Applicant: Keaton Mining (Pty) Limited

DMR Reference Number: MP30/5/1/2/2/309MR

CHANGES TO SURFACE INFRASTRUCTURE AT VANGGATFONTEIN MINE

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

SUBMITTED IN SUPPORT OF AN EXISTING MINING RIGHT IN TERMS OF SECTION 39 AND OF REGULATIONS 50 AND 51 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002) (the Act)

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IDENTIFICATION OF THE REPORT

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorised to act as representative of the applicant in terms of the resolution submitted with the application, and confirm that the above report comprises EIA and EMP compiled in accordance with the guideline on the Departments official website and directive in terms of Sections 29 and 39(5) in that regard.

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CHANGES TO SURFACE INFRASTRUCTURE AT VANGGATFONTEIN COAL MINE

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ACRONYMS AND ABBREVIATIONS

Below a list of acronyms and abbreviations used in this report.

Acronyms / Abbreviations	Definition
%	Percentage
ABA	Acid Base Accounting
AER	Acceptable Environmental Risk
AP	Acid Potential
ARD	Acid Rock Drainage
ARL	Acceptable Risk Level
Al	Aluminium
BID	Background information document
Ca	Calcium
Cd	Cadmium
CEC	Cation exchange capacity
Cr	Chrome
Cl	Chloride
CO	Carbon monoxide
dBA	A-weighted decibel
DEA	Department of Environmental Affairs
DEDET	Department of Economic Development, Environment and Tourism
DMR	Department of Mineral Resources
DRDLR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWEA	Department of Water and Environment Affairs
EAP	Environmental Assessment Practitioners
EAPSA	Environmental assessment practitioner of Southern Africa
EC	Electrical conductivity (EC)
EIA	Environmental impact assessment
EMP	Environmental management programme
ESS	Earth Science Solutions
ESIA	Environmental Social Impact Assessment
Fe	Iron (Fe)
GDP	Gross domestic profit
IAPs	Interested and/or affected parties
IDP	Integrated Development Plan
IFC	International Finance Corporation
K	Potassium
km^2	Square kilometres
LOM	Life of mine
m	Meters
mamsl	Meters above mean sea level
m/s	Meters per second
m^2	Square meter
m^3	Cubic meter
MAR	Mean annual runoff
mbgl	Metres below ground level
Mg	Magnesium

Acronyms / Abbreviations	Definition
mm	Millimetres
MRDF	Mine residue disposal facility
MTPB	Mpumalanga Tourism and Parks Board
MPRDA	Mineral and Petroleum Resources Development Act
MVA	Megavolt ampere
MW	Megawatts
N	Nitrogen
NAAQS	National Ambient Air Quality Standards
NAG	Net Acid Generation
Na	Sodium
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management: Air Quality Act
Ni	Nickel
NDM	Nkangala District Municipality
NO_2	Nitrous oxide
NSS	Natural Scientific Services
^{O}C	Degrees Celsius
PM_{10}	Particulate matter with a fraction smaller than 10µm (microns)
ROM	Run-of-mine
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
Se	Selenium
SHE	Safety, Health and Environment
SO_2	Sulphur dioxide
SO_4	Sulphate (SO_4)
SPLP	Synthetic Precipitation Leaching Procedure
TDS	Total dissolved solids
TSF	Tailings storage facility
TSP	Total suspended particles
VKLM	Victor Khanye Local Municipality
WHO	World Health Organisation
WMA	Water Management Area

EXECUTIVE SUMMARY

Keaton Mining (Pty) Ltd (Keaton) owns and operates an opencast coal mining operation on the farm Vanggatfontein 251 IR in the Delmas Magisterial District of the Nkangala District Municipality in Mpumalanga Province, known as the Vanggatfontein Coal Mine. As part of the project Keaton is seeking approval for the changes to surface infrastructure at Vanggatfontein Coal Mine.

Initially the project scope, as presented in the background information document (BID) and at the scoping meeting, included the mining of a sensitive wetland area on the farm Vanggatfontein 251 IR that had been previously excluded from the mining area in the approved EIA and EMP report (Metago, 2008). The proposed mining of this wetland area required environmental authorisations from the Department of Economic Development, Environment and Tourism (DEDET) in terms of the National Environmental Management Act, 107 of 1998 (NEMA) and the Department of Water and Environmental Affairs in terms of the National Water Act, 36 of 1998. After consideration of specialist water resources input and after consideration of the IAP comments, Keaton's management team removed the mining of the wetland from the project scope and the NEMA application has subsequently been withdrawn.

The mine falls within the Nkangala District Municipality and the Victor Khanye Local Municipality in the Mpumalanga Province. The location of the project is outlined below.

TABLE 1: PROJECT LOCALITY INFORMATION

Location of project	
Province	Mpumalanga
District	Nkangala District Municipality
Local authorities	Victor Khanye Local Municipality
Farms	Vanggatfontein 251 IR
Nearest towns	Delmas (±15km north west), Devon (±18km south), Leandra (±20km west), Argent (±15km north), Kendal (±19km north east), Bapsfontein (±48km north west), Pretoria (±80km north west), Springs (±28km south west), and Bronkhorstspruit (±40km north)
Surrounding communities	Land owners land occupiers and farm labourers
Catchment	Olifants River Catchment – Tertiary Catchment B20 (Wilge River)

Legal framework and process

Given that the project is located on an operating mine the environmental assessment process and report was done and compiled in accordance with the requirements of the Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA). Other amendments to existing applications/permits needed for the project as identified during the process, including an amendment to the current integrated water use license application, will be applied for at the required time.

Metago Environmental Engineers (Pty) Ltd, a part of the SLR Group (Metago SLR), is the independent firm of consultants that has been appointed by the applicant company to undertake the environmental impact assessment (EIA) and related processes. The EIA and environmental management programme

(EMP) report is the product of the EIA process and provides a detailed description of the project, presents the results of specialist investigations, identifies and assesses potential impacts and recommends mitigation measures should the project be approved. As part of the EIA process, a stakeholder engagement process was conducted comprising notification of interested and affected parties (IAP) through newsletters, newspaper advertisements, site notices and a background information document; stakeholder meetings; and distribution of reports and report summaries for review. A team of professional specialists and engineers were appointed by Metago SLR to investigate potential issues associated with the development of the project. All issues, concerns and comments raised by IAPs have been addressed in the EIA and EMP report and included in the comments and response report in Appendix D of the EIA and EMP report. Full copies of correspondence are included in Appendix C.

Overview of the project

The current surface infrastructure layout at Vanggatfontein Mine deviates from the approved layout included in the EIA and EMP report as a result of an underground Transnet pipeline that crosses the farm Vanggatfontein 251 IR diagonally. This pipeline was only discovered after the EIA and EMP report had been approved by the relevant authorities, during the construction phase of the mine. As certain restrictions apply to the pipeline servitude in terms of development, excavations, blasting and crossing over the pipeline, Keaton has redesigned the layout of the surface infrastructure to avoid the servitude area.

The new infrastructure and approved infrastructure to be relocated and/or redesigned is listed below:

New infrastructure:

Following the changes to surface infrastructure at the mine, the stormwater management plan has been revised to comply with Government Notice 704 of the National Water Act. As a result the stormwater management facilities have been reconfigured, with associated channels to ensure that dirty water is captured, recycled and reused. In this regard, there is planned stormwater control capcity to the north and south of the MRDF and to the south of the processing plant.

Repositioning/redesign of approved surface infrastructure:

With reference to Figure A, the following approved infrastructure has been repositioned and/or redesigned:

- the following surface infrastructure has been repositioned:
    - topsoil, run-of-mine and product stockpiles;
    - waste rock dump/overburden stockpiles;
    - hard park area;
    - weigh bridge;
    - conveyor belts;
    - sewage treatment plant;
    - contractor yard;

  - laboratory;
  - diesel bay;
  - offices and workshop;
- the mine residue disposal facility (MRDF) has been reconfigured and consists of separate sections on either side of the Transnet pipeline;
- the footprint of the open pit mining area has changed; and
- the production capacity of the plant will increase from 250 000 to 300 000 tonnes per month.

Summary of environmental impacts

Potential environmental impacts were identified by Metago SLR in consultation with IAPs, regulatory authorities, specialist consultants and Keaton. The range of environmental issues considered in the EIA was given specific context and focus through consultation with authorities and IAPs.

It should be noted that the impact assessment that has been undertaken for this report looks at the potential impacts from the mining operation as a whole as a result of the changes to surface infrastructure.

A summary of the potential impacts (as per Section 7 of the EIA and EMP report) in the unmitigated and mitigated scenarios is provided in Table 2 below.

TABLE 2: POTENTIAL IMPACTS AND SIGNIFICANCE RATINGS

Impact	Significance	
	Unmitigated	Mitigated
Loss and sterilisation of mineral resources	L	L
Hazardous excavations/structures	H	M
Surface subsidence related to backfilling	M	L
Surface subsidence related to sinkholes	H-M	-
Loss of soil resources	H	M
Loss of land with agricultural potential	H	M
Impact on habitats and species	H	M
Pollution of surface water	H	L-M
Alteration of drainage patterns	H	M
Reduction in groundwater levels / availability for groundwater users	M	L
Reduction in groundwater levels / availability effect on base flow	M	M
Groundwater contamination	H	M-H
Dust generation	H	M (H for Receptors 1, 2 and 3)
Disturbing noise	M-H (H for Receptors 2, 3 and 4)	M (H for Receptors 2, 3 and 4)
Negative visual impacts	H	M
Disturbance of heritage andcultural sites	H	L
Disturbance of paleontological sites	M	L
Blasting hazards	H	M
Road and traffic impacts	H	M
Positive socio-economic impact	M+-H+	M+-H+

Impact	Significance	
	Unmitigated	Mitigated
Negative socio-economic impact (relocation)	H	M
Negative socio-economic impact (informal settlements, safety and security)	H	M
Negative socio-economic impact (land values)	H	M-L

Conclusion

Generally speaking, the potential impacts from the changes to surface infrastructure at the Vanggatfontein Coal Mine are not expected to differ significantly from what was assessed in the approved EIA and EMP report (Metago, 2008). In this regard, all the identified impacts should be managed at acceptable levels provided the mitigation measures are successfully implemented. One notable difference is that the 2008 EIA and EMP report (Metago, 2008) assumed that all farmers and farmworkers residing withing the mining right area would be relocated prior to the commencement of mining. To date, this has not occurred and therefore the significance of a number of impacts has increased for receptors residing within the mining right area unless they are relocated.

CHANGES TO SURFACE INFRASTRUCTURE AT VANGGATFONTEIN COAL MINE

INTRODUCTION AND LEGAL FRAMEWORK

Introduction

Keaton Mining (Pty) Ltd (Keaton) owns and operates an opencast coal mining operation on the farm Vanggatfontein 251 IR in the Delmas Magisterial District of the Nkangala District Municipality in Mpumalanga Province, known as the Vanggatfontein Coal Mine. It should be noted that the name "Emadzilini Colliery" which was used during the initial consultation phase of the environmental assessment process to describe the mine, was used prematurely and the mine should be referred to as the Vanggatfontein Coal Mine.

The regional and local settings of the mine are illustrated in Figure 1 and Figure 2 respectively. The surface infrastructure layout, as per the approved environmental impact assessment (EIA) and environmental management programme (EMP) report (Metago, 2008) has been included for ease of reference and is illustrated in Figure 3.

The surface infrastructure layout at Vanggatfontein Mine deviates from the approved layout included in the approved EIA and EMP report (Metago, 2008) as a result of an underground Transnet pipeline that crosses the farm Vanggatfontein 251 IR diagonally (Figure 3). This pipeline was only discovered after the 2008 EIA and EMP report had been approved by the relevant authorities, during the construction phase of the mine. As certain restrictions apply to the pipeline in terms of development, excavations, blasting and crossing over the pipeline, Keaton has redesigned the layout of the surface infrastructure to avoid the servitude area. As part of the project, Keaton is seeking approval for the changes to surface infrastructure at the Vanggatfontein Coal Mine.

The initial project scope included mining through a wetland area on the farm Vanggatfontein 251 IR. Following consideration of the sensitivity of mining through the wetland area and input received by IAPs during the scoping process, Keaton took a decision to exclude this component from the project scope. As a result, the NEMA application has been withdrawn.

FIGURE 1: REGIONAL SETTING OF VANGGATFONTEIN MINE

FIGURE 2: LOCAL SETTING OF VANGGATFONTEIN MINE

FIGURE 3: APPROVED INFRASTRUCTURE LAYOUT AT VANGGATFONTEIN MINE SHOWING THE LOCATION OF THE TRANSNET PIPELINE

Decisions required and legal framework

Prior to the commencement, environmental authorisation is required from governmental departments. These include:

- an environmental decision from the Department of Mineral Resources (DMR) in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 28 of 2002 for the changes to surface infrastructure at the mine; and
- a water use license from the Department of Water Affairs (DEA) in terms of the National Water Act, 36 of 1998 (NWA).

This report is the environmental impact assessment (EIA) (Section 1) and environmental management programme (EMP) (Section 2) for the project. Given the legal framework above, this report has been compiled strictly in accordance with the DMR EIA and EMP report template, and was informed by the guidelines posted on the official DMR website. To assist with cross-referencing in the report, the chapter numbering in the EMP section follows on from the chapter numbering in the EIA section.

Other approvals / permits

Other amendments to applications/permits needed for the project are listed below. In this regard, there are other approvals that are required prior to construction and/or commissioning of the mining and related activities. This list does not cover mine health and safety legislation requirements.

- Prior to conducting any water uses as defined in Section 21 of the National Water Act, 36 of 1998, the mine will submit either an amendment to their existing water use license application (WULA) or a new application to the Department of Water Affairs (DWA). This will include any exemptions from Regulation 704 of 4 June 1999. The water uses and exemptions could include:
  - Section 21(g) - Disposing of waste in a manner which could detrimentally impact upon a water resource – reconfiguration of dirty water storage dams, modifications to the mine residue disposal facility (MRDF) and overburden dumps;
  - Section 21 (j) - Removing water from underground for the safe continuation of an activity – the potential additional dewatering;
  - R704 exemption for Condition 5 – “May not use any residue or substance which causes or is likely to cause pollution of water resource for the construction of any dam or other impoundment or any embankment, road or railway or for any other purpose which is likely to cause pollution of a water resource”. The construction of roads and containment facilities may require the use of waste rock/overburden.
- All dams with both a wall greater than 5 m and a capacity of 50 000 m^3 must be registered as safety risk dams with DWA in terms of the National Water Act, 36 of 1998.
- Prior to damaging or removing heritage resources such as graves, permissions are required in terms of the National Heritage Act, 25 of 1999, the Ordinance on Exhumations, 12 of 1980, and the Human Tissues Act, 65 of 1983.

- Prior to removing or damaging any protected plant species, the necessary permits will be obtained from DWA in terms of the National Forests Act, 84 of 1998.
- Prior to storage, handling, transportation and disposal of explosives the relevant licenses and written permissions are required in terms of the Explosives Act, 25 of 1956, and the Mine Health and Safety Act, 29 of 1996, as amended.

EIA approach and process

A summary of the approach and key steps in the combined EIA process and corresponding activities are outlined in Table 3.

TABLE 3: EIA PROCESS

Objectives	Corresponding activities
Project initiation and application phase (January – March 2011)	
• Notify the decision making authority of the project. • Initiate the environmental impact assessment process.	• NEMA application submitted to DEDET in January 2011 • DEDECT acknowledge receipt of NEMA application • Notify DMR of the process
Scoping phase (April – October 2011)	
• Identify interested and/or affected parties (IAPs) and involve them in the scoping process through information sharing. • Identify potential environmental issues associated with the project. • Consider alternatives. • Identify any fatal flaws. • Determine the terms of reference for the EIA.	• Notify IAPs of the project and environmental assessment process (social scans, distribution of BIDs, newspaper advertisements, telephone calls and site notices) (April – May 2011) • General scoping meeting (June 2011) • Distribute scoping report to DMR, IAPs and other authorities for review (September 2011)
Retraction of NEMA application (August 2011)	
• Notify DEDET of project change in scope and retraction of NEMA application	• Letter submitted to DEDET informing the department of the change in project scope (i.e. the proposed mining of the wetland component of the project had been removed from the project scope), and the subsequent retraction of the NEMA application. • IAPs were notified of a change in scope via a newsletter (Appendix C)
Detailed specialist investigations (September 2011 – August 2012)	
• Describe the affected environment. • Define potential impacts. • Give management and monitoring recommendations.	• Investigations by technical project team and appointed specialists (see Table 4) of issues identified during the scoping stage including investigations into alternatives.
EIA/EMP phase (August – December 2012)	
• Assessment of potential environmental impacts. • Design requirements and management and mitigation measures.	• Compilation of EIA and EMP report. • Distribute EIA and EMP report to IAPs, DMR and other authorities for review (October 2012). • Feedback meeting with IAPs (November 2012). • Record comments (November 2012).

Objectives	Corresponding activities
• Receive feedback on application	• Forward IAP comments to DMR (November 2012). • Circulate record of decision to all registered IAPs registered.

EIA team

Metago Environmental Engineers (Pty) Ltd, a part of the SLR Group (Metago SLR), is the independent firm of consultants that has been appointed by the applicant company to undertake the environmental assessment and related processes. Fiona Bolton (project manager) has six years of relevant experience. Brandon Stobart (Reviewer) has 14 years of relevant experience and is certified as an Environmental Assessment Practitioner (EAP) with the Interim Certification Board of Environmental Assessment Practitioners of South Africa (EAPSA).

Neither Fiona, Brandon nor Metago SLR has any interest in the project other than fair payment for consulting services rendered as part of the environmental assessment process.

The environmental project team comprises Metago SLR's environmental assessment practitioners, specialist consultants and the technical feasibility team (Table 4).

TABLE 4: PROJECT TEAM

Name	Designation	Tasks and roles	Company
Environmental impact assessment and public involvement team			
Fiona Bolton	Project manager	Management of the assessment process, stakeholder engagement and report compilation.	Metago SLR
Caitlin Pringle	Project administrators		
Brandon Stobart	Project reviewer	Report and process review	
Specialist environmental assessment consultant team			
Hanlie Liebenberg-Enslin	Air quality specialist	Air quality assessment	Airshed Planning Professionals
Mark Bollaert Stephen van Niekerk	Hydrologist and engineer	Hydrology, and stormwater management plan	SLR
Rian Titus Theo Rossouw	Geohydrologist	Groundwater study	SLR
Professor Bruce Rubidge	Palaeontology specialist	Palaeontology study	BPI for Palaeontological Research
Paul van der Westhuisen	Traffic specialist	Traffic study	Siyazi
Stephen van Niekerk	Engineer	Closure liability	Metago SLR
Technical project team			
Mandi Glad	Operations director		Keaton Mining
Eben Ferreira	SHEQ manager		
Isak Nkosi	Mine manager		

Contact details for responsible parties

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Project Motivation (Need and Desirability)

The surface infrastructure layout at Vanggatfontein Mine deviates from the approved layout included in the approved EIA and EMP report (Metago, 2008) as a result of an underground Transnet pipeline that crosses the farm Vanggatfontein 251 IR diagonally (see Figure 3). This pipeline was only discovered after the 2008 EIA and EMP report had been approved by the relevant authorities, during the construction phase of the mine. As certain restrictions apply to the pipeline in terms of development, excavations, blasting and crossing over the pipeline, Keaton has redesigned the layout of the surface infrastructure to avoid the servitude area.

SECTION 1 – ENVIRONMENTAL IMPACT ASSESSMENT

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

This section provides a description of the current baseline conditions of the mine site and surrounding areas within which the project will be undertaken. Each discussion provides a link to anticipated impacts and highlights the relevance of the information provided, identifies how data was collected (either by the specialist and/or Metago SLR) to inform the baseline description, provides the results/outcomes of research and/or studies undertaken and concludes with the main findings as relevant to the impact assessment and management plan.

The environmental aspects are discussed as follows:

- baseline description of bio-physical environment (Section 1.1)
- baseline description of land uses, socio-economic conditions, heritage and cultural aspects (Section 1.3).

Key environmental aspects requiring protection or remediation are identified in Section 1.2. Maps showing environmental features on and off site are included in Section 1.1 and cross-referenced in the relevant baseline descriptions. A list of supporting specialist information used in the baseline description is included in Section 1.5. Assumptions and uncertainties identified by the specialist studies are outlined in Section 11.

1.1 ON-SITE ENVIRONMENT (BIO-PHYSICAL) RELATIVE TO SURROUNDING ENVIRONMENT (BIO-PHYSICAL)

1.1.1 GEOLOGY

Introduction and link to anticipated impact

The geology of a particular area will determine the following factors:

- the type of soils present since the soils can be derived from the parent rock material;
- the presence and quality of groundwater and the movement of the groundwater in the rock strata;
- the presence of paleontological resources in the rock strata;
- the potential for acid generation.

All of the above aspects are considered in this EIA in the relevant sections below.

Data collection

Geological baseline information was sourced from the approved EIA and EMP report (Metago 2008).

Results

Regional and local geology

The Vanggatfontein Coal Mine is located on the western edge of the Central Witbank Coalfield. Figure 4 provides a conceptual understanding of the geological layers that occur at the mine. The target coal seams are contained within a 70m thick succession of sedimentary rocks in the Witbank Coalfield. Though the Number 3 Seam is not developed in certain boreholes, the mining area shows the complete sequence of the Witbank Coalfield. The distribution and altitude of the Number 1 and Number 2 Seams are to a large extent controlled by the pre-Karoo topography, particularly erosional glacial valleys. The Number 4 and Number 5 seams are controlled by the present day land surface, with parts or all of these seams eroded away in places.

The mine is predominantly covered by rocks of the Karoo Supergroup and small outcrops of the non-coal bearing Transvaal Supergroup also occur in the far eastern portion. The pre-Karoo basement on the mine area also consists of rocks of the Transvaal Supergroup. Most of these are overlain by impermeable sedimentary rocks of the Dwyka Group. Boreholes that have penetrated through the Dwyka Group into the basement intersect mainly Malmani Group dolomites of the Transvaal Supergroup, some of which show evidence of karst topography. An important related aspect is the existence of impermeable zones comprising all or some of 1 seam/mudrock, Dwyka Tilite and/or other sediment zones. These impermeable zones occur below the target coal seams (2, 4 and 5) across most of the mine site, and play an important role in preventing the flow of potential contaminants from the mined areas into the dolomites.

The stratigraphy of the mine area may be subdivided into three main sequences, a basal Number 2 Seam sequence, overlain by the Number 4 Seam Sequence, which in turn is overlain by the Number 5 Seam sequence (Winter et al, 1987). The Number 1 Seam is not well developed in the mine area, and where present forms a coal and carbonaceous mudrock rich interval. The Number 2 Seam is well developed over much of the mine area and consists of a number of zones of alternating bright and dull coal and shaly coal. The most characteristic feature of the Number 4 seam is its coarsening upwards nature.

The depth of weathering is variable and is dependent on the surface lithogies, with the average soft overburden thickness being 7.5m and the average depth of weathering being 17.1m.

Presence of structural features

The area is also characterised by numerous dolerite intrusions, which occur at various stratigraphic levels. Sills and dykes were also intersected above and below the Number 4 and 2 Seam, further west of the mine. They were also intersected on the contact of the Dwyka Group with the basement.

<u>Geochemical analysis</u>

A geochemical assessment was undertaken on various samples collected during the exploration phase of the Vanggatfontein Coal Mine. The objective of the assessment was to geochemically characterise the potential waste material (overburden, coarse discard and coal slurry) and assess the potential for Acid Rock Drainage (ARD) and the potential of contamination by metalliferous elements that could leach from the waste material.

At the time of the geochemical assessment, the mine was at the design stage; therefore actual waste samples were not available. Samples were therefore selected from drill cores made available through the exploration programme undertaken in 2008 as part of the original environmental assessment. Samples were taken from positions that were generally just above or just below the coal seam, namely:

- Core 111 Top Seam 2;
- Core 111 Bottom Seam 2;
- Core 111 Top Seam 4;
- Core 111 Bottom Seam 4;
- Core 111 Top Seam 5; and
- Core 111 Bottom Seam 5.

The following laboratory testing was undertaken:

- Acid Base Accounting (ABA) analysis was undertaken to determine the acid neutralising potential (NP) and the acid generating potential (AP) of the waste rock samples;
- Net Acid Generation (NAG) analysis was undertaken to determine the acid generating potential of sulphur minerals in a sample by oxidation with hydrogen peroxide (H_2O_2); and
- Synthetic Precipitation Leaching Procedure (SPLP) was undertaken on the samples to provide an indication of the metals and salts that could be leached.

A first order risk assessment has been undertaken based on the results retrieved from the above specified tests. First order risk assessments link a potential source (i.e. tailing storage facility or overburden/waste rock dump) directly to a potential receptor (i.e. human beings or the environment), by comparing the leachate quality results to following water quality standards (physical parameter):

- Department of Water Affairs and Forestry (DWAF) Acceptable Risk Levels;
- DWAF Drinking Water for Domestic Use Guideline values;
- South African National Standard (SANS) 241 Class II (Upper Limit) for Drinking Water;
- World Health Organisation (WHO) Guidelines for drinking-water quality (WHO, 2006);
- International Finance Corporation (IFC) Guidelines for Mining Effluents (IFC, 2007);

The ABA and leach test results of the six core samples are presented in Table 5 and Table 6 and are discussed below.

ABA

With reference to Table 5, the ABA results suggest that out of the six samples tested:

- four samples are considered to be Non-Acid Generating; and
- two samples are considered to be Potential Acid Generating, namely:
    - Core 111 Bottom Seam 2; and
    - Core 111 Top Seam 4.

NAG Tests

- the NAG pH value for two of the six samples was below pH 3.5 which suggests a risk of acid generation. These samples are:
    - Core 111 Bottom Seam 2; and
    - Core 111 Top Seam 4.
- the NAG pH for one of the six samples (Core 111 Top Seam 2) was between pH 3.5 and pH 5.5 which suggests that there is a low risk of acid generation; and
- the NAG pH for three samples was above pH 5.5 which indicates no risk of acid generation.

SPLP

Elevated concentrations of a number of parameters have been recorded in samples that were leached under acidic conditions (pH5). The main parameters of concern (those with several exceedences) are:

- aluminium;
- arsenic;
- cadmium;
- chromium;
- copper;
- iron;
- lead;
- manganese;
- phosphorous; and
- zinc.

TABLE 5: SUMMARY OF ABA RESULTS FOR VANGGATFONTEIN SAMPLES

Sample ID	Acid Potential (AP) (kg/t)	Neutralization Potential (NP)	Net Acid Production Potential (NAPP) (KgH2SO4t-1)	NAG pH: (H2O2)	NAG 4.5 (kg H2SO4 / t)	NAG 7.0 (kg H2SO4 / t)	Classification
Core 111 Top Seam 2	3.4	<10	-6.6	5.3	<0.2	2.7	Non-Acid Forming
Core 111 Bottom Seam 2	27.5	<10	17.5	3.3	5.5	27.4	Potentially Acid Generating
Core 111 Top Seam 4	11.6	<10	1.6	3.1	3.9	5.9	Potentially Acid Generating
Core 111 Bottom Seam 4	0.9	<10	-9.1	6.3	<0.2	0.6	Non-Acid Forming
Core 111 Top Seam 5	0.9	<10	-9.1	6.8	<0.2	0.2	Non-Acid Forming
Core 111 Bottom Seam 5	0.9	<10	-9.1	6.7	<0.2	0.4	Non-Acid Forming

TABLE 6: SUMMARY OF LEACH TEST RESULTS FOR VANGGATFONTEIN SAMPLES

Determinand	S	SO4	SS_DIFF	C	CO3	Final_PH	Al	Ba	Ca	Cu	Fe	K	Mg	Mn
Acceptable Risk Level (ARL)	-	-	-	-	-	-	0.39	7.8	-	0.1	9	-	-	0.3
DWAF Domestic Use (DU) Guideline	-	-	-	-	-	6 – 9	0.15	-	32	1	0.1	-	30	0.05
WHO Standard for Drinking Water (2011)	N/A	N/A	N/A	N/A	N/A	N/A	0.2	0.7	N/A	2.0	N/A	N/A	N/A	N/A
IFC Mining Effluent (2007)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	2	N/A	N/A	N/A
SANS 241 Upper Class II (2006)	N/A	N/A	N/A	N/A	N/A	4-10	0.5	N/A	300	2	2	100	100	1
Units	%	%	%	%	%	Nounit	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l
Top Seam 2	0.14	0.07	0.11	4.36	0.38	5.29	5.3	0.37	4.1	0.1	0.79	7.3	2.8	0.11
Bottom Seam 2	0.91	0.1	0.88	12.9	0.05	2.76	31	0.26	5	0.17	130	5.2	2.6	0.8
Top Seam 4	0.41	0.12	0.37	0.15	<0.05	3.07	3.1	0.28	3.1	0.13	1.2	7.7	1.3	0.46
Bottom Seam 4	0.03	<0.03	0.03	4.83	0.52	6.19	1.2	0.1	0.99	<0.02	0.06	3	0.5	0.02
Top Seam 5	0.07	0.12	0.03	0.76	0.21	6.72	11	0.19	6.6	<0.02	9.9	12	3.6	0.18
Bottom Seam 5	0.06	0.12	0.02	5.29	0.1	6.74	7.8	0.37	8.5	<0.02	4.1	12	5.1	0.04

Determinand	Na	Ni	P	S	Si	Sr	Ti	V	Zn	Zr	As	Cd	Cr	Pb
Acceptable Risk Level (ARL)	-	1.14	0.1	-	-	-	-	1.3	0.7	2	430	31	4700	100
DWAF Domestic Use (DU) Guideline	100	-	-	-	-	-	-	0.1	3	-	10	5	-	10
WHO Standard for Drinking Water (2011)	N/A	0.07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	3	50	10
IFC Mining Effluent (2007)	N/A	0.5	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	100	50	100	200
SANS 241 Upper Class II (2006)	400	0.35	N/A	N/A	N/A	N/A	N/A	0.5	10	N/A	50	10	500	50
Units	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	µg/l	µg/l	µg/l	µg/l
Top Seam 2	24	<0.05	<0.53	28	22	0.27	0.07	<0.07	0.51	<0.05	<1	1.9	100	4
Bottom Seam 2	24	0.42	4.1	140	30	0.38	<0.02	0.07	0.54	0.05	55.9	5.3	250	43
Top Seam 4	21	<0.05	<0.53	46	12	0.1	<0.02	<0.07	0.31	<0.05	<1	8.6	21	12
Bottom Seam 4	21	<0.05	1.4	11	19	0.06	0.12	0.14	<0.17	<0.05	2.5	<1	6	<3
Top Seam 5	19	<0.05	3.2	11	31	0.06	0.25	<0.07	0.31	<0.05	15.1	<1	25	28
Bottom Seam 5	21	<0.05	1.9	7.9	36	0.32	0.17	<0.07	<0.17	<0.05	5.6	<1	37	14

Conclusion

Impermeable zones found across most of the mine site can assist with the prevention of potential contaminants from the mined areas reaching the dolomites. It is important that management meausres to protect these impermeable zones are considered during the mining operation.

Geochemical analysis indicates that waste from the Vanggatfontein Coal Mine could be potentially acid generating. In addition, there is the potential for seepage concentrations to exceed the relevant water quality standards for various parameters. Both of these aspects present a potential pollution risk for both surface and groundwater in the both the short and long term. It follows that short and long term pollution prevention and/or treatment measures must be considered.

1.1.2 CLIMATE

Introduction and link to anticipated impact

As a whole, the various aspects of climate (as discussed below) influence the potential for environmental impacts and related mine design. Specific issues are listed below:

- rainfall influences erosion, vegetation growth, rehabilitation planning, dust suppression and surface water management planning;
- temperature influences air dispersion through impacts on atmospheric stability and mixing layers, vegetation growth, and evaporation which influences rehabilitation planning; and
- wind influences erosion, the dispersion of potential air pollutants and rehabilitation planning.

To understand the basis of these potential impacts, a baseline situational analysis is described below.

Data collection

Climatic data was sourced from the approved EIA and EMP report (Metago, 2008).

Results

Regional climate

The mine falls within the Limpopo and Olifants River Basin, as defined by the weather bureau, Department of Environmental Affairs (1994), which has a semi-arid to hot climate. The average annual precipitation ranges from 600mm to 700mm (WRC, 1994). Rainfall is generally in the form of thunderstorms.

Weather stations

Precipitation, evaporation and temperature data

Apart from wind data, climatic data from weather recording stations in the vicinity of the mine was obtained from the South African Weather Service (SAWS) and the Water Research Commission (WRC). Weather stations used are summarised in Table 7. An indication of the data used is included in the table.

All weather stations within a 50km radius of the mine were analysed and the use of data from the various stations depended on the availability of data from the weather station and the length of the data record.

TABLE 7: DETAILS OF SOUTH AFRICAN WEATHER SERVICES STATIONS IN THE VICINITY OF VANGGATFONTEIN

	South Africa Weather Stations			
	Witbank Strehla	**Delmas Vlakplaas**	**Delmas**	**Witbank Cologne**
Station number	0477762 5	0477494 6	0477309 1	0478008 1
Latitude (South)	26^{o} 12' 00"	26^{o} 13' 48"	26^{o} 09' 00"	26^{o} 07' 48"
Longitude (East)	28^{o} 55' 48"	28^{o} 46' 48"	28^{o} 40' 48"	29^{o} 01' 12"
Elevation (mamsl)	1585	1615	1571	1585
Length of data record available	1920 to 2008	1973 to 1989	1924 to1989	1924 to 1989
Elevation difference based on the mean 1581 mamsl for the site	+4m	+34m	-10m	+4m
Distance and direction from the mine	10km South East	6.5km West	15.28km North West	20km South East

Rainfall

Average rainfall data, as included in Table 8, was sourced from the four South African Weather Service stations identified in Table 7.

The mean annual precipitation (MAP) for the area is 667.8 mm (SAWS). For the Witbank Strehla Station, over the last ten year period, 1974 recorded the highest rainfall in a year with 939.7 mm while the lowest of 421.5 mm was recorded in 1965 (WRC). The majority of the rainfall falls during the summer months of October to March at which time approximately 85% of the annual rainfall occurs. Only 15% of the rainfall occurs between April and September.

TABLE 8: RAINFALL DATA FOR VANGGATFONTEIN MINE

Month	**Rainfall**			
	Average (mm)	**Maximum recorded daily rainfall**	**Date of maximum rainfall**	**Average number of rain days**
January	112.4	98	1972/01/20	9.1
February	88.4	90	2004/02/13	6.6
March	80.7	103	1995/03/25	6.2
April	37.7	64	1990/04/28	3.4
May	17.2	98.8	1936/05/23	1.8
June	7.6	38.9	1940/06/17	0.8
July	5.5	35	1957/07/03	0.6
August	7.9	32.3	1922/08/23	0.8
September	20.1	52.2	1987/09/27	1.8
October	69.6	85	1995/10/29	6.1
November	105.9	106.5	1977/11/29	8.9
December	114.9	125.5	1989/12/05	8.9
Annual	**667.9**	**929.2**	**-**	**-**

Maximum rainfall depths

The highest intensity storm recorded in the area (Witbank Strehla Station) was 125.5 mm in the month of December (Table 8). The storm events for specific return periods are outlined below.

Return period (years) *Reference method used*	**24-Hour rainfall depth** *South African Weather Bureau*
1:25	81 mm
1:50	94 mm
1:100	106 mm

Temperature

The closest station to the mine that has a record of temperature statistics is South African Weather Service's Witbank Station (05153208). The average monthly maximum and minimum values are shown in Table 9.

From the table it can be seen that the area experiences an average maximum temperature of 26.1^{0}C and an average minimum temperature of 4^{0}C. The maximum temperature which the area has experienced is 34.2^{0}C in summer and a minimum of -4.3^{0}C in winter over the recorded years the station was operational.

TABLE 9: AVERAGE TEMPERATURES RECORDED IN THE REGION OF THE MINE – WITBANK STATION

Month	**Daily average**			**Extremes**			
	Min	**Max**	**Mean**	**Max**	**Year/day**	**Min**	**Year/day**
January	15.1	26.0	20.6	34.2	01/11	7.3	01/03
February	14.9	26.1	20.5	32.9	98/07	11.1	96/16
March	13.5	24.9	19.2	33.5	99/02	7.0	03/26
April	10.6	23.0	16.8	31.4	98/06	2.3	97/29
May	7.0	20.3	13.7	27.6	98/01	-1.3	94/29
June	4.8	18.5	11.7	26.4	98/25	-5.4	94/30
July	4.0	18.2	11.1	26.5	02/29	-3.5	96/26
August	6.5	21.1	13.8	28.4	97/26	-4.3	03/21
September	9.4	24.2	16.8	33.9	97/29	0.5	99/11
October	11.9	25.4	18.7	33.4	06/24	3.3	04/09
November	13.4	25.3	19.4	33.4	05/03	4.4	02/07
December	14.5	25.9	20.2	33.2	03/14	4.8	94/12
Year average	**10.5**	**23.2**	**16.9**	**34.2**		**-5.4**	

Wind

Wind data and dispersion potential

Kendal Power Station's ambient monitoring station is regarded as representative of the local meteorology. The predominant wind direction in the area is from the north, north-west and north-east with frequencies up to 12 %, with strong wind speeds of up to 15 m/s. Calm conditions (wind speeds below 1 m/s) occurred 7.6 % of the time.

Annual average, day-time and night-time wind roses (January 2007 to December 2007) are depicted in Figure 5. Day-time conditions indicated a similar pattern, with winds predominantly from the north, north-westerly and north-easterly sectors, with an increase in frequency of winds from the north-westerly sector. Night-time conditions were characterised by winds from the north and north-easterly sectors. The frequency of occurrence of the winds from the north and north-easterly was 13 % and 12 % respectively.

Seasonal wind roses are presented in Figure 6. During the summer months, winds from the northerly, north-easterly and north westerly sectors were dominant, with stronger winds of up to 15 m/s. During autumn, the strong winds of up to 15 m/s blew more frequently from the north-westerly and north easterly sectors with frequencies of up to 11 %. The winter months reflected the dominancy of winds from the north-westerly sector although there was a noticeable decrease in the frequency of winds from the north easterly sector compared to the summer months. In spring, wind flow was predominant from the north and north-westerly sectors, with an increase in wind speeds and frequencies of occurrence being evident.

<u>Evaporation</u>

The evaporation data was sourced from the Water Research Commission, Bronkhorstspruit dam station (B2E001), which is the closest station to the mine with available evaporation data (35km from the site). The mean Average S-Pan evaporation is 1532mm per year (Table 10). Evaporation reaches a peak in March of 171.6mm, with the lower evaporations occurring in September (160.7mm) and October (79.81mm).

TABLE 10: EVAPORATION DATA FOR THE MINE AREA – BRONKHORSTSPRUIT DAM

Month	Evaporation Average (mm)
January	165.1
February	155.8
March	171.6
April	168.5
May	140.5
June	138.6
July	106.63
August	89.8
September	72.92
October	79.81
November	105.7
December	136.96
Annual	**1532**

<u>Extreme events</u>

Rainfall conditions are highly variable and droughts and floods do occur. Hail occurs approximately two to four times per season.

Conclusion

The area in which Vanggatfontein Coal Mine is situated is characterised by summer rainfall and moderate temperatures. High evaporation rates reduce infiltration rates while the high rainfall levels can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. Although the area experiences wind from all directions, the predominant wind directions are from the north, west and east. These climatic aspects need to be taken into consideration during impact mitigation, monitoring, rehabilitation and surface water management planning.

1.1.3 TOPOGRAPHY

Introduction and link to anticipated impact

The topography of a particular area will determine the following factors:

- the flow of surface water, and in many cases, also groundwater;
- the depth of soils and the potential for soil erosion, for example, in the case of steep slopes;
- the type of land use, for example flat plains are more conducive to crop farming;
- the aesthetic appearance of the area;
- climatic factors such as wind speeds and direction, for example, wind will be channelled in between mountains along valleys.

Changes in the topography caused by mining related activities could therefore alter all of the above-mentioned aspects of the environment. Mining-related activities have the potential to alter the topography of the site through the establishment of both temporary and permanent infrastructure.

This section provides an understanding of the topographical features relevant to the mine and surrounding area from which to measure potential change.

Data collection

Topographic data was sourced from the approved EIA and EMP report (Metago, 2008).

Results

The Vanggatfontein Coal Mine lies between the Bronkhorstspruit in the west and the Wilge River in the east. The mine is characterised mostly by flat and/or gently sloping plains. The elevation is approximately 1600 meters above sea level (masl).

Conclusion

Mining activities, infrastructure and communities have the potential to alter the topography and the natural state of undisturbed areas. An alteration of the natural topography has the potential to present dangers to both animals and people and to alter natural systems such as water flow. The design of future infrastructure should be such that any changes to topography result in stable topographic features which do not pose significant risk to third parties, limit impacts on the visual character of the area and allow for effective surface water management.

1.1.4 SOILS

Introduction and link to anticipated impact

Information for this section was sourced from the approved EIA and EMP report (Metago, 2008) and the pedological specialist study (ESS, 2008) that was undertaken for the approved EIA and EMP report. Note that this section covers the entire Vanggatfontein mining area.

Soil is an important natural resource and provides ecosystem services that are critical for life, such as:

- water filtering;
- providing growth medium for plants, which in turn provide food for plant-eating animals; and
- provide habitat for a wide variety of life forms.

Soil forms rather slowly by the breaking down of rock material and is therefore viewed as a non-renewable resource. Soil determines the type of land use the area is suitable for, for example, soil with high nutrients will be able to support crop farming.

Soil resources are vulnerable to pollution, erosion and compaction, which could be caused by mining-related activities.

Data collection

The reconnaissance pedological study of the site was performed based on a grid overlay of 300m x 300m. The survey was undertaken between July 2007 and December 2007. In addition to the grid point observations, a representative selection of the soil forms mapped was sampled for representative chemistry of the soils.

Results

<u>Soil type and depth</u>

Soils were classified using the Taxonomic Soil Classification System for South Africa (Mac Vicar et al, 2nd edition 1991). This system employs two main categories or levels of classes: an upper level containing soil forms, and a lower, more specific level containing soil families.

All areas included in the study have been ranked according to the soil classification nomenclature. Soil types identified in the project area are summarised below in Table 11 and illustrated in Figure 7. Since the survey was undertaken the eastern portion of the mining right area has been significantly transformed by mining infrastructure and activities. Given this, Table 11 data (particularly soil depth) will be relevant in undisturbed areas but not always in the areas that have been transformed.

TABLE 11: SUMMARY OF THE SOILS PRESENT AT THE MINE

Label on Figure 7	Soil name	Soil depth (m)	Area covered by soil type (Ha)
4-6 Av	Avalon	4-6	103.242
4 Av/Bv	Avalon/Bainsvlei	2-4	5.986
0-2 Av/Bv	Avalon/Bainsvlei	0-2	26.402
0-2 Av/We	Avalon/Westleigh	0-2	94.657
4-6 Bv	Bainsvlei	4-6	13.835
4-6 Bd	Bloemdal	4-6	33.247
6-8 Cv/Gf	Clovelly/Griffin	6-8	509.190
Dam	Dam		5.922
2-4 Gc	Glencoe	2-4	7.438
4-6 Gc	Glencoe	4-6	160.946
6-8 Gc	Glencoe	6-8	131.217
6-8 Gf	Griffin	6-8	17.909
8-10 Gf	Griffin	8-10	20.740
6-8 Hu	Hutton	6-8	132.326
10-12 Hu	Hutton	10-12	23.392
12-15 Hu	Hutton	12-15	1.816
6-8 Hu/Gf	Hutton/Griffin	6-8	8.822
6-8 Hu/Sd	Hutton/Shortlands	6-8	133.462
2-4 Ka/Kd	Katspruit/Kroonstad	2-4	153.347
0-2 Ka/Kd	Katspruit/Kroonstad	0-2	62.496
3 We	Westleigh	0-3	3.603
Pan	Pan		9.384
Total Area (Ha)			**1659.379**

** The letters are an abbreviation for the soil name while the numbers preceding the letters refer to the soil depths*

Hutton (Hu)

These soils comprise predominantly fine grained sandy, to silty loams or fine to medium grained sandy clay loams, depending on the lithological unit from which they are derived. They generally exhibit an apedal to weak crumby structure. In terms of colours, they returned pale red/brown to yellow red in the topsoils and fine to medium grained sandy clay and clay loams, with dark orange reds and dark red in the subsoil horizons. These strong red colours are mainly due to the high magnesium and iron content of the soils. Clay content varies from 6% to 15% in sandy topsoils and in some instances, between 25% to 35%, depending on the position that they occupy in the topographic sequence. The soils classify as having a mesotrophic or dystrophic leaching status (moderately to highly leached) and are generally luvic in character. The effective rooting depths varies from 400mm to greater than 1500mm.

Clovelly (Cv), Griffin (Gf)

These soils are generally derived from the same parent material as that of the Hutton Form and have similar physical and chemical characteristics. Their colours vary from pale grey brown to yellow brown colours (very fine to medium grained sandy/silty loam) to darker yellow reds and less leached colours (clay rich sandy clay loam). They exhibit a predominantly dystrophic leaching status and luvic characteristics. The effective rooting depths vary from a minimum of 400mm to greater than 1500mm. Compaction and erosion are physical hazards to be aware of, and catered for when working with these soils types.

Avalon (Av)

These soils fall within the "hydromorphic" category of soils as classified. They are generally associated with down slope of the dry, sandy loams and sandy clay loams and form the transition zone of the moist grasslands. These soils are influenced by a rising and falling water table, hence the mottling within the lower portion of the profile and the pale background colours. Depths of utilizable agricultural soil vary from 200 mm to 1000 mm. In general, these soils are high in transported clay in the lower "B" horizon with highly leached topsoils and pale denuded horizons at shallow depths.

Glencoe (Gc)

These soils are generally associated with the Av soils and are confined to the lower slope positions. They are classified as wet soils types and characterised by a hard plinthic (ouklip) layer at the base of the profile. They are often found in mid, and in some cases, upper midslope positions, as residual or old land forms. They are generally pale red to brown and apedal in structure in the topsoils. They have moderate to low clay contents randing from 6% to 12% and moderate to low water holding capabilities ranging from 40 mm/m to 60mm/m. The subsoil is generally pale yellow/red to pale red in colour and has moderate clay content ranging from (12% to 22%).

Westleigh (We)

By definition, this is a soil form with hydromorphic characteristics. The soil form exhibits strong indications of wetness at shallow depths in the form of strong red to yellow/red mottling on a strong grey background. These soils are generally high in transported clay in the lower "B" horizon with highly leached topsoils and pale denuded horizons at shallow depths. Compaction is a problem to contend with if these soils are to be worked during the wet months of the year.

Kroonstad (Kd) and Katspruit (Ka)

These soils are found associated exclusively with the wetland and vlei areas alongside the rivers and around the prominent pan features. They are highly susceptible to compaction and erosion.

Shortlands (Sd)

These soils are generally associated with the Hutton Form and have similar chemistry. They are generally dark red to dark red brown and exhibit moderate crumbly to weak blocky structure. They have moderately low intake rates, high water holding capabilities and in certain cases showed evidence of expansive clays (predominantly smictite) and a range in depths of 600mm to 800mm. These soils have a very high clay content and are erosive in nature.

<u>Soil properties</u>

A suite of representative samples from different soil forms/types were taken for both physical and chemical analysis.

The soils in the mining area are predominantly light textured, sandy loam to sandy clay loams in nature with generally moderate to low levels in most minerals with related sodic/salinity rating. Light to moderate textured soils showed a pH (KCl) of between 4.55 and 6.15 with a base status ranging from 1.0 me% to 3.8 me%. Nutrient levels showed acceptable levels of potash, magnesium and sodium with deficiencies in potassium, calcium and zinc and with low to moderate organic matter. Structured and basic derived soils showed higher values of calcium, magnesium and sodium and were low in potassium reserves. These soils also showed low levels of zinc and potash. There are no indications of any toxic elements that are likely to limit natural plant growth in the soils mapped. In general, the dominant soils mapped in the mining right area are neutral to slightly acidic (pH average of approximately 5.00), which is within accepted range for good nutrient mobility. Due to the general lack of adequate clay particles of the soils and the low organic carbon in the soils, the cation exchange capacity (CEC) of the soils is moderate to low. The majority of the soils mapped in the project area have a moderate to high erodibility.

Dryland agricultural (production) potential

The dryland production potential of the shallow Katspruit Form soils is poor to very poor, while that of the Avalon is considered to be moderate. The dry land production potential of the Hutton, Clovelly and Griffin Form soils is moderate to high under normal rainfall conditions. This is mainly due to the general low nutrient status of the soils in their natural state. In order to increase the productivity to a viable and sustainable cropping potential, additional fertilizers, water (irrigation) and extremely good drainage management will be required.

Irrigation Potential

In terms of soil structure and drainage capability, the irrigation potential of the arable soils (Hutton, Griffin, Clovelly, and deep Avalon Form soils) can be described as moderate to good. The remainder of the soils are generally drainage impaired and adequate drainage and good water management would be required in order for the soils to be economically cultivated to irrigate crops.

Conclusion

The baseline soil information has been used to identify sensitive soil types, to guide the project planning in order to avoid sensitive soil types where possible, to determine how best to conserve the soil resources in the area and allow for proper rehabilitation of the site once mining ceases.

1.1.5 PRE-MINING LAND CAPABILITY

Information in this section was sourced from the approved EIA and EMP (Metago, 2008) and the pedological specialist study (ESS, 2008) that was undertaken for the approved EIA and EMP report. Note that this section covers the entire Vanggatfontein mining area.

Introduction and link to impact

The land capability classification is based on the soil properties and related potential to support various land use activities. Mining operations have the potential to significantly transform the land capability. To understand the basis of this potential impact, a baseline situational analysis is described below.

Data collection

The reconnaissance pedological study of the site was performed based on a grid overlay of 300m x 300m. The survey was undertaken between July 2007 and December 2007. In addition to the grid point observations, a representative selection of the soil forms mapped was sampled for representative chemistry of the soils.

Results

The pre-mining land capability of the mining right area was classified into four classes (wetland, arable land, grazing land and wilderness) according to the Chamber of Mines Guidelines, 1991. The distribution of the land capability classes within the mining right area is illustrated in Figure 7 and summarised in Table 12 below. It must be noted that the land capability classification (which is based on soil types in their natural state) may not match the actual land use. In this regard, the extent of land that was historically used for crop farming in the mining right area was significantly more than the amount of land that is classified as arable.

TABLE 12: LAND CAPABILITY DISTRIBUTION

Land Capability	Area (Ha)	Description	% of Total
Arable	197.319	Substantial areas have already been cultivated and sustained by large capital inputs, highly resistant and high yielding crops and good water/drainage management. Rehabilitation of areas to an arable land capability is limited to the utilisation of deep well drained soils and deeper hydromorphic soil forms.	11.89%
Grazing	1092.825	These areas are generally confined to the shallower and transitional hydromorphic soil forms that are moderately well drained.	65.86%
Pan	9.384	These zones are dominated by hydromorphic soils that are often structured, and have plant life that is associated with aquatic processes. In some of these areas, the historical cultivation and/or grazing activities have transformed the underlying wetland nature and capability.	0.57%
Dam	5.922		0.36%
Wetland	353.929		21.33%
Total Area	1659.379		100%

Conclusion

The pre-mining land capability of the majority of the mining right area is classified as grazing, arable and wetland. It should however be noted that land capability classifications may not match the actual land use due to anthropogenic influence (mainly agriculture related). The historic land capability within the mining right area has been changed with the development of the mine, particularly in the eastern portion of the mining right area. Therefore, impact management and rehabilitation planning are required to achieve acceptable post rehabilitation land capabilities.

1.1.6 BIODIVERSITY

Information in this section was sourced from Keaton's approved EIA and EMP report (Metago, 2008) and the biodiversity specialist study (NSS, 2008) that was undertaken for the approved EIA and EMP report. Note that this section covers the entire Vanggatfontein mining area.

Introduction and link to anticipated impact

Biodiversity refers to fauna (animals) and flora (plants). According to the International Union of Conservation of Nature (IUCN) (2011), biodiversity is crucial for the functioning of ecosystems which provide us with products and services which sustain human life. Healthy ecosystems provide us with oxygen, food, fresh water, fertile soil, medicines, shelter, protection from storms and floods, stable climate and recreation.

The establishment of mining-related infrastructure and support facilities have the potential to result in the loss of vegetation, habitat and related ecosystem functionality through physical disturbance and/or contamination of soil and/or water resources.

The baseline information on biodiversity in the mining right area area has been used to identify sensitive areas, to guide the project planning in order to avoid sensitive areas where possible, to determine how best to conserve the fauna and flora in the area and allow for proper rehabilitation of the site once mining ceases.

Data collection – vegetation

Various sampling methods were used to determine the various vegetation communities within the mining right area. These sampling methods included field surveys and data analysis. Field surveys used the Braun-Blanquet Cover classes. Data analysis was undertaken using a TWINSPAN analysis to delineate the different vegetation communities and the Detrended Correspondence Analysis ordination to determine the proximity and the relationship between the various vegetation communities.

Data collection – animal life

Methods used during the study of animal life within the mining right area included a literature review and fieldwork. The main fieldwork components included visual observations (day and night) and live trapping.

Data collection – aquatic investigation

Three indicators of wetland health were used to assess the river systems within the mining right area:

- ecological integrity / present ecological state (PES) through SASS5 monitoring;

- habitat – stream availability, and abundance and diversity of biotopes; and
- water quality – conductivity, pH, dissolved oxygen and temperature.

Results – Flora

The mine falls within two vegetation types. These are the Rand Highveld Grassland and Eastern Highveld Grassland. Both of these vegetation types are classified as endangered, but in this regard, it must be noted that the mining right area does not fall within the Mpumalanga Parks Board Biodiversity Conservation Plan because it is significantly influenced by agriculture and mining and the natural vegetation is already significantly fragmented. According to Mucina and Rutherford (2006), endangered vegetation types have lost up to 40% of their original extent and are exposed to partial loss of ecosystem function. Figure 9 illustrates the regional vegetation types.

Three broad vegetation units were identified consisting of nine distinct floristic assemblages and four sub-assemblages. The following vegetation/habitat units and associated assemblages and sub-assemblages (Figure 9 and Figure 10) exist within the mining right area:

Natural Grassland

- *Trachypogon spicatus – Berkheya setifera* mixed grassland on dolerite outcrops.
- *Hyparrhenia hirta – Eragrostis chloromelas* secondary grassland.
- *Eragrostis plana – Kyllinga erecta* moist grassland bordering drainage and associated floodplains:
    - *Eragrostis plana – E. curvula* grazed grassland sub-assemblage.
    - *Eragrostis plana – K. erecta* moist grassland sub-assemblage.
- *Leersia hexandra – Agrostis* wet grassland:
    - *Kyllinga erecta – Agrostis lachnantha* wet grassland sub-assemblage.
    - *Leersia hexandra – Carex sp*. Wet grassland sub-assemblage.

Artificial Grassland

- *Zea mays* cultivated land.
- *Eragrostis tef* pasture.

Exotic Plantations

- *Eucalyptus camaldulensis* groves.
- *Populus x canescens* groves.
- *Prosopis cf. chilensis* groves.

A full list of the vegetation species identified on site is given in Table 13. The key for the associated vegetation assemblages (numbered as 1 to 9 in the right column of the table) is as follows: 1=*Trachypogon spicatus – Berkheya setifera* mixed grassland; 2=*Hyparrhenia hirta – Eragrostis chloromelas* secondary grassland; 3=*Eragrostis plana – Eragrostis curvula* grazed grassland; 4=*Eragrostis plana – Kyllinga erecta* moist grassland; 5=*Kyllinga erecta – Agrostis lachnantha* wet grassland; 6=*Leersia hexandra – Carex sp.* wet grassland; 7=*Zea mays* cultivated land; 8=*Eragrostis tef* pastures and 9=Exotic plantations. *- Exotic species.

TABLE 13: FULL LIST OF SPECIES IDENTIFIED WITHIN THE MINING RIGHT AREA

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Acalypha angustata var. glabra		Euphorbiaceae	Perennial Herb	✔		✔	✔					
Agrostis lachnantha var. lachnantha	Bent Grass	Poaceae	Perennial/Annual Tufted Grass			✔	✔	✔	✔			
Albuca cf. setosa	Slymuintjie	Hyacinthaceae	Geophyte	✔	✔							
Alectra sessiliflora	Verfblommetjie	Orobanchaceae	Perennial Parasitic Herb				✔					
Alloteropsis semialata subsp. semialata	Black-seed Grass	Poaceae	Perennial Rhizomatous/Tufted Grass	✔	✔							
Aloe greadheadii var. davyana		Asphodelaceae	Perennial Acaulescent Succulent	✔	✔							
Alysicarpus rugosus		Fabaceae	Perennial Herb	✔								
Amaranthus hybridus	Pigweed	Amaranthaceae	Annual Herb			✔	✔					
Andropogon appendiculatus	Vlei Bluestem	Poaceae	Perennial Tufted Grass					✔				
Andropogon eucomis	Snowflake Grass	Poaceae	Perennial Tufted Grass			✔						
Andropogon schirensis	Stab Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Anthospermum rigidum subsp. pumilum		Rubiaceae	Perennial Herb	✔	✔							
Arctotis arctotoides		Asteraceae	Perennial Herb				✔					
Aristida bipartite	Rolling Grass	Poaceae	Perennial Tufted Grass					✔				
Aristida congesta subsp. barbicollis	Spreading Three Awn	Poaceae	Perennial Tufted Grass	✔	✔					✔		✔
Aristida congesta subsp. congesta	Tassel Three-awn	Poaceae	Perennial Tufted Grass	✔	✔					✔		✔
Aristida diffusa	Iron Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Aristida junciformis subsp. junciformis	Gongoni Three-awn	Poaceae	Perennial Tufted Grass					✔	✔			
Aristida meridionalis	Giant Three-awn	Poaceae	Perennial Tufted Grass			✔						
Aristida transvaalensis		Poaceae	Perennial Tufted Grass	✔								
Arundinella nepalensis	River Grass	Poaceae	Perennial Tufted Grass						✔			
Ascolepis capensis		Cyperaceae	Perennial Herb			✔	✔					
Asparagus laricinus		Asparagaceae	Perennial Herb	✔								
Aster bakerianus		Asteraceae	Perennial Herb	✔	✔							
Babiana hypogea var. hypogea		Iridaceae	Geophyte	✔	✔							
Barleria cf. pretoriensis		Acanthaceae	Perennial Herb	✔	✔							
Becium obovatum subsp. obovatum	Cat's Whiskers	Lamiaceae	Perennial Herb	✔	✔							
Berkheya macrocephala		Asteraceae	Perennial Herb	✔								

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Berkheya pinnatifida subsp. ingrata		Asteraceae	Perennial Herb		✔	✔	✔					
Berkheya radula	Boesmansrietjie	Asteraceae	Perennial Herb	✔	✔	✔	✔	✔				
Berkheya setifera		Asteraceae	Perennial Herb	✔		✔	✔					
Berkheya zeyheri subsp. zeyheri		Asteraceae	Perennial Herb	✔								
Bewsia biflora	False Love Grass	Poaceae	Perennial Tufted Grass	✔								
Bidens bipinnata*	Spanish Blackjack	Asteraceae	Annual Herb	✔								
Bidens pilosa*	Blackjack	Asteraceae	Annual Herb	✔	✔	✔	✔	✔				
Blepharis cf. maderaspatensis		Acanthaceae	Perennial Herb	✔	✔							
Boophone disticha	Poison Bulb	Amaryllidaceae	Geophyte	✔	✔							
Brachiaria serrata	Velvet Signal Grass	Poaceae	Perennial Rhizomatous/Tufted Grass	✔	✔							
Bromus cf. catharticus	Rescue Grass	Poaceae	Perennial Tufted Grass				✔					
Bulbine abyssinica	Bushy Bulbine	Asphodelaceae	Perennial Succulent Geophyte	✔								
Bulbostylis cf. hispidula		Cyperaceae	Annual Herb					✔				
Calamagrostis epigeios var. capensis		Poaceae	Perennial Tufted Grass				✔					
Carex sp.1		Cyperaceae	Perennial Herb					✔	✔			
Carex sp.2		Cyperaceae	Perennial Herb						✔			
Centella asiatica		Apiaceae	Perennial Herb				✔					
Chaetacanthus burchellii	Fairy Stars	Acanthaceae	Perennial Herb	✔								
Chamaecrista mimosoides		Fabaceae	Perennial Herb				✔					
Cheilanthes hirta		Pteridaceae	Perennial Herb	✔								
Chenopodium album*	White Goosefoot	Chenopodiaceae	Perennial Herb			✔	✔					
Chloris virgata	Feather-top Chloris	Poaceae	Perennial Tufted Grass				✔					
Chlorophytum (=Anthericum) fasciculatum		Anthericaceae	Geophyte	✔	✔							
Ciclospermum leptophyllum*		Apiaceae	Annual Herb			✔	✔	✔	✔	✔		✔
Cirsium vulgare*	Scotch Thistle	Asteraceae	Annual Herb		✔	✔	✔	✔	✔			
Commelina Africana	Yellow Commelina	Commelinaceae	Perennial Spreading Herb	✔								
Commelina benghalensis	Bengal Wndering Jew	Commelinaceae	Perennial Herb							✔		✔
Conyza albida*	Tall Fleabane	Asteraceae	Annual Herb	✔	✔	✔	✔	✔				
Conyza bonariensis*	Flax-leaf Fleabane	Asteraceae	Annual Herb	✔								

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Conyza canadensis*	Horsewood Fleabane	Asteraceae	Annual Herb			✔	✔	✔		✔		
Conyza podocephala		Asteraceae	Perennial Herb	✔	✔							
Corchorus cf. confuses		Tiliaceae	Perennial Herb	✔								
Cortaderia selloana*	Pampas Grass	Poaceae	Perennial Tufted Grass					✔				
Cosmos bipinnatus*	Cosmos	Asteraceae	Annual Herb	✔	✔	✔	✔	✔	✔			
Crassula capitella		Crassulaceae	Perennial Succulent Herb	✔								
Crepis hypochoeridea		Asteraceae	Perennial Herb				✔					
Ctenium concinnum	Sickle Grass	Poaceae	Perennial Tufted Grass	✔								
Cucumis hirsutus		Cucurbitaceae	Perennial Herb	✔								
Cucumis zeyheri		Cucurbitaceae	Perennial Herb	✔								
Cycnium tubulosum		Scrophulariaceae	Perennial Herb			✔	✔					
Cymbopogon excavatus	Broad-leaved Turpentine Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Cymbopogon pospischilii (=C. plurinodis)	Narrow-leaved Turpentine Grass	Poaceae	Perennial Tufted Grass			✔	✔					
Cynodon cf. nlemfuensis*	Star Grass	Poaceae	Perennial Stoloniferous Grass					✔				
Cynodon dactylon	Couch grass	Poaceae	Perennial Rhizomatous/Stoloniferous Grass	✔	✔	✔	✔					
Cyperus (=Mariscus) congestus		Cyperaceae	Perennial Hydrophyte/Herb			✔	✔	✔	✔			
Cyperus (=Mariscus) solidus		Cyperaceae	Perennial Herb			✔	✔	✔				
Cyperus cf. denudatus		Cyperaceae	Perennial Herb						✔			
Cyperus esculentus	Yellow Nutsedge	Cyperaceae	Perennial Herb					✔				
Cyperus rotundus	Purple Nutsedge	Cyperaceae	Perennial Herb			✔	✔					
Cyperus sp. 1		Cyperaceae	Perennial Herb					✔	✔			
Cyperus sp. 2									✔			
Datura stramonium*	Thorn-apple	Solanaceae	Annual Herb							✔		✔
Denekia capensis		Asteraceae	Perennial Herb					✔	✔			
Dicoma anomala subsp. circioides		Asteraceae	Perennial Herb	✔								
Digitaria eriantha	Common Finger Grass	Poaceae	Perennial Rhizomatous/Stoloniferous/Tufted Grass		✔							
Digitaria monodactyla	One-finger Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Digitaria ternate	Black-seed Finger Grass	Poaceae	Annual Tufted Grass				✔			✔		✔
Diheteropogon amplectens	Broadleaved Bluestem	Poaceae	Perennial Tufted Grass	✔								

Scientific Name	**Common Name**	**Family**	**Growth Form**	**Habitat/Vegetation Unit**								
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Diheteropogon filifolius	Thread-leaved Bluestem	Poaceae	Perennial Tufted Grass	✔								
Diospyros lycioides subsp. guerkei	Quilted Bluebush	Ebenaceae	Shrub	✔								
Echinochloa cf. crus-galli*		Poaceae	Perennial Tufted Grass				✔					
Echinochloa holubii	Kalahari Water Grass	Poaceae	Perennial Tufted Grass				✔					
Eleocharis cf. dregeana		Cyperaceae	Perennial Herb						✔			
Elephantorrhiza elephantine	Elephant's Root	Fabaceae	Suffrutex	✔	✔							
Elionurus muticus	Wire Grass	Poaceae	Perennial Tufted Grass		✔							
Eragrostis capensis	Heart-seed Love Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Eragrostis chloromelas	Narrow Curly Leaf	Poaceae	Perennial Tufted Grass	✔	✔	✔	✔	✔				
Eragrostis curvula	Weeping Love Grass	Poaceae	Perennial Tufted Grass		✔	✔	✔	✔				
Eragrostis gummiflua	Gum Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Eragrostis heteromera	Bronze Love Grass	Poaceae	Perennial Tufted Grass				✔					
Eragrostis plana	Tough Love Grass	Poaceae	Perennial Tufted Grass	✔	✔	✔	✔		✔			
Eragrostis pseudosclerantha	Footpath Love Grass	Poaceae	Perennial Stoloniferous Grass				✔					
Eragrostis racemosa	Narrow-leaved Love Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Eragrostis sp.		Poaceae	Perennial Tufted Grass				✔					
Eragrostis tef*	Tef	Poaceae	Annual Tufted Grass								✔	
Erythrina zeyheri	Ploegbreker	Fabaceae	Suffrutex		✔							
Eucalyptus camaldulensis*	Red River Gum	Myrtaceae	Tree									✔
Euphorbia striata var. striata		Euphorbiaceae	Perennial Herb		✔							
Falkia oblonga		Convolvulaceae	Perennial Herb				✔					
Felicia muricata subsp. muricata		Asteraceae	Perennial Herb	✔	✔							
Fimbristylis complanata		Cyperaceae	Perennial Herb				✔	✔				
Flaveria bidentis*	Smelter's Bush	Asteraceae	Annual Herb		✔							
Fuirena pubescens		Cyperaceae	Perennial Herb					✔				
Gazania krebsiana subsp. serrulata	Botterblom	Asteraceae	Perennial Herb		✔							
Geigeria burkei	Vermeerbos	Asteraceae	Perennial Herb	✔	✔	✔						
Gerbera piloselloides	Swartteebossie	Asteraceae	Perennial Herb	✔								
Gerbera viridifolia subsp. viridifolia		Asteraceae	Perennial Herb	✔								

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Gladiolus crassifolius		Iridaceae	Geophyte	✔								
Gnidia caffra		Thymelaeceae	Perennial Herb	✔								
Gnidia capitata		Thymelaeceae	Perennial Herb	✔	✔							
Gomphocarpus fruticosus	Milkweed	Apocynaceae	Perennial Herb	✔	✔	✔	✔					
Gomphrena celosioides*	Bathelor's Button	Amaranthaceae	Perennial Herb			✔	✔			✔		✔
Haplocarpha scaposa		Asteraceae	Perennial Herb					✔				
Helichrysum aureonitens		Asteraceae	Perennial Herb			✔	✔	✔	✔			
Helichrysum callicomum		Asteraceae	Perennial Herb		✔							
Helichrysum coriaceum	Teebossie	Asteraceae	Perennial Herb		✔							
Helichrysum mundtii		Asteraceae	Perennial Herb					✔				
Helichrysum nudifolium	Hottentot's Tea	Asteraceae	Perennial Herb	✔								
Helichrysum rugulosum		Asteraceae	Perennial Herb	✔	✔	✔	✔					
Helictotrichon turgidulum	Small Oats Grass	Poaceae	Perennial Tufted Grass					✔				
Hermannia depressa	Creeping Red Hermannia	Sterculiaceae	Perennial Herb	✔								
Heteropogon contortus	Spear Grass	Poaceae	Perennial Tufted Grass					✔				
Hibiscus aethiopicus var. ovatus		Malvaceae	Perennial Herb	✔	✔							
Hibiscus trionum*	Bladderweed	Malvaceae	Annual Herb			✔	✔					
Hyparrhenia dregeana		Poaceae	Perennial Tufted Grass				✔	✔	✔			
Hyparrhenia hirta	Common Thatching Grass	Poaceae	Perennial Rhizomatous/Tufted Grass	✔	✔	✔	✔					
Hypochaeris radicata*	Hairy Wild Lettuce	Asteraceae	Perennial Herb	✔	✔	✔	✔	✔	✔			
Hypoxis argentea var. argentea	Small Yellow Star-flower	Hypoxidaceae	Geophyte	✔	✔							
Hypoxis hemerocallidea	Star-flower	Hypoxidaceae	Geophyte			✔	✔					
Hypoxis iridifolia		Hypoxidaceae	Geophyte		✔							
Hypoxis multiceps		Hypoxidaceae	Geophyte	✔								
Hypoxis rigidula var. rigidula	Silver-leaved Star-flower	Hypoxidaceae	Geophyte	✔	✔							
Imperata cylindrical	Cottonwood Grass	Poaceae	Perennial Rhizomatous Grass			✔	✔	✔				
Indigofera cf. costatum		Fabaceae	Perennial Herb	✔								
Indigofera comosa		Fabaceae	Perennial Herb		✔							
Indigofera filipes		Fabaceae	Perennial Herb	✔								

Scientific Name	**Common Name**	**Family**	**Growth Form**	**Habitat/Vegetation Unit**								
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Ipomoea bathycolpos		Convolvulaceae	Trailing Perennial Herb	✔								
Ipomoea ommaneyi	Beespatat	Convolvulaceae	Trailing Perennial Herb	✔	✔							
Isolepis sp.		Cyperaceae	Perennial Herb					✔	✔			
Juncus cf. dregeanus		Juncaceae	Perennial Herb					✔	✔			
Juncus effuses		Juncaceae	Perennial Helophyte					✔	✔			
Juncus oxycarpus		Juncaceae	Perennial Herb			✔	✔	✔	✔			
Justicia anagalloides		Acanthaceae	Perennial Herb	✔	✔							
Kohautia amatymbica		Rubiaceae	Perennial Herb	✔	✔							
Kyllinga erecta		Cyperaceae	Perennial Herb		✔	✔	✔	✔	✔			
Kyllinga sp.1		Cyperaceae	Perennial Herb					✔	✔			
Kyllinga sp.2		Cyperaceae	Perennial Herb		✔							
Lactuca capensis		Asteraceae	Perennial Herb	✔	✔	✔	✔	✔				
Ledebouria ovatifolia		Hyacinthaceae	Geophyte		✔							
Ledebouria revoluta		Hyacinthaceae	Geophyte									
Leersia hexandra	Rice Grass	Poaceae	Perennial Hydrophytic/Rhizomatous Grass					✔	✔			
Lobelia flaccida subsp. flaccida		Lobeliaceae	Perennial Herb					✔	✔			
Macledium zeyheri		Asteraceae	Perennial Herb	✔								
Marsilea cf. macrocarpa		Marsileacae	Perennial Herb									
Melinis nerviglumis	Bristle-leaved Red Top	Poaceae	Perennial Tufted Grass	✔								
Melinis repens subsp. repens	Natal Red Top	Poaceae	Annual Tufted Grass	✔								
Microchloa caffra	Pincushion Grass	Poaceae	Perennial Tufted Grass				✔	✔	✔			
Mimulus gracilis		Scrophulariaceae	Perennial Herb				✔	✔	✔			
Monopsis decipiens		Lobeliaceae	Perennial Herb				✔	✔	✔			
Monsonia angustifolia	Crane's Bill	Geraniaceae	Perennial Herb			✔	✔					
Nidorella anomala		Asteraceae	Perennial Herb			✔	✔	✔				
Nidorella hottentotica		Asteraceae	Annual Herb	✔		✔	✔					
Nidorella resedifolia		Asteraceae	Annual Herb			✔	✔					
Oenothera rosea*	Rose Evening Primrose	Onagraceae	Annual Herb			✔	✔	✔	✔			
Oldenlandia herbacea var. herbacea		Rubiaceae	Perennial Herb	✔								

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Ornithogalum (=Dipcadi) viride	Grootslymuintjie	Hyacinthaceae	Bulbous Herb	✔								
Osteospermum muricatum subsp. muricatum		Asteraceae	Perennial Herb		✔							
Oxalis obliquifolia	Sorrel	Oxalidaceae	Perennial Herb	✔	✔	✔	✔	✔	✔			
Panicum natalense	Natal Panicum	Poaceae	Perennial Tufted Grass	✔								
Panicum schinzii	Sweet Grass	Poaceae	Annual Tufted Grass						✔	✔		✔
Paspalum dilatatum*	Dallis Grass	Poaceae	Perennial Rhizomatous/Tufted Grass			✔	✔	✔	✔			
Paspalum distichum*	Water Couch	Poaceae	Perennial Stoloniferous Grass									
Paspalum urvillei*	Vasey Grass	Poaceae	Perennial Tufted Grass			✔	✔	✔				
Pearsonia cajanifolia		Fabaceae	Perennial Herb	✔								
Pelargonium alchemilloides	Pink Trailing Pelargonium	Geraniaceae	Perennial Herb				✔					
Pelargonium luridum		Geraniaceae	Perennial Herb	✔								
Pellaea calomelanos var. calomelanos		Pteridaceae	Perennial Herb	✔								
Pennisetum clandestinum*	Kikuyu Grass	Poaceae	Perennial Rhizomatous/Stoloniferous Grass				✔	✔	✔	✔		✔
Pennisetum sphacelatum	Bull Grass	Poaceae	Perennial Tufted Grass					✔	✔			
Pentanisia angustifolia		Rubiaceae	Perennial Herb	✔								
Pentanisia prunelloides	Wild Verbena	Rubiaceae	Perennial Herb	✔								
Pentarrhinum insipidum		Apocynaceae	Perennial Herb							✔		✔
Persicaria lapathifolia*	Spotted Knotweed	Polygonaceae	Annual Herb					✔				
Persicaria limbata*		Polygonaceae	Perennial Herb						✔			
Peucedanum magalismontanum	Wild Parsley	Apiaceae	Perennial Herb	✔								
Phragmites australis	Common Reed	Poaceae	Perennial Grass						✔			
Physalis viscosa*	Sticky Gooseberry	Solanaceae	Perennial Herb		✔			✔				
Plantago lanceolata*	Narrow-leaved Plantain	Plantaginaceae	Perennial Herb	✔								
Plantago major		Plantaginaceae	Perennial Herb		✔							
Pogonathria squarrosa	Herringbone Grass	Poaceae	Perennial Tufted Grass	✔	✔					✔		✔
Pollichia campestris	Waxberry	Illecebraceae	Perennial Herb	✔								
Polygala amatymbica		Polygalaceae	Perennial Herb			✔						
Polygala hottentotta		Polygalaceae	Perennial Herb	✔	✔							
Populus x canescens*	Grey Poplar	Salicaceae	Tree									

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Prosopis cf. chilensis*		Fabaceae	Tree									
Pseudognaphalium luteo-album		Asteraceae	Annual herb		✔			✔				
Pulicaria scabra		Asteraceae	Perennial Herb				✔					
Pycreus nitidus		Cyperaceae	Perennial Herb						✔			
Pycreus polystachyos		Cyperaceae	Perennial Herb			✔	✔	✔	✔			
Ranunculus meyeri	Bog Buttercup	Ranunculaceae	Perennial Herb		✔							
Ranunculus multifidus		Ranunculaceae	Perennial Herb									
Rhus dentate		Anacardiaceae	Shrub	✔								
Rhus discolour		Anacardiaceae	Perennial Herb	✔								
Rhus rigida		Anacardiaceae	Shrub	✔								
Rhynchosia sp.		Fabaceae	Perennial Herb	✔								
Rhynchosia totta		Fabaceae	Perennial Herb	✔								
Richardia brasiliensis*		Rubiaceae	Perennial Herb		✔	✔	✔	✔		✔		✔
Rorippa nasturtium-aquaticum*	Watercress	Brassicaceae	Perennial Herb				✔	✔	✔			
Rumex crispus*	Curley Dock	Polygonaceae	Annual herb									
Rumex lanceolatus	Smooth Dock	Polygonaceae	Perennial Herb					✔				
Salvia repens	Kruipsalie	Lamiaceae	Perennial Herb			✔	✔					
Scabiosa columbaria	Wild Scabious	Dipsacaceae	Perennial Herb	✔	✔							
Schistostephium crataegifolium	Bergkruie	Asteraceae	Perennial Herb					✔				
Schkuhria pinnata*	Dwarf Marigold	Asteraceae	Annual Herb		✔	✔	✔	✔	✔	✔	✔	✔
Schoenoplectus corymbosus		Cyperaceae	Perennial Hydrophyte/Herb				✔		✔			
Schoenoplectus sp.		Cyperaceae	Perennial Hydrophyte/Herb				✔		✔			
Scirpus sp.		Cyperaceae	Perennial Hydrophyte/Herb				✔		✔			
Schizachyrium sanguineum	Red Autumn Grass	Poaceae	Perennial Tufted Grass									
Selago densiflora		Selageriaceae	Perennial Herb		✔							
Senecio cf. serratuloides		Asteraceae	Perennial Herb	✔	✔			✔				
Senecio consanguineus	Starvation Senecio	Asteraceae	Bi-annual Herb		✔	✔	✔	✔				
Senecio erubescens var. crepidifolius		Asteraceae	Perennial Herb			✔						
Senecio inornatus		Asteraceae	Perennial Herb	✔								

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Senecio polypodon		Asteraceae	Perennial Herb				✔					
Seriphium plumosum (=Stoebe vulgaris)	Bankrupt Bush	Asteraceae	Perennial Herb	✔	✔							
Setaria nigrirostris		Poaceae	Perennial Tufted Grass					✔				
Setaria pallide-fusca	Garden Bristle Grass	Poaceae	Annual Tufted Grass			✔	✔					
Setaria sphacelata var. sericea	Golden Bristle Grass	Poaceae	Perennial Tufted Grass			✔	✔	✔				
Setaria sphacelata var. torta	Creeping Bristle Grass	Poaceae	Perennial Rhizomatous/Tufted Grass	✔	✔	✔	✔					
Setaria verticillata	Bur Bristle Grass	Poaceae	Annual Tufted Grass							✔		
Solanum lichtensteinii		Solanaceae	Perennial Herb			✔						
Solanum nigrum*		Solanaceae	Annual Herb					✔				
Solanum panduriforme		Solanaceae	Perennial Herb		✔	✔	✔					
Solanum sisymbriifolium*		Solanaceae	Shrub			✔				✔		✔
Sonchus oleraceus*	Sow Thistle	Asteraceae	Annual Herb					✔				
Sporobolus africanus	Ratstail Dropseed	Poaceae	Perennial Rhizomatous/Tufted Grass	✔	✔	✔	✔					
Sporobolus pectinatus		Poaceae	Perennial Tufted Grass	✔								
Sporobolus pyramidalis	Catstail Dropseed	Poaceae	Perennial Tufted Grass	✔								
Tagetes minuta*	Khaki Weed	Asteraceae	Annual Herb		✔	✔	✔					
Tephrosia capensis var. capensis		Fabaceae	Perennial Herb	✔	✔							
Tephrosia elongata		Fabaceae	Perennial Herb	✔								
Themeda triandra	Red Grass	Poaceae	Perennial Rhizomatous Grass	✔	✔	✔	✔					
Thesium cf. utile		Santalaceae	Perennial Herb	✔								
Trachypogon spicatus	Giant Spear Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Trichoneura grandiglumis	Small Rolling Grass	Poaceae	Perennial Tufted Grass	✔	✔							
Triraphis andropogonoides	Broom Needle Grass	Poaceae	Perennial Tufted Grass	✔								
Tristachya leucothrix	Hairy Three-awn	Poaceae	Perennial Tufted Grass	✔	✔							
Typha capensis	Bullrush	Typhaceae	Perennial Herb					✔	✔			
Urelytrum agropyroides	Quinine Grass	Poaceae	Perennial Tufted Grass	✔								
Urochloa oligotricha		Poaceae	Perennial Tufted Grass			✔	✔					
Urochloa panicoides	Garden Urochloa	Poaceae	Annual Tufted Grass				✔					
Verbena bonariensis*	Wild Verbena	Verbenaceae	Annual Herb		✔	✔	✔	✔		✔		✔

Scientific Name	Common Name	Family	Growth Form	Habitat/Vegetation Unit								
				1	2	3	4	5	6	7	8	9
Verbena brasiliensis*		Verbenaceae	Annual Herb		✔	✔	✔	✔		✔		✔
Verbena officinalis*	European Verbena	Verbenaceae	Annual Herb			✔	✔	✔		✔		✔
Vernonia natalensis		Asteraceae	Perennial Herb	✔								
Vernonia oligocephala	Bicoloured-leaved Vernonia	Asteraceae	Perennial Herb	✔								
Veronica anagallis-aquatica		Scrophulariaceae	Bi-annual Herb				✔		✔			
Wahlenbergia krebsii		Campanulaceae	Perennial Herb			✔	✔					
Wahlenbergia undulata		Campanulaceae	Perennial Herb			✔	✔					
Xanthium strumarium*	Large Cocklebur	Asteraceae	Annual Herb							✔		✔
Zaleya pentandra*	African Purslane	Aizoaceae	Perennial Herb									
Ziziphus zeyheriana		Rhamnaceae	Suffrutex	✔								

Ecologically sensitive habitats

Mixed grassland (*Trachypogon – Berkheya*); moist grassland (Eragrostis plana); and wet grassland (Leersia and Kylinga), including the wetlands associated with these systems, are all considered to be of *high* conservation importance and ecological function (see Figure 10).

The mixed grassland is characterised by high spatial heterogeneities (due to the dolerite outcrops), thereby contributing to a myriad of microhabitat types and niche space. This high diversity in microhabitat types is likely to support a high species richness for both faunal and floral taxa. The mixed grassland also supports a number of medicinal plant species, as well as protected species. These species are mainly geophytes consisting of *Boophone disticha, Hypoxis hemerocallidea* (high densities) and *Gladiolus crassifolius.* Emery *et al.* (2002) consider the two former species to be "Near-threatened" in Mpumalanga and of economic importance. The mixed grassland is structurally more diverse in comparison to the other vegetation units. Therefore, the presence of a woody layer is able to support a faunal community (especially avifauna) not expected from any of the other units.

The moist and wet grassland units (that have not been transformed by farming and mining) have the inherent ability to support unique floral assemblages that may enhance local biodiversity richness. It also provided habitat for the "Vulnerable" Marsh Sylph butterfly (*Metisella meninx*), Giant Bullfrog (*Pyxicephalus adspersus*) and suitable roosting and breeding habitat for the "Vulnerable" African Grass Owl (*Tyto capensis*). These units have the inherent potential to function as important dispersal corridors for both mammal and bird species since it increased the probability of colonisation of areas outside of the study site. Such movement of faunal species will enhance gene flow and reduce inbreeding depression and loss of genetic variability. Figure 11 highlights some of the possible movement corridors and other areas of sensitivity and concern.

Commonly occurring species

As stated, three broad vegetation units were discernible consisting of nine distinct floristic assemblages and four sub-assemblages.

Natural grassland

Trachypogon spicatus – Berkheya setifera mixed grassland

This assemblage was located on the eastern part of the study site and corresponded to relatively shallow soils underlain by dolerite intrusions. This vegetation unit is structurally a late-successional grassland sere and floristically rich in both graminoid and forb species dominated by *Trachypogon spicatus, Tristachya leucothrix* and *Setaria sphacelata* var. *torta*.

Hyparrhenia hirta – Eragrostis chloromelas secondary grassland

This assemblage was located on the eastern part of the study site and corresponded to relatively shallow soils of various geological origins. This vegetation unit was structurally a mid-successional grassland sere and corresponded to areas subjected to past livestock disturbances, such as grazing and trampling. The species composition of this assemblage was dominated by the graminoid species *Hyparrhenia hirta* and *Eragrostis chloromelas,* of which the former contributed to more than 50 % of the similarity.

Eragrostis plana – Kyllinga erecta moist grassland

This assemblage was located on the floodplains of the various drainage lines and seep zones. It could be described as open moist grassland dominated by *Eragrostis plana*, a species that competitively replaced *Themeda triandra* as a result of persistent grazing by livestock. This assemblage comprised of two sub-assemblages namely an *Eragrostis plana – Eragrostis curvula* grazed grassland and an *E. plana – Kyllinga erecta* moist grassland.

The former sub-assemblage (*E. plana – E. curvula* grazed grasslands) was dominated by either *E. plana* or *E. curvula,* but also included many other mid-successional taxa such as *Eragrostis chloromelas, Hyparrhenia hirta, Sporobolus africanus* and *Setaria pallide-fusca.* The latter sub-assemblage (*E. plana – Kyllinga erecta* moist grasslands) based on its geographic placement, many obligate and facultative wetland indicator species were typical of the composition such as *Kyllinga* spp., *Monopsis decipiens, Mimulus gracilus, Helichrysum aureonitens, Haplocarpha scaposa, Arundinella nepalensis, Leersia hexandra, Paspalum dilatatum* and *Themeda triandra*.

Leersia hexandra – Agrostis lachnantha wet grassland

This assemblage was confined to wetland habitat types and was specifically located on areas subjected to permanent and seasonal inundation. It consisted of two distinct sub-assemblages, namely a *Kyllinga erecta – Agrostis lachnantha* wet grassland sere and a *Leersia hexandra – Carex sp*. wet grassland sere.

The former sub-assemblage was distributed along the edges of the drainage lines as opposed to being confined to the channel systems and seep zones. The graminoid composition was dominated by *Agrostis lachnantha, Aristida bipartita, Aristida junciformis* and *Paspalum urvillei*. The *Leersia hexandra – Carex sp*. wet grassland sere was typically associated with the main channel systems of the various drainage lines and seep zones, and consisted of many taxa belonging to the Cyperaceae such as *Carex* spp., *Cyperus* spp., *Eleocharis* cf. *dregeana* and *Pycreus nitidus.*

Artificial grassland

Zea mays cultivated land

This artificial assemblage was located on cultivated land utilised for the production of maize. It represented the largest surface area of all plant assemblages on the study site and corresponded to deep soils with a sandy texture. This assemblage was generally cleared of any native vegetation to accommodate a monoculture of *Zea mays,* although a variety of weed species (*Tagetes minuta, Cosmos bipinnatus* and *Bidens pilosa*) contributed to its composition.

Eragrostis tef pastures

This monoculture was located on the northern part of the study site and was present in the form of a pasture to supplement livestock grazing. The species composition of this assemblage was dominated by the exotic graminoid *Eragrostis tef*.

Endangered or rare species

According to the conservation assessment conducted by the Mpumalanga Parks Board (MPB) (currently the Mpumalanga Tourism and Parks Authority [MTPA]) revealed that the province comprises of one extinct taxon, 9 “Critically Endangered”, 16 “Endangered” and 37 “Vulnerable” taxa (Emery *et al.,* 2002). A further 18 taxa were also placed within the “Near-Threatened” category (Emery *et al*., 2002). No Red Data species as described above were identified within the study area. Only six species listed on the Threatened Species Programme (TSP) (January 2007) as Least Concern (LC) were identified on site.

Victor & Keith (2004) introduced the concept of an Orange List for plant taxa that warrant conservation measures but do not meet the IUCN criteria. These taxa include those species at risk of becoming threatened (all taxa currently considered “Near-threatened” or “Data Deficient”) or considered to comprise of rare or declining populations. Table 14 provides a list of species likely to be associated with the various vegetation assemblages on the mining right area.

TABLE 14: RED DATA AND ORANGE LISTED PLANT SPECIES THAT COULD OCCUR AT THE MINE

Species	Flowering Season	Suitable Habitat	Probability of occurrence	Conservation Status
Orange Listed Taxa				
Callilepis leptophylla (Commonly known as the bergbitterbossie)	August-January and May	Open grassland.	High	Declining*
Hypoxis hemerocallidea (Commonly known as Star-flower)	September-March	Grassland & mixed woodland.	Confirmed	Near-threatened** and declining***
Eucomis autumnalis subsp*. Clavata* (Commonly known as Pineapple flower)	November-April	Open grassland and marshes.	High	Near-threatened** and declining***

*-Information provided by MTPA; **-Status according to Emery et al. (2002); *** - conservation status according to the Threatened Plant Species Programme (2007) of SANBI.

Only one plant species was observed and listed as protected under Schedule 11 of the Nature Conservation Ordinance of Transvaal (No 12 of 1983) during the field work that was undertaken for the ecological assessment. It should be noted noted that this ordinance, although old, is still applicable. This species is listed in Table 15 below and requires a permit prior to removal from site.

TABLE 15: PROTECTED PLANT SPECIES

Species	Status on study site	Vegetation Unit
Gladiolus crassifolius (commonly known as Gladiolus)	Localised but widespread on the eastern part of the mining right area.	*Trachypogon spicatus – Berkheya setifera* mixed grassland *Hyparrhenia hirta – Eragrostis chloromelas* secondary grassland

Medicinal species

A complete list and description of medicinal plant species found within the mining right area is summarised in Table 16.

TABLE 16: LIST OF MEDICINAL SPECIES OBSERVED IN THE MINING RIGHT AREA

Species Identified within Van Wyk *et al.* (1997) with medicinal value		
Species	**Parts used**	**Treatment**
Dicoma anomala	Leaves	Used to treat fever.
Elephantorrhiza elephantina	Roots	Treatment of fever, ulcers, and to stop bleeding.
Gomphocarpus fruticosus	Leaves	Treatment of headaches, tuberculosis and general body aches.
Helichrysum spp.	Leaves & stems	Treatment of coughs, colds, fever, infections and menstrual pain.
Hypoxis hemerocallidea	Corm	Treatment of dizziness, bladder disorders and insanity. Valued in HIV treatment.
Pelargonium luridum	Roots	Treatment of diarrhoea and dysentery.
Pellaea calomelanos	Leaves and rhizomes	Treatment of colds and asthma.
Scabiosa columbaria	Leaves & roots	Used as a remedy for colic and heartburn.
Typha capensis	Rhizomes	Treatment of venereal diseases or during pregnancy to ensure an easy delivery.
Vernonia oligocephala	Leaves and twigs	Used to treat abdominal pain and colic.

Species Identified within Pooley (1998) to contain medicinal value	
Species	**Treatment**
Aloe greatheadii	Treatment of burns and wounds.
Becium obovatum	Used to treat stomach complaints.
Boophone disticha	Used as a narcotic or to treat pain.
Commelina Africana	Used for a wide variety of ailments including fevers, fits, heart complaints and bladder infections.
Gladiolus crassifolius	Corms used as treatment for a variety of ailment - sweet
Hypoxis argentea	Used to treat cracked cows' teats and wounds of horses.
Hypoxis iridifolia	Similar to *H. hemerocallidea.*
Species Identified within Pooley (1998) to contain medicinal value	
Species	**Treatment**
Hypoxis multiceps	Similar to *H. hemerocallidea*
Hypoxis rigidula	Similar to *H. hemerocallidea*
Ledebouria spp.	Treatment of flu and backaches.
Senecio inornatus	Treatment of palpitations.

*Important (heavily utilised) species are highlighted in blue.

Intruder or exotic species

Scattered alien and invasive plant species were located throughout the mining right area. A list of these species is provided in Table 17 below.

TABLE 17: INTRUDER SPECIES

Species	Common Name	Type	Control Measure	Category
Cirsium vulgare	Scotch Thistle	Weed	Control	1
Cortaderia selloana	Pampas Grass	Weed	Eradicate	1
Cynodon dactylon	Couch Grass	Proposed invader	Control	2
Datura stramonium	Common Thorn-apple	Weed	Control	1
Eucalyptus camaldulensis	Red River Gum	Invader	Control	2
Pennisetum clandestinum	Kikuyu Grass	Proposed Invader	Control	2
Populus x canescens	Grey Poplar	Invader	Control	3
Solanum sisymbriifolium	Wild Tomato	Weed	Eradicate	1

Results – Fauna

Commonly occurring faunal species

Mammal species identified on the mining right area, through actual observation or capture, and through evidence of presence, are listed in Table 18.

TABLE 18: IDENTIFIED MAMMAL SPECIES

Species	Common Name	Conservation Status	Location
Lepus saxatilis	Scrub Hare	LC	All three trap sites
Hystrix africaeaustralis	Cape Porcupine	LC	Maize plantations
Mastomys coucha	Southern Multimammate Mouse	LC	Trap site B
Otomys angoniensis	Angoni Vlei Rat	LC	Trap site B
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Trap site A and C
Sylvicapra grimmia	Common Duiker	LC	Trap site A and C
Redunca arundinum	Southern Reedbuck	LC	Dams/Trap site C
Raphicerus campestris	Steenbok	LC	Dams/Trap site C

* LC = Least Concern

Bird species identified on site, through actual observation or capture, and through evidence of presence, are listed in Table 19.

TABLE 19: IDENTIFIED BIRD SPECIES

Species	Common Name	Conservation Status
Acridotheres tristis	Common Myna	LC
Acrocephalus baeticatus	African Reed-Warbler	LC
Acrocephalus gracilirostris	Lesser Swamp-Warbler	LC
Acrocephalus palustris	Marsh Warbler	LC
Afrotis afraoides	Northern Black Korhaan	LC

Species	Common Name	Conservation Status
Alcedo cristata	Malachite Kingfisher	LC
Alopochen aegyptiaca	Egyptian Goose	LC
Anas erythrorhyncha	Red-billed Teal	LC
Anas hottentota	Hottentot Teal	LC
Anas sparsa	African Black Duck	LC
Anas undulate	Yellow-billed Duck	LC
Anhinga rufa	African Darter	LC
Anthus cinnamomeus	African Pipit	LC
Apus affinis	Little Swift	LC
Apus caffer	White-rumped Swift	LC
Ardea cinerea	Grey Heron	LC
Ardea melanocephala	Black-headed Heron	LC
Ardea purpurea	Purple Heron	LC
Asio capensis	Marsh Owl	LC
Bostrychia hagedash	Hadeda Ibis	LC
Bradypterus baboecala	Little Rush-Warbler	LC
Bubulcus ibis	Cattle Egret	LC
Burhinus capensis	Spotted Thick-knee (Dikkop)	LC
Buteo vulpinus	Steppe Buzzard	LC
Charadrius tricollaris	Three-banded Plover	LC
Chersomanes albofasciata	Spike-heeled Lark	LC
Chlidonias hybrid	Whiskered Tern	LC
Chlidonias leucopterus	White-winged Tern	LC
Chrysococcyx caprius	Diderick Cuckoo	LC
Cisticola aridulus	Desert Cisticola	LC
Cisticola fulvicapilla	Neddicky	LC
Cisticola juncidis	Zittting Cisticola	LC
Cisticola textrix	Cloud Cisticola	LC
Cisticola tinniens	Levaillant's Cisticola	LC
Columba guinea	Speckled Pigeon	LC
Corvus albus	Pied Crow	LC
Cossypha caffra	Cape Robin-Chat	LC
Coturnix coturnix	Common Quail	LC
Crex crex	Corn Crake	VU
Dendrocygna bicolour	Fulvous Duck	LC
Dendrocygna viduata	White-faced Duck	LC
Egretta alba	Great Egret	LC

Species	Common Name	Conservation Status
Egretta ardesiaca	Black Heron/Egret	LC
Egretta garzetta	Little Egret	LC
Elanus caeruleus	Black-shouldered Kite	LC
Estrilda astrild	Common Waxbill	LC
Euplectes afer	Yellow-crowned Bishop	LC
Euplectes albonotatus	White-winged Widowbird	LC
Euplectes ardens	Red-collared Widowbird	LC
Euplectes axillaris	Fan-tailed Widowbird	LC
Euplectes orix	Southern Red Bishop	LC
Euplectes progne	Long-tailed Widowbird	LC
Falco amurensis	Amur/Eastern Red-footed Falcon	LC
Fulica cristata	Red-knobbed Coot	LC
Gallinago nigripennis	African Snipe	LC
Gallinula chloropus	Common Moorhen	LC
Glareola nordmanni	Black-winged Pratincole	NT
Hirundo albigularis	White-throated Swallow	LC
Hirundo cucullata	Greater Striped Swallow	LC
Hirundo rustica	Barn Swallow	LC
Hirundo spilodera	South African Cliff-Swallow	LC
Jynx ruficollis	Red-throated Wryneck	LC
Lanius collaris	Common Fiscal	LC
Lybius torquatus	Black-collared Barbet	LC
Macronyx capensis	Cape Longclaw	LC
Merops apiaster	European Bee-eater	LC
Mirafra Africana	Rufous-naped Lark	LC
Motacilla capensis	Cape Wagtail	LC
Numida meleagris	Helmeted Guineafowl	LC
Ortygospiza atricollis	African Quailfinch	LC
Passer diffuses	Southern Grey-headed Sparrow	LC
Passer domesticus	House Sparrow	LC
Passer melanurus	Cape Sparrow	LC
Phalacrocorax africanus	Reed Cormorant	LC
Phalacrocorax lucidus	White-breasted Cormorant	LC
Philomachus pugnax	Ruff	LC
Phoeniculus purpureus	Green Wood-Hoopoe	LC
Plectropterus gambensis	Spur-winged Goose	LC
Plegadis falcinellus	Glossy Ibis	LC

Species	Common Name	Conservation Status
Ploceus velatus	Southern Masked-Weaver	LC
Podiceps cristatus	Great Crested Grebe	LC
Prinia subflava	Tawny-flanked Prinia	LC
Pternistis swainsonii	Swainson's Spurfowl	LC
Riparia paludicola	Brown-throated Martin	LC
Sarothrura rufa	Red-chested Flufftail	LC
Saxicola torquatus	African Stonechat	LC
Scleroptila levaillantoides	Orange River Francolin	LC
Scleroptila shelleyi	Shelley's Francolin	LC
Serinus atrogularis	Black-throated Canary	LC
Sphenoeacus afer	Cape Grassbird	LC
Spreo bicolour	Pied Starling	LC
Streptopelia capicola	Cape Turtle Dove	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Streptopelia senegalensis	Laughing Dove	LC
Tachybaptus ruficollis	Little Grebe	LC
Terpsiphone viridis	African Paradise-Flycatcher	LC
Threskiornis aethiopicus	African Sacred Ibis	LC
Trachyphonus vaillantii	Crested Barbet	LC
Tringa glareola	Wood Sandpiper	LC
Tringa nebularia	Common Greenshank	LC
Upupa Africana	African Hoopoe	LC
Vanellus armatus	Blacksmith Lapwing/Plover	LC
Vanellus coronatus	Crowned Lapwing	LC
Vanellus melanopterus	Black-winged Lapwing	LC
Vanellus senegallus	African Wattled Lapwing	LC
Vidua macroura	Pin-tailed Whydah	LC

* LC = Least Concern; NT = Near Threatened; VU= Vulnerable

No Reptiles were found on site, however a desktop review identified 63 species that could potentially occur on site. **Amphibian** species identified on site, through actual observation or capture, and through evidence of presence, are listed in Table 20.

TABLE 20: IDENTIFIED AMPHIBIAN SPECIES

Species	Common Name	Location
Xenopus l. Laevis	Common Platanna	confirmed at site B
Afrana angolensis	Common River Frog	confirmed at site B
Bufo gutturalis	Guttural Toad	confirmed at site C
Cacosternum boettgeri	Common Caco	confirmed at site A & C

Species	Common Name	Location
Phrynobatrachus natalensis	Snoring Puddle Frog	confirmed at all sites
Kassina senegalensis	Bubbling Kassina	confirmed at all sites

Invertebrate species from that were identified on site, through actual observation or capture, and through evidence of presence, are listed in Table 21.

TABLE 21: IDENTIFIED INVERTEBRATE SPECIES

CLASS	ORDER	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS
INSECTA	COLEOPTERA	Carabidae		Ground Beetles - various sp	LC
		Scarabaeidae	*Plaesiorrhinella plana*	Yellow-belted Fruit Chafer	LC
			Heteronychus arator	Black maize beetle	LC
	DIPTERA	Muscidae	*Musca domestica*	House Fly	LC
		Calliphoridae	*Lucilia sericata*	European Green Blowfly	LC
	HEMIPTERA	Reduviidae		Assassin Bugs	LC
		Cercopidae		Froghoppers	LC
		Pentatomidae		Stink and Shield bugs	LC
	HYMENOPTERA	Formicidae		Various species	LC
		Apidae	*Apis mellifera*	Honey bee	LC
	LEPIDOPTERA	Nymphalidae	*Danaus chrysippus aegyptius*	African Monarch	LC
			Junonia hierta cebrene	Yellow Pansy	LC
			Hypolimnas misippus	Common diadem	LC
			Junonia orithra madagascariensis	Eyed pansy	LC
			Byblia ilithyia	Spotted joker	LC
		Pieridae	*Pontia helice helice*	Meadow white	LC
			Eurema brigitta	Broad-bordered Grass Yellow	LC
		Hesperiidae	*Metisella meninx*	Marsh sylph	VU
	ORTHOPTERA	Acrididae		Various species	LC
		Gryllidae	*Gryllus bimaculatus*	Common Garden Cricket	LC
	ODONATA	Coenagrionidae		Various species	LC
		Aeshnidae	*Anax imperator*	Blue emperor	LC
		Libellulidae	*Orthetrum Julia*	Julia skimmer	LC
			Trithemis arteriosa	Red-veined dropwing	LC
			Palpopleura jucunda	Yellow-veined Widow	LC
	ISOPTERA	Termitidae	*Trinervitermes*	Snouted harvestor termite	LC
	NEUROPTERA	Chrysopidae	*Chrysemosa jeanneli*	Grey Lacewing	LC

CLASS	ORDER	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS
	DERMAPTERA	Forficulidae		Common Earwigs	LC
ARACHNIDA	ARANEAE (ARANEOMORPHS)	Theridiidae		Comb-footed spiders	LC
		Agelenidae	*Olorunia spp.*	Grass Funnel-web Spiders	LC
		Ctenizidae		Trapdoor spiders	LC

* LC = Least Concern; NT = Near Threatened; VU= Vulnerable

<u>Rare or endangered species</u>

Mammals

Red Data listed animals that have the potential to occur within and/or adjacent to the mine are outlined below.

The Mpumalanga Parks Board (MPB) Biobase data did not list any mammal species of conservation concern on site, or in the vicinity within the quarter degree square 2628BB. However, those listed in Table 22 could potentially occur within and/ or adjacent to the mining right area.

TABLE 22: POTENTIALLY OCCURRING RARE OR ENDANGERED MAMMALS

Species	Conservation Status & Habitat Requirements
Hyaena brunnea (Brown Hyena)	The Brown Hyena is currently listed as 'NT' on a national level and globally it falls under a lower risk category (IUCN, 2001). It occurs in a wide range of habitats, including urban developments, but it prefers drier regions (Smithers, 2000; Walker, 1996). During the day it requires holes or thick cover (Smithers, 2000). Due to its scavenging nature, the Brown Hyena, if it does occur in the study area, may be attracted to the site by increasing numbers of small mammals killed during the pre-construction phase.
Mellivora capensis (Honey Badger)	The Honey Badger is widespread in its distribution (Smithers, 2000). It is commensural with humans and occurs in a wide range of habitats including grasslands, savannas and deserts (Friedmann and Daly, 2004). This species is currently not listed as Red Data globally and is listed as 'NT' nationally. The Honey Badger is a generalist predator and is likely to occur on the study site.
Lutra maculicollis (Spotted-Necked Otter	The Spotted-Necked Otter is limited to aquatic habitats and is found in close proximity to artificial or natural water features such as ponds, rivers and streams, wetlands and water holding facilities (Smithers, 2000; Friedmann and Daly, 2004). It is currently classified as 'NT' nationally but is not listed globally (Friedmann and Daly, 2004). Although the species may not have been recorded in the vicinity recently (based on museum records and observations), there are several dams on and near the site to support this species.
Atelerix frontalis (South African Hedgehog)	Although this species is currently classified as 'NT', Friedmann and Daly (2004) suggest it is approaching a listing as 'VU'. Anecdotal reports by a local farmer suggest that the species has been seen towards the northern areas of Vanggatfontein (around tree clumps).
Amblysomus septentrionalis (Highveld Golden Mole)	The Highveld golden mole should be regarded as a Mpumalanga endemic and is listed nationally as NT. Current distribution data available (Bronner, 1996) suggests that southern Mpumalanga is the centre of distribution within the country. This species is found in various grassland types (Rautenbach, 1982) and, normally occurs on soft or sandy level ground. The Highveld golden mole

Species	Conservation Status & Habitat Requirements
	has so far been identified at nine fragmented localities. Research suggests that .*A. septentrionalis* can coexist with man, however, changing land-use practices and mismanagement of grassland habitat threaten these populations. Due to the nature of the habitat on site, this species may occur at Vanggatfontein.
Dasymys incomtus (Water Rat)	The Water Rat is commonly associated with bogs, marches and wetlands. It is nationally classified as 'NT', but it is not listed globally. This species may occur on site due to the presence of dams, wetlands and generally moist grassland.
Chiroptera	Five 'NT' bat species and one 'VU' species could occur in the area. Most bats require caves or rock crevices in which to roost and they are known to roost in trees and man-made structures (Taylor, 2000). Due to the site's proximity to housing and tall trees in adjacent areas, most of these species may well occur in the area and may use this site for foraging.

* LC = Least Concern; NT = Near Threatened; VU = Vulnerable

Birds

Only one species, the Maccoa Duck (*Oxyura maccoa*), has been highlighted by Mpumalanaga Parks Board as a species of concern in this area due to the sensitivity of their habitat. The species is however not Red Data listed. It has previously been recorded on the farm Vanggatfontein, as well as on surrounding farms.

Marsh Owls (*Asio capensis*) were encountered, and Grass Owls (*Tyto capensis*), a Vulnerable species, often occur together with Marsh Owls (*pers comm*. Lockwood, 2008). In addition, there were suitable habitat patches for Grass Owl. Furthermore, the VU Corncrake and NT Black-winged Pratincole were found. The Corncrake is listed as birds of "urgent threat status" within the Nkangala District Municipality (NDM) (NDM, 2006).

Bird species of conservation importance that may occur on site, due to correct distribution and adequate habitat occurrence, but were not observed during the site visits, are listed in Table 23 (*pers comm*. Lukas Niemand (2008), April).

TABLE 23: POTENTIALLY OCCURRING RARE OR ENDANGERED BIRDS

Scientific Name	Common Name	Habitat Requirements	Status
Ciconia nigra	Black Stork	Marshlands and flooded grasslands, dams, pans rivers and estuaries. Likely to occur in the flooded parts of the site.	NT
Mycteria ibis	Yellow-billed Stork	Generally found in wetlands and flooded grasslands, thus likely to occur on site	NT
Gyps coprotheres	Cape Vulture	Prefers a wide range of habitat.	VU
Circus ranivorus	African Marsh Harrier	Prefers to forage away from wetlands but over open grasslands and croplands; feeds primarily on small mammals; may occur on site.	VU
Circus maurus	Black Harrier	Often found in grassland and agricultural areas; may occur on site	NT
Falco biarmicus	Lanner Falcon	Open grasslands and agricultural	NT

Scientific Name	Common Name	Habitat Requirements	Status
		areas, may use buildings and trees for nesting. Likely to occur on site.	
Falco naumanni	Lesser Kestrel	May occur in agricultural areas and parts of the grassland biome	VU
Anthropoides paradisea	Blue Crane	Open grasslands and wetlands as well as agricultural fields. This species may well occur on site	VU
Eupodotis caffra	White-bellied Korhaan	Prefers tall dense grass; is also found in pasture lands. Most of the study area would be suitable for this species.	VU
Eupodotis caerulescens	Blue Korhaan	This species prefers flat undulating terrain, often most ground, with short vegetation. Parts of the study site, primarily near the drainage lines could be suitable for this species.	NT
Mirafra cheniana	Melodious Lark	Prefers open grasslands dominated by Eragrostis sp. and Themeda triandra. May well occur on site.	NT

* LC = Least Concern; NT = Near Threatened; VU = Vulnerable

Reptiles and amphibians

Two endemic (national) reptile species and one 'VU' species were recently identified on farms nearby and have been highlighted by MPB to be of concern. These include: *Leptotyphlops conjunctuc conjunctus* (Eastern Thread Snake), *Psammophylax r. rhombeatus* (Spotted/Rhombic Skaapsteker), *Cordylus vittifer* (Transvaal Girdled Lizard) and *Pachydactylus capensis* (Cape Thick-toed Gecko).

Another species of concern is the Striped Harlequin Snake (*Homoroselaps dorsalis*), currently identified as 'Rare'. This rare endemic has been recorded from widely scattered localities (Branch, 1988). It appears to be associated mainly with grasslands and is usually found in old termitaria. Branch (1988) notes that populations appear to have declined as a result of habitat modification through agricultural activity. Due to the fact that there are very few termitaria associated with this site, one would not expect to find this species here.

Furthermore, recent DEDET (previously Department of Agriculture and Land Administration [DALA]) records confirm the occurrence of the Giant Bullfrog (*Pyxicephalus adspersus*) on one of the neighbouring farms. *Pyxicephalus adspersus* has recently been classified as 'NT' by Branch and Harrison (2004). However, this classification applies at a regional level only – the species is not red-data listed globally.

Invertebrates

A recent study by Emery *et al* (2002) highlighted the central highveld regions of Mpumalanga as important for the conservation of threatened invertebrates. The biggest threat to invertebrates is habitat destruction. Agricultural and forestry activities are the most extensive land uses that have resulted in the greatest loss of insect populations.

The Red Data Marsh Sylph butterfly *Metisella meninx* (VU) was found throughout the mining right area along the drainage lines. It should be noted that destruction of this habitat will have significant consequences for these populations, as its habitat consists only of marshy headwater areas. This butterfly may thus be threatened by alterations of its wetland habitat (Emery *et al.,* 2002). It has been found at six sites in Mpumalanga, but it has been suggested that it may be wider spread in wetlands of the Province.

Exotic or invasive species

Invasive, alien or domesticated mammal species that were observed during field investigations included domestic dogs, cats and feral pigeons. Bird alien species associated with these types of habitat include the Indian or Common Myna (*Acridotheres tristis*).

Results – Aquatic ecology

Drainage systems within the mining area are outlined in Section 1.1.7. The only river/drainage line flowing nearest to the mining area during the time of the field investigations was the Wilge River. Although all drainage lines/rivers were visited during the field investigations, a detailed bio-monitoring assessment was performed on the Wilge and its tributaries, upstream and downstream of the mine.

The mine falls within the B20A quarternary catchment of the Olifants River-Management Area. This unit is classified as poor in terms of the overall Ecostatus and macro-invertebrate integrity. The major contributors to this poor status are surrounding mining and farming operations.

A summary of the river characteristics at each sampling point within the project area is outlined in Table 24 and Table 25. The aquatic sampling points are indicated on Figure 14. The ecological function of the smaller drainage areas is almost non-existent due to farming practices and waste disposal.

On the Wilge River, a total of 24 aquatic macro-invertebrate taxa were sampled during the March 2008 study. The dominant taxa sampled were those of the families Notonectidae (Backswimmers), Baetidae (Small minnow flies), Caenidae (Squaregills), Coenagrionidae (Sprites & Blues), Chironomidae (Midges), Gyrinidae (Whirligig beetles), and Simuliidae (Blackflies). No highly sensitive taxa were recorded, however, two species of moderate sensitivity (score = 6 -9) were recorded at TW1 – Lestidae (Emerald Damselflies) and Hydracarina (Water Mites).

TABLE 24: RIVER CHARACTERISTICS AT SAMPLING POINTS ALONG THE WILGE RIVER

Point Name	W1		W2	
Photographic Record	Upstream	Downstream	Upstream	Downstream
Channel Type	Mixed bedrock and alluvial		Bedrock	
Channel Dimensions	Active Channel Width: 1 - 6m ; Water Depth: 30 - 100cm		Active Channel Width: 1 - 3m ; Water Depth: 5 - 70cm	
Water Level	*High flow*: water filling the active channel; water into the riparian vegetation.		*High flow*: water filling the active channel; water into the riparian vegetation.	
Water Chemistry	**Temp** (°C): 22 ; **pH**: 7.3 ; **DO** (mg/L):3.7 ; **EC** (mS/m): 26.6		**Temp** (°C): 23 ; **pH**: 7.6 ; **DO** (mg/L): 4.3 ; **EC** (mS/m): 39.4	
Water turbidity	*Opaque*: water cloudy, riverbed not visible (10cm)		*Discoloured*: water clear, but with a definite tinge to it, light brown(but riverbed still visible) (50cm+)	
IHI (according to Kleynhans, 1999))	C - Moderately modified		D – Largely modified	
Canopy Cover	Open		Open	
Algal Presence	Limited		Limited	
River Disturbances/ Modifications	*Instream*: Minimal disturbance at sampling point; upstream dams; road crossing *Riparian*: Low density human settlement; road crossing		*Instream*: Minimal disturbance at sampling point, however, upstream road crossings, dams, litter fallen trees. *Riparian*: Grazing.	

TABLE 25: RIVER CHARACTERISTICS AT SAMPLING POINTS ALONG THE TRIBUTARIES OF THE WILGE RIVER

Point Name	TW1		TW2	
Photographic Record	Upstream	Downstream	Upstream	Downstream
Channel Type	Alluvial		Alluvial	
Channel Dimensions	Active Channel Width: 0.5 - 8m ; Water Depth: 30 - 100cm		Active Channel Width: 0.5 - 2m ; Water Depth: 30 - 200cm	
Water Level	*High flow*: water filling the active channel; water into the riparian vegetation.		*High flow*: water filling the active channel; water into the riparian vegetation.	
Water Chemistry	**Temp** (°C): 21 ; **pH**: 7.5 ; **DO** (mg/L): 4.7 ; **EC** (mS/m): 37.8		**Temp** (°C): 18 ; **pH**: 7.1 ; **DO** (mg/L): 4.8 ; **EC** (mS/m): 23.3	
Water turbidity	*Discoloured*: water clear, but with a definite tinge to it, light brown (but riverbed still visible) (80cm)		*Opaque*: water cloudy, riverbed not visible (500cm)	
IHI (according to Kleynhans, 1999))	C - Moderately modified		D - Largely modified	
Canopy Cover	Open		Open	
Algal Presence	Limited/ Some		Limited	
River Disturbances/ Modifications	*Instream*: Road crossing, culverts, upstream dams *Riparian*: Grazing		*Instream*: Numerous up stream dams, alien vegetation, road crossing *Riparian*: Alien vegetation, minimal erosion, grazing	

Conclusion

Within the mining right area, there is a wide range of ecological sensitivity, ranging from low where anthropogenic activities such as farming and mining have occurred, to high where untransformed mixed, moist and wet grassland habitats are present and support a number of fauna and flora species of conservation concern.

1.1.7 HYDROLOGY

The information in this section was sourced from the approved EIA and EMP report (2008) and specialist hydrology study conducted by SLR Consulting (Africa) (Pty Ltd (2012) included in Appendix E.

Introduction and link to anticipated impact

Surface water resources include drainage lines and paths of preferential flow of stormwater runoff. Mining related activities have the potential to alter the drainage of surface water through the placement of both temporary (such as processing infrastructure and support facilities) and permanent (if present) infrastructure and/or result in the contamination of the surface water resources through seepage and/or spillage of potentially polluting materials, non-mineralised (general and hazardous) and mineralised wastes. Key to understanding the hydrology of the site is the climatic conditions of the site. As a baseline, this section provides an understanding of the hydrological catchments that could be affected by the mine and the status of surface water resources in the mining right area.

Data collection

Data used in determining the surface water characteristics include climatic data (Section 1.1.2) and topographical data (Section 1.1.3). Rainfall and evaporation data for the site was considered from various sources including weather stations managed by the South African Weather Services (SAWS).

The 24-hour rainfall depths for various return periods were calculated from one day rainfall results obtained from Water Research Commission (WRC) software developed in 2001 which has a database of rainfall stations records up to the year 2000.

Results

With reference to Figure 12 the perennial Wilge River, flows in a northerly direction just to the east of the mine. The Kromdraaispruit and the Dieplaagte River are tributaries of the Wilge River and join it to the south east of the mine. The mine incorporates two tributaries of the Wilge River. The first tributary flows eastwards along the southern edge of the mine and the second one, which is fed by a spring, flows eastwards on the eastern side of the mine. These tributaries are both non-perennial although water is observed in the spring fed tributary for most months of the year. To the west of the mine, there is a non-perennial water course which flows in a northerly direction until it joins the perennial Bronkhorstspruit which also flows northwards. North of the mine boundary, there are two tributaries, one a tributary of the Wilge River and the other a tributary of the Bronkhorstspruit.

Mean annual runoff

According to Midgley et al (1994) the closest station with appropriate flow data is the Bronkhorstspruit station (B2R001). It is found that the mean annual run-off (MAR) for quaternary catchment B20A is 50.67 million m^3/year. The rainfall/run-off response factor for this quaternary catchment is 8 and has a mean annual run-off depth of 20-50mm per unit area.

The run-off for the mine site catchments are not gauged in the direct vicinity of the mine site. The Wilge River, Bronkhorstspruit, Kromdraaispruit and Dieplaagte tributaries are non-perennial. The rainfall/run-off response for the various catchments may therefore be assumed to be the same as that of the regional rainfall/run-off response as determined by Midgley et al (1994) and given above. These response parameters were used to calculate the mean annual run-off (MAR) for each catchment as shown in Table 2-20.

The MAR for the catchments associated with the mine are presented in Table 26.

TABLE 26: MEAN ANNUAL RUNOFF

Catchment	Area (km^2)	MAR (x106m^3/annum)
WCA 1	2.56	0.103
WCA 2	1.24	0.050
WCA 3	0.096	0.004
WCA 4	0.698	0.028
WCA 5	6.58	0.264
WCA 6	3.7	0.148

Normal dry weather flow

The normal dry weather flow for the two Wilge River tributaries on site is zero. The normal dry weather flow of the Wilge River is dependent on the rate of release from the Bronkhorstspruit and Kromdraaispruit dams situated about 6km upstream of the mine site. The flow of the Bronkhorstspruit will be dependent on the flow of water from the source. Flow measured at the Bronkhorstspruit gauge in the Bronkhorstspruit (gauge no. B2R001; Lat 25°53'15''; Long 28°43'30'' situated downstream of the mine site) given by Midgley et al (1994) and calculated over the period 1949 – 1987 indicates a normal monthly dry weather flow of $1.32x10^6$ m^3.

Flood peaks and volumes

The site has been divided into a number of sub-catchments as depicted in Figure 12 for the purpose of characterising surface flows. For each sub-catchment, the rational method has been used to obtain peak flow rates. The peak flow rates are summarised in Table 27.

TABLE 27: PEAK FLOWS

Catchment number	Flow (m^3/s) 1:50 yr flood	Flow (m^3/s) 1:100 yr flood
WCA 1	16	23
WCA 2	14	20
WCA 3	1.5	2

Catchment number	Flow (m^3/s) 1:50 yr flood	Flow (m^3/s) 1:100 yr flood
WCA 4	7.5	10.5
WCA 5	32	46
WCA 6	26	37

<u>Floodlines</u>

Floodlines for the area were determined using the software package HEC-RAS River Analysis System version 3.1.3 (2005). Input data included the relevant hydrological data and survey information supplied by Keaton. The relevant 100 m offset and 1:100 year flood line are shown on Figure 13 in relation to surface infrastructure.

<u>River diversions</u>

No rivers or streams will be diverted, however the upper reaches of two unnamed minor non-perennial tributaries in the western section of the mine will be impeded/damaged by the placement of the open pit. In addition, the non-perennial stream in the eastern section of the mine will be crossed by a bridge for internal roads.

<u>Surface water quality</u>

Sixteen sampling points make up the current surface water monitoring network. Three of these points are not yet applicable as they relate to the undeveloped activities on the western portion of the site. The monitoring points comprise pans, dams and streams within and around the current project site. Table 28 below presents the details of the surface water monitoring points. Note that not all the points are sampled as they are either not yet applicable to the project (i.e. those on the western portion of the mine) or there is insufficient water to sample.

TABLE 28: SURFACE WATER MONITORING POINTS

Reference	Water point type	Location (and farm owner)	South Coordinate	East Coordinate	Water Quality monitoring
VF-F1	Spring	Vanggatfontein 251 IR (Keaton, wetland area)	S26° 10' 29.6 "	E28° 51' 19.0"	Quarterly
SW1	Stream	Stream - Tributary of the Wilge River south of the mine at tar road bridge	S26° 11' 53.5"	E28° 51' 54.9"	Quarterly
SW2	Dam outlet	Dam/Stream – Point at outlet of farm dam on same river as point SW1 just prior to the confluence with the Wilge River	S26° 11' 32.9 "	E28° 52' 47.1"	Quarterly
SW3	Stream	Stream - Wilge River upstream of confluence with stream on which point SW2 is located	S26° 11' 27.3 "	E28° 52' 58.2"	Quarterly
SW4	Stream	Stream - Tributary of the Wilge River, upstream of SW1, south of the mine at boundary of the mining right area	S26° 11' 44.4 "	E28° 50' 56.0"	Quarterly
SW5	Stream	Stream - Tributary of the Wilge River, upstream of point SW14	S26° 10' 35.9 "	E28° 51' 36.4"	Quarterly
SW6	Pan	Pan - adjacent to the tar road just north of the mine	S26° 10' 26.3 "	E28° 49' 32.3"	Quarterly

Reference	Water point type	Location (and farm owner)	South Coordinate	East Coordinate	Water Quality monitoring
SW7	Stream	Stream – at sand road bridge crossing north of the mine	S26° 09' 17.3"	E28° 50' 33.3"	Quarterly
SW8	River	River – Wilge river where sand road crosses	S26° 08' 30.6 "	E28° 52' 37.8"	Quarterly
SW9		(To the west of the mine – not required at this stage)	S26° 13' 14.7 "	E28° 48' 51.8"	-
SW10		(To the west of the mine – not required at this stage)	S26° 11' 19.1 "	E28° 46' 39.4"	-
SW11		(To the west of the mine – not required at this stage)	S26° 09' 45.3 "	E28° 46' 07.7"	-
SW12	Dam	Farm Dam	S26° 11' 29.0 "	E28° 50' 06.7"	Quarterly
SW13	Dam	Farm Dam upstream from point SW12	S26° 11' 17.3 "	E28° 49' 39.6"	Quarterly
SW14	Stream	Stream – downstream of point SW5 at fence boundary of farm and about 800m away from the Wilge River	S26° 10' 19.6 "	E28° 52' 32.3"	Quarterly
SW15	River	Wilge River, just upstream of confluence with stream on which SW14 is located	S26° 10' 18.0 "	E28° 52' 47.6"	Quarterly

The results for the monitoring exercise over the period April 2011 to January 2012 are summarised in Table 29 below. The maximum, minimum and average values over this period have been presented with the SANS 241:2006 standard included. Only the average values have been compared to the SANS standard.

TABLE 29: SUMMARY OF SURFACE WATER QUALITY RESULTS

Determinand	Limit for SANS241		Class II maximum consumption period*	SW1			SW12			SW13			SW14			SW15		
	Class I	Class II		MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE
Physical and organoleptic determinand																		
Electrical conductivity at 25° C	< 150	150 - 370	7 years	20.2	73.7	41.7	27.5	42.9	34.6	30.9	40.5	34.3	31.0	39.2	33.8	44.6	87.1	64.4
Total Disolved solids	< 1000	1000 - 2400	7 years	166.0	524.0	278.5	155.0	308.0	221.0	180.0	264.0	211.3	190.0	218.0	203.3	256.0	570.0	400.0
pH value at 25 °C	5.0 - 9.5	4.0 - 10.00	No limit	7.10	8.30	7.85	7.80	8.10	7.90	7.70	8.40	8.03	7.80	8.50	8.20	8.20	8.60	8.43
Chemical requirements - macro determinand																		
Calcium as Ca	< 150	150 - 300	7 years	13.00	45.00	28.00	13.00	21.00	16.33	14.00	19.00	16.00	24.00	27.00	26.00	27.00	58.00	43.00
Chloride as Cl	< 200	200 - 600	7 years	14.00	84.00	40.25	26.00	49.00	37.33	31.00	46.00	36.67	15.00	23.00	20.00	24.00	40.00	32.33
Flouride as F	< 1.0	1.0 - 1.5	1 year	0.20	0.40	0.28	0.20	0.60	0.43	0.50	0.70	0.60	0.20	0.20	0.20	0.20	0.40	0.33
Magnesium as Mg	< 70	70 - 100	7 years	8.00	29.00	17.50	7.00	13.00	10.00	9.00	12.00	10.00	17.00	19.00	17.67	20.00	57.00	36.67
Nitrate as N	< 10	10.0 - 20.0	7 years	0.20	0.50	0.30	0.20	0.90	0.63	0.20	0.50	0.30	2.70	6.20	4.10	0.20	0.60	0.43
Pottassium as K	< 50	50 - 100	7 years	3.60	15.40	8.05	6.00	9.50	7.33	5.80	9.00	7.10	1.60	3.90	2.83	5.70	5.80	5.73
Sodium as Na	< 200	200 - 400	7 years	13.00	64.00	31.00	27.00	62.00	42.00	31.00	49.00	38.33	12.00	24.00	17.00	29.00	59.00	44.33
Sulphate as SO^4	< 400	400 - 600	7 years	18.00	107.00	47.75	27.00	62.00	44.67	29.00	53.00	43.00	8.00	13.00	11.33	39.00	131.00	85.00
Zinc as Zn	< 5.0	5.0 - 10.0	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.026	0.025
Chemical requirements - micro determinand																		
Aluminium as Al	< 0.3	0.3 - 0.5	1 year	0.117	1.570	0.617	0.212	1.030	0.583	0.179	0.783	0.409	0.100	0.248	0.149	0.115	0.369	0.259
Antimony as Sb	< 0.01	0.01 - 0.05	1 year	0.010	0.021	0.013	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.022	0.014	0.010	0.031	0.017
Arsenic as As	< 0.01	0.01 - 0.05	1 year	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Cadmium as Cd	< 0.005	0.005 - 0.01	6 months	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005
Total Chromium as Cr	< 0.1	0.1 - 0.5	3 months	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt as Co	< 0.5	0.5 - 1	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Copper as Cu	< 1	1.0 - 2.0	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Iron as Fe	< 0.2	0.2 - 2	7 years	0.790	1.990	1.550	0.669	1.500	1.136	0.632	1.240	0.839	0.238	1.260	0.579	0.368	0.622	0.476
Lead as Pb	< 0.02	0.02 - 0.05	3 months	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Manganese as Mn	< 0.1	0.1 - 1	7 years	0.040	1.000	0.387	0.089	0.267	0.199	0.090	0.126	0.102	0.117	0.625	0.292	0.103	0.470	0.233
Mercury as Hg	< 0.001	0.001 - 0.005	3 months	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nickel as Ni	< 0.15	0.15 - 0.35	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Selenium as Se	< 0.02	0.02 - 0.05	1 year	0.020	0.026	0.022	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.022	0.021	0.020	0.035	0.025
Vanadium as V	< 0.2	0.2 - 0.5	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025

Determinand	SW2			SW3			SW4			SW5			SW7			SW8		
	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE
Physical and organoleptic determinand																		
Electrical conductivity at 25° C	46.7	55.4	49.5	32.6	83.8	56.5	22.4	26.5	24.5	23.7	23.7	23.7	15.1	29.9	21.8	36.5	60.6	48.4
Total Disolved solids	266.0	320.0	293.5	242.0	548.0	361.0	156.0	170.0	163.0	164.0	164.0	164.0	115.0	182.0	142.3	242.0	360.0	294.0
pH value at 25 °C	7.80	8.60	8.15	7.60	8.60	8.28	7.10	7.10	7.10	8.20	8.20	8.20	7.50	8.20	7.97	7.90	8.50	8.15
Chemical requirements - macro determinand																		
Calcium as Ca	29.00	55.00	39.75	24.00	71.00	41.25	14.00	15.00	14.50	11.00	11.00	11.00	9.00	17.00	12.67	24.00	41.00	31.75
Chloride as Cl	16.00	24.00	21.25	16.00	38.00	28.25	20.00	34.00	27.00	15.00	15.00	15.00	11.00	27.00	20.00	23.00	38.00	28.75
Flouride as F	0.20	0.40	0.33	0.20	0.40	0.35	0.20	0.40	0.30	0.20	0.20	0.20	0.20	0.30	0.23	0.30	0.50	0.43
Magnesium as Mg	28.00	47.00	35.50	16.00	65.00	34.00	8.00	9.00	8.50	7.00	7.00	7.00	7.00	13.00	9.67	18.00	32.00	24.75
Nitrate as N	0.20	0.70	0.40	0.20	0.50	0.30	0.30	0.40	0.35	3.30	3.30	3.30	0.20	0.50	0.33	0.20	0.50	0.30
Pottassium as K	6.60	11.80	8.78	5.40	7.20	6.03	3.20	3.40	3.30	3.50	3.50	3.50	3.20	4.00	3.47	4.80	7.10	6.13
Sodium as Na	13.00	29.00	19.75	22.00	81.00	44.50	20.00	23.00	21.50	23.00	23.00	23.00	10.00	20.00	16.67	28.00	49.00	37.50
Sulphate as SO^4	5.00	15.00	8.25	37.00	120.00	77.00	19.00	23.00	21.00	8.00	8.00	8.00	7.00	21.00	12.33	37.00	73.00	51.75
Zinc as Zn	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Chemical requirements - micro determinand																		
Aluminium as Al	0.100	0.253	0.177	0.100	1.230	0.457	0.100	0.289	0.195	0.301	0.301	0.301	0.158	1.660	0.662	0.100	0.663	0.343
Antimony as Sb	0.010	0.030	0.015	0.010	0.025	0.014	0.010	0.010	0.010	0.018	0.018	0.018	0.010	0.026	0.015	0.010	0.021	0.013
Arsenic as As	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Cadmium as Cd	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Total Chromium as Cr	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt as Co	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Copper as Cu	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Iron as Fe	0.073	0.814	0.347	0.050	2.200	0.766	1.100	1.470	1.285	0.983	0.983	0.983	2.360	3.770	3.273	0.241	1.360	0.743
Lead as Pb	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Manganese as Mn	0.025	0.760	0.226	0.065	0.214	0.161	0.141	0.190	0.166	0.058	0.058	0.058	0.074	1.090	0.457	0.129	0.285	0.204
Mercury as Hg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nickel as Ni	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Selenium as Se	0.020	0.030	0.025	0.020	0.026	0.023	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.025	0.022	0.020	0.025	0.021
Vanadium as V	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025

0.00– values highlighted in yellow exceed the SANS Class 1 standard

0.00 – values highlighted in red exceed the SANS Class 2 standard

The results indicate that the iron and aluminium concentrations in certain of the surface waters are elevated to exceed the SANS Class 2 standard. Antimony, cadmium, manganese and selenium are also slightly elevated at certain locations to exceed the SANS Class 1 standard. It must be noted however that the analysis detection limit for antimony and cadmium is the same as the Class 1 standard thus the actual values may be lower than the reported values. The iron and aluminium levels are consistent with the baseline values recorded in 2008 and it is unlikely that Keaton's mining activities are influencing these concentrations at this stage.

Surface water use

Surface water in the area is used for livestock and crop watering, and for limited domestic purposes.

Wetlands

The presence of wetlands within the mining right area is shown on Figure 8 and Figure 10 and are associated with specific soil and wet grassland types. These are discussed in relation to biodiversity in Section 1.1.6. The main associated conclusion is that the undisturbed wetlands are functional ecosystems that host some species of conservation concern. Where wetlands have been disturbed (by historic agricultural and mining activities) their functionality and ability to host any species has been compromised.

Conclusion

The mine and associated activities have the potential to pollute surface water resources that may be used for ecosystem functionality as well as by third parties for domestic, recreation and/or agricultural activities. Therefore the mine must be managed in a way that pollution of water resources is prevented. Moreover, care is required to ensure that the disturbance of surface run-off patterns is limited as far as possible to promote the continued flows of water and nutrients.

1.1.8 GROUNDWATER BASELINE

The information in this section was sourced from the groundwater study that was undertaken by JMA Consulting (Pty) Ltd for the mine's approved EIA and EMP report (Metago, 2008), a project-specific groundwater study undertaken by SLR (Appendix F) and monitoring data.

Introduction and link to impacts

Groundwater is a valuable resource and is defined as water which is located beneath the ground surface in soil/rock pore spaces and in the fractures of lithologic formations. Understanding the geology of the area provides a basis from which to understand the occurrence of groundwater resources. Project related activities such as open pit mining, the handling and storage of hazardous materials and handling and storage of mineralised and non-mineralised wastes have the potential to result in the loss of groundwater resources, both to the environment and third party users, through dewatering and pollution.

As a baseline, this section provides an understanding of the current groundwater conditions (quality, quantity and use) and the potential for dewatering cones of depression and pollution plumes to occur as a result of mining-related activities.

Data collection

Sources of data include the following:

- review of existing reports, databases (Keaton's monitoring database) and maps; and
- conducting a hydrocensus to identify water users as well as to determine the quality and quantity of water resources.

Results

Groundwater zone

The predominant ground water zone in the project area is defined by the Karoo aquifer system which has three zones. These include: a shallow perched zone in the soft overburden, a shallow weathered zone, and a deeper fractured zone. This aquifer system is expected to be a minor aquifer system. In addition, there is a deeper dolomitic aquifer zone that occurs further below the Karoo aquifer system. This dolomitic aquifer zone is generally more than 100 m below surface and may be classified as a major aquifer system, because, although this dolomitic aquifer zone has been stressed by regional use, it has the potential to contain significant zones of higher yields. The target coal seams (Numbers 2, 4 and 5) all occur above the dolomitic aquifer zone. Importantly, in most of the mine area, between the bottom of the target coal seams and the dolomitic aquifer, there are different geological combinations comprising coal seam/mudrock, sediments and Dwyka Tillite that are considered to be impermeable zones (refer to Section 1.1.1 for more discussion on the geology). Where these impermeable zones exist, flow of water in the Karoo aquifer system is expected to be horizontal above the impermeable zones and not vertical into the deeper dolomitic aquifer.

Groundwater levels, flow and use

Groundwater in the project area is typically between 0.3 and 28 m below ground level. Groundwater flow is generally influenced by the topography in the project area and is essentially horizontal. In certain instances, interconnection between the aquifer types can introduce vertical flow components. Most of the boreholes located on the farms around the mine are used for domestic and agricultural (livestock and irrigation) purposes. Aside from seasonal fluctions between the wet and dry seasons, no significant impacts on groundwater levels have been identified to date.

Groundwater quality

Twenty three ground water points make up the monitoring network. These are boreholes located within and around the mining right area. Table 30 below presents the details of the groundwater monitoring points. Not all the groundwater points are sampled as the boreholes either no longer exist/have been damaged or are equipped but the pump is no longer working.

TABLE 30: GROUNDWATER MONITORING POINTS

Reference	Water point type	Location (and farm owner)	South coordinate	East coordinate	Water quality monitoring	Water level monitoring
VF-7	Borehole	Vanggatfontein 251 IR (Keaton reservoir near plant)	S26° 10' 07.0"	E28° 51' 20.2"	Quarterly	*Not possible
BF-8	Borehole	Vanggatfontein 251 IR	S26° 11' 40.5 "	E28° 50 56.2"	Quarterly	*Not possible
VF-1	Borehole	Vanggatfontein 251 IR (Keaton front gate reservoir)	S26° 10' 19.8 "	E28° 50' 02.4"	Quarterly	*Not possible
VF-2	Borehole	Vanggatfontein 251 IR (Claasens household)	S26° 10 12.4 "	E28° 50' 13.6"	Quarterly	*Not possible
VF-8	Borehole	Vanggatfontein 251 IR (Venter property)	S26° 10' 03.3 "	E28° 51' 30.5"	Quarterly	*Not possible
VF-11	Borehole	Vanggatfontein 251 IR (Venter)	S26° 10' 56.0 "	E28° 50' 33.3"	Quarterly	*Not possible
BF-2	Borehole	Vanggatfontein 251 IR (Venter farm manager)	S26° 12' 24.5 "	E28° 50' 42.6"	Quarterly	*Not possible
RK-3	Borehole	Rietkuil 249 IR (Schalekamp)	S26° 10' 27.9 "	E28° 48' 19.2"	Quarterly	*Not possible
VG-3	Borehole	Vanggatfontein 250 IR (Opperman)	S26° 09' 36.5 "	E28° 50' 10.8"	Quarterly	*Not possible
VF-12	Borehole	Vanggatfontein 251 IR – around tailings dam	S 26^{o} 09' 46.07"	E 28^{o} 51' 40.19"	Quarterly	Monthly
Vf-13	Borehole	Vanggatfontein 251 IR - around tailings dam	S 26^{o} 09' 35.65"	E 28^{o} 52' 11.66"	Quarterly	Monthly
VF-14	Borehole	Vanggatfontein 251 IR - around tailings dam	S 26^{o} 09' 56.64"	E 28^{o} 51' 58.44"	Quarterly	Monthly
VF-15	Borehole	Straffontein 252 IR - around tailings dam	S 26^{o} 10' 17.22"	E 28^{o} 52' 09.44"	Quarterly	Monthly
VF-16	Borehole	Vanggatfontein 250 IR - around tailings dam	S 26^{o} 10' 28.64"	E 28^{o} 51' 11.33"	Quarterly	Monthly
VF-6	Borehole	Vanggatfontein 2501IR (Keaton office tap)	S 26° 10' 01.1"	E 28° 51' 34.8"	Quarterly	*Not possible
BF-2a	Borehole	Brakfontein 264 IR (Venter farm manager)	S 26° 12' 28.9"	E 28° 50' 36.6"	Quarterly	*Not possible
VF-10	Borehole	Brakfontein 264 IR (Venter)	S 26° 11' 02.7"	E 28° 51' 05.3"	Quarterly	*Not possible
Gerricke	Borehole	Brakfontein 264 IR (Gerricke)	S 26° 12' 54,6"	E 28° 51' 42,1"	Quarterly	*Not possible
Opperman	Borehole	Vanggatfontein 250 IR and Vogelfontein 222 IR (Opperman)	S 26° 09' 33.6"	E 28° 50' 05.1"	Quarterly	*Not possible
VdM	Borehole	Straffontein 252 IR (Van der Merwe)	S 26° 09' 24.9"	E 28° 53' 39.6"	Quarterly	*Not possible
Kleyn	Borehole	Straffontein 252 IR (Kleyn) (2 boreholes feed a reservoir)	S 26° 09' 33.8"	E 28° 53' 52.0"	Quarterly	*Not possible

Reference	Water point type	Location (and farm owner)	South coordinate	East coordinate	Water quality monitoring	Water level monitoring
Bezuidenhout	Borehole	Welgelegen (Bezuidenhout)	S 26° 08' 14.7"	E 28° 51' 40.3"	Quarterly	*Not possible
Welbez	Borehole	Vanggatfontein 250 IR, Straffontein 252 IR and Vogelfontein 222 IR (Bezuidenhout farm manager house)	S 26° 08' 32.4"	E 28° 53' 29.1"	Quarterly	*Not possible

*- not possible as the boreholes are equipped.

The results for Keaton's monitoring exercises over the period April 2011 to January 2012 are summarised in Table 31 and Table 32 below. The maximum, minimum and average values over this period have been presented with the SANS 241:2006 standard included. Only the average values have been compared to the SANS standard.

TABLE 31: SUMMARY OF GROUNDWATER QUALITY RESULTS

Determinand	Limit for SANS241 Class I	Limit for SANS241 Class II	Class II maximum consumption period*	BEZUIDENHOUT			BF2			GERRICKE			KLEYN			OPPERMAN			VdM			VF1			VF10			VF12		
				MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE
Physical and organoleptic determinand																														
Electrical conductivity at 25° C	< 150	150 - 370	7 years	50.5	57.2	53.5	43.6	47.0	45.5	39.4	41.5	40.5	5.0	45.2	17.0	16.9	18.5	17.5	6.9	7.4	7.2	23.3	27.1	25.7	27.9	30.6	29.1	24.1	32.1	26.6
Total Disolved solids	< 1000	1000 - 2400	7 years	312.0	372.0	346.0	268.0	316.0	294.5	246.0	260.0	252.0	28.0	298.0	114.0	101.0	130.0	113.8	44.0	60.0	50.3	142.0	154.0	146.7	170.0	186.0	176.0	162.0	192.0	178.8
pH value at 25 °C	5.0 - 9.5	4.0 - 10.00	No limit	7.5	8.3	7.9	7.3	8.6	7.9	7.3	8.5	7.7	5.6	7.5	6.6	7.0	7.9	7.5	6.2	7.2	6.7	8.1	8.2	8.2	7.6	8.5	8.0	7.2	8.2	7.8
Chemical requirements - macro determinand																														
Calcium as Ca	< 150	150 - 300	7 years	11.0	17.0	13.8	36.0	53.0	44.5	39.0	49.0	45.5	2.0	21.0	7.3	12.0	17.0	14.0	2.0	3.0	2.3	13.0	16.0	14.7	25.0	31.0	27.7	15.0	23.0	18.6
Chloride as Cl	< 200	200 - 600	7 years	27.0	36.0	32.0	14.0	20.0	17.5	10.0	11.0	10.5	5.0	66.0	21.5	15.0	19.0	17.3	6.0	7.0	6.8	8.0	16.0	12.7	5.0	6.0	5.7	12.0	15.0	13.4
Flouride as F	< 1.0	1.0 - 1.5	1 year	0.8	0.9	0.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.9	2.3	1.7	0.2	0.2	0.2	0.2	0.7	0.3
Magnesium as Mg	< 70	70 - 100	7 years	3.0	5.0	3.8	16.0	24.0	19.0	18.0	21.0	19.5	2.0	18.0	6.5	5.0	7.0	6.0	2.0	3.0	2.8	7.0	7.0	7.0	9.0	12.0	10.3	13.0	20.0	16.8
Nitrate as N	< 10	10.0 - 20.0	7 years	1.1	2.0	1.5	1.9	2.4	2.2	0.5	0.8	0.7	0.9	11.0	4.2	1.9	3.5	2.6	3.3	4.4	4.0	0.3	3.0	1.4	0.2	0.3	0.2	9.6	12.0	11.3
Pottassium as K	< 50	50 - 100	7 years	1.4	2.3	1.8	4.3	4.7	4.5	5.9	7.0	6.4	3.0	27.0	9.7	2.8	3.9	3.2	3.1	3.5	3.2	2.0	2.1	2.1	5.3	6.3	5.8	3.9	4.8	4.5
Sodium as Na	< 200	200 - 400	7 years	85.0	106.0	97.0	29.0	39.0	33.0	9.0	11.0	9.8	4.0	19.0	8.5	8.0	11.0	9.8	4.0	6.0	5.3	19.0	34.0	28.3	15.0	19.0	17.0	5.0	6.0	5.4
Sulphate as SO^4	< 400	400 - 600	7 years	103.0	126.0	114.8	21.0	28.0	24.0	21.0	29.0	26.3	5.0	47.0	16.3	6.0	14.0	11.3	5.0	5.0	5.0	5.0	6.0	5.3	5.0	5.0	5.0	5.0	5.0	5.0
Zinc as Zn	< 5.0	5.0 - 10.0	1 year	0.025	0.228	0.103	0.031	0.102	0.071	0.025	0.025	0.025	0.025	0.075	0.051	0.051	0.102	0.070	0.025	0.026	0.025	0.025	0.306	0.119	0.853	1.290	1.118	0.025	0.802	0.184
Chemical requirements - micro determinand																														
Aluminium as Al	< 0.3	0.3 - 0.5	1 year	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.124	0.107	0.100	0.100	0.100	0.111	0.863	0.524	0.100	0.109	0.103	0.100	0.100	0.100	0.445	5.210	1.823
Antimony as Sb	< 0.01	0.01 - 0.05	1 year	0.010	0.024	0.014	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.020	0.013	0.010	0.028	0.015	0.010	0.022	0.013	0.010	0.030	0.017	0.010	0.021	0.014	0.010	0.017	0.012
Arsenic as As	< 0.01	0.01 - 0.05	1 year	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Cadmium as Cd	< 0.005	0.005 - 0.01	6 months	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Total Chromium as Cr	< 0.1	0.1 - 0.5	3 months	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.306	0.088
Cobalt as Co	< 0.5	0.5 - 1	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.028	0.026
Copper as Cu	< 1	1.0 - 2.0	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.246	0.141	0.025	0.025	0.025	0.025	0.027	0.026	0.025	0.073	0.041	0.025	0.079	0.043	0.025	0.025	0.025
Iron as Fe	< 0.2	0.2 - 2	7 years	0.025	0.124	0.052	0.025	0.038	0.028	0.025	0.025	0.025	0.025	0.149	0.056	0.244	1.130	0.508	0.034	0.078	0.054	0.025	0.506	0.185	1.050	1.660	1.403	0.776	7.830	2.620
Lead as Pb	< 0.02	0.02 - 0.05	3 months	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Manganese as Mn	< 0.1	0.1 - 1	7 years	0.025	0.026	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.184	0.067	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.047	0.032	0.140	0.231	0.185	0.030	0.669	0.210
Mercury as Hg	< 0.001	0.001 - 0.005	3 months	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nickel as Ni	< 0.15	0.15 - 0.35	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.043	0.104	0.077	0.025	0.029	0.026	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.059	0.032
Selenium as Se	< 0.02	0.02 - 0.05	1 year	0.020	0.022	0.021	0.020	0.020	0.020	0.020	0.022	0.021	0.020	0.020	0.020	0.020	0.022	0.021	0.020	0.020	0.020	0.020	0.021	0.020	0.020	0.028	0.023	0.020	0.030	0.022
Vanadium as V	< 0.2	0.2 - 0.5	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025

0.00– values highlighted in yellow exceed the SANS Class 1 standard

0.00 – values highlighted in red exceed the SANS Class 2 standard

TABLE 32: SUMMARY OF GROUNDWATER QUALITY RESULTS CONTINUED

Determinand	Limit for SANS241		Class II maximum consumption period*	VF13			VF14			VF15			VF16			VF2			VF6			VFF1			WELBEZ		
	Class I	Class II		MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE	MIN	MAX	AVE
Physical and organoleptic determinand																											
Electrical conductivity at 25° C	< 150	150 - 370	7 years	34.0	36.8	35.9	29.6	32.6	31.1	12.4	20.2	18.2	22.6	22.6	22.6	23.0	26.5	25.2	32.7	35.6	34.5	12.1	12.1	12.1	4.6	28.3	10.6
Total Disolved solids	< 1000	1000 - 2400	7 years	192.0	248.0	220.4	168.0	222.0	203.2	106.0	166.0	134.8	186.0	186.0	186.0	142.0	154.0	149.0	188.0	208.0	200.0	82.0	82.0	82.0	26.0	168.0	64.3
pH value at 25 °C	5.0 - 9.5	4.0 - 10.00	No limit	7.4	8.5	7.9	7.5	8.3	7.9	6.5	8.1	7.4	5.7	5.7	5.7	8.1	8.6	8.4	7.7	8.3	8.0	7.7	7.7	7.7	6.7	8.2	7.3
Chemical requirements - macro determinand																											
Calcium as Ca	< 150	150 - 300	7 years	28.0	45.0	38.6	21.0	28.0	24.2	8.0	14.0	11.4	16.0	16.0	16.0	12.0	15.0	13.8	26.0	36.0	30.5	6.0	6.0	6.0	2.0	5.0	2.8
Chloride as Cl	< 200	200 - 600	7 years	5.0	7.0	6.0	11.0	23.0	16.2	9.0	14.0	11.6	18.0	18.0	18.0	8.0	14.0	12.3	20.0	24.0	22.5	13.0	13.0	13.0	5.0	44.0	14.8
Flouride as F	< 1.0	1.0 - 1.5	1 year	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	2.0	1.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	4.0	1.2
Magnesium as Mg	< 70	70 - 100	7 years	14.0	20.0	17.6	19.0	27.0	23.4	6.0	9.0	7.6	12.0	12.0	12.0	6.0	9.0	7.5	17.0	24.0	19.8	4.0	4.0	4.0	2.0	2.0	2.0
Nitrate as N	< 10	10.0 - 20.0	7 years	4.9	6.9	5.8	0.8	12.0	8.8	5.0	9.0	7.9	17.0	17.0	17.0	0.2	3.0	1.1	8.6	9.8	9.1	4.1	4.1	4.1	0.2	0.6	0.4
Pottassium as K	< 50	50 - 100	7 years	1.5	2.2	1.9	4.1	5.2	4.6	1.0	1.5	1.1	4.7	4.7	4.7	1.8	2.4	2.1	2.7	3.9	3.2	2.7	2.7	2.7	2.9	4.3	3.7
Sodium as Na	< 200	200 - 400	7 years	8.0	11.0	9.4	5.0	10.0	7.2	9.0	11.0	9.8	10.0	10.0	10.0	22.0	33.0	28.3	9.0	13.0	10.5	7.0	7.0	7.0	4.0	53.0	16.3
Sulphate as SO^4	< 400	400 - 600	7 years	5.0	5.0	5.0	5.0	18.0	7.6	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Zinc as Zn	< 5.0	5.0 - 10.0	1 year	0.025	0.186	0.057	0.025	0.450	0.113	0.025	0.136	0.047	0.040	0.040	0.040	0.025	0.123	0.069	0.043	0.254	0.113	0.025	0.025	0.025	0.083	0.426	0.235
Chemical requirements - micro determinand																											
Aluminium as Al	< 0.3	0.3 - 0.5	1 year	0.263	1.870	0.995	1.700	6.750	3.734	0.100	0.925	0.298	2.280	2.280	2.280	0.100	0.100	0.100	0.100	0.101	0.100	0.196	0.196	0.196	0.100	0.179	0.120
Antimony as Sb	< 0.01	0.01 - 0.05	1 year	0.010	0.018	0.012	0.010	0.012	0.011	0.010	0.016	0.012	0.010	0.010	0.010	0.010	0.022	0.013	0.010	0.028	0.015	0.022	0.022	0.022	0.010	0.028	0.015
Arsenic as As	< 0.01	0.01 - 0.05	1 year	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Cadmium as Cd	< 0.005	0.005 - 0.01	6 months	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Total Chromium as Cr	< 0.1	0.1 - 0.5	3 months	0.025	0.025	0.025	0.025	0.841	0.207	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt as Co	< 0.5	0.5 - 1	1 year	0.025	0.025	0.025	0.025	0.041	0.030	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Copper as Cu	< 1	1.0 - 2.0	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.085	0.040	0.025	0.025	0.025	0.025	0.027	0.026
Iron as Fe	< 0.2	0.2 - 2	7 years	0.383	1.990	1.303	2.090	7.630	4.212	0.027	1.220	0.355	9.000	9.000	9.000	0.025	0.182	0.075	0.025	0.038	0.032	2.600	2.600	2.600	0.117	3.040	1.384
Lead as Pb	< 0.02	0.02 - 0.05	3 months	0.020	0.022	0.020	0.020	0.026	0.023	0.020	0.020	0.020	0.023	0.023	0.023	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Manganese as Mn	< 0.1	0.1 - 1	7 years	0.042	0.257	0.128	0.403	1.100	0.700	0.025	0.140	0.048	0.657	0.657	0.657	0.025	0.025	0.025	0.025	0.025	0.025	0.110	0.110	0.110	0.025	0.039	0.029
Mercury as Hg	< 0.001	0.001 - 0.005	3 months	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nickel as Ni	< 0.15	0.15 - 0.35	1 year	0.025	0.025	0.025	0.025	0.083	0.043	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Selenium as Se	< 0.02	0.02 - 0.05	1 year	0.020	0.028	0.023	0.020	0.029	0.022	0.020	0.026	0.021	0.020	0.020	0.020	0.020	0.023	0.021	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.022	0.021
Vanadium as V	< 0.2	0.2 - 0.5	1 year	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.026	0.026	0.026	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025

0.00– values highlighted in yellow exceed the SANS Class 1 standard

0.00 – values highlighted in red exceed the SANS Class 2 standard

The results of the water analysis indicate that the groundwater from certain of the new monitoring boreholes installed around the tailings dam (VF12 – VF16) indicates elevated aluminium and iron concentrations. The aluminium and iron may be due to fine sediments of rock or sand which remain in the borehole from the drilling process and which get captured in the water sample.

The antimony, cadmium and lead are slightly elevated at certain locations but it must be noted that the analysis detection limit for these parameters is the same as the Class 1 standard thus the actual values will be lower than these reported values.

The iron and aluminium measured in a few of the samples taken off-site from existing farm boreholes may be due to the steel casings and piping used which are generally old and show signs of rusting.

Fluoride is elevated in the water from boreholes VF-1 and VF-2 and exceeds Class 2 standards. The pre-mining baseline results indicate that the average fluoride value for the area was 0.18 mg/l. The cause of this slightly elevated fluoride is most likely related to the weathering of intrusive dykes or sills in the Karoo Sandstones.

Conclusion

The mine and associated activities have the potential to pollute groundwater resources that may be used for ecosystem functionality as well as by third parties for domestic, recreation and/or agricultural activities. Aside from seasonal fluctions between the wet and dry seasons, no significant impacts on groundwater levels have been identified to date. Therefore the mine must be managed in a way that pollution of groundwater resources is prevented.

1.1.9 AIR QUALITY BASELINE

Information in this section was sourced from air specialist studies that have been undertaken by Airshed Planning Professionals (Airshed 2008) for the pre-mining status and the project specific study (Airshed, 2012) included in Appendix G.

Introduction and link to anticipated impact

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change in ambient air quality can result in a range of impacts which in turn may cause a disturbance and/or health impacts to nearby receptors. Potential receptor sites include the residential areas (farmer and farm worker houses) and natural environments that have been described in Section 1.3.1. The current land uses in the broader area include mining and agricultural activities. Regionally, there are several mining operations (mostly coal mining).

Data collection

Data was obtained from the review of existing literature, available studies and monitoring data. In this regard, the three data types are meteorological data (weather data), dust fallout data, and ambient pollution concentration data (PM_{10} concentrations).

Results

Regional air quality

The Mpumalanga Highveld region has been the focus of various air pollution studies for two reasons:

- elevated air pollution concentrations have been observed in the region; and
- elevated sources of emissions in the region are associated with potential for both regional and more widespread impacts on air quality.

Criteria pollutants of concern in the region include: particulates, sulphur dioxide and nitrogen oxides. Sources of these pollutants include:

- power stations;
- industry;
- mining operations;
- dust entrainment on both paved and unpaved roads;
- wind erosion of exposed open areas and stockpiles;
- domestic fuel burning;
- biomass burning;
- vehicle tailpipe emissions; and
- informal refuse burning.

Project area

Dust fallout monitoring data

The mine operates a network of dust buckets for the purpose of monitoring monthly fallout in and around the mining right area. Existing monitoring points are illustrated in Figure 15. A summary of dust fallout collected from September 2010 to February 2012 is provided in Table 33.

Dust fall out levels on the northern boundary of the mine in particular exceed the SANS residential limit of 600 mg/m²-day. Most of the monitoring stations within the mining right area are in compliance with the SANS industrial limit of 600 – 1 200 mg/m²-day except for monitoring stations K09 (located at the plant) and K07 (located at the Venter's residence). It should however been noted that although monitoring station K07 is located within the mining right area, the SANS residential limit should apply for a long as third parties reside at this house.

Predicted PM_{10} concentrations

As the mine does not currently monitor PM_{10} concentrations, Airshed has modelled the PM_{10} predictions in both the unmitigated and mitigated scenarios for the current operations (Airshed, 2012). Without monitoring data, it is not possible to ascertain where the mine lies between the unmitigated and mitigated scenarios. As such, predictions for both scenarios are presented below.

In the unmitigated scenario, where no mitigation measures are in place, it is predicted that both the daily and annual limits are exceeded both within and outside of the mining right area. With mitigation measures in place for the unpaved access road, the recommended PM_{10} levels for both daily and annual limits are exceeded off-site, particularly to the north of the mine due to the proximity of the access road to the mine boundary.

TABLE 33: SUMMARY OF AVERAGE DAILY DUST FALL

Site	Maximum Daily Dust Fall (mg/m^2-day)																							
	10-Sept	**10-Oct**	**10-Nov**	**10-Dec**	**11-Jan**	**11-Feb**	**11-Mar**	**11-Apr**	**11-May**	**11-Jun**	**11-Jul**	**11-Aug**	**11-Sept**	**11-Oct**	**11-Nov**	**11-Dec**	**12-Jan**	**12-Feb**	**12-Mar**	**12-Apr**	**12-May**	**12-Jun**	**12-Jul**	**12-Aug**
K01	724	489	400	N/A	356	943	508	46	1 202	1 209	1 146	1 670	1 577	1 255	892	N/A	264	1 687	N/A	1 321	509	461	610	467
K02	8 698	1 172	863	115	685	919	514	383	691	697	789	2 816	1 658	809	1 130	982	793	3 110	N/A	1 266	959	733	760	288
K03	420	458	291	113	330	332	231	534	147	152	234	261	146	234	207	283	393	304	N/A	494	600	190	150	253
K04	158	330	164	44	100	110	47	98	65	69	50	136	126	150	264	198	122	106	N/A	99	441	63	100	N/A
K05	189	383	92	34	106	118	71	49	105	110	100	310	131	158	167	232	95	117	N/A	90	527	77	70	217
K06	179	384	240	95	163	114	106	145	168	172	107	1 047	172	249	360	396	175	136	N/A	151	106	137	170	182
K07	614	1 209	486	133	150	119	141	75	230	235	125	354	323	1 320	1 693	899	233	252	N/A	112	239	96	280	134
K08	231	336	196	82	46	115	66	83	157	161	117	1 330	342	349	231	N/A	208	173	N/A	240	1 083	172	180	214
K09	446	957	460	330	127	227	279	240	1 056	1 063	925	708	1 422	1 768	2 869	3 073	999	985	N/A	N/A	1 380	842	2 000	828
K10	224	573	472	197	50	159	70	173	244	249	251	220	399	252	226	246	79	255	N/A	253	402	239	380	198
K11	232	393	405	N/A	86	118	88	70	0	0	327	637	774	437	332	N/A	364	413	N/A	465	456	257	480	92
K12	175	310	123	99	90	112	306	16	0	0	122	145	129	189	176	193	92	157	N/A	148	213	91	80	119

Notes

- (green) Within SANS Industrial Threshold Band of 600 – 1 200 mg/m^2-day, but exceeds residential threshold of 600 mg/m^2-day
- (yellow) Within SANS Action Threshold Band of 1 200 to 2 400 mg/m^2-day
- (red) Exceeds the SANS Alert Threshold of 2 400 mg/m^2-day
- N/A – no results available due to damaged equipment

Potential receptor sites

In the context of the mine, the related receptor sites are the farmers and farm workers located within the mining right area and those located on neighbouring farms. A list of farmers is included in Section 1.3.1. The on-site receptor areas are also shown in Figure 2.

Conclusion

The Vanggatfontein Mine is located in a region which is already exposed to a wide range of air pollution sources. Keaton's mining operations are contributing to elevated dust fall out and PM_{10} concentrations, therefore the design of the mine and air mitigation measures must be focused on the control of these impacts.

1.1.10 NOISE BASELINE

Information in this section was sourced from Keaton's approved EIA and EMP report and the noise specialist study that was undertaken by Acusolv (Acusolv, 2008) for the pre-mining ambient noise levels as well as monitoring data.

Introduction and link to anticipated impact

Certain noise generating activities may cause an increase in ambient noise levels in and around the mine. This may cause a disturbance to nearby receptors. Potential receptor sites include farmers and farm workers on-site and on neighbouring properties (Figure 2) as well as animals that have been described in Section 1.3.1.

Data collection

The Vanggatfontein noise study and monitoring exercises are carried out in accordance with relevant guidelines. In this regard, field surveys were conducted at residences closest to the mining operations using equipment that conformed to IEC 61672-1 Electro-acoustics – Sound Level Meters – Part 1: Specifications.

Results

The pre-mining ambient noise levels were characterised as rural and were not subjected to elevated noise levels. The pre-mining ambient noise levels varied from 45 dBA during the day, to 35 dBA at night.

The ambient noise levels have been altered by activities associated with the Vanggatfontein Coal Mine. Monitoring data indicates that the current mining activities generally have limited impacts on receptors within and adjacent to the mining right area. However, this is not the case for the Venter residence and the associated farm workers residence on the property (see R3 and R4, and by implication also R2 on Figure 2) as the average night-time noise level has increased by between 10 and 15 dBA from the recorded pre-mining noise levels.

Conclusion

Ambient noise levels have been influenced by Keaton's current mining activities. The current mining operations generally have a low impact on receptors, with the exception of the Venter residence and associated farm workers residence. Careful design, planning and mitigation interventions will need to be taken into consideration in order to manage disturbing noise levels.

1.1.11 VISUAL ASPECTS

Information in this section is taken from Keaton's approved EIA and EMP report (Metago, 2008).

Introduction and link to anticipated impact

Mining-related activities have the potential to alter the landscape character of the site and surrounding area through the establishment of both temporary (such as processing infrastructure, support facilities and open pits) and permanent infrastructure (such as MRDF). As a baseline, this section provides an understanding of the visual aspects of the area against which to measure potential change as a result of mine infrastructure and activities.

Data collection

Data on the visual resource was collected from 1:50 000 topographical maps and on-site observations.

Results

In describing the visual landscape a number of factors are considered, including landscape character, sense of place, scenic quality, and sensitive views. Each of these concepts is discussed below:

<u>Landscape character</u>

The mine lies between the Bronkhorstspruit in the west and the Wilge River in the east. The mining area is characterised mostly by flat and/or sloping plains. The immediate environment in and around the mine is characterised by rural agricultural, community and mining activities. Within the site and further afield there are railway lines, power lines, a cell phone mast, telephone lines, roads, a power station and mining activities.

<u>Sense of place</u>

Central to the concept of sense of place is that the landscape requires uniqueness and distinctiveness that is not compromised by infrastructure and activities that do not form part of the natural uniqueness. As described in the landscape character section above, the mine is located within a rural agricultural farming region that is influenced to some degree by services infrastructure, a power station and other mines. Taken together the landscape can be described as having a moderate sense of place.

Landscape quality and aesthetic value

The landscape quality describes the experience when viewing the landscape. Some views of the landscape are pleasant and peaceful with views of farms and wetlands. Other views are broken by the infrastructure described in the landscape character section above. The quality and aesthetic value can therefore be described as moderate.

Sensitive views of the mine

Views in general relate to the views of the mine from surrounding areas. Sensitive views are to a large degree determined by concerns and issues raised by interested and affected parties during the scoping process and by any potential views from tourism routes and destinations. Although there are people within the mining right area and on the neighbouring properties that will have views of the mine, no issues or concerns regarding visual impacts have been raised. Furthermore the project site is not on any known tourism route nor is it visible from tourism destinations. It is therefore concluded that there are no particularly sensitive views.

Conclusion

The area can be described as a rural agricultural farming region that is influenced to some degree by services infrastructure, a power station and mining operations. The visual resource of the site has been altered as a result of Keaton's existing mining activities. This baseline information should be taken into consideration from a planning and mitigation perspective.

1.2 ENVIRONMENTAL ASPECTS WHICH MAY REQUIRE PROTECTION OR REMEDIATION

Environmental aspects both on the mine site and in the surrounding area which may require protection or remediation during the life of the mine are listed below:

- drainage patterns on site after closure;
- stripped and stockpiled soils;
- in-situ soils and land capabilities;
- non-perennial tributaries of the Wilge River;
- biodiversity;
- groundwater resources;
- surface water resources;
- ambient air qualities;
- noise environment;
- visual and landscape quality;
- surrounding land uses, socio-economic conditions and economic activity; and
- heritage (and cultural) and palaeontological resources.

This list is based on the concise descriptions provided in Sections 1.1 and 1.3.

1.3 LAND USES, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

A description of the specific land uses, cultural and heritage aspects and infrastructure on site and on neighbouring properties/farms is provided in this section. This section identifies whether or not there is potential for the socio-economic conditions of other parties to be affected by the mining operations.

1.3.1 LAND USES

Introduction and link to impacts

Mining activities have the potential to affect land uses both on the site (through land development) and in the surrounding areas (through direct or indirect positive and/or negative impacts). As a baseline, this section outlines existing land tenure including surface and prospecting/mining rights (both on the site and in the surrounding area), describes the land uses on site and in the surrounding area, and identifies third party service infrastructure. This section provides the context within which potential impacts on land uses and existing economic activity may occur.

Data collection

Surface right information was provided by Keaton. Information on existing prospecting/mining rights was compiled with input from Keaton and Metago SLR's knowledge of the area.

Information on the context of the area and the presence of infrastructure was compiled by Metago SLR using information provided by the various specialist studies, observations during site visits and study of aerial and satellite images.

Results – Mineral / Prospecting rights

Mining rights in the mine area (Vanggatfontein 251 IR) are held by Keaton Mining (Pty) Ltd (MP30/5/1/2/2/309MR).

Results – Land ownership

Keaton owns portions 4, 5 and a portion of portion 8 of the farm Vanggatfontein 251 IR, where mining activities are currently located. The surface right owners and corresponding title deed numbers of the land in and adjacent to Keaton's mining right area are listed in Table 34 and illustrated in Figure 16.

TABLE 34: SURFACE RIGHTS ON AND SURROUNDING THE PROJECT SITE

Farm Name	Portion number	Title deed number	Registered property owner
On the mining right area			
Vanggatfontein 251 IR	0	T17657/2005	Andries Schoeman Brakfontein (Pty) Ltd C/o FA Venter

Farm Name	Portion number	Title deed number	Registered property owner
	1	T130512/2000	Vanggatfontein Beleggings (Pty) Ltd C/o Johan Claassens
	2		
	3		
	4	T000011014/2010	Keaton Mining (Pty) Ltd
	5	T000010751/2010	Keaton Mining (Pty) Ltd
	A portion of portion 8	T61176/1994*	Keaton Mining (Pty) Ltd
	A portion of portion 8		Johan Venter Will Trust C/o F.A Venter
Neighbouring farms			
Vogelfontein 222 IR	0 (Remaining extent) and 1	T33971/1967 T40009/1975	Daniel Jacobus Operman
Rietkuil 249 IR	3	T130512/2000	Vanggatfontein Beleggings (Pty) Ltd C/o Johan Claassens
	4	T112486/1992	Cecilia Jacoba De Bruin
	8	T122930/2006	Klaprops 93 CC C/o J.G.P and M.A Schalekamp
	11	T46908/1980	Maarten Adriaan Schalekamp
	12	T13491/2004	Johan Gerhardus Petrus Schalekamp
	13	T74197/2002	Hannes Potgieter Trustfonds C/o Mr J.J Potgieter
	14	T122930/2006	Klaprops 93 CC C/o J.G.P and M.A Schalekamp
	18	T13492/2004	Maarten Adriaan Schalekamp
	24	T40524/1979	Transnet Limited C/o Susan Finger
	26	T7646/1994	
	27	T54249/1994	
	28	T10286/1994	
	29	T87975/1994	
	30	T23358/1994	
	31	T54249/1994	
	32	T87975/1994	
Rietkuil 278 IR	0 (Remaining Extent)	T105152/1966	Maarten Adriaan Schalekamp
Brakfontein 277 IR	0 (Remaining Extent)	T894/2005	MA Schalekamp Trust C/o Maarten Adriaan Schalekamp
Vanggatfontein 250 IR	2	T708/1986	Daniel Jacobus Opperman
	3	T709/1986	Petrus Johannes Bezuidenhout
Brakfontein 264 IR	0	T33954/1979	Andries Schoeman Brakfontein Boerdery (Pty) Ltd C/o FA Venter
	4	T91112/1995	
	10	T33954/1979	
	11	T29521/1986	Hendrik Gericke C/o Johan Gericke
	29	T58972/2003	Andries Schoeman Brakfontein Boerdery (Pty) Ltd C/o FA Venter
Straffontein 252 IR	1	T69536/1987	Rooibult Trust C/o Magda Kleyn
	2		
	27		
	4	T47016/1998	Gert Johannes van der Merwe C/o Gerson van der Merwe
	5		
	6		
	7		
	10	T1349/1994	Maria Elizabeth & Carel Peach
	23	T47426/2007	Welbez Beleggings (Pty) Ltd

Farm Name	Portion number	Title deed number	Registered property owner
	24		C/o: Petrus Johannes Bezuidenhout
	44	T61983/1994	Francois Aalwyn Venter

* Note: Portion 8 of the farm Vanggatfontein 251 IR has been subdivided. The subdivision is currently undergoing registration.

Results - Land uses

Context

To give context to the discussion below, the Vanggatfontein Coal Mine is situated approximately 10 km east of the town of Delmas in the Mpumalanga Province. Current land uses within and outside of the mining right area are a mixture of mining, farming, residential, small business and general community activities.

With reference to Figure 1 and Figure 2, a network of roads exists in the vicinity of the mine, including:

- the R50 (road P36-2) between Delmas and Leandra;
- the regional R555 (road P29-1) between Delmas and the N12;
- the D2543 between Dryden and Leandra;
- the D1147 (through Rietkuil) linking the R50 with the D2543;
- the D1390 (alternative road to Kendal through Welgelegen);
- the D686 alternative road from Leandra to Kendal;
- various unnamed gravel roads including the Brakfontein Road; and
- dirt tracks.

There is a railway line to the west of the mine and a railway siding to the south of the mine (Hawerklip Siding).

A high tension power line passes the property along the western boundary (not shown on map). Another line passes from north to south approximately two kilometres to the east of the mine, while another line runs along the northern boundary of the mine.

There is a cell phone mast on the western portion of the mining right area, adjacent to the farmer's house.

An underground Transnet fuel pipeline traverses the mining right area from the north-east to the south-west.

Residential

The residential areas closest to the mining operations are illustrated in Figure 2 (R1 – R4). It should be noted that farmers and farm workers on the farm Vanggatfontein 251 IR still reside within the mining right area.

<u>Farming</u>

Land in and surrounding the mining right area is mostly used for the following:

- crop farming;
- livestock farming (including cattle, sheep, chickens and pigs); and
- general community activities (mainly farmer/worker residences).

<u>Communities</u>

The farmers in the area have been listed in Table 34 above. There are also various farm worker communities within the mining right area. These farm workers work for the farmers situated within the mining right area. Moreover, some of the people that reside in the farm worker communities do not work for the farmers.

<u>Mining</u>

In addition to Keaton's Vanggatfontein Mine, there are various existing mining operations in the area (Figure 1). These include:

- Leeuwpan Mine (Exxaro) (west of the Vanggatfontein Mine);
- Kuyasa Mining (Pty) Ltd (south of the Vanggatfontein Mine);
- Delmas Colliery (Ingwe Coal Corporation Ltd) (north west of the Vanggatfontein Mine);
- Stuart Coal (Pty) Ltd (north east of the Vanggatfontein Mine);
- SamQuarz (Petmin Limited) (north west of the Vanggatfontein Mine);
- Bankfontein Colliery (Shanduka) (north west of the Vanggatfontein Mine);
- Phalanndwa Colliery (Umthombu Resources); and
- Brakfontein Colliery (Universal Coal).

Conclusion

Land uses on and surrounding the Vanggatfontein Coal Mine comprise mining, farming, and residential activities. The information regarding current land uses has been used by the project team to assess impacts on these land users and to inform mitigation measures as required.

1.3.2 CULTURAL ASPECTS

Cultural aspects of the project area are discussed below as part of the heritage discussion.

1.3.3 HERITAGE, CULTURAL AND PALEONTOLOGICAL RESOURCES

Information in this section was sourced from the approved EIA and EMP report (Metago, 2008), the Phase I heritage impact assessment (HIA) (Pistorius 2008) and specialist palaeontological study (BPI for Palaeontological Research, 2011) (Appendix H).

Introduction and link to impacts

Mining operations have the potential to impact heritage, cultural and paleontological resources through the placement of infrastructure and through the related construction and operational activities. To understand the basis of these potential impacts, a situational analysis is described below.

Data collection

Data collection for the heritage surveys was done by an accredited specialist through review of available databases, published reports and maps, consulting with relevant spokesperson and site specific field work.

Data collection for the Palaeontological survey was done by an accredited specialist through a desktop review of geological information and relevant palaeontological research.

Results: Heritage and cultural resources

Heritage resources include sites of archaeological, cultural or historical importance. Heritage resources identified in the mining right area are outlined in Table 35 and illustrated in Figure 17.

TABLE 35: HERITAGE RESOURCES IDENTIFIED IN THE MINING RIGHT AREA

Site	Will site be disturbed by mining?	Comments	Approimate surface area	Level of significance
Middle Stone Age				
General objects of heritage significance	Possible	Scattered throughout the project area. These were not geo-referenced as limited in number. They are generally marked by stone artefacts that are found scattered on the land surface.	Not applicable	Not applicable
Graveyards				
G01	No	Single grave between maize fields. Edged with white washed stones and fitted with cement head stone. Located out with the mining right area.	Not applicable as out with mining area	High
GY1	Yes	Approximately 5 graves next to a sisal bush. Covered with stones. One grave fitted with cement head stone.	$12m^2$	High
GY2	No	Approximately 15 graves covered with stones, some fitted with cement head stones. On edge of maize field. Located out with the mining right area.	Not applicable as out with mining area	High
GY3	No	Approximately 35 graves on eastern border of project area.	$100m^2$	High
GY4	No	Three graves between maize fields. Fitted with cement head stones with inscriptions.	$8m^2$	High
GY5	No	Approximately 7 graves In maize field near pylon. Covered with kosmos flowers.	$12m^2$	High
GY6	Yes	Approximately 20 graves near the border of Vanggatfontein. Mostly covered with stones.	$50m^2$	High

Site	Will site be disturbed by mining?	Comments	Approimate surface area	Level of significance
GY7	No	Approximately 30 graves in maize field. Covered with kosmos flowers.	$100m^2$	High

Results: Palaeontological resources

The main findings of the specialist study are summarised below, with further detail provided in the specialist report.

Most of the mining right area is underlain by rocks of the Permian Vryheid Formation of the Ecca Group of the Karoo Supergroup. Following the Geological Map, in the north-eastern portion of the mining right area there are outcrops of the Carboniferous Dwyka Group and also the Precambrian Timeball Hill, Hekpoort and Loskop Formations of the Transvaal Supergroup. To the northwest and southwest of the mining right area there are outcrops of the Malmani Subgroup of the Transvaal Supergroup and it is likely that this formation underlies the younger rocks of the Vryheid Formation on the farm Vanggatfontein 251 IR.

The rocks of the Vryheid Formation of the Ecca Group are known to contain plant fossils of the Gondwanan Glossopterus flora which has been defined from Permian-aged rocks. This flora is the source of the coal which is mined from the Vryheid Formation in South Africa and on which the Vanggatfontein Mine is cited.

As the rocks of the Dwyka Group comprise coarse-grained diamictite and were deposited in a glacial environment in the Carboniferous Period it is unlikely that these rocks will contain fossils.

Apart from stromatolites, which are reasonably plentiful, the rocks of the Transvaal Supergroup are not known to contain fossils.

Conclusion

Numerous graves are found throughout the mining right area. No other heritage (or cultural) resources of consequence were observed on-site. There are grave yards on the property that may be affected by the mining operations. The mine management team will need to plan effectively and follow due process with regards to the exhumation and relocation of any graves.

In terms of palaeontological resources, it is considered likely that plant fossils will occur on site, particularly mudrocks of the Vryheid Formation.

1.3.4 SOCIO-ECONOMIC ENVIRONMENT/PROFILE

Information in this section was sourced from Keaton's approved EIA and EMP report (Metago, 2008).

Introduction and link to anticipated impact

Mining projects have the potential to influence various aspects of the socio-economic profile of a community. This baseline section describes the current socio-economic status of the region and project area thereby providing the context within which the operations' potential impacts will occur.

Data collection

Data was collected through review of available databases and field observations.

Results

1.3.4.1 Magisterial district and local/regional authorities

The Vanggatfontein Coal Mine is located near Delmas, on the farm Vanggatfontein 251 IR, which falls within within the Nkangala District Municipality (NDM), and the Delmas Local Municipality (DLM). In the context of social interventions in general, the integrated development planning of both the NDM and the DLM should be taken into account.

1.3.4.2 Socio-economic profile

<u>Provincial level</u>

Population

Approximately 3.37 million people reside in the Mpumalanga Province. This is a 7.7% increase from the 1996 Census statistics. Of this approximately 60% are of a working age between 15 and 65 years. The average household size is 4 people per household.

Education

The level of education in the people that comprise the workforce age (19 to 65 years) is poor. Of these people only 17.7% have completed secondary education and only 6% have completed tertiary education.

Economy/employment

Excluding the informal sector, the unemployment rate within the province is at 23% with the economically not active rate higher at 38%. The main contributors to employment in the province are community services, agriculture, wholesale and retail trade and manufacturing. The mining industry only contributed 7.4% to the Mpumalanga Province in terms of employment in 2001 and that has since grown to 19.4 in 2006. The income statistics indicate that 93% of the population receive under R1600 per month, 5.4% receive between R1600 and R6400 per month and only 1.5% receive above R6400 per month.

Housing and services

There are approximately 831 000 households in the Mpumalanga Province. The majority of the population (63%) are in "formal" brick dwellings on a separate stand. Of these residents, 35% utilise flush toilets, 74% have access to some sort of regional or local water scheme, 36% are serviced by municipal waste disposal, 69% use electricity for lighting.

District and Local municipality level – NDM and DLM

Population

Approximately 1.02 million people reside in the NDM and of that 56 200 people reside in the DLM area. Of this approximately 62 to 64% are of a working age between 15 and 64 years. The average household size at local municipality level is 3 people per household compared to 4 in the district and provincial level.

Education

As is the case for the province, the local level of education in the people that comprise the workforce age (19 to 65 years) is poor. Of these people only 20% (NDM) and 14% (DLM) have completed secondary education and only 6% (NDM) and 5% (DLM) have completed tertiary education.

Economy/employment

Excluding the informal sector, the unemployment rate is between 24 and 27% with the economically not active rate similar to that of the province at between 31 and 36%. As for the province, the main contributors to employment are community services, agriculture, wholesale and retail trade, manufacturing and private households. At municipal level, the contribution to the mining industry is between 7 and 13%. The income statistics indicate that between 60 and 72% of the working population receive under R1600 per month, between 5 and 7% receive between R1600 and R6400 per month and only 1.4 to 1.8% receive above R6400 per month.

Housing and services

There are about 256 900 households in NDM, of which 13 950 are in DLM. At a municipal level, the majority of the population (66% for NDM and 56% for DLM) are in “formal” brick dwellings on a separate stand. Of these residents, between 44 and 63% utilise flush toilets, between 75 and 83% have access to some sort of regional or local water scheme, between 42 and 63% are serviced by municipal waste disposal, and between 65 and 79% use electricity for lighting. At local municipality level, there are 34 schools, 13 pre-schools/crèches, one hospital, 6 clinics (inclusive of three mobile clinics) and three police stations (inclusive of one satellite office).

Local level – Delmas

Population

Delmas is the major town in the area. Approximately 3 500 people reside in Delmas. This small town forms part of the Maputo corridor as the vital N12 cuts through the area. It also plays a vital role as it is close to major infrastructures and is more or less central to large cities and towns. The majority of Delmas residents (64%) are of a working age between 15 and 64 years. The average household size is smaller than 3.1 people per household.

Education

In comparison to the provincial and municipal levels, the population of Delmas is well educated. Just under a third of the population have completed secondary education and a further third are in possession of tertiary education qualifications.

Economy/employment

Excluding the informal sector, the unemployment rate is at a 6% low with the economically not active rate at 36%. The main contributors to employment are community services, wholesale and retail trade and financial intermediation/business services. The contribution to the mining industry is 7.6%. The income statistics indicate that 19% the working population receive under R1600 per month, 50% receive between R1600 and R6400 per month and 32% receive above R6400 per month.

Housing and services

Delmas is seen as the economic hub of the local municipal area. The majority of the population (90%) are in "formal" brick dwellings on a separate stand. Of these residents, 97% utilise flush toilets, almost everyone has access to some sort of regional or local water scheme, 99% are serviced by municipal waste disposal, and 96% use electricity for lighting. In Delmas, there are two schools, one clinic and one police station.

Local level – Vanggatfontein

The project area population is characterised by farmers and farm workers. Each group is described below. Most of the information provided below is relevant, however it should be noted that the study was conducted in 2008 and there has been a movement of farmers and farm workers in the interim period.

Farmers

The farmers on and surrounding the project site represent an archetypal farming community with the following characteristics:

- for most of them, the farms have been in their possession for many generations and hence living in this farming community is important to them;
- they have an undoubted affinity to the land that they have lived on for many generations;
- in addition to farming, most of their leisure time over weekends is also spent on the farms;
- most of the farmers have families and children going to school in Delmas and hence they are heavily invested in the well-being of the Delmas farming community;
- in terms of all citizens in South Africa, the farm owners are relatively wealthy, have access to capital and other resources. In terms of poverty, this group of people cannot be categorised as vulnerable from a poverty perspective;
- this group of stakeholder is literate and numerate (most of them have a Grade 12 qualification or more) and their children are equally well educated;
- they have mixed crops on their farms but farm predominantly with maize; and
- they also have mixed livestock including cattle, sheep, pigs and chickens.

Farmworkers

The total farm worker population of the farm Vanggatfontein is expected to be less than 200. The age distribution of the farm workers is reasonably balanced with 26 % being economically productive adults and relatively low pensioners (dependants). The household size is on average five people (2 adults and three children) and this is aligned to many communities in South Africa.

Changes since the development of the mine include the relocation of Mr Peach's workers from the north-easter portion of the mining right area. These workers left the farm when Mr Peach sold the property and moved. In addition, there are some people residing in the remaining farm worker communities that do not work for the farmers.

Education

The farm workers' experience is limited to farm work and none of the adults surveyed had a qualification higher than secondary school (no one indicated that they had a Grade 12). Hence the illiteracy and semi-illiteracy rate is high at 54 % of the population emphasising their vulnerability.

Economy/employment

The average farm worker earns very little, and their income was calculated to be slightly above the poverty line at R2 175 pm. Along with this a household would pay for their rent for residing in a house with an average of three-four rooms.

Housing and services

Majority of the houses are brick structures. All the households have a house, water and an energy source (either electricity or gas) which allow them to live relatively comfortably. Every household is a reasonably stable family unit which in itself ensures the well-being of dependent family members. The children go to school on the farm and grocery shopping is done in Delmas. As their main form of transport is on foot, and there are no taxi services in this area, they have to either get a lift with the farmer or with a passer-by. Thus, the farm workers are dependent on the farmer for transport and communication, access to health care and other social services.

Conclusion

When considering socio-economic impacts, the existing situation indicates that there is potential for inward migration of people with resultant pressure on basic infrastructure and services (health, education, sanitation, water etc.), informal settlement development, increased crime, introduction of disease and disruption to existing social structures within established communities.

1.4 MAPS SHOWING THE SPATIAL LOCALITY AND AERIAL EXTENT OF ENVIRONMENTAL FEATURES

Maps showing the spatial locality and aerial extent of all environmental, cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms are included in the baseline description. These include:

- conceptual geological map (Figure 4);
- day-time, night-time and seasonal wind roses (Figure 5 and Figure 6);
- soil types in the mining right area (Figure 7);
- land capabilities in the mining right area (Figure 8);
- regional vegetation types (Figure 9);
- vegetation based habitat zones (Figure 10);
- areas of sensitivity from a biodiversity perspective (Figure 11);
- hydrological catchments (Figure 12);
- flood lines in relation to surface infrastructure (Figure 13);
- surface water and groundwater monitoring points (Figure 14);
- dust fallout monitoring points (Figure 15);
- property boundaries (Figure 16);
- heritage (and cultural) resources (Figure 17).

1.5 SUPPORTING DOCUMENTS

The following specialist studies are attached as appendices to this report:

- hydrological assessment and stormwater management plan (Appendix E);
- groundwater study (Appendix F);
- air study (Appendix G);
- paleontology study (Appendix H);
- traffic study (Appendix I);
- engineering design report (Appendix J);
- climatic water balance report (Appendix K); and
- closure cost calculation (Appendix L).

The previous specialist work that was undertaken for the approved 2008 EIA and EMP report has not been attached, but has been referenced where relevant.

FIGURE 4: CONCEPTUAL GEOLOGICAL STRUCTURE

FIGURE 5: DAY-TIME AND NIGHT-TIME WIND ROSES

FIGURE 6: SEASONAL WIND ROSES

FIGURE 7: SOIL TYPES IN THE MINING RIGHT AREA

FIGURE 8: LAND CAPABILITIES IN THE MINING RIGHT AREA

FIGURE 9: REGIONAL VEGETATION TYPES

FIGURE 10: VEGETATION-BASED HABITAT ZONES IN THE MINE AREA

FIGURE 11: SENSITIVE AREAS

FIGURE 12: HYDROLOGICAL CATCHMENTS

FIGURE 13: FLOODLINES IN RELATION TO SURFACE INFRASTRUCTURE

FIGURE 14: SURFACE WATER AND GROUNDWATER MONITORING POINTS

FIGURE 15: DUST FALLOUT MONITORING POINTS

FIGURE 16: PROPERTY BOUNDARIES IN THE VICINITY OF THE MINE

FIGURE 17: HERITAGE (AND CULTURAL) RESOURCES

2 MINING OPERATION

The aim of this report is to obtain approval from the DMR for the changes to the layout of surface infrastructure that was approved in accordance with Keaton's EIA and EMP report (Metago, 2008). The required changes are as a result of an underground Transnet pipeline servitude that is located diagonally across the property (Figure 3). The servitude is 12 m wide (6 m on either side of the pipeline) where no infrastructure may be constructed. In addition, there is a 100 m buffer zone in which no excavations may take place and a 500 m buffer zone in which blasting is regulated by the servitude holder (Transnet).

The new infrastructure, and approved infrastructure that has been repositioned and/or redesigned, is listed below. Note that the approved infrastructure layout (as per the approved EIA and EMP report [Metago, 2008]) has been included in Figure 3 for ease of reference.

New infrastructure:

Following the changes to surface infrastructure at the mine, the stormwater management plan has been revised to comply with Government Notice 704 of the National Water Act. As a result the stormwater management facilities have been reconfigured, with associated channels to ensure that dirty water is captured, recycled and reused. In this regard, there is planned stormwater control capcity to the north and south of the MRDF and to the south of the processing plant (Figure 18).

Repositioning / redesigning of approved infrastructure:

With reference to Figure 18, the approved infrastructure listed in Table 36 has been repositioned and/or redesigned.

TABLE 36: CHANGES TO INFRASTRUCTURE AT VANGGATFONTEIN MINE

Infrastructure	Approved position (refer to Figure 3)	Current/planned position (refer to Figure 18)	Redesigned
Topsoil stockpile	Various topsoil stockpiles positioned around the mine residue disposal facility (MRDF) as well as the on the perimeter of the opencast mining areas.	One of the topsoil stockpiles is located near the northern boundary of the eastern section of the mining right area. Smaller topsoil stockpiles will be established at each of the other pits on both the eastern and western potions of the mining right area.	Not applicable.
Run of mine (ROM) stockpile	Located in the north east of the mining right area, between the opencast mining area and the MRDF.	Located within the coal washing plants.	Not applicable.
Product stockpile	Located in the north eastern section of the mining right area, between the opencast mining area and the MRDF.	Located to the east of the Eskom Plant.	Not applicable.
Waste rock / overburden stockpiles	Various waste rock/overburden stockpiles located on the perimeter of the opencast mining areas.	One large waste rock/overburden stockpile will be located along the northern, western and southern boundary of the main opencast pit on the eastern portion of the mining right area. Smaller waste rock/overburden stockpiles will be located at each of the opencast mining areas.	Not applicable.
Hard park area	Located in the north eastern section of the mining right area, between the opencast mining area and the MRDF.	Located to the north west of the 5 seam plant.	Not applicable.
Weigh bridge	Located on the northern boundary of the mining right area, between the opencast mining area and the MRDF.	Located to the north of the coal washing plant.	Not applicable.
Conveyor belts	Positioned in the north east of the mining right area, linking the ROM stockpiles, coal washing plant and product stockpiles.	Located within the coal washing plants.	Not applicable.
Sewage treatment plant	Located in the north east corner of the mining right area, to the west of the MRDF.	Located in the south western corner of the 5 Seam Plant.	Not applicable.

Infrastructure	Approved position (refer to Figure 3)	Current/planned position (refer to Figure 18)	Redesigned
Contractor work area yard	Located in the north eastern corner of the mining right area, between the opencast mining area and the MRDF.	Located within the coal washing plant.	Not applicable.
Laboratory	Located in the north eastern corner of the mining right area, between the opencast mining area and the MRDF.	Located within the 5 Seam plant.	Not applicable.
Diesel bay	Located in the north eastern corner of the mining right area, between the opencast mining area and the MRDF.	Located within the 5 Seam plant.	Not applicable.
Offices / workshops	Located in the north eastern corner of the mining right area, between the opencast mining area and the MRDF.	Located within the 5 Seam plant.	Not applicable.
Mine Residue Disposal Facility (MRDF)	Located in the north eastern corner of the mining right area.	The redesigned MRDF is located in the same area as the approved facility, however the layout has changed to take account of the underground pipeline.	A summary of the redesigned MRDF is included below. Refer to Section 2.7.12.2 for further detail. • The MRDF consists of three separate facilities. Phases 1 and 2 have been constructed on the northern side of the Transnet pipeline, while Phase 3 is future facility that is planned on the southern side of the Transnet pipeline. • Coarse and fine residues will be stored separately. • Phase 1 storage capacity: 303,800 m^3 of fines and 189,700m^3 of discard. • Phase 2 storage capacity: 955,411m^3 of fines and 1,989,166m^3 of discard. • Phase 3 provisional storage capacity: 1,265,544m^3 of fines and 6,841,043m^3 discard. • Fine residue disposal facilities have been designed to store excess slurry water, thereby eliminating the need for a separate return water dam. The fine residue disposal facilities are lined with an

Infrastructure	Approved position (refer to Figure 3)	Current/planned position (refer to Figure 18)	Redesigned
			HDPE liner.
Footprint of open pit mining area	Opencast mining was planned in the eastern and western portions of the mining right area.	The layout of the opencast mining area on the eastern portion of the mining right area has changed. No changes to the opencast mining areas on the western portion of the mining right area are planned.	Not applicable.
Increase in the capacity of the coal washing plant	Positioned in the north east of the mining right area, between the opencast mining area and the TSF.	Positioned in the same location.	The capacity of the coal washing plant will be increased from 250 000 to 300 000 tonnes per month.

2.1 MINERAL TO BE MINED

The Vanggatfontein Coal Mine exploits coal resources on the farm Vanggatfontein 251 IR.

2.2 MINING METHOD TO BE EMPLOYED

It should be noted that there will be no changes to the existing mining method currently employed at the Vanggatfontein Coal Mine. Information in this section has been taken from Keaton's approved EIA and EMP report (Metago, 2008) and should be read with reference to the drawings Figure 18 and Figure 19.

Three general sections are planned as part of the opencast mining operations. The largest opencast area will extend along approximately 3 km of the strike in the central/eastern portion of the property. The target seams in this area are number 2, 4 and 5 seams. The other two areas will be operated in the western and south western portion of the mine with a total strike length of approximately 2.2 km. The target seam in these areas is number 5 seam. Shallow underground mining will take place as an extension of the opencast operation to a depth of a maximum of 100 m below surface.

The main mining contractor's yard will be located to the north of the eastern mining sections near to the plant. Satellite mining contractor's camps will also be established in the western part of the project area. These yards will collectively incorporate offices, workshops, stores, diesel and lubricant handling facilities, change houses and ablution facilities.

2.2.1 OPEN PIT MINING

The mining method comprises a standard open pit truck and shovel method where mining and rehabilitation take place simultaneously.

Initial boxcuts have a base dimension ranging between 300 to 1300 m, widths of 40 m wide, and hanging walls of up to 60 m. The boxcuts will be located in both the eastern and western sections of the mine at each pit. At any one time there are between three and five boxcuts open. From these boxcuts further development will take place until steady state mining is reached. Access to the shallow underground coal will be by means of portal clusters that are developed from the base of the hanging wall. Ventilation will be controlled through the portal clusters. The additional depth of the underground access takes the mining depth to a maximum of 100 m below surface.

This will involve the following key activities:

- **Removal of topsoil**

  All topsoil will be dozed into stockpiles along the low wall (outcrop) sides of the open pits. On completion of the mining operation, the topsoil will be replaced in the reverse sequence, thus ensuring that the vegetated layer is on the surface (see procedure in Section 7.2.4).

- **Removal of overburden**

  The removal of overburden above the coal seams will be done as a bulk operation by load and haul with large equipment. The overburden spoil material will be placed on the pit extremities so that final voids can be rehabilitated.

- **Drilling and blasting**

  Once the topsoil has been removed, the area will be drilled as per the drill design. Charges will be designed to prevent excessive ground vibration and fly rock. The remaining overburden and the coal will be drilled and blasted together. The blast design may be modified from time to time in order to optimise grade and minimise dilution.

- **Removal of coal**

  Coal removal will be by means of truck and shovel.

- **Rehabilitation**

  Rehabilitation is concurrent with the mining method. Spoil/overburden will be used to backfill voids and then topsoil will be placed over the spoil/overburden and vegetation will be re-established. The specific backfill sequence is covered in detail in Table 40.

No final voids are anticipated in the current scenario because there will be sufficient spoil/overburden and topsoil to backfill and rehabilitate the open pit.

2.2.2 UNDERGROUND MINING

With reference to Figure 18, shallow underground mining may take place as an extension of the opencast operation to a depth of 100 m below surface.

2.2.3 ACCESS TO WORKINGS

The access to the opencast pits will be by means of haul roads and boxcuts with ramps in the actual open pit mining area. Access to the shallow underground sections will be by means of short decline shafts.

2.2.4 BLASTING

The blast programme will be changed as required during the life of mine. Blasting will generally take place in the afternoon, and will not be performed on weekends in the normal course.

2.2.5 SURFACE SUBSIDENCE AND STRUCTURES THAT COULD BE AFFECTED BY BLASTING

Surface subsidence is discussed in Section 7.2.3. Discussions on structures that could be affected by blasting are provided in Section 7.2.16.

2.2.6 MINERAL PROCESSING

An overview of the mining and mineral processing activities is provided in Table 37 and illustrated in Figure 19.

TABLE 37: MINING AND MINERAL PROCESSING ACTIVITIES

Component	Activities	Inputs/Outputs	Waste/emissions
Mining	**Opencast and underground mining** The opencast mining operation will take place in a number of areas as indicated on Figure 18. At any given time there could be a number of operating sections within the mine boundary. Overburden and topsoil is excavated, temporarily stockpiled and used for on-going rehabilitation. As the opencast mining advances, the overburden/waste rock will be replaced in the mined-out cuts. When these mine-out areas have been filled, the material will be flattened and the usable soil that was previously removed will be replaced and levelled. Excess overburden/waste rock is used for other construction and rehabilitation activities such as roads, the MRDF, and screening berms. Drilling and blasting will be required as part of the operation. Blasting will take place approximately twice weekly in the eastern operating section and once weekly in each of the western operating sections. A typical truck and shovel operation to a high wall of 60m will be used. Shallow underground mining may take place as an extension of the opencast operation to a depth of 100 m below surface. Approximately 250 000 - 300 000 tons run of mine (ROM) tonnes per month will be produced when the mine is operating at full capacit. The ROM is transported to the plant by truck.	Mining equipment Explosives Overburden/ Spoil piles Coal Process water Haul trucks/conveyor Air Fuel Lubricants	Explosives packaging Vibrations Fly rock Process water Dust/fumes Noise Run off Seepage Temporary waste rock and run of mine stockpiles
Washing plant	**Mineral processing configuration** The mineral processing operation is split into two streams to accommodate the different characteristics of the coal seams. These are: thermal coal product and meturlurgical coal product. Each stream will have the components described below.	-	-
	Materials handling and storage For each plant stream, separate ROM stockpiles will be used. Material will be off loaded onto the stockpiles by the haul trucks and moved from the stockpiles by front-end loaders and/or bulldozers to the plant conveyor feeders. The base of the stockpiles will be prepared to prevent seepage. This will be achieved with compacted soil. Seepage and run off collection systems will be in place to channel dirty water to the stormwater dam.	Coal Equipment Vehicles	Dust Run off Seepage Noise
	Coal sampling Sampling of coal is an important part of the process control in the washing plant. A routine sample will be taken at a set frequency, either over a period of time or per shipment. Analysis will be done at an off-site facility initially with the option of introducing an on-site facility at a later stage.	Not applicable	Not applicable

Component	Activities	Inputs/Outputs	Waste/emissions
Washing plant (cont.)	**Crushing and Screening** Crushing reduces the overall size of the run of mine coal so that it can be more easily handled and processed within the washing plant design. Screens will be used to group process particles into ranges by size. These size ranges are also called grades. Dewatering screens will be used to remove water from the product. Screens can be static, or mechanically vibrated.	Equipment Coal Electricity Water Compressed air	Dust Noise Spillages
	Dense media separation process (larger fraction) The larger fraction material will be beneficiated using dense medium separation. This process uses the density differential between coal and residue, such that the material is separated into coarse discard and product. Magnetite will be used in the flotation process.	Equipment Water Electricity Magnetit Coal Coarse discard	Dust Noise Spillages Seepage
	Fine coal process (smaller fraction) Cyclones will be used to separate the smaller fraction material from the fine slurry.	Equipment Water Electricity Coal Fine slurry	Dust Noise Spillages Seepage
	Mine residue disposal facility (MRDF) Approximately 100 000 – 150 000 tonnes of waste per month (combined number for coarse and fine waste) will be produced at the coal washing plants. Coarse and fine waste will be disposed separetly onto the MRDF. Design details are provided in Section 2.7.12.2.	Tailings Water Pumps Pipes Electricity Vehicles Fuel Lubricants	Spillages Seepage Run off Dust
	Product coal Approximately 150 000 – 175 000 tonnes of coal product will be produced per month and stockpiled before loading and transportation. Loading will be done by front end loaders. The product will be loaded into trucks for transportation off site. In regard to seepage and run-off controls, the product stockpiles will be prepared in a similar fashion to the run of mine stockpiles described above.	Coal product Loading equipment Trucks	Dust Seepage Run off Noise

2.3 LIST OF MAIN ACTIONS/ACTIVITIES/PROCESSES ON SITE

Key activities that will take place on site during each phase (construction, operational, decommissioning, closure) of the project are listed in Table 38 below. For the purposes of this report, in broad terms, construction is the phase in which the mine infrastructure is established, operational covers the production phase of the mine and plant, decommissioning is when production has ceased, infrastructure is being removed and the site rehabilitated in line with a closure plan and the closure phase refers to the period of time when maintenance and aftercare of rehabilitated areas and facilities is required to ensure closure objectives are met.

TABLE 38: LIST OF PROJECT ACTIONS / ACTIVITIES / PROCESSES

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
Site preparation	Selective bush clearing in line with Keaton's biodiversity management plan	On-going	On-going	As required	
	Removal of existing structures such as fencing (if present).	On-going	As required	As required	
	Establishing the construction contractor's area	At start of phase			
Earthworks Earthworks on site relate mainly to the moving of soil and rock.	Stripping and stockpiling of soil resources in line with Keaton's soil management programme.	On-going	As required	As required	
	Bulldozing activities	On-going	As required	As required	
	Establishing gravel roads	On-going	As required	As required	
	Digging trenches and foundations. Possible blasting	On-going	As required	As required	
	Development and management of borrow pits (backfilling of material from borrow pits)	On-going	As required	As required	
	Establishing stormwater controls (channels, berms) as per stormwater management plan	At start of phase	As required	As required	
Civil works Civil works on site relate mainly to any steel and concrete work.	General building activities and erection of structures	On-going	As required	As required	
	Foundation excavations and compaction	On-going	As required	As required	
	Use of scaffolding and cranes	On-going	As required	As required	
	Concrete work including silos, culverts and plinths	On-going	As required	As required	
	Steel work (including grinding and welding)	On-going	As required	As required	
	Installation of cables/lines and pipelines	On-going	As required	As required	
	Installing reinforcement steel	On-going	As required	As required	
Open pit and underground mining	Drilling and blasting	At start of phase	On-going		
	Removal of overburden by dozing and load and haul	On-going	On-going		
	Stockpiling of overburden for backfilling	On-going	On-going		
	Excavation of sample trenches	At start of phase			
	Removal of ore by dump trucks and transported to washing plant		On-going		
	Water management facilities include: - collection of dirty run-off water in settling facilities and re-used - clean water run-off and sheet flow will be diverted around dirty areas	On-going	On-going	On-going	
	Dewatering		As required		

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
	Delivery of ROM from truck and transferred to conveyors and stored on stockpiles		On-going		
Mineral processing	Washing plant (crushing and screening, dense media separation/cyclone)		On-going		
	Water management facilities including: - collection of dirty run-off, process water and spills using sumps, pipes canals, pumps and dams - storage facilities for receiving recycled process water, clean make-up potable water and stormwater - diversion of clean water around infrastructure	On-going	On-going		
	Construction and utilisation of site supporting services including: - stores for the storage of oil, grease, conveyor lining, general equipment and spares - workshops and wash bays - laydown areas for contractors - powerlines - storage of hazardous and non-hazardous waste - ROM and concentrate stockpiles	On-going	On-going		
Overburden and tailings management	Overburden stored on site: backfilling of open pits	On-going	On-going		
	Delivery of tailings from washing plant to the tailings dam via pipelines		As required		
	Coarse discard trucked to the MRDF		On-going		
Power supply and use **continue until infrastructure can be removed or alternative end use identified*	Delivery of power to site via Eskom power lines	On-going	On-going	On-going*	
Water supply and use **continue until infrastructure can be removed*	Delivery of clean water to site (water to be tanked in during construction, permanent supply from boreholes)	On-going	On-going	On-going*	
	Storage of clean water on site	On-going	On-going	On-going*	
Polluted water treatment facility **long term pollution prevention measures, if required*	Placement of a curtain of boreholes adjacent to the MRDF to pump contaminated water and prevent it from reaching third party boreholes / surface water resources		On-going	On-going*	On-going*
	Capture of any contaminated decant from backfilled pits to prevent run-off and seepage		On-going	On-going*	On-going*
	Treatment of all captured contaminated water in the on-		On-going	On-going*	On-going*

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
	site water treatment plant (Section 2.7.14.2). post-closure, this plant will have to be routinely maintained and upgraded to allow for treatment in perpetuity				
Stormwater management **continue until infrastructure can be removed or successfully rehabilitated*	Diversion of clean water	On-going	On-going	On-going*	
	Collection of dirty water using channels, berms	On-going	On-going	On-going*	
	Storage of dirty water in dams for re-use	On-going	On-going	On-going*	
Transport systems **continue until infrastructure can be removed or alternative end use identified*	Construction, operation and maintenance of gravel and tar roads.	On-going	On-going	On-going	
	Transport of staff to and from site (using buses, taxi's and private cars via surfaced and gravel roads)	On-going	On-going	On-going	
	Transport of supplies, services and waste removal (using trucks and vans via surfaced and gravel roads)	On-going	On-going	On-going	Limited
	Vehicles/machinery movement within the site boundary (via gravel roads)	On-going	On-going	On-going	Limited
	Pumping of materials (i.e. water) via pipelines		On-going	On-going*	
	Taxi and bus on- and off- loading areas for employees	On-going	On-going	On-going*	
	Transport of ROM, soil and waste rock within site boundary via truck and conveyor		On-going	On-going	Limited
	Transport of product off-site via truck. Route will be determined by the location of the buyer		On-going		
Non-mineralised (general and industrial hazardous) waste management	Collection of general and hazardous waste on site	On-going	On-going	On-going	
	Separation of oil and water at wash bays	On-going	On-going	On-going	
	Disposal and/or treatment of contaminated soils	On-going	On-going	On-going	
	Temporary storage of general and hazardous waste within dedicated demarcated containers/areas	On-going	On-going	On-going	
	Sorting of general and hazardous waste for re-use and/or recycling purposes	On-going	On-going	On-going	

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
	Removal of waste by contractor for recycling, re-use and/or final disposal at permitted waste disposal facilities	On-going	On-going	On-going	
Site support services *continue until infrastructure can be removed or alternative end use identified*	Operating office(s)	On-going	On-going	On-going*	
	Parking of vehicles	On-going	On-going	On-going*	
	Laboratory at plant		On-going		
	Change house	On-going	On-going	On-going	
	Medical facility	On-going	On-going	On-going	
	Helicopter landing pad	On-going	On-going	On-going	
	Security check points at all entrances	On-going	On-going	On-going	
	Fencing and lighting for security	On-going	On-going	On-going	
Storage and maintenance services/ facilities *continue until infrastructure can be removed or alternative end use identified*	Washing of machinery and vehicles (wash bays)	On-going	On-going	On-going*	
	Service machinery and vehicles (workshops)	On-going	On-going	On-going*	
	Storage (stores, tanks) and handling of non-process materials, consumables and hazardous substances including explosives, oil/lubricants, hydraulic fluid, diesel, and heavy fuel oil for the generator.	On-going	On-going		
Housing	No on site housing is planned	N/A	N/A	N/A	N/A
Site management	Appointment of contractors and workers	At start of phase and on-going	At start of phase and on-going	At start of phase	
	Site management	On-going	On-going	On-going	
Demolition	Removing mining contractor's camp area (if not incorporated into plant footprint)	At end of phase		At end of phase	
	Dismantling and demolition of infrastructure and equipment. Possible blasting		For maintenance	On-going	
	Utilisation of site supporting services: - access control and security - contractors yard - workshops and wash bays - general stores - storage area for hazardous and non-hazardous waste - portable toilets at digging sites and open cast pits - formal ablution facilities within contractor yard - diesel tanks and/or diesel bowsers (re-fuelling equipment)		For maintenance	On-going	

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
Rehabilitation	Backfill and rehabilitating of open pits with provision for surface subsidence	On-going	On-going	On-going	
	Replacing soil resources	On-going	On-going	On-going	
	Slope stabilisation and erosion control	On-going	On-going	On-going	
	Landscaping	On-going	On-going	On-going	
	Re-vegetation of disturbed areas and where infrastructure was removed	On-going	On-going	On-going	
	Removal of alien invasive species from rehabilitated sites	On-going	On-going	On-going	
	Restoration of natural drainage patterns as far as practically possible	On-going	On-going	On-going	
	Rehabilitation of all mineralised waste facilities and other stockpiles (tailings, overburden)		On-going	On-going	
Maintenance and aftercare	Initiation of aftercare and maintenance			At end of phase	
	Monitoring, maintenance and repair of facilities and rehabilitated areas				On-going
	Maintain and upgrade polluted water treatment facility (if treatment of contanimated water is necessary)				On-going

2.4 PLAN SHOWING LOCATION AND EXTENT OF OPERATIONS

The overall infrastructure layout at Vanggatfontein Coal Mine is shown in Figure 18.

2.5 LISTED ACTIVITIES IN TERMS OF EIA REGULATIONS (NEMA)

Initially the project scope, as presented in the background information document (BID) and at the scoping meeting, included the mining of a wetland area on the farm Vanggatfontein 251 IR that had been previously excluded from the mining area in the approved EIA and EMP report. The proposed mining of this wetland area required environmental authorisations from the Department of Economic Development, Environment and Tourism (DEDET) in terms of the National Environmental Management Act, 107 of 1998 (NEMA) and the Department of Water and Environmental Affairs in terms of the National Water Act, 36 of 1998. After consideration of specialist water resources input and after consideration of the IAP comments, Keaton's management team has decided not to mine through the wetland area and has subsequently withdrawn the NEMA application.

2.6 INDICATION OF PHASES AND TIMEFRAMES ASSOCIATED WITH THE MAIN ACTIONS / ACTIVITIES / PROCESSES

An indication of the phases and estimated timeframes in relation to the main actions, activities or processes and infrastructure is provided in Table 38 above.

FIGURE 18: OVERALL INFRASTRUCTURE LAYOUT

FIGURE 19: CONCEPTUAL PROCESS FLOW DIAGRAM

2.7 ADDITIONAL INFORMATION

CONSTRUCTION PHASE

It should be noted that the mine is in the operational phase. Details on the construction phase have been included for completeness.

The construction activities focussed on the washing plant, mine residue facility, transport infrastructure, mining contractor's yard, water management infrastructure and other support infrastructure. Given that the mine is an opencast mine, there was no significant construction required for the establishment of the mining area.

2.7.1 WORKFORCE AND HOUSING

The number of temporary construction workers will vary depending on the construction activities at any given time. Approximately 140 temporary workers will be on the site at any stage during the construction period. Construction employees will be housed off-site in guest houses, guest farms, dormitories and other formal housing options in the Delmas area.

2.7.2 TRANSPORT SYSTEMS

Construction related transport will make use of the following roads to travel to and from the mine (Figure 2):

- the R50 between Delmas and Leandra;
- the D2543 between the Leandra and Dryden;
- the D1147 linking the R50 and the D2543
- the D686 between the R50 and Kendal on the eastern side of the mine; and
- The R555 between Delmas and Witbank.

The types of materials that could be transported to and from site include:

- **To site:**
  - staff;
  - building materials;
  - mining and plant equipment;
  - prefabricated offices and containers for the contractor's camp; and
  - consumables
- **From site:**
  - staff;
  - domestic, industrial and sewage waste.

Traffic volumes for the construction period will vary depending on the activities at site. The peak period (when construction and open pit mining coincide) will see approximately:

- two 33 tonne trucks travelling to and from site per day; and
- twenty-six trips to and from site for construction employees (including open pit mining employees if mining and the construction period overlap) that will use a combination of light vehicles, taxis and buses.

2.7.3 WATER SUPPLY AND MANAGEMENT

During construction, water will be used for drinking, sanitation, dust suppression, and earthworks. Approximately 15 m^3 per day potable water and between 200 and 400 m^3 per day process water (mainly for cement mixing) may be required as a construction peak. This water will be sourced from sustainable ground water abstraction.

Water management infrastructure described in Sections 7.2.7 and 7.2.8 will be established on site at the start of construction.

2.7.4 POWER SUPPLY

Approximately 5MVA is required for construction. Ccontractors will use potable generators until the Eskom supply has been established.

2.7.5 WASTE MANAGEMENT

The types of wastes that could be generated during the construction phase include:

- domestic waste such as office waste, detergents, food waste;
- sewage waste; and
- industrial waste such as building rubble, electrical/plastic/material off cuts, spent oil and grease, polluted soil (from accidental spills), oils and grease, paints and solvents, containers, scrap and rubble.

All domestic and industrial waste generated during the construction phase of the mine will be stored and managed as outlined in Section 7.2.4. Mobile enclosed portable toilets will be placed at construction sites. The enclosed chemical toilets will be cleaned and serviced twice a week by a contractor. Sufficient chemical toilets will be placed on site to cater for workers.

2.7.6 TIMING

Construction commenced in 2010 and took approximately 10 months.

OPERATIONAL PHASE

2.7.7 WORKFORCE AND HOUSING

No on-site housing facilities will be provided for employees. Keaton's current policy is not to provide a housing allowance for employees.

2.7.8 TRANSPORT SYSTEMS

There are no planned material changes to the transport routes and mechanisms that were identified and assessed in the original EIA and EMP report (Metago, 2008). In this regard, the actual current number of trucks associated with product transport is approximately 190 truck loads per day for the 175 000 tons of product per month. This is more than the 133 trucks that were originally planned as part of the 2008 EIA and EMP report.

2.7.8.1 Roads and access points

There is an existing network of roads in the project area as illustrated in Figure 1 and Figure 2. The main roads that will be used / affected by mine related traffic include:

- the R50 between Delmas and Leandra;
- the D2543 between the Leandra and Dryden;
- the D1147 linking the R50 and the D2543;
- the D686 between the R50 and Kendal on the eastern side of the project area; and
- the R555 between Delmas and Witbank.

None of the existing gravel roads in the area will be used by project related trucks. Additional roads and access points required for the mine are detailed below.

Haul roads at open pit operations

Internal haul roads will be constructed for the mining operation on the low-wall side of the mining pits and will be used to transport coal and overburden/spoil to the washing plant stockpiles in the eastern part of the project area. A single trip will provide for dump truck. The haul roads will be constructed of suitably sized and compacted waste rock.

Main access roads to the mine

The main access road to the mine will be off the D2543. Accordinl to the original plan (Metago, 2008), between two and four new access points were required for the mining operation (refer to Figure 3). To date, one new access point has been established on the D2543, at the northern boundary of the mine. A typical design of the road upgrade associated with the access points is shown in Figure 20. Stop controls are required on the mine's feeder side roads, as are new dedicated lanes on both the western and eastern approaches of the D2543.

2.7.8.2 Railways

The nearest railway line is the regional line to the west of the mine and the nearest siding is Hawerklip siding to the south (Figure 1). Use of this railway siding by the mine will necessitate that additional material storage and loading capacity is constructed at the siding. Additional talks with Transnet will take place to finalise these issues. Any modifications to the siding will form part of a separate study that is managed by Transnet.

2.7.9 PIPELINES

New pipeline(s) were established to supply potable and process water to the operational mine. Local boreholes are used for water supply, and internal pipelines follow the haul road routes and will cross under the D2543 through constructed culverts when mining commences on the western portion of the mining right area.

2.7.10 CONVEYOR

Conveyors are located between the ROM stockpiles and the coal washing plant and will be 1.2 m above ground and have a width of approximately 1.2 m. All transportation of run of mine coal from the opencast pits to the washing plant is carried out by trucks as discussed above. Conveyors between the washplant and product stockpiles are inclined in order to discharge on top of the stockpiles.

2.7.11 POWER SUPPLY

Power to the site is supplied by Eskom at a voltage of 22kV, which is stepped down in an on-site sub-station (labelled as mini sub-station on Figure 18) to 11kV for site reticulation.

FIGURE 20: CONCEPTUAL INTERSECTION LAYOUT

2.7.12 WASTE AND RESIDUE MANAGEMENT

2.7.12.1 Domestic and industrial waste

There are no on-site waste disposal facilities and none are planned for the mine. Domestic waste from the mine is collected, compressed and then transported to a municipal dump at Delmas. Hazardous waste is collected and transported back to suppliers for recycling or by a waste disposal company to the Holfontein waste site in Springs, Gauteng. Domestic and industrial wastes is removed from site on a monthly basis as a minimum.

The types of waste that will be generated by the mine are summarised in Table 39. The complete waste management programme is included in Section 7.2.4.

TABLE 39: INDUSTRIAL, HAZARDOUS AND DOMESTIC WASTE

Waste Type	Method of temporary storage
First aid clinic	Designated sealed containers in covered store
Laboratory chemicals	Designated sealed containers in covered store
Scrap metal and electrical waste	Open air scrap yard and salvage yard
Building rubble	Open air scrap yard
Used oil and grease	Drums in bunded store/collecting sump
Packaging for hazard material	Sealed containers in bunded store
Chemicals/chemical contaminated containers and material	Sealed containers in bunded store
Vehicle parts	Open air scrap yard
General industrial, non-hazardous waste	Designated skip
General domestic, non-hazardous waste	Designated skip
Sewage sludge	Removed by municipality
Sewage screenings	Sealed container in bunded store

2.7.12.2 Mine residue disposal

Overburden

There is provision for several overburden spoil piles at the mine. The location of which, are shown in Figure 18. Design details are provided in Table 40.

TABLE 40: DESIGN PARAMETERS OF THE OVERBURDEN SPOIL PILES

Feature	Detail
Physical dimensions	Area expected to be covered by spoil piles over the life of the mine is approximately 50 ha. The target is to remove all of these by the end of the mining operation.
Overburden management, transport, placement and mine void backfilling	In the original EIA and EMP report (Metago, 2008) open pit overburden was to be loaded selectively onto mine dump trucks and transported either to spoil piles or directly to backfill. Selective handling would have included separate handling of soft (excavatable) and hard (blasted) material. Blasted material was to be further subdivided into significantly carboniferous or sulphidic and oxidised or, non-carboniferous and non sulphidic material. The acid generating potential of the overburden was expected to be limited, but as part of on-going rehabilitation and pollution control, backfilling mine voids was designed with specific profiles to limit possible acid generation. The planned practice was to reinstate the original profile comprising topsoil on top, with soft subsoil (excavatable) material, non-carboniferous material, and any carboniferous or sulphide containing material

Feature	Detail
	(material that has potential for acid generation) in the sequential layers below. Since commencement of mining activities, Keaton has determined that some of these requirements are impractical. The new practise is to store all overburden together (but separate from topsoil) and to backfill overburden in no particular sequence of layers. Spoil pile access ramps constructed with a maximum gradient of 1V:7H (8°) for mine dump trucks. Overburden is then dumped and spread / flattened with a bulldozer.
Diversion	Storm water trenches / swales to be provided around the upstream boundaries of the spoil piles that direct clean storm water run-off around and away from the spoil piles.
Topsoil stripping	Topsoil in spoil pile footprint areas will be stripped and stockpiled in accordance with the soil conservation guide (Section 6) in close proximity to the final toe of each spoil pile. Stripping and stockpiling of topsoil will be done immediately in advance of dumping.
Lining	No lining will be provided to spoil piles. Where practical, carboniferous and sulphide containing material will be placed directly into its final position within a portion of the opencast mine that is already mined, thus avoiding the need for environmental protection measures to be applied to spoil piles.
Side slopes	The slopes of the temporary stockpiles are not a critical issue. Compaction limited to vehicle traffic on top surface and ramps. Slopes of any remaining stockpiles will be 1V:6H.
Under drains	No under drainage will be provided. Surface run-off from the spoil piles and toe seepage will be released to the environment.
Access and access control	Mining haul roads will have a minimum width of 6 m and will be constructed using waste rock/ overburden. No perimeter fence will be provided around individual spoil piles. Rather a perimeter fence around the whole of the mine site will be installed.
Waste minimisation	No waste minimization opportunities
Monitoring	Monitoring of soil cover only. No formal surface water quality or seepage quality monitoring specific to spoil piles.
Dust control	Operational Phase: Watering of roads for dust suppression. Post Operational Phase: No measures necessary due to rehabilitation. Monitoring will form part of the overall site monitoring.
Closure	Most spoil piles will have been removed as backfill to the final pits. Where spoil piles remain after mining as a result of the bulking factor, (referred to as residual spoil piles), these will be flattened to a maximum side slope of 1V:6H. Residual spoil piles will be covered with subsoil and stockpiled topsoil and re-vegetated with a final vegetation cover comprising a combination of indigenous trees, shrubs, grasses and aloe species etc. to mimic the vegetation cover of natural topographical features in the area. Topsoil stripped prior to development will be used to provide the growth medium. The vegetation will be irrigated initially until it is no longer dependent on artificial irrigation for survival. On closure of any remaining spoil piles, access ramps and berms will be eliminated prior to rehabilitation to reduce erosion risks. No active groundwater protection measures are envisaged given the relatively low pollution potential of the residual spoil material. In the event that ad-hoc or investigative surface water quality monitoring around any residual spoil piles indicates that Class 4 (SANS 241:2005) water emanates as surface run-off from the spoil piles, catchment paddocks and soak-aways will be

Feature	Detail
	provided to minimise the risk of exposure of Class 4 water to wildlife, livestock and humans. The footprint of temporary spoil piles will be rehabilitated by ripping the underlying subsoil, then replacing the topsoil, vegetating and applying fertilizer and irrigating the new growth for a short period.
Rehabilitation success criteria	Rehabilitation success will be determined by monitoring trends in soil nutrient levels, soil microbial levels, vegetation cover and vegetation biodiversity levels and comparing data and temporal trends in the data to numerical targets.
Design drawings	The relevant design drawings are included in Appendix M.

Tailings complex (mine residue disposal facility – MRDF)

There is provision for one MRDF at the Vanggatfontein Coal Mine, located in the north-east corner of the mining right area. The intention is to develop a co-disposal facility over the entire footprint designated for the MRDF. As the Transnet pipeline bisects the MRDF site it is necessary to reconfigure the MRDF. The facilities are being developed in phases, namely:

- Phase 1 is located on the north-west side of the pipeline, and has been designed and constructed to cater for the storage of 303 800 m^3 of coal fines and 189 700 m^3 of coal discard material;
- Phase 2 is located on the north-west side of the pipeline, and has been designed and constructed to cater for the storage of 955 411 m^3 of coal fines and 1 989 166 m^3 of coal discard material; and
- Phase 3 is located on the south-east side of the pipeline, and has been preliminarily designed to cater for the storage of 1 265 544 m^3 of coal fines and 6 841 043 m^3 of coal discard material. This Phase 3 facility has not been constructed yet.

The fine residue disposal facitlities are lined with an HDPE liner.

The design parameters are provided in Table 41.

TABLE 41: DESIGN PARAMETERS OF THE MINE RESIDUE DISPOSAL FACILITY

Feature		Detail					
MRDF development and geometry		The MRDF will be developed in three phases. Phases 1 and 2 have been developed. Phase 3 is a future facility.					
Physical dimensions	-	**Slurry pond (Phase 1)**	**Coal discard (Phase 1)**	**Slurry pond (Phase 2)**	**Coal discard (Phase 2)**	**Slurry pond (Phase 3)**	**Coal discard (Phase 3)**
	Footprint (ha)	7	12.2	6	15.5	24.9	72.3
	Volume (m^3)	303,800	189,700	955,411	1,989,166	3,275,739	5,379,716
	Capacity (tons)	236,964	223,846	745,220	2,347,216	2,555,076	6,375,513
	Elevation (mamsl)	1,584.5	1,584.5	1,602	1,602	1,575	1,575
	Height (m)	8.5	8.5	19	24	26	26
Topsoil stripping		The Phase 1 and Phase 2 slurry ponds and discard dumps footprint areas have been cleared of vegetation and a layer of ±300mm of topsoil have been stripped from the site footprint and stockpiled for use in the rehabilitation process (Table 45). It is expected that a similar approach will be implemented for Phase 3.					

Feature	Detail
Under drains and seepage collection	Subsoil drains have been constructed underneath the Phase 1 and Phase 2 coal discard dump footprint to drain seepage into the drainage collector sump and stormwater control dam. Control of groundwater seepage from the facilities will be effected by: – Subsurface drainage system beneath Phase 1 discard dump gravitating into the drainage collector sump and discard stormwater control dam where it will collect before re-use. – Subsurface drain pipes beneath the Phase 2 slurry ponds and discard dumps gravitating towards into the stormwater control dam. It is expected that a similar approach will be implemented for Phase 3.
Walls and embankments	The coal discard toe walls have been constructed from material excavated from the stormwater control dam and Phase 1 slurry pond basins. The materials have been placed and compacted by the contractor. The Phase 1 slurry pond walls have been constructed of material excavated from the Phase 1 slurry pond basin. The materials have been placed and compacted by the contractor. The Phase 2 slurry pond starter embankments have been constructed from coal discards and compacted accordingly by the contractor. The walls of the slurry ponds will be raised accordingly by placing coal discards and compacting by the operators. It is expected that a similar approach will be implemented for Phase 3.
Lining	The silt hillwash layers under the facility have been left intact. The footprint of the Phase 2 discard dump has been compacted. A 1500 micron HDPE lining has been installed to the Phase 1 and Phase 2 slurry ponds by a specialist contractor. It is expected that a similar approach will be implemented for Phase 3.
Delivery and deposition	Slurry will be pumped from the processing plant to the Phase 1 slurry pond perimeter in a 75 mm NB HDPE (PE63 PN16) pipe. Slurry to the Phase 2 slurry pond perimeter will be pumped from the processing plant via a 180 OD HDPE pipe (Class PE100 PN12.5). It is intended that the system be capable of delivering slurry to anywhere around the perimeter. The slurry delivery pipeline has been equipped with off-takes at 25 m centres with valves to control discharge. Similar delivery and deposition is expected for Phase 3.
Diversions and stormwater controls	For Phase 1 and Phase 2, stormwater containment trenches along the downstream edge of the slurry ponds and discard dumps drain into the lined stormwater dams. The stormwater control dam is positioned at the lowest elevation of the MRDF to capture runoff generated at the facility. The stormwater containment trenches along the downstream edge of the slurry ponds and discard dumps are intended to drain into the stormwater control dam. The stormwater control dam. The stormwater control dam comprises: – A lined stormwater control dam designed to ensure that water arising from rainfall events is not released more than once in 50 years (34,900m3). – The necessary decant outlet and pipe work to a single return water pump station located down slope of the stormwater control dam, from where excess stormwater will be returned to the plant. The stormwater control layout is included in Figure 10-2 of Appendix J. It is expected that a similar approach will be implemented for Phase 3.
Return water system and slurry pond decant	Water from the slurry pond return water systems and stormwater control dams will be pumped back to the plant. The slurry pond return water system comprises a barge fitted with a submersible pump for the recovery of excess decant slurry water. It is expected that a similar approach will be implemented for Phase 3.
Access and access control	A fence will be established around the perimeter of the MRDF and/or the mine. Warning signs must erected around the perimeter of the MRDF.

Feature	Detail
	Manila ropes to the lined slurry ponds will enable anyone falling into the pond to climb out. Access to the stormwater control dam decant outlet will be via a catwalk and is to be operated within accepted safety standards.
Waste minimisation	Where possible, coarse discard and slurry will be sold as a product thereby minimising the final disposal volumes.
Monitoring	The monitoring of the MRDF will include: • Safety aspects e.g. monthly review of freeboard during operational phase, presence of seepage, functioning of under drains, slurry and coarse discard production rates compared to planned production rates etc, quarterly inspections (operational phase) and annual audits. • Groundwater pollution aspects including monitoring of at least 3 boreholes located on the perimeter of the MRDF to ascertain upstream and downstream groundwater levels and quality including pH, EC, TDS, NO_3, Ca, Mg, Fe, Mn, Na, Cl, K, SO_4, HCO_3, PO_4 and piezometric level. Monitoring frequency of major cations and anions quarterly, minor constituents annually after 2 years of quarterly monitoring – quarterly report. • Vegetation cover and success rate. The rehabilitation and vegetation of the outer slope of the MRDF will be done during the operational phase – quarterly report. • Erosion damage and general condition of catchment paddocks, drainage outlet pipes, solution trench and sumps – quarterly report. Approximately twelve dust monitoring buckets will be placed around the mine to quantify dust emissions from the mine (including the MRDF and plant). Results documented in the annual report.
Dust control	The MRDF access roads and ramps will be watered as necessary to ensure that dust pollution is kept to a minimum. In addition, concurrent rehabilitation and vegetation of the MRDF outside slopes will further reduce dust emission rates.
Rehabilitation and capping	The outer faces of the toe walls, drainage collector sump, and stormwater control dam embankments will be first be covered with a layer of lime, followed by a layer of 'soft overburden' (minimum of 0.5 m) and finally a layer of topsoil (minimum of 0.3 m) and vegetated with a mixture of indigenous grasses, shrubs and trees. Topsoil stripped from the basin of the Phase 1 and Phase 2 slurry ponds during the contruction of the civil works has been placed on a designated stockpile for use in on-going rehabilitation of the side slopes and crests of the facilities.
Closure	On completion of the mine life (20 years) the following activities will be required to decommission and close the facility. • Remove all pipelines, pumps, catwalks, electrical cables etc. from the MRDF surfaces and surrounding areas. • Within a period of between 1 to 2 years after deposition ceases grout up the under drainage outlet pipes to prevent ingress of oxygen into the discard facility. • Construct the final cover to the top surface by using the same sequence of materials as described under rehabilitation above. • Establish vegetation on the top surface of the MRDF using a selection of indigenous trees, shrubs, grasses etc. • MRDF side slopes will be 1V:4H for Phase 1 and Phase 2, and 1V:6H for Phase 3. • On closure of the MRDF, access ramps and berms will be eliminated prior to rehabilitation to reduce erosion risks. • The crest of the MRDF will be provided with a durable rehabilitated coarse discard berm.
Design drawings	The relevant design drawings are included in Appendix J.

The environmental classification for the MRDF is medium to high hazard facility because of the potential for long term ground and surface water pollution.

The safety classification for the MRDF is a medium hazard facility. This was determined in accordance with the South African Code of Practice for Mine Residue Deposits (SABS 0286:1998) and the requirements of Mineral Regulation 527 of 23 April 2004. The summarised classification is included in Table 42 below.

TABLE 42: MINE RESIDUE DUMP SAFETY CLASSIFICATION

Criteria No.	Criteria		Comment	Safety Classification
1	No. of residents in Zone of Influence	0 (Low hazard) 1 -10 (Medium hazard >10 (High hazard)	There are no settlements downstream of the slurry ponds and discard dumps that are at risk by a failure.	Low hazard
2	No. of workers in Zone of Influence	<10 (Low hazard) 11 – 100 (Medium hazard) >100 (High hazard)	The slurry ponds are located down gradient of the plant area. Although it is planned the phase 3 slurry pond and associated works will be in the zone of influence, no mining activities are planned in the zone of influence.	Low hazard
3	Value of 3rd party property in Zone of Influence	0 – R2 Million (Low hazard) R2 – R20 million (Medium hazard) >R20 million (High hazard)	The zone of influence includes the Transnet servitude and buried pipeline immediately downstream of the slurry ponds and discard dumps.	Medium hazard
4	Depth to underground mine workings	>200 m (Low hazard) 50 m – 200 m (Medium hazard) <50 m (High hazard)	No underground mining is planned in the vicinity of the slurry ponds site.	Low hazard

2.7.13 SEWAGE MANAGEMENT

Provision has been made for the establishment of an on-site sewage treatment plant (Metago, 2008). The plant is designed to cater for the daily waste from approximately 220 personnel, and is capable of handling sewage and waste water from the plant change house, offices and ablutions and the mining change houses and office area. The design capacity is in the order of 7.5 m^3/day with a design peak flow of 2.2 m^3/hr. As part of the changes to surface infrastructure at the mine, the sewage treatment plant has been repositioned (see Figure 18).

2.7.14 WATER USE AND MANAGEMENT

2.7.14.1 Water balance

With reference to Figure 21, the water balance for Vanggatfontein Coal Mine has been updated to cater for the changes to surface infrastructure. The dynamic simulation model depicts all water flows between the various components at Vanggatfontein Coal Mine. The blue lines represent the clean water cirucuit and red lines represent the dirty water circuit. Table 43 provides the modelled volumes within the water balance over a ten year modelling period. A copy of the specialist report is included in Appendix K.

TABLE 43: 10 YEAR WATER BALANCE VOLUMES

No	Flow From	Flow To	10 yr m^3	avg m^3/a	INFLOWS	OUTFLOWS	INTERNAL USE
1	Process Water Dam (PWD)	Process Water Tank at Plant-5 (PWT5)	574 065	57 407			57 407
2	Borehole Reservoir (BR)	Plant-5 process make-up (PWT5)	6 508	651			651
3	Borehole Reservoir (BR)	Plant-5 flocculant make-up	38 025	3 802			3 802
4	Process Water Dam (PWD)	Process Water Tank at Plant-2 (PWT2)	7 922 351	792 235			792 235
5	Borehole Reservoir (BR)	Plant-5 process make-up (PWT5)	363 539	36 354			36 354
6	Borehole Reservoir (BR)	Plant-5 flocculant make-up	549 888	54 989			54 989
7	Borehole Reservoir (BR)	Potable water use (both plants)	485 439	48 544			48 544
8	Potable water use (both plants)	Sewage treatment plant (STP)	485 439	48 544			48 544
9	Sewage treatment plant (STP)	Sewage treatment plant - Losses	72 816	7 282		7 282	
10	Sewage treatment plant (STP)	Plant Storm Water Dam (Plant SWD)	412 623	41 262			41 262
11	Process Plant-5	Plant-5 Losses - Moist in product	90 315	9 032		9 032	
12	Process Plant-5	Plant-5 Losses - Evaporation	18 558	1 856		1 856	
13	Process Plant-5 (tailings)	Slurry Dam (SD)	509 724	50 972			50 972
14	Process Plant-2	Plant-2 Losses - Moist in product	1 290 024	129 002		129 002	
15	Process Plant-2	Plant-2 Losses - Evaporation	265 073	26 507		26 507	
16	Process Plant-2 (tailings)	Slurry Dam (SD)	7 280 681	728 068			728 068
17	Borehole(s)	Borehole Reservoir (BR)	1 443 998	144 400	144 400		
18	Seepage (into Pit)	Open Cast Pit (OC)	2 049 720	204 972	204 972		
19	Open Cast Pit (OC) dewatering	Process Water Dam (PWD)	3 607 393	360 739			360 739
20	Coal discard dump	Stormwater Control Dam (SCD)	-	-	-		
21	Stormwater Control Dam (SCD)	Water trucks (1st priority)	314 025	31 403		31 403	
22	Stormwater Control Dam (SCD)	Return Water Sump (RWS)	1 325 601	132 560			132 560
23	Slurry Dam (SD)	Seepage and Interstitial Losses	3 130 973	313 097		313 097	
24	Slurry Dam (SD) seepage	Return Water Sump (RWS)	1 347 109	134 711	134 711		
25	Slurry Dam (SD) return	Return Water Sump (RWS)	2 872 109	287 211			287 211
26	Return Water Sump (RWS)	Plant Storm Water Dam (Plant SWD)	5 540 383	554 038			554 038
27	Plant Storm Water Dam (Plant SWD)	Water trucks (2nd priority)	1 257 750	125 775		125 775	
28	Plant Storm Water Dam (Plant SWD)	Process Water Dam (PWD)	3 761 019	376 102			376 102
29	Slurry Dam (SD) return	Process Water Dam (PWD)	1 834 399	183 440			183 440
30	Process Water Dam (PWD)	Water trucks (3rd priority)	589 825	58 983		58 983	
31	Process Water Dam (PWD)	Plant Storm Water Dam (Plant SWD)	94 766	9 477			9 477
32	Plant Storm Water Dam (Plant SWD)	Overflow A	1 114 683	111 468		111 468	
	Blue = clean water flows			**Rainfall runoff**	375 858		
	Red = dirty water flows			**Evaporation**		36 633	
				TOTAL	**859 940**	**851 038**	**3 766 395**
		Average yearly water balance (infows - outflows)			**8 903**	(remains in storage)	

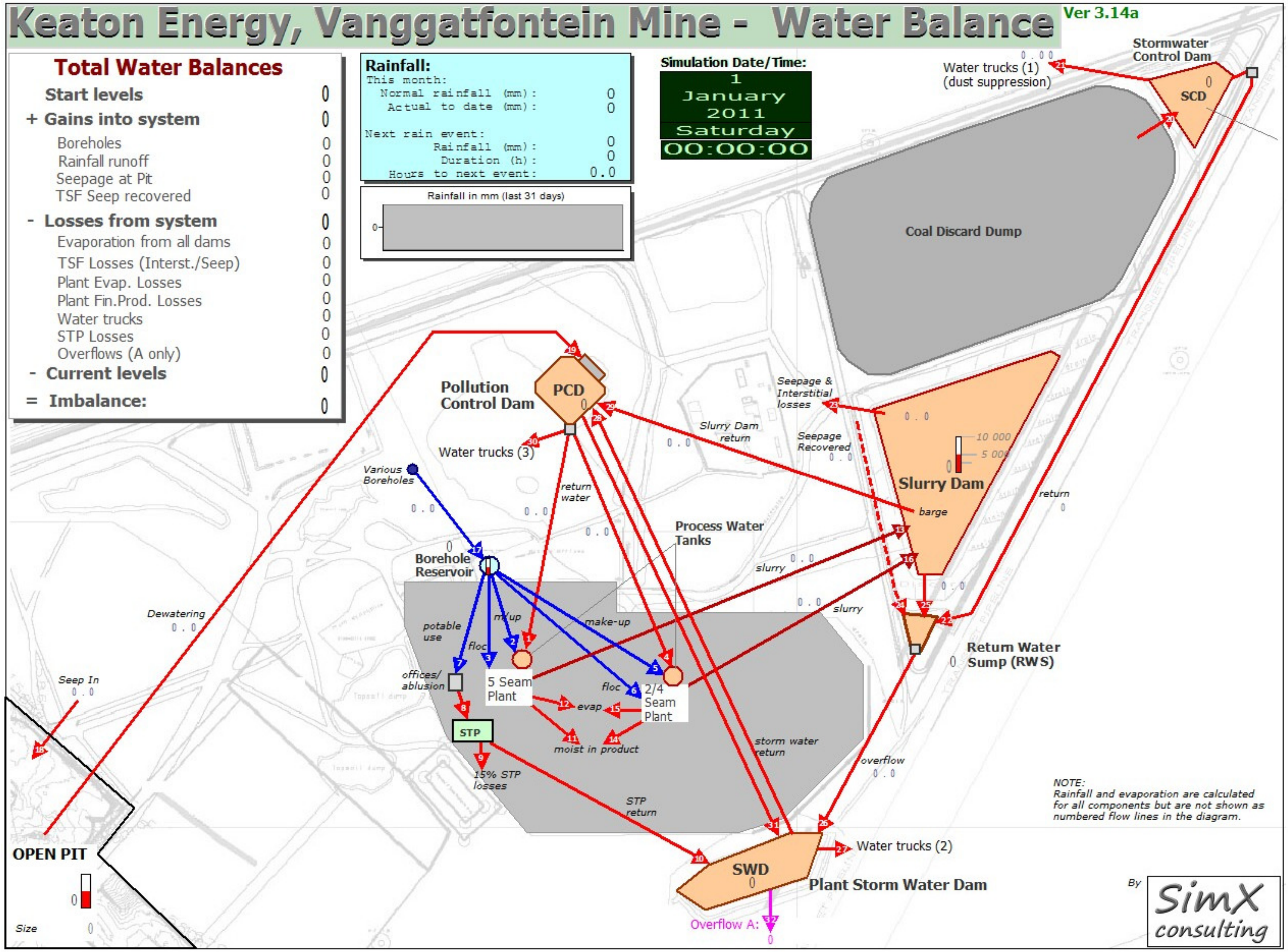

FIGURE 21: WATER BALANCE SIMULATION

2.7.14.2 Polluted water treatment facility

Apart from the sewage facility described in Section 2.7.13, another water treatment facility is required to treat excess process water prior to discharge into the environment. This treatment plant has the following design specifications:

- treatment rate of 1 500 m^3 per day;
- continuous monitoring of the inflow quality and quantity;
- lime neutralisation to both raise the pH and precipitate the dissolved metals;
- precipitation into a settling tank with the underflow that comprises sludge passing through a thickener before being discharged to either the MRDF slurry ponds or at the Holfontein waste disposal site; and
- continuous monitoring of outflow quality and quantity with the target of meeting the discharge quality as specified by DWA.

Depending on water license conditions, the final specifications of the plant may be adjusted and in certain scenarios (e.g. removal of TDS) a reverse osmosis plant may be required. The brine from the reverse osmosis plant would also be disposed onto the MRDF slurry ponds where most of the dissolved solids will be locked up in the coal slurry.

2.7.14.3 Water management system

This section should be read with reference to the water balance depicted on Figure 21, surface water infrastructure depicted on Figure 22, and the specialist studies attached in Appendix E, Appendix J and Appendix K.

Separate clean and dirty water systems at the mine have been designed and will be implemented and managed in accordance with the provisions of Regulation 704, 4 June 1999 (Regulation 704) for water management on mines. In general, the footprint of all dirty areas will be minimised by isolating these areas from clean water runoff and dirty water will be contained in designated systems. The clean and dirty water areas are illustrated in Figure 22.

Mining area

The pit dewatering dam for the main pit area on the eastern portion of the mining right is located north of the coal washing plant, to the east of the main pit area. This facility is a holding dam for excess water being pumped out of the open pit workings. The facility comprises the following:

- a lined storage dam with a capacity of 8 000 m^3;
- three concrete silt traps in a parallel configuration;
- a decant outlet and pipe work will be located down slope of the facility, from where excess pit water will be returned to the plant; and
- a spillway on the downstream side of the dam to facilitate the release of water into the surrounding environment should the facility need to overflow.

The layout of this facility is included in the specialist study attached in Appendix J

At each section of the open pits on the western portion of the mining right area, dirty water collecting in the pits will be pumped to a portable, lined facility for re-use. From the portable lined facility – excess water not required for workings will be used for dust suppression by tankers or pumped to the permanent pit dewatering dam on the eastern portion of the mining right area.

Clean runoff water will diverted around the mining areas (pits and stockpiles) into the natural environment. These run-off diversions will advance as mining advances.

Plant area

Dirty water from all areas in the plant will be directed into the stormwater dam located to the south of the coal washing plant. This is a lined facility with a capacity of 45 000 m^3 that has been designed to prevent spillage more than once in 50 years in accordance with Regulation 704. The layout of this facility is included in Appendix J. Clean water will be diverted around the plant area by means of diversion berms.

MRDF

The stormwater control dams at the MRDF have been positioned at the lowest elevation to capture run-off generated at the site. The stormwater containment trenches along the downstream edge of the slurry ponds and discard dumps are intended to drain into the stormwater control dams. The stormwater control dams return water system comprises:

- lined stormwater dams that have been designed to prevent spillage more than once in 50 years in accordance with Regulation 704.
- a decant outlet and related pipe work to a single return water pump station located down slope of the stormwater control dams, from where excess storm water will be returned to the plant.

The management of surface water associated with the MRDF's requires the isolation of the site from its surrounding surface water environment. This will be achieved by the construction of stormwater diversion trenches along the edges of the complex to divert run-off arising from the upslope area which will be directed around the facilities where it will be released, after passing through gabion lined energy dissipation structures.

2.7.15 DISTURBANCE OF WATER COURSES

All major mine infrastructure is located outside of the 100 m or 1:100 year floodline zones of relevant watercourses except for the following (Figure 18):

- the headwaters of two minor non-perennial drainage lines in the western section of the project site;
- bridges for internal road crossings in the eastern and western section of the project site.

For each of the bridges, a Rocla type culvert is to be used as a river crossing for the internal road. The design of this crossing will withstand pneumatic on-road trucks with a gross loading of 116 tons. Conceptually the bridge's length is approximately 20 m with a width of 8 m. The flow area underneath the bridge will be sufficient to allow for the passage of water when the streams are in flood. The ramp up to and from the bridges are to be compacted with treated soil at 300 mm layers until they reaches the base level of the bridges. The culverts will be arranged in such a manner so as not to disrupt the flow of the river. They are to be placed alongside each other to form the required length and width of the bridges. The concrete surface of the bridge is used to fill the voids and to keep the culverts in place. Consideration will also be given to biodiversity protection and pathways for biodiversity movement.

2.7.16 ADDITIONAL SUPPORT SERVICES AND FACILITIES

In addition to the abovementioned core infrastructure and activities, the support services and facilities include the following:

- laboratory at the plant – used for sample preparation and analysis;
- workshops and wash bays – used for servicing equipment and general maintenance;
- laydown and storage areas;
- stores, tanks and handling areas for storage of general raw materials, consumables, and hazardous chemical substances including oil/lubricants, hydraulic fluid, diesel, and heavy fuel oil for the generator;
- The volume of stored hazardous substances may vary during the course of the operation depending on delivery and scheduling constraints. As an order of magnitude guide the following volumes are provided. The volume of the combined diesel storage tanks is approximately 250 000 litres. The approximate storage volume of the other substances is approximately as follows: 100 000 litres of oil and lubricants, 20 000 litres of hydraulic fluid, and 100 000 litres of heavy fuel oil. The storage method of all these substances is to contain them in sealed containers within impermeable, bunded areas with sufficient capacity to contain spilled materials. All spilled materials must drain to sumps with oil traps that must also be equipped to allow collection and removal of spilled substances as per SANS 10089-1:2003;
- salvage yard areas for the temporary storage of waste before re-use or collection and removal;
- an explosives storage magazine and destruction area designed and operated in accordance with the relevant mine explosives safety and security legislation. In this regard, it will be reinforced and locked with strict access control measures and will only be used to store the type and quantity of explosives required in accordance with the final blast design and procedures;
- change houses with ablution facilities for all employees;
- a medical clinic facility for the primary treatment of injuries and illness;
- bus/taxi off-loading and loading areas;
- mining contractors areas (workshop/yard area);
- security checkpoints at all entrances;
- fencing and lighting (with masts) within the mine area for security and safety reasons;

- infrastructure for communication – telephone lines and communication masts; and
- main office/admin block at the concentrator complex and secondary offices at the mining contractors area.

2.7.17 DECOMMISSIONING AND CLOSURE

Broadly speaking, the decommissioning phase will include the removal of infrastructure from site and the final rehabilitation of areas where it is required. The broad closure objective is to re-establish the pre-mining land capabililty (i.e. agriculture) to all areas except the MRDF which will remain in perpetuity and will be rehabilitated to a wilderness/biodiversity capability. No final voids are anticipated in the current scenario because there will be sufficient spoil/overburden and topsoil to backfill and rehabilitate the open pit.

As is required by the relevant mining legislation (Act, 28 of 2002 and Regulation 527), a detailed closure plan will be submitted to the DMR prior to decommissioning and closure. This process will also involve other regulatory authorities and IAPs in a similar fashion to the involvement of people during the EIA process. The detailed closure plan will determine specific closure strategies and action plans taking regulatory, environmental, social, economic and sustainable development principles into account. Critical commitments in this regard are:

- that within the first three years of operation, the mine must establish numerical key performance indicators to measure achievement of the closure land use objectives. These indicators will drive ongoing rehabilitation and end closure initiatives; and
- as part of the closure plan, provision must be made for long term post closure treatment of contaminated water as required, and for compensation for any contamination related losses that may be experienced by water users.

2.7.18 LIFE OF MINE

The design life of the mine is approximately 20 years from the project initiation date (May 2010). The changes to surface infrastructure will not extend the overall life of the Vanggatfontein Coal Mine.

FIGURE 22: CLEAN AND DIRTY WATER SEPARATION AT VANGGATFONTEIN COAL MINE

3 POTENTIAL IMPACTS ON THE BIO-PHYSICAL ENVIRONMENT

3.1 LIST OF POTENTIAL IMPACTS ON ENVIRONMENTAL ASPECTS

This section provides a list of potential impacts on environmental aspects (excluding social and cultural aspects – see Section 6) separately in respect of each of the main project actions / activities and processes. The potential impacts are presented for each of the project phases in tabular format (Table 44).

TABLE 44: LIST OF POTENTIAL IMPACTS AS THEY RELATE TO PROJECT ACTIONS / ACTIVITIES / PROCESSES (EXCLUDING SOCIAL AND CULTURAL)

Activity	Phase	Impacts (unmitigated)
Site preparation Bush clearing, removal of infrastructure, establishing construction area	Construction Operation decommissioning	Physical destruction of biodiversity General disturbance of biodiversity Air pollution Disturbing noise Visual impacts
Earthworks (for all infrastructure)	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Disturbing noise Blasting damage Visual impacts
Civil works Building activities, erection of structures, concrete work, steel work, electrical installation, establishing pipelines	Construction Operation Decommissioning	Loss and sterilisation of mineral reserves Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Visual impacts
Open pit mining Drilling, blasting, load, hauling, dewatering	Construction Operation Decommissioning	Loss and sterilisation of mineral resources Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Contamination of groundwater Dewatering impacts Air pollution Disturbing noise Blasting damage Visual impact s

Activity	Phase	Impacts (unmitigated)
Underground mining Drilling, blasting, load, hauling, dewatering	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Dewatering impacts Blasting damage
Mineral processing (one coal washing plant)	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Disturbing noise Visual impacts
Mine Residue Disoposal Facility	Operation Decommissioning Closure	Loss and sterilization of mineral resources Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts
Power supply and use Distribution on site	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Visual impacts
Water supply and use	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts
Transport systems	Construction Operation Decommissioning	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Disturbing noise

Activity	Phase	Impacts (unmitigated)
		Traffic impacts Visual impacts
Non-mineralised waste management (general and industrial hazardous)	Construction Operation Decommissioning Closure (limited)	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts
General site management	Construction Operation Decommissioning Closure	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Visual impacts
Other support services and amenities	Construction Operation Decommissioning	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts
Demolition	Construction Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Air pollution Disturbing noise Blasting damage Visual impacts
Rehabilitation	Construction Operation Decommissioning	Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Disturbing noise

Activity	Phase	Impacts (unmitigated)
		Visual impacts
Maintenance and aftercare	Closure	Loss and sterilisation of mineral resources Hazardous structures/excavations/surface subsidence Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts

3.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative environmental impacts include:

- hazardous structures/excavations/surface subsidence;
- loss of soil resources and land capability through pollution;
- loss of soil resources and land capability through physical disturbance;
- physical destruction of biodiversity;
- general disturbance of biodiversity;
- pollution of surface water resources;
- contamination of groundwater;
- alteration of natural drainage patterns;
- air pollution;
- disturbing noise;
- blasting damage;
- traffic impacts; and
- visual impacts.

3.3 POTENTIAL FOR ACID MINE DRAINAGE OR GROUNDWATER CONTAMINATION

Detailed information on these issues is provided in Sections 1.1.1 and 7.2.10. In summary, geochemical tests and analysis incated that waste rock / overburden stockpiles are potentially acid-generating. This presents a potential pollution risk for both surface and groundwater in both the short and long term.

4 ALTERNATIVE LAND USE OR DEVELOPMENT

4.1 DESCRIPTION OF ALTERNATIVE LAND USE OF THE AREA

The eastern section of the mining site (associated with the changes to surface infrastructure) is currently used for mining activities. The western section of the mining site is currently used for farming and residential activities. Refer to Section 1.3.1 for a detailed description of existing land uses within the mining right area.

As an alternative to the mine, the current land uses on the western section of the mining right area would continue. The eastern section of the mining right area is currently used for mining activities and therefore no other land use has been considered at this stage.

4.2 MAIN FEATURES AND INFRASTRUCTURE RELATED TO ALTERNATIVE LAND USE / DEVELOPMENT

Potential features and infrastructure that could be associated with the alternative land use/development are listed below.

Feature / infrastructure	**Description**
Livestock farming	Introducing additional/new livestock to the farms Establishing watering holes
Roads	Gravel roads providing access to cultivated lands
Agriculture	Preparing and working agricultural field, abstraction of groundwater from boreholes and surface water from farm dams

4.3 PLAN SHOWING LOCATION AND EXTENT OF ALTERNATIVE LAND USE / DEVELOPMENT

A plan showing the location and extent of the alternative land use / development is not possible to present at this stage as this would depend on the individual landowners preferences and financial situation.

5 POTENTIAL IMPACTS OF ALTERNATIVE LAND USE OR DEVELOPMENT

5.1 LIST OF POTENTIAL IMPACTS

Potential impacts, expected to occur as a result of the alternative land use / development described in Section 4 above, are listed below:

Feature / infrastructure	Potential impacts
Livestock farming	Increased pressure on veld resources Loss of soils through incorrect management Increased income and associated socio-economic benefits Increased pressure on water resources
Roads	Dust generation
Water supply	Increased pressure on water resources
Agriculture	Alteration of natural drainage patterns Surface and/or groundwater pollution through the use of fertilisers Dust generation from exposed areas Increased income and associated socio-economic benefits

5.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with the alternative land use, when compared to the existing land use on site and in the surrounding area, are expected to include:

- increased pressure on water resources; and
- increased pressure on veld resources for grazing purposes.

6 POTENTIAL SOCIAL AND CULTURAL IMPACTS

6.1 LIST OF POTENTIAL IMPACTS ON SOCIO-ECONOMIC CONDITIONS OF THIRD PARTY LAND USE ACTIVITIES

Potential impacts on the socio-economic conditions of other parties land use activities both on site and in the surrounding area are discussed in detail in Section 7 and listed below.

- loss of current land uses through impacts on the bio-physical environment;
- dust;
- blasting hazards;
- noise;
- project-related road use and traffic;
- economic impacts (positive and negative);
- inward migration.

6.2 CULTURAL ASPECTS AND POTENTIAL IMPACTS THEREON

Cultural aspects are discussed as part of heritage discussion below.

6.3 HERITAGE FEATURES AND POTENTIAL IMPACTS THEREON

6.3.1 HERITAGE (AND CULTURAL) FEATURES

A number of graves have been identified within the Vanggatfontein mining right area (refer to Section 1.3.3 for further details). It is possible that further heritage resources are uncovered during the development of future activities. Potential impacts on heritage (including cultural) features include the loss of these resources for future generations through physical destruction and/or disturbance (described further in Sections 7.2.14). These resources are protected by national legislation and require mitigation prior to any disturbance.

6.3.2 PALAEONTOLOGICAL FEATURES

The potential does exist for palaeontological features to occur on site (see Section 1.3.3 for further detail). Potential impacts on palaeontological resources include the loss of these resources for future generations through physical disturbance (described further in Section 7.2.14). Should any fossils be uncovered during the development of the site, a palaeontologist or palaeoanthropologist should be consulted as this could open up possibilities for research.

6.4 QUANTIFICATION OF IMPACT ON SOCIO-ECONOMIC CONDITIONS

Socio-economic impacts have been assessed in Sections 7.2.18 and 7.2.19. The main findings are as follows:

- the changes to surface infrastructure at the Vanggatfontein Coal Mine will enable the mine to operate optimally. This will allow the positive economic impacts to continue by ensuring the continuation of the mine (following the discovery of the Transnet underground pipeline);
- in the original EIA and EMP report (Metago, 2008), the assumption was made that all the land in the mining right area would be purchased by Keaton and that the farmers and farm workers associated with Mr Peach, Classens and Venter would therefore vacate the mining right area and that the closest human receptors to the mining operation would be the residents on adjacent farms. In the current scenario, only Mr Peach and his workers have vacated the area leaving some of the other farmers and farm workers within the high impact zone for various environmental aspects. The related socio-economic impact is a reduced quality of life of the remaining people and relocation will be considered as a mitigation option; and
- a decrease in property values as well as an influx of people can result in significant socio-economic impacts. These can however be mitigated to acceptable levels through the implementation of management measures.

7 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

7.1 LIST OF EACH POTENTIAL IMPACT

Potential environmental impacts were identified by Metago SLR in consultation with IAPs, regulatory authorities, specialist consultants and Keaton. The impacts are discussed under issue headings in this section. All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area and those potentially associated with the mine are discussed and assessed together.

Potential impacts that have been identified include:

- loss and sterilization of mineral resources (Section 7.2.1)
- hazardous excavations/structures (Section 7.2.2)
- surface subsidence (Section 7.2.3)
- loss of soil resources (Section 7.2.4)
- loss of land with agricultural potential (Section 7.2.5)
- impact on habitat and species (Section 7.2.6)
- pollution of surface water (Section 7.2.7)
- alteration of surface drainage patterns (Section 7.2.8)
- reduction in groundwater levels/availability (Section 7.2.9)
- contamination of groundwater (Section 7.2.10)
- dust generation (Section 7.2.11)
- disturbing noise (Section 7.2.12)
- negative visual impacts (Section 7.2.13)
- impacts on heritage and cultural resources (Section 7.2.14)
- disturbance of paleontological sites (Section 7.2.15)
- blasting impacts (Section 7.2.16)
- road and traffic impacts (Section 7.2.17)
- positive socio-economic impacts (Section 7.2.18)
- negative socio-economic impacts (Section 7.2.19)

7.2 IMPACT RATING FOR EACH POTENTIAL IMPACT

The impact rating for each potential impact listed above (Section 7.1) is provided in the section below. The criteria used to rate each impact is outlined in Section 7.3. The potential impacts are rated with the assumption that no mitigation measures are applied and then again with mitigation. An indication of the phases in which the impact will occur is provided below and summarised in Section 7.4 together with the estimated timeframes for each rated impact.

This assessment has been structured to provide the significance ratings from the original EIA and EMP report (Metago, 2008) as a comparison for the impacts associated with the changes to surface infrastructure at the mine. In some cases, the significance ratings have remained the same, while in other cases the significance ratings have changed. The impact assessment that has been undertaken for this report looks at the potential impacts from the mining operation as a whole as a result of the changes to surface infrastructure.

GEOLOGY

Information in this section was sourced from Keaton's approved EIA and EMP report (Metago, 2008).

7.2.1 ISSUE: LOSS AND STERILISATION OF MINERAL RESOURCES

Introduction

Mineral resources can be sterilised and/or lost through the placement of infrastructure and activities in close proximity to mineral resources, by preventing access to potential mining areas, and through the disposal of mineral resources onto mineralised waste facilities.

This potential impact was rated as having a low significance in Keaton's approved EIA and EMP report (Metago, 2008) in both the unmitigated and mitigated scenario as the aim of the mine is to exploit target minerals. The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact as infrastructure has been located to avoid the sterilisation of minerals and no changes to the production process is planned.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Civil works	Open pit mining Mine residue management and disposal Civil works	Rehabilitation Mine residue management and disposal	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

The severity of sterilising mineral resources is considered to be high because of the associated potential economic value that is lost when sterilisation occurs. In the unmitigated scenario, this may occur in the event that the mine develops or decommissions infrastructure in a manner that it prohibits the mining of feasible resources, or where it disposes of feasible mineral resources onto waste facilities in a manner that makes it difficult or impossible to access the resources.

In the mitigated scenario, planning and co-ordination between the mining, infrastructure projects and processing decision makers can help to prevent the unacceptable sterilisation of resources, without compromising safety requirements. The mitigated severity reduces to low.

Duration

Sterilisation related impacts generally extend for as long as or beyond the life of the mine. This is a medium to long term duration.

Spatial scale / extent

The spatial extent of the physical impact is linked to the spatial extent of Keaton's mining right area. This is a localised spatial extent.

Consequence

The unmitigated consequence is high. The mitigated consequence is medium.

Probability

In both the unmitigated and mitigated scenarios, the probability of resource sterilisation is low as the objective of the project is to exploit mineral resources. In the mitigated scenario, the probability of the impact occurring is reduced further as the mine has planning structures in place to avoid infrastructure and development related sterilisation.

Significance

The significance in both the unmitigated and mitigated scenarios remains low.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	M-H	L	M	L	L

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	L	M	L	L	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 54).

Objective

To prevent unacceptable mineral sterilisation.

Actions

Both the current mine plan and infrastructure layout prevent sterilisation of third party minerals. This issue must be considered by the mine geologist, SHE manager and mine manager in the pre feasibility/planning stage of any changes to the mine plan and infrastructure layout.

Emergency situations

Not applicable.

TOPOGRAPHY

Information in this section was sourced from Keaton's approved EIA and EMP report (Metago, 2008).

7.2.2 ISSUE: HAZARDOUS EXCAVATIONS/INFRASTRUCTURE

Introduction

Hazardous excavations and infrastructure include all structures into or off which third parties and animals can fall and be harmed. Included in this category are facilities that can fail, such as mineralised waste facilities. Hazardous excavations and infrastructure occur in all mine phases from construction through operation to decommissioning and closure. In the construction and decommissioning phases these hazardous excavations and infrastructure are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term hazardous excavations and infrastructure and the closure phase will present final land forms that are considered hazardous.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Rehabilitation	Open pit mining Mine residue management and disposal Water supply and storage infrastructure Power supply infrastructure Rehabilitation	Demolition Open pit mining Mine residue management and disposal Water supply and storage infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

In the unmitigated scenario, most of the identified hazardous excavations/infrastructure presents a potential risk of injury and/or death to both animals and third parties. This is a potential high severity.

In the mitigated scenario the severity reduces to medium as security and access control will be implemented at the mine, and the design of the MRDF and the open pit rehabilitation components will be implemented to prevent and/or mitigate impacts.

Duration

In the context of this assessment, death or permanent injury is considered a long term, permanent impact.

Spatial scale / extent

Direct impacts associated with hazardous infrastructure and excavations at the mine will be located within the mine boundary, with or without mitigation. Direct impacts associated with the failure of MRDF will extend beyond the site boundary. The potential indirect impacts will extend beyond the site boundary to the families/communities to which the injured people and/or animals belong.

Consequence

The consequence is high in both the unmitigated and mitigated scenarios.

Probability

In the unmitigated scenario, without design and management interventions, the probability of the impact occurring is expected to be medium. The mitigation measures focus on infrastructure safety design and implementation as well as on limiting access to third parties and animals which reduces the probability of the impact occurring.

Significance

In the unmitigated scenario, the significance of this potential impact remains high. In the mitigated scenario, the significance of this potential impact remains medium because the probability of the potential impact occurring is reduced.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	M	H	M	H	L	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 55).

Objective

To prevent physical harm to third parties and animals from potentially hazardous excavations and infrastructure.

Actions

Until hazardous excavations are rehabilitated and closed, they will each have a barrier to prevent access by people and animals. The barrier may be in the form of fences, walls or berms. In addition, the barriers must have warning signs at appropriate intervals. These warning signs must be in picture format and/or written in English, Afrikaans and Zulu.

Dams with a safety risk (this includes all dams that hold 50 000 m^3 of water and that have a wall of 5 m or more) will be monitored by a professional civil engineer in accordance with Section 12.

During decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases.

At closure, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long term safety and/or stability risk.

At closure the hazardous excavations and subsidence associated with the open pits will have been dealt with as follows:

- all pits will have been backfilled and rehabilitated;

- the potential for surface subsidence will be addressed by providing a bulking factor for backfilled pits;
- monitoring and maintenance will take place to observe whether the relevant long term safety objectives have been achieved and to identify the need for additional intervention where the objectives have not been met.

Where the mine has caused injury to third parties and/or animals, appropriate compensation will be provided.

The SHE manager and appointed engineer are responsible for ensuring that these actions are implemented during the construction phase of the excavations, and that they are maintained until rehabilitation and closure.

Emergency situations

If people or animals fall off or into hazardous excavations or infrastructure causing injury, or if any mineralised waste or water facilities fail causing injury to people or animals, the emergency procedures in Section 20 must be followed.

7.2.3 ISSUE: SURFACE SUBSIDENCE

Introduction

In the context of both opencast and shallow underground mining, surface subsidence can occur if backfilled material is inadequately compacted; if insufficient support is left behind in shallow underground mining; or if acid mine drainage (AMD) seeps into the dolomitic zone causing decay of dolomitic material and the formation of sink holes.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact. However the backfilling techniques specified in the approved EIA and EMP report (Metago 2008) to mitigate the generation of AMD are not being implemented at the mine. In addition, no geochemical testing of mine waste from the operational phase has been conducted, nor has investigatory work been conducted on the impermeable zones beneath the opencast mining areas. As these mitigation measures for sinkhole formation are not being implemented at the mine, this assessment considers only the unmitigated scenario for impacts related to sinkhole formation. Due to the number of uncertainties, this assessment has taken a precautionary approach.

This assessment has been split to asses into two separate impacts, namely:

- surface subsidence related to backfilling; and

- formation of sinkholes related to AMD seepage into the dolomitic zones.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
N/A			
-	Open pit and underground mining Mine residue management and disposal Water supply and use	Mine residue management and disposal Water supply and use	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

Shallow surface subsidence related to backfilling

In the event that limited surface subsidence does occur it can create depressions which cause an alteration of surface drainage patterns and pooling of water. This is a medium severity in the unmitigated scenario, and can be reduced to low with mitigation.

Sinkholes

In more severe cases of surface subsidence, the depressions can be hazardous to people, structures and animals. The seepage of AMD into the dolomitic zone causing severe cases of surface subsidence is a possibility and therefore this is a high severity.

Duration

Shallow surface subsidence related to backfilling

Limited surface subsidence related to backfilling is largely limited to the life of the mining operation. This is a medium duration.

Sinkholes

Severe surface subsidence and related impacts can occur once operations have ceased. This is a long term duration.

Spatial scale / extent

Shallow surface subsidence related to backfilling

Impacts associated with surface subsidence as a result of incorrect backfilling or insufficient support in underground mining will be located within the mine boundary.

Sinkholes

Impacts associated with AMD seeping into the dolomitic zone can result in surface subsidence occuring off-site. This is a medium spatial scale.

<u>Consequence</u>

Shallow surface subsidence related to backfilling

The consequence is medium in both the unmitigated and mitigation scenarios.

Sinkholes

The consequence is high.

<u>Probability</u>

Shallow surface subsidence related to backfilling

It is possible for limited surface subsidence to occur in the unmitigated scenario, however with the implementation of mitigation measures such as compaction of backfilled material and leaving mine support in place the probability of the impact occurring reduces to low.

Sinkholes

The probability of the impact occurring relies on a causal chain that comprises four main elements:

- What is the likelihood of AMD forming?
- What is the likelihood of the potential AMD seepage reaching the dolomitic zone?
- Is there a potential for cavity formation within the dolomitic zone?
- What is the likelihood of the bridging material (the ground between the cavity and land surface) collapsing?

The first element is that AMD is generated from the backfilled pits and long term stockpiles and mineralised waste facilities. As discussed in Section 1.1.1, some samples from the Vanggatfontein Mine show potential for AMD formation and other samples show no potential for AMD formation (Metago, 2008). The precautionary approach is to assume that AMD formation is possible.

The second element is that the potential AMD seepage reaches the dolomitic zone. With reference to Section 1.1.1, there are impermeable zones that occur below the target coal seams (2, 4 and 5) across most of the mine site. If preserved, these zones could play an important role in preventing the flow of potential contaminants from the mined areas into the dolomites. Since the onset of mining activities (including blasting) no additional information on the status of the impermeable zones is available for inclusion in this study. Therefore it is not possible to conclude whether the integrity of these zones has been reduced or not. The precautionary approach is to assume that it is possible for AMD seepage to pass through this zone into the underlying dolomites.

The third element is the potential for cavity formation within the dolomitic zone. With reference to Section 1.1.1, prospecting boreholes that have penetrated through the Dwyka Group into the basement intersect mainly Malmani Group dolomites of the Transvaal Supergroup, some of which show evidence of karst topography. It is therefore possible that cavities have formed or are in the process of forming within the dolomitic zone beneath the site. The size of these cavities is unknown.

The fourth element is the collapse of bridging material that occurs between the potential cavity in the dolomitic zone and the earth's surface. This would depend on the stability of the bridging material and the depth of the cavity. The dolomitic zones in this region are located approximately 100 m deep. While the areas that have not been mined will have stable bridging material, the same cannot be said for areas that have been mined and subsequently backfilled.

With all of the above taken into consideration, the probability of the impact occurring is medium-low.

Significance

Shallow surface subsidence related to backfilling

The significance of this potential impact is medium in the unmitigated scenario and can be reduced to low with mitigation.

Sinkholes

The significance of this potential impact is medium-high.

Shallow surface subsidence related to backfilling

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	M	H	L	M	M	M

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	M	M	L	M	L	L

Sinkholes

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	H	M	H	M-L	M-H

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 56).

Objective

To prevent surface subsidence.

Actions

Shallow surface subsidence related to backfilling

Backfilling operations, as specifically outlined in Table 40, must take the possibility of surface subsidence into account. For opencast areas, backfilled material will be compacted, a bulking factor will be calculated, and a slight swell above ground level will be established. For the shallow underground section, this requires appropriate support pillars. Final replacement of subsoil and topsoil onto the backfilled overburden / spoil material should be done with the understanding that if subsidence occurs thereafter, re-stripping of topsoil and additional backfilling with overburden / spoil will be required. Thereafter the subsoil and topsoil will have to be replaced.

These actions are the responsibility of the SHE manager and will be implemented whenever backfilling of the open pits occurs.

Sinkholes

Sinkhole prevention is necessarily linked to the prevention of potential AMD seepage into the dolomitic zone by the conservation of impermeable zones below the target coal seams. No mitigation measures will be implemented.

Additional testing should be conducted on actual samples from the mining operation to determine the geochemical characterisation.

Emergency situations

Sudden surface subsidence is considered an emergency situation. In such cases, the emergency procedures for hazardous excavations as set out in Section 20 must be followed.

SOILS

Information in this section was sourced from Keaton's approved EIA and EMP report (Metago, 2008).

7.2.4 ISSUE: LOSS OF SOIL RESOURCES

Introduction

Soil is a valuable resource that supports a variety of ecological functions. The mine has the potential to damage soil resources through physical disturbance and/or contamination. Contamination of soils also has the potential to impact both surface and groundwater resources (see Sections 7.2.7 and 7.2.10). This section focuses on the potential for disturbance and contamination of the soil resources.

Soil resources can be damaged and/or lost through:

- the failure to strip and stockpile soil in areas that will be disturbed by infrastructure and activities – these soils could become compacted and/or diluted in large stockpiles of overburden/spoil;
- wind and water erosion of exposed soils and soil stockpiles; and
- pollution by the spillage of dirty water, waste and chemicals – in particular hydrocarbons.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management Transport systems Non-mineralised waste management	Site management Transport systems Opencast mining Non-mineralised waste management Mine residue management and disposal Water supply and use Mine residue disposal	Demolition Site management Transport systems Non-mineralised waste management Mine residue management and disposal Water supply and use	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity/nature

Approximately 650 ha of land will be disturbed as part of the Vanggatfontein mining operations. Limited additional sources of pollution will be established as part of the revised layout of the mining operations. However, the underground Transnet pipeline is a potential significant source of pollution, which could result in a loss of soil resources if damaged.

In the unmitigated scenario, the severity is high as mining is a temporary land use and soils are required to rehabilitated disturbed areas and re-establish post closure land potential that will support community, biodiversity and agricultural land uses. Soil is a key element in the rehabilitation process because it is the medium through which landscape function is re-established. In the mitigated scenario, disturbed soils will be stripped and conserved and the number of pollution events should be significantly less which reduces the potential severity to medium.

Duration

Soil is a non-renewable resource and therefore the loss of soils as a result of pollution and disturbance is considered long term. In the mitigated scenario most of the potential impacts should either be avoided or be remedied within the life of the mine, which reduces the duration to medium. This will be achieved by implementing the soil conservation procedure, through basic infrastructure design and the effectiveness of pollution clean-up teams and the chosen remediation methods.

Spatial scale/extent

In both the unmitigated and mitigated scenarios the potential loss of soil resources would be limited to the mine boundary.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is reduced to medium as the severity and duration of the impact is reduced.

Probability

In the unmitigated scenario the probability of this potential impact occurring is high. With mitigation, the probability can be reduced to medium as measures will be in place to prevent the loss of soil resources.

Significance

In the unmitigated scenario, the significance of this potential impact remains high. In the mitigated scenario, the significance remains medium because mitigation measures will reduce the severity, duration and probability of the potential impact occuring.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	H	L	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	M	M	L	M	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 57).

Objective:

To conserve soil resources.

Actions

The mine will implement the soil conservation procedure as set out in Table 45.

The mine will conduct all potentially polluting activities in a manner that pollutants are contained at source. In this regard the mine will ensure that:

- all vehicles and equipment will be serviced in workshops and washbays with contained impermeable, floors, dirty water collection facilities and oil traps;
- all new and used chemical, fuel, oil storage and handling facilities will be designed and operated in a manner that all spillages are contained in impermeable areas and cannot be released into the environment;
- ad hoc spills of potentially polluting substances (whether in dirty areas or in the environment) will be reported to the SHE manager immediately and cleaned up/remediated immediately;
- all buffer specifications associated with the Transnet servitude will be adhered to to avoid causing pipeline damage and associated soil pollution;
- specific engineering design measures to control potential acid mine drainage pollution from overburden spoil piles, mine void backfilling activities and the MRDF (as detailed in Table 40 and Table 41) must be strictly adhered to;
- a dirty water management system, as set out in Section 7.2.7 implemented; and
- the waste management practices, as set out in Table 46 below, are implemented.

The SHE manager is responsible for implementing these actions, procedures and practices from the start of the construction phase through to closure.

TABLE 45: SOIL CONSERVATION PROCEDURE

Steps	Factors to consider	Detail
Delineation of areas to be stripped		Stripping will only occur where soils are to be disturbed by activities that are described in the EIA and EMP report, and where a clearly defined end rehabilitation use for the stripped soil has been identified.
Reference to biodiversity action plan		All requirements for moving and preserving fauna and flora according to the biodiversity action plan will be adhered to.
Fertilization prior to stripping		Soils from areas that have not previously been fertilized should be fertilized with superphosphate prior to being stripped. This is likely to promote vegetation establishment during stockpiling and to reduce the requirement for fertilization at the rehabilitation stage.
Stripping	Topsoil and subsoil	The target soil stripping depth is 80cm unless the bed rock is less than 80cm from surface. Topsoil and subsoil will be stored separately.
Delineation of stockpiling areas	Location	Stockpiling areas have been identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas.
Stockpile management	Vegetation establishment and erosion control	Rapid growth of vegetation on the topsoil stockpiles will be promoted by hydroseeding with a mix of naturally occurring grasses. The purpose of this exercise will be to encourage vegetation growth on soil stockpiles and to combat erosion by water and wind. Four to six weeks after initial germination additional fertilizer should be applied (eg. ammonium sulphate). Ongoing maintenance and management must ensure that the stockpiles are repaired and managed for the life of mine to ensure the preservation of the topsoil resource.
	Storm water controls	Stockpiles will be established with storm water diversion berms to prevent run off erosion.

Steps	Factors to consider	Detail
	Height and slope	The ideal specifications for storing soil is as follows: Soil stockpiles height will be restricted to avoid compaction and damage to the underlying soils. The ideal stockpile height for storage periods greater than 3 years is 1.5m. For short-term stockpiles (less than 3 years) the allowable height is greater than 1.5m but these stockpiles should be benched. Each bench should ideally be 1.5m high and the side slopes should be 1 vertical: 6 horizontal to promote vegetation growth and reduce run-off related erosion. Deviations from these specifications are possible. However, any deviations must be agreed with an appropriately qualified person.
	Waste	No waste material will be placed on the soil stockpiles.
	Vehicles and animals	Vehicle and animal movement on top of the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seedbank.
Rehabilitation of disturbed land: restoration of land capability	Placement of soil	A final land use plan for the rehabilitated land will be developed by modelling the final topography and soil thickness according to pre-mining coal seam thickness, topsoil depth and overburden swell factors. Different topsoil thickness will then be placed accordingly. In this context the target topsoil stripping and replacing depth is 80cm, particularly for areas that will have arable potential going forward
	Fertilisation	A few samples of stripped soils will be analysed to determine the nutrient status of the soil. As a minimum the following elements will be tested for: cation exchange capacity, pH and phosphate. These elements provide the basis for determining the fertility of soil. Based on the analysis, fertilisers will be applied if necessary.
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.
Pollution of soils	In situ remediation	If soil (whether stockpiled or in its undisturbed natural state) is polluted, the first management priority is to treat the pollution by means of in situ bio-remediation. The acceptability of this option must be verified by an appropriate soils expert and by DWA, on a case by case basis, before it is implemented.
	Off site disposal	If in situ treatment is not possible or acceptable then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF 1998) and disposed at an appropriate, permitted, off-site waste facility.

TABLE 46: WASTE MANAGEMENT PRACTICES FOR DOMESTIC WASTE AND INDUSTRIAL WASTE

Items to be considered		Intentions
General	**Specific**	
Classification and record keeping	General	The waste management procedure for the mine will cover the storage, handling and transportation of waste to and from the mine. The mine will ensure that the contractor’s responsible are made aware of these procedures.
	Waste opportunity analysis	In line with DWAs’ strategy to eliminate waste streams in the longer term, the mine will assess each waste type to see whether there are alternative uses for the material. This will be done as a priority before the disposal option.
	Classification	Wastes will be broadly classified in terms of the DWAF Minimum Requirements for Waste Disposal (DWAF, 1998).
	Inventory of wastes produced	An inventory of wastes will be compiled and will include estimated quantities of waste. The inventory will be kept up to date.
	Disposal record	Written evidence of safe disposal of waste will be kept.
Waste management facilities	Collection points	Designated waste collection points will be established on site. Care will be taken to ensure that there will be sufficient collection points with adequate capacity and that these are serviced frequently.

Items to be considered		Intentions
General	Specific	
	Laydown/ salvage areas	During decommissioning and closure, lay down areas for re-usable non-hazardous materials will be established. Mixing of re-usable materials with other wastes, especially hazardous wastes will be prevented.
	General waste	Will be stored in designated skips and removed by an approved contractor for disposal at a licensed facility.
	Scrap metal and building rubble	Care will be taken to ensure that scrap metal and building rubble does not become polluted or mixed with any other waste. The scrap metal will be collected in a designated area for scrap metal (salvage yard). It will be sold to scrap dealers. Building rubble will be used to backfill mining voids
	Hazardous wastes	Medical waste, laboratory chemicals, explosives packaging, used chemicals and chemical containers will be temporarily stored in sealed containers in a bunded store before removal by an approved waste contractor and disposal in a licensed facility.
	Oil and grease	Oil and grease will be collected in suitable containers at designated collection points. The collection points will be bunded and underlain by impervious materials to ensure that any spills are contained. Notices will be erected at each waste oil point giving instructions on the procedure for waste oil discharge and collection. An approved subcontractor will remove oil from site.
	Any soil polluted by a spill	If remediation of the soil *in situ* is not possible, the soils will be classified as a waste in terms of the Minimum Requirements and will be disposed of at an appropriate permitted waste facility.
	Dried sewage sludge and screenings from the sewage plant	All sludge will be removed from site with the screenings as hazardous waste and disposed at a licensed facility.
Disposal	Off site waste disposal facilities	Waste will be disposed of at appropriate permitted waste disposal facilities as outlined below. For general waste the closest permitted site is in Delmas. For hazardous waste the closest permitted site is at Holfontein (Springs).
Waste transport	Contractor	A qualified waste management subcontractor will undertake the waste transport. The contractor will provide an inventory of each load collected and proof of disposal at a licensed facility.
Banned practices	Long-term stockpiling of waste	Stockpiling of waste is a temporary measure. Waste stockpiling sites must have an impervious floor, be bunded and have a drainage system for collection and containment of water on the site.
	Burying of waste	No wastes other than mine residues will be placed on site.
	Burning of waste	Waste may only be burned in legally approved incinerators.

Emergency situations

Major spillage incidents that have the potential to pollute soils both on and off site must be handled in accordance with the emergency procedure attached in Section 20.

Emergency situations

None identified.

LAND CAPABILITY

Information in this section is derived from Keaton's approved EIA and EMP report.

7.2.5 ISSUE: LOSS OF LAND WITH AGRICULTURAL POTENTIAL

Introduction

Mining activities have the potential to reduce land capability through the disturbance of soils, clearing of vegetation, and a reduction in water quantity and quality. Although the pre-mining natural land capability of the farm Vanggatfontein 251 IR was largely classified as grazing (Section 1.1.5), the extent of land that was historically used for crop farming was significantly more that the amount of land that was classed as arable. This section focusses on the potential loss of land that has agricultural potential.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management	Civil works Open pit mining Site management Non-mineralised waste managment Water supply and use Mine residue management and disposal	Site management Non-mineralised waste managment Water supply and use Mine residue management and disposal	Site management Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity/nature

Approximately 650 ha of land will be disturbed as part of the Vanggatfontein mining operation. The land that has been disturbed by the revised mine footprint was largely demarcated for surface infrastructure as part of the approved layout (Metago, 2008). If the disturbed land is not rehabilitated correctly, the pre-mining land capability will not be re-established. The severity of this impact is high in the unmitigated scenario, and reduces to medium with mitigation.

Duration

In the unmitigated scenario, the potential loss of land with agricultural capabilities will extend beyond the life of the mine. In the mitigated scenario some of the impacts should be remedied within the life of the mine, which reduces the duration to medium. This will be achieved by limiting the footprint of the mine, implementing the soil conservation procedure (Table 45) and effective rehabilitation.

Spatial scale/extent

In both the unmitigated and mitigated scenarios, the potential loss of land with agricultural capabilities would be restricted to the area within the mine boundary.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is reduced to medium as the severity and duration of the impact is reduced.

Probability

In the unmitigated scenario the probability of this potential impact occurring is high. With mitigation, the probability can be reduced to medium with the implemenetation of effective rehabilitation measures.

Significance

In the unmitigated scenario, the significance of this potential impact remains high. In the mitigated scenario, the significance remains medium as the severity, duration and probability of the potential impact occurring are reduced.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	H	L	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	M	M	L	M	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 58).

Objective:

To limit the mine's impact on land capability.

Actions:

Land disturbance by mine activities will be limited to those activities that are described in the EIA and EMP report.

Rehabilitation will commence in mined out areas as soon as mining advances to new areas. All rehabilitation initiatives will have the target that historical land capabilities are restored through the conservation and replacement of soil (Section 7.2.4 above).

The MRDF and remaining overburden spoil piles cannot be rehabilitated for future agricultural use. This area of approximately 139 ha for the MRDF will be rehabilitated to a wilderness/biodiversity land use. The same end use applies to any remaining overburden spoil piles.

The mine surveyor and the SHE manager are responsible for ensuring that these actions are implemented during all phases of the mine.

Emergency situations

Not applicable.

BIODIVERSITY

Information in this section is derived from Keaton's approved EIA and EMP report (Metago, 2008).

7.2.6 ISSUE: IMPACT ON HABITATS AND SPECIES

Introduction

By way of introduction to this section of the impact assessment, The International Council for Mining and Metals (ICMM) has been instrumental in research and development of good environmental practices in mining. The ICMM's Good Practice Guidance for Mining and Biodiversity provides some useful insights into issues around biodiversity. In the broadest sense, biodiversity provides value for ecosystem functionality, aesthetic, spiritual, cultural, and recreational reasons. The known ecosystem related value is listed as follows:

- soil formation and fertility maintenance;
- primary production through photosynthesis, as the supportive foundation for life;
- provision of food and fuel;
- provision of shelter and building materials;
- regulation of water flows and water quality;
- regulation and purification of atmospheric gases;
- moderation of climate and weather;
- control of pests and diseases; and
- maintenance of genetic resources (key for medicines, crop and livestock breeding).

The assessment below considers impacts on:

- land linked habitats and species; and
- water-resource linked habitat and species.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact as no additional sensitive areas will be disturbed.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works Transport system Site management	Open pit mining Site management Transport system Non-mineralised waste management Water supply and use Mine residue management and disposal	Opencast mining Site management activities Transport system Non-mineralised waste management Water use and management Mine residue management and disposal	Site management activities Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity/nature

Although the aquatic and terrestrial biodiversity in the mine area has been impacted by upstream mining and localised farming and community activities, there are valuable biodiversity resources on and adjacent to the mine site (see Section 1.1.6) which include: the mixed, moist and wet grassland habitats. Some of these are associated with water courses and wetlands that drain towards the off site Wilge River.

While the in-stream aquatic biodiversity has been compromised and does not include sensitive in-stream biodiversity, the related habitats support the vulnerable Marsh Sylph Butterfly (*Metisella meninx*), the vulnerable Corn Crake and the near threatened Black Winged Pratincole. The habitats are suitable for and could also support other rare, vulnerable or neat threatened bird, animal, reptile, amphibian and invertebrate species that have been observed on neighbouring land or in the region.

The sensitive grassland habitats and some of the other habitats on the mine site were found to host the protected Gladiolus (*Gladioulus crassifolius)* and the endangered Star Flower (*Hypoxis hemerocallidea)* species. There is also potential for the occurrence of other endangered vegetation species.

Mining related activities on-site have the potential to cause additional habitat destruction, habitat fragmentation, and reduction in species. With regard to habitat destruction and species disruption, the impacts on the majority of the more sensitive grassland, wetland and aquatic habitats have been limited through placement of most of the mine related infrastructure to avoid the sensitive areas and to focus the infrastructure in areas that are already disturbed by agriculture. With regards to fragmentation, there will be some limitation to the movement of biodiversity, but the layout provides for the most important aquatic and terrestrial habitats and linkages to remain in place.

In the unmitigated scenario, mining activities could further destroy habitat through air, water and soil pollution, uncontrolled vehicle movements, hunting, fires, and plant harvesting. This will result in the destruction and/or displacement of biodiversity systems and species.

The severity of this potential impact is high in the unmitigated scenario, and can be reduced to medium with the implementation of a biodiversity action plan and by limiting the footprint of the operations.

Duration

In the unmitigated scenario, the potential loss of species and habitat will extend beyond the life of the mine. With the implementation of mitigation measures, the duration of this potential impact can be reduced, however areas that are rehabilitated during decommissioning will only become functional from a biodiversity perspective after the life of the mine.

Spatial scale/extent

In the unmitigated scenario, the potential impacts could extend to areas off-site as a result of the tributaries that drain the site. With mitigation measures in place, the potential impacts would be limited to within the mining right area. This will be achieved by implementing a biodiversity action plan as described below.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is reduced to medium as the severity and duration of the impact is reduced.

Probability

In the unmitigated scenario the probability of this potential impact occurring is high. With mitigation, the probability can be reduced to medium with correct management measures and concurrent rehabilitation.

Significance

The significance of this impact remains high in the unmitigated scenario and can be reduced to medium with mitigation.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning and closure						
Mitigated	M	M/H	L	M	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 59).

Objective:

To limit the short and long term negative impacts on land and water resource related biodiversity.

Actions:

The mine will implement an updated biodiversity action plan that will be refined and implemented in consultation with a biodiversity specialist. This action plan will include the following management actions:

- the initial baseline biodiversity field work will be augmented with follow up field work at the end of winter 2008;
- The mine will limit mine infrastructure, activities and disturbance to those specifically identified and described in this EIA and EMP report (see Figure 18), with controlled access and zero tolerance of disturbances to the identified sensitive habitats and associated species. As a general rule, a buffer zone will be put in place around sensitive habitats (Section 1.1.6) that are not disturbed by the approved activities;
- if removal of protected vegetation species is required for the establishment of approved project infrastructure this may only be done if the required permits are in place;
- the engineering design work of rehabilitation of headwaters and river crossings will be done in consultation with a qualified ecologist with water course related expertise to limit the destruction of habitat and species and to promote re-establishment thereof. Where possible, pebbles, rocks and biodiversity will be re-established in the headwaters and these areas will be re-scanned for sensitive fauna and flora prior to construction;
- there will be planning on the removal of fauna and flora (plants and seeds) species prior to disturbance by mine infrastructure and activities. This will include planning on the preservation, cultivation and re-use of these species in ongoing rehabilitation. In this regard, the mine will establish an on-site nursery for plants that disturbed by the mining operations. Links will also be made to the soil conservation procedure and actions, and the ongoing MRDF rehabilitation (Section 7.2.4); and
- there will be implementation of an alien/invasive/weed management programme in collaboration with DAgric, DWA and Working for Water to control the spread of these plants onto and from disturbed areas. Care will be taken to prevent the encroachment of alien plant species into rehabilitated areas.

The SHE manager is responsible for implementing these actions prior to the construction phase and through to closure.

Emergency situations

Not applicable.

SURFACE WATER

Information in this section is derived from Section 1.1.7 and the specialist study attached in Appendix E.

The Vanggatfontein Coal Mine could result in an alteration of drainage patterns, as well as potentially contaminate surface water resources. These issues are assessed separately below.

7.2.7 ISSUE: POLLUTION OF SURFACE WATER

Introduction

There are a number of pollution sources at the mine that have the potential to pollute surface water, particularly in the unmitigated scenario. In the construction and decommissioning phases these potential pollution sources are temporary in nature. Although these sources may be temporary, the potential pollution may be long term. The operational phase will present more long term potential sources and the closure phase will present final land forms (such as the MRDF) that have the potential to contaminate surface water through long term seepage and/or run-off.

This potential impact was rated as having a high significance in the unmitigated scenario and low-medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). As the potentially polluting facitlies at the Vanggatfontein Coal Mine are still present, the changes to surface infrastructure are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Transport systems Site management Water supply and use Non-minerarlised waste management Mine residue management and disposal	Open pit and underground mining Transport systems Mineral processing Site management Water supply and use Non-minerarlised waste management Mine residue management and disposal Pollution control treatment facility	Open pit and underground mining Transport systems Mineral processing Site management Water supply and use Non-minerarlised waste management Mine residue management and disposal Pollution control treatment facility	Pollution control treatment facility Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

<u>Severity/nature</u>

In the unmitigated scenario, surface water may collect contaminants (hydrocarbons, salts, and metals) from numerous sources. In the unmitigated scenario, potential construction phase pollution sources include:

- sedimentation from erosion;
- spillage of construction solvents, paint, fuel, oil, cement; and

- sewage.

In the unmitigated scenario, potential operation and decommissioning phase pollution sources include:

- spills of operational chemicals, fuel and oil (including spills that may occur as a result of damage to the underground Transnet pipeline);
- contaminated discharges (particularly acid mine drainage) from the dirty water systems including: the pits, plant, MRDF, rock dumps, dirty water and waste pipelines, sewage plant, water treatment plant, machinery maintenance workshops and washbays; and
- sedimentation from erosion.

The severity of this potential impact is high in the unmitigated phase, and reduces to medium with mitigation. This will be achieved by the implementation of pollution prevention procedures and dirty water management systems, and compliance with Transnet's servitudes for protecting the fuel pipeline (see Section 7.2.16).

Duration

In the unmitigated scenario the potential impacts are long term, occurring for periods that exceed the life of the mine. With mitigation, pollution can be prevented and most impacts can be mitigated within the life of the mine.

Spatial scale/extent

In the mitigated and unmitigated scenarios the spatial scale is likely to extend beyond the mine boundary because contamination is mobile once it reaches flowing water courses.

Consequence

In the unmitigated scenario the consequence is high and in the mitigated scenario it is medium.

Probability

In the unmitigated scenario it is possible that there will be significant pollution incidents that would impact on downstream ecosystems and users. The probability is therefore rated as high in the unmitigated scenario. In the mitigated scenario this impact can be reduced to low with the implementation of management and mitigation measures that contain pollution at source or enable fast remediation.

Significance

In the unmitigated scenario, the significance of this potential impact remains high. In the mitigated scenario, the significance remains low-medium because of the reduction in severity, duration and probability.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	L	L-M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 60).

Objective:

To prevent the pollution of surface water.

Actions:

In regard to soil/erosion management, pollution prevention and management, and waste management; the procedures, practices and actions included in Section 7.2.4 will be implemented.

The clean and dirty water systems, as depicted in the mine's water balance and described in Section 2.7.14, will be designed, implemented and managed in accordance with the provisions of Regulation 704 for water management on mines. In this regard:

- clean water will be diverted around operational areas;
- areas in which hazardous and/or polluting substances can be spilled will be minimised and contained. The storage method of all these substances is to contain them in sealed containers within impermeable, bunded areas with sufficient capacity to contain spilled materials (in accordance with SANS 10089-1:2003). All spilled materials must drain to sumps with oil traps that must also be equipped to allow collection and removal of spilled substances; and
- all other dirty water will be contained in the dirty water run-off and/or process water system that comprises dirty water pipes, channels and dams, and from which dirty water will be reused rather than discharged to the environment. These systems will be routinely inspected to detect possible breaches and implement preventative or corrective action.

The sewage and process water treatment plants must be designed and implemented in accordance with the parameters included in Sections 2.7.13 and 2.7.14.2. These processes and related discharges must be licensed with DWA.

The mine will implement a monitoring programme of surface water in the vicinity of its operations and when possible (during the rainfall season) this will include continuous surface water sampling points of discharges, and periodic monitoring of environmental resources both up and downstream (where possible) of the mining operations. Further detail is provided in Section 20.1. In addition, details of the volumes and quality of surface water that is used by surrounding users will be documented prior to commencement of the mine.

Should any contamination be detected the mine (through the mine manager's office) will immediately notify DWA. The mine, in consultation with DWA and an appropriately qualified person, will then notify potentially affected users, identify the source of contamination, identify measures for the prevention of this contamination (in the short term and the long term) and then implement these measures. Any related loss caused by the mine (in the short and long term) will be addressed through compensation which may include an alternative water supply of equivalent quality and quantity.

The environmental and engineering managers are responsible for implementing these actions from prior to construction through to closure.

Emergency situations

Any significant pollution incident is considered an emergency situation. In such instances the emergency procedure included in Section 20 will be followed.

7.2.8 ISSUE: ALTERATION OF SURFACE DRAINAGE PATTERNS

Introduction

Natural drainage across the mine site is via sheet flow and/or non-perennial tributaries. There are a number of activities/infrastructures which will alter drainage patterns either by reducing the volume of run-off into the downstream catchments or through their location within watercourse floodlines.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). Given that the stormwater management plan has been modified to take into account the changes to surface infrastructure at the Vanggatfontein Coal Mine, the overall significance of this potential impact is not expected to change.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Transport systems Site management Non-mineralised waste management	Earthworks Civil works Open pit mining Transport systems Non-mineralised waste management Mine residue management and disposal	Demolition Site management Transport systems Non-mineralised waste management Mine residue management and disposal Water supply infrastructure	Maintenance and aftercare of final land forms and rehabilitated areas

Construction	Operational	Decommissioning	Closure
	Water supply infrastructure Power supply infrastructure Rehabilitation	Power supply infrastructure Rehabilitation	

Rating of impact

Severity/nature

There have been no changes to the footprint of mine-related infrastructure on the western portion of the mining right area, and therefore the mining activities will still impede the upper reaches of two unnamed non-perennial tributaries of the tributary of the Wilge River. The changes to surface infrastructure and the footprint of opencast mining areas on the eastern side of the mining right area do not impact any watercourses. Low level bridge crossings are still required on both the eastern and western portions of the mining right area.

The severity of this potential impact is high in the unmitigated scenario because of the potential for change to surface water courses and the potential for a significant volume of surface run-off to be removed from the natural drainage system. In the mitigated scenario, this reduces to medium because of measures to limit the impact on water courses and to divert clean water around mine infrastructure and into the environment.

Duration

In both the unmitigated and mitigated scenarios, the alteration of drainage patterns will extend beyond the life of the mine.

Spatial scale/extent

In the mitigated and unmitigated scenario the physical alteration of drainage patterns will extend beyond the site boundary as flow reduction impacts could extend further downstream.

Consequence

In the unmitigated scenario the consequence is high for all project phases. In the mitigated scenario the consequence is reduced to medium prior to closure and low thereafter because of reductions in duration and severity.

Probability

In the unmitigated scenario the probability of altering drainage patterns is high. With mitigation, such as limiting the mine footprint and associated catchment areas of mine infrastructure, the probability can be reduced to medium until closure when it is expected to reduce to low.

Significance

In the unmitigated scenario, the significance of this potential impact remains high. In the mitigated scenario, the significance remains medium as the severity and probability of occurance is reduced.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	H	M	M	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 61).

Objective:

To minimise the alteration of surface drainage in the project area.

Actions:

Application must be made to DWA for the destruction of the non-perennial upper reaches and the bridge crossings. This application will be in accordance with the requirements of Regulation 704, 4 June 1999, and the requirements of the National Water Act, 36 of 1998. Any related conditions that are stipulated by DWA will be implemented by the mine. In this regard, consideration will be given to the biodiversity and rehabilitation requirements as detailed in Sections 7.2.6 and 7.2.3 of the EIA and EMP report.

The footprint and associated catchment of all mine infrastructure will be minimised in accordance with Regulation 704 to limit the impact on stream flow reduction by diverting clean water around dirty areas.

The post-mining topography will be modelled to ensure that there is a free-draining topography and rehabilitation done accordingly.

This is the responsibility of the SHE manager in the planning, construction, operational and closure phases.

Emergency situations

No emergency situations have been identified.

GROUNDWATER

Information in this section is derived from Keaton's approved EIA and EMP report, and the specialist study attached in Appendix F.

The 2008 groundwater investigation that was conducted by JMA Consulting (Pty) Ltd assessed the potential impacts associated with the original layout of mine (Metago, 2008). The specialist investigation that was undertaken for this project (SLR 2012) assessed the potential impacts associated with the revised layout of the mine. The conclusions of the 2012 investigation corroborate the conclusions of the 2008 investigation, thereby giving confidence to the conclusions of the 2008 groundwater investigation.

7.2.9 ISSUE: REDUCTION IN GROUNDWATER LEVELS/AVAILABILITY

Introduction

Groundwater levels in and adjacent to the mining right area may be reduced by dewatering during mining and abstraction of borehole water for process and potable water. This may cause a loss in water supply to surrounding borehole users as well as a reduction in the base flow of non-perennial water courses.

This potential impact was rated as having a high significance in the unmitigated scenario (for both aspects) and a low (for effects on groundwater users) and medium (effects on base flow of watercourses) significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
			N/A
Water supply	Open pit and underground mining Water supply	Water supply	-

Rating of impact

<u>Severity/nature</u>

Effects on groundwater users

It is predicted that the water level in boreholes that are located within one kilometre of the mine may be lowered. In the unmitigated scenario this is a significant impact that has negative consequences for the groundwater users in the area because ground water is used for both potable and agricultural purposes. In the mitigated scenario the severity of this potential impact can be reduced to low.

Effects on base flow of watercourses

Furthermore, it is predicted that dewatering will reduce the base flow of the non-perennial water courses in the mining right area and the contribution of some of this base flow to the Wilge River. In the unmitigated scenario this may have a high severity. With the implementation of mitigation measures this will have a medium impact on the integrity of these water resources.

Duration

Effects on groundwater users

The duration of this potential impact in the unmitigated scenario is limited to the life of the mine, as when dewatering and abstraction activies cease the groundwater levels will recover. With mitigation, the duration of the potential impact can be reduced.

Effects on base flow of watercourses

The duration of this potential impact in the unmitigated scenario is high as it will take longer for systems to recover. With mitigation, the duration is limited to the life of the mine, as when dewatering and abstraction activies cease the groundwater levels will recover.

Spatial scale/extent

Effects on groundwater users

In both the unmitigated and mitigated scenarios, the spatial scale of this potential impact could extend beyond the mine boundary as water levels in boreholes surrounding the mine could be reduced.

Effects on base flow of watercourses

In both the unmitigated and mitigated scenarios, the spatial scale of this potential impact could extend beyond the mine boundary as a reduction in base flow of non-perennial watercourses within the mining right area could contribute to a decrease in base flow of the Wilge River downstream.

Consequence

Effects on groundwater users

In the unmitigated scenario the consequence is medium. With mitigation it reduces to low.

Effects on base flow of watercourses

In the unmitigated scenario the consequence is high. With mitigation it reduces to medium.

Probability

Effects on groundwater users

The probability of this potential impact occurring is medium in the unmitigated scenario. With mitigation the probability that groundwater users will be affected reduces to low as the mine will provide compensation, which could include an alternative water supply of equivalent water quality and quantity, if any mine related loss of water supply is experienced by the borehole users.

Effects on base flow of watercourses

The probability of this potential impact occurring is high in the unmitigated scenario and reduces to medium in the mitigated scenario.

Significance

Effects on groundwater users

In the unmitigated scenario the significance is medium. This reduces to low with mitigation.

Effects on base flow of watercourses

The significance of this impact is high without mitigation, reducing to medium with mitigation.

Effects on groundwater users

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	M	M	M	M	M

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	L	M	L	L	L

Effects on base flow of watercourses

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 62).

Objective

To prevent any loss of water supply to third parties and to limit water losses to surrounding water courses.

Actions

Prior to the commencement of mine dewatering and potential borehole abstraction, the mine will conduct a detailed hydrocensus of all boreholes that are in use in the potentially affected zones to verify whether there are additional boreholes to those that have already been identified. This hydrocensus will confirm the borehole location, water depth, water quality, yield and water use for each identified borehole. All additional potentially affected boreholes will be included in the water monitoring programme for boreholes located both on and off the mine site as described in Section 21.1.1.

To mitigate impacts on the base flow of the water courses in and adjacent to the mining area, mining must not take place within 100 m of the two significant non-perennial tributaries on the mine site.

Borehole monitoring must also take place down gradient of mining pits and adjacent to the non-perennial watercourses in the mining area (see Section 21.1.1). This will assist in determining the impact of dewatering on the flow of water in the watercourses. If such an impact is observed, measures to compensate for the dewatering impact (such as controlled discharge into the watercourse) can be tailored to the degree of the dewatering impact in consultation with a specialist, key stakeholders and the DWA.

If any mine related loss of water supply is experienced by the borehole users, the mine will provide compensation which could include an alternative water supply of equivalent water quality and quantity.

The SHE manager is responsible for implementing these actions from prior to construction through to closure.

Emergency situations

Not applicable.

7.2.10 ISSUE: GROUNDWATER CONTAMINATION

Introduction

There are a number of sources at the mine that have the potential to pollute groundwater, including the underground Transnet pipeline if damaged. Given that responsible housekeeping at all potential contamination sources at the opencast pits, the plant and related areas can largely control contamination sources, the main pollution concern relates to the dispersion of contamination from the MRDF, overburden / spoil dumps, and the backfilled pits.

This potential impact was rated as having a high significance in the unmitigated scenario and medium-high significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008).

The changes to surface infrastructure at Vanggatfontein Coal Mine are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works	Open pit and underground mining Mineral processing Water use and management Non-mineralised waste management Mine residue management and disposal	Open pit and underground mining Mineral processing Water use and management Non-mineralised waste management Mine residue management and disposal	Pollution control treatment facility Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

<u>Severity/nature</u>

Contaminant transport modelling of groundwater contamination from the mine assumed responsible house keeping for all potential sources of contamination at the plant and related areas and responsible management of diffuse contamination sources. Details of all these measures are provided in Section 2 of this EIA and EMP report. Given this, the main pollution concern relates to the dispersion of contamination from the MRDF, overburden dumps, and the backfilled pits. Geochemical analysis undertaken during the original EIA (Metago, 2008) indicated that this contamination has acid mine drainage potential.

Of geological importance in most of the mining right area, is the occurrence of impermeable zones beneath the target coal seams (2, 4 and 5) and above the dolomitic aquifer (see Section 1.1.1). In their pre-mining state these zones are considered by groundwater and geological specialists to be adequate to withstand controlled blasting and therefore they should prevent vertical movement of contaminants. Two related issues are:

- the impact of mining on these impermeable zones; and
- the impact of mining where these impermeable zones are not considered to be adequate.

In the unmitigated scenario, blasting may cause fracturing of these impermeable zones which may provide vertical seepage paths for contaminant transportation. In this unmitigated scenario, the impact on the underlying dolomitic aquifer zone could be significant from both a groundwater pollution and potential sinkhole formation (assessed in Section 7.2.3) perspective. Similarly, mining in areas where inadequate impermeable zones are in place would have similar potential consequences. Management measures to both prevent pollution and to conserve the integrity of the impermeable zones are provided at the end of this section.

Further to the above discussion, modelling predicts that there will be limited contaminant dispersion related impacts on surrounding ground and surface water resources during the construction and operation phases of the mine. In this regard, key related factors include:

- no mining will take place in areas where there are insufficient impermeable zones below the target coal seams;
- the impermeable zones below the target coal seams will be conserved and therefore flow of potential contaminants will be horizontal above these zones;
- the time it takes for contaminants to migrate spatially, and
- the impact of the open pit dewatering cone which will draw contaminants towards the mine. This water will be pumped out and used in the process water circuit and/or treated before controlled discharge into the surface water system or supply to surrounding domestic users.

Given this, the impact assessment that follows is focussed more on the longer term, post closure impacts with the emphasis on predicting horizontal migration of contaminated water.

In the longer term post closure scenario, modelling predicts that in the unmitigated scenario, contaminated groundwater from the MRDF will reach the non-perennial tributary of the Wilge River located to the south of the MRDF. It follows that contamination will migrate down this tributary to the Wilge River. In addition, in the unmitigated scenario, modelling predicts that contaminated water will decant from the various opencast pit areas and flow into the environment and related surface and ground water resources. Viable mitigation measures are available to capture and treat contaminated water.

In the unmitigated, the severity of this impact is high. With mitigation it can be reduced to medium.

<u>Duration</u>

In the unmitigated scenarios, the duration of this potential impact is expected to be long term. With the implementation of mitigation measures the duration reduces to medium because in order for closure planning to be approved the measures to intercept, treat and sell/discharge treated water would have to be in place.

<u>Spatial scale/extent</u>

In both the unmitigated and mitigated scenarios, the spatial scale of this potential impact could extend beyond the mine boundary. This is a medium spatial scale.

<u>Consequence</u>

In the unmitigated scenario the consequence is high. With mitigation this reduces to medium.

Probability

In the unmitigated scenario, the probability of this impact occurring is high. With the successful implementation of mitigation measures it can be reduced to medium.

Significance

The significance of this potential impact remains high in the unmitigated scenario, and medium in the mitigated scenario.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	H	M	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 63).

Objective

To prevent contamination of water resources.

Actions

In addition to the management actions that are included in Section 7.2.4 of this report, the following actions, as detailed in Section 2 of this report, will be implemented through all project phases. These are summarised as follows:

- management and disposal of waste strictly in accordance with the provisions of Section 2.7.12; and
- management and disposal of water strictly in accordance with the provisions of Sections 2.7.14.2 and 2.7.14.2.

No mining will take place in areas where there are inadequate impermeable zones below the target coal seams and the blast design will be matched to the specifications that are required to protect the adequate impermeable zones that are in place. The specific required actions are as follows:

- design of blasting, by an appropriately qualified blast engineer, for each type of zone that has been described in CCIC geological assessment (Appendix M);
- record keeping that confirms whether the blasting design for each type of mining zone is being adhered to; and

- investigation will be done at an early stage of mining to determine whether permeability tests (e.g. packer tests) can be used to compare the permeability of the impermeable zones in the pre and post blasting scenarios. If it is technically possible to obtain meaningful results from permeability tests, these should be conducted to verify whether the design and implementation of the blasts are adequate to prevent fracturing of the impermeable zones and the related potential contamination of the dolomitic aquifer. In the scenario where blasting is found to be causing unacceptable fracturing of the impermeable zones, a collective decision on the way forward must be made by the mine, DWA, the blast designer and the relevant geotechnical and geohydrological specialists.

All buffer specifications associated with the Transnet servitude will be adhered to to avoid causing pipeline damage and associated groundwater pollution (see Section 7.2.16). Should the Transnet pipeline be damaged as a result of mining activities, the emergency procedure included in Section 20 will be followed.

Prior to the commencement of the mine, the mine will conduct a detailed hydrocencus of all boreholes that are in use in the potentially affected zones to verify whether there are additional boreholes to those that have already been identified. This hydrocencus will confirm the borehole location, water depth, water quality, yield and water use for each identified borehole. All potentially affected boreholes will be included in the water monitoring programme for boreholes located both on and off the mine site as described below. Boreholes, adjacent to the pits and the MRDF and between these facilities and the potentially affected third party boreholes and water courses in the potential impact zone, will be part of the monitoring programme (Section 21.1.1).

The long term post closure actions for pollution prevention are described below. If any potential for long-term water contamination is identified, the actions set out below will be implemented prior to closure:

- placement of a curtain of boreholes adjacent to the MRDF to pump contaminated water and prevent it from reaching third party boreholes or surface water resources;
- capture of any contaminated decant from backfilled mining pits to prevent run-off and seepage; and
- treatment of all captured contaminated water in the on-site water treatment plant as per Section 2.7.14.2. In the post closure scenario, this treatment plant will have to be routinely maintained and upgraded to allow for treatment in perpetuity.

Should any contamination be detected the mine (through the mine manager's office) will immediately notify DWA. The mine, in consultation with DWA and an appropriately qualified person, will then notify potentially affected users, identify the source of contamination, identify measures for the prevention of this contamination (in the short term and the long term) and then implement these measures. If any mine related contamination and loss of water supply is experienced by water users, the mine will provide compensation which could include an alternative water supply of equivalent water quality and quantity.

Prior to closure, provision will be made by the mine for post closure compensation that may be required for any future negative impacts. This will form part of detailed closure planning (Section 25).

The groundwater model will be recalibrated when the MRDF source concentrations and seepage infiltration rates have been determined more accurately.

The SHE manager is responsible for implementing these actions from prior to construction through to closure.

Emergency situations

Any significant pollution incident is considered an emergency situation. In such instances the emergency procedure included in Section 20 will be followed.

AIR QUALITY

Information in this section is derived from Keaton's approved EIA and EMP report (Metago, 2008) and the specialist study included in Appendix G.

There are a number of activities/infrastructure associated with mining operations that have the potential to pollute the air. In the construction and decommissioning phases these activities are temporary in nature. The operational phase will present more long term activities and the closure phase will present final land forms that may have the potential to pollute the air through long term wind erosion.

The Vanggatfontein Mine is located in a region which is already exposed to a wide range of air pollution sources. This assessment however, focusses on the incremental impacts associated with the Vanggatfontein Coal Mine.

This potential impact was rated as having high significance in the unmitigated scenario and medium-low significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). Although the dust generating sources at Vanggatfontein Coal Mine have not changed significantly, there are landowners and land users still living within the mining right area. The 2008 assessment assumed that these people would have moved off-site. The location of these receptors residing on-site is illustrated in Figure 2.

7.2.11 ISSUE: DUST GENERATION

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works	Open pit mining Transport systems	Transport systems Site management	Maintenance and aftercare of final land forms and rehabilitated areas

Construction	Operational	Decommissioning	Closure
Transport systems Site management	Mineral processing Site management Mine residue management and disposal	Non mineralised waste management Mine residue management and disposal	

Rating of impact

Severity/nature

The impact associated with the dust emissions sources has two elements. Each of these is described below:

- PM_{10} element - the fraction of the particulates that is smaller than ten micron in size (PM_{10}) is inhalable and can cause health impacts in people with excessive exposure to high levels over long time periods; and
- TSP element - the heavier total suspended particulates (TSP) can cause nuisance impacts when deposited in high concentrations causing visibility reduction and soiling. This nuisance includes the impact of vegetation soiling which can negatively impact on the associated ecological and farming functions.

In order to determine the potential for health impacts, the evaluation criteria outlined in Table 47 have been used.

TABLE 47: AIR POLLUTION CRITERIA EVALUATION

Contaminant	Averaging Period	Evaluation criteria	Source
PM_{10}	Daily	Current - 120 microgram/m^3 2015 - 75 microgram/m^3	NEM:AQA – National Ambient Air Quality Standards, GN 1210, December 2009
	Annual	Current - 50 microgram/m^3 2015 - 40 microgram/m^3	
TSP	Industrial	Current draft - 1 200 microgram/ (m^2.day)	
	Residential	Current draft - 600 microgram/ (m^2.day)	

In the unmitigated scenario, emissions from upaved roads represent the largest source of emissions of total PM_{10} and TSP. Wind erosion of open areas is predicted to be the second biggest emitter, followed by excavation within pits.

PM_{10} element

The current daily and annual South African standards will be exceeded for a large area off-site, particularly north and south of the mine. These standards will also be exceeded at most of the residential receptor sites located within the mine boundary.

It follows that the more stringent 2015 evaluation criteria will be exceeded for a wider area. The 2015 criteria would also be exceeded at most of the residential receptors within the mine boundary.

TSP element

The current draft South African standards for industrial limits will be exceeded on and off-site, particularly at the northern boundary of the mine as a result of the location of the access road.

In the mitigated scenario, the contributors are similar although the amount of emitted dust can be reduced depending on the level of mitigation applied to each source. It follows that the predicted dispersion of dust and the extent of the negative impact is reduced.

It should however be noted that with a control efficience of 75 % applied to the unpaved roads, the relevant standards will still be exceeded and therefore additional management measures are required.

PM_{10} element

The current annual South African standards will be exceeded at a modelled distance of 420 m from the northern boundary of the mine. The current daily South African standards will be exceeded at a modelled distance of approximately 1 km from the northern boundary of the mine. These standards will be exceeded at most of the residential receptors located within the mine boundary.

Similarly, it is predicted that the 2015 standards will be exceeded to the north of the mine for a slightly larger area. The 2015 standards will also be exceeded at most of the residential receptors within the mine boundary.

TSP element

The current draft South African standards for residential limits will be exceeded in a zone of approximately 200 m off-site along the northern boundary. There are no residences currently situated in this zone. TSP for most of the on-site receptors will be within the residential limits.

In the unmitigated scenario, the severity of this potential impact is rated high. With mitigation, the severity reduces to medium for most receptors, except most of the receptors residing within the mine boundary where it remains high. In this regard, the concern is around PM_{10} pollution and not TSP.

<u>Duration</u>

Without mitigation the duration of the health impacts could extend beyond closure. With mitigation, the duration of impacts will be limited to the life of the mine.

<u>Spatial scale/extent</u>

The spatial scale of the potential impact extends off site in both the mitigated and unmitigated scenarios.

Consequence

In the unmitigated scenario, the consequence is high. With mitigation, the consequence is medium for all off-site receptors, but remains high for most of the on-site receptors.

Probability

The health impact probability is linked to the probability of ambient concentrations exceeding the evaluation criteria. Given that there is potential for exceedances of the criteria the probability is high in the unmitigated scenario. With mitigation the probability reduces to medium except for the residential receptors within the mine boundary mentioned above.

Significance

The significance remains high in the unmitigated scenario. With mitigation, the significance for most receptors reduces to medium as the duration is reduced, however for Recptors 1, 2 and 3 who reside within the mine boundary the significance is medium-high unless they are relocated in which case the significance will be medium.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M (H for Receptors 1, 2 and 3)	M (H for Receptors 1, 2 and 3)	M	M (H for Receptors 1, 2 and 3)	M (H for Receptors 1, 2 and 3)	M (H for Receptors 1, 2 and 3)

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 64).

Objective

To minimise the generation of dust and related impacts.

Actions

The following specific measures will be implemented by the mine:

- unpaved roads – target dust control efficiency of a minimum of 75 % - achieved by a combination of waste rock covering, chemical binding agent and water suppression at a rate of 0.058 litres/m^2/hour;

- wind erosion – target dust control efficiency of 60 % – achieved by ensuring that the concurrent rehabilitation and vegetation cover is established on the MRDF, facilitating vegetation of the topsoil and subsoil stockpiles, and spraying other uncovered stockpiles; and
- materials handling and crushing – target dust control efficiency of 62 % – achieved by water sprays and partially enclosing the conveyor.

In order to prevent unacceptable exceedences of the proposed future PM_{10} standards the mine must consider either:

- keeping heavy run of mine and product truck traffic on roads that are not aligned on the mine boundaries. The use of the road that runs along the northern project boundary for this type of traffic should be avoided. Similar principles apply to the road that runs to the south western pit; or
- purchasing or leasing land around significant sources to create an off-site buffer zone within which the land use of third parties is not compromised.

In order to prevent unacceptable health risks to the receptors located within the mining right boundary, people residing at Receptor points 1, 2 and 3 will be relocated outside of the significant impact zone.

In addition to the abovementioned specific actions, the mine will develop and implement other key elements of an air quality control system. This system will include inter alia:

- monitoring in accordance with Section 21.1.2; and
- if monitoring determines that unacceptable dust emissions is occurring, immediate steps will be taken to address the issue in consultation with a suitable air quality specialist.

These actions are the responsibility of the SHE manager and must be implemented from prior to construction through to closure.

Emergency situations

Not applicable.

AMBIENT NOISE

Information in this section is derived from Keaton's approved EIA and EMP report (Metago, 2008) and Keaton's noise monitoring data.

7.2.12 ISSUE: DISTURBING NOISE

Introduction

Noise pollution can create nuisance that will have different impacts on different receptors because some are very sensitive to noise and others are not. The most noise sensitive receptors are considered to be the residents within and surrounding the mining right area and the noise sensitive piggery to the east of the mine located on the Straffontein 252 IR. Unacceptable noise levels may impact on the quality of life of these people and the productivity of the piggery.

Sources of noise pollution associated with the mine include: excavation activities, vehicle movement, drilling, blasting, crushing and materials handling. Refer to Figure 18 for the location of these noise sources.

This potential impact was rated as having medium-high significance in the unmitigated scenario and medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). Although the noise generating sources at Vanggatfontein Coal Mine have not changed, there are landowners and land users still living within the mining right area. The 2008 assessment assumed that these people would have moved off-site. The location of the receptors residing on-site is illustrated in Figure 2. Keaton's noise monitoring data will be used as part of this assessment.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works Transport systems	Open pit mining Mineral processing Transport systems Mine residue management and disposal Rehabilitation	Demolition Mine residue management and disposal Transport systems	-

Rating of impact

<u>Severity/nature</u>

The SANS guidelines (SANS10103, 2008) stipulate that noise levels from a development that cause ambient background noise levels to increase in excess of 3 to 5dBA will create a noise disturbance. In addition, SANS specifies that the guideline limits for urban areas are 55dBA (day) and 45dBA (night). These are the evaluation criteria for this assessment.

The changes to surface infrastructure at Vanggatfontein Coal Mine do not pose potential for significant additional noise disturbances. However, the landowners and land users that remain within the mining right area and the immediately surrounding are exposed to disturbing noise from the mine. Monitoring data indicates that noise levels are generally acceptable at most of the receptor sites, except the Venter residence (Receptor 3) and the associated farm worker residence near the workshop (Receptor 4) where noise levels have increased by an average of 10 dB, but often up to 15 dB, during the night. No monitoring has been done at Receptor 2 but given their proximity to the operations it is expected that the results would be similar and that noise levels would have increased to disturbing levels. This amounts to a high severity in both the mitigated and unmitigated scenario for this specific group of receptors. For other receptors, the severity is medium in the mitigated scenario.

Duration

In both the unmitigated and mitigated scenarios the noise related impacts will occur until the closure phase of the mine when the noise generating activities are stopped. In the normal course, one would expect noise related impacts to stop when the noise generating activities stop, however in the case of Receptors 2, 3 and 4, it is possible that indirect stress-related impacts may occur for a while post closure.

Spatial scale/extent

In both the unmitigated and mitigated scenarios the noise impacts will extend to third party receptors. This is a medium spatial scale.

Consequence

The unmitigated consequence is medium for most receptors, except Receptors 2, 3 and 4 for which it is high. This can be reduced to medium-low with mitigation for all receptors except Receptors 2, 3 and 4 for which it remains high.

Probability

In the unmitigated scenario, the probability of this potential impact is high. With mitigation, the probably is reduced to medium for all receptors, except Receptors 2, 3 and 4 for which it remains high.

Significance

The unmitigated significance is considered to be medium for most receptors, except Receptors 2, 3 and 4 for which it is high. With mitigation, the significance is expected to reduce to medium-low for most receptors, except Receptors 2, 3 and 4 for which it is high unless they are relocated in which case the significance will be medium.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	M (H for Receptors 2, 3 and 4)	M	M (H for Receptors 2, 3 and 4)	H	M-H (H for Receptors 2, 3 and 4)

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M-L (H for Receptors 2, 3 and 4)	M (H for Receptors 2, 3 and 4)	M	M-L (H for Receptors 2, 3 and 4)	M (H for Receptors 2, 3 and 4)	M (H for Receptors 2, 3 and 4)

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 65).

Objective:

To prevent public exposure to disturbing noise.

Actions:

Before blasting cognisance will be taken of unfavourable wind directions, cloud cover and temperature inversions.

Specific noise monitoring will be conducted in accordance with Section 20.1 by an environmental noise professional at receptor sites to the north, south, east and west of the mine. If unacceptable noise levels are recorded the options for mitigation will be assessed and implemented in consultation with the affected parties and an independent specialist. The options could include:

- limiting the operating times for noise generating activities;
- adjusting the blast design to reduce airblast and noise emissions;
- constructing noise berms out of waste rock, sub soil, topsoil and vegetation; and/or
- point source noise emitters will also be investigated.

The mine will record and respond without delay to complaints about disturbing noise. All such complaints will be documented and recorded as incidents. The measures taken to address these complaints will be included in the documentation. These records will be kept for the life of mine.

In order to prevent unacceptable noise impact to the receptors located within the mining right boundary, people residing at Receptor points 2, 3 and 4 will be relocated outside of the significant impact zone.

The SHE manager will be responsible for implementing these actions from construction through to closure.

Emergency situations

Not applicable.

VISUAL ASPECTS

7.2.13 ISSUE: NEGATIVE VISUAL IMPACTS

Introduction

Negative visual impacts may be caused by activities and infrastructure in all mine phases. The more significant visual impacts relate to the larger infrastructure components (such as the opencast mining) and the long term infrastructure (such as the MRDF) that will remain post closure.

This potential impact was rated as having high significance in the unmitigated scenario and low significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). Although the changes to surface infrastructure largely take place within the footprint of that which was approved in 2008, there are landowners and land users still living within the mining right area. The 2008 assessment assumed that these people would have moved off-site.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Transport system	Civil works Open pit mining Transport system Non-mineralised waste management Mine residue management and disposal	Demolition Transport system Non-mineralised waste management Mine residue management and disposal	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity/nature

The assessment of visual impacts should take the following issues into account: the pre-mining visual resource and the visibility, visual intrusion, sensitivity of viewing receptors, and visual exposure, associated with the mine. These are discussed below.

The visual resource of the mine area is determined by considering landscape character, sense of place, and landscape quality. As discussed in Section 1.1.11, the pre-mining visual resource was considered to be of moderate value because the predominantly rural agricultural setting of the broader area is compromised by power lines, a railway line, roads, telephone lines, a cell phone mast, a distant power station and mining activities further afield. The visual resource has been altered by Keaton's approved mining operations.

Visibility refers to the extent to which people in the surrounding areas will see the project. The mine can be seen from all directions.

Visual intrusion refers to the magnitude of the intrusion that the mine has on existing views. The visual intrusion of the mine is high during the operational phase, which can be reduced to a low intrusion with successful implementation of the requirements for rehabilitation and closure.

Sensitivity of visual receptors refers to the fact that the visual impact varies according to the sensitivity of the receptors in the project area. Although various landowners and users remain within the mining right area no issues regarding visual impacts have been raised during routine stakeholder meetings or the current environmental process. It must therefore be concluded that the visual impact is not a sensitive issue.

Visual exposure is the extent to which infrastructure and activities will appear in various views. It follows that the closer the infrastructure and activities, the greater the visual exposure.

The severity of this potential impact is medium in both the unmitigated and mitigated scenarios and reduces to low during the closure phase in the mitigated scenario.

Duration

In the unmitigated scenario the duration is high because the impacts will continue post closure. In the mitigated scenario the impacts would largely be limited to the life of the mine as disturbed areas will be rehabilitated on an on-going basis and surface infrastructure would be removed during the decommissioning phase.

Spatial scale/extent

The visual impacts are likely to extend beyond the mine area in both the unmitigated and mitigated scenarios. This is a medium spatial scale.

Consequence

The consequence in the unmitigated scenario is high. With mitigation it reduces to medium.

Probability

The unmitigated probability of this potential impact occurring is high. With mitigation, prior to closure, this reduces to medium and then to low post closure.

Significance

In the unmitigated scenario, the significance remains high. With mitigation, the significance is medium except after closure where the significance reduces to low.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	M	M
Closure						
Mitigated	L	L	M	L	L	L

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 66).

Objective:

To minimise visual impacts on sensitive receptors.

Actions:

The mine will:

- ensure that the absolute minimum amount of vegetation and land is disturbed during site development and operation. This is extremely important on the boundaries of the mining right area where vegetation can assist with screening;
- implement the recommended air pollution control system to avoid plumes of dust that can reduce visibility (Section 7.2.11);
- paint structures and buildings in colours (eg. browns and greens) that reflect and compliment the natural landscape;
- rehabilitation of all mined out areas in accordance with the principles of ongoing rehabilitation that includes: backfilling and compacting overburden, placement of sub soils and topsoils and re-establishment of vegetation;
- effective rehabilitation of the MRDF is extremely significant because this will be a permanent post closure feature. In this regard, the dam will be raised with gentle side slopes to allow a cover to be placed concurrently. This cover will be investigated and could comprise a buffer layer, pollution control membranes, subsoil, topsoil and vegetation;
- a similar approach to that described for the MRDF, will be applied to any overburden/spoil dumps that remain at mine closure. In this case, the side slopes will be flattened to 1v:6h prior to topsoiling and vegetation establishment.
- all vegetation that is planted as part of rehabilitation should reflect the natural vegetation of the area;

- night lighting will be fitted with fixtures to prevent light spillage and focus the light on precise mine activities and infrastructure, fitted as low to the ground as is practicable, and most security lights will be activated with movement sensors.

The SHE manager will be responsible for implementing these actions from construction through to closure.

Emergency situations

Not applicable.

HERITAGE, PALEONTOLOGICAL AND CULTURAL RESOURCES

7.2.14 ISSUE: DISTURBANCE OF HERITAGE (INCLUDING CULTURAL) RESOURCES

Information in this section is derived the from Keaton's approved EIA and EMP report (Metago, 2008).

Introduction

There are a number of activities/infrastructure in all phases prior to closure that have the potential to damage heritage (including cultural) resources and result in the loss of the resource for future generations. Heritage resources include sites of archaeological, cultural or historical importance.

This potential impact was rated as having a high significance in the unmitigated scenario and a low significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure will not affect any additional known heritage sites and therefore is not expected to alter the significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
			N/A
Earthworks Civil works Transport systems Site management Site support services	Earthworks Transport systems Site management Site support services Open pit mining Water and power supply infrastructure	Demolition Site management Transport systems	-

Rating of impact

<u>Severity/nature</u>

There are numerous graves located within the mining right area (see Section 1.3.3). No other heritage resources of consequence were observed on the mining right area. As per the current and undeveloped infrastructure layout, there are graves that will potentially be disturbed by the Phase 3 of the MRDF. In the unmitigated scenario, these graves will be permanently destroyed which results in a high severity. In the mitigated scenario, these graves will be exhumed and relocated in accordance with the relevant legislation which results in a low severity. The revised surface infrastructure layout plan will not disturb any other grave sites because, where relevant, these have been fenced off and are being preserved.

Duration

In the unmitigated scenario, the loss of heritage resources will be permanent. With mitigation, the heritage resources can be moved and therefore the duration would be short term.

Spatial scale/extent

The spatial scale is limited to the mining right area in both the unmitigated and mitigated scenarios.

Consequence

The consequence is high in the unmitigated scenario. With mitigation, this reduces to low.

Probability

In the unmitigated scenario, the probability of this potential impact occurring is high. With mitigation, the probability reduces to low as the heritage resouces would be relocated.

Significance

In the mitigated scenario the significance of this potential impact remains high. With mitigation, the significance remains low as the severity, duration and probability is reduced.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	L	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	L	L	L	L	L

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 67).

Objective:

To minimise the disturbance of heritage resources.

Actions:

The mine will ensure that all workers (temporary and permanent) are educated about heritage and cultural resources that may be encountered and about the need to conserve these.

Prior to damaging or destroying any of the identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local Police. The exhumation process must comply with the requirements of the relevant Ordinance on Exhumations, and the Human Tissues Act, 65 of 1983.

Where graves are located in the project area, but will not be disturbed these should be fenced off and left undisturbed. Descendents (if known) will be given access as required. This should be arranged with the mine manager.

The SHE manager will be responsible for implementing these actions from construction through to closure.

Emergency situations

The uncovering of graves and sites during the mining operations is considered an emergency situation. Procedures outlined in Section 20 will be followed.

7.2.15 ISSUE: DISTURBANCE OF PALEONTOLOGICAL RESOURCES

Information in this section is derived the from the specialist study attached in Appendix H.

Introduction

Paleontological resources have the potential to be disturbed by mining related activities. Given the geology of the area where the Vanggatfontein Coal Mine is located, it is possible that paleontological resources will occur. Paleontological resources largely include fossilised remains.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
		N/A	N/A
Earthworks	Opencast and underground mining	-	-

Rating of impact

Severity/nature

A range of paleontological resources have the potential to occur within the Vanggatfontein mining right area. With reference to Section 1.1.1, the rocks of the Vryheid Formation of the Ecca Group are known to host plant fossils of the Gondwanan *Glossopterus* flora which has been described from Permian-aged rocks. This flora is the source of the coal which is mined from the Vryheid Formation in South Africa and on which the Vanggatfontein Coal Mine is cited. As the rocks of the Dwyka Group comprise coarse-grained diamictite and were deposited in a glacial environment in the Carboniferous Period it is unlikely that these rocks will contain fossils. Although the rocks of the Transvaal Supergroup contain stromatolites (bacterial related fossil records), a reasonably plentiful paleontogical resource, they are generally not known to contain fossils.

The severity of this potential impact is medium in the unmitigated scenario, and can be reduced to low with the implementation of mitigation measures such as a chance/find procedure.

<u>Duration</u>

In the unmitigated scenario the loss of paleontological resources is considered long term as the resource will be permanently destroyed. With mitigation, paleontological resources can be removed for further research.

<u>Spatial scale/extent</u>

In both the unmitigated and mitigated scenario, the disturbance of paleontological resources will be limited to the mining right area.

<u>Consequence</u>

In the unmitigated scenario, the consequence is medium. With mitigation it reduces to low.

<u>Probability</u>

The probability of this potential impact occurring is medium in the unmitigated scenario and low in the mitigated scenario.

<u>Significance</u>

In the unmitigated scenario, the significance of this potential impact is medium. With mitigation, the significance reduces to low as mitigation measures will be in place to reduce the severity and duration.

<u>Unmitigated – summary of the rated impact per phase of the project</u>

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction and operation						
Unmitigated	M	H	L	M	M	M

<u>Mitigated – summary of the rated impact per phase of the project</u>

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction and operation						
Mitigated	L	L	L	L	L	L

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 67).

Objective:

To minimise the disturbance of paleontological resources.

Actions:

The mine will ensure that all workers (temporary and permanent) are educated about the paleontological resources that may be encountered and about the need to conserve these.

In the event that paleontological resources are discovered, the mine will follow a chance find emergency procedure, which includes the following:

- mine related work at the find will be stopped to prevent damage; and
- an appropriate specialist will be appointed to assess the find and related impacts.

Emergency situations

The uncovering of paleontological resources during the mining operations is considered an emergency situation. Procedures outlined in Section 20 will be followed.

LAND USES

7.2.16 ISSUE: BLASTING HAZARDS

Information in this section was taken from Keaton's approved EIA and EMP report (Metago, 2008).

The impacts associated with the loss of soil resources, surface and ground water contamination related to the potential damage to the Transnet pipeline from blasting have been discussed under Sections 7.2.4, 7.2.7 and 7.2.10 respectively and are not included in the assessment below.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). While no changes to the blast design are expected, third party infrastructure (such as residences and the underground Transnet pipeline) is still present on-site and within the 500 m blast zone.

Introduction

With reference to Table 48 below, opencast mining could impact on people, animals and structures. Issues related to blasting dust and blasting noise have been assessed as part of Sections 7.2.11 and 7.2.12 respectively.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
		N/A	N/A
Earthworks (if required)	Openpit and underground mining	-	-

Rating of impact

Severity/nature

Injury to third parties and livestock may be caused by fly rock. Damage to third party infrastructure may be caused by: fly rock, ground vibration, and/or air blast. To give spatial context to this discussion, Table 48 below provides an indication of the proximity of non-mine (third party) infrastructure to the opencast pits.

TABLE 48: PROXIMITY OF STRUCTURES, ANIMALS AND PEOPLE TO OPENCAST PITS

	within 500m	**within 1000m**	**Within 1500m**
Western project area	Farmer and farm worker residences Wild animals Various dirt roads (including pedestrians and vehicles). Transnet pipeline Boreholes Graves A dam/pan The D2543 (the Dryden/Leandra Road) Fences	Farmer and farm worker residences Wild animals Various dirt roads (including pedestrians and vehicles). Transnet pipeline Boreholes Graves A dam/pan Rural power and telephone lines The D2543 (the Dryden/Leandra Road) Fences	Farmer and farm worker residences Wild animals Various dirt roads (including pedestrians and vehicles). Transnet pipeline Boreholes Graves A dam/pan Rural power and telephone lines The D2543 (the Dryden/Leandra Road) Fences Buildings and other structures on the adjacent properties to the north, west and south of the project area.
Eastern project area	Farmer and farm worker residences Transnet pipeline Livestock and wild animals Various dirt roads (including pedestrians and vehicles). Boreholes Graves The D2543 (the Dryden/Leandra Road)	Farmer and farm worker residences Transnet pipeline Livestock and wild animals Various dirt roads (including pedestrians and vehicles). Boreholes Graves Rural power and telephone lines The D2543 (the Dryden/Leandra Road)	Farmer and farm worker residences Transnet pipeline Livestock and wild animals Various dirt roads (including pedestrians and vehicles). Boreholes Graves Rural power and telephone lines The D2543 (the Dryden/Leandra Road) Buildings and other structures on the adjacent properties to the north and south of the project area.

Fly rock generation is related to the energy or mass of explosives and the containment of the energy on all sides of the blast area. In general, larger blastholes tend both to throw larger rocks and to threaten over greater distances. Containment of fly rock is important because it has the potential to cause injury and death to people and animals. It also has the potential to damage structures. In unmitigated scenarios fly rock can extend up to 1000 m from the blast site. This could harm animals and/or structures listed in the 1000 m zone of Table 48 above. In the mitigated scenario, this can be kept within a range of less than 500 m.

Ground vibrations from blasting travel directly through the ground. The related impact on structures (such as buildings, boreholes and underground pipelines) depends on velocity and frequency of vibrations and the integrity of the built structures. The United States Bureau of Mines (USBM) standard of 12 mm/s peak particle velocity is applied as a general guideline for blast management in South Africa as a "safe" limit for brick and mortar structures in the usual range of blasting vibration frequencies (4 – 12 Hz). In the unmitigated scenario structures could be at risk outside of the zone where peak particle velocities greater than 12 mm/s are generated by blasting. In the mitigated scenario, assuming that the blast design will consistently result in a peak particle velocity of 12 mm/s at all third party structures, these should not be damaged. However, the blanket application of this guideline is the subject of debate because permanent displacements along existing cracks in sub standard buildings (often associated with rural houses) can be induced by lower vibrations, and structures such as the Transnet pipeline will have their own specification which differ from brick and motar structures completely. As a result the blast design must be specific to manage impacts on surrounding structures. A related issue is the possibility of affecting surrounding geology and associated water supply zones. In accordance with the above discussion, it is expected that there is limited chance of blasting causing displacement of geological off-site features and affecting water supply.

Airblast is an air pressure pulse that has both a high frequency audible sound and a low frequency inaudible concussion. If the pressure is great enough damage can be caused to structures. It is expected that if airblast is contained to 130 dB or less, then damage should not be caused to surrounding structures.

Some or all of the above issues could have greater significance if blasting takes place at the same time as climatic conditions such as low cloud cover, temperature inversions and unfavourable wind direction occur at the time of blasting.

In the unmitigated scenario, this impact it is considered to have high severity. With mitigation, the blast design and impact controls will reduce the potential for exceeding the recommended limits which reduces the severity to medium.

Duration

Generally speaking damage to infrastructure can be repaired in the short term, however injury or death is considered to have a long-term duration.

Spatial scale/extent

Blast impacts may extend beyond the mining boundary particularly in the unmitigated scenario. This is a medium spatial scale.

Consequence

The consequence in both the unmitigated and mitigated scenarios is high.

Probability

The probability of injury to third party or damage to third party infrastructure is considered to be high in the unmitigated scenario. This can be reduced to low with the implementation of management and mitigation measures.

Significance

The significance has been rated as high in the unmitigated scenario. This can be mitigated to medium.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	H	M	H	L	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 68).

Objective:

To control blasting and explosive storage so as to avoid damaging structures and to prevent injury to animals and people.

Actions:

The following specific actions are required in addition to compliance with the relevant blasting and explosives legislation including the Explosives Act and the Mine Health and Safety Act.

The blast design will, as a minimum standard, ensure that the peak particle velocity from all blasts is less than 12 mm/s at all vulnerable third party structures, that flyrock is contained within 500 m of each blast and that the airblast is less than 130 dB for all blasts. This will be tracked through the monitoring of blasts. Further detail is provided in Section 21.1.5. In cases where the pre-blast survey identifies sub standard structures, or where blasting approaches within 500 m of any third party structures (residences, tarred road, pipeline etc.) the blast design will be amended to manage potential impacts accordingly. In this regard, when blasting is within 500 m of residences, the relevant people will need to be evacuated for each blast or relocated.

Regarding the underground Transnet pipeline, blasting within 500 m may only take place in accordance with Transnet's specifications. No blasting may take place within 100 m of the pipeline. A copy of Transnet's servitude specifications is included in Appendix N.

All vulnerable structures (see Table 48 as a minimum) within 1500 m of the blast will be marked on a site plan and surveyed photographically in the presence of the owner before blasting takes place. A crack survey has been conducted and will be updated when necessary. If surrounding property owners have vulnerable structures outside of this zone, they can request the mine to have them included in the pre blast survey. All parties that exist and/or that have property and/or that provide services within 1500 m of the blast sites will be informed, prior to mining, about the blast programme and associated safety precautions.

Power lines, telephone lines and pipelines (excluding the underground Transnet pipeline) that could be impeded or damaged by the mining and/or blasting activities must be diverted out of harm's way prior to mining with the consent of the relevant stakeholders/service providers. The distance between the mining operations and the diverted infrastructure will be determined on a case by case scenario with the relevant service provider. In addition, the diversion of the infrastructure must be done in a manner that other users relying on this infrastructure are inconvenienced as little as possible.

In deciding whether or not to set off blasts, a procedure must be developed to take temperature inversions, low cloud cover and wind direction into account.

For each blast the mine will observe the following procedural safety steps:

- the fly rock danger zone associated with each blast is delineated and people and animals are cleared from this zone before every blast;
- if the D2543 is within this zone it will temporarily closed 5 minutes before the blast until the blast has been set off and the area declared safe; and
- an audible warning is given at least three minutes before the blast is fired.

The mine will respond immediately to any blast related complaints. These complaints and the follow up actions will be dated, documented and kept as records for the life of mine. Where the mine has caused blast related damage it will provide appropriate compensation.

The mine, safety and SHE managers are responsible for implementing these actions before and during the construction phase and during the operational phase.

Emergency situations

Any significant damage or death from flyrock is considered an emergency situation. In such instances the emergency procedure included in Section 20 will be followed.

7.2.17 ISSUE: ROADS AND TRAFFIC IMPACTS

Information in this section is taken from Keaton's approved EIA and EMP report (Metago, 2008) and the specialist study included in Appendix I.

Introduction

An increase in traffic on existing public road networks can result in an inconvenience to current road users, greater accidents (for people and animals) and increased road damage. Related issues are: reduction of service levels because of insufficient road capacities, deterioration and maintenance of roads, spillages off coal and run of mine material on roads, and an increased number of pedestrians.

This potential impact was rated as having a high significance in the unmitigated scenario and a medium significance in the mitigated scenario in Keaton's approved EIA and EMP report (Metago, 2008). The change in surface infrastructure layout and the increase in plant production at the Vanggatfontein Coal Mine, are not expected to alter the overall significance of this potential impact.

Project phase and link to activities

Construction	Operational	Decommissioning	Closure
			N/A
Transport systems (including the movement of staff and raw materials)	Transport systems (including the movement of staff, consumables and product)	Transport systems (including the movement of staff and dismantled infrastructure)	-

Rating of impact

<u>Severity/nature</u>

In the unmitigated scenario, potential impacts may occur as a result of the following:

- **construction of mine access points:** between two and four access points are required for the mining right area (Figure 18), all of which are located along the D2543. To date, one access point has been established at the mine; and
- **transportation of workers, supplies, run-of-mine and coal product:** the traffic specialist is of the view that both the current and future traffic volumes associated with the mine will not create capacity problems and will therefore not significantly change the level of service on the network of public roads in the vicinity of the mine. However, there could be negative road condition and safety impacts that, without the implementation of specific management measures, could result in a greater chance of accidents, injury and death.

In the unmitigated scenario, this impact has a high severity. With the implementation of mitigation measure, the severity can be reduced to medium.

Duration

Any serious injury or death is a long term impact in both the unmitigated and mitigated scenarios.

Spatial scale/extent

Possible accident sites could be located within or outside the mining right area and the indirect impacts associated with any injuries or fatalities will extend to the communities to which the injured people/animals belong. This is a medium spatial scale.

Consequence

The consequence is high in both unmitigated and mitigated scenarios.

Probability

In the unmitigated scenario the probability of traffic accidents occuring is medium because although the possibility exisits, accidents do not occur on a continuous basis. With mitigation this reduces to low.

Significance

The unmitigated significance remains high. With mitigation the significance remains medium.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Mitigated	M	H	M	H	L	M

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 69).

Objective:

To limit mine related road disturbance and traffic safety impacts.

Actions:

The access points/intersections from the D2543 to the mine must be designed in accordance with the recommendations of the traffic specialist and must be approved by the Mpumalanga Department of Roads and Transport. In concept the following measures apply:

- traffic leaving the mine area and joining the D2543 will be stop controlled;
- the access junctions will be equipped with lighting;
- additional dedicated right turning lanes will be provided at all access points to allow other traffic to continue unimpeded, and 60m shoulders will be provided to filter left turning traffic out of the main lanes to allow other traffic to continue unimpeded; and
- facilities must be provided for offloading people that are transported to the mine on public transport. Employees will have dedicated drop off points on the access roads outside the security control points. All these measures are designed to limit disturbance of traffic on the D2543.

Public dirt roads will not be used by trucks for any project related transport.

Trucks will not be overloaded thereby preventing spillages of run of mine and coal on public roads. A procedure will be implemented where public roads will be checked on an hourly basis and if necessary, spilled material will be cleared and taken to the plant area for processing.

In regard to road maintenance, the mine will, in conjunction with the Mpumalanga Department of Roads and Transport, and other significant users of the public roads, establish a joint road maintenance plan to ensure that the condition and integrity of the public roads is acceptable. Part of this plan will include initial investigations into the quality and lifespan of the roads on which trucks will travel.

The mine will record and respond, appropriately and without delay, to any complaints about usage of roads by mine vehicles.

The environmental and safety managers are responsible for implementing these actions through all mining phases prior to closure.

Emergency situations

In the event of mine related road accidents the emergency procedure included in Section 20 will be followed.

ISSUE: ECONOMIC IMPACT (POSITIVE AND NEGATIVE)

The information in this section is derived from Keaton's approved EIA and EMP report (Metago, 2008).

7.2.18 ISSUE: POSITIVE SOCIO-ECONOMIC IMPACTS

Introduction

The development of a mining operation generally has a number of positive socio-economic impacts including the economic impact on the local, regional and national economies.

This potential impact was rated as having a positive medium significance in both the unmitigated and mitigated scenarios in Keaton's approved EIA and EMP report (Metago, 2008). The changes to surface infrastructure will not create any additional employment opportunities. The increase in plant production will have a slight additional positive impact on the economy, however this is not expected to alter the overall significance of this potential impact.

Rating of impact

Severity/nature

Positive economic impacts related to the mine result from direct economic impacts on the local, regional and national economies. Direct benefits are derived from wages, taxes and profits. Indirect benefits through the procurement of goods and services, and the increased spending power of employees will accrue to mainly the construction, transport, trade and financial sectors. Moreover, the Gross Geographic Product contribution of the mine is significantly more than the losses of agricultural production for the site, and after mining and rehabilitation of the site is complete, it will be possible for most of the site to be re-used for livestock farming and possibly also some crop production.

There are also social benefits which are realised through the implementation of Keaton's social and labour plan (SLP) commitments to support local government approved integrated development plan (IDP) and local economic development (LED) projects.

Duration

Positive socio-economic benefits are largely limited to the life of the mine. This is a medium duration.

Spatial scale/extent

Positive socio-economic impacts that occur as a result of Keaton's SLP and the operation of the mine extend to a local and regional level respectively.

Consequence

The consequence is medium-high in both unmitigated and mitigated scenarios.

Probability

The probability of this potential impact occurring with or without mitigation is high.

Significance

The significance is medium-high positive in both the umitigated and mitigated scenarios.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H+	M	M-H	M-H	H	M+-H+

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	H+	M	M-H	M-H	H	M+-H+

Conceptual description of the proposed mitigation actions

Objective:

To maximise the positive socio-economic benefits.

Actions:

No specific management measures are required as the impact is positive.

Emergency situations

Not applicable.

7.2.19 ISSUE: NEGATIVE SOCIO-ECONOMIC IMPACTS

Mining projects tend to bring with them an expectation of employment. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. Other negative socio-economic impacts include relocation and a decrease in property values for landowners surrounding the mining operations.

Rating of impact

The various potential negative socio-economic impacts are discussed separately below.

Relocation

Severity/nature

The remaining farmers and workers in the mining right area, although not yet in the physical land disturbance zone of the mine, should be relocated because of one or more of the following impact types: air pollution, noise pollution, and blasting impacts (see Sections 7.2.11, 7.2.12 and 7.2.16 respectively). The mechanism for this is likely to involve a commercial agreement between the mine and the farmers which means that relocation of the workers by the mine will only be required if the farmers do not relocate their workers. Relocation of other dwellers in the mining right area is unlikely to be addressed by the farmers and will probably have to be addressed by the mine.

In the unmitigated scenario, the negative impacts than can arise in this context are: loss of employment, loss of income sources and/or production resources, weakening of social networks and social structures, loss of cultural identity, long term hardship, impoverishment, and xenophobic conflict in the receiving areas where these people try to relocate. This is considered a high severity. Managing these issues requires the development and implementation of a community specific resettlement plan, however there is no guarantee that the resettlement plan will be successful.

Duration

In both the unmitigated and mitigated scenarios, the duration of this potential impact is considered to be long term.

Spatial scale

In both the unmitigated and mitigated scenarios, the impacts of this potential impact could be far reaching, depending on the area where the community relocates.

Consequence

The consequence is high in the unmitigated scenario. With mitigation the consequence reduces to medium.

Probability

In the unmitigated scenario, the probability of this potential impact occurring is high. With the implementation of a community specific resettlement plan (as detailed below), the probabitilty is reduced to medium.

Significance

The significance remains high in the unmitigated scenario and medium in the mitigated scenario as the probability of the impact occurring reduces.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	M	M

Informal settlements, safety, security

Severity/nature

In the unmitigated scenario, the mine could attract an influx of job seekers to the area, which could cause an increase of people moving through the area and the development of informal settlements. This situation can be worsened if the mine does not do adequate planning for employee housing and transport.

In general, both increased movement of poor people into an area and informal settlements are associated with poor standards of living which can promote disease, crime and a general threat to the safety and security of an area. In addition, poor control of employees can lead to increased trespassing on private farm land.

This is a high severity without mitigation, reducing to medium with mitigation.

Duration

In the normal course, social impacts will occur for the life of the mine, but negative social issues associated with the influx of people can continue beyond the closure of the mine, particularly in the unmitigated scenario.

Spatial scale

In both the unmitigated and mitigated scenarios, the effects of this potential impact could extend beyond the mine boundary and into surrounding communities.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario, the consequence is reduced to medium.

Probability

In the unmitigated scenario the impact is considered to be high. With mitigation, which includes a law enforcement forum, a clear and effective recruitment policy, a clear and effective housing policy, and a clear and effective transport policy, the probability reduces to low.

Significance

The significance of this potential impact remains high in the unmitigated scenario and medium in the mitigated scenario as the probability of the impact occurring is reduced.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	L	M

Land values

Severity/nature

The impact on land values can be both positive and negative. Positive impacts are observed where mining companies require land adjacent to their operations and as such land owners often sell land at a premium. Negative impacts are observed when the productivity of land surrounding mines is compromised by unacceptable negative environmental and social impacts. For the purposes of this assessment, it is assumed that there is less concern about the scenario where land is purchased at a premium, so the focus of this section is on the possibility of land devaluation from unacceptable negative environmental and social impacts.

In the unmitigated scenario land surrounding the mine may experience unacceptable impacts which are likely to cause a loss in productivity and related land values. In the scenario where the mine successfully implements the stipulated environmental and social management measures, these impacts can be managed to acceptable levels which should not reduce the land productivity or value. Establishing a base valuation prior to mining is an important issue in this regard.

Duration

In the unmitigated scenario, a decrease in land value would extend beyond the life of the mine. With mitigation, it can be limited to the life of the mine.

Spatial scale

In both the unmitigated and mitigated scenario, the potential impact will extend beyond the mine boundary. This is a medium spatial scale.

Consequence

In the unmitigated scenario, the consequence is high. With mitigation it reduces to medium.

Probability

In the unmitigated scenario, the probability of this potential impact occurring is high. With mitigation such as the successful implementation of the stipulated environmental and social management measures, the probability of the potential impact occurring reduces to low.

Significance

The significance of this potential impact remains high in the unmitigated scenario and medium-low in the mitigated scenario as the severity, duration and probability of occurring reduces.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	M	M	M	L	M-L

Conceptual description of the proposed mitigation actions

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19, Table 70).

Objective

To limit negative socio-economic impacts.

Actions

Relocation

If the affected farm workers and families are to be relocated with their current employees this must be captured as a condition in the land purchase contract between the farmers and the mine.

If the affected farm workers and their families do not relocate with their current employees, then the mine will appoint a team of professionals to design and implement a resettlement plan.

The resettlement must take place prior to the components of the operational phase that will necessitate resettlement and the plan must cover the relevant components from the following list which has been extracted from the World Bank Operational Directive on Involuntary Resettlement. The decision on which components to include in the plan will be made by the appointed team of professionals:

- clear statement on organisational responsibilities with mechanisms for the affected parties to be involved from the outset with their own professional representation;
- community participation and impacts on/integration with host populations;

- an updated socio-economic survey;
- a legal framework;
- alternative sites;
- valuation of and compensation for lost income and assets;
- land tenure, acquisition and transfer;
- access to training, employment and credit;
- shelter, infrastructure and social services;
- environmental protection and management; and
- implementation schedule, monitoring and evaluation.

In regard to the issue of providing access to training and employment, the mine should consider whether the farm workers and other dwellers that will have to be relocated (i.e. by the mine as opposed to the farmers) can be employed at the mine in skill appropriate roles.

The mine will ensure that its recruitment, training and housing policies incorporate the following:

Recruitment and training

- there will be no recruitment at the gates of the mine in either the construction or operational phase. All recruitment will take place on set dates and at an arranged venue - preferably in Delmas;
- there will be no ad hoc hiring of temporary casual labour, no matter how small and temporary the job (washing of vehicles or litter clearance). A sign clearly indicating that there will be no recruitment at the construction site will be erected at the entrance to the site. Also, a list of available temporary workers in the area will be drawn up and kept by the mine in the event that temporary labour is required.

Housing

Keaton's' current policy is not to provide workers with a housing allowance.

Transport

Formal transport will be provided for the majority of the workforce. Bulk transportation vehicles such as buses and mini vans will be used for this purpose.

Safety, security and informal settlements

In regard to crime, the mine will facilitate the establishment of a forum that comprises the local police force, its own security company and the neighbouring land owners. This forum will focus on developing strategies for combating crime in the vicinity of the project and surrounding farms and it will have particular focus on preventing trespassing on private land and on preventing the development of informal settlements.

Land value

The mine must effectively implement all the management actions that are set out in Sections 7 and 19 to ensure that the identified impacts are contained on the mining right area and/or do not compromise the productivity of surrounding land.

Prior to construction of the mine, a base case valuation of land surrounding the mine site must be done by an independent valuator that is acceptable to all parties and paid for by the mine. This valuation will provide a basis for future discussions if landowners are of the view that mine related impacts have caused a decrease in productivity and associated land value. If any loss in land value has been caused by unacceptable mine related impacts, the mine will compensate the relevant land owners accordingly.

Emergency situations

The establishment of informal settlements in the area is considered an emergency situation. Procedures outlined in Section 20 will be followed.

7.3 DEFINITION OF CRITERIA USED

Both the criteria used to assess the impacts and the method of determining the significance of the impacts is outlined in Table 49. This method complies with the method provided in the EIA guideline document. Part A provides the approach for determining impact consequence (combining severity / nature, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D. Unmitigated scenario is considered for each impact.

7.4 PHASES AND TIMEFRAMES OF POTENTIAL IMPACTS

An indication of the phases in which impacts could occur is included in Section 7.2. This section also provides an indication of the duration of potential impacts. Potential impacts associated with the project have the potential to occur in almost all project phases and on a continuous basis if unmitigated. With the implementation of the mitigation as presented in Section 19, the monitoring programmes as presented in Section 21 and the emergency response procedures as presented in Section 20 the timeframe of potential impacts will be reduced significantly.

TABLE 49: CRITERIA FOR ASSESSING IMPACTS

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

PART B: DETERMINING CONSEQUENCE					
			SEVERITY / NATURE = L		
DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**
			SEVERITY / NATURE = M		
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
			SEVERITY / NATURE = H		
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			SPATIAL SCALE / EXTENT		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

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

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

8 COMPARATIVE ASSESSMENT OF IDENTIFIED LAND AND DEVELOPMENT ALTERNATIVES

8.1 ALTERNATIVE LAND USES WHICH COULD BE IMPACTED ON

The alternative land uses that could be affected have been described and assessed in Section 7.2.5. These include agricultural and residential activities.

8.2 RESULTS OF SPECIALIST COMPARATIVE LAND USE ASSESSMENT

In the normal course, for a greenfields project site, a comparative land use assessment is required to determine the economic, environmental and social sustainability of a project.

In this case of this project, the approved surface infrastructure at Vanggatfontein Coal Mine has been relocated and/or redesigned and additional surface infrastructure has been constructed largely within the footprint of the approved mining operations. As such, it is Metago SLR's opinion that a comparative land use assessment is not necessary as the land has already been approved for and disturbed by mining activities.

The economic analysis of mining versus agricultural production is addressed in Section 7.2.18. It shows that the Gross Geographic Product contribution of the mine is significantly more than the losses of agricultural production for the site. In addition, once mining and rehabilitation of the site is complete, it will be possible for most of the site to be re-used for livestock farming and possibly crop production.

9 LIST OF SIGNIFICANT IMPACTS

A list of significant impacts, when considered **without mitigation**, as identified in the assessment conducted in Section 7 is provided below.

It should be noted that the changes to surface infrastructure at the Vanggatfontein Coal Mine are not expected to alter the overall significance of potential impacts associated with the mining operation. In this regard, the list of significant impacts listed below considers the mining operation as a whole.

- hazardous structures / excavations (high);
- surface subsidence (high);
- loss of soil resources (high);
- loss of land with agricultural potential (high);
- impact on habitats and species (high);
- pollution of surface water resources (high);
- alteration of drainage patterns (high);
- reduction in groundwater levels / availability (high);
- groundwater contamination (high);
- increase in air pollution (high);
- increase in disturbing noise levels (medium-high);
- negative landscape and visual impacts (high);
- disturbance of heritage resources (medium-high);
- disturbance of paleontological resources (medium);
- blasting hazards (high);
- project-related road use and traffic (high);
- positive socio-economic impacts (medium positive); and
- negative socio-economic impacts, including relocation; informal settlements, safety and security; and land values (high).

10 STAKEHOLDER ENGAGEMENT PROCESS

This section provides a description of the engagement process with interested and affected persons (IAPs) followed during the course of the environmental assessment process. It outlines how IAPs were identified, confirms the details of the engagement process (with supporting documentation included as appendices), and how issues raised have been addressed.

10.1 IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES

The stakeholder engagement process commenced with a stakeholder analysis that was aimed at identifying parties to be involved during the environmental assessment process and associated communication structures. This was done through a deeds search of the relevant properties within the project site and immediately adjacent portions of land, social scans including site visits in the surrounding areas, networking and direct discussions with IAPs. Key stakeholders identified for the project include:

IAPs:

- landowners, land occupiers and communities on and surrounding the project areas;
- tribal authorities/communities;
- mines and industries in the area;
- non-government organisations and associations;

Regulatory authorities:

- Department of Mineral Resources (DMR);
- Department of Economic Development, Environment and Tourism (DEDET) (previously the Department of Agriculture and Land Administration);
- Department of Water Affairs (DWA);
- South Africa Heritage Resource Agency (SAHRA);
- Department of Agriculture (DA);
- Department of Rural Development and Land Reform (DRDLR) (previously the Department of Land Affairs);
- Mpumalanga Department of Roads and Transport (MDRT);
- Mpumalanga Tourism and Parks Board (MTPB);
- Regional Land Claims Commission;

Local authorities:

- Nkangala District Municipality (BPDM);
- Victor Khanye Local Municipality (MKLM); and
- relevant ward councillors.

A full list of landowner names, local communities, other IAPs and non-government organisations consulted is provided in the IAPs and regulatory authorities' database included in Appendix A. The database is updated on an ongoing basis throughout the environmental process.

10.2 DETAILS OF ENGAGEMENT PROCESS

Stakeholder engagement is an integral component of any development process. The goal of stakeholder engagement is to facilitate and improve communication between stakeholders (including the applicant) in the interest of facilitating better decision-making and more sustainable development (DEAT, 2002). In accordance with the requirement of Chapter 6 of the EIA Regulations, 2006, a stakeholder engagement programme has been developed to set out a coordinated process through which IAPs are informed of the development and environmental assessment process and provided with an opportunity to provide input into the project plan and proposed mitigation measures. By consulting with authorities and IAPs, the range of environmental issues to be considered in the EIA has been given specific context and focus. Included below is an outline of the process followed, and the people engaged. Refer to Section 10.3 for a list of issues that were identified during the engagement process.

10.2.1 STEPS IN THE PUBLIC PARTICIPATION PROCESS

Steps in the process that have been conducted to date are set out in Table 50 below.

TABLE 50: PARTICIPATION PROCESS WITH IAPS AND AUTHORITIES

Task	Description	Date
Notification - regulatory authorities and IAPs		
Application to DEDET	Formal applications were submitted to DEDET.	17 January 2011
DMR notification	A meeting was held with the DMR to discuss the project.	20 June 2011
Consultation with land claims commissioner	The land claims commissioner was consulted as part of the 2008 environmental assessment in order to verify if any land claims had been lodged on any of the farms. The commissioner confirmed that there are no gazetted claims on the property in question. Refer to Appendix B for a copy of the response received from the land claims commissioner.	2008 (as part of previous EIA process)
Social scan	A social scan of the project area was conducted by Metago SLR. The purpose of the social scans was: • to identify relevant municipal ward councillors, landowners, land occupiers, and other interested and affected parties; • to obtain contact details for IAPs; • to identify appropriate communication structures; and • inform IAPs of the project, upcoming public process and associated scoping and EIA processes. As part of the social scan, notification and information-sharing took place through informal discussions, focussed meetings and/or telephonic discussions. A record of discussions and minutes of meetings are included in Appendix C. Issues raised are included in the comments and response report in Appendix D. One output of the social scan is an IAP database (Appendix A).	April - May 2011

<table>
<tr><th>Task</th><th>Description</th><th>Date</th></tr>
<tr><td>Distribution of background information document (BID)</td><td>A background information document (BID) was compiled by Metago SLR for information-sharing purposes. The purpose of the BID was to inform IAPs and authorities about the project, the environmental assessment process, possible environmental impacts and means of inputting into the environmental assessment process. Attached to the BID was a registration and response form, which provided IAPs with an opportunity to submit their names, contact details and comments on the project.
BIDs were distributed to IAPs by email, post and fax using contact details obtained during the social scan, at the scoping meeting and by fax and/or e-mail to authorities on the project's public involvement database. A copy of the BID is attached in Appendix C.</td><td>April 2011</td></tr>
<tr><td>Site notices</td><td>Laminated A2 site notices in English and Afrikaans were placed at key conspicuous positions in and around the project site, including:
• Intersection of the D2543 and D1147;
• AgriHall, Delmas
• Brakfontein Meat Market,
• Delmas Country Lodge,
• Mr Frans Venter's residence (property neighbouring Vanggatfontein Mine),
• Victor Khanye Local Municipality,
• Pick 'n Pay, Delmas,
• Entrance to Vanggatfontein Mine.
Copies of the site notices are included in Appendix C together with photos of where the site notices were placed.</td><td>April 2011</td></tr>
<tr><td>Newspaper advertisements</td><td>Block advertisements were placed in one national (The Citizen) on 8 April 2011 and one local newspaper (Streeknuus) on 15 April 2011. Copies of the advertisements are included in Appendix C.</td><td>April 2011</td></tr>
<tr><td colspan="3">Scoping stage meetings and comments received</td></tr>
<tr><td>Public scoping meeting</td><td>One general scoping meeting was held in Delmas for IAPs and regulatory authorities. The meeting was held in English and Afrikaans. The purpose of the meeting was to provide IAPs with an outline of the project and environmental assessment process, identify potential issues to be investigated further, provide input into the terms of reference for specialist studies and agree on the way forward. Minutes of the meetings are included in Appendix C. Issues raised are included in the comments and response report in Appendix D.</td><td>5 May 2011</td></tr>
<tr><td>Written comments</td><td>Written comments were received by Metago SLR during the scoping process. Copies of the comments are included in Appendix C and a summary is included in the comments and response report in Appendix D.</td><td>April and May 2011</td></tr>
<tr><td colspan="3">Change in project scope and withdrawal of NEMA application</td></tr>
<tr><td>Change in project scope</td><td>Initially the project scope, as presented in the BID and at the scoping meeting, included the mining of a wetland area on the farm Vanggatfontein 251 IR. After consideration of specialist water resources input and after consideration of the IAP comments, Keaton's management team decided not to mine through the wetland area and this specific activity was removed from the project scope.</td><td>May 2011</td></tr>
<tr><td>DEDET site visit</td><td>At the request of the Department, a site visit was undertaken on 12 July 2011.</td><td>July 2011</td></tr>
<tr><td>Withdrawal of NEMA application</td><td>Due to the changes in project scope, and following the site visit with DEDET, the NEMA application was withdrawn.</td><td>August 2011</td></tr>
</table>

Task	Description	Date
Review of scoping report		
Authority review of scoping report	The following authorities were involved in the review process: DMR, DEDET, DWA, SAHRA, DA, DRDLR, MTPB, MDRT, Nkangala District Municipality and Victor Khanye Local Municipality.	September – October 2011
Public review of scoping report	Copies of the scoping report and summary were made available for public review at Delmas Public Library, Mr Gericke's residence, Vanggatfontein Mine security office and at Metago SLR's offices in Fourways, Johannesburg.	12 September – 24 October 2011
Written comments	Written comments were received by Metago SLR following the review of the draft scoping report. Copies of the comments are included in Appendix C, and a summary is included in the comments and response report in Appendix D.	September – October 2011
Forward comments to DMR	All comments received during the review of the Scoping Report were forwarded to the DMR.	October 2011

10.2.2 SPECIALIST TEAM

Upon input from IAPs on the potential impacts that may arise as a result of the development, several specialists (see Table 4 for a complete list of all appointed specialist, their roles and responsibilities) were appointed to assess the potential impact of the development. Details are provided in the specialist reports included as appendices.

10.2.3 REVIEW OF EIA AND EMP REPORT BY REGULATORY AUTHORITIES

Seven copies of the EIA and EMP report were submitted to the DMR for review on 05 October 2012.

In addition, the following Departments received a copy of the EIA and EMP report from Metago SLR: DWA, DEDET, DA, DRDLR, SAHRA, MTPB, Nkangala District Municipality and Victor Khanye Local Municipality.

Once the DMR has issued a record of decision, the IAPs will be notified by e-mail and post in accordance with the instructions from the DMR.

10.2.4 REVIEW OF THE EIA AND EMP REPORT BY IAPS

Copies of the EIA and EMP report will be made available for public review at the following places:

- Delmas Public Library;
- Mr Gericke's residence;
- Vanggatfontein Mine security office; and
- Metago SLR's offices in Fourways, Johannesburg.

Electronic copies of the report will be made available to IAPs on request (electronically on CD).

All comments received from IAPs during the review period will be forwarded to the DMR for decision-making.

10.2.5 FEEDBACK MEETING

Feedback on the EIA and EMP report will be provided at the quarterly stakeholder's meeting that will be held in November 2012 in Delmas. IAPs will be notified once details of the meeting have been finalised. The purpose of this is to provide IAPs with:

- an opportunity to discuss the outcomes of the EIA process; and
- a chance to submit comments on the EIA and EMP report.

The details of the feedback meeting have been distributed to IAPs together with a summary of the EIA and EMP report.

10.3 MANNER IN WHICH ISSUES RAISED WERE ADDRESSED

Stakeholder meetings and public review of the scoping reports provided IAPs an opportunity to comment on the baseline environment and potential impacts of the project (including social and cultural impacts). **All views, issues and concerns raised have been captured into the comments and response report (Appendix D).** The comments and response report provides responses to issues raised and identifies where the issues have been addressed in the EIA and EMP report.

11 ADEQUACY OF PREDICTIVE METHODS AND ASSUMPTIONS, AND UNCERTAINTIES

Assumptions, uncertainties and limitations have been discussed throughout the EIA report and in the various specialist studies. The more significant of these are included below.

11.1 ENVIRONMENTAL ASSESSMENT LIMIT

The EIA focused on third parties only and did not assess health and safety impacts on workers because the assumption was made that these aspects are separately regulated by health and safety legislation, policies and standards, and that Impala will adhere to these.

11.2 PREDICTIVE MODELS IN GENERAL

All predictive models are only as accurate as the input data provided to the modellers. If any of the input data is found to be inaccurate or is not applicable because of project design changes that occur over time, then the model predictions will be less accurate.

11.3 GEOLOGY

None.

11.4 CLIMATE

None.

11.5 TOPOGRAPHY

None.

11.6 SOILS

None.

11.7 LAND CAPABILITY

None.

11.8 BIODIVERSITY

No specialist biodiversity study was undertaken for this project. The specialist study, conducted by Natural Scientific Services (Pty) Ltd, undertaken for the 2008 environmental assessment covered the entire mining right area. As such, information from this study was used for the compliation of this EIA and EMP report.

11.8.1 VEGETATION LIMITATIONS

Sampling method

The Braun-Blanquet cover-abundance scale was used to analyse vegetation. For extensive surveys this method provides sufficiently accurate baseline data to allow environmental impact assessment as required by regulatory agencies. However problems that have been detected with this sampling method include:

- it can be seen as subjective and dependent upon the experience and knowledge of the vegetation type by the surveyor. The cover estimate may vary from observer to observer; and
- there also may be a problem when the cover estimate is very close to two different classes (on the border so to speak) and then it is for the observer to decide which class it should be allocated to.

Sampling season

Although the majority of the sampling was conducted during the summer season, it must be noted that the absence of species on site does not conclude that the species is not present at the site as species emerge and flower at different times of the year. Reasons for not finding certain species may be due to:

- sampling season does not coincide with flowering season of specific floral species;
- the disturbed nature of the site;
- the inconspicuous nature of species; and
- lack of species presence.

11.8.2 ANIMAL LIFE LIMITATIONS

The time available for the trapping field visit was limited, and sampling was conducted in late summer. It should be noted that the absence of species on site during site visits does not conclude that the species are not present. Reasons for not finding certain species may be due to:

- breeding season of animals does not correlate with the time of the survey;
- lack of suitable habitat and foraging potential on site for animal species;
- the disturbed nature of the site;
- the inconspicuous nature of species; and
- high species mobility and therefore lack of species presence at the time of the survey.

11.9 SURFACE WATER

None.

11.10 GROUNDWATER

MRDF source concentrations and seepage infiltration rates had to be assumed by the groundwater specialist. The model should be recalibrated in time when these parameters have been determined more accurately.

11.11 AIR

The most important assumptions and limitations of the air quality impact assessment are summarised as follows:

- emissions are based on the process description and mine layout plan as provided by the mine;
- particle size distributions for stockpiles were not available and therefore particle sizes from similar operations were utilised;
- the dispersion model cannot compute real time mining processes, therefore average mining process throughputs were utilised;
- routine emissions for the mining operations were simulated. Atmospheric releases occurring as a result of upset conditions were accounted for in the form of blasting.
- the impact assessment was limited to airborne particulates in general only. No chemical speciation was available to quantify specific airborne metal concentrations and fallout rates.

11.12 NOISE

None.

11.13 VISUAL

None.

11.14 BLASTING

None.

11.15 TRAFFIC

None.

11.16 HERITAGE AND CULTURAL RESOURCES

No specialist heritage (and cultural) study was undertaken for this project. The specialist study, conducted by Dr Julius Pistorius, undertaken for the 2008 environmental assessment covered the entire mining right area and therefore information from this study was used for the compliation of this EIA and EMP report. It is possible that some heritage and cultural resources have not been discovered and/or recorded. If any new heritage and cultural resources are exposed the mine's chance find procedure will be implemented.

11.17 PALAEONTOLOGICAL RESOURCES

A specialist paleontological desktop study was undertaken by BPI for Paleontological Research. The methods used and assumptions made are considered adequate for this area.

11.18 SOCIO-ECONOMIC

None.

11.19 GEOCHEM

No actual waste samples have been tested as the analysis was conducted during the exploration phase of the mine. A critical success factor for any geochemical characterisation program is the selection of representative samples considering material type (e.g. lithology), spatial (e.g. vertical and horizontal area to be mined) and compositional (e.g. all material types based on sulphur content) representation as well as sample storage and handling (e.g. fresh or weathered samples). Additional testing should therefore be conducted on actual samples from the mining operation.

11.20 CLOSURE COST CALCULATIONS

The closure cost calculations are based on the technical information and site layout as provided by the technical project team, and are assumed accurate at the time of compiling the report.

12 ARRANGEMENTS FOR MONITORING AND MANAGEMENT OF IMPACTS

This section describes the arrangements for monitoring and management of environmental impacts. It identifies the impacts that require monitoring programmes and outlines the functional requirements, roles and responsibilities and timeframes for the monitoring programmes. Further detail on each monitoring programme is included in Section 21.

12.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring include:

- hazardous excavations and structures (failure of MRDF and water dams);
- impacts on biodiversity (habitats and species);
- reduction in groundwater levels / availability;
- contamination of groundwater;
- pollution of surface water;
- increase in air pollution;
- increase in disturbing noise levels;
- blasting hazards; and
- project-related road use and traffic.

In addition to the above, the commitments as included in the EMP report will require monitoring to a) ensure that they are being implemented and b) that they are effective in mitigating potential impacts on the environment, socio-economic conditions of third parties and heritage/cultural aspects. This will be done through regular internal auditing by mine personnel.

12.2 FUNCTIONAL REQUIREMENTS OF MONITORING PROGRAMMES

The purpose of the monitoring programmes is to review the mine's impact on various aspects of the environment and to report on changes needed to the management programme as proposed in this report.

As a general approach, the mine will ensure that the monitoring programmes comprise the following:

- a formal procedure;
- appropriately calibrated equipment;
- where samples require analysis they will be preserved according to laboratory specifications;
- an accredited, independent, commercial laboratory will undertake sample analyses;
- parameters to be monitored will be identified in consultation with a specialist in the field and/or the relevant authority;
- if necessary, following the initial monitoring results, certain parameters may be removed from the monitoring programme in consultation with a specialist and/or the relevant authority;
- monitoring data will be stored in a structured database;

- data will be interpreted and reports on trends in the data will be compiled by an appropriately qualified person on a quarterly basis; and
- both the data and the reports will be kept on record for the life of mine.

12.3 ROLES AND RESPONSIBILITIES

The roles and responsibilities for the execution of the monitoring programmes are defined below.

- SHE manager:
    - ensure that the monitoring programmes are scoped and included in the annual mine budget;
    - identify and appoint appropriately qualified specialists/engineers to undertake the programmes; and
    - appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards

12.4 TIMEFRAMES FOR MONITORING AND REPORTING

The timeframes for monitoring and reporting thereof are detailed in the monitoring programme (see Section 21). A summary is provided below:

Programme	Timeframe and frequency	Reporting*
Waste dumps and water dams	All project phases Daily and monthly by dam operators and quarterly by professional engineer	Monthly internally and quarterly by professional engineer
Biodiversity	All project phases Annually	Annually by specialist
Groundwater and surface water	All project phases Monthly (water levels), quarterly (water qualities), annually (update groundwater model and climatic water balance)	Quarterly and annually by specialists Annually to DWA
Surface water	All project phases Quarterly (water qualities)	Quarterly and annually by specialists Annually to DWA
Air	All project phases Monthly (dust)	Quarterly and annually by specialist Annually to the DMR and DEDET
Noise	From the start of construction to the end of decommissioning Annually	Annually by specialist
Blasting	During operation of the mine Every blast	Monthly by specialist
Traffic aspects	As required (dependant on stakeholder complaints)	As required
Internal auditing	From start of construction to end of closure On-going	As required
External auditing	From start of construction to end of closure Every two years	Every two years to DMR

** The requirements of any water license take precendence over these timeframes.*

13 TECHNICAL SUPPORTING INFORMATION

Technical and supporting information included as appendices to this report are listed below.

- stakeholder database (Appendix A);
- information-sharing with regulatory authorities (Appendix B);
- information-sharing with IAPs (Appendix C);
- comments and response report (Appendix D);
- hydrological specialist report (Appendix E);
- geo-hydrological specialist report (Appendix F);
- air quality specialist report (Appendix G);
- palaeontological specialist report (Appendix H);
- traffic specialist report (Appendix I);
- design report for the MRDF (Appendix J);
- water balance report (Appendix K);
- closure liability calculations (Appendix L);
- information provided by Keaton (Appendix M); and
- Transnet servitude specifications (Appendix N).

SECTION 2 – ENVIRONMENTAL MANAGEMENT PROGRAMME

14 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR CLOSURE

14.1 ENVIRONMENTAL ASPECTS THAT DESCRIBE THE PRE-MINING ENVIRONMENT

Environmental aspects that describe the pre-mining environment as informed by the baseline description (Section 1) are listed below. This list serves to guide the setting of environmental objectives for mine closure.

- relatively flat topography;
- pre-mining soils supported arable, grazing, wetland and wilderness land capabilities and/or uses;
- a functioning ecosystem (including wetlands);
- non-perennial drainage patterns (although water is observed in the eastern spring-fed tributary for most months of the year);
- good quality groundwater;
- reliance on groundwater for domestic and agricultural purposes; and
- quiet rural environment.

14.2 MEASURES REQUIRED FOR CONTAINMENT OR REMEDIATION

Measures required to contain or remedy any causes of pollution or degradation or migration of pollutants, both for closure of the mine and post-closure are listed below.

- implement a waste management procedure for general and hazardous waste on site throughout the project life;
- ensure immediate clean-up of any spills as per the emergency response procedures;
- establish and maintain dirty stormwater control measures in line with regulatory requirements, until such time as potentially polluting areas are rehabilitated;
- contain pollutants at source by storing and handling potentially polluting substances on impermeable substrates, within bunded areas and with the capacity to contain spills;
- design, construct and operate the waste dumps with runoff control measures;
- rehabilitate the site in line with a detailed closure plan to be developed during the operational phase at least five years prior to decommissioning; and
- if any potential contamination is observed before closure, the actions set out below will be implemented prior to closure:
    - placement of a curtain of boreholes adjacent to the MRDF to pump contaminated water and prevent it from reaching third party boreholes or surface water resources;
    - capture of any contaminated decant from backfilled mining pits to prevent run-off and seepage; and
    - treatment of all captured contaminated water in the on-site water treatment pland as per Section 2.7.14.2. In the post closure scenario, this treatment plant will have to be routinely maintained and upgraded to allow for treatment in perpetuity.

Further detail on the proposed action plans and mitigation measures is included in Section 19.

15 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR MANAGEMENT OF IDENTIFIED ENVIRONMENTAL IMPACTS

The environmental objectives and specific goals for the management of identified environmental impacts are detailed in this section.

15.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring include:

- hazardous excavations and structures (open pit, water dams and MRDF);
- physical destruction and general disturbance of biodiversity;
- dewatering impacts on third party users;
- contamination of groundwater;
- pollution of surface water;
- increase in air pollution;
- increase in disturbing noise levels;
- blasting hazards; and
- traffic increase and road use.

15.2 ACTIVITIES AND INFRASTRUCTURE

The source activities of potential impacts which require management are detailed in Section 2.3 and listed below.

- Site preparation
- Earthworks
- Civil works
- Open pit mining
- Underground mining
- Mine redisue disposal facility (MRDF)
- Water supply infrastructure
- Power supply infrastructure
- Transportation system
- Non-mineralised waste management
- General site management
- Demolition
- Rehabilitation
- Maintenance and aftercaree

15.3 MANAGEMENT ACTIVITIES

Management activities which will be conducted to control the project actions, activities or processes which have the potential to pollute or result in environmental degradation are detailed in Section 19.

15.4 ROLES AND RESPONSIBILITIES

The key personnel to ensure compliance to this EMP report will be the operations executive, the environmental department manager and the stakeholder engagement manager. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities will include:

- Senior Operational Manager and Environmental Department Manager:
  - ensure that the monitoring programmes and audits are scoped and included in the annual mine budget;
  - identify and appoint appropriately qualified specialists/engineers to undertake the programmes;
  - appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards;
- Stakeholder engagement department:
  - liaise with the relevant structures in terms of the commitments in the SLP;
  - ensure that commitments in the SLP are developed and implemented in a timeously fashion;
  - establish and maintain good working relations with surrounding communities and landowners;
  - facilitate stakeholder communication, information sharing and grievance mechanism.

16 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR SOCIO-ECONOMIC CONDITIONS

16.1 ASPECTS OF THE SOCIO-ECONOMIC CONDITIONS

The socio-economic conditions in the vicinity of the mine are described in Section 1.3.4.

16.2 OBJECTIVES AND GOALS

Specific environmental objectives and goals to control, remedy or stop potential impacts emanating from the mine which may impact on communities and IAPs are described below. The information is presented in tabular format (Table 51).

TABLE 51: ENVIRONMENTAL OBJECTIVES AND GOALS – SOCIO-ECONOMIC CONDITIONS

Aspect	Environmental objective	Goals
Land uses	To prevent unacceptable impacts on surrounding land uses and their economic activity	To co-exist with existing land uses To negatively impact existing land uses as little as possible
Blasting	To minimise the potential for third party damage and/or loss	To protect third party property from project-related activities, where possible Where damage is unavoidable, to work together with the third parties to achieve a favourable outcome To ensure public safety
Traffic	To reduce the potential for safety and vehicle related impacts on road users	To ensure the mine's use of public roads is done in a responsible manner
Socio-economic	To enhance the positive economic impacts and limit the negative economic impacts	To work together with existing structures and organisations
Informal settlements	To limit the impacts associated with inward migration	To establish and maintain a good working relationship with surrounding communities, local authorities and land owners
Relocation	To prevent the risk of harm and injury to people and animals and the damage of associated buildings	To work together with existing structures and organisations To establish and maintain a good working relationship with surrounding communities and land owners
Evacuation	To prevent to potential of third party harm and injury	To protect third parties and property from harm and injury as a result of the project-related activities To ensure public safety

17 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR HISTORICAL AND CULTURAL ASPECTS

Environmental objectives and goals in respect of historical and cultural aspects are listed in the table below (Table 52).

TABLE 52: ENVIRONMENTAL OBJECTIVES AND GOALS – HISTORICAL AND CULTURAL ASPECTS

Aspect	Environmental objective	Goals
Heritage and cultural	To prevent unacceptable loss of heritage resources and related information	To protect heritage resources where possible If disturbance is unavoidable, then mitigate impact in consultation with a specialist and the SAHRA and in line with regulatory requirements
Palaeontological resources	To minimise loss of fossil resources and related information	To protect palaeontological resources where possible through mitigation If disturbance is unavoidable, then provide opportunity for research

18 APPROPRIATE TECHNICAL AND MANAGEMENT OPTIONS

18.1 PROJECT ACTIONS, ACTIVITIES AND PROCESSES

All activities associated with the mine have the potential to cause pollution or environmental degradation. These are described in Section 2 of this EIA and EMP report.

18.2 TECHNICAL AND MANAGEMENT OPTIONS

Appropriate technical and management options chosen to modify, remedy, control or stop any action, activity or process associated with the mine which will cause significant impacts on the environment, socio-economic conditions and historical and cultural aspects are listed in the table below (Table 53) and described in detail in Section 7. In addition to these, the mine will implement an environmental management system to assist in the implementing and monitoring of commitments included in this EIA and EMP report.

TABLE 53: TECHNICAL AND MANAGEMENT OPTIONS

Potential impact	Technical and management options
Loss and sterilization of mineral resources	Mine workings will be developed and designed taking cognisance of potential ore reserves Extraction of all possible minerals prior to final disposal
Hazardous excavations and infrastructure	Construction of berms, fencing, barriers and access control Warning signs Backfilling pits Implement monitoring programme Implement an emergency response procedure
Loss of soil resources and land capability through pollution	Implement hazardous waste, dirty water and mineralised and non-mineralised waste management procedures Permanent infrastructure designs to take long term soil prevention, land function and confirmatory monitoring into account
Loss of soil and land capability through physical disturbance	Implementation of a soil management plan Limiting disturbance of soil to what is necessary Stripping, storing, maintenance and replacement of topsoil in accordance to soil management procedures
Physical destruction of biodiversity	Implementation of the biodiversity management plan Restrict mine footprint Limit disturbance on highly sensitive biodiversity areas Implementation of monitoring programmes Rehabilitate disturbed areas
General disturbance of biodiversity	Prevention of the killing of animal species Implementation of dust control measures Pollution prevention measures Prevention of the disturbance of ecosystems

Potential impact	Technical and management options
Pollution of surface water resources	Appropriate design of polluting facilities and pollution prevention facilities (by qualified person) Implement and maintain storm water controls that meet regulatory requirements Implement site-specific soil management plan Implement a monitoring programme (water use, process water quality, rainfall-related discharge quality) Implement emergency response procedure Implementation and maintenance of licence requirements
Alteration of natural drainage lines	Implement and maintain storm water controls that meet regulatory requirements
Contamination of groundwater	Appropriate design of pollution facilities Correct handling of hazardous wastes, mineralised and non-mineralised wastes Compensation for loss Implement and maintain terms and conditions of regulatory requirements Implementation of a monitoring programme Implement emergency response procedure Implementation and maintenance of licence requirements Establishment of on-site water treatment plant
Dewatering	Compensation for loss Implementation of monitoring programme
Air pollution	Implementation of air quality management plan Implementation an air quality monitoring programme Control dust plumes Implementation of an air complaints procedure Maintenance of abatement equipment Implement an emergency response procedure
Noise pollution	Maintenance of vehicles and equipment Implementation of a noise complaints procedure Reducing operational hours Educate workers Equip machinery with silencers Construction of noise attenuation measures
Blasting damage	Implementation of a blast management plan Pre-mining crack survey Communication of planned blasting times with stakeholders Pre-blast warning Monitoring blasts Audit and review to adjust blast design were necessary Investigate blast related complaints Rectify damage to third party structures Implementation of a blasting complaints procedure Implement emergency response procedure Implement an evacuation plan
Traffic increase	Implementation of a traffic safety programme Education and awareness training of workers Use of pedestrian crossing by pedestrians Placement of signage to create awareness Maintenance of the transport systems Implementation of a traffic complaints procedure Implement emergency response procedure

Potential impact	Technical and management options
Visual impacts	Limit the clearing of vegetation Limit the emission of visual air plumes Use of screening berms Concurrent rehabilitation Painting infrastructure to compliment the surrounding environment where possible Implementation of a closure plan Management through care and aftercare
Heritage and cultural	Limit project infrastructure, activities and related disturbances to demarcated areas as per this EIA and EMP report Project specific heritage studies will be conducted to identify any resources should the project footprint change Education of workers Exhumation and relocation of graves where required Implement emergency response procedure
Economic impact	Hire people from closest communities To extend the formal bursary and skills development to closest communities Implement a procurement mentorship programme Local procurement of goods and services Compensation for loss of land use Closure planning to make consideration for skills, economic consideration and the needs of future farming
Inward migration	Good communication in terms of recruitment, procurement and training Number of temporary and permanent new job opportunities and procurement will be made public Employment and procurement opportunities provided to closest communities No recruitment at the mine gate Notify unsuccessful job seekers Accommodation allocation to employees and contractors Maintaining an environmental profile Monitor and prevent the development of informal settlements through the interaction with neighbours, local authorities and law enforcement officials Implement a health policy on HIV/AIDs and tuberculosis to promote awareness and training Addressing social service constraints and social problems relating to education, health, water supply, solid waste management, sanitation and housing Implement emergency response procedure
Land use	Implementation of EMP commitments that focus on environmental and social impacts Take necessary steps to prevent negative impact on surrounding land Closure planning to incorporate measures to achieve future land use plans

19 ACTION PLANS TO ACHIEVE OBJECTIVES AND GOALS

Action plans to achieve the objectives and goals set out in Section 15 (bio-physical environment), Section 16 (socio-economic conditions) and Section 17 (historical and cultural) above, are listed in tabular format together with timeframes for each action. The action plans include the timeframes and frequency for implementing the mitigation measures as well identifies the responsible party.

Action plans as described below, include technical and management options for all existing operations currently being undertaken at Vanggatfontein Mine, as well as any new technical and management options that are not currently in place but are however relevant to the project.

TABLE 54: ACTION PLAN – LOSS AND STERILISATION OF MINERAL RESOURCES

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Civil works	M	L	• Incorporate cross discipline planning structures for all new mining and infrastructure developments • Current mine plan and infrastructure layout prevents sterilisation of third party minerals.	At start At start	Once off Once off	Mine resource manager Mine resource manager
Operation	Civil works Open pit mining Mineralised waste dumps	M	L	• Extraction of mineral resources prior to final disposal	On-going	On-going	Mine resource manager
Decommission	Waste rock management Rehabilitation Process water management	M	L				
Closure	Maintenance and aftercare of rehabilitated areas	M	L				

TABLE 55: ACTION PLAN – HAZARDOUS STRUCTURES / EXCAVATIONS

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works	H	M	• Maintain barrier with warning signs (in picture format and/or written in English, Afrikaans and Zulu) around all hazardous excavations.	As required	Once-off	Environmental site manager
Operation	Earthworks Civil works Open pit and underground mining Waste rock dumps Washing plant Mine residue disposal Water supply and storage infrastructure Power supply infrastructure Transport infrastructure Rehabilitation	H	M	• Professional civil engineer to monitor dams with safety risk. • All existing and proposed mineralised waste facilities and water dams will be designed and constructed in a manner to ensure stability related safety risks to third parties and animals are addressed. Provision will be made to address long term and safety risks in the decommissioning and rehabilitation planning. • Educate third parties about potential risks • If subsidence occurs after backfilling, re-strip topsoil and re-backfill with overburden/spoil followed by replacement of subsoil and topsoil • In opencast areas – compact backfilled material, calculate bulking factor, and create slight swell above ground level • In shallow underground section – maintain appropriate support pillars	On-going On-going As required On-going As required As required	As required On-going As required On-going As required As required	Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Decommission	Earthworks Civil works Demolition Rehabilitation Water use and water management Mine residue disposal Void positions	H	M	• During decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases. • At closure of any part of the mine, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long term safety and/or stability risk. • In case of injury or death due to hazardous excavations, follow emergency response procedure in Section 20 will be followed.	As required As required As required	As required As required As required	Environmental site manager Environmental site manager Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	• For sinkhole prevention – comply with measures in Table 63	As required	As required	Environmental site manager

TABLE 56: ACTION PLAN – SURFACE SUBSIDENCE

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	N/A	-	-	-	-	-	-
Operation	Opencast mining Underground mining Mine residue disposal Water use and management	H	M	• Backfilling operations, as specifically outlined in Table 40, must take the possibility of surface subsidence into account.	On-going	On-going	Environmental site manager
				• For opencast areas, backfilled material will be compacted, a bulking factor will be calculated, and a slight swell above ground level will be established.	On-going	On-going	Environmental site manager
Decommission	Opencast mining Underground mining Mine residue disposal Water use and management	H	M	• For the shallow underground section, this requires appropriate support pillars.	As required	As required	Environmental site manager
				• Final replacement of subsoil and topsoil onto the backfilled overburden / spoil material should be done with the understanding that if subsidence occurs thereafter, re-stripping of topsoil and additional backfilling with overburden / spoil will be required. Thereafter the subsoil and topsoil will have to be replaced.	On-going	On-going	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	• Additional testing should be conducted on actual samples from the mining operation to determine the geochemical characterisation of waste material.	On-going	On-going	Environmental site manager

TABLE 57: ACTION PLAN – LOSS OF SOIL RESOURCES

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Transport system Site management	H	M	• The mine will implement the soil conservation procedure as wet out in Table 40.	On-going	On-going	Environmental site manager
				• The mine will conduct all potentially polluting activities in a manner that pollutants are contained at source	On-going	On-going	Environmental site manager
Operation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Site support services Open pit mining MRDF Water supply infrastructure Power supply infrastructure	H	M	• All vehicles and equipment will be serviced in workshops and washbays with impermeable floors, dirty water collection facilities and oil traps.	On-going	On-going	Environmental site manager
				• Design and operate all new and used chemical, fuel, oil storage and handling facilities such that spillages are contained in impermeable areas and cannot be released into the environment.	On-going	On-going	Environmental site manager
				• Report ad hoc spills immediately to SHE manager and clean up/remediate spill immediately	On-going	On-going	Environmental site manager
				• All buffer specifications associated with the Transnet servitude will be adhered to to avoid causing pipeline damage and associated soil pollution	On-going	On-going	Environmental site manager
				• Specific engineering design measures to control potential acid mine drainage pollution from overburden spoil piles, mine void backfilling activities and the MRDF (as detailed in Table 40, and Table 41) must be strictly adhered to.	On-going	On-going	Environmental site manager
				• Implement dirty water management system (Sections 7.2.7 and 7.2.8)	On-going	On-going	Environmental site manager
				• Implement waste management practices (see Table 46).	On-going	On-going	Environmental site manager
Decommission	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Site support services MRDF Water supply infrastructure Power supply infrastructure Rehabilitation	H	M	• The design of any permanent and potentially polluting structures (mineralised waste facilities) will take account of the requirements for long term soil pollution prevention, land function and confirmatory monitoring.	As required	As required	Environmental site manager
				• In case of any major spillage incidents the emergency response procedure in Section 20 will be followed.	As required	As required	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M				

TABLE 58: ACTION PLAN – LOSS OF LAND WITH AGRICULTURAL POTENTIAL

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Site management Transport systems Site support services Rehabilitation	H	M	• Land disturbance by mine activities will be limited to those activities that are described in the EIA and EMP report. • Rehabilitation will commence in mined out areas as soon as mining advances to new areas. All rehabilitation initiatives will have the target that historical land capabilities are restored through the conservation and replacement of soil (see Table 57). • This area of approximately 139 ha for the MRDF will be rehabilitated to a wilderness/biodiversity land use. The same end use applies to any remaining overburden spoil piles. • In case of a major incident the emergency response procedure in Section 20 will be followed.	On-going As required As required As required	On-going As required As required As required	Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Operation	Earthworks Site management Transport system Non-mineralised waste management Site support services Open pit mining Mine residue disposal Rehabilitation	H	M				
Decommission	Demolition Earthworks Site management Transport system Non-mineralised waste management Site support services Mine residue disposal Rehabilitation	H	M				
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M				

TABLE 59: ACTION PLAN – BIODIVERSITY

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works Transport systems Power supply Site support services Storage and maintenance services / facilities Site management	H	M	• Limit the project footprint and activities to that identified in this EIA and EMP report.	On-going	On-going	Environmental site manager
				• Implement and refine biodiversity action plan in consultation with a biodiversity specialist. This action plan will be in place prior to the construction phase of the mine, and will include the following management actions:	Pre-construction	Once off	Environmental site manager
				○ conduct winter survey (2008);	Pre-construction	Once off	Environmental site manager
Operation	Opencast mining Mine residue disposal Coal washing plant Power supply Transport systems Site support services Storage and maintenance services / facilities Site management	H	M	○ limit mine infrastructure, activities and disturbance to those specifically identified and described in EIA and EMP report (see Figure 18) with controlled access and zero tolerance of disturbance to sensitive habitats and species;	On-going	On-going	Environmental site manager
				○ place a buffer zone around sensitive habitats (Section 1.1.6) that are not disturbed by approved activities;	On-going	On-going	Environmental site manager
				○ permits required prior to removal of protected vegetation species;	On-going	On-going	Environmental site manager
				○ engineering design work of rehabilitation of headwaters and river crossings to be done in consultation with qualified ecologist with water course related expertise to limit destruction of habitat and species and to promote re-establishment thereof – where possible, re-establish pebbles, rocks and biodiversity in headwaters and rescan areas for sensitive fauna and flora prior to construction;	Pre-construction	Once off	Environmental site manager
Decommission	Demolition Mine residue disposal Power supply Transport systems Site support services Site management Rehabilitation	H	M	○ plan for removal of fauna and flora (plants and seeds) prior to disturbance by mine infrastructure and activities – plan will include preservation, cultivation and re-use of species in ongoing rehabilitation. In this regard, the mine will establish an on-site nursery for plants that disturbed by the mining operations. Links will also be made to the soil conservation procedure and actions and the ongoing MRDF rehabilitation (Section 7.2.4);	Pre-construction	Once off	Environmental site manager
				○ implement alien/invasive/weed management programme in collaboration with DAgric, DWA, Working for Water – care will be taken to prevent intrusion of alien plant species into rehabilitated areas.	On-going	On-going	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	• Monitor vegetation establishment in line with rehabilitation plan	As required	As required	Environmental site manager

TABLE 60: ACTION PLAN – POLLUTION OF SURFACE WATER RESOURCES

Phase of operation	Activities (see Table 38)	Sig UM	Sig M	Technical and management options	Action plan: Timeframe	Action plan: Frequency	Action plan: Responsible parties
Construction	Earthworks civil works Water use and management Non-mineralised waste management Site support services Storage and maintenance services / facilities Site management	H	L-M	• Design, implement and manage clean and dirty water systems in accordance with provisions of Regulation 704: o divert clean water around operational areas; o minimise areas in which hazardous and/or polluting substances can be spilled and contain spills. Store hazardous/polluting substances in sealed containers within impermeable bunded areas with sufficient capacity to contain spills. All spilled materials must drain to sumps with oil traps that must also be equipped to allow collection and removal of spilled substances; o contain all dirty water in dirty water run-off and/or process water system (pipes, channels, dams); o re-use dirty water rather than discharge to environment; o routinely inspect systems to detect breaches and implement preventative/corrective action.	On-going	On-going	Environmental site manager
Operation	Open pit mining Mine residue disposal Mineral processing Water use and management Transport systems Non-mineralised waste management Site support services Storage and maintenance services / facilities Site management	H	L-M	• Design and implement sewage and process water treatment plant in accordance with parameters in Sections 2.7.13 and 2.7.14.2.	On-going	On-going	Environmental site manager
				• License sewage and process water treatment plant processes and related discharges with DWA.	As required	Once off	Environmental site manager
				• Implement suface water monitoring programme (see Section 21.1)	On-going	On-going	Environmental site manager
Decommission	Mine residue disposal Water use and management Transport systems Non-mineralised waste management Site support services Storage and maintenance services / facilities Site management Demolition Rehabilitation	H	L-M	• Document volumes and quality of surface water used by surrounding users prior to commencement of the mine.	Pre-construction	Once off	Environmental site manager
				• Notify DWA immediately of any contamination; notify potentially affected users of contamination in consultation with DWA and appropriately qualified person; identify source of contamination; identify measures for prevention (short and long term); and implement these measures.	All phases	Immediately	Environmental site manager
				• Compensate affected users for any mine-related loss of water supply (short and long term).	All phases	As required	Environmental site manager
				• In case of a major incident the emergency response procedure in Section 20 will be followed.	As required	As required	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L-M	• Provision must be made for long term post closure treatment of contaminated water, and for compensation for any contamination related losses that may be experienced by water users.	As required	As required	Environmental site manager

TABLE 61: ACTION PLAN – ALTERATION OF DRAINAGE PATTERNS

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Non-mineralised waste management Transport system Stormwater management Site support services Site management	H	M	• Apply to DWA for destruction of non-perennial upper reaches and the bridge crossings in accordance with requirements of Regulation 704, 4 June 1999, and the requirements of the National Water Act, 36 of 1998 • Comply with any related conditions that are stipulated by DWA. • Comply with measures in Section 7.2.6 and 7.2.3 • The footprint and associated catchment of all mine infrastructure will be minimised in accordance with Regulation 704 to limit the impact on stream flow reduction by diverting clean water around dirty areas.	Pre-construction On-going On-going On-going	Once off On-going On-going On-going	Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Operation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Site support services Site management Opencast mining Mineral processing Mine residue disposal Water and power supply infrastructure Stormwater management Rehabilitation	H	M				
Decommission	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Site support services Site management Mine residue disposal Water and power supply infrastructure Stormwater management Rehabilitation	H	M				
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L	• Maintain stormwater controls (through inspection and repair) until such time as facilities can be removed • Monitor re-instated drainage patterns to ensure natural flow	As required On-going	On-going As required	Environmental site manager Environmental site manager

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				patterns occur as far as possible			

TABLE 62: ACTION PLAN – REDUCTION OF GROUNDWATER LEVELS / AVAILABILITY

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	N/A	-	-	• Conduct detailed hydrocensus of all boreholes in use in potentially affected zones to verify if there are additional boreholes (borehole location, water depth, water quality, yield and water use).	Pre-mining	Once off	Environmental site manager
Operation	Open pit mining Underground mining	M* M#	L* M#	• No mining allowed within 100m of the two significant non-perennial tributaries on the project site. • If dewatering is impacting base flow of watercourses, implement measures to compensate for dewatering in consultation with specialist, key stakeholders and DWA. • Implement water monitoring programme (Section 21.1.1) • Compensate affected users for any mine-related loss of water supply (short and long term).	Construction Construction to operational All phases All phases	On-going As required Monthly and quarterly As required	Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Decommission	N/A	-	-	-	-	-	-
Closure	N/A	-	-	-	-	-	-

Notes:
* Effects on groundwater users
# Effects on base flow of watercourses

TABLE 63: ACTION PLAN – CONTAMINATION OF GROUNDWATER RESOURCES

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Water use and management Non-mineralised waste management Storage and maintenance services / facilities Site management	H	M-H	• Manage and dispose of waste strictly in accordance with Section 2.7.12.	All phases	On-going	Environmental site manager
Operation	Waste rock management Water use and management Non-mineralised waste management Storage and maintenance services / facilities Site management	H	M-H	• Manage and dispose of water strictly in accordance with Sections 2.7.14.2 and 2.7.14.2.	All phases	On-going	Environmental site manager
Decommission	Waste rock dumps Water use and management Non-mineralised waste management Storage and maintenance services / facilities Site management	H	M-H	• No mining allowed in areas where there are inadequate impermeable zones below the target coal seams.	Operational	On-going	Environmental site manager
				• Match blast design to specifications required to protect impermeable zones (blast design by appropriately qualified blast engineer for each type of zone, record keeping to confirm blast design is adhered to).	Operational	Every blast	Environmental site manager
				• Investigate use of permeability tests to compare permeability in impermeable zones pre and post blasting.	Pre-blasting	As required	Environmental site manager
				• If its possible to obtain meaningful results from permeability tests, these should be conducted to verifyadequacy of blast design and implementation.	Operational to closure	Regularly	Environmental site manager
				• If blasting is causing unacceptable fracturing of impermeable zones, collective decisions on way forward must be made by the mine, DWA, blast designer and relevant geotechnical and geohydrological specialists.	Operational	On-going	Environmental site manager
				• Conduct detailed hydrocensus of all boreholes in use in potentially affected zones to verify if there are additional boreholes (borehole location, water depth, water quality, yield and water use).	Pre-construction	Once-off	Environmental site manager
				• Implement water monitoring programme (Section 21.1.1).	All phases	Monthly and quarterly	Environmental site manager
				• Recalibrate groundwater model when MRDF source concentrations and seepage infiltration rates have been determined more accurately.	Operational	On-going	Environmental site manager
				• If any potential for long-term water contamination is identified, the actions set out below will be implemented prior to closure: o place curtain of boreholes adjacent to MRDF, o capture any contaminated decant, o treat all captured contaminated water in on-site plant, o maintain and upgrade plant to allow for treatment in perpetuity.	On-going	On-going	Environmental site manager
				• Notify DWA immediately of any contamination; notify potentially affected users of contamination in consultation with DWA and appropriately qualified person; identify source of contamination; identify measures for prevention (short and long term); and implement measures.	All phases	As required	Environmental site manager
				• Compensate affected users for any mine-related loss of water supply (short and long term)	All phases	As required	Environmental site manager

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• Make provision for post closure compensation – this will form part of detailed closure planning (Section 25)	Pre-closure	As required	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M-H	• The on-site water treatment plant will be routinely maintained and upgraded to allow for treatment in perpetuity (applies to the closure and post-closure phases).	On-going	On-going	Environmental site manager

TABLE 64: ACTION PLAN – AIR POLLUTION

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works Transport systems Site support services Site management	H	M* H#	• Implement the following measures: o For unpaved roads – target dust control efficiency of a minimum of 75% - combination of waste rock, chemical binding agent and water suppression.	All phases	On-going	Environmental site manager
				o For wind erosion – target dust control efficiency of 60% - concurrent rehabilitation, vegetation cover on MRDF, facilitating vegetation cover of topsoil and subsoil stockpiles, spraying other uncovered stockpiles.	All phases	On-going	Environmental site manager
Operation	Open pit mining Mineral processing Mine residue disposal Transport systems Site support services Site management	H	M* H#	o For material handling and crushing – target dust control efficiency of 62% - water sprays, partially enclosed conveyor.	All phases	On-going	Environmental site manager
				• Consider either of following measures to prevent unacceptable exceedances of proposed future PM_{10} standards: o Keep heavy run of mine and product traffic on roads not aligned with project boundaries – avoid roads that run along northern project boundary and road to south western pit;	Operational	On-going	Environmental site manager
Decommission	Mine residue disposal Demolition Rehabilitation	H	M* H#	o Purchase / lease land around significant sources to create an off-site buffer zone.	Operational	Once-off	Environmental site manager
				• People residing at Receptor points 1, 2 and 3 will be relocated outside of the significant impact zone.	Immediately	Once-off	Environmental site manager
				• Implement monitoring programme (Section 21.1.2).	All phases	Monthly	Environmental site manager
				• If monitoring determines unacceptable dust emissions, take immediate steps to address issue in consultation with a suitable air quality specialist.	All phases	As required	Environmental site manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M* H#	• As part of closure planning, the designs of any permanent and potentially polluting structures (particularly mineralised waste facilities) will, on the basis of modelling, incorporate measures to address long term pollution prevention.	As required	As required	Environmental site manager
				• Monitor and maintain vegetation cover on final land forms and rehabilitated areas	6 years	On-going	Environmental site manager

Notes:
* Other receptors
# Receptors 1, 2 and 3 (located within the mining right area)

TABLE 65: ACTION PLAN – INCREASE IN NOISE DISTURBANCE

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works Transport systems Site support services Site management	M-H* H#	M* M-H#	• Before blasting cognisance will be taken of unfavourable wind directions, cloud cover and temperature inversions. • Conduct noise monitoring by an environmental noise professional at receptor sites to the north, south, east and west of project site as detailed in Section 21.1.3.	Operational On-going	Every blast On-going	Environmental site manager Environmental site manager
Operation	Opencast mining Mineral processing Mine residue disposal Transport systems Site support services Site management	M-H* H#	M* M-H#	• If unacceptable noise levels recorded, assess options for mitigation and implement in consultation with affected third parties and independent specialist (i.e. limit operating times, adjust blast design, construct noise berms, point source emitters). • Record and respond without delay to complaints about disturbing noise (document and record as incidents, include measures to address these complaints, keep records for life of mine).	On-going On-going	On-going On-going	Environmental site manager Environmental site manager
Decommission	Demolition Mine residue disposal Transport systems	M-H* H#	M* M-H#	• In order to prevent unacceptable noise impact to the receptors located within the mining right boundary, people residing at Receptor points 2, 3 and 4 will be relocated outside of the significant impact zone.	Immediately	Once-off	Environmental site manager
Closure	N/A	-	-	-	-	-	-

Notes:

* Other receptors

Receptors 2, 3 and 4 (located within mining right area)

TABLE 66: ACTION PLAN – VISUAL IMPACTS

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Site management Rehabilitation Non mineralised waste management Site support services	H	M	• Disturb minimal amount of vegetation and land during site development and operation – especially on boundaries of project areas. • Implement air pollution control system (Section 7.2.11) • Paint structures and buildings in colours that reflect natural landscape. • Rehabilitate all mined out areas in accordance with the principles of ongoing rehabilitation (i.e. backfilling and compacting overburden, placement of sub soils and topsoils, re-establishment of vegetation). • effective rehabilitation of the MRDF is extremely significant because this will be a permanent post closure feature. In this regard, the dam will be raised with gentle side slopes to allow a cover to be placed concurrently. This cover will be investigated and could comprise a buffer layer, pollution control membranes, subsoil, topsoil and vegetation. • Rehabilitate overburden/spoil dumps that remain at closure (side slopes flattened to 1v:6h prior to topsoiling and vegetation establishment). • All vegetation planted as part of rehabilitation should reflect natural vegetation of area. • Night lighting will be fitted with fixtures to prevent light spillage (light focused on precise mine activities and infrastructure, as low to ground as practicable, most security lights with movement sensors).	On-going On-going As required On-going On-going As required As required On-going	On-going On-going As required On-going On-going As required As required On-going	Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Operation	Earthworks Civil works Opencast mining Mineral processing Mine residue disposal Water and power supply infrastructure Transport systems Non-mineralised waste management Site support services	H	M				
Decommission	Earthworks Civil works Mineral processing Mine residue disposal Water and power supply infrastructure Transport systems Non-mineralised waste management Site support services Site management Demolition Rehabilitation	H	M				
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L	• Final land forms will be managed through a care and maintenance programme to limit long term post closure visual impacts.	As required	As required	Environmental site manager

TABLE 67: ACTION PLAN – HERITAGE (INCLUDING CULTURAL) AND PALEONTOLOGICAL RESOURCES

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Site management Transport systems Site support services Rehabilitation	H* M#	L* L#	• Project infrastructure, activities and related disturbances will be limited to those specifically identified and described in this report. • Prior to damaging or destroying any of the identified graves, obtain permission for the exhumation and relocation of graves from the relevant descendants (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police. • Fence off any graves in the mining area that will not be disturbed by the project. Allow access to descendents – to be arranged through the Mine Manager. • All workers (temporary and permanent) will be educated about the heritage, cultural and paleontological sites that may be encountered in their area of work and about the need to conserve these. • In the event that new heritage, cultural and/or paleontological resources are discovered, the mine will follow an emergency procedure, which includes the following: o work at the find will be stopped to prevent damage; o an appropriate heritage/paleontological specialist will be appointed to assess the find and related impacts; o permitting applications will be made to SAHRA, if required. • In the case of a major incident, the emergency response procedure in Section 20 will be followed	On-going As required Pre-construction As required As required As required	On-going As required On-going As required As required As required	Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager Environmental site manager
Operation	Earthworks Site management Transport systems Non-mineralised waste management Site support services Open pit mining Mine residue disposal Water and power supply infrastructure Rehabilitation	H* M#	L* L#				
Decommission	Demolition Earthworks Site management Transport systems Non-mineralised waste management Site support services Mine residue disposal Water and power supply infrastructure Rehabilitation	H* M#	L* L#				
Closure	Not applicable	-	-	-	-	-	-

Notes:
* Heritage resources
# Paleonotological resources

TABLE 68: ACTION PLAN – BLASTING DAMAGE

Phase of operation	Activities (see Table 38)	Sig UM	Sig M	Technical and management options	Action plan: Timeframe	Action plan: Frequency	Action plan: Responsible parties
Construction	Earthworks	H	M	• Comply with relevant blasting and explosives legislation including Explosives Act and Mine Health and Safety Act.	All phases	On-going	Environmental site manager
Operation	Opencast mining Shallow underground mining	H	M	• Blast design will, as a minimum standard, ensure that the peak particle velocity (PPV) from all blasts is less than 12 mm/s at all vulnerable third party structures, that flyrock is contained within 500m of each blast and that the airblast is less than 130 dB for all blasts.	Pre blast	Every blast	Environmental site manager
				• Implement monitoring programme (Section 21.1.5)	Operational	Every blast	Environmental site manager
				• Photographically survey all vulnerable structures (see Table 48 as a minimum) within 1 500 m of the blast in presence of owner, and mark on site plan. A crack survey has been conducted and will be updated when necessary.	On-going	On-going	Environmental site manager
				• Divert power lines, telephone lines and pipelines (excluding underground Transnet pipeline) that could be impeded or damaged by the mining and/or blasting activities in consent of the relevant stakeholder/service providers.	Pre-mining	As required	Environmental site manager
				• Apply the following safety steps: ○ delineate fly rock danger zone and clear people and animals from this zone; ○ if D2543 is within this zone, temporarily close road 5 minutes before blast and until the area is declared safe; ○ give audible warning at least 3 minutes before the blast is fired.	On-going	On-going	Environmental site manager
				• Amend blast design if blasting will take place within 500 m of any third party structures (residences, tarred road, pipeline etc.). In this regard, when blasting is within 500 m of residences, the relevant people will need to be evacuated for each blast or relocated.	On-going	On-going	Environmental site manager
				• With regards to the underground Transnet pipeline, blasting within 500 m may only take place in accordance with Transnet's specifications. No blasting may take place within 100 m of the pipeline	On-going	On-going	Environmental site manager
				• Develop a procedure that takes temperature inversions, low cloud cover and wind direction into consideration to assist with deciding when to blast.	On-going	On-going	Environmental site manager
				• Respond immediately to any blast related complaints and keep a record of complaints and follow ups.	On-going	On-going	Environmental site manager
				• If mine has caused blast related damage, appropriate compensation will be provided.	On-going	Quarterly	Environmental site manager
				• In case of a major incident the emergency response procedure in Section 20 will be followed.	As required	As required	Environmental site manager
Decommission	N/A	-	-	-	-	-	-

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Closure	N/A	-	-				

TABLE 69: ACTION PLAN – TRAFFIC

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Transport systems	H	M	• Design and establish access points/intersections in accordance with recommendations of traffic specialist and approval of Mpumalanga Department of Roads and Transport i.e.: ○ traffic leaving the mine and joining the D2543 will be stop controlled; ○ access junctions equipped with lighting; ○ provide additional dedicated right turning lanes and 60m shoulders for left turning traffic at all access points; ○ facilities must be provided for offloading people that are transported to the mine on public transport. Employees will have dedicated drop off points on the access roads outside the security control points. All these measures are designed to limit disturbance of traffic on the D2543	Construction	Once off	Environmental site manager
Operation	Transport systems	H	M	• Public dirt roads will not be used by project-related traffic.	All phases	On-going	Environmental site manager
Decommission	Transport systems	H	M	• Trucks will not be overloaded. Implement procedure to check public roads on an hourly basis and clear up spilled material if necessary.	Operational	On-going	Environmental site manager
				• Establish joint road maintenance plan in consultation with Mpumalanga Department of Roads and Transport and other significant users of public roads to ensure condition and integrity of public roads are acceptable. Plan to include initial investigations on quality and lifespan of roads trucks will travel.	Construction	On-going	Environmental site manager
				• Record and respond appropriately and without delay to any complaints about road usage by mine vehicles.	All phases	As required	Environmental site manager
				• In case of a major incident the emergency response procedure in Section 20 will be followed.	As required	As required	Environmental site manager
Closure	Not applicable	-	-	-	-	-	-

TABLE 70: ACTION PLAN – NEGATIVE SOCIO-ECONOMIC

Phase of operation	Activities (see Table 38)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Negative socio-economic							
Construction	All activities			• Recruitment, training and housing policies will be drafted and implemented and will incorporate the measures detailed in Section 7.2.19.	Pre-construction	On-going	Environmental site manager
Operation	All activities						
Decommission	All activities						
Closure	All activities			• Formal transport (busses and mini vans) will be provided for the majority of the workforce.	On-going	On-going	Environmental site manager
Relocation							
Construction	All activities	H	M	• If farm workers relocate with current employees, include as a condition of land purchase agreement between farmers and the mine.	Pre-construction	Once off	Keaton management
Operation	All activities	H	M				
Decommission	All activities	H	M				
Closure	All activities	H	M	• If farm workers do not relocate with current employees, the mine will appoint team of professionals to design a resettlement plan.	Pre-development of specific area	Once off	Keaton management
				• Implement resettlement plan, if required.	As required	As required	Keaton management
Informal settlements, safety and security							
Construction	All activities	H	M	• Facilitate establishment of forum comprising local police force, the mine's security company and neighbouring land owners.	Pre construction	On-going	Environmental site manager
Operation	All activities	H	M				
Decommission	All activities	H	M				
Closure	All activities	H	M				
Land values							
Construction	All activities	H	M-L	• Implement all management actions set out in Sections 7 and 19.	On-going	On-going	Environmental site manager
Operation	All activities	H	M-L				
Decommission	All activities	H	M-L	• Conduct base case valuation of land surrounding mine site by independent valuator.	Pre-construction	Once off	Keaton management
Closure	All activities	H	M-L				
				• If loss in land value caused by unacceptable mine related impacts, compensate relevant land owners accordingly.	As required	As required	Keaton management

20 PROCEDURES FOR ENVIRONMENTAL EMERGENCIES AND REMEDIATION

Emergency procedures apply to incidents that are unexpected and that may be sudden, and which lead to serious danger to the public and/or potentially serious pollution of, or detriment to the environment (immediate and delayed). Emergency environmental situations that have been identified for the Vanggatfontein Coal Mine are shown in Table 71.

20.1 ONGOING MONITORING AND MANAGEMENT MEASURES

The on-going monitoring as described in Section 20.2 will be undertaken to provide early warning systems necessary to avoid environmental emergencies.

20.2 GENERAL EMERGENCY PROCEDURE

The general procedure that should be followed in the event of all emergency situations is as follows.

- Applicable operational managers must be notified of an incident upon discovery;
- Area to be cordoned off to prevent unauthorised access and tampering of evidence;
- If residue facilities/dams, storm water diversions, etc., are partially or totally failing and this cannot be prevented, the emergency siren is to be sounded (nearest one available). After hours the Plant Manager on shift must be notified;
- Take photographs and samples as necessary to assist in investigation;
- Report the incident to the responsible person of the Safety, Health Environment and Quality (SHEQ) department (or equivalent);
- The SHEQ department must comply with Section 30 of the National Environmental Management Act (107 of 1998) such that:
  - The mine (through the mine manager's office) must immediately notify the Director-General (DEA, DMR and Inspectorate of Mines as appropriate), the South African Police Services, the relevant fire prevention service, the provincial head of DEDET, the head of the local municipality, the head of the regional DWA office and any persons whose health may be affected of:
    - The nature of the incident;
    - Any risks posed to public health, safety and property;
    - The toxicity of the substances or by-products released by the incident; and
    - Any steps taken to avoid or minimise the effects of the incident on public health and the environment.
  - The SHEQ department must as soon as is practical after the incident:
    - Take all reasonable measures to contain and minimise the effects of the incident including its effects on the environment and any risks posed by the incident to the health, safety and property of persons;

    - Undertake clean up procedures;
    - Remedy the effects of the incident; and
    - Assess the immediate and long term effects of the incident (environment and public health);
- Within 14 days the mine (through the mine manager's office) must report to the Director-General DEA, the provincial head of DEDET, the head of the local municipality, the head of the regional DWA office such information as is available to enable an initial evaluation of the incident, including:
    - The nature of the incident;
    - The substances involved and an estimation of the quantity released;
    - The possible acute effects of the substances on the persons and the environment (including the data needed to assess these effects);
    - Initial measures taken to minimise the impacts;
    - Causes of the incident, whether direct or indirect, including equipment, technology, system or management failure; and
    - Measures taken to avoid a recurrence of the incident.

20.3 IDENTIFICATION OF EMERGENCY SITUATIONS

Emergency procedures apply to incidents that are unexpected and that may be sudden, and which lead to serious danger to the public and/or potentially serious pollution of, or detriment to the environment (immediate and delayed). The site wide emergency situations that have been identified together with specific emergency response procedures are described in the table below (Table 71).

TABLE 71: EMERGENCY SITUATIONS AND RESPONSE

ITEM	EMERGENCY SITUATION	RESPONSE IN ADDITION TO GENERAL PROCEDURES
1	Spillage of chemicals, engineering substances and waste	Where there is a risk that contamination will contaminate the land (leading to a loss of resource), surface water and/or groundwater, the mine will: Notify residents/users downstream of the pollution incident. Identify and provide alternative resources should contamination impact adversely on the existing environment;. Cut off the source if the spill is originating from a pump, pipeline or valve (e.g. TSF delivery pipeline, refuelling tanker) and the infrastructure ‘made safe’. Contain the spill (e.g. construct temporary earth bund around source such as road tanker). Pump excess hazardous liquids on the surface to temporary containers (e.g. 210 litre drums, mobile tanker, etc.) for appropriate disposal. Remove hazardous substances from damaged infrastructure to an appropriate storage area before it is removed/repaired.
2	Discharge of dirty water to the environment	Apply the principals listed for Item 1 above. To stop spillage from the dirty water system the mine will: Redirect excess water to other dirty water facilities where possible; Pump dirty water to available containment in the clean water system, where there is no capacity in the dirty water system; and Carry out an emergency discharge of clean water and redirect the spillage to the emptied facility. Apply for emergency discharge as a last resort.
3	Pollution of surface water	Personnel discovering the incident must inform the SHEQ department of the location and contaminant source. Apply the principals listed for Item 1 above. Absorbent booms will be used to absorb surface plumes of hydrocarbon contaminants. Contamination entering the surface water drainage system should be redirected into the dirty water system. The SHEQ department will collect in-stream water samples downstream of the incident to assess the immediate risk posed by contamination.
4	Groundwater contamination	Use the groundwater monitoring boreholes as scavenger wells to pump out the polluted groundwater for re-use in the process water circuit (hence containing the contamination and preventing further migration). Investigate the source of contamination and implement control/mitigation measures.
5	Burst water pipes (loss of resource and erosion)	Notify authority responsible for the pipeline (if not mine responsibility). Shut off the water flowing through the damaged area and repair the damage (if the mine’s pipeline). Apply the principals listed for Item 1 above if spill is from the dirty/process water circuit.
6	Flooding from failure of surface water control infrastructure	Evacuate the area downstream of the failure (e.g. opencast pits). Using the emergency response team, rescue/recover and medically treat any injured personnel. Temporarily reinstate/repair storm water diversions during the storm event (e.g. emergency supply of sandbags). Close the roads affected by localised flooding or where a storm water surge has destroyed crossings/bridges.

ITEM	EMERGENCY SITUATION	RESPONSE IN ADDITION TO GENERAL PROCEDURES
7	Risk of drowning from falling into water dams	Attempt rescue of individuals from land by throwing lifeline/lifesaving ring. Get assistance of emergency response team whilst attempting rescue or to carry out rescue of animals. Ensure medical assistance is available to recovered individual.
8	Veld fire	Evacuate mine employees from areas at risk. Notify downwind residents and industries of the danger. Assist those in imminent danger/less able individuals to evacuate until danger has passed. Provide emergency fire fighting assistance with available trained mine personnel and equipment.
9	Overtopping or failure of the tailings dam	Sound the alarm to evacuate danger area. Pump water from top of dam and follow redirection of water as indicated in Item 2 above. Stop pumping tailings to the TSF. Recover casualties resulting from dam failure using the emergency response team. Make the remaining structure safe. Apply the principles of Item 1 above.
10	Injury from fly rock	The person discovering the incident will contact the mine emergency response personnel to recover the injured party and provide medical assistance. Whilst awaiting arrival of the emergency response personnel, first aid should be administered to the injured party by a qualified first aider if it is safe to do so.
11	Falling into hazardous excavations	Personnel discovering the fallen individual or animal must mobilise the emergency response team to the location of the incident and provide a general appraisal of the situation (e.g. human or animal, conscious or unconscious, etc). The injured party should be recovered by trained professionals such as the mine emergency response team. A doctor (or appropriate medical practitioner)/ambulance should be present at the scene to provide first aid and transport individual to hospital.
12	Road traffic accidents (on site)	The individual discovering the accident (be it bystander or able casualty) must raise the alarm giving the location of the incident. Able personnel at the scene should shut down vehicles where it is safe to do so. Access to the area should be restricted and access roads cleared for the emergency response team. Vehicles must be made safe first by trained professionals (e.g. crushed or overturned vehicles). Casualties will be moved to safety by trained professionals and provided with medical assistance. Medical centres in the vicinity with appropriate medical capabilities will be notified if multiple seriously injured casualties are expected.

ITEM	EMERGENCY SITUATION	RESPONSE IN ADDITION TO GENERAL PROCEDURES
13	Uncovering of graves and sites	Prior to damaging or destroying any of the identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local Police. The exhumation process must comply with the requirements of the relevant Ordinance on Exhumations, and the Human Tissues Act, 65 of 1983.
14	Development of informal settlements	The mine will inform the local authorities (municipality and police) that people are illegally occupying the land and ensure that action is taken within 24hrs.

20.4 TECHNICAL, MANAGEMENT AND FINANCIAL OPTIONS

Technical, management and financial options that will be put into place to deal with the remediation of impacts in cases of environmental emergencies are described below.

- The mine will appoint a competent management team with the appropriate skills to develop and manage a mine of this scale and nature.
- In order to prevent the occurrence of unacceptable negative impacts and/or emergency situations, the mine as a minimum will implement the mine plan and mitigation measures as included in this EIA and EMP report.
- On an annual basis, the mine will undertake a risk assessment as part of its auditing procedures to identify and check potential risks associated with its operations. The findings of the risk assessment will be reported to mine management to be actioned.
- As part of its annual budget, the mine will allow a contingency for handling of any risks identified and/or emergency situations.
- Where required, the mine will seek input from appropriately qualified people.

21 PLANNED MONITORING AND EMP PERFORMANCE ASSESSMENT

21.1 PLANNED MONITORING OF ENVIRONMENTAL ASPECTS

Environmental aspects requiring monitoring are listed below.

- water resources – see Section 21.1.1 for details;
- air – see Section 21.1.2 for details;
- noise – see Section 21.1.3 for details;
- biodiversity – see Section 21.1.4 for details;
- blasting – see Section 21.1.5 for details; and
- MRDF, waste dumps and other water dams – see Section 21.1.6 for details.

21.1.1 WATER RESOURCES

Table 72 and Table 73 below set out the monitoring points, programme and parameters for both ground and surface water on and off the site (where relevant). The location of these monitoring points is included in Figure 23. The parameters may be modified on the basis of input from an appropriate specialist and DWA. It is also possible that the programme will be modified as part of the integrated water license process.

TABLE 72: MONITORING PARAMETERS FOR ANALYSIS AND REPORTING

PARAMETERS	
PH	Fluoride
Electrical Conductivity (EC)	Boron
Total dissolved Solids (TDS)	Aluminium
Alkalinity as $CaCO_3$	Barium
Acidity as H^+	Iron
Calcium	Manganese
Magnesium	Chrome (VI)
Sodium	Copper
Potassium	Lead
Sulphate	Zinc
Chloride	Cadmium
Nitrate as N	Selenium
Ammonia as N	Arsenic
Phosphate	Mercury

TABLE 73: WATER MONITORING PROGRAMME

Water source	Reference	Water point type	Location	South co-ordinate	East co-ordinate	Water Quality monitoring	Water level monitoring
Groundwater	VF-7	Borehole	Vanggatfontein 251 IR	S26° 10' 07.0"	E28° 51' 20.2"	Quarterly	Monthly If Possible
	BF-8	Borehole	Vanggatfontein 251 IR	S26° 11' 40.5 "	E28° 50 56.2"	Quarterly	Monthly If Possible
	VF-1	Borehole	Vanggatfontein 251 IR	S26° 10' 19.8 "	E28° 50' 02.4"	Quarterly	Monthly If Possible
	VF-2	Borehole	Vanggatfontein 251 IR	S26° 10 12.4 "	E28° 50' 13.6"	Quarterly	Monthly If Possible
	VF-8	Borehole	Vanggatfontein 251 IR	S26° 10' 03.3 "	E28° 51' 30.5"	Quarterly	Monthly
	VF-11	Borehole	Vanggatfontein 251 IR	S26° 10' 56.0 "	E28° 50' 33.3"	Quarterly	Monthly If Possible
	BF-2	Borehole	Vanggatfontein 251 IR	S26° 12' 24.5 "	E28° 50' 42.6"	Quarterly	Monthly
	RK-3	Borehole	Rietkuil 249 IR	S26° 10' 27.9 "	E28° 48' 19.2"	Quarterly	Monthly
	VG-3	Borehole	Vanggatfontein 250 IR	S26° 09' 36.5 "	E28° 50' 10.8"	Quarterly	Monthly If Possible
	WN2	Borehole	Welgelegen	TBD	TBD	Quarterly	Monthly If Possible
	VF-12	Borehole	Vanggatfontein 251 IR	S26° 09' 46.07 "	E28° 51' 40.19"	Quarterly	Monthly
	VF-13	Borehole	Vanggatfontein 251 IR	S26° 09' 35.65 "	E28° 52' 11.66"	Quarterly	Monthly
	VF-14	Borehole	Vanggatfontein 251 IR	S26° 09' 56.64 "	E28° 51' 58.44"	Quarterly	Monthly
	VF-15	Borehole	Straffontein 252 IR	S26° 10' 17.22 "	E28° 52' 09.44"	Quarterly	Monthly
	VF-16	Borehole	Vanggatfontein 250 IR	S26° 10' 28.64 "	E28° 51' 11.33"	Quarterly	Monthly
	VF-6	Borehole	Vanggatfontein 2501IR	S 26° 10' 01.1"	E 28° 51' 34.8"	Quarterly	*Not possible
	BF-2a	Borehole	Brakfontein 264 IR	S 26° 12' 28.9"	E 28° 50' 36.6"	Quarterly	*Not possible
	VF-10	Borehole	Brakfontein 264 IR	S 26° 11' 02.7"	E 28° 51' 05.3"	Quarterly	*Not possible
	Gerricke	Borehole	Brakfontein 264 IR	S 26° 12' 54,6"	E 28° 51' 42,1"	Quarterly	*Not possible
	Opperman	Borehole	Vanggatfontein 250 IR and Vogelfontein 222 IR	S 26° 09' 33.6"	E 28° 50' 05.1"	Quarterly	*Not possible

Water source	Reference	Water point type	Location	South co-ordinate	East co-ordinate	Water Quality monitoring	Water level monitoring
	VdM	Borehole	Straffontein 252 IR	S 26° 09' 24.9''	E 28° 53' 39.6''	Quarterly	*Not possible
	Kleyn	Borehole	Straffontein 252 IR	S 26° 09' 33.8''	E 28° 53' 52.0''	Quarterly	*Not possible
	Bezuidenhout	Borehole	Welgelegen	S 26° 08' 14.7''	E 28° 51' 40.3''	Quarterly	*Not possible
	Welbez	Borehole	Vanggatfontein 250 IR, Straffontein 252 IR and Vogelfontein 222 IR	S 26° 08' 32.4''	E 28° 53' 29.1''	Quarterly	*Not possible
Surface water	VF-F1	Spring	Vanggatfontein 251 IR	S26° 10' 29.6 ''	E28° 51' 19.0''	Quarterly	N/A
	SW1	Stream	Stream - Tributary of the Wilge River south of the site at tar road bridge	S26° 11' 53.5''	E28° 51' 54.9''	Quarterly	N/A
	SW2	Dam outlet	Dam/Stream – Point at outlet of farm dam on same river as point SW1 just prior to the confluence with the Wilge River	S26° 11' 19.1 ''	E28° 46' 39.4''	Quarterly	N/A
	SW3	Stream	Stream - Wilge River upstream of confluence with stream on which point SW2 is located	S26° 09' 45.3 ''	E28° 46' 07.7''	Quarterly	N/A
	SW4	Stream	Stream - Tributary of the Wilge River, upstream of SW1, south of the site at boundary of the site	S26° 11' 32.9 ''	E28° 52' 47.1''	Quarterly	N/A
	SW5	Stream	Stream - Tributary of the Wilge River, upstream of point SW14	S26° 11' 27.3 ''	E28° 52' 58.2''	Quarterly	N/A
	SW6	Pan	Pan - adjacent to the tar road just north of the site	S26° 11' 44.4 ''	E28° 50' 56.0''	Quarterly	N/A
	SW7	Stream	Stream – at sand road bridge crossing north of the site	S26° 10' 35.9 ''	E28° 51' 36.4''	Quarterly	N/A
	SW8	River	River – Wilge river where sand road crosses	S26° 10' 26.3 ''	E28° 49' 32.3''	Quarterly	N/A
	SW9		(To the west of site – not applicable to the project at this stage)	S26° 09' 17.3''	E28° 50' 33.3''		N/A
	SW10		(To the west of site – not applicable to the project at this stage)	S26° 08' 30.6 ''	E28° 52' 37.8''		N/A
	SW11		(To the west of site – not applicable to the project at this stage)	S26° 13' 14.7 ''	E28° 48' 51.8''		N/A
	SW12	Dam	Farm Dam	S26° 11' 29.0 ''	E28° 50' 06.7''	Quarterly	N/A
	SW13	Dam	Farm Dam upstream from point SW12	S26° 11' 17.3 ''	E28° 49' 39.6''	Quarterly	N/A

Water source	Reference	Water point type	Location	South co-ordinate	East co-ordinate	Water Quality monitoring	Water level monitoring
	SW14	Stream	Stream – downstream of point SW5 at fence boundary of farm and about 800m away from the Wilge River	S26° 10' 19.6 "	E28° 52' 32.3"	Quarterly	N/A
	SW15	River	Wilge River, just upstream of confluence with stream on which SW14 is located	S26° 10' 18.0 "	E28° 52' 47.6"	Quarterly	N/A

N/A = Not Applicable

Note:

1. groundwater levels to be measured where possible i.e. where boreholes are not equipped
2. Co-ordinates are in Long / Lat and WGS84 datum

21.1.2 AIR QUALITY

A network of 12 dust buckets has been implemented at the mine. The dust buckets have been be placed on the boundaries of the mining right area and immediately downwind of potentially significant dust generating sources (see Figure 23). The target off-site dust fallout reading is less than 600mg/m^2/day. The buckets will be monitored on a monthly basis.

21.1.3 NOISE

Noise monitoring will be done on an annual basis to confirm that implemented noise management measures are effective. Monitoring will be done by an appropriately qualified environmental noise specialist. The noise measurement points will be selected by the specialist and may be modified on the basis of input from IAPs. A report will be produced to document the measurement points, the methodology used, the measured results and recommendations, if required, to further minimise the mine's impact.

21.1.4 BIO MONITORING

The mine will monitor the aquatic ecology integrity of water courses in the vicinity of the mining operations as per the expected water license. Monitoring points are shown on Figure 23. Additional monitoring points may be determined in consultation with an appropriately qualified specialist who will also conduct the sampling and analysis.

21.1.5 BLASTING

Monitoring will be done for each blast to verify that fly rock is being contained within 500m of the blast, that the ground vibration is less than or equal to a peak particle velocity of 12 mm/s at the closest third party structure, and that the airblast is less than or equal to 130 dB at the closest third party structure. Specific locations of the monitoring seismographs will be identified by an appropriate speciailist during the pre-blast survey. These points will also move as the opencast mining progresses and the position thereof may be influenced by the requests of IAPs. The mine will adhere to all blast conditions stipulated by Transnet when blasting occurs within 500 m of the underground pipeline.

21.1.6 DAMS WITH A WALL OF 5M OR MORE AND A CAPACITY OF 50 000M^3 OR MORE

In addition to the abovementioned environmental monitoring programmes the following issues will, as a minimum, be monitored by a professional engineer on a quarterly basis:

- phreatic surface, slope stability, adequacy of freeboard, integrity of walls, the position of the pools, silt trap sediment, presence of seepage, and functioning of drains;
- the success of vegetation establishment on the outer side walls; and

- erosion damage.

The findings will be documented for record-keeping and auditing purposes and addressed where relevant to achieve the stated objectives.

FIGURE 23: MONITORING NETWORK

21.2 AUDITING AND PERFORMANCE ASSESSMENTS

The SHE manager will conduct internal management audits against the commitments in the EMP. During the construction and decommissioning phases, these audits will be conducted every two weeks. In the operational and closure phases, these audits will be conducted on a quarterly basis. The audit findings will be documented for both record keeping purposes and for informing continual improvement. In addition, and in accordance with mining regulation R527, an independent professional will conduct an EMP performance assessment every two years. The site's compliance with the provisions of the EMP and the adequacy of the EMP report relative to the on-site activities will be assessed in the performance assessment.

21.3 FREQUENCY FOR REPORTING

As a minimum, the following documents will be submitted to the relevant authorities from the start of construction until mine closure:

- EMP performance assessment, submitted every two years to DMR;
- updated closure and rehabilitation cost estimate, submitted annually to the DMR;
- water monitoring reports, submitted annually to DWA – these reports will not only present monitoring data but will also provide interpretations of trends in the data and reporting on compliance with water quality guidelines;
- air monitoring reports, submitted annually to the DMR and DEDET
- detailed plan for decommissioning/closure, submitted to DMR at least five years prior to decommissioning.

22 FINANCIAL PROVISION

The information in this section was sourced from the closure cost calculation study completed by Metago SLR (Appendix L).

22.1 PLAN SHOWING LOCATION AND AERIAL EXTENT OF PROPOSED OPERATION

A plan showing the location and aerial extent of the operation is provided in Figure 18.

22.2 ANNUAL FORECASTED FINANCIAL PROVISION

As required in terms of the MPRDA, Keaton has submitted an annual closure liability update for 2012 to the DMR (see Appendix L). The 2012 closure liaibility update was compiled for the current operations and therefore caters for the changes to surface infrastructure as detailed in this report. The financial closure liability associated with the Vanggatfontein Mine (as at end February 2012) is R53 524 048.00 (including VAT).

22.3 CONFIRMATION OF AMOUNT TO BE PROVIDED

The amount that has been provided for the Vanggatfontein Mine (as at end February 2012) is R53 524 048.00 (including VAT).

22.4 METHOD OF PROVIDING FINANCIAL PROVISION

A guarantee has been provided by an approved financial institution.

23 ENVIRONMENTAL AWARENESS PLAN

This document describes the environmental awareness plan for the Vanggatfontein Mine. The purpose of the environmental awareness plan is to ensure that all personnel and management understand the general environmental requirements of the site. In addition, greater environmental awareness must be communicated to personnel involved in specific activities which can have a significant impact on the environment and ensure that they are competent to carry out their tasks on the basis of appropriate education, training and/or experience. The environmental awareness plan should enable the mine to achieve the objectives of the SHE policy.

23.1 ENVIRONMENTAL POLICY

A copy of the mine's SHE policy (which includes an environmental policy) will be displayed prominently at the mine entrance and key notice boards at the mine's business units. The mine's SHE policy is described below:

- to minimise the impact of Keaton's mining operations on the environment wherever possible;
- to comply with all applicable environmental legislation and the commitments contained in Keaton's Environmental Management Programme (EMP) report.
- to ensure that all mine employees, contractors and sub-contractors:
    - are aware of the impact of their activities on the environment;
    - are informed about the measures required to prevent, mitigate and manage environmental impacts; and
    - apply these principles whilst carrying out their work.
- to establish and maintain a good relationship with surrounding communities, industries and other interested and affected parties, with regard to the mine's activities;
- to develop a localised environmental strategy with the local authority and nearby industries; and
- to provide relevant and constructive consultation/public participation on the management of the potential environmental impacts posed by the mine in the future.

23.2 STEPS TO ACHIEVE THE ENVIRONMENTAL POLICY OBJECTIVES

The mine's SHE policy (which includes an environmentl policy) will be realised by setting specific and measurable objectives. It is proposed that new objectives are set throughout the life of mine, but initial objectives are as follows:

1. Management of environmental responsibilities:

The mine will establish and appoint an Environmental/SHE Manager at senior mine management level, who will be provided with all necessary resources to carry out the management of all environmental aspects of the site as a primary function, for example:

- compliance with environmental legislation and EMP commitments;
- implementing and maintaining an environmental management system;
- developing environmental emergency response procedures and coordinating personnel during incidents;
- manage routine environmental monitoring and data interpretation;
- environmental trouble shooting and implementation of remediation strategies; and
- closure planning.

2. Communication of environmental issues and information:

Meetings, consultations and progress reviews will be carried out, and specifically the mine will:

- set the discussion of environmental issues and feedback on environmental projects as an agenda item at all company board meetings;
- provide progress reports on the achievement of policy objectives and level of compliance with the approved EIA and EMP report to the Department of Mineral Resources;
- ensure environmental issues are raised at monthly mine management executive committee meetings and all relevant mine wide meetings at all levels; and
- ensure environmental issues are discussed at all general liaison meetings with local communities and other interested and affected parties.

3. Environmental awareness training:

Keaton will provide environmental awareness training to individuals at a level of detail specific to the requirements of their job, but will generally comprise:

- basic awareness training for all prior to granting access to site (e.g. short video presentation requiring registration once completed). Employees and contractors who have not attended the training will not be allowed on site;
- general environmental awareness training will be given to all employees and contractors as part of the Safety, Health and Environment induction programme. All non Keaton personnel who will be on site for more than five days must undergo the SHE induction training; and
- specific environmental awareness training will be provided to personnel whose work activities can have a significant impact on the environment (e.g. workshops, waste handling and disposal, sanitation, etc).

4. Review and update the environmental topics already identified in the EMP which currently includes the following issues:
   - geology (sterilisation of mineral resource);
   - topography (hazardous excavations and surface subsidence);
   - soil management (loss of soil resource);
   - land capability (loss of land with agricultural and conservation/ecotourism potential);

- surrounding land use (traffic management, agriculture, and damage from blasting);
- management of biodiversity (impacts on land and water related habitats and species);
- surface water management (alteration of surface drainage and pollution of surface water);
- groundwater management (reduction in groundwater levels/availability and groundwater contamination);
- management of air quality (dust generation);
- noise (specifically management of disturbing noise);
- visual aspects (reduction of negative visual impacts);
- heritage resources (management of archaeological, cultural, historical and paleontological sites);
- socio-economic impacts (management of positive and negative impacts); and
- interested and affected parties.

5. All mine projects will be designed to minimise impact on the environment and to accomplish closure/rehabilitation objectives.

6. Keaton will maintain records of all environmental training, monitoring, incidents, corrective actions and reports.

7. Contractors and employees will be contractually bound to participate in the achievement of SHE policy objectives and compliance with the EIA and EMP report.

23.3 TRAINING OBJECTIVES OF THE ENVIRONMENTAL AWARENESS PLAN

The environmental awareness plan ensures that training needs are identified and that appropriate training is provided. The environmental awareness plan should communicate:

- the importance of conformance with the SHE policy, procedures and other requirements of good environmental management;
- the significant environmental impacts and risks of individuals work activities and explain the environmental benefits of improved performance;
- individuals roles and responsibilities in achieving the aims and objectives of the SHE policy; and
- the potential consequences of not complying with environmental procedures.

23.3.1 GENERAL CONTENTS OF THE ENVIRONMENTAL AWARENESS PLAN

To achieve the objectives of the environmental awareness plan the general contents of the training plans are as follows:

- Module 1 – Basic training plan applicable to all personnel entering the site:
  - short (15min) presentation to indicate the site layout and activities at specific business units together with their environmental aspects and potential impacts.

  - individuals to sign off with site security on completion in order to gain access to the site.
- Module 2 – General training plan applicable to all personnel at the site for longer than 5 days:
  - general understanding of the environmental setting of the mine (e.g. local communities and industries and proximity to natural resources such as rivers);
  - understanding the environmental impact of individuals activities on site (e.g. excessive production of waste, poor housekeeping, energy consumption, water use, etc);
  - indicate potential site specific environmental aspects and their impacts;
  - Keaton's environmental management strategy;
  - identifying poor environmental management and stopping work which presents significant risks;
  - reporting incidents;
  - examples of poor environmental management and environmental incidents; and
  - procedures for emergency response and cleaning up minor leaks and spills.
- Module 3 – Specific training plan:
  - environmental setting of the workplace (e.g. proximity of watercourses, vulnerability of groundwater, proximity of local communities and industries, etc);
  - specific environmental aspects such as:
    - spillage of hydrocarbons at workshops;
    - spillage of explosive liquids in the open pits;
    - poor waste management such as mixing hazardous and general wastes, inappropriate storage and stockpiling waste large amounts of waste;
    - poor housekeeping practices; and
    - poor working practices (e.g. not carrying oil changes in designated bunded areas).
  - impact of environmental aspects, for example:
    - hydrocarbon contamination of local watercourses resulting in loss of resource to downstream users;
    - groundwater contamination also resulting in loss of resource due to potential adverse aesthetic, taste and health effects; and
    - dust impacts on local communities (nuisance and health implications).
  - Keaton's duty of care (specifically with respect to waste management); and
  - purpose and function of Keaton's environmental management system.

Individuals required to complete Module 3 (specific training module) will need to complete Modules 1 and 2 first. On completion of the Module 3, individuals will be subject to a short test (written or verbal) to ensure the level of competence has been achieved. Individuals who fail the test will be allowed to re-sit the test after further training by the training department.

The actual contents of the training modules will be developed based on a training needs analysis.

Key personnel will be required to undergo formal, external environmental management training (e.g. how to operate the environmental management system, waste management and legal compliance).

In addition to the above Keaton will:

- conduct refresher training/presentations on environmental issues for mine employees (permanent and contractors) at regular intervals.
- promote environmental awareness using relevant environmental topic posters displayed at strategic locations on the mine. These topics will be changed monthly, and will be reviewed annually by the SHE Manager to ensure relevance.
- participate and organise events which promote environmental awareness, some of which will be tied to national initiatives e.g. National Arbor Week, World Environment Day and National Water Week.

24 TECHNICAL SUPPORTING INFORMATION

The following specialist studies are attached as appendices to this report:

- hydrological study (Appendix E);
- geohydrological study (Appendix F);
- air quality study (Appendix G);
- paleontology study (Appendix H);
- traffic study (Appendix I);
- engineering design report (Appendix J);
- climatic water balance (Appendix K).
- calculation of financial closure liability report (Appendix L);

25 CAPACITY TO MANAGE AND REHABILITATE THE ENVIRONMENT

This section outlines the applicant's capacity to rehabilitate and manage negative impacts on the environment.

As is required by the relevant mining legislation (Act, 28 of 2002 and Regulation 527), a detailed closure plan will be submitted to the DMR prior to decommissioning and closure. This process will also involve other regulatory authorities and IAPs in a similar fashion to the involvement of people during the EIA process. The detailed closure plan will determine specific closure strategies and action plans taking regulatory, environmental, social, economic and sustainable development principles into account. Critical commitments in this regard are:

- that within the first three years of operation, Keaton must establish numerical key performance indicators to measure achievement of the closure land use objectives. These indicators will drive ongoing rehabilitation and end closure initiatives; and
- as part of the closure plan, provision must be made for long term post closure treatment of contaminated water as required, and for compensation for any contamination related losses that may be experienced by water users.

25.1 AMOUNT REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT

Information in this section was provided by Keaton.

The table below details the estimated environmental budget for the remaining life of the mine (from September 2012 to August 2026).

Life of Mine Environmental budget from September 2012 to August 2026	
Item	**Approximate amount budgeted**
Environmental Personnel	R 3.5 million
SHEQ operations	R 5 million
Discard and slurry disposal	R 200 million
Waste disposal	R 2 million
Environmental consultants	R 22 million
Infrastructure maintenance	R 8 million
Steady state pit backfill	R 15.56/BCM
Steady state topsoil placement	R 15.56/BCM
Water treatment plant	R 6 million
Water treatment annuity (running cost after closure)	R 9 million
Final void rehabilitation	R 185 million
Note: BCM - Bank Cubic Metre	

25.2 AMOUNT PROVIDED FOR

The amount required as per the above budget has been provided for in the current Keaton budgeting period.

26 UNDERTAKING SIGNED BY APPLICANT

COMMITMENT/UNDERTAKING BY APPLICANT

I,...

the undersigned and duly authorised thereto by

....……………………………………

undertake to adhere to the requirements and to the conditions set out in the approved EMP with the exception of the exemption(s) and amendment(s) agreed to be relevant by the Regional Manager: _________________________ (include relevant province).

Signed at: ....……………

On: ....

Signature: …………………...………………

Designation: ……………………...……………

REGIONAL MANAGER: __________________ REGION

In terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) this document of …………………………………….………………………. is approved subject to the conditions as set out in the letter of approval.

Signed at: ....………………...

On: ....

Signature: …………………………………..

Designation: …………………………………..

REGIONAL MANAGER: _________________

27 ENVIRONMENTAL IMPACT STATEMENT & CONCLUSION

This document presents the project plan as defined by Keaton, presents findings of specialist studies, identifies and assesses potential impacts on the receiving environment in both the unmitigated and mitigated scenarios, including cumulative impacts, and identifies measures together with monitoring programmes to monitor and mitigate potential impacts.

A summary of the potential impacts (as per Section 7) associated with the mine in the unmitigated and mitigated scenarios for all project phases are included in Table 74 below.

Generally speaking, the potential impacts from the changes to surface infrastructure at the Vanggatfontein Coal Mine are not expected to differ significantly from what was assessed in the approved EIA and EMP report (Metago, 2008). In this regard, all the identified impacts should be managed at acceptable levels provided the mitigation measures are successfully implemented. One notable difference is that the 2008 EIA and EMP report (Metago, 2008) assumed that all farmers and farmworkers residing withing the mining right area would be relocated prior to the commencement of mining. To date, this has not occurred and therefore the significance of a number of impacts has increased for receptors residing within the mining right area unless they are relocated.

TABLE 74: TABULATED SUMMARY OF POTENTIAL IMPACTS

Impact	Significance	
	Unmitigated	Mitigated
Loss and sterilisation of mineral resources	L	L
Hazardous excavations/structures	H	M
Surface subsidence related to backfilling	M	L
Surface subsidence related to sinkholes	H-M	-
Loss of soil resources	H	M
Loss of land with agricultural potential	H	M
Impact on habitats and species	H	M
Pollution of surface water	H	L-M
Alteration of drainage patterns	H	M
Reduction in groundwater levels / availability for groundwater users	M	L
Reduction in groundwater levels / availability effect on base flow	M	M
Groundwater contamination	H	M-H
Dust generation	H	M (H for Receptors 1, 2 and 3)
Disturbing noise	M-H (H for Receptors 2, 3 and 4)	M (H for Receptors 2, 3 and 4)
Negative visual impacts	H	M
Disturbance of heritage andcultural sites	H	L
Disturbance of paleontological sites	M	L
Blasting hazards	H	M
Road and traffic impacts	H	M
Positive socio-economic impact	M+-H+	M+-H+
Negative socio-economic impact (relocation)	H	M

Impact	**Significance**	
	Unmitigated	**Mitigated**
Negative socio-economic impact (informal settlements, safety and security)	H	M
Negative socio-economic impact (land values)	H	M-L

Fiona Bolton (EAP)
(Project Manager)

Brandon Stobart (EAPSA)
(Project Reviewer)

Metago SLR

28 REFERENCES

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Siyazi Gauteng (Pty) Ltd. May 2011. Traffic engineering related input for the existing Keaton Energy Coal Mine, Delmas: Additional traffic related input in terms of an increase in production related to the traffic impact assessment conducted in 2008. Ref 08029/LR/pvdw/001.

APPENDIX A: STAKEHOLDER DATABASE

APPENDIX B: INFORMATION-SHARING WITH REGULATORY AUTHORITIES

- Correspondence received from land claims commission as part of original EIA (October 2008)
- DEDET acknowledged receipt of NEMA application (11 March 2011)
- Invitation to attend Scoping meeting (13 April 2011)
- Email received from DWA (18 April 2011)
- Email received from Mpumalanga Wetland Forum / DEDET (5 May 2011)
- Minutes of a meeting held with the DMR (20 June 2011)
- Minutes of a site visit and meeting held with DEDET (12 July 2011)
- Letter informing DEDET of NEMA application withdrawal (2 August 2011)
- DEDET acknowledge receipt of the Scoping Report (dated 28 September 2011)
- MPTB comments on Scoping Report (dated 29 September 2011)

APPENDIX C: INFORMATION-SHARING WITH IAPS

- Background information document (in English and Afrikaans) for information-sharing purposes
- Site notice (in English and Afrikaans) and photos showing where site notices were displayed
- Newspaper advertisements placed in The Citizen (8 April 2011) and The Streeknuus on 13 April 2011
- Minutes of a general stakeholder meeting (5 May 2011)
- Letter informing IAPs of the change in project scope (30 May 2011)
- Scoping report summary and cover letter
- Written comments received from IAPs

APPENDIX D: COMMENT AND RESPONSE REPORT

APPENDIX E: HYDROLOGICAL STUDY

Specialist report prepared by SLR, May 2012

APPENDIX F: GEOHYDROLOGICAL STUDY

Specialist report prepared by SLR, August 2012

APPENDIX G: AIR QUALITY STUDY

Specialist report prepared by Airshed Planning Professionals, May 2012

APPENDIX H: PALEONTOLOGY STUDY

Paleontogical report prepared by Professor Bruce Rubidge, February 2011

APPENDIX I: TRAFFIC STUDY

Specialist report prepared by Siyazi, May 2012

APPENDIX J: ENGINEERING DESIGN REPORT

Specialist report prepared by Epoch, July 2012

APPENDIX K: CLIMATIC WATER BALANCE

Specialist report prepared by Simx Consulting, June 2011

APPENDIX L: CLOSURE COST CALCULATION STUDY

Specialist report prepared by SLR, March 2012

APPENDIX M: INFORMATION PROVIDED BY KEATON

- Design drawings for the overburden stockpile located between the D2543 road and the opencast mining area on the eastern portion of the mining right area (north of the Transnet pipeline).
- CCIC geological investigation.

APPENDIX N: TRANSNET SERVITUDE SPECIFICATIONS

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Title:	CHANGES TO SURFACE INFRASTRUCTURE AT VANGGATFONTEIN COAL MINE
Report Number:	2
Proponent:	Keaton Mining (Pty) Limited

Name	Entity	No. of copies	Date issued	Issuer
NB Matodzi	Department of Mineral Resources	7	October 2012	F Bolton
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G Cowden	Mpumalanga Wetland Forum	1	October 2012	F Bolton
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