caseID: 1574

THE DEPARTMENT OF MINERALS AND ENERGY

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Reference nr: LP 30/5/1/1/3/2/1/ 806 EM

REGISTERED MAIL
The Provincial Manager
SAHRA- Limpopo
P. O. Box 137
POLOKWANE
0700

Attention: Mr. Donald Lithole/ Victor Netshiavha

CONSULTATION OF AN AMMENDED ENVIRONMENTAL MANAGEMENT PLAN SUBMITTED IN TERMS OF SECTION 102 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT 2002, (ACT 28 OF 2002) IN RESPECT OF THE FARMS MOORDKOPJES 813 LR AND ZWARTFONTEIN 814 LR, SITUATED IN THE MAGISTERIAL DISTRICT OF POLOKWANE. APPLICANT: AKANANI MINING (PTY) LTD.

Attached herewith, please find a copy of the Environmental Management Plan received from the above-mentioned applicant, for your comments.

It would be appreciated if you could forward any comments or requirements your Department may have in the case in hand to this office and to the applicant within 60 days of this letter **i.e. on or before 24 July 2009**, failure of which will lead to the assumption that your Department has no objection(s) or comments with regard to this application and this Department will in that instance proceed with the finalisation thereof.

In an attempt to expedite the consultation process please contact **Ms. Mapula Mashile** of this office to make arrangements for a site inspection or for any other enquiries with regard to this application.

Your co-operation will be appreciated.

.....
THE REGIONAL MANAGER
LIMPOPO REGION – POLOKWANE
DATE: 27 MAY 2009

LONMIN

AKANANI MINING (PTY) LTD

AMENDMENT TO ENVIRONMENTAL MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT ASSESSMENT FOR CHANGES TO APPROVED PROSPECTING RIGHT

DME PROSPECTING RIGHT NUMBER 249 / 2006 / CPRD

Impact Assessment Phase

Third document for comment

MAY 2009

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR PROPOSED LONMIN AKANANI BULK SAMPLING PROSPECTING SHAFT DEVELOPMENT MOKOPANE, LIMPOPO PROVINCE

EIA REPORT AND EMP AMENDMENT

Proponent: LONMIN PLATINUM

LONMIN

Golder Associates

Golder Project: 11808
Golder Report Number: 11808-8511-4

PURPOSE OF THIS DOCUMENT

Lonmin Platinum (Lonmin) is investigating the feasibility of developing a platinum ore body (referred to as the Platreef) about 25 km north of the town of Mokopane (formerly Potgietersrus) in the Limpopo Province. A new order Prospecting Right and Environmental Management Plan (EMP) for the prospecting activities on the farms Zwartfontein 814 LR and Moordkopje 813 LR have been approved. The prospecting area is referred to as the "Akanani prospecting area".

Lonmin intends amending the approved Prospecting Right and EMP to include the sinking of a single prospecting shaft over a three year period within the approved Akanani prospecting area on the farm Zwartfontein 814 LR. The prospecting shaft is needed to obtain a bulk sample of 3 000 tons which can be used to determine the metallurgical properties of the Platreef at the Akanani project area. The prospecting shaft will be about 7 to 10 m in diameter, and approximately 1 000 m deep. The prospecting shaft site will be approximately 2 ha in extent. The mined ore will be transported by 35 ton trucks to Mintek in Johannesburg for test work.

In order to amend the approved Prospecting Right and EMP, Lonmin is required to conduct an Environmental Impact Assessment (EIA) process and compile an EMP Amendment in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002). Golder Associates Africa (Pty) Ltd, an independent company, is conducting the EIA and compiling the EMP to support the Prospecting EMP amendment application.

The first phase of an EIA is the Scoping Phase (**Figure i**). Interested and Affected Parties (I&APs) were given the opportunity to comment on the Draft Scoping Report for the proposed project. The Draft Scoping Report was made available for a 30-day public comment period, from 22 August 2008 to 23 September 2008. The report was then made available for an additional public comment period from 1 October 2008 to 21 October 2008, to provide the public with a further opportunity to raise their concerns, comments and suggestions, and to verify that their comments have been captured. A public meeting was held on 14 October 2008 to present the contents of the Draft Scoping Report to I&APs and to obtain their comments on the report.

The purpose of this EIA Report and EMP Amendment is to define the significance of potential impacts and to document the comments received from I&APs thus far. I&APs are invited to comment on this document during the period from Thursday, 28 May 2009 to Thursday, 25 June 2009, where after it will be finalised and submitted to the decision-making authority.

Summary of what the EIA Report and EMP Amendment contains

This report contains:

- An overview of the EIA process followed, including public participation undertaken to date,
- A description of the existing environment at the affected area (i.e. prospecting shaft site),
- A detailed description of the proposed project and alternatives considered,
- An assessment of potential impacts,
- An Environmental Management Plan aimed at mitigating potential environmental impacts, and
- A list of I&APs involved to date and their comments (Issues and Response Report)

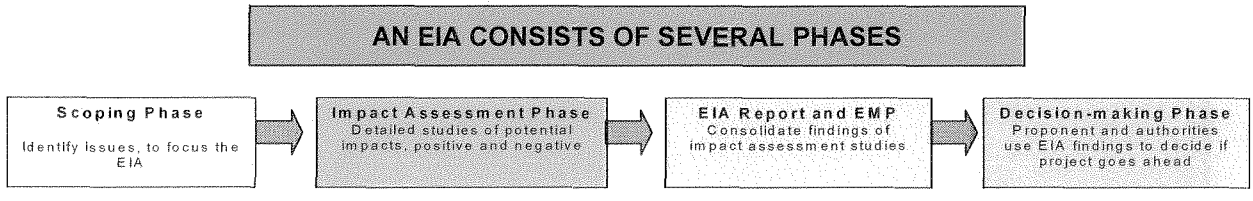

Figure i: An Environmental Impact Assessment consists of various phases

The EIA for the Lonmin Akanani prospecting shaft development is now in the **EIA Report and EMP Phase**.

PUBLIC REVIEW OF THE EIA REPORT AND EMP AMENDMENT

This EIA Report and EMP Amendment will be available for comment for a period of four weeks from **Thursday, 28 May 2009** to **Thursday, 25 June 2009**. Copies of the Report are available at the following public places:

Public Place	Contact person	Contact number
Mapela Thusong Service Centre	Ms Andrina Mabusela	015 413 0000
Mapela Post Office	Mr J Ledwaba	015 413 0001
Seritarita Secondary School	Mr Frans Somo	082 936 5160
Hans Masibe Primary School	Mr Makwena Nong	082 881 0516
Mapela Tribal Office	Mr Godfrey Mothiba	015 413 0036
Dikwena General Dealer	Mr Manamela	076 384 1970
Sephonono Shop	Peter Mathoga	082 488 2517
Lonmin Akanani Division	Mr Victor Tseka	082 448 2643
Golder Associates Africa, Midrand	Ms Alet Visser	011 254 4978

The report is also available on the Golder Associates website: www.golder.co.za

OPPORTUNITIES TO COMMENT

Stakeholders can comment on the EIA Report and EMP Amendment and accompanying Issues and Response Report as well as the Specialist Reports in any of the following ways:

- Completing the comment sheets enclosed with the reports at the public places, and
- Submitting additional comments by e-mail, fax or telephone to the public participation office.

DUE DATE FOR COMMENT ON THIS EIA REPORT AND EMP IS

Thursday, 25 June 2009

Please submit comments to the Golder public participation office:

Mari de Villiers / Alet Visser
Golder Associates Africa
P O Box 6001
HALFWAY HOUSE, 1685
Tel: (011) 254-4978
Fax: (011) 315-0317
Email: mdevilliers@golder.co.za / avisser@golder.co.za

EXECUTIVE SUMMARY

Introduction and Project Description

Lonmin Platinum (Lonmin) is investigating the feasibility of developing a platinum ore body (referred to as the Platreef) about 25 km north of the town of Mokopane (formerly Potgietersrus) in the Limpopo Province. A new order Prospecting Right and Environmental Management Plan (EMP) for the prospecting activities on the farms Zwartfontein 814 LR and Moordkopje 813 LR have been approved. The prospecting area is referred to as the "Akanani prospecting area". The proposed prospecting shaft site is located in the south-eastern corner of the broader prospecting area, about 700 m south-east from the Skimming and Leruleng Villages and a bit further from the GaMasenya Village (Hans).

Lonmin intends amending the approved Prospecting Right and EMP to include the sinking of a single prospecting shaft over a three year period within the approved Akanani prospecting area on the farm Zwartfontein 814 LR. The prospecting shaft is needed to obtain a bulk ore sample of 3 000 tons which can be used to determine the metallurgical properties of the Platreef at the Akanani project area. The prospecting shaft will be about 7 to 10 m in diameter, and approximately 1 000 m deep. The prospecting shaft site will be approximately 2 ha in extent. The mined ore will be transported by 35 ton trucks to Mintek in Johannesburg for test work.

In order to amend the approved Prospecting Right and EMP, Lonmin is required to conduct an Environmental Impact Assessment (EIA) process and compile an EMP Amendment in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002). Golder Associates Africa (Pty) Ltd, an independent environmental practitioner, is conducting the EIA and compiling the EMP to support the Prospecting EMP amendment application.

Key Project Components

The following infrastructure will be constructed within the proposed ~ 2 ha prospecting shaft site: bulk sampling shaft; workshops; temporary diesel bowser (± 2000 litres); water settlers; waste rock dump; batch plant; substation and transformer; service, stage and kibble winders; sinking fan; jumbo stores and container offices; electrical cable laydown area; and upgrade of existing access roads. No explosives will be stored on-site.

The proposed method of development of the prospecting shaft, and associated project phases, can be summarised as follows:

- **Construction phase**: Equipment mobilisation and site establishment -
  - Surface infrastructure comprising offices, workshops, stores, first aid facilities and change houses will be erected. A surface batching plant, for cement mixing, will be erected and commissioned and a concrete cube testing facility will be established.
- **Operational phase**: Sinking of the shaft -
  - Shaft sinking activities will include excavating by means of earthmoving equipment, drilling and blasting.
  - Blasted rock will be transported to a temporary waste rock dump located within the prospecting shaft site.
  - The shaft will be ventilated by axial flow fans exhausting through steel ventilation columns.
  - Water intercepted during the shaft sinking operation will be pumped by means of pneumatically powered pumps directly into kibbles for bailing to surface. Siphon facilities will be provided on surface for the bailing of water. The water will be contained in settling facilities situated on the surface for re-use.
  - Shaft wall support in the form of pattern and welded mesh will be installed concurrent with shaft sinking.
  - The shaft will be lined with concrete (transferred from the surface batch plant to the shaft).
  - Mining of the bulk sample -

- Once the shaft barrel reaches the elevation of the economic horizon of the Platreef, which is approximately 1 000 metres below surface, the bulk sample will be mined. The bulk sample will be obtained by continuing the sinking operation in the plane of the reef for 12 to 15 metres.
- Blasted ore will be hoisted to surface.
- On surface, the ore will be temporarily stockpiled and transported by trucks to Mintek in Johannesburg for metallurgical test work.

- **Decommissioning and closure phase**: Decommissioning of the shaft -
  - Should the feasibility studies indicate that the Akanani platinum project is economically viable, the prospecting shaft is intended to be used as the ventilation shaft for the future requirements of the Akanani Mine. The installed equipment will eventually be removed according to the mine's Closure Plan. A separate, full EIA and EMP process must be conducted and approved by the relevant decision-making authorities before full-scale mining activities may commence.
  - Should the Akanani platinum project not be viable, all equipment will be removed, the waste rock on the surface will be dumped back into the shaft and a concrete slab will be constructed over the mouth of the shaft. The rest of the disturbed area will be rehabilitated to its former state, as far as practically possible.

Overview of the Existing Environment, Impacts and Mitigation Measures

Geology

Existing environment: The study area is underlain by the Main Zone of the Northern Limb of the Bushveld Complex comprising mainly norites, gabbronorites and anorthosites. These rocks overlie the Platreef Unit, which occurs at depths of between 1 000 m and 1 800 m along the eastern boundary of the broader prospecting area.

Potential impact and mitigation: During the operational phase, the geological structure at the prospecting shaft will be permanently altered by blasting and shaft development. The surface diameter of the shaft will be between 7 and 10 m. This is an unavoidable cost of developing the prospecting shaft, and no mitigation measures can be implemented to remediate this permanent impact on the local geological structure.

Soils

Existing environment: The proposed prospecting shaft site is underlain by the Arcadia Soil Form (0-10 Ar), which is characterised by high clay contents, often of a swelling variety that produce strongly structured and blocky fabric, and are generally pale in colour (grey to grey brown) and highly leached.

Potential impact and mitigation: During construction, topsoil removed within the shaft footprint area should be stockpiled. The impact on these soils will have a low significance, since the soil has limited agricultural potential and development will be limited to an area of approximately 2 hectares. Special attention will be necessary to limit erosion of exposed soils.

Land capability and land use

Existing environment: The land capability of the proposed prospecting shaft site was rated as grazing land. Grazing land does not qualify as wetland or arable land and has soil, or soil-like material, which is permeable to roots of native plants.

Potential impact and mitigation: Construction activities will result in a change in the land capacity and use of the proposed site. An area of more than 2400 ha of grazing land is situated within the Akanani prospecting area, which is approximately 4,000 ha in extent. This land is utilised for communal grazing purposes. The impact associated with the loss of approximately 2 ha of grazing land will be low and insignificant, compared to the extent of grazing land available in the surrounding area.

Ecology: Fauna and Flora

Existing environment: The current ecological state of the proposed prospecting shaft site can be considered as poor to moderate due to previous cultivation and utilisation of the land leading to the degradation of the environment. Although Red Data species have been recorded in the region historically, no Red Data or protected fauna and/or flora species were found on the proposed site during the Red Data survey.

Potential impact and mitigation: The impact on fauna and/or flora will be low due to the low conservation value of the site and the absence of Red Data species. Mitigation measures proposed to minimise potential

impacts include clearly demarcating the specific construction areas, and confining all vehicles and other activities to these demarcated areas, in order to minimise environmental damage to the surrounding natural vegetation.

Ecology: Wetlands

Existing environment: The proposed prospecting site is situated within grazing land. No wetland areas were identified in close proximity to the proposed prospecting shaft site.

Potential impact and mitigation: The construction phase of the proposed prospecting shaft project will not impact on any wetlands, since no wetland areas were identified in the vicinity of the proposed site.

Surface water

Existing environment: The proposed prospecting shaft site falls within the Limpopo Water Management Area in the A61G quaternary catchment (Mogalakwena catchment). It is drained by the non-perennial Mohlosane River situated approximately 300 m north of the site. This river drains into the northward-flowing Mogalakwena River, which drains into the Limpopo River west of Alldays.

Potential impact and mitigation: Stripping of vegetation during the construction phase may increase erosion, which might increase the amount of suspended solids in downstream watercourses, if not prevented and intercepted successfully. Clean stormwater runoff on site could furthermore be contaminated and could pollute the Mohlosane River, if proper clean and dirty water management structures are not developed on site. Proposed mitigation measures include developing proper storm water management structures before construction commences.

Groundwater

Existing environment: A relatively shallow aquifer occurs at the project area, within the weathered and fractured norite and gabbro-norite. These intersections generally occurred between 8 and 10 metres below ground level (mbgl). There is a single aquifer within the weathered and fractured norite. It is reasonable to assume that faults and fracture zones enhance and extend the groundwater flow conditions along such linear geological features to some depth.

Potential impact and mitigation: Project activities during construction and operation may result in localised changes to the groundwater flow regime and groundwater levels in the shallow weathered and fractured norite aquifer in the immediate vicinity of the bulk sampling shaft, settling dams and pollution control dam. Such changes could potentially result from seepage of stored water from the unlined settling dams and pollution control dam into the groundwater. Groundwater intersection during the construction of the shaft (blasting) may lead to a temporary increase in the pumping volumes from the shaft, which would be matched by commensurate reduction in the pumping of water from production boreholes on the farm Amoede. The majority of these intersections will be sealed off by the concrete lining of the shaft. Higher-yielding groundwater intersections, which cannot be sealed off by the concrete liners should be incorporated into the operational water system. Changes in groundwater quality associated with the bulk sampling activities will be primarily in response to the mineralised mine water which will be pumped from the shaft or recovered from the batch plant and discharged to the unlined settling dams.

The potential impact on groundwater could be reduced if the proposed mitigation measures are implemented successfully. Proposed mitigation measures include sizing stormwater facilities appropriately and lining of settling dams and pollution control dams.

Air quality

Existing environment: Dust fallout throughout the prospecting area is fairly low, with an average of 226 mg/m^2/day, with some exceptions where elevated dust levels were measured close to gravel roads and other dust-generating activities in the area.

Potential impact and mitigation: During the construction phase, the main potential air quality pollutant will be particulate matter. The associated impact will be temporary and proposed mitigation measures include activities such as wet dust suppression. Blasting will be an intermittent (non-routine) source of emissions (dust and trace gases) and will occur once a day for a limited period of time during shaft sinking operations. The associated impacts are regarded as a source of nuisance dust only, and rated as moderately significant. If successfully mitigated with dust suppression methods, the significance of this impact can be reduced to low.

Noise and Vibration

Existing environment: The measured sound pressure levels at the villages surrounding the prospecting shaft site are generally higher during night-time than during the day-time periods, due to the existing neighbouring mine which operates on a 24-hour basis. Prevailing vibration levels for the area surrounding the proposed site were found to be insignificant.

Potential impact and mitigation: The main potential noise impact during construction could be from vehicles manoeuvring on site. No vibration-related impacts are anticipated during the construction phase. Although the significance of the anticipated impact associated with blasting activities during the first few weeks of shaft development (operational phase) could be seen as moderate, the effect of this impact will be reduced to low if the proposed mitigation measures are implemented successfully. Proposed mitigation measures include measures such as ensuring that the correct design relationship exists between the burden, spacing and hole diameter. The existing exposure of residents to blasting and other noise sources in the area further reduces the potential significance of this impact. The impact will be temporary and will reduce significantly as shaft development proceeds.

Structural damage associated with vibration is only expected to occur at a vibration level in excess of 5.0 mm/s. Due to the distance from the proposed site to surrounding residences (more than 700 m) and the low expected vibration impacts during blasting, no structural damage is expected at surrounding villages.

Sites of archaeological and cultural interest

Existing environment: The Phase I HIA study for the Akanani prospecting shaft site revealed the following types and ranges of heritage resources:

- Stone tools uncovered in the Mohlosane River - mostly derived from the Middle Stone Age, dating back 200 000 years to 22 000 years. These stone tools were limited in number and were not found occurring as large concentrations (assemblages) in a closed (sealed) stratigraphical context.
- Remains dating from the Late Iron Age/Historical Period that consisted of a scatter of metal working slag. It is possible that these remains date from the Late Iron Age (AD1600-1840) or from the Historical Period (AD1840-1880).
- Remains from the recent past (i.e. less than sixty years old) consist of remains of dwellings scattered across the project area. Four of these remains were recorded. It is possible that more remains, particularly graves, may exist but that they are unmarked or located in inconspicuous locations.
- Graves, of which six were found during the Phase 1 HIA. These graves are informal and are demarcated by means of stones. It is possible that more of these graves exist, but that they are unmarked or located in inconspicuous locations.

Potential impact and mitigation: The proposed project will have no, or an insignificant impact, on the stone tools and remains from the Late Iron Age/Historical Period and recent past found in the vicinity of the prospecting shaft site.

The potential impact of the construction phase on the six graves found within the study area is of high significance. This significance rating could however be reduced if the recommended mitigation measures are successfully implemented. Mitigation measures include actions such as conserving graveyards *in situ* by demarcating them with brick walls and/or fences.

Sensitive landscapes

Existing environment: The proposed project site can be described as a 'sensitive landscape' based on the presence of archaeological sites in the direct vicinity of the proposed site.

Potential impact and mitigation: Refer to 'Sites of archaeological and cultural interest' above.

Visual aspects

Existing environment: The proposed prospecting shaft site is located south of Anglo Platinum's Potgietersrust Platinum Mine ("PP Rust"), an open pit operation. The PP Rust mine's overburden stockpiles are situated approximately 500 m south of the prospecting shaft site, and constitute the dominant landscape feature as viewed from the proposed site and/or surrounding villages.

Potential impact and mitigation: The significance of the potential visual impact resulting from the proposed prospecting shaft and associated structures is considered to be low, since it will be visually 'absorbed' by the

PP Rust mine overburden stockpile which will form the background as viewed from the majority of viewpoints in the area.

Socio-economic aspects

Existing environment: The proposed prospecting shaft site is located in Ward 18 of the Mogalakwena Local Municipality, situated within the Waterberg District Municipality in the Limpopo Province. According to the 2001 Census statistics, the Mogalakwena Local Municipality has a total population of approximately 298 400, which accounts for almost half of the District Municipality's population.

Potential impact and mitigation: The main socio-economic impacts associated with the proposed project will relate to the following aspects: Employment creation, influx of job seekers, development of a labourers' camp, increased pressure on service provision, loss of land, social impacts derived from physical impacts, impacts on graves and spiritual sites, safety impacts (relating to traffic and construction excavations) and community perceptions and responses. The significance of these potential impacts will range between low and moderate. One of the measures proposed to mitigate potential socio-economic impacts is that Lonmin should reconsider the requirement to establish a labourers' camp on site. It was suggested that the workforce should preferably be housed in existing accommodation in Mokopane and transported to the site by bus. Lonmin subsequently confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane.

Traffic and transport

Existing environment: The proposed prospecting shaft site will be accessed *via* an existing gravel road which intersects the public tar road at the Skimming Village. The existing public tar road links the area with Mokopane, situated towards the south. The ore obtained via the proposed prospecting shaft will be transported by 35 ton trucks to Mintek in Johannesburg for metallurgical test work. The 3,000 tonnes of ore will be transported over a period of approximately 6 months, resulting in approximately 14 truck-loads per month. This calculates to approximately one truck load every 2 days.

Potential impact and mitigation: The vehicles entering, manoeuvring on and exiting the prospecting shaft site are not expected to contribute to significant environmental impacts. The limited number of additional vehicles associated with transporting the ore to Johannesburg will furthermore not have a significant impact on the traffic load of public roads in the area.

Stakeholder consultation process

A stakeholder database was proactively compiled and several individuals and organisations were involved in this project to date. Background information documents were distributed to stakeholders during announcement of the project. Several focus group meetings and workshops were held during the project and a public meeting was held during the comment period on the Draft Scoping Report. The Draft Scoping Report was made available for public review at several public places in the area. Meetings were also held with officials from several Government Departments.

An Issues and Response Report was compiled, which contains all the issues raised by stakeholders during the EIA process and the responses provided by the proponent and the EIA team.

Conclusion

This EMP Amendment identifies the expected environmental consequences associated with the proposed development of the Lonmin Akanani bulk sampling prospecting shaft. A number of specific mitigation measures have been identified to ensure that the impacts associated with the project are properly mitigated, managed and/or avoided (where possible).

It can be concluded that the environmental impacts associated with the proposed project will not result in unacceptable long-term environmental impacts, should the proposed mitigation and monitoring measures discussed in this document be implemented diligently.

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Appendix D **Table of the South African Water Quality Guidelines (1996)**

GLOSSARY OF TERMS AND ABBREVIATIONS

CDT	Constant discharge test.
dB	Decibel. The sound pressure level measured for a specific period, such as for a second or a milli-second.
dBA	A-weighted dB. The average noise level where all the sound pressure levels (dB) are integrated over a period of time, normally 10 minutes. The result thereof is the logarithmic average in dBA.
DME	The Department of Minerals and Energy, who have primary responsibility in South Africa for administration of mining, and who act as the lead agent in approval of Applications for Mining Rights.
EMP	Environmental Management Plan. A report required under the Mineral and Petroleum Resources Development Act (Act 28 of 2002) to support an application to amend a prospecting EMP. The EMP must be based on an Environmental Impact Assessment report.
EMP amendment	An amendment to the information contained in the approved EMP. Typically an EMP amendment is prepared when significant changes are made to the infrastructure present on a mine or prospecting site, or when the mine plan changes significantly. A new EIA is then done which informs the development of the EMP amendment.
FDEM	Frequency Domain Electromagnetic.
HIA	Heritage Impact Assessment.
I&AP	Interested and Affected Party. Any person, group of persons or organisation interested in or affected by an activity, and any organ of state that may have jurisdiction over any aspect of the activity.
LEDET	Limpopo Department of Economic Development, Environment and Tourism.
Mamsl	Metres above mean sea level.
Mbgl	Metres below ground level.
MAP	Mean annual precipitation.
MPRDA	Mineral and Petroleum Resources Development Act (Act 28 of 2002): Legislation that supersedes the Minerals Act (Act 50 of 1991). The MPRDA requires all applicants for mining or prospecting rights in a particular area to submit an Environmental Management Programme or an Environmental Management Plan respectively based on the results of an Environmental Impact Assessment. The MPRDA outlines specific actions to be taken in conducting the EIA.
NEMA	National Environmental Management Act (Act 107 of 1998): legislation that provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state, and to provide for matters connected therewith.
NWA	National Water Act, 1998 (Act 36 of 1998).
PGE	Platinum Group Elements, which include, in a roughly decreasing order of abundance: platinum (Pt), palladium (Pd), ruthenium (Ru), rhodium (Rh), iridium (Ir), and osmium (Os).
PGM	Platinum Group Metal. The two triads of the elements ruthenium, rhodium, palladium and osmium, iridium, platinum are grouped together under the name platinum metals. The platinum metals are all found native, almost always associated with each other and mixed with gold, silver, copper, nickel and iron.
Prospecting	Intentionally searching for any mineral by means of any method that: disturbs the surface or subsurface of the earth, including any portion of the earth that is under the sea or under other water; or in or on any reside stockpile or residue deposit, in order to establish the existence of any mineral and to determine the extent and economic value thereof.
Prospecting area	The area which is the subject of any Prospecting Right in terms of the MPRDA.
Prospecting Right	The right to prospect in terms of Section 17(1) of the MPRDA.
Prospecting Work Programme	The planned Prospecting Work Programme to be followed in order to establish the occurrence of any mineral resource in the prospecting area during the period applied for in terms of the MPRDA.
SDT	Step discharge test.

1. INTRODUCTION

1.1 DETAILS OF THE APPLICANT FOR PROSPECTING RIGHTS AMENDMENT

Name of Applicant	Western Platinum Limited	
Company Registration No	1963/003589/06	
Postal Address	PO Box 98811 Sloane Park Sandton 2152	
Physical Address	17 Georgian Crescent Bryanston Sandton 2191	
Contact Person	Dr Andries Venter	
Contact Details	**Telephone Number**	**Fax Number**
	(011) 516 1400	086 634 1997
	Cell Number	**Email**
	-	Andries.Venter@lonmin.com
Alternative Contact Person	Mrs Elize Swart	
Alternative Contact Details	**Telephone Number**	**Fax Number**
	(014) 571 2811	+27 86 635 1681
	Cell Number	**Email**
	-	Elize.Swart@lonmin.com

1.2 NAME AND ADDRESS OF PROSPECTING RIGHTS HOLDER

Name of Applicant	Akanani Mining (Pty) Ltd
Company Registration No	1999/009073/07
Postal Address	PO Box 98811 Sloane Park Sandton 2152
Physical Address	17 Georgian Crescent Bryanston Sandton 2191

1.2.1 Brief history of the Akanani Prospecting Rights Holders

In April 2004, Akanani Mining (Pty) Ltd received approval of the Environmental Management Plan (EMP) for prospecting on the farms Zwartfontein 814 LR (± 2 018 ha) and Moordkopje 813 LR (± 2 077 ha) from the Department of Minerals and Energy (DME).

On 13 June 2006, the DME granted Akanani Mining (Pty) Ltd conversion of their Old Order Prospecting Rights to New Order Prospecting Rights. In terms of the agreement constituted by the New Order Prospecting Rights between the DME and Akanani Mining (Pty) Ltd on 13 June 2006, the converted Prospecting Rights for Platinum Group Metals (PGM's) and associated precious and base metals, were granted to Akanani Mining (Pty) Ltd for a period of five years, i.e. the Prospecting Right is valid until 12 June 2011.

AfriOre Ltd owned a 74% interest in Akanani Mining (Pty) Ltd, as per the terms of the Company's agreement with Akanani Mining (Pty) Ltd, and has been undertaking prospecting activities at Akanani since November 2004 under the originally granted Old and New Order Prospecting Rights. Western Platinum Ltd (hereafter Lonmin) bought AfriOre Ltd and its Akanani platinum project as part of its plans to grow output to two million ounces (56.7 tons) beyond 2012. The remaining 26% interest in the Akanani platinum project is held by a number of black economic empowerment investors.

Lonmin is thus the current Prospecting Rights Holder for the farms Zwartfontein 814 LR and Moordkopje 813 LR.

1.3 DETAILS OF THE PROPERTY ON WHICH PROSPECTING WILL BE CONDUCTED

Name of Property	Zwartfontein	
Name of Subdivision	814 LR	
Surveyor-general 21 digit site (erf/farm/portion) reference numbers	TOIR0000000008140000	
Approximate Centre of Prospecting Area	**Latitude**	**Longitude**
	23° 59' 35.71" S	28° 53' 28.65" E
Magisterial District	Waterberg District Municipality (DC36)	
Local Municipality	Mogalakwena Local Municipality (LIM367)	
Name of registered Property Owner	Republic of South African Limpopo Department of Land Affairs: State Land Unit	
Contact Details of Property Owner	**Telephone Number**	**Postal Address**
	(015) 297 3539	Private Bag X9312 Polokwane 0700
	Fax Number	
	(015) 297 4988	

1.4 REGIONAL SETTING

The Akanani prospecting area is located about 25 km north of the town of Mokopane (formerly Potgietersrus) and approximately 60 km west-south-west of Polokwane in the Limpopo Province of South Africa. The approved prospecting area falls under the Mogalakwena Local Municipality (LIM367) and the Waterberg District Municipality (DC36).

The approved prospecting area is located on the farms Zwartfontein 814 LR and Moordkopje 813 LR (as shown in **Figure 1**), which together cover an area of about 4 000 hectares. This area is located immediately west and northwest of the Anglo Platinum's Potgietersrust Platinum Mine ("PPRust"), an open pit platinum mining operation.

The ~4000 ha Akanani prospecting area is rural with several villages present, mostly in the northern and southern portions. The villages of GaMosoge and GaModipana are situated in the northern portion of the prospecting area, whilst GaMasenya Village (Hans) is in the south. A smaller village, Mapela, is situated in the centre of the prospecting area. The central and south-western portions of the prospecting area are least

populated. The Akanani prospecting area is served by two gravel roads which intersect in the village of GaMosoge. These roads link the prospecting area with Mokopane in the south.

The area earmarked specifically for the proposed bulk sampling prospecting shaft will be approximately 2 ha in extent, and will be located within the approved Akanani prospecting area on the farm Zwartfontein 814 LR. The proposed prospecting shaft site is located in the south-eastern corner of the broader prospecting area, about 700 m south-east from the Skimming and Leruleng Villages and a bit further from the GaMasenya Village (Hans). The proposed prospecting shaft site is situated approximately 300 m from the Mohlosane River. The prominent Fonthane Mountain Range is located to the west of the prospecting shaft site. Refer to **Figure 1** for the location of the proposed prospecting shaft.

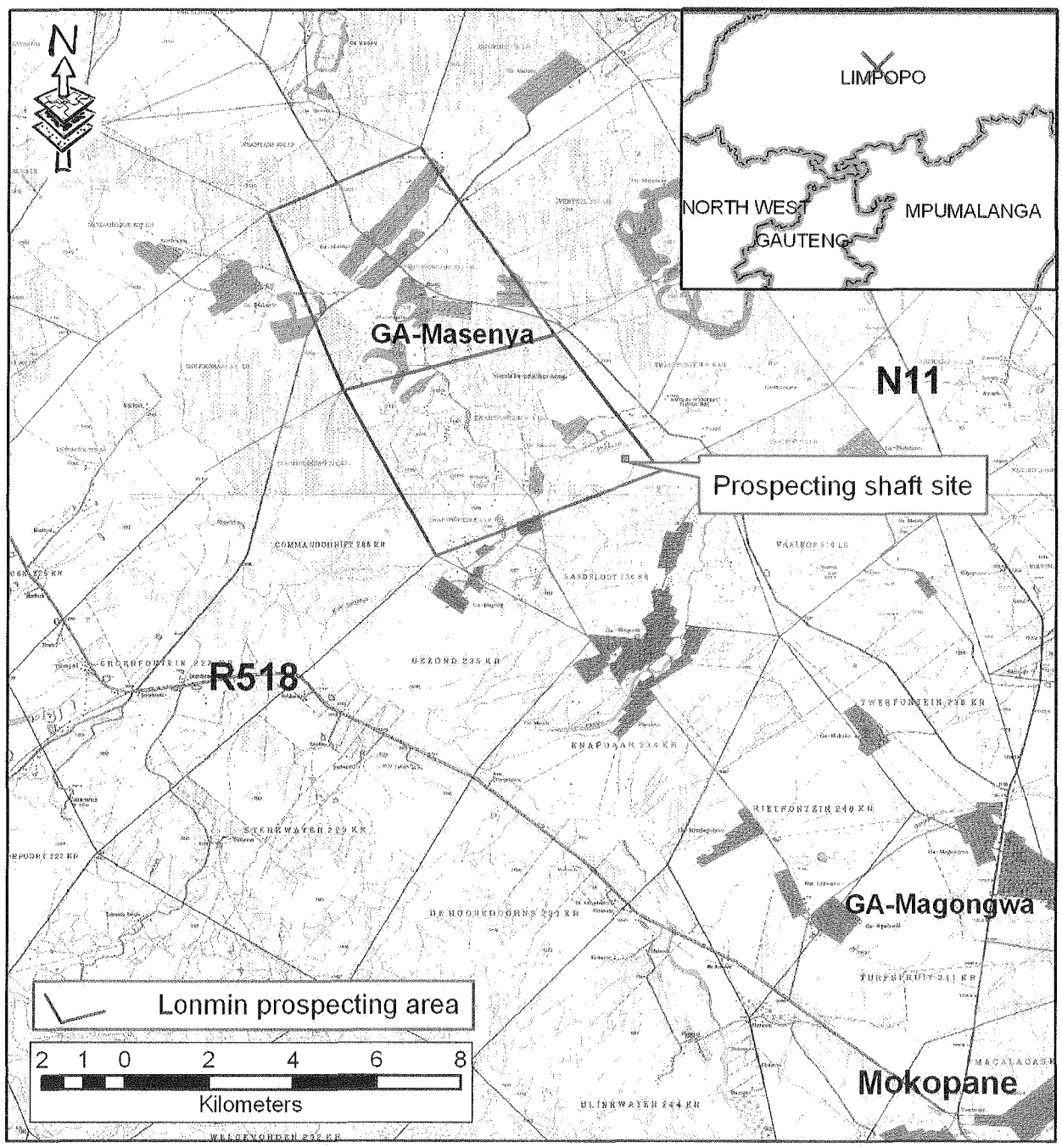


Figure 1: Locality of the proposed Lonmin Akanani prospecting shaft site and the broader prospecting area covering the farms Zwartfontein 814 LR and Moordkopje 813 LR.

1.4.1 Name of Nearest Town

The proposed prospecting shaft site is situated approximately 25 km north of the town of Mokopane (formerly Potgietersrus) in the Limpopo Province. Refer to **Figure 1**.

1.4.2 Surface Infrastructure

Roads and Transport

The proposed prospecting shaft site will be accessed by an existing gravel road which intersects the public tar road at the Skimming Village. The existing public tar road links the area with Mokopane, situated towards the south.

The ore extracted via the proposed prospecting shaft will be transported by 35 ton trucks to Mintek in Johannesburg for metallurgical test work.

Water and Electricity

The proposed shaft sinking operations will require approximately 1 Ml (1 000 m^3) of water per day for process use. The water will be sourced from a borehole located on the farm Armoede 823 LR.

The abstraction of groundwater and the storage thereof are defined as Water Uses in terms of Section 21 of the National Water Act, 1998 (Act 36 of 1998, NWA). An application for a Water Use Licence / Registration in terms of the NWA for these Water Uses will be submitted to the Department of Water Affairs and Forestry (DWAF) in the near future.

Potable water will be transported to site by truck and stored in the two 500 litre tanks.

Electricity transmission lines will be constructed by Eskom. This does not form part of the scope of this EIA.

The capacity of the existing transformer located on-site is 20 to 40MVA. A step-down transformer will supply 11kV of electricity to the construction substation. From there, it will be stepped down to 550 Volts for use at the prospecting shaft site.

Servitudes

No additional servitudes will be registered for this project. Servitudes might however be required for the electricity transmission lines to the site. These transmission lines are not part of the scope of this EIA and will be dealt with separately by Eskom.

1.4.3 Land Use of Immediately Adjacent Land

Land use in the study area is predominantly characterised as subsistence agricultural, mining and rural residential.

The proposed prospecting shaft site is located about 700 m from the Skimming and Leruleng Villages, and a bit further from the Hans Village (GaMasenya). Land situated immediately adjacent to the proposed prospecting shaft site is vacant and used for communal grazing purposes from time to time.

1.4.4 Existing Land Uses that Impact on the Environment at the Proposed Prospecting Area

The natural vegetation at the proposed prospecting shaft site was previously disturbed by grazing and other anthropogenic activities such as utilising indigenous plant species for fuel, traditional medicine or other traditional uses.

1.4.5 River Catchment

The study area, including the prospecting shaft site, falls under the Limpopo Water Management Area in the A61G quaternary catchment (Mogalakwena catchment). The Akanani prospecting area is drained by two main non-perennial channels, namely the Thathwe River in the northern and central portions of the prospecting area, on the farm Moordkopje 813 LR, and the Mohlosane River along the southern boundary,

on the farm Zwartfontein 814 LR. Both of these rivers drain into the northward flowing Mogalakwena River, which drains into the Limpopo River west of Alldays. Both the Thathwe and Mohlosane Rivers are non-perennial.

1.5 BRIEF PROJECT OVERVIEW

In general, the following infrastructure will be constructed / erected within the proposed ~ 2 ha prospecting shaft site:

- Bulk sampling shaft,
- Workshops,
- Temporary diesel bowser (± 2000 litres),
- Water settlers,
- Waste rock dump,
- Batch plant,
- Substation and transformer,
- Service, stage and kibble winders,
- Sinking fan,
- Jumbo stores and container offices,
- Electrical cable laydown area, and
- Access roads (existing).

No explosives will be stored on-site. Refer to **Figure 9** for the proposed layout of the prospecting shaft site.

1.6 LEGAL REQUIREMENTS

1.6.1 Mineral and Petroleum Resources Development Act, Act 28 of 2002

The Old Order Prospecting Right held by Akanani Mining (Pty) Ltd was converted to a New Order Prospecting Right in terms of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA), on 13 June 2006 for the farms Moordkopje 813 LR and Zwartfontein 814LR. The Akanani Prospecting EMP was approved by the DME on 30 April 2004 in terms of the Minerals Act, Act 50 of 1991, and remains valid and applicable in terms of the MPRDA.

Section 102 of the MPRDA provides that a Prospecting Right and EMP may not be amended or varied without the written consent of the Minister. Clause 4.1 of the converted Prospecting Right also provides that the terms of the Prospecting Right may not be amended or varied without the written consent of the Minister. A Prospecting Right amendment application is thus required for the proposed prospecting shaft development project in terms of Section 102 of the MPRDA. The Prospecting Right amendment application requires an amendment to the Prospecting Work Programme as well as an amendment to the current approved EMP. In addition, Section 20(2) of the MPRDA requires that the holder of a Prospecting Right must acquire written permission from the Minister to remove and dispose, for the holder's own account, of bulk samples of any minerals found in the course of prospecting operations.

Lonmin has amended the Prospecting Work Programme to include obtaining the proposed 3 000 ton bulk sample through the sinking of a prospecting shaft to approximately 1 000 m below surface. A motivational letter in terms of Section 20 of the MPRDA has been submitted to the DME.

This EIA is being undertaken to meet the requirements of the Department of Minerals and Energy. This EIA Report and EMP Amendment identify the potential impacts associated with the proposed prospecting shaft, and propose measures to mitigate potential impacts.

1.6.2 National Environmental Management Act, Act 107 of 1998

During a meeting held with the Limpopo Department of Economic Development, Environment and Tourism (LEDET) on 31 March 2009, the Department advised that all environmental authorisations related to the prospecting activities associated with the bulk sample site are regulated in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002) and would fall within the jurisdiction of the Department of Minerals and Energy (DME). Consequently, Lonmin would not be required to submit an application for authorisation in respect of the NEMA, read together with the EIA Regulations, GN R 385, GN R386 and GN R 387 for any listed activities associated with the prospecting shaft whilst still within the prospecting phase of the project.

Refer to **Appendix A** for the letter received from the LEDET confirming the above.

Consequently, the EIA process adopted for this project is designed to satisfy the requirements of the MPRDA, with the Department of Minerals and Energy as the lead decision-making authority.

1.6.3 Other applicable legislation

Other applicable legislation is relevant to this EIA process:

- National Heritage Resources Act, 1999 (Act 25 of 1999),
- Environment Conservation Act, 1989 (Act 73 of 1989), and
- National Water Act, 1998 (Act 36 of 1998).

1.7 THE EIA PROCESS

In broad terms, an EIA process has two phases. The first phase is the Scoping Phase, during which the nature and extent of the required impact assessment is defined. The Draft Scoping Report was circulated to Interested and Affected Parties (I&APs) for their comment on the scope of the EIA. Following stakeholder review and comment, the report was finalised and submitted as a Final Scoping Report to the lead decision-making authority, the DME.

During the Impact Assessment Phase of the EIA, relevant issues identified during scoping were assessed by environmental specialists. The outcomes of the assessments were consolidated into this EIA Report and EMP Amendment which is now being presented to I&APs for comment. After lapsing of the comment period, the document will be finalised and submitted to the DME for decision-making. Based on the findings in the EIA Report and EMP, the DME will decide, in consultation with other relevant authorities, whether the Lonmin Akanani prospecting shaft development project may proceed or not, and under what conditions.

1.7.1 Who is conducting the EIA?

The applicant, Lonmin Platinum, has appointed an independent consultant, Golder Associates Africa (Pty) Ltd (hereafter Golder) to undertake the Environmental Impact Assessment for the amendment to the existing approved Akanani Prospecting Right Environmental Management Plan.

Golder Associates is experienced in environmental management and assessment and fully conversant with the EIA requirements for mining-related projects. The company is well-known for its integrity and independence as well as for its skill in assisting I&APs to participate in the EIA process. Golder has no vested interest in the proposed project.

1.7.2 Who will evaluate the EIA Report and EMP?

Following stakeholder comment on the EIA Report and EMP Amendment, the Final EIA Report and EMP Amendment will be submitted to the Department of Minerals and Energy (Limpopo Office) for decision-making.

2. DESCRIPTION OF THE ENVIRONMENT

The information contained in this section was sourced mainly from the various specialist studies undertaken as part of this EIA.

2.1 GEOLOGY

The study area is underlain by the Main Zone of the Northern Limb of the Bushveld Complex comprising mainly norites, gabbronorites and anorthosites. These rocks overlie the Platreef Unit, which occurs at depths of between 1 000 m and 1 800 m along the eastern boundary of the broader prospecting area. The Main Zone overlies the Platreef Unit, which comprises variable pyroxenitic lithologies dipping between 35° and 45° to the west. The Platreef Unit varies in thickness from tens of metres to 250 metres. The basal contact of the Platreef unit is generally transitional with calc-silicates and other metasediments of the Transvaal Supergroup or with the Archaean granitic and gneissic basement (Prospecting Works Programme, dated April 2005).

2.2 TOPOGRAPHY

The central, northern and eastern portion of the broader Akanani prospecting area is characterised by a generally flat plain sloping gently from the southeast, at an elevation of approximately 1 090 metres above mean sea level (mamsl), to approximately 1 010 mamsl in the extreme north-western portion of the prospecting area. Some prominent rugged hills and valleys are present in the south with elevations of up to 1 238 mamsl at the Molotswi Hill.

Moordkopje 813 LR is relatively flat and is traversed by the northwestern trending road between Mokopane and Suswe. A number of villages occur on the farm. A range of hills occurs on the western side of Zwartfontein 814 LR and continues into the southwestern corner of Moordkopje 813 LR. Most of the hills have altitudes greater than 1 000 mamsl with the isolated hill on Moordkopje 813 LR having an altitude of 1 118 mamsl (EMP, dated April 2004).

2.3 CLIMATE

2.3.1 Data Collection

The background climate data described below was sourced mainly from the "*Baseline Air Quality Assessment for the proposed Prospecting Shaft Development Project at the Lonmin Akanani Prospecting area, North of Mokopane, Limpopo*", compiled by Gondwana Environmental Solutions during September 2008. See **Appendix B.1**.

The air quality specialist study sourced meteorological data for the project area from the South African Weather Service (SAWS), for the period September 2006 to June 2008, because at the time of the study, there was no meteorological station located close enough to the proposed site for it to be considered as site representative. Akanani is in the process of installing two meteorological stations at the site, which will be used for future climate monitoring purposes.

2.3.2 Description

The proposed prospecting shaft site lies within a region where rainfall is strongly seasonal with 87 % of the rain occurring in the summer months (October to March). The mean annual precipitation (MAP) is 585 mm. The driest months fall in mid-winter (June to August) with around 5.5 mm of rain on average. The mean annual Symon's Pan (S-Pan) evaporation rate for the area is 1 800 mm. Winters are mild and mostly frost-free. The study area experiences an average daily maximum of 25 °C and average daily minimum of 12 °C.

The predominant wind direction is east-north-east (18% of the time) throughout all four seasons with lesser wind components from the north-east (13% of the time). Refer to **Figure 2**. No significant seasonal shift in wind variation is observed.

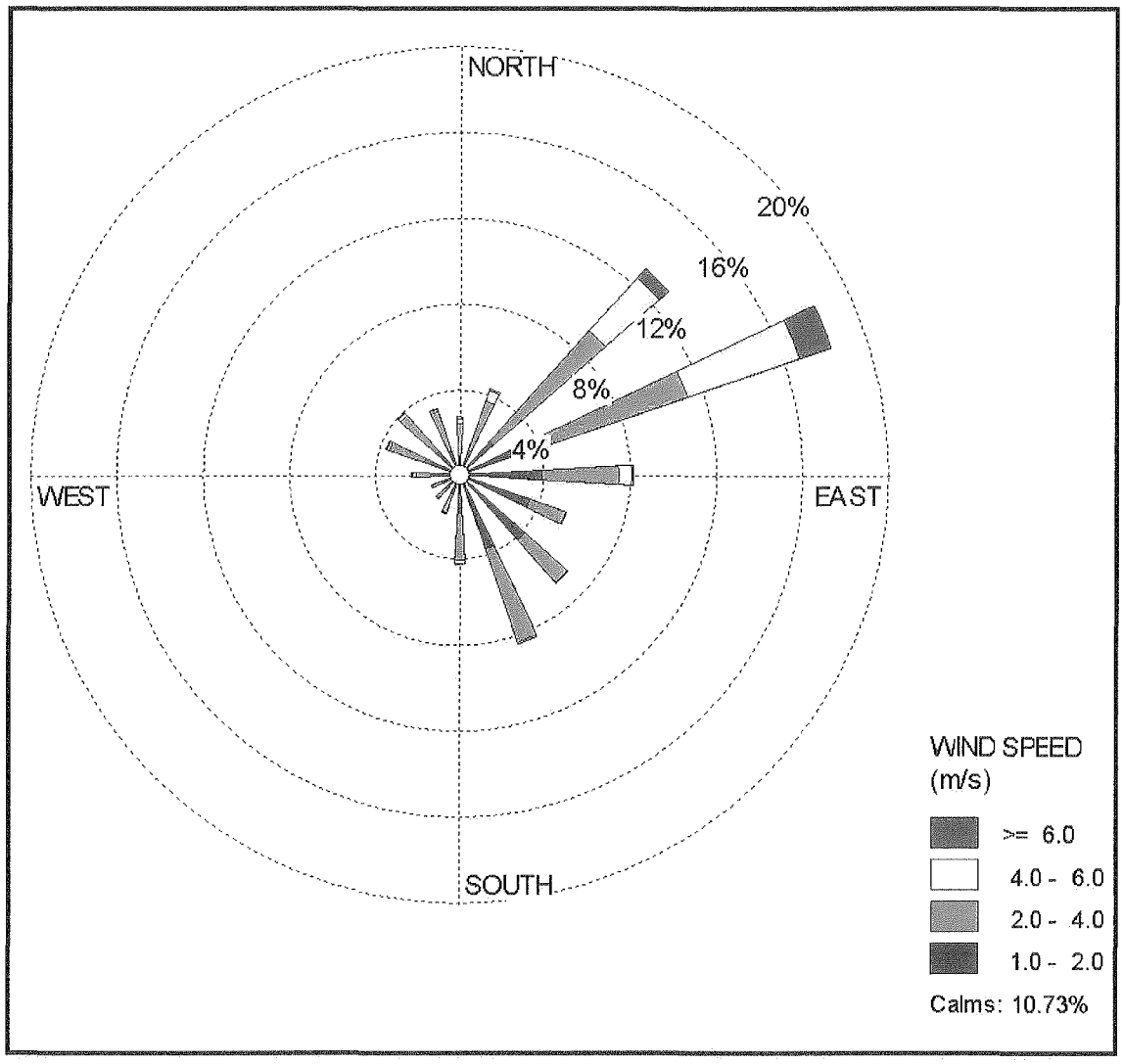


Figure 2: Surface wind rose for the Akanani Prospecting Area, September 2006 to June 2008.

Wind speeds are generally slow to moderate (between 2 and 6 metres per second) although wind speeds exceeding 6 meters per second have been recorded. Wind speeds of less than 1 metre per second, which are designated as calm, occur infrequently (10.73% of the time).

2.4 SOILS

2.4.1 Data Collection

As part of the environmental and social pre-feasibility investigations for the Akanani platinum project, a soil, land use and land capability study has been done for the broader Akanani prospecting area. The information provided below was sourced from the report entitled "*Lonmin Akanani, Pedological and Land Capability Studies*", compiled by Earth Science Solutions during July 2008,

Soil data was collected by means of the following:

- Review of the following published reports and maps:
  - Land Type Mapping of South Africa (1:250 000 scale),
  - Geological Map of South Africa, and
  - Local knowledge of the soils and land capability, amongst others.
- Field work comprised the following:

- The soil study was performed on a 300 m x 300 m grid. In addition to the grid point observations, a representative selection of the mapped soil Forms were sampled for representative chemistry of the soils.
- The majority of observations used to classify the soils were made using a hand-operated bucket auger and dutch (clay) augers. In all cases, the observation points were excavated to a depth of 1 500 mm or until refusal was experienced. Standard mapping procedures and field equipment were used throughout the survey.

- Soil profile identification and description procedure:
  - The identification and classification of soil profiles were carried out using the Taxonomic Soil Classification System (Mac-Vicar et al, 2nd edition 1991).

2.4.2 Description

The major soil types encountered on the ~ 4 000 ha Akanani prospecting area include the moderate to deep orthic-phase Hutton Soil Form and significant areas of highly structured Shortlands, Sterkspruit, Swartland, Valsrivier and Arcadia Soil Forms. The vast majority of the Akanani prospecting area is characterised by shallow, structured and poor quality soils that are at best classified as wilderness lands.

The proposed prospecting shaft site is underlain by the Arcadia Soil Form (0-10 Ar), which is characterised by high clay contents, often of a swelling variety that produce strongly structured and blocky fabric, and are generally pale in colour (grey to grey brown), highly leached, and are, in almost all cases associated with the bottomland areas where accumulations of transported soils make up the majority of the soil pedogenesis.

The vertic structure is the distinctive feature of these soils, the Arcadia, by definition being a vertic horizon on a soft rock base. With it's distinctive greyish background colour and yellow/red mottling, these soils are distinctive of semi permanent saturation. Chemically, this soil form returns moderate to poor levels of most nutrients (Al, P and N materialisation capacity). Conversely the salts (K and Zn) return as higher levels, resulting in a greater potential for moderate to severe salinity and/or sodicity problems.

2.5 LAND CAPABILITY AND LAND USE

2.5.1 Data Collection

As mentioned previously, a soil, land use and land capability study has been done for the broader Akanani prospecting area as part of the environmental and social pre-feasibility investigations for the Akanani platinum project. The information provided below was sourced from the report entitled "*Lonmin Akanani, Pedological and Land Capability Studies*", compiled by Earth Science Solutions during July 2008,

The land capability of the study area was classified into four classes (wetland, arable land, grazing land and wilderness) as guided by the Chamber of Mines Guidelines, 1991.

2.5.2 Description

The majority of the ~ 4000 ha Akanani prospecting area was rated as grazing land, with the remainder of the land being rated as housing, wilderness and arable land. Relatively small areas were rated as wetland and river.

The land capability of the proposed prospecting shaft site was rated as grazing land. Grazing land does not qualify as wetland or arable land and has soil, or soil-like material, which is permeable to roots of native plants. The soil, or soil-like material, of grazing land is generally more than 250mm thick and contains less than 50% by volume of rocks, or pedocrete fragments larger than 100mm. It supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.

The proposed prospecting shaft site is from time to time used for grazing purposes.

2.6 ECOLOGY

2.6.1 Fauna and Flora

Data Collection

As part of the environmental and social pre-feasibility investigations for the Akanani platinum project, an ecological assessment and biomonitoring were conducted. The assessment covered the Akanani prospecting area of approximately 4000 ha. The information provided below was partly sourced from the report entitled "*Ecological assessment for the Lonmin Akanani lease area near Mokopane in the Limpopo Province, South Africa*". The ecological assessment was undertaken by Golder during July 2008.

A Red Data fauna and flora assessment was furthermore conducted by Golder on the proposed prospecting shaft site during October 2008. The relevant report "*Lonmin Akanani Sampling Shaft Red Data Survey*" is attached to this document as **Appendix B.2**. Some of the information provided below was sourced from this document.

The groups of species investigated during the July 2008 baseline study included the following:

Vegetation

The vegetation assessment on broader project area was based on a variation of the Braun-Blanquet method whereby vegetation is stratified by means of aerial/satellite imagery with physiognomic characteristics as a first approximation. Representative areas within these stratifications were then surveyed by means of line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Data obtained from these surveys were then subjected to analysis to establish differences or similarities between observed units. A floral and faunal survey was conducted in February and March 2008. The desktop analysis of data was used to establish differences or similarities between vegetation communities, which were then described in terms of floristic species composition as well as driving environmental parameters.

Arthropoda (Insects)

Arthropods were surveyed on the ~ 4000 ha Akanani prospecting area by means of setting out pitfall traps in selected areas within the various vegetation communities, and intensive transects making use of visual identification. Capture of species on the wing was also undertaken in order to aid identification, and this was done by means of sweep-netting. Identification of species was done to the lowest possible taxonomic level using Picker, et al (2002). Suitable habitat was identified for scorpions, spiders and butterflies in order to select areas in which to sample by means of pitfall traps and visual identification, as well as to determine the possibility of the occurrences of Red Data or protected species of these taxa.

Avifauna (Birds)

Avifauna occurring in the ~4000 ha Akanani prospecting area were surveyed by means of transects and point counts, depending on the vegetation density, using visual identification and the calls of birds to identify species. Where possible, visual identification was used to confirm identifications made by means of bird calls. Bird ranges were confirmed using Harrison, et al (1997a and b).

Mammals

Sherman traps were set in grids in all recognized vegetation types within the ~4000 ha prospecting area in order to trap and thereby identify small mammals. Visual sightings and other indications such as scats and spoor were used to identify the small mammal inhabitants of the study area. Stuart and Stuart (1993) and Smithers (1992) were used for identification purposes.

Herpetofauna (Reptiles)

Suitable reptile habitats within the ~4000 ha Akanani prospecting area were identified and reptiles were sampled using active search and capture methods. Searches were concentrated in rocky areas and disused ant hills were investigated for the presence of snakes. Snakes and other reptiles were identified visually and only captured if visual identification was hampered by swift-moving reptiles or if the reptile was obscured from view. Branch (1996) was used as an identification guide, where necessary.

Amphibia (Frogs)

Suitable areas for frogs within the ~4000 ha Akanani prospecting area were sampled by means of active search and capture and acoustic identification methods, especially at night when highest amphibian activity was expected. Areas were also netted for tadpoles, and amphibian species were identified by means of tadpoles. Carruthers (2001) was used to confirm identification where necessary.

Aquatic fauna

In order to enable a characterisation of the general integrity of the aquatic environment, certain ecological indicators were selected to represent each of the responding, habitat and stressor components involved in the aquatic environment. These included:

- Stressor Indicators:
  - *In situ* water quality
- Habitat Indicators:
  - General Habitat Assessment, and
  - Invertebrate Habitat Assessment System (IHAS, *version 2*).
- Response Indicators:
  - Aquatic Macroinvertebrates (SASS5), and
  - Ichthyofauna (Fish).

Red Data fauna and flora assessment

The "*Red Data fauna and flora assessment*" conducted by Golder on the proposed prospecting shaft site started with site identification via aerial/satellite imagery. The proposed site then underwent line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Through the transects, identification of the vegetation took place to verify whether any Red Data or protected species are present.

This survey was conducted at the end of September 2008; cognisance was taken of the following environmental attributes and general information:

- Biophysical environment (geology, topography, aspect, slope etc.),
- Current status of habitats,
- Red Data habitat suitability,
- Digital photographs, and
- GPS reference points.

Red Data Species were determined through the collection of baseline PRECIS data for the grid squares 2428BB and 2328DD. This was then compared to the Limpopo Province Protected and Red Data plant species list to compile a list of Red Data and protected plant species that may potentially occur within the study area.

Description

Vegetation

Vegetation occurring in the project area is described in Mucina and Rutherford (2006) as Makhado Sweet Bushveld. However, some areas, especially the rocky hillsides, show some elements of Waterberg Mountain Bushveld. Characteristic vegetation includes short and shrubby bushveld with a poorly developed grass layer. From a faunal perspective, these vegetation types are likely to support species typically associated with bushveld.

The following vegetation communities were identified within the broader Akanani prospecting area, and are named according to the area in which they occur, physiognomy and/or dominant floral species occurring within the vegetation communities (**Figure 3**) [Golder (a), 2008]:

- Riparian vegetation,
- Cultivated areas,
- Semi-natural vegetation, and
- Hillslope vegetation.

The proposed prospecting shaft site is vegetated with semi-natural vegetation that has been disturbed to a moderate extent by grazing and other anthropogenic activities such as utilisation of indigenous plant species for fuel, traditional medicine or other traditional uses. This vegetation type is a species-poor version of the natural vegetation that may be expected in the region.

Fauna

The arthropod species known to occur in the area, 206 species were recorded during the ecological surveys across the ~4000 ha Akanani prospecting area. Seven reptile species were recorded during the surveys conducted in the area; these include the Puff Adder, Striped Skink and Water Monitor. Only five amphibian species were observed during the study. Ninety-seven bird species were observed or heard during the field survey. 13 species of mammals were recorded during the surveys and include the Forest Shrew, Scrub Hare and Common Duiker. Red Data species are likely to make use of the study area, of which the following four were observed during the field survey (December 2007 and January 2008) *Falco naumanni* (Lesser Kestrel, VU), *Mysorex varius* (Forest Shrew, DD), *Graphiurus platyops* (Rock Dormouse, DD) and *Crocidura silacea* (Lesser Grey Musk Shrew, DD). Other Red Data bird species may also use the study area, but they are expected to use the area far less frequently. No further Red Data species were observed during the field survey across the broader area. Eight additional species have a high probability of occurring within the study area [Golder (a), 2008].

A total of 30 aquatic macroinvertebrate taxa were recorded in the ~4000 ha Akanani prospecting area during the January 2008 survey. Based on the results of the biomonitoring survey, the fish assemblage in the project area consists of widespread and tolerant fish species, due to the limited availability of sufficient habitat. *Barbus* trimaculatus (Threespot barb) was collected at two of the sample sites and comprised 79% of the total catch.

Red Data fauna and flora assessment

The current ecological state of the proposed prospecting shaft site can be considered as poor to moderate due to previous cultivation and utilisation of the land leading to the degradation of the environment. Although Red Data species have been recorded in the region historically, no Red Data or protected fauna and/or flora species were found on the proposed site during the survey.

2.6.2 Wetlands

Data Collection

As part of the environmental and social pre-feasibility investigations for the Akanani platinum project, a soil, land use and land capability study has been done for the broader Akanani prospecting area. The information provided below was sourced from the report entitled "*Lonmin Akanani, Pedological and Land Capability Studies*", compiled by Earth Science Solutions during July 2008.

The Akanani prospecting area of approximately 4000 ha was mapped to a GIS format as part of the above study. The land capability of the study area was classified into four classes (wetland, arable land, grazing land and wilderness), as prescribed by the Chamber of Mines Guidelines, 1991.

Description

According to the above-mentioned land capability classification, the proposed prospecting site is situated within grazing land. No wetland areas were identified in close proximity to the proposed prospecting shaft site.

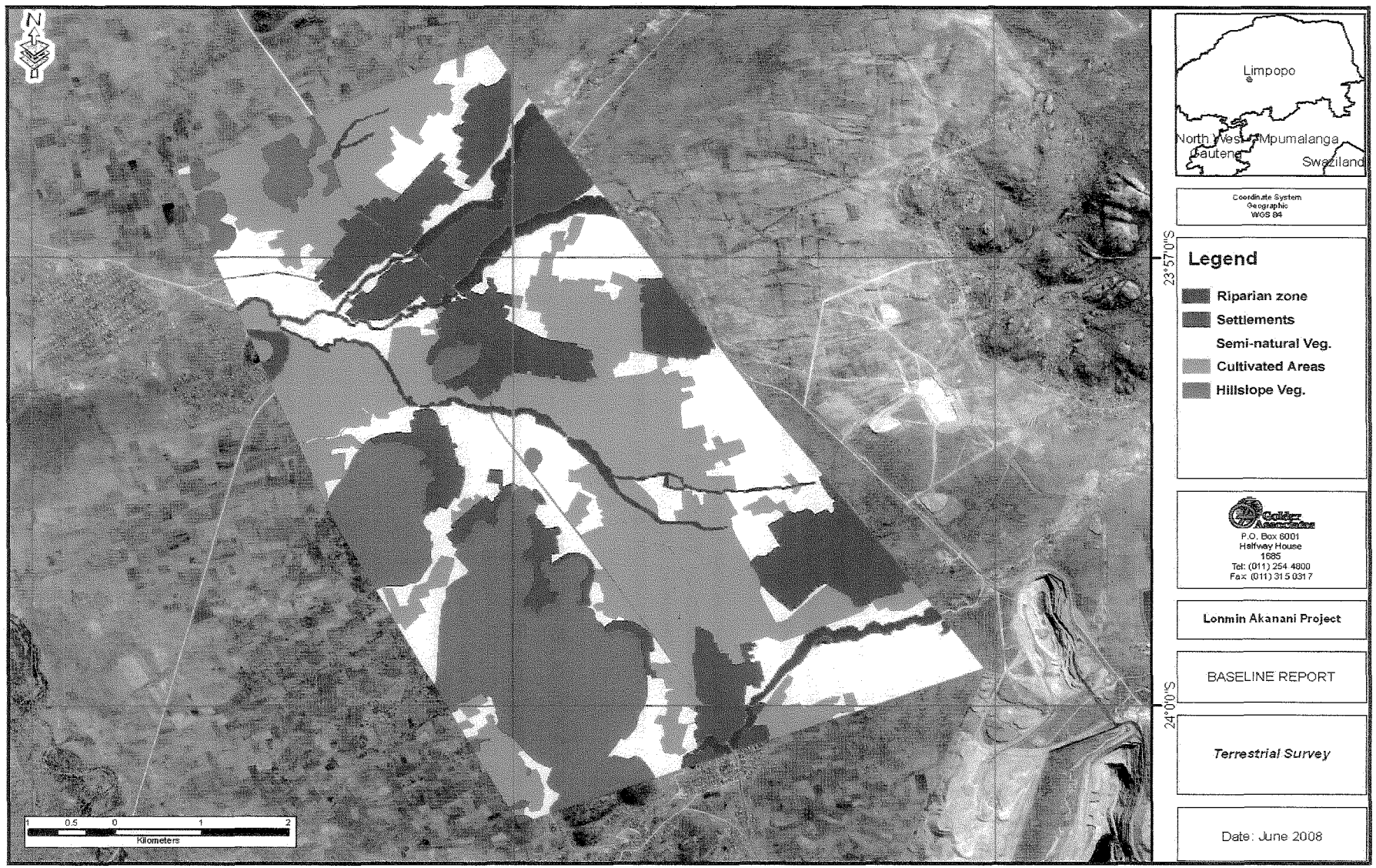


Figure 3: Vegetation communities within the broader Akanani prospecting area (Golder Associates, July 2008).

2.7 SURFACE WATER

2.7.1 Data Collection

Background information pertaining to the baseline surface water environment was sourced from the various specialist reports that have been compiled as part of the environmental and social pre-feasibility investigations for the Akanani platinum project. Information pertaining to surface water quality was extracted from the report titled "*Baseline Monitoring, Aquatic Environment associated with the Proposed Platinum Mine of Lonmin Akanani*", dated May 2008, compiled by Golder. As part of the aquatic study, water quality was measured (Total Dissolved Solids, pH, Dissolved Oxygen, Temperature) in the field with lightweight compact field instruments.

2.7.2 Description

The study area, including the prospecting shaft site, falls within the Limpopo Water Management Area in the A61G quaternary catchment (Mogalakwena catchment). The study area is drained by two main non-perennial drainages, namely the Thathwe River in the northern and central portions of the prospecting area, on the farm Moordkopje 813 LR, and the Mohlosane River along the southern boundary, on the farm Zwartfontein 814 LR. Both these rivers drain into the northward flowing Mogalakwena River, which drains into the Limpopo River west of Alldays. The Thathwe and Mohlosane Rivers are non-perennial. The proposed prospecting shaft site is situated approximately 300 m from the Mohlesane River.

In situ pH values for the Mohlosane River were approximately 8.8, Dissolved Oxygen concentrations in the sample area were adequate (> 5 mg/l), Total Dissolved Solids concentrations ranged from 97.5 mg/l to 611 mg/l, and water temperatures ranged from 22.1°C to 29.9°C. Water quality in terms of Total Dissolved Solids concentrations, Dissolved Oxygen and temperature of the relevant watercourses was deemed acceptable at the time of the survey.

2.8 GROUNDWATER

2.8.1 Data Collection

A specialist groundwater assessment was undertaken by Golder during October 2008. The relevant report: *"A Baseline Groundwater Review and Impact Assessment for the Proposed Prospecting Shaft at the Akanani Project Site*", is attached to this document as **Appendix B.3**.

A geophysical survey comprising FDEM (Frequency Domain ElectroMagnetic) and a Magnetic survey was undertaken across the Akanani Project Area in June 2008. The magnetic traverses generally followed the same lines as the FDEM traverses. Several magnetic anomalies were identified associated with lineaments or intrusive bodies (dykes).

A summary of the three boreholes is presented in **Table 1**. The positions of these boreholes relative to the bulk sampling shaft are shown in **Figure 4.** Weathered to fresh norite was found in the boreholes.

Table 1: Summary Drilling Table.

Hole ID	UTM Zone 35 J (WGS84)		Elevation	Date Drilled (Completed)	Drilling Depth	Drilling Diam	Casing Depth	Internal Casing Diam.	Slotted Casing Depth	Depth of Weathering	Depth of Fracturing	Water Strike Depths	Final Blowing Yields
	Y(m)	X(m)	(mamsl)		(mbgl)	(mm)	(mbgl)	(mm)	(mbgl)	(mbgl)	(mbgl)	(mbgl)	l/s
AK01	7345859	692525	1091	30 July 08	85	165	4	171	N/A	17		10	0.2
AK02	7345446	691936	1082	31 July 08	64	165	3	171	N/A	2	6-8	8	0.1
AK03	7345324	692897	1094	01 August 08	23	165			N/A	Min 23	-	10	3
AK03A	7345329	692895	1094	03 August 08	61	165	13	171	N/A	13	25-26	26	0.4

2.8.2 Description

Drilling of boreholes AK01 to AK03A has shown that a relatively shallow aquifer occurs within the weathered and fractured norite and gabbro-norite. These intersections generally occurred between 8 and 10mbgl, coinciding closely with the base of the weathered zone in the norite and gabbro-norite lithology.

The very similar water levels intersected in the borehole pair AK03 and AK03A suggests that there is a single aquifer within the weathered and fractured norite. It is reasonable to assume that faults and fracture zones enhance and extend the groundwater flow conditions along such linear geological features to some depth.

In addition the drilling has shown:

- Blowing yields varied from approximately <0.1 l/s to 3 l/s;
- Static water levels varied from 2.5 mbgl to 6.85 mbgl;
- No water intersections occurred below 26 mbgl in massive unfractured norite; and
- Weathering depth generally varies between 2 mbgl and 23 mbgl.

Testing

Limited short-term testing of the boreholes to gain an understanding of the aquifer hydraulics was undertaken. The hydraulic parameters determined from the test data provide an essential inputs to the numerical flow (and future solute transport) model.

Testing was undertaken in August 2008. AK02 was tested using a slug-test method since the hydraulic conductivities (K) of the ground were too low to allow pumping tests. Boreholes AK01 and AK03A were tested with a step-discharge test (SDT) consisting of 3 to 4 steps. After water levels recovered to their original levels, a 12-hour constant discharge test (CDT) was followed by the measurement of the recovery of the water level after the pump was switched off. These data have been used to calculate the transmissivity (T) of the intersected aquifer unit in the boreholes.

The CDT data were analysed using the Cooper-Jacob method to obtain T values. An overall transmissivity of 2 m^2/day was estimated for both boreholes AK01, and AK03A. A hydraulic conductivity value (K) of 0.1m/day was obtained for borehole AK02 using the slug test data obtained.

A transmissivity value of 65 m^2/day was obtained for borehole AK03, while AK03A was pumped. The relatively immediate drawdown of the water level in borehole AK03 in response to the pumping in borehole AK03A suggests a fairly direct hydraulic connection between the shallow water strike (10mbgl) in AK03 and the deeper water strike (26mbgl) in AK03A.

The testing indicated the presence of a shallow heterogeneous weathered and fractured norite aquifer zone. Based on the geological logs it is estimated that the aquifer zones near the bulk sampling facility are on average in the order of 1 to 5m thick and at approximate depths of between 5 and 25m. Enhanced depths of weathering and fracturing are likely to be associated with linear geological features such as faults and fracture zones.

Water Levels

Combining the water levels measured during the hydrocensus and those from the current drilling investigation shows that the groundwater flow directions on a regional scale is generally towards the north-west towards the Mogalakwena River. In the southern portion of the project area there is a westerly to south-westerly groundwater flow component along the Mohlosane River drainage.

Groundwater Quality

Four groundwater samples were taken during from boreholes AK01 and AK03. These samples were submitted to UIS Analytical Services in Pretoria, an accredited laboratory.

Samples obtained during the CDT tests represent boreholes that have been purged significantly longer than those taken during the SDT. Based on the analyses of the samples, there was no significant change in the

overall composition of the groundwater after pumping for this time. The water is dominated by bicarbonate (HCO_3) and carbonate (CO_3) ions in solution.

The quality of the groundwater compares favourably with the water sampled across the Akanani prospecting site during the hydrocensus and is consistent with the generally decreasing groundwater quality trend from east to west across the site.

The water sampled in boreholes AK01 and AK03 fall within the class 0 to class 1 range with respect to most groundwater quality parameters. The magnesium concentration of the groundwater sampled in borehole AK01 is slightly elevated (81 & 85 mg/l) but is still within the class 2 limit (SANS 241). The groundwater in boreholes AK01 and AK03 have ideal levels of iron (Fe), below the analytical detection limit of 0.05mg/l.

2.9 AIR QUALITY

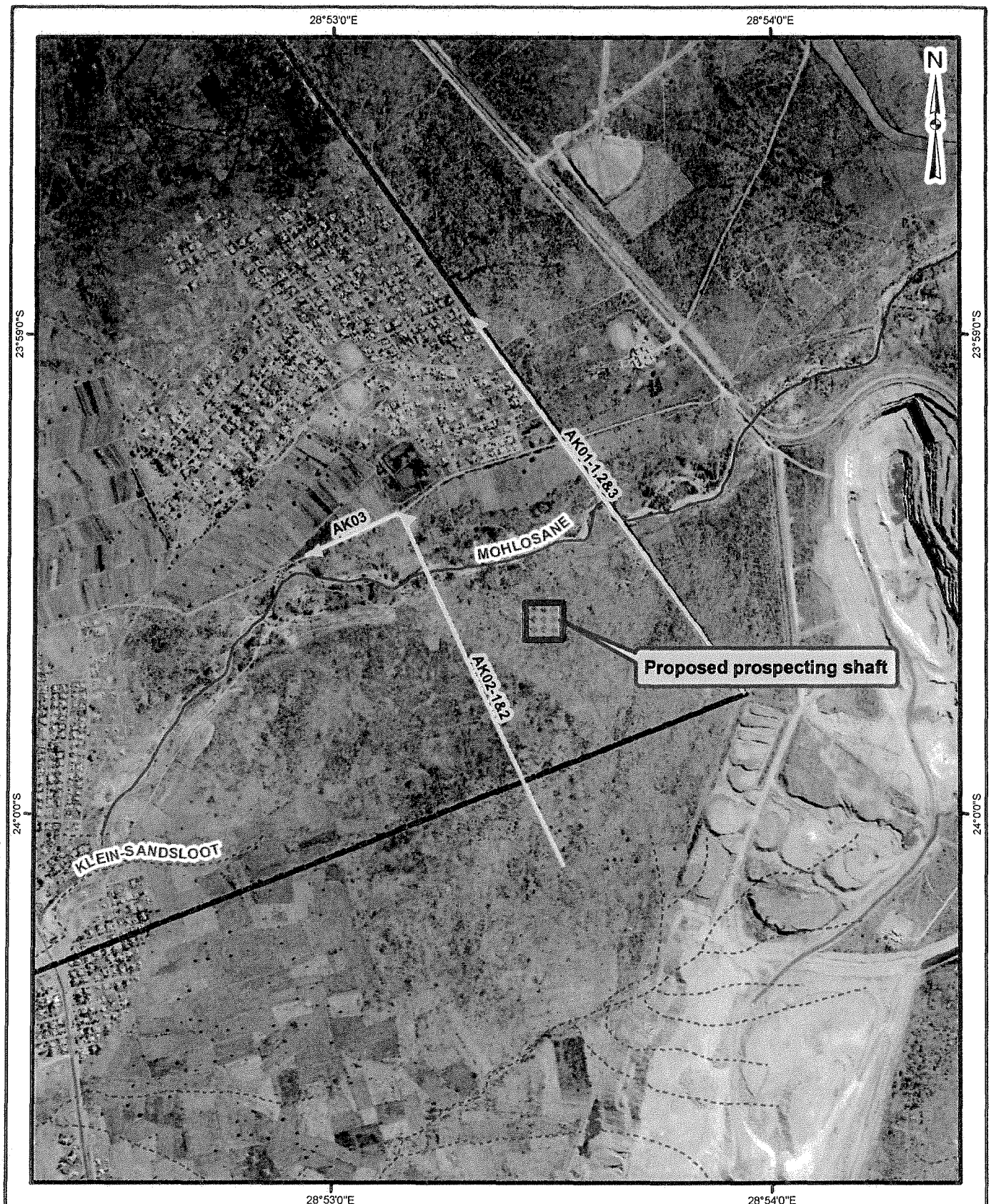
2.9.1 Data Collection

As part of the environmental and social pre-feasibility investigations for the Akanani Platinum Project, dust fallout rates at specific sites within the study area were monitored on a monthly basis from December 2007 to August 2008. The American Society for Testing and Materials standard method for collection and analysis of windblown dust deposition with dust buckets was used. A total of 17 dust buckets were installed on site, as shown in **Figure 5** below.

Monthly reports are compiled which describe the dust fallout rates relative to the Dust Fallout Guidelines of the Department of Environmental Affairs and Tourism (DEAT), **Table 2** and the SANS 1929 four-band scale for dust deposition, **Table 3**.

Table 2: DEAT dust fallout guidelines.

Classification	Dust fall-out averaged over 1 month (30 day average) ($mg/m^2/day$)
Very heavy	> 1 200
Heavy	500 – 1 200
Moderate	250 – 500
Slight	< 250



LEGEND

- Proposed prospecting shaft
- Geophysical traverse
- Drainage
- River
- Study area

REFERENCE

Projection: Transverse Mercator Datum: WGS84 Coordinate System: LO 29

REVISION 1

250 0 250 500 750 1,000

SCALE 1:20,000 METRES

PROJECT

LONMIN AKANANI

TITLE

GEOPHYSICAL SURVEY LINES
NEAR THE PROPOSED PROSPECTING SHAFT

Golder Associates
Johannesburg, South Africa

PROJECT No. 11608			SCALE AS SHOWN	REV. 0
DESIGN	MM	09/10/2008		
GIS	MM	09/10/2008		
CHECK	TD	09/10/2008		
REVIEW	GLH	09/10/2008		

FIGURE: 4

G:\GIS\GIs Projects\11608 - EIA&MP for bulk sample Akanani Mine, Lonmin Plat\Mxds\Oct 2008\Geophysical survey.mxd

Table 3: Four-band scale evaluation criteria for dust deposition (SANS 1929).

Band number	Band description label	Dust fall rate (D) ($mg/m^2/day$), 30 day average	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1 200	Permissible for heavy commercial and industrial
3	Action	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	Alert	2 400 < D	Immediate action and remediation required following the first exceedance. Incident report to be submitted to the relevant Authority.

2.9.2 Description

In terms of baseline ambient air quality, no suitable information (within a 20 km radius of the proposed site) on the background air quality in the proposed project area is available as no monitoring appears to be undertaken except for the recording of dust fallout by Anglo Platinum at the PP Rust Mine. The project falls outside of the Highveld National Priority Area, however, air quality in the Limpopo Province has been noted as having the potential to be an issue of concern if air pollution from the other provinces were to undergo transboundary transport.

Ambient air quality in the Limpopo Province is strongly influenced by regional atmospheric movements, together with local climatic and meteorological conditions. This province experiences distinct weather patterns in summer and winter that affect the dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. Summer rainfall also aids in removing pollutants through wet deposition. In contrast, winter is characterised by atmospheric stability caused by a persistent high pressure system over South Africa. This dominant high pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality.

Based on the baseline dust fallout monitoring for the Akanani Project carried out by Gondwana Environmental Solutions, the dust fallout throughout the entire prospecting area is fairly low, with an average of 226 $mg/m^2/day$ for the entire monitoring period, (December 2007 to August 2008) except for Site 6 and Site 4 (see **Figure 5**). Site 6 is located on a main dirt access road between two operational mining areas operated by Anglo Platinum. Elevated dust fallout levels may therefore be expected at this site. Site 4 is located on the property of the Department of Water Affairs and Forestry. The higher level of dust fallout from this site may be as a result of elevated levels of traffic to this government office. The office is also surrounded by several dirt roads which are used by the community residing in the near vicinity.

2.10 Noise and Vibration

2.10.1 Data Collection

A specialist "*Noise and Vibration Assessment*" was undertaken by dBAcoustics during June 2008. Refer to **Appendix B.4**.

A site visit was carried out in and around the proposed prospecting shaft area in order to:

- Identify the major contributors to the prevailing ambient noise level in the vicinity of the study area;
- Identify the nearest sensitive noise receptors (residential areas) and to identify major feeder roads; and
- Identify potential measuring positions within the study area.

Ambient noise readings were carried out at 21 measuring points in the study area in order to get a representative ambient noise level in the proposed prospecting shaft area and the immediate surrounding residential villages. Nighttime ambient noise level readings were done at the same measuring points as for the daytime period.

2.10.2 Description

Noise

The results indicate that the sound pressure levels on the western side of GaMasenya (Hans) Village is typical for an area next to a provincial road whereas the nighttime noise level on the eastern side of this Village is higher during the nighttime than during the daytime.

The nighttime ambient noise level on the northern side of Skimming Village is higher than the daytime period. The day and nighttime sound pressure levels are more or less the same at the northern and southern sides of Leruleng village.

According to the South African National Standards (SANS) the daytime ambient noise level should normally be about 10dBA higher than the nighttime period, which is not the case for the measured areas, due to of the neighboring existing mining activities which influence the nighttime sound pressure levels.

The following noise sources occur in the vicinity of the study area:

- GaMasenya Village (Hans): Traffic noise, distant mining activity noise, animal noise, rattling sounds from vehicles traveling on the gravel road, domestic type noises, insects, birds and wind noise.
- Skimming village: Distant and near mining noise, farming activity noises, rattling sounds from vehicles traveling on the gravel road, domestic type noises, animal and bird life noise and wind noise.
- Leruleng village: Distant and near mining noise, traffic noise, rattling sounds from vehicles traveling on the gravel road, domestic type noises, animal and bird life noise and wind noise.

Vibration

Prevailing vibration levels were measured at 13 of the 21 noise measurement points in the study area. The vibration levels at all these points were found to be insignificant.

2.11 SITES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

2.11.1 Data Collection

During July 2008, Dr Julius Pistorius completed a Phase I Heritage Impact Assessment (HIA) for the proposed Akanani prospecting shaft area, as required in terms of Section 38 of the National Heritage Resources Act, Act 25 of 1999. The aims of the study were:

- To determine if any of the types and ranges of heritage resources (the 'national estate') as outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999) do occur within the boundaries of the proposed Akanani prospecting site and to establish the levels of significance of these heritage resources; and
- To establish whether these heritage resources will be affected by the new mining development project and, if so, to propose mitigation measures for those heritage resources that may be affected by the development project.

Figure 5: **Pin pointers denote the locations of the 17 dust fallout buckets at the Lonmin Akanani site. Green pointer = slight dust fallout; yellow pointer = moderate dust fallout; orange pointer = heavy dust fall out; red pointer = very heavy dust fallout.**

2.11.2 Description

The Limpopo Province has a rich heritage comprised of remains dating from the pre-historic and historical (or colonial) periods of South Africa. Pre-historic and historical remains in the Limpopo Province present a record of the heritage of most groups living in South Africa today. The original and present occupants of the wider Akanani Project Area are the Langa Ndebele who occupied this area for several centuries. The Langa Ndebele subjugated a large number of clans in the region.

The proposed prospecting shaft site is surrounded by communities whose ancestors were once part of the sphere of influence of the Langa Ndebele, a community whose origins can be traced to Nguni (Kwa Zulu-Natal) ancestry. The Langa Ndebele intermarried, over centuries, with numerous Sotho and other clans. They occupied villages and homesteads in the territory within the broader Akanani prospecting site.

The descendants of the Ledwaba/Maune Ndebele clans live in the Bergzicht-Kalkspruit and Mašašane townships to the east of the Akanani prospecting area.

The Phase I HIA study for the Akanani prospecting shaft site revealed the following types and ranges of heritage resources:

- Stone tools uncovered in the Mohlosane River - mostly derived from the Middle Stone Age, dating back 200 000 years to 22 000 years. These stone tools were limited in number and were not found occurring as large concentrations (assemblages) in a closed (sealed) stratigraphical context.
- Remains dating from the Late Iron Age/Historical Period that consisted of a scatter of metal working slag. It is possible that these remains date from the Late Iron Age (AD1600-1840) or from the Historical Period (AD1840-1880).
- Remains from the recent past (i.e. less than sixty years old) consist of remains of dwellings scattered across the project area. Four of these remains were recorded. It is possible that more remains, particularly graves, may exist but that they are unmarked or located in inconspicuous locations.
- Graves, of which six were found during the Phase 1 HIA. These graves are informal and are demarcated by means of stones. It is possible that more of these graves exist, but that they are unmarked or located in inconspicuous locations.

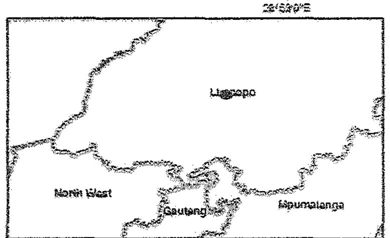
The stone tools, remains from the Late Iron Age/Historical Period (scattered metal working slag), some of the remains from the recent past and the graves were geo-referenced and mapped during the Phase 1 HIA, as shown in **Figure 6** below. It must be noted that the remains from the recent past are extensive and that not all of these remains were mapped.

2.12 SENSITIVE LANDSCAPES

A 'sensitive landscape' usually falls within one of the following categories:

- Nature conservation areas and important natural resources;
- Unstable physical environments;
- Sites of archaeological, cultural and historical value;
- Sites of scientific interest;
- Green belts or public open spaces; *or*
- Wetlands.

Based on the vegetation and faunal investigations undertaken at the project area, the most sensitive ecological zones are considered to be the hillslope vegetation, with high ecological function and conservation importance, and the semi-natural vegetation and riparian vegetation, with medium conservation importance and ecological function.



LEGEND

- Grave
- Prospecting shaft infrastructure
- Fence

NOTES

150 75 0 150 300 450 600

Metres

REFERENCE

Projection: GCS WGS 1984

PROJECT

LONMIN AKANANI

TITLE

LOCATION OF IDENTIFIED HERITAGE SITES RELEVANT TO THE PROPOSED AKANANI PROSPECTING SHAFT SITE

Golder Associates
Johannesburg, South Africa

FIGURE: 6

G:\GIS\GIS Projects\11808 - EIA EMP Akanani Mine Lonmin Plan\Maps\May 2009\Heritage.mxd

The semi-natural vegetation types identified on the proposed prospecting shaft site are well-represented outside of the study area, and are thus not considered a threatened ecosystem or 'important natural resource'.

The proposed project site can be described as a 'sensitive landscape' based on the presence of archaeological sites in the direct vicinity of the proposed site.

Also refer to Section 2.11 above.

2.13 VISUAL ASPECTS

The proposed project site is relatively flat, covered with grass and bush with scattered trees. The site has been seriously denuded by overgrazing. The abutting residential area GaMasenya (Hans) and Skimming/Leruleng is situated towards the north and west of the prospecting shaft site. Agricultural land, often largely abandoned or fallow, occurs in the vicinity of the villages.

The proposed prospecting shaft site is located south of Anglo Platinum's Potgietersrust Platinum Mine ("PP Rust"), an open pit operation. The PP Rust mine's overburden stockpiles are situated approximately 500 m south of the prospecting shaft site, and constitute the dominant landscape feature as viewed from the proposed site and/or surrounding villages.

The Mohlosane River is located approximately 300 m north of the proposed prospecting shaft site and the Fonthane Mountain Range is located towards the west of the prospecting shaft site.

2.14 REGIONAL SOCIO-ECONOMIC STRUCTURE

2.14.1 Data Collection

A Social Impact Assessment (SIA) for the proposed prospecting shaft project was carried out by Golder in mid 2008 and completed in October 2008. The SIA was based on existing information collected as part of the baseline socio-economic study ("*Socio-economic baseline study for Lonmin Akanani near Mokopane, Limpopo Province*", October 2008) that was conducted on the broader Akanani prospecting area.

2.14.2 Description

The proposed prospecting shaft site is located in Ward 18 of the Mogalakwena Local Municipality, situated within the Waterberg District Municipality in the Limpopo Province. According to the 2001 Census statistics, the Mogalakwena Local Municipality has a total population of approximately 298 400, which accounts for almost half of the District Municipality's population.

The land on which the proposed prospecting shaft is to be constructed is owned by the South African Government, and is used mainly for communal grazing. No households are located in the ~2 ha study site. See **Figure 7**.

The closest residential areas to the proposed prospecting shaft site are Skimming and Leruleng, located in Ward 14 of the Mogalakwena Local Municipality, approximately 700 m towards the north of the proposed prospecting shaft site and GaMasenya Village (Hans), located in Ward 17 of the Mogalakwena Local Municipality, approximately 3 km towards the west of the proposed prospecting shaft site.

The villages in the study area form part of the Mapela Traditional Authority, which presides over a total of 42 villages spread over a large geographical area. Skimming and Leruleng have an estimated combined population of approximately 3 710 with an estimated total of 530 households, whilst GaMasenya Village (Hans) has an estimated population of approximately 2 170 with an estimated total of 310 households. The villages in the study area are experiencing a growth in population.

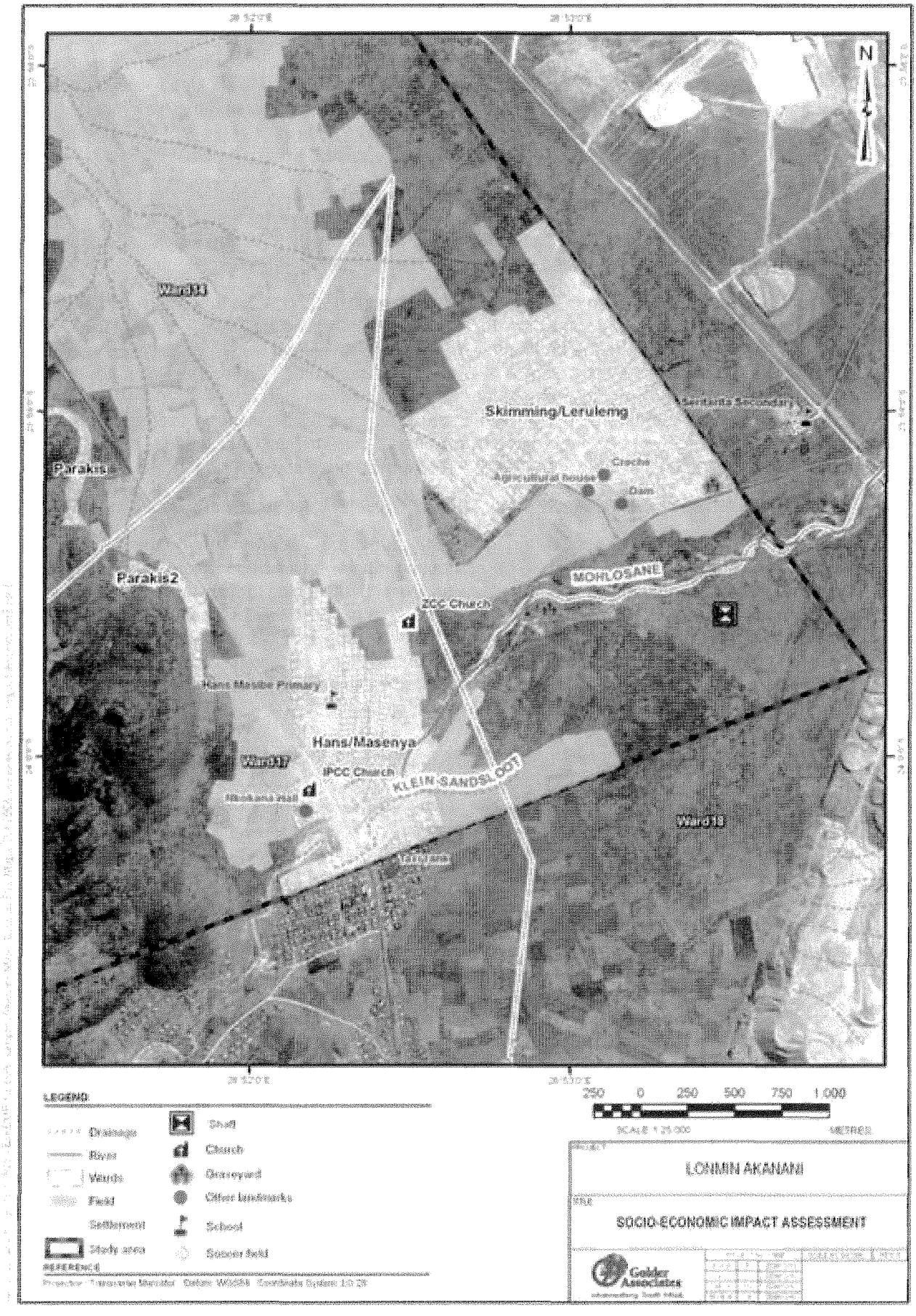


Figure 7: Villages and socio-economic infrastructure located in the study area.

The main economic activities in the area are the mining and agriculture sectors, which account for the majority of the employment opportunities in the study area. Subsistence agriculture is practiced as a secondary economic activity to supplement a household's income and sustenance. Unemployment rates are estimated to be in excess of 40%. Information that was gathered from a desktop review of documents as well as site visits indicates unemployment may not be as high as community members believe. This is corroborated by the continued influx of people into the area. However, there is a shortage of skills and funds in the area, which hampers efforts to develop small enterprises.

A large proportion (more than 75%) of the households in the study area are dependent on child grants or pension grants for partial household income, which typically have to sustain more than seven people in a household. Education levels in the study area are low, with nearly 50% of the population having no or limited primary education, which is the case throughout the entire Limpopo Province.

According to the Lonmin Akanani Stakeholder Landscape Report, Leruleng has fertile soil, utilising gravity irrigation from an adjacent ground dam to optimise their farming activities. However, the extent of this is expected to be limited due to the particularly dry climate with limited water resources. Livestock husbandry is not prevalent in this area either, also as a result of the particularly dry and hot climate. It is estimated that approximately 5% of households keep cattle, with herd sizes varying between 20 and 50 head of cattle. The scarcity of water presents a significant limitation to agricultural activities in the study area. The proposed prospecting shaft site will be situated in an area that is currently used for grazing purposes. During the SIA study, no agricultural fields were identified in the proposed project area.

Whilst all households have electricity supply to their houses, water supply and sanitation services are limited.

From discussions with local people during the SIA study, it is apparent that communities in the study area have two main needs that they wish to be addressed, namely skills training to obtain employment and water provision. However, communities are highly mistrusting of mining activities in the area due to previous negative experiences involving resettlement. The communities are also concerned that they will see a repetition of the disappointment that they experienced from undelivered past promises by mining houses. However, communities request that preferential employment be given to the local communities, with the potential of skills development programmes being implemented prior to the commencement of mining activities, rather than sourcing workers from other areas.

2.15 INTERESTED AND AFFECTED PARTIES AND PUBLIC PARTICIPATION PROCESS

Golder Associates conducted an extensive public consultation process as part of the EIA process which commenced during June 2007. The public participation process followed for the Akanani EIA compiles with the requirements of the MPRDA and the NEMA. The EIA is however being undertaken in terms of the MPRDA, with the DME as lead Authority.

2.15.1 Objectives of Public Participation

Public participation in an EIA is not only a statutory requirement, but a process that should lead to a joint effort by stakeholders. Stakeholders should represent all relevant interests and sectors of society, technical specialists and the various relevant organs of state who work together to produce better decisions than if they had acted independently. It also results in better implementation of decisions through stakeholders "owning" the process.

The public participation process for this EIA was designed to provide sufficient and accessible information to I&APs in an objective manner to assist them to:

- During the Scoping Phase:
  - Raise issues of concern and suggestions for enhanced benefits;
  - Contribute local knowledge and experience; and
  - Verify that their issues have been captured.
- During the Impact Assessment Phase:
  - Verify that their issues have been considered by the EIA technical investigations; and

- Comment on the findings of the impact assessment, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative impacts.

Key elements of the process are described below.

2.15.2 Who are the stakeholders?

The stakeholders involved in the Scoping and Impact Assessment Phases of this EIA include representatives from several sectors of society, including relevant government departments at three levels (national, provincial and local), the Lonmin Community Forum[1], the Mapela Tribal Council, spokespeople for key organisations, NGOs, leaders of previously disadvantaged communities in the area and others. A stakeholder database was proactively compiled for this project, resulting in more than 150 individuals and organisations being involved in the Scoping and Impact Assessment Phases of this EIA. Correspondence with stakeholders during the Scoping and Impact Assessment Phases is outlined below. The full list of stakeholders (i.e. Interested and Affected Parties) involved in this EIA thus far is attached as **Appendix C.1**.

Issues raised to date were incorporated into an Issues and Response Report attached to this document as **Appendix C.2**.

2.15.3 Summary of the Public Participation process during the Scoping Phase

A summary of the Public Participation process followed thus far, i.e. during the Scoping Phase of this EIA, is tabulated below.

Table 4: Summary of the Public Participation process followed thus far.

Dates	Description
Project Announcement:	
July 2008	The EIA and the opportunity to contribute was announced by way of: • An ***announcement letter*** and ***Background Information Document (BID)***, available in Sepedi and English, distributed to all stakeholders on the stakeholder database (refer to **Appendix C.3**); • Two ***advertisements*** (one in Sepedi and the other in English) were published in a local newspaper, Die Bosvelder, on 24 July 2008 (**Appendix C.4**); and • Eight ***site notices*** were displayed at various locations in the vicinity of the proposed project site from 30 July 2008 (**Appendix C.5**).
8 July 2008	An ***Authorities Meeting*** was held with the Department of Minerals and Energy (DME), the Limpopo Department of Economic Development, Environment and Tourism (LEDET), the Waterberg District Municipality and the Mogalakwena Municipality in Polokwane on Tuesday, 8 July 2008. The Department of Water Affairs and Forestry (DWAF) was invited to this meeting but could not attend. The attendance register for the Authorities Meeting is attached as **Appendix C.6**. The main objectives of this meeting were: • To inform the authorities about the EIA; • To confirm the EIA process with the authorities and obtain their guidance and buy-in on this process; and • To capture any issues and/or suggestions for enhanced benefits. The issues raised during this meeting are captured in the Issues and Response Report (**Appendix C.2**).
14 July 2008	A ***Meeting*** was held with the ***Mapela Tribal Council*** on 14 July 2008. The main objectives of the meeting were: • To inform them of the proposed project and EIA; • To formally request permission from them for the process to announce the project to the general public in their area; and • To formally request permission, as a courtesy, to send various specialists to the community to conduct the specialist studies as part of the EIA. The attendance list for this meeting is attached as **Appendix C.7**. The issues and comments raised during this meeting are incorporated into the attached Issues and Response Report (**Appendix C.2**).

[1] The Lonmin Community Forum comprises chairpersons representing the seven Villages situated within the Akanani prospecting area.

Dates	Description
29 July 2008	Two ***Key Stakeholder Meetings*** were held on 29 July 2008. Refer to **Appendix C.8** for the attendance registers. The main objectives of these meetings were: • To inform key stakeholders about the proposed project; • To invite them to comment on the proposed project; and • To capture initial issues and/or suggestions for enhanced benefits. The issues raised during these meetings are captured in the Issues and Response Report (**Appendix C.2**).
Scoping Phase:	
August to October 2008	A ***progress feedback letter*** to announce the availability of the Draft Scoping Report for public comment, together with a ***comment sheet*** and ***provisional programme*** for the Public Meeting (**Appendix C.9**) was mailed/emailed to all stakeholders on the database, including the Lonmin Community Forum and the Mapela Tribal Council on 15 August 2008, with the following objectives: • To inform them of the availability of the Draft Scoping Report for public comment; • To invite them to request a copy of the Report should they so wish; and • To invite them to the public meeting. The Draft Scoping Report was made available for a 30-day public comment period form 22 August to 23 September 2008. Stakeholders were invited to comment on the Draft Scoping Report and accompanying Issues and Response Report in any of the following ways: • Raising comments during the public meeting; • Completing the comment sheets enclosed with the reports at the public places; and • Submitting additional written comments by e-mail or fax, or by telephone to the public participation office. Subsequent to requests from the Lonmin Community Forum, the Scoping Report was made available for an extended public comment period from 1 October 2008 to 21 October 2008, to provide the public with a further opportunity to raise their concerns, comments and suggestions. The initial public meeting date was also subsequently moved to 14 October 2008. A ***progress feedback letter*** to announce the extended comment period and new public meeting date, together with a ***comment sheet*** and ***provisional public meeting programme***, was mailed to all stakeholders on the database. Refer to **Appendix C.10**. It was agreed hat all EIA public documents will, in future, be mailed to the Lonmin Community Forum representatives before distribution to the communities. This will help the representatives to assist community members to comment on the documents.
August to October 2008	Distribution of the Draft Scoping Report and Issues and Response Report were as follows: • Left at the following public places: - Mapela Thusong Service Centre - Mapela Post Office - Seritarita Secondary School - Hans Masibe Primary School - Mapela Tribal Office - Lonmin Akanani Division, Reception - Golder Associates Africa, Midrand • Distributed to everyone who requested a copy • Placed on the Golder website: www.golder.co.za
14 October 2008	A ***Public Meeting*** was held on Tuesday, 14 October 2008 at the Mapela Tribal Council Hall. The main objectives of the meeting were: • To present to stakeholders the content of the Draft Scoping Report; • For stakeholders to verify that the issues they have raised thus far in the process have been captured correctly; • For stakeholders to comment on the scope of the specialist studies; and • For stakeholders to raise additional issues of concern and suggestions for enhanced benefits. The Public Meeting attendance register is attached as **Appendix C.11**. The issues and comments raised during this meeting are incorporated into the attached Issues and Response Report (**Appendix C.2**).
October 2008	The Draft Scoping Report and Issues and Response Report was updated with additional issues raised by Interested and Affected Parties and new information generated as a result, and submitted to the DME. (The DME subsequently indicated that the Department will only comment on the Prospecting EIA Report and EMP Amendment, and will not issue formal comments on the Scoping Report.) Refer to **Appendix C.13** for the relevant confirmation letter.

2.15.4 Public Participation during the Impact Assessment Phase

Public participation during the impact assessment phase of the EIA revolves around a review of the findings of the EIA, presented in the EIA Report and EMP, and the volume of Specialist Studies. These reports are available for public comment from **Thursday, 28 May 2009 to Thursday, 25 June 2009**.

Stakeholders are invited to comment on the EIA Report and EMP in any of the following ways:

- Completing the comment sheets enclosed with the reports at the public places; and
- Submitting additional written comments, by e-mail or fax, or by telephone to the public participation office.

Distribution of the EIA Report and Specialist Studies for comment is as follows:

- Left at the following public places:
  - Mapela Thusong Service Centre
  - Mapela Post Office
  - Seritarita Secondary School
  - Hans Masibe Primary School
  - Mapela Tribal Office
  - Lonmin Akanani Division, Reception
- Golder Associates Africa, Midrand
  - Distributed to everyone who requests a copy
  - Placed on the Golder website: www.golder.co.za

All the issues raised during the comment period on the EIA Report and EMP will be added to the Issues and Response Report that will accompany the Final EIA Report and EMP when submitted to the Department of Minerals and Energy for decision-making.

2.15.5 Authorities' final decision

Once the DME have taken a final decision, the public participation office will immediately notify stakeholders of this decision and of the opportunity to appeal within 30 days.

3. PROJECT MOTIVATION AND ALTERNATIVES CONSIDERED

The following sections describe the potential benefits associated with the proposed project, as well as the alternatives considered.

3.1 BENEFITS OF THE PROPOSED PROJECT

Platinum Group Metals (PGMs) are primary platinum-related products. The mining of this group is mainly driven by the international demand for platinum. Lonmin aims to capture and build growth opportunities to supply healthy market demand for PGMs. Accordingly, Lonmin is investigating the feasibility of developing the platinum ore body (i.e. Platreef) about 25 km north of the town of Mokopane, formerly Potgietersrus. The project is referred to as the Akanani platinum project.

Due to the complexity of process technologies and a lack of understanding of the behaviour of the Platreef ore in the Akanani platinum project area, a large amount of test work is needed to determine process flow sheets, operating parameters and process mass balances. These are required for the detailed engineering designs needed to build the processing infrastructure. Due to the unique nature of the Platreef and the significant difference in mineralogy from the Merensky and UG2 reefs (which are Lonmin's experience base), a detailed test programme will be required to firm up on design and operating parameters for the various processing operations. No similar reef currently exists which could be used to benchmark against, and therefore a bulk sample (+/- 3 000 tons) of the Platreef is required. The size of the bulk sample needed is due to the nature of the process chain and the significant upgrading of the ore that occurs at each part of the process. By way of example:

- 3 000 tons of ore yields approximately 120 tons of flotation concentrates for smelting test work,
- 120 tons of concentrate yields approximately 20 tons of matte for Base Metal Refinery test work, and
- 20 tons of matte yields approximately 128 kg of concentrate for Precious Metals Refinery test work.

These quantities are considered to be the minimum required to minimise risk and result in a robust process design that will ensure the technical and economic viability of the Akanani platinum project.

The existing approved method for bulk sampling and testing, as stipulated in the approved Prospecting Work Programme, is drilling. If the bulk sample is collected through prospecting drill holes, it would take roughly 25 years to collect a bulk sample of 3 000 tons. The only other viable method to collect the bulk sample is through the sinking of a prospecting shaft, which will take about 3 years.

The sinking of the proposed prospecting shaft is thus necessary for the collection of a bulk sample of 3 000 tons of the Platreef for metallurgical testing, which will form a vital part of the feasibility investigations for the Akanani platinum project.

Should the proposed prospecting shaft not be developed, it would not be possible to obtain a bulk sample of the required size (3 000 tons). This would significantly influence the development of the Akanani platinum project.

3.2 CONSIDERATION OF PROJECT ALTERNATIVES

Alternatives are defined in Government Regulation 385, published in terms of the National Environmental Management Act, Act 107 of 1998, as "different means of meeting the general purpose and requirements of the activity, which may include alternatives to –

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity; *and*
(e) the operational aspects of the activity."

In terms of Section 50(d) of the Regulations published under the Mineral and Petroleum Resources Development Act, Act 28 of 2002, "the contents of an environmental impact assessment report must include a comparative assessment of the identified land use and development alternatives and their potential environmental, social and cultural impacts."

This section provides an overview of feasible and reasonable alternatives that have been considered as part of this project. Where alternatives have been discarded, reasons are provided.

3.2.1 Location alternatives

The proposed location of the prospecting shaft site was determined by the underlying geology of the area. The site was identified based on the depth of the Platreef and other geological and technical characteristics. No location alternatives were therefore considered, due to the geological and technical constraints relevant to the selection of a prospecting site such as the one being proposed.

3.2.2 Activity alternatives

As explained earlier, the existing approved method for bulk sampling and testing, as stipulated in the approved Prospecting Work Programme, is drilling. If the required bulk sample is collected through prospecting drill holes, it would take roughly 25 years to collect a bulk sample of 3 000 tons. The only other viable method to collect the bulk sample is through the sinking of a prospecting shaft, which will take about 3 years.

The sinking of the proposed prospecting shaft is thus necessary for the collection of a bulk sample of 3 000 tons of the Platreef for metallurgical testing, which will form a vital part of the feasibility investigations for the Akanani platinum project.

The only other project activity alternative, drilling, is therefore not feasible, and the proposed development of a prospecting shaft is the only feasible method (activity) to obtain the required bulk sample.

3.2.3 Technology used in the activity / Process alternatives

Two alternative bulk sampling methods have been investigated, namely drilling and by sinking of a prospecting shaft.

If a bulk sample is collected through prospecting drill holes (reef starts at 800 metres below surface), approximately 10 000 to 14 000 reef intersections/boreholes would be required. The cost to accumulate such a sample by drilling is not financially feasible. Furthermore, the time to accumulate adequate core from drilling would be in excess of 25 years.

The only viable alternative to collect the bulk sample is through the sinking of a prospecting shaft. This option, of sinking a prospecting shaft, will take a period of 3 years. This option is thus the preferred option for acquiring the bulk sample. Subsequent to obtaining the bulk sample, it is proposed that the prospecting shaft be converted to a ventilation shaft to be used during the operation of the Akanani Mine, should the Akanani project commence to that stage.

3.2.4 Land use alternatives

As mentioned earlier in this document, the land capability of the proposed prospecting shaft site was rated as grazing land. Grazing land does not qualify as arable land and will therefore most likely not be suitable for crop production. The only current land use alternative for the proposed site would be to continue utilising the land for grazing purposes, i.e. to implement the 'no-go' alternative as discussed below.

3.2.5 The 'no go' alternative

Should the project not go ahead, i.e. should the 'no-go' option be implemented, the bulk sample for metallurgical testing will not be obtained. This is particularly true, since the only alternative method in obtaining the bulk sample is by means of drilling, which, as mentioned previously, is not feasible.

Lonmin will thus not be able to learn more about the reef and ore at Akanani. In addition, Lonmin will not be able to refine the basic metallurgical process and will not be able to design a suitable beneficiation plant. In short, the technical feasibility investigations associated with the Akanani platinum project would be seriously hindered. Since the technical feasibility of the mine would be unknown, this would result in Lonmin not being able to make sound investment decisions in terms of the Akanani platinum project. The implementation of the 'no-go' option for the prospecting shaft development project would probably result in the implementation of the 'no-go' option for the Akanani platinum project, and the loss of the significant socio-economic benefits associated therewith.

4. DESCRIPTION OF THE PROPOSED PROJECT

The proposed project will include the sinking of a single prospecting shaft and the construction of associated infrastructure. This prospecting shaft will be used to obtain a bulk sample of about 3 000 tons for the testing of the metallurgical properties of the Platreef at the Akanani platinum project area, which will form part of the technical feasibility investigations associated with the Akanani platinum project.

4.1 LOCATION AND REGIONAL SETTING

The approved Akanani prospecting area is located about 25 km north of the town of Mokopane, formerly Potgietersrus, and approximately 60 km west-south-west of Polokwane in the Limpopo Province of South Africa. The approved prospecting area falls under the Waterberg District Municipality (DC36) and the Mogalakwena Local Municipality (LIM367).

The approved prospecting area is located on the farms Zwartfontein 814 LR and Moordkopje 813 LR, as shown in **Figure 1**, which together cover an area of about 4 000 hectares. This area is located immediately west and northwest of the Anglo Platinum's Potgietersrust Platinum Mine ("PP Rust"), an open pit platinum mining operation.

The prospecting area is rural, with several villages present within the prospecting area, mostly in the northern and southern portions. The villages of GaMosoge and GaModipana are in the northern portion of the prospecting area, whilst GaMasenya (Hans) and Skimming and Leruleng Villages are situated in the south. A smaller village, Mapela, is situated in the centre of the prospecting area. The central and south western portions of the ~4000 ha prospecting area are the least populated. The Akanani prospecting area is served by two gravel roads that intersect in the village of GaMosoge. These roads link the prospecting area with Mokopane in the south.

The area earmarked for development of the proposed prospecting shaft will be approximately 2 ha in extent, and is located within the approved Akanani prospecting area on the farm Zwartfontein 814 LR. The prospecting shaft site is located in the south-eastern corner of the Farm Zwartfontein 814 LR. The proposed prospecting shaft site is located about 700 m south-west of the Skimming and Leruleng Villages and a bit further west of the GaMasenya (Hans) Village. It is situated roughly 300 m from the Mohlesane River. The prominent Fonthane Mountain Range is located towards the west of the prospecting shaft site. Refer to **Figure 1** for an indication of the proposed location of the prospecting shaft.

4.2 FEASIBILITY INVESTIGATIONS BY LONMIN ON THE AKANANI PLATINUM PROJECT

As mentioned previously, Lonmin is investigating the feasibility of the Akanani platinum project. **Box 1** outlines how companies go about undertaking their feasibility studies.

Currently, Lonmin is in the Pre-feasibility Phase. As part of this phase, various environmental and social investigations for the Akanani platinum project commenced towards the end of 2007. Such studies include characterisations (regional and site specific) of surface water and groundwater resources, a baseline biodiversity (flora and terrestrial fauna) study, a study on the aquatic ecosystems of the project-affected area, a baseline socio-economic study, a soil and geological study, a baseline vibration study, an air quality study, an archaeological and cultural heritage assessment, a noise survey, and an investigation into environmentally sensitive landscapes.

Box 1: What is a feasibility study?

A feasibility study is a structured process through which a company investigates and evaluates three key areas of a new or existing business venture or project (see **Figure 8**):

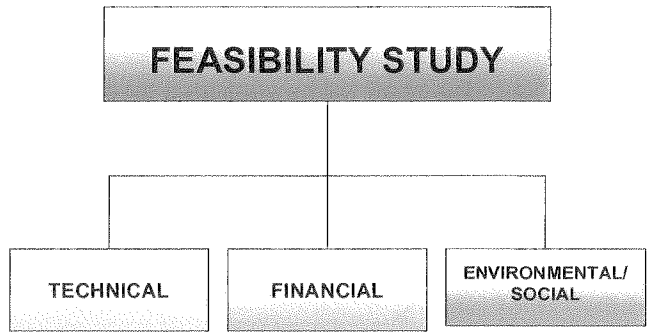


Figure 8: A feasibility study typically consists of three components: technical, financial and environmental/social feasibility.

Technical feasibility of the business or project: The technical investigation for a new mine considers the quality and volume of the mineral to be mined, the condition of the supporting geology and how easy or difficult it will be to process the mined material to get a clean, marketable product. For example, if the geology is uneven, and the ore body is interrupted in places by large areas of rock, it becomes less and less technically feasible to mine. Obviously, if a new mine is not technically feasible, perhaps because there is not sufficient ore of the right quality, or it is technically too difficult to get the ore out, there is no point in any further investigations.

Financial feasibility: The financial investigation considers the cost to develop, operate and close the mine, what long-term risks the company will be exposed to and how long it will take for the mine to generate a profit. If it becomes clear at an early stage that the project will not be financially feasible, perhaps because it is technically highly difficult and costly to mine, or because of long-term environmental costs, then the company will discontinue its investigations.

Environmental and social feasibility: The environmental and social component of a feasibility study looks at the potential environmental and social impacts and long-term risks of the project, and whether it is possible to mitigate these impacts or not. It also looks at benefits of the project to the social and biophysical environment, and the cost of managing the environmental and social risk. It may be that environmental management measures are possible but so costly that they cause the project to no longer be financially feasible.

Nowadays, companies start very early with the environmental and social feasibility investigations of proposed projects, and integrate these investigations at an early stage with technical and financial feasibility assessments. This helps to achieve a thorough, upfront feasibility study that provides the information on which a company can base sound investment decisions.

4.2.1 Surface Rights Owner

The Limpopo Provincial Department of Land Affairs: State Land Unit is the custodian of the land (i.e. the farm Zwartfontein 814 LR), on behalf of the registered land owner, the South African Government.

4.3 ACTIVITIES TO FORM PART OF THE PROSPECTING SHAFT DEVELOPMENT

The proposed method of development of the prospecting shaft, and associated project phases, can be summarised as follows:

- **Construction phase**: Equipment mobilisation and site establishment -
  - Surface infrastructure comprising offices, workshops, stores, first aid facilities and change houses will be erected. A surface batching plant, for cement mixing, will be erected and commissioned and a concrete cube testing facility will be established.

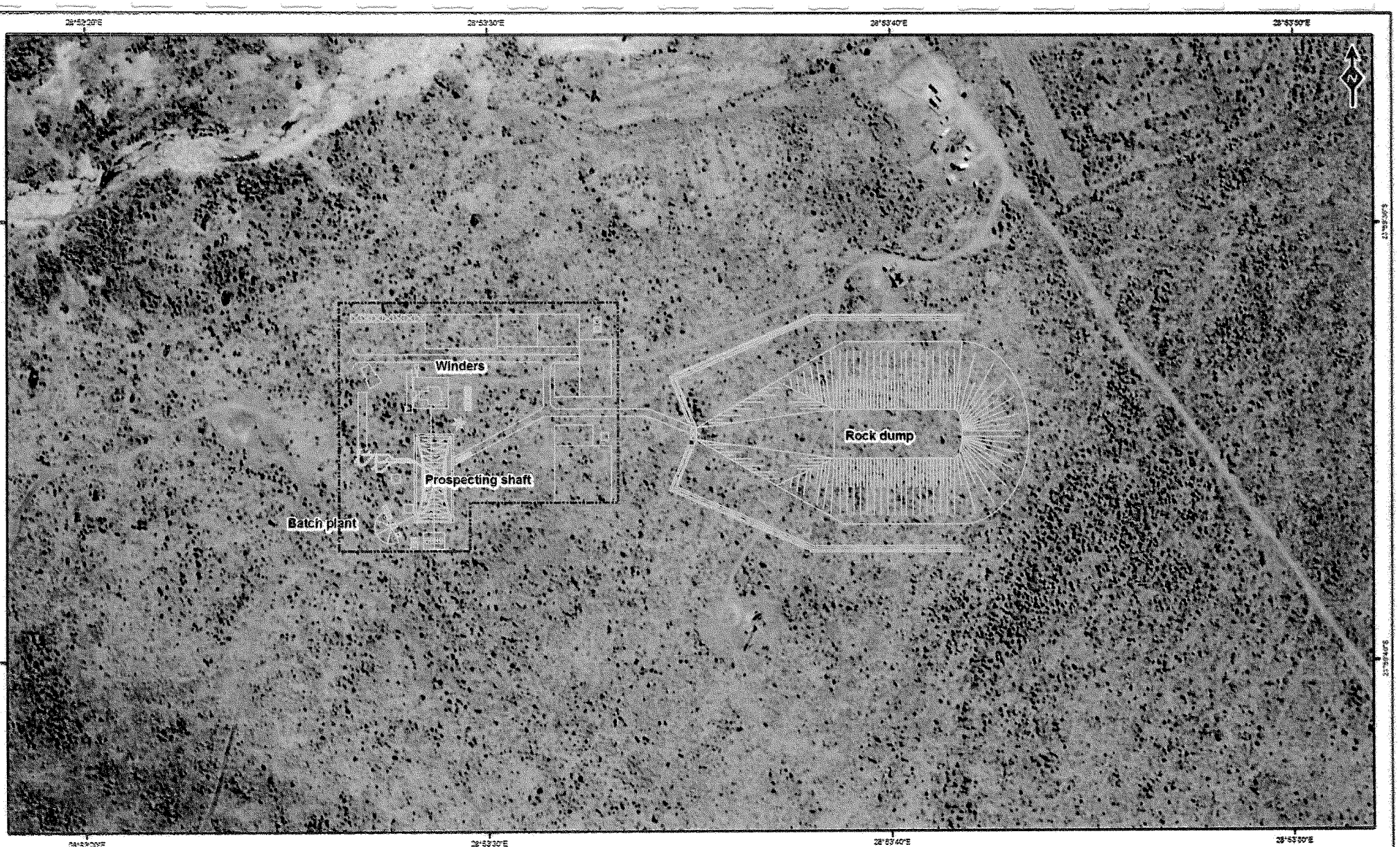
- **Operational phase**: Sinking of the shaft -
  - Shaft sinking activities will include excavating by means of earthmoving equipment, drilling and blasting.
  - Blasted rock will be transported to a temporary waste rock dump located within the prospecting shaft site.
  - The shaft will be ventilated by axial flow fans exhausting through steel ventilation columns.
  - Water intercepted during the shaft sinking operation will be pumped by means of pneumatically powered pumps directly into kibbles for bailing to surface. Siphon facilities will be provided on surface for the bailing of water. The water will be contained in settling facilities situated on the surface for re-use.
  - Shaft wall support in the form of pattern and welded mesh will be installed concurrent with shaft sinking.
  - The shaft will be lined with concrete (transferred from the surface batch plant to the shaft).
  - Mining of the bulk sample -
    - Once the shaft barrel reaches the elevation of the economic horizon of the Platreef, which is approximately 1 000 metres below surface, the bulk sample will be mined. The bulk sample will be obtained by continuing the sinking operation in the plane of the reef for 12 to 15 metres.
    - Blasted ore will be hoisted to surface.
    - On surface, the ore will be temporarily stockpiled and transported by trucks to Mintek in Johannesburg for metallurgical test work.
- **Decommissioning and closure phase**: Decommissioning of the shaft -
  - Should the feasibility studies indicate that the Akanani platinum project is economically viable, the prospecting shaft is intended to be used as the ventilation shaft for the future requirements of the Akanani Mine. The installed equipment will eventually be removed according to the mine's Closure Plan. A separate, full EIA and EMP process must be conducted and approved by the relevant decision-making authorities before full-scale mining activities may commence.
  - Should the Akanani platinum project not be viable, all equipment will be removed, the waste rock on the surface will be dumped back into the shaft and a concrete slab will be constructed over the mouth of the shaft. The rest of the disturbed area will be rehabilitated to its former state, as far as practically possible.

Refer to the "*Mining Work Programme for the Prospecting Right Amendment*", attached as **Appendix D**, for a detailed description of the activities associated with development of the proposed prospecting shaft.

4.4 INFRASTRUCTURE AND SERVICES

The proposed layout of the prospecting shaft site is indicated in **Figure 9** below. In general, the following infrastructure will be constructed / erected within the proposed prospecting shaft site:

- Prospecting shaft,
- Workshops,
- Temporary diesel bowser (± 2000 litres),
- Water settlers,
- Waste rock dump,
- Batch plant,
- Substation and transformer,
- Service, stage and kibble winders,
- Sinking fan,
- Jumbo stores and container offices,
- Electrical cable laydown area, and
- Access roads..



LEGEND

Prospecting shaft infrastructure

Fence

NOTES

30 15 0 30 60 90 120

Metres

REFERENCE

Projection: WGS 1984 Transverse Mercator

PROJECT

LONMIN AKANANI

TITLE

PROPOSED LAYOUT OF THE LONMIN AKANANI PROSPECTING SHAFT SITE

Golder Associates Johannesburg South Africa

PROJECT No. 11803	SCALE 1:2,500	A3	REV. 0
PHASE 1	TASK 7		
CAS	MM	21/05/2009	
CHECK	MNV	21/05/2009	
REVIEW	BM	21/05/2009	

FIGURE: 9

G:\GIS\Gis Projects\11803 - EIA\EMP Akanani Mine Lonmin Plat\Maps\May 2009\Layout.mxd

All explosives will be shaft head deliveries from the AEL factory, thus no explosives will be stored on-site.

4.4.1 Transport

The proposed prospecting shaft site will be accessed *via* an existing gravel road which intersects the public tar road at the Skimming Village. The existing public tar road links the area with Mokopane, situated towards the south. The tar road next to the Skimming Village passes Anglo's PP Rust mine towards the south and continues in a south-easterly direction until it meets up with the N11. Mokopane is situated approximately 22 km south on the N11.

The ore mined via the proposed prospecting shaft will be transported by 35 ton trucks to Mintek in Johannesburg for metallurgical test work.

4.4.2 Water Supply

The shaft sinking operations will require approximately 1 Ml (1 000 m^3) of water per day for potable and process use, which will be sourced from a borehole located on the farm Armoede 823 LR.

Abstracted borehole water will be stored in two potable water storage tanks (5 000 l tanks) located on-site.

The abstraction of groundwater and the storage thereof are defined as Water Uses in terms of Section 21 of the National Water Act (Act 36 of 1998, NWA). An application for a Water Use Licence / Registration in terms of the NWA for these Water Uses will be submitted to the Department of Water Affairs and Forestry (DWAF) within the near future.

4.4.3 Power Supply

Electricity transmission lines will be constructed by Eskom. This does not form part of the scope of this EIA.

The capacity of the existing transformer located on-site is 20 to 40MVA. A step-down transformer will supply 11kV of electricity to the construction substation. From there, it will be stepped down to 550 Volts for use at the prospecting shaft site.

4.4.4 Waste Rock Dump

The proposed temporary waste rock dump will cover a footprint area of approximately 1 ha. An estimated 360 000 tons of waste rock will be stored on the dump. Based on Lonmin's experience, the waste rock dump will consist of non-hazardous material; however, a study might be required to confirm this. If the results of the study indicate that the waste rock dump material is indeed hazardous, the temporary waste rock dump could be defined as a Water Use in terms of Section 21g of the NWA: "Disposing of waste in a manner which may detrimentally impact on a water resource". The waste rock dump would then be included in the Water Use Licence Application which will be submitted to the DWAF.

It is important to note that the waste rock dump will be managed as a temporary facility during the prospecting shaft project. Should mining take place at the Akanani Mine, the waste rock will be re-used for the construction of roads and/or incorporated into the mine waste rock dump. If no mining takes place, the waste rock will be backfilled into the prospecting shaft.

4.4.5 Solid Waste Management

Minimal volumes of domestic and industrial waste will be generated during the shaft sinking operations. Domestic and industrial waste generated on-site will be stored in skip containers, removed by a licensed waste contractor and disposed of at a municipal waste disposal site.

4.4.6 Water Pollution Management

Groundwater management

Groundwater abstracted from dewatering of the prospecting shaft will be pumped to two temporary settling dams on the surface. The clarified water will be re-used during the shaft sinking operations, e.g. for dust suppression purposes.

Each dam will have the following dimensions: 10 m x 4 m x 2 m = 80 m^3 (or 80,000 litres).

The settling dams could be defined as Water Uses in terms of Section 21 of the NWA. The dams will thus be included in the Water Use Licence Application which will be submitted to the DWAF in the near future.

Storm water management

A storm water management system will be designed to comply with Regulations GN 704, dated June 1999, under the NWA. This will involve the sizing of a pollution control dam and berm system to manage any contaminated storm water emanating from the proposed prospecting shaft site, including the waste rock area.

The pollution control dam could be defined as a Water Use in terms of Section 21 of the NWA. The dam will thus be included in the application for a Water Use Licence, which will be submitted to the DWAF within the near future.

Refer to **Appendix B.5** for the "*Stormwater Routing Framework, or Conceptual Design, for the proposed Lonmin Akanani Bulk Sampling Prospecting Shaft*", compiled by Golder Associates during the last quarter of 2008. This framework should be used to inform the detailed design of the relevant infrastructure.

4.4.7 Sanitation

Employees will make use of chemical toilets that will be located on-site.

4.5 STAFF REQUIREMENTS

Approximately 250 to 300 employees will be employed during the shaft sinking operations. As mentioned previously, temporary offices and change houses will be erected for the staff.

4.6 PRODUCTION SCHEDULE

The preliminary production schedule is as follows:

- Commence access and terrace construction: Third quarter of 2009
- Commence sinking of prospecting shaft: Fourth quarter of 2009 / First quarter of 2010
- Commence with obtaining bulk sample: Second quarter of 2012

The above production schedule is subject to the authorisation of this EIA Report and EMP Amendment by the DME, as well as internal strategic decisions and capital approval by Lonmin.

Shaft sinking operations are scheduled to be carried out on three 8-hour shifts per day, 23 days per month. Sundays and off-Saturdays will be utilised for the statutory weekly hoist examinations; shaft maintenance; steady, tape and skid brackets; and cable extensions.

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1 APPROACH TO IMPACT ASSESSMENT

The EIA for this project complies with the requirements of the Mineral and Petroleum Resources Development (Act 28 of 2002), which applies to all prospecting and mining operations. Principles contained in the NEMA, South Africa's overarching environmental legislation, serve as guidelines for interpreting and implementing the EIA requirements of the MPRDA.

Key principles contained in the NEMA include:

- Sustainability – development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.
- Mitigation hierarchy – avoidance of environmental impact, or where this is not possible, minimising the impact and remediating the effects of the impact.
- The NEMA establishes that developers have a duty of care towards the environment.

The assessment of the impacts associated with the proposed Lonmin Akanani prospecting shaft development project was done within the context provided by these principles and objectives.

The impacts assessment was divided into several fields of specialist study. The findings of the specialist studies were integrated into the following sections of this Chapter and the impacts were ranked using a scoring system that compares the relative significance of each impact, as described below.

It is important to note that, as part of the Akanani platinum project, several specialist baseline investigations for the broader prospecting area commenced towards the end of 2007. Since the proposed prospecting shaft site is located within the broader prospecting area, the relevant information generated during the studies was used during the impact assessment of the prospecting shaft, where possible, in addition to the specialist studies undertaken as part of this EIA.

5.2 METHODOLOGY FOR ASSESSING IMPACTS

The significance of the identified impacts was determined using the approach outlined below. This incorporates two aspects for assessing the potential significance of impacts (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998), namely occurrence and severity, which are further sub-divided as follows:

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Magnitude (severity) of impact	Scale / extent of impact

To assess each of these factors for each impact, the following four ranking scales are used:

PROBABILITY	DURATION
5 - Definite/don't know	5 - Permanent
4 – Highly probable	4 - Long-term (> 15 years)
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 – None	

SCALE	MAGNITUDE
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 – Local	4 - Low
1 - Site only	2 - Minor
0 – None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = Consequence (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance are rated as follows:

SP >60	Indicates **high** environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 60	Indicates **moderate** environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates **low** environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	**Positive impact**	An impact that is likely to result in positive consequences/effects.

Potential impacts were assessed using the above calculation and rating system, and mitigation measures were proposed for all relevant project phases (construction to decommissioning). The full impact assessment matrices for the three project phases are tabulated in **Table 5**, **Table 6** and **Table 8**.

5.3 SUMMARY OF ENVIRONMENTAL COMPONENTS CONSIDERED

The impact assessment considered the potential impacts of the proposed prospecting shaft development on each of the following environmental components:

- Geology
- Topography
- Soil
- Land capability and land use
- Fauna and flora
- Surface water

- Groundwater
- Air quality
- Noise and vibration
- Sites of archaeological significance
- Sensitive landscapes
- Visual aspects
- Socio-economic
- Traffic.

Lonmin originally anticipated undertaking a crack survey as part of this EIA, as disused in the Scoping Report distributed for public comment during August / September 2008. The minimal anticipated impacts associated with vibration during blasting on site, however dismissed the need to undertake the crack survey as part of this proposed project.

5.4 PROJECT PHASES

For the purposes of this impact assessment, the project timeframe was subdivided into the following three phases:

- Construction Phase;
- Operational Phase; and
- Decommissioning and Closure Phase.

Potential cumulative impacts were also identified and assessed for each component, where applicable.

The **Construction phase** marks the beginning of physical changes to the site. During this phase, construction equipment will be mobilised and the site will be established. Surface infrastructure comprising offices, workshops, stores, first aid facilities and change houses will be erected. A surface batching plant, for cement mixing, will be erected and commissioned and a concrete cube testing facility will be established. It is anticipated that the construction phase will take approximately **3 months** to complete.

During the **Operational phase**, the shaft will be sunk and the bulk sample will be mined. The anticipated timeframe for completion of the operational phase is approximately **3 years**. The activities associated with this phase are summarised as follows:

- Shaft sinking activities will include excavating by means of earthmoving equipment, drilling and blasting.
- Blasted rock will be transported to a temporary waste rock dump located within the prospecting shaft site.
- The shaft will be ventilated by axial flow fans exhausting through steel ventilation columns.
- Water intercepted during the shaft sinking operation will be pumped by means of pneumatically powered pumps directly into kibbles for bailing to surface. Siphon facilities will be provided on surface for the bailing of water. The water will be contained in settling facilities situated on the surface for re-use.
- Shaft wall support in the form of pattern and welded mesh will be installed concurrent with shaft sinking.
- The shaft will be lined with concrete (transferred from the surface batch plant to the shaft).
- Once the shaft barrel reaches the elevation of the economic horizon of the Platreef, which is approximately 1 000 metres below surface, the bulk sample will be mined. The bulk sample will be obtained by continuing the sinking operation in the plane of the reef for 12 to 15 metres.
- Blasted ore will be hoisted to surface.
- On surface, the ore will be temporarily stockpiled and transported by 35 ton trucks to Mintek in Johannesburg for metallurgical test work.

Decommissioning and Closure Phase: Should the feasibility studies indicate that the Akanani platinum project is economically viable, the prospecting shaft is intended to be used as the ventilation shaft for the future requirements of the Akanani Mine. The installed equipment will eventually be removed according to the mine's Closure Plan. Should the Akanani platinum project not be viable, the waste rock on the surface will be dumped back into the shaft and a concrete slab will be constructed over the mouth of the shaft. The rest of the disturbed area will be rehabilitated to its former state, as far as practically possible.

This EIA focuses on the second scenario, where the shaft will be closed after prospecting. Impacts associated with re-using the shaft as a ventilation shaft should be addressed in a separate EIA and EMP, which should focus on proposed mining, should it be feasible.

Also refer to the "*Mining Work Programme for the Prospecting Right Amendment*", attached as **Appendix D**, for a detailed description of the activities associated with development of the proposed prospecting shaft.

5.5 IMPACT CRITERIA

The following section describes the criteria used to assess the potential impacts of the proposed project on the environmental components most relevant to this project. Refer to Section 5.2 for the impact assessment methodology employed.

Geology

There are no specific impact criteria for geology. Impacts on geology are assessed indirectly based on their effects on other environmental media such as groundwater.

Topography

There are no specific impact criteria for topography. Topographic impacts are assessed indirectly based on their effects on other environmental media as well as on an aesthetic basis, based on the change in the landscape character that may result from the topographic change.

Fauna

Impacts on fauna are assessed qualitatively based on the anticipated change in species numbers and type, and animal populations. Potential impacts on Red Data species are also considered during the impact assessment.

Flora

Impacts on flora are assessed qualitatively based on the anticipated change in species numbers and type, and the density of cover. Potential impacts on Red Data species are also considered during the impact assessment.

Surface water

Surface water impacts are assessed based on the potential of an activity to change the quality or quantity of surface water affected by the proposed development.

Activities, known as "water uses", which may impact on surface water quantity or quality are identified in the National Water Act (Act 36 of 1998). Such activities must be identified by the project proponent (in this case, Lonmin) and must be authorised by the Department of Water Affairs and Forestry (DWAF).

Water uses associated with this project were identified and Water Use licence applications will be submitted to the DWAF.

Groundwater

The groundwater level at any particular point represents an equilibrium between recharge to and discharge from the aquifer. Groundwater levels therefore vary during the year. Levels may rise in response to increased recharge during the rainy season, conversely, levels may fall in response to the dry season as groundwater flows down-gradient and/or discharges to watercourses and the local base level.

Groundwater quality is assessed in relation to relevant National Standards. Two standards are considered applicable in the context of the proposed development:

- South African National Standard SANS 241 (2005) Drinking Water Standard which applies to water supplies intended for drinking purposes.
- South African Water Quality Guidelines SAWQG (1996) *Domestic and/or Agricultural Use* which applies to any water source intended for domestic and /or agricultural use. Refer to **Appendix E** for the relevant Water Quality Guidelines.

Noise and vibration

Noise and vibration impacts are assessed using the following national standards and guidelines:

- SANS 10328 – Methods for environmental noise impact assessments,
- SANS 10103:2008 – The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication,
- Guidelines for community noise impact assessments.

Site of archaeological significance

A Phase I Heritage Impact Assessment was undertaken on the proposed prospecting shaft site. During a Phase I assessment, types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999), are identified and mitigation measures are proposed to mitigate potential impacts.

5.6 CONSTRUCTION PHASE

It is envisaged that the construction phase of the proposed prospecting shaft will take approximately 3 months to complete. **Table 5** below summarises those impacts directly related to the construction phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 5: Environmental Impact Assessment Matrix for the proposed Lonmin Akanani prospecting shaft – Construction Phase.

POTENTIAL ENVIRONMENTAL IMPACT: Construction Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1. Geology												
Permanent impacts on the geological structure at the prospecting shaft due to construction of the surface water management structures, pollution control dam, etc.	2	5	1	3	**24**	L	2	5	1	3	**24**	L
2. Topography												
Development of the proposed prospecting shaft will enhance current areas of topographical variance. The main impact on topography during the construction phase will be from establishment of the site and surface infrastructure.	2	2	2	4	**24**	L	2	2	2	4	**24**	L
3. Soils												
Loss of topsoil and sub-soil during clearing of site for construction.	4	2	1	2	**14**	L	4	2	1	2	**14**	L

POTENTIAL ENVIRONMENTAL IMPACT: Construction Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Hydrocarbon contamination of soils from construction equipment and/or vehicle spillages.	2	2	1	2	**10**	L	2	2	1	2	**10**	L
Loss of usable topsoil due to soil compaction.	2	2	1	2	**10**	L	2	2	1	2	**10**	L
Loss of usable topsoil due to soil erosion.	4	2	1	3	**21**	L	2	2	1	2	**10**	L
4. Land capability and use												
Loss of ~2 ha land with (limited) grazing potential.	1	2	2	5	**25**	L	1	2	2	5	**25**	L
5. Ecology: Flora and fauna												
Removal of vegetation for construction .	2	2	1	5	**25**	L	2	2	1	5	**25**	L
Loss of habitat for local fauna due to removal of vegetation.	2	2	1	5	**25**	L	2	2	1	5	**25**	L
6. Ecology: Wetlands												
Not applicable, since no wetlands were identified on or in the vicinity of the proposed site.	-	-	-	-	-	-	-	-	-	-	-	-
7. Surface water												
Contamination of clean stormwater run-off on site.	6	2	2	4	**40**	L	4	2	1	2	**14**	L
Pollution of surface water sources through dirty surface run-off from site.	6	2	2	4	**40**	L	4	2	1	2	**14**	L
Stripping of vegetation may increase erosion, which might increase the amount of suspended solids in downstream watercourses.	4	5	2	3	**33**	L	2	2	1	2	**10**	L
Surface water contamination from hydrocarbons and other hazardous substances.	4	2	2	3	**24**	L	2	1	1	2	**8**	L
Contaminated of surrounding surface water sources if the water quality in the two temporary settler dams degenerates while reusing this water during the construction phase.	4	2	2	3	**24**	L	2	1	1	2	**8**	L
Damage to water sources caused by the abstraction of water required for construction purposes.	4	2	2	3	**24**	L	2	1	1	2	**8**	L
Surface water pollution associated with general and/or hazardous waste.	6	3	3	4	**48**	M	4	2	1	3	**21**	L
8. Groundwater												
Impact on groundwater level and flow as a result of construction activities.	4	2	3	3	**27**	L	2	2	2	2	**12**	L
Impact on groundwater quality as a result of construction activities.	4	2	3	3	**27**	L	2	2	2	2	**12**	L

POTENTIAL ENVIRONMENTAL IMPACT: Construction Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Hydrocarbon contamination of groundwater from construction equipment and/or vehicle spillages.	4	2	2	2	16	L	2	1	1	2	8	L
Groundwater pollution due to contamination of surface water with general and/or hazardous waste	6	2	3	3	33	M	4	2	1	3	21	L
9. Air quality												
Generation of nuisance dust and fumes from construction vehicle movement.	4	1	2	3	21	L	4	1	2	2	14	L
10. Noise and Vibration												
Noise impacts associated with construction activities.	4	1	2	3	21	L	4	1	2	3	21	L
Vibration impacts associated with construction activities.	-	-	-	-	-	-	-	-	-	-	-	-
11. Archaeological and heritage sites												
Potential impact on the six graves found within the study area.	10	5	1	4	64	H	4	1	1	3	18	L
12. Sensitive landscapes												
Potential impact on the six graves found within the study area.	10	5	1	4	64	H	4	1	1	3	18	L
13. Visual aspects												
Visual impact from shaft surface infrastructure.	2	2	2	4	24	L	2	2	2	4	24	L
14. Socio-economic aspects												
Creation of employment opportunities.	4	2	3	4	36	M+	6	2	3	5	55	M+
Influx of job seekers into surrounding areas which may place a strain on the local communities.	6	2	2	4	40	M	4	2	2	3	24	L
Establishment of a labourers' camp at the proposed prospecting shaft site.	8	2	2	4	48	M	4	2	2	2	16	L
Increased pressure on service provision due to establishment of labourers' camps.	4	2	2	4	32	M	4	2	2	2	16	L
Loss of approximately 0,8 % of grazing land available in the immediate surrounding area.	2	3	1	3	18	L	2	3	1	3	18	L
Safety impacts associated with traffic and construction excavations.	6	2	3	4	44	M	4	2	2	2	16	L
Community perceptions and responses	6	3	3	4	48	M	4	2	2	3	24	L
15. Traffic and transport												
Impact of construction vehicles on regional traffic and on the surrounding environment.	2	2	3	4	28	L	2	2	3	3	21	L

5.6.1 Geology

During construction, the geological structure at the prospecting shaft will be impacted upon as the topsoil and overburden are stripped and stockpiled, and during the construction of the surface water management structures and pollution control dam. This is an unavoidable cost of developing the prospecting shaft, and no mitigation measures can be implemented to restore this permanent impact on the local geological structure. The significance of this potential impact will be **low**.

5.6.2 Topography

Context

The proposed prospecting shaft site is relatively flat and is located south of Anglo Platinum's Potgietersrust Platinum Mine ("PP Rust"), an open pit operation. PP Rust mine's overburden stockpiles are situated approximately 500 m south of the prospecting shaft site, and constitutes the main landscape and topographical feature as viewed from the proposed site and/or surrounding villages.

Impact assessment

The potential impact on topography during the construction phase will relate to the development of site and shaft surface infrastructure, which will be set in a relatively flat area, but against the backdrop of the PPRust mine overburden stockpiles. The significance of the potential impact on topography will be **low**.

5.6.3 Soils

Context

The proposed prospecting shaft site is underlain by the Arcadia Soil Form (0-10 Ar), which is characterised by high clay contents, often of a swelling variety that produce strongly structured and blocky fabric, and are generally pale in colour (grey to grey brown), highly leached, and are, in almost all cases associated with the bottomland areas were accumulations of transported soils make up the majority of the soil pedogenesis.

This soil form is not generally associated with high agricultural potential and the land capability at the proposed prospecting shaft site is limited to grazing.

Impact assessment

During construction, topsoil removed within the shaft footprint area should be stockpiled. The impact on these soils will have a low significance, since it will be limited to an area of approximately 2 hectares. The limited agricultural potential of the soil further limits the significance of this impact.

During construction, soils within the project footprint may be compacted, and may be contaminated by fuel and lubricant spillages from vehicles within the bounds of the construction activities. These impacts will be of **low** significance. Mitigation of these impacts is possible and is described in Chapter 6 of this report. Special attention will furthermore be necessary to limit erosion of exposed soils.

5.6.4 Land Capability or Land Use

Context

The land capability of the proposed prospecting shaft site was rated as grazing land. The site is from time to time used by surrounding communities for grazing purposes.

Impact assessment

The construction activities will result in a change in the land capacity and use of the proposed site, which will occupy a footprint area of approximately 2 hectares. According to the report entitled "*Lonmin Akanani, Pedological and Land Capability Studies*", compiled by Earth Science Solutions during July 2008, an area of more than 2400 ha of grazing land is situated within the approximately 4000 ha Akanani prospecting area. This land is utilised for communal grazing purposes. The impact associated with the loss of approximately 2 ha of grazing land will be **low** and insignificant, compared to the extent of grazing land available in the surrounding area.

5.6.5 Ecology: Fauna and Flora

Refer to **Appendix B.2** for the specialist Red Data Survey report compiled by Golder Associates during October 2008.

Context

The proposed prospecting shaft site is vegetated with semi-natural vegetation that has been disturbed to a moderate extent by grazing and other anthropogenic activities such as utilisation of indigenous plant species for fuel, traditional medicine or other traditional uses. This vegetation type is a species poor version of the natural vegetation that may be expected in the region. The proposed site is therefore classified as being of low conservation importance.

Impact assessment

During the construction phase the vegetation occurring on site will be removed when the topsoil is stripped from the infrastructure footprint area.

The site survey found that although Red Data species have been historically recorded in the region, no Red Data or protected fauna and/or flora species were found on the proposed site during the survey.

The impact on fauna and/or flora will be **low** due to the low conservation value of the site and absence of Red Data fauna or flora species.

5.6.6 Ecology: Wetlands

Context

The proposed prospecting site is situated within grazing land. No wetland areas were identified in close proximity to the proposed prospecting shaft site.

Impact assessment

The construction phase of the proposed prospecting shaft project will **not impact** on any wetlands, since no wetland areas were identified in the vicinity of the proposed site.

5.6.7 Surface Water

Refer to **Appendix B.5** for the "*Stormwater Routing Framework (Conceptual Design) for the proposed Lonmin Akanani Bulk Sampling Prospecting Shaft*" compiled by Golder.

Context

The proposed prospecting shaft site is situated approximately 300 m south of the Mohlosane River.

Groundwater abstracted for dewatering of the prospecting shaft will be pumped to two temporary settler dams on the surface. These dams will be used for settling the fines from the water pumped from the shaft; the settled water will be re-used during the shaft sinking operations, e.g. for dust suppression purposes.

Impact assessment

During the construction phase, topsoil will be removed and the prospecting shaft will be developed. Stripping of vegetation may increase erosion, which might increase the amount of suspended solids in downstream watercourses. The significance of this potential impact is **low**.

Clean stormwater runoff on site could be contaminated and could pollute the Mohlosane River, if proper clean and dirty water management structures are not developed on site. The significance of this potential impact is **moderate**, but will be reduced to **low**, if proper storm water management structures are in place during the construction phase.

Surface water could be contaminated in the event of hydrocarbon spillages from construction equipment and/or vehicle. The significance of this potential impact is **low**.

Surrounding surface water sources could become contaminated if the water quality in the two temporary settler dams degenerates while reusing this water during the construction phase. This water might be used for activities such as wet dust suppression. If this contaminated water reaches the surrounding surface water source, it could result in an impact with a **low** significance rating. Proposed mitigation measures include monitoring and management of the settler dam water quality, as discussed in Chapter 6.

5.6.8 Groundwater

Refer to **Appendix B.3** for the "*Baseline Groundwater Review and Impact Assessment for the Proposed Prospecting Shaft at the Akanani Project Site*", compiled by Golder Associates.

Context

Boreholes drilled in the direct vicinity of the proposed prospecting shaft site have shown that a relatively shallow aquifer occurs within the weathered and fractured norite and gabbro-norite. These intersections generally occurred between 8 and 10mbgl, coinciding closely with the base of the weathered zone in the norite and gabbro-norite lithology.

Impact assessment

Project activities during construction may result in localised changes to the groundwater flow regime and groundwater levels in the shallow weathered and fractured norite aquifer in the immediate vicinity of the bulk sampling shaft, settling dams and pollution control dam. Such changes could potentially result from seepage of stored water from the unlined settling dams and pollution control dam into the groundwater.

Construction of the proposed prospecting shaft site is expected to have a **low** impact on groundwater levels and flow, as well as groundwater quality. This impact could however be further reduced if the mitigation measures as proposed in Chapter 6 are implemented successfully. Proposed mitigation measures include sizing stormwater facilities appropriately and lining of settling and pollution control dams.

5.6.9 Air Quality

Refer to **Appendix B.1** for the "*Baseline Air Quality Assessment for the proposed Prospecting Shaft Development Project at the Lonmin Akanani Prospecting area, North of Mokopane, Limpopo*", compiled by Gondwana Environmental Solutions.

Context

Based on the baseline dust-fallout monitoring for the Akanani Project carried out by Gondwana Environmental Solutions, the dust fallout throughout the entire prospecting area is fairly low, with an average of 226 mg/m^2/day for the entire monitoring period.

Impact assessment

The construction phase will include land clearing and topsoil removal activities in addition to the building of the necessary infrastructure. Sources of fugitive dust emissions during the construction phase of the proposed prospecting shaft could include:

- Vehicle entrained dust from the construction site;
- Wind erosion from open areas and stockpiles;
- Dust generated by materials handling operations, i.e. loading and off-loading of material; and
- Pushing and scraping operations (earthworks).

Emissions from diesel-fuelled vehicles include particulate matter, NOx, SO2, CO and hydro-carbons, the majority of which occurs from the exhaust. Vehicle emissions may be grouped into three different sources, namely:

- Entrainment of dust from road surface due to the wheel action;
- Exhaust fumes; and
- Fuel evaporation.

Thus, during the construction phase, the main pollutant will be particulate matter (PM). The impact can be considered to have a temporary and **low** impact. The significance of this impact can be reduced to **low** if the mitigation measures proposed in Chapter 6 are implemented successfully. Proposed mitigation measures include activities such as wet dust suppression.

5.6.10 Noise and Vibration

A "*Noise and Vibration Assessment*" of the proposed Lonmin Akanani prospecting shaft was undertaken by dBAcoustics during the middle of 2008. The report is attached to this document as **Appendix B.4**.

Context

The night-time ambient noise levels measured in the villages surrounding the proposed prospecting shaft site are generally higher than the daytime noise levels. According to the SANS, the daytime ambient noise level would typically be 10dBA higher than the night-time period, which is not the case for the measured areas, due to the neighbouring existing mining activities which influence the night-time sound pressure levels.

Prevailing vibration levels were measured at 13 of the 21 noise measurement points in the study area. The vibration levels at all these points were found to be insignificant.

Impact assessment

The construction phase will include land clearing, topsoil removal and the building of surface infrastructure. The main potential noise pact associated with this project phase could be from vehicles manoeuvring on site. No vibration-related impacts are anticipated during the construction phase.

The significance of the potential noise impact associated with vehicles manoeuvring on site during the construction phase is **low**.

5.6.11 Sites of Archaeological and Cultural Interest

A "*Phase I Heritage Impact Assessment for the proposed Akanani exploration shaft near Mokopane, Limpopo Province*", was undertaken by Dr Julius Pistorius during July 2008. Refer to **Appendix B.6** for the relevant report.

Context

The significance of the heritage resources that may be affected by the proposed mining development project was determined by means of stipulations from the National Heritage Resources Act (No 25 of 1999) and by means of various other criteria relating to the types and ranges of heritage resources to be affected.

The Phase I HIA study for the Akanani Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) in the project area, namely:

- Stone tools uncovered in the Mohlosane River, mostly derived from the Middle Stone Age, dating back 200 000 years to 22 000 years ago. These stone tools were limited in number and were not found occurring as large concentrations (assemblages) in a closed (sealed) stratigraphical context.
- Remains dating from the Late Iron Age/Historical Period that consisted of a scatter of metal working slag. It is possible that these remains date from the Late Iron Age (AD1600-1840) or from the Historical Period (AD1840-1880).
- Remains from the recent past (i.e. less than sixty years old) consisting of the disintegrated remains of dwellings which are scattered across the project area. Four of these remains were recorded. It is possible that more of these remains, particularly graves, may exist but that they are unmarked or located in inconspicuous locations.
- Graves, of which six were found during the Phase 1 HIA. These graves are informal and are demarcated by means of stones. It is possible that more of these graves exist, but that they are unmarked or located in inconspicuous locations.

The stone tools, remains from the Late Iron Age/Historical Period (scattered metal working slag), some of the remains from the recent past and the graves were geo-referenced and mapped during the Phase 1 HIA, as shown in **Figure 6**. It must be noted that the remains from the recent past are extensive and that not all of these remains were mapped.

Impact assessment

The stone tools found along the banks of the Mohlosane River will not be affected by the proposed Akanani Prospecting Shaft development.

Remains from the Late Iron Age/Historical Period qualify as archaeological remains and are protected by Section 35 of the National Heritage Resources Act, Act 25 of 1999. These remains will not be affected by the proposed prospecting shaft development.

The remains from the recent past have no significance as they are not older than sixty years. Even if these remains did qualify as historical remains, because they are older than sixty years, they have low significance due to the following criteria:

- These types of remains are abundant and occur throughout the larger project area, and
- These remains have little to offer in the sense of research, educational or tourism value.

All graveyards and graves can be considered to be of **high** significance and are protected by various laws. Legislation with regard to graves includes Section 36 of the National Heritage Resources Act, Act 25 of 1999 whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (Act 65 of 1983), as amended.

The proposed project will have **no**, or an **insignificant impact**, on the stone tools and remains from the Late Iron Age/Historical Period and recent past found in the vicinity of the prospecting shaft site.

The potential impact of the construction phase on the six graves found within the study area is of **high** significance. This significance rating could however be reduced to **low**, if the recommended mitigation measures as described in Chapter 6 are successfully implemented. Recommended mitigation measures include actions such as conserving graveyards *in situ* by demarcating them with brick walls and/or fences.

5.6.12 Sensitive Landscapes

Context

A 'sensitive landscape' usually falls within the following categories:

- Nature conservation areas and important natural resources;
- Unstable physical environments;
- Sites of archaeological, cultural and historical value;
- Sites of scientific interest;
- Green belts or public open spaces; *and*
- Wetlands.

The proposed prospecting shaft site can be described as a 'sensitive landscape' based on the presence of archaeological sites in the direct vicinity of the proposed site, as described in Section 5.6.11 above.

The potential impact of the construction phase on the six graves found within the study area is of **high** significance. This significance rating could however be reduced to **low**, if the recommended mitigation measures as described in Chapter 6 are successfully implemented. Recommended mitigation measures include actions such as conserving graveyards *in situ* by demarcating it with brick walls and/or fences.

5.6.13 Visual aspects

Refer to **Appendix B.7** for the "*Visual Assessment for the proposed Lonmin Akanani Exploration Shaft*" compiled by Newtown Landscape Architects during July 2008.

Context

The proposed prospecting shaft site is located south of Anglo Platinum's Potgietersrust Platinum Mine (PP Rust"), an open pit operation. PP Rust mine's overburden stockpiles are situated approximately 500 m south of the prospecting shaft site, and constitutes the main landscape feature as viewed from the proposed site and/or surrounding villages.

Impact assessment

The surface infrastructure associated with the proposed prospecting shaft site will be established during the construction phase. The views from the surrounding villages have already been influenced negatively by the neighbouring PP Rust mine. The prospecting shaft structure will reach more than 30 m above ground level and is proposed to be constructed between the existing PP Rust overburden stockpile and the villages, and would therefore result in little change to the landscape as viewed from the villages, since it would be visually 'absorbed' by the overburden stockpile which forms the background to these views.

The significance of the potential visual impact resulting from the construction of the proposed prospecting shaft and associated structures is therefore considered to be **low**. The shaft would however have a cumulative impact on the visual environment. The cumulative impact will also be of low significance.

5.6.14 Socio-Economic Aspects

A "*Socio-economic Impact Assessment for the proposed Lonmin Akanani Prospecting Shaft Development, Mokopane, Limpopo Province*", was compiled by Golder Associates during October 2008. Refer to **Appendix B.8**.

Context

During the SIA study conducted during 2008 as part of this EIA, the potential socio-economic impacts of the proposed prospecting shaft and associated surface infrastructure were determined. The socio-economic circumstances of the local communities were taken into account during this assessment.

Impact assessment

The SIA identified the following socio-economic impacts related to the construction phase of the proposed project:

- **Employment creation:** A subcontractor will be appointed by Lonmin Akanani to conduct the bulk sampling. It is estimated that between 250 and 300 workers will be employed during the construction phase. It is expected that approximately 65% (approximately 160-195) of these workers will be unskilled, whilst 35% (approximately 90-105) will be skilled. Lonmin Akanani estimated that approximately 60% of the workers will be locally employed within the Mogalakwena Local Municipality area.

  Employment creation will result in a **positive impact**, rated of **moderate** significance. If the measures proposed to optimise the benefits as proposed in Chapter 6 are implemented, this positive impact will be elevated. Measures proposed to optimise benefits include, amongst others, the establishment of a "labour and employment desk" as a contact point for local community members who wish to seek employment on the project.

- **Influx of job seekers:** When news of prospecting activities and potential employment opportunities becomes known to the general public, an influx of job seekers from other areas may arise. This influx is especially likely to occur due to the high levels of unemployment throughout the province. However, given the high number of residents in the study area (the villages in the study area have an estimated combined population of nearly 7 000 residents), this influx will not constitute a major increase in population numbers in the study area.

Social pathologies arising as a result of the potential population influx could result in a **negative impact** rated as **moderate**, but this significance rating could be reduced to **low** if the proposed mitigation measures are implemented. Mitigation measures proposed in Chapter 6 include, for example, employing local people where possible.

- **Labourers' camp:** It is currently envisaged that all non-local workers for the proposed project will be housed in a labourers' camp, located near the proposed prospecting shaft site. The workers will remain in the labourers' camp to work during the operational phase.

  Communities in the study area have voiced concerns regarding the location of labourers' camp in close proximity to their villages, which will require the labourers to be managed efficiently so as to minimise any potential impacts that may arise from the camp. Local workers who require transport will be transported to and from the construction site daily by means of buses.

  The sudden presence of additional people in the area will impact on the current social conditions in various ways. Social impacts that may result from the presence of a labourers' camp include the proliferation of pollution (litter, waste water and unsanitary ablution facilities), destruction of vegetation (indigenous wood used for fuel) and negative aesthetic impacts. Other social impacts that may result from the presence of the labourers' camp include alcohol and drug abuse, the sex worker trade and, hence, sexually transmitted diseases, or STDs (notably HIV/AIDS).

  Another possibility is that conflict may arise between local inhabitants, the occupants of labourers' camps and job seekers, especially if workers and job seekers are from a different parts of South Africa, or beyond, and/or have different social or ethnic affiliations. The possibility for conflict would be increased under the following conditions:

  - If there is a real or perceived increase in crime in the area, and responsibility for these criminal acts is associated with the workers or job seekers; and/or
  - If the perception exists that the workers or job seekers are taking jobs that could have gone to locals.

  A remaining risk is that the labourers' camp may be occupied by squatters once it is vacated.

  The impacts associated with the labourers' camp and housing of workers was rated as **negative** and of **moderate** significance, which could be reduced to a **low** significance if the proposed mitigation measures described in Chapter 6 are implemented successfully. Mitigation measures include the recommendation that Lonmin should reconsider the requirement to establish a labourers' camp, and that the workforce should preferably be housed in Mokopane and transported to site by bus, instead of developing the labourers' camp. **Lonmin subsequently confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane.**

- **Increased pressure on service provision:** It will be necessary to provide the labourers' camp with adequate basic services such as water, electricity, sanitation and health facilities. The need to provide these services may place pressure on the local municipality, particularly in cases where the local municipality is resource-constrained and is experiencing large backlogs in the provision of basic services to households in its areas of jurisdiction.

  The labourers' camp will source electricity from a nearby power substation, which will constitute an increase in electricity demand in the project area. Water will be sourced from boreholes, and will therefore place no additional strain on the limited municipal water supply. Sanitation facilities will be provided in the camp.

  The increased pressure on service provision could result in a **negative impact** of **moderate** significance, which could be reduced to **low** significance if the recommended mitigation measures are implemented. **Lonmin subsequently confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane.**

- **Loss of land:** The footprint of the proposed prospecting shaft site is approximately 2 ha in extent. This area will be lost during the construction and operational phases. The area is currently being utilised for communal grazing purposes.

  The total grazing area in the direct vicinity of Leruleng, Skimming and GaMasenya Villages (Hans) is approximately 245 ha. A loss of 2 ha will therefore constitute a loss of approximately 0.8% of the total grazing area. The significance of the impact associated with the reduction in grazing land is considered to be **very low**.

- **Social impacts derived from physical impacts:** Once construction activities commence, a number of physical impacts may have an effect on the surrounding communities. Examples of these impacts include noise, dust and vibrations that are caused by blasting, vehicles, excavation activities etc. Other EIA specialist studies investigated the potential impacts of noise, vibrations and dust. Thus, refer to the relevant sections of this report dealing with these aspects.

- **Impacts on graves and spiritual sites:** Please refer to Section 5.6.11.2 of this report, which deals with sites of archaeological and cultural interest, and potential impacts on these sites.

- **Safety impacts (traffic and construction excavations):** Construction activities normally result in an increase in traffic in the area, especially if construction workers are housed off-site and need to be transported to and from the construction site daily. This increase in traffic flow may pose a potential safety risk to residents in the study area, especially children. Animals may also be at risk of collision with vehicles. The area adjacent to the project site is mined by Anglo, which indicates that the area is already experiencing the movement of mining vehicles. The additional presence of construction-related vehicles is not expected to constitute a major socio-economic impact.

  The risk also exists that people and/or animals may fall into construction excavations, for example, trenches.

  Potential safety impacts are rated as of **moderate** significance. If the prescribed mitigation measures are implemented, the significance of this impact could be reduced to a **low**. Recommended mitigation measures include fencing off of the construction site and ensuring that adequate security measures are implemented.

- **Community perceptions and responses:** Communities in the study area are highly sensitised to the issue of relocation from previous negative experiences of resettlement. As a result, the communities are in favour of prospecting activities, which they associate with no risk for resettlement, but opposed to mining operations, which they believe may result in resettlement. This has also resulted in mistrust and tension between the communities in the study area, as well as tension within the communities. Communities in the study area are characterised by a turbulent political climate, with some groups challenging the established structures and norms of the Traditional Authority. This has been evident in the public participation process for the proposed project, where various groups have attempted to prevent the public participation process from proceeding. Environmental activists have been approached by some of the stakeholder groups, and these groups have attempted to derail the environmental authorisation process on numerous occasions. The tension that exists in the communities (for example, in the villages of Leruleng/Skimming during the time of the writing of this report) has the potential to lead to social mobilisation against the proposed project and future activities by Lonmin Akanani.

  Negative community perceptions and responses could result in impacts of **moderate** significance. This could be reduced to a **low** significance rating if the mitigation measures proposed in Chapter 6 are implemented. One of the proposed mitigation measures is that Lonmin should engage with stakeholders and communities on a transparent and continuous basis.

5.6.15 Traffic and transport

Context

As discussed earlier, the proposed prospecting shaft site will be accessed by means of an existing gravel road which intersects the public tar road at the Skimming Village. The existing public tar road links the area

with Mokopane, situated towards the south. The tar road next to the Skimming Village passes Anglo's PP Rust mine towards the south and continues in a south-easterly direction until it meets up with the N11. Mokopane is situated approximately 22 km south on the N11.

Impact assessment

No additional access road will be developed as part of the proposed project.

The construction-phase vehicles entering, manoeuvring on and exiting the area and the prospecting shaft site are not anticipated to contribute to significant environmental impacts, if the mitigation measures proposed in Chapter 6 are implemented successfully. The limited number of additional vehicles associated with the construction phase is furthermore not expected to have a significant impact on the traffic load of public roads in the area.

5.7 OPERATIONAL PHASE

It is envisaged that the operational phase of the proposed prospecting shaft will take approximately **3 years** to complete. **Table 6** below summarises those impacts directly related to the operational phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 6: Environmental Impact Assessment Matrix for the proposed Lonmin Akanani prospecting shaft – Operational Phase.

POTENTIAL ENVIRONMENTAL IMPACT: Operational Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1. Geology												
Permanent impacts on the geological structure at the prospecting shaft due to shaft development (including blasting) and construction of surface water management structures and pollution control dam.	4	5	1	4	**40**	**M**	4	5	1	4	**40**	**M**
2. Topography												
Not applicable, since the proposed project will not result in additional changes to the topography during the operational phase.	-	-	-	-	-	-	-	-	-	-	-	-
3. Soils												
Impacts on stockpiled topsoil and subsoil during the operational phase.	4	2	1	2	**14**	**L**	4	2	1	2	**14**	**L**
Hydrocarbon contamination of soils from equipment and/or vehicle spillages.	4	2	1	2	**14**	**L**	4	2	1	2	**14**	**L**
4. Land capability and use												
Not applicable, since the proposed project will not result in additional changes to the land use or capability.	-	-	-	-	-	-	-	-	-	-	-	-
5. Ecology: Flora and fauna												
Not applicable, since the proposed project is not likely to result in additional impact on fauna and flora during the operational phase.	-	-	-	-	-	-	-	-	-	-	-	-

POTENTIAL ENVIRONMENTAL IMPACT: Operational Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
6. Ecology: Wetlands												
Not applicable, since there are no wetlands in the immediate vicinity of the project.	-	-	-	-	-	-	-	-	-	-	-	-
7. Surface water												
Contamination of clean stormwater run-off on site.	6	2	2	4	**40**	**M**	4	2	1	2	**14**	**L**
Pollution of surface water sources through dirty surface run-off from site.	6	2	2	4	**40**	**M**	4	2	1	2	**14**	**L**
Surface water contamination from hydrocarbons and other hazardous substances.	4	2	2	3	**24**	**L**	2	1	1	2	**8**	**L**
Contaminated of surrounding surface water sources if the water quality in the two temporary settler dams degenerates while reusing this water during the construction phase.	4	2	2	3	**24**	**L**	2	1	1	2	**8**	**L**
Damage to water sources caused by the abstraction of water required for operational purposes.	4	2	2	3	**24**	**L**	2	1	1	2	**8**	**L**
Surface water pollution associated with general and/or hazardous waste.	6	3	3	4	**48**	**M**	4	2	1	3	**21**	**L**
8. Groundwater												
Impact on groundwater level and flow as a result of operational activities such as shaft sinking.	4	2	3	4	**45**	**M**	4	2	3	3	**27**	**L**
Impact on groundwater quality as a result of operational activities such as shaft sinking.	4	2	3	4	**45**	**M**	2	2	1	2	**10**	**L**
Hydrocarbon contamination of groundwater from operational equipment and/or vehicle spillages.	4	2	2	2	**16**	**L**	2	1	1	2	**8**	**L**
Groundwater contamination from polluted surface water.	6	2	2	4	**40**	**M**	2	1	1	2	**8**	**L**
9. Air quality												
Generation of nuisance dust and fumes from blasting and vehicle movement during the operational phase.	6	1	2	4	**36**	**M**	4	1	2	2	**14**	**L**
10. Noise and Vibration												
Noise impacts due to blasting activities during the first few weeks of shaft sinking.	6	1	2	4	**36**	**M**	4	1	2	3	**21**	**L**
Vibration impacts due to blasting activities during the first few weeks of shaft sinking.	4	1	2	3	**21**	**L**	4	1	2	3	**21**	**L**
11. Archaeological and heritage sites												
Potential impact on the six graves found within the study area.	10	5	1	4	**64**	**H**	4	1	1	3	**18**	**L**

POTENTIAL ENVIRONMENTAL IMPACT: Operational Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
12. Sensitive landscapes												
Potential impact on the six graves found within the study area.	10	5	1	4	**64**	**H**	4	1	1	3	**18**	**L**
13. Visual aspects												
No additional visual impacts are expected during the operational phase, since all surface infrastructure will be developed during the construction phase.	-	-	-	-	-	-	-	-	-	-	-	-
14. Socio-economic aspects												
Creation of employment opportunities.	4	2	3	4	**36**	**M+**	6	2	3	5	**55**	**M+**
Influx of job seekers into surrounding areas which may place a strain on the local communities.	6	2	2	4	**40**	**M**	4	2	2	3	**24**	**L**
Establishment of a labourers' camp at the proposed prospecting shaft site.	8	2	2	4	**48**	**M**	4	2	2	2	**16**	**L**
Increased pressure on service provision due to establishment of labourers' camps.	4	2	2	4	**32**	**M**	4	2	2	2	**16**	**L**
Loss of approximately 0,8 % of grazing land available in the immediate surrounding area.	2	3	1	3	**18**	**L**	2	3	1	3	**18**	**L**
Safety impacts associated with traffic and construction excavations.	6	2	3	4	**44**	**M**	4	2	2	2	**16**	**L**
Community perceptions and responses.	6	3	3	4	**48**	**M**	4	2	2	3	**24**	**L**
15. Traffic and transport												
Impact of operational vehicles on local and regional traffic and on the surrounding environment.	2	2	3	4	**28**	**L**	2	2	3	3	**21**	**L**

5.7.1 Geology

During the operational phase, the geological structure at the prospecting shaft will be permanently altered by blasting and development of the shaft. The surface diameter of the shaft will be approximately 7 m. This is an unavoidable cost of developing the prospecting shaft, and no mitigation measures can be implemented to restore this permanent impact on the local geological structure. The significance of this potential impact will be **moderate**.

5.7.2 Topography

No additional impacts on topography are expected during the operational phase.

5.7.3 Soils

Soil could become contaminated if equipment and/or vehicles used during the operational phase is not maintained sufficiently. Equipment and vehicles should furthermore be maintained in one designated workshop area on site which should be efficiently surfaced and managed, as proposed in Chapter 6. The significance of the impact associated with the contamination of soil from hydrocarbons is **low**.

5.7.4 Land Capability and Land Use

No additional impacts on land capability and land use are expected during the operational phase.

5.7.5 Ecology: Fauna and Flora

No additional impacts on fauna and flora are expected during the operational phase.

5.7.6 Ecology: Wetlands

No impacts on wetlands are expected during the operational phase.

5.7.7 Surface Water

Clean stormwater runoff on site could be contaminated and could pollute the Mohlosane River, if proper clean and dirty water management structures are not developed on site. The significance of this potential impact is **moderate**, but will be reduced to **low**, if proper storm water management structures are set in place during the construction phase.

Surface water could be contaminated in the event of hydrocarbon spillages from construction equipment and/or vehicles. The significance of this potential impact is **low**.

Surrounding surface water sources could become contaminated if the water quality in the two temporary settler dams degenerates while reusing this water during the operational phase. This water might be used for activities such as wet dust suppression. If this contaminated water reaches the surrounding surface water source, it could result in a **low** impact. Proposed mitigation measures include monitoring and management of the settler dam water quality, as discussed in Chapter 6.

5.7.8 Groundwater

Project activities during the operational phase may result in localised changes to the groundwater flow regime and groundwater levels in the shallow weathered and fractured norite aquifer in the immediate vicinity of the bulk sampling shaft, settling dams and pollution control dam. These changes will be a response mainly to the potential seepage of stored water from the unlined settling dams and pollution control dam to the groundwater.

Groundwater intersection during the construction of the shaft (blasting) may lead to a temporary increase in the pumping volumes from the shaft, which would be matched by commensurate reduction in the pumping of water from production boreholes on the farm Amoede. The majority of these intersections will be sealed off by the concrete lining of the shaft. Higher yielding groundwater intersections, which cannot be sealed off by the concrete liners should be incorporated into the operational water system.

Changes in groundwater quality associated with the bulk sampling activities will be primarily in response to the mineralised mine water which will be pumped from the shaft or recovered from the batch plant and discharged to the unlined settling dams. Polluted runoff from dirty areas such as the waste rock dump will be collected in the unlined pollution control dam. Seepage from these unlined dams will recharge the shallow weathered and fractured norite aquifers. Further recharge of the aquifer beneath the waste rock dump will occur. This seepage is likely to be elevated with respect to most dissolved major cations and anions, as well as some metals when compared to the background groundwater quality near the proposed bulk sampling plant.

Construction of the proposed prospecting shaft site is expected to have a **moderate** impact on groundwater levels and flow, as well as groundwater quality. This impact could however be reduced to **low** if the mitigation measures as proposed in Chapter 6 are implemented successfully. Proposed mitigation measures include sizing stormwater facilities appropriately and lining of settling dams and pollution control dams.

5.7.9 Air Quality

The operational phase will include activities such as blasting, shaft sinking, and transportation of the bulk sample material to Johannesburg for testing. Sources of fugitive dust emissions during the operational phase of the proposed prospecting shaft include:

- Vehicle entrained dust from the operational site;
- Wind erosion from open areas and stockpiles;
- Blasting and drilling activities; and
- Dust generated by materials handling operations, i.e. loading and off-loading of material.

Blasting is seen as an intermittent (non-routine) source of emissions (dust and trace gases) and will occur once a day for a limited period of time. The impacts are thus generally regarded as a source of nuisance only, and rated as **moderately** significant. If mitigated with dust suppression methods, the significance of this impact can be reduced to **low**.

Emissions from diesel-fuelled vehicles include particulate matter, NOx, SO2, CO and hydro-carbons, the majority of which occurs from the exhaust. Vehicle emissions may be grouped into three different sources, namely:

- Entrainment of dust from road surface due to the wheel action;
- Exhaust fumes; and
- Fuel evaporation.

Thus, during the operational phase, the main pollutant is particulate matter (PM). Dust and fume emissions from the operational phase will be limited to certain timeframes and can therefore be considered to have a temporary and **moderate** impact. The significance of this impact can be reduced to **low** if the mitigation measures proposed in Chapter 6 are implemented successfully. Proposed mitigation measures include activities such as wet dust suppression.

5.7.10 Noise and Vibration

The most significant noise and vibration impact during construction will be associated with blasting activities.

Noise

Previous experience and noise surveys at a similar blasting exercise revealed the following sound pressure levels during a blast:

- At a depth of 3 m below ground level, the sound pressure level at 30 m from the blasting area was 113 dB.
- At a depth of 30 m below ground level, the sound pressure level at 30m from the blasting area was 103 dB.

Refer to **Table 7** for the line of sight attenuation during blasting.

Table 7: Line of sight noise attenuation during blasting.

Activity	Line-of- Sight Estimated Noise Level*						
	30 m	60 m	100 m	200 m	400 m	800 m	1600 m
Blasting at 3m below ground level	113 dB	107 dB	101 dB	95 dB	89 dB	83 dB	76 dB
Blasting at 30m below ground level	103 dB	97 dB	91 dB	87 dB	81 dB	75 dB	69 dB

**The above values are in dB and not the integrated sound pressure level over time (dBA), the duration associated with the above values is 2 seconds on the maximum per blast.*

The occupants within the study area are already exposed to open cast blasting from the adjoining platinum mine. A noise survey done during a blast at the neighboring mine, measured from the south-eastern corner of the Farm Zwartfontein 814 LR (approximately 400 m south-east of the prospecting shaft site) recorded a maximum sound pressure level of 83.7 dB. This survey was done approximately 2000 m from the blasting site. The residents next to the provincial road experience maximum sound pressure levels of 69.5 dBA when a truck or speeding car uses the road.

It was calculated that at 2000 m from the prospecting site blasting activity, the sound pressure level would be 61.0dB, lasting for two seconds only, whereas the sound pressure level for the open cast blasting was 83.7dB and lasted for up to 7 seconds.

The maximum sound pressure level associated with blasting at the proposed prospecting shaft will reduce as blasting proceeds deeper below ground level. Those residents situated closest to the site will experience a sound pressure level of between 83 dB and 74 dB for 2 seconds at a time, for a maximum of one blast per day during the first few weeks of shaft development, where after the noise impact will reduce significantly.

Although the significance of the anticipated impact associated with blasting activities during the first few weeks of shaft development could be seen as **moderate**, the effect of this impact will be reduced to **low** if the mitigation measures proposed in Chapter 6 are implemented successfully. Proposed mitigation measures include measures such as ensuring that the correct design relationship exists between the burden, spacing and hole diameter. The existing exposure of residents to blasting and other noise sources in the area further reduces the potential significance of this impact. The impact will furthermore be temporary and will reduce significantly as shaft development proceeds.

The impact of other operational activities on the residential villages to the north and west of the prospecting shaft due to the shaft sinking activities (other than blasting) will be minimal. Also refer to **Appendix B.4**.

Vibration

Previous experience indicated the following seismographic readings during blasting of a similar shaft:

- At a depth of 5 m, and 50 m from the blasting area: 1.25 mm/s
- At a depth of 11 m, and 50 m from the blasting area: 1.05 mm/s
- At a depth of 15 m, and 50 m from the blasting area: 1.28 mm/s
- At a depth of 16 m, and 50 m from the blasting area: 1.25 mm/s
- At a depth of 17 m, and 50 m from the blasting area: 1.27 mm/s.

There are however variables that must be considered such as distance from blasting, geology and blast design data, i.e. hole diameter, depth, size of charge and nature of tamping.

Structural damage is only expected to occur at a vibration level in excess of 5.0 mm/s. Due to the distance from the proposed site to surrounding residences (more than 700 m) and the low expected vibration impacts during blasting, no structural damage is therefore expected at surrounding villages. The significance of potential impacts associated with vibration is therefore **low**.

5.7.11 Sites of Archaeological and Cultural Interest

The same *in situ* mitigation measures should be implemented during the operational phase for the six graves identified in the direct vicinity of the site, as proposed for the construction phase of the proposed project. See Chapter 6. If the grave sites are adequately managed *in situ*, the significance of associated potential impacts on these sites will be reduced from **high** to **low**.

5.7.12 Sensitive Landscapes

The same *in situ* mitigation measures should be implemented during the operational phase for the six graves identified in the direct vicinity of the site, as proposed for the construction phase of the proposed project. See Chapter 6. If the grave sites are adequately managed *in situ*, the significance of associated potential impacts on these sites will be reduced from **high** to **low**.

5.7.13 Visual Aspects

No additional impacts on visual aspects are expected during the operational phase, since all surface infrastructure will be developed during the construction phase.

5.7.14 Socio-Economic Aspects

Context

The same subcontractor that will be appointed by Lonmin Akanani to undertake the operational phase, as will be used for the construction of the proposed prospecting shaft. The employee numbers are expected to remain the same as that for the construction phase, with the same distribution of skilled/unskilled and local/non-local employees being present. Thus, it is estimated that between 250 and 300 workers will be employed for the operational phase of the proposed project. It is expected that approximately 65% (approximately 160-195) of these 250-300 workers will be unskilled workers, whilst 35% (approximately 90-105) will be skilled. Lonmin Akanani estimates that approximately 60% of the workers will be local employees from the Mogalakwena Local Municipality.

Impact assessment

The same socio-economic impacts and significance ratings as identified for the construction phase in Section 5.6.11 above will be applicable during the operational phase of the proposed project. Refer to Chapter 6 for the relevant mitigation measures.

5.7.15 Traffic and transport

Context

The ore obtained via the proposed prospecting shaft will be transported by 35 ton trucks to Mintek in Johannesburg for metallurgical test work. The 3000 tonnes of ore will be transported over a period of approximately 6 months, resulting in approximately 14 truck-loads per month. This calculates to approximately one truck load every 2 days.

Impact assessment

The operational-phase vehicles entering, manoeuvring on and exiting the prospecting shaft site are not expected to contribute to significant environmental impacts, if the mitigation measures proposed in Chapter 6 are implemented successfully. The limited number of additional vehicles associated with transporting the ore to Johannesburg will not have a significant impact on the traffic load of public roads in the area.

5.8 DECOMMISSIONING AND CLOSURE

The prospecting shaft is intended to be used as the ventilation shaft for the future requirements of the Akanani Mine, should the feasibility studies indicate that the Akanani platinum project is economically viable. The installed equipment will eventually be removed according to the mine's Closure Plan. A separate, full EIA and EMP process must be conducted and approved by the relevant decision-making authorities before full-scale mining activities may commence.

Should the Akanani platinum project not be viable, the waste rock on the surface will be dumped back into the shaft and a concrete slab will be constructed over the mouth of the shaft. The rest of the disturbed area will be rehabilitated to its former state, as far as practically possible.

Table 8 below summarises those impacts directly related to the Decommissioning and Closure Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 8: Environmental Impact Assessment Matrix for the proposed Lonmin Akanani prospecting shaft – Decommissioning and Closure Phase.

POTENTIAL ENVIRONMENTAL IMPACT: Decommissioning and Closure Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1.Geology												
Not applicable.	-	-	-	-	-	-	-	-	-	-	-	-
2. Topography												
Not applicable.	-	-	-	-	-	-	-	-	-	-	-	-
3. Soils												
Not applicable.	-	-	-	-	-	-	-	-	-	-	-	-
4. Land capability and use												
Positive impact expected if a section of the rehabilitated land is returned to grazing land.	2	5	1	3	**24**	L	2	5	1	3	**24**	L+
5. Ecology: Flora and fauna												
Positive impact expected if a section of the site is re-vegetated and rehabilitated.	2	5	1	3	**24**	L+	2	5	1	3	**24**	L+
6. Ecology: Wetlands												
Not applicable.	-	-	-	-	-	-	-	-	-	-	-	-
7. Surface water												
If prospecting activities indicates that mining will be unfeasible, the site will be rehabilitated to its free-draining former state.	4	5	2	3	**33**	M+	4	5	2	3	**33**	M+
Surface water pollution associated with general and/or hazardous waste.	6	3	3	4	**48**	M	4	2	1	3	**21**	L
8. Groundwater												
No additional impacts on groundwater are anticipated.	-	-	-	-	-	-	-	-	-	-	-	-
9. Air quality												
No additional impacts on air quality are expected.	-	-	-	-	-	-	-	-	-	-	-	-
10. Noise and Vibration												
No additional impacts on noise and vibration are expected.	-	-	-	-	-	-	-	-	-	-	-	-
11. Archaeological and heritage sites												
No additional impacts are expected if the site is rehabilitated to its former state.	-	-	-	-	-	-	-	-	-	-	-	-
12. Sensitive landscapes												
No additional impacts are expected if the site is rehabilitated to its former state.	-	-	-	-	-	-	-	-	-	-	-	-

POTENTIAL ENVIRONMENTAL IMPACT: Decommissioning and Closure Phase	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation (Refer to Chapter 6 for relevant mitigation measures)					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
13. Visual aspects												
The removal of surface shaft infrastructure will result in a positive impact on visual aspects.	2	3	2	4	**28**	L	2	3	2	4	**28**	L+
14. Socio-economic aspects												
Rehabilitation of land to its former land use (where possible).	2	4	1	3	**21**	L+	2	4	1	3	**21**	L+
Safety impacts if the site is not rehabilitated and the shaft mouth covered appropriately.	6	4	1	3	**33**	M	4	4	1	2	**18**	L
Loss of employment opportunities.	6	4	2	4	**48**	M	4	3	2	3	**27**	L

5.8.1 Geology

No additional impacts on geology are expected during the decommissioning and closure phase.

5.8.2 Topography

No additional impacts on topography are expected during the decommissioning and closure phase.

5.8.3 Soils

No additional impacts on soils are expected during the decommissioning and closure phase.

The disturbed area will be rehabilitated to its former state, as far as practically possible, should the Akanani platinum project not be viable. The soil stockpiled on site will be used for these rehabilitation purposes during the decommissioning and closure phase.

5.8.4 Land Capability and Land Use

The disturbed site will be rehabilitated to its former state, as far as practically possible, should the Akanani platinum project not be viable. This will result in a **positive impact** with **low** significance if the site is returned to grazing land.

5.8.5 Ecology: Fauna and Flora

If the disturbed site is rehabilitated to its former state, the associated re-vegetation of indigenous flora at the site will result in a **positive impact** of **low** significance. The re-vegetation of indigenous flora should furthermore result in fauna species migrating back onto the site.

5.8.6 Ecology: Wetlands

No impacts on any wetlands are expected during the decommissioning phase.

5.8.7 Surface Water

The surface water management structures will be removed and the site rehabilitated to its free-draining former state, if prospecting activities indicate that mining will be unfeasible at Lonmin mining. This will result in a **positive impact** of **low** significance, since the site will be returned to its previous free-draining state.

5.8.8 Groundwater

No additional impacts on groundwater are anticipated during the decommissioning and closure phase.

5.8.9 Air Quality

No additional impacts on air quality are expected during the decommissioning and closure phase.

5.8.10 Noise and Vibration

No additional impacts on noise and vibration are expected during the decommissioning and closure phase.

5.8.11 Sites of Archaeological and Cultural Interest

No additional impacts on sites of archaeological and cultural interest are expected during the decommissioning and closure phase, if the site is rehabilitated to its former state.

5.8.12 Sensitive Landscapes

No additional impacts on sensitive landscapes are expected during the decommissioning and closure phase, if the site is rehabilitated to its former state.

5.8.13 Visual Aspects

All surface infrastructure will be removed and the site rehabilitated if prospecting activities conclude that the Akanani platinum project will not be viable. The removal of the infrastructure will reduce the human-induced visual variance created by the prospecting shaft infrastructure, and will result in a **moderate positive** impact on visual aspects.

5.8.14 Socio-Economic Aspects

The following socio-economic impacts are related to the the decommissioning and closure phase of the proposed project:

- **Potential for alternative land uses:** Should the proposed Lonmin Akanani platinum project prove not to be viable, the disturbed area will be rehabilitated to its former state as far as practically possible. This will allow the land to become available again for other activities, such as expansion of residential areas or grazing. Since the area that was lost/disturbed is relatively small in comparison to the surrounding area, and taking into account that the covered shaft mouth will remain unavailable for development and/or vegetation as well as that the natural vegetation may not necessarily return to its prime state, the associated **positive impact** is expected to be limited and of **low** significance.
- **Safety impacts:** As mentioned above, should the proposed Lonmin Akanani Platinum Project prove not to be financially viable, the proposed prospecting shaft will be backfilled and covered with a concrete slab. Should this covering not be done effectively, potential safety impacts to communities in the area can reasonably be expected, especially with children and animals being at risk of falling into the shaft if it is not closed properly.

  This impact was rated of **moderate** significance, but if the mitigation measures as prescribed in Chapter 6 are implemented successfully, this rating will be reduced to a **low** significance.
- **Loss of employment opportunities:** Once the operational phase of the proposed project is completed after approximately 3 years, the employment opportunities associated with the proposed project will be lost. Although it is possible that non-local employees (approximately 90-105 employees) may be utilised by the contractor on other projects, it is expected that the majority of the local employees (approximately 160-195 employees) will be retrenched. Retrenchments will lead to loss of income, loss of local expenditure as well as retrenchments of indirect job beneficiaries in other sectors.

  This loss of employment will be a negative impact, as current socio-economic conditions in the area are relatively poor with numerous unemployed individuals. Loss of employment could result in significant increases in social pathologies. However, as mining activities are continuing to expand as an economic sector in the Limpopo Province, the skills that are developed during the proposed project may be of value to employees to obtain other employment opportunities.

  This impact was rated of **moderate** significance, but if the mitigation measures prescribed in Chapter 6 are implemented, this rating is reduced to a **low** significance.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 BRIEF OVERVIEW AND CONTEXT TO THIS EMP

6.1.1 Purpose of this document

This Environmental Management Plan is an Amendment to Lonmin's existing EMP for their Akanani prospecting activities.

This EMP is based on the results of the Environmental Impact Assessment as outlined in Chapter 5 of this document, and addresses the management and mitigation of the environmental impacts resulting from the proposed prospecting activity, as described above. Both the EIA Report and this EMP, in combination also called the EMP Amendment, have been prepared in accordance with the requirements of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002, MPRDA).

6.1.2 Updating of the EIA/EMP Report and legal status of the EMP

Lonmin's original Akanani prospecting EMP covers certain prospecting activities, but site-specific Amendments need to be compiled for additional activities, such as this proposed bulk sampling prospecting shaft. Approval of the EIA Report and EMP Amendment has to be obtained from the Department of Minerals and Energy (DME), in terms of the MPRDA. When approved, Chapter 6, the EMP, becomes a legally binding document.

6.1.3 Structure of the EIA Report

Chapter 1: Introduction

Chapter 2: Description of the environment

Chapter 3: Project motivation and alternatives considered

Chapter 4: Description of the proposed project

Chapter 5: Environmental impact assessment

Chapter 6: Environmental Management Plan (This is a freestanding document and is included as part of the EIA Report and EMP volume (EMP Amendment) to meet regulatory requirements).

6.1.4 Structure of the EMP (this document/chapter)

This Environmental Management Plan (EMP) comprises the following parts;

Section 6.1: Brief overview and context to this EMP

Section 6.2: Implementation of the overall EMP

Section 6.3: Construction Phase EMP (which guides contractors and the proponent regarding environmental management while commissioning the proposed activities);

Section 6.4: Operational Phase EMP (which describes operational environmental management measures to be implemented)

Section 6.5: Decommissioning and Closure Phase EMP (which describes decommissioning and closure environmental management measures to be implemented).

6.2 IMPLEMENTATION OF THE EMP

A number of activities must take place before commencement of construction. Certain of these activities are not directly related to physical work on site, but are presented below, as they should be addressed before commencement of, or during the early phases of construction.

6.2.1 Lonmin's responsibility for EMP implementation

Primary responsibility for implementation of the EMP rests with Lonmin. Lonmin will ensure that all contracting companies tendering for work receive a copy of the EMP and understand their responsibility to operate within the framework of the measures defined in the EMP. When adjudicating tenders, Lonmin will ensure that contractors have made appropriate allowance for the management of environmental matters. Lonmin will appoint an Environmental Control Officer (ECO) who will be present on site as often as possible, but as a minimum undertake bi-weekly EMP audits during the construction phase. ECO audit intervals during the operational phase should be confirmed and agreed with the ECO before commencement with the operational phase.

Lonmin will ensure that, on appointment, all contracting companies operating on the site have a copy of the EMP and understand their responsibility to operate within the framework of the measures defined in the EMP.

6.2.2 Responsibility of contractors

All contracting companies will receive a copy of the EMP at time of tender. Each contractor is to familiarise himself with the environmental management measures for the site and ensure that contracting prices allow for environmental costs.

At appointment the contractor should have his copy of the EMP on site. It is the responsibility of the contractor to ensure that all of their staff are aware of the measures applicable to their area of work on site. It is the responsibility of the contractor to bring to the attention of the Lonmin ECO any environmental incident or breach of the conditions of the EMP, within 12 hours of occurrence of such event, through the company's Incident Reporting System.

6.2.3 Environmental incidents and breaches of EMP conditions

The ECO will bring to the attention of the Lonmin site manager major environmental incidents or breaches of the conditions of the EMP, within 12 hours of occurrence of such event. The site manager will notify the controlling authority within 48 hours of such an incident, if the environmental incident constitutes a breach of any permit or licence condition.

The ECO will continuously monitor the contractor's adherence to the EMP and will issue the contractor with a notice of non-compliance whenever transgressions are observed. The ECO will record the nature and magnitude of the non-compliance in a register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. The contractor should act immediately when a notice of non-compliance is received and implement the agreed corrective action.

Any avoidable non-compliance with the EMP will be considered sufficient grounds for the imposition of a penalty. The value of the penalty will not be less than the payment that would have been due to the contractor for the day's production of the relevant item of work that gave cause for the infringement. Any non-compliance with the agreed procedures of the EMP is a transgression of the various statutes and laws that define the manner in which the environment is managed. Set penalties should be enforced. Penalties shall be specified in the contract wit the Contractor. Failure to rectify the cause will be reported to the relevant authority to deal with the transgression, as it deems fit.

6.2.4 Complaints management

Complaints received regarding activities on the construction site pertaining to the environment should be recorded in a register and the response noted with the date and action taken. This record should be submitted with the monthly reports and a verbal report should be given at the monthly site meetings.

6.3 CONSTRUCTION PHASE EMP

The following mitigation measures have been identified for the construction phase of the proposed project.

Table 9: Environmental Management Plan for the Lonmin Akanani prospecting shaft – Construction Phase.

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
1. Geology				
3.1	**Project activity:**	Construction of the surface water management structures, pollution control dam, etc.	Not applicable	
	Impact:	Permanent impacts on the geological structure at the prospecting shaft.		
	Mitigation measure(s):	None		
2. Topography				
3.1	**Project activity:**	Construction of surface infrastructure.	Not applicable	
	Impact:	Enhanced areas of topographical variance.		
	Mitigation measure(s):	None		
3. Soils				
3.1	**Project activity:**	Topsoil removal and site preparation for construction.	Construction contractors	
	Impact:	Loss of topsoil and sub-soil during clearing of site for construction.		
	Mitigation measure(s):	Soil should be stripped ahead of the development, and: • Handled when dry. • Stockpiled at a gentle slope to prevent erosion by flowing water. • Stockpiled topsoil should be vegetated with indigenous vegetation to prevent soil erosion. • All topsoil stockpiles shall be maintained in a weed-free condition throughout the contract period. Weeds appearing on the stockpiled topsoil shall be removed by hand before the weeds seed. • Topsoil stockpiles shall be confined to the ECO-designated area. • Stockpiled soil shall be located away from drainage lines and areas of temporary inundation by water. • Topsoil stockpiles shall not exceed a height of 2m. • Repeated handling of the soil must be avoided. • Equipment used during soil stripping, handling and placement should be guided by the following: o Soil stripping is best performed using a truck and backhoe; o Soil piles should be spread using a light track-dozer; and o No graders to be used in re-shaping. Lonmin should ensure that erosion controls are included in the designs of all linear infrastructure such as pipelines. Such linear structures will be inspected on a regular basis to check that the measures are effective.		
3.2	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Hydrocarbon contamination of soils from construction equipment and/or vehicle spillages.		
	Mitigation measure(s):	The following measures should be implemented: • Excessive soil contamination by fuel or oil spills should be collected to be treated at a pre-determined		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		and dedicated location, or will be treated *in situ* using bioremediation, in accordance with Lonmin's existing procedures. • Vehicles should be maintained regularly and kept in a good working order. • Vehicle maintenance should be limited to an appropriately bunded and surfaced area.		
3.3	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Loss of usable topsoil due to soil compaction.		
	Mitigation measure(s):	Clearly demarcate construction areas and limit vehicle movement to demarcated areas to prevent unnecessary soil compaction.		
3.4	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Loss of usable topsoil due to soil erosion.		
	Mitigation measure(s):	The following measures should be implemented: • Areas that may be prone to erosion or where signs of erosion are evident (e.g. water trenches) shall be stabilised. Methods of stabilisation include: brush-cut packing, mulch or chip cover, straw stabilising, sodding, hydro-seeding, soil binders and physical stabilisation methods such as gabions, reno-mattresses, armour flex or retaining walls. • Traffic and movement over stabilised areas shall be restricted and controlled, and damage to stabilised areas shall be repaired and maintained to the satisfaction of the ECO. • All presently eroded areas within the construction site shall be rehabilitated to a state comparable to the surrounding vegetation. • To prevent soil erosion, ensure storm water is diverted away from exposed areas and soil stockpiles. Ensure storm water runoff from exposed areas and un-vegetated soil stockpiles passes through settling ponds to trap sediment prior to the water flowing off site.		
4. Land capability and use				
4.1	**Project activity:**	Site clearing and construction activities.	Construction contractors	
	Impact:	Loss of ~2 ha land with (limited) grazing potential.		
	Mitigation measure(s):	Clearly demarcate construction areas and limit vehicle movement to demarcated areas to prevent unnecessary land disturbance.		
5. Ecology: Flora and fauna				
5.1	**Project activity:**	Site clearing and construction activities.	Construction contractors	
	Impact:	Removal of vegetation for construction and loss of habitat for local fauna.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The specific construction area shall be clearly demarcated, preferably with red and white tape. All vehicles and activity shall be confined to these demarcated construction areas, in order to minimise		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		environmental damage to the surrounding natural vegetation. • Only vegetation falling directly within the demarcated areas shall be removed. • Demarcation shall remain in place for the duration of construction on site. If damaged, demarcation shall be repaired or replaced immediately. • The outbreak of an uncontrolled fire shall be reported to the site manager immediately and the necessary steps shall be taken to control and extinguish the fire. • A firebreak must be developed and maintained around the construction and surrounding areas. • Smoking shall be prohibited in the vicinity of flammable substances. • Open fires for heating and cooking shall not be permitted. • The contractor shall ensure that fire-fighting equipment is available on site, in particular where flammable substances are being stored or used. • Any welding or other sources of heating of materials shall be done in a controlled environment and under appropriate supervision, in such a manner as to minimise the risk of fires and/or injury to staff. • The contractor shall be held responsible for any damage caused as a result of fires caused by his employees or sub-contractors. • The contractor shall provide adequate facilities for his staff so that they are not encouraged to supplement their comforts on site by accessing what can be taken from the natural surroundings. • The contractor shall ensure that energy sources are available at all times for personnel for heating and cooking purposes. No natural materials may be harvested and burned for the use of cooking or heating.		
6. Ecology: Wetlands				
6.1	Not applicable.			
7. Surface water				
7.1	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Contamination of clean stormwater run-off on site.		
	Mitigation measure(s):	Construct stormwater cut-off berms up-gradient from the site to divert clean stormwater away from the site, to a clean water storage dam. The "*Stormwater Routing Framework (Conceptual design)*" compiled by Golder should be used as a framework when doing the detailed design of the berm system. Refer to **Appendix B.5**.		
7.2	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Pollution of surface water sources through dirty surface run-off from site.		
	Mitigation measure(s):	Construct a surface water diversion berm down-gradient of the site, which will intercept dirty surface water run-off and divert it to the pollution control dam. The "*Stormwater Routing Framework (Conceptual design)*" compiled by Golder should be used as a framework when doing the detailed design of the berm		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		system. Refer to **Appendix B.5**. Additional mitigation measures include the following: • Contaminated water discharged from the construction site shall meet the required DWAF water quality standards.		
7.3	**Project activity:**	Vegetation removal.	Construction contractors	
	Impact:	Stripping of vegetation may increase erosion, which might increase the amount of suspended solids in downstream watercourses.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The specific construction area shall be clearly demarcated, preferably with red and white tape. • Only vegetation falling directly within the demarcated areas shall be removed.		
7.4	**Project activity:**	Storage of abstracted groundwater in the temporary settler ponds, and re-use of this water during construction.	Construction contractors	
	Impact:	Contaminated of surrounding surface water sources if the water quality in the two temporary settler dams degenerates while reusing this water during the construction phase.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The temporary settler dams should be appropriately sized. • Settling dams should be lined.		
7.5	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Surface water contamination from hydrocarbons and other hazardous or contaminating substances.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • All repairs done on machinery that makes use of hydrocarbons as fuels or lubricants shall be carried out on a concreted surface, and will make use of a drip tray placed strategically to avoid incidental spillage. • Drip trays shall be inspected and emptied daily and serviced when necessary. In particular drip trays shall be closely monitored during rain events to ensure that they do not overflow. The contractor shall maintain a used oil storage container within an appropriately bunded area. • Workers shall be made aware of the health risks associated with any hazardous substances used (e.g. smoking near refuelling depots), and shall be provided with appropriate protective clothing / equipment in case of spillages or accidents. • Refuelling and maintenance of vehicles shall occur within specified depots only. Working / fuel transfer areas within these depots shall be underlain by an impermeable surface and shall have grease traps to ensure that no spillage of greases, oils or fuels occurs into local soil or water resources. • Proper storage facilities, placed on an impermeable		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		surface, shall be provided for the storage of oils, grease, fuels, chemicals and other hazardous materials to be used. Fuel shall be stored in a secure area in a steel tank supplied and maintained by the fuel suppliers. Leakage of fuel shall be avoided. An adequate bund wall, 110% of the combined container volume, shall be provided for fuel and diesel areas to accommodate any spillage or overflow from these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. • Storage areas for potentially contaminating materials shall be roofed with impervious material. The ingress of wind-blown rain shall be avoided by sufficient roof overhang or sides of sufficient height. • Hazard signs indicating the nature of stored materials shall be displayed on the storage facility or container. Before containers or storage facilities are erected, the contractor shall furnish the ECO with details of the preventative measures he proposes to instate in order to mitigate pollution of the surrounding environment from leaks or spillage. The preferred method is a concrete floor that is bunded. The proposal shall also indicate the emergency procedures in the event of misuse or spillage that may negatively affect an individual or the environment. • The storage facilities (including any tanks) shall be surrounded by a bund wall, in order to ensure that accidental spillage does not pollute local soil or water resources. • The storage areas shall be kept tidy and the area shall be rehabilitated after use. • An inventory of hazardous chemicals/substances (including that within equipment) kept on site, along with a description of possible ill effects and treatment of health-related afflictions resulting from accidents, shall be kept in the storage area as well as by the relevant manager. These areas shall be securely fenced. • A notice board with the contact details of the responsible party shall be displayed at the gate to the storage area. • Gas welding cylinders and LPG cylinders shall be stored in a secure, well-ventilated area. • Cement and other potential environmental pollutants shall be stored and mixed on an impermeable substratum. The potential for environmental contamination should be severely limited. • The Contractor is responsible for spill treatment. The individual responsible for, or who discovers a hazardous waste spill, shall report the incident to the ECO. The ECO will assess the situation and act as required. In all cases, the immediate response will be to contain the spill. The exact treatment of		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		polluted soil/water shall be determined by the contractor in consultation with the ECO. • The contractor shall report spill incidents to the ECO within 12 hours of its occurrence and the ECO shall report it to DWAF within one working day. • The contractor shall prevent discharge of any pollutants, such as cement, concrete, lime, fertiliser, chemicals and fuels into any water sources or soils. • "Grey water" from kitchens, showers, sinks, etc. shall be diverted to, and treated at a treatment facility on site. • The ECO shall monitor the quality of water bodies on a monthly basis. These baseline values shall not be adversely affected by construction-related activities. • The contractor shall ensure the provision and proper utilisation, maintenance and management of toilet, wash and waste facilities. Chemical toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 15 workers. The exact location of the toilets shall be approved by the ECO prior to establishment. All temporary / portable toilets shall be secured to the ground to the satisfaction of the ECO to prevent them from toppling due to wind or any other cause.		
7.6	**Project activity:**	Abstraction of water required for construction purposes.	Construction contractors	
	Impact:	Damage to water sources caused by the abstraction of water required for construction purposes.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Water for construction and drinking purposes shall be obtained from a sustainable source. The ECO shall indicate to the contractor which sources of water may be used for potable usage and washing. The contractor shall ensure that water is drawn from a sustainable source that shall not result in significant depletion of the existing water supply to the aquatic ecosystem. • The contractor shall not cause any physical damage to any aspects of a watercourse, other than that necessary to complete the works as specified.		
7.7	**Project activity:**	General and hazardous waste management during the construction phase.	Construction contractors	
	Impact:	Surface water pollution associated with general and/or hazardous waste.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Solid waste shall be stored in an approved area in covered, tip-proof metal drums, preferably skip containers, for collection and disposal. • The waste collection point shall be fenced off with diamond mesh wire with a minimum height of 1.8 metres. The fence needs to keep out all animals, above and below ground level. • A refuse control system shall be established for the		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		collection and removal of refuse to the satisfaction of the ECO. • Disposal of solid waste shall be at a Department of Environmental Affairs and Tourism (DEAT) licensed landfill site or at a site approved by the DEAT in the event that an existing operating landfill site is not within reasonable distance from the site. • No waste shall be burned at the site offices or anywhere else on the site, including the approved solid waste disposal site. • All building rubble shall be a) removed from the site and disposed of at an appropriate dumping site, or b) temporarily stored in a clearly demarcated area on site for future use. • No littering by construction workers shall be allowed. During the construction period, the facilities shall be maintained in a neat and tidy condition and the site shall be kept free of litter. • The contractor shall provide enough rubbish bins / skips for later safe disposal at approved sites. • Littering, discarding or burying of any materials on site shall not be allowed. • Hazardous waste such as tar and oil shall be disposed of at a DEAT approved hazardous waste site, or through a registered hazardous waste management company. Special care shall be taken to avoid spillage of tar products such as tar primer or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating water. • Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and returned to the supplier. Water and oil shall be separated in an oil trap. Oils collected in this manner shall be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at an approved hazardous waste disposal site. Oil collected by a mobile servicing unit shall be stored in the service unit's sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company. • Wherever possible, materials used or generated by construction shall be recycled or reused. • Where possible and practical, such as at stores and offices, waste shall be sorted for recycling purposes, into the following categories: paper, aluminium, metals (other than aluminium), organic waste and glass. • Separate containers for glass, paper, metals and plastics shall be provided. Office and camp areas are particularly suited to this form of recycling process.		
8. Groundwater				
8.1	**Project activity:**	Construction of surface water infrastructure and other surface infrastructure on site.	Construction contractors	

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	Impact:	Impact on groundwater level and flow as a result of construction activities.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Stormwater facilities should be appropriately sized. • Settling dams and pollution control dams should be lined. • Quality Assurance and Supervision should be ensured during construction.		
8.2	**Project activity:**	Construction of surface water infrastructure and other surface infrastructure on site.	Construction contractors	
	Impact:	Impact on groundwater quality as a result of construction activities.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Stormwater facilities should be appropriately sized. • Settling dams and pollution control dams should be lined. • Quality Assurance and Supervision should be ensured during construction. • Pollution containment systems should be inspected on a scheduled basis and appropriately repaired when necessary. Accidental damage to pollution containment systems and spills should be responded to immediately and appropriately.		
8.3	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Hydrocarbon contamination of groundwater from construction equipment and/or vehicle spillages.		
	Mitigation measure(s):	See Section 7.5 (Surface water) above.		
9. Air quality				
9.1	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Generation of nuisance dust and fumes from vehicle movement and construction activities.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The contractor shall be responsible for the control of dust arising from the operations and for any costs incurred by the employer for damages resulting from the dust. • The contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the ECO. • Dust on all roads on site shall be controlled by implementing dust suppression measures, such as using water spray vehicles, or the use of a Rain Bird or similar water spray method. • Water used for dust suppression shall be used in quantities small enough not to generate run-off and cause erosion. Wherever possible water that has been captured in sediment control dams/silt traps will be used for dust suppression in preference to using clean water from streams or dams in the area		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		• The removal of vegetation shall be avoided until such time as soil stripping is required and exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible. • Excavation, handling and transport of erodible materials shall be avoided under high wind conditions. • Where possible, soil stockpiles shall be located in sheltered areas where they are not exposed to the erosive effects of the wind. Where erosion of stockpiles becomes a problem, erosion control measures shall be implemented at the discretion of the ECO. • Regular visual monitoring of air quality with respect to particulates and dust fall shall be undertaken • Vehicle speeds shall not exceed 30km/h when manoeuvring on site.		
10. Noise and Vibration				
10.1	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Noise and vibration impacts associated with construction activities.		
	Mitigation measure(s):	The following mitigation measures should be implemented • Construction activities shall be restricted to working hours (06h00 – 18h00) seven days a week, unless otherwise approved by the ECO. • The contractor shall endeavour to keep noise and vibration generating activities to a minimum. The on-site activities shall not cause the noise level at any off-site human settlement to exceed 45 dBA as determined for rural districts in terms of SANS:10103, Table 2. • Noise levels at possible sensitive receptors (e.g. neighbouring houses) should be measured frequently and should stay within acceptable levels. • All construction vehicles and machinery used on site shall be kept in good repair to prevent unnecessary noise.		
11. Archaeological and heritage sites				
11.1	**Project activity:**	Site clearing and construction activities.		
	Impact:	Potential impact on the six graves found within the study area.		
	Mitigation measure(s):	If any of the identified graves are to be affected by the proposed prospecting shaft development project the following mitigation measures should be implemented: • Graveyards should be demarcated with brick walls or with fences. Conserving graveyards *in situ* in mining areas creates the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for their future unaffected existence and maintenance and that controlled access must exist for any relatives or friends who wish to visit the graves. • Graveyards can also be exhumed and relocated. The exhumation of human remains and the relocation of		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		graveyards are regulated by various laws, regulations and administrative procedures. This task should be undertaken by forensic archaeologists or by reputable undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains has to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police. • More inconspicuous graves may occur in the Akanani Project Area. Some of these may be exposed during construction activities. If more graves are exposed during construction, the development must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) contacted to obtain the necessary permits from the Limpopo Heritage Resources Agency (LIHRA) to remove the human remains.		
12. Sensitive landscapes				
12.1	**Project activity:**	Site clearing and construction activities.	Construction contractors	
	Impact:	Potential impact on the six graves found within the study area.		
	Mitigation measure(s):	Refer to 11.1 (Archaeological and heritage sites) above.		
13. Visual aspects				
13.1	**Project activity:**	Construction of surface infrastructure.	Not applicable	
	Impact:	Visual impact from shaft and other surface infrastructure.		
	Mitigation measure(s):	None		
14. Socio-economic aspects				
14.1	**Project activity:**	Employment of between 250 and 300 workers during the construction phase.	Construction contractors and Lonmin	
	Impact:	Creation of employment opportunities.		
	Mitigation measure(s):	Mitigation measures to optimise relevant benefits: • Establish a "labour and employment desk" as a contact point for local community members who wish to seek employment on the project. • One of the tasks of the labour and employment desk will be to create a skills register of the qualifications and work experience of local community members who apply at the desk for employment on the project. The relevant details of all applicants are to be recorded, regardless of whether or not they are successful in their applications. If future opportunities for employment arise in the operational phase of the project, these persons may be invited to apply for suitable positions. • In order to promote the creation of employment opportunities for women and youths (within the legal		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		age limit), it is recommended that 10% of local employment opportunities on the project be reserved for women and younger persons, respectively. These positions should only be filled with persons outside of these categories if it can be demonstrated that no suitable persons are recorded in the skills register to fill these positions. The performance indicator for the promotion of employment of women and youth would be the number of local women and persons under the age of 35 who are employed in the construction phase of the project. • Establish a monitoring system to ensure that the construction contractor honours the specified employment policy. • Where economically feasible, use labour-intensive methods of construction. • Make multi-skilling of construction workers a priority, as employment opportunities during construction are only temporary. This would involve identifying skills that may be acquired during construction that can be built upon or supplemented through limited additional training to equip workers for jobs that would become available during the operational phase of the project. This could be either through the project itself or through Corporate Social Investment initiatives that may be undertaken by Lonmin Akanani in the area.		
14.2	**Project activity:**	Employment of between 250 and 300 workers during the construction phase.	Construction contractors and Lonmin	
	Impact:	Influx of job seekers into surrounding areas which may place a strain on the local communities.		
	Mitigation measure(s):	The following measures should be implemented:: • Make use of local labour as far as possible, thereby reducing the need to bring outsiders into the study area. • Liaise with local community structures to identify the local labour pool.		
14.3	**Project activity:**	Establishment of a labourers' camp near the site to accommodate workers.	Construction contractors and Lonmin	
	Impact:	Various socio-economic impacts associated with establishment of a labourers' camp at the proposed prospecting shaft site.		
	Mitigation measure(s):	In order to mitigate these impacts, the following measures are recommended: • Measures to be implemented prior to the establishment of labour camps: ○ **Lonmin should reconsider the requirement to establish a labourers' camp on site. The workforce should preferably be housed in existing accommodation in Mokopane and transported to the site by bus. The relevant potential socio-economic impacts identified can be pro-actively prevented by not developing a labourers' camp on site.** Lonmin subsequently confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane.		
14.4	**Project activity:**	Establishment of a labourers' camp near the site to accommodate workers.	Construction contractors	

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	Impact:	Increased pressure on service provision due to establishment of labourers' camps.	and Lonmin	
	Mitigation measure(s):	Lonmin confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane. No additional mitigation measures are therefore required.		
14.5	**Project activity:**	Construction activities.	Construction contractors and Lonmin	
	Impact:	Loss of approximately 0.8 % of grazing land available in the immediate surrounding area.		
	Mitigation measure(s):	None		
14.6	**Project activity:**	Construction activities.	Construction contractors and Lonmin	
	Impact:	Safety impacts associated with traffic and other construction activities, equipment or material.		
	Mitigation measure(s):	The following measures should be implemented: • Construction vehicles travelling in the area must obey speed limits and traffic laws. • Construction vehicles must be clearly identified as working for the contractor or Lonmin Akanani. • The construction site must be fenced off and security measures must be put in place to prevent people or animals from entering the construction site both during working hours and after-hours. • Communities in the vicinity of the project area should be exposed to an education and awareness campaign to inform communities of the dangers associated with construction activities. • All the necessary handling of safety equipment required for the safe use of petrochemicals and oils shall be provided by the contractor to, and used or worn by, the staff whose duty it is to manage and maintain the contractor's and his subcontractor's equipment. • Workers shall be equipped with adequate personal protective equipment (PPE), e.g. equipment providing protection from the sun. • Hazardous materials shall be transported, stored, used and disposed of in the correct manner. • The contractor shall maintain and update all safety records.		
14.7	**Project activity:**	Construction activities.	Construction contractors	
	Impact:	Community perceptions and responses.		

Construction Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	Mitigation measure(s):	To improve relations with communities, the following mitigation measures are proposed: • Open liaison channels shall be established between the Proponent, the Contractors and Interested and Affected Parties, so that any queries, complaints or suggestions can be dealt with quickly and by the appropriate person(s). • The ECO shall establish a complaints register to record / register all complaints relating to the Activities. The ECO shall develop a protocol relating to the steps that would be followed once a complaint has been received. The protocol shall cover at least the following steps: registration, investigation, reporting, follow-up action and close out. This protocol shall be maintained by the operator once the Activity is operational. • Provide for local employment opportunities.	and Lonmin	
14.8	**Mitigation measure(s):**	**Staff training:** • As part of the induction programme, staff shall be educated as to the need to refrain from destruction of animals and plants, as well as from indiscriminate defecation, waste disposal and/or pollution of local soil and water resources, from trespassing on surrounding property and from theft of crops and animals from surrounding properties. Immediate and decisive action shall be taken should this occur. • Machine / vehicle operators shall receive clear instructions to remain within demarcated access routes and construction areas.	Construction contractors and Lonmin	
15. Traffic and transport				
15.1	**Project activity:**	Movement of construction vehicles on public roads, access roads and on site.		
	Impact:	Impact of construction vehicles on local and regional traffic and on the surrounding environment.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The access roads shall have storm water drainage channels to prevent soil erosion. • Transport routes to and within the site and construction areas shall be clearly demarcated prior to use. Any deviations from the principal road plan must be cleared with the ECO. • All personnel and vehicles used for transportation and/or construction purposes shall remain within these demarcated routes and areas, i.e. vehicles shall not be allowed to drive randomly, but shall remain within the approved routes. The purpose of this measure is to: a) limit unnecessary compaction of topsoil; and b) prevent disturbance of vegetation outside the construction areas. • Ensure contractor's staff arrive and depart promptly to prevent loitering of contractor's staff outside the designated working hours.		

6.4 OPERATIONAL PHASE EMP

The following mitigation measures have been identified for the operational phase of the proposed project:

Table 10: Environmental Management Plan for the Lonmin Akanani prospecting shaft – Operational Phase.

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
1. Geology				
1.1	**Project activity:**	Shaft development (blasting) and construction of other infrastructure.	Not applicable	
	Impact:	Permanent impacts on the geological structure at the prospecting shaft due to shaft development.		
	Mitigation measure(s):	None		
2. Topography				
2.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	Not applicable, since the proposed project will not result in additional changes to the topography during the operational phase.		
	Mitigation measure(s):	None		
3. Soils				
3.1	**Project activity:**	Management of stockpiled topsoil and subsoil during the operational phase.	Operational contractors	
	Impact:	Impacts on stockpiled topsoil and subsoil during the operational phase.		
	Mitigation measure(s):	Stockpiled soils should be managed as follows: • Stockpiled topsoil should be vegetated with indigenous vegetation to prevent soil erosion. • All topsoil stockpiles shall be maintained in a weed-free condition throughout the contract period. Weeds appearing on the stockpiled topsoil shall be removed by hand before the weeds seed. • Repeated handling of the soil must be avoided.		
3.2	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Hydrocarbon contamination of soils from construction equipment and/or vehicle spillages.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Excessive soil contamination by fuel or oil spills should be collected to be treated at a pre-determined and dedicated location, or will be treated *in situ* using bioremediation, in accordance with Lonmin's existing procedures. • Vehicles should be maintained regularly and kept in good working order. • Vehicle maintenance should be limited to appropriately bunded and surfaced vehicle workshops on site.		
4. Land capability and use				
4.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	Not applicable		
	Mitigation	Not applicable		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	measure(s):			
5. Ecology: Flora and fauna				
5.1	Project activity:	Operational activities.	Operational contractors	
	Impact:	The proposed project is not likely to result in additional impacts to fauna and flora during the operational phase. Measures should however be implemented to prevent damage to vegetation and loss of habitat for local fauna during the operational phase.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • All vehicles and activity shall be confined to the demarcated site areas, in order to minimise damage to the surrounding natural vegetation. • The outbreak of an uncontrolled fire shall be reported to the site manager immediately and the necessary steps shall be taken to control and extinguish the fire. • A firebreak must be developed and maintained around the site. • Smoking shall be prohibited in the vicinity of flammable substances. • Open fires for heating and cooking shall not be permitted. • The contractor shall ensure that fire-fighting equipment is available on site, in particular where flammable substances are being stored or used. • Any welding or other sources of heating of materials shall be done in a controlled environment and under appropriate supervision, in such a manner as to minimise the risk of fires and/or injury to staff. • The contractor shall be held responsible for any damage caused as a result of fires caused by his employees or sub-contractors. • The contractor shall provide adequate facilities for his staff so that they are not encouraged to supplement their comforts on site by accessing what can be taken from the natural surroundings. • The contractor shall ensure that energy sources are available at all times for personnel for heating and cooking purposes. No natural materials may be harvested and burned for cooking or heating purposes.		
6. Ecology: Wetlands				
6.1	Not applicabl4		Not applicable	
7. Surface water				
7.1	Project activity:	Operational activities.	Operational contractors	
	Impact:	Contamination of clean stormwater run-off on site.		
	Mitigation measure(s):	Maintain the stormwater cut-off berms system to ensure the optimised performance of this system during the operational phase.		
7.2	Project activity:	Operational activities.	Operational contractors	
	Impact:	Pollution of surface water sources through dirty surface run-off from site.		
	Mitigation measure(s):	The following mitigation measures should be implemented:: • Maintain the dirty water runoff system and pollution		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		control dam to ensure the optimised performance of this system during the operational phase. • Contaminated water discharged from the site shall meet the required DWAF water quality standards.		
7.3	**Project activity:**	Storage of abstracted groundwater in the temporary settler ponds, and re-use of this water during operation.	Operational contractors	
	Impact:	Contamination of surrounding surface water sources if the water quality in the two temporary settler dams degenerates while reusing this water during the operational phase.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The temporary settler dams should be appropriately sized. • Settling dams should be lined.		
7.4	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Surface water contamination from hydrocarbons and other hazardous or contaminating substances.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • All repairs done on machinery that makes use of hydrocarbons as fuels or lubricants shall be carried out on a concreted surface, and will make use of drip trays placed strategically to avoid incidental spillage. • Drip trays shall be inspected and emptied daily and serviced when necessary. In particular drip trays shall be closely monitored during rain events to ensure that they do not overflow. The contractor shall maintain a used oil storage container within an appropriately bunded area. • Workers shall be made aware of the health risks associated with any hazardous substances used (e.g. smoking near refuelling depots), and shall be provided with appropriate protective clothing / equipment in case of spillages or accidents. • Refuelling and maintenance of vehicles shall occur within specified depots only. Working / fuel transfer areas within these depots shall be underlain by an impermeable surface and shall have grease traps to ensure that no spillage of greases, oils or fuels occurs into local soil or water resources. • Proper storage facilities, placed on an impermeable surface, shall be provided for the storage of oils, grease, fuels, chemicals and other hazardous materials to be used. Fuel shall be stored in a secure area in a steel tank supplied and maintained by the fuel suppliers. Leakage of fuel shall be avoided. An adequate bund, equivalent to110% of the combined container volume, shall be provided for fuel and diesel areas to accommodate any spillage or overflow from these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. • Storage areas for potentially contaminating materials shall be roofed with impervious material. The ingress		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		of wind-blown rain shall be avoided by sufficient roof overhang or sides of sufficient height. • Hazard signs indicating the nature of stored materials shall be displayed on the storage facility or container. Before containers or storage facilities are erected, the contractor shall furnish the ECO with details of the preventative measures he proposes to instate in order to mitigate pollution of the surrounding environment from leaks or spillage. The preferred method is a concrete floor that is bunded. The proposal shall also indicate the emergency procedures in the event of misuse or spillage that may negatively affect an individual or the environment. • The storage facilities (including any tanks) shall be surrounded by a bund wall, in order to ensure that accidental spillage does not pollute local soil or water resources. • The storage areas shall be kept tidy and the area shall be rehabilitated after use. • An inventory of hazardous chemicals/substances (including that within equipment) kept on site, along with a description of possible ill effects and treatment of health-related afflictions resulting from accidents, shall be kept in the storage area as well as by the appropriate manager. These areas shall be securely fenced. • A notice board with the contact details of the responsible party shall be displayed at the gate to the storage area. • Gas welding cylinders and LPG cylinders shall be stored in a secure, well-ventilated area. • Cement and other potential environmental pollutants shall be stored and mixed on an impermeable substratum. There shall be no opportunity for environmental contamination. • The Contractor is responsible for spill treatment. The individual responsible for, or who discovers a hazardous waste spill, shall report the incident to the ECO. The ECO will assess the situation and act as required. In all cases, the immediate response will be to contain the spill. The exact treatment of polluted soil/water shall be determined by the contractor in consultation with the ECO. • The contractor shall report spill incidents to the ECO within 12 hours of its occurrence and the ECO shall report it to DWAF within one working day. • The contractor shall prevent discharge of any pollutants, such as cement, concrete, lime, fertiliser, chemicals and fuels into any water sources or soils. • "Grey water" from kitchens, showers, sinks, etc. shall be diverted to, and treated at a treatment facility on site. • The ECO shall monitor the quality of water bodies on a monthly basis. These baseline values should not be adversely affected by operational-related activities.		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		• The contractor shall ensure the provision and proper utilisation, maintenance and management of toilet, wash and waste facilities. Chemical toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 15 workers. The exact location of the toilets shall be approved by the ECO prior to establishment. All temporary / portable toilets shall be secured to the ground to the satisfaction of the ECO to prevent them from toppling due to wind or any other cause.		
7.5	**Project activity:**	Abstraction of water required for operational purposes.	Operational contractors	
	Impact:	Damage to water sources caused by the abstraction of water required for operational purposes.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Water for operational activities and drinking purposes shall be obtained from a sustainable source. The ECO shall indicate to the contractor which sources of water may be used for potable usage and washing. The contractor shall ensure that water is drawn from a sustainable source that shall not result in significant depletion of existing water supply to the aquatic ecosystem. • The contractor shall not cause any physical damage to any aspects of a watercourse, other than that necessary to complete the works as specified.		
7.6	**Project activity:**	General and hazardous waste management during the operational phase.	Operational contractors	
	Impact:	Surface water pollution associated with general and/or hazardous waste.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Solid waste shall be stored in an approved area in covered, tip-proof metal drums, preferably skip containers, for collection and disposal. • The waste collection point shall be fenced off with diamond mesh wire with a minimum height of 1, 8 meter. The fence needs to keep out all animals, above and below ground level. • A refuse control system shall be established for the collection and removal of refuse to the satisfaction of the ECO. • Disposal of solid waste shall be at a Department of Environmental Affairs and Tourism (DEAT) licensed landfill site or at a site approved by the DEAT in the event that an existing operating landfill site is not within reasonable distance from the site. • No waste shall be burned at the site offices or anywhere else on the site, including the approved solid waste disposal site. • All building rubble shall be a) removed from the site and disposed of at an appropriate dumping site, or b) temporarily stored in a clearly demarcated area on site for future use.		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		• No littering by operational workers shall be allowed. During the operational phase, the facilities shall be maintained in a neat and tidy condition and the site shall be kept free of litter. • The contractor shall provide enough rubbish bins / skips for later safe disposal at approved sites. • Littering, discarding or burying of any materials shall not be allowed on site. • Hazardous waste such as tar and oil shall be disposed of at a DEAT approved hazardous waste site, or through a registered hazardous waste management company. Special care shall be taken to avoid spillage of tar products such as tar primer or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating water. • Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and returned to the supplier. Water and oil shall be separated in an oil trap. Oils collected in this manner shall be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at an approved hazardous waste disposal site. Oil collected by a mobile servicing unit shall be stored in the service unit's sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company. • Wherever possible, materials used or generated by construction shall be recycled or reused. • Where possible and practical, such as at stores and offices, waste shall be sorted for recycling purposes, into the following categories: paper, aluminium, metals (other than aluminium), organic waste and glass. • Separate containers for glass, paper, metals and plastics shall be provided. Office and camp areas are particularly suited to this form of recycling process.		
8. Groundwater				
8.1	**Project activity:**	Shaft sinking and blasting activities.	Operational contractors	
	Impact:	Impact on groundwater level and flow as a result of operational activities such as shaft sinking and blasting.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The majority of groundwater intersections should be sealed off by the concrete lining of the shaft. • Higher yielding groundwater intersections, which cannot be sealed off by the concrete liners, should be incorporated into the operational water system. • Quality Assurance and Supervision should be ensured during shaft development.		
8.2	**Project activity:**	Shaft sinking and blasting, and other operational activities.	Operational contractors	
	Impact:	Impact on groundwater quality as a result of operational activities such as shaft sinking.		
	Mitigation	The following mitigation measures should be		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	measure(s):	implemented: • Stormwater facilities should be appropriately sized. • Settling dams and pollution control dams should be lined. • Quality Assurance and Supervision should be ensured during shaft development. • Pollution containment systems should be inspected on a scheduled basis and appropriately repaired when necessary. Accidental damage to pollution containment systems and spills should be responded to immediately and appropriately.		
8.3	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Hydrocarbon contamination of groundwater from construction equipment and/or vehicle spillages.		
	Mitigation measure(s):	See Section 7.4 (Surface water) above.		
9. Air quality				
9.1	**Project activity:**	Blasting, vehicle movement and other operational activities.	Operational contractors	
	Impact:	Generation of nuisance dust and fumes from blasting and vehicle movement during the operational phase.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Blast dust levels should be reduced by surface wetting, exhausting the dust and fumes via the untraveled return route and mist suppression systems. • The contractor shall be responsible for the control of dust arising from the operations and for any costs incurred by the employer for damages resulting from the dust. • The contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the ECO. • Dust on all roads on site shall be controlled by implementing dust suppression measures, such as using water spray vehicles, the use of a Rain Bird or similar water spray method. • Water used for dust suppression shall be used in quantities small enough not to generate run-off and cause erosion. Wherever possible, water that has been captured in sediment control dams/silt traps will be used for dust suppression in preference to using clean water from streams or dams in the area. • The removal of vegetation shall be avoided until such time as soil stripping is required and exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible. • Excavation, handling and transport of erodible materials shall be avoided under high wind conditions. • Where erosion of stockpiles becomes a problem, erosion control measures shall be implemented at the discretion of the ECO. • Regular visual monitoring of air quality with respect to particulates and dust fall shall be undertaken • Vehicle speeds shall not exceed 30km/h when manoeuvring on site.		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
10. Noise and Vibration				
10.1	**Project activity:**	Blasting, vehicle movement and other operational activities.	Operational contractors	
	Impact:	Noise and vibration impacts associated with blasting activities during the first few weeks of shaft sinking, and other operational activities.		
	Mitigation measure(s):	The following mitigation measures should be implemented • Noise-generating operational activities shall be restricted to between 06h00 and 18h00, seven days a week, unless otherwise approved by the ECO. • Specific days and times of blasting operations should be established. The blasting schedule should be communicated to surrounding villages, neighbours (such as the PP Rust mine) and institutions situated in the area (such as schools, old age homes, etc.). • Ensure that the correct design relationship exists between burden, spacing and hole diameter. • The contractor shall endeavour to keep noise and vibration generating activities to a minimum. The on-site activities shall not cause the noise level at any off-site human settlement to exceed 45 dBA as determined for rural districts in terms of SANS:10103, Table 2, except during blasting activities. • Noise levels at possible sensitive receptors (e.g. neighbouring houses) should be measured frequently and should stay within acceptable levels. • All construction vehicles and machinery used on site shall be kept in good repair to prevent unnecessary noise. • Implement an appropriate noise and vibration monitoring programme.		
11. Archaeological and heritage sites				
11.1	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Potential impact on the six graves found within the study area.		
	Mitigation measure(s):	If any of the identified graves are to be affected by the proposed development, the following mitigation measures should be implemented: • Graveyards should be demarcated with brick walls or with fences. Conserving graveyards *in situ* in mining areas create the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for their future unaffected existence and maintenance and that controlled access must exist for any relatives or friends who wish to visit the graves. • Graveyards can also be exhumed and relocated. The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task should be undertaken by forensic archaeologists or by reputed undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully implemented / Corrective action required)
		period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police. • More inconspicuous graves may occur in the Akanani Project Area. Some of these may be exposed during operational activities. If more graves are exposed during operation, the development must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) contacted to obtain the necessary permits from the Limpopo Heritage Resources Agency (LIHRA) to remove the human remains.		
12. Sensitive landscapes				
12.1	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Potential impact on the six graves found within the study area.		
	Mitigation measure(s):	Refer to 11.1 (Archaeological and heritage sites) above.		
13. Visual aspects				
13.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	Visual impact from shaft and other surface infrastructure.		
	Mitigation measure(s):	None		
14. Socio-economic aspects				
14.1	**Project activity:**	Employment of between 250 and 300 workers during the operational phase.	Operational contractors	
	Impact:	Creation of employment opportunities.		
	Mitigation measure(s):	Mitigation measure to optimise relevant benefits: • Establish a "labour and employment desk" as a contact point for local community members who wish to seek employment on the project. • One of the tasks of the labour and employment desk will be to create a skills register of the qualifications and work experience of local community members who apply at the desk for employment on the project. The relevant details of all applicants are to be recorded, regardless of whether or not they are successful in their applications. If future opportunities for employment arise in the operational phase of the project, these persons may be invited to apply for suitable positions. • In order to promote the creation of employment opportunities for women and youth, it is recommended 10% of local employment opportunities on the project be reserved for women and younger persons, respectively. These positions may only be filled with persons outside of these categories if it can be demonstrated that no suitable persons are recorded in the skills register to fill these positions. The performance indicator for the promotion of employment of women and youth would be the number of local women and persons under the age of 35 who are employed in the construction phase of the project. • Establish a monitoring system to ensure that the		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		operational contractor honours the specified employment policy. • Where economically feasible, use labour-intensive methods of operation. • Make multi-skilling of operational workers a priority, as employment opportunities during operation are only temporary. This would involve identifying skills that may be acquired during operation that can be built upon or supplemented through limited additional training to equip workers for other jobs that would become available,. This could be either through the project itself or through Corporate Social Investment initiatives that may be undertaken by Lonmin Akanani in the area.		
14.2	**Project activity:**	Employment of between 250 and 300 workers during the operational phase.	Operational contractors	
	Impact:	Influx of job seekers into surrounding areas which may place a strain on the local communities.		
	Mitigation measure(s):	The following measures should be implemented:: • Make use of local labour as far as possible, thereby reducing the need to allow outsiders into the study area. • Liaise with local community structures to identify the local labour pool.		
14.3	**Project activity:**	Establishment of a labourers' camp near the site to accommodate workers.	Operational contractors	
	Impact:	Various socio-economic impacts associated with the establishment of a labourers' camp at the proposed prospecting shaft site.		
	Mitigation measure(s):	In order to mitigate these impacts, the following measures are recommended: • Measures to be implemented prior to the establishment of labour camps: o **Lonmin should reconsider the requirement to establish a labourers' camp on site. The workforce should preferably be housed in existing accommodation in Mokopane and transported to the site by bus. The relevant potential socio-economic impacts identified can be pro-actively prevented by not developing a labourers' camp on site.** Lonmin subsequently confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane.		
14.4	**Project activity:**	Establishment of a labourers' camp near the site to accommodate workers.	Operational contractors	
	Impact:	Increased pressure on service provision due to establishment of labourers' camps.		
	Mitigation measure(s):	Lonmin confirmed that no labourers' camps will be developed at the proposed site, and that contractors will be required to accommodate labourers in Mokopane. No additional mitigation measures are therefore required.		
14.5	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Loss of approximately 0.8 % of grazing land available in the immediate surrounding area.		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
	Mitigation measure(s):	None		
14.6	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Safety impacts associated with traffic and operational activities.		
	Mitigation measure(s):	The following measures should be implemented: • Operational vehicles travelling in the area must obey speed limits and traffic laws. • Operational vehicles must be clearly identified as working for the contractor or Lonmin Akanani. • The operational site must be fenced off and security measures must be put in place to prevent people or animals from entering the construction site both during working hours and after-hours. • Communities in the vicinity of the project area should be provided with an education and awareness campaign to inform communities of the dangers associated with operational activities. • All the necessary handling of safety equipment required for the safe use of petrochemicals and oils shall be provided by the contractor to, and used or worn by, the staff whose duty it is to manage and maintain the contractor's and his subcontractor's equipment. • Workers shall be equipped with adequate personal protective equipment (PPE), e.g. equipment providing protection from the sun. • Hazardous materials shall be transported, stored, used and disposed of in the correct manner. • The contractor shall maintain and update all safety records.		
14.7	**Project activity:**	Operational activities.	Operational contractors	
	Impact:	Community perceptions and responses.		
	Mitigation measure(s):	To improve relations with communities, the following mitigation measures are proposed: • Open liaison channels shall be established between the Proponent, the Contractors and Interested and Affected Parties, so that any queries, complaints or suggestions can be dealt with quickly and by the appropriate person(s). • The ECO shall establish a complaints register to record / register all complaints relating to the Activities. The ECO shall develop a protocol relating to the steps that would be followed once a complaint has been received. The protocol shall cover at least the following steps: registration, investigation, reporting, follow-up action and close out. This protocol shall be maintained by the operator once the Activity is operational. • Provide for local employment opportunities.		
14.8	**Mitigation measure(s):**	**Staff training:** • As part of the induction programme, staff shall be educated as to the need to refrain from destruction of animals and plants, as well as from indiscriminate defecation, waste disposal and/or pollution of local soil and water resources, from trespassing on surrounding property and from theft of crops and animals from surrounding properties. Immediate and decisive action		

Operational Phase: Environmental Management Plan			Responsible party	ECO Monitoring column (Successfully Implemented / Corrective action required)
		shall be taken should this occur. • Machine / vehicle operators shall receive clear instructions to remain within demarcated access routes. • During the induction programme, workers shall be instructed about safety on site and entering onto neighbours' properties.		
15. Traffic and transport				
15.1	**Project activity:**	Movement of operational vehicles on public roads, access roads and on site.	Operational contractors	
	Impact:	Impact of operational vehicles on local and regional traffic and on the surrounding environment.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • The access roads shall have storm water drainage channels to prevent soil erosion. • Transport routes, to and within the site and construction areas shall be clearly demarcated prior to use. Any deviations from the principal road plan must be cleared with the ECO. • All personnel and vehicles used for transportation and/or operational purposes shall remain within demarcated routes and areas, i.e. vehicles shall not be allowed to drive randomly, but shall remain within the approved routes. The purpose of this measure is to: a) limit unnecessary compaction of topsoil; and b) prevent disturbance of vegetation outside the construction areas. • Ensure contractor's staff arrive and depart promptly to prevent loitering of contractor's staff outside the designated working hours.		

6.5 DECOMMISSIONING AND CLOSURE PHASE EMP

6.5.1 Approach to Closure Planning

Due to the uncertainties surrounding future mining opportunities posed by a prospecting project, closure planning would need to consider the following two scenarios:

- Prospecting activities only: at the end of the three year prospecting period, the project is deemed not feasible and all activities are stopped; or
- Prospecting activities converted to full scale mining operations: at the end of the three year prospecting period, the project is deemed feasible and is converted to full-scale mining operations.

The closure goal and objectives provided have been compiled with the above scenarios in mind.

Bearing the above in mind, the closure perspective adopted for the Lonmin prospecting shaft activities include, but are not limited to, the following:

- The steel headgear would be dismantled and disposed of, and the shaft would be in-filled and capped according to DME guidelines;
- Topsoil removed during development of the prospecting activities would be temporarily stored around the footprint of the waste rock stockpile, acting as a temporary water diversion berm;

- The waste rock stockpile would be developed to the west of the shaft, and it is foreseen that the over the three year period, a total of approximately 360 000 tons of waste rock would be disposed of on the dump. Should prospecting activities be decommissioned after three years, a portion of the waste rock would be used to in-fill the shaft, and the remaining waste rock would be shaped, levelled and re-vegetated. Should the prospecting activities be converted to mining operations, the waste rock stockpile would be shaped and levelled to form the base terrace for ongoing waste rock deposition; and
- As most of the administration buildings would be temporary structures, dismantling and removal of these would be the responsibility of the relevant contractors.

6.5.2 Overall Closure Goal

Regardless of whether or not the prospecting activities are converted to long-term mining operations, the overall goal for reclamation and closure of the Lonmin Akanani prospecting site is:

To re-instate a wilderness state that is stable and safe to both humans and animals in the long-term, taking into account any unavoidable remaining residue and/or disturbances, albeit being reclaimed from either prospecting or mining activities that could remain after closure.

6.5.3 Closure Objectives

The specific closure objectives that underpin the overall goal are the following:

Physical stability

To remove and/or stabilise surface infrastructure and unavoidable prospecting and/or mining residue and/or disturbances that remain on the site after closure in order not to compromise the post-closure land use, by:

- Should prospecting activities be converted to mining operations:
    - Shaping and levelling the temporary waste rock stockpile according to pre-determined detailed engineering designs to form the base terrace for future waste rock dump;
- Should activities on-site be stopped after prospecting:
    - Back-filling as much waste rock as possible from the temporary stockpile into the prospecting shaft;
    - Shaping, levelling and re-vegetating remaining waste rock that is not used for back-filling; and
    - Ripping and re-vegetating remaining footprint area.
- Ensuring all contractors' temporary surface infrastructure, including project office, change houses, etc., are removed;
- Closing, removing and disposing of all additional surface infrastructure that has no beneficial post-closure uses; and
- Reclaiming (ripping and vegetating) 5 m wide gravel roads to the final land use of the site.

Environmental quality

To ensure that local environmental quality is not adversely affected by possible physical effects and chemical contaminants arising from the site after closure, by:

- Conducting soil clean-up/reclamation of the unbunded laydown areas utilised for erection of the winder house and shaft headgear, once this infrastructure has been erected, to ensure that the planned land-use can be implemented; and
- Limiting/minimising the potential for long-term contamination on the reclaimed prospecting/mine site that could cause health effects to surrounding landowners and local animals.

Health and safety

To limit the health and safety threats to humans and animals using the reclaimed site after closure, by:

- Sealing the shaft according to acceptable practices, once prospecting/mining has ceased; and
- Collection and removing for safe off-site disposal of all potential contaminated soils.

Land capability/land-use

To re-instate suitable land capability over as large as possible a portion of the site to facilitate the return of the planned land use, by:

- Ensuring that the closed site is stable in the long-term;
- Shaping and levelling the reclaimed site to be free-draining towards local drainage lines;
- Ensuring that the closed site is not a threat to health and safety of people and animals; and
- Vegetating disturbed areas, after suitable preparation.

Aesthetic quality

To leave behind a reclaimed site with acceptable aesthetic quality/appearance, by:

- Achieving visual "harmony" of the reclaimed waste rock dump footprint area within the local landscape;
- Ensuring that the site is properly tidied-up, with no fugitive/scattered waste piles; and
- Landscaping and vegetating the reclaimed areas to blend into the surrounding topography.

Biodiversity

To encourage the re-establishment of local, natural vegetation and animal life on the areas surrounding the reclaimed prospecting site such that the pre-mining biodiversity is largely re-instated over time, by:

- Stabilising disturbed areas to prevent erosion in the short- to medium-term until suitable vegetation cover has been established;
- Establishing viable self-sustaining vegetation communities that will encourage the re-introduction of local fauna, in keeping with the surrounding natural vegetation; and
- Control exotic/invader species that may be detrimental to site's overall biodiversity.

The mitigation measures tabulated below have been identified for the Decommissioning and Closure Phase of the proposed project.

Table 11: Environmental Management Plan for the Lonmin Akanani prospecting shaft – Decommissioning and Closure Phase 8.

Decommissioning and Closure Phase: Environmental Management Plan		Responsible person	For ECO Monitoring Purposes only (Successfully Implemented / Corrective action required)
1. Geology			
1.1	Not applicable, since the proposed project will not result in changes to the geology.	Not applicable	
2. Topography			

Decommissioning and Closure Phase: Environmental Management Plan			Responsible person	For ECO Monitoring Purposes only (Successfully Implemented / Corrective action required)
2.1	Not applicable, since the proposed project will not result in changes to the topography.		Not applicable	
3. Soils				
3.1	**Project activity:**	Site rehabilitation.	Rehabilitation contractor	
	Impact:	Stockpiled soils will be used for rehabilitation during decommissioning and closure. No additional impacts on soils will occur during this project phase.		
	Mitigation measure(s):	Stockpiled subsoil and topsoil should be spread across the site evenly.		
4. Land capability and use				
4.1	**Project activity:**	Site rehabilitation.	Rehabilitation contractor	
	Impact:	Positive impact expected if a section of the rehabilitated land is returned to grazing land.		
	Mitigation measure(s):	Rehabilitate the largest possible portion of the site to its pre-prospecting grazing potential.		
5. Ecology: Flora and fauna				
5.1	**Project activity:**	Site rehabilitation.	Rehabilitation contractor	
	Impact:	Positive impact expected if a section of the site is re-vegetated and rehabilitated.		
	Mitigation measure(s):	The following measures should be implemented: • Rehabilitate the largest possible portion of the site with indigenous vegetation. • Implement a management plan to eradicate exotic and/or invasive species. • Areas compacted by vehicles during construction shall be scarified or ripped, if necessary, to allow penetration of plant roots and the re-growth of natural vegetation if outside the boundaries of the site footprint.		
6. Ecology: Wetlands				
6.1	Not applicable.		Not applicable	
7. Surface water				
7.1	**Project activity:**	Site rehabilitation.	Rehabilitation contractor	
	Impact:	If prospecting activities indicate that mining will be unfeasible, the site will be rehabilitated to its free-draining former state.		
	Mitigation measure(s):	Rehabilitate site to its pre-prospecting free-draining topography.		
7.2	**Project activity:**	General and hazardous waste management during the construction phase.	Lonmin, and decommissioning and closure contractors	
	Impact:	Surface water pollution associated with general and/or hazardous waste.		
	Mitigation measure(s):	The following mitigation measures should be implemented: • Solid waste shall be stored in an approved area in covered, tip-proof metal drums, preferably skip containers, for collection and disposal. • The waste collection point shall be removed and rehabilitated.		

Decommissioning and Closure Phase: Environmental Management Plan			Responsible person	For ECO Monitoring Purposes only (Successfully Implemented / Corrective action required)
		• Disposal of solid waste shall be at a Department of Environmental Affairs and Tourism (DEAT) licensed landfill site or at a site approved by the DEAT in the event that an existing operating landfill site is not within reasonable distance from the site. • No waste shall be burned at the site offices or anywhere else on the site, including the approved solid waste disposal site. • All building rubble shall be a) removed from the site and disposed of at an appropriate dumping site, or b) temporarily stored in a clearly demarcated area on site for future use. • No littering by workers shall be allowed. • The contractor shall provide enough rubbish bins / skips for later safe disposal at approved sites. • Littering, discarding or burying of any materials shall not be allowed on site. • Hazardous waste such as tar and oil shall be disposed of at a DEAT approved hazardous waste site, or through a registered hazardous waste management company. Special care shall be taken to avoid spillage of tar products such as tar prime or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating water. • Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and returned to the supplier. Water and oil shall be separated in an oil trap. Oils collected in this manner shall be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at an approved hazardous waste disposal site. Oil collected by a mobile servicing unit shall be stored in the service unit's sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company. • Wherever possible, materials used or generated by construction shall be recycled or reused. • Where possible and practical, such as at stores and offices, waste shall be sorted for recycling purposes, into the following categories: paper, aluminium, metals (other than aluminium), organic waste and glass. • Separate containers for glass, paper, metals and plastics shall be provided. • The contractor shall ensure the provision and proper utilisation, maintenance and management of toilet, wash and waste facilities. Chemical toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 15 workers. The exact location of the toilets shall be approved by the ECO prior to establishment. All temporary / portable toilets shall be secured to the ground to the		

Decommissioning and Closure Phase: Environmental Management Plan			Responsible person	For ECO Monitoring Purposes only (Successfully Implemented / Corrective action required)
		satisfaction of the ECO to prevent them from toppling due to wind or any other cause.		
8. Groundwater				
8.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	No additional impacts on groundwater are anticipated.		
	Mitigation measure(s):	Not applicable		
9. Air quality				
9.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	No additional impacts on air quality are anticipated.		
	Mitigation measure(s):	Not applicable		
10. Noise and Vibration				
10.1	**Project activity:**	Not applicable	Not applicable	
	Impact:	No additional impacts on noise and vibration are anticipated.		
	Mitigation measure(s):	Not applicable		
11. Archaeological and heritage sites				
11.1	**Project activity:**	Not applicable	Lonmin	
	Impact:	No additional impacts are expected if the site is rehabilitated to its former state.		
	Mitigation measure(s):	Conduct a separate, full EIA process to assess the potential impacts associated with mining, if mining is proofed to be feasible. Implement relevant measures as stipulated in that EIA and EMP.		
12. Sensitive landscapes				
12.1	**Project activity:**	Not applicable	Lonmin	
	Impact:	No additional impacts are expected if the site is rehabilitated to its former state.		
	Mitigation measure(s):	Conduct a separate, full EIA process to assess the potential impacts associated with mining, if mining proves to be feasible. Implement relevant measures as stipulated in that EIA and EMP.		
13. Visual aspects				
13.1	**Project activity:**	Removal of shaft infrastructure.	Not applicable	
	Impact:	The removal of surface shaft infrastructure will result in a positive impact on visual aspects.		
	Mitigation measure(s):	None		
14. Socio-economic aspects				
14.1	**Project activity:**	Decommissioning and closure.	Lonmin	
	Impact:	Rehabilitation of land to its former land use (where possible).		

Decommissioning and Closure Phase: Environmental Management Plan			Responsible person	For ECO Monitoring Purposes only (Successfully Implemented / Corrective action required)
	Mitigation measure(s):	Liaise with the Mapela Traditional Authority and the Mogalakwena Local Municipality timeously to allow them to integrate alternative land uses into their planning.		
14.2	**Project activity:**	Decommissioning and closure.	Decommis-sioning and closure contractors, and Lonmin	
	Impact:	Safety impacts if the site is not rehabilitated and if the shaft mouth is not covered appropriately.		
	Mitigation measure(s):	The following mitigation measures are recommended to mitigate the potential safety impacts of closure of the proposed prospecting shaft: • Ensure that the contractor adheres to safety regulations and design of the cover over the shaft. • Conduct awareness campaigns in the communities to inform communities of the safety risks related to the decommissioned prospecting shaft site.		
14.3	**Project activity:**	Decommissioning and closure.	Decommis-sioning and closure contractors, and Lonmin	
	Impact:	Loss of employment opportunities.		
	Mitigation measure(s):	The following mitigation measures are recommended to mitigate the impact of the loss of employment opportunities: • Provide skills training to employees of Lonmin Akanani and the contractor to diversify the skills-base in the area at least two months prior to retrenchment, to allow employees to obtain alternative employment when the proposed project is completed. • Provide retrenchment packages to staff employed by Lonmin Akanani or the contractor in accordance with conditions of employment and the labour law. • Re-allocate staff to other Lonmin mines where possible.		

6.6 EMERGENCY PROCEDURES

The following emergency procedures are relevant to the proposed project:

- Lonmin's existing emergency procedures, as relevant to this project, shall be implemented.
- The ECO shall define emergency reporting procedures for the project.
- Ensure that all personnel are aware of emergency reporting procedures and their responsibilities.
- Ensure immediate clean up of any spills in accordance with relevant legislation.
- Telephone numbers of emergency services, including the local fire fighting service, shall be conspicuously displayed.

6.7 FINANCIAL PROVISION

A Closure Cost Assessment was undertaken for the proposed Lonmin Akanani prospecting shaft and associated infrastructure. The assessment was conducted by Andrew Brown from Golder, in accordance with the DME guideline titled "The Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine", dated January 2005. The guideline document provides an overall framework for closure

costing and the setting of financial provision for mine closure. Based on the results of the assessment, the financial provision for the prospecting shaft (i.e. the Trust Fund) will have to be adjusted accordingly.

As the prospecting shaft activities were not initiated prior to this EIA and EMP Amendment, no unscheduled closure costs could be calculated. Hence, the closure costs provided in this EMP Amendment represent the scheduled closure scenario, assuming that prospecting would be discontinued after three years. Should the prospecting activities prove viable and be converted to operational activities an updated closure cost assessment for both the scheduled and unscheduled long-term mining scenarios would need to be compiled. The scheduled closure cost for decommissioning, dismantling and reclamation of the prospecting shaft activities and related infrastructure, as at December 2008, is approximately R 8.2 million. A breakdown of this amount is provided in **Appendix B.9**.

The overall context for Closure of the Lonmin prospecting shaft activities has taken the following main infrastructure into account:

- Operational prospecting infrastructure, including:
    - Shaft (7 m wide x 1 000 m deep);
    - Temporary steel headgear (45 m high);
    - Waste rock stockpile (footprint area of approximately 0.26 ha).
- Supporting infrastructure, including:
    - Batch plant;
    - Winder house (kibbler- and stage winder);
    - Administration buildings including offices and change house; and
    - Gravel access roads (5 m wide).

6.8 PROPOSED TIMETABLE, DURATION, SEQUENCE

The table below provides an anticipated project schedule for the proposed Lonmin Akanani bulk sampling prospecting shaft project.

Table 12: Development schedule for the tailings dam expansion project

ACTIVITY	TIMING
EIA Report and EMP Amendment submitted to the Department of Minerals and Energy	June 2009
Final decision from the Department of Minerals and Energy	September 2009
If proposed project is authorised: Commence with construction phase	October 2009
Completion of construction phase, commencement of operational phase	January 2010
Completion of operational phase, commencement of decommissioning and closure, unless mining has proved to be feasible	First quarter 2013

6.8.1 Start and duration of construction period

Construction will start immediately on approval of this EMP Amendment by the Department of Minerals and Energy, which is expected during September 2009.

The construction phase will last for a period of approximately 3 months.

6.8.2 Commencement and cessation of the proposed activity

The bulk sampling site will be operational for a period of approximately 3 years. The bulk sample will be removed more or less during the final 6 months of operation.

6.8.3 Proposed date for closure application

The date for application for closure is not currently known.

- Should the feasibility studies indicate that the Akanani platinum project is not viable, the waste rock on the surface will be dumped back into the shaft and a concrete slab will be constructed over the mouth of the shaft. The rest of the disturbed area will be rehabilitated to its former state, as far as practically possible.
- Should the Akanani platinum project be economically viable, the prospecting shaft is intended to be used as the ventilation shaft for the future requirements of the Akanani Mine. The installed equipment will eventually be removed according to the mine's Closure Plan. A separate, full EIA and EMP process must be conducted and approved by the relevant decision-making authorities before full-scale mining activities may commence.

7. CONCLUSION

This EMP Amendment identifies the expected environmental consequences associated with the proposed development of the Lonmin Akanani bulk sampling prospecting shaft. A number of specific mitigation measures have been identified to ensure that the impacts associated with the project are properly mitigated, managed and/or avoided (where possible).

It can be concluded that the environmental impacts associated with the proposed project will not result in unacceptable long-term environmental impacts, should the proposed mitigation and monitoring measures discussed in this document be implemented diligently.

8. REFERENCES

Earth Science Solutions. 2008. *Lonmin Akanani, Pedological and Land Capability Studies*. Earth Science Solutions: Nelspruit

Golder (a). 2008. *Ecological assessment for the Lonmin Akanani lease area near Mokopane in the Limpopo Province, South Africa.* Golder: Johannesburg

Golder (b). 2008. *Socio-economic baseline study for Lonmin Akanani near Mokopane, Limpopo Province*". Golder: Johannesburg

Lonmin. 2008. Prospecting Works Programme. Lonmin Platinum: Johannesburg

UNDERTAKING

I, M.S. VAN STADEN, the undersigned and duly authorised thereto by the Company Lonmin Western Platinum Ltd. have studied and understand the contents of this document in it's entirety and hereby duly undertake to adhere to the conditions as set out therein including the amendment(s) agreed to by the Regional Manager and approved on 25/05/2009.

Signed at MARIKANA on this 25TH day of MAY 2009.

.....
Signature of applicant

SENIOR PROJECT MANAGER
Designation

Appendix A

Letter received from the LEDET, confirming advice that the DME is the lead authority for this EIA

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
ECONOMIC DEVELOPMENT, ENVIRONMENT & TOURISM

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Attention: Ms Mari Devilliers

PROPOSED PROSPECTING SHAFT DEVELOPMENT PROJECT AT THE LONMIN AKANANI PROSPECTING AREA NORTH OF MOKOPANE WITHIN MOGALAKWENA LOCAL MUNICIPALITY: WATERBERG DISTRICT OF LIMPOPO PROVINCE

The above matter has reference.

As per the meeting held between the Limpopo Department of Economic Development, Environment and Tourism (LEDET) and the Golder Associates, we therefore like to confirm that the project at the prospecting phase does not require Environmental Impact Assessment (EIA) process to be conducted. In the prospecting phase the leading authority is Department of Minerals and Energy (DME) and LEDET will only be giving comments.

Please communicate with DME for mining and prospecting rights as per Mineral and Petroleum Resource Development Act 2002, (Act 28 of 2002). The EIA process will be conducted after the mining rights have been obtained from DME and the development legally required environmental authorization for EIA prior construction of the activity.

In case of any queries do not hesitate to contact this Department concerning the above mentioned development.

Sincerely,

DEPUTY MANAGER
ENVIRONMENTAL IMPACT MANAGEMENT
DATE: 06/05/2009

Appendix B

Specialist Studies

Appendix B.1

Baseline Air Quality Assessment for the proposed Prospecting Shaft Development Project at the Lonmin Akanani Prospecting area, North of Mokopane, Limpopo; Gondwana Environmental Solutions

BASELINE AIR QUALITY ASSESSMENT FOR THE PROPOSED PROSPECTING SHAFT DEVELOPMENT PROJECT AT THE LONMIN AKANANI PROSPECTING AREA NORTH OF MOKOPANE, LIMPOMPO

September 2008

Prepared by:

GONDWANA
ENVIRONMENTAL SOLUTIONS

PROJECT NO	2008GOL-0119
REPORT NO	GOL_RN_080002
AUTHORS	N. Ngcukana and A. Bennett

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EXECUTIVE SUMMARY

Gondwana Environmental Solutions (GES) was appointed by Golder Associates to undertake a baseline air quality assessment of Lonmin's proposed Akanani prospecting shaft and related processes located north of Mokopane in the Limpopo Province. The main objective of the assessment was to provide a professional opinion of the potential impact of the proposed prospecting shaft on the surrounding ambient air quality.

A baseline air quality assessment was undertaken through the following:

- Identification and classification of air pollution sources within the proposed prospecting area.
- Analysis of modelled meteorological data from the South African Weather Services (SAWS) for the period September 2006 – June 2008.
- Analysis of the Lonmin Platinum Akanani dust fallout monitoring programme and dust fallout results.
- Desktop literature review of the Limpopo regional and local air quality.

Baseline dust fallout monitoring for the Akanani project showed that the dust fallout throughout the entire prospecting area is fairly low except for Site 6 and Site 4. Site 6 is located on a main dirt access road between two operational mining areas operated by Anglo Platinum. Therefore elevated dust fall levels may be expected at this site due to this project.

Based on the baseline information and Gondwana Environmental Solutions experience with similar mining operations we are of the opinion that in terms of air quality there should not be a major impact if mitigation measures to control dust and gaseous emissions are instituted. However, should the proposed prospecting shaft (and mine development as a whole) proceed to the EIA phase, then a further study must be undertaken to quantify the pollutant concentrations in the area around the prospecting shaft. This can be achieved through a detailed air quality impact assessment with dispersion modelling so that the impact of the emissions may be quantified prior to the construction phase.

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APPA	-	Atmospheric Pollution Prevention Act, No. 45 of 1965
AQA	-	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
BMP	-	Best practicable means
CAPCO	-	Chief Air Pollution Control Officer
CO	-	Carbon monoxide
DEAT	-	Department of Environmental Affairs and Tourism
DJF	-	December, January, February
DME	-	Department of Minerals and Energy
EIA	-	Environmental Impact Assessment
EMPR's	-	Environmental Management Programme Reports
FEV_1	-	Forced Expiratory Volume over one second
FVC	-	Forced Vital Capacity
HC	-	Hydrocarbons
JJA	-	June, July, August
LHD	-	Load Haul Dump
MAM	-	March, April, May
MPRDA	-	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
NEMA	-	National environmental Management Act (Act No. 107 of 1998)
NO_2	-	Nitrogen dioxide
NO_x	-	Oxides of nitrogen
PEF	-	Peak Expiratory Flow
PM10	-	Particulate matter with an aerodynamic diameter of less than 10 µm
PM2.5	-	Particulate matter with an aerodynamic diameter of less than 2.5 µm
ppb	-	Parts per billion
ppm	-	Parts per million
PPRust	-	Anglo Platinum's Potgietersrust Platinum Mine
SAAQIS	-	South African Air Quality Information System
SAWS	-	South African Weather Service
SON	-	September, October, November
SO_2	-	Sulphur dioxide
SO_x	-	Oxides of sulphur
$\mu g/m^3$	-	Micrograms per cubic meter
USEPA	-	United States Environmental Protection Agency
VOC	-	Volatile Organic Compounds
WHO	-	World Health Organisation

1. INTRODUCTION

Lonmin Platinum intends to amend its approved prospecting right to include the development of a prospecting shaft for bulk sampling purposes at its Akanani project prospecting area north of Mokopane in the Limpopo province. Gondwana Environmental Solutions (GES) was appointed by Golder Associates to undertake a baseline air quality assessment of the proposed prospecting shaft. The main objective of the assessment was to provide a professional opinion of the potential impact of the prospecting processes on the surrounding ambient air quality.

In terms of the Mineral and Petroleum Resources Development Act, Act 28 of 2002, an Environmental Impact Assessment (EIA) must be undertaken before prospecting can be undertaken. As part of this process, a specialist air quality investigation is required. An initial baseline assessment is undertaken which includes a review of available meteorological data, dust fallout data and general regional air quality data. The most significant pollutant that will be generated from the prospecting process is particulates (PM). These particulate emissions will be generated from dust during the construction and operation phases and from vehicle entrainment from the trucks transporting the bulk sample. In addition, there will be vehicle tailpipe emissions from the trucks. Pollutants from vehicle tailpipe emissions include sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) and small amounts of volatile organic compounds (VOC's). Blasting and drilling operations will also lead to particulate emissions and some trace gas emissions.

1.1. Terms of Reference

The terms of reference required to evaluate the potential impact that emissions from the Akanani project prospecting area will have on the surrounding environment are as follows:

- Detailed literature review of emissions from the prospecting process,
- Review of potential health effects associated with these activities,
- Description of the general surroundings of the site as well as the relevant site specific environment,
- Evaluate meteorological data to determine the prevailing meteorological conditions,

- ξ Identify pollutants released from the prospecting process and associated activities, and
- ξ Provide recommendations to possibly limit the impacts of the prospecting process on the ambient air quality of the area.

1.2. Outline of Report

An introduction to the proposed prospecting and overview of the site location, including surrounding receptors and topography is provided in **Sections 1 and 2.** The South African air quality legislation and ambient air quality standards for the criteria pollutants are provided in **Section 3. Section 4** describes the health impacts of the criteria pollutants. The baseline assessment which includes the meteorological overview, dust fallout in the project area, regional and local air quality and emission sources are provided in **Section 5**. Mitigation measures are recommended in **Section 6** and the conclusions and recommendations are discussed in **Section 7**.

2. BACKGROUND

2.1. Site Location and Description

The Akanani project is located approximately 25 km north of the town of Mokopane in the Limpopo Province (Figure 1). The proposed site for the prospecting is located on 2 farms, namely Zwartfontein 814 LR and Moordkopje 813 LR. These farms together cover an area of 4000 hectares adjacent to Anglo Platinum's Potgietersrust Platinum Mine (PPRust), which is an open pit operation.

Land-use surrounding the proposed plant is predominantly mining, subsistence agriculture and informal residential. Sensitive receptors in the area include residential properties and the Mohlesane River which are approximately 700 m and 300 m from the proposed site respectively.

2.2. Topography

Topography surrounding the proposed prospecting area is characterised as gently undulating surrounded by mountainous regions (Figure 2). The surrounding elevation ranges from 1000 m to 1 500 m.

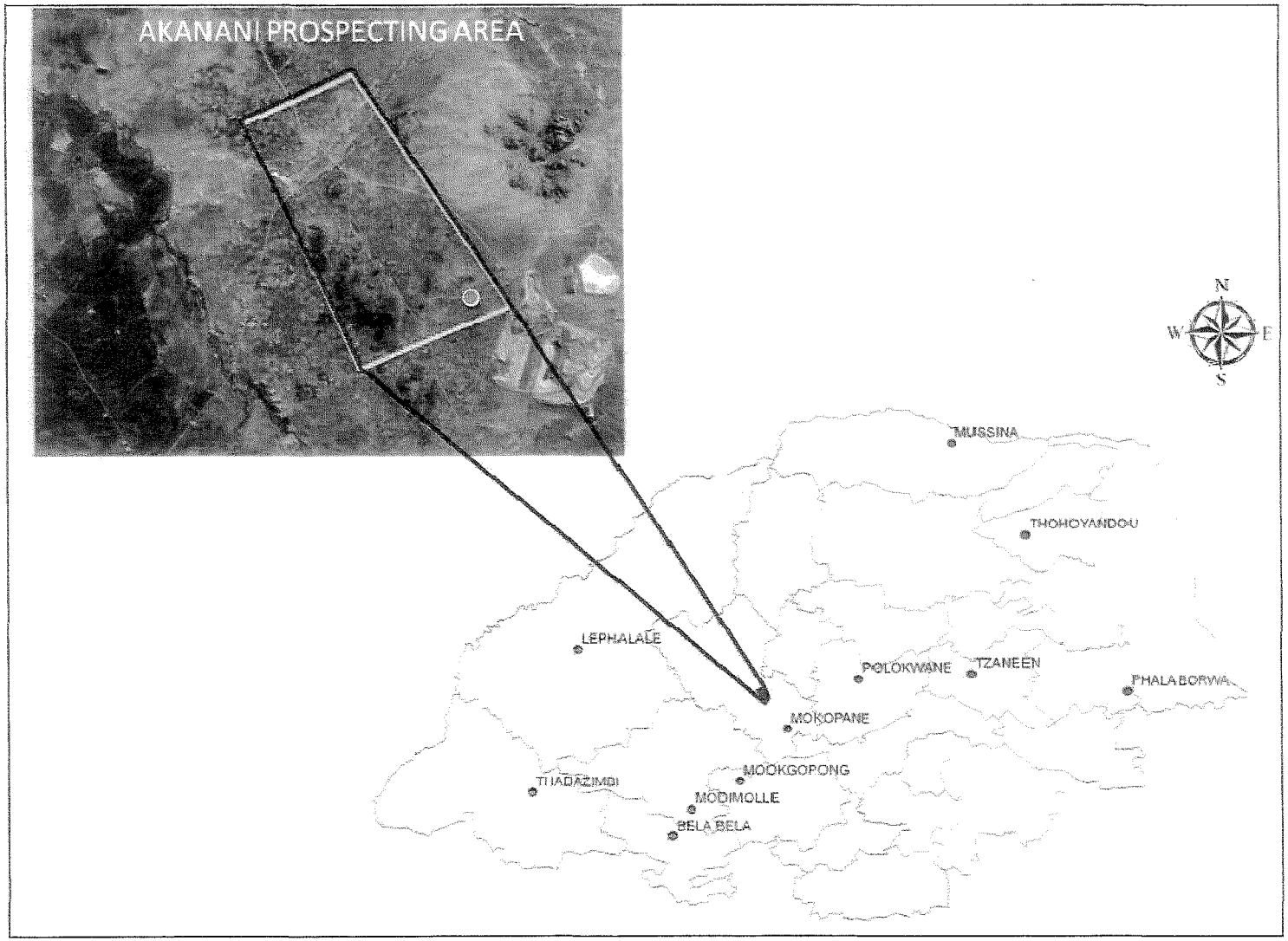

Figure 1: Location of the Akanani prospecting area (yellow polygon). The orange dot denotes the proposed prospecting shaft.

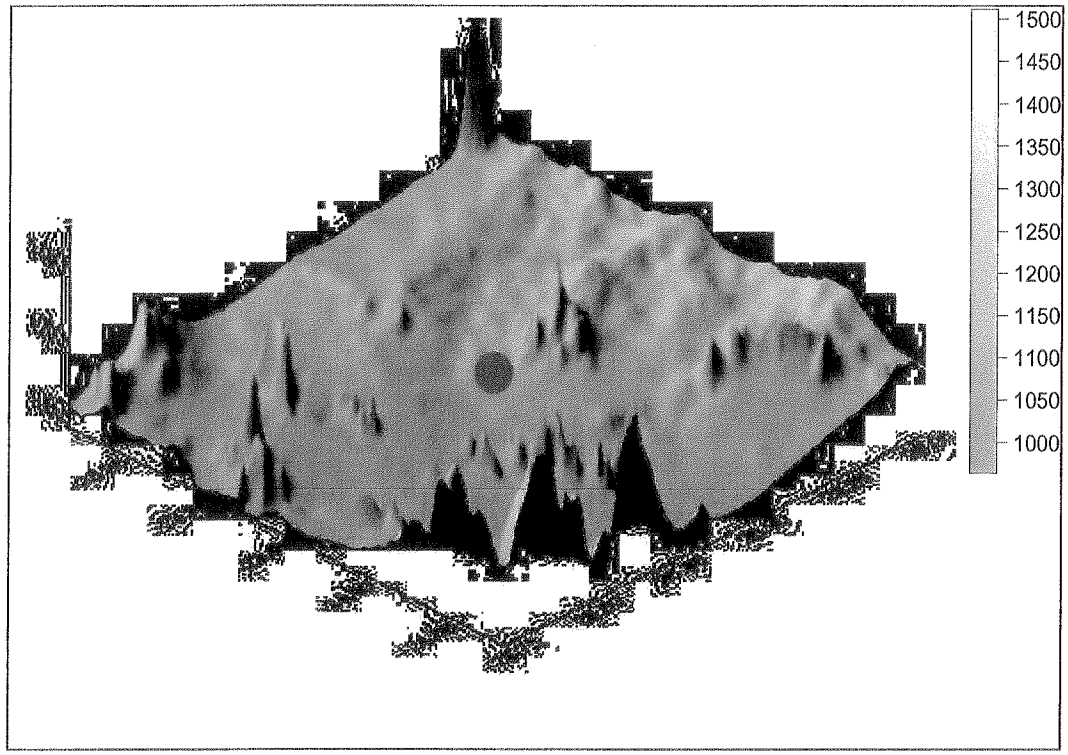

Figure 2: **Topography surrounding the proposed prospecting area (red dot).**

2.3. Overview of the Prospecting Process

A bulk sample of 3 000 tons for testing purposes will be obtained by sinking a single vertical prospecting shaft over a three year period. The prospecting shaft will be about 7 to 10 metres in diameter, and approximately 1 000 metres deep. The ore will be transported by 35 ton trucks to Mintek in Johannesburg for test work. The prospecting shaft site will be approximately 2 ha in extent. The prospecting shaft infrastructure will be developed within the project footprint of ± 2 ha.

Shaft sinking operations are scheduled to be carried out on three 8-hour shifts per day, 23 days per month. From the date of that the contract is awarded to the shaft sinking contractor, a period of approximately 30 days will be required for the mobilisation of resources. Detailed design work will be initiated based on pre-feasibility phase designs. During the detailed design and manufacturing phase the contractor's labour and equipment resources will be mobilised and brought to site. The contractor's team will be

passed through the Lonmin Platinum medical screening and induction programme. Surface infrastructure comprising offices, workshops, stores, first aid facilities and change houses will be erected and the access control and time and attendance systems commissioned. Sinking winder positions will be surveyed and foundations and winder houses erected. The surface batch plant will be erected and commissioned and a concrete cube testing facility will be established.

The shaft will be excavated to the bedrock by means of earthmoving equipment. A ramp will be constructed into the excavation to allow trucks to be loaded by a back-actor. On reaching the bedrock, drilling and blasting will take place. On reaching solid rock the excavation will be reduced to the designed collar dimensions and sunk vertically. A reinforced collar will be constructed to the surface bank elevation and the area behind the collar backfilled. At this time a scotch derrick type crane will be commissioned adjacent to the shaft to allow access and spoil removal by means of kibbles from the pre-sink. On reaching 25m depth a single deck stage suspended from six 10 ton hydraulic crab winches will be installed in the shaft to act as a cover for the protection of persons. Blast holes to a depth of 1,5m will be drilled by means of pneumatically powered hand held rock drills. Support in the form of split sets, mesh and a layer of 100mm steel crate will be installed before drilling of the round (unit of prepared rock for blasting). The round will be charged with water gel based explosives and set off electrically from the bank. Blasting will be done after all precautions for safety have been taken and only once per day in the afternoon. Blasted rock will be loaded by means of a crawler mounted 630 Eimco into the kibbles for tipping. The rock will be transported to a waste rock dump nearby. The pre-sink excavation will be continued to a depth of 60m. The shaft will then be stripped of pre-sink equipment.

The installation of the kibble winder or multiple kibble winders and stage winders will take place during the pre-sink period. On completion of the pre-sink, the sinking stage will be installed in the shaft, bank doors installed and the headgear erected. The head gear will be constructed of steel in the form of an A-frame of approximately 45 meters in height. The sinking contractor will commission shaft sinking and interlocking devices including crosshead separation, dipper lights, ECAM signalling on the stage, pull bell communications in the headgear, bank, stage, and shaft bottom. Cables will be reticulated between these signalling points and the winding engine drivers cabin. The winders and stage will be roped up, commissioned and licensed for sinking.

A 7-boom shaft drill rig will be utilised for drilling of a blast round comprising 320 holes to a depth of 3.25m for an expected advance of 3.0m per blast. Holes will be flushed and charged with water gel based explosives. Detonation will be by means of shock tubes and detonating cord set off from a blasting box on surface. Perimeter holes will be closely drilled and lightly charged to prevent damage to the surrounding rock. The blast will be set off electrically from the bank. Blasting will be done after all precautions for safety have been taken and only once per day in the afternoon, until such time as the shaft has reached a depth of around sixty meters. A 30 minute re-entry period will be observed following the blast. The shaft will be cleaned by means of a 0.85m³ cactus. The drive unit will be centrally mounted on the bottom deck of the stage. Blasted rock will be loaded into 15 ton kibbles for hoisting to surface. Tractor and trailers will be used to transport the rock to the waste dump. The shaft will be ventilated by axial flow fans exhausting through two 1015mm Ø core-ten rigid steel ventilation columns. The ventilation columns will be suspended from the shaft wall with brackets that contain creep. Ventilation will be adequate to allow a 30-minute re-entry period after the blast and handle the significant level development required. Water encountered during the sinking operation will be pumped by means of pneumatic powered pumps directly into kibbles for bailing to surface. A maximum of one kibble per hour can be handled without delaying sinking operations. Siphon facilities will be provided on surface for the bailing of water. The water will be treated in settling facilities situated on the bank for re-use.

Shaft wall support in the form of 1.8m split sets on a 1m by 1m pattern and welded mesh will be installed concurrent with shaft sinking. Denser support requirements may be required dependant on the rock formation and condition, which will influence the shaft sinking cycles. Formwork in 6m lifts will be hung from chains suspended from the already set portion of the lining. Concrete will be transferred from the surface located batch plant into the shaft launder into the steel concrete columns for gravity feed to the stage. The concrete will be re-mixed in a remix kettle before placement behind the formwork with a flexible hose. Full shaft lining is planned for the full length of the shaft. Each lift will be 6.0m with the lining carried 18 to 24m from the shaft bottom during the sinking operation. Detailed procedures relating to aggregate quality control, mixing and cube testing will be applied. The contractor will be responsible for the aggregates and will utilise the services of a concrete technologist. Test cubes will be taken and crushed as described in the cube testing procedure. The formwork proposed for this work is the

"Canadian" style shutter that has successfully been used at the Kombat shaft in Namibia. This shutter combines a number of innovations giving practical advantages.

The curb is a complete ring section and is never split (unbolted). The curb accommodates heavy duty square scribing tubes at approximately 500mm centres. The square tubes are cut to lengths to suit the excavated diameter. Where over break occurs a longer square tube can be used and/or steam piping can be inserted inside the tubes. Boards are cut into radius sections and used as scribing stop-ends when placed on the tubes, and sealed against the sidewalls with paper. These boards have a better re-use factor than conventional scribing planks as the tubes provide better support. The curb is suspended on cut to length "hanging" bars spaced at approximately three metre centres at a radius 75mm greater than the shaft lining. The bars are cast into the lining. The lengths of bars are cut to the exact lift height and are joined with a special coupler, which has an indexing arrangement to ensure the bars remain at the same elevation. When setting up the curb, the elevation and levelling is done by adjustment with special nuts, which run on the rifling of the hanging bars. The tubing plates, which are lowered and located onto the curb ring are built up in a brick wall pattern and the only longitudinal joint is at the key plates. The solid curb ring and brick pattern of the tubing plates assists in keeping the shutter round and enhances the quality, ensuring the concentricity of successive lifts and eliminating steps in the lining. When moving to the next lift of the lining the next set of bars is coupled to the end of the bars supporting the curb. The adjusting and support nuts are screwed into place before the curb is broken from the last lift and lowered into its new position. The curb is already aligned and quickly elevated resulting in a quicker and safer operation. Tubing winches on the stage are used to lower the formwork in rings.

Seven plum bob wires will be located around the circumference of the shaft for lining up concrete and service columns to set and align the curb. Over break will be measured on 1m offsets from the shutter chains to the sidewall and recorded by the surveyors. Tape brackets will be surveyed into the lining every 50m to hang calibrated metal tapes. Steady brackets for the plumb wires will be surveyed in every 100m and protected with skid plates. Detailed survey procedures will be followed to ensure accuracy of directions and elevations. During sinking, the service pipes will be installed on racks against the sidewall and will be extended every 6 to 12m depending on the pipe lengths.

During sinking, cables will be installed on cable racks against the sidewall and extended every 400m, changing from TRS trailing cables to PVC cable. An 8-hole cover will be drilled at 36m intervals as the shaft advances. The holes, 48mm in diameter, will be drilled to a depth of 42 metres through 3.0m solid drawn casing pipes. The holes will be spun towards the succeeding hole in the ring at an angle of rake of 10 degrees from the vertical. Should water be intersected cementation by means of OPC/PFA and or chemical injections will be carried out through 25mm grout columns fed from the cementation plant located on surface. Grout will be mixed in double drum mixers and injected with high-pressure positive displacement pumps. Detailed working procedures for cover drilling and cementation injections are available. A period of 36 hours per cover lift is typically included in the construction programme. Cementation outside of the allowed 36-hour period will extend the construction programme.

The immediate station bulk brows and catwalk will be mined concurrently with the shaft bottom using a drill rig as far as possible. The advance rate for the mining outside the shaft barrel will be $90m^3$ per day. The station brows will be supported as specified, 50mm polypropylene fibrecrete lining and 6m long, 38 ton cable anchors as specified by the design of the rock engineer. Station brow support is an inline critical activity. Initial Station cutting will be done by conventional hand-held drilling and crawler mounted rocker shovel cleaning methods. Once a Load Haul Dumper (LHD) can be protected from the blast it will be transported underground and used for the cleaning of the development ends. As soon as is practically possible a development jumbo drill rig will be introduced onto the stations. Development cleaning will be by means of rubber tyres LHD's tipping spoil on the station footwall for loading by the cactus grab. Development will progress to the ventilation hole or rock pass position for raise boring of the pre-piloted ventilation hole or rock pass to commence. Development will continue concurrently with the reaming of the rock pass to the level above so the chips can be removed. The station floor will be cast when development is complete.

3. AIR QUALITY LEGISLATION AND PROPOSED STANDARDS

3.1. Air Pollution Prevention Act No. 45 of 1965 (APPA)

The Atmospheric Pollution Prevention Act, No. 45 of 1965 (APPA) focused mainly on source based control with registration certificates issued for scheduled processes. Scheduled processes were defined as processes which emit more than a defined quantity of pollutants per year. This legislation made provision for the control of noxious or offensive gases from scheduled processes which are subject to the Best Practicable Means (BPM) of pollution abatement. BPM was a set of guidelines issued by the DEAT stipulating the level of technology that is the best practicable means of preventing or reducing to a minimum the escape of noxious or offensive gases into the atmosphere at source.

The Chief Air Pollution Control Officer (CAPCO) of DEAT was responsible for the implementation of the BPM approach. Control of smoke emissions was enforced by local authorities through regulation and smoke control zones. Dust emissions from mining and quarrying activities were also controlled and were enforced by the CAPCO as well by the Department of Minerals and Energy (DME) through the inspection of mines. Provision was also made for the control of exhaust emissions emitted from vehicles. However, APPA was outdated and has been replaced with the National Environmental Air Quality Act, Act No. 39 of 2004 (AQA) which came into effect on 11 September 2005. Section 60 of AQA repeals APPA but provision is made for sections of APPA to remain in force pending the establishment of appropriate systems and services by AQA. The different provisions of AQA will come into effect at different times.

3.2. National Environmental Management: Air Quality Act No. 39 of 2004 (AQA)

The National Environmental Management (NEMA): Air Quality Act 39 of 2004 (AQA) has shifted the approach of air quality management from source-based control to receptor-based control. The basis of this approach will be control of all major sources, including mining, industrial, vehicles and domestic sources in terms of ambient air concentrations and will be the responsibility of Local Government.

The Act makes provision for *'measures of the control of dust in specified places or areas, either in general or by specified machinery or in specified instances'*. More stringent

standards can be established at the provincial and local levels. The control and management of emissions in AQA relates to the listing of activities that are sources of emission and the issuing of emission licences. Listed activities are defined as activities which *'result in atmospheric emissions and are regarded to have a significant detrimental effect on the environment, including human health'* will be identified by the Minister of the Department of Environmental Affairs and Tourism (DEAT). Once published, atmospheric emission standards will be established for each of these activities and an atmospheric emission licence will be required to operate. The issuing of emission licences for Listed Activities will be the responsibility of the Metropolitan and District Municipalities. In addition, the minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a Pollution Prevention Plan.

In terms of Section 24 and 24D of NEMA, Lonmin has to apply for an environmental authorisation as prospecting is listed as a Scheduled Process.

3.3. South African Air Quality Information System (SAAQIS)

In order to address problems of air quality data management in the near future, the Department of Environmental Affairs and Tourism (DEAT) has proposed the South African Air Quality Information System (SAAQIS) which aims to provide access to this information which will be housed by the South African Weather Service (SAWS). This project was brought about by the need to become aligned with the requirements of the National Environmental Management: Air Quality Act (AQA), No. 39 of 2004.

SAAQIS will make information available to stakeholders, provide a common system for managing air quality in South Africa and provide uniformity in the way data; information and reporting are managed in South Africa. A central aim of SAAQIS is that it will allow the public access to air quality information. It is proposed that SAAQIS will improve the availability of information, facilitate transparency in processes, inform decision making, and build capacity. SAAQIS will streamline the flow of relevant information; provide a tool to assist in managing air quality and build awareness about air quality among stakeholders in general. SAAQIS is to be built in such a way as to assist providers and users of information and, thereby, motivate the maintenance and updating of information by users.

3.4. Proposed Ambient Air Quality Standards

Guidelines provide a basis for protecting public health from adverse effects of air pollution and for eliminating, or reducing to a minimum, those contaminants of air that are known or likely to be hazardous to human health and wellbeing (WHO, 1999). Once the guidelines are adopted as standards, they become legally enforceable. These guidelines/standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area. If the air quality guidelines/standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest. DEAT has drafted National ambient air quality standards for the criteria pollutants (Table 1)

Table 1: **Proposed South African Air Quality Standards with allowable frequencies of exceedance shown in brackets. The values indicated in blue are expressed in ppb.**

Pollutant	Averaging Period	Immediate	2012	2017	2022
Sulphur dioxide SO_2	10-minute running average	500 (526) (191)	500 (263) (191)	500 (50) (191)	
	1-hr average	350 (88) (134)	350 (44) (134)	350 (9) (134)	
	24-hr average	125 (4) (48)	125 (2) (48)	125 (1) (48)	
	Annual average	50 (0) (19)			
Nitrogen dioxide NO_2	1-hr average	376 (0) (200)	288 (88) (153)	244 (44) 129)	200 (9) (106)
	Annual average	100 (0) (53)	70 (0) (37)	55 (0) (29)	40 (0) (21)
Carbon monoxide CO	1-hr average	30 000 (0) (26 000)			
	8-hourly running average	10 000 (0) (8 700)			
Ozone O_3	8-hourly running average	235 (0) (120)	178 (0) (92)	150 (0) (80)	120 (0) (61)
Particulate Matter PM10	24-hr average	180 (0)	127 (4)	100 (2)	75 (1)
	Annual average	60 (0)	50 (0)	45 (0)	40 (0)
Lead Pb	Annual average	0.5 (0)			
Benzene C_6H_6	Annual average	10 (0) (3.2)	5 (0) (1.6)		

3.5. Dust Deposition Standards and Guidelines

DEAT have published guideline values for allowable dust fallout (Table 2). These values have been accepted by the Department of Minerals and Energy (DME) as the reference fallout rates for dust deposition for the purpose of Environmental Management Programme Reports (EMPR's)

The four-band scale recommended in the evaluation of dust deposition is shown in Table 3. Target, Alert and Action levels for dust deposition are indicated in Table 4. Dust fallout

rates are expressed in units of mg/m^2/day over a 30-day averaging period (SANS 1929, 2004).

Table 2: DEAT dust fallout guidelines.

CLASSIFICATION	Dust fallout averaged over 1 month (30-day average) (mg/m^2/day)
Very Heavy	> 1200
Heavy	500 – 1200
Moderate	250 – 500
Slight	< 250

Table 3: Four-band scale evaluation criteria for dust deposition (SANS 1929)

BAND NUMBER	BAND DESCRIPTION LEVEL	DUST-FALL RATE (D) (mg/m^2/day), 30-day average)	COMMENT
1	RESIDENTIAL	D < 600	Permissible for residential and light commercial
2	INDUSTRIAL	600 < D < 1 200	Permissible for heavy commercial and industrial
3	ACTION	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	ALERT	2 400 < D	Immediate action and remediation required following the first exceedance. Incident report to be submitted to the relevant authority.

Table 4: Target, action and alert thresholds for ambient dust-fall (SANS 1929).

LEVEL	DUST-FALL RATE (D) (mg/m^2/day), 30-day average)	AVERAGING PERIOD	PERMITTED FREQUENCY OF EXCEEDENCE
TARGET	300	Annual	-
ACTION RESIDENTIAL	600	30 days	Three within any year, no two sequential months.
ACTION INDUSTRIAL	1 200	30 days	Three within any year, not sequential months.
ALERT THRESHOLD	2 400	30 days	None. First exceedance requires remediation and compulsory report to the authorities.

3.5.1. Margin of Tolerance and Exception

No industry may operate within the fourth band (alert band) as specified in Table 3. Industry may operate within the third band (action band) for a limited period of time provided that they have received written authorisation from the relevant authorities. Furthermore, this authorisation may only be granted by the authorities if it is essential in terms of practical operational reasons and provided that an appropriate dust suppression technology is applied for the duration of the required operation.

Dust fallout that exceeds the specified guidelines may be discounted by the authorities for enforcement and control purposes if they are shown to be the result of an extreme weather or geological event. Such an extreme event may typically be characterised by excessive dust fallout over an entire metropolitan area, and not be localised to a particular operation. Natural seasonal variations will not be considered as extreme events and will thus not be discounted.

4. HEALTH EFFECTS OF THE CRITERIA POLLUTANTS

4.1. Particulates

Particles can be classified by their aerodynamic properties into coarse particles, PM10 (particulate matter with an aerodynamic diameter of less than 10μm) and fine particles, PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5μm) (Harrison and van Grieken, 1998). The fine particles contain the secondarily formed aerosols such as sulphates and nitrates, combustion particles and recondensed organic and metal vapours. The coarse particles contain earth crust materials and fugitive dust from roads and industries (Fenger, 2002).

In terms of health effects, particulate air pollution is associated with complaints of the respiratory system (WHO, 2000). Particle size is important for health because it controls where in the respiratory system a given particle deposits. Fine particles are thought to be more damaging to human health than coarse particles as larger particles are less respirable in that they do not penetrate deep into the lungs compared to smaller particles (Manahan, 1991). Larger particles are deposited into the extrathoracic part of the respiratory tract while smaller particles are deposited into the smaller airways leading to the respiratory bronchioles (WHO, 2000).

Short-term exposure

Recent studies suggest that short-term exposure to particulate matter is associated with health effects, even at low concentrations of exposure. Various studies undertaken during the 1980s and early 1990s have looked at the relationship between daily fluctuations in particulate matter and mortality at low levels of exposure. Pope *et al* (1992) studied daily mortality in relation to PM10 concentrations in Utah Valley during the period 1985 - 1989. A maximum daily average concentration of 365μg/m^3 was recorded with effects on mortality observed at concentrations of < 100μg/m^3. The increase in total daily mortality was 13% per 100μg/m^3 increase in the 24 hour average. Studies by Schwartz (1993) in Birmingham recorded daily concentrations of 163μg/m^3 and noted that an increase in daily mortality was experienced with an increase in PM10 concentrations. Relative risks for chronic lung disease and cardiovascular deaths were higher than deaths from other causes.

However, in the past, daily particulate concentrations were in the range 100 – 1000 $\mu g/m^3$ whereas in more recent times, daily concentrations are between 10 – 100$\mu g/m^3$. Overall, exposure-response can be described as curvilinear, with small absolute changes in exposure at the low end of the curve having similar effects on mortality to large absolute changes at the high end (WHO, 2000).

Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Pope and Dockery (1992) studied panels of children in Utah Valley in winter during the period 1990 – 1991. Daily PM10 concentrations ranged between 7 – 251$\mu g/m^3$. Peak Expiratory Flow (PEF) was decreased and respiratory symptoms increased when PM10 concentrations increased. Pope and Kanner (1993) utilised lung function data obtained from smokers with mild to moderate chronic obstructive pulmonary disease in Salt Lake City. The estimated effect was a 2% decline in FEV_1 (Forced Expiratory Volume over one second) for each 100$\mu g/m^3$ increase in the daily PM10 average.

Long-term exposure

Long-term exposure to low concentrations (~ 10$\mu g/m^3$) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000).

Studies have indicated an association between lung function and chronic respiratory disease and airborne particles. Older studies by Chestnut *et al* (1991) found that FVC (Forced Vital Capacity) decreases with increasing annual average particulate levels with an apparent threshold at 60$\mu g/m^3$. Using chronic respiratory disease data, Schwartz (1993) determined that the risk of chronic bronchitis increased with increasing particulate concentrations, with no apparent threshold.

Few studies have been undertaken documenting the morbidity effects of long-term exposure to particulates. Recently, the Harvard Six Cities Study showed increased respiratory illness rates among children exposed to increasing particulate, sulphate and hydrogen ion concentrations. Relative risk estimates suggest an 11% increase in cough and bronchitis rates for each 10$\mu g/m^3$ increase in annual average particulate concentrations.

4.2. Sulphur Dioxide

Health effects associated with exposure to SO_2 are mainly associated with the respiratory system. Being soluble, SO_2 is readily absorbed in the mucous membranes of the nose and upper respiratory tract (Maroni *et al.*, 1995).

Short-term exposure

Most information on the acute effects of SO_2 is derived from short-term exposure in controlled chamber experiments. These experiments have demonstrated a wide range of sensitivity amongst individuals, as SO_2 concentrations can lead to severe bronchconstriction in some individuals, while others remain completely unaffected. Response to SO_2 inhalation is rapid with the maximum effect experienced within a few minutes. Continued exposure does not increase the response. Effects of SO_2 exposure were short lived with lung function returning to normal within a few minutes to hours (WHO, 2000).

Exposure over 24 hours

The effects of exposure, averaged over a 24 hour period, are derived from epidemiological studies in which the effects of SO_2, particulates and other associated pollutants are assessed. Studies of the health impact of emissions from the inefficient burning of coal in domestic appliances have shown that when SO_2 concentrations exceed 250µg/m^3 in the presence of particulate matter, an exacerbation of symptoms is observed in selected sensitive patients. More recent studies of health impacts in ambient air polluted by industrial and vehicular activities have demonstrated at low levels effects on mortality (total, cardiovascular and respiratory) and increases in hospital admissions. In these studies, no obvious SO_2 threshold level was identified (WHO, 2000).

Long-term exposure

Long-term exposure to SO_2 has been found to be associated with an increase in respiratory symptoms and a small to no reduction in lung function in children. In adults, respiratory symptoms such as wheeze and cough are increased. Assessments during the coal-burning period in Europe determined the lowest-observed-adverse-effects to be at an annual average of 100µg/m^3, together with particulate matter. More recent studies

have shown adverse effects below this level in the presence of industrial air pollution. A closer relationship between mortality and particulate matter, rather than SO_2 concentrations has been found (WHO, 2000).

4.3. Carbon Monoxide

Carbon monoxide is one of the most common and widely distributed air pollutants (WHO, 2000). CO is a tasteless, odourless and colourless gas which has a low solubility in water. In the human body, after reaching the lungs it diffuses rapidly across the alveolar and capillary membranes and binds reversibly with the haem proteins. Approximately 80 - 90% of CO binds to haemoglobin to form carboxyhaemoglobin. This causes a reduction in the oxygen-carrying capacity of the blood which leads to hypoxia as the body is starved of oxygen.

Short and Long-term exposure

Severe hypoxia due to acute poisoning results in headaches, nausea and vomiting, muscular weakness, loss of consciousness, shortness of breath and finally death, depending on the concentration and time of exposure. Poisoning may cause both reversible, short-lasting neurological deficits and severe, often delayed, neurological damage. Neurobehavioural effects include impaired co-ordination, tracking, driving ability, vigilance and cognitive ability (WHO, 2000).

High risk patients with regards to CO exposure include persons with cardiovascular disease (especially ischaemic heart disease), pregnant mothers and the foetus and newborn infants.

4.4. Nitrogen Dioxide

NO_x is a primary pollutant emitted from the combustion of stationary sources (heating, power generation) and from motor vehicles. Nitrogen dioxide is formed through the oxidation of nitric oxide in the atmosphere.

Blasting also generates quantities of NO_x, however the NO_x levels represent only a very small proportion in comparison to the total mining operations NO_x emissions, the rapid release and high concentration associated with such activities may pose a health risk

Short-term exposure

At concentrations greater than 1880µg/m^3, changes in the pulmonary function of adults is observed. Normal healthy people exposed at rest or with light exercise for less than 2 hours to concentrations above 4700µg/m^3, experience pronounced decreases in pulmonary function. Asthmatics are potentially the most sensitive subjects although various studies of the heath effects on asthmatics have been inconclusive. The lowest concentration causing effects on pulmonary function was reported from two laboratories that exposed mild asthmatics for 30 – 110 minutes to 565µg/m^3 during intermittent exercise (WHO, 2000).

Long-term exposure

Animal studies have shown that exposure to 1880µg/m^3 over a period of several weeks to months, causes effects in the lung and other organs such as the spleen and liver. The lung effects may be reversible or irreversible. Structural changes include a change in cell type in the tracheo-bronchial (levels above 640µg/m^3) and pulmonary regions to emphysema-like effects. Nitrogen dioxide concentrations as low as 940µg/m^3 can also increase susceptibility to bacterial and viral infections of the lung (WHO, 2000).

Epidemiological studies have been undertaken on the indoor use of gas cooking appliances and health effects. Studies on adults and children under 2 years found no association between the use of gas cooking appliances and respiratory effects. Children aged 5 – 12 years have a 20% increased risk for respiratory symptoms and disease for each increase of 28µg/m^3 NO_2 concentration, where the weekly average concentrations are in the range of 15 – 128µg/m^3 (WHO, 2000).

Outdoor studies consistently indicate that children with long-term ambient NO_2 exposures exhibit increased respiratory symptoms that are of a longer duration. However, no evidence is provided for the association of long-term exposures with health effects in adults (WHO, 2000).

4.5. Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are organic chemicals that easily vaporise at room temperature and are colourless. VOCs are released from vehicle exhaust gases either as unburned fuels or as combustion products, and are also emitted by the evaporation of solvents and motor fuels. Short-term exposure to VOCs can cause eye and respiratory

tract irritation and damage, headaches, dizziness, visual disorders, fatigue, loss of coordination, allergic skin reactions, nausea, and memory impairment, damage the bone marrow and even death. Long-term exposure to high levels of VOCs has been linked to an increase in occurrence of leukaemia. VOCs can also cause damage to the liver, kidneys and central nervous system.

4.5.1. Benzene

Benzene in air exists predominantly in the vapour phase, with residence times varying between a few hours and a few days, depending on the environment, climate and the concentration of other pollutants. The only benzene reaction, which is important in the lower atmosphere, is the reaction with hydroxy radicals. The products of this reaction are phenols and aldehydes, which react quickly and are removed from air by rain.

Benzene is a natural component of crude oil, and petrol contains 1 – 5% by volume. Benzene is produced in large quantities from petroleum sources and is used in the chemical synthesis of ethyl benzene, phenol, cyclohexane and other substituted aromatic hydrocarbons. Benzene is emitted from industrial sources as well as from combustion sources such as motor engines, wood combustion and stationary fossil fuel combustion. The major source is exhaust emissions and evaporation losses from motor vehicles, and evaporation losses during the handling, distribution and storage of petrol.

Information on health effects from short-term exposure to benzene is fairly limited. The most significant adverse effects from prolonged exposure to benzene are haematotoxicity, genotoxicity and carcinogenicity. Chronic benzene exposure can result in bone marrow depression expressed as leukopenia, anaemia and/or thrombocytopenia, leading to pancytopenia and aplastic anaemia. Based on this evidence, C_6H_6 is recognized to be a human and animal carcinogen. An increased mortality from leukemia has been demonstrated in workers occupationally exposed (WHO, 2000).

The health effects of the criteria pollutants are summarised in Table 5 below.

Table 5: Short-term and long-term health effects associated with exposure to PM, SO_2, NO_2 and CO (after WHO, 2004).

Pollutant	Short-term exposure	Long-term exposure
Carbon Monoxide	ξ Severe hypoxia ξ Headaches ξ Nausea ξ Vomiting ξ Muscular Weakness ξ Shortness of breath	ξ Neurological Deficits ξ Neurological Damage
Particulate matter	ξ Lung inflammatory reactions ξ Respiratory symptoms ξ Adverse effects on the cardiovascular system ξ Increase in medication usage ξ Increase in hospital admissions ξ Increase in mortality	ξ Increase in lower respiratory symptoms ξ Reduction in lung function in children ξ Increase in chronic obstructive pulmonary disease ξ Reduction in lung function in adults ξ Reduction in life expectancy ξ Reduction in lung function development
Sulphur dioxide	ξ Small reduction in lung function ξ Increase in specific airway resistance ξ Respiratory symptoms (wheeze and cough) ξ Increase in hospital admissions	ξIncrease in respiratory symptoms ξReduction in lung function, especially in asthmatics
Nitrogen dioxide	ξ Effects on pulmonary function, especially in asthmatics ξ Increase in airway allergic inflammatory reactions ξ Increase in hospital admissions ξ Increase in mortality	ξ Small reduction in lung function ξ Increased probability of respiratory symptoms
Benzene	ξ Adverse effects on the cardiovascular system ξ Adverse effects on the Central Nervous system	ξ Neurological damage ξ Increase in cardiovascular systems

5. BASELINE AIR QUALITY ASSESSMENT

5.1. Meteorological Overview

There is no meteorological station located close to the proposed site for it to be considered as site representative. A modelled meteorological dataset was thus obtained from the South African Weather Service (SAWS) for the period September 2006 – June 2008.

The predominant wind direction is east-north-east (18% of the time) with lesser wind components from the north-east (13% of the time) (Figure 3). Wind speeds are generally slow to moderate although wind speeds exceeding 6m/s have been recorded. Wind speeds of less than 1m/s, which are designated as calm, occur infrequently (10.73% of the time).

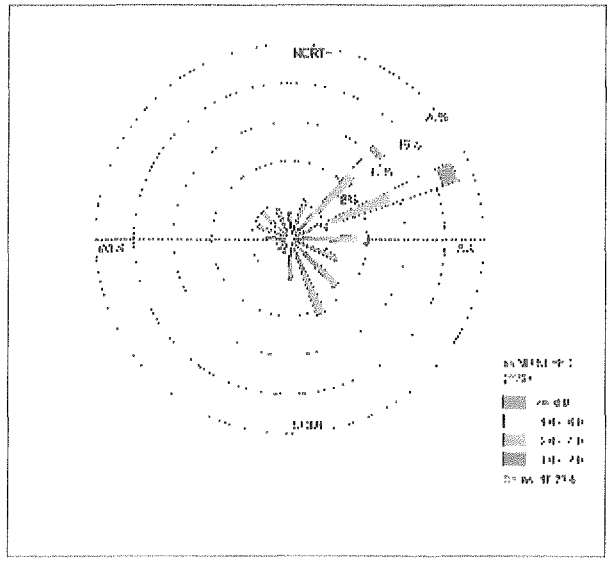

Figure 3: Surface wind rose for Prospecting Area (Akanani), September 2006 – June 2008.

A slight diurnal variation in wind is observed (Figure 4). Between 00:00 – 06:00, winds are predominantly from the south-south-east (18.5% of the time) and east-north-east (17% of the time). During the morning (06:00 – 12:00), the south-south-east component weakens while the north-east (14% of the time) and east-north-east (13% of the time) remain the dominant components. During the afternoon and early evening (12:00 –

18:00), the north-east (14.5% of the time) and east-north-east (11.5% of the time) remain the dominant components. During the late evening (18:00 – 24:00), the east-north-east component remains dominant (33% of the time).

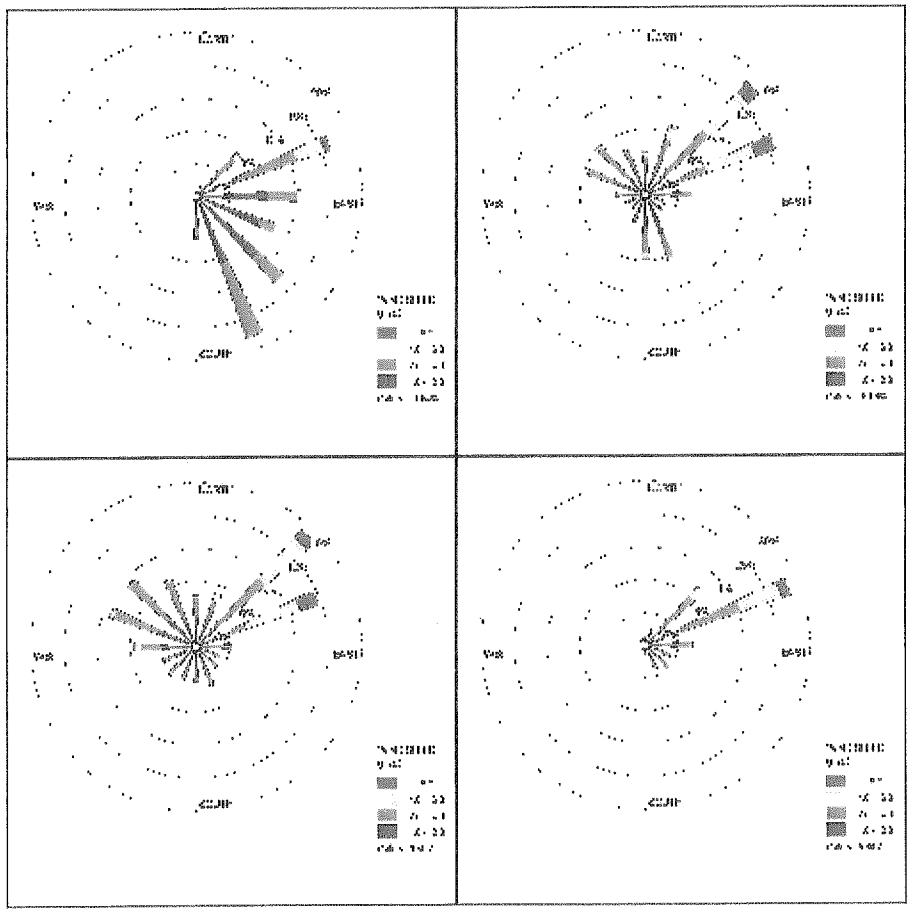

Figure 4: **Diurnal variation of winds between 00:00 – 06:00 (top left), 06:00 – 12:00 (top right), 12:00 – 18:00 (bottom left) and 18:00 – 24:00 (bottom right).**

No significant seasonal shift in wind variation is observed (Figure 5). The wind is predominantly from the east-north-east throughout all four seasons.

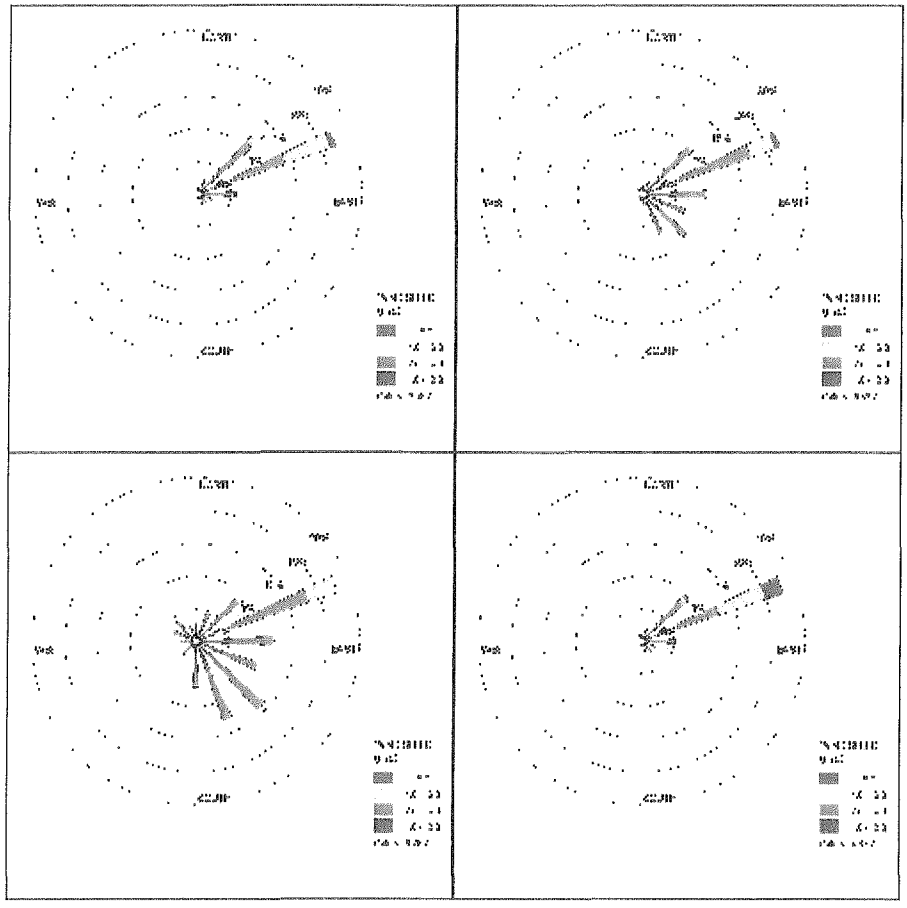

Figure 5: **Seasonal variation of winds in summer (DJF) (top left), autumn (MAM) (top right), winter (JJA) (bottom left) and spring (SON) (bottom right).**

5.2. Baseline Ambient Air Quality

No suitable information (within a 20 km radius of the proposed site) on the background air quality in the proposed project area is available as no monitoring appears to be undertaken except for the recording of dust fallout by Anglo Platinum at the PPRust mine. The project falls outside of the Highveld National Priority Area. Never the less, air quality in Limpopo was noted as having the potential to be an issue of concern if air pollution from the other provinces were to undergo transboundary transport (Limpopo State of Environment Report, 2003). This would be of particular concern in urban, industrial and mining areas where high levels of polluting activities take place.

Limpopo Province experiences a wide range of both natural and anthropogenic sources of air pollution ranging from veld fires to industrial processes, agriculture, mining activities, power generation, paper and pulp processing, vehicle use and domestic use of fossil fuels. Different pollutants are associated with each of the above activities, ranging from volatile organic compounds and heavy metals to dusts and odours.

Ambient air quality in this region of South Africa is strongly influenced by regional atmospheric movements, together with local climatic and meteorological conditions. The most important of these atmospheric movement routes are the direct transport towards the Indian Ocean and the recirculation over the sub-continents (Scholes, 2002) (Figure 8). It is these climatic conditions and circulation movements that are responsible for the distribution and dispersion of air pollutants within Limpopo and between neighbouring provinces and countries bordering South Africa.

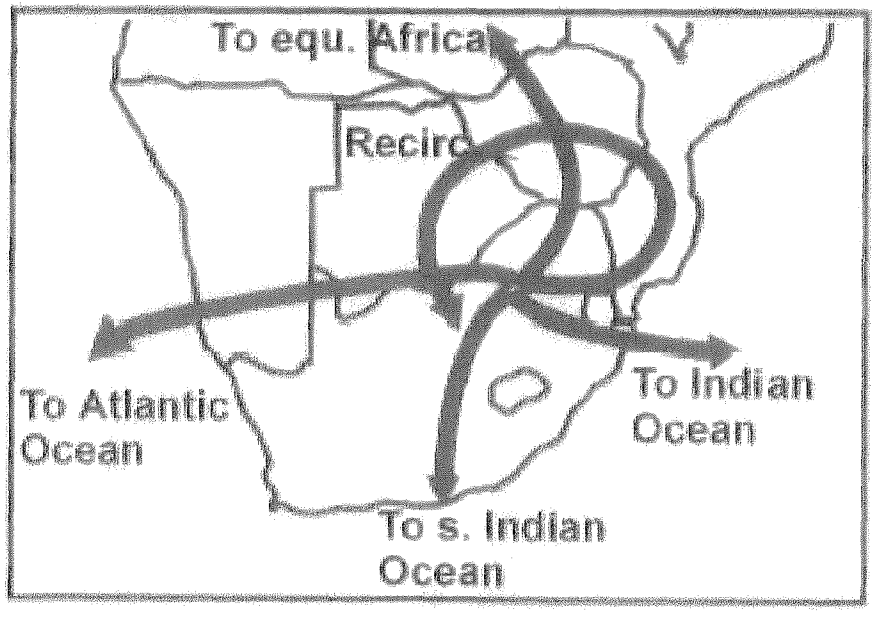

Figure 6: **The main transport pathways out of the Highveld, (Scholes, 2002)**

Limpopo experiences distinct weather patterns in summer and winter that affect the dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. Summer rainfall also aids in removing pollutants through wet deposition. In contrast, winter is characterised by atmospheric stability caused by a persistent high pressure system over

South Africa. This dominant high pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality. Preston-Whyte and Tyson (1988) describe the atmospheric conditions in the winter months as highly unfavourable for the dispersion of atmospheric pollutants.

5.3. Dust Fallout

Lonmin Platinum has undertaken dust fallout monitoring at the Akanani project prospecting area from 05/12/2007 to 06/08/2008 at seventeen locations (Figure 6). If one considers the average dust fallout on a per site basis over the entire monitoring period no incidents of VERY HEAVY dust fallout are encountered. One incident of HEAVY dust fall was encountered at Site 6 which averaged with 1035 mg/m^2/day. Three incidents of MODERATE dust fallout were encountered at Site 4, Site 12 and Site 2 which averaged with 409 mg/m^2/day, 319 mg/m^2/day and 254 mg/m^2/day respectively (Table 6 and Figure 7). The remaining sites all experienced dust fallout in the SLIGHT range. The average across all sites was 226 mg/m^2/day for the entire monitoring period 05/12/2007 to 06/08/2008.

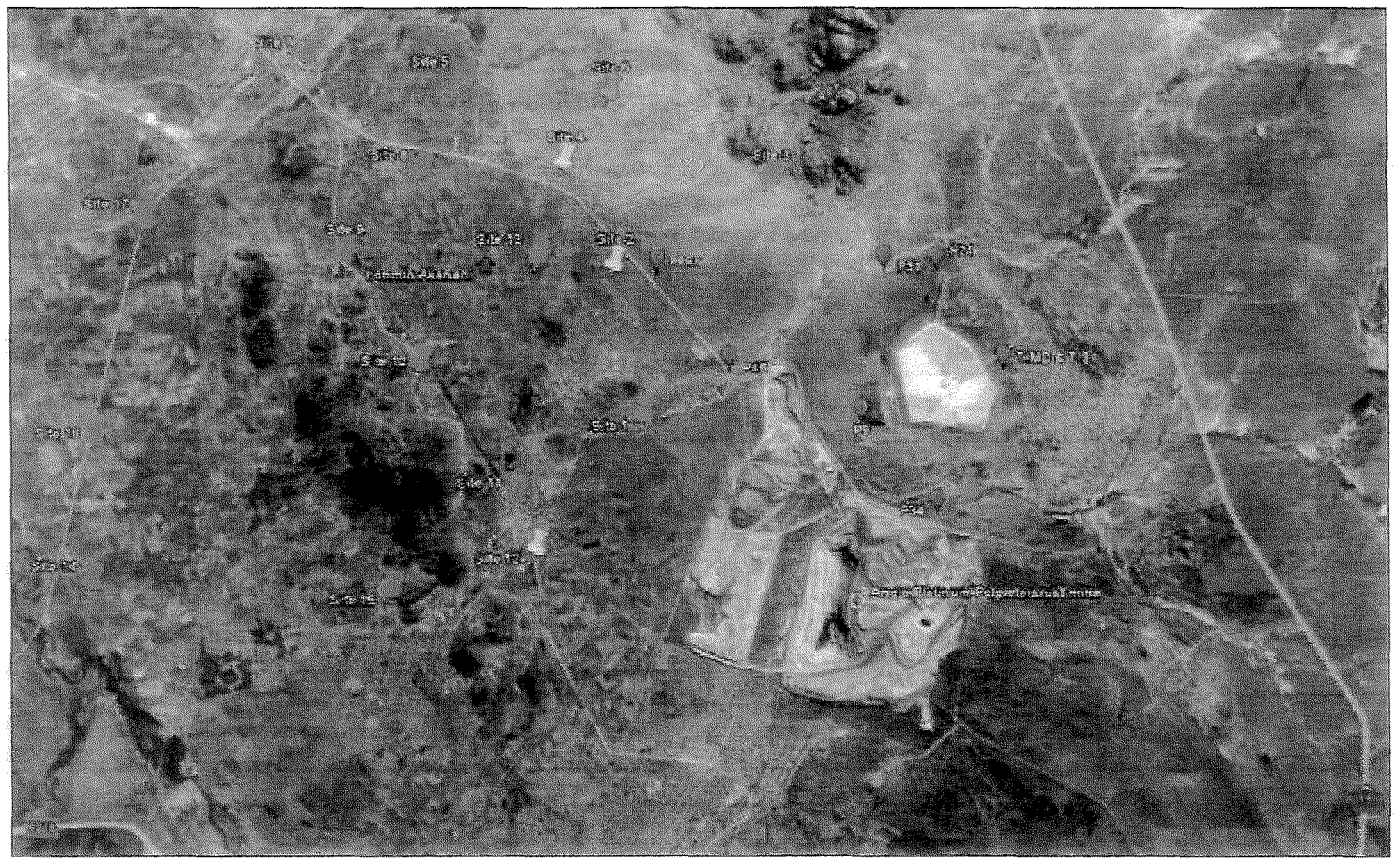

Figure 7: **Pin pointers denote the exact locations of 17 dust fallout samplers at Lonmin Akanani. Green pointer = slight dustfall; yellow pointer = moderate dustfall; orange pointer = heavy dustfall; red pointer = very heavy dust fall. Pink balloon pointers denote Anglo platinum dust fallout samplers (image source: Google Earth)**

Table 6: Dust fallout data at the Lonmin Akanani project site for 05/12/2007 06/08/2008.

Dust Fallout Data: 05/12/2007 - 06/08/2008											
Sample ID	Location	Dust Deposition ($mg/m^2/day$) 05/12/2007-10/01/2008	Dust Deposition ($mg/m^2/day$) 10/01/2008 - 05/02/2008	Dust Deposition ($mg/m^2/day$) 05/02/2008 - 06/03/2008	Dust Deposition ($mg/m^2/day$) 06/03/2008 - 03/04/2008	Dust Deposition ($mg/m^2/day$) 03/04/2008 - 06/05/2008	Dust Deposition ($mg/m^2/day$) 06/05/2008-05/06/2008	Dust Deposition ($mg/m^2/day$) 05/06/2008-04/07/2008	Dust Deposition ($mg/m^2/day$) 04/07/2008-06/08/2008	Cumulative Dust Deposition ($mg/m^2/day$) 05/12/2007-06/08/2008	Average Dust Deposition per site ($mg/m^2/day$) 05/12/2007-06/08/2008
1	Site 1	N/A	69	191	158	231	205	309	337	1499	214
2	Site 2	166	166	251	N/A	339	326	263	265	1777	254
3	Site 3	111	62	139	146	205	135	169	210	1178	147
4	Site 4	210	238	549	414	453	329	444	636	3274	409
5	Site 5	58	66	162	154	169	159	170	NA	936	117
6	Site 6	405	454	1004	718	1026	1858	1429	1387	8280	1035
7	Site 7	62	44	122	143	212	144	139	129	994	124
8	Site 8	12	101	152	134	148	95	130	180	951	119
9	Site 9	79	56	137	632	171	89	109	172	1444	181
10	Site 10	5	44	N/A	75	132	122	95	111	583	83
11	Site 11	56	60	N/A	224	187	177	157	182	1042	149
12	Site 12	N/A	186	N/A	309	373	271	305	470	1914	319
13	Site 13	N/A	N/A	N/A	N/A	N/A	188	231	113	532	177
14	Site 14	N/A	N/A	N/A	N/A	N/A	273	62	55	391	130
15	Site 15	N/A	N/A	N/A	N/A	N/A	NA	NA	246	246	123
16	Site 16	N/A	N/A	N/A	N/A	N/A	93	76	153	322	107
17	Site 17	N/A	N/A	N/A	N/A	77	133	140	284	634	158
All sites cumulative ($mg/m^2/day$) 05/12/2007-06/08/2008											3848
All sites average dust deposition ($mg/m^2/day$) 05/12/2007-06/08/2008											226
Note : Exceedances highlighted in yellow											

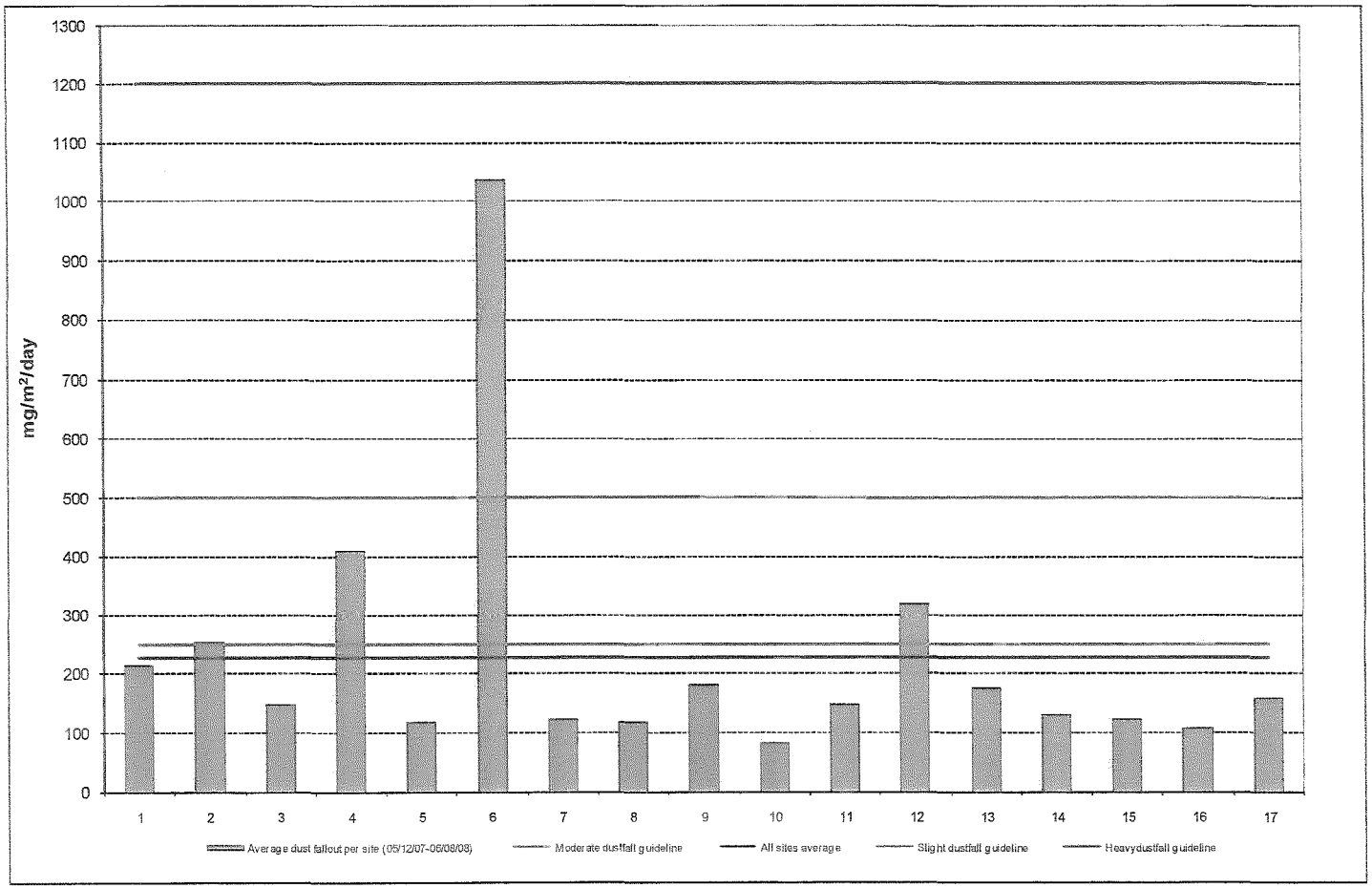

Figure 8: Average dust fallout per site at all monitoring stations for the period 05/12/2007 to 06/08/2008.

In general dust fallout throughout the entire prospecting area is fairly low except for Site 6 and Site 4. Site 6 is located on a main dirt access road between two operational mining areas operated by Anglo Platinum. Therefore elevated dust fall levels may be expected at this site. Site 4 is located in the property of the Department of Water Affairs and Forestry. The higher level of dust fallout from this site may be as a result of elevated levels of traffic to this government office. The office is also surrounded by several dirt roads which are used by the community residing in the near vicinity.

5.4. Sources of Emissions

Sources of emission associated with the various construction and transport activities are shown in Table 7. The emissions listed are the result of uncontrolled processes. However; by applying mitigation measures these potential emissions can be reduced.

Table 7: The prospecting process and related emissions.

PROCESSES	EMISSIONS
SHAFT CONSTRUCTION	
Drilling and Blasting	Particulate matter
Crushing and Screening	Particulate matter
Materials Handling	Particulate matter
Pushing and scraping operations (earth works)	Particulate matter
Stockpiles (waste rock dump)	Windblown Particulate matter
TRANSPORTATION	
Loading and offloading	Particulate matter
Vehicle entrainment	Particulate matter
Vehicle tailpipe emissions	SO_2, CO and Particulate matter

5.4.1. Fugitive Dust Emissions during Construction and Operational Phases

The construction phase normally comprises land clearing and topsoil removal activities in addition to the building of the necessary infrastructure. Depending on the extent of such activities, and the efficiency of dust control measures implemented, dust impacts occurring during the construction phase may have a significant impact on the surrounding area over a short period of time. Sources of fugitive dust emissions during the construction phase include:

- Vehicle entrained dust from the construction site;
- Wind erosion from open areas and stockpiles;
- Dust generated by materials handling operations, i.e. loading and off-loading of material; and
- Pushing and scraping operations (earthworks).

Similarly to the construction phase, the operation phase may include some land clearing and topsoil removal activities in addition to the building of additional infrastructure as the mines footprint expands. The operation phase however will include regular drilling and blasting. Depending on the extent of such activities, and the efficiency of dust control measures implemented, dust impacts occurring during the operational phase may have a significant impact on the surrounding area over a short period of time. Sources of fugitive dust emissions during the operational phase include:

- Vehicle entrained dust from access roads ;
- Wind erosion from open areas and stockpiles;
- Dust generated by materials handling operations, i.e. loading and off-loading of material;
- Pushing and scraping operations (earthworks);
- Crushing and screening; and
- Blasting and drilling operations.

Blasting is seen as an intermittent (non-routine) source of emissions (dust and trace gasses) and usually occurs once a day for a limited period of time (less than an

hour). Blasting in a full air quality impact assessment is usually modelled to reflect highest hourly impacts, but since no hourly ambient air quality standards or guidelines exists for particulates (limited to 24-hour averages) the significance of these impacts cannot be determined against the existing standards. The impacts are thus generally regarded as a source of nuisance only. If mitigated with dust suppression methods the impact of the nuisance dust can be greatly reduced.

5.4.2. Vehicle Emissions

Emissions from diesel fuelled vehicles include particulate matter, NO_x, SO_2, CO and HC, the majority of which occurs from the exhaust. Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel fuelled vehicles the contribution of soot to particulate emissions is between 40% and 80%. The black smoke observed to emanate from poorly maintained diesel fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase.

Vehicle emissions may be grouped into three different sources, namely:

- Entrainment of dust from road surface due to the wheel action,
- Exhaust fumes, and
- Fuel evaporation.

Fugitive dust emissions occur whenever a vehicle travels over a paved surface. These emissions originate mostly from material previously deposited on the travel surface, although re-suspension of material from tyres and undercarriages can be significant when vehicles travel from unpaved to paved areas.

6. MITIGATION MEASURES

Measures available to reduce fugitive dust emissions include the restriction of vehicle numbers, vehicle speeds and surface treatments. Surface treatments include wet suppression, the application of hygroscopic materials such as chloride salts or chemical soil stabilisers as well as wind speed reduction methods (Table 8).

Table 8: Mitigation measures to control dust emissions (USEPA, 1995).

SOURCE	SUGGESTED CONTROL METHOD
Debris handling	Wind speed reduction, Wet suppression
Truck transport	Wet suppression, Paving, Chemical stabilization
Cut/fill materials handling	Wind speed reduction, Wet suppression
Cut/fill haulage	Wet suppression, Paving, Chemical stabilization
General construction	Wind speed reduction, Wet suppression, Early paving of permanent roads
Bulldozers	Wet suppression
Pan scrapers	Wet suppression

Surface treatments such as wet suppression use water which is easily accessible although it is considered to be an expensive option. Other surface treatments include the use of chemicals such as calcium chloride or magnesium chloride. These chemicals attract moisture which acts to draw moisture out of the air during periods of high humidity and also reduces the evaporation rate of water during hot periods (Ferguson *et al.*, 1999). Another approach to dust control involves the application of organic or synthetic compounds that physically bind the dust particles together. Calcium lignosulphanate, a by-product of the pulp and paper industry, is a commonly available dust suppressant. A locally developed, commercial product, SASBIND, can significantly reduce fugitive dust emissions.

6.1. Dust Control Options for Paved Roads

Re-entrained dust from paved roads is related to both the amount of particulate loading on the road and the amount of travel on the roadway. Abatement strategies adopted should therefore include both measures aimed at reducing the availability of dust on roadways, and traffic control measures. Control programs aimed at reducing the particulate loading may consist of either preventative or mitigation measures, or a combination of both. Preventative measures impede the deposition of materials onto

the travel surface, whereas mitigation measures remove that which has been deposited. Ideally a higher priority should be given to measures aimed at preventing material from depositing on the road surface in the first place, rather than relying extensively on road cleaning.

The control of spillages from haul trucks and the prevention of track-on from the unpaved access roads represent possibly the most important preventative measures applicable to the proposed site. The contractor is to provide for rapid clean up of temporary sources of dust on paved roads. Furthermore, control total road surface dust loading by water flushing, broom sweeping and vacuuming the travelled portion of the road. The control efficiency of vacuum and broom sweepers is dependent on sweeper design and maintenance, the frequency of sweeping, the nature of the area being swept, and the particle size distribution of the dust on the road.

Until recently, the control efficiency of vacuum sweepers was given as being generally in the range of 0 to 60%. The frequent use of efficiently designed and well-maintained vacuum sweepers was found to provide an estimated PM10 control efficiency of between 30 to 60 % by studies conducted in the 1980's. Developments in vacuum and broom sweepers over the past decade have resulted in significant increases in their PM10 control efficiency, with certain of the latest sweepers being shown to have efficiencies in excess of 80%.

6.2. Dust Control Options on Blasting and Drilling Operations

Even though blasting and drilling are seen as intermittent (non-routine) sources of emissions (dust and trace gasses) they should be mitigated to reduce their impact.

Drilling dust can be suppressed by water or foam injected through the drill steel. This has been a common practice for many years (ILO, 1965). Usually this action reduces, respirable dust by 95% or better (MSA Research Corp., 1974), however this does not, prevent dust from entering the air during the initial collaring period as the drill hole is started. Various means (i.e. hand held sprays, suction traps around the drill bits etc.) have been tried to prevent the escape of dust during drill hole collaring however none of these methods are very effective (Kissell, 2003). Research undertaken by the MSA Research Corporation in 1974 proved that many of the factors leading to high drilling dust levels are the result of poor maintenance and/or

improper use of the drilling equipment (Kissell, 2003). Some of these factors included the failure to use water, inadequate quantities of water, plugged water holes in the drill bits, dull drill bits, and dry collaring (Kissell, 2003).

Water is important in controlling dust generated by blasting operations. The area surrounding the blast should be thoroughly sprayed beforehand. This precaution will prevent dust settled out during previous blasting operations from becoming airborne during the blast. A uniform rock moisture content of only 1% greatly reduces dust compared to dry rock (Quilliam, 1974). However, since it is difficult to wet rock uniformly, the optimum moisture content may be much higher (Kissell, 2003).

Mist sprays used during blasting are also effective methods to reduce dust levels however the use of too much water can cause other problems for the mining operations. Furthermore the use of mist sprays becomes problematic when the blasting area is large.

The water used for dust suppression, particularly in drilling and in blasting, should be as clean as possible, because the evaporation of dirty water can also release dust. Sufficient ventilation is critical for the control of blasting dust since water alone is usually inadequate. Blasting dust and fumes should be diluted quickly and exhausted to the surface via an untraveled return route. If this is not possible, the common practice is to arrange the blasting schedule so that the contaminated air will pass through working places when the miners are absent.

7. CONCLUSION AND RECOMMENDATIONS

In order to assess the baseline ambient air quality, a meteorological review was undertaken through a review of modelled meteorological data from the South African Weather Service (SAWS) for the period September 2005 – June 2008. Based on this assessment:

- Winds are predominantly from the east-north-east with lesser wind components from the north-east and south-south-east,
- Wind speeds are generally slow to moderate, with stronger winds recorded from the east.

During the construction activity, the main pollutant is particulate matter. Emissions from the construction phase will be limited to the duration of construction and can therefore be considered to be have a temporary impact. Any particulate emissions generated during this phase can be minimised with mitigation measures such as wet suppression. During the transportation, particulates and SO_2 have been identified to be the main pollutants of concern. Sources of these pollutants include vehicle entrainment and vehicle tailpipe emissions.

Similar to the construction phase, the main pollutant is particulate matter for the operational phase. Any particulate emissions generated during this phase can be minimised with mitigation measures such as wet suppression.

Drilling dust levels may be reduced by proper maintenance and operation of the drilling equipment and drill steel wetting. Blast dust levels can be reduced by surface wetting, exhausting the dust and fumes via the untraveled return route and mist suppression systems. The impact on the mine workers may be reduced by the blasting being scheduled so that the contaminated air will pass through working places when the miners are absent.

7.1. Dust Fallout Monitoring

The main pollutant that would need to be monitored is dust fallout as dust will be generated during the construction and transportation. It is thus recommended that the current dust fallout monitoring programme by Lonmin Platinum in the Akanani prospecting area be expanded in alignment with the American Society for Testing and Materials standard method for collection and analysis of windblown dust

deposition (ASTMD1739) to include an additional six dust fallout buckets around the proposed prospecting shaft. This expansion to the dust fallout monitoring network must be implemented once construction of the shaft starts, thus allowing for the monitoring of dust fallout from the shaft sinking operations.

7.2. Proposed Air Quality Monitoring Programme

It is proposed that a fine particulate monitoring programme be established, which include at least two particulate monitors to monitor PM10 and two particulate monitors to monitor PM2.5 from the prospecting site. These units must also monitor wind speed and wind direction as this data is extremely useful when analysing the particulate matter data. Ideally these units should be installed at least 1 year prior to the construction phase to allow for the collection of a baseline data set.

7.3. Proposed Meteorological Monitoring Programme

It is proposed that at least two full meteorological stations be established, which include the following parameters: wind speed and direction, solar radiation, temperature, humidity, pressure and rainfall as currently there is no meteorological station in the region which presents valid data for the Akanani prospecting area. Ideally these units should be installed at least 1 year prior to the construction phase to allow for the collection of a baseline data set.

7.4. Professional Opinion

Based on the baseline information and Gondwana Environmental Solutions experience with similar mining operations we are of the opinion that in terms of air quality there should not be a major impact if mitigation measures to control dust and gaseous emissions are instituted. However, should the proposed prospecting shaft (and mine development as a whole) proceed to the EIA phase, then a further study should/must be undertaken to quantify the pollutant concentrations in the area around the prospecting shaft. This can be achieved through a detailed air quality impact assessment with dispersion modelling so that the impact of the emissions may be quantified prior to the construction phase.

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Appendix B.2

Lonmin Akanani Sampling Shaft Red Data Survey, Golder Associates

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REPORT ON

Lonmin Akanani Sampling Shaft Red Data Survey

Report No : 11808-8468-3

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EXECUTIVE SUMMARY

Golder Associates Africa (Pty) Ltd was approached by Lonmin to do an ecological survey through the identification of rare and endangered fauna and flora prior to the establishment of a sampling shaft on the Lonmin Akanani project. The proposed site for the development of the bulk sampling shaft site stretches over 1ha and will need to be cleared of all Red Data or protected species as the construction will impact the vegetation in this area. All the Red Data and protected species identified will then need to be relocated to a site with similar environmental conditions. If no species of conservation value is found within the 1ha site, the project can proceed without any relocation procedures.

The current state of the site on which the proposed development will take place is previously cultivated and utilised land that led to degradation of the environment. Due to the fact that little or no natural vegetation occurs here and the cultivation that took place, these areas are classified as being of low conservation importance. The site survey found that although there are Red Data species that occur in the area in which the site is situated, no Red Data or protected species were found during the survey. Species lists that contain the protected species of the Limpopo Province as well as PRECIS data and other Red Data lists were considered during the survey. Due to fact that no Red Data or protected species were found, no relocation procedures will be necessary prior to the development of the project.

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1 INTRODUCTION

Golder Associates Africa (Pty) Ltd was approached by Lonmin to conduct an ecological survey through the identification of rare and endangered fauna and flora prior to the establishment of a sampling shaft for the Lonmin Akanani project. The proposed site for the development of the bulk sampling shaft site stretches over 1ha and will need to be cleared of all vegetation (including Red Data or protected species) in this area.

All the Red Data and protected species identified will therefore need to be relocated to a site with similar environmental conditions. If no species of conservation value are found within the 1ha site, the project can proceed without any relocation procedures.

2 AIMS AND OBJECTIVES

The main aim of the project was to conduct a detailed and intensive survey of the proposed bulk sampling shaft site to enable the identification of any rare or endangered flora or fauna that may be destroyed during the construction process.

The objectives of this project include:

- Identification of Red Data and protected species
- Relocation of Red Data and protected species
- Identification of site specific impacts
- Mitigation measures for site specific impacts

3 SCOPE OF WORK

The proposed scope of work was limited to the following:

- Conducting a detailed and intensive survey of the proposed site footprint with the specific purpose of identifying rare or endangered species.
- Recording the GPS location and photographing the identified species;
- Identify possible impacts and recommend mitigation for said impact;
- Compiling a summary of findings; and
- Designing a proposed relocation plan for identified species, if required.

4 LIMITATIONS

In order to obtain a comprehensive understanding of the dynamics of communities and the status of endemic, rare or threatened species in any area, vegetation and faunal assessments should always consider investigations at different time scales (across seasons/years) and through replication.

However, due to time constraints such long-term studies are not feasible and most conclusions will be based on instantaneous sampling bouts. Problems with this method of sampling are as follows:

- Temporal changes in biodiversity are not taken into account during instantaneous sampling bouts.
- Variations in biodiversity due to temporal animal movements, such as migrations, are not taken into account.
- Unusual environmental conditions (such as unusually high or unusually low rainfall) may cause unusual states of biodiversity during the period of study, which may not usually exist.

5 METHODOLOGY

The Red Data assessment started with the site identification via aerial/satellite imagery. The 1 hectare site then underwent line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Through the transects identification of the vegetation took place to verify whether any Red Data or protected species are present.

This survey was conducted at the end of September 2008; cognisance was taken of the following environmental attributes and general information:

- Biophysical environment (geology, topography, aspect, slope etc.).
- Current status of habitats.
- Red Data habitat suitability.
- Digital photographs.
- GPS reference points

Red Data Species were determined through the collection of baseline PRECIS data for the grid squares 2428BB and 2328DD. This was then compared to the Limpopo Province Protected and Red Data plant species list to compile a list of Red Data and protected plant species that may potentially occur within the study area. A survey of this kind (instantaneous sampling bout or "snapshot" investigation) poses severe limitations to the identification of Red Data plant species.

6 FINDINGS

During the site visit, it was determined that the site has been severely transformed from its original ecological state. Habitat transformation, destruction and fragmentation pose serious threats to the survival of threatened plant and animal species. Historically, planning and developments did not include the environment and consequently lead to the wasteful exploitation, destruction and contamination of many natural environments. Therefore the site shows the effects of development and/or cultivation without considering sustainability or conservation. It is necessary that environmental factors be considered during development planning in order to identify and allocate the areas that could potentially be considered as areas of conservation importance.

The site on which the Lonmin operations are situated, are in close vicinity to tribal land that include settlements of Ga-Masenya and Ga-Malebana. The vegetation communities of this area are semi-natural vegetation, due to the fact that much of the area has been disturbed to some extent due to grazing and other anthropogenic impacts such as utilisation of indigenous plant species for fuel, traditional medicine or other traditional uses. Cultivated areas include areas that are presently or previously cultivated land areas. These areas are either denuded of natural vegetation (in presently cultivated lands) or host to a number of pioneer and exotic species (in previously cultivated areas); encroachment is also widespread in this area due to the disturbed nature of the vegetation. The biodiversity for this site is low, with the presence of a low number of species.

6.1 Fauna

During the site survey, no Red Data or protected species were observed. Red Data faunal species that might occur on the site were considered during the site survey including Avifauna species (Table 1), Mammals (Table 2) and Amphibians (Appendix D), although these species were not observed during the site visit, the probability of occurrence in this site are predominantly low and moderate value for the avifauna. The mammals show a higher probability of occurrence in the area, but none were observed on the site.

Table 1: Red Data bird species that might occur in the proposed area, this includes migratory birds

Scientific Name	Common Name	Status	Probability of Occurrence on site
Spizocorys fringillaris	Botha's Lark	Endangered	Low
Anthus chloris	Yellow-breasted Pipit	Vulnerable	Low
Heteromirafra ruddi	Rudd's Lark	Vulnerable	Moderate
Grus carunculatus	Wattled Crane	Vulnerable	Moderate
Grus paradisea	Blue Crane	Vulnerable	Moderate
Sarothrura ayresi	White-winged Flufftail	Endangered	Low
Torgos tracheliotos	Lappet-faced Vulture	Vulnerable	Moderate
Gyps coprotheres	Cape Vulture	Vulnerable	Moderate
Falco naumanni	Lesser Kestrel	Vulnerable	High
Geronticus calvus	Southern Bald Ibis	Vulnerable	Moderate
Campethera notata	Knysna Woodpecker	Near Threatened	Low
Crex crex	Corncrake	Near Threatened	Low
Falco fasciinucha	Taita Falcon	Near Threatened	Low
Egretta vinaceigula	Egret Slaty	Vulnerable	Medium
Neophron percnopterus	Egyptian Vulture	Endangered	Low
Circus macrourus	Harrier Pallid	Near Threatened	Medium
Coracias garrulus	Roller Eurasian	Near Threatened	High
Sagittarius serpentarius	Secretary Bird	Near Threatened	High
Gorsachius leuconotus	Heron Whitebacked Night	Near Threatened	Low
Gallinago media	Great Snipe	Near Threatened	Medium
Neotis denhami	Stanley's Bustard	Near Threatened	Low

Table 2: Red Data Mammals that occur or have a possibility of occurring on the site

Scientific Name	Common Name	Status	Probability of Occurrence on site
Elephantulus myurus	Eastern Rock Sengi	Data Deficient	High
Mysorex varius	Forest Shrew	Data Deficient	High
Crocidura mariquensis	Swamp Musk Shrew	Data Deficient	Medium
Crocidura cyanea	Reddish-grey Musk Shrew	Data Deficient	High
Crocidura silacea	Lesser Grey Musk Shrew	Data Deficient	High
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient	High
Graphiurus platyops	Rock Dormouse	Data Deficient	High
Tatera leucogaster	Bushveld Gerbil	Data Deficient	Medium
Tatera brantsii	Highveld Gerbil	Data Deficient	Low
Lemniscomys rosalia	Single-striped Grass Mouse	Data Deficient	Medium
Panthera pardus	Leopard	Vulnerable	Medium

6.2 Flora

The study area is located within Makhado Sweet Bushveld. Within the proposed area for the development of the sampling shaft, no Red Data or protected species were found. During the survey protected species of Limpopo Province were taken into consideration as well as the PRECIS Red Data species list of the associated grid squares (Table 3). Species found on the site are mentioned to be exempted from the protected species list of the Limpopo Province, these species include: *Aloe marlothii; Aloe greatheadii*

Table 3: PRECIS data retrieved containing the Red Data species for the proposed site

GRIDREF	Taxon	1996 Global Status	Interim 2007 Global Status	Interim 2007 National Status
2328DD	Argyrolobium muddii Dummer		EN	EN
2428BB	Ozoroa albicans R.& A.Fern.	K	LC	LC
2428BB	Gladiolus dolomiticus Oberm.	R	LC	Rare
2428BB	Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.		LC	Declining
2428BB	Nuxia gracilis Engl.	K	LC	LC
2328DD	Brachystelma inconspicuum S.Venter	K	LC	Rare
2428BB	Erythrophysa transvaalensis I.Verd.	R	LC	LC
Ex – Extinct **E** – Endangered **V** – Vulnerable **R** – Rare **I** – Indeterminate **K** – Insufficiently Known **nt** – Not Threatened				

6.3 Impact Evaluation

An impact can be evaluated according to the following criteria:

- Extent or spatial scale of the impact.
- Intensity or severity of the impact.
- Duration of the impact.
- Potential for mitigation.
- Degree of certainty/probability.

By using the above mentioned criteria, a concrete judgement can be made on classifying the impact and the importance it plays in the development of the project and attaining sustainability in the environment (DEAT, 2002). Calculation of the severity of the impact is based on the Department of Environmental Affairs' guideline document on EIA Regulations, April 1998.

Significance of Impact = Consequence (magnitude + duration + spatial scale) x Probability

All the criteria have a specific ranking system (Table 4) used to assess the impact, through the ranking system the significance can be calculated as to establish the importance of the impact and its ranking in comparison to the other impacts.

Table 4: Consequence and probability ranking

Magnitude/Severity	Duration	Spatial Scale	Probability
10 - Very high/don't know	5 - Permanent	5 - International	5 - Definite/don't know
8 - High	4 - Long-term (impact ceases after operational life)	4 - National	4 - Highly probable
6 - Moderate	3 - Medium-term (5-15 years)	3 - Regional	3 - Medium probability
4 - Low	2 - Short-term (0-5 years)	2 - Local	2 - Low probability
2 - Minor	1 - Immediate	1- Site only	1 - Improbable
0 - None			0 - None

The maximum value, which can be obtained, is 100 significance points (SP). Environmental effects are rated on the following basis:

- SP>60 Indicates high environmental significance

- SP 30 to 60 Indicates moderate environmental significance
- SP<30 Indicates low environmental significance
- SP = 0 Indicated no environmental impact

The descriptors for the ratings (DEAT, 2002) are as follows:

- High - Of the highest order possible within the bounds of impacts that could occur, there is no possible mitigation that could offset the impact, or mitigation is difficult.
- Moderate - Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Mitigation is both feasible and fairly easily possible
- Low - Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved or little mitigation is required, or both.
- No impact - Zero Impact

The impacts associated to the proposed development have been evaluated according to the criteria suggested by DEAT (2002), after which the appropriate ranking have been given to the impact (Table 5). This is also an indication of how the rating changed after mitigation measures have been applied.

Table 5: Rating and ranking of the impacts associated to the project

Impact	Significance Score						Recommended mitigation
	P	D	SS	Mag	Total	Rating	
Habitat degradation due to the removal of vegetation of terrestrial habitats and exposure of bare ground that increases erosion.	**SBM**						The removal of the vegetation is the automatic removal of faunal habitats. The erosion associated with vegetational removal will then lead to further degradation of the proposed environment. This impact can be mitigated by effective sediment and run-off management practices and by clearly demarcating the buffer zone and closely monitoring that it is adhered to. This will allow impact reduction.
	5	5	2	8	75	H	
	SAM						
	4	4	1	6	44	M	
Decrease in biodiversity due to disturbance and loss of habitat of faunal species.	**SBM**						The proposed development will most definitely cause disturbances such as noise and vibration that will in turn cause species to evacuate their habitats. This impact can be mitigated through minimization of the noise and the vibration throughout the lifecycle of the project.
	5	5	2	10	85	H	
	SAM						
	4	5	2	6	52	M	
Habitat degradation due to spillage of poisonous or toxic substance.	**SBM**						Any spillage from the construction process (e.g. fuel or oil from vehicles) to the surrounding habitats will have a negative effect of the fauna and flora of the area. Spillages, depending on what is spilled have long term effects on the environment. It can be mitigated by putting measures in place to prevent spillage in these areas.
	3	4	2	8	42	M	
	SAM						
	2	4	1	6	22	L	

P – Probability **D** – Duration **SS** – Spatial Scale **Mag** – Magnitude **SBM** – Significance Before Mitigation **SAM** – Significance After Mitigation

7 CONCLUSION

The current ecological state of the site, on which the proposed development will take place, can be considered as poor to moderate due to previous cultivation and utilisation of the land leading to the degradation of the environment. Due to the fact that little or no natural vegetation occurs here and the cultivation that took place, these areas are classified as being of low conservation importance. The site survey found that although Red Data species have been historically recorded in the region, no Red Data or protected species were found on the development site during the survey. Species lists that contain the protected species of the Limpopo Province as well as PRECIS data and other Red Data lists were considered during the survey.

8 REFERENCES

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APPENDIX A

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APPENDIX B

PROTECTED SPECIES OF THE LIMPOPO PROVINCE

SCHEDULE 11

SPECIALLY PROTECTED PLANTS
All plants, of all indigenous cycads of the Genus Encephalartos, excluding cultivated seedlings of plants.

SCHEDULE 12

PROTECTED PLANTS
The plants, referred to in this schedule, do not include plants which have been improved by selection or cross-breeding.

Cycads

COMMON NAME	SCIENTIFIC NAME
All cultivated seedlings of indigenous cycads	Encephalartos spp

Trees and shrubs

COMMON NAME	SCIENTIFIC NAME
The following Adenia species	Adenia fruticosa simpliciflora
Baobab	Adansonia digitata
Beech	Faurea macnaughtonii
Bitter false thorn	Albizia amara sericocephala
The following Boscia species	Boscia angustifolia var. corymbosa
	Boscia foetida minima
Borassus palm	Borassus aethiopicum
Brackenridgea	Brackenridgea zanguebarica
Capper bush	Capparis sepiaria var. subglabra
The following Combretum species	Combretum collinum taborense
	Combretum padoides
	Combretum petrophilum
	Combretum vendae
The following Commiphora species	Commiphora zanzibarica
Currant	Allophylus ainifolius
The following elephantorrhiza species	Elephantorrhiza praetermissa
The following Grewia species	Grewia rogersii
The following Hibiscus species	Hibiscus articulatus
	Hibiscus barnardii
	Hibiscus sabiensis
Large cape myrtle	Myrsine pillansii
Large-leaved dragon tree	Dracaena hookerana
Large leaved saucer-berry	Cordia africana
The following Maytenus species	Maytenus oxycarpa
	Maytenus pubescens
The following Ochna species	Ochna glauca
Pepper-bark tree	Warburgia salutaris
Pincushion	Leucospermum saxosum
The following Rhus species	Rhus batophylla
Sand ironplum	Drypetes mossambicensis
Salati palm	Borassus aethiopicum
Stinkwood, Black	Ocotea bullata
Stinkwood, Transvaal	Ocotea kenyensis
Tamboti	Spirostachys africana
The following tarenna species	Tarenna zygoon
Transvaal red balloon	Erythrophysa transvaalensis
Venda bead-string	Alchornea laxiflora

Wild banana	Ensete ventricosum
Wild teak	Pterocarpus angolensis
Yellowwood, Outeniqua	Podocarpus latifolius
Yellowwood, Real	Podocarpus falcatus

Succulents

COMMON NAME	SCIENTIFIC NAME
All species of aloes indigenous to the Province, excluding the following species:	
Aculeata	Aloe aculeata
Aloe, Catstail	A.castanea
Aloe, Krans	A. arborescens
Aloe, Mountain	A. marlothii
Ammophilla	A. ammophilla
Davyana	A. davyana
Fosteri	A. fosteri
Globuligemma	A. globuligemma
Grandidentata	A. grandidentata
Greatheadii	A. greatheadii
Lutescens	A. lutescens
Mutans	A. mutans
Parvibracteata	A. parvibracteata
Transvaalensis	A. transvaalensis
Wickensii	A. wickensii
All species of brachystelma	Brachystelma spp
All species of ceropegia	Ceropegia spp
All species of duvalia	Duvalia spp
The following species euphorbias:	Euphorbia barnardii, E. clivicola, E. grandialata, E. groenewaldii, E. louwii, E. restricta, E. rowlandii, E. tortirama E. waterbergensis
Ghaap	Hoodia lugardii
All species of ghaap	Tavaresia spp
All species of huernia	Huernia spp
All species of huerniopsis	Huerniopsis spp
The following impala lilies	Adenium multiflorum
Multiflorum en oleifolium	A. olefolium
Kudu lily	Pachypodium saundersii
All species of orbeanthus	Orbeanthus spp
All species of orbeas	Orbea spp
All species of orbeopsis	Orbeopsis spp
All species of pachycymbiums	Pachycymbium spp
All species of riocreuxias	Riocreuxia spp
All species of stapeliads	Stapelia spp
Stone plant	Lithops leslieii

Other plants

COMMON NAME	SCIENTIFIC NAME
The following agapanthus species	Agapanthus coddii, A. dyeri
The following anacampseros species (now A. rhodesica)	Anacampseros bemenkampii
All species of anomatheca	Anomatheca spp
The following anthericum species	Anthericum cyperaceum
The following arum lilies: Jucunda, pentlandii and rehmannii	Zantedeschia jucunda, Z.pentlandii, Z. rehmannii
The following babiana species	Babiana hypogea var. longituba
Batesiana gasteria	Gasteria batesiana
Blue squill	Scilla natalensis
Clivia	Clivia caulescens
The following cyathula species	Cyathula natalensis
The following eragrostis species	Eragrostis arenicola
The following eriosema species	Eriosema transvaalense
The following eulophia species	Eulophia coddii
	E. leachii
The following felicia species	Felicia fruticosa brevipendunculata
The following festuca species	Festuca dracomontana
All species of fire lily	Cyrtanthus spp
The following freylinia species	Freylinia tropica
The following gladiolus species	Gladiolus macneilii
The following habernaria species	Habernaria kraenzliniana
The following heinsia species	Heinsia crinita
The following hermstaedtia species	Hermstaedtia capitata
The following hippocratea species	Hippocratea parvifolia
The following hymenodictyon species	Hymenodictyon parvifolium parvifolium
The following hyptis species	Hyptis spicigera
The following inula species	Inula paniculata
The following jasminum species	Jasminum abyssinbicum
The following kalanchoe species	Kalanchoe crundallii
	K. rogersii
The following kniphofia species	Kniphofia coralligemma
	K.crassifolia
	K. rigidifolia
The following kotschya species	Kotschya thymodora
The following melinus species	Melinus tenuissima
The following mondia species	Mondia whitei
The following monsonia species	Monsonia lanuginosa
The following neobulosia species	Neobulosia tysonii
The following nervillia species	Nervillia umbroza
The following nymphaea species	Nymphaea lotus
The following oberonia species	Oberonia distichia
The following oreosyce species	Oreosyce africana
Paint brush	Haemanthus montanus
The following peristrophe species	Peristrophe cliffordii
	P. gililandorum
	P. transvaalensis
The following phyllanthus species	Phyllanthus pinnatus
The following pilea species	Pilea rivularis
The following plinthus species	Plinthus rehmannii
The following polycarpea species	Polycarpia eriantha var. effusa
The following polystachya species	Polystachia albescens imbricata

The following portulaca species	Portulaca foliosa
	P. trianthemoides
The following rhyncosia species	Rhyncosia vendae
Royal paint brush (Blood lily)	Scadoxis puniceus
The following sartidia species	Sartidia jucunda
The following schizagyrium species	Schizagyrium brevifolium
All species of South African orchid	Family Orchidaceae
The following stadmania species	Stadmania oppositifolia
The following streptocarpus species	Streptocarpus decipiens
The following strophanthus species	Strophanthus luteolus
The following sutera species	Sutera maerantha
The following thorncroftia species	Thorncroftia media
All species of tree ferns	Cyathea spp
All species of tree moss	Porothamnium, Pilotrichella and Papillaria spp
The following trilepisium species	Trilepisium madagascariensis
The following tristachya species	Tristachya trifaria
The following turbina species	Turbina shirensis
The following watsonia species	Watsonia densiflora
	W. transvaalensis
	W. wilmsii
Wild ginger	Burmannia madagascariensis
Wild ginger	Siphonochilus aethiopicus
The following xylopia species	Xylopia parviflora

APPENDIX C

RED DATA AMPHIBIANS OF SOUTH AFRICA

Scientific Name	IUCN Red List Status	Vernacular Name	Family	Probability of occurrence
Leptopelis bocagii		Bocage's Tree Frog	Arthroleptidae	Medium
Leptopelis xenodactylus	Endangered (EN)	Long-toed Tree Frog	Arthroleptidae	Low
Breviceps bagginsi	Data Deficient (DD)		Brevicipitidae	Low
Breviceps gibbosus	Vulnerable (VU)	Giant rain frog	Brevicipitidae	Low
Breviceps macrops	Vulnerable (VU)	Desert rain frog	Brevicipitidae	Low
Breviceps maculatus			Brevicipitidae	Low
Breviceps sopranus	Data Deficient (DD)		Brevicipitidae	Low
Breviceps sylvestris	Vulnerable (VU)	Forest rain frog	Brevicipitidae	Medium
Bufo amatolicus	Endangered (EN)	Amatola toad	Bufonidae	Low
Bufo pantherinus	Endangered (EN)	Western Leopard Toad	Bufonidae	Low
Capensibufo rosei	Vulnerable (VU)	Rose's toad	Bufonidae	Low
Heleophryne hewitti	Critically Endangered (CR)	Hewitt's ghost frog	Heleophrynidae	Low
Heleophryne rosei	Critically Endangered (CR)	Rose's ghost frog	Heleophrynidae	Low
Hemisus guttatus	Vulnerable (VU)	Spotted Snout-Burrower	Hemisotidae	Low

Scientific Name	IUCN Red List Status	Vernacular Name	Family	Probability of occurrence
Afrixalus knysnae	Endangered (EN)	Knysna Spiny Reed Frog	Hyperoliidae	Low
Afrixalus spinifrons	Vulnerable (VU)	Natal Spiny Reed Frog	Hyperoliidae	Low
Hyperolius horstockii	Vulnerable (VU)	Horstock's Reed Frog	Hyperoliidae	Low
Hyperolius pickersgilli	Endangered (EN)		Hyperoliidae	Low
Hyperolius poweri		Power's reed frog	Hyperoliidae	Low
Xenopus gilli	Endangered (EN)	Cape Clawed Toad	Pipidae	Low
Afrana vandijki	Data Deficient (DD)	Van Dijk's river frog	Ranidae	Low
Anhydrophryne rattrayi	Endangered (EN)	Rattray's frog	Ranidae	Low
Arthroleptella drewesii	Data Deficient (DD)	Drewes' moss frog	Ranidae	Low
Arthroleptella landdrosia	Near Threatened (NT)	Landdross Moss frog	Ranidae	Low
Arthroleptella lightfooti	Near Threatened (NT)	Lightfoot's moss frog	Ranidae	Low
Arthroleptella ngongoniensis	Critically Endangered (CR)	Mistbelt moss frog	Ranidae	Low
Arthroleptella subvoce			Ranidae	Low
Cacosternum capense	Vulnerable (VU)	Cape dainty frog	Ranidae	Low
Cacosternum karooicum	Data Deficient (DD)		Ranidae	Low

Scientific Name	IUCN Red List Status	Vernacular Name	Family	Probability of occurrence
Cacosternum poyntoni	Data Deficient (DD)		Ranidae	Low
Cacosternum striatum	Data Deficient (DD)		Ranidae	Low
Microbatrachella capensis	Critically Endangered (CR)	Micro frog	Ranidae	Low
Natalobatrachus bonebergi	Endangered (EN)	Boneberg's frog	Ranidae	Low
Poyntonia paludicola	Near Threatened (NT)	Montane Marsh Frog	Ranidae	Low
Strongylopus springbokensis	Vulnerable (VU)	Namaqua stream frog	Ranidae	Low
Strongylopus wageri	Near Threatened (NT)	Wager's stream frog	Ranidae	Low

Appendix B.3

A Baseline Groundwater Review and Impact Assessment for the Proposed Prospecting Shaft at the Akanani Project Site; Golder Associates

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REPORT ON

A BASELINE GROUNDWATER REVIEW AND IMPACT ASSESSMENT FOR THE PROPOSED PROSPECTING SHAFT FACILITY AT THE AKANANI PROJECT SITE

Report No : 11808/8188/2

Submitted to:

Lonmin Akanani
Postnet Suite #63
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0600

DISTRIBUTION:

2 Copies - Lonmin Akanani
1 Copy - Golder Associates Africa (Pty) Ltd – Library

October 2008 11808

EXECUTIVE SUMMARY

As part of the Akanani Project baseline studies required to obtain the necessary government authorisations, a characterisation of the groundwater situation near the proposed prospecting shaft has been prepared. This report describes the hydrogeological situation surrounding the proposed prospecting shaft site and assesses the potentisl impacts of the proposed activities on the groundwater regime.

The proposed prospecting shaft facility will occupy an area of approximately 2 ha in the south-eastern portion of the Akanani Project Area. It will be operated over a period of three years to obtain a 3000 tonne bulk sample, required to determine the metallurgical properties of the Platreef at Akanani.

Field investigations were carried out for the overall Akanani Baseline Hydrogeological Study and data relevant to the vicinity of the proposed prospecting shaft site are described and considered in this report.

Based on the field investigations, the hydrogeological regime is conceptually understood to comprise a relatively shallow, weathered and fractured, norite-hosted aquifer zone. In the vicinity of the proposed prospecting shaft the aquifer zone is generally observed to be in the order of 1-5 m thick and located to depths of approximately 10 mbgl. Along fracture zones aquifer parameters are enhanced and extend to depths of at least 25-30 m.

A qualitative risk assessment was undertaken based on the Department of Environmental Affairs and Tourism Guideline document. The outcome of this assessment is that the environmental impacts of the proposed bulk sampling activities on the groundwater regime are considered to be low.

Mitigation measures, which can be implemented to further reduce these risks and which will allow the monitoring of the described potential impacts on the groundwater regime, are given.

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1 INTRODUCTION

In order for Lonmin to commence the sinking of the bulk sampling shaft at the Akanani Project Site near Mokopane, authorisations are required to comply with the Mineral and Petroleum Resources Development Act (MPRDA), the National Environmental Management Act (NEMA) and the National Water Act (NWA). As part of the baseline studies required to obtain the necessary authorisations, a characterisation of the groundwater situation in the vicinity of the proposed prospecting shaft is needed.

This report briefly describes the hydrogeological situation surrounding the proposed prospecting and bulk sampling shaft site and assesses the likely impacts of the proposed activities on the groundwater regime. The description and impact assessment is based on the wider baseline hydrogeological studies currently being undertaken on the Akanani Project Area.

The proposed prospecting shaft facility will be operated over a period of three years and is required to obtain a 3000 tonne bulk sample to determine the metallurgical properties of the Platreef at Akanani. The associated surface infrastructure will occupy an area of approximately 2 ha. The sample extracted will be transported to the Mintek Laboratories in Johannesburg for processing and analyses.

2 OBJECTIVES OF THE GROUNDWATER STUDY

The objective of the study is to provide a basic hydrogeological description of the areas surrounding the site of the proposed prospecting shaft. Based on this description a further objective is to assess the likely impacts of the exploration shaft sinking and subsequent sampling operations on the groundwater environment and existing groundwater users in the area.

3 SCOPE OF WORK

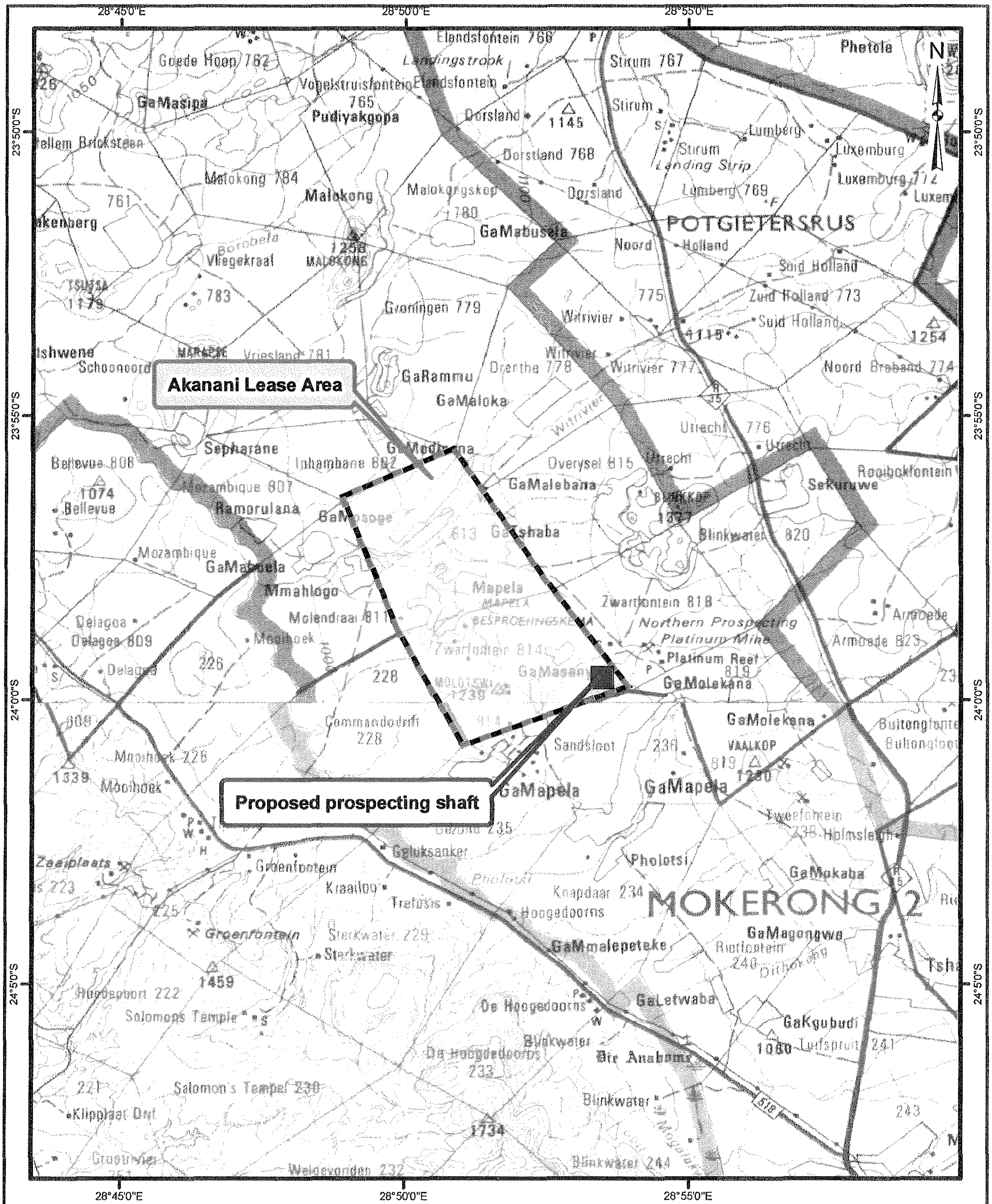
The scope was undertaken in conjunction with the field studies undertaken at the Akanani Project Area. The scope for this particular investigation is limited to:

- A description of the hydrogeological regime in the vicinity of the proposed prospecting shaft site; and
- A risk assessment of the proposed shaft sinking and bulk sampling activities.

4 BRIEF PHYSICAL DESCRIPTION OF THE AKANANI MINE LEASE AREA

4.1 Location

The Akanani Project Area, shown in Figure 1, covers 4095 ha in a northwest-southeast orientated rectangular block of approximately 9 km by 4.5 km. The site comprises two adjoining farms, Zwartfontein 814LR to the north and Moordkopje 813LR to the south. It is located approximately 25km north of the town of Mokopane in the Limpopo Province. The project area is also located immediately west and northwest of the Anglo Platinum Potgietersrus open pit platinum mining operations.



LEGEND

Proposed prospecting shaft

Study area

3 0 3 6 9

SCALE 1:170,000 KILOMETRES

PROJECT

LONMIN AKANANI

TITLE

LOCATION OF THE AKANANI PROJECT LEASE AREA

REVISION 1

REFERENCE

GCS WGS 1984

Golder Associates
Johannesburg, South Africa

PROJECT No. 11808			SCALE AS SHOWN	REV. 0
DESIGN	MM	09/10/2008	**FIGURE: 1**	
GIS	MM	09/10/2008		
CHECK	TD	09/10/2008		
REVIEW	GLH	09/10/2008		

The area for this particular study is confined to the south-eastern portion of the Akanani Project Area, near the seasonal Mohlosane River drainage. The closest village to the bulk sampling shaft is GaMasanya (Figure 1)

The area is served by two gravel roads which cross in the village of GaMosoge further north on the lease area. These roads link the lease area with Mokopane in the south.

4.2 Topography

The central, northern and eastern portion of the project area is characterised by a generally flat plain sloping gently from the southeast, at an elevation of approximately 1090 metres above mean sea level (mamsl), to approximately 1010 mamsl in the extreme northwestern portion of the lease area. Some prominent rugged hills and valleys are present in the south with elevations of up to 1238 mamsl at the Molotswi Hill. The bulk sampling shaft is located in the relatively flat south-eastern portion of the Akanani Project Area.

A prominent southeast-northwest trending ridge, forming the eastern edge of the Waterberg Range and rising to elevations of between approximately 1300 and 1800mamsl lies some 10km to the southwest of the area.

4.3 Surface Water System

The project area falls under the Limpopo Water Management Area in the A61G quaternary catchment. It is drained by two main non-perennial drainages, the Thathwe in the northern and central portions and the Mohlosane River drainage near the southern boundary. Both of these drainages form tributaries of the Mogalakwena River, which drains into the Limpopo River west of Alldays.

The bulk sampling shaft is located approximately 200m south of the Mohlosane River drainage.

4.4 Rainfall

Rainfall is strongly seasonal with 87 percent of the rain occurring in the summer months (October to March). The mean annual precipitation (MAP) is 585 mm. The maximum rainfall occurs between December and January. The driest months fall in mid-winter (June to August) with around 5.5 mm of rain on average (Table 1). The mean annual Symon's Pan (S-Pan) evaporation rate for the area is 1800 mm.

Table 1: Average monthly rainfall and evaporation

Details	Oct	Nov	Dec	Jun	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	43.2	87.8	112.5	120.1	85.1	72.8	31.2	15.7	4.5	5.1	6.7	13.4
Evaporation (mm)	199.4	185.2	197.3	198.0	164.7	160.0	124.0	103.0	83.7	90.7	126.4	167.6

4.5 Geology

4.5.1 Regional Geology

The Bushveld Complex is the largest layered mafic intrusion in the world and outcrops over nearly 66,000 km^2. The Complex has intruded the rocks of the Transvaal basin and forms five separate lobes known as the Northern, Western, Far Western, Eastern and Bethal Limbs (Figure 2). It comprises several lithological units including the Rustenburg Layered Suite (RLS), which itself comprises a series of mafic and ultra mafic rocks. These contain economic deposits of chromium, titanium, vanadium, copper, nickel and PGMs.

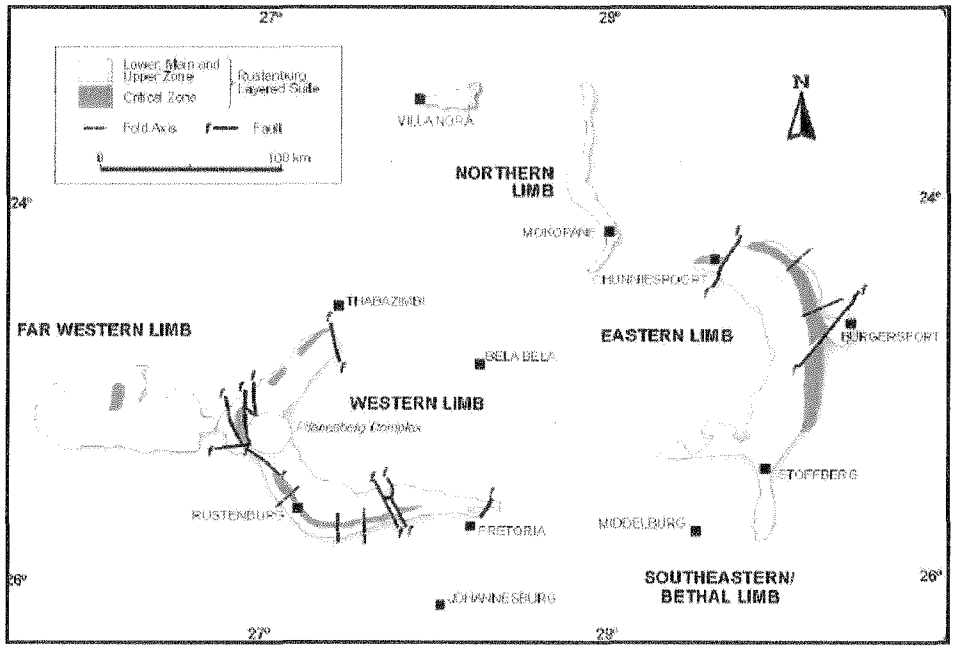


Figure 2: The Bushveld Complex (taken from Lonmin, 2007)

Historically the principal PGM deposits were mined on the Western Limb. In recent years a number of new mining projects have been initiated on the Eastern and Northern limbs of the complex including the Akanani mine lease area situated on the Northern Limb.

The geology of the Northern Limb (Figure 2) of the Bushveld Complex is unique and different from the Eastern and Western limbs. Specifically, the Northern Limb has a less distinct igneous stratigraphy and a limited development of rocks of the Lower Zone of the RLS (Figure 3). The Northern Limb of the Bushveld Complex extends from about 27km south-southwest of Mokopane, from the Zebediela Fault, to the north for a distance of some 115km, where it subcrops under Waterberg Supergroup sedimentary rocks and terminates against the Zoutfontein Fault (Figure 4). On the Northern Limb the RLS comprises units of the Upper Critical Zone, generally referred to as the Platreef Unit, the Main Zone and the Upper Zone. The Lower Zone is discontinuous.

The Platreef Unit, which is generally equivalent to the Upper Critical Zone of the Eastern and Western limbs of the Bushveld, occupies a similar stratigraphic position in the RLS and has similar rock and mineralisation types.

The Main Zone attains a maximum true thickness of about 2,000 metres and consists of gabbro, anorthosite, pyroxenite and noritic to troctolitic layers. The lower contact of the Main Zone against the underlying Platreef Unit at Akanani is well-defined and is commonly marked by a mottled anorthosite or a leuconorite.

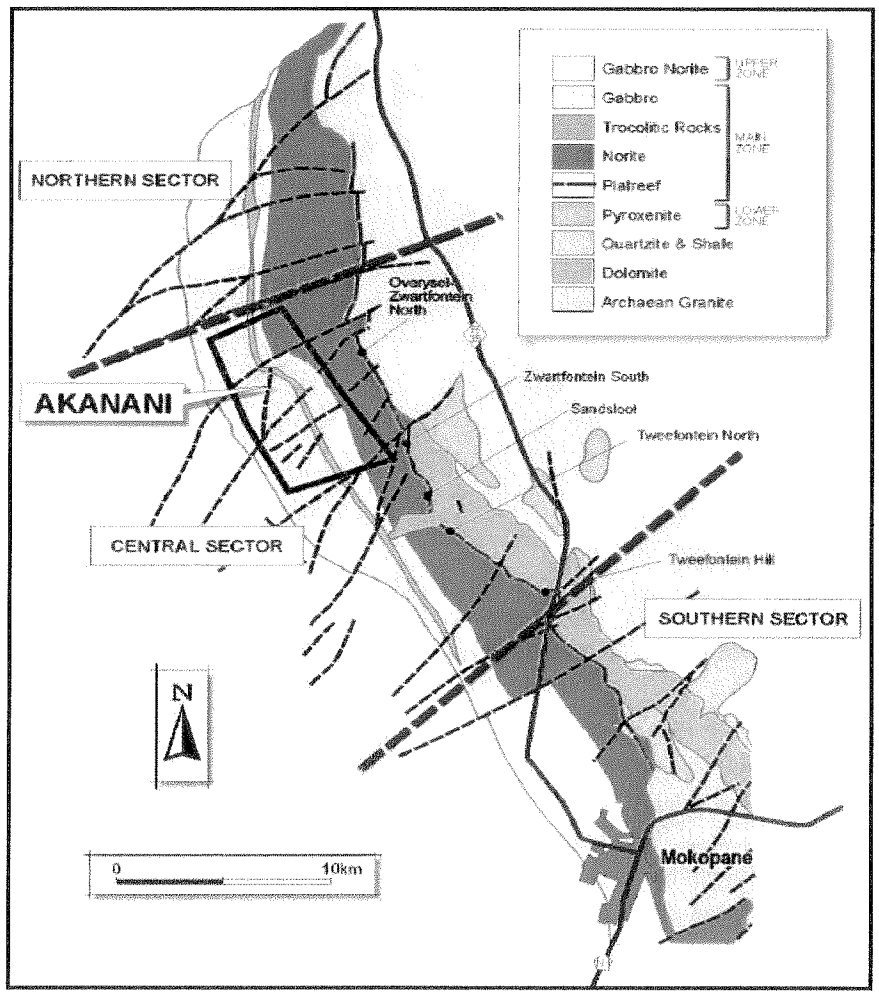


Figure 3: The surface geology of the Northern Limb of the Bushveld Complex (taken from Lonmin, 2007)

The Upper Zone attains a thickness of 1100 metres and comprises a series of gabbros and gabbro-norites. Vanadium-bearing magnetite layers occur towards the top of the Upper Zone. The Upper Zone has an unconformable lower contact with the Main Zone, and rocks of the Upper Zone outcrop against the Archean granite gneiss, north of the Akanani project area.

Regionally the Platreef Unit strikes north-south and dips to the west. A large-scale ENE-trending broad anticline, developed in response to a NW-SE compression phase, with its axis in the central area of the Akanani Project (Figure 4) crosses the project area. The Bushveld Complex rocks and the Transvaal Supergroup rocks generally dip to the west at between 15° and 50° degrees, but most commonly at 35° to 45° at outcrop.

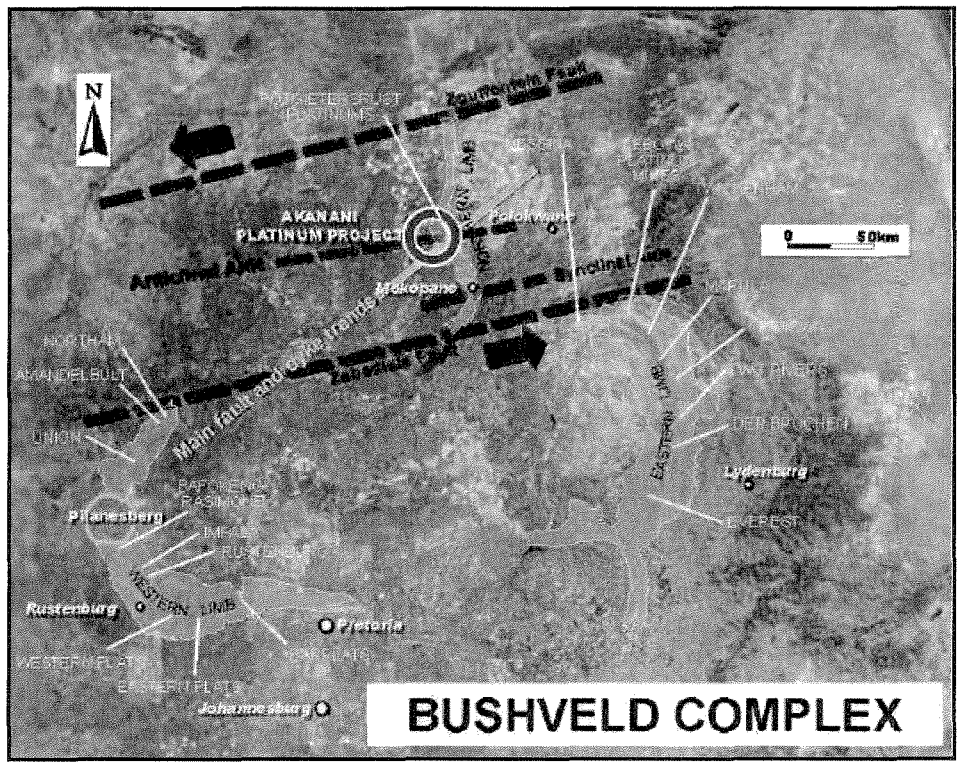


Figure 4: Major controlling features features on the Northern Limb of the Bushveld Complex (taken from Lonmin, 2007)

At outcrop the dip of the Platreef varies between 35° and 45°. The dip decreases westwards within the Main Zone rocks, with dips in the order of only 20° being recorded on surface some distance from the Platreef outcrop. These reduced dips have also been recorded in drilling of the Platreef Unit, at depth, within the SPA. The significant faults affecting the Akanani project area (Mohlosane and Thwatwe fault) are located at an oblique angle to the major regional faults with an overall sinistral displacement along the Zoutfontein and Zebediela faults.

4.5.2 Local Geology

The surface of the Akanani Project Area is entirely underlain by the mafic igneous rocks of the Main Zone of the RLS. The underlying Platreef outcrops between 800 metres (in the south) and 2000 metres (in the north) east of the Akanani boundary. The entire RLS succession dips at between 15 and 50 degrees to the west. Along the eastern boundary of the project area (in the general vicinity of the proposed prospecting shaft), the Platreef Unit is developed at projected depths of between 750 metres in the south (Figure 5) and 1300 metres, in the north central area.

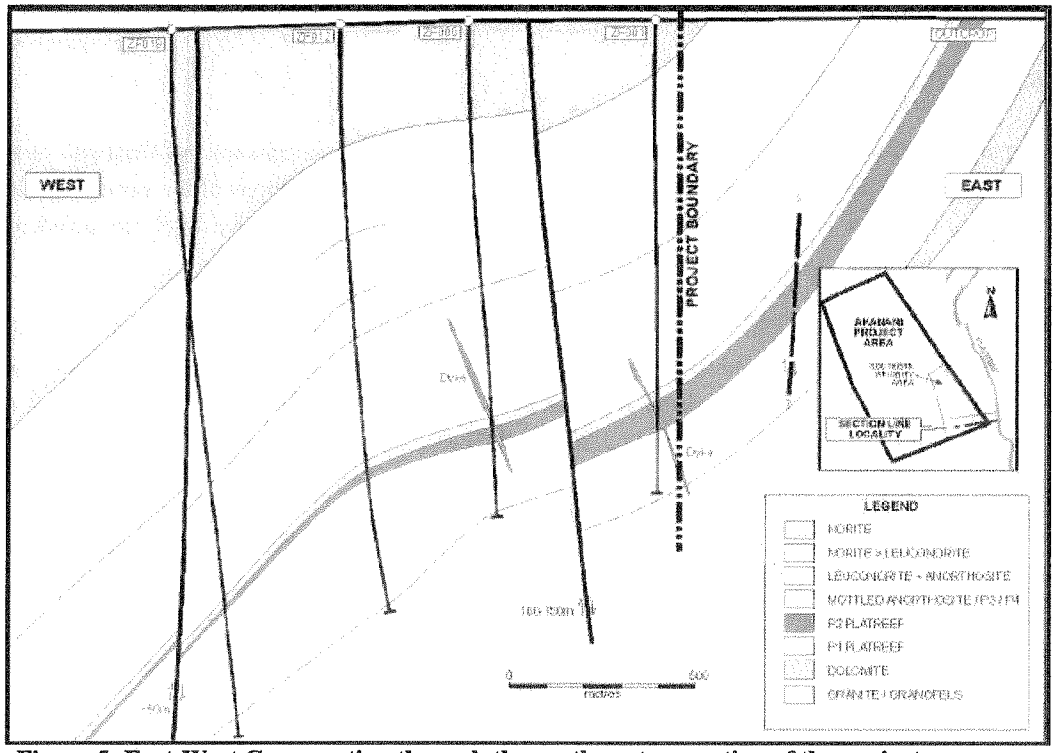


Figure 5: East-West Cross section through the south-eastern section of the project area, near the proposed bulk sampling shaft

In the west of the project area, the Platreef Unit is projected to be developed at depths of between 3,800 and 5,000 metres.

Most of the surface of the project area consists of flat sand covered areas with limited outcrop of the underlying gabbro norite of the Main Zone. In the west of the area, there is a break in the topography with a line of hills (the "pyramid gabbros"), rising from the plain and orientated in a north south direction. Most of the remaining outcrop is found in small isolated hills throughout the area and in river valleys and gulleys. Although there are local variations in the gabbro-norite sequence, which include leuconorites and mottled anorthosites zones, there is also a zone of troctolite striking north-south through the area. A number of the faults, many with a 080° orientation, have been mapped in river beds, and in certain areas dolerite intrusives are associated with some of these faults.

5 HYDROGEOLOGY

The first objective of this study is to describe the hydrogeological characteristics of the gabbro-norites of the Main Zone near the proposed bulk sampling shaft in the south eastern portion of the Akanani Project Area. In order to balance this objective with the client need to control costs, the investigative programme was combined with the wider baseline groundwater assessment of the entire project area.

Only the portions of the field investigations relevant to the proposed bulk sampling shaft in the south-eastern portion of the Akanani Project Area are described and discussed in this report.

5.1 Geophysical Survey

5.1.1 FDEM Survey

A geophysical survey comprising FDEM (Frequency Domain Electromagnetic) and Magnetic survey was undertaken across the Akanani Project Area in June 2008. The positions of the survey lines are shown in Figure 6. Plots of the FDEM traverses relevant to the bulk sampling shaft are included in Appendix A.

The FDEM traverses are illustrated by contour profile plots of frequencies 2-5, 4-6 and 7-8, showing variations in the apparent conductivity with depth. The higher apparent conductivity readings, shown as ranging from blue to purple shading, in comparison with a change in the non-uniformity of the contouring over depth is used to interpret zones of weathering and fracturing within the geological sequence traversed.

The profiles show distinct changes in apparent conductivity at specific locations along traverse lines. These are interpreted as being vertical to near vertical geological anomalies, potentially associated with changes in lithology and/or structural lineaments.

5.1.2 Magnetic Survey

The magnetic traverses were generally run along the same lines as the FDEM traverses (Figure 6). The data recorded for each magnetic traverse were captured in EXCEL and graphs generated. These are included in Appendix A. Several magnetic anomalies were identified associated with magnetic lineaments or intrusive bodies (dykes).

The magnetic field intensity for the area surveyed varies between approximately 27 000 and 30 000 nT as seen from the traverse profiles.

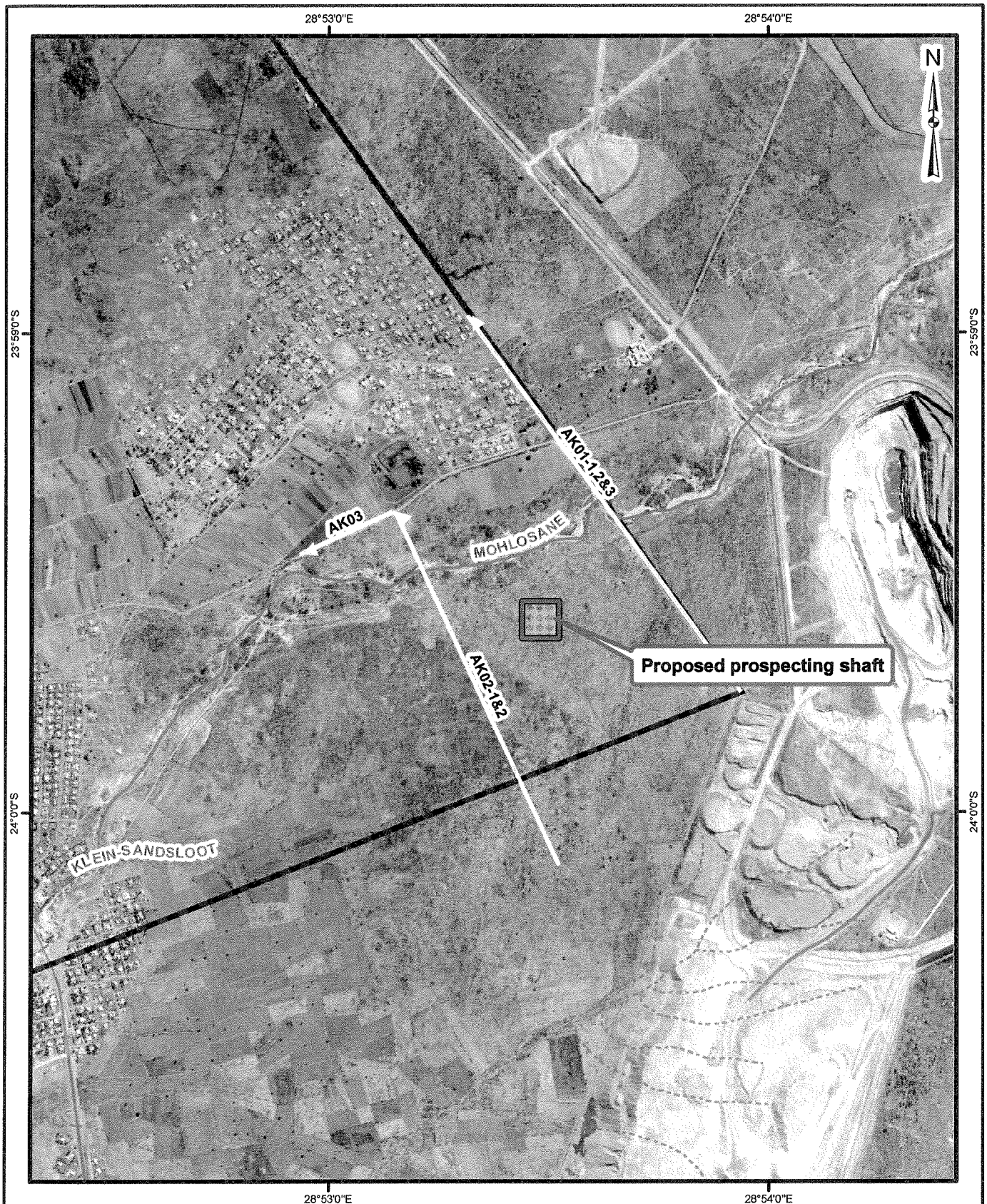
5.2 Drilling

A summary of the three borehole sites drilled near the bulk sampling shaft is presented in Table 2. Geological, hydrogeological and borehole construction logs are presented in Appendix B. The positions of these boreholes, relative to the bulk sampling shaft are shown in Figure 7.

The drilling confirms the presence of weathered to fresh norite near of the proposed bulk sampling shaft.

5.2.1 AK01

Borehole AK01 was drilled approximately 750m north of the proposed propecting shaft along the north-eastern boundary of the Akanani Project Area, targeting a geophysical (FDEM) anomaly. It is up-gradient of the proposed shaft. The borehole was drilled to a depth of 85 mbgl. A single measureable water intersections occurred at 10 metres below ground level (mbgl). The borehole was drilled into weathered and fresh norite.



LEGEND

- Proposed prospecting shaft
- Geophysical traverse
- Drainage
- River
- Study area

REFERENCE

Projection: Transverse Mercator Datum: WGS84 Coordinate System: LO 29

REVISION 1

250 0 250 500 750 1,000

SCALE 1:20,000 METRES

PROJECT

LONMIN AKANANI

TITLE

GEOPHYSICAL SURVEY LINES NEAR THE PROPOSED PROSPECTING SHAFT

Golder Associates
Johannesburg, South Africa

		PROJECT No. 11808	SCALE AS SHOWN	REV. 0
DESIGN	MM	09/10/2008		
GIS	MM	09/10/2008		
CHECK	TD	09/10/2008		
REVIEW	GLH	09/10/2008		

FIGURE: 6

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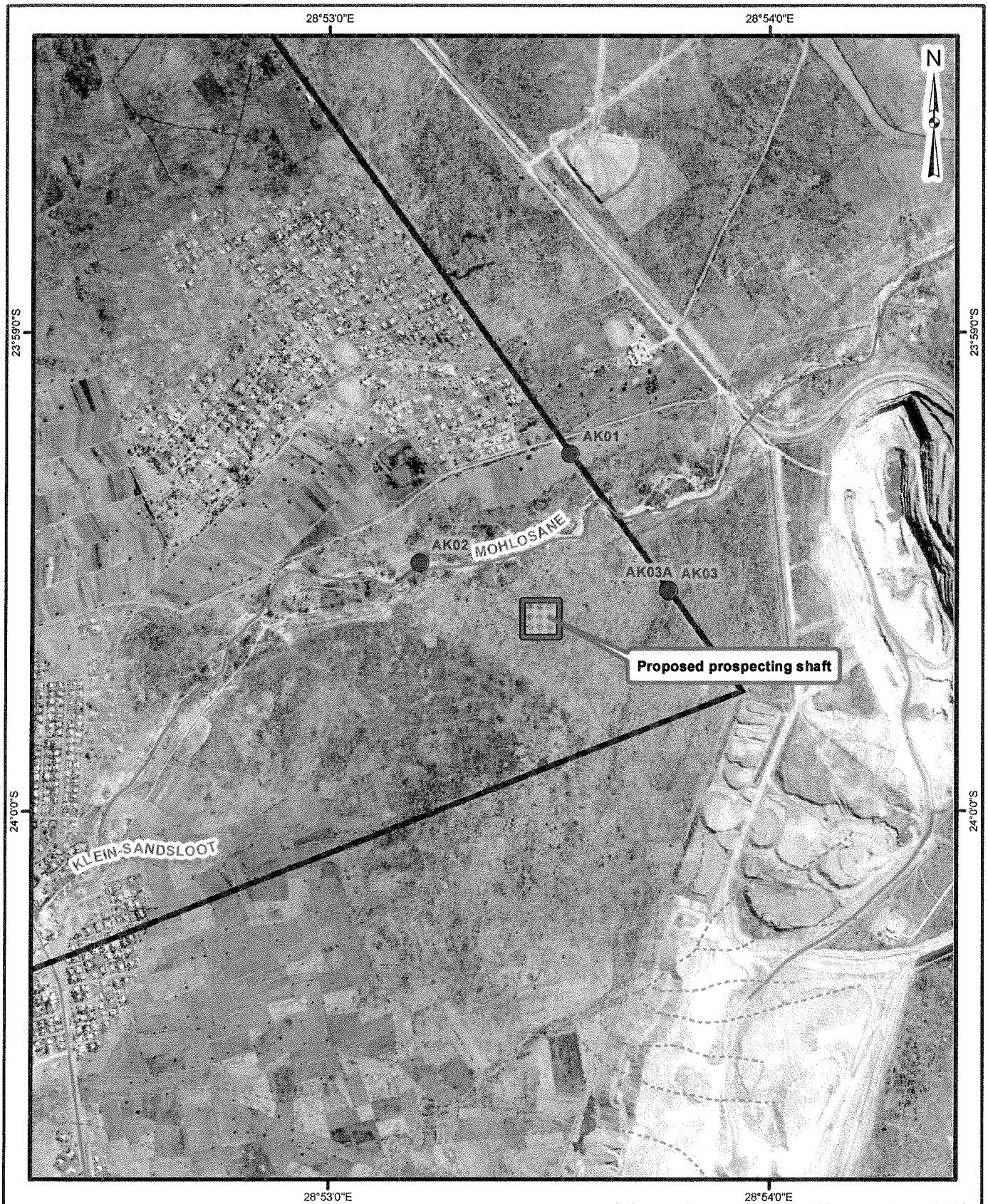
Table 2: Summary Drilling Table

Hole ID	UTM Zone 35 J (WGS84)		Elevation	Date Drilled (Completed)	Drilling Depth	Drilling Diam	Casing Depth	Internal Casing Diam.	Slotted Casing Depth	Depth of Weathering	Depth of Fracturing	Water Strike Depths	Final Blowing Yields
	Y(m)	X(m)	(mamsl)		(mbgl)	(mm)	(mbgl)	(mm)	(mbgl)	(mbgl)	(mbgl)	(mbgl)	l/s
AK01	7345859	692525	1091	30 July 08	85	165	4	171	N/A	17		10	0.2
AK02	7345446	691936	1082	31 July 08	64	165	3	171	N/A	2	6-8	8	0.1
AK03	7345324	692897	1094	01 August 08	23	165			N/A	Min 23	-	10	3
AK03A	7345329	692895	1094	03 August 08	61	165	13	171	N/A	13	25-26	26	0.4



LEGEND

- Borehole
- Drainage
- River
- Proposed prospecting shaft
- Study area

REFERENCE

Projection: Transverse Mercator Datum: WGS84 Coordinate System: LO 29

REVISION 1

250 0 250 500 750 1,000

SCALE 1:20,000 METRES

PROJECT

LONMIN AKANANI

TITLE

GROUNDWATER BOREHOLES DRILLED NEAR THE PROPOSED PROSPECTING SHAFT

Golder Associates
Johannesburg, South Africa

			PROJECT No. 11608	SCALE AS SHOWN	REV. 0
DESIGN	MM	09/10/2008			
GIS	MM	09/10/2008			
CHECK	TD	09/10/2008			
REVIEW	GLH	09/10/2008			

FIGURE: 7

G:\GIS\Gis Projects\11608 - EIA\EMP for bulk sample Akanani Mine, Lonmin Plat\Mxds\Oct 2008\Boreholes.mxd

A blowing yield of 0.2 l/s was recorded during the drilling of this borehole. A static water level of 6.68mbgl was measured after the borehole was completed. The static water level is slightly above the first water strike intersected which occurred at 10 mbgl. This could infer semi-confined and/or fractured aquifer conditions

5.2.2 AK02

This borehole was drilled approximately 500m northwest of the proposed bulk sampling shaft, immediately north of the Mohlosane River drainage on a geophysical (FDEM) anomaly. Borehole AK02, was drilled to a depth of 64 mbgl and intersected a weak water strike (Blowing yield of <0.1 l/s) at approximately 8mbgl in a slightly fractured zone at the base of the weathered norite. No deeper measurable water strikes were noted.

A static water level of 2.5 mbgl was measured after the borehole was completed. The static water level is well above the first water strike intersected which occurred at 8 mbgl. This could infer semi-confined and/or fractured aquifer conditions

5.2.3 AK03A

The borehole was drilled approximately 500m east of the proposed bulk sampling shaft along the north-eastern boundary of the Akanani Project Area on a geophysical (FDEM) anomaly. It is hydraulically up-gradient of the proposed shaft.

Borehole AK03A intersected groundwater at a shallow depth of approximately 10mbgl. A blowing yield of 0.2l/s was measured in weathered norite. The borehole was cased and sealed off to a depth of 13 mbgl to stop the seepage of this shallow water strike into the borehole. A second water strike (0.4l/s) occurred at 26mbgl in a thin (25-26mbgl) weathered and fractured norite zone. Borehole AK03A was drilled to a final depth of 61m. No deeper water strikes were recorded. A static water level was measured in this borehole at 6.85 mbgl after the borehole was completed. This is well above the main water strike which occurred at 26mbgl and infers semi-confined to confined and/or fractured aquifer conditions.

5.2.4 AK03

The borehole was drilled approximately 5m away from. The borehole was drilled to a depth of 23 mbgl in highly weathered to weathered norite. It also intersected a water strike at 10mbgl with a substantially higher blowing yield of approximately 3 l/s, than in the adjoining deeper borehole AK03A. The borehole was cased and sealed off to a depth of 3mbgl.

After the borehole was completed a static water level of 6.59 mbgl was measured in the borehole. This is above the main water strike which occurred at 10 mbgl and infers semi-confined and/or fractured aquifer conditions. The similar water levels strongly suggest that these two boreholes are hydraulically linked.

5.3 General discussion of drilling results

Drilling of boreholes AK01 – AK03A has shown that a relatively shallow aquifer occurs within the weathered and fractured norite and gabbro-norite. These intersections generally occurred between 8-10mbgl, coinciding closely with the base of the weathered zone in the norite and gabbro-norite lithology.

The very similar water levels intersected in the borehole pair AK03 and AK03A suggests that there is a single aquifer within the weathered and fractured norite. It is reasonable to assume that faults and fracture zones enhance and extend the groundwater flow conditions along such linear geological features to some depth.

In addition the drilling has shown:

- Blowing yields varied from approximately <0.1 l/s to 3 l/s;
- Static water levels varied from 2.5 mbgl to 6.85 mbgl;
- No water intersections occurred below 26 mbgl; in massive unfractured norite.
- Weathering depth generally varies between 2 mbgl and 23 mbgl.

5.4 Testing

Limited short term testing of the boreholes to gain an understanding of the aquifer hydraulics was undertaken. The hydraulic parameters determined from the test data provide essential inputs to the numerical flow (and future solute transport) model. Results obtained from the calculations are listed in Table 4.

Testing was undertaken in August 2008. AK02 was tested using a slug-test method since the hydraulic conductivites (K) of the ground were too low to allow pumping tests. Boreholes AK01 and AK03A were tested with a step-discharge test (SDT) consisting of 3-4 steps. After water levels recovered to their original levels, a 12-hour constant discharge test (CDT) was followed by the measurement of the recovery of the water level after the pump was switched off. These data have been

used to calculate the transmissivity (T) of the intersected aquifer unit in the boreholes. Table 3 summarises the testing activities undertaken.

The CDT data were analysed using the Cooper-Jacob method to obtain T values. Table 4 summarises the calculated aquifer parameters from the testing data. An overall transmissivity of 2 m^2/day was estimated for both boreholes AK01, and AK03A. A hydraulic conductivity value (K) of 0.1m/day was obtained for borehole AK02 using the slug test data obtained.

Table 3: Summary Table of borehole tests undertaken in boreholes near the proposed bulk sampling shaft

BH. No.	Date Tested	BH. Depth	Test Type	Pump Installation Depth	SWL	Main Observed WS	Available Drawdown	Step Discharge Test (SDT) Discharge Rate				Duration of Steps	Constant Discharge Test (CDT)			
								Step 1	Step 2	Step 3	Step 4		Duration	Abstraction Rate	Drawdown at end of pumping Period	Recovery monitored
				(mbgl)	(mbgl)	(mbgl)	(m)	(l/s)	(l/s)	(l/s)	(l/s)	(min)	(min)	(l/s)	(m)	(min)
AK01	15 Aug 08	85	SDT/CDT	80	6.45	10	3.55	0.5	1.07	2	3.1	60	1440	0.3	4.69	540
AK02	15 Aug 08	64	Slug	-	2.5	8	5.5	-	-	-	-	-	-			
AK03	18 Aug 08	23	Monitoring CDT	41m in BH AK03A	6.59	10	3.41	-	-	-	-	-	1440	0	0.3	120
AK03A	18 Aug 08	61	SDT/CDT	41	6.85	26	19.15	0.28	0.43	0.67	-	60	1440	0.75	11.1	240

Table 4: Summary Table of aquifer parameters obtained from boreholes near the proposed bulk sampling shaft

Borehole No.	Test Type	T-early Cooper - Jacob	T-late Cooper-Jacob	T- Recovery	K (m/day)	Final T (m^2/day)
AK01	CDT	3.8	1.9	1.5	N/A	2
AK02	Slug	N/A	N/A	N/A	0.1	N/A
AK03	Monitoring CDT	215	75	65	N/A	65
AK03A	CDT	1.7	2	1.7	N/A	2

Table 5: Concentration of various physical and inorganic requirements in the groundwater near the proposed bulk sampling shaft

BH #	pH	EC (mS/m @ 25°C)	TDS (mg/L @ 180°C)	Cl (mg/L Cl)	F (mg/L F)	Ca (mg/L Ca)	Mg (mg/L Mg)	K (mg/L K)	Na (mg/L Na)	Fe (mg/L Fe) LLD = 0.05	Zn (mg/L Zn) LLD = 0.05	NO3 measured (mg/L)	NO3 calculated(mg/L N)	SO4 (mg/L SO4)	Total Hardness (mg/L CaCO3)
AK01 late	8.5	77	534	47	0.49	42	51	2.9	59	0.05	0.05	20.9	4.7	24	
AK01 early	8.5	76	518	47	0.39	42	51	2.9	59	0.05	0.05	20.9	4.7	24	
AK03 late	8.4	99	668	75	0.43	53	85	4.5	70	0.05	0.05	32.4	7.3	35	
AK03 early	8.4	97	676	74	0.45	54	81	4.5	70	0.05	0.05	34	7.6	35	

All concentrations given in mg/L. Blank cells indicate determinants below detection limit.

Standard*	
	Target quality range from DWAF guidelines
	Class I Recommended Operational Limit
	Class II Maximum allowable for limited duration
	Exceeds maximum allowable

*SANS 241 Edition 2005 & DWAF Guidelines 1996

For Hardness**	
	Soft & moderately soft
	Slightly & moderately hard
	hard
	Very hard

** DWAF Guidelines 1996

A transmissivity value of 65 m^2/day was obtained for borehole AK03, while AK03A was pumped. The relatively immediate drawdown of the water level in borehole AK03 in response to the pumping in borehole AK03A suggests a fairly direct hydraulic connection between the shallow water strike (10mbgl) in AK03 and the deeper water strike (26mbgl) in AK03A.

The testing conceptually supports the presence of a shallow heteropgenous weathered and fracture norite aquifer zone. Based on the geological logs it is estimated that the aquifer zones near the bulk sampling facility are on average in the order of 1-5m thick and at approximate depths of between 5 and 25m. Enhanced depths of weathering and fracturing are likely to be associated with linear geological features such as faults and fracture zones.

5.5 Water Levels

Combining the water levels measured during the hydrocensus and those from the current drilling investigation shows that groundwater flow directions on a regional scale is generally towards the north-west towards the Mogalakwena River. In the southern portion of the project area there is a westerly to south-westerly groundwater flow component along the Mohlosane River drainage. Figure 8 illustrates the flow direction and piezometric groundwater elevations in the southern portion of the Akanani Project Area, in the vicinity of the proposed prospecting shaft.

5.6 Groundwater Quality

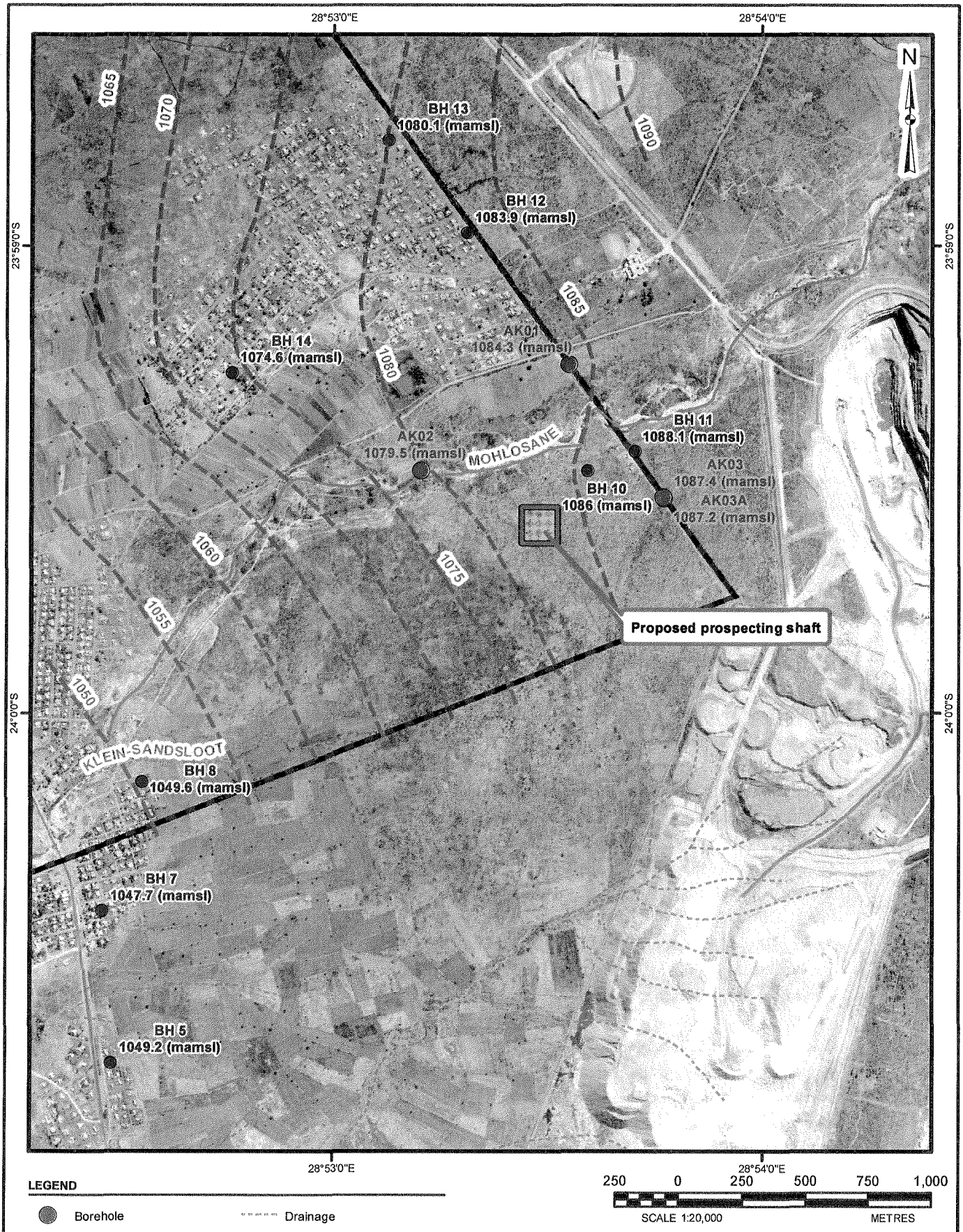
Four groundwater samples were taken during the SDT and CDT of boreholes AK01 and AK03. These samples were submitted to UIS Analytical Services in Pretoria, an accredited laboratory.

Samples obtained during the CDT tests represent boreholes that have been purged significantly longer than those taken during the SDT. Based on the analyses of the samples there is no significant change in the overall composition of the groundwater after pumping for this time. The Piper diagram (Figure 9) shows the overall hydrochemical composition. The Piper diagram indicates that the water is dominated by bicarbonate (HCO_3) and carbonate (CO_3) ions in solution.

The quality of the groundwater compares favourably with the water sampled across the Akanani Project site during the hydrocensus and is consistent with the general decreasing groundwater quality trend from east to west across the site (Table 5).

The water sampled in boreholes AK01 and AK03 fall within the class 0 to class 1 range with respect to most groundwater quality parameters. The magnesium concentration of the groundwater sampled in borehole AK01 is slightly elevated (81 & 85 mg/l) but is still within the class 2 limit (SANS 241). The groundwater in boreholes AK01 and AK03 have ideal levels of iron (Fe), below the analytical lower detection of <0.05mg/l.

The original analytical results obtained from the UIS laboratory for boreholes AK01 and AK03 are precented in Appendix C.



LEGEND

- Borehole
- Hydrocensus borehole
- Piezometric contour (mamsl)
- Proposed prospecting shaft
- Drainage
- River
- Study area

REVISION 1

REFERENCE

Projection: Transverse Mercator Datum: WGS84 Coordinate System: LO 29

PROJECT

LONMIN AKANANI

TITLE

PIEZOMETRIC GROUNDWATER ELEVATIONS NEAR THE PROPOSED PROSPECTING SHAFT

Golder Associates
Johannesburg, South Africa

PROJECT No. 11808			SCALE AS SHOWN	REV. 0
DESIGN	MM	09/10/2008		
GIS	MM	09/10/2008		
CHECK	TD	09/10/2008		
REVIEW	GLH	09/10/2008		

FIGURE: 8

G:\GIS\Gis Projects\11808 - EIAEMP for bulk sample Akanani Mine, Lonmin Pal\Maps\Oct 2008\Piezometric map.mxd

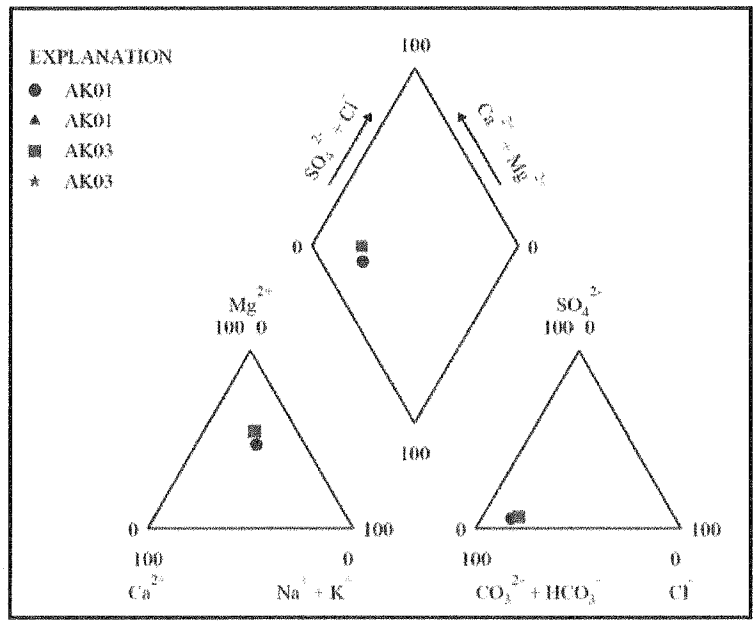


Figure 9: Piper Diagram indicating the overall composition of the groundwater found near the proposed prospecting shaft

6 IMPACT ASSESSMENT

The significance of the identified impacts will be determined using the approach outlined below. This incorporates two aspects for assessing the potential significance of impacts (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998), namely *occurrence* and *severity*,

There are five elements to the risk assessment of the bulk sampling shaft and associated site operations. The elements to consider are:

- Pollution source term;
- Pollution containment measures;
- Geosphere;
- Biosphere; and
- Social Tolerance.

The pollution source term defines the hazard component of risk. The chance of failure of containment measures on site are determined by the processes involved in the construction and operation of these containments system and in the underlying geosphere. In the biosphere the outcome is assessed and its acceptability determined by societal tolerance.

The leachate produced from the waste rock as well as contaminated groundwater discharged from the shaft constitute the source term. The containment systems are constructed to contain the contaminants.

Important factors to consider with such systems include the design reliability, construction quality and the long term degradation of the constructed elements. The un-intercepted seepage or discharged ground and mine water from the shaft corresponds to the input into the geosphere.

The geosphere is the soil and rock environment into which contaminants from the bulk sampling shaft site migrate. The contaminants released travel along pathways in the geosphere towards the biosphere.

The biosphere is the environment in which exposure to the contaminants occurs, with damage caused by the contaminant uptake and the health consequences. This can be related to humans, animals and plants.

The Social tolerance reflects the risk-benefit perception people may have on the criteria adopted to assess the accessibility of the bulk sampling facility. The risk assessment discussed below is qualitative

6.1 Issues Scoping

Development of the proposed prospecting shaft and associated waste rock dump will involve a degree of land disturbance over an area of approximately 2 ha. Disturbances will involve removal of vegetation, excavation, blasting and ground compaction.

The facility will also include the construction of:

- An approximately 1000m deep, 7-8m wide, concrete lined shaft.
- An approximate 100 000 m^3 waste rock dump.
- Workshops.
- Temporary diesel bowser (2000 l).
- Two Water settling dams
- Pollution control dam
- A concrete batch plant.
- Substation and transformer.
- Service, stage and kibble winders.
- Sinking fan.
- Stores and container offices.
- Electrical cable lay down area.

An access road and vehicle parking area will also be constructed. These disturbances will result in increased run-off from these areas during construction. Hence, the natural recharge volumes across the area will be reduced during construction and after the facility is placed into operation.

During operations storm water from areas designated as dirty, will be collected and contained in the pollution control dam. The waste rock dump will not be lined and a proportion of the precipitation falling on the dump will infiltrate into the ground. Groundwater pumped from the shaft will be discharged to the two surface settling dams. As a result it is possible that a groundwater mound may develop below the settling and pollution control dams as these are not expected to be lined.

The proposed prospecting shaft and associated activities have the potential to affect the groundwater regime as a result of a number of activities, including:

- Dewatering of the shaft of mineralised groundwater and mine water during the construction and operation of the bulk sampling shaft;
- Seepage through the waste rock facility;
- Accidental spills from the cement batch plant
- Accidental spills/discharge of polluted mine process water to the local surface water course and subsequent seepage to groundwater.

Consequently the project has the potential to affect the local water aquifers.

The key questions for groundwater are therefore:

- **What effect will the Bulk Sampling Facility have on groundwater levels and flows during normal operations?**
- **What effect will the Prospecting Shaft Facility have on the groundwater quality during normal operations?**
- **What effect will the Prospecting Shaft Facility have on the groundwater quality as a result of accidental spills and/or discharges?**
- **What effect will the Prospecting Shaft Facility have on the groundwater quality as a result of failure of containment facilities?**

The abstraction of groundwater on the farm Amoede 823LR, at a required rate of approximately 12l/s on a 24 hour basis, is not part of the scope of this investigation.

6.2 Impact Criteria

Qualitative assessment criteria and a scoring system for this groundwater impact assessment are presented in Table 6. The significance rating is calculated using the formula:

Significance Points = (Magnitude + Duration + Scale) x Probability

The environmental risks are ranked as low, moderate or high significance depending on the significance points scored in the assessment.

Table 6: Impact Assessment Criteria based on Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998,

Probability		Duration		Scale		Magnitude	
Definite/don't know	5	Permanent	5	International	5	Very high/don't know	10
Highly probable	4	Long-term (impact ceases after operational life of activity)	4	National	4	High	8
Medium probability	3	Medium-term (5 to 15 years)	3	Regional	3	Moderate	6
Low probability	2	Short-term (0 to 5 years)	2	Local	2	Low	4
Improbable	1	Immediate	1	Site only	1	Minor	3
None	0					None	1

Maximum Significance Points (SP) = 150
SP > 75 - High Environmental Significance
SP 50 to 75 - Moderate Environmental Significance
SP < 50 – Low Environmental Significance

6.3 Assessment Method

The assessment method of the hydrogeological regime to date has involved a desk study, hydrocensus, geophysical survey, drilling of groundwater exploration boreholes and pumping tests. Source term characterization has not been undertaken to date.

6.4 Impact Evaluation

- **What effect will the prospecting shaft and associated facilities have on groundwater levels and flows during normal operations?**

Project activities during construction, operation and closure may result in localised changes to the groundwater flow regime and groundwater levels in the shallow weathered and fractured norite aquifer in the immediate vicinity of the bulk sampling shaft, settling dams and pollution control dam. These changes will be a response mainly to the potential seepage of stored water from the unlined settling dams and pollution control dam to the groundwater. Groundwater intersection during the construction of the shaft may lead to the temporary increase in the pumping volumes from the shaft, which would be matched by commensurate reduction in the pumping of water from production boreholes on the farm Amoede. The majority of these intersections will be sealed off by the concrete lining of the shaft. Higher yielding groundwater intersections, which cannot be sealed off by the concrete liners will be incorporated into the operational water system.

- **What effect will the prospecting shaft and associated facilities have on the groundwater quality during normal operations?**

Changes in groundwater quality associated with the bulk sampling activities will be primarily in response to the mineralised mine water which will be pumped from the shaft or recovered from the batch plant and discharged to the unlined settling dams. Polluted runoff from dirty areas such as the waste rock dump will be collected in the unlined pollution control dam. Seepage from these unlined dams will recharge the shallow weathered and fractured norite aquifers. Further recharge will occur to the aquifer beneath the waste rock dump. This seepage is likely to be elevated with respect to most dissolved major cations and anions, as well as some metals when compared to the background groundwater quality near the proposed bulk sampling plant.

In the geosphere the impact is further influenced by the quality of the seepage, the nature of the underlying unsaturated zone, as well as the aquifer parameters and background quality of the groundwater in the aquifer underlying the facility.

Advection, dispersion, adsorption and degradation processes within the unsaturated and saturated zone will result in the vertical and lateral migration of the contaminants in the shallow weathered norite aquifer in the direction of the groundwater gradient. Available local and regional information suggests poor to medium aquifer potential in the shallow weathered norite aquifer (K = 0.1 m/day), implying a slow to medium rate of any migration of a potential pollution plume from the waste rock facility.

Several potential preferred groundwater pathways along linear geological features do, however, exist near the bulk sampling shaft and associated facilities. Contaminant migration away from the proposed waste disposal site may be accelerated south-westward along these pathways (T = 2 – 65m^2/day) towards the stream channel and nearby settlements.

In order to determine and quantify the development of pollution plumes associated with this seepage and groundwater quality changes, a numerical groundwater flow and solute transport model is required.

The relatively shallow water table suggests that during the rainy season flow in the seasonal Mohlosane River drainage will be supported by the shallow groundwater table. Elevated concentrations of salts may therefore occur in this drainage downstream of the proposed prospecting shaft.

- **What effect will the prospecting shaft and associated facility have on the groundwater quality as a result of accidental spills/discharges?**

Changes in groundwater quality associated with the prospecting shaft may also occur in response to accidental discharges or spills to the environment, either as a result of environmental conditions or equipment failure. The changes in the groundwater quality will depend on the nature, extent, frequency and duration of such spills and/or discharges.

Appropriate stormwater management design criteria will minimise the occurrence of spillages and/or discharges related to climatic factors to low frequency events. Appropriate operation and maintenance scheduling of all plant, equipment and facilities can minimise the risk of spillages/discharges relating to equipment failures.

Spillages and/or discharges are therefore considered to potentially have an infrequent, localised but potentially long term impact on the groundwater quality.

- **What effect will the prospecting shaft and associated facility have on the groundwater quality as a result of the failure of containment facilities?**

In the event that a catastrophic failure of pollution control dam will result in an accidental spill to the surface water environment and subsequently a proportion of this spill will seep into the shallow norite aquifer zone. Failures of one of the settling ponds should in most cases be contained within the pollution control dam.

Failure of containment facilities are therefore considered to potentially have a very infrequent, localised but potentially long term impact on the groundwater quality.

6.5 Impact Analysis

Table 7 below summarises the environmental significance of the Key questions. The results from this risk assessment matrix indicate a low environmental significance for the potential impacts on the groundwater regime emanating from the proposed waste disposal facility. A maximum significance rating of 45 points is given to the expected deterioration of the groundwater quality as a result of seepage.

Table 7: Environmental Risk Assessment Results

Probability	Duration	Scale	Magnitude	Environmental Significance
What effect will the Propsecting Shaft have on groundwater levels and flows?				
5	3	1	3	35
What effect will the Propsecting Shaft have on the groundwater quality during normal operations				
5	4	1	4	45
What effect will the Propsecting Shaft have on the groundwater quality as a result of spills and discharges?				
3	4	1	4	27
What effect will the Propsecting Shaft have on the groundwater quality as a result of failure of containment facilities?				
2	4	2	6	24

7 MITIGATION MEASURES

Mitigation measures to minimise the risk of groundwater pollution from the proposed bulk sampling plant include:

- Appropriately sized stormwater facilities;

- Lined settling dams and pollution control dams;
- Quality Assurance and Supervision during construction;
- Responsible operation according to documented procedures;
- Scheduled inspections and appropriate repairs to pollution containment systems; and
- Timeous and appropriate response to spills and accidental damage to pollution containment systems.

8 CONCLUSIONS

The following conclusions are based on the regional hydrogeological information gathered from available reports and monitoring data. Based on the information available to date the following conclusions can be drawn.

- There are currently no known groundwater users immediately down-gradient of the proposed bulk sampling site;
- Current groundwater gradients dictate that any groundwater contaminants are likely to enter the shallow weathered and fractured norite aquifer and may subsequently enter the Mohlosane River drainage downgradient of the site.

The following conclusions can be made concerning the potential impact of the proposed Akanani prospecting shaft may have on the groundwater regime, based upon the qualitative impact assessment:

It is likely that the settling dams will generate seepage to the shallow weathered norite groundwater aquifer. The quality of the seepage is expected to be poorer than the background groundwater quality at the site of the proposed bulk sampling shaft and may result in the groundwater at and downgradient of the site no longer meeting the DWAF and SANS 241 drinking water quality criteria. This poor quality groundwater may eventually daylight in the Mohlosane River drainage during the wet seasons.

It is likely that the pollution control dam will generate seepage to the shallow weathered norite groundwater aquifer. The quality of the seepage is expected to be poorer than the background groundwater quality at the site of the proposed bulk sampling shaft and may result in the groundwater at and downgradient of the site no longer meeting the DWAF and SANS 241 drinking water quality criteria. This poor quality groundwater may eventually daylight in the Mohlosane River drainage during the wet seasons.

It is likely that the waste rock dump will generate seepage to the shallow weathered norite groundwater aquifer. The quality of the seepage is expected to be poorer than the background groundwater quality at the site of the proposed bulk sampling shaft and may result in the groundwater at and downgradient of the site no longer meeting the DWAF and SANS 241drinking water quality criteria. This poor quality groundwater may eventually daylight in the Mohlosane River drainage during the wet seasons.

It is far less likely that an accidental spill and/or discharge will occur as a result of the catastrophic failure of one or more of the pollution containment systems. In the event that it does occur it will generate seepage to the shallow weathered norite groundwater aquifer. The quality of the seepage is expected be poorer than the background groundwater quality at the site of the proposed bulk sampling shaft and may result in the groundwater at and downgradient of the site no longer meeting the DWAF and SANS 241drinking water quality criteria.

The qualitative impact assessment and analysis based on available information and conducted as part of this investigation has therefore shown:

- That potential impacts of the proposed bulk sampling site on the groundwater regime are expected to be low to medium with respect to the impact on groundwater elevation, flow and quality; and
- No fatal flaws concerning the selected site for the proposed bulk sampling shaft with respect to its potential impact on the groundwater regime have been identified during the course of this investigation.

9 RECOMMENDATIONS

- A groundwater monitoring borehole downgradient of the waste rock dump and other facilities is recommended to:
  - Provide reliable and irrefutable data on the baseline quality and chemical composition of the groundwater;
  - Detect and quantify the presence and degree of any polluting substances in the groundwater at the earliest stage possible;
  - Provide a rational comparison between predicted flow and solute transport rates;
  - Provide an ongoing and reliable performance record for the design and control system(s) for effectively controlling pollution.
- Numerical groundwater flow and solute modelling to determine the development of pollution plumes in the groundwater and impact on the groundwater quality down-gradient of the proposed waste disposal site.

T. Demmer

G.L.Hubert

GOLDER ASSOCIATES AFRICA (PTY) LTD

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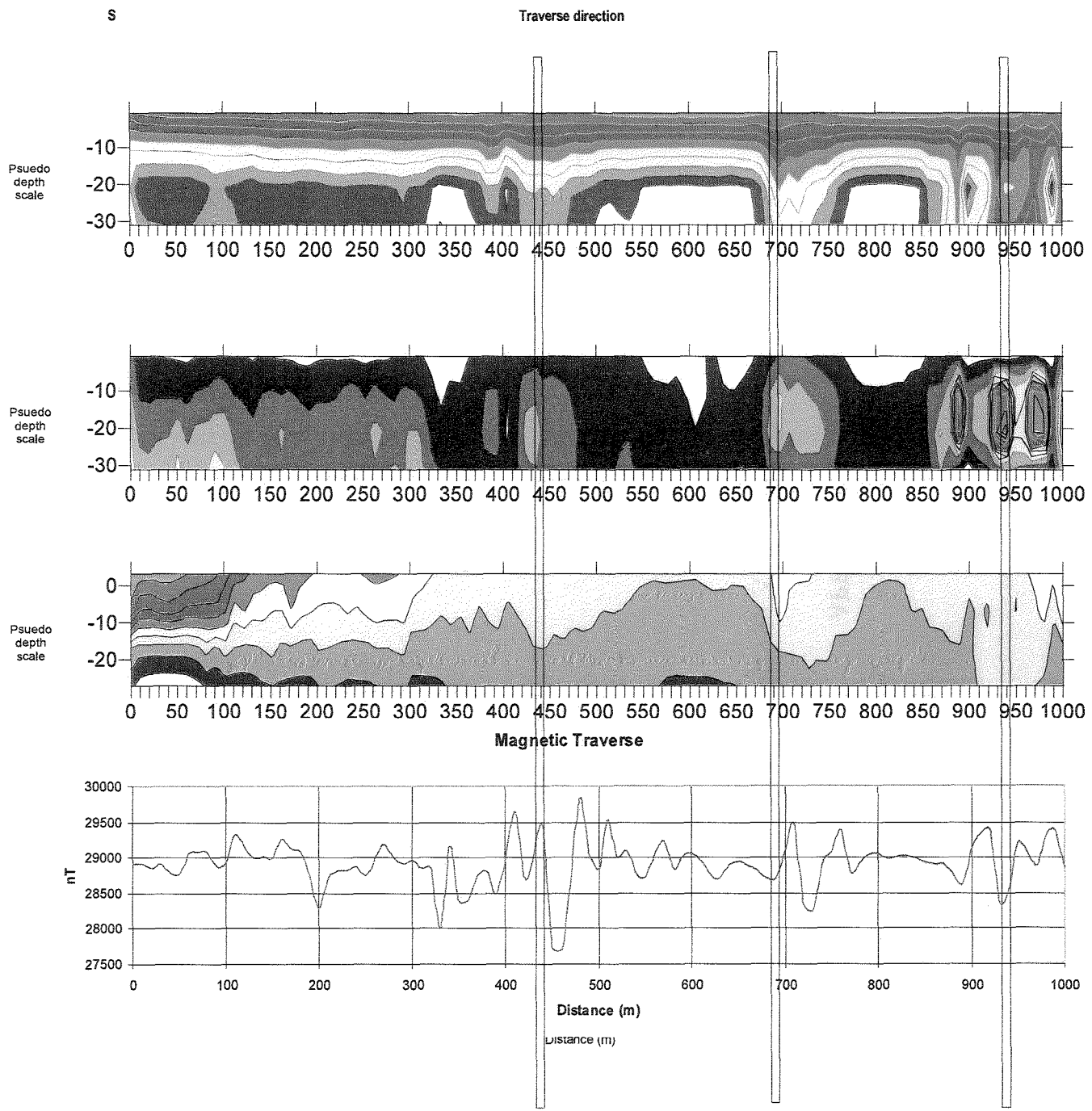
APPENDIX A

GEOPHYSICAL CROSS SECTIONS



FDEM / MAG Traverse No:

AK1-1 (D11)

LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Akanani Project

Project:

Tenke Fungurume Groundwater Geophysical Investigation

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7- 8.) and MAG Surve

GAA Project No:: 10651

Task No:

Drawn by: T. Demmer

Date: May. 2008

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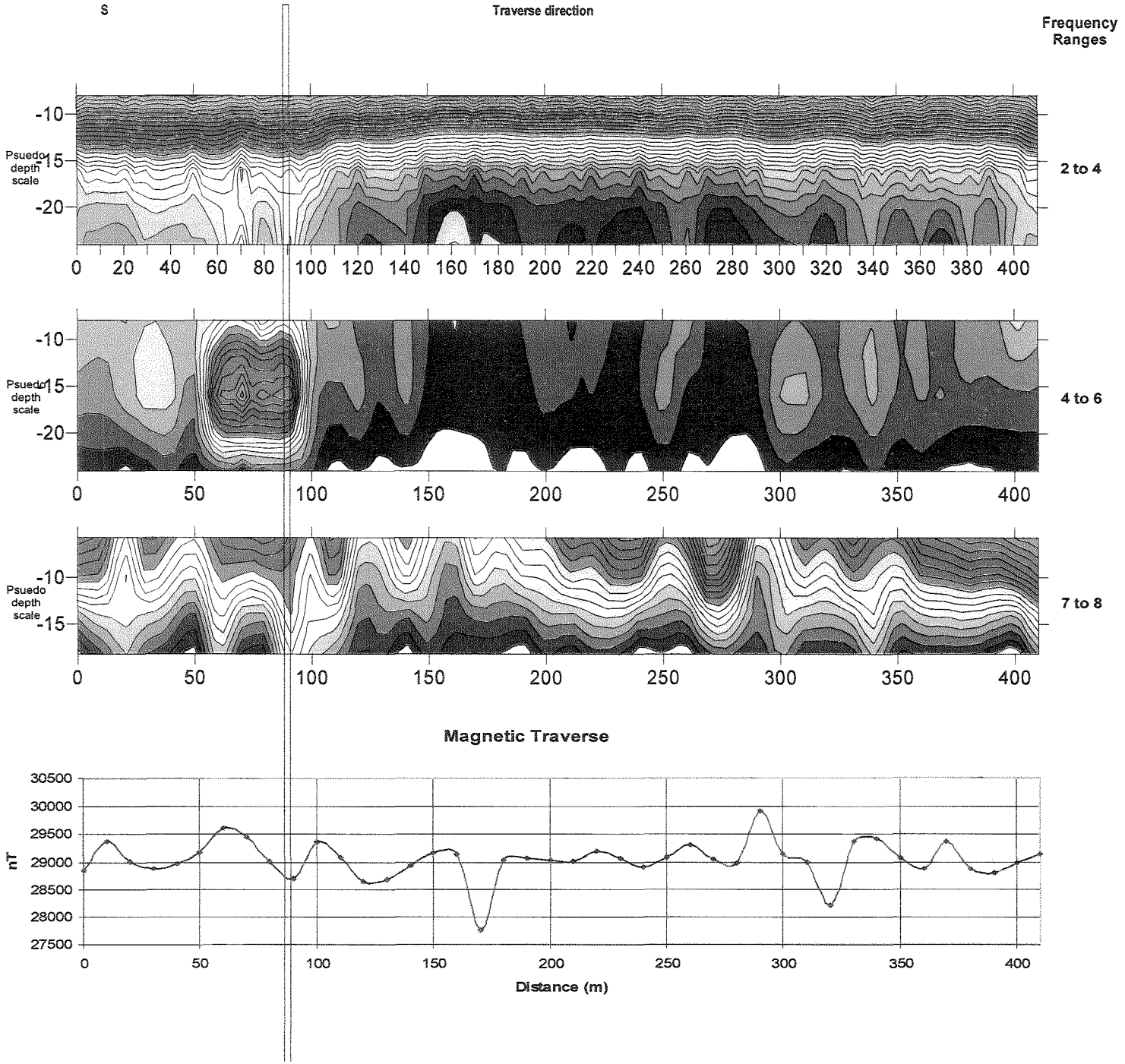

FDEM / MAG Traverse No:

AK1-2 (D12)

LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Akanani Project

Project:

Tenke Fungurume Groundwater Geophysical Investigation

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7 - 8.)
and
MAG
Survey

GAA Project No:: 10651

Task No:

Drawn by: T. Demmer

Date: May. 2008

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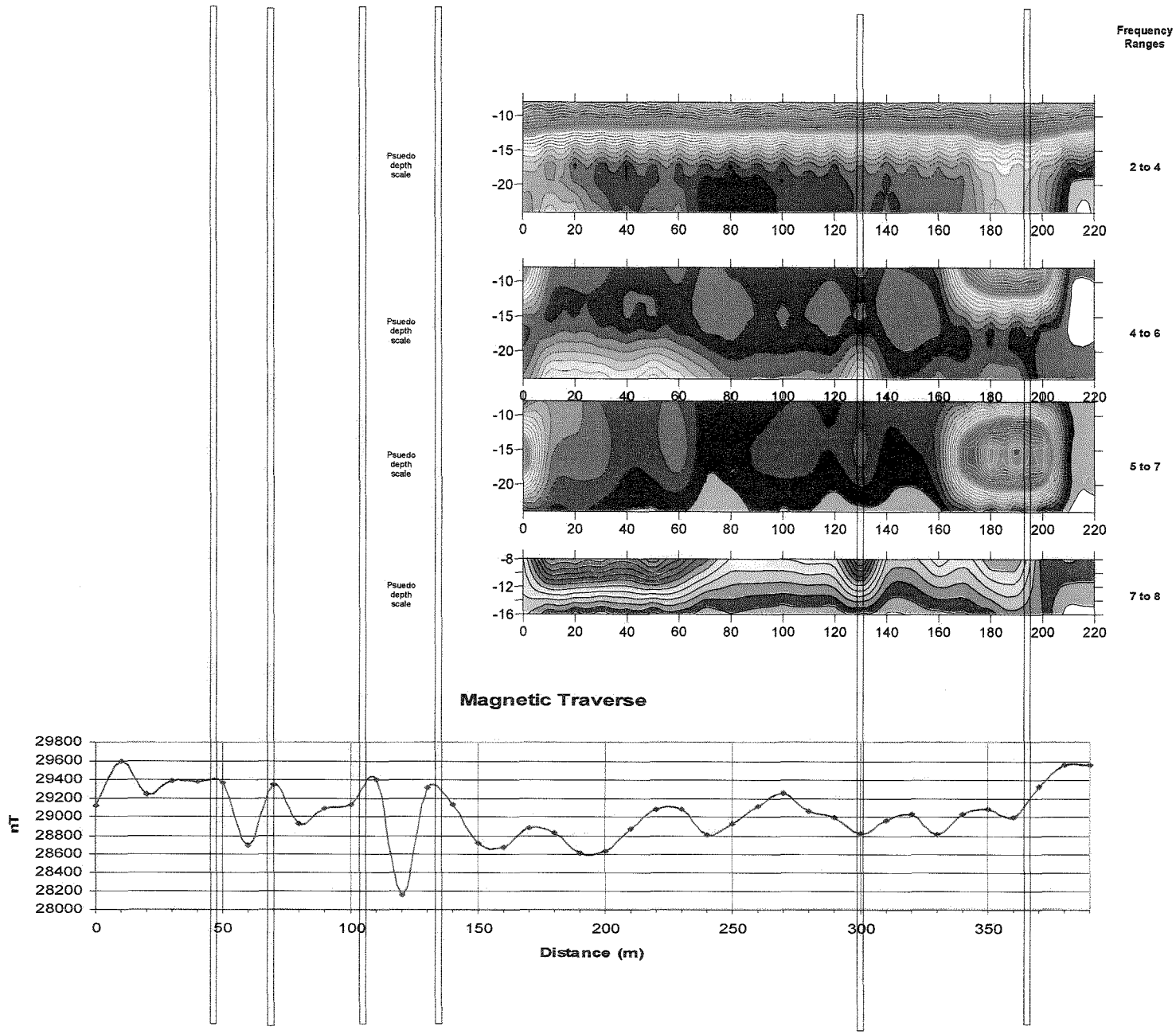
S

Traverse direction

FDEM / MAG Traverse No:

AK1-3 (D21)



LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Platinum Pty Ltd

Project:

Akanani Baseline Hydrogeological Assessment

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7 to 8.)
and MAG Survey

GAA Project No::	Task No:
10651	

Drawn by:	Date:
T. Demmer	May. 2008

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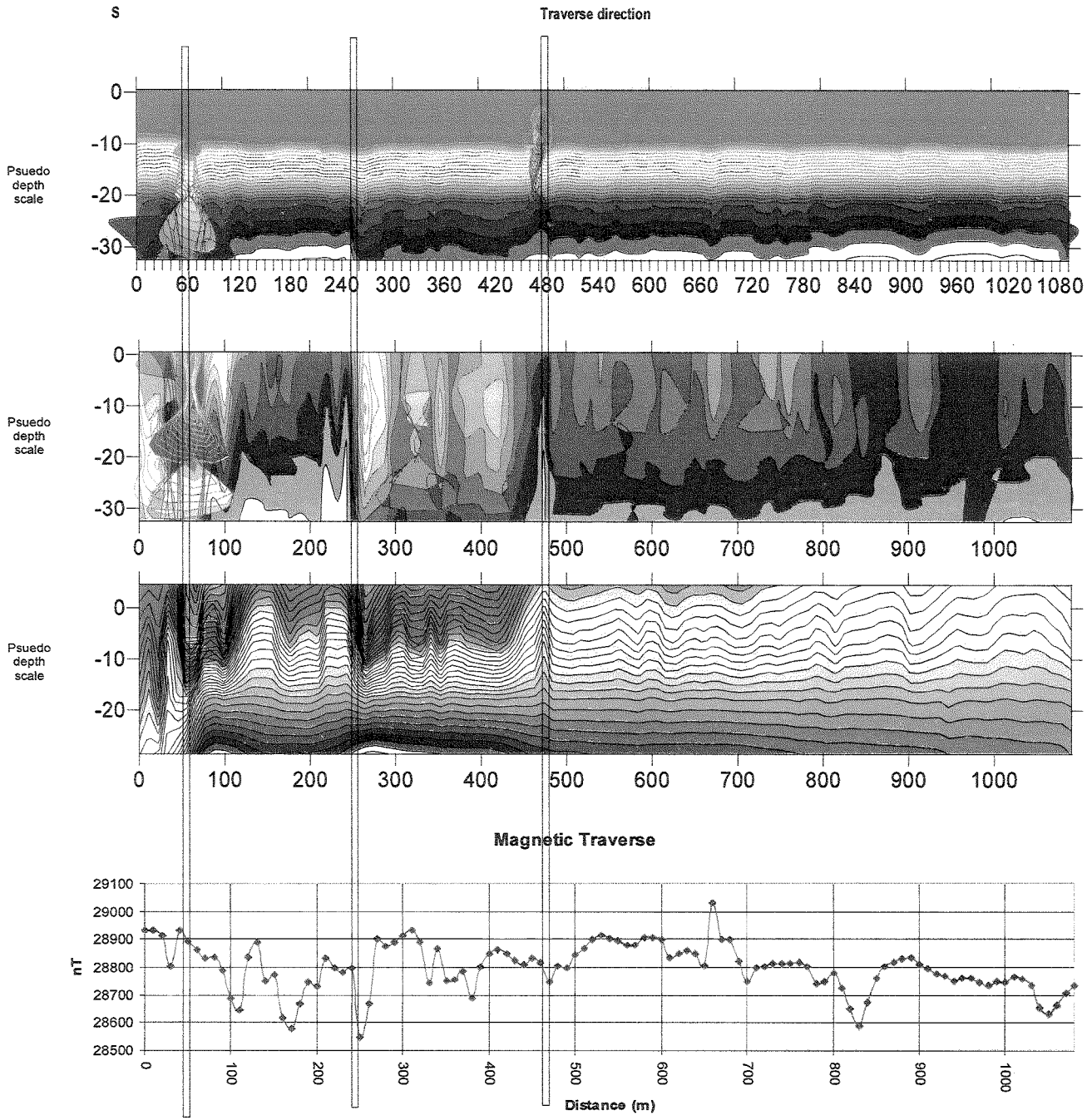

Frequency Ranges

2 to 4

4 to 6

7 to 8

FDEM / MAG Traverse No:

AK2-1 (D31)

LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Platinum Pty Ltd

Project:

Akanani Hydrogeological Baseline Investigation

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7 to 8.)
and MAG Survey

GAA Project No:: 10651

Task No:

Drawn by: T. Demmer

Date: May. 2008

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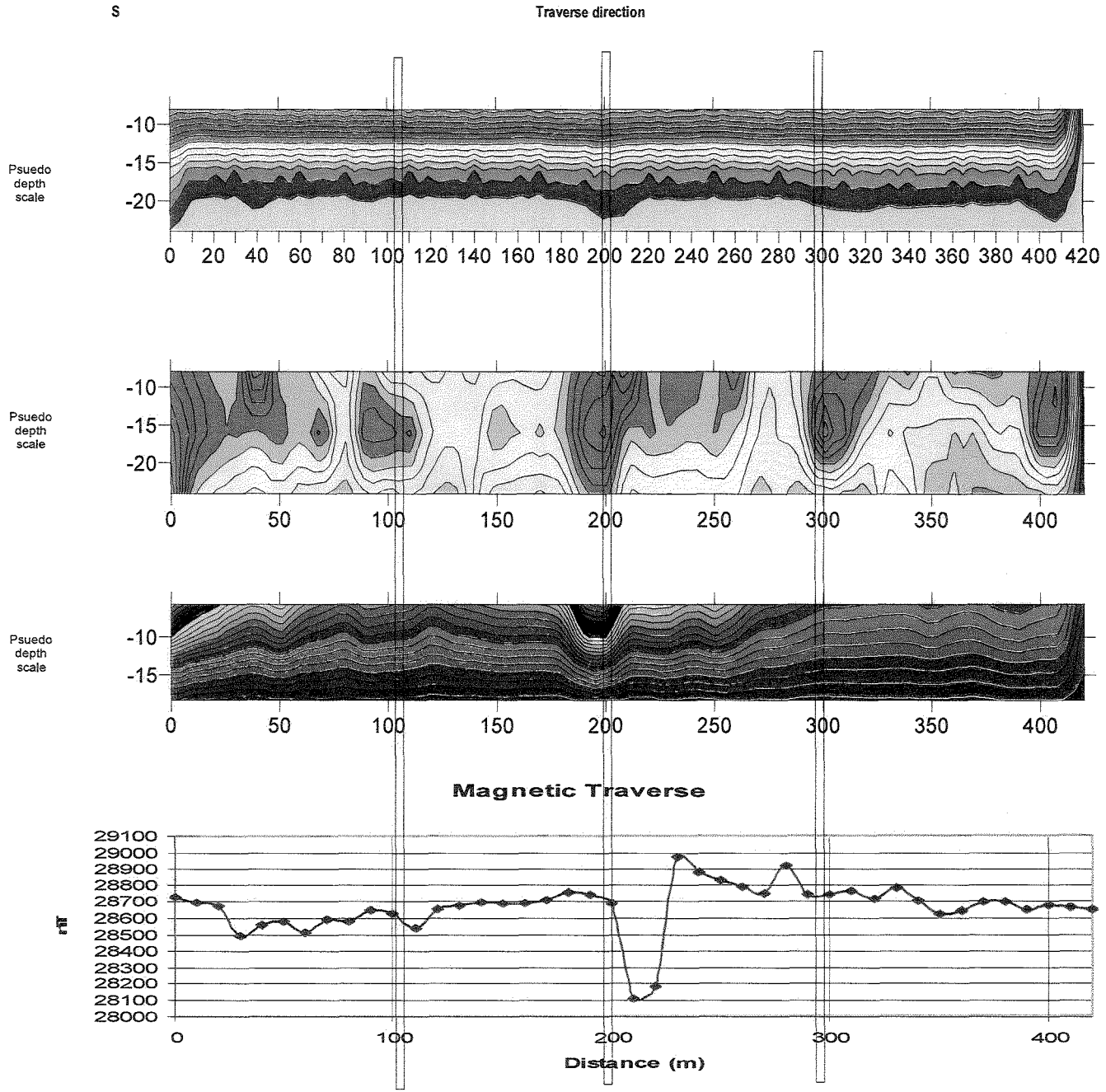

FDEM / MAG Traverse No:

AK2-2 (D32)

LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Akanani Project

Project:

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7 - 8.)
and
MAG
Survey

GAA Project No:: 10651

Task No:

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Date: May. 2008

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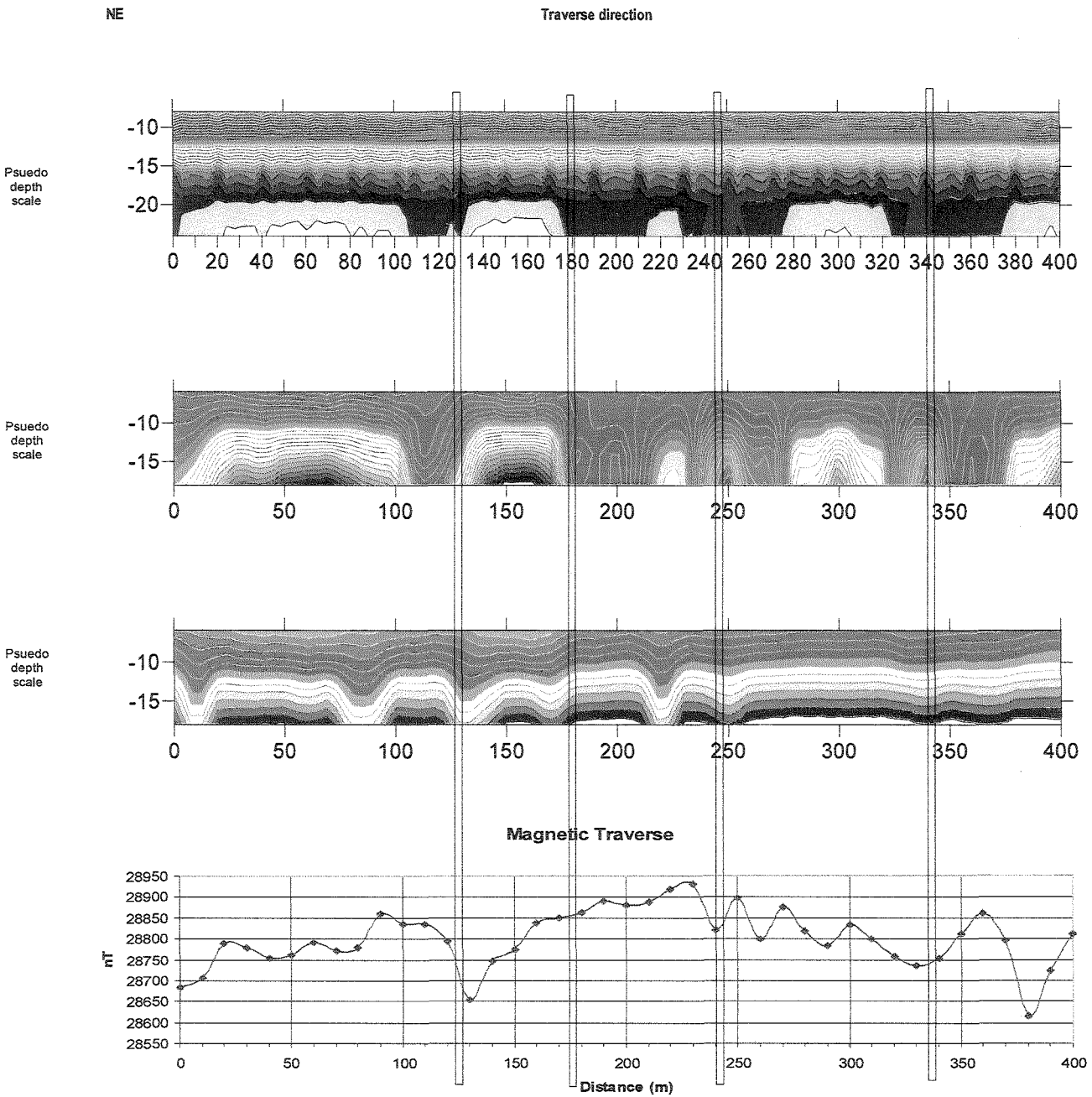

Frequency Ranges

2 to 4

4 to 6

7 to 8

FDEM / MAG Traverse No:

AK3 (D34)

LEGEND:

Apparent Conductivity Scale Bar

High

Low

Client:

Lonmin Platinum Pty Ltd

Project:

Akanani Hydrogeological Baseline Investigation

Title:

FDEM
(Frequencies 2 to 4, 4 to 6 and 7 to 8.)
and MAG Survey

GAA Project No:: 10651

Task No:

Drawn by: T. Demmer

Date: May. 2008

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APPENDIX B

BOREHOLE LOGS

Borehole Construction and Geological Log

Date compiled: 07/10/2008

BASIC SITE INFORMATION: ***Site Identifier:*** 2328DDX0022 ***Number:*** AK01 ***Site type:*** Borehole

Distr./Farm No.: 814LR ***Site Name/Des.:*** ZWARTFONTEIN

Region Type: Water supply authority ***Region Descr.:*** MOGALAKWENA LM

Longitude [°]:	23.987550	***Reg./BB.:***	***Topo-set.:***	***Depth [m]:***	85.00
Latitude [°]:	28.892450	***G-Nr.:***	***Site status:*** Unused	***Col. ht. [m]:***	0.30
Altitude [m]:	1091.00		***Site purp.:*** Production (water supply)	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units		***Use applic.:*** Domestic - all purposes	***Drain. reg.:***	A61G
Coord. meth.:	Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***	GOLD

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

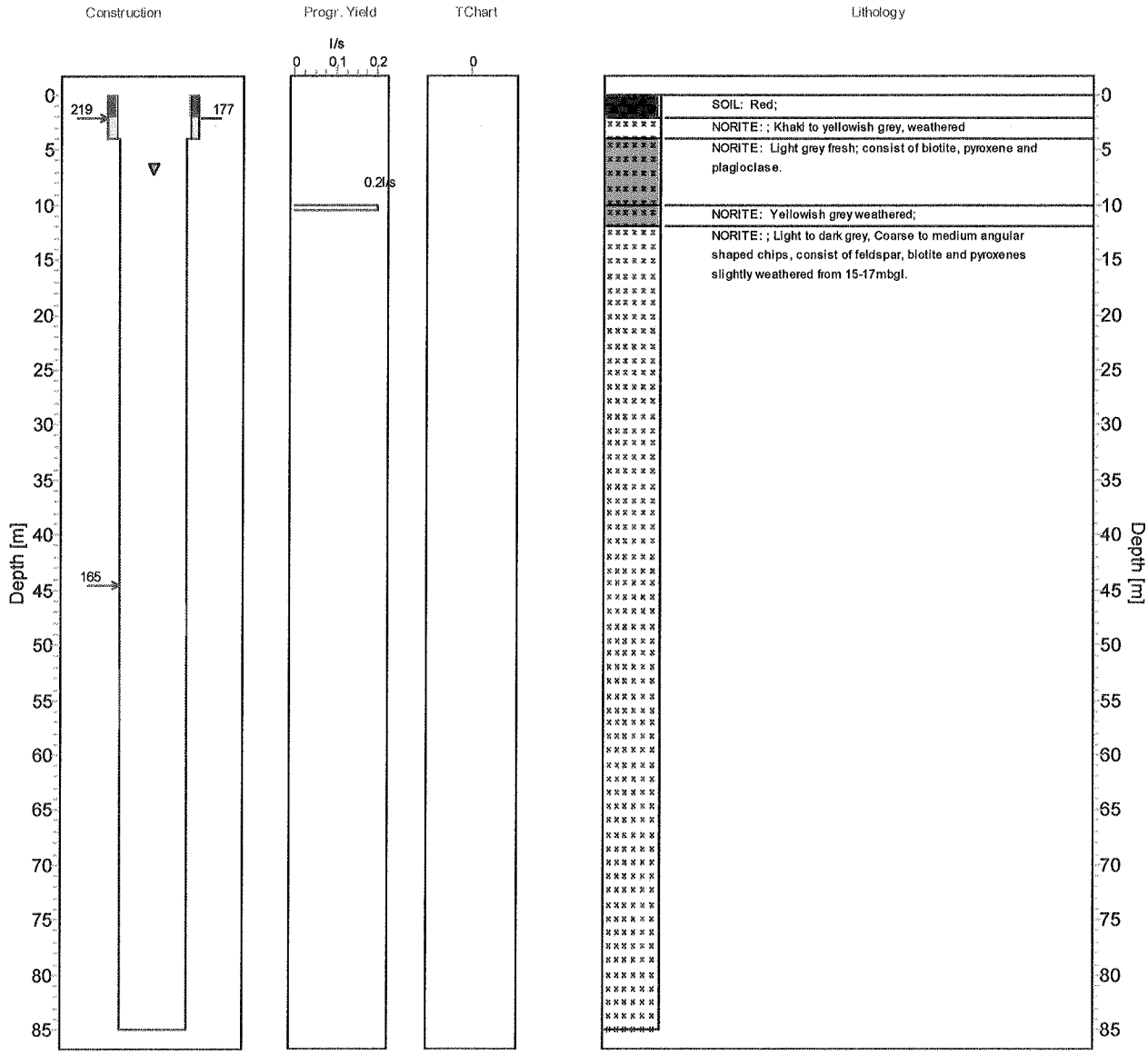
Construction and Geohydrological Legend

Hole — Hole diameter [mm] (165) — Sanitary seal

Casing (plain / perforated, sloted) — Casing diameter [mm] (152) — Drill cuttings

Screen / Mesh Screen — Waterlevel measured: 01/08/08

Piezometer — Piezometer (Nr. & Diameter [mm]) (0:50)



COMMENT:

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Halfway House,1685
Tel: 011 - 254 4800
Fax: 011 - 315 0317

Borehole Construction and Geological Log

Date compiled: 07/10/2008

BASIC SITE INFORMATION: ***Site Identifier:*** 2328DDX0023 ***Number:*** AK02 ***Site type:*** Borehole

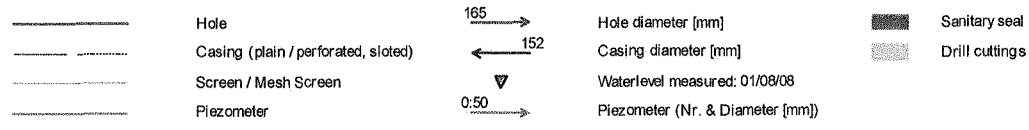
Distr./Farm No.: 814LR ***Site Name/Des.:*** ZWARTFONTEIN

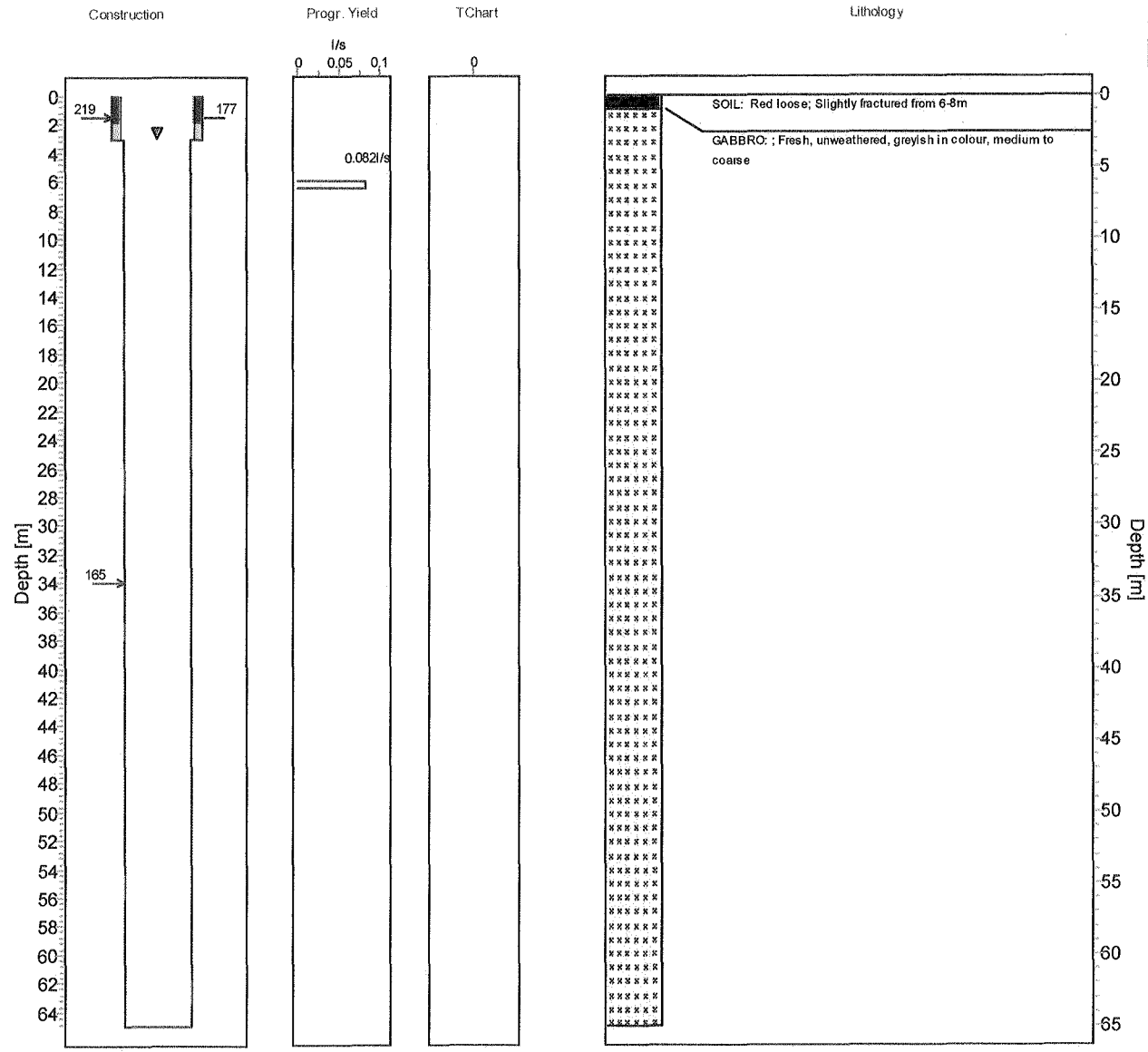
Region Type: Water supply authority ***Region Descr.:*** MOGALAKWENA LM

Longitude [°]:	23.991350	***Reg./BB.:***	***Topo-set.:***	***Depth [m]:***	65.00
Latitude [°]:	28.886710	***G-Nr.:***	***Site status:*** Unused	***Col. ht. [m]:***	0.20
Altitude [m]:	1082.00		***Site purp.:*** Production (water supply)	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units		***Use applic.:*** Domestic - all purposes	***Drain. reg.:***	A61G
Coord. meth.:	Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***	GOLD

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend





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Borehole Construction and Geological Log

Date compiled: 07/10/2008

BASIC SITE INFORMATION: ***Site Identifier:*** 2328DDX0025 ***Number:*** AK03 ***Site type:*** Borehole

Distr./Farm No.: 814LR ***Site Name/Des.:*** ZWARTFONTEIN

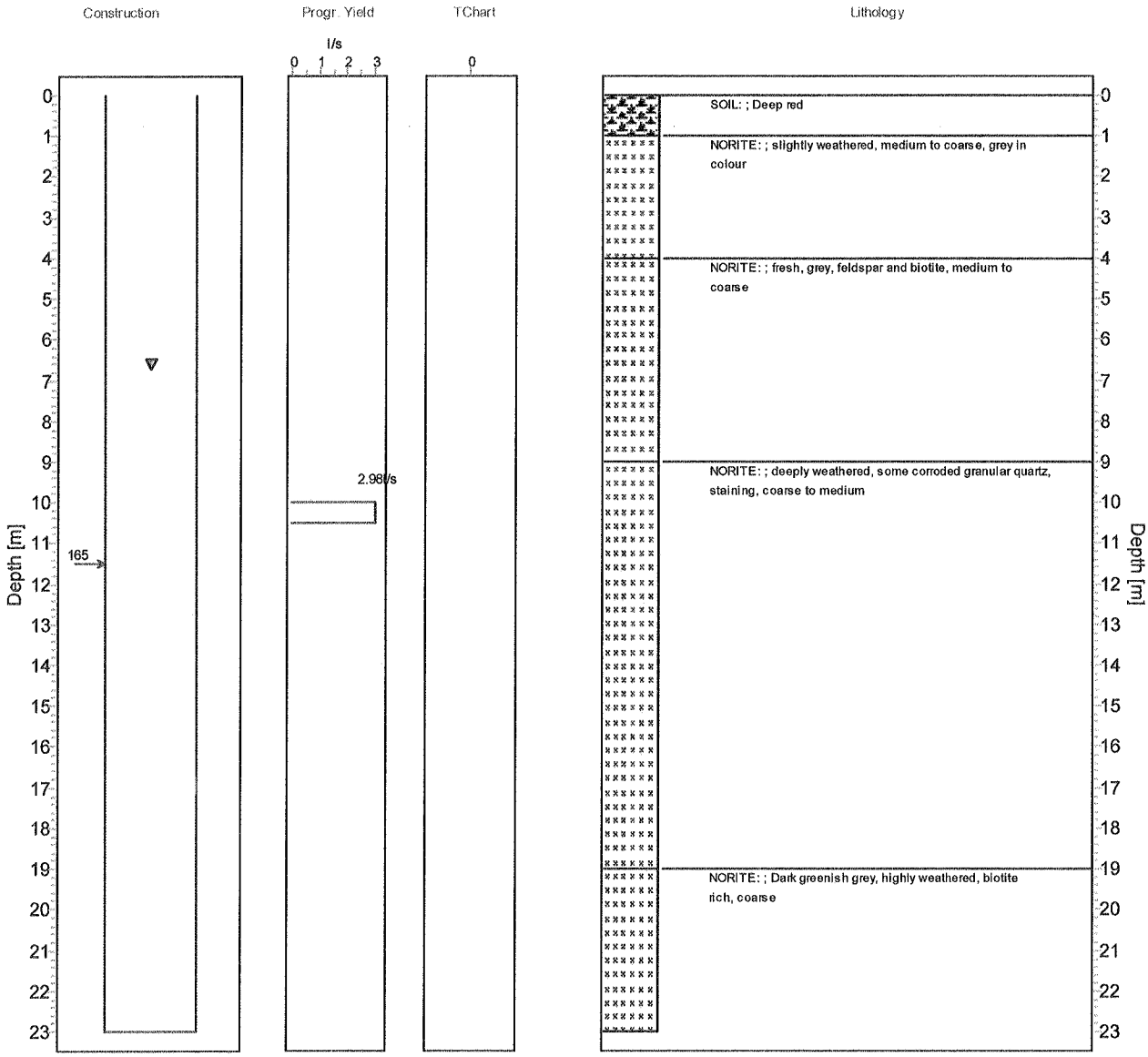
Region Type: Water supply authority ***Region Descr.:*** MOGALAKWENA LM

Longitude [°]:	23.992330	***Reg./BB.:***	***Topo-set.:***	***Depth [m]:***	23.00
Latitude [°]:	28.896170	***G-Nr.:***	***Site status:*** Unused	***Col. ht. [m]:***	0.30
Altitude [m]:	1094.00		***Site purp.:*** Production (water supply)	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units		***Use applic.:*** Domestic - all purposes	***Drain. reg.:***	A61G
Coord. meth.:	Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***	GOLD

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend

- Hole — 165 → Hole diameter [mm]
- Casing (plain / perforated, sloted) — ← 152 Casing diameter [mm]
- Screen / Mesh Screen — ▽ Waterlevel measured: 01/08/08
- Piezometer — 0:50 → Piezometer (Nr. & Diameter [mm])



COMMENT:

Golder Associates Africa, Midrand
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Halfway House,1685
Tel: 011 - 254 4800
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Borehole Construction and Geological Log

Date compiled: 07/10/2008

BASIC SITE INFORMATION: ***Site Identifier:*** 2328DDX0026 ***Number:*** AK03A ***Site type:*** Borehole

Distr./Farm No.: 814LR ***Site Name/Des.:*** ZWARTFONTEIN

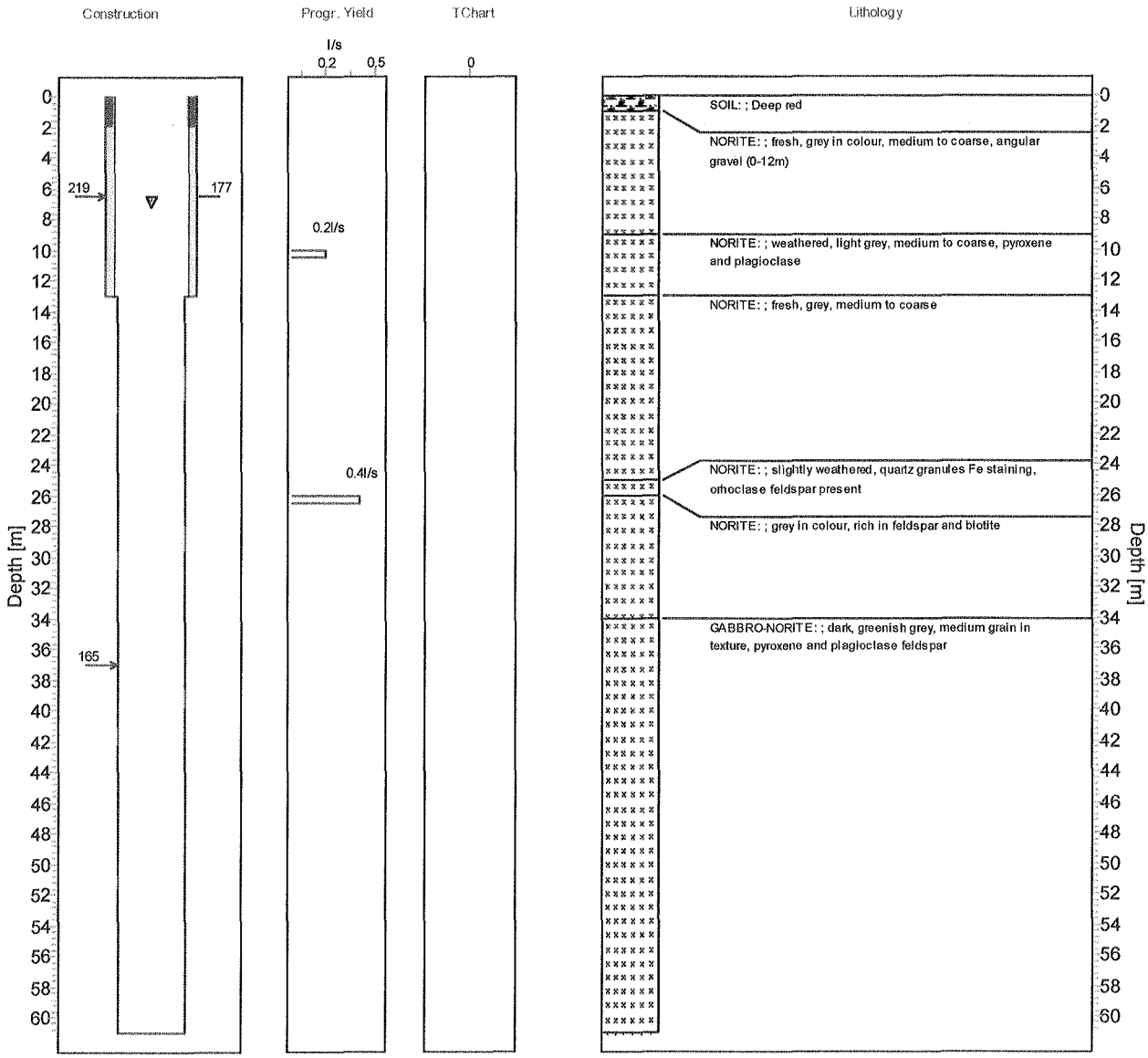
Region Type: Water supply authority ***Region Descr.:*** MOGALAKWENA LM

Longitude [°]:	23.992290	***Reg./BB.:***	***Topo-set.:***	***Depth [m]:***	61.00
Latitude [°]:	28.896150	***G-Nr.:***	***Site status:*** Unused	***Col. ht. [m]:***	0.30
Altitude [m]:	1094.00		***Site purp.:*** Production (water supply)	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units		***Use applic.:*** Domestic - all purposes	***Drain. reg.:***	A61G
Coord. meth.:	Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***	GOLD

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend

Hole
Casing (plain / perforated, sloted)
Screen / Mesh Screen
Piezometer
165 — Hole diameter [mm]
152 — Casing diameter [mm]
Waterlevel measured: 01/08/08
0:50 — Piezometer (Nr. & Diameter [mm])
Sanitary seal
Drill cuttings
Bentonite or clay



COMMENT:

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APPENDIX C

GROUNDWATER QUALITY RESULTS

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION:

Site Identifier: 2328DDX0022 **Number:** AK01 **Site type:** Borehole

Distr./Farm No.: 814LR **Site Name/Descr.:** ZWARTFONTEIN

Longitude [°]:	23.987550	**Alt. No. 1:**		**Diam. [mm]:**	165	**Water lev. [m]:**	6.68
Latitude [°]:	28.892450	**Alt. No. 2:**		**Depth [m]:**	85.00	**WL status:**	Static
Altitude [m]:	1091.00	**Rep. inst.:**	GOLD	**Col. ht. [m]:**	0.30	**Date WL meas.:**	20080801

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:

Type of Inst.: **Pulley Diam. [mm]:**

Manufacturer: **Depth to Intk. [m]:**

Engine:

Manufacturer: **Power Rating [kW]**

Type of Power: **Pulley Diam. [mm]:**

USE APPLICATION:

Site Status: Unused

Purpose: Production (water supply)

Consumer: Non-urban

Application: Domestic - all purposes

WATER CHEMISTRY:

Sample No.: AK01-CD **Date sampled:** 20081007 **Depth sampl. [m]:** 0 **Comment:**

Main Parameters:						Calculated Parameters:		Bacteriol. Parameters:
pH:	8.53	**Na:**	58.8	**Cl:**	46.74	**Langel.:**	1.01	**E.Coli:**
EC: [mS/m]	77 †	**K:**	2.86	**NO3 as N:**	4.71	**Aggr-Ind:**	13.09	**Faec. co:**
TDS:	534 †	**Si:**	21.2	**SO4:**		**Ion-bal:**	1.38	**Total Co:**
T. Alk.:	348.8	**Al:**	< 0.05	**F:**	0.49	**CaCO3:**	313.39	**SPC:**
Ca:	41.7	**Fe:**	< 0.05					
Mg:	50.9	**Mn:**	< 0.05					

Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption
† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit
! Value exceeds recommended minimum limit ¡ Value exceeds minimim allowable limit

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield[l/s]	Method meas.	Aquifer type	Comment
10.00	10.50	0.20	Notch (V- or U-notch)		

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]: Length	Width	Hor. Dist.	Vert. Dist.
0.00	4.00	177	Steel		Plain casing				

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MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION:

Site Identifier: 2328DDX0025 **Number:** AK03 **Site type:** Borehole

Distr./Farm No.: 814LR **Site Name/Descr.:** ZWARTFONTEIN

Longitude [°]:	23.992330	**Alt. No. 1:**		**Diam. [mm]:**	165	**Water lev. [m]:**	6.59
Latitude [°]:	28.896170	**Alt. No. 2:**		**Depth [m]:**	23.00	**WL status:**	Static
Altitude [m]:	1094.00	**Rep. inst.:**	GOLD	**Col. ht. [m]:**	0.30	**Date WL meas.:**	20080801

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:

Type of Inst.: **Pulley Diam. [mm]:**

Manufacturer: **Depth to Intk. [m]:**

Engine:

Manufacturer: **Power Rating [kW]**

Type of Power: **Pulley Diam. [mm]:**

USE APPLICATION:

Site Status: Unused

Purpose: Production (water supply)

Consumer: Non-urban

Application: Domestic - all purposes

WATER CHEMISTRY:

Sample No.: AK03-CD **Date sampled:** 20081007 **Depth sampl. [m]:** 0 **Comment:**

Main Parameters:						Calculated Parameters:		Bacteriol. Parameters:
pH:	8.37	**Na:**	70.4	**Cl:**	75.04	**Langel.:**	1.01	**E.Coli:**
EC: [mS/m]	99 †	**K:**	4.53	**NO3 as N:**	7.33	**Aggr-Ind:**	13.13	**Faec. co:**
TDS:	668 †	**Si:**	38.4	**SO4:**	34.52	**Ion-bal:**	3.01	**Total Co:**
T. Alk.:	433.56	**Al:**	< 0.05	**F:**	0.43	**CaCO3:**	481.19	**SPC:**
Ca:	53.4	**Fe:**	< 0.05					
Mg:	84.6 †	**Mn:**	< 0.05					

Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption
† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit
! Value exceeds recommended minimum limit ¡ Value exceeds minimim allowable limit

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield[l/s]	Method meas.	Aquifer type	Comment
10.00	10.50	2.98	Notch (V- or U-notch)		

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APPENDIX D

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Appendix B.4

Noise and Vibration Assessment; dBAcoustics

dBAcoustics

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Environmental Noise and Vibration Impact Assessment

Exploration Shaft

Lonmin Akanani Project
Mapela
Limpopo Province

Project No: 077/2008
Compiled by: B v/d Merwe
Date: 30 June 2008

Member: BJB van der Merwe CK 1996/060044/23

Contents:

1. Purpose of the study
2. Introduction
3. Background to noise
4. Method of evaluation
5. Comments
6. Methodology of the study
    - 6.1 Site visit
    - 6.2 Ambient noise measurements
    - 6.3 Noise emissions from the daytime and nighttime activities in the vicinity of the Lonmin Akanani Exploration Shaft footprint area.
    - 6.4 Noise Impacts
    - 6.5 Assessments of the noise impact
7. Results of the Noise Surveys
    - 7.1 Measured Ambient Noise Levels – Description of the measuring sites
    - 7.2 Atmospheric conditions during the time of the noise assessment
    - 7.3 Measured ambient noise levels at the measuring positions
    - 7.4 Results i.t.o SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.
    - 7.5 Calculation of the projected sound levels at the exploration shaft
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        - 7.6.1 Construction
        - 7.6.2 Operational
8. Discussion
9. Recommendations
10. Conclusion and summary

1. Purpose of the study

- The noise survey was carried out in order to determine the prevailing ambient noise levels in the vicinity of the proposed exploration shaft, which will be situated in the Eastern corner of the Lonmin Akanani project area at Mapela, Potgietersrus.
- To determine the prevailing ambient noise levels and vibration levels at the abutting residential areas.
- Quantify the alleged impact of noise and vibration on the prevailing vibration and noise levels and the outdoor environment.
- To make recommendations on engineering control measures.

2. Introduction

The study area is in the Southeastern corner of the proposed mining area. The abutting residential area Ga Mesenya and Skimming/Leruleng are situated on the Northern and Western side of the mining area.

The proposed exploration shaft is adjacent to an existing open cast mine with mining activities and the subsequent noise from the mining activities is audible in the study area. The feeder road to this area is a gravel road, which is situated on the Eastern side, and the entrance road to the village is a gravel road.

In order to determine the prevailing ambient noise level for the proposed exploration shaft and the abutting villages, it was necessary to take noise readings at representative measuring points in and around the study area.

The noise and vibration study was done on 19 and 20 June 2008 during the day and night time periods at pre-selected measuring points, which will be representative to the noise level the occupants of the villages are exposed to currently with the abutting mining activities. The daytime and nighttime period, according to the SANS 10103 of 2008 is for the daytime period from 06h00 until 22h00 and the nighttime period is from 22h00 until 6h00.

The prevailing ambient noise level in the vicinity of the study area is predominantly made up out of industrial type noise (far field – the existing open cast mine on the Eastern side), traffic noise, agricultural activities and the odd aircraft. During nighttime the ambient noise level is made up out of nighttime noises i.e. traffic, mining activities, insects and frogs.

The ambient noise level is proportional to the type of activity i.e. traffic and industrial type noise far and near field, wind direction, inversion conditions, additional sounds i.e. frogs, animals, insects etc. present at the time in a specific area.

The alleged noise and vibration impact on the environment and the residents living in the vicinity of the proposed exploration shaft will be investigated.

3. Background to sound and vibration

Sound

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

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – inverse square law. Expressed logarithmically as decibels, this means the

sound level decrease 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance.

The decibel scale is logarithmic therefore decibel levels cannot be added together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 dB.

Air absorption is important over large distances at high frequencies, depends on the humidity but is typically about 40 dB/km @ 4000 Hz. Road Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

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

Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. Sound propagation upwind is refracted upwards creating a sound shadow and downwind refracted towards the ground producing a slight increase in sound level over calm isothermal conditions.

The velocity of sound is inversely proportional to the temperature so a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

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

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

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3-5 dBA.

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

- Long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95 dBA. This will seldom happen in far-field conditions.
- Interference with speech where important information by the receiver can not be analyzed due to loud noises
- Excessive loudness
- Annoyance

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

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

Types of noise exposure:

Continuous exposure to noise – The level is constant and does not vary with time e.g. traffic on freeway and an extractor fan.
Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens.

Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

Depending upon the intensity of the sound, the length of time of exposure and how often over time the ear is exposed to it; noise may affects our human condition in a number of ways. Urban dwellers are besieged by noise, not only in the city streets but also in the busy workplaces and household noises.

The World Health Organisation has published a series of recommended maximum sound pressure levels applicable to various situations:

Table 1 – Recommended maximum sound pressure levels to various situations

Descriptor	Limit	Situation or effect
LAeq, 24	70 dBA	Negligible risk of hearing impairment
LAeq, 8	75 dBA	Negligible
LAeq	30 dBA	Excellent speech intelligibility
LAeq	55 dBA	Fairly good speech intelligibility
LAeq	30 dBA	No sleep disturbance in a bedroom
LAmax	45 dBA	No sleep disturbance – peak inside bedroom
LAeq	55 dBA	Residential areas, outdoors, daytime
LAeq	45 dBA	Residential areas, outdoors, night time

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

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

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

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

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

- The trained healthy human ear is able to discern changes in sound levels of 1 dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3 dBA;
- A change in sound level of 5 dBA is a readily perceptible increase in noise level;
- A 10-dBA change in the sound level is perceived as twice as loud as the original source.

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

- Residential area – 55 dBA for the daytime and 45 dBA for the nighttime period;
- Industrial area – 70 dBA for the day- and nighttime period.

Vibration

Human reaction to vibration will be in response to the resulting effects of both ground and airborne vibration and in particular the combined effects of such a vibration. In the shaft sinking process, the biggest contributor to vibration is the blasting process. This type of blasting will take place under controlled conditions as the shaft will be for exploration purposes.

Wavelength differences associated with this frequency range mean that any effects of topography are likely to be pronounced for the audible component of air overpressure rather than the concussive component. A topographic barrier i.e. an earthberm or rock face will play an important role in reducing the audible effect than for the concussive effect. The deeper the shaft goes the less impact will be on the environment. This process will only be for the time it takes to sink the shaft.

Blasting can be controlled by managing the overpressure levels, number of blasts, days and times of blasting, allowable ground vibration levels not to be exceeded, vibration monitoring, and complaint procedures to be in place.

4. Method of evaluation

The noise survey was conducted in terms of the provisions of SANS 10103 of 2008 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.

The instruments used in the noise survey:

Instrument 1

Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072
Larsen Davis Pre-amplifier – Serial no. PRM831 0206
Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184
Larsen Davis Calibrator 200 – Serial no.3073

Instrument 2

Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 824A3282
Larsen Davis Pre-amplifier – Serial no. PRM 902/3493
Larsen Davis ½" free field microphone – Serial no. 2541/7937
Larsen Davis Calibrator 200 – Serial no.3073
Larsen Davis Shear Accelerometer – Model no. Sen025/P63720

The instrument was calibrated before and after the measurements were done and coincided within 0, 5 dBA.

Batteries were fully charged.

A windshield was in use at all times.

The calibration certificates are attached as Appendix A.

Member: BJB van der Merwe CK 1996/060044/23

5. Comments

The noise survey was carried out at the following measuring points:

- Position 1 – Eastern corner of the exploration footprint
- Position 2 – Proposed exploration shaft
- Position 3 – Northeastern corner of the exploration shaft
- Position 4 – Northwestern corner of the exploration shaft
- Position 5 – Southwestern corner of the exploration shaft
- Position 6 – Southwestern corner of the Hans Masenya Village
- Position 7 – Western boundary of Hans Masenya Village onto the provincial road
- Position 8 – Along the provincial road in the vicinity of Hans Mashabe Primary School
- Position 9 – Next to the Hans Mashabe Primary School
- Position 10 – Eastern boundary of Ga Masenya Village
- Position 11 – Eastern boundary of Ga Masenya Village
- Position 12 – Northern corner of Ga Masenya Village
- Position 13 – Northwestern boundary of Skimming
- Position 14 – Northern boundary of Skimming
- Position 15 – Northeastern corner of Leruleng
- Position 16 – Eastern boundary of Leruleng
- Position 17 – Southeastern corner of Leruleng
- Position 18 – Southern boundary of Leruleng
- Position 19 – Southern boundary of Leruleng
- Position 20 – Southern boundary of Skimming
- Position 21 – Southwestern corner of Skimming

Table 2: Coordinates of the measuring positions

Position	X WGSDD	Y WGSDD
1	23°59.733S	28°53.927E
2	23°59.329S	28°53.461E
3	23°59.358S	28°53.288E
4	23°59.391S	28°53.145E
5	24°00.043S	28°53.334E
6	24°00.219S	28°52.591E
7	24°00.326S	28°52.396E
8	24°00.114S	28°52.289E
9	23°59.848S	28°52.243E
10	24°00.008S	28°52.438E
11	23°59.629S	28°52.498E
12	23°59.570S	28°52.280E
13	23°58.746S	28°52.928E
14	23°58.941S	28°52.826E
15	23°58.627S	28°53.891E
16	23°58.809S	28°53.202E
17	23°59.189S	28°53.506E
18	23°59.199S	28°53.424E
19	23°59.272S	28°53.288E
20	23°59.194S	28°53.106E
21	23°59.262S	28°52.862E

Table 3: Distance between the proposed shaft and the measuring positions in the abutting residential areas:

	Measuring position	Distance
Shaft	6	1400m
Shaft	7	2150m
Shaft	8	2260m
Shaft	9	2120m
Shaft	10	1810m
Shaft	11	1720m
Shaft	12	2180m
Shaft	13	1880m
Shaft	14	2180m
Shaft	15	1990m
Shaft	16	1510m
Shaft	17	944m
Shaft	18	845m
Shaft	19	875m
Shaft	20	1254m
Shaft	21	1390m

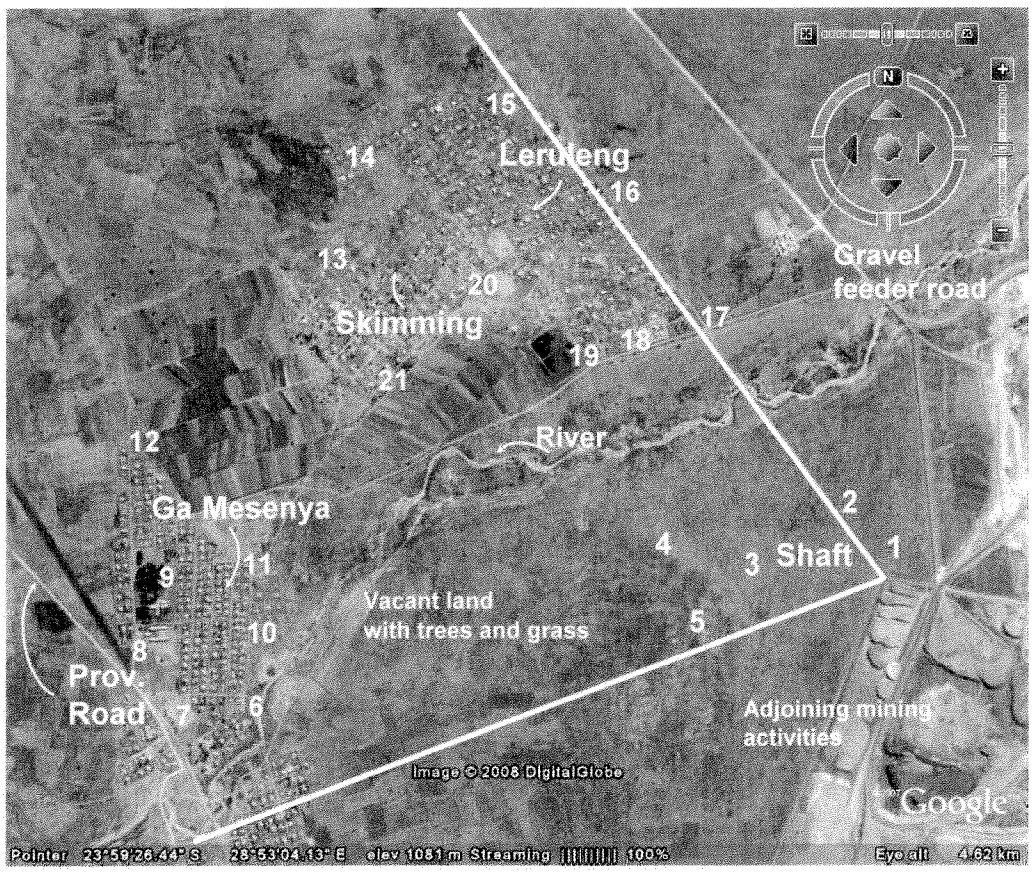

Figure 1: Measuring points and other relevant information of the proposed exploration shaft

In terms of Table 5 of SANS 10103 of 2008 the following response by groups can be expected should the ambient noise level be exceeded:

Table 4: Categories of community/group response

1	2	3
Excess $)L_{Req,T}$ [1)] dB	**Estimated community/group response**	
	Category	**Description**
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

1) Calculate $)L_{Req,T}$ from the appropriate of the following:

a) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).

b) $)L_{Req,T}$ = $L_{req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.

c) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2.

The difference between the actual noise and the ambient noise level will determine how people will respond to sound.

The following is of relevance to the ambient noise measurements:

- The L_{Aeq} was measured over a sampling period of at least 10minutes at each measuring point.
- The noise survey was carried out during the day and nighttime period being 6h00 to 22h00 for the day time and 22h00 to 6h00 for the night time period.
- The noise measurements were taken in accordance with the procedures specified in SANS 10103 of 2008.

Table 5: The following are recommended sound pressure levels for a residential area according to the guidelines of the World Bank – Environmental, Health and Safety Guidelines.

LAeq	55 dBA	Residential areas, outdoors, daytime
LAeq	45 dBA	Residential areas, outdoors, night time
LAeq	70 dBA	Industrial areas

There are residential areas and/or points of reception where people are living in zones where the sound pressure levels exceed the above recommended sound pressure levels i.e. next to the feeder road from the North to the South and some of the gravel roads.

A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received.

Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and day cares; hospitals and nursing homes; places of worship; and parks and campgrounds.

6. Methodology of the study

6.1 Site visit

6.2 Ambient noise measurements

6.3 Noise emissions from the daytime and nighttime activities in the vicinity of the proposed mining area

6.4 Noise Impacts

6.5 Assessments of the noise impact

6.1 Site visit

A site visit was carried out in and around the proposed exploration shaft mining area in order to:

- Identify the major contributors to the prevailing ambient noise level in the vicinity of the study area.
- Identify the nearest sensitive noise areas being residential areas and to identify major feeder roads.
- The site visit was furthermore done to identify potential measuring positions within the study area.

The following observations were made:

- The proposed exploration site abuts existing mining activities on the East and Southern side and residential villages at some distance to the North and West.
- There are flat plains and these areas are covered with trees and grass with soft ground conditions at times, which will enhance the absorption of propagated sound.
- There is a river, which may at times when the river is in flood lead to an increase in the ambient noise level.
- There are prevailing winds, which blow at times and give rise to a higher ambient noise level.
- The Provincial feeder road is a very busy road with heavy duty and normal traffic frequenting this road during the daytime and not so much during the nighttime period.
- The ambient noise level on the Eastern and Southern side of the proposed exploration shaft area is made up of traffic and mining activities i.e. blasting, fans, heavy-duty vehicles etc.
- The nighttime ambient noise level is made up out of predominantly traffic and activities at the existing mine, noise, insects i.e. crickets and frogs.
- Noise from distant open cast mining activities was audible during nighttime on the Eastern boundary of the study area.

- The residents on the Eastern boundary and along the feeder roads of the study area are already exposed to higher noise levels created by traffic and existing mining activities.

6.2 Ambient noise measurements

Ambient noise readings were carried out at 21 measuring points in the study area in order to get a representative ambient noise level in the proposed exploration shaft mining area and the immediate abutting residential villages. Nighttime ambient noise level readings were done at the same measuring points as for the daytime period.

6.3 Noise emissions from the daytime and nighttime activities in the vicinity of the proposed exploration shaft area

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

Ga Mesenya village

- Traffic noise
- Distant mining activity noise
- Animal noise
- Rattling sounds from vehicles traveling on the gravel road
- Domestic type noises
- Insects
- Birds
- Wind noise

Skimming village

- Distant and near mining noise
- Farming activity noises
- Rattling sounds from vehicles traveling on the gravel road
- Domestic type noises
- Animal and bird life noise
- Wind noise

Leruleng village

- Distant and near mining noise
- Traffic noise
- Rattling sounds from vehicles traveling on the gravel road
- Domestic type noises
- Animal and bird life noise
- Wind noise

6.4 Noise Impact

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

Table 6: Typical rating levels for ambient noise in districts

1	2	3	4	5	6	7
	Equivalent continuous rating level $L_{Req.T}$ for ambient noise dBA					
	Outdoors			Indoors, with open windows		
Type of district	Day-night L_{Rdn} [2]	Daytime L_{Rd} [1]	Night-time L_{Rn} [1]	Day-night L_{Rdn} [2]	Daytime L_{Rn} [1]	Night-time L_{Rn} [1]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

The reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and are for daytime between 6h00 to 22h00 and for nighttime between 22h00 and 6h00.

The response to noise can be classified as follows:

- An increase of 0dBA or less will cause no response from the affected community. For a person with normal hearing an increase of less than 3 dBA will not be noticeable
- An increase between 0dBA – 10 dBA will elicit little to sporadic response. When the difference is more than 5 dBA above the ambient noise level a person with normal hearing will start to hear the difference.
- An increase between 5dBA and 15 dBA will elicit medium response from the affected community.
- An increase between 10dBA and 20 dBA will elicit strong community reaction.

The overlapping categories are because there is no clear-cut transition from one community response to another and there are variables, which should be taken into consideration during the evaluation of a potential noise problem.

There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, industrial activities and major roads in close proximity of each other.

The villages were predominantly in a rural area before the adjoining mining activities commenced and since then the type of district has changed from a rural district to an urban type district with the subsequent increase in the noise levels.

6.5 Assessment of noise impacts

The measured ambient noise level during the daytime and nighttime periods will be the baseline ambient noise criteria for the study area and the projected noise levels from the proposed mining activities will be evaluated in terms of SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

7. Results of the Noise Surveys

7.1 Measured Ambient Noise Levels – Description of the measuring sites

7.2 Atmospheric conditions during the time of the noise assessment

7.3 Measured ambient noise levels at the measuring positions

7.4 Results i.t.o SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

7.5 Calculation of the projected sound levels at the:

- 7.5.1 Exploration shaft
- 7.5.2 During blasting at the exploration shaft

7.6 Rating of impact

- 7.6.1 Construction
- 7.6.2 Operational

7.1 Measured Ambient Noise Levels - Description of the measuring sites

- Position 1 – Eastern corner of the exploration footprint – Flat surfaced with trees and grass
- Position 2 – Proposed exploration shaft – Flat surfaced with trees and grass
- Position 3 – Northeastern corner of the exploration shaft – Flat surfaced with trees and grass
- Position 4 – Northwestern corner of the exploration shaft – Flat surfaced with trees and grass
- Position 5 – Southwestern corner of the exploration shaft – Flat surfaced with trees and grass
- Position 6 – Southwestern corner of the Ga Masenya Village – Houses and open land
- Position 7 – Western boundary of Ga Masenya Village onto the provincial road – Houses and provincial road
- Position 8 – Along the provincial road in the vicinity of Hans Mashabe Primary School – Houses and provincial road
- Position 9 – Next to the Hans Mashabe Primary School – Built up area
- Position 10 – Eastern boundary of Ga Masenya Village – Built up area an open land with trees and grass
- Position 11 – Eastern boundary of Ga Masenya Village – Built up area an open land with trees and grass
- Position 12 – Northern corner of Ga Masenya Village – Built up area an open land with trees and grass
- Position 13 – Northwestern boundary of Skimming – Built up area an open land with trees and grass
- Position 14 – Northern boundary of Skimming – Built up area an open land with trees and grass

- Position 15 – Northeastern corner of Leruleng – Built up area an open land with trees and grass
- Position 16 – Eastern boundary of Leruleng – Built up area an open land with trees and grass
- Position 17 – Southeastern corner of Leruleng – Built up area an open land with trees and grass
- Position 18 – Southern boundary of Leruleng – Built up area an open land with trees and grass
- Position 19 – Southern boundary of Leruleng – Built up area an open land with trees and grass
- Position 20 – Southern boundary of Skimming – Built up area an open land with trees and grass
- Position 21 – Southwestern corner of Skimming – Built up area an open land with trees and grass

7.2 Atmospheric conditions during the time of the noise assessment

The noise readings were carried out at the different measuring points and the prevailing atmospheric conditions i.e. wind speed, wind direction and temperature were taken into consideration. The readings were done away from any large vertical structures, which may have an influence on the outcome of the readings.

The following meteorological conditions were recorded:

19 June 2008 - Daytime

- Wind speed – 0.2 – 2.2 m/s
- Temperature – 24.0°C – No strong temperature gradient occurred near the ground
- Cloud cover – No clouds
- Wind direction – The wind direction was in the direction of the measuring site from the Northeastern side.
- Humidity – No humidity was recorded.

19 June 2008 - Nighttime

- Wind speed – less than1.0 m/s
- Temperature – 13.0°C
- Cloud cover – High scattered
- Wind direction – The wind was insignificant and did not influence the noise readings.
- Humidity – None

20 June 2008 - Daytime

- Wind speed – less than 1.0 m/s
- Temperature – 23.0°C
- Cloud cover – Overcast conditions
- Wind direction – The wind was insignificant and did not influence the noise readings.
- Humidity – None

7.3 Measured Vibration and Ambient noise levels

Vibration

Prevailing vibration levels were determined at the following measuring points:

- Position 6 – Insignificant
- Position 10 – Insignificant
- Position 11 – Insignificant
- Position 12 – Insignificant
- Position 13 – Insignificant
- Position 14 – Insignificant
- Position 15 – Insignificant
- Position 16 – Insignificant
- Position 17 – Insignificant
- Position 18 – Insignificant
- Position 19 – Insignificant
- Position 20 – Insignificant
- Position 21 – Insignificant

Ambient noise levels

- Position 1 – Eastern corner of the exploration footprint

Daytime

Leq: 42.8 dBA
Lmax (fast): 61.2 dBA
Lmin (fast): 34.1 dBA

Nighttime

Leq: 50.7 dBA
Lmax (fast): 60.8 dBA
Lmin (fast): 45.9 dBA

- Position 2 – Proposed exploration shaft

Daytime

Leq: 44.4 dBA
Lmax (fast): 62.3 dBA
Lmin (fast): 37.7 dBA

Nighttime

Leq: 47.5 dBA
Lmax (fast): 55.7 dBA
Lmin (fast): 43.7 dBA

- Position 3 – Northeastern corner of the exploration shaft

Daytime

Leq: 43.1 dBA
Lmax (fast): 58.3 dBA
Lmin (fast): 38.0 dBA

Nighttime

Leq: 49.3 dBA
Lmax (fast): 59.4 dBA
Lmin (fast): 43.6 dBA

- Position 4 – Northwestern corner of the exploration shaft

Daytime

Leq: 40.7 dBA
Lmax (fast): 60.6 dBA
Lmin (fast): 33.9 dBA

Nighttime

Leq: 48.4 dBA
Lmax (fast): 63.0 dBA
Lmin (fast): 43.5 dBA

- Position 5 – Southwestern corner of the exploration shaft

Daytime

Leq: 40.8 dBA
Lmax (fast): 62.9 dBA
Lmin (fast): 34.2 dBA

Nighttime

Leq: 48.1 dBA
Lmax (fast): 55.2 dBA
Lmin (fast): 45.0 dBA

- Position 6 – Southwestern corner of the Ga Masenya Village

Daytime

Leq: 44.4 dBA
Lmax (fast): 63.1 dBA
Lmin (fast): 36.0 dBA

Nighttime

Leq: 43.3 dBA
Lmax (fast): 62.6 dBA
Lmin (fast): 39.5 dBA

- Position 7 – Western boundary of Hans Masenya Village onto the provincial road

Daytime

Leq: 59.9 dBA
Lmax (fast): 79.2 dBA
Lmin (fast): 37.3 dBA

Nighttime

Leq: 54.8 dBA
Lmax (fast): 74.6 dBA
Lmin (fast): 39.9 dBA

- Position 8 – Along the provincial road in the vicinity of Hans Mashabe Primary School

Daytime

Leq: 60.3 dBA
Lmax (fast): 76.0 dBA
Lmin (fast): 34.4 dBA

Nighttime

Leq: 53.1 dBA
Lmax (fast): 57.7 dBA
Lmin (fast): 39.2 dBA

- Position 9 – Next to the Hans Mashabe Primary School

Daytime

Leq: 45.1 dBA
Lmax (fast): 64.3 dBA
Lmin (fast): 37.2 dBA

Nighttime

Leq: 42.6 dBA
Lmax (fast): 54.0 dBA
Lmin (fast): 39.2 dBA

- Position 10 – Eastern boundary of Ga Masenya Village

Daytime

Leq: 44.3 dBA
Lmax (fast): 64.6 dBA
Lmin (fast): 34.8 dBA

Nighttime

Leq: 43.6 dBA
Lmax (fast): 61.9 dBA
Lmin (fast): 40.0 dBA

- Position 11 – Eastern boundary of Ga Masenya Village

Daytime

Leq: 41.0 dBA
Lmax (fast): 62.9 dBA
Lmin (fast): 33.4 dBA

Nighttime

Leq: 44.4 dBA
Lmax (fast): 63.1 dBA
Lmin (fast): 39.6 dBA

- Position 12 – Northern corner of Ga Masenya Village

Daytime

Leq: 41.3 dBA
Lmax (fast): 63.7 dBA
Lmin (fast): 34.3 dBA

Nighttime

Leq: 43.9 dBA
Lmax (fast): 58.6 dBA
Lmin (fast): 39.8 dBA

- Position 13 – Northwestern boundary of Skimming

Daytime

Leq: 42.9 dBA
Lmax (fast): 63.7 dBA
Lmin (fast): 36.4 dBA

Nighttime

Leq: 48.0 dBA
Lmax (fast): 61.6 dBA
Lmin (fast): 44.1 dBA

- Position 14 – Northern boundary of Skimming

Daytime

Leq: 48.3 dBA
Lmax (fast): 74.2 dBA
Lmin (fast): 34.3 dBA

Nighttime

Leq: 49.6 dBA
Lmax (fast): 57.3 dBA
Lmin (fast): 45.5 dBA

- Position 15 – Northeastern corner of Leruleng

Daytime

Leq: 48.1 dBA
Lmax (fast): 61.2 dBA
Lmin (fast): 39.6 dBA

Nighttime

Leq: 45.3 dBA
Lmax (fast): 56.4 dBA
Lmin (fast): 39.8 dBA

- Position 16 – Eastern boundary of Leruleng

Daytime

Leq: 41.4 dBA
Lmax (fast): 54.6 dBA
Lmin (fast): 37.4 dBA

Nighttime

Leq: 44.8 dBA
Lmax (fast): 63.9 dBA
Lmin (fast): 38.5 dBA

- Position 17 – Southeastern corner of Leruleng

Daytime

Leq: 43.4 dBA
Lmax (fast): 65.3 dBA
Lmin (fast): 38.0 dBA

Nighttime

Leq: 50.4 dBA
Lmax (fast): 72.8 dBA
Lmin (fast): 43.6 dBA

- Position 18 – Southern boundary of Leruleng

Daytime

Leq: 53.5 dBA
Lmax (fast): 69.2 dBA
Lmin (fast): 43.4 dBA

Nighttime

Leq: 50.1 dBA
Lmax (fast): 54.8 dBA
Lmin (fast): 46.0 dBA

- Position 19 – Southern boundary of Leruleng

Daytime

Leq: 50.6 dBA
Lmax (fast): 73.6 dBA
Lmin (fast): 38.0 dBA

Nighttime

Leq: 48.0 dBA
Lmax (fast): 60.3 dBA
Lmin (fast): 43.6 dBA

- Position 20 – Southern boundary of Skimming

Daytime

Leq: 45.9 dBA
Lmax (fast): 64.2 dBA
Lmin (fast): 39.9 dBA

Nighttime

Leq: 44.9 dBA
Lmax (fast): 56.3 dBA
Lmin (fast): 39.4 dBA

- Position 21 – Southwestern corner of Skimming

Daytime

Leq: 54.9 dBA
Lmax (fast): 68.7 dBA
Lmin (fast): 35.4 dBA

Nighttime

Leq: 44.5 dBA
Lmax (fast): 58.3 dBA
Lmin (fast): 40.1 dBA

Table 7: Sound pressure levels during day – and nighttime:

Position	Leq – Daytime dBA	Leq – Nighttime dBA
1	42.8	50.7
2	44.4	47.5
3	43.1	49.4
4	40.7	48.4
5	40.8	48.1
6	44.4	43.3
7	59.9	54.8
8	60.3	53.1
9	45.1	42.6
10	44.3	43.6
11	41.0	44.4
12	41.3	43.9
13	42.9	48.0
14	48.3	49.6
15	48.1	45.3
16	41.4	44.8
17	43.4	50.4
18	53.5	50.1
19	50.6	48.0
20	45.9	44.7
21	54.9	44.5

7.4 Results i.t.o. SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

Table 8: Prevailing ambient noise level in Ga Mesenya, Skimming and Leruleng Villages

Area	Daytime	Nighttime
Western side of Ga Mesenya village	60.1dBA	53.9dBA
Eastern side of Ga Mesenya village	42.8dBA	43.7dBA
Northern side of Skimming village	45.6dBA	48.8dBA
Southern side of Skimming village	49.7dBA	44.6dBA
Northern side of Leruleng village	48.2dBA	47.5dBA
Southern side of Leruleng village	49.2dBA	49.5dBA

The above results indicate that the sound pressure levels on the Western side is normal for an area next to a provincial road whereas the nighttime noise level on the Eastern side of Ga Mesenya is higher during the nighttime than during the daytime.

The nighttime ambient noise level on the Northern side of Skimming is higher than the daytime period and the day and nighttime sound pressure levels are more or less the same at the Northern and Southern side of Leruleng village.

According to the SANS the daytime ambient noise level should be 10dBA higher than the nighttime period, which in this case it is not because of the existing mining activities which influence the nighttime sound pressure levels.

7.5 Projected sound levels at the:

- 7.5.1 Exploration shaft
- 7.5.2 During blasting at the exploration shaft

7.5.1 Exploration shaft

The overall noise at 15m from the exploration shaft is taken at 85.0 dBA. This is a combination of sound pressure levels from the extractor fans and other exploration shaft activities. This sound pressure level is for unmitigated conditions.

Table 9: Estimated noise level attenuation

Equipment	Line-of-Sight Estimated Noise Level Attenuation - dBA						
	15m	30m	60m	120m	240m	480m	960m
Plant	85	79	73	67	61	55	49

The closest residential area to the plant will be the Southern side of Skimming and Leruleng, which are 878m and 845m respectively. The noise from the exploration shaft will be 50.0 dBA, which is in line with the prevailing ambient noise levels at measuring points 18 and 19 being 53.5dBA during daytime and 50.1dBA during the night time periods for measuring point 18 and 50.6dBA during daytime and 48.0dBA during the night time period for measuring point 19 respectively .