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Impala Platinum Limited	Report G1059-R1
Impala No 18 Shaft and Sewage Treatment Plant Project (Shaft 18 Complex Project)	
Noise Study for Environmental Impact Assessment	
For: Impala Platinum Limited - Rustenburg	Revised: 10-Sep-2013

Declaration of independence

I am a single proprietor, independent acoustic consulting engineer. I have no commercial interest in Impala Platinum Limited, or the above-mentioned project.

A personal curriculum vitae in support of my qualifications, expertise and experience to undertake studies of this nature, is attached in Appendix B of this report.

Executive Summary

This report presents the results of a specialist noise study which was carried in support of an Environmental Impact Assessment of the proposed Shaft 18 Complex Project conducted by SLR Consulting (Africa) (Pty) Ltd. The study finds that because of the large distances involved, the project will not have any significant noise impact on residents of the nearest villages. Noise from the shaft and the associated Linear Infrastructure Corridor will not be audible in the villages. Project noise will also have no effect on the Ga-Nape Cultural Landscape, as it will not be audible to daytime visitors.

Locomotive and associated rail noise will however have a significant impact on singular informal settlements situated in close proximity of the Linear Infrastructure Corridor. Noise from No 18 Shaft will not be audible at this location. Relocation of the informal settlements is the only option which would effectively mitigate the impact of railway noise on people living in this area.

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1 Introduction to the proposed project

1.1 Location and description of the proposed activity

Impala Platinum Limited (Impala) operates a platinum mining and processing operation near Rustenburg in the North West Province. Figure 1.1 shows the local and regional setting of the mine. The operation has an approved environmental impact assessment (EIA) and environmental management programme (EMP) report (SRK, August 1997) that has been amended numerous times to incorporate a range of expansion projects.

Impala now plans to develop the following new projects:

- Development of No 18 shaft complex;
- Development of new sewage treatment plants at the existing No 17 shaft and at the proposed No 18 shaft; or the development of a new centralised plant that will cater for all of the new shafts;
- The backfilling of some mined out areas at No 17 and 19 shaft using tailings from the processing plant. These shafts will each require a tailings treatment plant to prepare the tailings for usage as support and ventilation barriers in mined out areas.

A previous assessment completed in October 2011 differed from the current study in that the scope then also included a proposed Shaft 19 Complex.

The Shaft 18 Complex project area falls within the Rustenburg Local Municipality and the Bojanala Platinum District Municipality in the North West province.

Figure 1.2 shows the infra-structure and the local setting of the project.

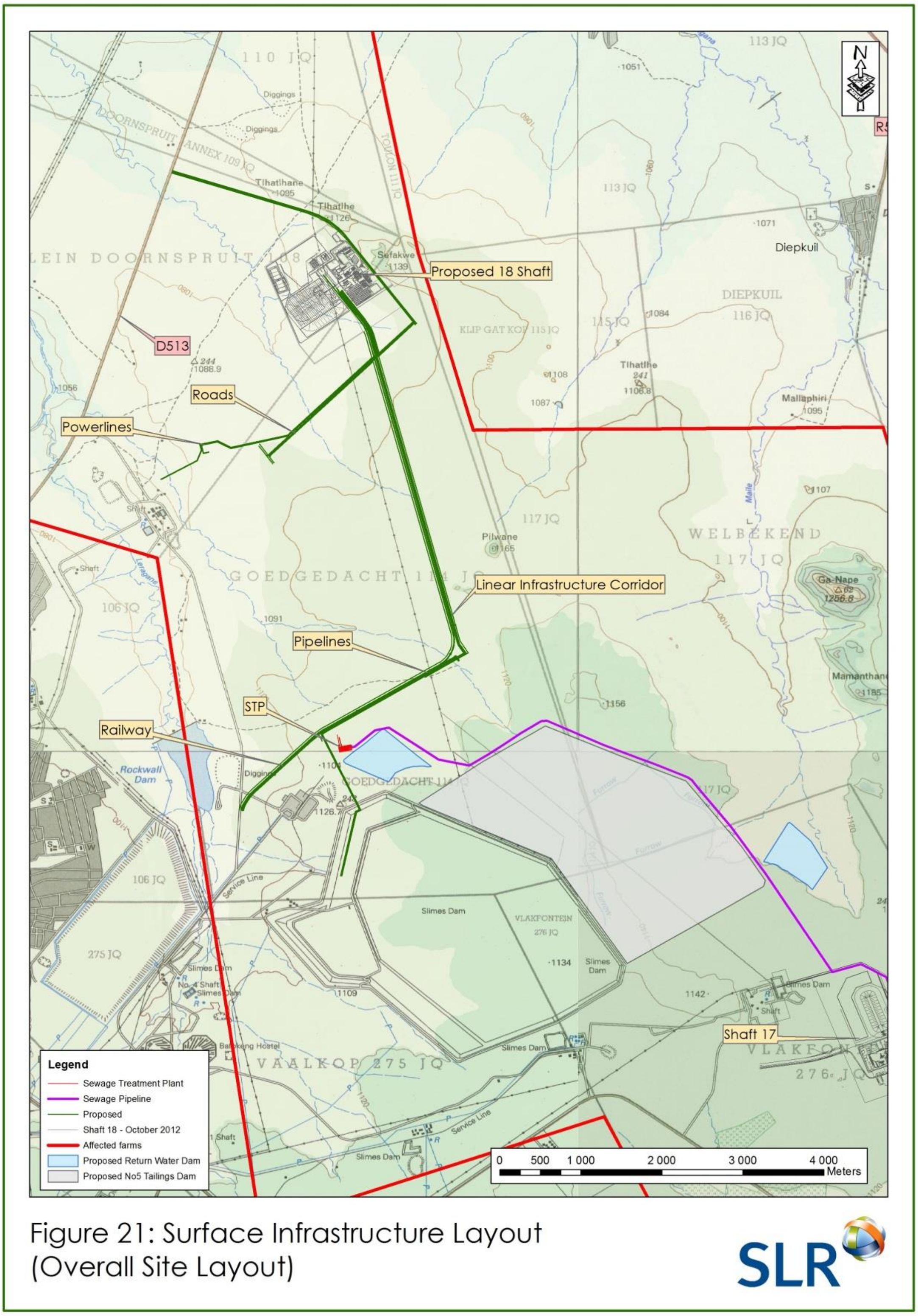


Figure 1.2

Shaft 18 project infrastructure - Local and regional setting

1.2 Terms of reference and scope of work

The acoustic specialist's brief was to investigate the noise impact of the proposed development on residents in the area and to consider the requirements and options for mitigation. The noise study focused on the external surroundings outside the mining rights boundaries shown on the map in Figure 1.1.

In addition to assessing the impact on residents in the area, it was also requested to comment on the noise implications of the proposed project for the Ga-Nape Cultural Landscape area south-west of Shaft 18 as indicated in Figure 1.2. Although no boundaries have been mapped as yet, the Bafokeng are planning to develop the heritage park.

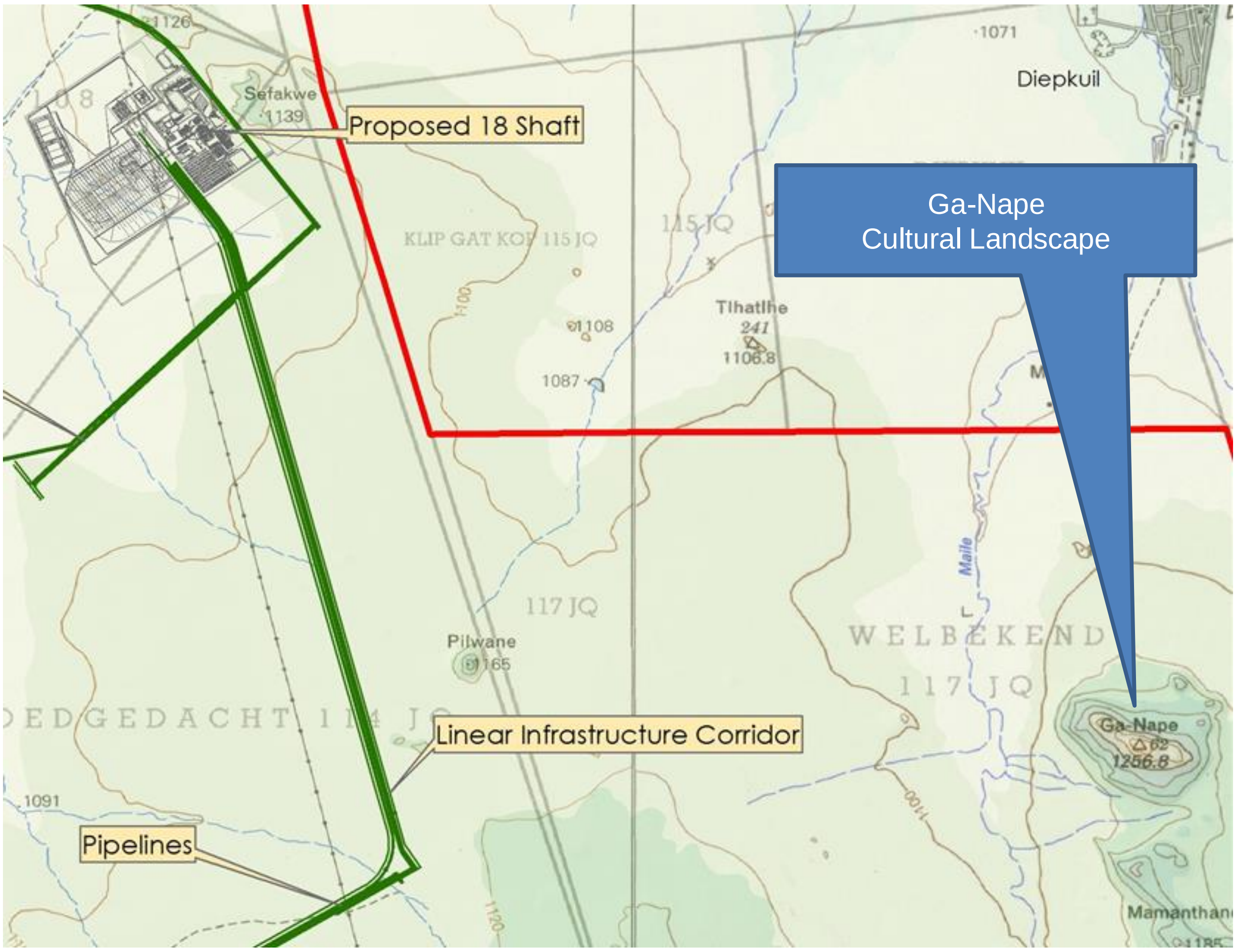


Figure 1.2

The setting of Ga-Nape Cultural Landscape relative to the proposed Shaft 18

This report presents the results of the baseline ambient survey and of the predictive noise study as part of the overall project Environmental Impact Assessment (EIA) conducted by Metago Environmental Engineers (Pty) Ltd. The scope of work required to carry out such a study involves the following two main tasks:

Scoping and baseline study

Carry out a physical scoping and a measurement survey to assess the nature of the existing noise environment and to determine typical existing, i.e. predevelopment outdoor ambient sound levels in the area.

Predictive noise impact study

Carry out a study in which the expected impact of the development is quantified and assessed by means of computer modeling of the emission and atmospheric propagation of noise expected to be generated by mining-related surface operations at and around the shafts and by the associated infrastructure.

2 Methodology

2.1 General

The Shaft 18 Complex noise study was carried out in accordance with SANS 10328 [1], a South African Standard presenting guidelines on procedures to conduct noise assessments.

2.2 Baseline Study

2.2.1 Baseline field survey

Selection of noise monitoring locations

Criteria and practical considerations which influence the selection of suitable locations for noise monitoring, include the following:

- **Community concerns:** In selecting locations for noise monitoring, concerns raised by interested and affected parties should be taken into account.
- **Worst-case impact:** Focus on areas where maximum noise impact is expected.
- **Suitability for future surveys:** As far possible, select locations likely to be accessible in future surveys.
- **Avoid interference:** As far as practically possible, stay clear of and avoid interference by localised noise sources which may distort the data. Examples are power distribution boxes, barking dogs, speech interference by curious visitors and insects in close proximity of the microphone.
- **Equipment safety:** Measurement procedure, integration periods and sample size depend on the availability of facilities for safeguarding equipment. Long duration samples are only possible at locations where facilities are available to lock away recording equipment connected via a cable to a microphone positioned outdoors at a point clear of vertical reflecting surfaces and protected from the elements.

Meteorological considerations

Outdoor noise measurement is not permitted under certain weather conditions. Rain, drizzle or fog affects the conductivity of measurement microphones, resulting in faulty readings. It may also damage the microphone and measuring equipment. Secondly, although measurement often has to be performed in the presence of wind, care should be taken to verify that wind turbulence noise on the microphone capsule is negligible compared to the sound level being measured. There is no fixed upper limit for permissible wind speed - it all depends on the level being measured. Another weather phenomenon which may cause interference and spoil measurement data is the occurrence of lightning and thunder.

Meteorological conditions also affect the acoustic environment and the actual sound levels without causing interference or measurement error. Normal fluctuations in atmospheric conditions may cause large variations in noise level which cannot and should not be avoided in the planning and execution of noise monitoring surveys. These variations constitute the natural variance in both background and intrusive noise levels. Noise levels at a distance from large sources are highly dependent on meteorological conditions. In fact, the difference in characteristic day and night meteorological patterns is one reason why 24-hour mining or industrial operations always have much greater noise impacts at night[1].

It should be noted that, for the reasons explained above, the monitoring of meteorological conditions, such as temperature, wind and humidity on the ground can at best only serve to avoid errors and distortion of measurement data. Knowledge of cloud cover, temperature, humidity and wind conditions which prevailed during the course of a noise survey has little if any value in the post-processing and interpretation of data.

Sampling considerations

To be of any use as an environmental management tool, noise monitoring has to produce accurate and relevant data. As a minimum requirement, the right equipment should be used and measurements performed with the necessary precision and accuracy as laid down in SANS 10103 [2]. Just as important, no matter how accurate the measurements, the data is only as good as the sample. What complicates noise sampling is that ambient noise is all but constant. As a rule, it is the net result of contributions from various constant, cyclic and randomly fluctuating sources.

To account for the intrinsic 24-hour cyclic variation, measurements should be taken within the relevant period of interest, e.g. daytime, night-time or a 24-hour cycle. Noise regulations require that the noise investigated must be measured (averaged) over a period of at least 10 minutes; i.e. 10 minutes or longer.

Noise survey conducted in the Shaft 18 Complex study

A scoping investigation was carried out to assess the proposed location of the shafts and associated infrastructure, the location of villages and settlements, as well as the topographical characteristics of the area. This included a visit to the Ga-Nape Cultural Landscape. Ambient noise measurements in the area surrounding the proposed development were conducted during the period 30-May-2011 to 02-Jun-2011. Locations where samples were taken, are shown in Figure 2.1.

Since no facilities suitable for long-duration unattended recordings were available, ambient noise levels were probed and samples taken in which the level was averaged over sufficiently long time durations to obtain good estimates of the average ambient level. This involved time-integrated averaging for a period long enough for the running average to converge to a constant level with less than 1 dB variance. A-weighted, equivalent continuous sound pressure levels L_{Aeq} (dBA) were measured, using an integrating sound analyser.

2.2.2 Test equipment

Field measurements were carried out using the following equipment:

(a) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1875497)

(b) Brüel & Kjaer Type 4189 Measurement Microphone (Ser no. 1858498)

(c) Brüel & Kjaer Type 4231 Sound Calibrator (Ser no. 2606011)

Equipment conformed to IEC 61672-1 Electro-Acoustics – Sound Level Meters

Calibration: M& N Calibration Services Certificates No’s 2010-1164 & 2010-1165

1 *The other main reason is increased sensitivity at night due to a decline in road traffic and human activity noise.*

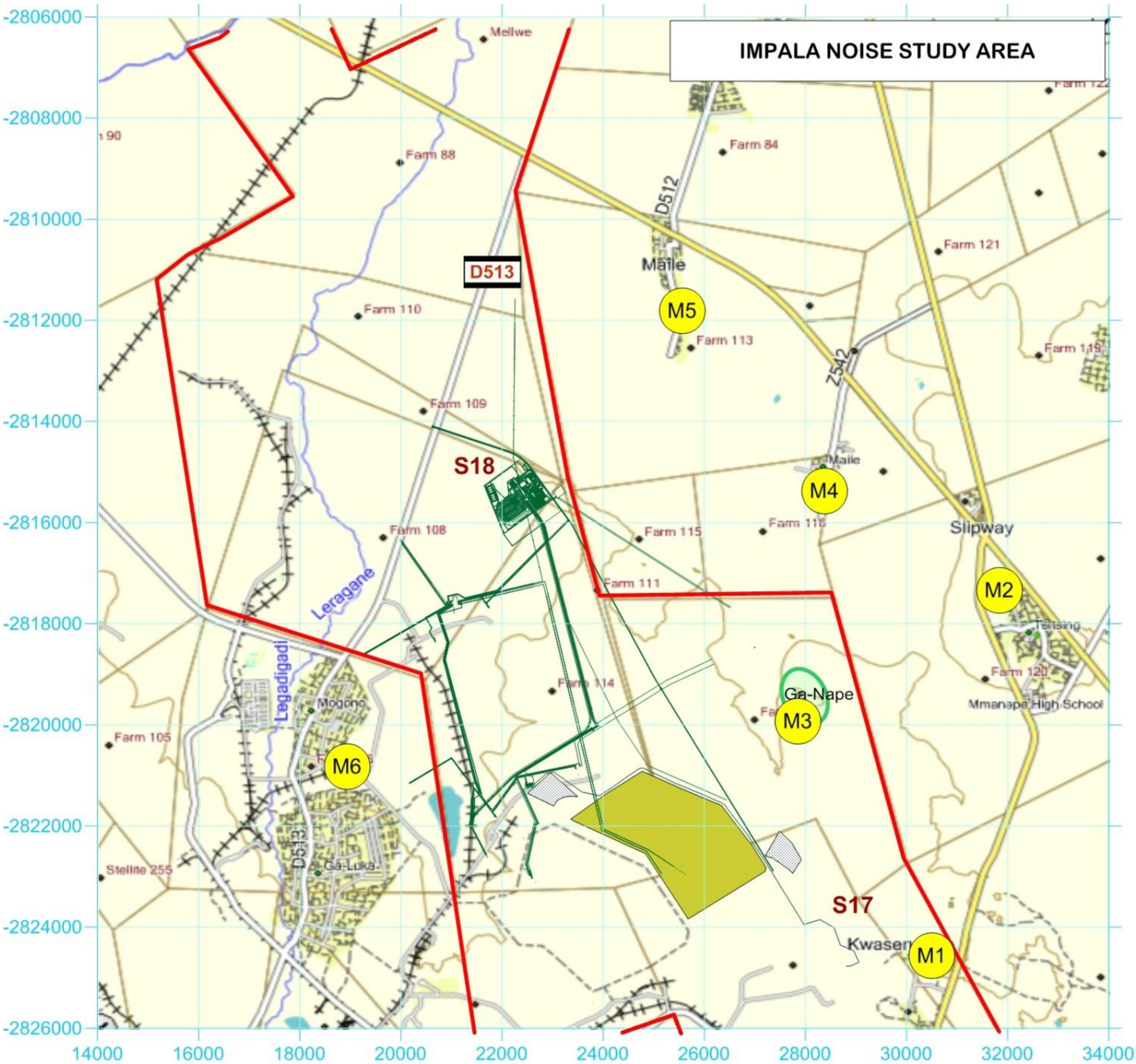


Figure 2.1

Noise monitoring locations

Monitoring location	Coordinate	Monitoring location	Coordinate
M1 Kwaserutube	S25 32 29.2 E27 18 08.9	M4 Maile Diepkuil	S25 26 26.0 E27 16 58.3
M2 Tsitsing	S25 28 12.6 E27 18 52.3	M5 Maile	S25 24 46.1 E27 15 11.9
M3 Heritage site (Rural Area)	S25 29 25.5 E27 17 20.5	M6 Ga-Luka	S25 29 53.6 E27 11 35.3

2.3 Predictive noise impact study

2.3.1 Noise modelling

Estimates of future noise levels to be generated by the development in the study area were derived with the aid of a model simulating noise emission from all major noise-generating components and activities in the development. To this end, it was required to quantify the acoustic emission (sound power) levels, as well as the frequency and directional characteristics of individual or groups of sources. Calculation of geometric dispersion and atmospheric propagation of noise is based on the principles of the Concawe method SANS 10357:2000 [3], extended to deal with more complex source configurations, as well as to simulate the effect of wind.

2.3.2 Noise modelling – Nature and scale of operations

Main parameters

The shaft layout is shown in Figure 2.2. Table 2.1 summarises activities and operations taken into account in the simulation of the shaft and associated infrastructure for purposes of noise modelling.

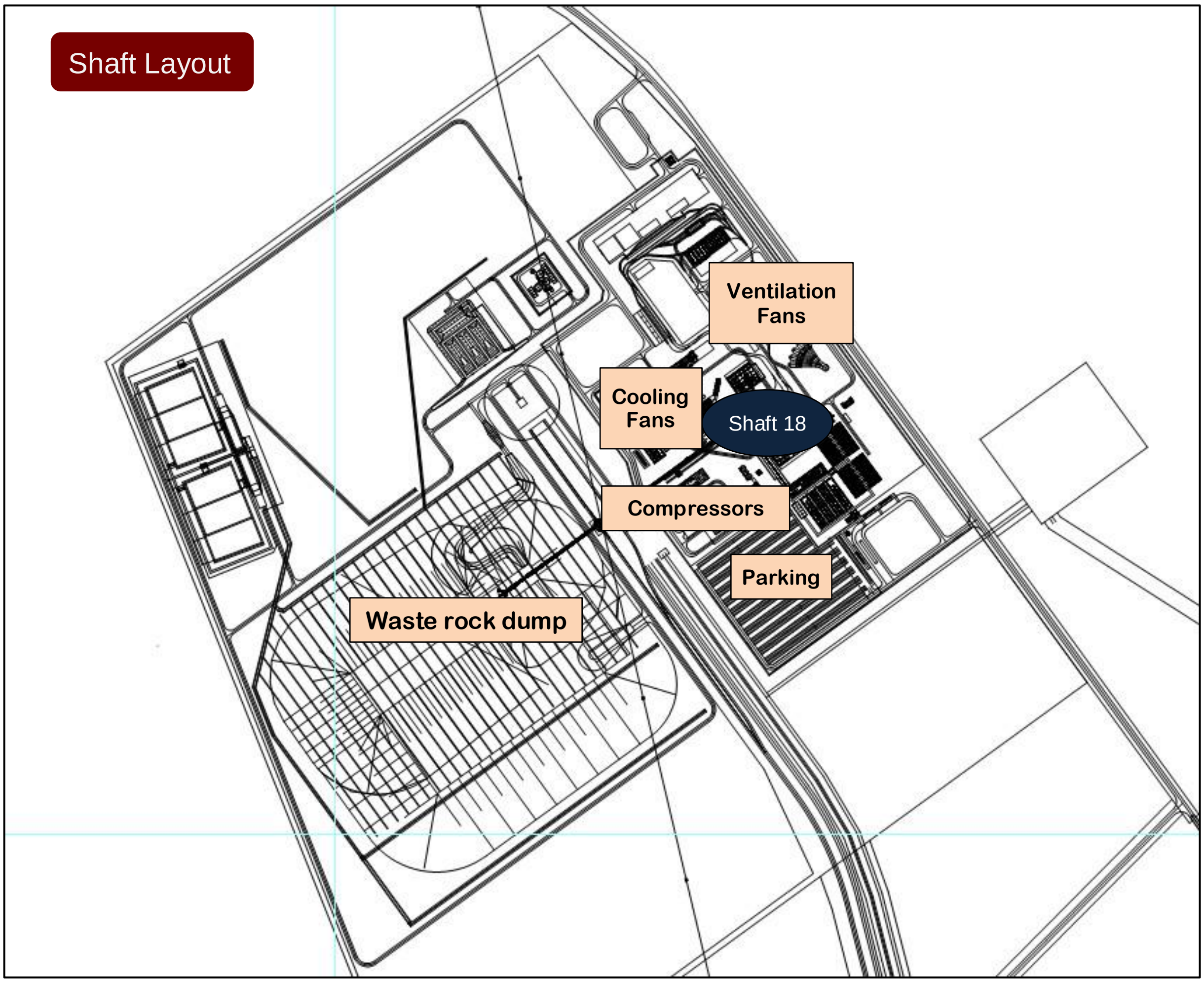


Figure 2.2

Shaft layout

Table 2.1

Project data summarising the nature and scale of operations

Features		No 18 Shaft
Group	**Parameter**	
Main vertical shaft	Depth	1 940 m
	Diameter	10 m
Mining	Target mineral	Platinum Group Metals (PGMs) and gold in UG2 and Merensky Reefs
	Mineable area	12 897 567 m^2
	Resource estimation	57,669,009 tons
	Rate	225 kilo tons per month (ktpm) of reef plus 35 ktpm of waste rock
	Life of mine per shaft	Approximately 25 – 35 years
Mine residues	Waste rock	Approximately 300 0000 m^3 in total
Resource use	Water demand	Approximately 150 0000 m^3 per month
	Power demand	50 MVA
Employment	Staff: construction	Approximately 1 200
	Staff: operational	Workforce to be moved from other shafts therefore no jobs to be created
	Operating times	Typical operating times will be 06h00 – 16h00, then 22h00 – 06h00. Continuous operations are possible once steady state mining is reached.

Other project components

Other project components include:

- New sewage treatment plant at No 18 Shaft and a new sewage pipeline that runs from Shaft 17 to the new plant.
- A new tailings facility.

2.3.3 Sources of noise during the various phases

The following is an outline of activities, equipment and operational parameters expected in the various phases of the project and taken into account in identifying potential contributors to overall project noise. The findings of the impact assessments for the various phases are presented in Section 3.

A Construction phase

Construction phase facilities

Facilities expected to be located at the shaft complex site during construction are as follows:

- Contractors lay down areas;
- Workshops, stores, wash bays, lay-down areas, fuel handling and storage area, offices, ablution facilities such as chemical toilets or septic tanks;
- Handling and storage area for construction materials (paints, solvents, oils, grease) and waste;
- Generators for temporary power supply;
- Stockpiles;
- Water management infrastructure;
- Explosive magazines;
- Run of mine (ROM) pads;
- Haul roads;
- Temporary access roads;
- Temporary services (water, electricity);
- Ventilation infrastructure including fans;
- Drill rigs for geotechnical drilling;
- Portable air compressors for the sinking operations;
- Settling ponds for the sinking operations.

These facilities will either be removed at the end of the construction phase or incorporated into the layout of the operational mine.

Construction phase activities

Significant activities expected to take place during construction include the following:

- Sinking of vertical shafts from surface for the shaft complex ;
- Setting up contractors laydown areas;

- Establishing access roads. Temporary access roads will be used initially but the strategy is to construct the permanent access roads early for construction vehicles to access the sites;
- Selective clearing of vegetation in areas designated for surface infrastructure in line with a biodiversity management plan and soil conservation procedure to be developed;
- Stripping and stockpiling topsoil and sub-soil;
- Digging of foundations, trenches and pits;
- Preparing residue disposal areas;
- Delivery of materials;
- Blasting;
- General building/construction activities;
- Geotechnical drilling for the site preparations and shaft sinking.

Construction phase transport Systems

Temporary (gravel) road access will be provided to the No 18 Shaft from No 14B Shaft, along the same servitude corridor as the temporary power and water supply, which will be sourced from No 14 Shaft.

Construction phase power supply

Temporary power of 8 MVA will be supplied directly by Eskom from the Millennium substation at 6,6 kV from 2 x 10 MVA transformers. The new twin 33 kV overhead lines which will be used for construction and permanent conditions will initially be operated at 6,6 kV with an initial demand of around 2 MVA from November 2012. The twin 33 kV lines will follow the mechanical services corridor.

Construction phase waste management

Sewage

During the early construction phase, sewage will be collected in trucks and transported to the sewage works at the No 14 Shaft.

Construction Phase Timing

The bulk of construction activities to enable the build-up to full production should take nine years, commencement pending the EIA authorisation process.

Construction phase sources of noise

Not all of the activities listed above will contribute significantly to overall construction noise. Activities and operations which will constitute the main potential sources of noise in the construction phase are summarised in Table 2.2.

Table 2.2

Sources of noise in the construction phase

Construction Activity	Primary sources of noise
• Sinking of vertical shafts	Diesel engine noise
• Site preparation: Clearing, soil stripping	Bulldozer, loading, truck movement
• Foundations and pits	Excavators, digging, engine noise
• Building construction	Cutting, sawing, grinding, hammering
• Road construction	Bulldozer, grader, compactor, trucks
• Delivery – Equipment and materials	Trucks & other vehicles on access road
• Blasting	Air blast noise
• Geotechnical drilling	Drill rig - engine and drilling noise

B Operational phase

Operational Phase Surface infrastructure

The bulk of the surface infrastructure will be accommodated in approximately two square kilometres. Shaft infrastructure will typically include:

- A Main Shaft intended for personnel, material and rock hoisting with a diameter of 10 m and depth of 1 940 m. This shaft will be equipped with headgear, hoisting facilities and winder houses;
- An upcast Ventilation Shaft with a diameter of 9 m and depth of 1 680 m and equipped with five surface fans, the sinking headgear, as well as one winder house;
- Downcast shaft for chilled air (Fridge Shaft), with a diameter of 7,5 m and depth of 1 380 m;
- A separate short bulk air cooling (BAC) duct with a short feeder shaft of 30 m into the Main Shaft for the shaft complex ;
- Air compressors housed in a building;
- A waste rock dump;
- A cementation/grout plant;
- Conveyors;
- Road access and internal roads;
- Change houses, lamp rooms, a medical first aid facility;
- Offices, shaft access and security offices;
- Parking areas;

- Water storage facilities and surface water control measures;
- New sewage treatment plant and pipeline to No 17 Shaft;
- Waste handling station;
- A reticulation system for all services. In addition, the following services will be run in approved servitudes:
  - Compressed air connection into the Impala compressed air circuit;
  - Tailings pipelines to the tailings dam;
  - A pipeline to the tailings dams area for any excess water from the shaft to be utilised in the processing plant;
  - Overhead 33 kV Electrical power lines;
  - Rail lines;
  - Access roads.

Operational Phase Transport Systems

Transport in the operational phase will comprise of the following:

- Permanent (tarred) road access to the No 18 Shaft will be provided from the D513 tarred road linking Luka village to the R556 (Sun City road) with a ring linking existing road infrastructure on the No. 14 Shaft.
- Approximately 30 buses per day are expected to transport staff to and from site during the operational phase, and approximately 10 trucks per day for transport of materials along the R556, D513 and site roads.
- Ore will be trammed by locomotive and hopper on the Impala surface rail system, linking the No. 18 Shaft into the rail network at the No. 11 Shaft.

Waste Disposal

<u>Sewage</u>

New sewage treatment plant will be constructed at No 18 Shaft and will be connected via a new sewage pipeline to No 17 Shaft.

<u>Waste Rock Disposal</u>

A waste rock dump will be provided for the expected 25 year life of mine at the shaft complex . The dumps will incorporate groundwater seepage protection and run-off collection facilities. The sides of the dumps slope will initially be 1:1,5. During the course of operations, the dumps will be spread at a slope of 1:3 to minimize erosion and allow for topsoil capping. The maximum final height of each waste rock dump will be approximately 38 metres.

Life of Mine

The mine design allows for approximately 25 to 35 years life of mine for No 18 shaft.

Operational phase sources of noise

Underground operations will not contribute to audible noise in the area surrounding the project and will have no direct effect on ambient noise levels. Moreover, not all of the surface components and activities listed above will contribute significantly to overall project noise. The larger part of surface operation noise is expected to emanate from the ventilation fans. These and other components considered to be the main potential sources of noise in the operational phase are summarised in Table 2.3. The listing of any given component or activity in Table 2.3 confirms that it is included in the comprehensive noise model, not that it is necessarily audible, disturbing, or even a significant contributor to the total noise.

Table 2.3

Primary sources of noise in the operational phase
All sources operating 24 hours/day; 7 days/week

Primary Group	Component	Noise source
Shaft Surface Infrastructure	Shaft	Cage alarms, sirens, small fans, hoisting and winder houses
	Ventilation Fans	5 Fans - 1 500 kW each Fan house breakout noise Fan noise emitted atmospheric side
	Compressor House	Motor-Compressor units (screened off)
	Cementation plant	Engine noise Grouting
	Conveyors	Belt-idler impact and rotation noise Transfer station noise
	Sewage treatment	Pumps
Waste rock dump	Trucks & dozers	Diesel engine noise
		Reverse alarms
Water/sewage treatment	Water treatment plant	Pumps
Tailings	Tailings disposal	Pumps
Roads	Roads internal access	30 Buses twice a day 800 cars per 16 hours Road traffic noise Parking areas – traffic noise
Rail lines	Locomotives & trains	2 Trains per day Diesel locomotive noise Wheel-rail rolling noise

C Decommissioning and Closure

The conceptual plan is to remove surface infrastructure and rehabilitate the disturbed areas.

2.4 Noise regulations and assessment criteria

2.4.1 South African noise regulations

In 1994, with the devolution of regulatory power from governmental to provincial level, the authority to promulgate noise regulations was ceded to provinces. Each province could henceforth decide whether to develop their own regulations, or to adopt and adapt existing regulations. As yet, however, only three provinces (Gauteng, Free State and Western Cape) have promulgated such regulations. Elsewhere, including North West Province, no provincial noise regulations have been put in place.

Consequently, in noise studies undertaken in provinces lacking official noise regulations, specialists usually consider the old national noise regulations [4] to apply by default. For further guidance, it is noted that noise criteria in all previous national and current provincial regulations, as well as current metropolitan noise policies, are derived from SANS 10103. SANS 10103 defines the relevant acoustic parameters that should be measured, gives guidelines with respect to acceptable levels and assessment criteria and specifies test methods and equipment requirements. In this noise study, the provisions of the old national noise regulations are taken into account, but noise assessment is based by and large on the principles, guidelines and criteria of SANS 10103.

Prohibitions

Prohibition of disturbing noise

In accordance with international and South African standard practice, noise impact assessments are made with respect to outdoor noise levels. Noise regulations prohibit any changes to existing facilities, or uses of land, or buildings or the erection of new buildings, if it will house activities that will cause a disturbing noise, unless precautionary measures to prevent disturbing noises have been taken to the satisfaction of the local authority. Noise is deemed to be disturbing, if it exceeds certain limits. Depending on what data is available, SANS 10103 allows for different formulations of the excess.

- **If the actual residual ambient level is known:** The excess is taken to be the difference between the noise under investigation and the residual noise measured in the absence of the specific noise under investigation. This definition, based on the *noise emergence criterion,* finds application in both predictive and noise monitoring assessments, if baseline noise data is available.

- **If the actual residual ambient level is unknown:** Alternatively, the excess may also be defined as the difference between the ambient noise under investigation and the acceptable ambient rating for the type of district under consideration in accordance with SANS 10103. This definition, based on the *acceptable level criterion,* is employed in predictive noise studies and in noise monitoring assessments, if there is no baseline data available or if an existing source of intrusive noise cannot be switched off for purposes of measuring the residual background level.

In terms of the old national noise regulations a disturbing noise means a noise that causes the ambient sound level to increase by 7 dB or more above the designated zone level, or if no zone level has been designated, the ambient sound level measured at the same point. Noise regulations also require that the measurement and assessment of ambient noise comply with the guidelines of SANS 10103.

It needs to be cautioned, however, that the 7 dB limited should not be construed as the upper limit of acceptability. SANS 10103 (See Table 2.5 in this report) warns that an increase of 5 dB is already significant and that an increase of 7 dB can be expected to evoke widespread complaints from the community. In the EIA phase, i.e. in the design and planning stage of a new development, it is advised that the design target be set at 3 dB, while 5 dB is considered a significant impact. This also brings the assessment in line with World Bank guidelines.

Prohibition of a noise nuisance

Noise regulations also prohibit the creation of a noise nuisance, defined as any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person. The intent of this clause is to make provision for the control of types of noise not satisfactorily covered by measurement and assessment criteria applicable to disturbing noises. These are noises which are either difficult to capture[2], or noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes, when assessed against standard criteria. Noise regulations list specific activities which are prohibited if exercised in a manner to cause a noise nuisance, such as[3]:

- The playing of musical instruments and amplified music;
- Allowing an animal to cause a noise nuisance.
- Discharging fireworks;
- Discharge of explosive devices, firearms or similar devices which emit impulsive sound, except with the prior consent in writing of the local authority concerned and subject to conditions as the local authority may deem necessary;
- Load, unload, open, shut or in any other way handle a crate, box, container, building material, rubbish container or any other article, or allow it to be loaded, unloaded, opened, shut or handled, (if this may cause a noise nuisance).
- Drive a vehicle on a public road in such a manner that it may cause a noise nuisance.
- Use any power tool or power equipment used for construction work, drilling or demolition work in or near a residential area, (if this may cause a noise nuisance).
- Except in an emergency, emit a sound, or allow a sound to be emitted, by means of a bell, carillon, siren, hooter, static alarm, whistle, loudspeaker or similar device (if it may cause a noise nuisance).

One or more of these activities may occur on industrial sites and in project activities. A common cause of noise nuisance is the beeping sound of reverse alarms, the last item listed above.

The essential difference between a disturbing noise and a noise nuisance is as follows:

Noise disturbance – Is quantifiable and its assessment is based on estimated or measured sound levels, expressed in decibel (dBA). Investigation and assessment of existing noise disturbance problems involve the measurement of ambient levels in the presence of a specific source under investigation and comparison of this level with either the level measured in the absence of the source, or a table value deemed to be an acceptable level for the type of district under consideration.

[2] *For example, barking dogs. Not only is the occurrence of the noise unpredictable and erratic, but the presence of a person investigating the problem with a noise meter is likely to attract attention and trigger incessant barking.*

[3] *See Noise Regulations for the full list of prohibited activities.*

Noise nuisance – Is difficult to quantify and is not confirmed or assessed by measurement. Judging whether a noise qualifies as a nuisance is based purely on its character and audibility, in conjunction with subjective considerations such as the perceived intent of the noise maker and connotations attributable to the source of noise. Where measurement is possible, measured data may serve as supplementary information.

SANS 10103

As mentioned before, noise regulations require that the measurement and assessment of noise comply with the guidelines of in SANS 10103. The concept of noise nuisance, however, only features in the regulations. SANS 10103 only deals with quantifiable noise (noise disturbance), without any guidelines for, or reference to noise nuisance whatsoever.

It is normally expected of EIA noise studies as well as EMP surveys to make findings based on quantitative assessment of predicted or actual noise levels, i.e. based on noise disturbance considerations. But once an industrial site or mine starts operating, predictable as well as unexpected sources of noise nuisance may emerge. If present, they often constitute a major cause of complaints. It is therefore imperative that, in addition to quantitative predictions and measurements, noise studies as well as monitoring surveys also identify potential and actual sources of noise nuisance.

2.4.2 SANS 10103 - Acceptable ambient levels

Noise regulations require that the rating level of the ambient noise be compared with the rating level of the residual noise (where this can be measured), or alternatively (where the noise source cannot be switched off or interrupted), with the appropriate rating level given in Table 2 of SANS 10103. Neither the noise regulations, nor SANS 10103 defines or refers to the term noise impact. It is however generally understood and defined for purposes of this study, as the amount in dB by which the total noise level exceeds the nominal or the measured ambient level rating, whichever is applicable, for the area under consideration.

Table 2.4 in this report summarises SANS 10103 criteria for acceptable ambient levels in various districts. Note that ratings increase in steps of 5 dB from one to the next higher category and that, in general, regardless of the type of district, ambient noise levels tend to decline by typically 10 dB from daytime to night-time. It follows that, for the same level of intrusive noise, the noise impact would typically increase by 10 dB from daytime to night-time.

Table 2.4

Typical outdoor ambient noise levels in various districts (SANS 10103)

Type of district	Noise level Equivalent continuous level L_{Aeq} (dBA)		
	Day-Night L_{dn}	**Day-time** L_d	**Night-time** L_n
(a) Rural	45	45	35
(b) Suburban – With little road traffic	50	50	40
(c) Urban	55	55	45
(d) Urban - With some workshops, business premises & main roads	60	60	50
(e) Central business districts	65	65	55
(f) Industrial districts	70	70	60

A 24 hour cycle is divided into the following periods:

Day-time (06:00 – 22:00)
Night-time (22:00 – 06:00)
Day-Night (24-hour day-night period)

The day-night level L_{dn} represents a 24-hour average of the ambient noise level, with a weighting of +10 dB applied to night-time levels, yielding numerically equal values for daytime and day-night levels.

SANS 10103 also gives guidelines in relation to expected community response to different levels of noise impact (increase in noise level), as summarized in Table 2.5.

Table 2.5

Expected community response to an increase in ambient noise level
(SANS 10103)

Increase in ambient level [dB]	**Expected community reaction**
0 - 10	Sporadic complaints
5 - 15	Widespread complaints
10 - 20	Threats of community action
More than 15	Vigorous community action

3 Results and findings – Baseline Conditions

3.1 Baseline study

3.1.1 Current state of the environment - Background ambient noise levels

General

The noise study area in the Shaft 18 Project is located in a district where in most areas the ambient noise still has a rural village character. With the exception of Ga-Luca, villages nearest to the proposed development are still outside audible reach of noise emanating from existing Impala Mine operations such as the plant and shaft complexes, as well as noise from other existing mines and industries in the district. The nearest existing mining and industrial operations in the larger area include:

- Merafe Ferrochrome and Mining – approximately 10 km from Impala's mineral processing complex (MINPRO);
- Anglo Platinum, Rustenburg division - approximately 5.5 km from the existing UG2 plant;
- Anglo Platinum – Bafokeng Rasimone Platinum Mine (BRPM) – approximately 11 km from MINPRO;
- Omnia Fertilizers – adjacent to MINPRO.

Ambient noise comprises mainly of relatively low levels of road traffic and community activity noise. On the whole, the area in its current state (in terms of SANS 10103 guidelines) rates as a "Suburban District – With little road traffic" with typical daytime and night-time ambient levels of 50 dBA and 40 dBA, respectively (see Table 2.4). These levels are just 5 dB above typical ambient levels in Rural Districts, the lowest noise category.

Noise at M1 (Kwaserutube)

Ambient noise in the Kwaserutube and Kana townships is determined primarily by relatively low levels of road traffic and community activity noise. No mining or industrial noise was discernable during the survey. Average daytime and night-time ambient levels measured in the survey were 45 dBA (daytime) and 39 dBA (night-time), respectively.

Noise at M2 (Tsitsing)

Ambient noise in Tsitsing is determined primarily by relatively low levels of road traffic on the R556 main road and local roads, as well as community activity noise. No mining or industrial noise was discernable during the survey. Average daytime and night-time ambient levels measured in the survey were 49 dBA (daytime) and 40 dBA (night-time), respectively.

Noise at M3 (Ga-Nape Cultural Landscape)

The site is currently uninhabited with no public road access. Situated about 4 km from the nearest public road, no traffic, mining or human activity noise could be detected during the survey. The ambient noise character is typical of Rural Districts. Daytime ambient levels measured in the survey ranged between 37 and 45 dBA and were determined primarily by bird, insect and wind sounds. The site could not be accessed for probing of night-time levels, but in the presence of insect sounds, night-time levels can be expected to be similar to daytime levels. If developed as a heritage site, public access to visitors is likely to be restricted to daytime hours. Consequently, in considering the potential impact of noise from the proposed No 18 Shaft development, the ambient levels of concern would be daytime rather than night-time levels.

Noise at M4 (Maile Diepkuil)

Ambient noise in this area is determined primarily by road traffic on local roads and by community activity noise. No mining or industrial noise was discernable during the survey. Average daytime and night-time ambient levels measured in the survey were 47 dBA (daytime) and 41 dBA (night-time), respectively.

Noise at M5 (Maile)

Ambient noise in this area is similar to that measured in Maile Diepkuil, determined primarily by road traffic on local roads and community activity noise. No mining or industrial noise was discernable during the survey. Average daytime and night-time ambient levels measured in the survey were 44 dBA (daytime) and 42 dBA (night-time), respectively.

Noise at M6 (Ga-Luka)

Although noise from the mine was slightly audible at times, ambient levels in Ga-Luka are determined predominantly by road traffic on local roads and by community activity noise. Average daytime and night-time ambient levels measured in the survey were 51 dBA (daytime) and 44 dBA (night-time), respectively.

Noise in the rural surroundings outside villages

Noise in the rural area outside the villages would be of significance for any informal settlements or singular dwellings found to be located within the noise footprint of the shafts and linear infrastructure. Three such informal dwellings have been identified next to the linear infrastructure route south of No 18 Shaft. The samples of ambient noise levels taken in the Ga-Nape Cultural Landscape surroundings serve as indicators of the predevelopment ambient noise climate in that area. Unlike Ga-Nape where the daytime level is of significance, the relevant baseline level for people living in this area would be 35 dBA, the night-time level for Rural Districts.

Summary

The results of the survey are summarised on the map in Figure 3.1. Daytime and night-time periods are as defined in SANS 10103 (See Table 2.4 in Section 2.4.2).

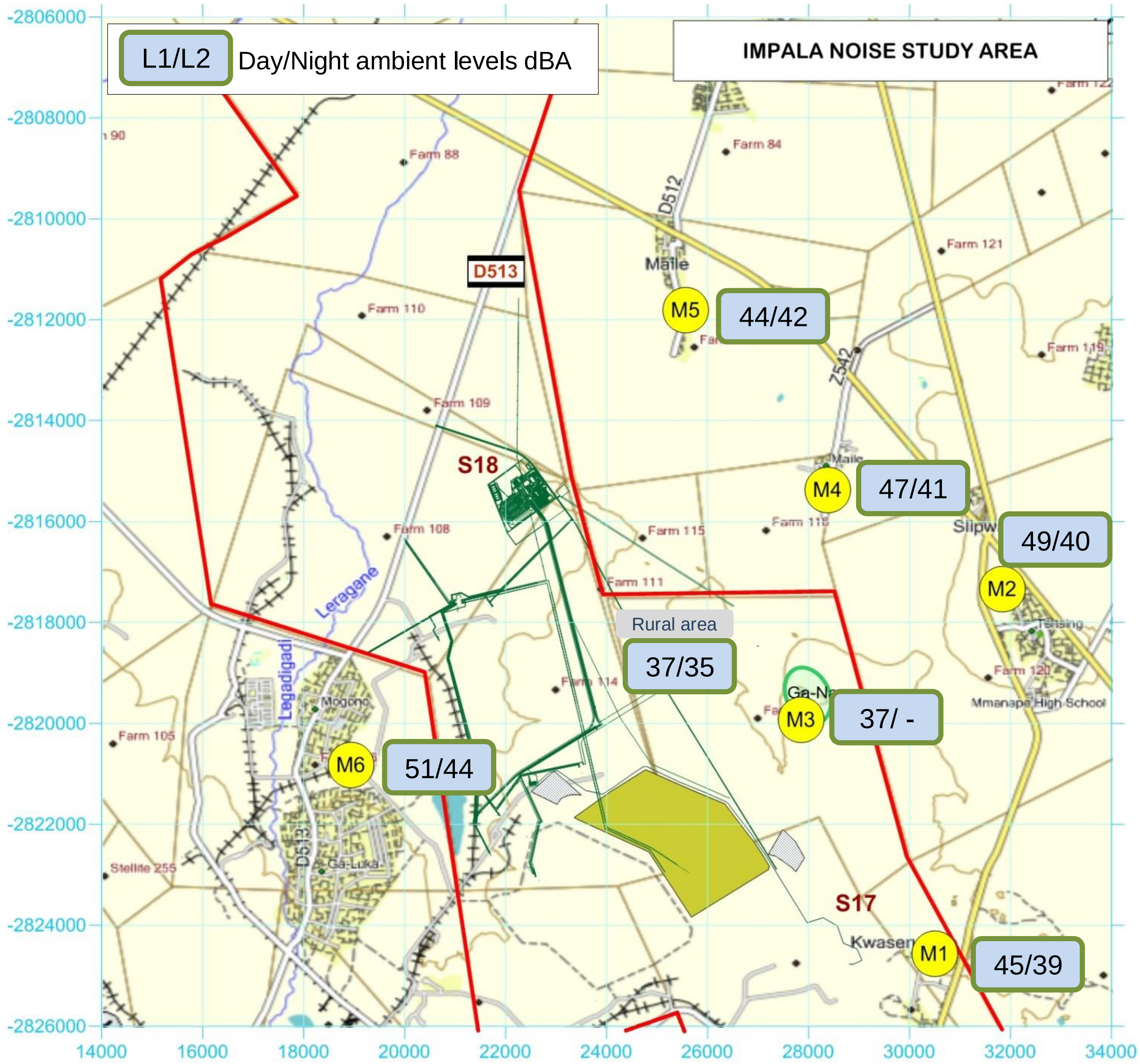


Figure 3.1

Results of baseline survey

Existing ambient noise levels measured in the study area

Monitoring location		Coordinate	Monitoring location		Coordinate
M1	Kwaserutube	S25 32 29.2 E27 18 08.9	M4	Maile Diepkuil	S25 26 26.0 E27 16 58.3
M2	Tsitsing	S25 28 12.6 E27 18 52.3	M5	Maile	S25 24 46.1 E27 15 11.9
M3	Heritage site (Rural Area)	S25 29 25.5 E27 17 20.5	M6	Ga-Luka	S25 29 53.6 E27 11 35.3

3.1.2 Baseline ratings

In assigning baseline ambient ratings to any area, it should be borne in mind that the levels obtained in any particular survey do not represent absolute or constant values, but samples only of what is a variable parameter. Ambient noise is not fixed and even relatively long-duration averages of day and night levels at any location will vary over time. This is in response to variances in noise source emission levels, as well as unpredictable day, night and seasonal fluctuations in atmospheric conditions.

It should also be noted that for purposes of noise impact assessment, noise contours are calculated at nominal intervals best suited for evaluation of specific locations of concern, as well as for the global study area.

With these considerations in mind, the ratings assigned to locations within the study area were determined by rounding the levels obtained in the survey to the nearest 5 dB day or night interval of typical levels for district categories in accordance with SANS 10103 guidelines (See Table 2.4). The result is summarised in Table 3.1. These are realistic best estimates of baseline ambient noise ratings for the area, used to define limits in the EIA noise impact assessment of this study.

Table 3.1

Shaft 18 Complex Project
Baseline outdoor ambient noise levels derived from field surveys
Rounded to the nearest day and night ratings for districts according to SANS 10103 guidelines

Area	**Baseline ambient noise level** L_{Aeq} (dBA)	
	Day-time L_d	**Night-time** L_n
Villages and townships nearest to Shafts 18 and 19	45	40
Ga-Nape Cultural Landscape	40	-
Ga-Luka township	50	45
Rural area around shafts	40	35

3.1.3 Recommended limits

24-hour operation noise - Maximum impact occurs at night

Daytime intrusive noise levels created by distant industrial noise sources, such as the No 18 Shaft Complex under consideration, are as a general rule substantially lower than the levels created by the same sources at night. The reason is that typical daytime meteorological conditions result in skyward refraction of sound propagation, in contrast with downward diffraction caused by typical night-time temperature profiles (vertical gradients). During the day, most of the noise emitted by a large source does not reach the ground, while at night, both direct sound and a portion of the energy radiated skywards are focussed back to earth. This contrast between day and night levels is further accentuated by a considerable drop at night in the residual ambient level due to a decline in road traffic and human activity noise. As a consequence, not only are the levels of intrusive noise from distance sources much higher at night, but the sensitivity of the environment increases sharply, as well.

It implies that for continuous noise from a 24-hour operation, such as the shaft with associated infrastructure, maximum impact will occur at night and that for all practical purposes, provided the night-time impact is contained to within acceptable levels, the daytime impact would not be of any consequence or concern at all. One exception in this study is the Ga-Nape Cultural Landscape where public access is likely to be granted during daytime only. In that area, however, the daytime ambient level happens to be more or less the same as the night-time levels (40 dBA) experienced in the townships.

Significant impact

As a matter of responsible planning it is advised that the target be set to prevent the impact on the nearest noise-sensitive receptors from exceeding 3 dB, which is still an insignificant impact. An impact of 3 dB at any location occurs if the specific level of project noise rises to the point where it equals the ambient level at that location. For the nearest villages in the surrounding area this condition would arise if project noise rises to 40 dBA at night (Table 3.1). For the Ga-Nape heritage site where daytime rather than night-time conditions are of concern, the relevant (daytime) threshold is also 40 dBA. For people living in the rural area outside the villages, such as the informal dwellings near the shaft and linear infrastructure route, the relevant night-time threshold is 35 dBA.

With reference to the principles explained in Section 2.4, a significant impact is deemed to occur if intrusive project noise elevates the existing ambient rating in Table 3.1 (the acceptable level) by 5 dB or more.

Ga-Luka is less sensitive and much less prone to a significant impact by noise emanating from the project. Not only is it located further away from the development (resulting in lower project noise levels), but existing ambient levels are also higher than levels in the remainder of the study area. A risk of significant night-time impact in this area only arises if project noise exceeds 50 dBA. It follows that Ga-Luka will be more than adequately covered by the more stringent criteria applied in the main assessment focusing on the more sensitive areas.

4 Results and findings – No 18 Shaft Project impact

4.1 Noise impact – Construction phase

General construction noise

Construction to reach full production is expected to take nine years. Construction activities will take place mainly at the Shaft Complex, but there will also be road works and railroad construction activities along the new access road and railway route. Most of the work will occur during the day when the environment is relatively insensitive to noise.

Work at the shaft will involve clearing and soil stripping, sinking of vertical shafts, excavation and digging of foundations and building construction. In all these activities the primary source of noise will be diesel engines. Noise levels produced by general construction activities at the shaft and on the access road will be low and are not expected to be noticeable at the nearest noise-sensitive residential locations. The shortest distance between the shaft complex and village residents, is 4,2 km (Maile). Construction noise will not be audible in the villages, but it will be highly disturbing at the informal settlement dwellings near the shaft.

Blasting

Blasting may occur during shaft construction and possibly also during road and rail construction. Depending on atmospheric conditions, it will at times be clearly audible and occasionally cause a significant impact at the nearest villages. It will however be an infrequent event and will only be audible during the brief period when shaft construction commences at surface level and during road and rail construction.

Blasting will be disturbing at informal settlement dwellings remaining near the shaft and infrastructure route.

Significance

Overall, the noise impact of the project during construction will be of low significance in the villages and Ga-Nape heritage site and at times of high significance at informal dwellings near the shaft.

4.2 Noise impact – Operational phase

4.2.1 Presentation of results

The operational noise footprint of the entire project, including the shaft complex with associated infrastructure, road and rail traffic, is presented with the aid of noise contour maps. The contours delineate the expected 3 dB (acceptable limit) and 5 dB (significant noise impact) footprints of the proposed development. For clarification of the significance of the 3 dB and 5 dB thresholds, please refer to the summary of SANS 10103 assessment criteria in Table 2.4 as well as the explanation in Section 3.1.3.

4.2.2 Results and findings - Unmitigated operational noise

Depending on the time of day or night and on meteorological conditions in particular, noise levels produced by industrial sources over long distances vary by a considerable margin. Noise contours were derived from calculations intended to investigate probable worst-case conditions (Night-time levels and Concawe model Meteorological Category 6). On average, typical levels are expected to be lower. “Probable worst-case”, in the context of this study refers to levels that are higher than typical or average levels. Although less probable than typical levels, they are expected to occur from time to time during the course of the year, at times possibly for several days on end. Its occurrence is not simplistically related to weather conditions and not limited to any particular season of the year.

The noise impact at any location will of course depend on wind direction. The diagram in Figure 4.1 shows that wind in the study area blows predominantly from a direction within the east-to-south quadrant and slightly overlapping towards south-south-west. Although the most frequent direction is south-south-east, noise contours for the villages were calculated for the case where the wind is blowing from the south-west, as this would constitute a worst-case condition affecting the largest number of townships and residents.

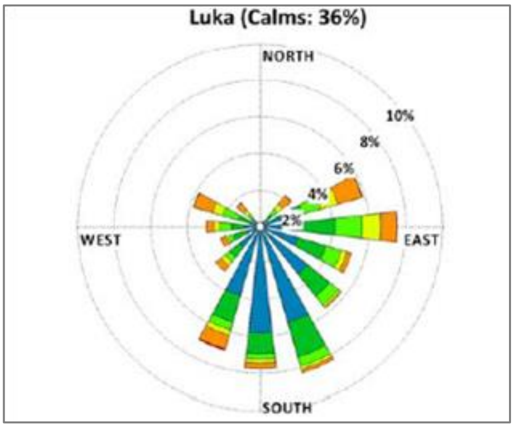


Figure 4.1

Wind rose for the study area - Data recorded at Ga-Luka

The results of the predictive study for worst-case wind directions are presented on Noise Maps 4.1 and 4.2.

Confidence in the predictions which are based on appropriately scaled data obtained in measurements at various other (existing) shaft complexes, ventilation fans and railway lines is high. It should nevertheless be cautioned that predicted noise levels and contours are not to be taken as absolute. Noise maps must be interpreted with caution. Although the confidence level in the acoustic model is high, predicted levels are valid for the assumptions made in respect of meteorological and other conditions. Since meteorological conditions in particular are highly variable, levels produced at a distance by a source at a constant acoustic output will vary considerably, even during the course of a single day-time or night-time period. Variance in noise level due to changes in atmospheric conditions increases with distance from the source. The contours represent best estimates of continuous project activity noise levels averaged over a relatively long duration, in this case the nominal night-time period of 8 hours.

Noise impact on the nearest villages

Contours on Noise Map 4.1 show the expected increase in ambient level relative to 40 dBA calculated for conditions when the wind is blowing from the south-west. The 40 dBA reference corresponds to the nominal night-time background level in the surrounding villages, as well as the nominal daytime background level for the Ga-Nape Cultural Landscape. The contours on Noise Map 4.1 therefore represent the relevant impacts on the villages as well as Ga-Nape.

Inspection of the map reveals that the widest reach of the significant (5 dB) noise impact footprint extends maximally about 2,7 km in a downwind direction from the centre of the shaft complex. It is clear that the nearest noise-sensitive formal residential area (Maile at 4,2 km from Shaft 18) is located well outside the night-time 5 dBA significant impact as well as the 3 dB acceptable level footprints of the project. It is concluded that the noise impact on villages in the area will be negligible.

Noise impact on Ga-Nape Cultural Landscape

Noise Map 4.1 also shows that, should Ga-Nape Cultural Landscape be developed as a heritage site, daytime visitors outdoors will not be aware of any noise from Shaft 18 (distance 6 km) or the Linear Infrastructure (distance 4 km) at all. The Shaft 18 Project noise impact will be negligible.

Noise impact on informal settlements near shafts

The typical noise level and noise impact calculated for informal settlements in the rural area near the shaft are summarised in Table 4.1 and illustrated by noise impact contours on Noise Map 4.2. Because of the proximity of informal settlement dwellings to the Linear Infrastructure corridor (locations indicated on Noise Map 4.2), wind direction is irrelevant; at such short distance the level of railway noise in particular will be the same regardless of wind direction. The noise map shows that the railway noise will be very disturbing for people living in that area.

Table 4.1

Noise impact on informal settlements in close proximity of Linear Infrastructure

Night-time noise and expected increase (relative to 35 dBA) in night-time ambient level

Unmitigated project noise

Location	**Sources of noise**	**Noise level** dBA	**Level increase** (Noise impact) dB
Residents 1,2 & 3 (Noise Map 4.2)	No 18 Shaft Complex (Excluding Linear Infrastructure)	36	0,8
	Linear Infrastructure (Road & Rail)	48	13

4.3 Noise impact – Decommissioning phase

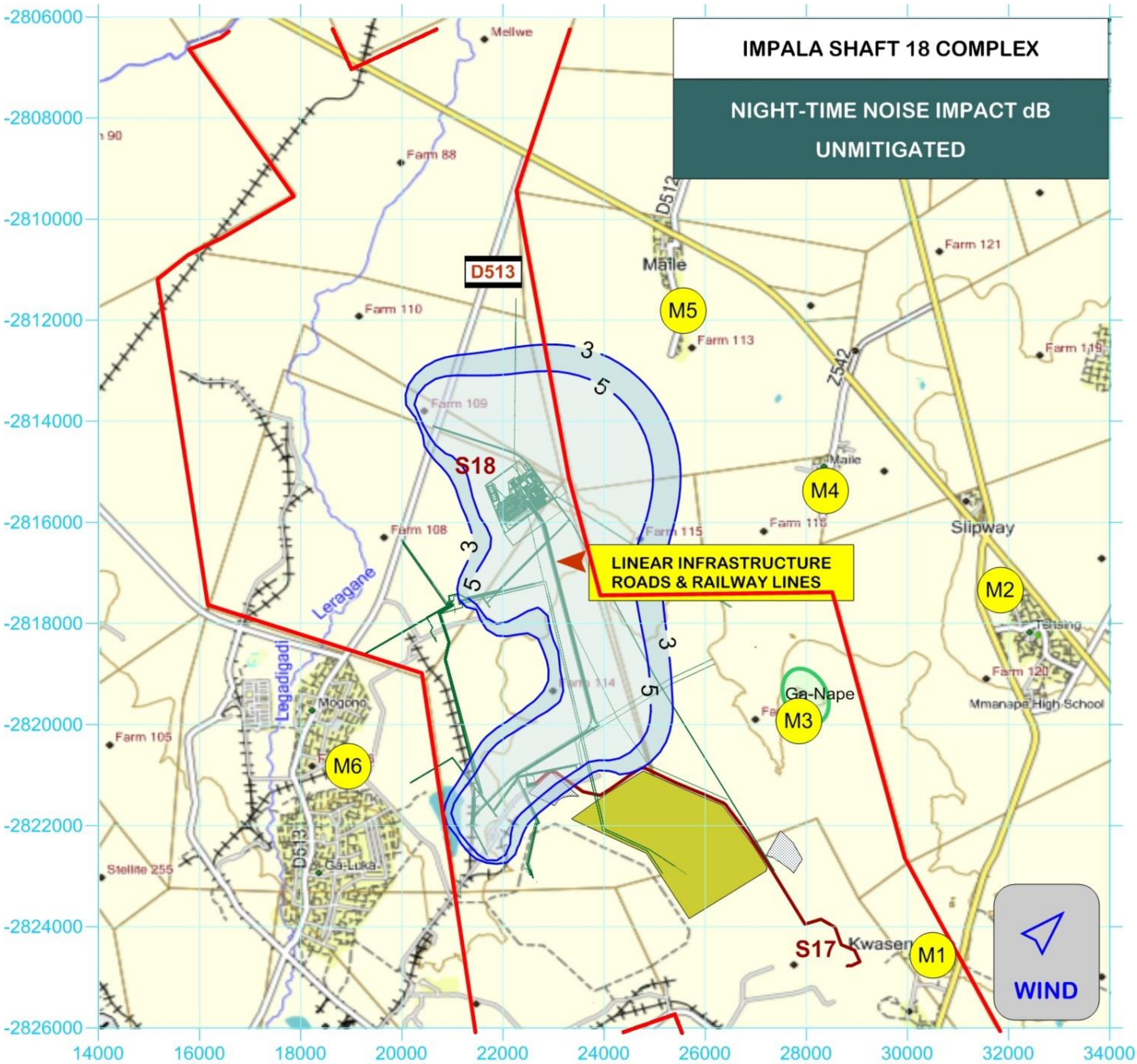
Noise in the decommissioning phase will be of a similar nature, but at a lower intensity and of shorter duration than in the construction phase. Decommissioning noise will be inaudible in noise-sensitive areas and the noise impact will be negligible.

4.4 Noise impact – Closure phase

No residual noise impacts will remain after decommissioning of the mine.

Noise Maps

Unmitigated Project Noise



Noise Map 4.1

Shaft 18 Complex Project

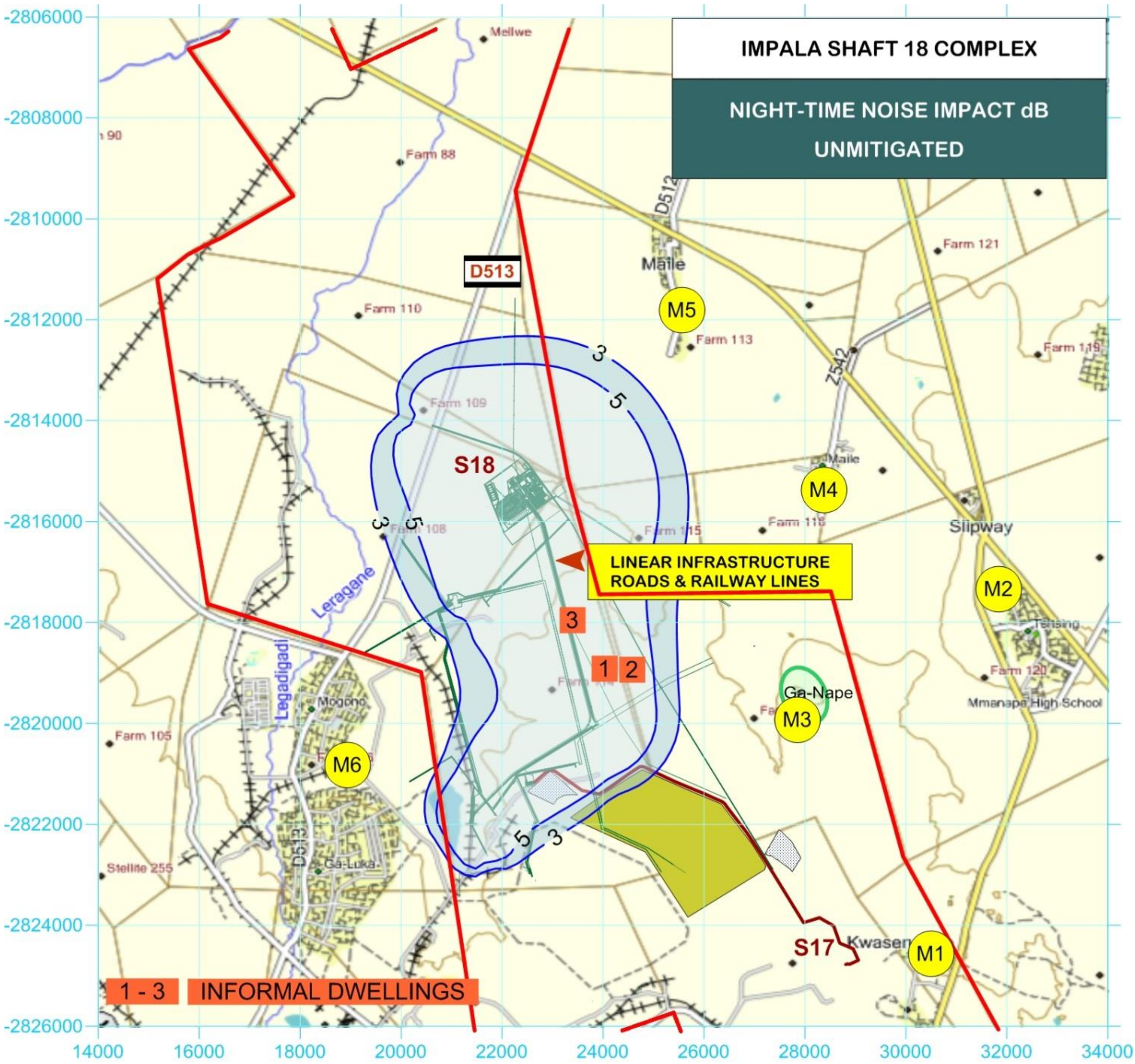
Unmitigated Project Noise

Project noise impact on villages (night-time) and Ga-Nape (daytime)

dB Increase in outdoor ambient noise level relative to 40 dBA

Worst-case condition for the nearest villages - Wind blowing from the south-west

Significant impact occurs inside the 5 dB contour
Acceptable level outside the 3 dB contour



Noise Map 4.2

Shaft 18 Complex Project

Noise impact on informal dwellings near Linear Infrastructure corridor

dB Increase in night-time level relative to 35 dBA Rural District criterion

All systems running as per current mining plan

Significant impact occurs inside the 5 dB contour
Acceptable level outside the 3 dB contour

5 Mitigation

5.1 Mitigation - Construction noise

General construction noise

As explained in Section 4.2, noise produced by general construction activities at the shafts and by construction of the conveyor is not expected to be noticeable at the nearest villages. No mitigation is required in that respect.

Excessive night-time impact on residents of informal settlements near the shafts and next to the infrastructure route can only be mitigated if construction is restricted to daytime hours. Mitigation of daytime impact to acceptable levels would still not be possible.

Blast noise

Although blasting will be infrequent and of brief duration, it should nevertheless be treated with caution. To minimize blast noise disturbance on residents of the villages, it is recommended that blasting be scheduled to take place in the afternoon, rather than during the morning hours of the day. Excessive blast noise disturbance impact on residents of informal dwellings near the shafts and next to the infrastructure route cannot be mitigated.

5.2 Mitigation - Operational noise

5.2.1 Impact on residents of nearest villages

The project will not have a significant impact on any of the formal residential areas in the surroundings.

No mitigation is required.

5.2.2 Impact on Ga-Nape

Noise from the shaft and from the Linear Infrastructure will not be audible at Ga-Nape. The noise impact of the project at this location will be insignificant.

No mitigation is required.

5.2.3 Impact on residents of informal settlements

Excessive day and night-time impact on residents of informal settlements near the shafts and next to the infrastructure route cannot be mitigated to acceptable levels.

5.3 Mitigation – Decommissioning phase

No mitigation will be required during decommissioning.

5.4 Mitigation – Closure phase

No mitigation will be required after decommissioning.

6 Summary of noise impact implications

To the best of the information available and the accuracy of noise prediction methods, the noise impact implications of the Shaft 18 Complex shaft project are as summarised in Tables 6.1 and 6.2.

Table 6.1

Noise impact implications for residents in the nearest villages

Receptor	**Activity**		**Before Mitigation**						**After Mitigation**					
			Severity	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**Significance**	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**Significance**
Construction phase														
Villages nearest to the mine	Shaft, rail and road construction		L	L	L	L	L	L	No mitigation required					
	Blasting		L	L	M	L	L	L	L	L	M	L	L	L
Operational Phase														
Villages nearest to the mine	Ventilation fans, air and cooling plants Road & rail traffic		L Low Inaudible in villages	M Life of Project	L Local Site	L Low	L Unlikely	L Low	No mitigation required					
Decommissioning Phase														
Villages nearest to the mine	Dismantling		L	L	L	L	L	L	No mitigation required					
Closure Phase														
Villages nearest to the mine	No residual noise		L	L	L	L	L	L	No mitigation required					

Table 6.2

Noise impact implications for informal settlements near Shaft 18 Linear Infrastructure

Receptor	**Activity**	**Before Mitigation**						**After Mitigation**					
		Severity	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**Significance**	**Severity**	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**Significance**
Construction phase													
Settlements Near shafts and infrastructure route	Shaft, rail and road construction	H	L	L	M	H	M	H	L	L	M	H	M
	Blasting	H	L	M	M	H	M	H	L	M	M	H	M
Operational Phase													
Settlements Near shafts and infrastructure route	Road & rail traffic	H	M	M	M	H	M	H	M	M	M	H	M
		High Disturbing noise	Reversible Life of Project	Local	Medium	Definite	Medium	High Disturbing noise	Reversible Life of Project	Local	Medium	Definite	Medium
Decommissioning Phase													
Study Area	Dismantling	L	L	L	L	L	L	No mitigation required					
Closure Phase													
Study Area	No residual noise	L	L	L	L	L	L	No mitigation required					

Table 6.3

Noise impact implications for Ga-Nape Cultural Landscape Site

Receptor	Activity	Before Mitigation						After Mitigation					
		Severity	Duration	Spatial Scale	Consequence	Probability	Significance	Severity	Duration	Spatial Scale	Consequence	Probability	Significance
Construction phase													
Daytime Visitors to Ga-Nape	Shaft, rail and road construction	L	L	L	L	L	L	No mitigation required					
	Blasting	L	L	M	L	L	L	L	L	M	L	L	L
Operational Phase													
Daytime Visitors to Ga-Nape	Ventilation fans, air and cooling plants Road & rail traffic	L Low Inaudible at Ga-Nape	M Reversible Life of Project	L Local	L Medium	L Unlikely	L Low	L Low Inaudible at Ga-Nape	M Reversible Life of Project	L Local	L Medium	L Unlikely	L Low
Decommissioning Phase													
Study Area	Dismantling	L	L	L	L	L	L	L	L	L	L	L	L
Closure Phase													
Study Area	No residual noise	L	L	L	L	L	L	L	L	L	L	L	L

7 Monitoring programme

Construction phase

Noise during the construction phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Operational phase

Based on the findings of the noise study it is unlikely that project will cause any noise disturbance in the surrounding villages. If deemed necessary to confirm the validity of these findings, an ambient noise survey may be conducted once the shafts, the ventilation fans in particular, are commissioned. Such a survey should cover the following:

(a) A noise survey should be carried out immediately after commissioning of the shaft with surface ventilation fans running.

(b) Follow up with annual surveys only if the results of the initial survey confirm or show a likelihood of possible noise disturbance.

(c) Measure noise levels at each of the reference points shown on the map in Figure 7.1.

(d) Measure the A-weighted equivalent continuous noise level in a sequence of 10-minute intervals covering a period of preferably 24 hours, but at least the night-time period from 22:00 to 06:00. If possible, arrange for the relevant noise source under investigation (ventilation fans or conveyor) to be stopped during night-time for a period of 30 minutes, after which it is started up again.

(e) Process the data and determine the increase in ambient level caused by fan or conveyor noise.

(f) Assess the noise impact of the mine and present the findings in a report. If applicable, make recommendations for steps required to mitigate excessive noise.

(g) Equipment, calibration and measurement procedures must comply with the requirements laid down in SANS 10103.

Decommissioning phase

Noise during the decommissioning phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Closure phase

Noise during the closure phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

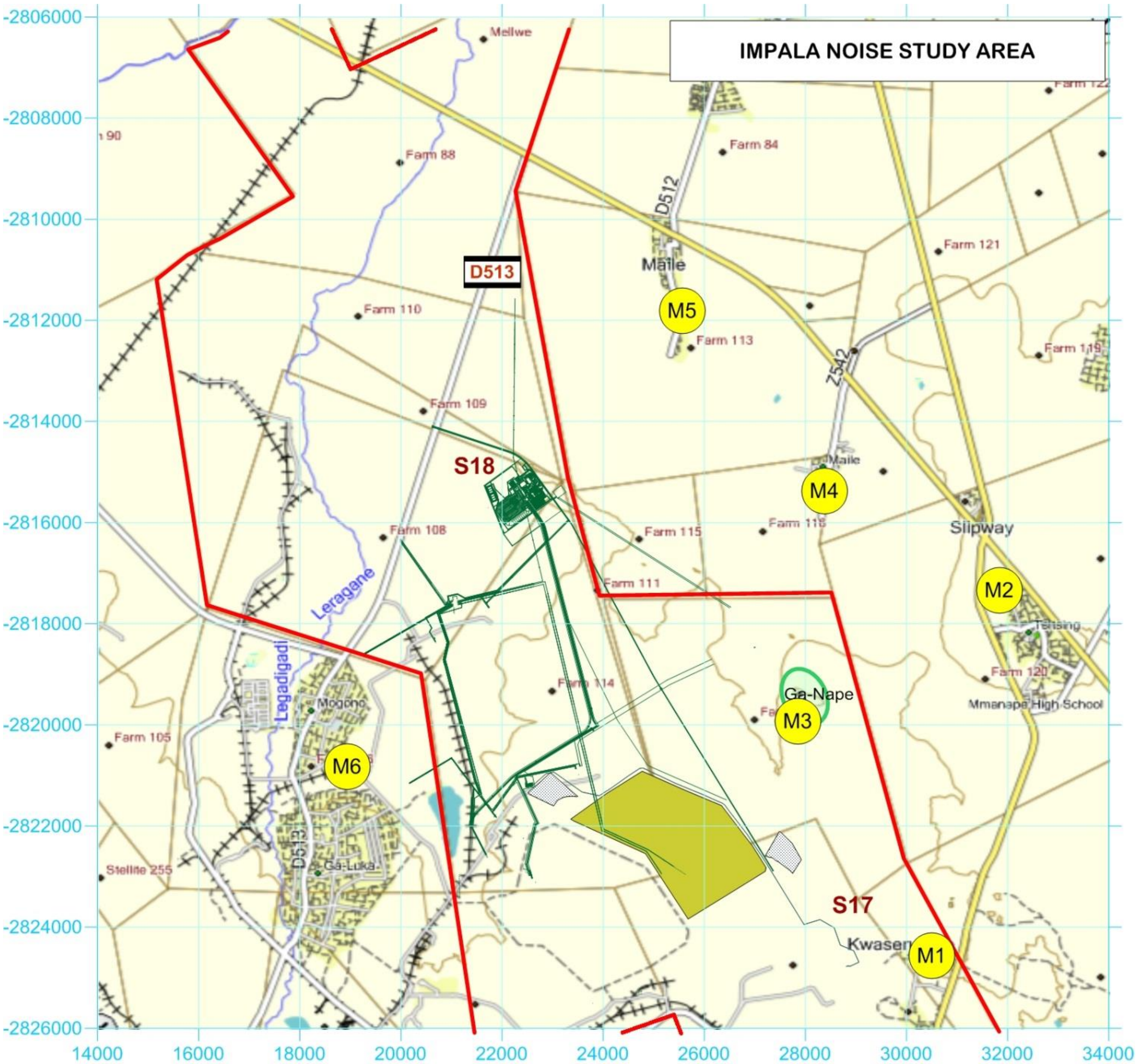


Figure 7.1

Noise monitoring locations

Monitoring location	Coordinate	Monitoring location	Coordinate
M1 Kwaserutube	S25 32 29.2 E27 18 08.9	M4 Maile Diepkuil	S25 26 26.0 E27 16 58.3
M2 Tsitsing	S25 28 12.6 E27 18 52.3	M5 Maile	S25 24 46.1 E27 15 11.9
M3 Heritage site (Rural Area)	S25 29 25.5 E27 17 20.5	M6 Ga-Luka	S25 29 53.6 E27 11 35.3

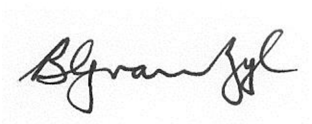
8 References

[1] SANS 10328: *Methods for environmental noise impact assessments.*

[2] SANS 10103: *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.*

[3] SANS 10357:2000 *The calculation of sound propagation by the Concawe method.*

[4] Department of environment affairs: *Noise control regulations under the environment conservation act*, (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.



Ben van Zyl MSc (Eng) PhD
Acoustical Engineer

Curriculum Vitae

Barend Gideon van Zyl - ID No 4605105089082
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Qualifications		Institution	Year Completed
(1)	BSc (Eng) Elec	University of Pretoria	1970
(2)	BSc (Eng) Hon Elec	University of Pretoria	1972
(3)	MSc (Eng) (Cum Laude)	University of Pretoria	1974
(4)	PhD	University of Natal	1986

MSc thesis: Sound intensity vector measurement
PhD thesis: Sound transmission analysis by measurement of sound intensity vector

Professional registration and membership

- Southern African Acoustics Institute Fellow (President 1994) Member since 1974

Career

CSIR
1971 – 1989

Join the Acoustics Division of the Council for Scientific and Industrial Research (CSIR) in 1971; Chief Specialist Research Engineer 1981 - 1989.

- Undertake basic and applied acoustic research & development projects;
- Pioneer technique and instrumentation for measurement of sound intensity vector, leading to sponsored research & consulting work in the Netherlands (TNO 1978) and Denmark (Brüel & Kjaer 1981).
- Acoustic consulting engineering services rendered in the fields of building acoustics, industrial noise control, acoustic materials development & environmental acoustics.

Advena
1989 – 1990

- SA Space Programme: Manager Systems Integration & Environmental Test Laboratories;
- Design and commissioning of ultra-high noise level simulation facilities for endurance testing of rocket launch vehicles, spacecraft, satellites, instrumentation and payload.

SABS
1991 – 1994

- Acoustic consulting engineering services rendered to industry
- Building acoustics, industrial noise control and environmental acoustics.

Acusolv
Private Practice
Since 1995

Private practice - Sole proprietor - Acoustic consulting engineering

- Noise studies; Environmental noise surveys; Blast noise measurement & assessment
- Design & problem solving: Building acoustics, Industrial & machinery noise reduction, Vehicle noise reduction (road, rail & air)
- Specialised services: Theoretical analysis & design of multi-layered acoustic panels.
- SABS Laboratory & field testing: Building systems and materials, Equipment & machinery noise

Papers and publications

- Several papers presented at international congresses and symposia.
- Several papers published in international acoustic journals, such as

Journal of the Acoustical Society of America; Applied Acoustics; Noise Control Engineering Journal.

- Several papers published in Southern African journals.

Other

- Part-time lecturer: Architectural acoustics, Department of Architecture, University of Pretoria;
- Associate of and specialist advisor to SABS Laboratory for Sound and Vibration

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Practice Profile

Sole Proprietor: Dr Ben van Zyl

Practicing since 1995.

Based in Pretoria South Africa, Ben van Zyl T/A Acusolv is an independent sole proprietor acoustic consulting engineering practice with in-house expertise and experience in various acoustic disciplines, including building acoustics, noise impact studies, industrial noise control, test and evaluation and acoustic materials development.

This practice is equipped with state-of-the-art acoustic measuring instruments employed in noise monitoring surveys, measurement of blast noise, laboratory and field testing of systems and materials and as an aid in the investigation and solving of noise problems.

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Examples of projects

Acoustic Field: Noise studies

Project	For	Aspects
• Gauteng Waste Plant	S E Solutions	Impact study: New waste plant
• Swartland	Centurus	Residential and commercial development - traffic
• Mapoch II	Marlin Granite	Quarry Impact study: Blasting, open cast mining
• Delmas Extension: mining dev	Ingwe Coal Corp	Noise study – Plant, conveyors, trains, roads
• Twistdraai new access roads	Sasol Coal	Noise study – Roads, conveyors
• Bosjesspruit shaft ventilation fans	Sasol Coal	Noise study; shaft & ventilation fan noise rural area
• Hillendale new mining development	Iscor Heavy Minerals	Noise study – Plant, road transport
• Empangeni Central Processing Plant	Iscor Heavy Minerals	Noise study – Large processing plant
• Rooiwater mining development	Iscor Mining	Noise study – Plants, road & rail transport
• Sigma overland conveyor	Sasol Mining	Conveyors: Analyse sources of conveyor noise
• Sigma overland conveyor	Sasol Mining	Noise study – Conveyors measurement survey
• Maputo steel project	Gibb Africa	Noise study peer review: trains, slurry pipe
• Pump station noise	Transvaal Suiker Bpk	Noise study & Design for noise reduction
• GPMC Environmental Resources Plan	GPMC	Noise policy & resources plan
• Damelin College Randburg	Titan Construction	Assess impact of traffic noise on college + design
• Atterbury Value Mart	Parkdev	Land use planning - City Council requirements noise
• Holmes Place HAC London	V Z de Villiers	Land use planning - City Council requirements noise
• Elmar College Pretoria	Iscor Pension Fund	Assess impact of traffic noise on college + design
• Sanae 4 Base Antarctica	Dept Public Works	Noise impact design for control - Plant rooms
• New truck fuel & service station	Bulktrans	Noise study & Design for noise control
• Country Lane	Country Lane Dev	Land use planning – Road traffic noise impact
• Randburg Water Front	Randburg City	Advisor & specialist court witness
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of idler properties
• Twistdraai East mining noise	Sasol Coal	Mitigation of noise impact on neighbouring farm
• Little Loftus – The Rest Nelspruit	TAP de Beer	Sports bar - Impact study
• Blast noise	Somchem	Blast noise impact assess & design noise control
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of conveyor design
• Leeuwpan Mine Delmas district	Iscor/Ticor	Noise study – Plant noise, loading
• Fairbreeze open cast mine KwaZulu	Iscor/Ticor	Noise study – Open cast mining; plant, transport
• Brandspruit mine	Sasol	Noise study - Ventilation fan noise rural area
• Irene Ext 47	Irene Land Dev Corp	Noise study - Mixed development; road traffic noise
• Irene Ext 55	Irene Land Dev Corp	Noise study - Residential; road traffic noise
• Lynnwood filling station & car wash	Town Planning Hub	Noise study: Filling station & car wash in residential
• Lyttleton 190	Ferero	Noise study: Residential next to N1 highway
• Twistdraai N-East Mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Wesput open cast mine	Petmin	Noise study: Blasting, excavation & transport
• Gedex open cast mine	Petmin	Noise study: Open cast excavation & transport
• Kensington college	Centurus	Noise study: Sport grounds, roads
• Spandow mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Twistdraai Central Mine Shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Addington Hospital	Delen Oudkerk	Equipment outdoor noise impact & mitigation
• Fourways Gardens Country Club	Fourways Gardens	Music noise impact assess & design for mitigation
• Irene Ext 29	Irene Land Dev Corp	Noise study: New township & highway noise
• Pick ‘n Pay Warehouse Meadowbrook	Pick ‘n Pay	Truck movement & loading: Assessment
• Irene Sports Academy	Centurus	Impact assessment: Sports grounds & road traffic
• Jameson substation transformer	EThekwini Municipal	Transformer noise: Assess & design mitigation
• Eugene Marais Hospital	Eugene Marais Hosp	Plantroom & outdoor equipment impact & mitigate
• Klipspruit mine wash plant	Billiton & DRA	Coal wash plant infra-sound: design for mitigation
• Eagle Quarry	Mapochs Action	Quarry new application: peer review
• Blast Test Facility Somchem	Denel	Blast noise impact: assess & design for mitigation
• Virgin Active Sandton Gym	Virgin Active	Aerobics, squash & equipment: assess & mitigate
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Zuid Afrikaans Hospital	Z A Hospital	Chiller outdoor noise: design for mitigation
• K54 Road	Tshwane	Noise Study: Future road through residential
• PWV6 Road	Gautrans	Noise Study: Future highway noise contours
• Zandfontein mine shaft	Sasol Mining	Noise Study: Mine shaft & fan noise outdoor impact
• Pierre van Ryneveld Ext 24	Van Vuuren Dev	Noise study: New township & highway noise
• PFG Glass new float plant	PFG Glass	Noise study: Future plant noise in residential area
• Sterkfontein residential development	M&T	Noise study: Road noise impact mitigation
• Sasol future Irenedale mine	Sasol	Noise study: Prediction of shaft & conveyor noise
• Ammunition demolition	SA Army	Noise study: Long distance noise impact assess
• Rietvlei Ridge residential development	M&T	Noise study: Road noise impact mitigation
• Mooiplaats / Hoekplaats	Chieftain	Noise study: Road noise impact mitigation
• Sasol Syferfontein conveyor	Bateman	Noise study: Noise complaints from farmers
• Madagascar Toliara Sands	Exxaro	Noise study: Future mining, plant, transport
• Rooipoort Mine	Sasol Mining	Noise study: Mining and conveyor noise
• Vlakplaats	Quantum	Noise study: Residential development
• Polokwane 2010 Soccer stadium	Africon	Noise study: Stadium noise in residential area
• New Clydesdale colliery	Exxaro	Noise study: Open cast mining, blasting and plant
• Grootfontein ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Cicada Pycna mating call study	Anglo Platinum	Cicada mating call – Mining noise interference
• Weltevreden ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Leandra North new colliery	Ingwe	Noise study: Mining development
• PTM new platinum mine	PTM Platinum	Noise study: Mining development
• Lyttleton X191	Pro-Direct	Noise study, new residential development
• Barking noise nuisance	Vd Merwe	Barking noise measurements, specialist report

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Vanggatfontein	Exxaro/Metago	Noise study: Open-cast mine
• Forfar clay mining extension	Forfar/Zimbiwe	Noise study: Open-cast clay mining operations
• Luhfereng Doringkop development	Bigen	Noise study: Mixed development, train noise
• K113 Road noise study	Heartland/Bokamoso	Noise study: Road, mixed development
• Eland Mine	Exstrata/Metago	Noise study: New access road for product transport
• Sheraton Hotel	Pan Pacific Property	Noise study: Hotel impact on residential area
• Sishen Infrastructure Relocation	Kumba/Synergistics	Noise study: Railway route options evaluation
• Tharisa Mine noise monitoring	Tharisa/Metago	Baseline noise monitoring surveys
• Sishen Mine baseline monitoring	Kumba/Synergistics	Baseline noise monitoring surveys
• Sishen Mine Protea discard dump	Kumba/Synergistics	Discard dump location - Noise screening assess
• Eastplats	Barplats/Metago	Noise study: New vertical shaft
• Inyanda Mine noise disturbance	Exxaro	Noise surveys: Noise complaints investigation
• Irenedale Mine commissioning	Sasol Mining	Noise Monitoring: New shaft operational phase
• Honey Ridge indoor shooting range	Insul-Coustic	Design for noise reduction
• Sishen Mine expansion project 2	Kumba/Synergistics	Noise study: New processing plant Sishen mine
• Sishen Mine noise monitoring	Kumba Iron Ore	Peer review: Baseline survey
• Sishen Mine new 10 MTon plant	Kumba/AGES	Noise study: New 10 MTon processing plant
• Khameni Kalkfontein/Tamboti Mine	Khameni/Metago	Noise study: New opencast mine and plant
• Exxaro Kalbasfontein rail load-out	Exxaro	Noise survey: Assess impact of railway loud-out
• Sishen Mine Lylyveld development	Kumba/EGES	Noise study: New opencast mine & transport
• Haasfontein new opencast mine	Exxaro/Synergistics	Noise study: New underground mine + conveyor
• Westlake mixed development	Heartland/SEF	Noise study: New urban mixed development
• Marlboro road M60	Heartland/SEF	Noise study: New road traffic noise modelling
• Driefontein Mine	Goldfields	Noise scoping assessment and recommendations
• Bokfontein Chrome Mine	Hernic/Metago	Noise study: New furnaces and beneficiation plant
• Eland opencast mine extensions	Exstrata/Metago	Noise study: Opencast mine extensions
• Tharisa Mine EMP noise monitoring	Tharisa/Metago	EMP noise monitoring survey 1
• Dragline noise reduction Kriel	Anglo Coal	Dragline noise – Design for noise reduction
• Ivory Coast noise studies	Metago	Peer review
• Eskom Grootvlei Power Station	Insul-Coustic	Design for noise reduction - internal
• Inyanda Mine	Exxaro	Design for plant noise reduction - enviromental
• Swakkop Uranium Husab Project	Swakkop Uranium	Noise study: New open-cast operation & plant
• Sasol Shondoni Shaft	Sasol Mining	Noise study: New shaft and overland conveyor
• Vanggatfontein EMP	Keaton	EMP annual noise surveys
• Doornpoort Plaza Service Station	Petroland	Noise study: New service station on N4 highway
• Hawerklip railway load facility	Exxaro	Noise study: New railway coal loading facility
• Lusthof Coal Mine	Black Gold	Noise study: New open-cast coal mine
• Conveyor noise parameters	Melco	Research investigation: Conveyor noise
• Sishen discard dumps	Kumba	Noise study: New discard dumps at Sishen
• Impala Shafts 18 & 19	Impala Platinum	Noise study: New shafts & infrastructure
• Tharisa noise complaint investigation	Tharisa Minerals	Noise complaint investigation, survey & assessment
• Moonlight Iron Ore Project	Turquoise Moon	Noise study: New Open-cast mine and plant
• New Largo	Anglo Coal	Noise study: New Open-cast mine
• Sishen Concentrator Plant	Kumba	Noise study: New concentrator plant at Sishen

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Phola-Kusile conveyor	Anglo Coal	Noise study: New conveyor to Kusile Power Station
• Leeuw Colliery	Leeuw Mine	Noise study: Leeuw Utrecht Colliery
• Letaba Crushers	F Kruger	Noise complaint investigation, survey & assessment

Acoustic Field: Industrial, machinery & equipment noise control

Project	For	Aspects
• Iscor New Compressor House	Voest Alpine	Design for noise reduction, inspection & testing
• Botswana TV centre Air-con system	Atlantic Tech	Design for control of plantroom & ducted noise
• Granulation plant	DOW Plastics	Design for noise reduction, inspection & testing
• CS2 Xantate plant	DOW Chemicals	Design for noise reduction, inspection & testing
• Alkylate chemical plant	DOW Chemicals	Design for noise reduction, inspection & testing
• SAP 4 Acid plant	Sasol Agri Palaborwa	Design for noise reduction, inspection & testing
• Motor pump enclosures	Sulzer	Design of noise hoods for large motor-pump units
• Rite Value Refrigeration Plant	Rite Value	Problem solving & design for noise reduction
• Sugar mills pump station	TSB	Design for noise reduction – noise impact control
• Pferd factory noise reduction	Pferd SA	Problem solving & design factory noise reduction
• Alusaf Bayside compressor plant	Alusaf	Problem solving & design for noise reduction
• Alusaf Bayside blower plant	Alusaf	Problem solving & design for noise reduction
• Alusaf Bayside cold rolling mill	Alusaf	Problem solving & design for noise reduction
• Sinter plant Van der Bijl Park	Iscor	Noise reduction strategy & requirements
• Blast furnace fan noise	Universal Fans	Design for fan noise reduction
• Aircraft Engine test facility	Kentron	Design for noise control – environmental impact
• Sulphuric acid plant noise	Fedmis	Design for noise reduction, inspection & testing
• Automotive assembly line	Nissan	Design & commissioning noise reduction canopies
• Scrubber fan noise	RBM	Design for noise reduction
• Ship unloader machine room noise	Algroup Alusuisse	Design for noise reduction
• Paint plant noise	Daimler Chrysler	Design for noise reduction on skid cleaner
• Mail sorting centre plantroom noise	Telkom Sapos	Design for plantroom noise control
• Scrubber system and fan noise	Aquachlor	Design for noise reduction
• Power station turbine hall noise	Eskom	Design for noise reduction
• Mill noise	PPC	Design for noise reduction in control rooms & offices
• Plantroom noise	Vodacom	Design for noise control in offices
• G6 armoured veh power plant noise	SME	Design enclosure for noise control
• Carltonville hospital boiler plant noise	Gauteng Health Dept	Design for noise reduction
• Refinery noise	Rand Refineries	Diagnostic investigation & strategy for noise reduct
• Engine test facility ultra-high noise	Sasol	Design for sound proofing engine test facility
• Chiller plant noise	Dep Public Works	Design for noise reduction
• New Chipper Plant	Sappi Tugela	Plant building design for external noise control
• Transformers	Hawker Siddeley	Acoustic test and evaluation
• Sappi Enstra Paper Mill	Sappi SA	Noise reduction programme and design
• Blast noise	Somchem	Blast noise eval; test facility design for noise control
• Mill noise	Anglo Platinum	Bond mill & sieve shaker design for noise reduction
• Vibration screen infra-sound problem	Billiton	Problem analysis and design for infra-sound control
• Bucket repair workshop	S A Coal Estates	Design enclosures & screens for noise reduction
• LoadHallDump vehicle noise reduction	Anglo-Coal	Design ventilated hood for noise reduction
• PMR Precious metal refinery	Anglo Platinum	Excessive ventilation noise: design to reduce
• Pebble bed ball impact test facility	Necsa	Noise control booth design

Acoustic Field: Industrial, machinery & equipment noise control (Continued)

Project	For	Aspects
• Sasol Syferfontein conveyor	Sasol Mining	Design: Overland conveyor noise reduction
• SARS Alberton new building	SARS	Plantroom design for noise impact control
• Sulzer large flow bend	Insul-Coustic	Design bend treatment for flow noise control
• BMW wax & seal test facility	Insul-Coustic	Test facility soundproofing design - Metal cutting
• Kumba induction panel test facility	Kumba	Test facility soundproofing
• KZN P Maritz B new legislative offices	KZN Dept P Works	Plantrooms and machinery design for noise control
• Alstom 32 MVA Power transformer	Alstom	Power transformer noise output tests
• Waterfall Boven	Nkalanga Municipal	New water purification design for noise control
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Harvest House Pretoria	Desmo Eng	Chiller & cooler plant design noise screening meas
• Ventilation fan noise problem	Anglo Coal	Surface ventilation fan - Design noise reduction
• Sasol Syferfontein conveyor	Sasol Mining	Diagnostic analysis: noise generating mechanisms
• Sasol Syferfontein conveyor	Sasol Mining	Design: Overland conveyor noise reduction
• Metal press noise	TRW	Design enclosures & screens for noise reduction
• Stone Duster Vehicle	Bird Machines	New vehicle – Design & achieve noise spec
• Gautrain	Insul-Coustic	Construction sites – Design noise enclosures
• Exxaro High-frequency generator	Insul-Coustic	Noise enclosure and soundproofing design
• Unisa new registration building	Unisa	Plantroom noise predictions and design inputs
• Columbus Steel	Insul-Coustic	Control room and pulpit soundproofing design
• Sesane TV studios	Insul-Coustic	Plantroom and machinery noise reduction design
• Safour air plant noise reduction	Insul-Coustic	Compressor enclosure and soundproofing design
• Rustenburg Mine Laboratories	Rustenburg Mine	Design for machine noise reduction
• Anglo Research Lab Mills	Anglo American	Research lab mills, design for noise reduction
• Safripol Blowers	Safripol	Blower noise, design for noise reduction

Acoustic Field: Specialised services

Project	For	Aspects
• Specialist advisor to SABS LVA	SABS	Specialist advisor for SABS Acoustics Laboratory
• Pakistan Airforce: Missile assessment	Dep Trade & Industry	Assessments non-proliferation treaty
• Taiwan push-pull loco bullet train	Union Carriage	Driver's cabin speech intelligibility & noise control
• NRZ rail coaches	Union Carriage	Acoustic design for noise reduction
• Locomotive Class 9E Electrical Sishen	Alstom	Design upgrade - Noise reduction for hearing safety
• Theoretical analysis sound insulation	CSIR & several other	Predict/analyse acoustical properties of materials
• Overland coal conveyor noise	Sasol	Diagnostic analysis: noise generating mechanisms
• G6 artillery vehicle – Gun shot noise	LIW	Acoustic measurements & assessment hearing risk
• Locomotive Class 11E Electrical	Spoornet	Design upgrade - Noise reduction for hearing safety
• Dakota aircraft upgrade	Aerosud	Design for noise reduction
• Hearing damage gunshot noise	SA Police	Hearing conservation programme
• New drywall product development	BPB Gypsum	Theoretical analysis of acoustical properties
• Power generators outside broadcast	Ontrack	Noise reduction and field tests
• Ermelo – Richards Bay Locomotive	Transwerk	Design upgrade speech intelligibility & noise control
• Indoor artillery test facility	Somchem	Design for environmental noise control
• MUF building systems	Chipboard Industries	System acoustic evaluation and development
• Locomotive Class 34GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 35GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 36GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 37GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 34GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 35GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 36GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• SABS acoustic test lab validation	SABS	Assess & validate SABS test laboratory & method
• Mobile partitioning system	L J Doors	Design input to improve insulation performance
• Locomotive Class 7E Elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Weapons and ammunition demolition	SA Navy	Measurement of hi-explosives detonation noise
• Locomotive Class 19E Elec	UCW	New Coal-link locomotive – Low noise design
• Locomotive Class 15E Elec	UCW	New Sishen iron ore loco - Low noise design
• Soshalowa power car	Transnet	Train set power car sound-proofing design
• Locomotive hooters	Transnet	Study hooter audibility at level crossings
• Aluglass building systems	Aluglass	Acoustic panel theoretical evaluation