BAKUBUNG PLATINUM MINE
ADDTIONAL WORKS
NOISE IMPACT ASSESSMENT

(March 2016)

REPORT PREPARED BY JONGENS KEET ASSOCIATES
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PROJECT TEAM CREDENTIALS

The noise impact assessment was undertaken by Derek Cosijn who is a partner with Jongens Keet Associates and Calyx Environmental cc. He is a professional engineer, registered with the Engineering Council of South Africa (ECSA). He is a Fellow of the South African Institution of Civil Engineers (SAICE), a Member of the Southern African Acoustics Institute (SAAI) and is also certified as an Environmental Assessment Practitioner of South Africa (EAPSA).

He has had 40 years of professional experience over a wide range of civil engineering, transportation planning, environmental and acoustic engineering projects. He qualified as a civil engineer in 1967 and then studied further to obtain a post-graduate Diploma in Town Planning (both at the University of the Witwatersrand). He has worked in both the planning and construction aspects of the civil engineering profession gaining experience in road construction, road planning, transportation planning, traffic engineering and general environmental and environmental noise issues. He has been directly involved in over 100 environmental and noise related projects since 1975, when he worked in Canada for three years. His area of special expertise is environmental noise (acoustical engineering). The environmental and noise projects have ranged through EIAs and noise impact assessments, policy formulation and procedural guideline development. He has worked with a wide client base, ranging from the National Departments, provincial transportation/road authorities, provincial environmental authorities, the metropolitan authorities and many local councils to private organizations.

DECLARATION OF INDEPENDENCE

I, Derek Cosijn, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signed:  Date : 24/03/2016

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS

	NEMA Regulations (2014) - Appendix 6	**Reference to section of specialist report or justification for not meeting requirement**
1	A specialist report or a report on a specialised process prepared in terms of these Regulations must contain -	
(a) i	the person who prepared the report; and	Page ii
(a) ii	the expertise of that person to carry out the specialist study or specialised process;	Page ii
(b)	a declaration that the person is independent in a form as may be specified by the competent authority;	Page iii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 Section 1.2
(d)	the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Appendix B, Section B3.2
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 3
(f)	the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 2.4.1
(g)	an identification of any areas to be avoided, including buffers;	
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Section 4
(k)	any mitigation measures for inclusion in the EMPr	Section 5
(l)	any conditions for inclusion in the environmental authorisation	
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation	Detailed monitoring guidelines need to be drawn up. The ToR for the Noise Impact Assessment study was conceptual guidelines only.
(n)	a reasoned opinion -	
.i	as to whether the proposed activity or portions thereof should be authorised and	Section 7
.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;	Section 6.3

	NEMA Regulations (2014) - Appendix 6	**Reference to section of specialist report or justification for not meeting requirement**
(o)	a description of any consultation process that was undertaken during the course of carrying out the study;	No specific consultation was undertaken or deemed necessary as part of this study. Comments received by SLR as part of the EIA were considered in the undertaking of this study
(p)	a summary and copies if any comments that were received during any consultation process, and -	No specific consultation was undertaken or deemed necessary as part of this study. Comments received by SLR as part of the EIA were considered in the undertaking of this study
(q)	any other information requested by the competent authority.	

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NOISE IMPACT ASSESSMENT OF THE PROPOSED ADDITINAL WORKS AT THE BAKUBUNG PLATINUM MINE

1 INTRODUCTION

1.1 Background

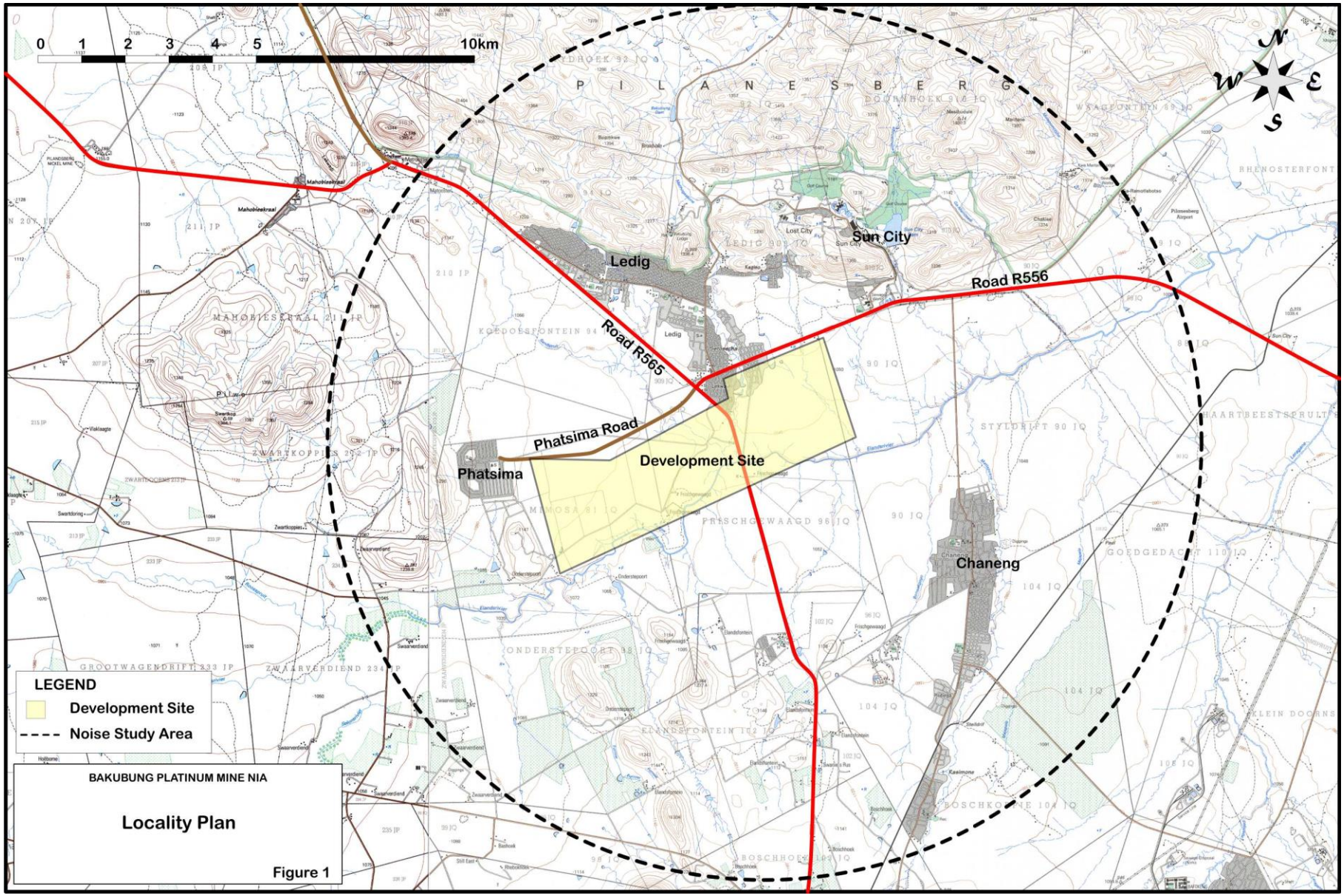
Wesizwe Platinum Limited (Wesizwe) is the owner of Bakubung Platinum Mine, currently shaft sinking on the farm Frischgewaagd 96JQ (Portions 3, 4 and 11). The mine is located near Ledig, just south of the Pilanesberg National Park and west of Sun City in the North West Province. Two reefs will be mined for Platinum Group Elements, namely platinum, palladium, rhodium and gold, with copper and nickel as by products.

The project area falls within the Rustenburg and Moses Kotane Local Municipalities of the Bojanala District Municipality. A locality map is provided in Figure 1. In 2008, Wesizwe conducted an Environmental Impact Assessment (EIA) process for the development of the Bakubung Platinum Mine.

The Mine received Environmental Authorisation in 2009, in terms of both the National Environmental Management Act (Act 107 of 1998) (NEMA) and Mineral and Petroleum Resources Development Act (Act 28 of 2002) (MPRDA). A Water Use Licence (WUL) was issued in terms of the National Water Act (Act 36 of 1998) (NWA) in 2010. While construction at the Bakubung Platinum Mine is underway, not all facilities have yet been constructed. Mining has not yet commenced.

Wesizwe is now proposing to make several changes to the approved mine. The changes are required in order to cater for an increase in ore processing capacity, as well as additional support infrastructure. The proposed changes will require additional Environmental Authorisations, a Waste Management Licence (WML) and additional water uses requiring an amendment to their existing WUL. Wesizwe also has an existing mining right but now propose to include waste rock into their existing mining right, in order to sell the waste rock as aggregate. New works are required and this will require an amendment to their mining right. For clarity in this document we will refer to Original Mine and Additional Works to indicate the existing mining right and the amended mining right application respectively.

Noise impact has been identified as one of the issues for investigation and Jongens Keet Associates (JKA) has been appointed to undertake an assessment of the potential noise impact of the Additional Works. This report documents the findings of the noise study.


0 1 2 3 4 5 10km
N
W
E
S
Ledig
Sun City
Road R556
Road R565
Phatsima Road
Development Site
Phatsima
Chaneng
LEGEND
Development Site
Noise Study Area
BAKUBUNG PLATINUM MINE NIA
Locality Plan
Figure 1

1.2 Terms of Reference

The terms of reference (TOR) were as follows:

i) A sufficiently detailed quantitative and qualitative assessment was to be undertaken at and within the area of influence of the Additional Works at the Bakubung Mine in order to enable a full appreciation of the nature, magnitude, extent and implications of the potential noise impact. The findings of the noise impact assessment of the Original Mine were also to be taken into consideration.

ii) The level of investigation was to that of an Environmental Impact Assessment (EIA).

iii) All aspects of the investigation were to conform to the requirements of relevant environmental legislation and noise standards.

iv) The potential impacts of the pre-construction, construction, operational and decommissioning phases of the project were to be assessed. The evaluation was to indicate the potential cumulative impacts (noise impacts in context of the surroundings)

v) Where relevant, appropriate noise mitigation measures were to be identified. These noise management measures needed only to be conceptual at this stage.

vi) A direct public participation programme involvement was not done by the acoustic specialist and is not deemed necessary as part of this study. However, comments received by SLR as part of the EIA were considered in the undertaking of this study.

1.3 Limitations and assumptions

The following assumptions and limitations were applied:

i) Noise is variable and can be influenced by climatic conditions so the findings of this study should not be taken as absolute/definitive

ii) The tailings facility design and the pipeline alignment changed during the course of the compilation of this report. These changes do not impact on the findings of this study and thus mapping with the previous layout has been retained.

iii) Sound power level of some of the new equipment is not yet available. Data from similar type equipment was used in the calculations.

1.4 Study Area

The core study area will be that within the area of influence of the noise generated by both the stages of development at the Mine. Where necessary however, a wider area of influence has been considered. Essentially an area within a 10 km radius from the shaft bank has been considered. The area considered in the noise impact investigation extends from the southern sector of the Pilanesberg National Park (Latitude 25°.20’.00’’) in the north to an imaginary line 4000 metres south of the Elands River in the south, and from just west

of Phatsima Village (Longitude 27°.00'.00'') in the west to just east of Chaneng Village (Longitude 27°.08'.00'') in the east. Refer to Figure 1.

1.5 The Bakubung Platinum Mine

1.5.1 Details of the Original Mine

The proposed Bakubung Mine is being developed on the farm Frischgewaagd 96-JQ and the farm Mimosa 81-JQ which lie approximately 30 kilometres north-west of Rustenburg. The proposed project area is situated to the south of Road R556 and the Pilanesberg National Park. The main mining area (shaft and processing plant) are being developed to the south-east of Ledig Village (on farm Frischgewaagd to the east of Road R565) while the tailings dam is to be developed to the west of Road R565 and south of the Reagile informal settlement on the farm Mimosa. Construction has started and mining is expected to start in Year 2020.

The original project comprises the construction of a vertical mine shaft, a ventilation shaft, the appurtenant infrastructure necessary to support this underground mining operation and a concentrator plant. The main site around the shaft complex and including the concentrator plant will cover an area of about 1000 m by 1000 m.

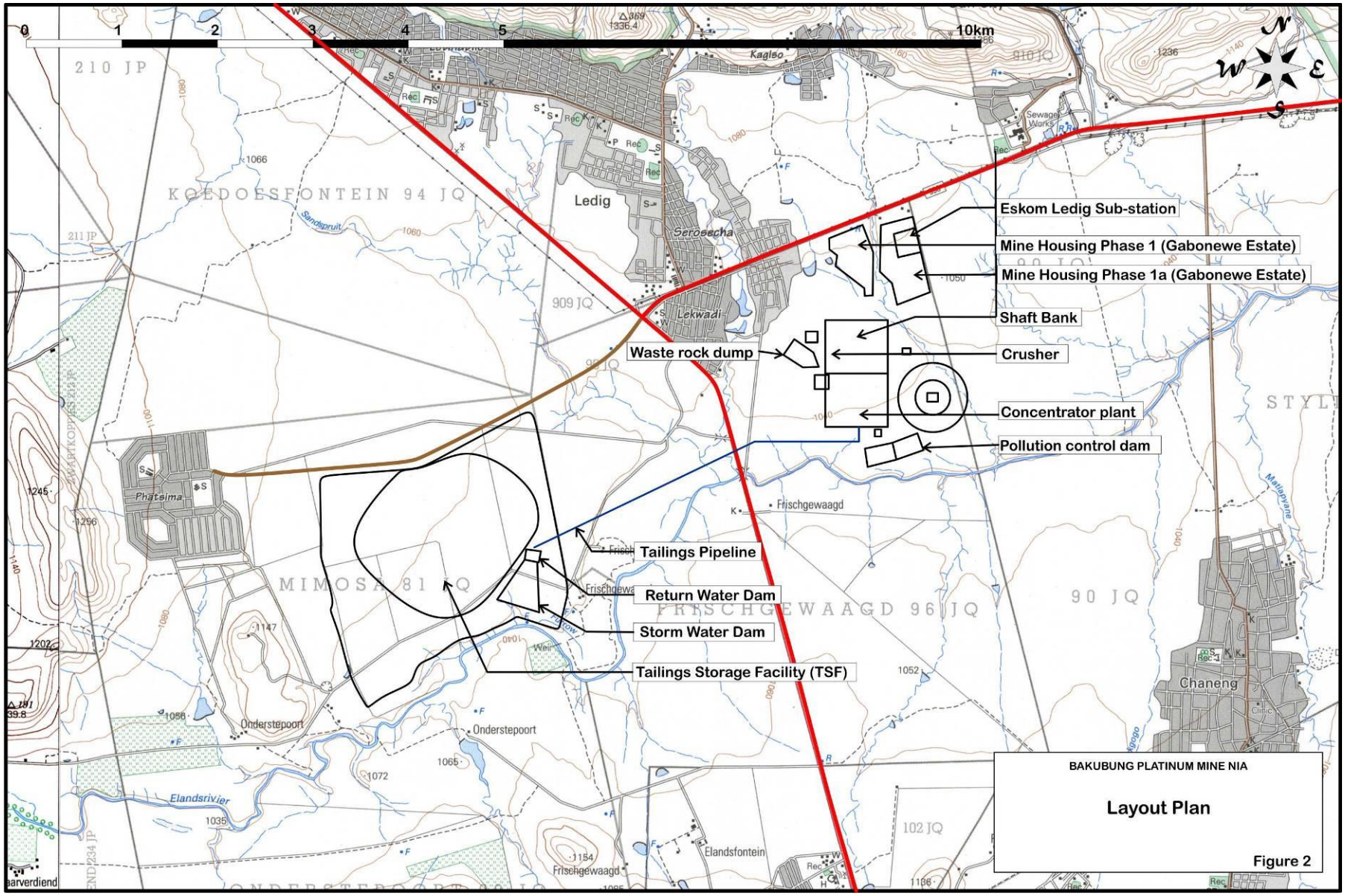
Mining method will be a standard underground drill and blast operation. The ore will firstly be processed through a crusher underground, then hauled to the surface, stockpiled, and processed through the concentrator plant. The ore concentrate will be transported by road to a smelter near Rustenburg. It is estimated that 14 truckloads of ore concentrate will be taken from the site daily. A 24-hour, 7-days a week mining operation will take place.

1.5.2 Proposed Changes to Approved Mine

Construction at the Bakubung Platinum Mine has started but not all the facilities have been constructed yet. Mining has not yet started. Wesizwe is now proposing to make several changes to the approved mine (see Figure 2). The changes are required in order to cater for an increase in ore processing capacity, as well as additional support infrastructure. The following changes are proposed to the Bakubung Platinum Mine, the noise-impact of which, where necessary, is addressed in this report:

- The construction of a larger Tailings Storage Facility (TSF) on the farm Mimosa 81JQ. The footprint area will increase from 142 ha to 166 ha. The height is planned to be 44m;
- The construction of a tailings pipeline between the mine and the TSF;
- The construction of a return water dam;
- The construction of a return water pipeline between the TSF and the mine.

- Relocation of the ore crusher circuit from underground to the surface;
- An increase in the capacity of the concentrator plant from 230 000 tons per month to approx. 265 000 tons per month;
- Increased capacity of the mine product stockpiles;
- Inclusion of the minerals in the waste rock into the mining licence, as the waste rock may potentially be crushed and sold as aggregate;
- Construction of erosion control measures along watercourses within the mine;
- The construction of a various pipeline and road crossings over watercourses;
- The construction of new sewage and water pipelines;
- The construction of pollution control dams;
- The construction of internal mine roads.
- The construction of ventilation shafts and raise boreholes;
- The installation of generators or possibly a solar power plant on site, for back-up power;
- The establishment of a salvage yard for temporary storage of general and hazardous waste;
- The construction of Phase 1a of the mine housing (Gabonewe Estate) and the access road from Road R556. This township will comprise two sections, namely Phase 1a and Phase 1. Phase 1a will have 400 houses and Phase 1 has been approved for 801 houses.
- The construction of a noise attenuation barrier (noise berm) .


0 1 2 3 4 5 10km
Eskom Ledig Sub-station
Mine Housing Phase 1 (Gabonewe Estate)
Mine Housing Phase 1a (Gabonewe Estate)
Shaft Bank
Crusher
Waste rock dump
Concentrator plant
Pollution control dam
Tailings Pipeline
Return Water Dam
Storm Water Dam
Tailings Storage Facility (TSF)
Ledig
Lekwadi
Seroseche
Kagiso
Phatsima
Chaneng
Onderstepoort
Frischgewaagd
Elandsfontein
Elandsrivier
KOEDOESFONTEIN 94 JQ
MIMOSA 81 JQ
FRISCHGEWAAGD 96 JQ
90 JQ
102 JQ
BAKUBUNG PLATINUM MINE NIA
Layout Plan
Figure 2

2 DETAILS OF THE STUDY AREA

Only the aspects, which have an influence on the potential noise impact are dealt with in this Section.

2.1 Topography

The terrain to the east and south of the shaft area is gently undulating. The land falls to the south towards the Elands River which flows in a west to east direction through the area on the southern boundary of the mine property. The Pilanesberg hills lie to the north of and parallel to Road R556. The study area is also characterised by isolated low hills to the west of Road R565 that extend in a north to south direction southwards of Phatsima Village.

2.2 Roads

The main roads influencing the study area are (refer to Figure 1):

i) Route R565, the main road from Rustenburg to Derdepoort, is aligned in a north-south direction through the central sector of the study area. To the south of its intersection with Road R556 towards Rustenburg lies Provincial Road P115/1 and to the north of the intersection towards Derdepoort is Provincial Road P51/2. It lies approximately 1,5 kilometres west of the Bakubung Mine shaft.

ii) Route R556 (Provincial Road P51/1), the main road from Ledig Village (and Sun City) to Brits is aligned in an east-west direction through the northern sector of the study area. It lies approximately 1,2 kilometres north of the Bakubung mine shaft.

iii) Phatsima Road is the road linking westwards from the Road R565/R556 intersection to Phatsima Village.

iv) Road Z546 links from Road R556 to Chaneng Village. It is aligned in a north to south direction and lies approximately 4 kilometres east of the mine shaft.

2.3 Railway Lines

The nearest railway line to the proposed site is the Rustenburg-Northam line which is aligned in a south-west to north-east direction through the area approximately 8 kilometres south-east of the mine. From a noise perspective, rail traffic has very little influence on the noise climate around the Bakubung Mine.

2.4 Land Use

2.4.1 Existing Situation

A large portion of the area is tribal land. The existing land uses in the area are:

i) Residential:

a) Ledig Village lies to the northwest of the mine complex. The village lies in the north-eastern and south-eastern quadrants of the intersection of R565 and R556 roads. The nearest sectors of the village are Kagiso Ext 2 (immediately adjacent to the west) and Lekwadi (west of Kagiso). The nearest houses are approximately 750 metres from the mine shaft.
b) Phatsima Village lies to the west of the planned tailings dam. The nearest houses are approximately 800 metres from the tailings dam.
c) Reagile (Casa Blanca) informal settlement is located in the south-western quadrant of the intersection of Road R565 and Road R556.
d) Chaneng Village lies to the southeast of the shaft complex. The nearest houses are approximately 4.5 kilometres from the proposed mine shaft.

ii) Educational: There are several schools/creches in the Lekwadi, Letlhabile and Serosecha sectors of Ledig Village. There are two schools in Phatsima Village. Refer to Figure 2 in the Noise Impact Assessment Report.

iv) Mining: The nearest mines to the Bakubung Mine site are the Styldrift and Maseve Mines to the south and south-east. Both these mines lie just to the south of the Elands Riiver and are less than 5 km from Bakubung Platinum Mine.

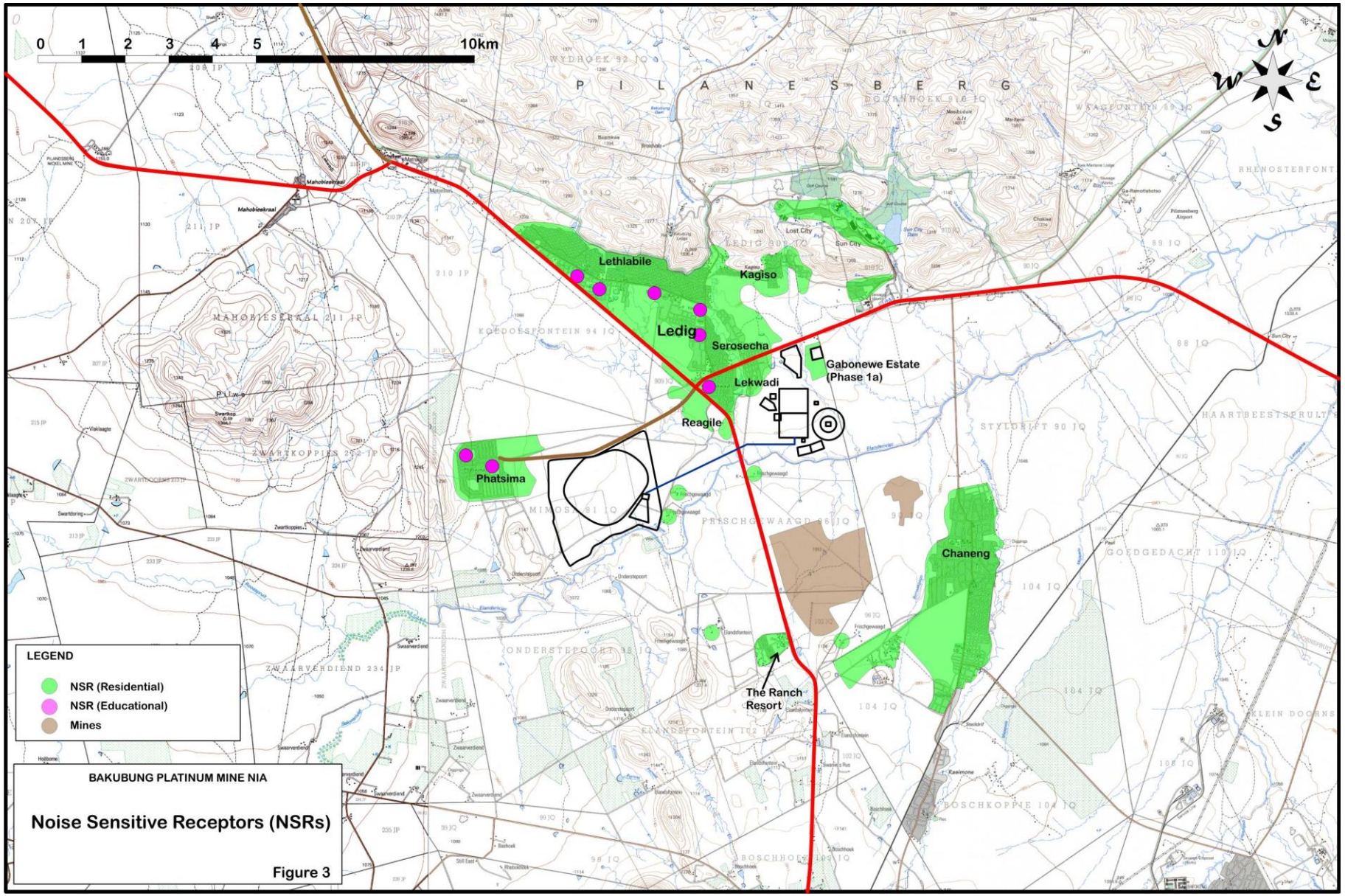
v) Agriculture: A large portion of the area is tribal farmland used for pastoral and dry-land farming.

vi) Institutional: A hospital (the Moses Kotani Hospital) is located in the north-western quadrant of the intersection of the roads R565 and R556.

vii) Tourism:

a) Sun City lies 4 kilometres to the north-east of the mine.
b) Pilanesberg National Park lies 4 kilometres to the north of the Bakubung Mine shaft.
c) Bakubung Lodge (Pilanesberg National Park) lies 4 kilometres to the north-west of the mine.
d) Melani Game Ranch lies to the south of the Elands River and to the west of Road R565.
e) The Sundown Ranch Hotel lies 5 kilometres to the south of the mine and just to the west of Road R565.

It is the existing residential areas (villages), the hospital and the schools in the study area that may be defined as noise sensitive land uses.


0 1 2 3 4 5 10km
N
W
E
S
Lethlabile
Kagiso
Ledig
Serosecha
Gabonewe Estate
(Phase 1a)
Lekwadi
Reagile
Phatsima
Chaneng
The Ranch
Resort
LEGEND
NSR (Residential)
NSR (Educational)
Mines
BAKUBUNG PLATINUM MINE NIA
Noise Sensitive Receptors (NSRs)
Figure 3

2.4.2 Planned Land Use

The mine housing estate, Gabonewe Estate, is being planned just north of the mine and just south of Road R556. Only Phase 1a, comprising 400 housing units is to be developed at this stage.

2.5 Aspects of Acoustical Significance

The terrain across the central sector of the study area which is relatively flat (falling gently to the south) will not afford much attenuation of noise. The drainage valley of the Elands River to the south will, to a small extent, act as a conduit for the transmission of noise from the mine area.

The main meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels. Analysis of the wind records for the area from October 2014 to October 2015 indicates that overall (day and night average) the main prevailing winds blow from the west-north-westerly and westerly sectors with almost 3% calm conditions.

3 METHODOLOGY

3.1 General

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328:2003: *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of an EIA. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard 8SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The investigation comprised the following:

i) Determination of the existing situation (prior to the construction of the Bakubung Mine Additional Works commencing, and the present situation, namely year 2016). Refer to Appendix B of this report.
ii) Determination of the situation during the pre-construction, construction and operation.
iii) Assessment of the change in noise climate and impact due to the intended changes to the Mine. The Original Mine was checked and recalculated with intended changes included.
iv) Identification of mitigation measures.

3.2 Determination of the Existing Conditions

This comprised the following:

i) The relevant technical details of the Mine Shaft Complex and the concentrator plant, the details of similar operating shaft complexes and concentrator plants, the existing traffic patterns and the existing and planned land use in the study area were reviewed in order to establish a comprehensive understanding of all aspects of the project (Changes to Infrastructure) that will influence the future noise climate in the study area.

ii) Using these data, the limits of the study area of the proposed site were determined and the potential noise sensitive areas, other major noise sources and potential problems in these areas were identified.

iii) Applicable noise standards were established. The National Noise Control Regulations, and SANS 10103:2008 were applied.

iv) The existing *noise climate* of the study area was determined by means of a field inspection and a noise measurement survey. The measurement survey appropriately covered the whole of the study area, focussing specifically on the identified noise sensitive/problem areas. Measurements were taken at 13 main monitoring sites in the study area. Both the daytime and night-time conditions were measured. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the Code of Practice SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and to Speech Communication*. Type 1 Integrating Sound Level meters were used for the noise measurements. All measurements were taken under dry weather and normal traffic (that is mid-week/school term) conditions. Refer to Appendix B.

v) On the general field inspection and at the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and that, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

vi) The existing noise climates along Road R565, Road R556 and Phatsima Road as related to the current traffic volumes and patterns were established. These traffic noise levels were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise* for the route. The Year 2016 traffic was

used as the baseline reference. The calculated 24-hour period noise indicators, as well as those for the daytime period and night-time period provided the main data for the impact assessment were established. The measured data provided a field check of the calculated acoustic conditions. Refer to Section A2 of Appendix A for details of the noise impact criteria used.

3.3 Assessment of Planning/Design and Construction Impacts

Aspects of the pre-design field surveys and construction activities that potentially will have a noise impact were identified and, where appropriate, mitigation measures have been recommended.

3.4 Assessment of Operational Impacts

The main focus of the operational stage assessment was to establish the nature, magnitude and extent of the potential change in *noise climate* in the study area directly related to and within the area of influence of the development of the Additional Works. This was based on the Original Mine study:

i) The impact of the proposed shaft bank complex with its ancillary operations (including road traffic) was established. Baseline noise data of various equipment and machinery that will be installed/used at the shaft complex and concentrator plant was determined from measurements at No 1 Shaft, Impala Platinum Mine (Rustenburg). Data from other similar projects (No 16 Shaft Impala Platinum Mine) were also used. The baseline noise profiles of the noisiest plant and equipment were then used to calculate the typical noise conditions generated by the operations at the shaft. The South African National Standard SANS 10357 *The Calculation of Sound Propagation by the Concawe Method* was used to model the situation.

ii) Measurements of the current (year 2016) noise climate situation at the mine were taken.

iii) A similar approach was used for the potential noise levels from the concentrator plant. The baseline noise measurements were taken at a similar facility at the Bafokeng Rasimone Platinum Mine.

iv) The Original Mine and the Additional Works noise elements were modelled.

v) Based on the findings, appropriate noise mitigation measures (site scale) have been investigated and recommendations made. These are conceptual and not detailed to final design level. Initially the worst situation was modelled. Where appropriate, SANS 10357 was used to model the likely reduction of noise that would be possible.

3.5 Rating of impact

This section outlines the method that has been used for assessing the significance of the

potential environmental impacts during the construction and operation of the Additional Works.

The proposed method for the assessment of environmental issues is set out in the Table 1. This assessment methodology enables the assessment of environmental issues including: cumulative impacts, the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

TABLE 1: CRITERIA FOR ASSESSING IMPACTS

Note: Part A provides the definition for determining impact consequence (combining severity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D.

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE

SEVERITY = L

DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**

SEVERITY = M

DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**

SEVERITY = H

DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**

			L	M	H
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		
PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

4 FINDINGS AND ASSESSMENT OF IMPACT

The following conditions were observed in the study area and the following aspects were determined from the surveys, calculations of noise indicators and the predictive modelling undertaken for the assessment of the noise impact of the development of the Additional Works of the mine.

4.1 General Details

General aspects of note were as follows:

i) The main source of noise (or potential source of noise) which presently affects the residual *noise climate* in the study area was found to be the traffic on Road R565, Road R556 and Phatsima Road.

ii) The existing noise sensitive areas which are likely or could possibly be impacted by the Additional works operations at the mine and plant are:
   a) Sectors of Ledig Village.
   b) The schools in Ledig Village and Phatsima Villages.
   c) Reagile informal settlement.
   d) Chaneng Village.

iii) The existing noise sensitive areas, which are likely or could possibly be impacted by operations at the tailings storage facility are:
   a) Phatsima Village.
   b) Reagile informal settlement.

c) Game farm lodge and farm houses south of the Elands River.

4.2 The Existing Ambient Noise Climate

The findings related to the existing conditions are based on the measurements and auditory observations taken at 13 main sites in the study area.

For the technical details of the measurement survey, refer to Appendix B. Conditions for the daytime and evening periods were ascertained. The summary of the noise measurements, which were taken at the various sites are given in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included). The measured data also provide an indication of the variability of the sound content, namely the variation between the maximums and minimums.

In order to complement the short-term noise measurements the main roads in the area, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on Road R565, Road R556 and Phatsima Road were also calculated. These data provide an accurate base for the SANS 10103 descriptors. Refer to Appendix B for more details. The noise levels at various offsets from the centreline of the main roads are summarised in Table B2 in Appendix B.

In overview, the existing situation with respect to the existing *noise climate* in the study area was found to be as follows:

i) The main sources of noise in the area will be from:
   a) Traffic on Road R565, Road R556 and Phatsima Road.
   b) Pilanesberg Airport.
   c) Construction work at the Bakubung Mine.
   d) Styldrift Mine and Maseve Mine.

ii) The existing *noise climate* alongside the main roads is degraded with regard to suburban residential living. Residences in some areas are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:
   a) Road R565 (North of R556) - 300 metres.
   b) Road R565 (South of R556) - 550 metres.

c) Road R556 (East of R565) - 550 metres.

d) Phatsima Road - 140 metres.

iii) The residual (existing background) noise levels are relatively low (quiet) in the areas of Ledig Village that are not close to and are relatively shielded from the main roads. Daytime ambient conditions range from about 45dBA to 62dBA. Evening conditions range from about 44dBA to 54dBA. These are acceptable suburban residential conditions (SANS 10103). Similar conditions occur in Phatsima Village and in the Reagile informal settlement.

iv) In general the residual noise levels in the undeveloped areas south and south-east of Lekwadi and Kagiso (east of Road R565) and areas to the south of Phatsima and Reagile (west of Road R565) are low (that is, the areas are very quiet). The noise levels are typically representative of a rural farming area, namely where the average daytime noise levels do not exceed 45dBA and the night-time levels do not exceed 35dBA. Actual night-time noise levels fall to 30dBA and less.

v) Due mainly to road traffic noise, the noise levels at the school in the south-eastern quadrant of the intersection of Roads R556 and R565 are already significantly higher than those desirable for educational facilities.

4.3 Noise Standards/Impact Criteria

From these findings and observations on site it was considered appropriate to apply the following noise standards and impact criteria to the study area:

i) Suburban residential: the noise impact on the formal residential areas and the villages should be determined on the basis of suburban residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 50 dBA and that for the night-time period should not exceed 40 dBA.

ii) Rural residential: the noise impact on the residences on farms in the area should be determined on the basis of rural residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 45 dBA and that for the night-time period should not exceed 35 dBA. Measured levels indicate that parts of the (rural) study area are already severely degraded close to the main sources of noise.

iii) Educational: Noise levels at the schools should not exceed 50 dBA (outdoor condition) with the proviso that indoor classroom conditions do not exceed 40 dBA.

iv) Nature reserves and environmentally protected areas: acceptable noise levels in these areas should be based on the naturally occurring sounds of that locality. Noise criteria used for assessing and controlling noise in urban and suburban residential districts are not applicable to Natural Quiet Spaces. All manmade sounds (instantaneous, as well as average) must be reduced to a minimum.

The above indicates the ideal situation, where noise sensitive receptors are not already degraded by the existing (residual) noise climate. However, it is likely that the residual noise level at some of the noise sensitive receptors already exceeds the recommended maximum (e.g. next to major roads). In order to assess the actual noise impact at any particular site, therefore, the residual noise climate has to be taken into account when determining impact. Where the noise level for a particular site is presently lower than the maximum ambient allowed (as indicated in SANS 10103) the recommended maximum shall not be exceeded by the introduction of the intruding noise. Where the noise level for the site is presently at or exceeds the maximum level allowed, the existing level shall not be increased by more than that indicated as acceptable in SANS 10103 (refer to Table A3 in Appendix A).

4.4 Assessment of the Pre-Construction Phase

Activities during the planning and design phase that normally have possible noise impact implications are those related to field surveys (such as seismic testing and geological test borehole drilling for large building/plant foundations). Noise levels of up to 50dBA will be experienced at a 200 metre offset from the drill rigs that are being used for exploration at present. As these activities are usually of short duration and take place during the day, they are unlikely to cause any noise nuisance in adjacent areas.

4.5 Assessment of the Construction Phase

4.5.1 General

The potential noise climate was established in general for the construction for the Additional Works. The potential noise climate was also established in general for the construction of the tailings dam to the west of Road R565. During the estimated three year construction phase, the contractors will provide the necessary facilities at a site chosen and managed by the contractors. The current plans indicate the lay-down area on the eastern side of the mine. These facilities will be removed after completion of the construction.

Although not all of the details of Additional Works have been finalised, general concepts have been used in the noise impact evaluation and these are adequate to provide a sound basis for the analysis of typical noise conditions and impacts that are likely to prevail on the project. Data related to construction have been sourced from various consultants and the experience that JKA has had working on similar sites.

4.5.2 Construction Noise Conditions

Surface construction will likely be carried out during the daytime only (06h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering and dust suppression operations may need to take place over a 24-hour period. There will be an overlap of Original Mine and Additional Works construction activities. Shaft sinking operations will be a 24-hour, 7-days per week operation. It is estimated that the construction of the project site works will take place over a period of three years.

4.5.2.1. *Sources of Noise*

For the Additional Works, the following are likely to be the main construction related sources of noise (inclusive of the Gabonewe Estate development):

i) Construction camp establishment. This will be for the site offices, workshops and stores on site. The construction lay-down area has been indicated on the eastern side of the mine property.
ii) Activities related to the relocation of services.
iii) Excavation of service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.
iv) Piling operations if necessary.
v) Excavation or raise boring of ventilation shafts.
vi) Erection of shuttering for concrete works.
vii) Fixing of steel reinforcing.
viii) Placing and vibration of concrete. Poker vibrators will be used.
ix) Stripping of shuttering after concrete pour.
x) Erection of structural steelwork.
xi) Installation of plant and equipment (pumps, crusher, etc.).
xii) Finishing operations on buildings. Cladding, services installation, etc.
xiii) General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) along the pipeline route between the mine and the TSF site.
xiv) Laying of pipelines.
xv) De-watering pumps for storm-water and ground water in the shafts. A 24-hour operation may sometimes be necessary.
xvi) Road construction and earth moving equipment. Scrapers, dozers, compactors, etc. (Construction of the internal road system, and access roads and preparation of the terraces for the concentrator and the houses).
xvii) Construction site fabrication workshops and plant maintenance workshops.

xviii) Construction material and equipment delivery vehicles.

xix) Concrete batching plant and asphalt batching plant on site (Shared with Original Mine construction).

The level and character of the construction noise from the Additional Works elements will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by various types of construction equipment are given in Table 2. These noise levels assume that the equipment is maintained in good order. Conservative attenuation conditions (related to intervening ground conditions and screening) have been applied. Using baseline data from typical construction sites, the ambient noise conditions at various offsets from the surface construction activities at the Additional Works construction sites are likely to be as indicated in Table 3.

TABLE 2: TYPICAL NOISE LEVELS GENERATED BY CONSTRUCTION EQUIPMENT

Plant/Equipment	Typical Operational Noise Level at Given Offset (dBA)							
	5m	10m	25m	50m	100m	250m	500m	1000m
Air compressor	91	85	77	71	65	57	51	46
Compactor0	92	86	78	72	66	58	52	46
Concrete mixer	95	89	81	75	69	61	55	49
Concrete vibrator	86	80	72	66	60	52	46	40
Conveyor belt	77	71	63	57	51	43	37	32
Crusher (aggregate)	90	84	76	70	64	56	50	44
Crane (mobile)	93	87	79	73	67	59	53	47
Dozer	95	89	81	75	69	61	55	49
Loader	95	89	81	75	69	61	55	49
Mechanical shovel	98	92	84	78	72	64	58	52
Pile driver	110	104	97	91	85	77	71	65
Pump	86	80	72	66	60	52	46	40
Pneumatic breaker	98	92	84	78	72	64	58	52
Rock drill	108	102	94	88	82	74	68	62
Roller	84	78	70	64	58	50	44	38
Trucks	87	81	73	67	64	60	57	54

TABLE 3: PREDICTED AMBIENT NOISE LEVELS AT GIVEN OFFSETS FROM SOME TYPICAL CONSTRUCTION OPERATIONS

Equipment	Sound pressure level at given offset (dBA)

	500m	1000m	1500m	2000m	2500m	3000m
Concrete Batching Plant	53.6	46.0	41.1	37.5	34.7	32.3
Concreting Operations	57-62	49-54	44-50	40-46	37-43	35-41
Earthworks	57.2	50.2	45.9	42.7	40.0	37.8

4.5.2.2. *Noise Impact*

The nature of the noise impact from the construction sites is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any daytime working period.

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme for the various components, work *modus operandi* and type of equipment have not been finalised. Ideally the daytime and night-time outdoor ambient noise levels (as specified in SANS 10103) should not exceed 50dBA and 40dBA respectively. Further westwards and north-westwards the effect on residents will decrease due to increasing distance from the noise source and the shielding effects from the houses in the intervening ground.

iii) The short-term maximum noise levels from general construction operations are unlikely to exceed 70dBA at the closest noise sensitive receptors. Refer to Table 1. There are thus likely to be some noise nuisance effects from intermittent loud noises on people living on the eastern periphery of this urban area.

iv) No major noise impacts are anticipated in Phatsima Village. Reagile informal settlement may be slightly affected by the construction activities of the pipeline to the tailings dam.

v) Noise from the construction of the access road on the western side of the site on to Road R565 is unlikely to be a problem for the nearest residents in Ledig Village, as it is not immediately adjacent to the built-up areas of the village.

vi) An assessment was made of the anticipated daily traffic that will be generated by the site during construction. The daily volume of traffic will be relatively small in comparison with the existing daily traffic on the external main road system and thus the noise impact from this additional traffic on the surrounding areas will be insignificant.

It should be noted that for residential areas, higher ambient noise levels than recommended in SANS 10103 are normally accepted as being reasonable during the construction period, provided that the very noisy construction activities are limited to the daytime and during the week, and that the contractor takes reasonable measures to limit noise at the work site. Note

that it has been assumed that surface facility construction will generally take place from 06h00 to 18h00 or 20h00 with no activities (or at least no noisy construction activities) at night. From the details presently available, it appears that the construction noise impact is not likely to be too severe in the residential areas near to the construction.

The noise from the construction from Additional Works will take place against the background of 24 hour of Original Mine shaft sinking operations.

4.6 Assessment of the Operational Phase

4.6.1 Sources of Noise

The main sources of noise that will affect the area once the Additional Works elements are commissioned will be the operations at, and related to the crusher, the general operations at the shaft bank and concentrator (inclusive of the crusher), the pumps (both at the mine and also at the TSF), and the traffic on the main roads and access roads.

4.6.2 Noise Sensitive Areas

The existing noise sensitive areas, which could possibly be impacted to some minor degree due to the cumulative effects of Additional Works operations and along the pipeline to the TSF are:

i) Sectors of Ledig Village.
ii) The school in the Lekwadi sector of Ledig Village.
iii) Reagile informal settlement.
iv) Chaneng Village.
v) Melani Game Ranch.
vi) Homes on the Gabonewe Estate.

Many of these areas are already severely impacted by traffic and Original Mine noise.

4.6.3 Predicted Noise Levels

4.6.3.1. *Shaft Bank*

The ambient noise climate that will be generated by the continuous operations at the shaft complex at various offsets from the shaft are indicated in Table 4. The increase that the Additional Works will bring about is not significant (0.6dBA). These are the unmitigated values and represent a worst case scenario. Note that the noise attenuation effects of the planned earth berm on the eastern side of Ledig Village between the residential area and the mine have also not been considered in this calculation.

TABLE 4: PREDICTED AMBIENT NOISE CONDITIONS FROM OPERATIONS AT THE BAKUBUNG MINE SHAFT COMPLEX (UNMITIGATED)

Time Period	Sound pressure (noise) level at given offset (dBA)										
	100m	500m	1000m	1500m	2000m	2500m	3000m	3500m	4000m	4500m	5000m
Original Mine	72.0	57.1	50.3	46.0	42.8	40.2	37.9	35.9	34.2	32.5	31.0
Original Mine Plus Additional Works	72.6	57.8	50.9	46.6	43.4	40.8	38.5	36.5	34.8	33.1	31.6

4.6.3.2. Concentrator Plant (Including Crusher)

The ambient noise climate that will be generated by the continuous and consistent operations at the concentrator plant at various offsets from the shaft are indicated in Table 5. The noise from the crusher will have a cumulative effect with the other noises from the mining operations. The increase that the Additional Works will bring about is not significant (maximum of 1.7dBA). In addition, there will be short term loud noises for example the tipping of waste rock. This has been included in the calculations. These are the unmitigated values and represent a worst case scenario. Note that the noise attenuation effects of the recommended earth berm on the eastern side of Ledig Village between the residential area and the mine have also not been considered in this initial calculation.

TABLE 5: PREDICTED AMBIENT NOISE CONDITIONS FROM OPERATIONS AT THE BAKUBUNG MINE CONCENTRATOR PLANT (UNMITIGATED)

Time Period	Sound pressure (noise) level at given offset (dBA)								
	100m	500m	1000m	1500m	2000m	2500m	3000m	3500m	4000m
Original Mine	68.0	53.2	46.2	41.8	38.5	35.8	33.5	31.4	
Original Mine Plus Additional Works	69.7	54.6	47.6	43.1	39.8	37.0	34.7	32.6	30.8

4.6.3.3. TSF

The main noise source from the tailings operations will be the pumps at the mine, and also at the TSF. The noise will be continuous and consistent.

The noise from the pumps at the tailings dam will not be a problem at noise sensitive sites more than 300 metres from a pump station. Residents in Phatsima Village and Reagile informal settlement are unlikely to be negatively affected by the noise. The residents on the farms to the south of the Elands River as well as the livestock and game (where relevant) on these farms will also not be negatively impacted by the pump noise, that is, it is unlikely that there will be a noise disturbance. However the character of the noise climate will alter in some parts of these southern areas that lie close to the tailings dam.

There will be no significant changes in noise levels from the pumps at the tailings dam from the Original Mine compared to the Additional Works. The levels in both cases are predicted to be lower than 35dBA at offsets more than 500 metres from the pump station. Refer to Table 6. There are no noise sensitive receptors within 500m of the pumps.

TABLE 6: PREDICTED AMBIENT NOISE CONDITIONS FROM OPERATIONS AT THE BAKUBUNG MINE TSF (UNMITIGATED)

Plant	Sound pressure (noise) level at given offset (dBA)							
	100m	**140m**	**180m**	**240m**	**300m**	**400m**	**500m**	**650m**
Pumps	50.3	472	44.9	42.1	40.0	37.2	34.9	32.2

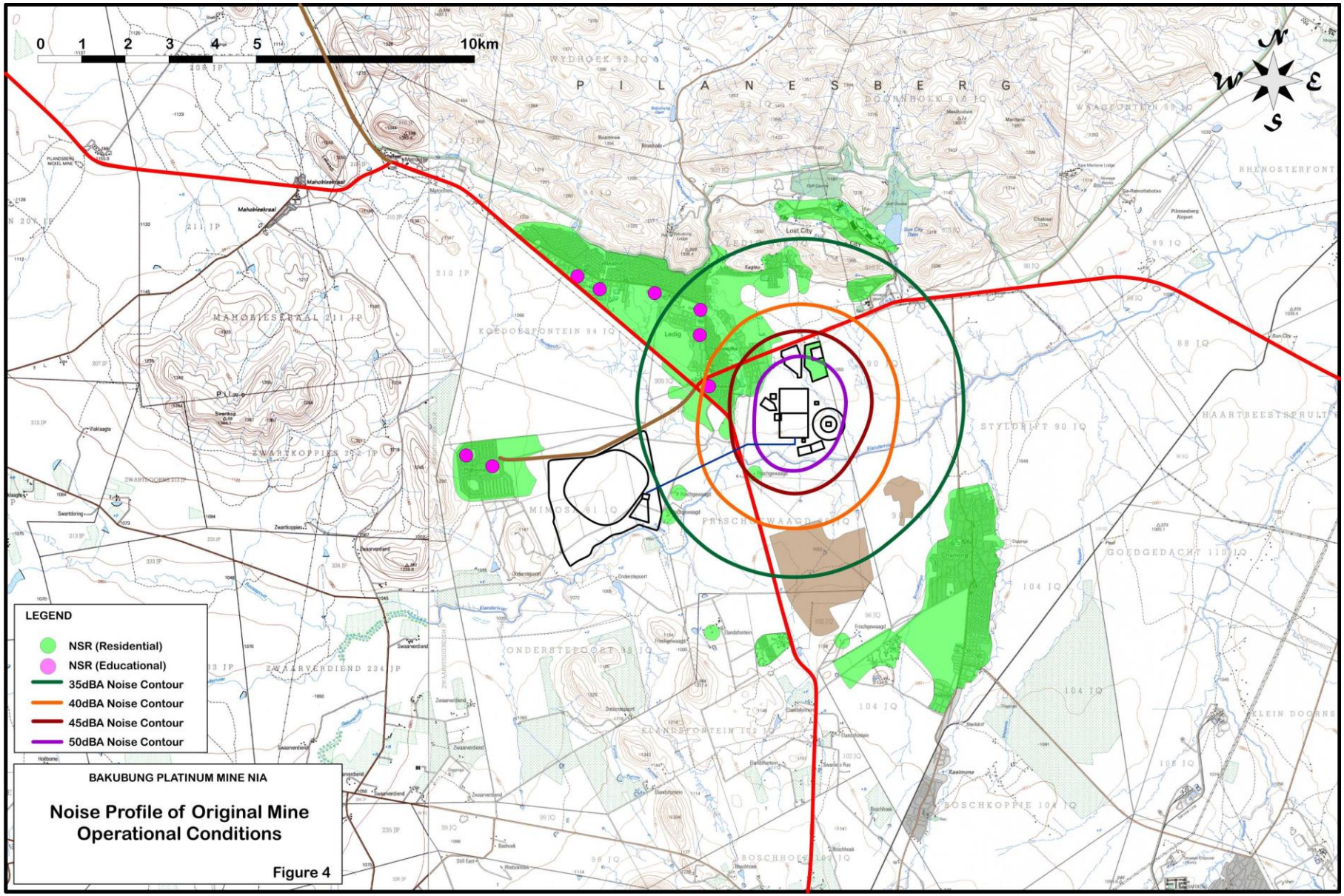
4.6.3.4. Site Generated Traffic

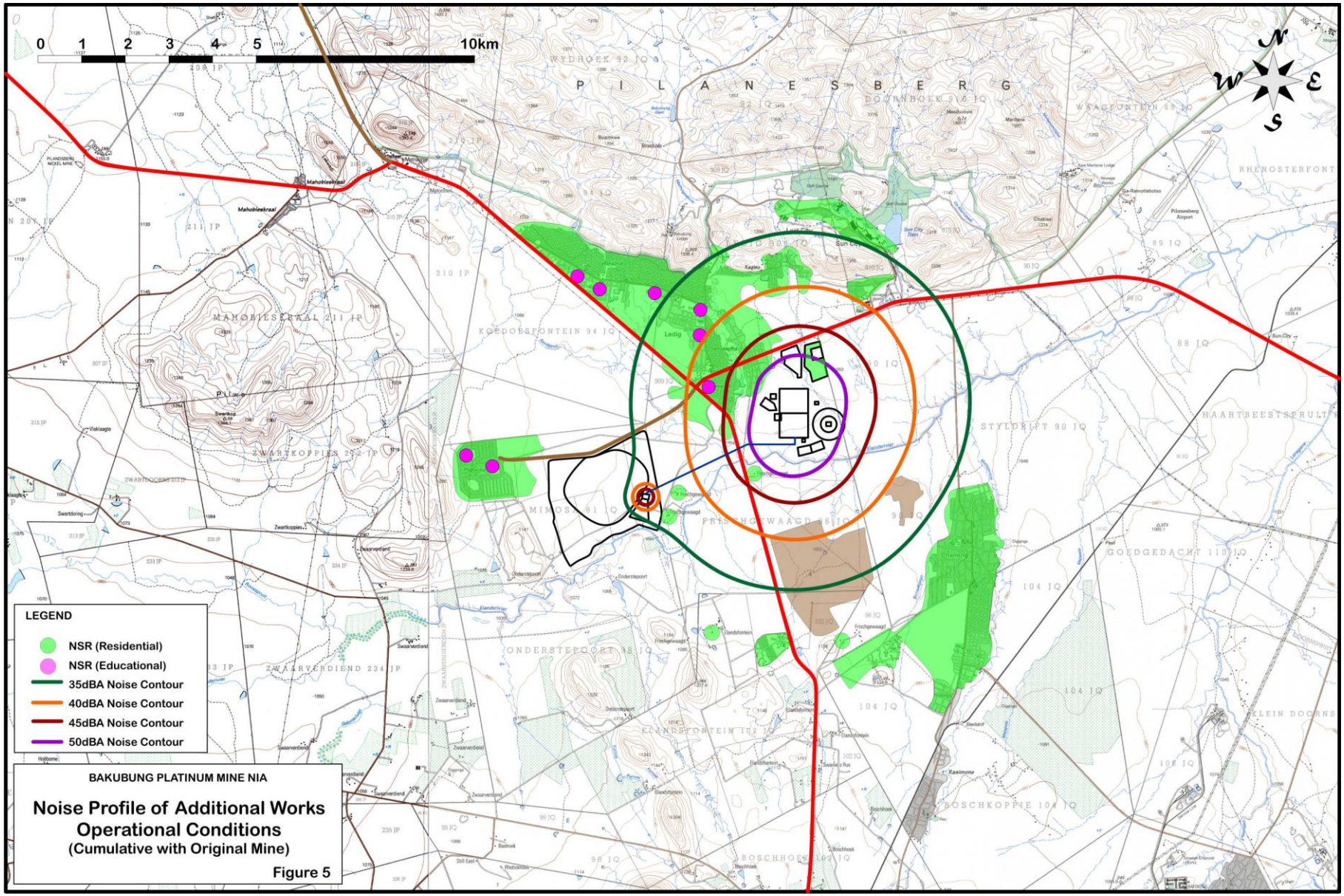
The noise levels from road traffic will continue to increase as road traffic increases. No assessment has been made of the anticipated daily traffic that will be generated by the operations of the Additional Works. It is anticipated that very small volumes will be generated and thus the noise impact from this additional traffic on the surrounding areas will be insignificant. No comprehensive Transportation Study has been undertaken.

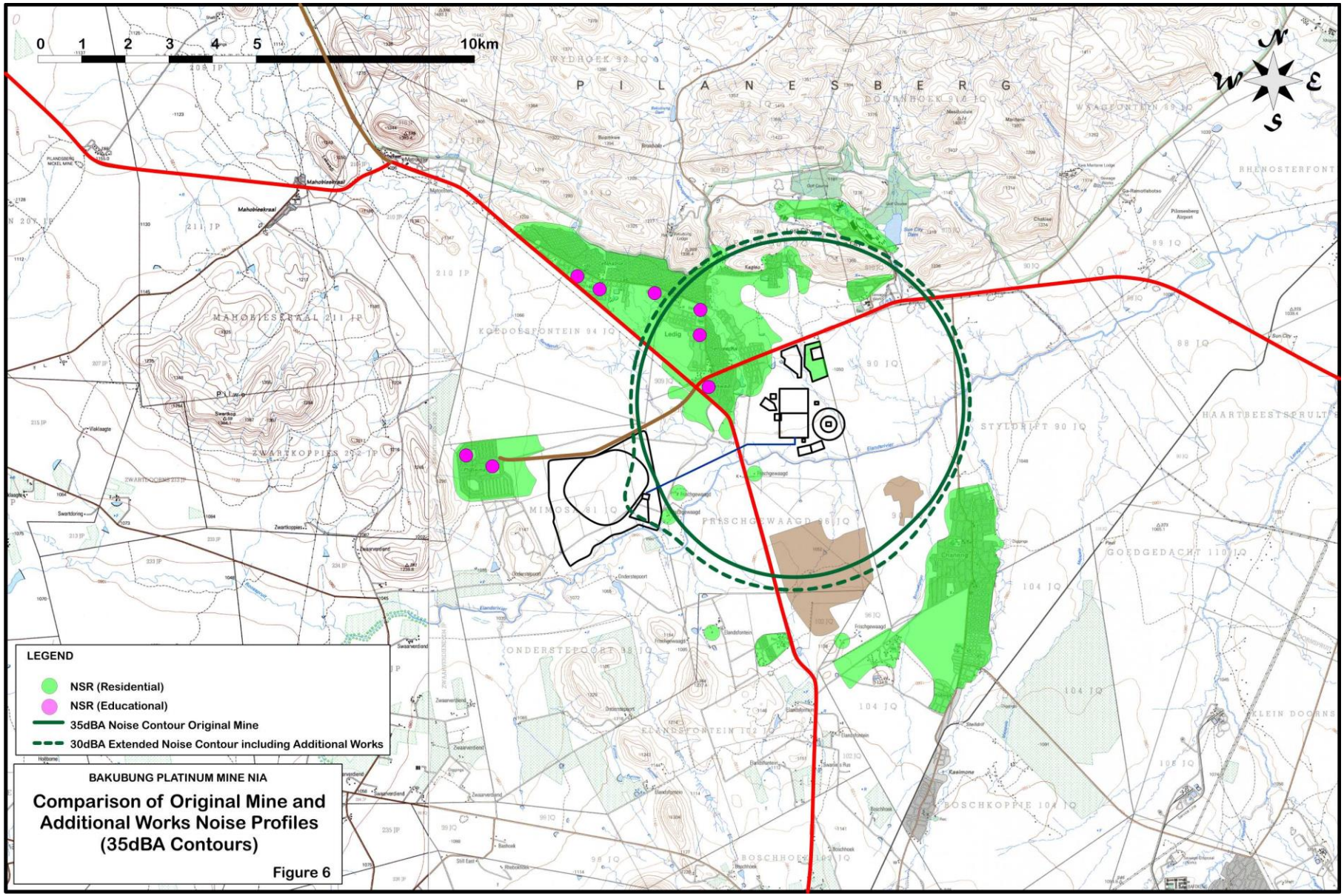
Phase 1a of the development of the Gabonewe Estate mine is planned to have 400 housing units. This has the potential to generate 1600 vehicle trips per day which in turn translates to the noise levels at various offset distances from the Gabonewe Estate Access Road as shown in Table 7.

TABLE 7: NOISE CLIMATE ALONG GABONEWE ESATE ACCESS ROADS YEAR 2020

Noise Climate Alongside Gabonewe Estate at Given Offset from Centreline (SANS 10103 Indicator) (dBA) Year 2020 with Development Traffic																							
25m Offset			**50m Offset**			**100m Offset**			**250m Offset**			**500m Offset**			**1000m Offset**			**1500m Offset**			**2000m Offset**		
L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
53.7	46.8	55	50.7	43.8	52.0	47.5	40.6	48.8	43.1	36.2	44.4	39.3	32.4	40.6	34.8	27.9	36.1	31.7	24.8	33.0	29.5	22.6	30.8


0 1 2 3 4 5 10km
N
W
E
S
LEGEND
NSR (Residential)
NSR (Educational)
35dBA Noise Contour
40dBA Noise Contour
45dBA Noise Contour
50dBA Noise Contour
BAKUBUNG PLATINUM MINE NIA
Noise Profile of Original Mine Operational Conditions
Figure 4


0 1 2 3 4 5 10km
N
W
E
S
LEGEND
NSR (Residential)
NSR (Educational)
35dBA Noise Contour
40dBA Noise Contour
45dBA Noise Contour
50dBA Noise Contour
BAKUBUNG PLATINUM MINE NIA
Noise Profile of Additional Works Operational Conditions
(Cumulative with Original Mine)
Figure 5


0 1 2 3 4 5 10km
N
W
E
S
LEGEND
NSR (Residential)
NSR (Educational)
35dBA Noise Contour Original Mine
30dBA Extended Noise Contour including Additional Works
BAKUBUNG PLATINUM MINE NIA
Comparison of Original Mine and Additional Works Noise Profiles (35dBA Contours)
Figure 6

5 ASSESSMENT OF IMPACT

Note that the assessment below (Sections 5.1 and 5.2) is for the cumulative impact of the total mine (that is, Original Mine plus Additional Works), as it is not meaningful to calculate the incremental noise impact by the Additional Works in isolation. This is due to the fact that cumulative impact of noise is calculated on a logarithmic scale, not a linear scale.

Section 5.3 below is a summary of the comparison between the Original Mine and the cumulative impact of the original Mine plus the Additional works.

5.1 Assessment of Construction Impact

Refer to Tables 2 and 3.

i) Severity / nature: The severity of the noise impact due to the construction of the TSF pipelines is medium. The impact is mainly of a nuisance nature. At times, there may be loud short-term noises. The severity of the cumulative noise footprint on the mine site due to the construction of the Original Mine plus the Additional Works is medium. The construction of the Additional Works will not increase the total construction noise footprint significantly. There will be some minor add-on effects, provided that construction takes place during the day-time.

ii) Duration: Short term, construction period only. This will be of the order of three years.

iii) Spatial scale / extent: Low to Medium. The noise footprint will extend slightly beyond the mine property at the mine site, and from the mine shaft area through to the TSF area along the pipeline route.

iv) Probability: The probability is high that there will be some disturbance due to the nature of the construction.

v) The significance of the impact will be medium prior to mitigation. Application of the proposed mitigation measures will lower the impact slightly.

5.2 Assessment of Operational Impact

Refer to Tables 4, 5 and 6 and to Figures 4, 5 and 6.

i) Severity / nature: The incremental noise increase due to the Additional Works elements will be between 0.6dBA and 1.7dBA. This is not a significant increase and will barely be perceptible. The severity of the cumulative noise footprint of the Original Mine and the Additional Works will not change from medium, i.e. a measurable deterioration and possibly widespread complaints.

ii) Duration: Long term, life of mine.

iii) Spatial scale / extent: The noise footprint due to the Additional Works elements essentially enlarges the Original Mine noise footprint by 500 metres in the south and

1200 metres in the south-west (in the area of the TSF pumps). The calculated noise footprint of the Original Mine was medium (beyond site boundary) and will still be medium when the Additional Works are operational.

iv) Probability: The probability is high, mitigation measures may reduce the probability to medium.

v) The significance of the impact will be medium prior and post mitigation.

5.3 Total Mine Impact: Comparison of Original Mine and Total Mine

TABLE 8: CONSTRUCTION IMPACT ASSESSMENT

Criteria	Original mine		Total Mine	
	Before mitigation	**After Mitigation**	**Before mitigation**	**After Mitigation**
Severity / Nature	Medium	Medium	Medium	Medium
Duration	Low	Low	Low	Low
Spatial Scale / Extent	Low - Medium	Low - Medium	Low - Medium	Low - Medium
Probability	High	High	High	High
Significance	Medium	Medium	Medium	Medium

TABLE 9: OPERATIONS IMPACT ASSESSMENT

Criteria	Original mine		Total Mine	
	Before mitigation	**After Mitigation**	**Before mitigation**	**After Mitigation**
Severity / Nature	Medium	Medium	Medium	Medium
Duration	Medium	Medium	Medium	Medium
Spatial Scale / Extent	Medium (Local)	Medium (Local)	Medium (Local)	Medium (Local)
Probability	High	Medium	High	Medium
Significance	Medium	Medium	Medium	Medium

6 MITIGATION MEASURES

Potential noise mitigation measures for the project were assessed.

6.1 Pre-construction Phase

Local residents are to be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities are to be undertaken at reasonable times of the day. These works should not take place at night or on weekends.

During this phase, consideration must be given to the noise mitigation measures required during the construction phase that should be included in the tender document specifications and the design.

6.2 Construction Phase

The noise mitigation measures to be considered during the construction phase are as follows:

i) Construction site yards, concrete batching plants, asphalt batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site.

ii) All construction vehicles and equipment are to be kept in good repair.

iii) Noisy construction activities are to be contained to reasonable hours during the day and early evening.

iv) The temporary ventilation system for the shaft construction should incorporate all the applicable noise mitigation measures.

v) With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents on how best to minimise the impact.

vi) In general operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993).

vii) Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment.

6.3 Operational Phase

The following noise mitigation measures, which will need to be considered where appropriate, are indicators of what needs to be done to reduce or control the noise generated by the proposed operations:

i) The designs of the plant for the Additional Works are to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous day/night rating level (L_{Rdn}), namely a noise level of 70dBA (just inside the *property projection plane*, namely the property boundary) as specified for industrial districts in SANS 10103. Refer to Appendix A. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the mine property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum for that land use zoning shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103. Note that the induced ambient noise levels in the residential areas of Ledig Village should ideally not exceed 50dBA during the day and 40dBA at night.

ii) The latest technology incorporating maximum noise mitigation measures for the shaft complex and concentrator plant components should be designed into the system.

iii) The design process is to consider, *inter alia*, the following aspects:
   a) The position and orientation of buildings on the site.
   b) The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
   c) The insulation of particularly noisy plant.

iv) Specifically measures need to be taken for the two types of equipment, which are responsible for the highest noise levels from the shaft complex, namely the compressor house and the mine ventilation system (upcast vent fans):
   a) The compressors should be fitted with effective silencers and the walls and roof of the compressor house should be constructed of a sufficiently dense material so as to achieve at least a 20dBA reduction (insertion loss) between the indoor noise and that transmitted to the outside of the building. Ventilation openings, if required, should be placed on the side of the building facing away from the noise sensitive areas.
   b) The mine ventilation system should preferably use centrifugal fans rather than radial fans. The upcast vent fan outlets should be oriented slightly upwards and to the south-east away from Ledig Village, and if possible the enclosure of the surface infrastructure in an insulated building should also be considered.
   c) Irrespective of the aforementioned mitigation measures that need to be taken at the sources of the noise, earth berms (noise attenuation barriers) should also be constructed:
      - Along the eastern perimeter of Ledig Village.
      - North of mine along the southern perimeter of the planned Gabonewe Estate (mine housing).

v) The design of the pump stations at the planned tailings dam is to incorporate all the necessary acoustic design aspects required in order that the induced ambient noise levels in the residential areas of Phatsima Village and Reagile informal settlement shall not exceed 50dBA during the day and 40dBA at night.

It should be noted that any mitigation measures taken at the development site will limit the impacts in the specific areas designed for, and will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem from another source(s).

This can be summarised as follows (see detail above):

TABLE 10: SUMMARY OF MITIGATION

Factor	Mitigation type	Reversibility	Loss of resource	Avoidance	Mitigation time period
Movable Plant/Equipment	Remedy and control	Partially	Definite	Managed	Life of mine
Static Plant/Equipment	Remedy and control	Partially	Definite	Managed	Life of mine
Road Traffic Noise	Control	Partially	Definite	Managed	Life of mine

7 CONCLUSIONS

The following conclusions may be drawn from the foregoing analysis:

i) The general noise climate in the study area remote from the urbanised areas and the main roads is very quiet. East of Road R565, these conditions extend across the Bakubung Mine property south of Road R556 and Ledig Village and continue into the area south of the Elands River. West of Road R565, these conditions prevail in the area south of the Elands River.

ii) The existing noise climates in the urban areas that are close to the main roads are degraded due to traffic noise. The situation improves the further one moves away from the roads.

iii) There is a potential for noise impact from the construction and operations of the Additional Works. This will be due to its cumulative effect with the Original Mine activities and will be minor.

iv) Once the mine is commissioned, the daytime ambient noise levels (unmitigated) on the south-eastern side of Ledig Village will not be a problem. Acceptable night-time conditions will however be exceeded in this area of the village.

v) None of the other sectors of Ledig Village, Phatsima Village, Chaneng Village or Reagile informal settlement will be adversely affected by the noise from any section of the mine.

vi) There are appropriate and technically feasible mitigation measures which can reduce the noise to acceptable levels at the potentially impacted noise sensitive areas/sites.

From the conclusions it may be deduced that the project can be authorised from a noise perspective with the proviso that noise mitigation measures are applied where possible.

8 RECOMMENDATIONS

The following are recommended:

i) The National Noise Control Regulations and SANS 10103 should be used as the main guidelines for addressing the potential noise impact on this project.

ii) Various measures to reduce the potential noise impact from the planned mine are possible, and the mitigation measures indicated in Section 6, *inter alia*, need to be considered.

iii) Noise monitoring guidelines for construction an operational phases need to be drawn up.

iv) The noise mitigation measures will need to be designed and/or checked by an acoustical engineer in order to optimise the design parameters and ensure that the cost/benefit of the measure is optimised.

v) At commissioning of the mine, the noise footprint of the new shaft complex, the concentrator plant and the tailings dam area should be established by measurement in accordance with the relevant standards, namely SANS ISO 8297:1994 and SANS 10103. The character of the noise (qualitative aspect) should also be checked to ascertain whether there is any nuisance factors associated with the operation.

9 REFERENCE LEGISLATION

i) BRITISH STANDARD BS 5228: 1997. *Noise and Vibration Control on Construction and Open Sites*.

ii) CROCKER, MJ (ed.) (2007). *Handbook of Noise and Vibration Control*. John Wiley & Sons: Hoboken, NJ.

iii) NELSON, P (ed.) (1987). *Transportation Noise Reference Book*. Butterworths: London

iv) SOUTH AFRICAN NATIONAL STANDARD SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and to Speech Communication*.

v) SOUTH AFRICAN NATIONAL STANDARD SANS 10210:2004, *Calculating and Predicting Road Traffic Noise*.

vi) SOUTH AFRICAN NATIONAL STANDARD SANS 10328:2008, *Methods for Environmental Noise Impact Assessments*.

vii) SOUTH AFRICAN NATIONAL STANDARD SANS 10357:2004, *The Calculation of Sound Propagation by the Concawe Method*.

viii) SOUTH AFRICAN NATIONAL STANDARD SANS ISO 8297:1994, *Acoustics -- Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment -- Engineering method.*

ix) SOUTH AFRICA. (2015). National Environmental Management Act, 2014 (Act 107 of 2014). (R982, 2014) Government Gazette 38282, December 4 (Regulation Gazette No. 10328).

x) SOUTH AFRICA. (1993). *Occupational Health and Safety Act* (Act 85 of 1993).

xi) WORLD HEALTH ORGANIZATION (WHO) (1999). *Guidelines for Community Noise*. Birgitta Berglund, Thomas Lindvall & Dietrich H Schwela (Eds.)

APPENDIX A

GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

APPENDIX A: GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

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

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2004. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.
- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.

- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of +10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the National Department of Environmental Affairs.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.
- **SANS 10103** means the latest edition of the South African National Standard SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.

- **SANS 10210** means the latest edition of the South African National Standard SANS 10210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **SANS 10357** means the latest edition of the South African National Standard SANS 10357 titled *The Calculation of Sound Propagation by the Concawe Method*.

- Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)					
	Outdoors			Indoors with open windows		
	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

TABLE A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quite
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the environmental guidelines of the World Bank and World Health Organisation, which specify 55dBA during the day (06:00 to 22:00) and 45dBA during the night (22:00 to 06:00) for residential purposes, determined over any hour. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (dBA)	Estimated Community/Group Response	
	Category	Description
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community/group action
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5dBA will be ‘little’ with ‘sporadic complaints’. For an increase of equal or more than 5dBA the response changes to ‘medium’ with ‘widespread complaints’.
- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated

community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

In the National Noise Control Regulations which are applicable in the North-West Province, an intruding noise is defined as ‘disturbing’ if it causes the ambient noise level to rise by 7dBA or more.

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and general *noise climate* investigation related to the potential noise impact of the proposed changes to the Bakubung Platinum Mine which is being developed in the area to the south of the Pilanesberg Game Reserve and Sun City in the North West Province are dealt with in this Appendix.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 *Methods for Environmental Noise Impact Assessments*. Daytime and evening period noise measurements were taken at 13 main monitoring sites at appropriate locations in the study area in order to establish the residual (existing) *noise climate*. The measurements taken in 2007 prior to the development of the Original Mine are also presented for comparison.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication*. Type 1 Integrating Sound Level Meters were used for the noise measurements. JKA were assisted by Airshed Planning Professionals. The following equipment were used:

i) Bruel and Kjaer Free-field Microphone
ii) Bruel and Kjaer Sound Calibrator Type 4231
iii) Bruel and Kjaer Hand Held Analyzer Type 2250-L
iv) Rion NA-28 Sound Level Meter
v) Rion NC-74 Calibrator

The meter was calibrated at an accredited acoustical laboratory within the last 2 years, in accordance with SANS 61672-1/IEC 61672-1, Electro acoustics – Sound level meters – Part 1: Specifications. Amdt 1.

The calibration status of the meter was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz was applied to the meters. The calibrators used are in accordance with SANS 60942/IEC 60942 (SABS IEC 60942), Electro acoustics – Sound calibrators.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aleq}), the maximum sound pressure level (L_{Almax}) and the minimum sound pressure level (L_{Almin}) during that measurement period were recorded. The frequency weighting setting was set on "A" and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 15 minutes were used. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the sites. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meter was set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of each meter.

At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

Various aspects of the weather were monitored, including wind speed, during each noise measurement. A Kestrel 4000 Pocket Weather Tracker is set up in the vicinity of the sound level meter and the following data were recorded.

- Temperature.
- Humidity
- Barometric pressure.
- Cloud cover: noted by direct observation.

A Garmin GPSMAP 60CSx was used to establish the GPS co-ordinates of each measurement site. These co-ordinates were also used when determining distances between measurement sites and other objects, such as roads and other sources of noise.

B3. MEASUREMENT DATA

B3.1. Measurement Sites

Noise measurements to establish current ambient noise conditions were taken at six main sites in the study area, as indicated in Figure B1 and Table B1. General auditory observations were taken at these sites as well as at a number of sites in the study area.

In addition, noise measurements were taken inside the mining property to establish the sound power level of the existing plant.

B3.2. Measurement Dates/Times

General observation of the noise conditions in the study area as well as the site specific sound pressure level (noise) measurements and observations were taken during the:

- daytime on Wednesday 30 September 2015 from 08h30 to 16h30 and on 1 October 2015 08h30 to 10h30.
- night-time on 30 September from 22h00 to midnight and on 1 October 2015 from 00h00 to 01h00.

Weather conditions were dry and wind speed below 0,5 km/h as required in SANS 10357.

B3.3. Noise Measurement Details

The results of the residual noise condition measurement survey in the study area (that is, external to the site) are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).

Noise measurements to establish current ambient noise conditions were taken at 13 main sites in the study area, as indicated in Figure B1. The noise measurements taken in 2007 are also indicated for comparison.

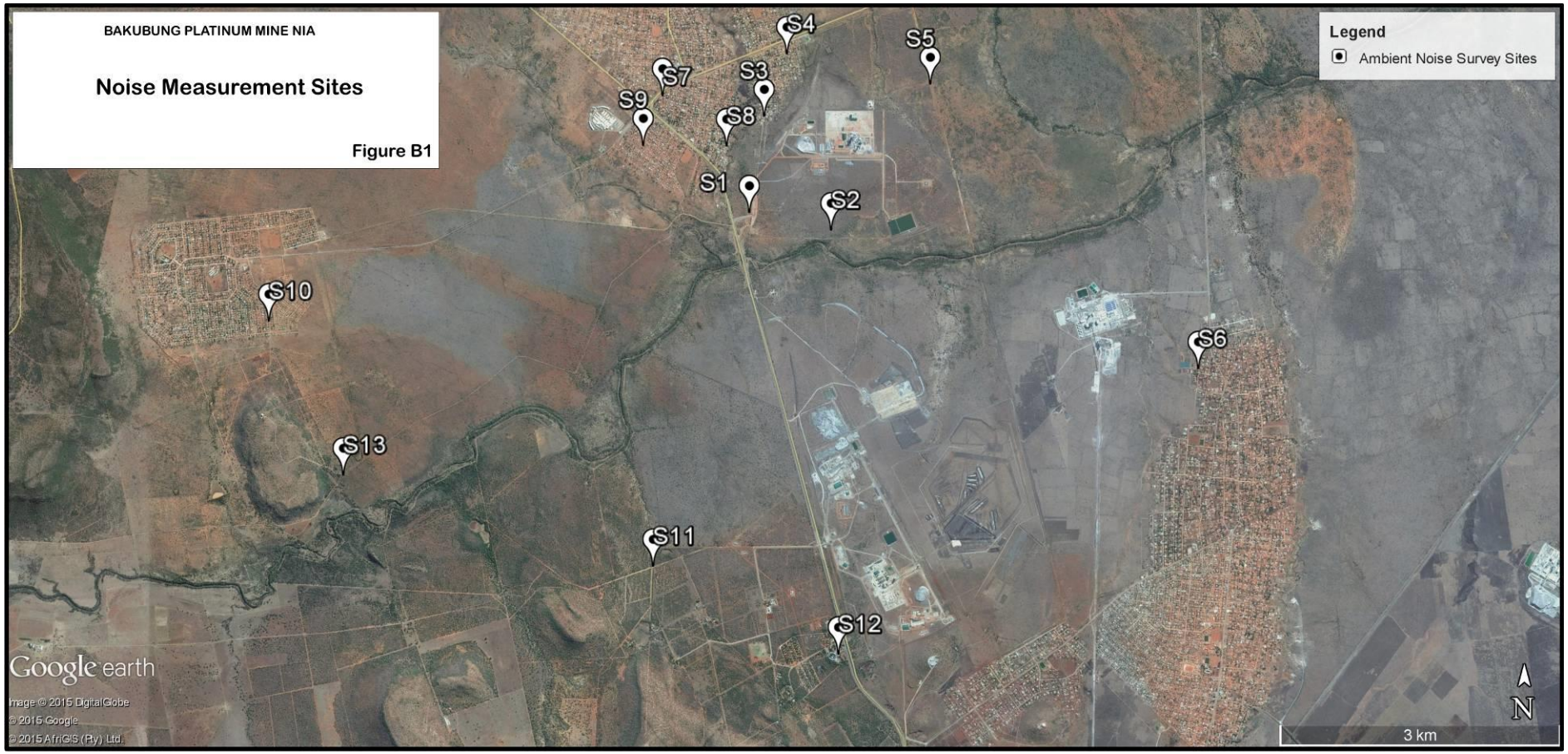

BAKUBUNG PLATINUM MINE NIA
Noise Measurement Sites
Figure B1
Legend
Ambient Noise Survey Sites
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
Google earth
Image © 2015 DigitalGlobe
© 2015 Google
© 2015 AfriGIS (Pty) Ltd.
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TABLE B1: MEASURED NOISE LEVELS IN THE BAKUBUNG MINE STUDY AREA (YEAR 2007 and YEAR 2015)

Site No	Location Description	GPS Co-ordinates	Measured Sound Pressure Level (dBA)					
			Daytime Period			Evening Period		
			L_{Aleq}	L_{max}	L_{min}	L_{Aleq}	L_{max}	L_{min}
1	At the Bakubung Mine entrance.	27° 4.292'E 25° 23.307'S	52.8 (45.6)	68.7 (64.8)	39.0 (33.7)	45.3 -	58.9 -	32.5 -
2	On the central southern portion of the Bakubung Mine property just north of the Elands River at borehole WF18.	27° 4.814'E 25° 23.407'S	50.0 (42.5)	61.3 (54.5)	41.3 (32.0)	- -	- -	- -
3	In the south eastern sector of Ledig Village (Kagiso Ext 2 sector)	27° 4.387'E 25° 22.752'S	49.7 (48.9)	62.5 (57.9)	37.1 (37.3)	- (51.1)	- (58.8)	- (35.7)
4	In the north eastern sector of Ledig Village (Kagiso Ext 2 sector)	27° 4.532'E 25° 22.393'S	50.7 (47.8)	67.0 (57.6)	41.9 (41.3)	54.0 (43.1)	70.1 (51.2)	29.3 (39.7)
5	Eastern boundary of the Bakubung Mine property approximately 1.2 km south of R556	27° 5.447'E 25° 22.567'S	44.8 (35.5)	63.1 (53.8)	31.5 (24.9)	- (32.7)	- (51.1)	- (28.7)
6	In the north western sector of Chaneng Village	27° 7.158'E 25° 24.205'S	45.7 (46.7)	58.7 (58.9)	34.0 (34.4)	50.4 (41.8)	73.1 (48.0)	25.2 (35.0)
7	In the north western sector of Ledig Village (Lekwadi sector) at a school in the south eastern quadrant of the R565 and R556 intersection.	27° 3.739'E 25° 22.633'S	61.2 (59.9)	78.6 (73.4)	40.9 (44.4)	- -	- -	- -
8	In the south eastern sector of Ledig Village (Lekwadi sector)	27° 4.147'E 25° 22.923'S	47.5 (44.6)	60.3 (59.3)	38.2 (34.1)	- -	- -	- -
9	In the north western sector of Reagile informal settlement	27° 3.615'E 25° 22.919'S	55.3 (54.7)	75.9 (64.4)	44.3 (48.8)	- (39.6)	- (52.2)	- (32.1)
10	In the south eastern sector of Phatsima Village	27° 1.225'E 25° 23.930'S	46.8 (49.7)	61.8 (63.9)	35.6 (35.2)	47.4 (40.1)	63.6 (51.8)	29.8 (36.5)
11	Along the southern boundary of Melani Game Ranch on access road and approximately 1.8 km west of R565.	27° 3.678'E 25° 25.342'S	51.7 (38.4)	74.6 (55.2)	33.3 (22.3)	44.1 (33.7)	67.0 (48.6)	26.5 (27.2)
12	At the Sundown Ranch Hotel, east of the parking lot. Approximately 90 m west of R565.	27° 4.861'E 25° 25.848'S	52.9 (54.1)	67.4 (69.2)	43.3 (35.7)	54.1 -	67.8 -	37.8 -
13	North of Elands River, 1.6 km south east of Phatsima Village, 5 km west of R565.	27° 1.700'E 25° 24.817'S	48.8 -	67.7 -	26.3 -	- -	- -	- -

Figures in brackets represent the noise measurement taken at the same sites in 2007.

The weather conditions on the survey days were such that the measurements to establish the ambient noise levels were not adversely affected and no specific corrective adjustments needed to be made.

B3.4. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements the main roads in the area, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on Road R565, Road R556 and Phatsima Road (Road R556 west of Road R565) were also calculated. These data provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation site. The Year 2016 traffic data were used as the baseline for the calculations. The traffic data were obtained from field surveys by Trafftrans, namely turning movement surveys undertaken at the intersection of routes R565 and R556 in Ledig Village (Lekwadi); and at the intersection of the mine access road on Road R565 and a 7 day electronic count just north. of the mine access road on Road R565.

The noise levels at various offsets from the relevant road centrelines were established and are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2008, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in Table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in Table), namely for the period from 22h00 to 06h00).

iii) Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in Table), namely for the 24 hour period from 06h00 to 06h00).

The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

TABLE B2: EXISTING NOISE CLIMATE ADJACENT TO THE MAIN ROADS IN THE BAKUBUNG MINE ADDITIONAL WORKS STUDY AREA (YEAR 2016 TRAFFIC)

Road	Noise Climate Alongside the Main Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA) Year 2016																																
	25m Offset			50m Offset			100m Offset			250m Offset			500m Offset			1000m Offset			1500m Offset			2000m Offset			2500m Offset			3000m Offset			4000m Offset		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R565N	60.4	53.5	61.7	57.4	50.5	58.7	54.2	47.3	55.5	49.8	42.9	51.1	46.0	39.1	47.3	41.5	34.6	42.8	38.4	31.5	39.7	36.2	29.3	37.5	34.3	27.4	35.6	32.9	26.0	34.2	30.4	23.5	31.7
R565S	64.8	57.9	66.1	61.8	54.9	63.1	58.6	51.7	59.9	54.2	47.3	55.5	50.4	43.5	51.7	45.9	39.0	47.2	42.8	35.9	44.1	40.6	33.7	41.9	38.7	31.8	40.0	37.3	30.4	38.6	34.8	27.9	36.1
R 556	63.7	56.8	65	60.7	53.8	62.0	57.5	50.6	58.8	53.1	46.2	54.4	49.3	42.4	50.6	44.8	37.9	46.1	41.7	34.8	43.0	39.5	32.6	40.8	37.6	30.7	38.9	36.2	29.3	37.5	33.7	26.8	35.0
Phatsima	56.7	49.7	57.9	53.7	46.7	54.9	50.5	43.5	51.7	46.1	39.1	47.3	42.3	35.3	43.5	37.8	30.8	39.0	34.7	27.7	35.9	32.5	25.5	33.7	30.6	23.6	31.8	29.2	22.2	30.4	26.7	19.7	27.9

B5.3. Prevailing Noise Climate

In overview, the existing situation with respect to the existing *noise climate* in the study area was found to be as follows:

i) The main sources of noise in the area are from:
   a) Traffic on Road R565, Road R556 and Phatsima Road.
   b) Pilanesberg Airport.
   c) Construction work at the Bakubung Mine.
   d) Styldrift and Maseve Mines

ii) The existing *noise climate* alongside the main roads is degraded with regard to suburban residential living. Residences in some areas are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:
   a) Road R565 (North of R556) - 300 metres.
   b) Road R565 (South of R556) - 550 metres.
   c) Road R556 (East of R565) - 550 metres.
   d) Phatsima Road - 140 metres.

iii) The residual (existing background) noise levels are relatively low (quiet) in the areas of Ledig Village that are not close to and are relatively shielded from the main roads. Daytime ambient conditions range from about 45dBA to 62dBA. Evening conditions range from about 44dBA to 54dBA. These are acceptable suburban residential conditions (SANS 10103). Similar conditions occur in Phatsima Village and in the Reagile informal settlement.

iv) In general the residual noise levels in the undeveloped areas south and south-east of Lekwadi and Kagiso (east of Road R565) and areas to the south of Phatsima and Reagile (west of Road R565) are low (that is, the areas are very quiet). The noise levels are typically representative of a rural farming area, namely where the average daytime noise levels do not exceed 45dBA and the night-time levels do not exceed 35dBA. Actual night-time noise levels fall to 30dBA and less.

v) The noise levels at the school in the south-eastern quadrant of the intersection of Roads R556 and R565 are significantly higher than those desirable for educational facilities.