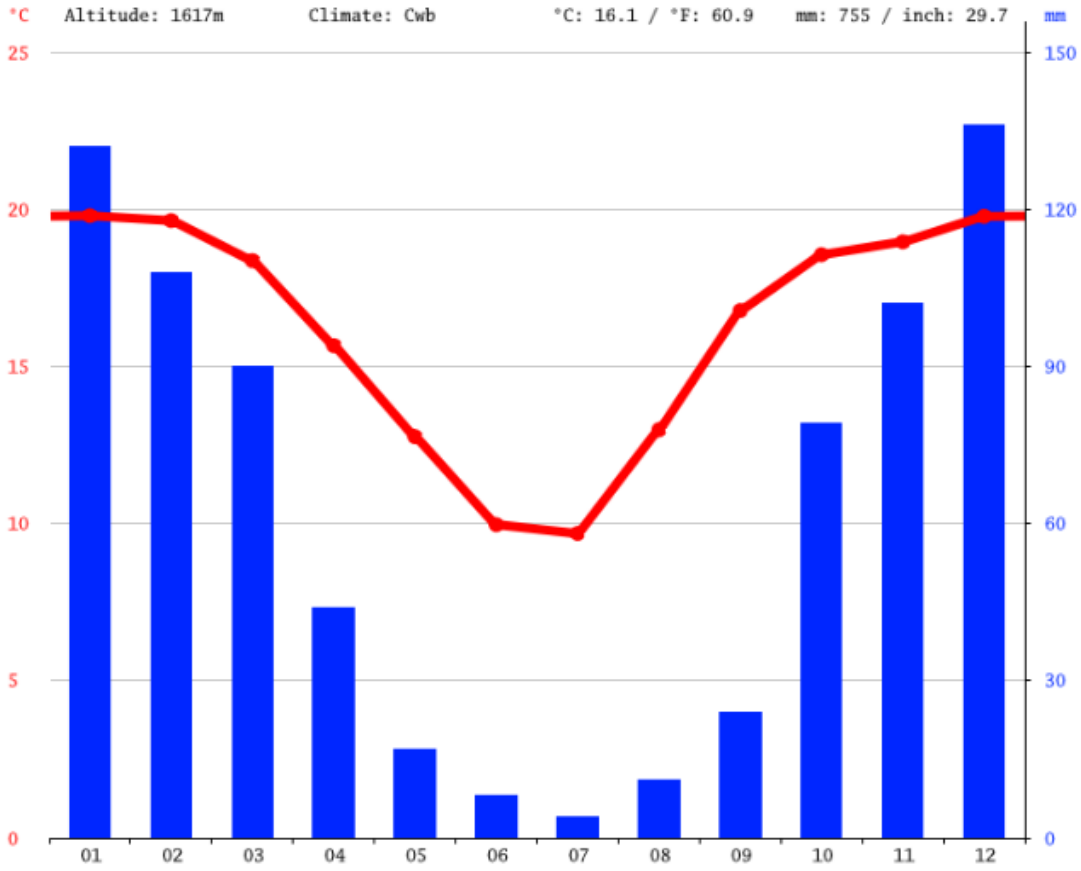
Alternative 1				
Noise receptor	**Central inverter**	**Sub-station**	**33kV**	**Maintenance activities**
A	518	537	494	437
B	400	389	514	500
C	430	424	479	355
D	479	455	411	374
E	730	742	786	678
SPCA	446	475	390	367
Alternative 2				
Noise receptor	**Central inverter**	**Sub-station**	**33kV**	**Maintenance activities**
A	515	480	482	368
B	453	445	504	384
C	329	331	444	258
D	241	258	415	210
E	624	604	773	528
SPCA	249	256	301	116
Alternative 3				

Noise receptor	Central inverter	Sub-station	33kV	Maintenance activities
A	240	259	307	138
B	165	150	277	83
C	201	188	246	102
D	348	337	355	220
E	497	481	562	419
SPCA	371	307	324	256
Alternative 4				
Noise receptor	Central inverter	Sub-station	33kV	Maintenance activities
A	419	408	422	271
B	406	410	458	313
C	333	336	402	285
D	364	375	372	255
E	664	671	721	549
SPCA	344	355	382	281

5.1 Climatic Data

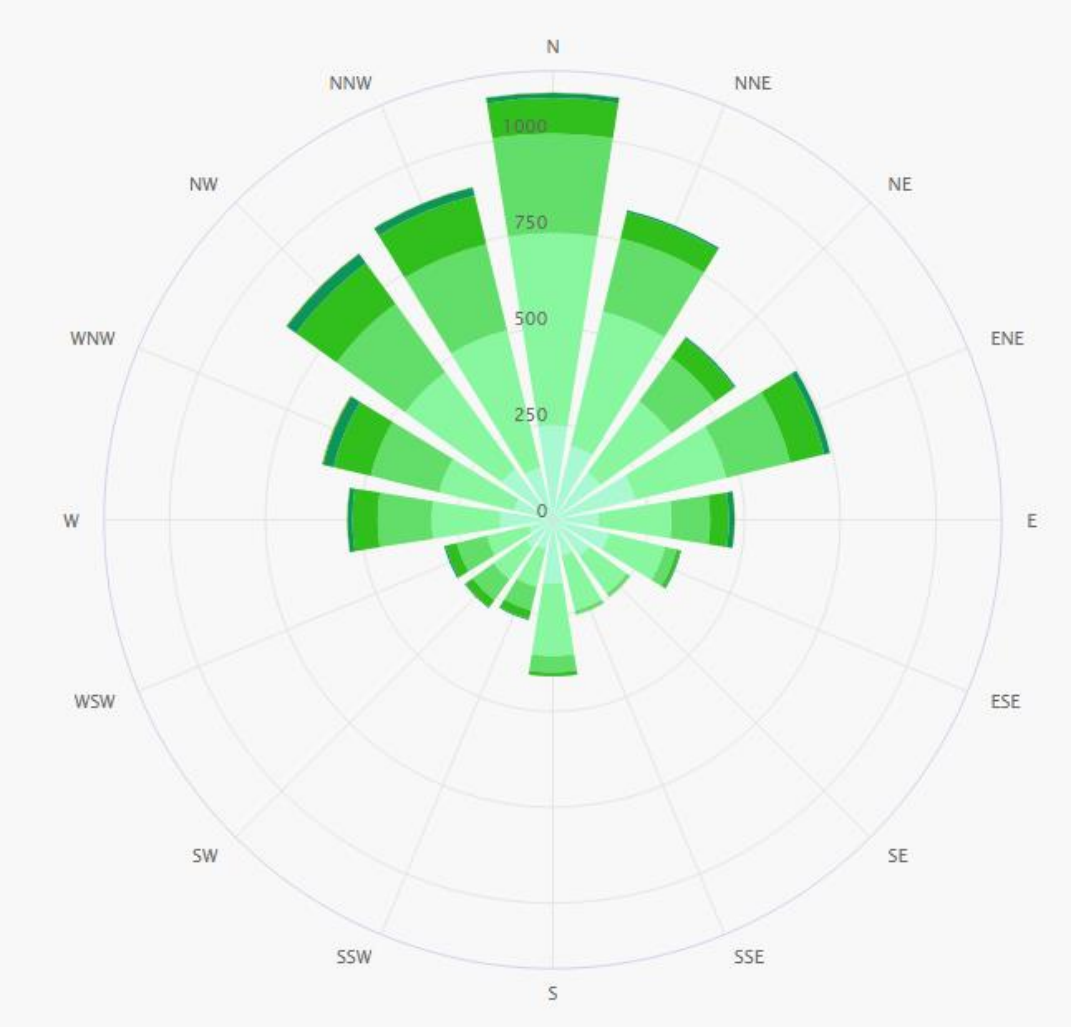
The climate in Boksburg is warm and temperate. In winter, there is much less rainfall in Boksburg than in summer. According to Köppen and Geiger, this climate is classified as Cwb. The average annual temperature in Boksburg is 16.1 °C. Precipitation here is about 755 mm per year. The average rainfall and temperature is illustrated in Figure 5.2 and the wind rose in Figure 5.3.

Figure 5-2: Average rainfall and temperatures



The predominant wind is from the north, north-west and the west.

Figure 5-3: Windrose for the study area



5.2 Topography of the study area

The northwest southeast profile is illustrated in Figure 5.4 and the northeast to southwest profile in Figure 5.5.

Figure 5-4: Northwest to southeast elevation profile

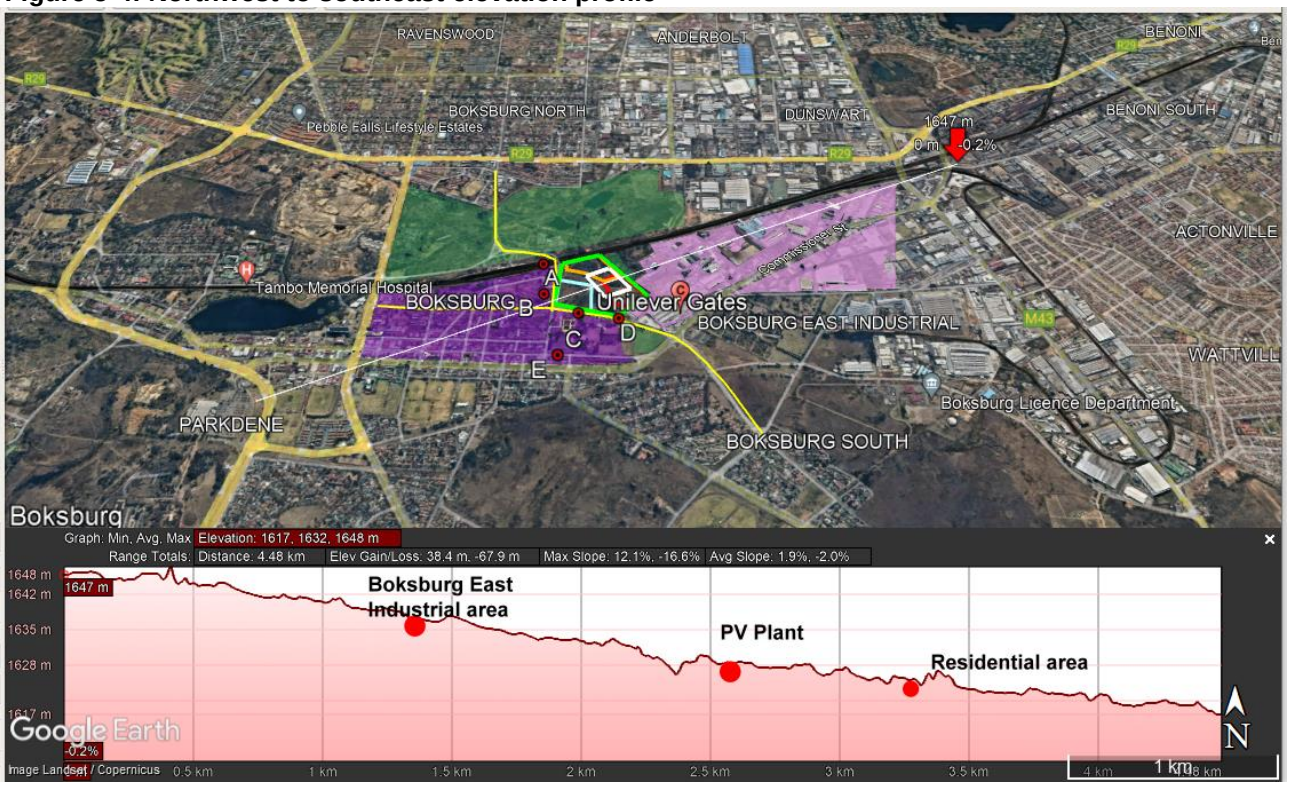
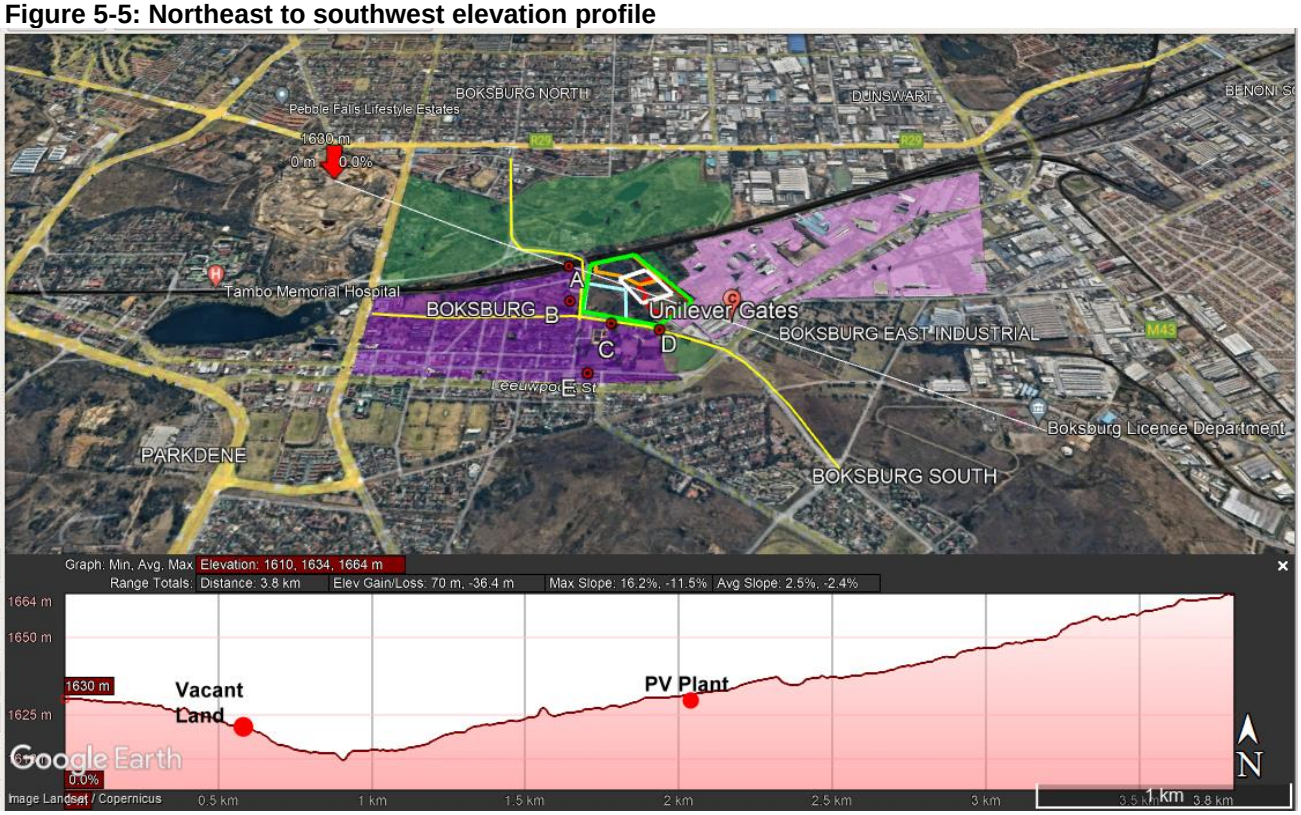


Figure 5-5: Northeast to southwest elevation profile



6. Results of the noise survey

The results of the environmental noise survey will include all the noise sources currently in the area such as domestic and natural noise sources and are given in Tables 6.1. 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: Day and night-time noise levels

Position	Daytime Noise Level			Remarks	Night-time 1 Noise Level			Remarks	Night-time 2 Noise Level			Remarks
	Ambient LAeq	LMax	LMin		Ambient LAeq	LMax	LMin		Ambient LAeq	LMax	LMin	
1	**53.0**	65.0	46.5	Distant Unilever plant & plant activities, distant and intermittent traffic, birds	**58.5**	63.7	47.8	Insects, intermittent traffic, distant Unilever plant & distant alarm. Measurement without alarm was 52.1dBA	**58.9**	67.6	46.6	Insects, intermittent traffic, distant Unilever plant & distant alarm. Measurement without alarm was 51.8dBA
2	**56.4**	79.9	41.9	Domestics, intermittent dogs barking, intermittent aircraft, intermittent traffic, distant traffic, distant Unilever Plant, distant schoolbell	**54.4**	75.3	42.8	Distant traffic, dogs barking, distant alarm & distant Unilever plant. Measurement without dogs barking was 53.0	**47.6**	70.1	39.5	Distant traffic, distant alarm & distant Unilever plant
4	**52.5**	66.8	44.9	Distant Unilever plant, distant traffic, birds, domestics, intermittent traffic & intermittent aircraft	**55.0**	69.7	51.3	Insects, distant alarm, distant traffic & domestics	**54.9**	76.9	48.9	Insects, distant alarm, distant traffic & domestics
5	**69.1**	85.5	45.2	Traffic, Distant Unilever Plant & domestics	**62.1**	75.6	51.4	Intermittent traffic, distant alarm & distant Unilever Plant	**63.8**	83.1	51.0	Insects, intermittent traffic, distant Unilever plant & distant alarm
6	**53.2**	71.9	47.3	Distant Unilever Plant, insects, distant traffic & intermittent, distant siren	**55.7**	60.4	51.4	Insects, distant Unilever Plant, intermittent, distant traffic	**61.6**	68.0	53.7	Insects, distant Unilever Plant, intermittent, distant traffic

Table 6-2: 24-hour results at MP 3 at SPCA

Position	Overall 24h in dBA			Remarks	Daytime in dBA	Remarks	Evening-time in dBA	Remarks	Night-time in dBA	Remarks
	L_{Aeq}	L_{Max}	L_{Min}		L_{Aeq}		L_{Aeq}		L_{Aeq}	
3	**51.8**	79.2	35	Distant Unilever Plant audible, distant traffic, birds, insects, dogs and other activity at Boksburg SPCA	**53.8**	LAeq for time period between 06h00 and 19h00	**48.2**	LAeq for time period between 19h00 and 22h00	**46.1**	LAeq for time period between 22h00 and 06h00

The noise results are illustrated in the following graphs.

Figure 6.1: Prevailing ambient noise levels – daytime

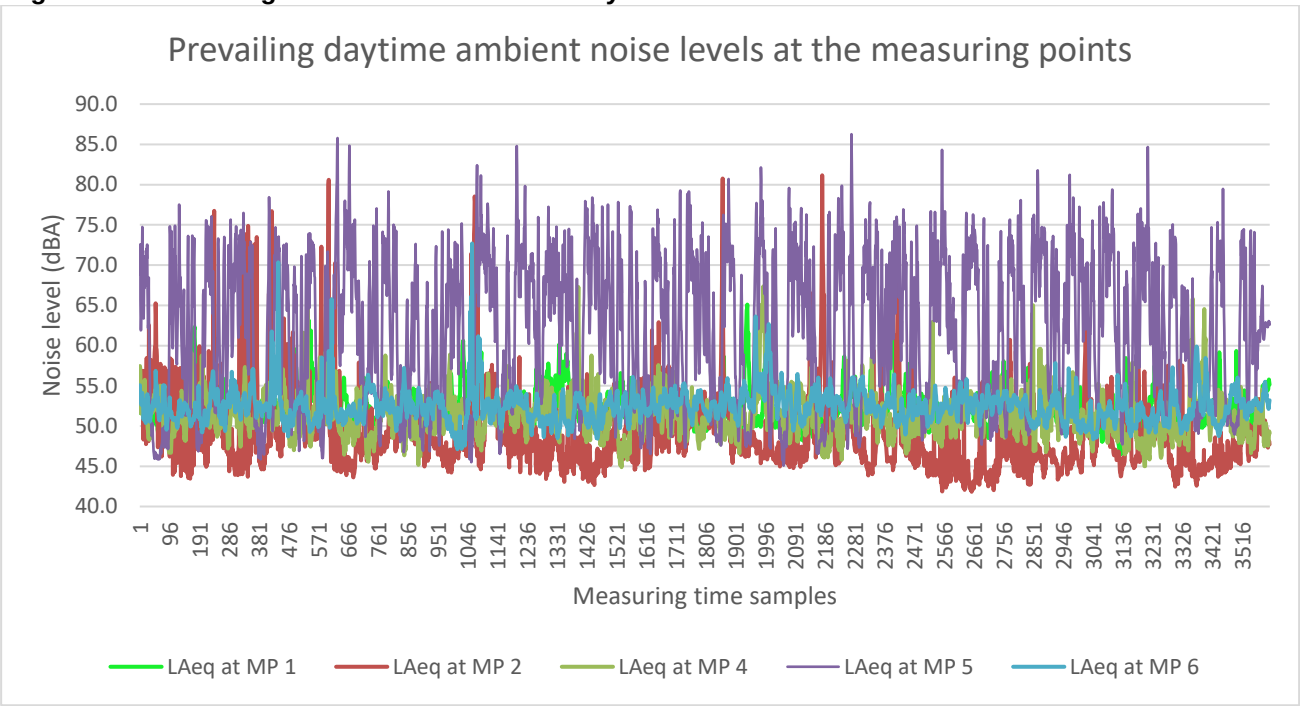
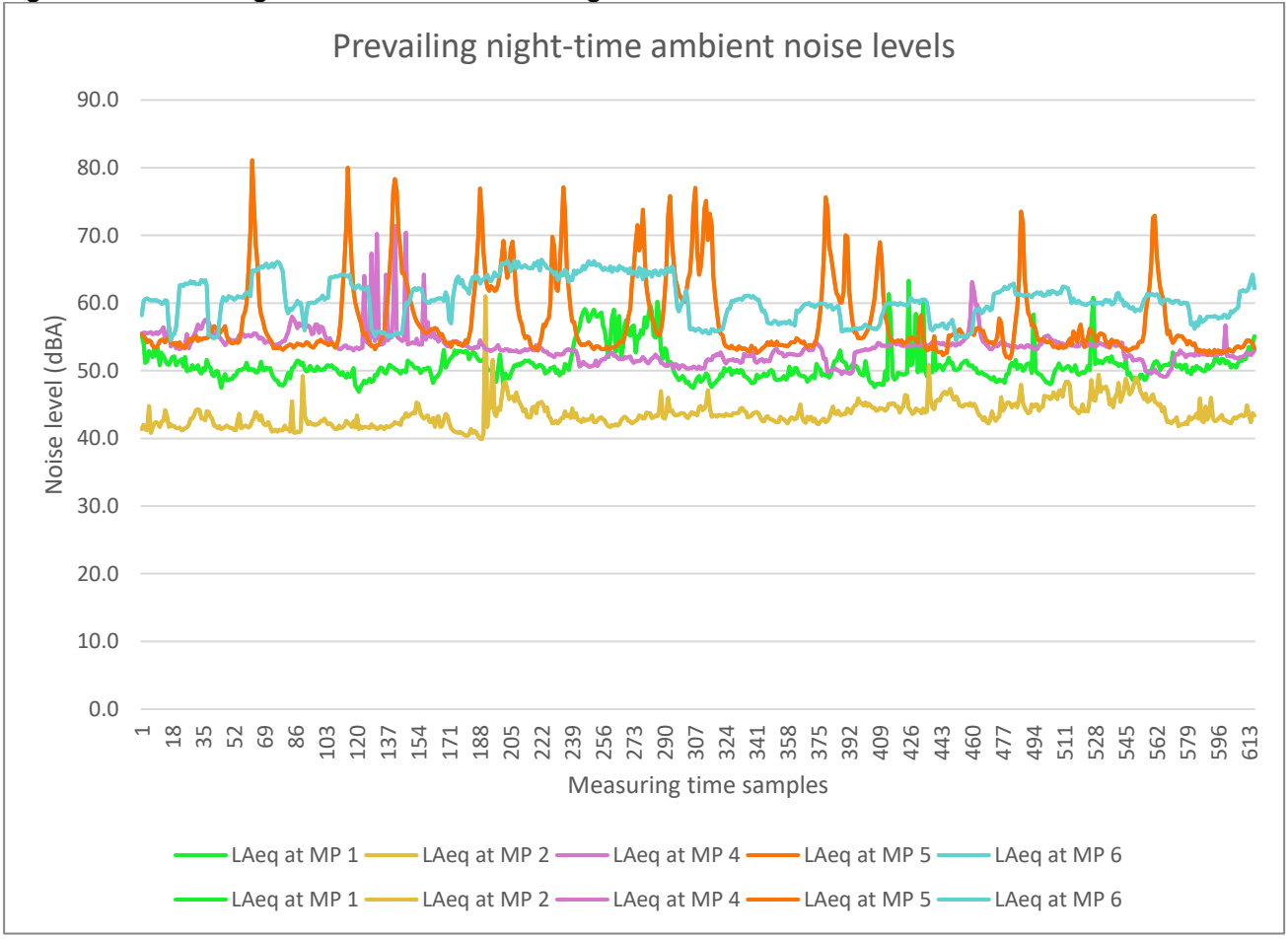
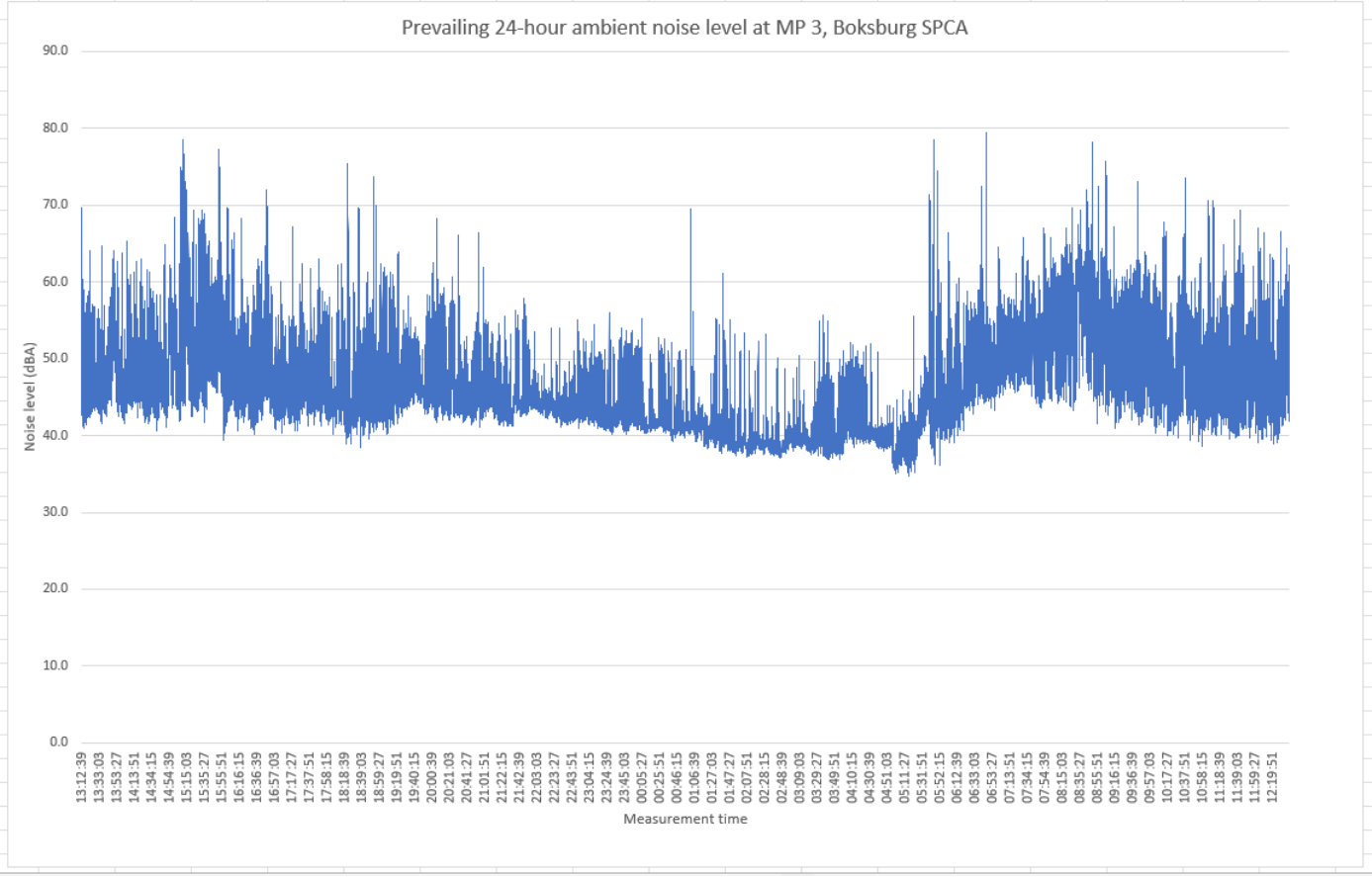


Figure 6.2: Prevailing ambient noise levels – night-time



The prevailing ambient noise level over a 24-hour period at the SPCA is given in Figure 6.3.

Figure 6.3: prevailing ambient noise level at SPCA over a 24-hour period



The different noise levels of machinery and/or equipment which may be used during construction of the PV plant are illustrated in Table 6.3. The machinery will not all work at one time.

Table 6-3: Noise levels of standard construction machinery

Equipment	Reduction in the noise level some distance from the source - dBA								
Cumulative distance from source in meters	**2m from the machinery and/or equipment**	**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
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	**101.5**	**72.9**	**66.9**	**60.9**	**54.9**	**48.9**	**42.8**	**36.8**	**30.8**

The noise reduction calculated in Table 6.4 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 60.9dBA at 60m and 36.8dBA at 960m from the construction area if all the machinery operates in a radius of 30m at one time. This will seldom happen, and the cumulative noise level will therefore be lower.

6.1 Noise impact at the different residential areas

The following formula was used to calculate the noise level at the noise receptors during the construction and operational phases respectively:

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

where, Lp is the sound level at a distance from the source in dBA;
Lw is the sound level at the source in dBA;
R is the distance from the source;
α is the noise reduction factor of 5 for air density, ground conditions.

This noise impact formula and the Interactive noise calculator (ISO 9613) will be used to determine the noise levels during the different phases 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 categorization of the intrusion levels during the construction and operational phases will be as follows. 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 phase – projected or calculated noise levels;

*L*Req,T (pre) – noise level before the proposed project – ambient noise level.

The noise levels at the noise receptors will be added in a logarithmic manner to determine the overall sound exposure at the receptor. The categorization of the intrusion levels during the construction and operational phases are as follows.The criteria for assessing the magnitude of a noise impact are illustrated in Table 6.4.

Table 6-4: Noise intrusion level criteria

Increase Δ-dBA	Assessment of impact magnitude	Color 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 following noise levels will be used to determine the noise impact at the different residential areas during the construction phase:

- Site clearing and grubbing of footprint – 85.0dBA;
- Civil construction activities – 85.0dBA
- Construction of internal roads – 85.0dBA;
- Transportation of building material to the different areas – 80.0dBA;
- Assembly of PV Panels – 85.0dBA; and,
- Building activities – 75.0dBA.

The following noise levels will be used in determining the noise impact at the residential areas during the operational phase of the project:

- Central Inverter - 85.0dBA;
- Sub-station – 80.0dBA;
- 33kV powerline – 75.0dBA (Corona fields); and,
- Maintenance activities - 75.0dBA.

The noise levels which will be propagated from the proposed PV plant activities to the residential areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor. The categorization of the noise intrusion levels during the construction and operational phases are given in Table 6.4 (Construction phase), Table 6.5 (Operational phase – no insects) and Table 6.6 (Operational phase – distant insects.

6.1.1 Construction phase

The arithmetic calculated noise levels (dBA) during the construction phase for the different activities in the vicinity of the residential areas, when these activities takes place along the nearest boundary to the residential areas, are illustrated in Table 6.5.

Table 6-5: Noise intrusion levels during the construction phase

Alternative 1										
Residential property	Clearing and grubbing of topsoil and vegetation	Construction activities at the PV PLANT	Construction activities at the PV PANELS	Installation of the INFRA-STRUCTURE	Construction activities of the OHP LINE	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level – night-time	Intrusion noise level - daytime	Intrusion noise level – night-time
A	29.2	28.7	28.7	28.2	26.6	35.4	52.6	54.9	0.1	0.0
B	31.5	31.0	31.0	30.5	26.3	37.3	56.5	51.2	0.1	0.2
C	30.8	30.3	30.3	29.8	26.9	36.8	53.1	58.6	0.1	0.0
D	29.9	29.4	29.4	28.9	28.2	36.2	53.1	58.6	0.1	0.0
E	26.2	25.7	25.7	25.2	22.6	32.3	69.1	62.9	0.0	0.0
SPCA	30.5	30.0	30.0	29.5	28.7	36.8	51.9	51.2	0.1	0.2
Alternative 2										
Residential property	Clearing and grubbing of topsoil and vegetation	Construction activities at the PV PLANT	Construction activities at the PV PANELS	Installation of the INFRA-STRUCTURE	Construction activities of the OHP LINE	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level – night-time	Intrusion noise level - daytime	Intrusion noise level – night-time
A	29.3	28.8	28.8	28.3	26.8	35.4	52.6	54.9	0.1	0.0
B	30.4	29.9	29.9	29.4	26.5	36.4	56.4	51.1	0.0	0.1
C	33.2	32.7	32.7	32.2	27.6	39.0	53.2	58.6	0.2	0.0
D	35.9	35.4	35.4	34.9	28.1	41.6	53.3	58.7	0.3	0.1
E	27.6	27.1	27.1	26.6	22.7	33.5	69.1	62.9	0.0	0.0
SPCA	35.6	35.1	35.1	34.6	30.9	41.5	52.2	51.5	0.4	0.5
Alternative 3										
Residential property	Clearing and grubbing of topsoil and vegetation	Construction activities at the PV PLANT	Construction activities at the PV PANELS	Installation of the INFRA-STRUCTURE	Construction activities of the OHP LINE	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level – night-time	Intrusion noise level - daytime	Intrusion noise level – night-time
A	35.9	35.4	35.4	34.9	30.8	41.8	52.9	55.1	0.4	0.2
B	39.2	38.7	38.7	38.2	31.7	44.9	56.7	52.0	0.3	1.0
C	37.4	36.9	36.9	36.4	32.7	43.4	53.4	58.7	0.4	0.1
D	32.7	32.2	32.2	31.7	29.5	38.8	53.2	58.6	0.2	0.0
E	29.6	29.1	29.1	28.6	25.5	35.6	69.1	62.9	0.0	0.0
SPCA	32.1	31.6	31.6	31.1	30.3	38.4	52.0	51.2	0.2	0.2
Alternative 4										
Residential property	Clearing and grubbing of topsoil and vegetation	Construction activities at the PV PLANT	Construction activities at the PV PANELS	Installation of the INFRA-STRUCTURE	Construction activities of the OHP LINE	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level – night-time	Intrusion noise level - daytime	Intrusion noise level – night-time
A	31.1	30.6	30.6	30.1	28.0	37.2	52.6	55.0	0.1	0.1
B	31.3	30.8	30.8	30.3	27.3	37.3	56.5	51.2	0.1	0.2
C	33.1	32.6	32.6	32.1	28.4	39.0	53.2	58.6	0.2	0.0
D	32.3	31.8	31.8	31.3	29.1	38.4	53.1	58.6	0.1	0.0
E	27.1	26.6	26.6	26.1	23.3	33.1	69.1	62.9	0.0	0.0
SPCA	32.8	32.3	32.3	31.8	28.9	38.8	52.0	51.3	0.2	0.3

*Calculated ambient noise level is the prevailing ambient noise level measured plus the cumulative noise level from the different activities at the residential areas A to E; and

*The noise intrusion level is the difference between the existing prevailing ambient noise level and the calculated noise level when the PV plant will be operational.

6.1.2 Operational phase

The arithmetic calculated noise levels (dBA) during the operational phase for the different activities in the vicinity of the residential areas are illustrated in Table 6.6.

Table 6-6: Noise intrusion levels during the operational phase

Alternative 1									
Residential property	Noise from the Central Inverter	Noise from the sub-station	Noise from the OHP	Noise from maintenance activities	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - night-time	Intrusion noise level - daytime	Intrusion noise level – night-time
A	31.3	28.4	14.1	15.7	33.2	52.6	54.9	0.1	0.0
B	33.5	31.2	13.8	14.5	35.6	56.4	51.1	0.0	0.1
C	32.9	30.5	14.4	17.5	35.0	53.1	58.6	0.1	0.0
D	31.9	29.8	15.7	17.0	34.2	53.1	58.6	0.1	0.0
E	28.3	25.6	10.1	11.9	30.3	69.1	62.9	0.0	0.0
SPCA	32.6	29.5	16.2	17.2	34.4	51.9	51.1	0.1	0.1
Alternative 2									
Residential property	Noise from the Central Inverter	Noise from the sub-station	Noise from the OHP	Reciprocation engines	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night-time	Intrusion noise level - daytime	Intrusion noise level - night-time
A	31.3	29.4	14.3	17.2	33.6	52.6	54.9	0.1	0.0
B	32.4	30.0	14.0	16.8	34.5	56.4	51.1	0.0	0.1
C	35.2	32.6	15.1	20.3	37.2	53.1	58.6	0.1	0.0
D	37.9	34.8	15.6	22.1	39.7	53.2	58.7	0.2	0.1
E	29.6	27.4	10.2	14.0	31.8	69.1	62.9	0.0	0.0
SPCA	37.6	34.8	18.4	27.2	39.7	52.1	51.3	0.3	0.3
Alternative 3									
Residential property	Noise from the Central Inverter	Noise from the sub-station	Noise from the OHP	Reciprocation engines	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night-time	Intrusion noise level - daytime	Intrusion noise level - night-time
A	37.9	34.7	18.3	25.7	39.8	52.7	55.0	0.2	0.1
B	41.2	39.5	19.2	30.1	43.6	56.6	51.7	0.2	0.7
C	39.5	37.5	20.2	28.3	41.9	53.3	58.7	0.3	0.1
D	34.7	32.4	17.0	21.7	36.9	53.1	58.6	0.1	0.0
E	31.6	29.4	13.0	16.1	33.8	69.1	62.9	0.0	0.0
SPCA	34.2	33.3	17.8	20.3	36.9	51.9	51.2	0.1	0.2
Alternative 4									
Residential property	Noise from the Central Inverter	Noise from the sub-station	Noise from the OHP	Reciprocation engines	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night-time	Intrusion noise level - daytime	Intrusion noise level - night-time
A	33.1	30.8	15.5	19.8	35.3	52.6	54.9	0.1	0.0
B	33.4	30.7	14.8	18.6	35.4	56.4	51.1	0.0	0.1
C	35.1	32.5	15.9	19.4	37.1	53.1	58.6	0.1	0.0
D	34.3	31.5	16.6	20.4	36.3	53.1	58.6	0.1	0.0
E	29.1	26.5	10.8	13.7	31.1	69.1	62.9	0.0	0.0
SPCA	34.8	32.0	16.4	19.5	36.8	51.9	51.2	0.1	0.2

*Calculated ambient noise level is the prevailing ambient noise level measured plus the cumulative noise level from the different activities at the residential areas A to E; and

*The noise intrusion level is the difference between the existing prevailing ambient noise level and the calculated noise level when the PV plant will be operational

6.1.3 Calculation of road traffic noise

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 preferred road. The calculations to determine the noise level from the additional traffic along the preferred road are based on the following equation:

Basic Model

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

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 calculation of the noise levels during the **construction phase** are based on a total of 7 vehicles per hour of which 4 will be heavy-duty vehicles and 3 will be motor-vehicles and during the **operational phase** 5 vehicles of which 1 will be heavy-duty vehicles and 4 will be motor vehicles.

The calculated traffic noise level at 50m from the road will be **39.8dBA** during the construction phase and **37.7dBA** during the operational phase.

7. Impact Identification and Assessment

Noise or sound is part of our daily exposure to different sources which is part of daily living and some of the sounds which are intrusive such as traffic noise forms part of the ambient noise to which people get accustomed to without noticing the higher sound levels. Any person in the workplace (during agricultural farming activities) and at home is exposed to the following noise levels as given in Table 7.1. These are the average noise levels in the workplace and at home that will mask noise from a source introduced into an area:

Table 7-1: 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
Home	Radio Playing in Background	45.0-50.0
Home	Background Music	50.0
Home	Insects – crickets	53.0
Home	Animals	55.0
Home	Children playing	60.0
Shops/village	Amplified music	75.0
Shebeen/entertainment area	Amplified music	85.0
Village	People talking	80.0
Village	Train noise	80.0
Village	Motor vehicle noise	75.0

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.

The impact assessment methodology requires that each potential impact identified is clearly described including the following:

- Extent (spatial scale) - will the impact affect the national, regional, or local environment or only that of the site?
- Duration (temporal scale) - how long will the impact last?
- Intensity - will the impact be of high, moderate, or low severity?
- Probability (likelihood of occurrence) - how likely is it that the impact may occur?

To determine the environmental significance (importance) of each identified potential impact, a numerical value has been assigned to each of the above criteria (Table 1). The following formula is used to calculate the environmental consequence of each impact:

Significance = Extent + Duration + Intensity + Probability

Nature	**Category**	
Extent (E)	Categories 1 – 4	
	1	Footprint / site
	2	Local (within a radius of 2 kms of site)
	3	Regional
	4	National
Duration (D)	Categories 1 – 4	
	1	Short (less than five years)
	2	Medium term (5-15 years)
	3	Long term (15-30 years)
	4	Permanent
Intensity (I)	Categories 1 – 4	
	1	Low
	2	Moderate
	3	High
	4	Very High
Probability (P)	Categories 1 – 4	
	1	Improbable
	2	Probable
	3	Highly Probable
	4	Definite
IMPACT : Cumulative		
Extent (E)		
Duration (D)		
Intensity (I)		
Probability (P)		
Significance	**Significance = E + D + I + P**	
	Minimum value of 4, maximum of 16	
	Status determines if positive / negative	
	Negative (13 - 16 points) NEGATIVE VERY HIGH	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a “very high impact” is likely to be a fatal flaw.
	Negative (10 - 12 points) NEGATIVE HIGH	These are impacts which individually or combined pose a significantly high negative risk to the environment. These impacts pose a high risk to the quality of the receiving environment. The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.

	Negative (7 - 9 points) **NEGATIVE MODERATE**	These are impacts which individually or combined pose a moderate negative risk to the quality of health of the receiving environment. These systems would not generally require immediate action, but the deficiencies should be rectified to avoid future problems and associated cost to rectify once in HIGH risk. Aesthetically and/or physically non-compliance can be expected over a medium term. In this case the impact is medium term, moderate in extent, mildly intense in its effect and probable. Mitigation is possible with additional design and construction inputs.
	Negative (4 - 6 points) **NEGATIVE LOW**	These are impacts which individually or combined pose a deleterious or adverse impact and low negative risk to the quality of the receiving environment, and may lead to potential health, safety, and environmental concerns. Aesthetically and/or physical non-compliance can be expected for short periods. In this case the impact is short term, local in extent, not intense in its effect and may not be likely to occur. A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction, or operating procedure.
	0 **Neutral**	Impact is neither beneficial nor adverse. These are impacts which cannot be classified as either positive, negative, or classified as null and void in the case of a negative impact being adequately mitigated to a state where it no longer renders a risk.
	Positive (4 - 6 points) **POSITIVE LOW**	These are impacts which individually or combined pose a low positive impact to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is short term, local in extent, not intense in its effect and may not be likely to occur. A low impact has no permanent impact of significance.
	Positive (7 - 9 points) **POSITIVE MODERATE**	These are impacts which individually or combined pose a moderate positive effect to the quality of health of the receiving environment. In this case the impact is medium term, moderate in extent, mildly intense in its effect and probable.
	Positive (10 - 12 points) **POSITIVE HIGH**	These are impacts which individually or combined pose a significantly high positive impact on the environment. These impacts pose a high benefit to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is longer term, greater in extent, intense in its effect and highly likely to occur. The effects of the impact may affect the broader environment.
	Positive (13 - 16 points) **POSITIVE VERY HIGH**	These are permanent and important beneficial impacts which may arise. Individually or combined, these pose a significantly high positive impact on the environment. These impacts pose a very high benefit to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is long term, greater in extent, intense in its effect and highly likely or definite to occur. The effects of the impact may affect the broader environment.

7.1 Impact assessment for the construction phase

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

Table 7-2: Site clearing and grubbing of the footprint area

Activity	***Site clearing and grubbing of the footprint area***						
Project phase	*Pre-construction and Construction phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	1	2	5	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels and during daytime only.*						
	Topsoil stripping should be limited to daytime only.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	1	2	5	Negative Low	-

Table 7-3: Civil construction activities such as slabs for PV panels

Activity	***Civil construction activities such as slabs for PV panels***						
Project phase	*Pre-construction and Construction phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	1	2	5	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
	Civil construction activities should be limited to daytime only.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	1	2	6	Negative Low	-

Table 7-4: Construction of internal roads

Activity	***Construction of internal roads***						
Project phase	*Pre-construction and Construction phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
	Construction of the internal roads should be limited to daytime only.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-

Table 7-5: Assembly of PV panels

Activity	***Assembly of PV Panels***						
Project phase	*Pre-construction and Construction phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-

Table 7-6: Transportation of building material to and from the specific areas

Activity	***Transportation of building material to and from the specific areas***						
Project phase	*Pre-construction and Construction phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	2	2	6	Negative Low	-

7. 2 Impact assessment for the operational phase

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

Table 7-7: Central Inverter

Activity	***Central Inverter***						
Project phase	*Operational phase to the Closure phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	2	8	Negative Moderate	-
	All equipment with noise levels exceeding 85.0dBA to be acoustically screened off by means of engineering control measure or the construct an acoustic screen between the inverter and the abutting residential area.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

Table 7-8: Sub-station

Activity	***Sub-station***						
Project phase	*Operational phase to the Closure phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	1	3	2	7	Negative Moderate	-
Management Measures	*All sources at the sub-station exceeding 85.0dBA to be acoustically screened off by means of engineering control measures.*						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

Table 7-9: 33kV Powerline

Activity	***33kV Powerline***						
Project phase	*Operational phase to the Closure phase*						
Impact Summary	*Noise increase at the boundary of the 33kV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-
Management Measures	*Cannot implement any measures when Corona noise is present. Corona noise will only be created when moist contents of the atmosphere are high.*						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

Table 7-10: Maintenance activities

Activity	***Maintenance activities***						
Project phase	*Operational phase*						
Impact Summary	*Noise increase at the boundary of the PV footprint and at the abutting houses*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-
Management Measures	*All equipment with noise levels exceeding 85.0dBA to be acoustically screened off by means of engineering control measures.*						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

7.3 Impact assessment for the decommissioning phase

The following activities are associated with the decommissioning phase:

- Planting of grass and vegetation at the rehabilitated areas;
- Removal of infra-structure.

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

Table 7-11: Removal of infra-structure

Activity	***Removal of infra-structure***						
Project phase	*Decommissioning phase*						
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
	Removal of infra-structure should be limited to daytime only.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

Table 7-12: Planting of grass and vegetation at rehabilitated areas

Activity	***Planting of grass and vegetation at the rehabilitated areas***						
Project phase	*Decommissioning phase*						
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*						
Potential Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-
Management Measures	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.*						
	Planting of grass and/or vegetation should be limited to daytime only.						
After Management Impact Rating	***Extent***	***Duration***	***Intensity***	***Probability***	***Impact***	***SIGNIFICANCE***	***+/-***
	1	3	2	1	6	Negative Low	-

8. Recommendations

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

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

The last option is not applicable as it was decided to control the noise levels at the source.

8.1 Acoustic screening recommendations

The acoustic screening measures for the project are given in Table 8.1. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 8-1: Recommended acoustic screening measures

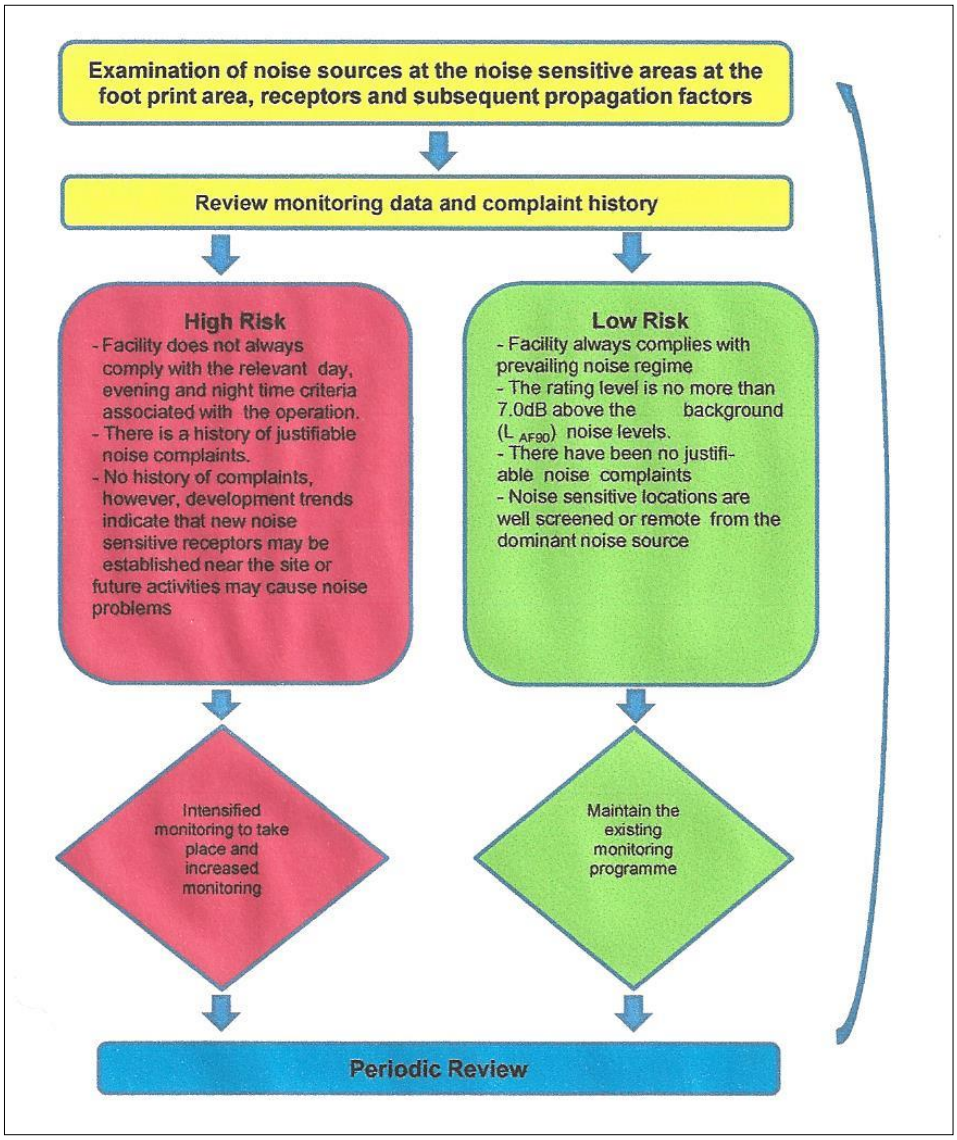
Activity	Recommendations
Construction phase	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.* *Construction activities to be done during daytime periods only.*
Operational phase	*All equipment with noise levels exceeding 85.0dBA to be acoustically screened off by means of engineering control measures.* *The Inverter will have to be acoustically screened off (acoustic screen on the side facing the residential areas) when the sound from the Inverter is audible at the abutting residential areas.* *The emergency generator will have to be acoustically screened off by means of engineering control measures such as to enclose the generator with a brick constructed building.*
Decommissioning phase	*Equipment and/or machinery which will be used must comply with the manufacturer's specifications on acceptable noise levels.* *Construction activities to be done during daytime periods only.*

The following are the Environmental, Health and Safety Guidelines of the IFC of the World Bank, which should be taken into consideration during the construction, operational and decommissioning phases of the project:

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

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

Figure 8-1: Noise management plan



9. Conclusion

The proposed PV Plant project will be situated in an area where there are feeder roads, industrial area, and residential areas. The noise impact assessment revealed that the noise impact will be negative low during the construction and decommission phases and negative moderate to negative low during the operational phase. The recommended noise mitigatory measures will ensure that the proposed PV Plant project will be environmentally sustainable.

Domestic animals depend on acoustic signals for essential functions. The noise impact will be below 1.0dBA which is very low and therefore classified as insignificant which will not interfere with the acoustic signals for essential functions.

There will be no noise intrusion into the abutting residential area to the west during the construction and/or operational phases and the preferred alternative will be no 1.

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 Environmental management Plan (EMP) for the proposed PV plant establishment will consist of the following as illustrated in Table 9.1. Environmental monitoring during the receipt of complaints will provide the data for reviewing, checking, and revising the EMP.

Table 9-1: 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.	Annual	The engineer during the construction phase.
Monitoring objective	Measure the environmental noise levels when complaints are lodged during the construction, operational and decommissioning phases of the project to ensure compliance to the recommended and threshold noise levels.	When complaints are lodged	Accredited environmental noise specialist.
Monitoring technology	The environmental noise monitoring must be done with a calibrated Class 1 noise monitoring equipment.	When complaints are lodged	Accredited environmental noise specialist.
Specify how the collected information will be used	The data must be collected and discussed with the owners of the PV Plant.	When complaints are lodged	Accredited environmental noise specialist.
Spatial boundaries	At the boundaries of the identified residential areas as well as at the PV plant footprint boundaries.	When complaints are lodged	Accredited environmental noise specialist.
Define how the data will be analysed and interpreted and how it should be presented in monitoring reports	Reports must be compiled, and the results must be made available to all relevant parties.	When complaints are lodged	Accredited environmental noise specialist.
Accuracy and precision of the data	The noise survey will have to be conducted in terms of the recommendations of Health and Safety Guidelines of the IFC and the applicable noise regulations.	Calibrated equipment which complies with the recommendations of Health and Safety Guidelines of the IFC must be used at all times.	Accredited environmental noise specialist.

The proposed PV plant project will comply with the relevant Noise Control Regulations provided that the noise mitigatory measures are in place and that the noise management plan be always adhered to.

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10 Abbreviations

dBA – A-weighted sound pressure level;

IFC – International Finance Corporation;

Km/h - Kilometers per hour;

Kg/m^3 – Kilogram per cubic meter;

m/s – meters per second;

mm/s – millimeter per second;

NSA – Noise sensitive areas;

L_{Basic} – Basic noise level in dBA;

SANS – South African National Standards;

TLB – Tractor-loader-backhoe

11 References

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